A HISTORICAL ANALYSIS OF THE MATHEMATICS MAJOR REQUIREMENTS AT SIX COLLEGES IN THE UNITED STATES FROM 1905 TO 2005

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ABSTRACT

A HISTORICAL ANALYSIS OF THE REQUIRED MATHEMATICS COURSES

OF THE MATHEMATICS MAJOR AT SIX COLLEGES IN THE UNITED STATES FROM 1905 TO 2005

Heather Lee Huntington

This study attempts to document and explore the history of the undergraduate mathematics major at six United States colleges during the twentieth century. The six colleges were chosen based on their geographical diversity and their success in producing mathematics Ph.D. students. Three of the colleges are private, and three are public colleges.

There are five key findings in this paper. Regarding specific courses, in 1955, courses in linear algebra, discrete mathematics, and computer science became widely available. This probably occurred due to the close relationship between discrete mathematics, linear algebra, and computing. Computer programming became easier and more popular during the 1950s, and computer science courses at most colleges migrated from the Mathematics Department to their own department. Yale was an exception; there were computer science courses available in the Mathematics Department at Yale until 2005.

Advanced applied courses (Category 9) became more prevalent in some cases and disappeared in others. These courses may have migrated to other academic departments at the schools where they disappeared. This migration may have occurred at CCNY, Colorado College, Stanford University, and Yale. These findings are consistent with Garfunkel and Young's (1990) research on mathematics courses outside of mathematics departments. At the University of Texas, Austin, the advanced applied courses dramatically increased between 1945 and 2005. This is most likely due to the merger of the Pure Mathematics Department and Applied Mathematics Department between 1945 and 1955.

Between 1975 and 1995, three of the four colleges from middle America and the west had many courses with unspecified content (Category 13). These courses included undergraduate colloquia, seminars, history of mathematics, problem-solving courses, tutorial courses, independent study, and experimental courses. Perhaps the schools outside the east coast experimented more with their upper division mathematics during this time.

The three colleges that produced a significant number of undergraduates who eventually earned a doctoral degree in a STEM field between 1997 and 2006 did not credit general education mathematics courses (Category 2) during the entire study. Furthermore, these top future Ph.D.-producing colleges state that their undergraduates can take graduate courses 23 times in this study, whereas the other three colleges only mention it 9 times. Stanford University encouraged their undergraduates to take on graduate courses the most, then Yale and the University of California, Berkeley.

After 1975, the percentage of mathematics courses needed to obtain the undergraduate degree converged at the colleges in this study to be in the range of 30% to 38%. The percentage never exceeded 40% at any of the schools in this study.

Keywords:

American universities, American higher education, City College of New York, Committee on the Undergraduate Program in Mathematics (CUPM), Florian Cajori, mathematics, history of higher education in the United States, history of the mathematics major, Stanford University, undergraduate mathematics curriculum, University of California at Berkeley, University of Texas at Austin, Colorado College, Yale University

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I owe a great debt of gratitude to the Cajori Two research group, as the mission of the Cajori Two group is to document all courses in the undergraduate mathematics programs throughout the United States. This includes Dr. Walter Meyer (Adelphi University), Larry D'Antonio (Ramapo College), Dr. Joseph Malkevitch (York College and Teachers College), Dean Nataro (Nassau Community College), JoAnne Taormina (Nassau Community College), and Dr. Jack Winn (Farmingdale State College) and Worku Bitew (Farmingdale State College). Having

those documents, along with some prior knowledge of the Cajori Two course codes, allowed me to analyze the data much more carefully and prepare a better dissertation.

I would also like to thank my father for helping me understand that furthering my education is a worthwhile endeavor. As a young child, I remember you used to tell me and Dan (as we were going out to rake leaves, take an engine apart, tear out a bathroom, or install a kitchen) that someday I should “get paid for my brains and not my hands.” Well, I would like to thank you for the fact that I actually enjoy using both, and I hope that my decisions and accomplishments in life will always make you proud.

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DEDICATION

To my late mother, Kathryn Huntington,

who taught me it is okay to be quirky and how to survive the storms.

To my father, Philip Huntington,

who taught me how to be confident enough to tackle any problem.

To my other mother, Rose Huntington,

who has taught me how to better communicate my ideas.

To my sister, Tricia Garay,

whom I look up to and adore because you have always enjoyed looking after me.

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who is one of my true partners in life.

My four beautiful God children; Braden, Madeline and Kevin Garay, Ella Huntington, and the newest addition; Avery Huntington.

You all make me so proud. Please do not ever lose those creative minds! I am so thrilled about watching you all become young adults and I am honored to be your aunt. Thank you.

And to all teachers everywhere.

Chapter I

INTRODUCTION

Need for the Study

This study is intended to document and explore the history of the undergraduate mathematics major. Currently there are many changes occurring to the undergraduate mathematics major requirements, and whenever large-scale reconstruction occurs to mathematics major requirements, an understanding of the development and evolution of the major should be considered in order to maintain integrity and provide the best outcome for students. It has been noted by the Mathematical Association of America (MAA) and its subcommittee, the Committee on the Undergraduate Program in Mathematics (CUPM), in 1992 that "unfortunately, in the area of undergraduate mathematics, good information is rare" (p. 243). "There is not much current data about the actual status and requirements of mathematical sciences major programs in this country. The quintennial sample survey data of the Conference Board of Mathematical Sciences (CBMS) provides partial snapshots, but not in sufficient detail about the major" (p. 244).

The current study draws its ideas from Cajori's (1890) *Teaching and History of Mathematics in the United States*. In this work, Cajori documented methods of mathematics teaching and the required mathematics courses at the elementary school level and at a selection of 25 colleges from the colonial period (circa 1650) until 1890. Since that work, few full-scale examinations of the mathematics major have been undertaken. The focus of Cajori's inquiry was to provide a portrait of mathematics over time, and his work documents the mathematics curriculum at each college in each time period.

In American colleges, the elective system became popular in the 19th century and allowed students to graduate from college with many low-level, disconnected courses. The paradigm shift toward an isolated subject of study began at the turn of the 19th century. A small number of colleges had started to require a subject concentration at the end of that century, but when Harvard adopted the “concentration and distribution” system in 1910, this led to a widespread trend. The rest of the colleges and universities in the United States began adopting the idea of a subject major, which is why this study begins at 1905 and utilizes course catalog information each decade thereafter until 2005 (Rudolph, 1977).

Tucker (2013) has begun to examine the history of the undergraduate mathematics major in the 20th century. Some of his conclusions can be found in the article, "The History of the Undergraduate Program in Mathematics in the United States." This article summarizes his personal experiences, given that both of his parents graduated with undergraduate mathematics degrees, and he reviewed some of the available literature. Moreover, he uses a small sample of college catalogs to support his claims. This study is similar in its focus, except this study encompasses a wider span of years and be more comprehensive in its analysis, since it includes six colleges.

Tucker found that the greatest change to the mathematics major occurred between 1955 and 1975. Some of these changes were due to the immigration of European mathematicians to America during World War II, along with increased enrollment in U.S. colleges after the war and the launching of the first satellite by the Soviet Union in 1957. Around the same time, the Mathematical Association of America (MAA) created the Committee on the Undergraduate Program (CUP) in 1953, later renamed the Committee on the Undergraduate Program in Mathematics (CUPM), to advise colleges on the undergraduate mathematics curriculum.

Purpose of the Study

This study was designed to document any significant changes to the mathematics major course requirements at six colleges in the United States at each decade between 1905 and 2005 and determine, where possible, societal reasons for the noteworthy changes. In some cases, a college may offer multiple types of mathematics degrees; however, the only degree considered in this research was the one intended to lead a student to graduate studies in pure mathematics. Six colleges were chosen for the purposes of this study:

1) City College of New York (New York)
2) Colorado College (Colorado)
3) Stanford University (California)
4) University of California at Berkeley (California)
5) University of Texas at Austin (Texas)
6) Yale University (Connecticut)

The following research questions guided the study.

Research Questions

1) How did the mathematics major requirements evolve from 1905 to 2005 at the six selected colleges in the United States?
2) How do the selected groups of colleges compare between each of the following groups during 1905 to 2005?
    - public and private
    - East Coast vs. West Coast vs. Middle America
    - colleges that produce many future mathematics Ph.D. students vs. those that do not
3) What, if any, are some of the noteworthy changes to the mathematics major course requirements during 1905 to 2005, and what are some potential reasons for the changes? Both required and elective courses will be considered.

Procedures of the Study

A stratified sample of six colleges was selected for the purposes of this study to be representative of public and private, various locations in the United States, and the college's likelihood to graduate students who eventually earn Ph.D.s in science and engineering. Here are the comparative groups of the six colleges:

- three public and three private;
- two colleges from each of the West Coast, Middle America, and East Coast; and
- three colleges on the list of top 50 schools or colleges that graduate the most science, technology, engineering, and mathematics (STEM) students who go on to receive a STEM doctorate, between 1997 and 2006, and three colleges that are not on the list of the top 50 and three colleges that are not on the list of the top 50 STEM doctorate origin-institutions (Burrelli, Rapoport, & Lehming, 2008).

Often mathematics programs offer several different baccalaureate degrees. If there was such a choice, the degree that most likely leads a student to graduate study in mathematics was used for this study. In the early part of the century, the mathematics major may have been defined as a "concentration" or "honors in mathematics," but toward the end of the century, the focus of this study was only on mathematics majors. Qualitative differences between the groups of colleges were studied. Below are the groupings of the six schools:

Three Public	Three Private
• CCNY • University of Texas at Austin • University of California at Berkeley	• Yale University • Colorado College • Stanford University

Two from the West Coast of the United States	Two from Middle America	Two from the East Coast of the United States
• University of California at Berkeley • Stanford University	• University of Texas at Austin • Colorado College	• CCNY • Yale University

Three that are on the list of the top 50 colleges that produce a significant amount of undergraduates who eventually go on to earn a doctoral degree in STEM	Three that are <u>not</u> on the list of the top 50 colleges that produce a significant amount of undergraduates who eventually go on to earn a doctoral degree in STEM
• Yale University • Stanford University • University of California at Berkeley	• University of Texas at Austin • CCNY • Colorado College

Course catalog information -- primary source data -- was obtained from 6 college campuses in the United States and is a subset of the data collected by the Cajori Two Research Group (i.e., Walter Meyer, Joseph Malkevitch, Larry D'Antonio, Jack Winn, Dean Nataro, Worku Bitew, JoAnne Taormina, and Heather Huntington). Photocopies of requisite pages from the college catalogs were acquired from the archives or special collections departments at each campus from year 1905 and each decade thereafter until 2005. The only pages used from the catalogs were the ones that stated the (1) overall graduation requirement, (2) mathematics major requirement, (3) mathematics course descriptions, and (4) term type (semesters, quarters, or trimesters). At times a college catalog uses phrasing such as "specialization," "cluster," "concentration," or "group." I considered all of these to be a "mathematics major" since they all have the same core idea.

In order to answer the first question, the required and elective mathematics courses that count toward the mathematics degree at each selected college during each decade starting at 1905 and ending at 2005 were recorded. Changes to the first mathematics course that counts toward requirements for the mathematics major were also noted and tracked throughout the century. The Cajori Two Course Inventory was used in order to classify clusters of courses. The amount of required mathematics for the degree was tracked from 1905 to 2005. Additionally, to document the variety of courses available to a mathematics major student, the total number of mathematics courses that could contribute (required and elective mathematics courses) toward a baccalaureate degree was counted and summarized during every decade from 1905 to 2005 at each college.

In order to answer the second question, the qualitative similarities and differences were noted between each group. Then the number of courses available within each group were used to compare between the groups. I was particularly interested to discover if different types of institutions seemed to focus on particular clusters of courses or a particular structure of the degree requirements.

Finally, for the third question, any points of interest identified from the comparisons of the schools were identified. Any noteworthy change in the trends of course clusters and mathematics major requirements was further investigated with a literature review.

Resources for the Study

The primary source of data for this study was college catalog information ten years apart, starting at 1905 and ending at 2005. The Cajori Two Research group, which includes Walter Meyer, Joseph Malkevitch, Larry D'Antonio, Jack Winn, and the principal investigator of this study, has been collecting college catalog data since 2007. Other sources of this study included book-length academic works, journal articles, committee reports, MAA discussion articles, memorandums, and interviews.

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Chapter II

LITERATURE REVIEW

Pre-Twentieth Century History of Higher Education in the United States

In order to better understand the evolution of the higher education system in the United States during the 20th century, it is necessary to start by looking at the higher education system of the prior century. Here are some of the past practices and trends that influenced the emerging trends and reforms of the 20th century.

Before the 1860s, most post-secondary institutions had a religious basis, and the aim of college education in the United States had been "to shape the character of the student according to a rigid model of a pious, righteous, and educated gentleman. The means employed for the attainment of this purpose was discipline. The mind of the student was to be disciplined by the study of classics and mathematics" (Ben-David, 1972, p. 52). In this period, the required subjects of study were Greek, Latin, and mathematics, and the mathematics topics were comprised of arithmetic, geometry, and algebra.

Aside from studying the classics, there was not much consistency among various post-secondary institutions. Higher education in the United States was not centrally directed. It was a collection of private and state institutions without an "organizational chart [nor] official rules … to serve as the starting point" (Ben-David, 1972, p. ix). This lack of centrality allowed higher educational institutions to experiment and "from 1865 until about 1903, the elective system gained ground at the expense of prescribed studies" (Veysey, 1965, p. 118).

Introduction of the Elective System in Colleges

In 1869, Charles W. Eliot became the president of Harvard University. He was a man with democratic ideals, an unpopular philosophy at the time for an academic leader. "He had been the principal advocate of the elective system; he supported the improvement of the professional schools and, eventually, the building up of graduate studies in the arts and sciences" (Ben-David, 1972, p. 39). Eliot believed that the elective system provided risks for the students, and "only through taking such risks could young people learn how to stand on their feet" (p. 56).

Around the same time, Cornell University, established in 1868 with Andrew D. White as the president, began its degree programs with an elective system. "Separately, Cornell and Harvard served as two pilot models for the transformation of American undergraduate education" (Veysey, 1965, p. 81).

The idea of the elective system, pioneered by Harvard and Cornell, became pervasive in higher education during the next 30 years. The elective system replaced "the old philosophy of mental discipline … [and] allowed the student to choose, within certain limits, between a great variety of courses and thus compose his own curriculum for the first degree" (Ben-David, 1972, p. 56).

Prior to the elective system, the teaching in higher education was typically conducted by the college president and a handful of additional teachers. "With the introduction of the electives, they were gradually replaced by specialized teachers grouped into departments representing recognized areas of science, scholarship, and professional competence" (Ben-David, 1972, pp. 57-58).

The elective system was widely accepted by both students and teachers in universities. "The students abandoned the old courses (e.g., Latin, Greek, mathematics, philosophy) because they were often demanding and practically never interesting" (Ben-David, 1972, p. 58). The teachers also generally welcomed the freedom to teach more interesting courses and the addition of new faculty members. "All the teachers of modern subjects welcomed the revolution against the classics and the old type of moral philosophy, since this gave them a chance to develop their fields without hindrance" (p. 59). Unfortunately, even though the newer courses may have been more interesting, many were less demanding.

Drawbacks of the Elective System

As in any reform movement, there were benefits and drawbacks to the elective system. After the elective system became widespread, college became a gateway and stepping stone to the middle class. College offered a new, utilitarian curriculum and a safe atmosphere for young adults away from home. This feature attracted both serious and less motivated students.

Regardless of the generation, there are less ambitious students enrolled in college who are not interested in scholarly studies. When colleges in the United States began to adopt an elective system, their intentions were for students to take charge of their own education and, by doing so, excel in their studies. However, too many students were graduating with unconnected or elementary coursework. “In 1898, for instance, 55 percent of the students at Harvard ‘elected little or nothing but elementary courses’ and almost 75 percent had programs without any major focus” (Rudolph, 1977, p. 227).

The meaning of the bachelor’s degree began to change. In the latter half of the 19th century, a bachelor’s degree no longer represented specialization in any field. In a majority of cases, an undergraduate degree “emphasize[d] breadth of education rather than expertise; in the minority of cases, it [was] a low-level, specialized professional degree” (Ben-David, 1972, p. 5).

The degree types had also changed due to the new elective system in order to differentiate from the old undergraduate degrees. It was around 1900 when most universities stopped granting separate degrees for students who lacked a background in the classics (Veysey, 1965, p. 118).

Benefits of the Elective System

The freedom for students to choose their own course of study in college, in addition to a greater number of students graduating from high school in the mid-1800s and more colleges becoming secularized, allowed the pursuit of a college degree to become an attainable goal for the general public at that time. “The abolition of the old college curriculum made it possible for [potential students] to come to terms with college" (Ben-David, 1972, p. 58). "The electives represented a fresh and lively contrast to the stale and sterile teaching of the traditional college, and offered new opportunities for teachers and students alike" (p. 59).

College study soon became a gateway to the middle class. College life offered a young adult the opportunity to live away from parents in a somewhat safe community with peers. "This was supposed to help a young person 'find himself,' 'round out his personality,' and 'become an adult'" (Ben-David, 1972, p. 59). This aspect of college not only helped the individual advance their social standing, but also helped advance society as a whole.

With more students attending colleges, faculty size increased, and specialized departments were created. "The elective principle led to the gradual elimination of the old curriculum and to the success of new scientific-scholarly disciplines and professional studies" (Eliot, cited in Rudolph, 1962, p. 304). The elective system gave freedom to both students and teachers. The formal course of study became more diverse and, at the same time, more specialized. "By granting academic freedom to both teachers and students, it made it possible for teachers who had easily identifiable specialized knowledge and skills, and for students interested in acquiring those things, to find each other and develop the relevant fields of study rapidly and without serious problems concerning the ends and the means of education" (Ben-David, 1972, p. 60).

A liberal education was considered to be a curriculum that allowed the "right" kind of people to shine and advance to the social elite. The idea was similar to the idea of "survival of the fittest." There existed various paths of study and competition among peers to graduate, which created a natural selection process. With the elective system in place, it was expected that "education only supplied the finish and polish to this ['right'] kind of person" (Ben-David, 1972, pp. 66-67). Education was no longer intended to create or mold character, which is what had been done in the past.

History of Higher Education in the United States during the Twentieth Century

At the beginning of the 20th century, it was becoming more common for young people to finish high school and move on to college. The initiation of American graduate schools in the 1890s also created an oversupply of Ph.D.s. This ultimately led to the availability of higher quality teachers for the higher education revolution of the 20th century, where many higher educational institutions changed to an elective curriculum leading to drastic increases in enrollments in college. “The number of students had jumped in the last decade of the nineteenth century from 156,756 to 237,592, and by 1910 was to rise to 355,213. By 1920 the enrollments had risen to 597,880” (DeVane, 1965, p. 15). This unfortunately was not the case for the reform movement in the 1960s.

Many of the prestigious schools, such as Harvard, Cornell, Columbia, and Yale, had an advantage, since they already attracted the best scholars and large donations. “They could ‘sell’ prestige for high fees and great donations, reinvest the resources into improvement of the plant and facilities, and use it to attract eminent scholars – thus generating for themselves new funds of prestige based on different criteria than their original prestige” (Ben-David, 1972, p. 39).

Only some of the newer campuses were able to use their available resources wisely to build up their graduate schools, professional schools, and services in engineering, agriculture, and education. This allowed them to gain traction and compete with the prestigious and already established schools. “By 1910, the University of California at Berkeley and the University of Michigan at Ann Arbor were not much different from the University of Chicago, Columbia, or Cornell. The rest, however, were not able to build up their graduate schools to an advanced level until the 1930s, or until after World War II” (Ben-David, 1972, p. 43).

West Point and Rensselaer Polytechnic, founded in 1802 and 1824, respectively, were two anomalies in the trends. These two technology-oriented institutions were hardly influenced by other colleges. As an example, the West Point curriculum maintained the traditional course in moral philosophy throughout the century (Rudolph, 1962, p. 229).

At the turn of the century, the elective system, lacking any prescribed curricular path, began to break down. Faculty expressed a need for change, and small colleges started to mark the new trend toward a general education, which included some prescribed general studies, also called "distribution," and a "concentration." Within a few years, many colleges had "concentration and distribution" general education requirements, but no two schools seemed to balance the concentration and distribution requirements quite the same. Some large universities even opened colleges of general studies.

The concentration requirements seemed to be easy for faculty to determine, but the "breadth, distribution, and general education [requirements] were hobby horses of new presidents, ambitious deans, and well-meaning humanists of the sort who were elected to curriculum committees" (Rudolph, 1977, p. 253). The balance would also constantly shift when faculty members managed to negotiate a change in the curriculum, and it was usually the concentration that benefited. "Senior projects, senior theses, reading courses, independent study, honors programs, and more demanding term papers, while narrowing the gap between the undergraduate course and the graduate school, threw further out of balance the special and general elements of the curriculum" (p. 253).

Devising the distribution requirements at each college was a permanent puzzle that created a great deal of problems and endless debates. It was hard to reach a consensus on "whether the goals of distribution were more readily achieved through specially designed general courses or generally oriented specialized courses or through regular courses" (Rudolph, 1977, p. 254). The choices that were made for the general education requirements implied some college-wide value judgment for or against any particular fields of study (Ben-David, 1972, p. 65).

History of the Idea of a Concentration or Major

In 1885, the president of Indiana University, David Starr Jordan, was one of the first to institute the idea of a major subject for an undergraduate. The degree consisted of a concentrated subject at both elementary and advanced levels (Rudolph, 1977, p. 227).

At the turn of the century, the elective system had run its course, and most colleges were ready to move away from the elective system and embrace more uniformity and conformity. In the old colleges, it may have been impossible, since knowledge was limited and professors were generalists. The elective system generated students who had survived and were flowing out of the graduate schools. These students were subject matter specialists with perspectives on education different from those of professors in the previous century. In 1901, Yale started to shift toward concentrations. In 1905, Cornell "required that approximately one fifth of a student's course work be distributed among four specified areas of knowledge. Wesleyan in Connecticut in 1908 adopted concentration and distribution requirements" (Rudolph, 1977, p. 228). In 1909, Harvard's new president, Abbott Lawrence Lowell, was a determined enemy of the elective system. In his inaugural address, he explained, in an example of what Rudolph describes to be "academic double-talk," how the college should go forward and develop the elective system, making it really systematic. Harvard's "distribution groups divided the course of study into the arts of expression (language, literature, fine arts, and music), the natural or inductive sciences, the inductive social sciences (including history), and the abstract or deductive studies (mathematics, philosophy, and law)" (Rudolph, 1977, p. 229). Similar to groups developed at other colleges, students were required to take a specific number of courses in each group. Additionally, they were required to concentrate in one subject matter with related courses. "The academic major and general education requirements were soon widely adopted, although the number of courses required in a major was initially modest" (Tucker, 2013, p. 687).

Subject matter in a major subject should reflect coherence and connectedness. Either faculty members devise a curriculum path for a major field of study, with or without options for students, or a student will submit a program plan, which needs to be approved by an official at the college. In both cases, it is ultimately up to members of each college to determine the acceptable major requirements.

An external influence on major requirements is “informal and often subjective, consisting as it does of the sum of total department beliefs about how success is achieved out there in the world, with the evidence fragmentary and anecdotal” (Weingartner, 1992, p. 70). A second influence is “more precise and steady. Often graduate departments … are quite explicit in their demands, to the point of specifying courses” (p. 70).

History of the Mathematics Program[1] and Major in the United States during the Twentieth Century

In the 1820s, a modern languages professor, George Ticknor, at Harvard had pushed for major courses of study and a reformed system to no avail. Ticknor had brought his German academic experiences back to the United States and tried to institute change at Harvard. “His scheme for reorganizing instruction at Harvard called for elective courses beyond the prescribed curriculum, adding tutorials and a syllabus to lecture courses, grouping students by ability, the creation of departments,” etcetera, but Harvard was not ready for such reforms at that time (Rudolph, 1977, p. 76). The most change that Ticknor was able to effect was to have students grouped by ability. It was only toward the end of the 19th century that the study of a

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[1]The term “program” refers to the (1) curriculum, (2) teachers, and (3) students.
[2] N.M. stands for “Not Mentioned”

[3]It is arguable that this course might belong to the “abstract structures” cluster; however, because there was no course description, it was coded as a linear algebra course.

[4]Course Inventory was created by Dr. Walter Meyer (Adelphi University), Larry D’Antonio (Ramapo College), Dr. Joseph Malkevitch (York College and Teachers College), and Dr. Jack Winn (Farmingdale University) in 2005.

[5]The slash indicates alternate titles or alternate wording that we consider equivalent.

[6]The terms used to define this category are late 20th century terms and may have not existed earlier. But presumably the concepts behind the terms often did. Elementary means not requiring calculus and taught at a

chosen major concentration became popular. The concept gained the most traction when Harvard adopted a "concentration and distribution" system in 1910, almost a century after Ticknor had pressed for a similar idea at the same college.

In the beginning of the 20th century, John Dewey was one of the major influences in education, and he "urged that higher education frankly adapt itself to the central role of vocation in human life" (Veysey, 1965, p. 116). A college education in the United States began to benefit all students without exception and train the students in effective ways of problem-solving. It is likely that some of his socialist philosophies led to the disinterest in a traditional curriculum of mathematics, which was thought to create elite scholars.

In 1918, the National Education Association report defined 14 subject subcommittees, but mathematics was not included. Mathematics soon became an elective subject in many high schools. "The impact of this movement on college mathematics instruction was a substantial increase in precollege (remedial) mathematics courses in arithmetic and beginning algebra" (Tucker, 2013, p. 687). The meaning of high school began to change. "School educators rejected college preparation as the meaning of high school in favor of a long series of 'needs' and 'life adjustment,' student-centered, philosophies which relegated the difficult subject of mathematics to a low priority indeed" (Duren, 1967, p. 24).

All of the changes to the secondary school curriculum seriously affected mathematics at the college level, as mathematics is a subject that is highly dependent on previous knowledge. Therein began a 25-year depression of mathematics education, circa 1915 to 1940, when high schools became overwhelmed with the influx of students and the general academic demand on the students became more lax.

Liberal arts college mathematics courses became more practical and useful. For example, at Colgate, "business mathematics, investment mathematics, and statistics (for actuaries) were added in the late 1920s, along with more electives (not taught every year) in number theory, axiomatic geometry, projective geometry, and mathematics for teachers" (Tucker, 2013, p. 690). The trends in the beginning of the century were in line with the utility reform movement happening at the K-12 level and were considered to be more effective for the masses of students entering college.

In 1930, Griffin, among others, argued that college mathematics lectures should be supplemented with information on the significance of the important concepts, such as history, applications, and mathematical philosophy. There was a belief by some around this time that the mathematics major should be more consistent and useful. Griffin suggested that the following courses be required for mathematics majors to take in their junior and senior years in his 1930 article:

1) Modern Geometry, Analytic and Synthetic
2) Descriptive Geometry
3) Higher Algebra
4) Advanced Calculus
5) Probability and Mathematical Statistics
6) Mathematics of Finance
7) Spherical Trigonometry and Surveying
8) Astronomy
9) Analytic Mechanics
10) History and Foundations

Griffin (1930) included "History and Foundations" because, in his experience with algebra teachers, they did not know the axioms well and could not prove simple statements. Instead, they reverted to analogies when explaining concepts (p. 52). He must have been presuming that most graduates of a mathematics major would become teachers.

Eventually the less useful courses were gradually eliminated, and those that proved to be valuable survived. To provide some insight of a particular case, Dr. Alan Tucker describes his mother's transcript as a mathematics major from Northwestern University during 1934 to 1938 in his 2013 article:

> She took courses in College Algebra and Analytic Geometry in her freshman year, in Differential and Integral Calculus in her sophomore year, and in her junior year, she took courses in Differential Equations, Advanced Calculus, and Theory of Equations. In her senior year, she took Higher Geometry, Functions of a Real

> Variable, and Honors Seminar. Note that these first two years of study were little changed from what a well-prepared student took in the late 1800s. (p. 690)

1955 to 1975: The Greatest Changes to the Mathematics Major

In 1953, the Committee on the Undergraduate Program (CUP), which was later renamed the Committee on the Undergraduate Program in Mathematics (CUPM) in 1957, was formed by the Mathematical Association of America (MAA). In 1954, CUP created a text called *Universal Mathematics*, which had a highly theoretical approach on the odd-numbered pages and a traditional approach on the even-numbered pages. The theoretical approach paved the way for an advanced theory-based mathematics major, which prepared students for graduate study in mathematics. Additionally, Tucker (2013) notes that more universities were requiring upper-level courses in their mathematics major requirements, such as at the University of Pennsylvania and Nebraska (p. 693), probably because of the recommendations of CUPM in the General Curriculum in Mathematics for Colleges (GCMC) and the *Universal Mathematics* textbook.

After World War II, many universities created a separate statistics major due to the high use of statistics during the war efforts. This new separation was probably part of the reason for the eventual decline in the enrollment of mathematics majors. A couple of decades later, the major experienced even more of a rapid decrease in popularity from 1970 to 1985 due to the increasing number of students interested in studying computer science. It is Tucker's (2013) belief that the "growth [in computer science graduates] is one of the reasons that the math major enrollments declined after 1970" (p. 695). The major has never recovered in popularity since then and still remains to have low enrollment.

There have been many speculations for the decline in popularity. According to Spanier in 1970, "the undergraduate program is slanted toward current mathematical research even though relatively few mathematics majors will go on to do research in mathematics (or in any other field)" (p. 753). Spanier recognized that most colleges required a course in abstract algebra but left number theory as an elective. He argued that this curriculum choice illustrated how the programs were preparing students for research. He believed abstract algebra was a more useful course for those students considering graduate school in mathematics and number theory was an easier course that helped to broaden an understanding of mathematics. The classical geometry courses were also less popular, since teachers were taught to be more abstract in their thinking. The issue with the classical geometry course is that students may be able to work through the mathematical proofs but not gain a true understanding of the concepts.

In Spanier's (1970) article, he recounted a recent experience of meeting average mathematics undergraduate students who were invited to a special CUPM conference. He and the other faculty members were disturbed by the students' lack of understanding of some historical concepts, such as the inability to trisect an angle and general insolubility of a quintic equation. The students did not seem to be aware of new developments in mathematics, nor did they seem to care about learning about them. To them, calculus was a collection of theorems, and they did not seem to know of any real uses for calculus. "In short, they exhibited narrowness of training, lack of mathematical taste, lack of intellectual curiosity, and no sense of responsibility for their own education" (p. 754). Spanier proceeded to explain that these shortcomings are primarily the fault of "graduate schools, both through their requirements on entering students and through training that they give to future college teachers" (p. 754). It is surprising that Spanier did not attribute any responsibility to undergraduate educators, although he did state that "it seems particularly important to re-evaluate the undergraduate program" (p. 755).

1975 to 2005: Multiple Mathematics Undergraduate Curriculum Tracks

In 1981, CUPM published another report to address the tension between students who wanted more career-oriented coursework and the mathematics faculty who wanted the major to remain highly theoretical. They added four tenets to their original five, which were: (1) attitudes and skills, (2) program level, (3) interaction, (4) applications and theory, and

(5) recruiting. The four added in 1981 were (6) concentrations, (7) technology, (8) transitions, and (9) advising.

It was suggested by CUPM that "a system of tracks within the mathematical sciences major is an appropriate response to the diverse interests of students and to the potential opportunities for undergraduate majors" (MAA & CUPM, 1992, p. 232). Moreover they recommended that all tracks should incorporate some theory (i.e., "pure") and application courses "so that bachelor's graduates will retain maximum flexibility in pursuing diverse opportunities for employment or further study" (p. 232). Additionally, they recommended that "every mathematical sciences major should include at least one semester of study of probability and statistics at a level which uses a calculus prerequisite" (p. 236). It was suggested that common courses be available to students in their first two years of study so they would not be forced to make choices about their career paths too early on. In order to help determine the courses for the first two years, it should be considered that "general mathematical techniques and reasoning skills are, in fact, the primary asset of mathematics graduates as they begin initial jobs or move to graduate study" (p. 238).

Some examples of the proposed applied tracks are:

- Actuarial Mathematics
- Applied Statistics
- Computational and Applied Analysis
- Computer Analysis
- Management Science
- Operations Research
- Pure Mathematics
- Scientific Computing
- Systems Analysis
- Teaching (Secondary)

Since then, the popularity of the mathematics major has been fairly constant. Two-year colleges have also become a common place for students to take mathematics courses. Initially two-year colleges aided those who wanted job training. However, they have increasingly become a starting place for students who intend to transfer into a bachelor's degree program.

Many college graduates nowadays complete all of their mathematics courses at two-year schools.

In 1996, Tucker conducted a study of ten college-level mathematics departments. The colleges he looked at were chosen because they were:

> seen as having undergraduate mathematics programs that are particularly successful in several of the following areas (i) attracting and preparing large numbers of mathematics majors, (ii) preparing students to pursue advanced study in mathematics, (iii) preparing future school mathematics teachers, and or (iv) attracting and preparing members of underrepresented groups in mathematics. (p. 1356)

Some of the common attributes Tucker (1996) noticed among all of the predetermined successful departments are how the faculty members continuously experimented with the programs. They also provided a variety of instructional and curricular approaches. Furthermore, he found that the course offerings were "designed to meet the needs of the program's students, not the program's faculty" (p. 1356). The first-year of calculus was deemed as the most important course to teach by the faculty at the schools. Even though most schools had an honors calculus course, most faculty members viewed the general calculus course more substantial to teach because it was a source for recruiting mathematics majors.

In the 1990s, many different calculus courses had begun to emerge. Calculus was beginning to show a "wide variation in arrangement of topics, levels or rigor, and methods of presentation" (MAA & CUPM, 1992, p. 235). In Tucker's (1996) study, he noticed that many programs were experimenting with precalculus and calculus, and some even connected them as a two-semester course.

There had begun to be many options and opportunities for students interested in mathematics. Many undergraduate programs offered extracurricular activities for teachers or students, such as continuing education programs, student competitions, and special programs for disadvantaged or talented students. Much of the impetus was placed on the student to take charge of their education and think about the discipline as a whole. Advisors also became more of a standard and common resource for students. An extreme example of empowering students to create their own path existed at one college of the ten colleges studied in Tucker's 1996 study. The ten colleges were determined by a subcommittee of MAA and all were considered to have a successful undergraduate programs. At one college, Tucker discovered that students were able to negotiate their own courses with a faculty advisor for their undergraduate mathematics degree and called it a "contract major" (p. 1358). While this may appear to be a novel idea, and potentially beneficial, it has remnants of the old elective system from the 19th century, a system that many students eventually abused.

Tucker (1996) noticed two opposite, and both effective, strategies for retaining students and helping them progress to more advanced mathematics. He found that they would either:

> (i) develop a major with an inclusive goal of preparing students for a wide variety of careers to attract a large number of students, and then motivate some of this large cohort to pursue graduate study, [or] (ii) have a major focused primarily on preparation for graduate study; this approach requires a selective student body and excellent instruction to avoid scaring most potential mathematics majors away. (p. 1358)

The undergraduate programs and majors have already been examined in the past; however, it was the intention of this study to document the evolution of the major in greater detail since it spans the entire century and includes a large number of programs. Overall, one should expect to see most changes to the mathematics major occurring after World War II and before the computer science major developed and flourished.

Purpose of a Mathematics Major

Holder (1913), as well as many others, acknowledged the importance of a mathematics degree as being able to develop a mathematical thinker so it may "enable him to recognize [the truth], to read it intelligently, to assimilate it, and thus to become a master of those things he is supposed to conquer" (p. 111). Often students who major in mathematics intend to become a teacher, actuary, statistician, or researcher.

In 1963 and 1964, Henry Pollak administered a survey to graduates with mathematics majors at 22 colleges in order to find out “what happens to undergraduate mathematics majors when they graduate” (Duren, 1967, p. 34). Out of 648 inquiries sent, 555 students replied. Of the 230 students who went on to full-time graduate studies, 141 of them had continued on to study mathematics. The type of graduate studies of the remaining 89 students in graduate school was a bit of surprise. Here are the results:

1) Medicine (20 students)
2) Business Administration (12 students)
3) Engineering (11 students)
4) Law (10 students)
5) Physical Sciences (10 students)
6) Humanities (8 students)
7) Social Sciences (6 students)
8) Statistics (4 students)
9) Biology (3 students)
10) Education (3 students)
11) Actuarial Science (1 student)
12) Library (1 student)

Of those who went on to full-time graduate studies, 39% did not choose mathematics. The interesting aspect of those 89 students who went on to full-time graduate studies and did not study mathematics is how 57 students were in non-STEM programs. One would have expected a field similar to mathematics, such as another STEM subject, like engineering or statistics. However, included in the top five destinations of mathematics majors who went on to full-time graduate study were medicine, business administration, and law school (Pollak, 1964). If students did not go on to graduate study, a large number of them were working in computer science-related fields.

One of the reasons students choose to major in mathematics before heading to medical or law school is that mathematics is believed to be successful at training mental discipline. Mental discipline is deemed as “training in intuition, judgment, memory, imagination, reasoning powers; an improvement in ability to concentrate, to think clearly, accurately, and logically; to recognize the essential elements in a problem, to note relationships, apply principles, and understand cause and effect" (Holder, 1913, p. 112).

Students who complete a mathematics degree have often been "viewed by industry, government, and academia as being well-prepared for jobs that require problem solving and creative thinking abilities" (MAA & CUPM, 1992, p. 231). The type of skills a mathematics degree provides can be useful in any career path.

The Beginnings of Statistics and Applied Mathematics as a Separate Branch

The fittest and most useful courses have survived the test of time. By this virtue, the courses in probability and statistics have certainly survived and, in many cases, developed their own department distinct from the mathematics departments. This trend seemed to begin in the 1930s, when statistics became more advanced and useful in agricultural research. The Institute of Mathematical Statistics was founded in 1935 and it was in those meetings that:

> demands for the establishment of a separate university department of statistics were voiced.... The first establishment of a separate department occurred at the University of North Carolina in cooperation with the state university of the same state, where, as in Iowa, there was important agricultural research interest in the subject. The establishment of such a department was rapidly followed by other universities, including the most prestigious ones. (Ben-David, 1972, pp. 99-100)

Prominent statisticians also influenced the creation of separate departments at the colleges during the '40s, such as Hotelling at Columbia University and Wilks at Princeton.

Mathematics course offerings expanded to include more applied mathematics to facilitate the rise of the new discipline. This became the most prominent between 1950 and 1960, when hybrid fields of research, such as bacteriology, mathematical statistics, applied clinical and engineering subjects, became popular and it was difficult to fit these courses in the preexisting framework.

If new applied departments were created, they began to offer their own majors. "To this day, however, there are a modest number of statistics majors, probably because most mathematically-oriented students are not ready to specialize in a particular mathematical science at the time they must pick a major" (Tucker, 2013, p. 695). If a separate department for applied mathematics was not created, it became popular for the mathematics department to offer an applied track for interested students.

Advanced Mathematics Courses Outside of the Mathematics Department

At the beginning of the 20th century, in an attempt to define modern mathematics, in the realm of higher mathematical branches, Smith (1906) stated that the applications of mathematics would receive only "incidental" consideration (p. 1). He believed mathematics was a mental discipline and tended to argue against applied mathematics being in the precollege mathematics curriculum (Stanic & Kilpatrick, 1992, p. 411). These kinds of sentiments may contribute to the fact that so many advanced mathematics courses are being taught outside of the mathematics department today.

In 1953, CUP studied "the needs of the social sciences, the new needs of engineering and physical sciences, of modern statistics, and biological sciences" (Duren, 1967, p. 28). Since the committee had reached out to engineers and specialists in other departments, it may have unintentionally helped to encourage mathematics' migration to other departments. Another possibility is that the mathematics departments did not heed the advice of the committee fast enough, because advanced mathematics courses began springing up in other departments and taught by the faculty in other departments.

In 1990, Garfunkel and Young devised a study in order to find out "where were the students of advanced mathematics" (p. 408). They noticed rising enrollments in mathematics-related degrees, such as engineering, biology, and social sciences, but not an equal increase in mathematics course enrollments. What they found is that advanced mathematics courses had slowly traveled to other departments, and fewer students were taking advanced mathematics offered by the mathematics departments.

There were large incentives for students to pursue fields involving applications of mathematics, and this created a great need for applied courses. For instance, Garfunkel and

Young (1990) found that "undergraduate mathematics majors who have learned some computer sciences can get jobs with starting salaries comparable to new mathematics Ph.D.s" (p. 408). Students deciding to major in mathematics doubled from 1960 to 1970. Then in the 1980s, that amount dropped back to the 1960 level – even though more students were attending college at that time and calculus enrollments tripled. "It is certainly clear from the survey that there are more enrollments in advanced work in mathematics outside of mathematics departments than within. (Approximately 173,000 as compared to 147,000)" (p. 410).

Garfunkel and Young (1990) further investigated why only the calculus enrollments were increasing. When they looked more closely at the advanced mathematics courses offered in other departments, it became clearer. In many cases, the only formal prerequisites for the mathematics courses taught in other departments were calculus or mathematical maturity.

To follow-up on their findings, Garfunkel and Young (1990) sent out 714 letters to the chairpersons of the non-mathematics departments offering the advanced mathematics courses to ask why those courses were being taught in their department and if the campus as whole knew that so much mathematics was being taught outside of the mathematics department. They received 292 replies, most of which were extremely critical of the mathematics departments on their campuses. Garfunkel and Young distilled the responses into five general responses:

1) The mathematics faculty does not know or appreciate applications.
2) Mathematics faculty teach mathematics as an art with full abstraction, not as a tool.
3) [Important and relevant] topics span too many mathematics courses.
4) The mathematics departments have not kept up with new applied mathematics.
5) Mathematics courses do not give students the knowledge or the mathematical maturity for further work.

In the conclusion of the article, it is refreshing to read Garfunkel and Young's (1990) personal opinions on the matter. They state:

> On a personal note, we find both the survey results and the attitudes of non-mathematics departments deeply disturbing. There is an indicated residue of ill-

> feeling toward mathematics departments. Worse yet, mathematics faculty and curricula are often seen as at best irrelevant and at worst counterproductive. Moreover, respondent after respondent expresses belief that mathematics departments are unconcerned about issues of the course offerings. (p. 410)

It seems from this study that if mathematics departments want to survive and maintain enrollments, they have to succumb to the pressures of the students and society. If mathematics departments do not align their courses with practical needs, they will risk low enrollment, and it has been revealed that other departments will pick up the slack. Departments can choose to remain as only pure mathematics, and pure mathematics still plays an important role in all of the other fields, but it comes with a cost of low enrollment.

Often useful ideas produced within a pure mathematics environment can be used in applications, so pure mathematics can lead to applications. Applied mathematical subjects and fields will then all share concepts with each other. However, it is not always the case that mathematical applications are used to advance pure mathematics. It is partly because of this dynamic that pure mathematics is not as popular a subject.

Collegiate Reform of Mathematics in the United States

Two major reform movements in K-12 mathematics, thus ultimately affecting reforms in college-level curricula, were (1) at the turn of the century when uniformity and utility became the focus of higher education and (2) after World War II, also around the launch of Sputnik in 1957. “The problem tying the two eras together and underlying all constraints on reform is that curriculum questions are moral and ethical, while reform efforts have had a technical character” (Stanic & Kilpatrick, 1992, p. 415). Nonetheless, the reform movements in K-12 had an effect on college mathematics because it changed the quality or amount of college-ready students and it initiated conversations among mathematicians about what should be taught in school mathematics in order to be prepared for college.

With the initiation of American graduate schools in the 1890s, this created an oversupply of Ph.D.s that led to better quality professors and teachers for the first reform movement of the 20th century. This unfortunately was not the case for the second reform movement in the 1960s, when enrollments grew faster than the available quality teachers.

Collegiate Mathematics Reform in the 1900s

One of the most significant “reform efforts [in school mathematics] during this century [has] been the move toward unified and applied mathematics as the century began” (Stanic & Kilpatrick, 1992, p. 407). Aiding this reform movement was an enormous increase in the number of students attending college. “In the 50-year period from 1890 to 1940, the percentage of 14- to 17-year-olds attending school increased from less than 10 percent to over 70 percent, while the number of 17-year-olds graduating increased from less than 5 percent to almost 50 percent" (James & Tyack, 1983, p. 400).

Reform movements are often fraught with turmoil. At the beginning of the 20th century, the mathematics community had grown to include many people with differing views. There were those who wanted a change to include more useful mathematics, and there were those who wanted to keep the curriculum abstract and traditional. David Eugene Smith was an advocate for the traditional curriculum, as he believed it was good for mental discipline. He “worried that any change would be for the worse – rejected unified mathematics and argued against too much applied mathematics in the curriculum” (Stanic & Kilpatrick, 1992, p. 411).

Smith was not the only person resisting change during this time. Holder (1913) also had a pessimistic outlook on changing the curriculum. He stated, “And so it is here and there and everywhere, we find this longing for something better. But often with the result that something worse appears” (p. 107). Holder argued that the technical and vocational schools were the main influences toward a shift to more practical mathematics courses in colleges, and he was not an advocate of reforming the mathematics curriculum in colleges to become more practical.

Most people who favored change at this time argued about the importance of making mathematics more modern and applicable to students. Those who argued in favor of maintaining the classical and traditional curriculum of mathematics usually believed that the modern approaches were less rigorous and less important. Inherently, applications and utility may make a course less abstract and rigorous, but on the flip side, they can still serve the need for mental discipline in a different way. Also, what is “important” is a relative term. What is important varies from person to person. Who should make the ultimate value judgments on what is important for a degree? This question is at the core of every curricular reform debate, and that is why they are usually difficult. A student who wants to become a research psychologist or astrophysicist will find different aspects of mathematics to be important.

Possibly as a consequence of the elective system in colleges, in the midst of the early 20th century reform movement, many secondary schools lost interest in mathematics. The college elective system allowed students to choose their own course of study, and thus, many graduated with low-level, unconnected courses. Part of the mission of high schools is to prepare students for college. When advanced mathematics was no longer necessary for a college degree, high schools began to modify their requirements accordingly. For example, in the 1920s, Ohio “ruled that an approved high school need not any longer require a unit of mathematics” (“Mathematics”, p. 641). This, in turn, negatively affected colleges even more, because there was an increase in students graduating from high school, and most of them went on to college without a proper educational background.

“Nonetheless, despite the practical values of American society, there were always a small number of college students who became fascinated with mathematics” (Tucker, 2013, p. 688). Fortunately, for the ambitious and scholarly students, there were many undergraduate mathematics faculty members with advanced degrees during the early part of the century. This created opportunities for the ambitious students to learn more than was expected by the curriculum.

Collegiate Mathematics Reform in the 1950s

Another significant reform effort during the 20th century was "the modern mathematics movement of the 1950s and 1960s.... [This] movement had a profound effect on the mathematics education community, particularly at the post-secondary level" (Stanic & Kilpatrick, 1992, p. 407). This movement is claimed to have "dumbed down" the mainstream curriculum to basic skills, thus taking away the opportunity from gifted students to learn advanced mathematics. It also created an increased amount of research in the field of mathematics education by mathematics educators at the post-secondary level.

After the Second World War, there was an influx of enrollments in college. Many high school graduates moved on to college "in order 'to find themselves' and to become independent and self-assured men and women" (Ben-David, 1972, p. 77). Students often specialized in a mathematics-related discipline in order to go to graduate school and obtain a secure job in research. Even if graduate school was not in their plans, "as far as the college student in 1960 was concerned … he could realistically look forward to secure lifelong income, rising steadily and rapidly to a very respectable height" (p. 82).

During this time, the college culture also shifted toward hosting more social activities, such as fraternities, sororities, clubs, and team sports. These activities were a distraction and benefited little toward the academic achievement of students. However, they served the purpose of a moral education, which had slowly been removed from schools when they became secular in the 19th century.

"By the end of World War II, industry came to value mathematics majors almost as much as engineers" (Tucker, 2013, pp. 690-691). The increased enrollments and new interest in applied mathematics offered mathematics departments an opportunity to grow. However, "now that undergraduate mathematics could really challenge a teacher with a full graduate education, such teachers were not available to the great majority of colleges" (Duren, 1967, p. 25).

During World War II, Europeans immigrated to the United States to help revamp mathematics research at the universities. "What emerged in the 1950s was not the realization of the ideal of elective higher education that could be used by different people for different purposes in the manner they saw fit, but a college that now accepted the university ideal of research and advanced training" (Ben-David, 1972, p. 73).

After the launch of Sputnik by the Soviet Union in 1957, the United States government began to fund many mathematical-related science programs, such as physics and engineering, and assisted the reform movement. This assisted reform efforts, and mathematics enrollments began to flourish for the next decade.

Collegiate Mathematics Reform after 1980

Since the 1970s, there have not been many major reforms in mathematics. What has persisted, though, is the continued tension among the issues surrounding applied and pure mathematics. In 1981, CUPM published a report to address the tension between students who wanted more career-oriented coursework and mathematics faculty who wanted the major to remain highly theoretical. The tension still remains today, as many mathematicians are interested in keeping their field of study pure and abstract. In any case, considering K-12 movements, "genuine reform requires a continuing struggle with the moral and ethical questions that constitute curriculum discourse" (Stanic & Kilpatrick, 1992, p. 416).

In 1984, Roberts argued in favor of reforming mathematics in order to motivate more students early on in their college career. He stated that "by emphasizing the traditional curriculum, we are misleading students about the nature of modern mathematics" (p. 383). "We are giving the students a biased view of what mathematics is all about, and clouding their view of what to expect should they continue in mathematics" (pp. 383-384). He suggested that modifying the first two years of the curriculum should be a priority.

In 1967, Duren wrote about his plans for the future of undergraduate mathematics. His outlook seemed optimistic and hopeful, but also unrealistic. He stated that "we must prepare to teach first year students subjects which we formerly taught in graduate school, only in a more modern way…. Certainly the absolute numbers of students entering with advanced capability will increase, and surely they will gravitate to more favored institutions, as they do now. There they will not need CUPM help" (p. 26).

Overall, the most changes to and the greatest amount of interest in the mathematics major came after World War II and before the computer science major flourished in the '70s. Since then there have been some changes to the mathematics major, such as an increase in mathematical modeling courses, more discrete mathematics, and more types of courses due to experimentation with different forms of pedagogy. However, nothing has seemed to create a paradigm shift as of yet that can be deemed a reform movement at the college-level.

External Influences on Mathematics Programs

World War II (1945), Sputnik (1957), and United States Immigration

After the Second World War, colleges in the United States began to take on the responsibility of research and advanced training. Qualified professors in the United States were at an all-time low, so immigration of European mathematicians to the United States during World War II helped revamp mathematics research at the universities. From 1950 to 1970, college enrollments quadrupled, and those years had the highest percentage of incoming freshmen who decided to major in mathematics – around 5%. The Soviet Union's launching of Sputnik in 1957 also drew increased interest in mathematics, since the United States wanted to remain a competitive world leader.

Later on "with the advent of Gorbachev's reforms in the mid-1980s, as the country became more open, hundreds of highly qualified mathematicians poured out of Russia into the West" (Karp & Vogeli, 2010, p. vii). This further benefited the quality of professors in America and aided the ability to do advanced training and research.

Mathematical Organizations' Recommendations

In 1915, the Mathematical Association of America (MAA) was formed to help address any issues that directly affected college-level mathematics. In the early 1900s, many institutions in the United States had moved to an all-elective curriculum, and students could graduate with very few courses in low-level mathematics. It is Duren's (1967) belief that MAA also existed to "give comfort and status to college mathematicians" (p. 24).

In 1953, a survey was sent out to colleges by MAA. Its results revealed that there was a "widespread dissatisfaction" with college mathematics programs. A national "program of 'doing' to overcome the inertia of the enormously ponderous structure which carries onward the present program with all of its deficiencies" was recommended (Duren, 1953, p. 511). This led to the establishment of the Committee on the Undergraduate Program (CUP). This committee was created in response to the survey and included five members who were initially charged to "prepare syllabi and commission the preparation of experimental teaching materials to implement a widespread trial of new mathematics courses in colleges," among other responsibilities (Duren, 1967, p. 27).

In 1954, the CUP had summer writing groups and created a text called *Universal Mathematics* with highly theoretical approaches on the odd-numbered pages and traditional approaches on the even-numbered pages. The theoretical approach paved the way for a theory-based mathematics major that would prepare students for graduate study in the field.

Universal Mathematics unfortunately did not become as popular as was hoped. The title included the word "universal" because it was hoped to be a curriculum suitable for all college students who had high school algebra and geometry. Part of the eventual demise of *Universal Mathematics* may have been insufficient funding. The members of the writing groups were either volunteers or were paid small stipends. As Duren (1967) stated, "One of its major mistakes [was] not to have a big grant" (p. 28). More funding could possibly have encouraged additional editions that may have had better explanations to attract all types of students and enabled better advertising.

CUP was run by a small group of people, and eventually the committee had "resolved to liquidate itself to clear the way for reorganization of Committee on the Undergraduate Program in Mathematics (CUPM) with new blood and larger organization" (Duren, 1967, p. 29). To aid the transition, CUP prepared reports and recommendations for CUPM in 1957. "Almost as an afterthought these reports included a sketchy outline of a recommended college curriculum in mathematics. The old CUP had avoided making [curricular] recommendations as being too prescriptive, but came to believe that its successor Committee on the Undergraduate Program in Mathematics (CUPM) should publish recommendations, and it did" (p. 29).

In 1958, the advisory committee was reorganized and named the Committee on the Undergraduate Program in Mathematics (CUPM). They gained their credibility early on and were "endorsed as a distinct arm of the [Mathematical] Association [of America]" (Duren, 1967, p. 30). The committee had improved due to new time limits on their appointments. This was added to encourage turnover and movement within the committee. Moreover, the number of positions had increased from 5 to 80.

The new committee was a great success, mostly due to the fact that they had initially landed a National Science Foundation (NSF) grant to support the organization's operations for two years. They also had continued to successfully receive funding to maintain the organization thereafter. This was also one year after the launch of Sputnik by the Soviet Union, which caused a great deal of national funding of STEM-related projects. CUPM released many documents with recommendations on curriculum, and they encouraged experimentation within colleges. Additionally, the members of CUPM were very active in the field and had a genuine passion for mathematics education. "Creighton Buck, Baley Price, John Kemeny, Henry Pollak, E.J. McShane, A.W. Tucker and others have been very active in this speaking service, which has turned out to be one of the most important activities to stem from CUPM" (Duren, 1967, p. 33).

The *General Curriculum in Mathematics for Colleges* (GCMC) was a report that was created by CUPM in 1965. This report offered suggestions for a mathematics program of one-semester course modular units. "Possibly the most significant curricular change arising from

General Curriculum in Mathematics for Colleges was the introduction of a sophomore-year linear algebra course; it was adopted widely at universities and colleges" (Tucker, 2013, p. 694). CUPM tried to avoid being overly prescriptive, leaving room for flexibility and local variation, too.

Some suggestions and lines of thinking in the GCMC report are listed here:

- What is the right normal starting point for college mathematics in 1965? Should we say that a three-hour Computer Science, which might be labeled Math. 2C, is the business and even responsibility of mathematics departments to teach? These are hot issues. Our attitude was: Let us wait and see. (Duren, 1965, p. 828)

- What geometry should the general curriculum include? We believed that, within some bounds, it is better to let a teacher teach what he knows and likes instead of trying to specify some preferred geometry. (p. 829)

- We omitted Number Theory from the list of 14 courses. Obviously this is a good course when there is someone who knows how to teach it and students take it. (p. 829)

- Should Algebraic Structures, Math. 6, have been extended to a year course where it could have included a little number theory and more advanced linear algebra than one can cover in the introductory and low-level Math. 3? (p. 828)

- Returning to advanced undergraduate mathematics, how much upper division mathematics can normally be required of a major? We used six semester courses as a norm. (p. 829)

In the 1960s, Spanier wrote a memorandum to the members of CUPM expressing concern about the state of affairs in undergraduate mathematics. Part of the memo "questioned whether an overall understanding of mathematics is best obtained (at the undergraduate level) by taking a major in mathematics or by pursuing some program outside the mathematics department (for example, in computer science)" (Spanier, 1970, p. 752). Two conferences resulted from this memorandum, and Spanier's article summarizes the concerns and conclusions from the conferences.

Spanier claimed, in 1970, that the goal of an undergraduate mathematics major was to understand mathematics' "internal structure and its relation with other disciplines" (p. 752). It was recommended that mathematics students needed a more global view of mathematics, and to better understand the trends and progress of the subject. According to Spanier, the courses of the mathematics major had "small bits of mathematics not tied together with each other very well and usually taught in a rigorous deductive style from axioms" (p. 753). He viewed the current curriculum to be slanted toward research, which would ultimately only benefit the few who would go on to graduate studies in mathematics.

Graduate Schools

Yale was the first institution to award an American Ph.D. in 1861. Furthermore, the first Mathematics Ph.D. was also granted by Yale, but in 1862. After that, the number of mathematics Ph.D.'s began growing geometrically. "Mathematics Ph.D. production increased from one or two per year in the 1860s and 1870s, to ten per year by 1900" (Tucker, 2013, p. 686). The growth of graduate schools and their local missions undeniably had an influence on the undergraduate curriculum. In many cases, the "actual state of undergraduate curriculum had been determined much more by the needs of disciplinary teaching of the graduate school than by the purposes of educating the terminal undergraduate" (Ben-David, 1972, p. 50).

Social Influences on Mathematics Curriculum: Focus on Race in Education

Some of the often unacknowledged external influences on the curriculum come from race. Walker (2009) claims that "some schools [with a large black and Latino population] offer limited numbers of high-level mathematics courses, thus restricting the number of students who can enroll" (pp. 48-49). In one high school, Walker found that "underserved high school students lobbied for an AP Calculus course, much to the principal's surprise" (p. 51). These inaccurate assumptions have revealed that they alter the curriculum in high schools, so it is likely to be the same case for colleges.

Chapter III

METHODS

This dissertation examines the mathematics major requirements at six colleges from 1905 to 2005. As Ben-David (1972) explains in the preface of his book, “a snapshot taken at any moment of time will rarely reveal the whole range of problems faced by the system, or the complete repertoire of responses to deal with those problems. One has to observe the system, therefore, through a period of time” (p. ix). This sentiment is the reason this study observes the mathematics major requirements over the course of one hundred years.

First, the six institutions in the study were chosen in order to satisfy the fact that they are in three different regions spanning the entire United States. Furthermore, they are an equal mix of public and private, and an equal mix of undergraduate colleges that have a reputation to be good science, technology, engineering and mathematics (STEM) doctoral feeder schools and those that are not. The six schools that were chosen are:

(1) City College of New York (New York)
(2) Yale University (Connecticut)
(3) Stanford University (California)
(4) University of California at Berkeley (California)
(5) University of Texas at Austin (Texas)
(6) Colorado College (Colorado)

The colleges are divided among the groupings of interest as follows:

Three Public	**Three Private**
• CCNY • University of Texas at Austin • University of California at Berkeley	• Yale • Colorado College • Stanford University

Two from the West Coast of the United States	**Two from the Mid-West of the United States**	**Two from the East Coast of the United States**
• University of California at Berkeley • Stanford University	• University of Texas at Austin • Colorado College	• CCNY • Yale

Three which are on the list of the top 50 colleges that produce a significant amount of undergraduates who eventually go on to earn a doctoral degree in STEM:	Three which are not on the list of the top 50 colleges that produce a significant amount of undergraduates who eventually go on to earn a doctoral degree in STEM:
• Yale • Stanford University • University of California at Berkeley	• University of Texas at Austin • CCNY • Colorado College

The primary sources of investigation for this study are the college course catalogs at each of the six institutions in every decade from 1905 to 2005. At each institution there are university archives or special collection libraries that house historical documents from the college, such as the course catalogs or course bulletins. The mathematics major degree requirements and course descriptions were collected from these university archives at each institution. At times archivists from the universities were helpful in photocopying the requisite pages in the course catalogs and mailing the photocopies for a small fee, and at other times a visit was made to collect the information or to retrieve anything missing from the first attempt at collecting all the necessary information. Scans of the college catalogs can be found online at the Cajori Two website noted in Appendix E.

Once the complete course catalog information had been obtained, the mathematics major requirements were analyzed and recorded. In many cases, a college may offer more than one type of mathematics degree. For the purposes of this study, the degree in pure mathematics was considered the most likely one to prepare a student for graduate study in mathematics.

There is no standard way to offer the major requirements at any institution, so as much information was recorded as possible. For instance, in many cases there may be a number of options for students who intend to major in mathematics depending on their initial level of mathematics, so it is difficult to pin down one set path that a mathematics major student would take. It also seems that there could be some typos or a college may have been ambiguous in the catalog description of the major requirements. These circumstances were noted. All of the required and elective mathematics courses that could count toward a degree in mathematics were recorded. Special attention was made to the amount of required mathematics courses and the types of courses available to students majoring in mathematics in each decade.

After information from all of the six colleges was recorded, qualitative comparisons were made based on the observed characteristics at each school. First the observed similarities and differences were noted within each group. Then the main similarities from within each group were used as a way to compare between the groups.

If any unusual and noteworthy trends or changes were noticed, they were documented. In order to answer the last research question and better understand why there might have been any unusual trends or circumstances, a follow-up literature review and interviews took place.

Limitations of the Study

This study only considers the course descriptions and major requirements as they are depicted in the course catalogs at the institution. The quality of instruction and amount of material covered may vary from instructor to instructor, and this study does not consider this variation. Some people may even consider the quality of instruction to be more important for the student than the actual contents of the course. Ben-David in 1972 described this sentiment, as he stated, "The difference in quality of the institutions manifests itself … in the quality of teachers and the students rather than in the formal contents of the courses" (p. 7).

On a day-to-day basis, it is possible that a course instructor or the quality of students is more important than the list of course topics described in the course catalog. However, with data from six campuses spanning back to 1905, it was hoped that patterns would emerge over time. Looking at multiple campuses, it was felt, would allow one to see how trends in mathematics major requirements had shifted in the United States over the last century.

Chapter IV

QUALITATIVE ANALYSIS

Answers to Research Question 1

College One: City College of New York (CCNY)

It seems in the 1906 to 1907 academic year, there was no specific sequence of courses listed in the catalog for a mathematics specialization. There were three science divisions leading to a B.S.; however, they were for general science, biology-chemistry, and mechanical, not mathematics. The sequence of courses considered was Arts I, which led to the A.B. degree, since this was the classical degree. In this prescribed sequence of courses, it appears that one would use their 29 counts of free electives as mathematics courses if one hoped to specialize in mathematics. It is interesting that students were expected to make a decision on their course of study early on, as the catalog states "every student shall, upon entering the College, elect the course he will follow, subject to such approval by the father of the student, or otherwise, as the President of the College shall direct" (CCNY Register, 1906-1907, p. 21).

In the 1915 to 1917 academic years, there were more calculus semesters offered and a specialization in Mathematics. The college bulletin stated that the "student may avail himself of the privilege of pursuing the more technical subjects offered by remaining as a special student for one of two terms after graduation in accordance with a resolution of the Board of Trustees, or he may, by advice, elect them as partial requirements for the bachelor's degree" (CCNY Register, 1915-1917, p. 39). The bulletin offered a prescribed set of courses "for students who wish to specialize in Mathematics and in Mathematical Physics with the view of pursuing University Courses in these subjects, or of entering the field of Physical Research" (p. 40).

During the 1923 to 1925 academic years, the prescribed curriculum was 87 credits, and so the remaining 41 credits were elective, which "under restrictions […] oblige a certain concentration but which permit beyond that either a wide distribution or further specialization, as the individual student may choose" (CCNY Bulletin, 1924-1924, p. 57). Furthermore, "at the end of the sophomore year each student is asked to decide in which of the divisions he desires to pursue his major work for the remainder of his college course. In the division chosen he will be required to take at least one-half of his elective credits and at least twelve credits of this number in one department of the division so selected" (p. 57). A student interested in pursuing graduate studies in mathematics while an undergraduate at CCNY in 1923 to 1925 would choose to do their elective work in the Division of Natural Science.

Requirements at CCNY during the academic year of 1935 to 1936 included a common core prescribed for all degrees amounting to 60 credits. A group of studies particular to the degree sought was required amounting to 19 to 24 credits. A specialization or concentration group of 24 credits was required and the plan was to be created by the student. "The essential features of the plan are that a group of subjects shall form an interrelated whole, they shall all sub serve a definite purpose, and that they shall render the student competent in some particular field of endeavor" (CCNY Bulletin, 1935-1936, p. 10). The remaining credits were to be used as free electives, and the total number of credits necessary to graduate was 128. Specialization in mathematics required 24 credits taken normally during their junior and senior years, and at least 12 credits had to be from one department; one would assume a student specializing in mathematics would elect to take those 12 credits from the Mathematics Department. Each student was required to submit a plan of courses to be elected as a specialization group during the second part of their sophomore year.

In 1945 to 1946, the initial mathematics course depended on high school achievement. A student would create their own sequence of courses in the sophomore year to be approved by an adviser, and it was to be submitted to the Registrar at the end of the sophomore year as an approved *Elective Concentration Card*.

> Each student is required to select a group of elective courses amounting to 24 credits; these courses are normally to be taken during the junior and senior years and should form a well-rounded, coherent group calculated to lead to a definite objective. These courses need not be selected in one department, nor need they be

> confined to one of the three major divisions of the college elective work; the essential features of the plan are that the group of courses shall form an interrelated whole, they shall all serve a definite purpose, and that they shall render the student competent in some particular field of endeavor. (CCNY Bulletin, 1945-1946, p. 11)

As had also been recommended in previous years, "students planning to take electives in Mathematics are advised to acquire, as early in their college course as possible, a reading knowledge of French and German" (p. 51). Furthermore, the calculus sequence of [7] and [8] was recommended for students "intending to take elective work in either Mathematics or Physics" (p. 10).

During this academic year, there were two courses listed within the prescribed set called "Fundamentals of Mathematics" I and II, or [61] and [62], respectively, which did not have a course description and were not noted as prerequisites for any advanced mathematics. It is because of this that those courses were not listed as part of a mathematics specialization.

Between 1935 and 1945, the following changes were noted:

- The name of the third group had changed from "Specialization Group" to "Elective Concentration."
- Mathematics [1] and [2] changed from a calculus course in 1935 to algebra and trigonometry and analytic geometry courses.
- Mathematics [42] no longer included spherical trigonometry. The title of Mathematics [43], Advanced Algebra, changed to College Algebra between 1935 and 1945.
- History of Mathematics went from 2 credits to 3 credits.
- Mathematics [13] and [14] changed from *Advanced Differential Calculus* and *Advanced Integral Calculus* to *Introduction* to *Higher Analysis I and II* respectively. Credits stay the same.
- Mathematics [19] *Theory of Probability* was no longer offered.
- Mathematics [21] and [22]: *Statistics I* and *II* became a new course between 1935 and 1945.
- Mathematics [32], *Introduction to Modern Analysis*, changed to *Theory of Functions of a Complex Variable* between 1935 and 1945.

At CCNY, between 1946 and 1955, the "common core" went up from 60 credits to 64 credits. The group of studies requirement ranged from 16 to 24 credits. The specialization or concentration group was 24 credits, with at least 12 credits from one department. The remaining credits were for free electives.

During the 1965 to 1966 academic year at CCNY, the common studies prescribed for all degrees amounted to 64 credits. “Studies forming a background for the particular degree or subdivision, such as mathematics for the natural sciences and history for the social sciences, etc (12 to 24 credits)” (CCNY Bulletin, 1965-1966, p. 15). A group of specialized courses comprised 24 credits, and the remaining credits were to be taken in free electives, which should amount to 128 credits. It was also recommended that a “Mathematics major is advised to select one of French, German, or Russian in his required language and to acquire a reading knowledge of two of these languages if he intends to do graduate work in Mathematics” (p. 92). Additionally, it seems clear that the B.S. degree was the one students would take if they were to major in mathematics since p. 91 stated, “For the B.S. degree with emphasis in on chemistry, geology, mathematics, or physics Mathematics 1, 2, and 3 or Mathematics 7 and 8 are required.”

Students who majored in mathematics at CCNY during the 1975 to 1976 academic year needed to complete 8 mathematics courses or a total of 27 credits in mathematics and collateral courses beyond the level of Mathematics 3 and 8. Students filed a specialization card by the end of their sophomore year outlining their specialization courses, which needed approval from the Director of Curricular Guidance. Surprisingly, Complex Analysis (Mathematics 32) and Combinatorics (Mathematics 16) were available courses; however, they were not recommended undergraduate courses for future mathematics Ph.D.’s. Students who intended to pursue graduate studies in mathematics seem to have been able to earn either a B.A. or B.S., and there was not a significant difference between the two. The course bulletin stated, “Students who complete at least two years of laboratory science and one year of calculus will be candidates for the Bachelor of Science degree. All others will be candidates for the Bachelor of Arts degree, except any student who wishes may choose to receive the Bachelor of Arts degree rather than the Bachelor of Science degree” (CCNY Bulletin, 1975-1976, p. 21).

In 1983-1985, students still completed a specialization card detailing their major courses by the end of their sophomore year and needed approval from a department advisor. To major in mathematics, students had to complete a minimum of either 27 credits or 8 courses of mathematics and collateral courses beyond the level of Math 203 [Calculus III] (or 208). "The Mathematics majors who are planning to graduate with a B.A. degree are required to take Math 210. The Vice-Chairman will indicate which course of study is appropriate for students who intend to enter graduate school" (CCNY Bulletin, 1983-1985, p. 172).

During the last recorded academics year, analysis of a complex variable was not recommended for future mathematics Ph.D.'s, and in this academic year it was recommended. Theory of Games and Mathematical Methods of Operations Research (Mathematics 371) was required this year. An advanced modeling course (Mathematics 367) and a history in mathematics course (Mathematics 342) were available; however, students interested in pursuing graduate study in mathematics were not required to take it. Even though the calculus sequence of [105] Elements of Calculus I (4 credits), [206] Elements of Calculus II (3 credits) was available to students majoring in mathematics and science, it was not considered above since all advanced work had only a prerequisite of [203] or [208], and there was no mention of students being advised to take either of these two courses after [206]. Two Calculus I courses, namely, Mathematics 101 and 105, offered an option, with two additional hours per week devoted to precalculus topics.

In the 1993 to 1995 academic years, it seems a student no longer submitted a specialization card. The college bulletin stated, "Each department or program sets specific course requirements for its majors" (CCNY Bulletin, 1993-1995, p. 50).

A course called Mathematics 204 was a "Bridge to Advanced Mathematics" course and was not necessarily required for a student majoring in mathematics, although it was included since the course description for [223] stated that [204] was a prerequisite or departmental permission. Advanced modeling (Mathematics 367), combinatorics (Mathematics 296), history of mathematic (Mathematics 342), and discrete mathematics (Mathematics 268) courses were available, although not required for students majoring in pure mathematics. This academic year, "students are also required to fulfill a minor requirement of two advanced courses with mathematical content from an allied discipline (e.g. Physical Sciences, Computer Science, Philosophy, Economics, or Engineering) to be approved by the Vice Chair" (CCNY Bulletin, 1993-1995, p. 158).

In 2003 to 2005 at CCNY, it seems that the mathematics major required one more course in mathematics above the eight course specialization requirement. The college bulletin stated, "In addition to completing the calculus sequence (20100, 20200 and 20300), students must complete a minimum of nine courses of mathematics" (CCNY Bulletin, 2003-2005, p. 100).

Two courses in financial modeling were available (Mathematics 38100 and 38200) and a course in the history of mathematics (Mathematics 34200); however, they were not required for students majoring in mathematics. Combinatorics (Mathematics 36500) was available to students majoring in mathematics this year. In addition to the mathematics courses required for the mathematics major, students were also required to "fulfill a minor concentration of two advanced courses with mathematical content from an allied discipline" (CCNY Bulletin, 2003-2005, p. 100). It was also recommended that students "planning to attend graduate school in mathematics … apply for admission to the department Honors Program, which may lead to a degree with honors. Candidates should see the departmental Honors Advisor no later than the beginning of their junior year to plan a program of study" (p. 100).

College Two: Colorado College

During the academic 1905-1906 academic year, students were required to choose a major subject. The Colorado College Bulletin states the following:

> In addition to the … prescribed subjects, each student shall select a major subject, or specialty, if possible before the end of the Sophomore year, and, in any case, not later than the beginning of the Junior year. The professor in charge of the major subject will act as the student's adviser, and will have authority, with the Dean, to require the completion of work amounting to fifteen (15) hours in the major subject, or in the major subject and in such minor subjects as he shall consider

> necessary, or collateral, work. Mention of the major subject will be made on the diploma. (1905-1906, pp. 26-27)

Most of the courses appear to be some kind of geometry course. There also are not many options for advanced mathematics courses.

Interestingly, the bulletin states that “it is recommended that students who are planning to work their way, in large part through College, take five years for their course” (Colorado College Bulletin, 1915-1916, p. 31). Students are also not required to choose a major at the beginning of their studies. The college bulletin states, “In addition to the above prescribed subjects, each student shall select a major subject, if possible before the end of the Sophomore year, and in any case, not later than the beginning of the Junior year” (p. 33). It is also important for one to obtain a decent grade in the major course since “no work done in Colorado College will be counted toward the completion of a major subject if the grade is below C (70)” (p. 34).

In the 1915 to 1916 academic year it does not seem that students majoring in mathematics have many options. If a student must complete at least 30 hours in a subject in order to major in that subject and there are only 26 hours available in the electives with 6 hours of mathematics required in the prescribed studies, that student must take all of the courses listed in the electives.

In terms of course changes from the previous sample, these courses disappeared between 1906 and 1915:

> [E] Modern Methods in Geometry (3 hours)
> [F] Theory of Equations (3 hours)
> [H] Determinants (2 hours)
> [J] Theoretical Mechanics (4 hours)
> [I] Elementary Surveying (2 hours)

Moreover, these course appeared:

> [8] Projective Geometry (3 hours)
> [9] Theory of Equations (3 hours)
> [10] Differential Equations (2 hours)

[11] Determinants (2 hours)
[13] Vector Analysis (3 hours)

Also interesting is how between 1906 and 195, the [5] Analytic Geometry (More Advanced) course hours changed from 3 to 2.

During the 1925 to 1926 academic year, there appears to be a Bachelor's degree with honors available to the students (Colorado College, 1925-1926, p. 33). It is interesting that courses from the astronomy, business, graphics, and physics departments can count toward the 30 hours required for the mathematics major. The course offered as [2] Solid and Spherical Geometry (3 hours) is not included in the list of required courses, since it does not count toward the 30 hours in a major subject and it is not listed as a prerequisite for any of the required courses.

During the 1934 to 1935 academic year at Colorado College, the mathematics courses are contained in the School of Natural Science. "The courses in the School of Natural Sciences are designed to fit the needs of several classes of students: (a) those who wish to include an adequate training in the natural sciences and mathematics as an essential part of a liberal education, (b) those who wish to teach those subjects, (c) those who are preparing for medical school, and (e) those who wish to do professional work in various fields of natural science" (Colorado College Bulletin, 1935, p. 38). Furthermore, students must be admitted to the School of Natural Sciences in order to major in mathematics, and the "student must have completed two full years of college work, and must satisfy the Executive Committee and his major professor that he is prepared to carry on successfully the work he intends to pursue in the School" (p. 38). It is also required for students to have completed mathematics through calculus in order to be admitted. Other than the calculus requirement, the "program of a student in his preliminary work as well as in the period of concentration will be made out according to his special abilities, interests, and aptitudes and not to meet specific rules and regulations" (p. 38).

In the 1945 to 1946 academic year, according to Jessy Randall, Curator and Archivist at Colorado College Special Collections, "the requirements for the School of Arts and Sciences are:

Four semesters in some one subject and one course in each of the other two groups of subjects (Math/Natural Science, Languages/Literature/Fine Art, Social Sciences). Total of first four semesters must be 25% general work, 25% in major, 25% in at least two 3-hour courses in English. Two consecutive semesters in one subject, at least one course in each of the other two groups" (J. Randall, personal communication, May 5, 2014). The set of required mathematics courses are not clear during the 1945 to 1946 academic year at Colorado College, especially since it states "first year of Mathematics" as a prerequisite for Calculus I, but no clear indication of what the first year should be. It is assumed that [105] and [106], or [107] and [108] are the first year of mathematics, since that is a two-semester sequence with precalculus concepts. The college bulletin states the "first four semesters in college in addition to the work in the high school will enable such students to obtain adequate elementary preparation in the natural and social sciences, in languages and literature, in art, in mathematics, and other subjects prerequisite to advanced studies in the subject or subjects of their choice" (Colorado College Bulletin, 1945-1946, p. 14). Moreover, the:

> requirements for the Bachelor of Arts degree are first, the completion of the work in the School of Arts and Sciences or its equivalent; second, admission to an advanced school; third, the completion of 64 semester hours in an advanced school; and fourth, passing of a comprehensive examination in the field of the student's major interest. The student's work in an advanced school is under the discretion of an advisor who, with the student, outlines a schedule of courses to be approved by the chairman of the department in which the major part of the student's work is to be done. (p. 16)

This is the first year in this study where a Bachelor of Arts with Honors is noted as available, and is obtained through high grades and the recommendation of the department from which the student has done a major part of their work.

During the 1955 to 1956 academic year, there do not seem to be enough mathematics courses listed in the course descriptions for a student to fulfill the 44 semester hour minimum in a major of mathematics. There must be more courses available to students in other years that are not listed in the bulletin. Also during this academic year, a student majoring in mathematics should complete the requirements for the Bachelor of Science (Colorado College Bulletin, 1955-1956, p. 24).

During the 1965 to 1966 academic year, students majoring in mathematics could choose either a Bachelor of Arts or Bachelor of Science degree. The “special requirements for the Degree of Bachelor of Science: This degree may be granted to students who present 40 to 44 hours in a major and a minimum of 72 hours in the division of the major” (Colorado College Bulletin, 1965-1966, p. 18). This year there are also two upper-level statistics course available to students majoring in mathematics.

It is interesting that some courses are repeated in the catalog with a ‘T’ following the course number, such as with [105], [105T] and [106], [106T]. According to the Registrar at Colorado College, “the letter T was used to designate a separate section of the same course. So, there were so many people taking that course in the math department that they had two sections each semester. Same course, different group of students” (J. Randall, personal communication, May, 6, 2014).

Between 1966 and 1975, Colorado College changed their course units from semester hours to units, and it is noted on p. 46 of the Colorado College Bulletin that “each unit is equal to 3.5 semester hours” (1975-1976). The mathematics department also offered a computer science course, and it was available to students majoring in mathematics as a mathematics elective. It is interesting that there is a mathematical modeling course available [241], but since it is not numbered 300 or higher, it does not count toward the mathematics major requirements.

The Academic Honor system, which was put in place in 1948 is noted in the 1985-1986 bulletin, which states:

> Administered by the students themselves since 1948, the Academic Honor System is an essential part of the College Program. Under the Honor System, students take examinations without proctors. The system is based on trust and maturity and is a reflection of the academic attitude of the Colorado College community. The purposes of the Honor System are to allow a more relaxed testing

> situation, to instill academic incentive and confidence and to promote individual responsibility. (Colorado College Bulletin, 1985-1986, p. 57)

There is also a new minor requirement after 1983: "Students shall take a five-unit thematic minor, composed of courses outside their major which are closely related through the examination of an issue, an area of the world, or time period" (p. 59)

The college bulletin offers the students much guidance through suggestions, with reasons for the suggestions. "The College believes that students should have a wide latitude of choice among these 20-plus units [outside of the major]; they should be able to choose many of them freely, even eccentrically. At the same time, students should be encouraged to bring focus and coherence to some of the work they do outside of the major. It seems especially important, considering the complexity of the world students will confront after graduation, they gain some experience in connecting ideas and approaches across disciplines, in seeing how different subjects relate to one another" (Colorado College Bulletin, 1985-1986, p. 61).

Computer science has become more closely tied to a mathematics major by 1995. The bulletin states that "students may take … a computer science concentration within the mathematics major" (Colorado College Bulletin, 1995-1996, p. 39). Furthermore, a distinction in mathematics is described in the catalog: "To be considered for graduation with *Distinction in Mathematics*, a student must complete three courses with a 300 level prerequisite, one of which must be 410…. Such students must complete a senior project, and be approved by a vote of the mathematics faculty" (p. 135). The [311] Topics in Advanced Calculus in 1986 changed to "Vector Analysis." Some new courses were added, such as [312] Fourier Analysis (1 unit), [318] Numerical Analysis (1 unit), [325] Graph Theory (1 unit), [329], [341] Special Topics in Computer Science (1 unit), and [345] Research in Mathematics: An Introduction to the Nature of Mathematical Research (1 unit). The following two courses were lost between 1986 and 1995: [317] Mathematical Statistics (1 unit) and [405] Real Analysis (1 unit).

Between 1996 and 2005, basic competency in a foreign language became a requirement (Colorado College Bulletin, 2005-2006, p. 44). Moreover, "a student majoring in mathematics must also attend at least four departmental seminars or department-approved talks after declaring the major, and submit a one-page summary of each to the chair within one week of the seminar" (p. 160). The Distinction in Mathematics is still available this academic year, but in addition to completing "three courses with a 300-level prerequisite, one of which must be 410 … students must complete a senior project and be approved by a vote of the department faculty" (p. 160).

A sequence of courses in order to minor in mathematics is listed this academic year. Some of the mathematics courses that were lost this year are: [308] Theory of Computation (1 unit), [310] Topics in Advanced Calculus (1 unit), [320] Linear Algebra (1 unit), [341] Special Topics in Computer Science (1 unit), and [407] Analysis of Algorithms (1 unit). The following course was added in between 1996 and 2005: [351] History of Mathematics (1 unit).

College Three: Stanford University

At Stanford University in 1906, the courses in the Applied Mathematics Department were not considered in the elective mathematics courses since they were designed to meet the needs of the engineering students. It is interesting regarding the admittance of women: "the Founding Grant of the University, as amended May 31, 1899, directs 'that the number of women attending the University as students shall at no time ever exceed five hundred'" (Stanford University Bulletin, 1906-1907, p. 4).

There were majors at Stanford University in 1906 as stated in the course bulletin:

> Each student selects as his major subject or specialty the work of some department. This department has the authority to require the completion of this major subject, and also of such minor subjects in other departments as may be considered necessary or desirable collateral work. Such major and minor requirements taken together will not (except in the departments of applied science) exceed forty units of University work, or one-third of the student's time during his undergraduate course. (Stanford University Bulletin, 1906-1907, p. 40)

It was also recommended for those who major in mathematics "begin the study of either French [or] German in their freshman year" (p. 83).

In 1915, the courses at Stanford University in the Applied Mathematics Department were not considered as possible elective mathematics courses since they were designed to meet the needs of the engineering students. “The courses in [the Mathematics] department have been arranged to meet the wants of two classes of students – students whose major subject is Mathematics, and students who, while taking their major in some other department, desire to include some mathematics in their course. Students in Engineering are provided for in the Department of Applied Mathematics” (Stanford University Bulletin, 1915-1916, p. 75). It was also suggested that students majoring in mathematics “begin the study either of French or of German in their freshman year” (p. 75).

The Stanford University course bulletin in 1923-1924 was brief and concise. The path for a student majoring in pure mathematics was set with little choice for the student.

There were three sequences of calculus at Stanford University in 1935, and students were “expected to complete the work in that series. Changing from one series to another are permitted [sic] only by special arrangement” (Stanford University Bulletin, 1935-1936, p. 241). The courses numbered 112 and above were for upper division and graduate students.

This is the first time a course in complex analysis had been recorded at Stanford University since 1905; additionally, there was an unusual course this year: [154] Fuchsian Groups (2 units). Students were allowed to take graduate courses and courses in other departments “having large mathematical content may be substituted” (Stanford University Bulletin, 1935-1936, p. 242) for Group II courses. There also began a statistics department between 1926 and 1935.

In 1941, the United States had entered World War II after Japan attacked Pearl Harbor. This impacted the colleges as well. The 1945 to 1946 Stanford Bulletin stated that “publication [of the announcement of courses] is made with the understanding that, as a result of war conditions, a number of courses may have to be abandoned and others modified or substituted” (1945-1946, cover page). The courses in mathematics were arranged in three groups: “(I) Elementary courses; (II) courses primarily for Lower Division students; (III) courses primarily for Upper Division and graduate students" (p. 281). Furthermore, there was a Statistics Department this year. The Statistics courses were not considered part of this study.

George Polya was a professor during the 1945-1946 academic year. He taught [110] Selected Topics from Elementary Geometry, [128] Interpolation and Numerical Integration, and [153] Theory of Groups with Applications.

There were two additional calculus sequences at Stanford University during the 1955-1956 academic year; one for students majoring in the physical sciences and one for students in a non-science degree. "By special permission, the student may substitute Functions of a Complex Variable (106) for [Vector Analysis] (113), and Differential Geometry (143a) for [Higher Geometry] (142)" (Stanford University Bulletin, 1955-1956, p. 221), and this is noted above in the requirements. "Candidates for graduation with mathematics as their major subject must take… enough courses from groups II or III to make a total of 36 units of credit in this group" (p. 221).

By 1955, George Polya became an emeritus professor and [112] Mathematical Fundamental Mechanics (3 units) (Group II) (Taught by Polya) and [153] Theory of Groups with Applications (3 units) (Taught by Polya) were no longer available.

A Computer Science Department exists at Stanford University in 1964. Regarding the standard studies, "the General Studies Program, inaugurated at Stanford in 1956, is directed towards satisfying [the balance of liberal and specialized study] and is the product of intensive study. They combined to create a better society and a more rewarding individual pattern for living" (Stanford University Bulletin, 1964-1965, p. 7).

There is more information this year regarding majors and their restrictions. "[The] school or department selected as a major has the authority to prescribe not more than 60 units in the major subject (exclusive of elementary courses which may have been offered for entrance.)… It shall be considered a general principle of University policy, to be departed from only in exceptional cases, that at least 90 of the 180 units required for the degree be taken outside the major field of study" (Stanford University Bulletin, 1964-1965, p. 10).

It is clearly noted this year that the "Candidates who fulfill [the] requirements in the [School] of … Mathematics receive the degree of Bachelor of Science; candidates who fulfill [the] requirements in other schools or departments receive the degree of Bachelor of Arts" (Stanford University Bulletin, 1964-1965, p 10). Regarding time required to obtain a degree, the bulletin states "forty- five units constitute a normal year's work. The degree is conferred whenever the requirements are met, provided the candidate has spent three quarters in resident study and completed at least 45 units (including the last 15) in this University" (p. 10). Moreover, students were able to obtain two degrees: "The holder of a Bachelor of Arts degree from Stanford may apply to the Subcommittee on Graduation for admission to candidacy for a Bachelor of Science degree, and the holder of a Bachelor of Science degree may apply in like manner for Bachelor of Arts degree" (p. 11).

There are recommendations for course paths for mathematics majors during the 1964-1965 academic year.

> The introductory courses consist of four alternative sequences in analytic geometry and calculus (10, 11, 21, 23, 44, 45, 46, or 41, 42, 43, 44, 45, 46, or 41, 52, 53, 54, 55, or 41, 62, 63, 64). These courses are provided for students who wish to graduate with a major in mathematics and for students in other departments who need or desire mathematics above the level of secondary school mathematics. Mathematics majors and others who plan further study in mathematics should elect one of the sequences including Mathematics 44 or 54. (Stanford University Bulletin, 1964-1965, p. 297)

"The honors courses, Mathematics 52, 53, 54 and 55, are for students intending to major in mathematics or physical sciences…. [S]tudents who take this sequence need to spend less time on drill, and consequently it is possible to explore some of the interesting implications of calculus in science, engineering, and mathematics" (p. 297).

In 1975 to 1976, the honors advanced calculus course numbered 54 states the "material covered is a more general version of 44, 45, together with some of the topics of 115, 116, and 117" (Stanford University Bulletin, 1975-1976, p. 419). The undergraduate curriculum was designed to be flexible, especially in the first two years. "The student plans an individual program of study, in consultation with his or her faculty advisor. The first two years may be spent primarily in pursuing a liberal education, or the student may begin specializing early, carrying both major and general courses over the four years" (p. 7). In terms of a language requirement, there was "no language requirement, but students intending to go to graduate work in mathematics [were] strongly urged to study at least on foreign language chosen from French, German, and Russian" (p. 416). Students intending to pursue graduate study in mathematics were "advised to include one or more 200 level courses in their programs and, to facilitate this, to complete 113, 114, 115, and 116 as early as possible" (p. 416). Furthermore, "graduate courses in the same subject may be substituted for the [required undergraduate] courses" (p. 416).

This academic year there was a "Mathematics Workshop" available as an introductory course for all students at 4 units in order to "have students learn that they can do mathematics, regardless of their previous experience. This course uses materials and techniques designed especially to help students master the art of solving problems. Its flexible format allows each student to build conceptual understanding in an atmosphere free of anxiety, and with as much personal attention as desired" (Stanford University Bulletin, 1975-1976, p. 418). Furthermore, it is interesting to note that [150] Introduction to Combinatorial Theory was offered by the Computer Science Department.

The 1985 to 1986 catalog has a two-page section on the "History of the University." Stanford University was founded in November of 1985. "On November 14, 1885, Senator and Mrs. Leland Stanford executed the Founding Grant of the Leland Stanford Junior University" (Stanford University Bulletin, 1985-1986, p. 6). The University was named after the Stanford's only child who died of "typhoid fever in Florence, Italy in 1884 just before his sixteenth birthday" (p. 6). The Stanfords decided to create a university in memory of their late son on their estate on the San Francisco Peninsula. "Although they consulted with several of the presidents of leading institutions, they were not content to model their university after eastern schools" (p. 6). The Stanfords did not feel that the young college-educated men from the eastern colleges were well prepared in life. "As the Stanfords' thoughts matured, their ideas of 'practical education' enlarged until they arrived at the concept of producing cultured and useful citizens who were especially prepared for personal success in their chosen professions" (p. 6). Also, Mr. Stanford is quoted as saying, "A man will never construct anything he cannot conceive" (p. 6).

Stanford University began as a coeducational university and, "like Johns Hopkins and Cornell, followed the German model of providing graduate as well as undergraduate instruction and stressing research along with teaching. Dr. Jordan [the first university president] installed the major subject system at the outset, and English was the only required entrance subject" (Stanford University Bulletin, 1985-1986, p. 6). In the 1950s, Stanford University had gained "national and international status as a major teaching and research university" (p. 7). "In 1930 Stanford granted 41 Ph.D. degrees. By 1950 the number was 100, and in 1983 it was 488" (p. 7). It was the goal of Stanford to provide "the means for its undergraduates to acquire a liberal education: an education which broadens the student's knowledge and awareness in each of the major areas of human knowledge; significantly deepens it in one or two; and prepares him or her for a lifetime of continual learning in the varied and changing application of knowledge to career and personal life" (p. 9). The undergraduate curriculum was designed to be flexible. "It permits each student to plan an individual program of study that takes into account personal educational goals consistent with particular interests, prior experience, and future aims" (p. 10).

"A governing principle, however, is that all programs of study should achieve some balance between *depth* of knowledge acquired in specialization and *breadth* of knowledge acquired through exploration. Guidance as to the limits within which that balance ought to be struck is provided by the University's Distribution Requirements and by the requirements set for major fields of study" (Stanford University Bulletin, 1985-1986, p. 10).

As for the major subject requirements, "the minimum requirements for each major field of study are set by the faculty teaching in the subject area. Those requirements usually allow latitude for tailoring a major program to a student's specific educational goals" (Stanford University Bulletin, 1985-1986, p. 12). It was the students' responsibility to develop a major program of study in consultation with an advisor. The general guidelines for a major at Stanford were as follows:

> In order to achieve the values of study in depth, a well-structured major should occupy no less than approximately one-third of a student's program (55-65 units). Similarly, it would be difficult to achieve the values of breadth and exploration if that program occupied more than about two-thirds of a student's program (115-125 units). Finally, to avoid intellectual parochialism, a major program should not require a student to take more than about one-third of his or her courses from within a single department. (Stanford University Bulletin, 1985-1986, p. 13)

There were many advisors available to students, and even though they were assigned one advisor, they were able to go to anyone for curriculum advice.

The course numbers gave an indication of the general year of the student. "Unless otherwise specified, courses numbered from 1 to 99 inclusive are primarily for first- and second-year undergraduates; from 100 to 199 inclusive, for third- and fourth-year undergraduates; from 200 to 499 inclusive, for graduate students" (Stanford University Bulletin, 1985-1986, p. 481).

There was a degree with honors for those majoring in mathematics.

> The Department of Mathematics offers a program leading to the degree of Bachelor of Science leading to the degree of Bachelor of Science in Mathematics with Honors…. Typically such a program includes, beyond the courses required for the B.S. degree, electives including graduate courses and courses in Independent Work, with one of the latter culminating in a scholarly paper. (Stanford University Bulletin, 1985-1986, p. 485)

Course [134A,B] "Honors Analysis" was "directed chiefly toward mathematics majors who would normally enroll in an honors sequence – but of use and interest to other majors who are at east with rigorous proofs and qualitative discussion" (Stanford University Bulletin, 1985-1986, p. 488).

During the 1994 to 1995 academic year, in some cases, courses with A, B and/ or C seem to be the same course just offered in different semesters when they are listed with one course description, and in some instances the courses are listed with different course descriptions. In the cases where it is listed with a separate course description, it is recorded as a separate course above.

It should be noted that “the University does not use any racial, religious, ethnic, geographic, or sex-related quotas in admissions. It is committed to the principles of Affirmative Action in the admission of students and in the employment of faculty and staff” (Stanford University Bulletin, 1994-1995, p. 7).

There is an emphasis in the 1994-1995 bulletin on producing good citizens: “Stanford expects student to adhere to the principles of its Fundamental Standard: ‘to show both within and without the University such respect for order, morality, personal honor, and the rights of others as is demanded of good citizens’” (Stanford University Bulletin, 1994-1995, p. 12).

Stanford University is on the quarter system and “Autumn, Winter, and Spring Quarters are approximately eleven weeks long. Except in certain programs, the Summer Quarter is eight weeks long. Any three quarters constitute an academic year (Stanford University Bulletin, 1994-1995, p. 44).

It is still the case that “faculty set the minimum requirements for the major in each department” (Stanford University Bulletin, 1994-1995, p. 32). Moreover, “the new algebra requirement for mathematics majors applies to students who declared a Mathematics major Autumn Quarter 1991 and thereafter” (p. 575).

The B.S. degree in Mathematics with Honors “is intended for students having a strong theoretical interests and abilities in mathematics. The goal is to give students a strong background in the three basic areas of pure mathematics: analysis, algebra, and geometry. Through the honors thesis program, a student is introduced to current mathematical research. The program provides an excellent background with which to enter a Ph.D. program in Mathematics” (Stanford University Bulletin, 1994-1995, p. 575). Mathematics 45H or 44, 113 and 130 are prerequisite for the honors program. Furthermore, 106, 114, 120, 134A,B, 171, and

173 are also required mathematics courses. In the honors program, “students are urged to include graduate-level courses numbered above 200, particularly 205A” (p. 575).

A more thorough description of Stanford’s history and the atmosphere on the campus in the early days was noted in the 2005-2006 bulletin.

> On October 1, 1891, more than 500 enthusiastic young men and women were on hand for opening day ceremonies at Leland Stanford Junior University. They came from all over: many from California, some who followed professors hired from other colleges and universities, and some simply seeking adventure in the West. They came to seize a special opportunity, to be part of the pioneer class in a brand new university. They stayed to help turn an ambitious dream into a thriving reality. As a pioneer faculty member recalled, "Hope was in every heart, and the presiding spirit of freedom prompted us to dare greatly.” (Stanford University Bulletin, 2005-2006, p. 6)

This enthusiasm was created by the fact that the University was a tribute to the Stanfords’ only son, who died of typhoid fever at age 15.

> From the beginning, it was clear that Stanford would be different. It was coeducational at a time when single-sex colleges were the norm. It was non-sectarian when most private colleges were still affiliated with a church. And it offered a broad, flexible program of study while most schools insisted on a rigid curriculum of classical studies. Though there were many difficulties during the first months (housing was inadequate, microscopes and books were late in arriving from the East) the first year foretold greatness. As Jane Stanford wrote in the summer of 1892, "Even our fondest hopes have been realized.” (Stanford University Bulletin, 2005-2006, p. 6)

It was important to create a culture on campus that enabled the production of “cultured and useful citizens who were well prepared for professional success” (Stanford University Bulletin, 2005-2006, p. 6). In speaking for a liberal education, “Leland Sanford wrote, ‘I attach great importance to general literature for the enlargement of the mind and for giving business capacity. I think I have noticed that technically educated boys do not make the most successful businessmen. The imagination needs to be cultivated and developed to assure success in life. A man will never construct anything he cannot conceive’” (p. 6).

The new campus philosophies attracted motivated and inspired individuals. “It is still true, as the philosopher William James said, during his stint as a visiting professor, that the climate is 'so friendly … that every morning wakes one fresh for new amounts of work'" (Stanford University Bulletin, 2005-2006, p. 6).

It is noted in the 2005-2006 catalog that

> Stanford's faculty, which numbers approximately 1,800, is one of the most distinguished in the nation…. Yet beyond their array of honors, what truly distinguishes Stanford faculty is their commitment to sharing knowledge with their students. The great majority of professors teach under graduates both in introductory lecture classes and in small freshman, sophomore, and advanced seminars. (Stanford University Bulletin, 2005-2006, p. 7)

The minimum requirements for the majors at Stanford were decided by the faculty. "These requirements usually allow latitude for tailoring a major program to a student's specific educational goals" (Stanford University Bulletin, 2005-2006, p. 24). Moreover,

> the structure of the major should be a coherent reflection of the logic of the discipline it represents. Ideally, the student should be introduced to the subject area through a course providing a general overview, and upper-division courses should build upon lower-division courses. The course of study should, if feasible, give the student the opportunity and responsibility of doing original, creative work in the major subject. Benefits of the major program are greatest when it includes a culminating and synthesizing experience such as a senior seminar, an undergraduate thesis, or a senior project. (p. 24)

Specific to the mathematics major,

> it is to be emphasized that the above regulations are minimum requirements for the major; students contemplating graduate work in mathematics are strongly encouraged to include the courses 116, 120, 121, 147, or 148, and 171 in their selection of courses, and in addition, take at least three Department of Mathematics courses over and above the minimum requirements laid out under items '1' and '2' above, including at least one 200-level course. Such students are also encouraged to consider the possibility of taking the honors program, discussed below. (Stanford University Bulletin, 2005-2006, p. 489)

It appears that only the students in the honors program needed to complete a senior thesis.

College Four: University of California at Berkeley

In 1905 to 1906 the University of California at Berkeley states "students wishing to make a specialty of Mathematics should elect Courses C and 5 in the Freshman year, and should consult the members of the department as early as possible" (Berkeley Bulletin, 1905-1906, p. 104). Some courses are offered throughout the year, and some may even begin in either half-year. I am counting these courses as two separate courses with the associated credits in each half-year.

In the 1925 to 1926 academic year, students were required to take a comprehensive mathematics exam in their senior year. The Berkeley Bulletin states that

> all candidates for a bachelor's degree whose major subject is mathematics will be expected to pass a general examination in that subject in lieu of the examinations of the special courses of their final half-year. The examination will be partly written and partly oral, and will include the following subjects:
>
> 1. Geometry of the plane and of space, both analytic and projective.
>
> 2. The differential and integral calculus, including the elements of differential equations.
>
> 3. Algebra: theory of algebraic equations. (1915-1916, p. 164)

The famous Florian Cajori was a professor of the History of Mathematics during the 1925-1926 academic year. With regard to the prerequisite work for the major, "it is essential that students who expect to take a major in mathematics should complete in the high school two years of algebra, plane trigonometry. For such students the basic courses leading either to the further work in mathematics or to the mathematical treatment of any science are the elementary courses in analytic geometry (course 5) and in calculus (courses 9A-9B)" (University of California, Berkeley, Bulletin 1925-1926, p. 175).

Students were allowed to include science courses as part of their major requirements. "Subject to this requirement of competence and, and with the approval of the Adviser, the student is at liberty to take theoretical courses in physics, astronomy, or other sciences as part of his major in mathematics" (University of California, Berkeley, 1935-1936, p. 86). For students majoring in mathematics, "course 200 (a graduate course) forms a desirable part of the program for senior students with facility for mathematics, as well as the courses listed in the upper division" (p. 86).

George Polya was a visiting Professor at Berkeley during the 1944-1945 academic year. Students were still encouraged to take at least one graduate course as an undergraduate. “Course 201 forms a desirable part of the program for senior students with facility for mathematics, as well as the courses listed in the upper division. Special attention is directed to course 199” (University of California, Berkeley, Bulletin, 1944-1945, p. 271).

During the 1954 to 1955 academic year, the students were encouraged to major in other subjects. “The attention of the student is directed to the possibility of making group majors with other departments. Such majors will be welcomed not only with the departments of the physical sciences, but also with some of the social sciences and philosophy” (University of California, Berkeley, Bulletin, 1954-1955, p. 226).

Courses [3H], [4G] and [4H] were “designed for students with special facility for mathematics” (University of California, Berkeley, Bulletin, 1954-1955, p. 227-228). The course on Theory of Functions numbered 150A-150B was “designed primarily for students who will work for higher degrees in mathematics and statistics” (p. 230). Additionally, the graduate course of Function Theory, numbered 201A-201B, is recommended for “students with facility in mathematics” during their senior year (p. 231).

During the 1965 to 1966 academic year, the bulletin stated that “Mathematics 105 [Integration] is a desirable part of the major program” so this course was included in the list of required courses (University of California, Berkeley, Bulletin, 1965-1966, p. 439). It was still acceptable to take a couple science courses in place of the required mathematics courses. “Subject to the requirement of competence in the major, and with the approval of the adviser, the student is at liberty to take not more than 6 units of theoretical courses in astronomy, physics, statistics, or other sciences as part of his major in mathematics” (p. 439). Courses H1A-H1B were “recommended as preparation for the major, particularly for honors candidates” (p. 440).

Between 1955 and 1965, the number of available theory of functions courses (Cajori Two Course Cluster 23) declines from five to one. This may be due to the fact that one of the graduate courses in this cluster was included in 1955 since it was recommended for seniors with a facility in mathematics. Also, the real analysis courses seemed to disappear and only the complex variable course remained in 1965. However, these courses in real analysis seem to reemerge in 1974.

During the 1974 to 1974 academic year, computer science courses were added to the list of science courses that could be substituted for mathematics courses in the major. “Subject to the requirement of competence in the major, and with the approval of the major advisor, the student may count not more than two mathematically theoretical courses in computer science, statistics, astronomy, physics, mathematical economics, or other sciences toward his requirements for the major in mathematics” (University of California, Berkeley, Bulletin, 1974-1975, p. 388). Moreover, “only one of courses 120A [Analysis for Applied Mathematics] and 185 [Introduction to Theory of Functions of a Complex Variable] can be offered as part of the major” (p. 388).

It is interesting that there is a self-paced calculus sequence and a course [163] that is a tutorial in upper division mathematics. This course description states, “Emphasis is placed on the individual’s experience in discovering and explaining mathematics. Examples of subjects which may be covered are game theory, category theory, differential topology, mathematical foundations of quantum mechanics, global theory of ordinary differential equations, and classical linear groups” (University of California, Berkeley, Bulletin, 1974-1975, p. 392). The University of California at Berkeley also began offering a course titled [191] Experimental Courses in Mathematics (units not listed) between 1966 and 1974. “The topics to be covered and the method of instruction to be used will be announced at the beginning of each quarter that such courses are offered” (p. 393).

The major in mathematics “gives the student the opportunity to obtain a strong well-rounded mathematical background, suitable for post-graduate study as well as for professional careers in science, industry or education. The courses required for the major emphasize theoretical material” (University of California, Berkeley, Bulletin, 1985-1986, p. 180). Students were still allowed to include “not more than two mathematically theoretical courses in computer science, statistics, physics, astronomy, mathematical economics, or other sciences toward requirements for the major in mathematics” (p. 180).

> Students preparing for graduate work in mathematics are strongly advised to acquire a reading knowledge of two foreign languages, from among French, German, and Russian. Course H117, designed to challenge the student’s ability to do creative thinking, is useful for students preparing to do graduate work. Undergraduate students also often take on or more of the following introductory graduate courses: 202A-202B, 214, 228A-228B, 250A-250B. (p. 181)

Many courses changed from 4 units to 3 units in between 1976 and 1985, and the overall degree requirements went from 180 units in 1976 to 120 units in 1985. Course 163 titled “Tutorial in Upper Division Mathematics” for 3 units was an unusual course. The course description states, “Emphasis is placed on the individual’s experience in discovering and explaining mathematics. Examples of subjects which may be covered are game theory, category theory, differential topology, mathematical foundations and quantum mechanics, global theory of ordinary differential equations, and classical linear groups. Content varies” (University of California, Berkeley, Bulletin, 1985-1986, p. 182).

Alan Schoenfeld (Education) is listed as an affiliated professor during the 1995-1997 academic years with a specialization in the psychology of problem solving. Many upper division courses changed from 3 units to 4 units between 1986 and 1995. Moreover, there is an interesting new course called Metamathematics ([225A] and [225B]). The course description states, “Metamathematics of predicate logic. Completeness and compactness theorems. Interpolation theorem, definability, theory of models. Metamathematics of number theory, recursive functions, applications to truth and provability. Undecidable theories” (University of California, Berkeley, Bulletin, 1995-1997, p. 322).

The degree-type changed from A.B. to B.A. in between 1997 and 2003. This is not such a huge change since they refer to the same type of degree (i.e., Artium Baccalaureatus (A.B.) Degree is the same as a Bachelor's in Arts (B.A.)). Students were still allowed to “count two mathematically theoretical courses in computer science, statistics, physics, astronomy, mathematical economics, or other sciences toward requirements for the major in mathematics" (University of California, Berkeley, Bulletin, 2003-2005, p. 333). Furthermore, "undergraduate students also often take one or more of the following introductory graduate courses: 202A-202B, 214, 22A-22B, 228A-228B, 250A-250B" (p. 334).

College Five: University of Texas at Austin

During the 1905 to 1906 academic year at the University of Texas, Austin, for the B.A. degree, the students were required to take "limited electives" with restrictions, and the remaining courses were considered as free electives. The "limited electives" were "five advanced courses, which may be taken in one school or in several schools. An advanced course is one (a) which is elected in any school after the completion of the numbered courses in that school… and (b) to which no student is admitted below the rank of a Junior, unless he has previously had two numbered courses in the subject" (University of Texas, Austin, Bulletin, 1905-1906, pp. 46-47). Calculus was included in the required courses above since its course description states that the "course should be taken in the second year by all who intend to go on in Mathematics, and particularly by students of Engineering and of Physics" (p. 105).

During the 1914 to 1915 academic year, it is interesting that "either Mathematics 3 [Calculus] or Mathematics 15 [Analytic Geometry] counts as advanced when both are completed" since Mathematics is not necessary for the mathematics group nor a prerequisite for the Calculus course (University of Texas, Austin, Bulletin, 1914-1915, p. 125). For all degree groups, it states the "courses laid down in one of these groups must be included in the twenty required for the B.A. degree. The student is advised to choose his group as early as possible in his college career, but not required to do so till (sic) the beginning of his junior year," and the requirement for the mathematics group is to have a major subject of five courses in mathematics and a minor subject of three courses (pp. 126-127). Students could arrange their courses to have two majors from the same or different groups. It is suggested that "such an arrangement is especially desirable for those who wish to teach two subjects" (p. 127).

In terms of signifying the difference between full courses and partial courses, it is noted that "full courses are designated by numbers under 100, one-third courses by numbers beginning with 100, two-thirds courses by numbers beginning with 200, four-thirds courses by numbers beginning with 400, and so on" (University of Texas, Austin, Bulletin, 1914-1915, p. 134). It must have been helpful to have the courses assigned to an exam schedule from the beginning. They referred to the exam groups with Roman numerals in parentheses and did not allow a student to choose two courses in the same examination group (p. 134).

The grading during the 1925 to 1926 academic year was quite unusual. "The student must make at least an average of thirty points per one-third course on the courses taken at the University which are required and counted toward the degree, an A grade on a third of a course counting as 42 points; a B as 36 points; a C as 30 points; a D as 24 points" (University of Texas, Austin, Bulletin, 1925-1926, p. 97). A comprehensive exam was administered at the end of a student's studies this academic year. The catalog states:

> Before May 15 of the spring term of his senior year, at a time and place fixed by the faculty of the department in which the student has elected to major, the student must pass a general four-hour written examination in his major subject. In setting this examination the faculty of the department will take into account the particular courses elected by the student, but will expect a more mature and comprehensive knowledge than is required in the regular term examination. (p. 97)

For a major subject in mathematics, a student was required to take "five courses in mathematics, of which at least two shall be advanced" (University of Texas, Austin, Bulletin, 1925-1926, p. 99). It was recommended for Mathematics 1 that "students should take three thirds of Mathematics 1 consecutive in natural order – otherwise, difficulty may be experienced" (p. 164).

Students who majored in mathematics had

> a choice of several lines of progress, corresponding to the different subdivisions of the subject. In addition to Pure Mathematics 3 (calculus) which should be included in

> every group of courses, the student interested in analysis should take Pure Mathematics 11, followed by 14, 24, 29, 23 or 22 followed by 17; in algebra, 205, 106, 206, 136, and 236,; in geometry, 10, 225, 115, and 107, in actuarial mathematics, 19 and 20,; a foundations of mathematics, 26 and 27. (University of Texas, Austin, Bulletin, 1925-1926, p. 165)

During the 1933 to 1935 academic year, thirty semester hours in mathematics, twelve of which needed to be advanced, were required for the mathematics group and "must be included in the 120 semester hours required for the degree" (University of Texas, Austin, Bulletin, 1933-1935, pp. 32-33). This year the mathematics courses had "pure" or "applied" distinctions. Just as in the previous decade,

> students who plan to major in mathematics have a choice of several lines of progress, corresponding to different subdivisions of the subject. In addition to Pure Mathematics 13 (calculus), which should be included in every group of courses, the student interested in analysis may take Pure Mathematics 21, 22, 83, 83K, 84, 85, 86, 92, 93, or 96; in algebra and number theory, 315, 323, 336, 337, 380, 381, 82, 82K, or 91; in foundations of mathematics and point-set theory, 323, 88, 89, or 90; in geometry, 327, 328, or 30; in probability, 45, 46, 47, or 83K. (p. 119)

The semester hours are not given with the course descriptions in this catalog, although the advanced courses could count as three to six semester hours depending on the number of mathematics courses previously taken. A student majoring in mathematics was probably recommended to take Mathematics 315s, since the course description for Mathematics 315s "Theory of Equations" states that it was "recommended as a fundamental course for students specializing in mathematics" (University of Texas, Austin, Bulletin, 1933-1935, p. 120).

Students were still allowed to take two majors belonging to the same or different groups. Regarding preparatory courses to calculus, "students who are interested in mathematics or the sciences are advised to take Pure Mathematics 302 and 303 if they have had trigonometry and 301 and 302 if they have not" (University of Texas, Austin, Bulletin, 1941-1945, p. 177). The mathematics major seems to still be subdivided by subject:

> Students who plan to major in mathematics have a choice of several lines of progress, corresponding to the different subdivisions of the subject. In addition to Pure Mathematics 13 (calculus), which should be included in every group of courses, preferably in the sophomore year, the student interested in analysis may take Pure

> Mathematics 21, 22, 24, 83, 83K, 84, 85, 86, 92, 93, or 96; in algebra and number theory, 315, 323, 336, 37, 380, 381, 82, 82K, or 91; in foundations of mathematics and point-set theory, 323, 24, 88, 89, or 90; in geometry, 327, 328, or 30; in probability, 45, 46, 47, or 83K. (p. 177)

"The Applied Mathematics and Astronomy and Pure Mathematics Departments were combined at the beginning of the 1953-1954 Long Session and the courses renumbered in one series" (University of Texas, Austin, Bulletin, 1953-1955, p. 129). The major was defined as "twenty-four semester hours in one of the subjects listed below, of which at least twelve must be in advanced courses" (p. 32). Nine hours of advanced astronomy could be substituted for advanced courses in mathematics.

It is interesting that Mathematics 613 "Calculus" "counted as three advanced hours if preceded by nine hours of mathematics, or as six advanced hours if preceded by twelve hours of mathematics" (University of Texas, Austin, Bulletin, 1953-1955, p. 130). Since the advanced courses were not clearly noted, the assumption used is that the courses designated for the "Undergraduates and Graduates" were the advanced courses.

During the 1963 to 1965 academic years, the first digit of the course seems to signify the number of semesters (i.e., 3XX is one semester and 6XX is two semesters), and the second two digits signify the course number. "The first two years of work in the College of Arts and Sciences prescribe many courses which are basic to all degrees within the College. For this reason it is possible for a student to choose his major as late as the beginning of his junior year" (University of Texas, Austin, Bulletin, 1963-1965, pp. 48-49). A student could take two majors, "however, since the major subject is not shown on the diploma, it is not possible for a student to receive a second Bachelor of Arts degree from The University of Texas" (p. 49). Mathematics major requirements were "twenty-four semester hours of mathematics above freshman rank, of which at least twelve must be in advanced courses" (p. 57).

During the 1973 to 1975 academic year, the mathematics major required a "minimum of thirty-two semester hours of mathematics, including Mathematics 808 or the equivalent, 311, 665a, 373K, and at least eighteen additional semester hours of upper-division courses"

(University of Texas, Austin, Bulletin, 1973-1975, p. 23). There was a B.A. available for a mathematics major with a main difference of only nine additional semester hours of upper division courses as opposed to eighteen for the B.S.

There is much more information on the degree requirements the 1983 to 1985 academic years. The catalog states:

> As an alternative to the Bachelor of Arts degree, the Bachelor of Science in Mathematics degree is designed with a twofold purpose: (1) to offer students a more extensive scientific program that may better prepare them for graduate study or employment, and (2) to recognize students who meet these standards. Students are given the opportunity to develop greater breadth and depth in their mathematical programs as well as to combine mathematics with a concentration in another scientific discipline. To accomplish this both the minimum hours of mathematics required and the maximum allowed are increased by nine hours. Specialization in one additional scientific area is encouraged, and the foreign language requirement, while shortened by one semester, specifies that the language be selected from among the scientific languages: French, German, or Russian. The total number of hours required is increased from 120 to 126. (University of Texas, Austin, Bulletin, 1983-1985, p. 49)

Computer science courses were a requirement this year. Students had to take Computer Science 304F (or 404G) or 304 (or 404) or the equivalent. Students were required to take "not less than forty-one but not more than forty-five semester hours of mathematics, including Mathematics 808 or the equivalent, 311, 427K or 370K, 362K, 665A, 373K, and at least twelve additional semester hours of upper-division courses in mathematics" (University of Texas, Austin, Bulletin, 1983-1985, p. 49). The course description of 318K for Calculus III states that the course "together with Mathematics 608E, forms the equivalent of Mathematics 808" (p. 125).

During the 1994 to 1995 year the catalog mentions how a transfer student had the same privileges as students who started at the University of Texas (Austin). It states that a "student who transfers to the University from and accredited public Texas junior college has the same catalog choices that he or she would have had if the dates of attendance at the University had been the same as the dates of attendance at the junior college" (University of Texas, Austin, Bulletin, 1994-1995, p. 17). It should also be noted that courses in the 300s were assumed to be 3 hours.

For the mathematics degree requirements, it states that "no fewer than forty-one but no more than forty-five semester hours of mathematics, including Mathematics 408C and 408D, or the equivalent, 311, either 325K or 328K, 427K, 362K, 365C, 373K, and at least nine additional semester hours of upper-division mathematics" (University of Texas, Austin, Bulletin, 1994-1995, p. 348).

Courses 129S, 229S, 329S, 429S, 529S, 629S, 729S, 829S, 929S were used to "record credit the student earns while enrolled at another institution in a program administered by the University's Study Abroad Office. Credit is recorded as assigned by the study abroad adviser in the Department of Mathematics" (University of Texas, Austin, Bulletin, 1994-1995, p. 387). Furthermore, there were many courses for actuaries this year offered by the Mathematics Department, and these were not considered since those courses geared students for the actuarial exams.

There were five paths for students who majored in mathematics during the 2004-2006 academic years. "Students seeking the Bachelor of Science in Mathematics must select one of five options: actuarial science, applied mathematics, mathematical sciences, pure mathematics, and mathematics for secondary teaching" (University of Texas, Austin, Bulletin, 2004-2006, p. 446). It should also be noted again that courses in the 300s were assumed to be 3 hours.

College Six: Yale University

The required courses at Yale College during 1904 to 1905 were the ones suggested for "students desiring to take honors in mathematics, or intending to pursue graduate studies [in mathematics]" (Yale Bulletin, 1904-1905, p. 120). If a student wished they could obtain a special honors in mathematics. In order to do so, "a candidate for special honors must pursue with distinction courses aggregating nine hours of work of B and C grades, of which at least three hours must be of C grade, and present a meritorious thesis embodying the results of individual research" (p. ii). Furthermore, "every student must complete before graduation two majors and three minors" (p. iii-iv) and to major in mathematics was at least seven hours in connected mathematical courses. "Courses to complete the remaining thirty-one hours of the sixty required for the degree of B.A. may be chosen without any other restriction than such as will be found in the printed statement of the individual courses" (p. iv). When a student decided on his sophomore studies, "he [was] expected also to indicate his plans for Junior and Senior years, and to show how he intend[ed] to satisfy the requirements for the Bachelor's degree" (p. vii).

During the 1914 to 1915 academic year, Yale College offered a major in mathematics. "In the Junior and Senior years each student must complete a major in some one group of studies, together with a minor in some related subject" (Yale Bulletin, 1914-1915, p. 159). The Yale Bulletin also states that the general principles "governing the choice of courses are based are (I) that each student should do a considerable amount of connected, graded work in some one group of studies, and (2) that this specialization should not be carried so far as to exclude a reasonable amount of training in other groups of studies" (p. 159).

During the 1925 to 1926 academic year at Yale College, courses in trigonometry and geometry (13a and 13b, respectively) were offered to students who had not passed those courses for entrance, but were not counted as credit towards the degree. "By means of these courses it is proposed to compensate for unequal school preparation in mathematics, so that all Freshmen who elect Mathematics will reach the same point in the study of the subject by the end of the year" (Yale Bulletin, 1925-1926, p. 111).

The requirements at Yale College during the 1934 to 1935 academic year are more ambiguous than in previous decades, since it only states information in broad terms. For example, for the graduation requirements it states on p. 160, "Every student shall take each year not more than five courses" (Yale Bulletin, 1934-1935). In order to specify a specialization, the 1934-1935 Bulletin states, "Every student shall elect a subject in which he will do his major work during his last two years, taking each year at least two courses in the subject" (p. 160). An interesting note is how Math 32 (Theory of Functions of a Complex Variable) and Math 33

(Projective and Differential Geometry) were required for a mathematics major a decade earlier but were not available this year.

During the 1945 to 1946 academic year at Yale, "the major in Mathematics will normally consist of five two term courses in Mathematics to be chosen from those open to undergraduates and numbered 26 or higher" (Yale Bulletin, p. 81). Furthermore, "the student shall normally elect five courses each term. Students in their final academic year shall take four courses each term, the essay or independent work required as part of the departmental major being counted as their fifth course" (p. 113).

During the 1954 to 1955 academic year at Yale College,

> the major consists of the equivalent of six year courses [or twelve term courses] in a single subject, normally taken, with the exception of the prerequisite, during Junior and Senior years. B.A. candidates, who take only four courses in Senior year, will be limited to five formal courses in the major subject, the equivalent of a sixth course being represented by the time allocated to preparation for the departmental examination. (Yale Bulletin, 1954-1955, p. 102)

Moreover, each student was required to take "at least ten term courses in three of the four fields: Algebra (Mathematics 50, 52a, 54b, 56b, 58a), Analysis (Mathematics 30, 32, 34a, 36b), Applied Mathematics (Mathematics 42, 44a, 46), and Geometry (Mathematics 60a, 62, 64a, 66b)" (p. 125).

It is interesting that in the 1964-1965 Yale Bulletin, the course Math 25a/ 25b Functions of Several Variables (which was also not scheduled to run this year) was not required for the major,and the other advanced mathematics courses hadonly either Math 22 or 25 as a prerequisite (p. 180). Sme courses were only one term long, and some were year-long, but the "major in mathematics will normally consist of ten term courses in mathematics numbered 30 or higher" (Yale Bulletin, 1964-1965, p. 177).

If students were not prepared in mathematics and "have had no previous training in trigonometry, and those who have had less than three years of mathematics in secondary school, [were] urged to apply for the Basic Mathematics Review Course" (Yale Bulletin, 1964-

1965, p. 179). If a student were to be strong in mathematics, there was an optional intensive major in mathematics. The Yale Bulletin states that "candidates for a degree with an Intensive Major in mathematics will be expected to include at least two terms of graduate work in their programs. Eligibility for admission to such a course will be determined by consideration of previous work in advanced courses, in particular Mathematics 31a and 31b, or in Mathematics 37" (p. 178).

In the 1974-1975 Yale Bulletin, the course curriculum seems to be more of a suggestion than in the past. "One of the distinguishing features of a liberal education is that it has no single definition. Yale consequently does not prescribe any specific course to be taken by a student, but instead urges each undergraduate to design for himself his own program of study, suited to the particular needs and interests, from the multitude of courses available to college students in a university" (p. 143). It is also suggested that "any student interested in mathematical research as a career is urged to take Mathematics 27, 31a, 32b, 36b, 50a, and 58b. A sample program in mathematics for such a student might consist of these courses plus three from Mathematics 64a, 66b, 70a, and 71b" (p. 299).

If students were not well prepared in mathematics or misplaced, it seems that students could transfer to another course during their first semester. The 1974-1975 Yale Bulletin states,

> As in the case of foreign languages, it is a frequent and normal occurrence for a student to change the level of his course in mathematics during the first half of the fall term. The department of Mathematics prepares a preliminary placement list of members of the Freshman class on the basis of their secondary-school records and other matriculation data, and circulates the list to the residential college deans and to faculty advisors in mathematics and in related fields…. These placements are tentative and often based on incomplete information on the student's background, including his experience in mathematics courses at Yale during the early weeks of the term. (p. 26)

At Yale in 1984 to 1985, students were still expected to design their own program of study, and in the latter years of study, they had to choose an area of concentration. Distributional requirements existed for the first two years. "One of the chief objectives of these Distributional Requirements is to assure that in the first two years of their undergraduate education students elect courses from a variety of departments and in this way become exposed to different ideas and various ways of thinking" (Yale Bulletin, 1985-1986, p, 10). Students were expected to specialize their studies toward the end of their time at the college. "Although no one should specialize to the neglect of distribution, knowledge advances by specialization, and one can gain some of the excitement by discovery by pressing toward the outer limits of human knowledge in a particular field" (p. 16). A major at Yale in 1985 usually included "twelve term courses [in the same area] taken for the most part in the Junior and Senior years" (p. 17). "The Mathematics major provides a broad education in various areas of mathematics in a program flexible enough to accommodate many of the ranges of interest" (p. 271).

It is interesting that in 1984-1985 Yale experimented with mini-seminars that covered topics not available in the standard courses. Furthermore, the language in the bulletin is suggestive and empowering as it includes phrases like "to understand the duties and problems facing everyone as a human being among other human beings" and "an educated person should have…" (Yale Bulletin, 1985-1986. p, 15). Furthermore, the bulletin states:

> One can be aware that in the last three hundred years science has come to be synonymous with rational inquiry and knowledge without realizing what a scientist means by 'knowing' or how some scientific facts are more prone to change than others. Only by studying a science can one develop the critical faculties that educated citizens need: an ability to evaluate the opinions of 'experts,' to distinguish quackery from responsible science, and to realize which things are known and which unknown, which are knowable and which unknowable, to science. (p. 15)

It is interesting that the verbiage in the bulletin attempts to convince the reader why something is important first and only makes suggestions for courses and has minimal guidelines. For example:

> What a student ultimately derives from four years of study at Yale obviously depends in large measure upon his careful planning of a program of study. In fulfilling these Guidelines, as in pursuing their other educational goals, students should seek broadly for informed advice, from their faculty advisers and Residential College Deans, and from Directors of Undergraduate Studies of other faculty members in the various departments and programs. No adviser will prescribe a

> particular set of courses, and the responsibility of shaping a program is the student's, but each student should make use of all the advice available in order to plan the most effective program. It would be impossible, and surely imprudent, for a student to attempt to map out at the beginning of his studies a firm schedule of courses for the next eight terms. Yet it is important for the student to think ahead, and always to plan with these principles in mind. (p. 15)

And,

> Although these Guidelines are not actual requirements (except that a student must display proficiency in a foreign language), Yale College expects that at student's program will reflect these principles. Every student's program must be approved by his dean and adviser, and every reasonable program will be approved. A student whose program departs markedly from the Guidelines will be obliged to persuade the Residential College Dean and faculty program adviser that it will still achieve for the student in its own way the goals of a liberal education. (pp. 15-16)

It seems that in the 1994 to 1995 academic year, Yale placed much of the responsibility of deciding their placements and scheduling on the students. The bulletin states, "In deciding the most appropriate level of placement, a student may want to attend courses on a trial basis. Freshmen have ample time after Freshman registration in which to submit their course schedules, so that a student can resolve doubts about placement by attending courses on two levels (or on two different aspects) of the same subject" (Yale Bulletin, 1994-1995, p. 32). Initial placement in the calculus sequence was subject to change in the student's first term. Furthermore, the Mathematics E.C. course in Mathematical Analysis that was found in the 1975 and 1985 bulletins disappeared between 1985 and 1994.

Still, in 2006, Yale College did not seem to lay out a strict set of guidelines for students to follow.

> Instead, [Yale College's] main goal is to instill in students the development of skills that they can bring to bear in whatever work they eventually choose. This philosophy of education corresponds with that expressed in the Yale Report of 1828, which draws a distinction between the "furniture" and the "discipline" of the mind. Acquiring facts is important, but learning how to think in a variety of ways takes precedence. (Yale Bulletin, 2006-2007, p. 13)

Some of the courses were only strongly recommended for mathematics majors.

> Each Mathematics major is urged to acquire additional familiarity with the uses of mathematics by taking courses in Applied Mathematics, Computer Science, Engineering and Applied Science, Economics, Operations Research, Physics, Statistics, or other departments. In some instances a limited number of such courses may be counted among the ten courses required for the major in Mathematics, with the approval of the director of undergraduate studies. (p. 442)

Interestingly, the oral exam had been eliminated as an exit option between 1995 and 2006. Furthermore, [355b] Geometric Algebra, [400a] Introduction to Mathematical Mechanics, [425b] Computational Algebraic Geometry, [450b] Introduction to Mathematical Logic, [454b] Foundations of Logic Programming, and [456b] Recursive Function were eliminated in between 1995 and 2006.

The following two courses were added between 1995 and 2006 and are also not easily code-able with the Cajori Two Course Inventory, although a course cluster was still assigned: Fractal Geometry: Concept and Applications (New course) (One-Term Course - Cajori Two Course Cluster 34), [360a] Introduction to Lie Groups (One-Term Course - Cajori Two Course Cluster 28). It is recommended that the Cajori Two Course Inventory be updated to include these types of courses.

Answers to Research Question 2

Comparison between Public and Private Colleges (Charts in Appendix U)

From observing the charts in the appendix, it is clear that the frequency of available courses increases over the century at all colleges. It can also be seen that at both the public and private colleges the Cajori Two Category 5 (Analysis following Basic Calculus) and Cajori Two Category 6 (Higher and Abstract Algebra, Linear Algebra and Number Theory) are the leading categories at both types of colleges and increase the most from 1905 to 2005. A difference between the two types of colleges is how Cajori Two Category 9 (Advanced Applied Courses) increases more at public colleges and the Cajori Two Category 4 (Basic Calculus Sequences) increases more at the private colleges.

From 1955-1994 at Stanford University, Group III was a group of courses that were "primarily for graduate students" but also available to undergraduates and even recommended to those who intended to go onto graduate studies in mathematics. Since there are so many upper-level courses in this category, it skews the data for the private colleges. Therefore, two sets of data and charts have been created: one including those courses intended for graduate students and one without.

Comparison among Colleges Grouped by Location (Charts in Appendix U)

With and without the graduate courses at Stanford University, it appears as though the colleges on the West Coast of the United States almost consistently (with exception of 1925) have offered more mathematics courses for the mathematics major. The colleges in middle-America and the East Coast seem to have similar amounts of course offerings.

Comparison within Selected Colleges on the East Coast (Between City College New York and Yale) (Charts in Appendix T)

Cajori Two Course Category 4 (Basic Calculus Sequences) gradually increased throughout the century at Yale, with two peaks of 10 courses in 1955 and 1985, whereas at City College New York, there was a peak of 8 courses in this category in 1935, but it generally remained consistent throughout the century. Cajori Two Course Category 5 (Analysis Following Basic Calculus) increased fairly similarly at both colleges, with the exception that it peaked at 1965 with 11 courses and 2005 with 10 courses at Yale, and peaked in 1985 at City College New York with 11 courses. There were always more Cajori Two Category 6 (Higher and Abstract Algebra, Linear Algebra and Number Theory) at Yale than at City College; however, they both appear to have the same increasing trend throughout the century.

Comparison within Selected Colleges in Middle America (Between Colorado College and University of Texas, Austin) (Charts in Appendix T)

Cajori Two Course Category 7 (Advanced Geometry and Topology) has been fairly consistent at the University of Texas (Austin) throughout the century, and there was a gap in this category at Colorado College during 1955 to 1965. Furthermore, Cajori Two Category 9 (Advanced Applied Courses) increased dramatically between 1945 and 2005 with a peak of 15 courses in 1955 at the University of Texas, whereas this category remained fairly low throughout the century and had no courses in this category in 1965 and 1985 at Colorado College. This is due to the fact that the Pure and Applied Mathematics Departments merged between 1945 and 1955 at the University of Texas. Cajori Two Category 6 (Higher and Abstract Algebra, Linear Algebra and Number Theory) remained fairly consistent throughout the century at the University of Texas (Austin), but dramatically increased at Colorado College after 1965.

Comparison within Selected Colleges on the West Coast (Between Stanford and University of California, Berkeley) (Charts in Appendix T)

Both colleges had the most number of courses over the course of the century in Cajori Two Category 5 (Analysis Following Basic Calculus) and peaked in 1975 to 1985, regardless of the inclusion of the graduate courses available to undergraduates at Stanford University. Moreover, regardless of the graduate courses at Stanford, Cajori Course Category 6 (Higher and Abstract Algebra, Linear Algebra and Number Theory) was consistently available throughout the century with 1 to 12 courses at Stanford; however, it spiked in 1935 with 21 available courses. This was due to a large number of courses in abstract structures and number theory that year. At the University of California (Berkeley), this category was consistent from 1905 to 1965 and then jumped from 5 courses to 12 courses between 1965 and 1975, then remained similarly popular until 2005.

Cajori Two Category 11 (Advanced Probability and Statistics with Mathematics Designations of No Designations) was available at Berkeley until 1955, then went to zero. Possibly Berkeley created a separate department for Probability and Statistics or just dispersed those courses throughout other departments. It was almost the opposite at Stanford. There were no courses in this category until 1935, and then it remained low but steady until 2005.

Comparison between Colleges Grouped by their Ability to Produce Students who go on to Earn STEM Doctorates (Charts in Appendix U)

Regardless of the vast amount of graduate courses available to the undergraduates at Stanford from 1955-1994, it appears as though there have consistently been more courses available to students at the colleges that have notably produced more Ph.D. students (with an exception of 1925). While interpreting the main source of data, it also appears that the three colleges (Yale, Stanford, and the University of California at Berkeley) mentioned more advice to students who intended on going to graduate school in mathematics and encouraged students to take graduate courses as undergraduates. It seems they were more willing to be flexible with the rules at the college, and this may be part of the reason for their success in preparing students for graduate school.

Opportunities for Undergraduates to Take Graduate Courses

During the 11 instances throughout the century that this study inspected the college bulletins, the three colleges in the top 50 colleges to produce Ph.D. students in the STEM fields between 1997 and 2006 (Burrelli, Rapoport, and Lehming, 2008) state that undergraduates can take graduate courses 23 times, whereas the colleges that are not leaders in producing Ph.D. students in STEM fields only mention it 9 times. Stanford University has encouraged it the most, then Yale and the University of California (Berkeley). This may play a role in encouraging undergraduate students to take on the challenge of Ph.D. studies and also bridge the gap to the new degree and level of study. The table below provides a summary of the colleges that make graduate courses available to their undergraduate students.

Table 1. Availability of Graduate Courses to Undergraduate Students at the Colleges in the Study

College	~1905	~1915	~1925	~1935	~1945	~1955	~1965	~1975	~1985	~1995	~2005
CCNY	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	Yes	Yes	Yes
Colorado College	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.	N.M.
Stanford	N.M.	Yes	N.M.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
University of CA (Berkeley)	N.M.	N.M.	N.M.	Yes	Yes	Yes	N.M.	N.M.	Yes	Yes	Yes
University of TX (Austin)	Yes	Yes	Yes	Yes	N.M.	Yes	Yes	N.M.	N.M.	N.M.	N.M.
Yale	Yes	Yes	Yes	N.M.	N.M.	N.M.	Yes	Yes	Yes	Yes	Yes

N.M. notation [2]

Answer to Research Question 3

The significant changes to the mathematics major requirements throughout the century are noted below.

City College New York (Chart in Appendix T)

The calculus courses did not vary much and remained fairly minimal and consistent over the course of the century at CCNY. After 1965, the theory of functions courses dramatically increased, creating a notable spike in Cajori Two Category 5 (Analysis Following Basic Courses), with a peak in 1985 of 6 courses. Linear algebra courses started being offered around 1965. Euclidean geometry was not offered at all at CCNY, and non-Euclidean geometry began to be offered after 1965. Foundations courses became available after 1965. There were only one to two applied courses available each decade. Only one discrete mathematics course was available in 2005. Probability and statistics courses became available sometime after 1905 and thereafter. A history/ philosophy course became available around 1965. The analysis following basic calculus courses grew the largest over the last century.

[2] N.M. stands for "Not Mentioned"

Colorado College (Chart in Appendix T)

At Colorado College, there were many elementary courses before calculus in 1905, and this declined over the century. Analysis courses following calculus increased over the century. After 1965, Colorado College included more calculus courses and offered some calculus with pre-calculus courses. There were no Cajori Two Category 6 (Higher and Abstract Algebra, Linear Algebra, and Number Theory) courses during 1945. There were no Cajori Two Category 7 (Advanced Geometry and Topology) courses from 1955 to 1965, no Cajori Two Category 8 Courses (Foundations) at all, and no advanced Euclidean Geometry courses in 1955 and thereafter. A discrete mathematics course first appeared in 1995. Probability and statistics courses first appeared in 1945.

Stanford University (Chart in Appendix T)

The courses primarily for graduate students were also included during 1955 to 1995 because it was recommended that those undergraduates intending on pursuing graduate school in mathematics take at least one graduate course. Most notably, after 1925, Stanford University began offering more types of Category 5 courses (Analysis Following Basic Calculus). Around 1975, the number of courses in this category peaked at 42, and then by 2005 it went down to 8 courses. Cajori Two Course Categories 3, 10, 12, 13, and 14 (Mathematics Expressly for Teachers, Discrete Mathematics, Computer Science Courses with Mathematics Designations of No Designations, Courses with Unspecified Content, and Other Courses Not in Previous Categories) had a substantial amount of courses in them between 1925 and 1995, but then all went to zero by 2005. Calculus courses gradually increased throughout the century. Courses in number theory and concrete studies in algebra declined throughout the century. Advanced Euclidean geometry stopped being offered sometime between 1945 and 1955. Geometry with other mathematical machinery peaked in 1985 and was the most popular geometry course at Stanford. Foundation courses (such as logic and set theory) were only offered after 1945.

Discrete mathematics courses were only offered between 1965 and 1995. Probability and statistics courses were available after 1925.

University of California, Berkeley (Chart in Appendix T)

An accelerated honors track in calculus began at the University of California (Berkeley) after 1925; otherwise, the calculus track remained fairly consistent. The theory of functions courses had a steep drop in 1965, but otherwise it gradually increased over the century. Differential equations courses and related courses peaked during 1975. Linear algebra courses only appeared after 1955. Algebraic structures appeared after 1925 and gradually increased. Concrete studies in algebra was popular in 1905, and sharply decreased in number until those courses were last seen in 1985. Number theory courses were fairly constant throughout the century.

Advanced Euclidean geometry became absent between 1955 and 1995. The geometry with other mathematical machinery appeared after 1945 and became increasingly popular. Foundations courses generally always existed at a steady rate. Differential equations courses peaked in 1975. Mathematical tools used primarily in physical science/engineering mainly appeared after 1945 and peaked around 1975. In 1955, there were five courses in actuarial science, which was a huge spike from either one or mostly no courses in this subject. The first and only course in discrete mathematics appeared in 2005. Probability and statistics courses existed from 1905 to around 1955, and then none in the mathematics department thereafter. The category that grew the most over the century was category 5 – analysis following basic calculus.

University of Texas, Austin (Chart in Appendix T)

Out of the six colleges in this study, the University of Texas (Austin) has offered the most mathematics courses expressly for teachers throughout the century. The calculus courses remained fairly consistent throughout the century, increasing a small amount toward the end. All of the analysis following basic calculus courses rose and peaked between 1945 and 1965.

There were only two linear algebra courses in 1925, until they regularly appeared after 1955. The advanced Euclidean geometry was only available until sometime around 1985. The only foundations courses appeared in 2005. The applied courses of mathematical tools used mainly in physical sciences began to be offered sometime after 1945 and were very popular. Discrete mathematics was available in 1965, but not 1975, and then came back in 1985 until 2005. Probability and statistics courses consistently existed from 1925 to 2005. Analysis courses took the lead throughout the century in 1965, and the advanced applied courses became the most popular category at the end of the century.

Yale University (Chart in Appendix T)

Yale began offering many different types of calculus courses after 1945. The only differential equations course appeared in 1945. The cluster of the theory of functions courses gradually increased in number of courses throughout the century. Most Cajori Two Category 6 (Higher and Abstract Algebra, Linear Algebra and Number Theory) courses appeared after 1925, and the first linear algebra courses appeared after 1955. It seems that when the advanced Euclidean geometry was not offered, geometry with other mathematical machinery courses were available. Logic and set theory courses were only available after 1965. Advanced Applied Courses seemed to be somewhat consistent and minimal throughout the century. With the exception of one course in 1955, discrete mathematics was only available after 1975. Statistics and probability courses were available after 1925.

Cajori Two Category 1 – Pre-college Mathematics (Charts in Appendix F)

All of the six colleges in this study allowed students majoring in mathematics to apply courses designated as pre-college mathematics courses to their degree at some point or another before 1965. After 1965, no more courses in this category would apply to the mathematics major degree requirements. This category mainly includes elementary geometry and pre-calculus courses.

Cajori Two Category 2 - Elementary Service Plus General Education (Charts in Appendix G)

CCNY, Stanford, the University of California (Berkeley), and Yale did not allow any of the courses in this category to count toward the degree requirements from 1905 to 2005. This includes all three colleges that produce a significant number of undergraduates who eventually earn a doctoral degree in a STEM field. However, Colorado College had three courses in 1925 and one course in 2005, and the University of Texas (Austin) made eight courses available to their mathematics major students in 1925, then one in 1935 and one in 1955.

The titles of the courses at Colorado College are [20] and [21] "Statistical Methods" (two courses with that same title) and [Business12] "Mathematics Theory of Investment." These statistical courses were included in this category and not in category 11 because they are elementary in nature based on their course descriptions. Their course descriptions are below as excerpts from the original course bulletins (Colorado College Course Bulletin, 1925-1926, pp. 81-82).

Mathematical Theory of Investments (Business 12)—Prerequisite, Mathematics 1. Logarithms, simple and compound interest, annuities, amortization, valuation of bonds, sinking funds and depreciation. Required of freshmen in business administration and banking. Second semester, 3 hours.—MR. ALBRIGHT.

20. *Statistical Methods*—Graphs and their interpretation, comparison by graphs, means, measures of dispersion, correlation. First semester, 3 hours.—MR. LOVITT.
21. *Statistical Methods*—Finite differences, interpolation, moments, curve fitting, correlation, Lexis series, Poisson exponential. Second semester, 3 hours.—MR. LOVITT.

The titles of the courses at the University of Texas (Austin) in 1925 were [9] "The Mathematics of Finance" in the fall, winter, and spring, [225] "Descriptive Geometry" in the fall and winter, and [8] "Mathematical Statistics" in the fall, winter, and spring. Their course descriptions are presented below as excerpts from the original course bulletins (University of Texas, Austin, 1925, pp. 165-166).

1. *The Mathematics of Finance.*—Compound interest, annui- amortization, sinking funds, depreciation, mortality tables, life nities, and pensions. Prerequisite: Pure Mathematics 1 with de of C or above. TTS 9 (IV). (Given also as a course in the ool of Business Administration.) Professor DODD.

225*fw*. *I*. *Descriptive Geometry.*—Methods of representing the ob- jects of space by drawings in the plane and the solution of the problems of space geometry by plane constructions. Prerequisite: Three thirds of Pure Mathematics 1. MWF 10 (V). Associate Professor ETTLINGER.

8. *A*. *Mathematical Statistics.*—Theory of classes, frequency dis- tributions, simple and partial correlation—with applications. Pre- requisite: Two courses in mathematics. MWF 11 (VII). Associate Professor BENNETT.

At the University of Texas (Austin), the courses with just a number were assumed to be full year courses (fall, winter, and spring), since [3] Calculus was listed without any notation on the semesters and it is stated in the course description that “Pure Mathematics 3 will count as one, two, or three thirds advanced” (University of Texas Bulletin, Austin, 1925-1926, p. 165). Some courses have ‘f,’ ‘w,’ or ‘s’ distinctions, for fall, winter, or spring, since some courses extend over one, two, or three semesters. In this academic year at the University of Texas (Austin), if a course was notated for two semesters, it was counted as two courses. If it was listed with just a number (as in the case with Calculus), it was counted as three courses.

Cajori Two Category 3 - Mathematics Expressly for Teachers (Charts in Appendix H)

All six colleges had sporadic offerings of mathematics courses expressly for teachers throughout the century except for Yale. CCNY only had one in 1925, whereas Colorado College had one from 1925 to 1965. Stanford and the University of California (Berkeley) generally offered none, one, or two between 1905 and 1975.

Cajori Two Category 4 -Basic Calculus Sequences (Charts in Appendix I)

Five of the six colleges started out with a constant number of standard basic calculus courses, and then started introducing more types of calculus courses throughout the century. CCNY was a little different. They offered a standard calculus sequence in addition to a course by the name of "Vector Analysis," which has been coded as cluster 19, or "Miscellaneous Calculus," until 1955 and then sometime after 1955, they became more conservative and decreased the number and variety of calculus courses.

The University of California (Berkeley) and Yale started expanding their variety of calculus courses around 1925, then Stanford around 1955, Colorado College around 1975, and the University of Texas (Austin) in 1985. Some of the calculus courses that became available are calculus with pre-calculus, accelerated/honors types of calculus courses, and separate courses for students in science, technology, engineering, and mathematics (STEM).

Cajori Two Category 5 - Analysis Following Basic Calculus (Charts in Appendix J)

For analysis following basic calculus courses, it seems there was generally a slight increase in these courses around 1935 and then many spikes in the numbers of these courses from 1955 to 1975. Mostly there were increases in the number of "Theory of Functions" cluster of courses.

Stanford University had a much larger amount of available analysis following basic calculus courses during 1955 to 1995, but this is mainly due to the fact that the graduate courses were available to undergraduate students during this time, so the graduate mathematics courses were also considered as part of this study. Otherwise, all six colleges always had these types of courses (except Colorado College had none in 1905, then one in 1915), and they generally increased in their amount throughout the century.

Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra, and Number Theory (Charts in Appendix K)

At CCNY, there were one to five courses in this category from 1925 to 2005, with linear algebra first appearing in 1965. At Colorado College, it seems that the concrete studies in algebra ended after 1935, and then courses opened up in 1955 in algebraic structures, then linear algebra and number theory courses around 1975.

At Stanford, there was a dramatic increase in the number of these courses in 1935, slowly coming back down again until 1955, when the number of courses started increasing again, reaching a peak in 1985, mostly because the graduate courses were included from 1955 to 1994, since they were available to students majoring in mathematics. In 1935, there was one course at Stanford titled "Linear Associative Algebras" [3] without any course description, and then it disappeared until 1965. In 1965, it was titled "Linear Algebra and Matrix Theory." Otherwise, the rest of the colleges began offering linear algebra around 1964, and the colleges on the West Coast seemed to have the most instances of linear algebra courses.

At the University of California (Berkeley), abstract structures courses were available, and then those courses and linear algebra courses peaked in 1975. It is unusual how the number of available linear algebra courses jumped from five courses in 1975, to one course in 1985, and then back to five courses in 1995. It seems that there were two different linear algebra courses, each with an honors section in 1975 and 1995, accounting for four of the courses. Then there was an additional course in 1975 titled "Linear Algebra," which appears to be the one that remained in 1985, and then in 1995 the fifth course was an optional computer laboratory course.

At the University of Texas (Austin), there was a peak in these courses in 1925, then again during 1975 to 1985. There were two linear algebra courses available in 1925; they disappeared until 1965, when they reappeared and remained available until the end of the century. It is

[3] It is arguable that this course might belong to the "abstract structures" cluster; however, because there was no course description, it was coded as a linear algebra course.

interesting that in 1925 at the University of Texas, there were two linear algebra courses by the name of "Linear Transformations." One was offered in the winter and the other in the spring. The course description states, "Invariants and the abstract theory of matrices with applications to analytical projective geometry" (University of Texas Bulletin, 1925-1926, p. 166). After 1925, it disappeared, and then this type course did not appear again at the University of Texas until 1965.

At Yale, there seemed to be an increase in the number of courses in this category in 1945, since it was the first time number theory, miscellaneous algebra, and differential equations and related courses became available. Courses in abstract structures and theory of functions steadily increased after 1955.

Cajori Two Category 7 - Advanced Geometry and Topology (Charts in Appendix L)

It appears that at most of the six colleges, advanced Euclidean Geometry, projective and non-Euclidean geometry, and miscellaneous geometry dwindled throughout the century, and by 2005 each college offered only one or two courses in these clusters. However, geometry with other mathematical machinery either became available mid-century and then increased by 2005 or increased throughout the century. It seems that the standard Euclidean courses were becoming less popular as the century progressed and the geometry with other mathematical machinery, such as point-set topology, algebraic/combinatorial topology, algebraic geometry, and differential geometry, was increasing in popularity throughout the century.

Cajori Two Category 8 – Foundations (Charts in Appendix M)

There were no courses found in this category throughout the century at Colorado College. At the other five colleges, it appears to have been the most prevalent category between 1955 and 2005. These types of courses in foundations are also often taught in the Philosophy Department, so that could be part of the reason this category was unsteady throughout the century.

Cajori Two Category 9 - Advanced Applied Courses (Charts in Appendix N)

At Colorado College, Stanford, the University of California (Berkeley), and the University of Texas (Austin), there appears to have been a dramatic increase in the number of courses listed as “mathematical tools used mainly in physical science/engineering” cluster in 1975. Yale made two courses available in this cluster in 1965 to mathematics majors, then none until 1995 again, when there were three courses available in this cluster. CCNY consistently had one course in this category throughout the century except from 1935 to 1945.

Cajori Two Category 10 - Discrete Mathematics (Charts in Appendix O)

None of the six colleges offered courses in discrete mathematics before 1955. Yale was the only college to offer one course in discrete mathematics in 1955, then nothing at Yale until 1985. This was a similar situation at the University of Texas (Austin) since there was one course in this category in 1965, and then none until 1985 like at Yale. Colorado College began offering one course in discrete mathematics in 1995, and the same for CCNY and the University of California (Berkeley) in 2005. Stanford had some courses available between 1965 and 1995, but nothing in 2005.

Cajori Two Category 11 - Advanced Probability and Statistics with Mathematics Designations (Charts in Appendix P)

At CCNY, mathematical probability and statistics courses appeared in 1915 and increased in number throughout the rest of the century. There were two courses in applied statistics in 1945 at Colorado College and then none again until 1965. After 1965, there remained at least two courses at Colorado College in this category.

Stanford and Yale began offering advanced probability and statistics courses in 1935, which continued until 2005, except it had dropped to only one course at Stanford University in 2005. There was a similar trend to Yale at the University of Texas (Austin), except a decade earlier, in 1925, was the first year of the study that an advanced probability and statistics course became available.

The University of California (Berkeley) had courses in mathematical probability and statistics from 1905 to 1955, but then nothing after that. It is likely that these courses transferred to another department after 1955.

Cajori Two Category 12 - Computer Science Courses with Mathematics Designations of No Designation (Charts in Appendix Q)

There were no courses before 1965 in this category at any of the six colleges, and none ever at the University of California (Berkeley). It appears that these courses may have eventually transferred to a separate department at all of the six colleges except for Yale. At Yale, three courses became available in this category in 1975. One was a programming course, another a theory course, and the third was an applications course. By 2005, there were still one programming course and two theory courses available.

Cajori Two Category 13 - Courses with Unspecified Content (Charts in Appendix R)

In 1975, Stanford University offered an unusually high number of courses in the courses with unspecified content category. Five of them were undergraduate courses with titles like “Perspectives in Mathematics,” “Topics in the History of Mathematics,” “Mathematics Workshop Consulting,” and undergraduate colloquium and seminars. There were five courses primarily for graduate students included in this study because these courses were available to the undergraduate students at Stanford University between 1955 and 1995. These titles ranged from “Directed Reading” to “Advanced Reading and Research” and “Seminar Participation.”

At the University of California (Berkeley), there was a high of seven courses in this category in 1985. The course titles included “Mathematical Problem Seminar,” “Computational Mathematics,” “Tutorial in Upper Division Mathematics,” “Experimental Courses in Mathematics,” “Special Topics in Mathematics,” “Honors Thesis,” and a “Supervised Independent Study and Research.”

At the University of Texas (Austin), there was a peak of ten courses in 1995 in this category. Some of the titles of those courses included “Topics in Mathematics,” “Cooperative

Mathematics," "Mathematics as Problem Solving," "Conference Course," "Computer Assisted Conference Course," and an "Honors Tutorial Course."

Cajori Two Category 14 - Other Courses Not in Previous Categories (Charts in Appendix S)

The only colleges from this study to offer a history course through the mathematics department during the 20th century were CCNY, Colorado College, Stanford University, and the University of California (Berkeley), and it was not very consistent nor popular at these colleges. It is possible that these types of courses were also available in other departments, such as in the history department, and this is why they have an inconsistent appearance in the mathematics departments.

Proportion of Mathematics Courses in the Degrees (Charts in Appendix V)

In 1905, the proportion of mathematics courses to the overall degree requirements ranged from .04 at CCNY to .25 at Yale and Colorado College. In 1935 and 1945, there were a few instances where the total degree requirements were unknown at Colorado College and Stanford. Moreover, the mathematics major did not seem stable in terms of the amount of required mathematics courses before 1975. After 1975, the proportion of mathematics required for the degree began to stabilize as it ranged from .28 at the University of Texas (Austin) in 1995 to .4 at Stanford University in 1985. Never did the mathematics requirements go above .4, or 40%, of the overall degree requirements at any of the six colleges in this study.

Follow-up Literature Review Findings

According to the unpublished report for the City College of New York Proposal – Major in Mathematics in Scientific and Industrial Applications (1981),

> Undergraduate Mathematics education has generally followed a traditional curriculum in both Pure and Applied Mathematics, based on the principle that rigorous training in Foundations (Analysis, Algebra, Topology, Probability, Mathematical Physics) through a fairly abstract curriculum would provide the intellectual preparation for further study, whether formal graduate study or on-the-job training in some branch of industry. (p. 1)

The City College of New York responded by creating an additional mathematics major, which focused on more applied mathematics, for those intending to go onto industry after college. “The proposed new course, Mathematics 367, presents solutions to industrial problems at a level appropriate for a Mathematics major, drawing on techniques from Linear Algebra, Probability, and Differential Equations” (p. 2). This course appeared in the course catalog from 1983 to 1995, and a similar course in modeling in 2005; however, this modeling course was not listed as a course recommended for a student majoring in pure mathematics. Moreover, there was a similar course numbered 241 in modeling at Colorado College during 1975, which did not count toward the mathematics major requirements. In 2005, there were two courses at Colorado College in modeling available to mathematics majors, namely, courses [217] “Probability ad Statistical Modeling” and [240] “Topics in Mathematics: Mathematical Modeling.” There was also a course in modeling available for the first time at the University of Texas (Austin) in 2005 numbered [474M] and titled “Introduction to Mathematical Modeling and Industrial Mathematics.”

The CCNY proposal recommended a capstone course for seniors to complete a project with guidance that would follow a cooperative education experience, and this type of course was not seen in the catalogs between 1983 and 2005. The addition of applied courses was also supposed to aid underprepared students.

> “Pure” mathematics requires the ability to prove mathematical theorems. This is first learned in Advanced Calculus, and also provides the kind of mental skills that tangentially benefit any intellectual endeavor. But our proposed program focuses on those skills that directly bear on applications, not on proving theorems, and can thus begin to be acquired earlier. (The City College of New York Proposal, 1981, p. 5)

Chapter V

CONCLUSIONS

Summary

Inspecting the mathematics major curriculum at each college in each decade offers a broad perspective of what was considered important to that college over the course of the century. “Because the curriculum always represents a selected sample from an almost unlimited universe of knowledge, it will always grant a privileged status to some knowledge over other knowledge. The main questions that guide work in the curriculum field – What should we teach? Why should we teach one thing rather than another?” (Stanic & Kilpatrick, 1992, p. 415). These questions are always in order to allow for the field of mathematics to evolve and grow to new depths of understanding.

Some overall patterns found in the data are how linear algebra, discrete mathematics, and computer science courses all entered the curriculum around the same time in 1955 and then became widely available. This is probably due to the close relationship between discrete mathematics, linear algebra, and computing. The computer science courses at most colleges eventually disappeared from the mathematics departments, most likely transferring to a new department at the college, except at Yale. There were computer science courses available in the Mathematics Department at Yale until 2005.

Most of the calculus tracks became more varied throughout the century, most likely to accommodate the wide range of background knowledge that students began coming to college with later on in the century as college became more available to the masses. After 1985, most colleges in the study had options such as calculus with pre-calculus, accelerated/honors calculus, and separate calculus courses for students in the science, technology, engineering, and mathematics (STEM) fields. There was even a self-paced calculus I, II, and III track available at the University of California (Berkeley) in 1975.

Foundations courses mainly appeared later on in the century. This may be due to the fact that it is one of the newer branches of mathematics and that often these courses are also taught in other departments, such as philosophy.

Advanced Euclidean geometry courses were generally available in the beginning of the century, but then the availability of these courses waned at all of the colleges during the middle of the century, and geometry with other mathematical machinery (such as different types of topological courses) became more popular toward the end of the century.

In some colleges, the advanced applied courses increased as the century progressed, and in some cases they disappeared. Most likely the ones that disappeared transplanted to another department at the college. This seemed to happen at CCNY, Colorado College, Stanford University, and Yale. These findings are consistent with Garfunkel and Young's (1990) research on mathematics courses outside of mathematics departments.

Not surprisingly, the most changes to the course offerings happened after World War II. Some more specific social changes during that time were the creation of the Committee on the Undergraduate Program (CUP), later renamed the Committee on the Undergraduate Program in Mathematics (CUPM), and the launching of Sputnik during the fifties. Courses became more varied and advanced during that time. Many discussions took place on the importance of mathematics and its purpose, and because of this a divide began to occur in mathematics departments, with more colleges creating a separate department for statistics and applied mathematics. As an exception, the University of Texas (Austin) had an Applied Department and Pure Department from 1905 to 1945, but then those two departments combined between 1945 and 1955.

In 1992, CUPM suggested a system of tracks within the mathematical sciences major, which was witnessed in most of the college bulletins. It became common to have tracks for actuarial mathematics, future teachers, pure mathematics, applied mathematics, and so on.

In 1965, CUPM's General Curriculum in Mathematics for Colleges recommended a Linear Algebra course for students in their sophomore year, and it seems that most colleges heeded this advice. Often linear algebra courses were not even available before 1965, and they became available around that time at all of the colleges in this study.

Holder (1913) asked some important questions: "What are the 'values' in mathematical study?" and "What is there in the subject to justify its place in the college curriculum?" (p. 112). Well, clearly there is not one answer, or no correct one for that matter, to these questions. There will always be a small number of people who feel that pure mathematics is important and rich with abstract problems and should not include applications. Then there are those that view pure mathematics as merely a stepping stone, or tool, to solve problems with a specific purpose. No matter what, mathematics has surely made its mark in college curricula and will always serve some sort of purpose to the general college population.

Questions for Further Study

If anyone were to further investigate this topic, I would recommend either continuing the essence of this study to include more of the influential schools during the 20th century, such as Harvard, Columbia, Cornell, Princeton, or the University of Chicago. Additionally, it would be interesting to learn what happened at Indiana University after 1885, since it was noted by Rudolph in 1977 (p. 227) that in 1885, the president of the college was one of the first to institute the idea of a major subject for undergraduates there. Much of the literature speaks to these campuses as trendsetters, and it would be nice to see if they had as much influence as speculated.

It would be interesting to also compare the effectiveness of the different types of calculus courses made available to the undergraduate students after 1985, when it seemed to become the most varied. Calculus is the one college-level mathematics subject that was expected for all mathematics majors at all colleges throughout the century.

Although courses in mathematical applications were found to have increased in number over the last century, this study did not focus on the creation of applied mathematics majors within the departments. It would be interesting to see if, and when, those majors began at colleges in the United States.

Furthermore, it would be interesting to look at non-mathematics course requirements, such as laboratory science requirements or applied mathematics requirements. There would be a significant difference if a student obtained a B.A. or B.S., since a B.S. usually requires more laboratory science courses.

As Tucker (1996) states, "Success in undergraduate mathematics depends on more than the curriculum" (p. 1356), so it would also be interesting to research and track other variables, such as professors of courses, undergraduate coursework, or the experiences of some famous mathematicians throughout history. It should be noted that Florian Cajori was listed as a professor at Colorado College in 1905 and 1915. George Polya was also listed as a professor at Stanford University and visiting professor at the University of California (Berkeley) around 1945.

In order to better judge curriculum effects, "it would also be helpful to have more information about subsequent experiences of former students" (MAA & CUPM, 1992, p. 244). If there were data available on the paths of students after earning their bachelor's degree, then one could track the undergraduate coursework of students who become Mathematics Ph.D. students to better determine an optimal path or courses.

Recommendations

It is recommended that administrators and faculty members remain knowledgeable about the evolution of the major and consider how the changes impact the quality of students. In today's times, it is easy to learn about new ideas for teaching and methods from other countries. This awareness opens the door for much experimenting to be done, but it is advised that this experimenting be done carefully and slowly.

Many of the changes occurring in colleges at present have themes of conforming to standards and having a common curriculum among colleges – especially public colleges. This has its advantages for the masses, as it can allow a seamless path of courses and may aid to a better understanding of the mathematics. This may ultimately lead more students to more advanced levels of mathematics earlier, and increase enrollment in the major. On the flip side, it may impact the creativity students have that can allow the field to grow. That is to be determined, and it is important to continually record and observe the effects, as was done in this study, for the advancement of the field.

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Bulletin of Yale University, 1994-1995. (1994). New Haven, CT: Yale University.

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APPENDIX A – LIST OF YEARS OF THE COLLEGE BULLETINS USED

Sometimes it was difficult to get the college catalog data for the exact year, so in this case the closest year was used. Here are the years of the college catalogs used for each college:

College:	Year:
City College of New York (CCNY)	1906 – 1907* 1915 – 1917 1923 – 1925 1935 – 1936 1945 – 1946 1955 – 1956 1965 – 1966 1975 – 1976 1983 – 1985 1993 – 1995 2003 - 2005
Colorado College	1905-1906 1915-1916 1925-1926 1935-1936 1945-1946 1955-1956 1965-1956 1975-1976 1985-1986 1995-1996 2005-2006

Stanford University	1906-1907* 1915-1916 1923-1924* 1935-1936 1945-1946 1955-1956 1964-1965 1975-1976 1985-1986 1994-1995 2005-2006
University of California, Berkeley	1905-1906 1915-1916 1925-1926 1935-1936 1944-1945 1954-1955 1965-1966 1974-1975 1985-1986 1995-1997 2003-2005

University of Texas, Austin	1905-1906 1914-1915 1924-1925 1933-1935 1941-1945 1953-1955 1963-1965 1973-1975 1983-1985 1994-1996 2004-2006
Yale	1904 – 1905 1914 – 1915 1925 – 1926 1934 – 1935 1945 – 1946 1954 – 1955 1964 – 1965 1974 – 1975 1984 – 1986 1994 – 1995 2006-2007*

* Course catalogs that are not exact, but within one year of the desired year.

APPENDIX B – LIST OF CAJORI TWO CATEGORIES

Category Name	Category number	Cluster Number	Cluster
Pre-college Mathematics	1	1	Pre-college mathematics
		2	Elementary College Level Geometry
		3	Pre-calculus courses
Elementary Service Plus General Education	2	4	Service of special interest for the sciences
		5	Service of special interest outside the sciences
		6	General Education
		7	Miscellaneous Service or General Education
Mathematics Expressly for Teachers	3	8	For elementary and middle school teachers
		9	For secondary school teachers
		10	Miscellaneous teacher's courses
Basic Calculus Sequences	4	11	Mainstream basic calculus sequence
		12	Calculus with precalculus
		13	Accelerated or honors mainstream basic calculus sequence
		14	Basic calculus sequence for students of STEM
		15	Briefer calculus sequence for students outside the sciences
		16	Calculus With Theory
		17	Calculus for Students with Prior Exposure To Calculus
		18	Other calculus Sequence
		19	Miscellaneous calculus
Analysis Following Basic Calculus	5	20	Extended basic calculus
		21	Advanced calculus
		22	Differential equations and related courses
		23	The theory of functions
		24	Advanced analysis
		25	Miscellaneous Analysis
Higher and Abstract Algebra, Linear Algebra and Number Theory	6	26	Concrete studies in algebra
		27	Linear algebra
		28	Abstract structures
		29	Number theory
		30	Miscellaneous algebra
Advanced Geometry and Topology	7	31	Advanced Euclidean geometry
		32	Projective and non-Euclidean geometry
		33	Geometry with other mathematical machinery
		34	Miscellaneous geometry

Category Name	Category number	Cluster Number	Cluster
Foundations	8	35	Logic and set theory
		36	Miscellaneous foundations
Advanced Applied Courses	9	37	Mathematical tools used mainly in physical science/engineering
		38	Modeling branches of physical science/engineering
		39	Mathematical tools often applicable outside physical science/engineering
		40	Modeling areas outside physical science/engineering, operations research, actuarial science
		41	Actuarial science
		42	Operations research
		43	Miscellaneous applications
Discrete Mathematics	10	44	Discrete mathematics
Advanced Probability and Statistics with Mathematics Designations	11	45	Applied Statistics
		46	Mathematical probabilitiy and statistics
		47	Miscellaneous probability and statistics
Computer Science Courses with Mathematics Designations or No Designation	12	48	Programming courses
		49	Systems
		50	Theory
		51	Applications
Courses with Unspecified Content	13	52	Unspecified
Other Courses Not in Previous Categories	14	53	History/Philosophy
		54	Astronomy
		55	Miscellaneous Other

APPENDIX C – LIST OF CAJORI TWO STANDARDIZED COURSE TITLES

Standardized Course Title	Category number	Number within category	Cluster Number	Cluster
Arithmetic/Quantitative Reasoning	1	1	1	Pre-college mathematics
Elementary Algebra	1	2	1	Pre-college mathematics
Plane Geometry	1	3	1	Pre-college mathematics
Intermediate Algebra	1	4	1	Pre-college mathematics
Trigonometry	1	5	1	Pre-college mathematics
Comprehensive Remedial Mathematics	1	6	1	Pre-college mathematics
Solid Geometry	1	7	2	Elementary College Level Geometry
Spherical Geometry	1	8	2	Elementary College Level Geometry
Solid and Spherical Geometry	1	9	2	Elementary College Level Geometry
Spherical Trigonometry	1	10	2	Elementary College Level Geometry
Solid Geometry and Spherical Trigonometry.	1	11	2	Elementary College Level Geometry
Surveying/Geodesy	1	12	2	Elementary College Level Geometry
Analytic Geometry/Graphic Algebra	1	13	2	Elementary College Level Geometry
College Algebra/Higher Algebra	1	14	3	Pre-calculus courses
College Algebra and Trigonometry	1	15	3	Pre-calculus courses
Elementary Functions/Precalculus	1	16	3	Pre-calculus courses
Comprehensive Preparation for Calculus.	1	17	3	Pre-calculus courses
Other	1	18	3	Pre-calculus courses
Descriptive Geometry/Engineering Drawing	2	1	4	Service of special interest for the sciences
Slide Rules and Other Mechanical Devices/The Art of Computation.	2	2	4	Service of special interest for the sciences
Boolean Algebra for Engineers	2	3	4	Service of special interest for the sciences
Business Mathematics/Mathematics of Finance.	2	4	5	Service of special interest outside the sciences
Elementary Probability	2	5	5	Service of special interest outside the sciences
Elementary Statistics	2	6	5	Service of special interest outside the sciences
Finite Mathematics/Finite Mathematics with Calculus	2	7	5	Service of special interest outside the sciences
Mathematics and Culture/Mathematics and History	2	8	6	General Education
Structure of Mathematics/The Nature of Mathematics/Number Systems	2	9	6	General Education
Mathematical Thinking	2	10	6	General Education
Elementary Mathematical Modeling	2	11	6	General Education
Standardized Course Title	Category number	Number within category	Cluster Number	Cluster

Mathematics for General Education/Mathematics for the Liberal Arts	2	12	6	General Education
Logic and Set Theory	2	13	7	Miscellaneous Service or General Education
Mathematics For Women	2	14	7	Miscellaneous Service or General Education
Mathematics for Agriculture Students	2	15	7	Miscellaneous Service or General Education
Other	2	16	7	Miscellaneous Service or General Education
Mathematics for Elementary School Teachers	3	1	8	For elementary and middle school teachers
Methods of Teaching Elementary School Mathematics	3	2	8	For elementary and middle school teachers
Mathematics for Middle School Teachers	3	3	8	For elementary and middle school teachers
Methods of Teaching Middle School Mathematics	3	4	8	For elementary and middle school teachers
Mathematics for Secondary School or Junior College School Teachers	3	5	9	For secondary school teachers
Methods of Teaching Secondary School or Junior College Mathematics	3	6	9	For secondary school teachers
Mathematics for Teachers	3	7	10	Miscellaneous teacher's courses
Methods of Teaching	3	8	10	Miscellaneous teacher's courses
Topics/Seminar in the Teaching of Mathematics	3	9	10	Miscellaneous teacher's courses
Other	3	10	10	Miscellaneous teacher's courses
Mainstream Calculus Term 1	4	1	11	Mainstream basic calculus sequence
Mainstream Calculus Term 2	4	2	11	Mainstream basic calculus sequence
Mainstream Calculus Term 3	4	3	11	Mainstream basic calculus sequence
Mainstream Calculus Term 4	4	4	11	Mainstream basic calculus sequence
Mainstream Calculus Term 5	4	5	11	Mainstream basic calculus sequence
Calculus with precalculus Term 1	4	6	12	Calculus with precalculus
Calculus with precalculus Term 2	4	7	12	Calculus with precalculus
Calculus with precalculus Term 3	4	8	12	Calculus with precalculus
Accelerated/Honors Calculus Term 1	4	9	13	Accelerated or honors mainstream basic calculus sequence
Accelerated/Honors Calculus Term 2	4	10	13	Accelerated or honors mainstream basic calculus sequence
Accelerated/Honors Calculus Term 3	4	11	13	Accelerated or honors mainstream basic calculus sequence
Calculus for Sci/Eng/Tech Term 1	4	12	14	Basic calculus sequence for students of STEM
Calculus for Sci/Eng/Tech Term 2	4	13	14	Basic calculus sequence for students of STEM
Calculus for Sci/Eng/Tech Term 3	4	14	14	Basic calculus sequence for students of STEM
Calculus for Sci/Eng/Tech Term 4	4	15	14	Basic calculus sequence for students of STEM
Standardized Course Title	**Category number**	**Number within category**	**Cluster Number**	**Cluster**
Calculus for Sci/Eng/Tech Term 5	4	16	14	Basic calculus sequence for students of STEM

Briefer Calculus Term 1	4	17	15	Briefer calculus sequence for students outside the sciences
Briefer Calculus Term 2	4	18	15	Briefer calculus sequence for students outside the sciences
Briefer Calculus Term 3	4	19	15	Briefer calculus sequence for students outside the sciences
Calculus With TheoryTerm 1	4	20	16	Calculus With Theory
Calculus With TheoryTerm 2	4	21	16	Calculus With Theory
Calculus With TheoryTerm 3	4	22	16	Calculus With Theory
Calculus With TheoryTerm 4	4	23	16	Calculus With Theory
Calculus With TheoryTerm 5	4	24	16	Calculus With Theory
Calculus For Those With Prior Exposure Term 1	4	25	17	Calculus for Students with Prior Exposure To Calculus
Calculus For Those With Prior Exposure Term 2	4	26	17	Calculus for Students with Prior Exposure To Calculus
Calculus For Those With Prior Exposure Term 3	4	27	17	Calculus for Students with Prior Exposure To Calculus
Other Calculus Term 1	4	28	18	Other calculus Sequence
Other Calculus Term 2	4	29	18	Other calculus Sequence
Other Calculus Term 3	4	30	18	Other calculus Sequence
Other Calculus Term 4	4	31	18	Other calculus Sequence
Other Calculus Term 5	4	32	18	Other calculus Sequence
Vector Analysis/Vector Calculus	4	33	19	Miscellaneous calculus
Other basic calculus	4	34	19	Miscellaneous calculus
Curve Tracing	5	1	20	Extended basic calculus
Infinite Series/Power Series	5	2	20	Extended basic calculus
Advanced Calculus with No Course Description	5	3	21	Advanced calculus
Advanced Calculus: Mixed Topics	5	4	21	Advanced calculus
Differential Equations	5	5	22	Differential equations and related courses
Dynamical Systems	5	6	22	Differential equations and related courses
Numerical Analysis	5	7	22	Differential equations and related courses
Real Analysis	5	8	23	The theory of functions
Complex Analysis	5	9	23	The theory of functions
Real and Complex Analysis	5	10	23	The theory of functions
Measure and Integration	5	11	24	Advanced analysis
Introduction to Functional Analysis/Linear Operators	5	12	24	Advanced analysis
Calculus of Variations	5	13	24	Advanced analysis
Integral Equations	5	14	24	Advanced analysis
Harmonic Analysis and Wavelets	5	15	24	Advanced analysis
Standardized Course Title	**Category number**	**Number within category**	**Cluster Number**	**Cluster**
Topics/Seminar in Analysis.	5	16	25	Miscellaneous Analysis

Other	5	17	25	Miscellaneous Analysis
Quaternions	6	1	26	Concrete studies in algebra
Higher Algebra/Theory Of Equations	6	2	26	Concrete studies in algebra
Determinants	6	3	26	Concrete studies in algebra
Matrix Theory	6	4	26	Concrete studies in algebra
Boolean Algebra	6	5	26	Concrete studies in algebra
Linear Algebra	6	6	27	Linear algebra
Quantics	6	7	27	Linear algebra
Abstract/Modern Algebra without Linear Algebra	6	8	28	Abstract structures
Abstract/Modern Algebra with Linear Algebra	6	9	28	Abstract structures
Group Theory	6	10	28	Abstract structures
Group Representations	6	11	28	Abstract structures
Galois Theory	6	12	28	Abstract structures
Finite Fields/Coding Theory	6	13	28	Abstract structures
Number theory	6	14	29	Number theory
Algebraic Number Theory	6	15	29	Number theory
Analytic Number Theory	6	16	29	Number theory
Topics/Seminar in Algebra	6	17	30	Miscellaneous algebra
Other	6	18	30	Miscellaneous algebra
Advanced Synthetic Euclidean Geometry/College Geometry/Ruler and Compass Constructions	7	1	31	Advanced Euclidean geometry
Conics/Advanced Analytic Geometry/Modern Analytic Geometry	7	2	31	Advanced Euclidean geometry
Solid Analytic Geometry	7	3	31	Advanced Euclidean geometry
Projective Geometry	7	4	32	Projective and non-Euclidean geometry
Non-Euclidean Geometry/Theories of Geometry	7	5	32	Projective and non-Euclidean geometry
Geometry and Group Theory	7	6	32	Projective and non-Euclidean geometry
Point Set Topology	7	7	33	Geometry with other mathematical machinery
Algebraic Topology/Combinatorial Topology	7	8	33	Geometry with other mathematical machinery
Algebraic Geometry/Algebraic Functions	7	9	33	Geometry with other mathematical machinery
Differential Geometry	7	10	33	Geometry with other mathematical machinery
Convex Sets	7	11	34	Miscellaneous geometry
Standardized Course Title	**Category number**	**Number within category**	**Cluster Number**	**Cluster**
Modern Geometry With No Course Description	7	12	34	Miscellaneous geometry

Standardized Course Title	Category number	Number within category	Cluster Number	Cluster
Higher Geometry	7	13	34	Miscellaneous geometry
Survey Of Geometry/Modern Geometry	7	14	34	Miscellaneous geometry
Topics/Seminar in Geometry	7	15	34	Miscellaneous geometry
Other	7	16	34	Miscellaneous geometry
Mathematical Logic/Symbolic Logic	8	1	35	Logic and set theory
Set Theory	8	2	35	Logic and set theory
Mathematical Logic and Set Theory	8	3	35	Logic and set theory
Fundamentals of Mathematics/Foundations of Arithmetic	8	4	36	Miscellaneous foundations
Introduction to Proofs/Transition to Higher Mathematics	8	5	36	Miscellaneous foundations
Topics/Seminar in Foundations	8	6	36	Miscellaneous foundations
Other	8	7	36	Miscellaneous foundations
Engineering Mathematics/Methods Of Applied Mathematics	9	1	37	Mathematical tools used mainly in physical science/engineering
Mathematical Physics	9	2	37	Mathematical tools used mainly in physical science/engineering
Tensor Analysis/Vector and Tensor	9	3	37	Mathematical tools used mainly in physical science/engineering
Partial Differential Equations /Boundary Value Problems	9	4	37	Mathematical tools used mainly in physical science/engineering
Special Functions/Elliptic Functions/Abelian Functions.	9	5	37	Mathematical tools used mainly in physical science/engineering
Laplace Transforms / Fourier Series/Theory of Transforms	9	6	37	Mathematical tools used mainly in physical science/engineering
Generalized Functions (Distributions)	9	7	37	Mathematical tools used mainly in physical science/engineering
Control Theory	9	8	37	Mathematical tools used mainly in physical science/engineering
Mechanics/Analytical Mechanics/Rational Mechanics/Analytical Statics	9	9	38	Modeling branches of physical science/engineering
Celestial Mechanics	9	10	38	Modeling branches of physical science/engineering
Signal Processing	9	11	38	Modeling branches of physical science/engineering
Potential Theory	9	12	38	Modeling branches of physical science/engineering
Elasticity	9	13	38	Modeling branches of physical science/engineering
Thermodynamics	9	14	38	Modeling branches of physical science/engineering

Standardized Course Title	Category number	Number within category	Cluster Number	Cluster
Hydrodynamics/Fluid Mechanics/Fluid Dynamics	9	15	38	Modeling branches of physical science/engineering
Exterior Ballistics	9	16	38	Modeling branches of physical science/engineering
Applied Linear Algebra	9	17	39	Mathematical tools often applicable outside physical science/engineering
Applied Abstract Algebra/Algebraic Coding Theory	9	18	39	Mathematical tools often applicable outside physical science/engineering
Mathematical Economics	9	19	40	Modeling areas outside physical science/engineering, operations research, actuarial science
Mathematical Biology	9	20	40	Modeling areas outside physical science/engineering, operations research, actuarial science
Bioinformatics	9	21	40	Modeling areas outside physical science/engineering, operations research, actuarial science
Number Theory and Cryptology	9	22	40	Modeling areas outside physical science/engineering, operations research, actuarial science
Cryptology	9	23	40	Modeling areas outside physical science/engineering, operations research, actuarial science
Drill and Preparation for an Actuarial Exam	9	24	41	Actuarial science
Elementary Financial and Actuarial Mathematics	9	25	41	Actuarial science
Finite Differences, Interpolation and Numerical Analysis for Actuaries	9	26	41	Actuarial science
Theory Of Interest	9	27	41	Actuarial science
Actuarial Modeling	9	28	41	Actuarial science
Other Actuarial	9	29	41	Actuarial science
Statistical Methods for Actuaries	9	30	41	Actuarial science
Operations Research for Actuaries	9	31	41	Actuarial science
Financial Modeling	9	32	41	Actuarial science
Operations Research/Management Science/Industrial Engineering	9	33	42	Operations research
Linear Programming/Mathematical Programming/Optimization	9	34	42	Operations research
Game Theory	9	35	42	Operations research
Dynamic Programming	9	36	42	Operations research
Optimization/Convex Programming/Non-linear Programming	9	37	42	Operations research
Network Flows	9	38	42	Operations research

Discrete Optimization/Combinatorial Optimization	9	39	42	Operations research
Data Mining	9	40	42	Operations research
Monte Carlo Methods	9	41	42	Operations research
Decision Theory	9	42	42	Operations research
Mathematical Modeling	9	43	43	Miscellaneous applications
Adjustment of Observations /Least Squares	9	44	43	Miscellaneous applications
Topics/Seminar in Applied Mathematics	9	45	43	Miscellaneous applications
Other	9	46	43	Miscellaneous applications
Finite Differences/Difference Equations/Interpolation	10	1	44	Discrete mathematics
Combinatorics	10	2	44	Discrete mathematics
Graph Theory	10	3	44	Discrete mathematics
Combinatorics and Graph Theory	10	4	44	Discrete mathematics
Graph Algorithms	10	5	44	Discrete mathematics
Discrete Mathematics/Discrete Mathematical Structures	10	6	44	Discrete mathematics
Topics (or Seminar) in Discrete Mathematics/Combinatorics/Graph Theory	10	7	44	Discrete mathematics
Other	10	8	44	Discrete mathematics
Design of Experiments	11	1	45	Applied Statistics
Sampling Theory	11	2	45	Applied Statistics
Statistical Quality Control	11	3	45	Applied Statistics
Data Analysis/Descriptive Statistics	11	4	45	Applied Statistics
Theory of Probability	11	5	46	Mathematical probabilitiy and statistics
Theory of Statistics	11	6	46	Mathematical probabilitiy and statistics
Probability and Statistics	11	7	46	Mathematical probabilitiy and statistics
Multivariate Statistics	11	8	46	Mathematical probabilitiy and statistics
Linear Statistical Models	11	9	46	Mathematical probabilitiy and statistics
Stochastic Processes	11	10	46	Mathematical probabilitiy and statistics
Queueing Theory	11	11	46	Mathematical probabilitiy and statistics
Bayesian Statistics	11	12	46	Mathematical probabilitiy and statistics
Nonparametric Statistics	11	13	46	Mathematical probabilitiy and statistics
Regression Analysis/Analysis of Variance	11	14	46	Mathematical probabilitiy and statistics
Time Series	11	15	46	Mathematical probabilitiy and statistics
Sequential Analysis	11	16	46	Mathematical probabilitiy and statistics
Standardized Course Title	**Category number**	**Number within category**	**Cluster Number**	**Cluster**
Topics/Seminar in Probability and Statistics	11	17	47	Miscellaneous probability and statistics

Other	11	18	47	Miscellaneous probability and statistics
Introduction to Computing/Computer Programming	12	1	48	Programming courses
Software Engineering	12	2	48	Programming courses
Data Structures	12	3	48	Programming courses
Assembler Language Programing/Machine Organization	12	4	49	Systems
Data Communications	12	5	49	Systems
Operating systems	12	6	49	Systems
Computer Architecture	12	7	49	Systems
Fundamentals of Algorithms/Analysis of Algorithms	12	8	50	Theory
Computational Complexity/Theory of Computation	12	9	50	Theory
Automata/Computability/Formal Languages	12	10	50	Theory
Computer Graphics	12	11	51	Applications
Computer Vision/Image Processing	12	12	51	Applications
Principles of Programming Languages	12	13	51	Applications
Artificial Intelligence	12	14	51	Applications
Database Management Systems	12	15	51	Applications
Compiler Design	12	16	51	Applications
Topics/Seminar in Computer Science	12	17	51	Applications
Other	12	18	51	Applications
Reading/Independent Study	13	1	52	Unspecified
Topics in Mathematics	13	2	52	Unspecified
Seminar course	13	3	52	Unspecified
Internship that carries credit	13	4	52	Unspecified
Capstone course	13	5	52	Unspecified
Problem Solving	13	6	52	Unspecified
Other	13	7	52	Unspecified
History of Mathematics	14	1	53	History/Philosophy
Philosophy of Mathematics	14	2	53	History/Philosophy
History and Philosophy of Mathematics	14	3	53	History/Philosophy
Descriptive Astronomy/Practical Astronomy	14	4	54	Astronomy
Basic Mathematical Astronomy	14	5	54	Astronomy
Standardized Course Title	Category number	Number within category	Cluster Number	Cluster
Other Astronomy	14	6	54	Astronomy
Topics/Seminar	14	7	55	Miscellaneous Other
Other (not astronomy)	14	8	55	Miscellaneous Other

APPENDIX D - CAJORI TWO COURSE DESCRIPTION INVENTORY[4]

Category 1. Elementary Courses in Algebra, Geometry and Trigonometry

(Worksheet Abbreviation: LeadCalc)

Cluster 1: Pre-college mathematics

1.1 Arithmetic/Quantitative Reasoning.

Fractions, decimals, percents, graphs, areas and perimeters and volumes.

1.2 Elementary Algebra.

The first secondary school level course in algebra. Unknowns, linear equations, word problems, interest, etc.

1.3 Plane Geometry.

Elementary Euclidean geometry in the plane. Congruent and similar triangles, properties of circles, right triangles, the Pythagorean theorem.

1.4 Intermediate Algebra.

Polynomials, quadratic equations, 2x2 linear systems, ratio, etc.

1.5 Trigonometry.

The trigonometric functions and trigonometric identities.

1.6 Comprehensive Remedial Mathematics.

Review of elementary algebra and plane geometry and possibly arithmetic as well. This combines the material of earlier listed courses and will presumably have a brisker pace as it is a review of these individual subjects.

[4]Course Inventory was created by Dr. Walter Meyer (Adelphi University), Larry D'Antonio (Ramapo College), Dr. Joseph Malkevitch (York College and Teachers College), and Dr. Jack Winn (Farmingdale University) in 2005.

Cluster 2: Elementary college level geometry

1.7 Solid Geometry.

Euclidean solid geometry, via axioms. Points, lines, planes, spheres, some polyhedra.

1.8 Spherical Geometry.

The geometry of points and great circles on the sphere. Angles, areas, spherical excess. Applications to mapmaking and navigation. Note that a course by this title could also be used to explore the axiom set for spherical geometry, comparing it to the axioms of Euclidean Geometry, and pave the way to a "foundations-oriented introduction to non-Euclidean geometry. If the course has this character very strongly, it might be best to classify it in the category Advanced Geometry and Topology under Non-Euclidean Geometry or perhaps Other.

1.9 Solid and Spherical Geometry.

Much of this course is similar to "Spherical Geometry: but it will also include the necessary grounding in the geometry of points, lines, planes and spheres in 3-space.

1.10 Spherical Trigonometry

The relations among angles and arcs in spherical triangles created by arcs of great circles.

1.11 Solid Geometry and Spherical Trigonometry.

Similar to "Spherical Trigonometry" but also including the necessary preliminaries about points, lines, planes and spheres in 3-space.

1.12 Surveying/Geodesy.

1.13 Analytic Geometry/Graphic Algebra.

Coordinate geometry in the plane. Applications to algebra and analysis. Functions, graphs, limits, slope and intercept for lines, tangency, etc. Conics. If there is any extensive discussion of 3d, consider "Solid Analytic Geometry" from Category 7.

[Note to coder: "Graphic Algebra" is terminology from early in the 20th century.]

Cluster 3: Pre-calculus courses

1.14 College Algebra/Higher Algebra.

Polynomials, roots, factorization, solution of quadratic, cubic and biquadratic equations. Combinations, permutations, real and complex numbers. Mathematical induction, binomial theorem, exponential and logarithmic functions. Determinants.

1.15 College Algebra and Trigonometry.

Polynomials, roots, factorization, solution of quadratic, cubic and biquadratic equations. Combinations, permutations, real and complex numbers. Trigonometric functions and identities.

[Note to coder: It can be hard to distinguish this course from Higher Algebra/Theory of Equations. It is largely a matter of level (College Algebra is more elementary) and also somewhat a matter of topics. Determinants, permutations and combinations are not usually part of this course but often occur in Higher Algebra/Theory of Equations. The latter, in level and topics list, points toward linear and abstract algebra, which is why it is not in this category.]

1.16 Elementary Functions/Precalculus[5].

The nature of polynomials (maximum number of extrema, Descartes' rule, etc.), logarithmic, exponential and possibly trigonometric functions.

1.17 Comprehensive Preparation for Calculus.

Algebra, trigonometry, coordinate geometry. Differs from Elementary Functions/Precalculus in that it does more (and more elementary) algebra, and a bit more emphasis on coordinate geometry. Probably earlier in the century than

1.18 Other

[5]The slash indicates alternate titles or alternate wording that we consider equivalent.

Category 2. Elementary Service Plus General Education[6]

(Worksheet Abbreviation: Serv+GenEd)

Note: General Education has indistinct boundaries and may often overlap other categories in this inventory. It especially often overlaps the set of service courses which is one reason we group Service and General Education. But we do make an attempt to separate them in our clusters.

Cluster 4: Service of special interest for the sciences

2.1 Descriptive Geometry/Engineering Drawing.

This course is largely a how-to course for engineers about how to draw 3-d objects on paper. There is normally no prerequisite except possibly solid geometry. There is a theory to this subject and if one encounters a version of this course where the objective is to explore the theory, then that ought to go in the Advanced Geometry category.

2.2 Slide Rules and Other Mechanical Devices/The Art of Computation.

Before the era of electronic calculation, slide rules, nomographs, planimeters, etc. were use to get approximate answers to a wide range of calculations. In the era before the electronic computer, every engineer had familiarity with such devices, especially a slide rule. The way in which calculations needed to be done was not obvious, hence courses of instruction, mostly by departments that served engineers. This course is a sort of forerunner of courses in scientific computation on electronic computers and also of courses in numerical analysis. Some elementary aspects of numerical analysis may be included in the course.

[6] The terms used to define this category are late 20th century terms and may have not existed earlier. But presumably the concepts behind the terms often did. Elementary means not requiring calculus and taught at a level where it can be taken by freshmen and sophomores. (Typically this might be inferred if the course occurs near the beginning of the list of courses in the catalog.) "Service" means it is primarily intended to assist students majoring or heavily concentrating in a discipline other than mathematics, e.g., astronomy, biology, economics, and would rarely be taken by mathematics majors. A course is in the General Education category if it is elementary and meant to broaden the intellectual horizons of a broad class of students and is rarely taken by mathematics majors.

2.3 Boolean Algebra for Engineers.

This also appears in the algebra category. The version meant here is dedicated to circuitry, designed for electrical engineers and is not at all abstract.

Cluster 5: Service of special interest outside the sciences

2.4 Business Mathematics/Math of Finance.

An elementary treatment, about at the level of finite mathematics or lower.

2.5 Elementary Probability.

A first course in probability without a calculus pre-requisite.

2.6 Elementary Statistics.

A first course in statistics without a calculus pre-requisite. May contain some probability.

[Note to coder: An elementary course in biostatistics would be classified under Elementary Statistics, but with a "bio" flavor.]

2.7 Finite Mathematics/Finite Mathematics with Calculus.

Matrices, linear programming, elementary statistical and probabilistic methods. Sets and Logic. May include some calculus.

Cluster 6: General education

Since the 1930's there have been a number of kinds of courses meant to provide a terminal mathematics experience for non-STEM majors[7]. The next four courses show 4 important approaches for this audience. Particular courses may blend all these approaches, so we provide a fifth course when approaches have been combined or can't be determined from the course description. The courses are often more defined by the audience than by the contents. These courses, in any of their guises, are not likely to appear early in the century according to the dissertation by Michael George at Teacher's College Columbia U.

[7]STEM = Science, Technology, Engineering and Mathematics

Other courses in this category, and in category 1 are sometimes allowed for general education credit at many departments.

2.8 Mathematics and Culture/Mathematics and History.

Mutual influences from various historical eras, or just one. Not much in the way of skill development.

2.9 Structure of Mathematics/The Nature of Mathematics/Number Systems.

Significant ideas in mathematics are made accessible for the many. An attempt to draw lessons about the overall enterprise of mathematics by examining serious mathematics.

2.10 Mathematical Thinking.

An attempt to improve the student's skills at the precise kind of thinking characteristic of mathematics, while also aiming for insight and interpretation. This course involves some skills development, often in a traditional areas such as those found in precalculus courses.

2.11 Elementary Mathematical Modeling.

Displaying modern mathematical applications that have only elementary mathematics at their base. Usually, the mathematics is new to the student. The kind of course that was given a big boost in For *All Practical Purposes*.

2.12 Mathematics for General Education/Mathematics for the Liberal Arts

A course for a broad range of students. Any blend of the approaches in the previous four courses, or any "general education" course where the approach can not be discerned.

Cluster 7: Miscellaneous service or general education

2.13 Logic and Set Theory.

Truth tables, Venn diagrams, quantified statements.

[Note to coder: one sometimes finds course with titles like Logic, Set Theory and Probability. Such a course would be handled by our policy on combination courses, as explained in the document *Classifying Courses: Standardized Courses and Categories* .]

2.14 Mathematics For Women.

Elementary mathematics serving the needs of women in industry and at home. Arithmetic, algebra, geometry.

2.15 Mathematics for Agriculture Students

2. 16 Other.

Category 3: Mathematics Expressly for Teachers

(Worksheet Abbreviation: ForTchrs)

These are courses that are mainly present for the benefit of prospective teachers. (In other words, if there were no math students headed for teaching, the course would probably not be there.) Many standard math courses, like linear algebra or calculus, may be recommended for teachers, but are not created largely for them. They are not included in this category. You need to judge from title and contents whether a course qualifies as a "teachers" course.

Cluster 8: For elementary and middle school teachers

3.1 Mathematics for Elementary School Teachers.

Content is mathematical with little or no attention to methods of teaching.

3.2 Methods of Teaching Elementary School Mathematics.

Some emphasis on methods as well as content.

3.3 Mathematics for Middle School Teachers.

Content is mathematical with little or no attention to methods of teaching.

3.4 Methods of Teaching Middle School Mathematics.

Some emphasis on methods as well as content.

Cluster 9: For secondary school teachers

3.5 Mathematics for Secondary School or Junior College School Teachers.

Content is mathematical with little or no attention to methods of teaching.

[Note to coders: Course which make no mention of junior college teaching, and only mention secondary school teaching, are considered in this category.]

3.6 Methods of Teaching Secondary School or Junior College Mathematics .

Some emphasis on methods as well as content.

[Note to coders: Course which make no mention of junior college teaching, and only mention secondary school teaching, are considered in this category.]

Cluster 10: Miscellaneous teacher's courses

3.7 Mathematics for Teachers.

A combination of "Mathematics for Elementary School Teachers", "Mathematics for Middle School Teachers" and "Mathematics for Secondary School Teachers".

3.8 Methods of Teaching.

A combination of "Methods of Teaching Elementary School Mathematics", "Methods of Teaching Middle School Mathematics" and "Methods of Teaching Secondary School Mathematics".

3.9 Topics/Seminar in the Teaching of Mathematics

3.10 Other.

Category 4: Basic Calculus Sequences

(Worksheet Abbreviation: BasicCalc)

The term "basic calculus sequence" refers to a sequence of courses providing the key manipulations of differentiation and integration. This would normally include material up to and including multivariable calculus and perhaps line and surface integrals. The degree to which theory is included can vary, but courses which primarily provide the theoretical basis of calculus (theorems about continuity, differentiability, convergence, uniform convergence, etc.) and where manipulations and formulas are negligible are not included here. More advanced courses with names such as “Differential equations”, “Theory of Functions”, “Analysis” are not generally part of a basic calculus sequence. “Advanced Calculus” is a gray area and the course description needs to be scrutinized.

Classification is difficult in this area and use should be made of the “Flavor abbreviations” described elsewhere. There can be more than one basic calculus sequence at a single college, especially in the latter part of the 20th century. There will be a mainstream sequence for math majors and many physical science students. But there may also be one, for weaker students, which integrates precalculus material with calculus; there may be a sequence for engineers; there may be a sequence for business and social science students, etc. We provide for 7 named sequences and the ubiquitous “Other” sequence.

We use flavors to give brief clues about the nature of the individual courses in a sequence. For example “fl: ag” indicates that the course included analytic geometry.

Each sequence is also a cluster.

Cluster 11: Mainstream basic calculus sequence

These courses may be with or without analytic geometry, the status to be indicated by the flavor abbreviation “ag”. This is a sequence recommended for mathematics majors and often many science and engineering students. In cases where there is only one calculus sequence suitable for mathematics majors, that is, by default, the mainstream basic sequence. In cases where there are two sequences, one of them faster or “honors”, then the “mainstream basic sequence” is the one which is not faster and not “honors”. We use the name “Accelerated mainstream basic calculus” for a faster or “honors” sequence (see below). The mainstream basic calculus sequence always presents a good deal of the manipulative principles of differentiation, integration, series and multivariable calculus, possibly including line and surface integrals. Some theory may be presented as well, but this varies from department to department and time to time. In cases we are aware of this sequence consists of more than one term, but depending on the department, the pace of the courses, number of hours in the courses, and whether semesters or quarters are in use, the number of terms can be anywhere from 2 to 5. Courses entitled “Advanced Calculus” may be part of this sequence if they are substantially manipulative – see the catalog description and our later discussion of advanced calculus. A brief introduction to advanced topics such as differential equations or complex variables might occur in this sequence. No prior training in calculus is necessary for taking this course.

4.1 Mainstream Calculus Term 1

4.2 Mainstream Calculus Term 2

4.3 Mainstream Calculus Term 3

4.4 Mainstream Calculus Term 4

4.5 Mainstream Calculus Term 5

Cluster 12: Calculus with precalculus

For students with inadequate preparation in algebra, trigonometry, etc. This sequence is typically meant to feed students into some course in the mainstream sequence (which is why we provide only 3 courses in this sequence.) In some cases there is only a single course in this sequence.

4.6 Calculus With Precalculus Term 1

4.7 Calculus With Precalculus Term 2

4.8 Calculus With Precalculus Term 3

Cluster 13: Accelerated or honors mainstream basic calculus sequence

4.9 Accelerated/Honors Calculus Term 1

4.10 Accelerated/Honors Calculus Term 2

4.11 Accelerated/Honors Calculus Term 3

Cluster 14: Basic calculus sequence for students of science, engineering and technology.

Similar to the mainstream sequence but with more practical concerns (more applications, less theory) and possibly a sequencing of topics that harmonizes better with what students will be learning in science and engineering and technology courses. We provide up to 5 terms.

4.12 Calculus for Sci/Eng/Tech Term 1

4.13 Calculus for Sci/Eng/Tech Term 2

4.14 Calculus for Sci/Eng/Tech Term 3

4.15 Calculus for Sci/Eng/Tech Term 4

4.16 Calculus for Sci/Eng/Tech Term 5

Cluster 15: Briefer calculus sequence for students outside the sciences.

Few if any transcendental functions or multivariable calculus. Up to 3 terms. (These courses are frequently called by titles such as *Calculus for Business*, *Calculus for Life Sciences* or *Calculus for Business and Life Sciences*.)

4.17 Briefer Calculus Term 1

4.18 Briefer Calculus Term 2

4.19 Briefer Calculus Term 3

Cluster 16: Calculus with theory.

This typically assumes students have a knowledge of basic calculus. This arguably belongs in the *Analysis Following Basic Calculus* category, except that this sequence is available as the first mathematics a student takes (for unusually well-prepared students.)

4.20 Calculus With Theory Term 1

4.21 Calculus With Theory Term 2

4.22 Calculus With Theory Term 3

4.23 Calculus With Theory Term 4

4.24 Calculus With Theory Term 5

Cluster 17: Calculus for students with prior exposure to calculus.

Some colleges (e.g., MIT, Reed) have a special sequence for those who bring transfer credit in calculus or advanced placement or knowledge gained other ways. At MIT, this sequence seem to be based on the idea that the knowledge gained elsewhere might not really be up to local standards. Typically, this sequence feeds into the mainstream sequence or to whatever might follow basic calculus (e.g. differential equations.) It differs from the "With Theory" cluster in that it does not have unusual emphasis on theory.

4.25 Calculus For Those With Prior Exposure Term 1

4.26 Calculus For Those With Prior Exposure Term 2

4.27 Calculus For Those With Prior Exposure Term 3

Cluster 18: Other calculus sequence.

4.28 Other Calculus Term 1

4.29 Other Calculus Term 2

4.30 Other Calculus Term 3

4.31 Other Calculus Term 4

4.32 Other Calculus Term 5

Cluster 19: Miscellaneous calculus

4.33 Vector Analysis/Vector Calculus.

The study of vector algebra and vector fields. The differentiation and integration of vector fields. The gradient theorem, Green's theorem, Stoke's theorem, the divergence theorem. Applications to electromagnetic fields, gravitational fields and fluid flow. Tensors.

[Note to coder: Much of the material in this course made its way into the mainstream basic calculus sequence, often under the course title "Multivariable Calculus", but sometimes distributed throughout the sequence. To determine whether a course found in a catalog should be classified as *Vector Analysis/Vector Calculus* or is part of the calculus sequence, or as *Advanced Calculus* use these guidelines: if the course contains line and surface integrals (Theorems of Green and Stoke, the divergence theorem) and contains only material pertaining to vector fields (e.g., no power series, techniques of integration, ordinary differential equations) then classify it as vector analysis. If line and surface integrals are present but with other calculus material which is not elementary (e.g., complex functions), perhaps Advanced Calculus would be better. If it contains line and surface integrals but also elementary calculus material, such as power series, see if it can fit into a basic calculus sequence. Heavy emphasis on tensors might indicate that the course is best classified as *Tensor Analysis* in Category 9.]

4.34 Other Basic Calculus

Topics and applications, perhaps for special categories of students. E.g., an overview for a broad array of students, serving rather like a general education course.

Category 5: Analysis Following Basic Calculus

(Worksheet Abbreviation: Anal)

Cluster 20: Extended basic calculus

5.1 Curve Tracing.

Tracing by points, symmetry. Orders of small quantities, forms of parabolic curves near the origin or at an infinite distance. Forms of curves in the neighborhood of the origin, multiple points. Forms of branches whose tangents at the origin are the coordinate axes. Asymptotes, including curvilinear asymptotes. The analytical triangle. Singular points. Systematic tracing of curves, repeating curves. Determination of the equation of a given curve.

5.2 Infinite Series/Power Series.

An extended version of the shorter treatment often presented (circa 2009) as part of a semester of calculus. Convergence tests, power series, infinite products, operations with series. Inversion of power series. Theorems of Abel, Dini and Pringsheim. Abel's and Dirichlet's tests. Asymptotic formulas for divergent series.

Cluster 21: Advanced calculus

5.3 Advanced Calculus with No Course Description

The reason for this entry in our inventory is that Advanced Calculus has meant many things (see below), many of which are classified under other standardized courses in this inventory. Without a course description (a situation that occurs often in the early part of the century) we can't tell whether to map a given catalog entry entitled *Advanced Calculus* to our inventory entry *Real Analysis* or to *Complex Analysis* or what. In such a case we use the standardized course described here. Of course, this is little more than an expression of ignorance. If there is a textbook mentioned we should cite it (e.g. "tx: Kaplan's *Advanced Calculus*".) We also indicate the catalog title by "ti: *Advanced Calculus*".

Examples of course content we have found in courses entitled *Advanced Calculus*:

1. Lots of what today would be regarded as special topics about single variable derivatives and integrals (techniques of integration not recently taught, evolutes, involutes, osculations, types of tangency). Such a course is basically an extension of today's Calculus 1 and Calculus 2. The examples we have seen were mostly early in the century. We map this to one of the entries in the basic calculus sequence.

2. Multivariable topics, such as the implicit function theorem, line and surface integrals (first showing up around 1935). We map this to some entry in the calculus sequence (the last course of the sequence) or maybe to *Vector Analysis.*

3. Introductory real analysis, with theorems about limits, continuity, etc. The first pure theory course in analysis. We map this to *Real Analysis*.

4. Topics specially directed at engineers and physicists (special functions, Fourier series and transforms) We map this to *Engineering Mathematics/Methods Of Applied Mathematics, or Mathematical Physics*

5. Ordinary differential equations. The obvious mapping.

6. Partial differential equations. The obvious mapping.

7. Complex variables. The obvious mapping.

8. Power series. The obvious mapping.

9. Finally, there may be a hard-to-classify mix of topics chosen from the areas previously listed here. For this we have the following standardized course.

5.4 Advanced Calculus: Mixed Topics.

A mix of topics, not easily classified any of the previous ways.

Cluster 22: Differential equations and related courses

5.5 Differential Equations.

The harmonic equation (mx" = -kx) and linear ordinary differential equations of the first and second order. Existence theorems, methods of solution, algebraic and geometric. Sturm-Liouville systems, etc. special solutions. The theory of envelopes. May include linear algebra.

5.6 Dynamical Systems.

Non-linear differential equations. Iterated function systems, bifurcations, periodicity, attractors, limit cycles, chaos. Fractals.

5.7 Numerical Analysis.

Numerical solution of differential equations (such as the Runge-Kutta method.) Approximation to solutions of integral equations. Fast fourier transforms and arithmetic with arbitrary precision. Finding eigenvalues and other problems in linear algebra. Finite element analysis.

Cluster 23: The theory of functions

5.8 Real Analysis.

Possibly including some instances of Advanced Calculus.

The theory behind calculus. Differentiability, continuity, integrability. Proofs using limits. Elements of a topological viewpoint. Advanced or accelerated versions might include measure and function spaces (Hilbert and Banach spaces) and theories of integration. This course has little or none of the formulas and manipulations of basic calculus. Note that not every course with title that includes “Advanced Calculus” is a reasonable match for the course being described here. See categories 4 and 9 for other possibilities.

5.9 Complex Analysis.

Possibly including some instances of Advanced Calculus.

Complex numbers, Cauchy's theorem and complex differentiation and integration. Analytic functions, analytic continuation, the Riemann mapping theorem, conformal mapping, etc. Advanced versions might include: meromorphic functions, harmonic and subharmonic functions. Theorems of: Rouche, Hurwitz, Runge, Weierstrass, Hadamard, Mittag-Leffler, etc.

5.10 Real and Complex Analysis.

Basic ideas of real analysis and basic ideas of complex analysis.

[Note to classifiers: in the early 20th century, textbooks (and probably courses) such as Frank Morley and James Harkness' "A Treatise on the Theory of Functions" combined real and complex analysis, but with the real variable material being brief and only in support of the more ambitious complex variable material. Such a course may be more appropriately classified as "Complex Variables". But it may not be possible to tell from a catalog description if the real variable material is really slight enough to justify the classification "Complex Variables". Hence this combined standardized course is made available.]

Cluster 24: Advanced analysis

5.11 Measure and Integration.

Measure spaces, Lebesgue measure and the Lebesgue integral. Product measures, Lp spaces, integral representations of linear functionals. Probability spaces.

5.12 Introduction to Functional Analysis/Linear Operators.

Hilbert, normed and Banach spaces, linear operators, dual spaces.

Representation theorems. Theorems of Riesz-Fischer, Hahn-Banach.

5.13 Calculus of Variations.

The calculus of variations is concerned with finding optimal solutions (shapes, functions, etc.) where optimality is measured by minimizing a functional (usually an integral involving the unknown functions) possibly with constraints. This course is an introduction to the classic ideas and techniques of the calculus of variations, such as the associated Euler-Lagrange equation, the Beltrami identity, and Dirichhlet's Principle . There may be applications such as: Fermat' Principle, isoperimetric problems, the Hamilton-Jacobi differential equation, eigenvalue-eigenfunction problems for the vibrating string.

5.14 Integral Equations.

Equations of Volterra and Fredholm. The Hilbert-Schmidt theorem. The Wiener-Hopf method. Singular integral equations of Cauchy type. Applications to solid mechanics, quantum mechanics, acoustics.

5.15 Harmonic Analysis and Wavelets. Fourier series on the circle, Fourier transforms on the line and in space. The Discrete Wavelet Transform, the Fast Wavelet Transform and filter-bank representation of wavelets. Applications to such areas as fingerprint representation and algorithmic recognition.

Cluster 25: Miscellaneous analysis

5.16 Topics/Seminar in Analysis.

5.17 Other.

Category 6: Higher and Abstract Algebra, Linear Algebra and Number Theory

(Worksheet Abbreviation: Alg+NumTh)

Cluster 26: Concrete studies in algebra

6.1 Quaternions.

Hamilton products and the algebra of quaternions. Conjugation, the norm, and division. Quaternions and the geometry of three-space. Connection to mechanics.

6. 2 Higher Algebra/Theory of Equations.

Binomial and multinomial theorems, permutations and combinations, infinite series, continued fractions. Descartes' Rule. Discriminant of an equation, polynomials, roots, approximation methods. Linear systems of equations.

6.3 Determinants.

Effect of elementary row and column operations. Methods of calculating a determinant. Application to solving linear systems of equation. Connection to linear transformations. Special determinants such as circulants.

6. 4 Matrix Theory.

Computational methods with matrices. Diagonalization. Linear equations (perhaps an introduction to linear programming, but an emphasis on the practical applications of matrix theory.) Linear transformations may be studied (and perhaps invariants of particular types as well) but concretely, as given by linear equations in *n* variables. Little or nothing about vector spaces or the abstract view of linear transformations.

6.5 Boolean Algebra.

Algebra of sets, propositional calculus, the algebraic and axiomatic viewpoint. Applications to switching circuits.

Cluster 27: Linear algebra

6.6 Linear Algebra.

Vector spaces, linear transformation. Linear independence and bases, matrix representations. Equivalence and similarity. Sets of linear transformations. Modules and other generalizations.

6.7 Quantics.

Quantics are homogeneous polynomials in any number of variables. The terminology dates from the 19th century – probably Cayley or Sylvester. Invariants of quantics is likely to be a main topic in the course.

Cluster 28: Abstract structures

6.8 Abstract/Modern Algebra without Linear Algebra.

Groups, rings, fields, vector spaces. Definitions and fundamental theorems. Homomorphisms and isomorphisms. Polynomials and field extensions.

6.9 Abstract/Modern Algebra with Linear Algebra.

Combination of Linear Algebra and Abstract/Modern Algebra with Linear Algebra.

6.10 Group Theory

Groups and subgroups. Special groups such as cyclic and permutation groups, symmetry groups, free groups. Normal subgroups, cosets, homomorhisms, Lagrange's theorem. Representations by matrices or by generators and relations. Cayley graphs.

6.11 Group Representations

Representing the elements of a group by invertible matrices under matrix multiplication. Irreducible representations. Modular representations. Applications to physics, chemistry.

6.12 Galois Theory.

The relation between roots and coefficients of a polynomial: elementary symmetric functions; complex roots of unity; and solutions by radicals of cubic and quartic equations. The characteristic of a field and the prime subfield. Factorisation and ideal theory in polynomial rings. The structure of a primitive field extension. Field extensions and characterisation of finite normal extensions as splitting fields. The structure and construction of finite fields. Counting field homomorphisms; the Galois group and the Galois correspondence. Radical field extensions. Soluble groups and solubility by radicals of equations.

6.13 Finite Fields/Coding Theory

Structure of finite fields and applictions to coding theory and number theory. Equations over finite fields, including Gauss and Jacobi sums, reciprocity theorems and special cases of the zeta function. Cyclotomy with applications to difference sets. Finite Fourier analysis.

Cluster 29: Number theory

6.14 Number Theory.

Definition and elementary properties of integers. Induction, factorization, congruences, residues, primitive roots, indices, etc.

6.15 Algebraic Number Theory

Algebraic number fields. Factorization, ideals, field extensions. Class numbers, Dirichlet's theorem, quadratic and cyclotomic fields.

6.16 Analytic Number Theory.

Dirichlet L-series, the totient function, the use of zeta functions and L-functions to prove distribution results concerning prime numbers (e.g., the prime number theorem in arithmetic progressions). Additive number theory including Goldbach's conjecture and Waring's problem.

Cluster 30: Miscellaneous algebra

6.17 Topics/Seminar in Algebra

6.18 Other.

Category 7: Advanced[8] Geometry and Topology

(Worksheet Abbreviation: AdvGeo+Top)

Cluster 31: Advanced euclidean geometry

7.1 Advanced Synthetic Euclidean Geometry/College Geometry/Ruler and Compass Constructions/.

Theorems of Ceva, Menelaus. The nine-point circle, the Simpson Line, Napolean's theorem. Special points in a triangle. Ruler and compass constructions.

7.2 Conics/Advanced Analytic Geometry/Modern Analytic Geometry.

What distinguishes this course from "Analytic Geometry/Graphic Algebra" in category 1 is one or more of the following: the phrase "modern methods", extensive treatment of conics, use of homogeneous coordinates or other kinds of alternative coordinate systems (Plücker, Grassmann), points and lines at infinity (the projective point of view), Plücker equations, significant attention to transformations and their invariants. If there is extensive treatment of 3d then the course might best be classed as "Solid Analytic Geometry".

[Note to coder: The article cited below includes: "In many American universities the courses in Modern Geometry have been during the past two decades courses in advanced analytic geometry. The text followed was either Salmon's conic sections, Smith's conic sections or some other text emphasizing the special properties of conic sections with some attention to homogeneous coordinates, abridged notation, etc., or else it was a text such as Miss Scott on *Modern Analytic Geometry*."]

7.3 Solid Analytic Geometry.

Lines and planes in space. Tangent planes. Quadric surfaces. Classification and invariants of quadrics. Matrix methods may be used.

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[8]A geometry course is advanced if it is not one of: Plane Geometry (as in high school), Plane Analytic Geometry, Solid Geometry, Trigonometry, Spherical Geometry, Spherical Trigonometry, Descriptive Geometry. Solid Analytic Geometry is advanced. Often "advanced" coincides with "upper division" but not always. At Berkeley in 1925 Projective Geometry was lower division. Solid Analytic Geometry was a freshman course at City College of New York in 1906.

Cluster 32: Projective and non-Euclidean geometry

7.4 Projective Geometry.

Theorems of Pappus, Desargues. Projections, collineations, projective transformations. Projective equivalence of conics. Pascal's theorem on conics. Cross ratio. This could be synthetic or coordinate based. If the latter, homogeneous coordinates will be included.

7.5 Non-Euclidean Geometry/Theories of Geometry

Systems of geometry that deny Euclid's parallel postulate: hyperbolic, spherical and elliptic geometries. Questions of consistency. The Klein or Poincare models. The course may include comparisons among geometries. Projective geometry may be used as an aid in a unified and comparative point of view.

7.6 Geometry and Group Theory.

Transformations of various kinds in various geometries (Euclidean, non-Euclidean, projective) and groups of invariants. The Erlangen Program.

Cluster 33: Geometry with other mathematical machinery

7.7 Point Set Topology.

Sets, cardinal numbers, functions, limits, continuity. Elementary point set topology. Metric spaces. Open and closed sets.

7.8 Algebraic Topology/Combinatorial Topology.

Simplexes, complexes, Betti numbers, homotopy groups, homology groups. Coefficient theorems. Applications to geometry and analysis.

7.9 Algebraic Geometry/Algebraic Functions.

Algebraic varieties over various fields. Simple and singular points of plane curves. The resultant. Bezout's theorem. Abelian varieties, Abelian functions.

7.10 Differential Geometry.

Calculus methods applied to curves and surfaces. Tangent vectors and tangent planes. Various concepts of curvature, torsion.

Cluster 34: Miscellaneous geometry

7.11 Convex Sets.

Intersections of convex sets. Theorems of Helly, Radon, Caratheodory. Support hyperplanes. Convex polyhedra. Curves of constant breadth. Convex functions and relation to inequalities.

7.12 Modern Geometry With No Course Description.

Early in the 20th century, titles often appeared with no course description. In many cases, the title is fairly descriptive. But "Modern Geometry" is not such an easy-to-understand case. From the present vantage we can imagine many interpretations for "modern". Fortunately a bit of surfing turned up this Monthly article: A Course in Geometry for College Juniors and Seniors, by J. N. Van Der Vries *The American Mathematical Monthly*, Vol. 24, No. 1 (Jan., 1917), pp. 21-23 1917. Therein we find:

"The term Modern Geometry seems to have grown up in our mathematical nomenclature for the purpose of distinguishing a college course in geometry under this name from the more elementary course in the secondary school, this latter being the elementary geometry of the Greeks, practically unchanged."

[The author goes on to say there is a bit of a trend to making Modern Geometry mean synthetic projective geometry. This illustrates his earlier remark that there is little consensus on what Modern Geometry means. He also claims that Modern Analytic Geometry and Modern Synthetic Geometry have not much consensus either.]

If we see course with the title Modern Geometry, but where there is a course description, we should classify it as one of the other courses in this category.

7.13 Higher Geometry.

This vague term may be encountered as a course title early in the century. If there is a course description, see if the course can be classified as one of the other courses in this category which has a more informative title. Otherwise, for example if the course is a catchall with topics such as contact transformations, inversion, a bit of projective geometry, use this title.

7.14 Survey Of Geometry/Modern Geometry.

A variety of topics showing the breadth of geometric ideas. Topics might include finite geometries, different axiom systems, tilings, symmetry, transformation geometry.

7.15 Topics/Seminar in Geometry

7.16 Other.

Category 8: Foundations

(Worksheet Abbreviation: Found)

Cluster 35: Logic and set theory

8.1 Mathematical Logic/Symbolic Logic

Propositional Calculus (Truth tables.) The first order predicate calculus. Perhaps some advanced topics such as recursive functions, decidability (Gödel's Theorem), etc. Applications of logic to mathematics or switching circuits.

[This course is aimed at math majors and needs to be distinguished from Boolean Algebra courses (see the Elementary Service+ General Education category and the Algebra+Number Theory category) aimed at electrical engineers (and convey practical skills in analyzing or simplifying "switching circuits" or digital circuits) or at abstract algebra issues in which one loses sight of the fact that our symbols stand for statements, that quantification may occur, etc. Tipoffs may include: Lack of high end math, lots of mention of circuit issues (e.g., minimizing Boolean expressions, Karnaugh maps), less than 3 semester hours, title, course number (Boolean Algebra for engineers was often a lower division course).]

8.2 Set Theory .

Operations on sets. Higher cardinal numbers, ordinal numbers.

8.3 Mathematical Logic and Set Theory.

Propositional Calculus (Truth tables. The first order predicate calculus. Applications of logic to mathematics. Decidability. Operations on sets. Higher cardinal numbers, ordinal numbers.

Cluster 36: Miscellaneous foundations

8.4 Fundamentals of Mathematics/Foundations of Arithmetic.

An introduction to the foundations of mathematics. Logic, sets, functions, equivalence and order relations, various axiomatic systems. Algebraic systems. Peano postulates for the natural numbers, construction of various number systems, including the real numbers.

8.5 Introduction to Proofs/Transition to Higher Mathematics.

Proof techniques: induction, direct and indirect proofs. Emphasis on the clarity, precision and correctness in expressing mathematical ideas.

8.6 Topics/Seminar in Foundations

8.7 Other.

Category 9: Advanced Applied Courses

(Worksheet Abbreviation: AdvAp)[9]

By "applied courses" we usually mean those whose *titles* announce that modeling, applicability, or an applied point of view, or certain particular applications are central to the design of the course. Advanced means that these are typically taken by juniors or seniors who have been through a good deal of a calculus sequence. In particular they are not service courses.

Finite mathematics, which typically contains applications, is not in this category because it is a service course, and not advanced. Calculus is not advanced. "Applied Linear Algebra" is in the this category. Subjective distinctions obviously.

[9]Arguably, much or all of *Category 11: Advanced Probability and Statistics With Mathematics Designations* could be included in the present category, but it seemed an undeserved denigration for probability and statistics not to appear at the category level, or to appear in hollowed out form. However, any study of applications in the curriculum should take category 11 into account. Similar remarks apply to category 12 (*Computer Science*).

Cluster 37: Mathematical tools used mainly in physical science/engineering

9.1 Engineering Mathematics/Methods Of Applied Mathematics.

Possibly including some instances of Advanced Calculus.

A selection of many topics, each covered lightly ("how-to" emphasized more than proofs.) Vector calculus, linear algebra, complex variable, numerical methods, optimization involving graphs (networks), differential equations. Applications of analysis and differential equations to problems of physics and chemistry. The Laplace and Fourier transforms, Fourier series and expansions.

[Note to coders: In rare cases this might be called "Operational Mathematics" after the title of a well-known book by Churchill.]

9.2 Mathematical Physics.

Possibly including some instances of Advanced Calculus.

Similar to Engineering Mathematics, but more sophistication in topics and approach. Complex variables, differential and integral equations, boundary value problems, transforms, Sturm-Liouville theory, calculus of variations. Directed at Math or Physics majors more than engineers.

9.3 Tensor Analysis/Vector and Tensor Analysis

Index notation and the summation convention. Contravariant and covariant vectors. Symmetry and Skew-symmetry. Multilinear algebra. Cartesian and General tensors. Line elements. Geodesics, curvature tensors. Differential Tensor Calculus. Riemannian geometry. Applications may include: rheology, relativity, continuum mechanics, elasticity.

9.4 Partial Differential Equations /Boundary Value Problems.

Possibly including some instances of Advanced Calculus

The method of characteristics. Existence theorems and methods of solution. Fourier series and transforms. The Cauchy-Kovalevsky Theorem. The Dirichlet Problem and Laplace's equation, Bessel functions, orthogonal polynomials. Sturm-Liouville problems. Special equations such as the Hamilton-Jacobi equation. Eigenfunctions and classification of PDE's.

[Note to classifiers: the flavor abbreviation "Ap" should be used if there seems to be significant mention of applications such as heat transmission, waves, vibrating membranes.]

9.5 Special Functions/Elliptic Functions/Abelian Functions.

Elliptic functions, Bessel functions, orthogonal functions, Hermite-Rodriguez functions , Legendre polynomials, etc.

[Notes to coder:

1. any course named for a particular family of functions should be considered an example of this standardized course.]

2. Note the similarity of the topic list to topics found in other courses mentioned here. The coder should be guided by the title even more than usually.]

9.6 Laplace Transforms / Fourier Series/Theory of Transforms.

Examples of partial differential equations describing physical systems, Fourier series, basic separation of variables, Sturm Liouville Theory, separation of variables with more complicated boundary conditions or sources, Fourier transforms, similarity methods, power series solutions of ordinary differential equations, separation of variables in spherical coordinates, Legendre polynomials and Fourier-Legendre expansions, regular singular points and the method of Frobenius, separation of variables in cylindrical coordinates, Bessel functions and Fourier-Bessel expansions. Linear systems of differential equations, convolution, elementary development of the delta function, and the use of transforms to solve systems.

[Note to coder: these course can be theoretical or with emphasis on applications. Use flavors if you can detect a significant emphasis.]

9.7 Generalized Functions (Distributions).

Test functions, functionals, continuity, distribution derivatives, Fourier Transforms, convolution, Green's function, application to ordinary and partial differential equations.

9.8 Control Theory

Controllability, observability, dynamic programming, maximum principle, optimal control, Lyapunov stability.

Cluster 38: Modeling branches of physical science/engineering

9.9 Mechanics/Analytical Mechanics/Rational Mechanics/Analytical Statics. A course in classical mechanics from the mathematical point of view. How forces and torques acting on bodies or systems of bodies create velocities and accelerations or leave the bodies(s) in equilibrium (Newton's laws.) Basic kinematics. Harmonic motion. Work, energy, momentum. Conservation laws. Reference frames. Lagrangian mechanics. Elasticity. Fluid Mechanics.

Rational mechanics describes an especially rigorous point of view for the same material in which physically obvious assertions are not allowed in arguments unless they have been specified in advance as axioms or proved as theorems.

Statics is the half of mechanics dealing with objects in equilibrium.

9.10 Celestial Mechanics.

The forces and resulting motions involving the heavenly bodies.

9.11 Signal Processing

Fourier series, sampling and aliasing, time and frequency analysis, filter design, z-transform, spectrum analysis, Discrete and Fast Fourier Transform, analog/digital conversion, wavelets, multirate signal processing.

9.12 Potential Theory

Properties of functions that satisfy Laplace's equation. Newtonian and vector potential, differential operators, problems related to Maxwell's equation, harmonic functions, Green functions, subharmonic functions, kernels.

9.13 Elasticity

Static and dynamic problems including linear elastic waves, Hooke's law, beam theory analysis of stress and strain, the constitutive equations, biharmonic equation, two dimensional problems, problems of prismatic bars, variational methods and energy principles, Beltrami-Michell equation.

9.14 Thermodynamics

First and second laws of thermodynamics; thermodynamic properties of gases, vapors, and gas-vapor mixtures; energy-systems analysis including power cycles, refrigeration cycles and air-conditioning processes. Introduction to thermodynamics of reacting mixtures. The Gibbs equation.

9.15 Hydrodynamics/Fluid Mechanics/Fluid Dynamics.

The motions resulting from forces acting on air or liquids. The Navier-Stokes equations. Turbulence, laminar flow.

[Note to coder: in the 19th century hydrodynamics was synonymous with fluid dynamics. With the development of meteorology and of aircraft it became useful to use hydrodynamics for the case where the fluid was water and fluid dynamics or when the "fluid" was air.]

9.16 Exterior Ballistics

The path of projectiles such as bullets. The back curve, the ballistic coefficient, the bore centerline, the critical zone.

Cluster 39: Mathematical tools often applicable outside physical science/engineering

9.17 Applied Linear Algebra. . Similar to standard linear algebra but applications such as to Leontieff input-output models, linear programming, differential equations, computer graphics, geometric transformations, population modeling, electrical circuits., etc.

9.18 Applied Abstract Algebra/Algebraic Coding Theory. The applications would typically involve codes for error correction such as Hamming codes, or data compression methods such as Huffman codes, although other applications might appear. Some of courses in this category may have no algebra prerequisite and take on the task of providing basic instruction in an area of algebra, e.g. basic algebraic structures such as groups, rings and fields (especially finite fields), or vector spaces, and then add applications as time permits. Alternatively, the course might require at least one prerequisite in either abstract algebra, linear algebra or number theory and then have more intense work on the applications.

[Note to coder: We consider these two forms of the course (with or without algebra prerequisites), to be different instances of the same course, distinguished in our worksheet by the algebra or number theory prerequisite or lack of it.]

Cluster 40: Modeling areas outside physical science/engineering, operations research, actuarial science

9.19 Mathematical Economics.

Monopoly, oligopoly, competition, taxation, utility, economic dynamics, general equilibrium, stability of equilibrium prices, welfare economics, growth and discounting, game theory, statistics, and econometrics (statistical methods in economics), Leontieff’s input-output analysis.

9.20 Mathematical Biology.

Many possibilities for topics: genetics, molecular biology (DNA, RNA), epidemiology, ecology, etc. Mathematical methods could include ordinary and partial differential equations, difference equations, probability, combinatorics, etc.

9.21 Bioinformatics

Biological database queries (BLAST); sequence alignment; edit distance; gene finding; hidden Markov chains; phylogenetics; protein structure prediction.

[Note to coder: if the course concentrates on a single topic or a single mathematical method, add a flavor.]

9.22 Number Theory and Cryptology.

Cryptography (making codes), cryptanalysis (breaking codes). Block ciphers, modes of operation, hash functions, digital signatures. Advanced Encryption Standard, and elliptic curve cryptography. Symmetric (also known as private key) and asymmetric (also known as public key) encryption, RSA, the discrete logarithm problem, public-key infrastructure, key distribution, and various applications.

9.23 Cryptology.

Similar to *Number Theory and Cryptology* except that cryptology in all of its aspects (not just number theory) is under discussion. Thus combinatorics could arise, non-mathematical topics such as one-time pads would be discussed, computational issues (including quantum computing perhaps.) But note, it has to be a course with MTH designation.

Cluster 41: Actuarial science

Actuarial exams have been given for about 100 years and have changed their nature over time. At the outset, the first one concerned English grammar. The latest era starts Jan 1, 2000. Most of the courses we list below are largely devoted to the individual actuarial exams either in the era starting in 2000 or the era just before. But note that we maintain a distinction between a course presenting new material and a course devoted to drill and preparation for an exam.

From surfing three actuarial programs:

Purdue – http://www.math.purdue.edu/academic/actuary,

Stony Brook - http://www.ams.sunysb.edu/undergraduate/actuarialtraining.shtml,

- and U. Texas at Austin – http://www.ma.utexas.edu/dev/actuarial/)

and the Society of Actuaries website (**http://www.soa.org/education/exam-req/edu-asa-req.aspx**) it seems reasonable to assume that:

1. Courses in actuarial science parallel the syllabi for the exams fairly strongly.

2. In some cases, more than one course may be given over to the topics we package into one course. We can handle this my making multiple entries in the cell for the one course we created. We call this multiple "instances" of a course. (Two instances of a course might be alternatives – one could take one or the other – or members of a sequence. The sequence form of multiple instances is most likely here.)

3. Some of the courses we describe below might be in a statistics department or a business school. Those seeking a full understanding of actuarial science need to remember that what we present here is the mathematics department's role in actuarial science.

4. In at least one department we found a "gentle introduction" to actuarial science that was not sufficient preparation for any exam, and only 2 credits. This would be an example of our "Financial and Actuarial Mathematics."

Courses likely to be found in both the pre-2000 and post-2000 era.

9.24 Drill and Preparation for an Actuarial Exam.

Such exams might be devoted to: Calculus; Calculus and Linear Algebra; Probability; Statistics and Finite Differences (all in the pre-2000 era), Theory of Interest (both eras), Probability and Statistics (post-2000 era.) The coder should enter the name or code for the exam at the end of the cell entry.

9.25 Elementary Financial and Actuarial Mathematics.

Basics of the theory of interest. Issues concerning mortality: Annuities, life tables, expectation of life. Financial aspects of insurance and pensions. Introduction to statistical methods in finance. This course combines features of "Financial Mathematics" and "Actuarial Models For Life Contingencies" and is an introductory course. But the level of mathematics is higher and might include calculus.

[Note to coders: This is a more advanced treatment of financial mathematics than in "Business Mathematics/Math of Finance" in the "Elementary Service Plus General Education" category , in part because it includes some actuarial matters (e.g., mortality issues), and in part due to the mathematical level. It might have a calculus prerequisite.

9.26 Finite Differences, Interpolation and Numerical Analysis for Actuaries

Ordinary differences and related operators, dividend differences; polynomial interpolation, numerical differentiation, osculatory interpolation, , approximate int4gration; difference equations. Applications to actuarial issues.

9.27. Theory Of Interest

Simple and compound interest and annuities, bonds and loans, portfolios and immunization. How those fundamental concepts are applied in calculating present and accumulated values for various streams of cash flows as a basis for future use in: reserving, valuation, pricing, asset/liability management, investment income, capital budgeting, and valuing contingent cash flows. Assumes basic knowledge of calculus and probability.

(As in pre-2000 actuarial exam #140. But covers only a portion of the post-2000 Exam FM.)

9.28 Actuarial Modeling.

This is a large subject, to which many catalog courses may be mapped. Course titles might include: *Credibility Theory and Loss Distributions*, *Single and Multiple Event Losses*, *Life Contingencies and Contingent Payments*. Topics might include: Markov chain models, present-value-of-benefit random variables and their expectations, variances. Poisson processes, estimation of parameters for a model. The effects of deductibles, limits, coinsurance; calculation of loss elimination ratios; evaluation of the effects of inflation on losses. Risk measures. Failure time and loss distributions (Kaplan-Meier estimator, Nelson-Åalen estimator, Kernel density estimators, the Kolmogorov-Smirnov test, the Anderson-Darling test, Chi-square goodness-of-fit test, the likelihood ratio test, the Schwarz-Bayesian criterion.) Construction and selection of parametric models. Simulation including the bootstrap and inversion methods.

The life contingencies materials is aimed at portion MLC of post-2000-era Exam M. Other material aimed at Post-2000 era Society of Actuaries Exam C (Casualty Actuary Society Exam #4). In the pre-2000 era exams targeted would be: Casualty Actuary Exam 4B, and Society of Actuaries Exam 150.

A thorough knowledge of calculus, probability, and mathematical statistics is assumed.

9.29 Other Actuarial.

The likely possibilities here are: reading courses (conference courses), internships, seminars.

Courses likely to be found mostly in the pre-2000 era.

9.30 Statistical Methods for Actuaries.

Regression, analysis of variance, time series analysis. Aimed at Society of Actuaries Exam 120.

9.31 Operations Research for Actuaries.

Linear programming, project scheduling, dynamic programming, queueing theory, decision theory, and simulation. Aimed at Society of Actuaries Exam 130.

Courses likely to be found mostly in the post-2000 era.

9.32 Financial Modeling.

An elementary course in this subject might combine the topics in "Theory of Interest" with financial economics including: derivatives, options, hedging and arbitrage, forwards, futures, swaps. This would be tailored to post-2000 Exam FM of the Society of Actuaries (also Casualty Actuary Society Exam 2) in Financial Mathematics. Assumes a basic knowledge of calculus and an introductory knowledge of probability.

A more advanced course might cover the Vasicek and Cox-Ingersoll-Ross bond price models the Black-Derman-Toy binomial model, the valuation of derivative securities (Black-Scholes equation, diffusion processes, Ito's lemma), simulation of security prices (e.g., Monte-Carlo techniques), risk-management techniques. A thorough knowledge of calculus, probability, and interest theory is assumed. Keyed to post-2000 Exam M, segment MFE (Models of Financial Economics) of the Society of Actuaries (also Exam 3F of the Casualty Actuary Society.)

Cluster 42: Operations research

9.33 Operations Research/Management Science/Industrial Engineering.

Optimizing activities in organizations of all types. This course will probably include linear programming but it has a broader selection of topics which might include: decision theory, inventory analysis, network flows, queues, game theory, scheduling. The course might even be restricted to one of the aforementioned. Models can be deterministic or stochastic.

[Note to coder: The last two versions of the course title are the titles usually used for this kind of material in business schools or engineering schools respectively. These titles will probably not be found in a mathematics department, but who knows?]

9.34 Linear Programming/Mathematical Programming/Optimization.

Optimization over feasible regions. Linear and (perhaps) non-linear boundaries, linear and (perhaps) non-linear objective functions. The simplex method. Integer programming. Dynamic programming. The connection of game theory to linear programming. However if it appears that Game Theory is the primary focus of the course, then we are dealing with the Game Theory course.

9.35 Game Theory.

Zero-sum games. Mixed strategies. Non-zero sum games such as Prisoner's dilemma. Equilibrium solutions. N-person games. Nash equilibrium. Shapley value. The connection to linear programming may be included. The distinction between this and the previous course is that in the previous course, variants of linear programming are featured and Game Theory is not a primary interest.

9.36 Dynamic Programming

Bellman equation; dynamic optimization; shortest paths; network flows; knapsack problems; sequence alignment.

9.37 Optimization/Convex Programming/Non-linear Programming

Non-linear optimization; constrained and unconstrained optimization; Lagrange multipliers, Kuhn-Tucker conditions; Hooke-Jeeves method; conjugate direction method (Powell's method); steepest descent methods.

9.38 Network Flows

Networks; flows; cuts; flow augmenting paths; max flow-min cut theorem; Dinic's algorithm; Hitchcock problem; minimum cost flows; shortest paths;

9.39 Discrete Optimization/Combinatorial Optimization

Greedy algorithms; shortest paths in directed and undirected graphs; Dikjstra's algorithm; Bellman's algorithm; breadth and depth first search; tree algorithms; minimum cost spanning trees; Kruskal's and Prim's algorithms; TSP (traveling salesman problem); network flows; heuristics; integer programming and linear programming.

9.40 Data Mining

Measurement and data; scoring functions; modeling for classification; pattern recognition; database choices; finding rules for patterns; ranking algorithms, decision tree and Bayesian learning.

9.41 Monte Carlo Methods

Simulation methods; Metropolis algorithm; Ising model; Markov chains; Gibbs sampling.

9.42 Decision Theory.

Decision trees, utilities, loss functions, risk functions, admissible decision rules, a priori distributions, Bayes decision rules, and minimax decision rules. Hypothesis testing. Game theory from t he decision-theoretic point of view. The theories of Ramsey and Savage, Bayesian inference.

Cluster 43: Miscellaneous applications

9.43 Mathematical Modeling.

Building and testing models in successive stages. Consideration of the fit between a model and what is being modeled. The areas of application may be diverse.

9.44 Adjustment of Observations /Least Squares.

9.45 Topics/Seminar in Applied Mathematics

9.46 Other.

Category 10: Discrete Mathematics

(Worksheet Abbreviation: Disc)

Cluster 44: Discrete mathematics

10.1 Finite Differences/Difference Equations/Interpolation.

Difference operators. Recurrence equations of various types (linear, non-linear, homogeneous, first order, second order, etc.)

10.2 Combinatorics.

Enumeration. Systems of distinct representatives. Matroids. Stirling numbers, binomial coefficients, Bernouili numbers. Generating functions. Polynomials related to graphs.

10.3 Graph Theory.

Connectivity, trees, traversibility, coloring. Valence sequences, planarity and the genus of a graph. Digraphs.

10.4 Combinatorics and Graph Theory.

Topics from the previous two courses.

10.5 Graph Algorithms

Design of efficient algorithms for : shortest path problems, spanning tree problems, search, graph decomposition, network flow, planarity testing, etc.

10.6 Discrete Mathematics/Discrete Mathematical Structures.

Number systems and modular arithmetic, logic (propositional calculus and predicate calculus), sets and relations (equivalence relations, total and partial order relations), induction and recursion (difference equations), proof techniques (parity, mathematical induction, etc.), functions, counting (permutations, combinations, binomial coefficients), graphs with an emphasis on trees (depth- and breadth-first search), algorithms.

Advanced counting (putting distinguishable and indistinguishable balls into distinguishable and indistinguishable boxes, Burnside's lemma, Polya's Theorem), generating functions, Stirling and Catalan numbers, automata, formal languages, Boolean algebra, Boolean functions, and logic circuits, graph theory (various topics).

10.7 Topics (or Seminar) in Discrete Mathematics/Combinatorics/Graph Theory

10.8 Other.

Category 11: Advanced Probability and Statistics With Mathematics Designations[10]

(Worksheet Abbreviation: AdvProbStat)

Clustering is tricky in statistics because many courses can be taught either at a theoretical - which is to say mathematical - level, normally requiring calculus and often linear algebra, or they can be taught at an applied level where computers implement the formulas and algorithms and the emphasis is on understanding assumptions and interpreting results. As computers became more powerful and available in the second half of the 20th century, many undergraduate courses migrated from the theory cluster to the applied cluster without changing their names. Sometimes the prerequisites of the course are the best indication of which cluster it really belongs in. Our clustering is probably most appropriate for the era up to about 1975.

[10]Thus a course in a department of "Mathematics" or "Mathematical Science" or "Mathematics and Statistics", etc., with an "M" or "MTH" designation, as in "MTH241 Regression Analysis" is counted, whereas if, in the same department, it is "STAT241 Regression Analysis", we ignore it. If the institution does not use alphabetical prefixes or any other form of designation as to subject (using merely numbers), we count all courses listed in the department. We acknowledge that the very same course can appear with opposite designations in different times and places. Our decision to reject courses with statistics designations, no matter how mathematical their content may be, is a rough-and-ready one largely adopted to make our project manageable. However, the data we provide in this way does give a clue, albeit a highly limited one, to the relationship between mathematics and statistics, and to the views and practices of some mathematics departments in the era in question.

Cluster 45: Applied Statistics

11.1 Design of Experiments

Fundamentals of collecting data, including components of experiments, randomization and blocking, randomized design and ANOVA, multiple comparisons, power and sample size, and balanced incomplete and other block designs.

11.2 Sampling Theory

Sampling from finite populations; sources of sampling and estimation bias; methods of generating efficient and precise estimates of population characteristics; acceptance sampling; random and other types of sampling.

11.3 Statistical Quality Control

Fundamental concepts of quality, dimensions of quality, quality metrics, total quality management, quality improvement tools, life testing and reliability, six sigma concepts, statistical analysis of process capability, process design and improvement. concepts of process capability, modeling process capability, probability distributions (hypergeometric, binomial, Poisson, normal, Weibull), estimation of process parameters, tests of hypotheses, Pareto charts, process flow chart, cause and effect diagram (Fishbone), Taguchi methods, statistical process control (SPC), control charts, acceptance sampling, advantages and disadvantages of sampling.

11.4 Data Analysis/Descriptive Statistics

Methods for interpreting and understanding data; stem and leaf plots, box plots, the use of information derived from random sampling, and techniques of summarizing applications; computer intensive methods, work with actual data sets.

Cluster 46: Mathematical probabilitiy and statistics

11.5 Theory of Probability .

Sample spaces, mean, variance, conditional probabilities. Probability densities, distributions, marginal distributions. Moment generating functions, normal curves and the central limit theorem. A calculus-based course.

11.6 Theory of Statistics.

Hypothesis tests, confidence intervals. Regression and analysis of variance. A calculus-based course.

11.7 Probability and Statistics.

Combines much of the elementary material in “Theory of Probability” with that in “Theory of Statistics”.

11.8 Multivariate Statistics.

Using matrices and multivariable calculus, especially in connection with the multivariate normal distribution. Discriminant analysis, principal components, factor analysis, canonical correlation, multidimensional scaling.

11.9 Linear Statistical Models

The general linear model in matrix terms. Multiple, polynomial and stepwise regression, multicollinearity, reparametrization, normal correlation models and analysis; basic and multi-factor analysis of variance, fixed and random effects.

11.10 Stochastic Processes

Martingales in discrete time, stopping times, Markov chains in discrete time, continuous time stochastic processes. Diffusion. The Poisson process. Brownian motion. Stochastic integral and stochastic differential equations, their application in option-pricing.

11.11 Queueing Theory.

The modeling and analysis of queueing systems, with applications in communications, manufacturing, computer operating systems, call centers, service industries and transportation. Topics include birth-death processes and simple Markovian queues, networks of queues and product form networks, single and multi-server queues, multi-class queueing networks, fluid models, adversarial queueing networks, heavy-traffic theory and diffusion approximations.

11.12 Bayesian Statistics

Bayes theorem, subjective models for probability, Stein paradox.

11.13 Nonparametric Statistics

Goodness of fit tests (chi-squared and Kolmogorov-Smirnov tests), order and rank statistics; tests based on runs, signs, ranks, and order statistics; the two-sample; confidence and tolerance intervals, nonparametric curve estimation, Wilcoxon signed-rank tests, Mann-Whitney and Friedman tests.

11.14 Regression Analysis/Analysis of Variance

Linear models for extrapolation of data, multiple regression, logistic regression, correlation and causation. Single and multifactor models analysis, analysis of factor effects, implementation of models, analysis of variance and of covariance.

11.15 Time Series

Forecasting; time series regression; decomposition methods; smoothing and running averages; Box-Jenkins ideas; applications to economic data and other data. May be directed to survival-model estimation if it is intended to prepare students for post-2000 actuarial exam #4. (About 30% of that exam is in time series and survival-model issues.)

11.16 Sequential Analysis

Theory of statistics when the sample size is random. Curtailed binomial sampling; Wald's sequential probability ratio test; operating characteristics, sample size and optimal properties; sequential estimation of regression function; Stein's double sampling plan; bounded length confidence intervals, selection procedures; sequential design of experiments.

Cluster 47: Miscellaneous probability and statistics

11.17 Topics/Seminar in Probability and Statistics.

11.18 Other.

Category 12: Computer Science Courses with Mathematics Designations Or No Designation[11]

Cluster 48: Programming courses

12.1 Introduction to Computing /Computer Programming

Principles of computer science; programming in FORTRAN, PL/I, C, Pascal, C++, Java or some other high level language. Algorithmic thinking and simple data structures may also be given special attention in this course.

[Note to coders: This is normally a year sequence, which we will, according to our practice, code as two instances of the same course. The standard version of this course does not especially emphasize algorithmic thinking or data structures. If these are strong features of the course, the flavor abbreviations "al" or "ds" should be used.]

12.2 Software Engineering

Software development and design principles, basics of project management, software cost estimation, object-oriented and real-time software, reliability of software, language choice.

12.3 Data Structures

Stacks, queues, linked lists, trees, heaps, sorting, recursion, trees, heaps, priority queues and hashing.

[11]Thus a course in a department of "Mathematics" or "Mathematical Science" or "Mathematics and Computer Science", etc., with an "M" or "MTH" designation, as in "MTH241 Data Structures" is counted, whereas if, in the same department, it is "CS241 Data Structures", we ignore it. If the institution doe not use alphabetical prefixes or any other form of designation as to subject (using merely numbers), we count all courses listed in the department. We acknowledge that the very same course can appear with opposite designations in different times and schools. In the early days of computer science, the decade or so surrounding 1980, mathematics departments often took on the responsibility for this subject – often a temporary arrangement but sometimes more durable in smaller or medium-sized schools. In those early days, some mathematics departments may even have regarded computer science as one of the mathematical sciences – a view ultimately rejected by the National Science Foundation. Our decision to reject course with computer science designations, no matter how mathematical their content may be, is a rough-and-ready one largely adopted to make our project manageable. However, the data we provide in this way does give a clue, albeit a highly limited one, to the unsettled early days of computer science and to the views and practices of some mathematics departments in that era.

Cluster 49: Systems

12.4 Assembler Language Programming/Machine Organization

Computer instructions and data organization, addressing concepts, data definition, binary and decimal instructions (hexadecimal), register manipulation, and linkage conventions, I/O to screen, printer, and disk interfaces.

12.5 Data Communications

Modems, codes, data compression, internet routing protocols

12.6 Operating systems

Processes, process management, synchronization, input/output devices and their programming, interrupts, memory management, resource allocation, and an introduction to file systems.

12.7 Computer Architecture

Boolean logic, data representation, CPU instruction sets processor organization and functional units; input/output, memory organization and hierarchy, virtual memory; system support software, and communication; data types, control unit design; buses and bus timing.

Cluster 50: Theory

12.8 Fundamentals of Algorithms/Analysis of Algorithms

Sorting, merging, searching, greedy algorithms, graph algorithms, breadth and depth first search, tree traversal. Complexity of algorithms: Polynomial time and exponential time algorithms, complexity classes, P, NP, NP-completeness, NP-hardness.

12.9 Computational Complexity/Theory of Computation

Models of computation, automata, languages, Turing machines, Church-Turing thesis, p polynomial time and exponential time algorithms, complexity classes, P, NP, NP-completeness, NP-hard, time-space tradeoffs, decidability.

[Note to coders: this course differs from the previous one in that it does not provide the students with their first introduction to standard commonly used algorithms such as searching and sorting.]

12. 10 Automata/Computability/Formal Languages

The kinds of machines (automata) that recognize various formal languages.

Cluster 51: Applications

12.11 Computer Graphics

Hidden line and hidden surface algorithms. Scan conversion, viewing models, illumination models (including some color theory), vector versus raster graphics.

12.12 Computer Vision/Image Processing

Camera models, projective geometry. Template matching, edge detection, segmentation, object recognition. Reconstructions using depth from stereo, structure from motion, and shape from shading. Properties of the human visual system, color representations, sampling and quantization, point operations, linear image filtering and correlation, transforms and subband decompositions, and nonlinear filtering, contrast and color enhancement, dithering, and image restoration, image registration.

12.13 Principles of Programming Languages

History and kinds of programming languages, object oriented, logic, and functional programming languages. Could include substantial introduction to a particular programming language.

12.14 Artificial Intelligence

Turing test, Lisp programming language, theorem proving, machine learning, game playing, self-organizing systems, rule-based systems, heuristics, expert systems.

12.15 Database Management Systems

Relational databases and index structures, entity-relationship model, functional dependency; advanced query languages, query processing and optimization, transaction processing, concurrency control, distributed databases, and database recovery, security, client server and transaction processing systems.

12.16 Compiler Design

Parsing, lexical analysis, translation specification, code generation.

12.17 Topics/Seminar in Computer Science

12.18 Other

Category 13: Courses With Unspecified Content

(Worksheet Abbreviation: Unspec)

Cluster 52: Unspecified

13.1 Reading/Independent Study

13.2 Topics in Mathematics

13.3 Seminar course.

Like a reading course except students are expected to present material based on their reading.

13.4 Internship that carries credit.

The work is done outside the university (a company, government agency, non-profit organization, etc.)

13.5 Capstone course.

A course which serves to integrate, in the students understanding, much of what he has learned in separate conventional courses. The subject matter could range freely over various mathematical areas and will likely be different each time the course is offered.

13.6 Problem Solving.

This course has no particular subject matter, but is designed to give students experience with strategies for solving a variety of problems. Books such as Polya's "How to Solve It" or theories of problem solving may be used. In contrast to the course "Introduction to Proofs/Transition to Higher Mathematics" there is not so much emphasis on proof as on the pursuit of the "Aha!" moment.

13.7. Other

Category 14: Other Courses Not in Previous Categories

(Worksheet Abbreviation: Other)

Cluster 53: History/Philosophy

14.1 History of Mathematics

14.2 Philosophy of Mathematics

14.3 History and Philosophy of Mathematics

Cluster 54: Astronomy

14.4 Descriptive Astronomy/Practical Astronomy

This course would consist of an overview of astronomy from a verbal and possibly graphic point of view and possibly including some introduction to astronomical equipment such as telescopes and sextants. It might be taught from a cultural, historic perspective and would include topics such as the solar system, planets, the Milky Way, galaxies, constellations, black holes (once these had been discovered), the sun, galaxies, stars and stellar evolution, how astronomers do science, the motions of celestial bodies, and the fate of the universe. This course would focus on the nature of the universe and might state that it is for non-science majors.

[Note to Coder: We know from Cajori that in the late 19th century, Astronomy was taught in Mathematics Departments. This was true at the U. of Nebraska and the U. of Texas at Austin till well into the 20th century. It appears (from reading prefaces of Astronomy texts) that prior to WW II a majority of Astronomy courses were similar to this course.]

14.5 Basic Mathematical Astronomy

This is a mathematically based course using elementary mathematics such as arithmetic and algebra and trigonometry. Calculus would not be a prerequisite. Topics might include the universe, earth in the sky, Newton's laws of gravitation and motion, motions of the earth and moon (phases and eclipses); dimensions of the moon; motions of the planets, comets, meteors; the sun, solar structure, solar atmosphere, solar activity; coordinates on the celestial sphere, time (solar days, sidereal days, time zones, seasons), perihelion, aphelion, 23.5 degree inclination of earth's orbit, calculating the mass of earth, density of the earth, refraction and other atmospheric effects, the Foucault Pendulum (computations of differences in velocity), deflection of projectiles, precession and nutation, sidereal and synodic periods, eclipses, tides on earth, features of the moon, escape of an atmosphere, Kepler's Laws, motion of the planets, physical properties of planets, escape velocity, calculating the velocity of a comet, electromagnetic radiation, Doppler Effect, and Relativity. There would be many computational problems included in the course.

14.6 Other Astronomy

Cluster 55: Miscellaneous Other

14.7 Topics/Seminar

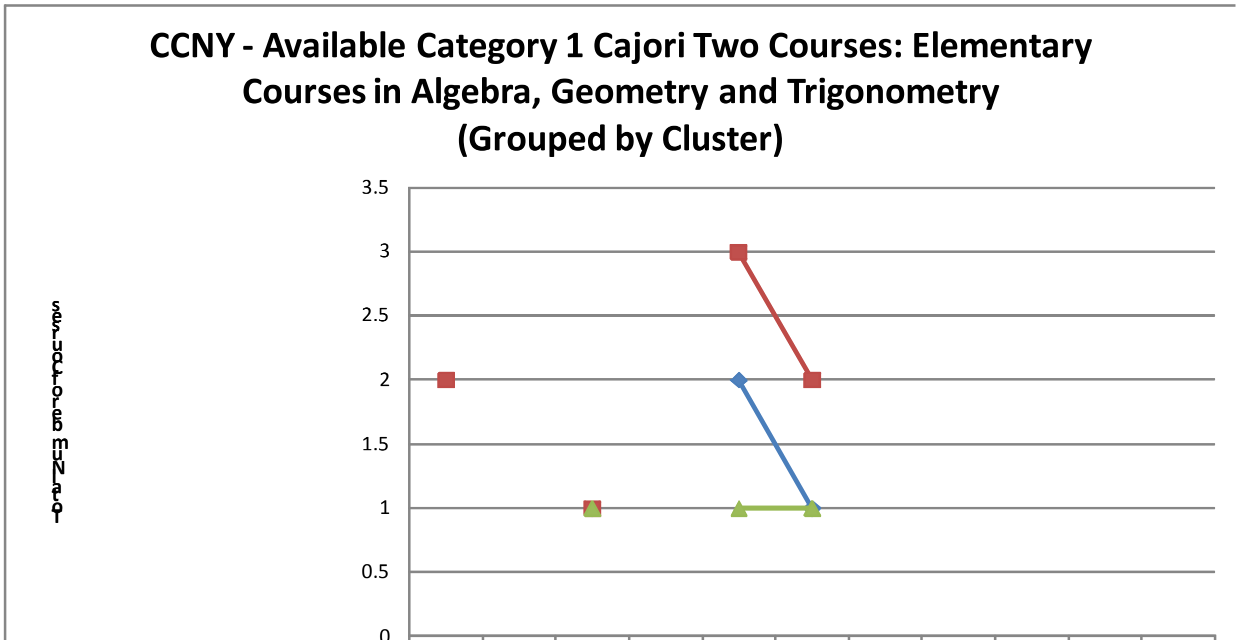
14.8 Other (not astronomy)

APPENDIX E – LINK TO ARCHIVED COLLEGE CATALOG SCANS

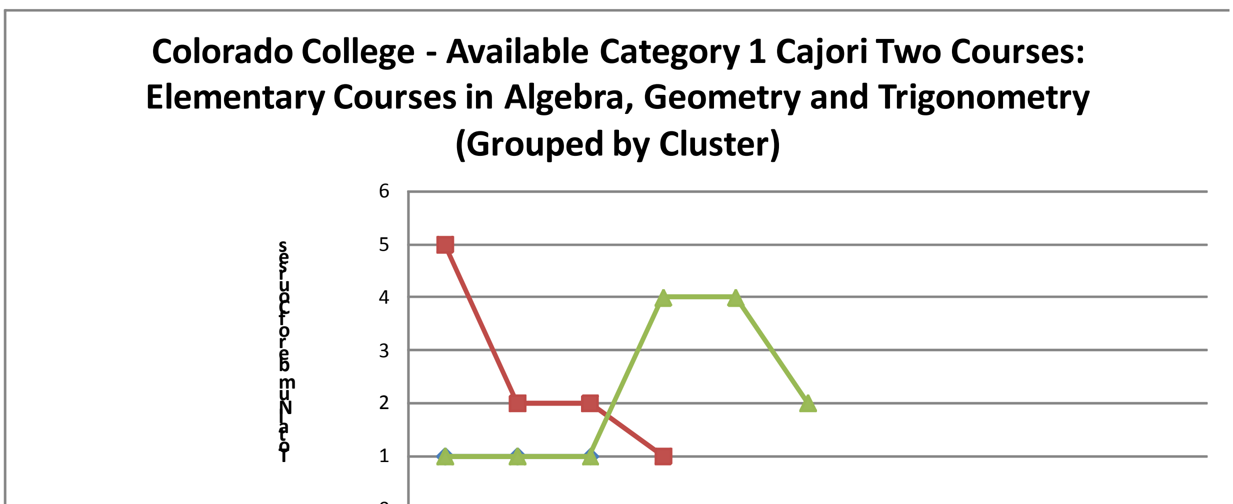
http://matcmp.ncc.edu/taormij/cajori_two/catalog_scans.php

APPENDIX F – ALL GRAPHS OF CAJORI TWO CATEGORY 1 (CLUSTERS 1-3)

Note: This category is also called "Pre-college Mathematics"

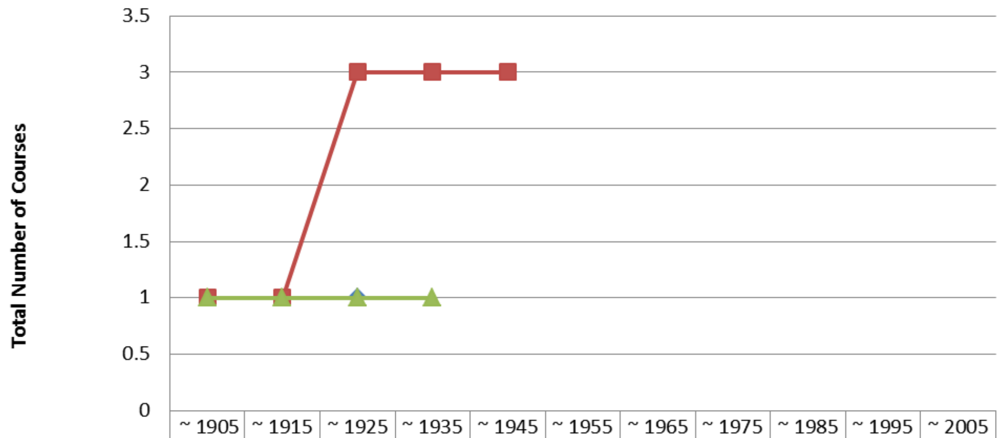


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Pre-college mathematics			1		2	1					
Elementary College Level Geometry	2		1		3	2					
Pre-calculus courses			1		1	1					



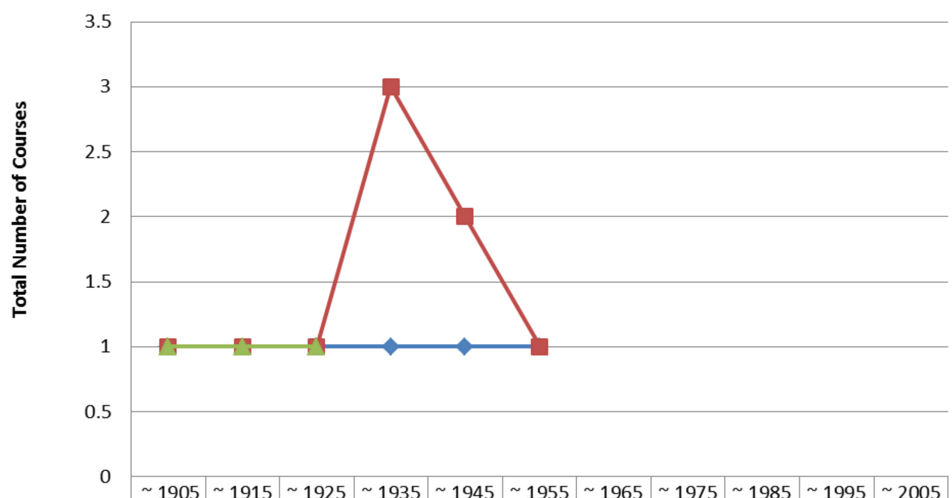
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Pre-college mathematics	1	1	1								
Elementary College Level Geometry	5	2	2	1							
Pre-calculus courses	1	1	1	4	4	2					

Stanford - Available Category 1 Cajori Two Courses: Elementary Courses in Algebra, Geometry and Trigonometry (Grouped by Cluster)

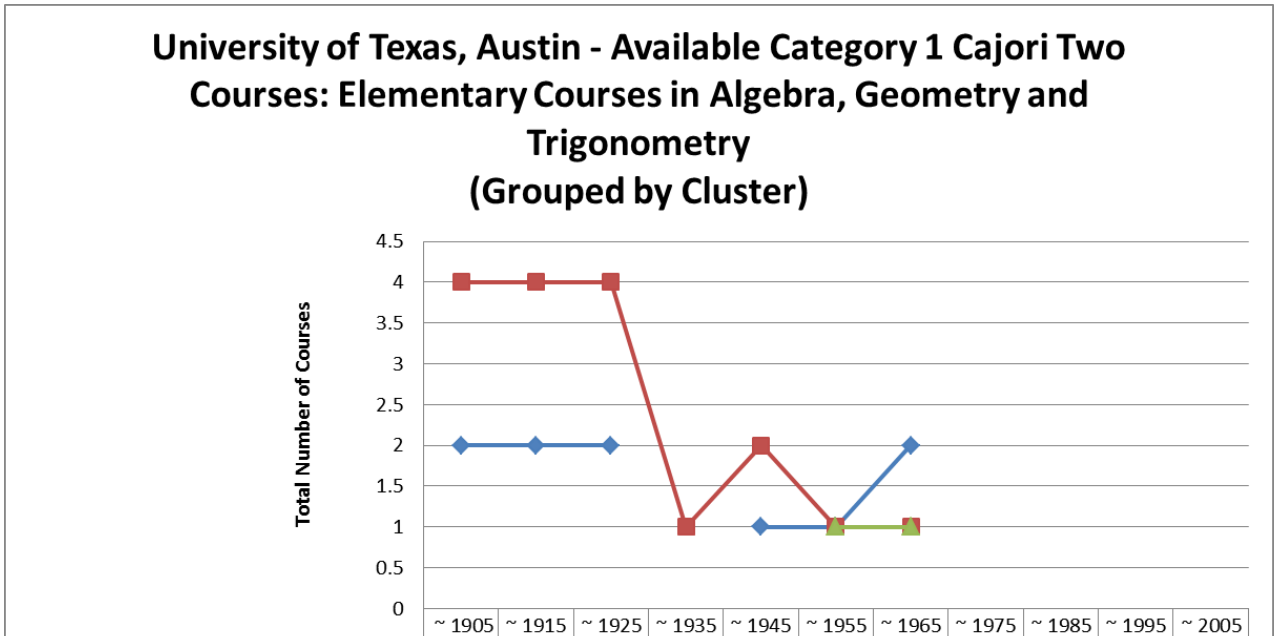


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Pre-college mathematics			1								
Elementary College Level Geometry	1	1	3	3	3						
Pre-calculus courses	1	1	1	1							

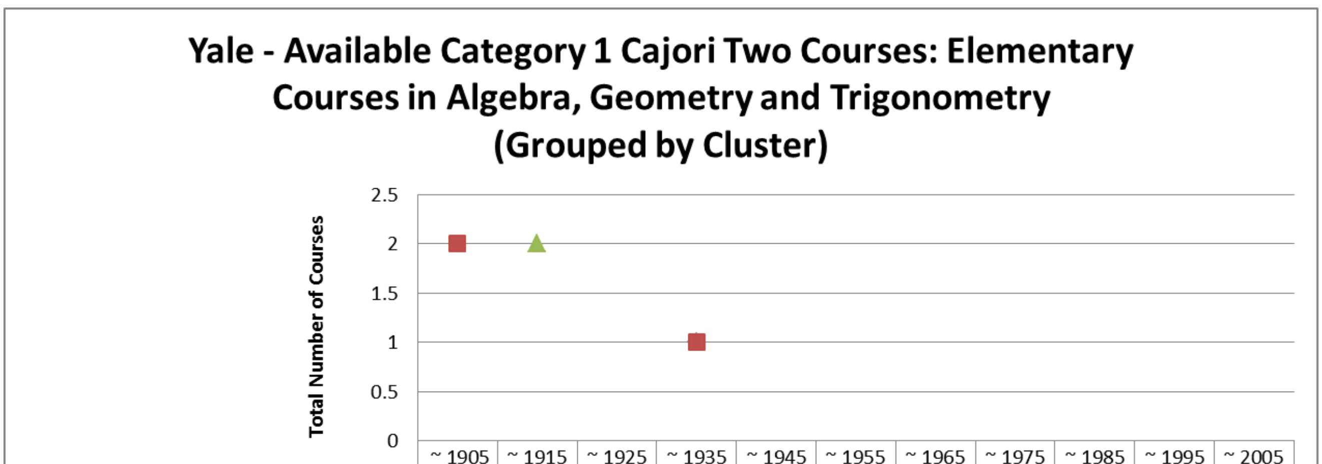
University of California, Berkeley - Available Category 1 Cajori Two Courses: Elementary Courses in Algebra, Geometry and Trigonometry (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Pre-college mathematics	1		1	1	1	1					
Elementary College Level Geometry	1	1	1	3	2	1					
Pre-calculus courses	1	1	1								



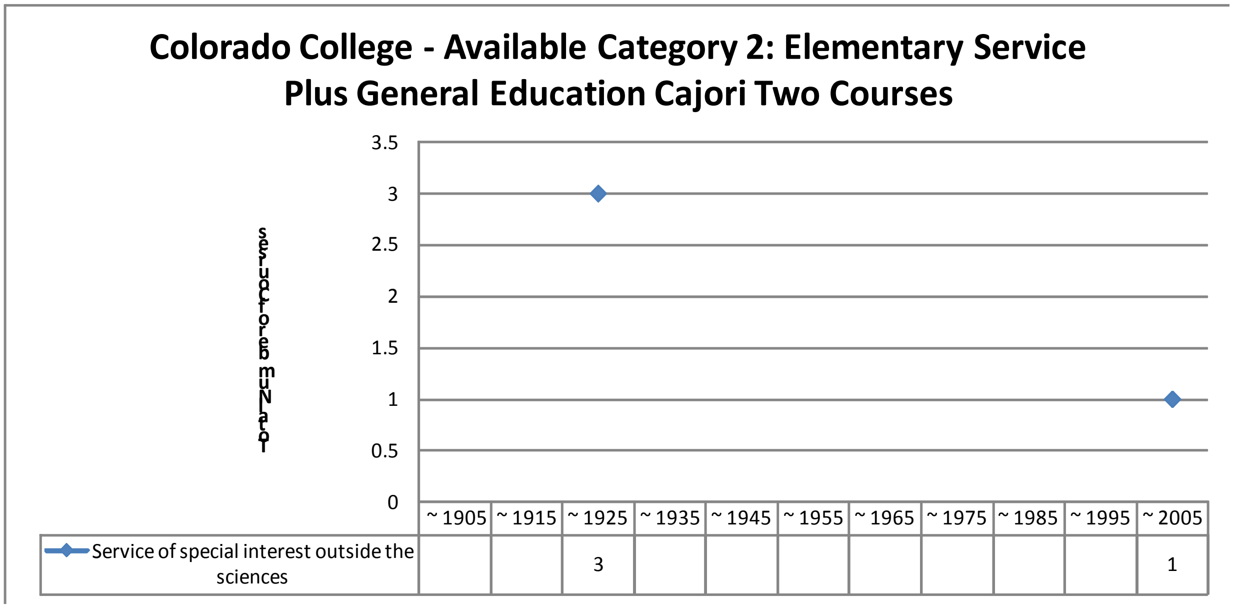
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Pre-college mathematics	2	2	2		1	1	2				
Elementary College Level Geometry	4	4	4	1	2	1	1				
Pre-calculus courses						1	1				



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Pre-college mathematics				1							
Elementary College Level Geometry	2			1							
Pre-calculus courses		2									

APPENDIX G – ALL GRAPHS OF CAJORI TWO CATEGORY 2 (CLUSTERS 4-7)

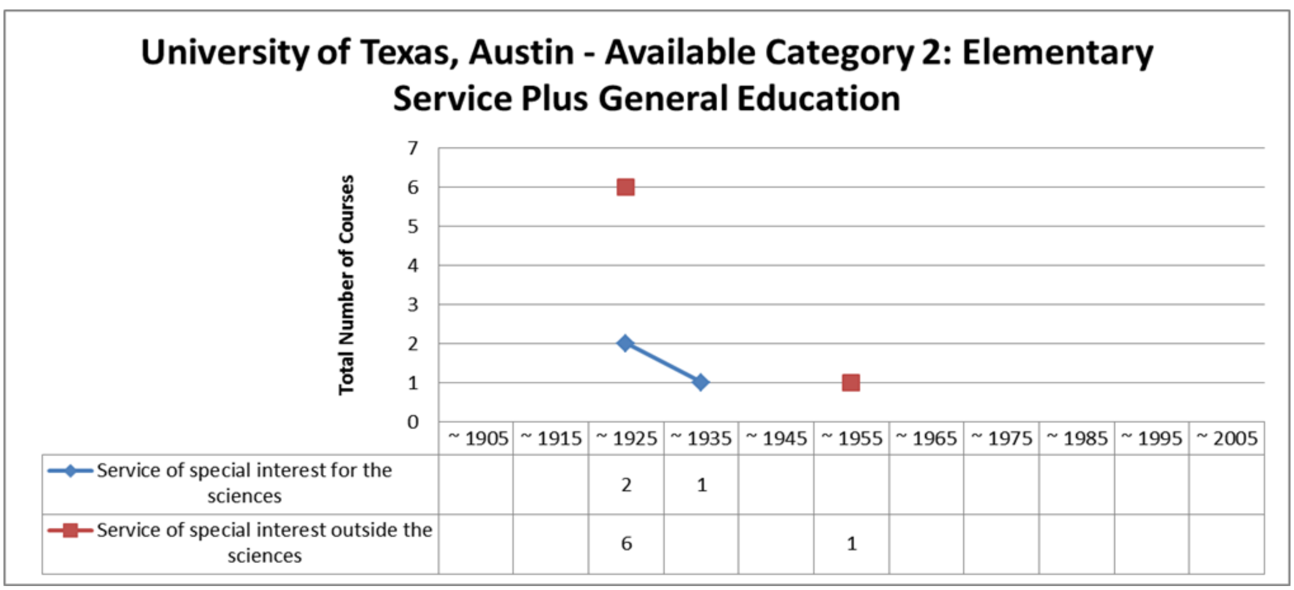
(CCNY - No Category 2 Cajori Two Courses)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Service of special interest outside the sciences			3								1

(Stanford University - No Category 2 Courses)

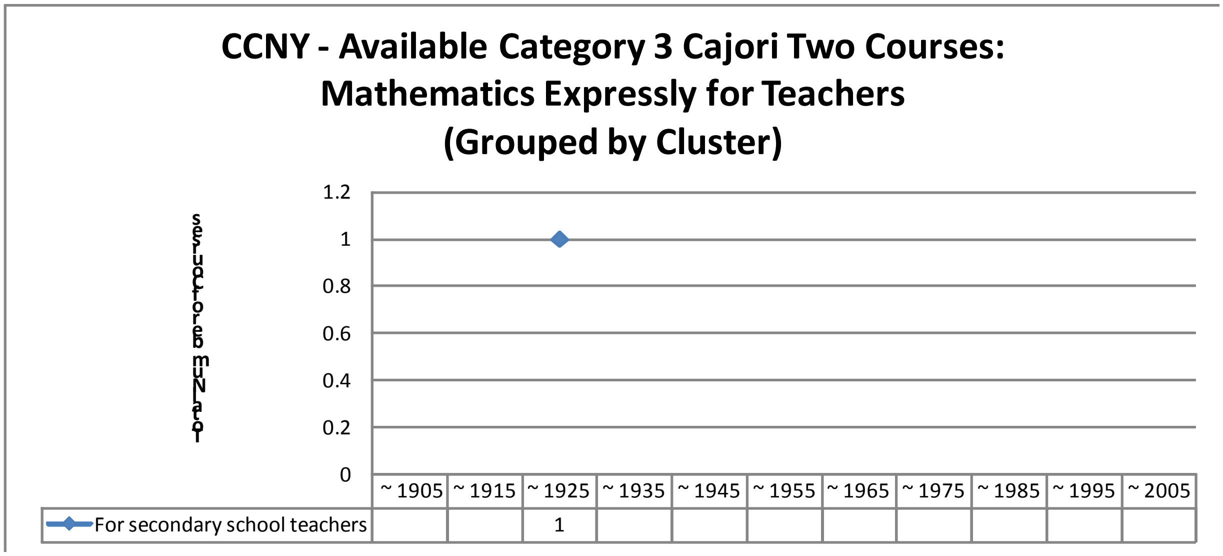
(University of California, Berkeley - No Category 2 Courses)



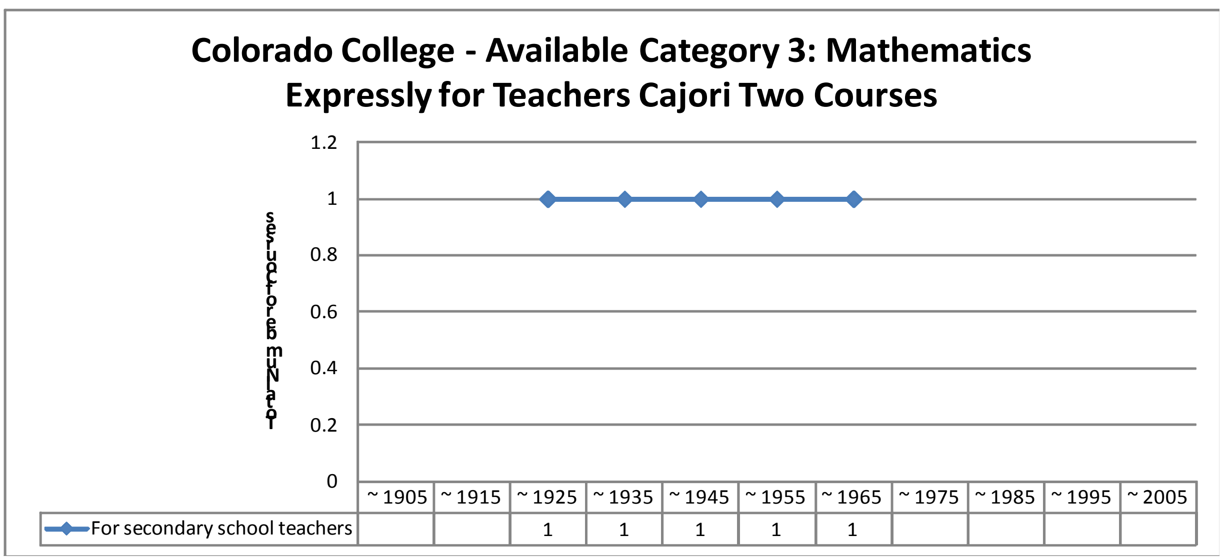
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Service of special interest for the sciences			2	1							
Service of special interest outside the sciences			6			1					

(Yale - No Category 2 Courses)

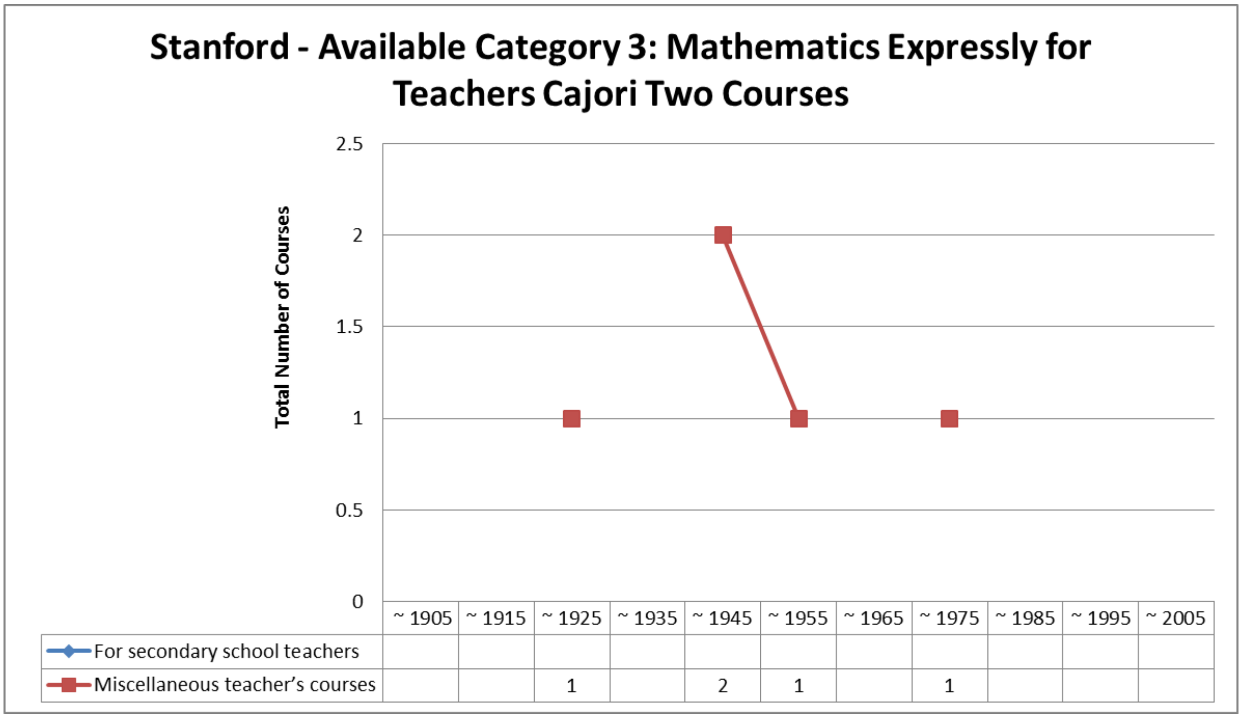
APPENDIX H – ALL GRAPHS OF CAJORI TWO CATEGORY 3 (CLUSTERS 8-10)



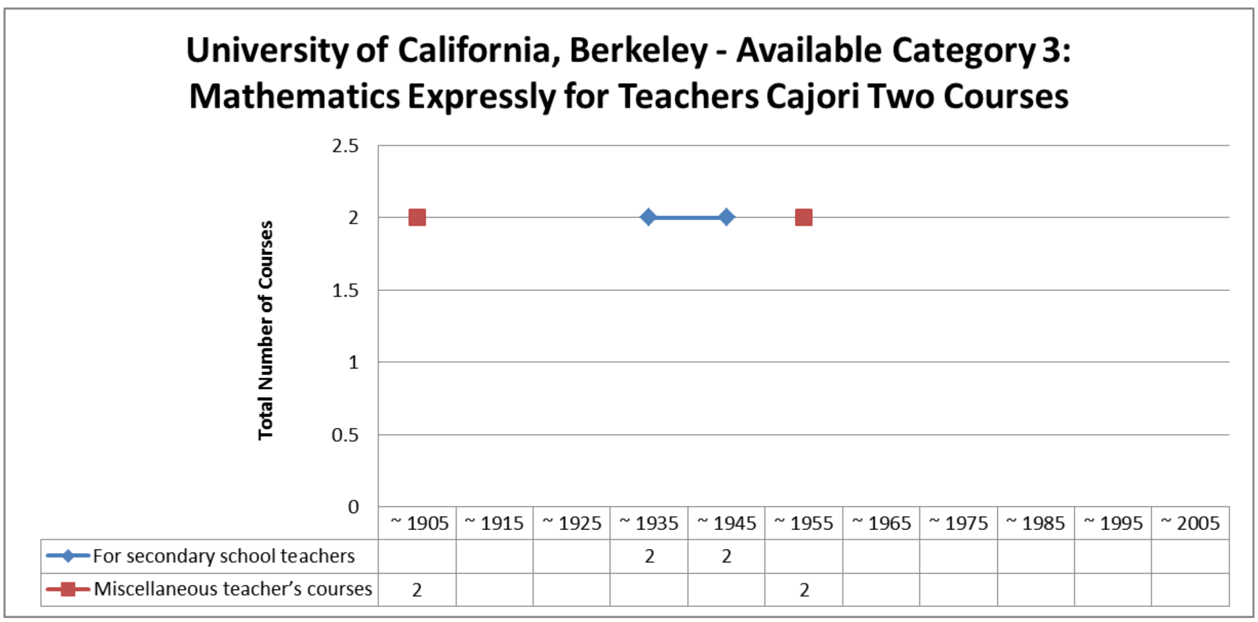
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
For secondary school teachers			1								



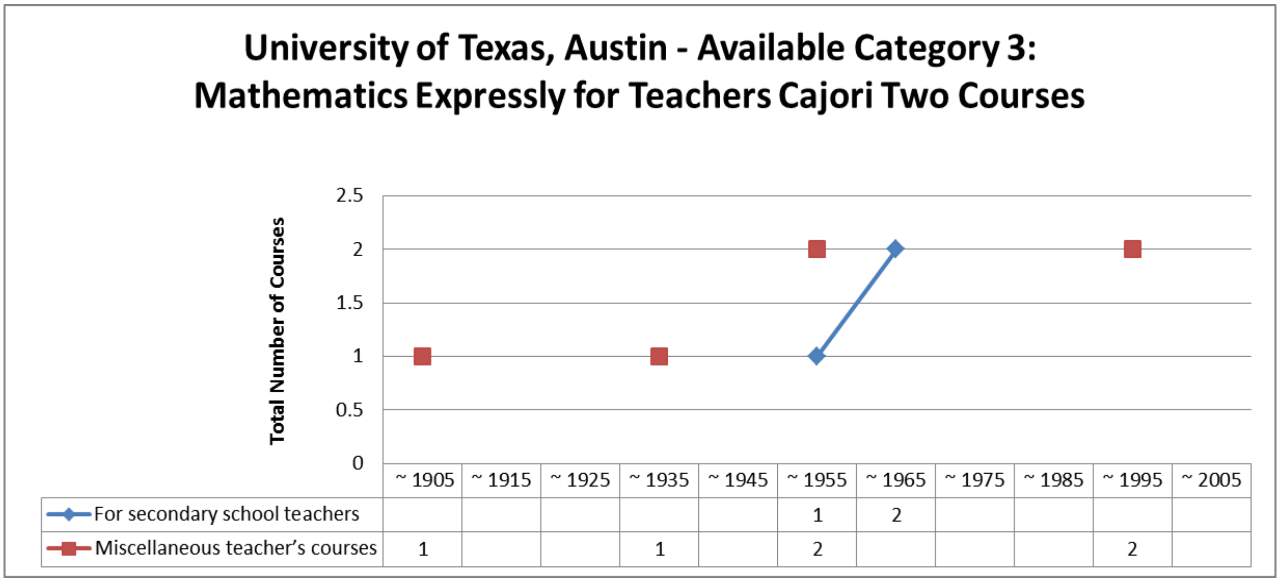
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
For secondary school teachers			1	1	1	1	1				



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
For secondary school teachers											
Miscellaneous teacher's courses			1		2	1		1			



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
For secondary school teachers				2	2						
Miscellaneous teacher's courses	2					2					

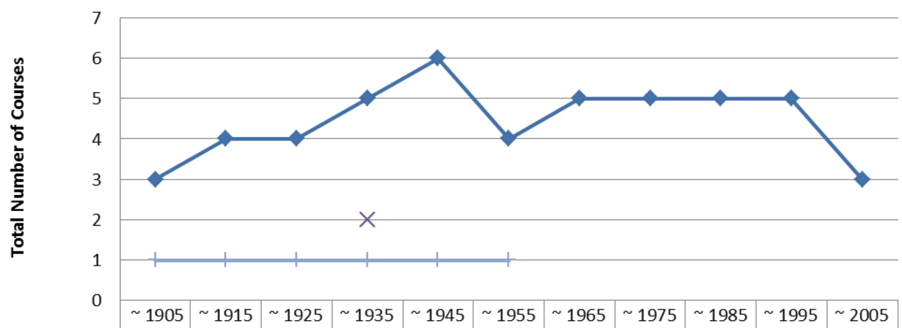


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
For secondary school teachers						1	2				
Miscellaneous teacher’s courses	1			1		2				2	

(Yale - No Category 3 Courses)

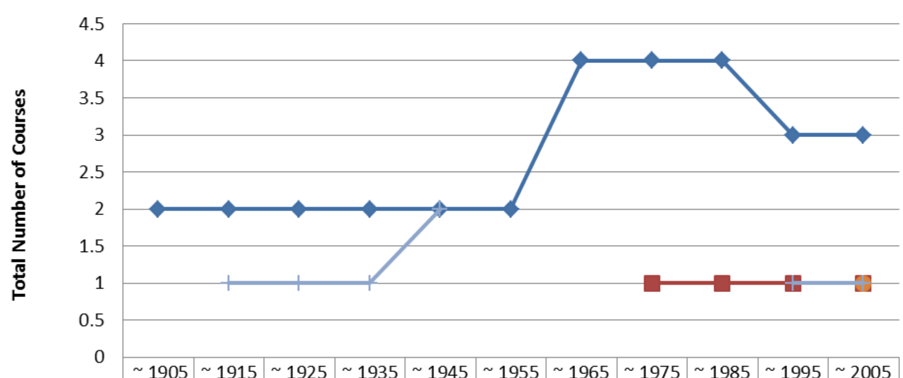
APPENDIX I – ALL GRAPHS OF CAJORI TWO CATEGORY 4 (CLUSTERS 11-19)

CCNY - Available Category 4 Cajori Two Courses: Basic Calculus Sequences (Grouped by Cluster)



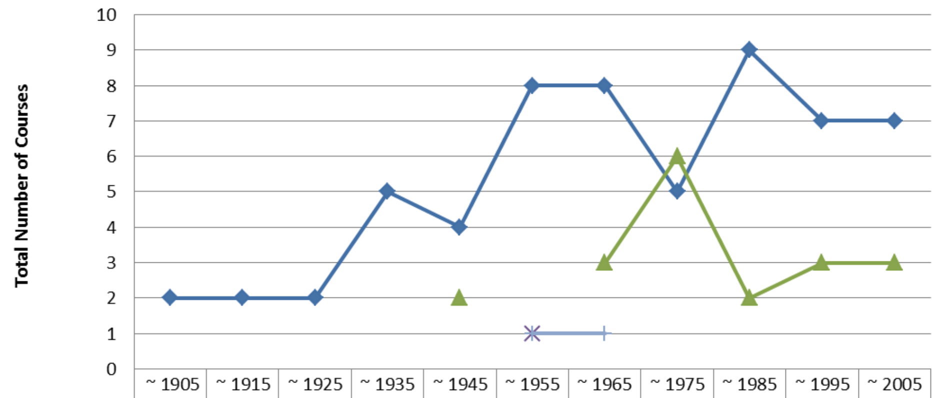
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mainstream basic calculus sequence	3	4	4	5	6	4	5	5	5	5	3
Calculus with precalculus											
Accelerated or honors mainstream basic calculus sequence											
Basic calculus sequence for students of STEM				2							
Calculus With Theory											
Calculus for Students with Prior Exposure To Calculus											
Miscellaneous calculus	1	1	1	1	1	1					

Colorado College - Available Category 4 Cajori Two Courses: Basic Calculus Sequences (Grouped by Cluster)



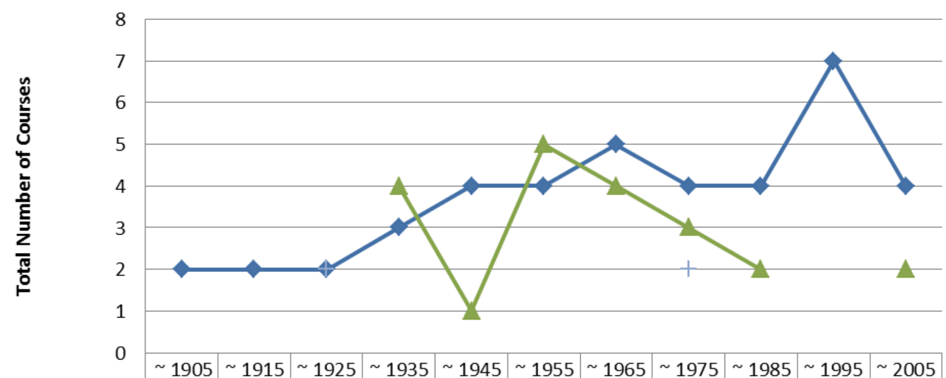
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mainstream basic calculus sequence	2	2	2	2	2	2	4	4	4	3	3
Calculus with precalculus								1	1	1	1
Accelerated or honors mainstream basic calculus sequence											
Basic calculus sequence for students of STEM											
Calculus With Theory											
Calculus for Students with Prior Exposure To Calculus											1
Miscellaneous calculus		1	1	1	2					1	1

Stanford - Available Category 4 Cajori Two Courses: Basic Calculus Sequences (Grouped by Cluster)



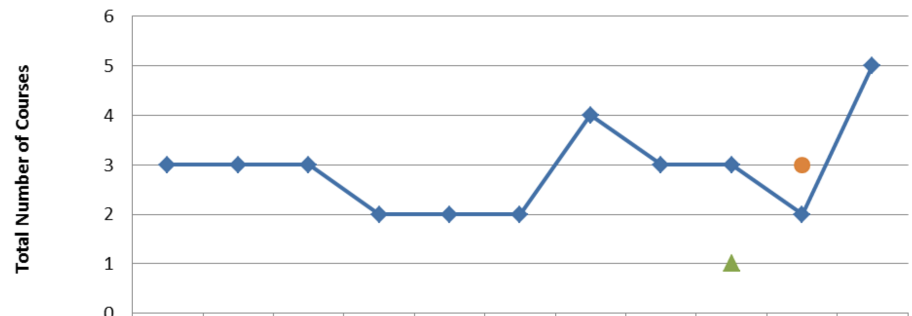
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mainstream basic calculus sequence	2	2	2	5	4	8	8	5	9	7	7
Calculus with precalculus											
Accelerated or honors mainstream basic calculus sequence					2		3	6	2	3	3
Basic calculus sequence for students of STEM						1					
Calculus With Theory											
Calculus for Students with Prior Exposure To Calculus											
Miscellaneous calculus						1	1				

University of California, Berkeley - Available Category 4 Cajori Two Courses: Basic Calculus Sequences (Grouped by Cluster)



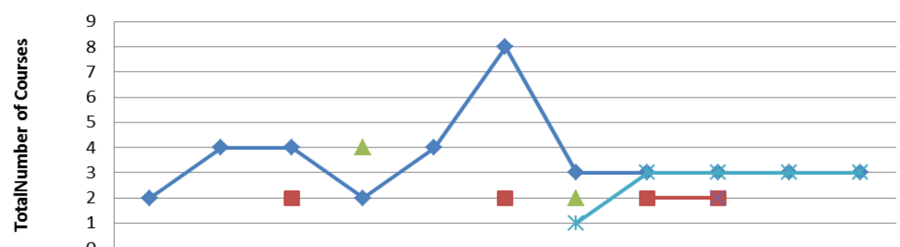
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mainstream basic calculus sequence	2	2	2	3	4	4	5	4	4	7	4
Calculus with precalculus											
Accelerated or honors mainstream basic calculus sequence				4	1	5	4	3	2		2
Basic calculus sequence for students of STEM											
Calculus With Theory											
Calculus for Students with Prior Exposure To Calculus											
Miscellaneous calculus			2					2			

University of Texas, Austin - Available Category 4 Cajori Two Courses: Basic Calculus Sequences (Grouped by Cluster)



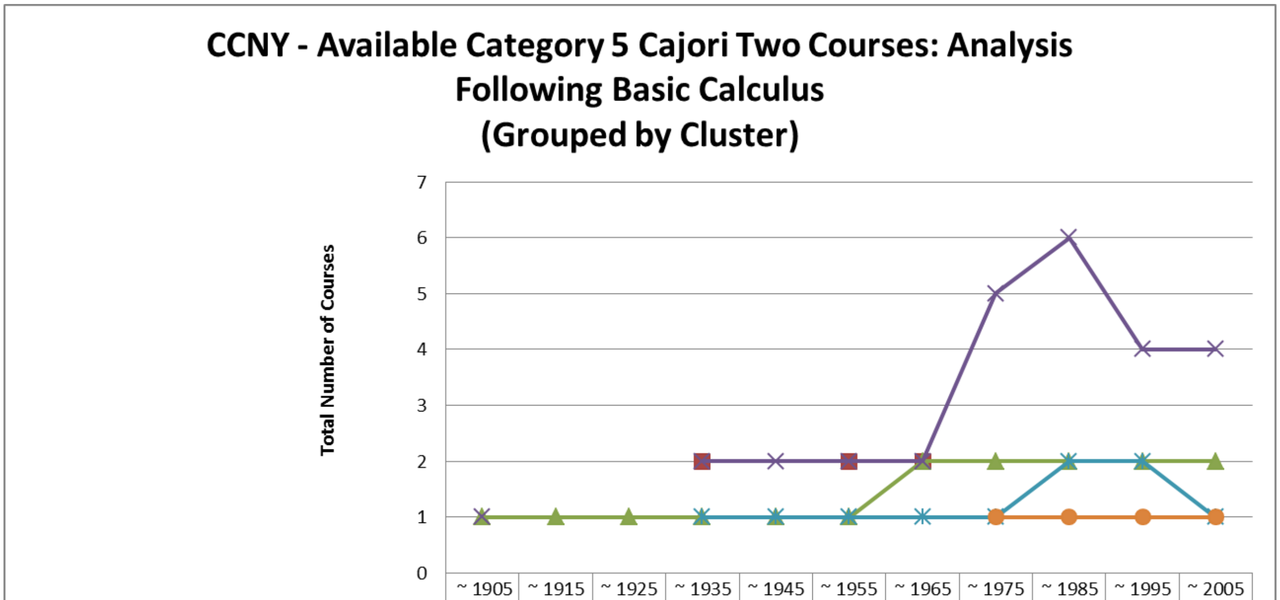
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mainstream basic calculus sequence	3	3	3	2	2	2	4	3	3	2	5
Calculus with precalculus											
Accelerated or honors mainstream basic calculus sequence									1		
Basic calculus sequence for students of STEM											
Calculus With Theory											
Calculus for Students with Prior Exposure To Calculus										3	
Miscellaneous calculus											

Yale - Available Category 4 Cajori Two Courses: Basic Calculus Sequences (Grouped by Cluster)

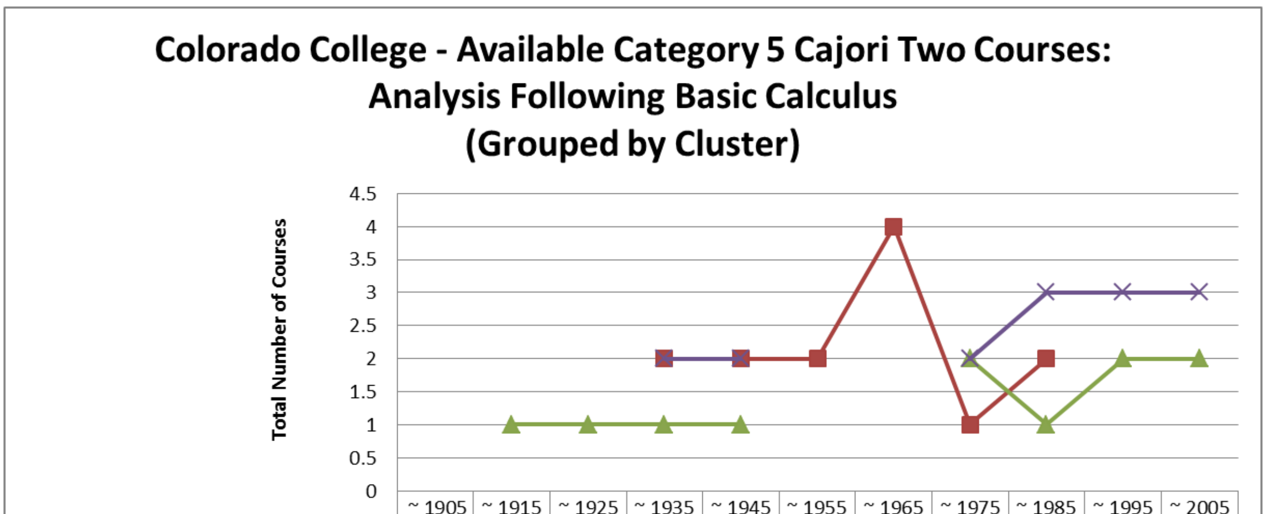


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mainstream basic calculus sequence	2	4	4	2	4	8	3	3	3	3	3
Calculus with precalculus			2			2		2	2		
Accelerated or honors mainstream basic calculus sequence				4			2				
Calculus With Theory									2		
Miscellaneous calculus							1	3	3	3	3

APPENDIX J – ALL GRAPHS OF CAJORI TWO CATEGORY 5 (CLUSTERS 20-25)

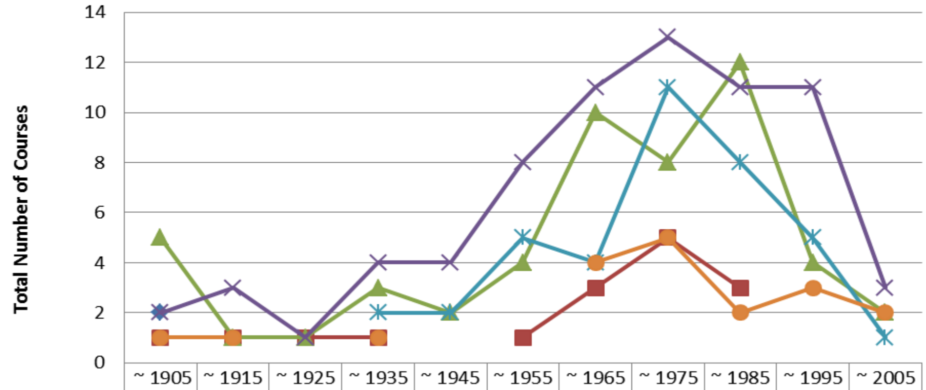


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Extended basic calculus											
Advanced calculus				2		2	2				
Differential equations and related courses	1	1	1	1	1	1	2	2	2	2	2
The theory of functions	1			2	2	2	2	5	6	4	4
Advanced analysis				1	1	1	1	1	2	2	1
Miscellaneous Analysis								1	1	1	1



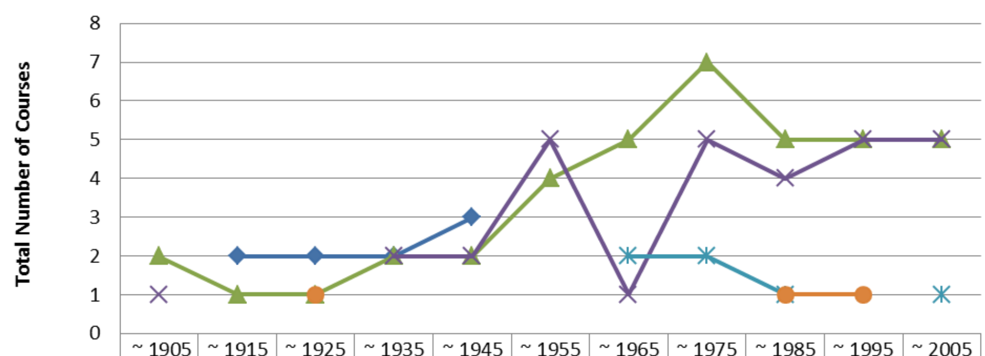
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Extended basic calculus											
Advanced calculus				2	2	2	4	1	2		
Differential equations and related courses		1	1	1	1			2	1	2	2
The theory of functions				2	2			2	3	3	3
Advanced analysis											
Miscellaneous Analysis											

Stanford - Available Category 5 Cajori Two Courses: Analysis Following Basic Calculus (Grouped by Cluster)

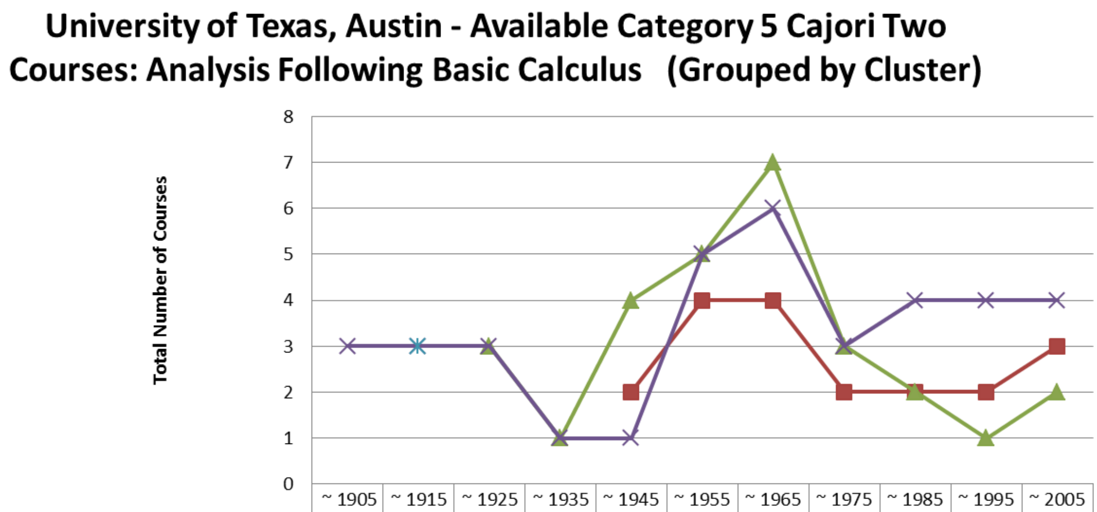


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Extended basic calculus	2										
Advanced calculus	1	1	1	1		1	3	5	3		
Differential equations and related courses	5	1	1	3	2	4	10	8	12	4	2
The theory of functions	2	3	1	4	4	8	11	13	11	11	3
Advanced analysis				2	2	5	4	11	8	5	1
Miscellaneous Analysis	1	1		1			4	5	2	3	2

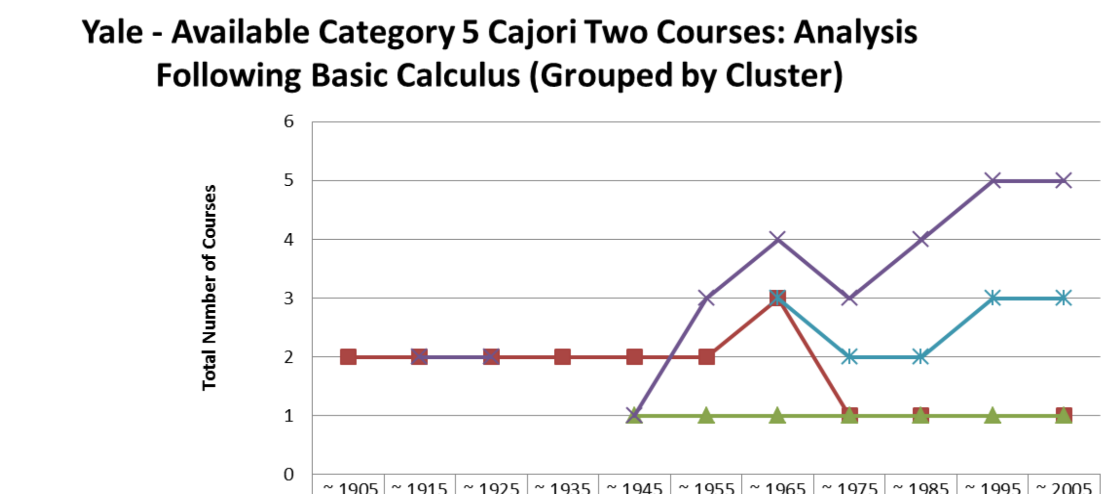
University of California, Berkeley - Available Category 5 Cajori Two Courses: Analysis Following Basic Calculus (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Extended basic calculus		2	2	2	3						
Advanced calculus											
Differential equations and related courses	2	1	1	2	2	4	5	7	5	5	5
The theory of functions	1			2	2	5	1	5	4	5	5
Advanced analysis							2	2	1		1
Miscellaneous Analysis			1						1	1	



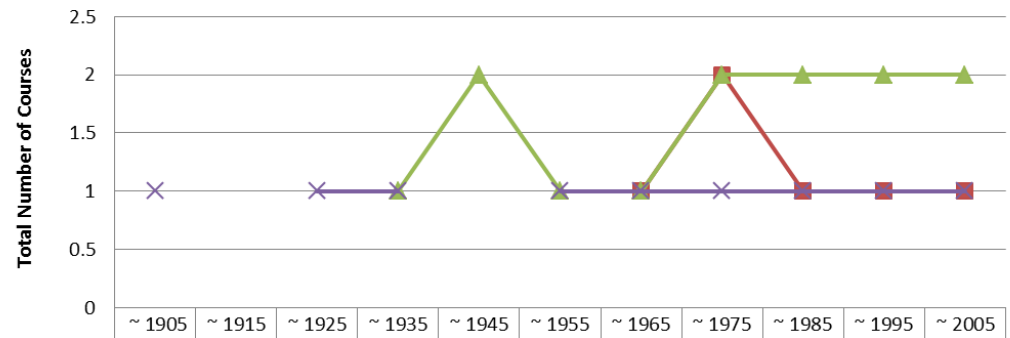
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Extended basic calculus											
Advanced calculus					2	4	4	2	2	2	3
Differential equations and related courses			3	1	4	5	7	3	2	1	2
The theory of functions	3	3	3	1	1	5	6	3	4	4	4
Advanced analysis		3									
Miscellaneous Analysis											



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Extended basic calculus											
Advanced calculus	2	2	2	2	2	2	3	1	1		1
Differential equations and related courses					1	1	1	1	1	1	1
The theory of functions		2	2		1	3	4	3	4	5	5
Advanced analysis							3	2	2	3	3
Miscellaneous Analysis											

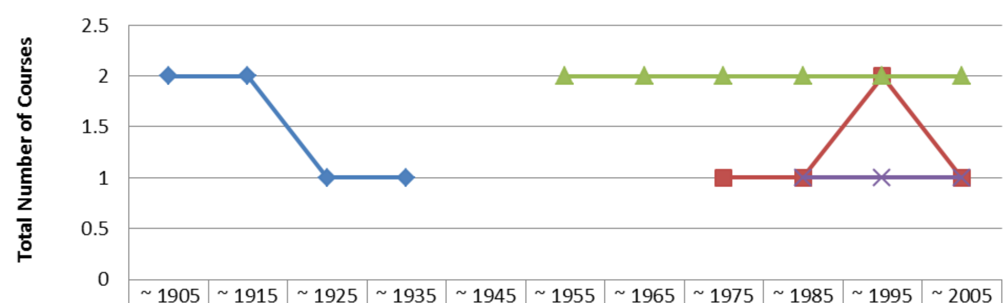
APPENDIX K – ALL GRAPHS OF CAJORI TWO CATEGORY 6 (CLUSTERS 26-30)

CCNY - Available Category 6 Cajori Two Courses: Higher and Abstract Algebra, Linear Algebra and Number Theory (Grouped by Cluster)



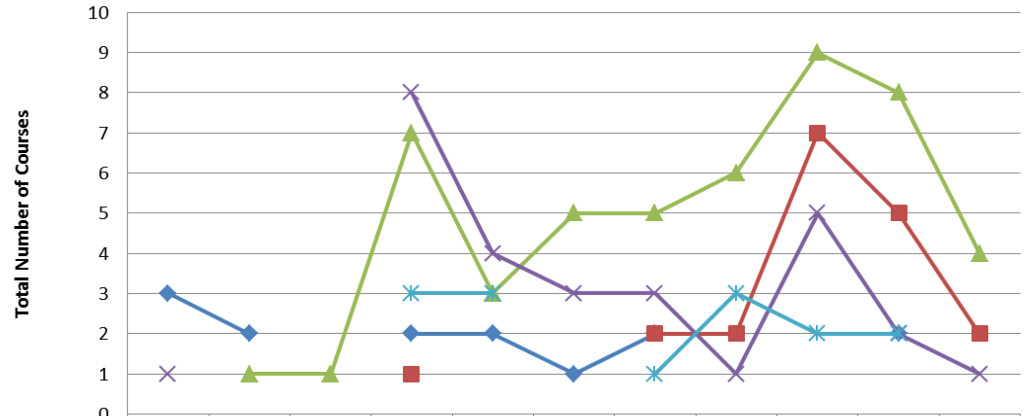
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Concrete studies in algebra											
Linear algebra							1	2	1	1	1
Abstract structures				1	2	1	1	2	2	2	2
Number theory	1		1	1		1	1	1	1	1	1
Miscellaneous algebra											

Colorado College - Available Category 6 Cajori Two Courses: Higher and Abstract Algebra, Linear Algebra and Number Theory (Grouped by Cluster)



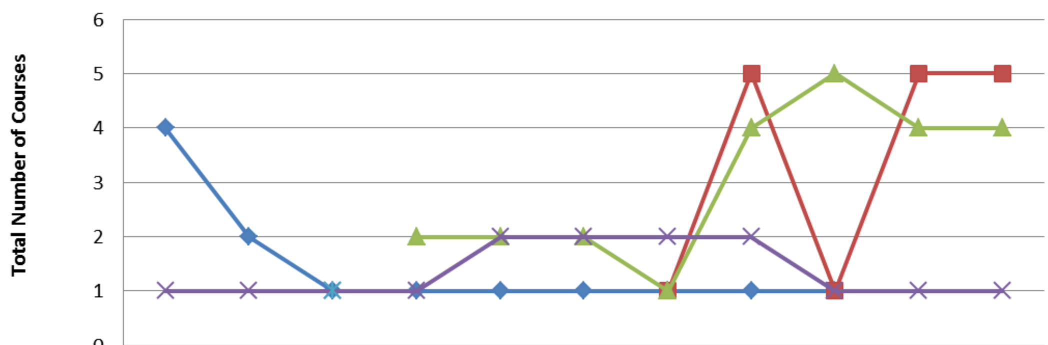
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Concrete studies in algebra	2	2	1	1							
Linear algebra								1	1	2	1
Abstract structures						2	2	2	2	2	2
Number theory									1	1	1
Miscellaneous algebra											

Stanford - Available Category 6 Cajori Two Courses: Higher and Abstract Algebra, Linear Algebra and Number Theory (Grouped by Cluster)

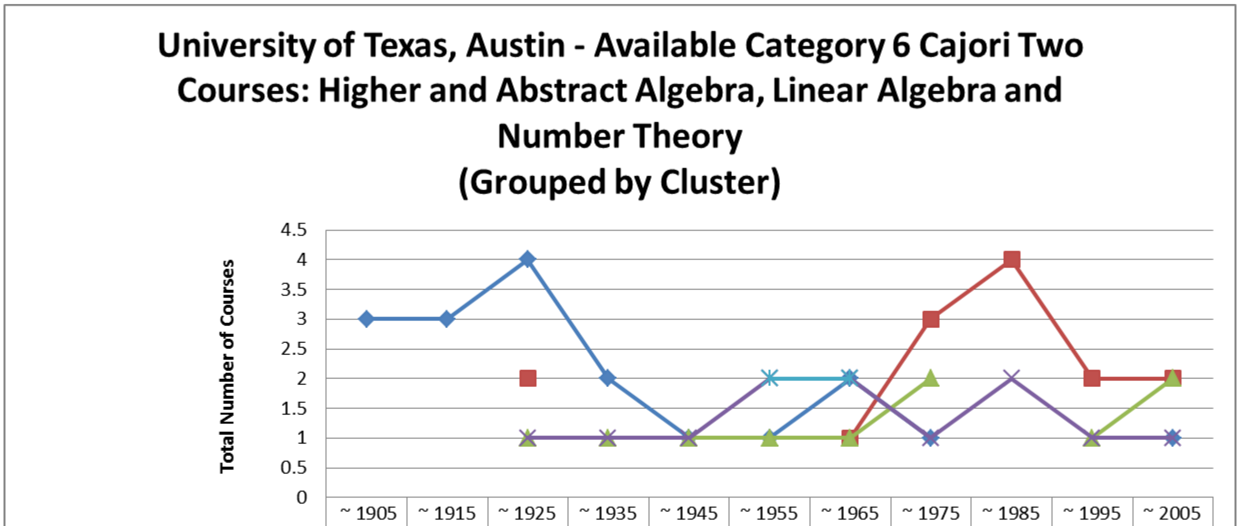


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Concrete studies in algebra	3	2		2	2	1	2			2	
Linear algebra				1			2	2	7	5	2
Abstract structures		1	1	7	3	5	5	6	9	8	4
Number theory	1			8	4	3	3	1	5	2	1
Miscellaneous algebra				3	3		1	3	2	2	

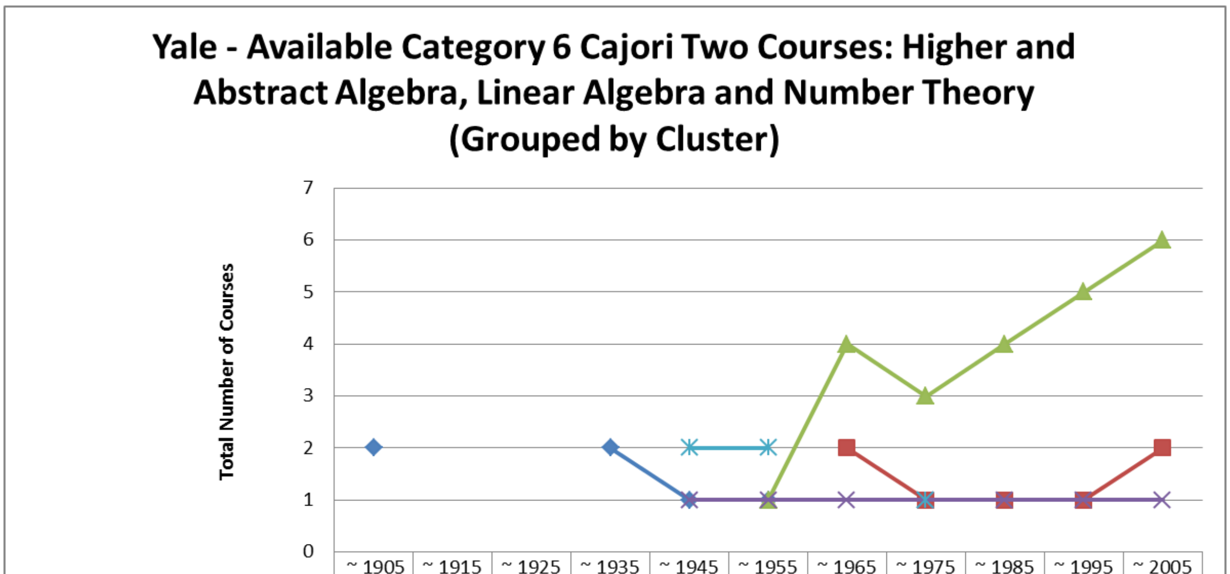
University of California, Berkeley - Available Category 6 Cajori Two Courses: Higher and Abstract Algebra, Linear Algebra and Number Theory (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Concrete studies in algebra	4	2	1	1	1	1	1	1	1		
Linear algebra							1	5	1	5	5
Abstract structures				2	2	2	1	4	5	4	4
Number theory	1	1	1	1	2	2	2	2	1	1	1
Miscellaneous algebra			1								



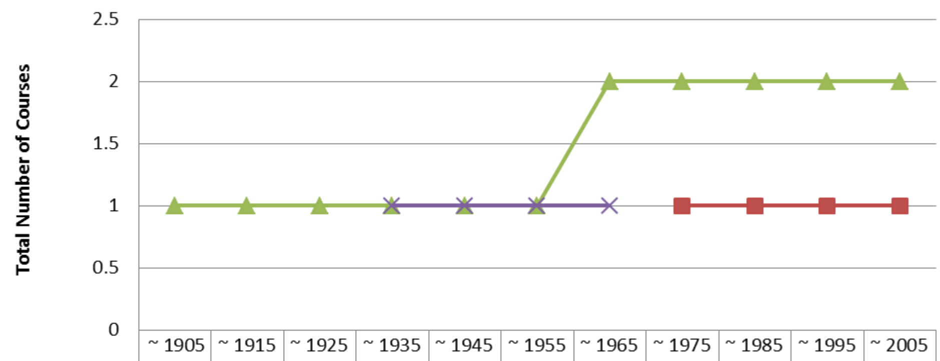
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Concrete studies in algebra	3	3	4	2	1	1	2	1			1
Linear algebra			2				1	3	4	2	2
Abstract structures			1	1	1	1	1	2		1	2
Number theory			1	1	1	2	2	1	2	1	1
Miscellaneous algebra						2	2				



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Concrete studies in algebra	2			2	1	1					
Linear algebra							2	1	1	1	2
Abstract structures						1	4	3	4	5	6
Number theory					1	1	1	1	1	1	1
Miscellaneous algebra					2	2		1			

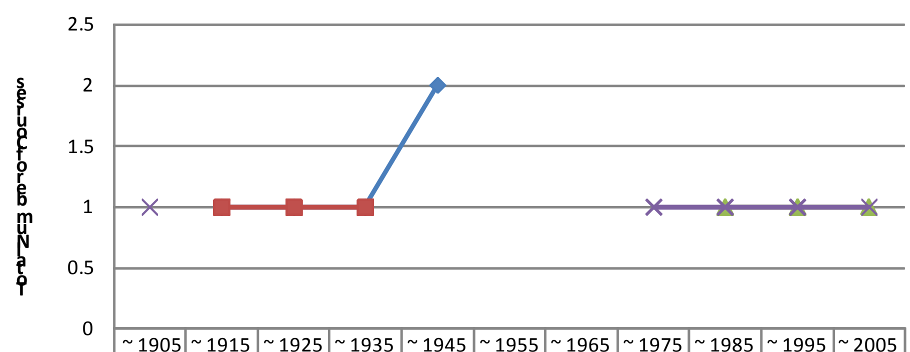
APPENDIX L – ALL GRAPHS OF CAJORI TWO CATEGORY 7 (CLUSTERS 31-34)

CCNY - Available Category 7 Cajori Two Courses: Advanced Geometry and Topology (Grouped by Cluster)

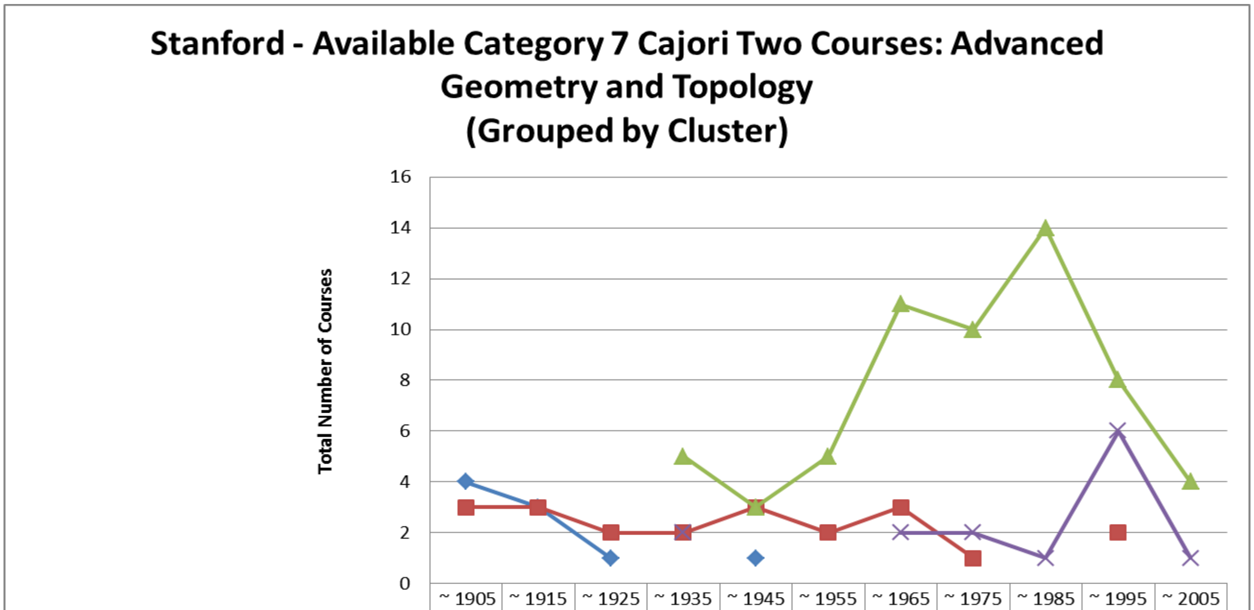


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Advanced Euclidean geometry											
Projective and non-Euclidean geometry								1	1	1	1
Geometry with other mathematical machinery	1	1	1	1	1	1	2	2	2	2	2
Miscellaneous geometry				1	1	1	1				

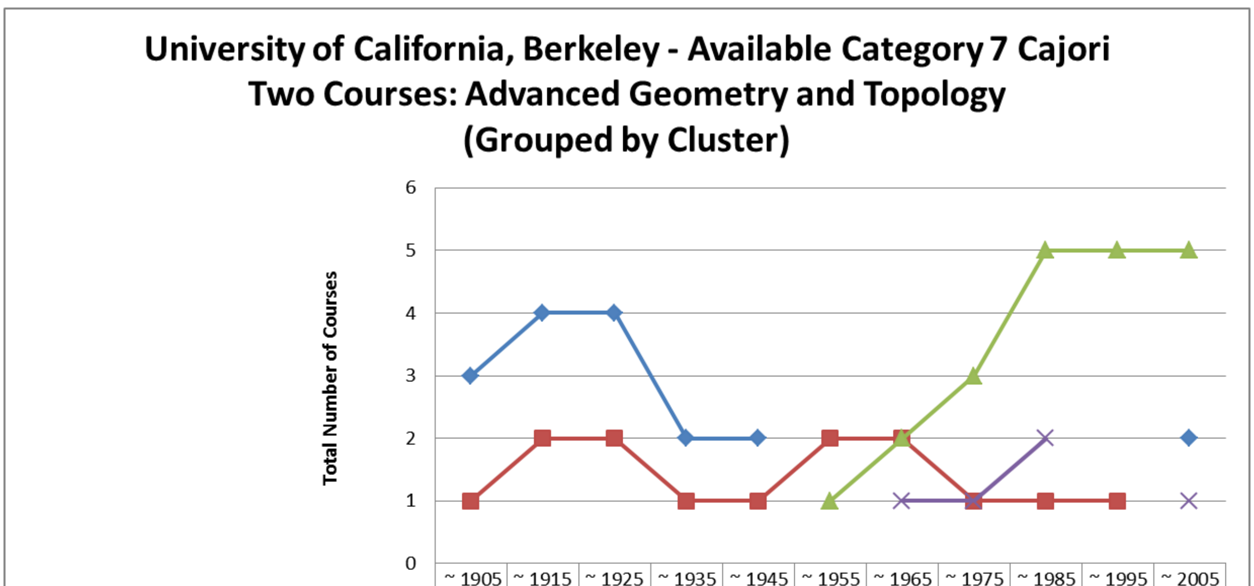
Colorado College - Available Category 7 Cajori Two Courses: Advanced Geometry and Topology (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Advanced Euclidean geometry		1	1	1	2						
Projective and non-Euclidean geometry		1	1	1							
Geometry with other mathematical machinery									1	1	1
Miscellaneous geometry	1							1	1	1	1

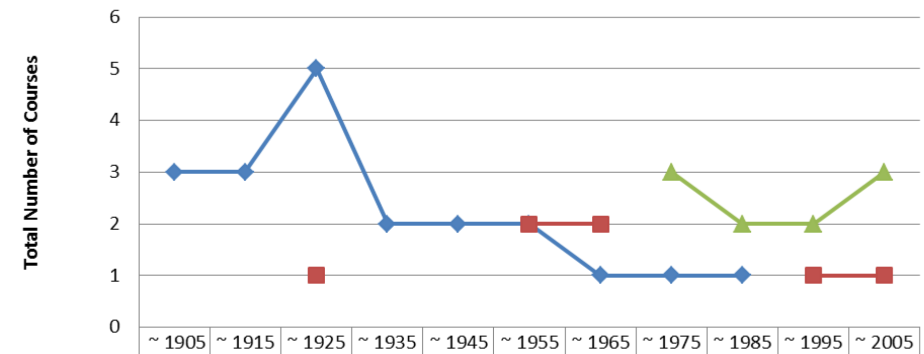


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Advanced Euclidean geometry	4	3	1		1						
Projective and non-Euclidean geometry	3	3	2	2	3	2	3	1		2	
Geometry with other mathematical machinery				5	3	5	11	10	14	8	4
Miscellaneous geometry				2			2	2	1	6	1



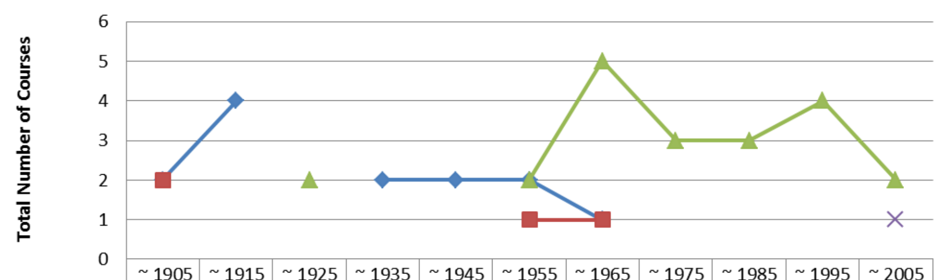
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Advanced Euclidean geometry	3	4	4	2	2						2
Projective and non-Euclidean geometry	1	2	2	1	1	2	2	1	1	1	
Geometry with other mathematical machinery						1	2	3	5	5	5
Miscellaneous geometry							1	1	2		1

University of Texas, Austin - Available Category 7 Cajori Two Courses: Advanced Geometry and Topology (Grouped by Cluster)



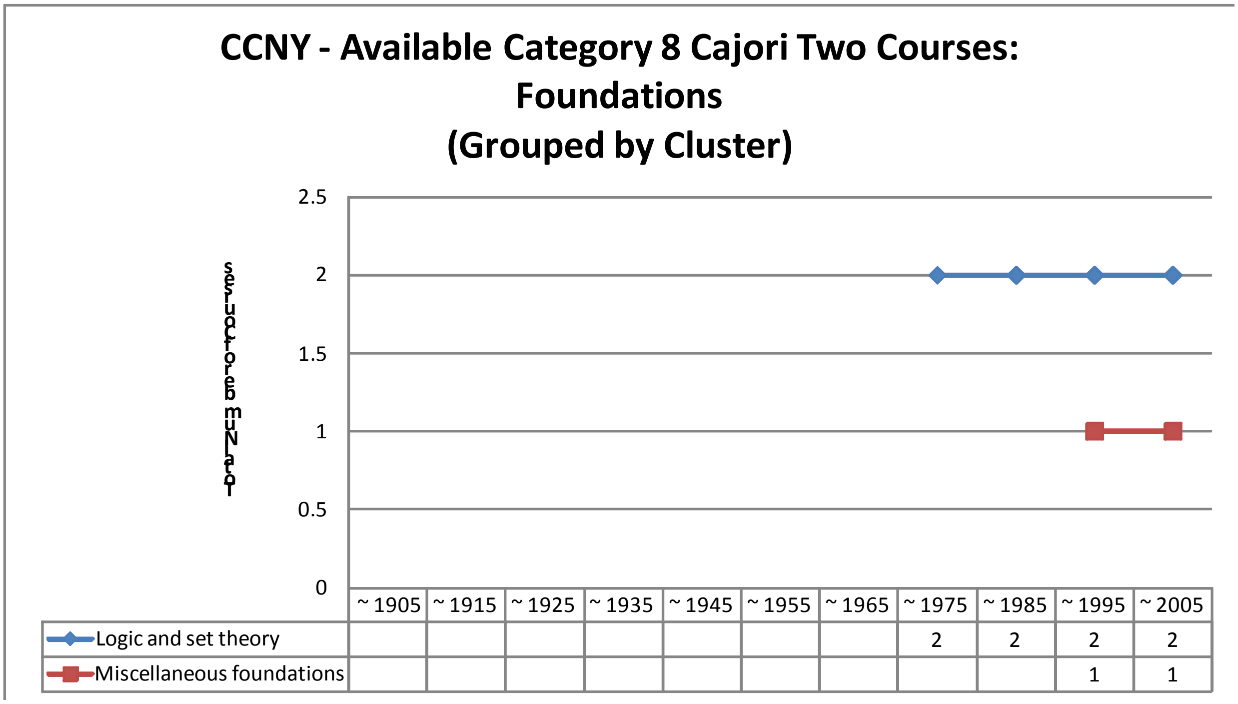
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Advanced Euclidean geometry	3	3	5	2	2	2	1	1	1		
Projective and non-Euclidean geometry			1			2	2			1	1
Geometry with other mathematical machinery								3	2	2	3
Miscellaneous geometry											

Yale - Available Category 7 Cajori Two Courses: Advanced Geometry and Topology (Grouped by Cluster)

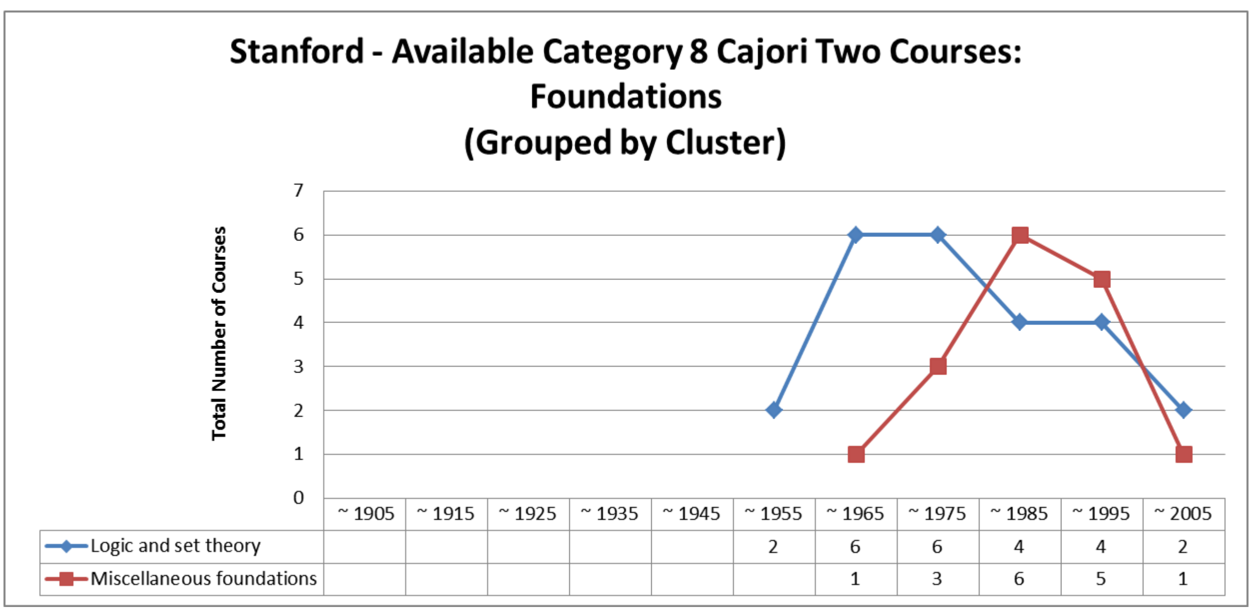


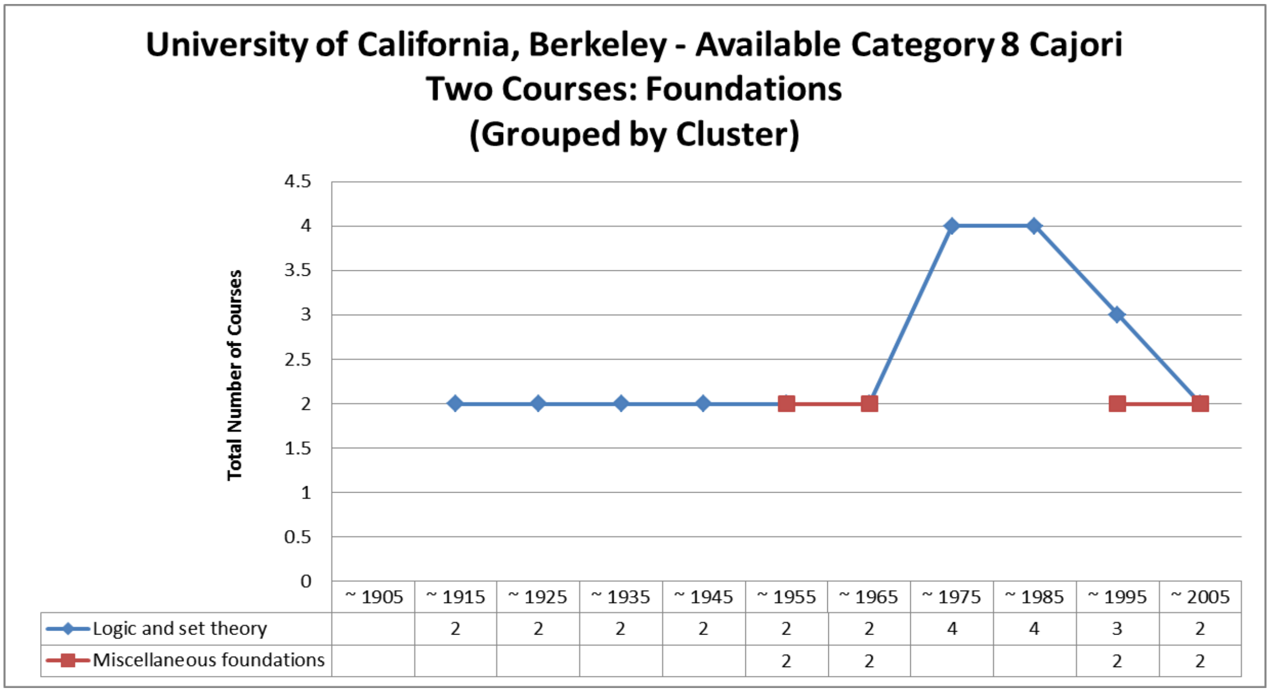
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Advanced Euclidean geometry	2	4		2	2	2	1				
Projective and non-Euclidean geometry	2					1	1				
Geometry with other mathematical machinery			2			2	5	3	3	4	2
Miscellaneous geometry											1

APPENDIX M – ALL GRAPHS OF CAJORI TWO CATEGORY 8 (CLUSTERS 35-36)

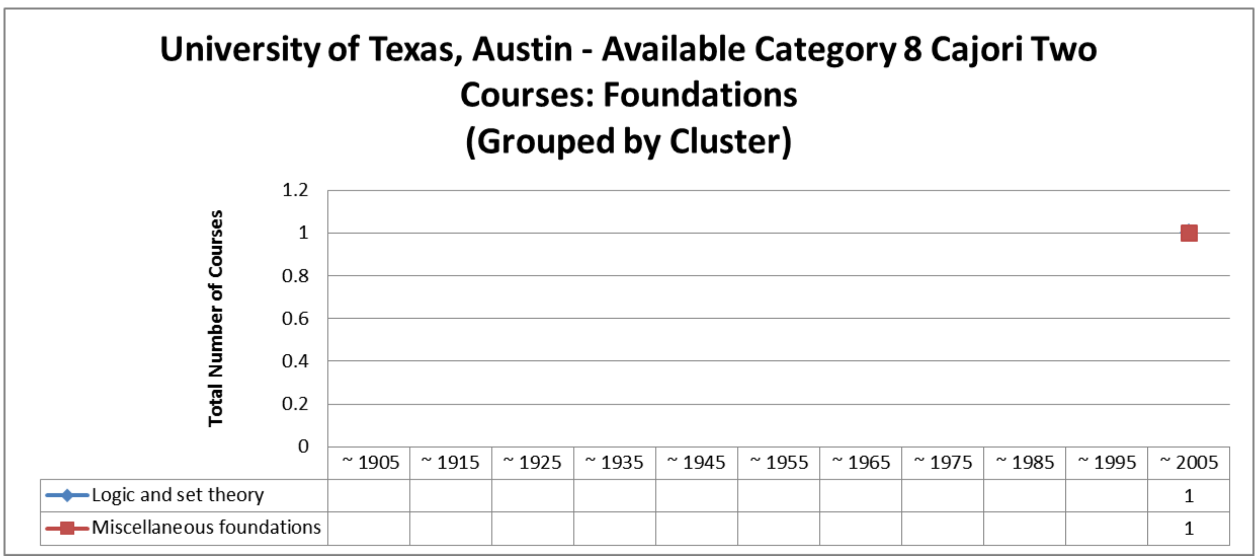


(Colorado College - No Category 8 Courses)

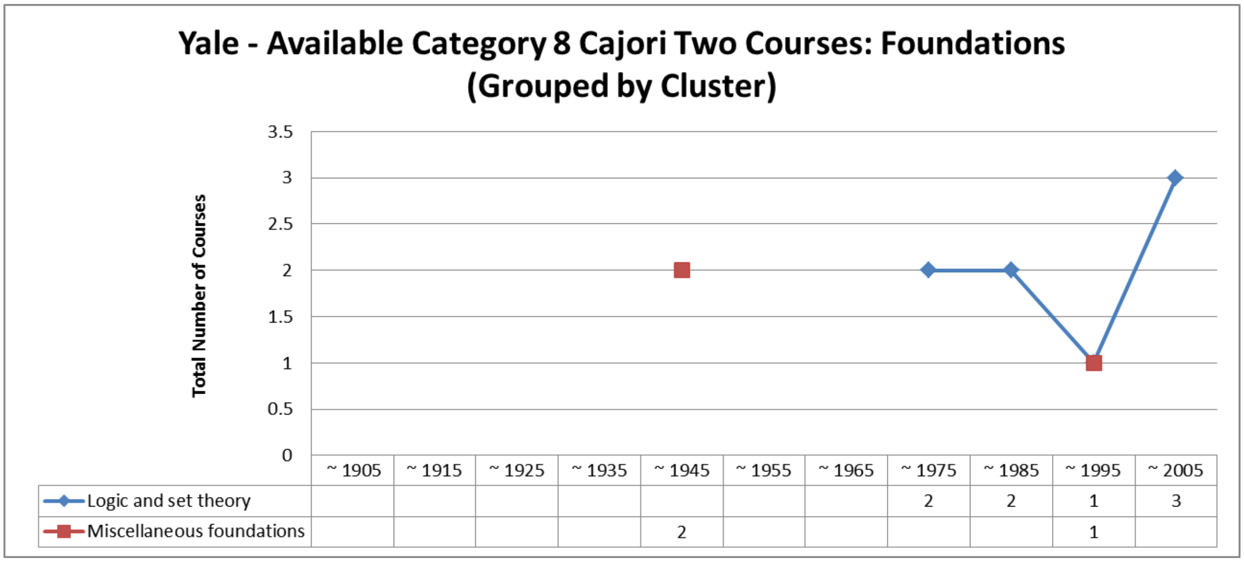




	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Logic and set theory		2	2	2	2	2	2	4	4	3	2
Miscellaneous foundations						2	2			2	2



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Logic and set theory											1
Miscellaneous foundations											1

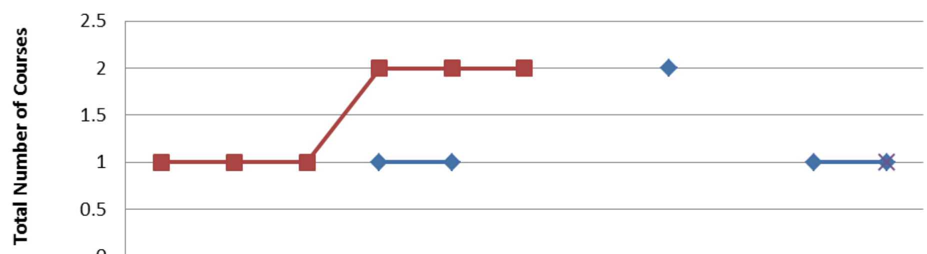

Yale - Available Category 8 Cajori Two Courses: Foundations
(Grouped by Cluster)
Total Number of Courses
3.5
3
2.5
2
1.5
1
0.5
0
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Logic and set theory 2 2 1 3
Miscellaneous foundations 2 1

APPENDIX N – ALL GRAPHS OF CAJORI TWO CATEGORY 9 (CLUSTERS 37-43)

CCNY - Available Category 9 Cajori Two Courses: Advanced Applied Courses (Grouped by Cluster)

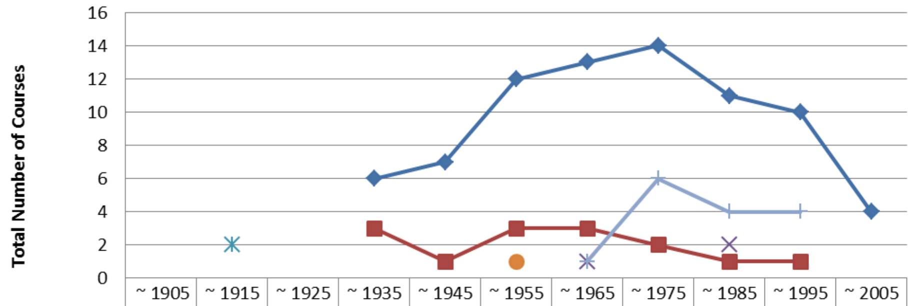
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mathematical tools used mainly in physical science/engineering	1	1	1			1	1	1	1	1	1
Modeling branches of physical science/engineering											
Mathematical tools often applicable outside physical science/engineering											
Modeling areas outside physical science/engineering, operations research, actuarial science											
Actuarial science			1	1	1	1	1				
Operations research								1	1	2	
Miscellaneous applications											

Colorado College - Available Category 9 Cajori Two Courses: Advanced Applied Courses (Grouped by Cluster)



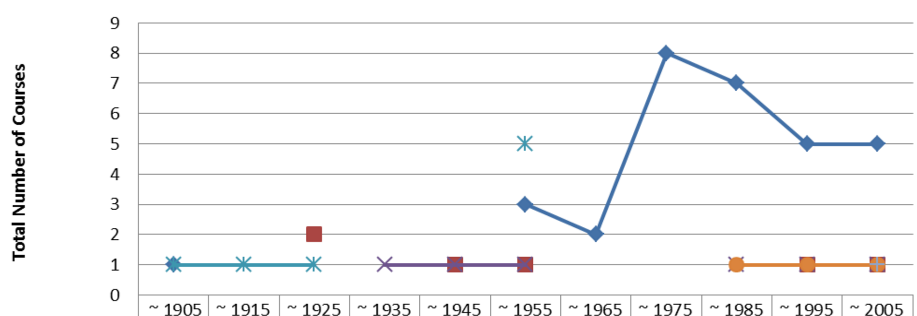
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mathematical tools used mainly in physical science/engineering				1	1			2		1	1
Modeling branches of physical science/engineering	1	1	1	2	2	2					
Mathematical tools often applicable outside physical science/engineering											
Modeling areas outside physical science/engineering, operations research, actuarial science											1
Actuarial science											
Operations research											
Miscellaneous applications											

Stanford - Available Category 9 Cajori Two Courses: Advanced Applied Courses (Grouped by Cluster)



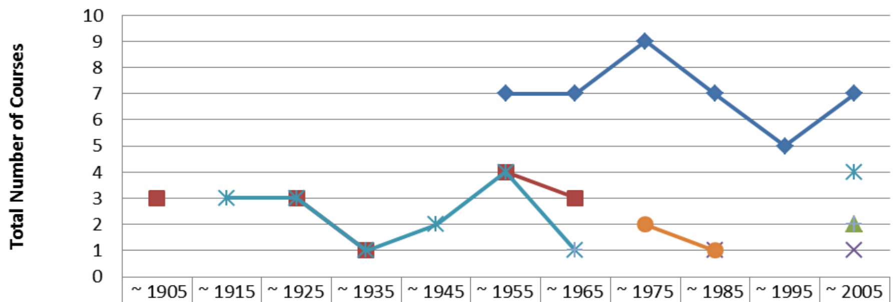
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mathematical tools used mainly in physical science/engineering				6	7	12	13	14	11	10	4
Modeling branches of physical science/engineering				3	1	3	3	2	1	1	
Mathematical tools often applicable outside physical science/engineering											
Modeling areas outside physical science/engineering, operations research, actuarial science							1		2		
Actuarial science		2									
Operations research						1					
Miscellaneous applications							1	6	4	4	

University of California, Berkeley - Available Category 9 Cajori Two Courses: Advanced Applied Courses (Grouped by Cluster)



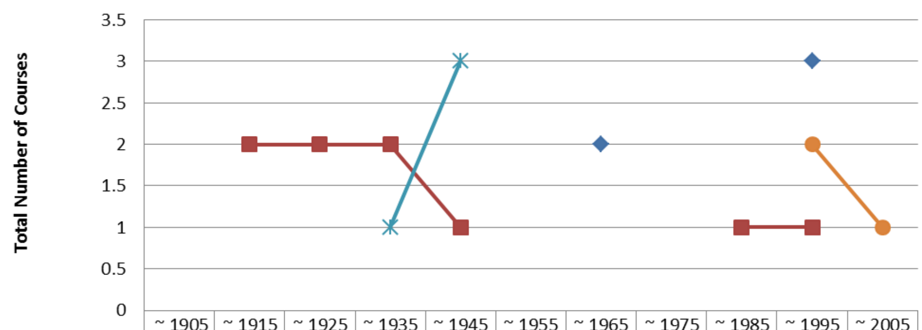
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mathematical tools used mainly in physical science/engineering	1					3	2	8	7	5	5
Modeling branches of physical science/engineering			2		1	1				1	1
Mathematical tools often applicable outside physical science/engineering											
Modeling areas outside physical science/engineering, operations research, actuarial science				1	1	1			1	1	1
Actuarial science	1	1	1			5					
Operations research									1	1	1
Miscellaneous applications											1

University of Texas, Austin - Available Category 9 Cajori Two Courses: Advanced Applied Courses (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mathematical tools used mainly in physical science/engineering						7	7	9	7	5	7
Modeling branches of physical science/engineering	3		3	1		4	3				
Mathematical tools often applicable outside physical science/engineering											2
Modeling areas outside physical science/engineering, operations research, actuarial science									1		1
Actuarial science		3	3	1	2	4	1				4
Operations research								2	1		
Miscellaneous applications							1				2

Yale - Available Category 9 Cajori Two Courses: Advanced Applied Courses (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Mathematical tools used mainly in physical science/engineering							2			3	
Modeling branches of physical science/engineering		2	2	2	1				1	1	
Mathematical tools often applicable outside physical science/engineering											
Modeling areas outside physical science/engineering, operations research, actuarial science											
Actuarial science				1	3						
Operations research										2	1
Miscellaneous applications											

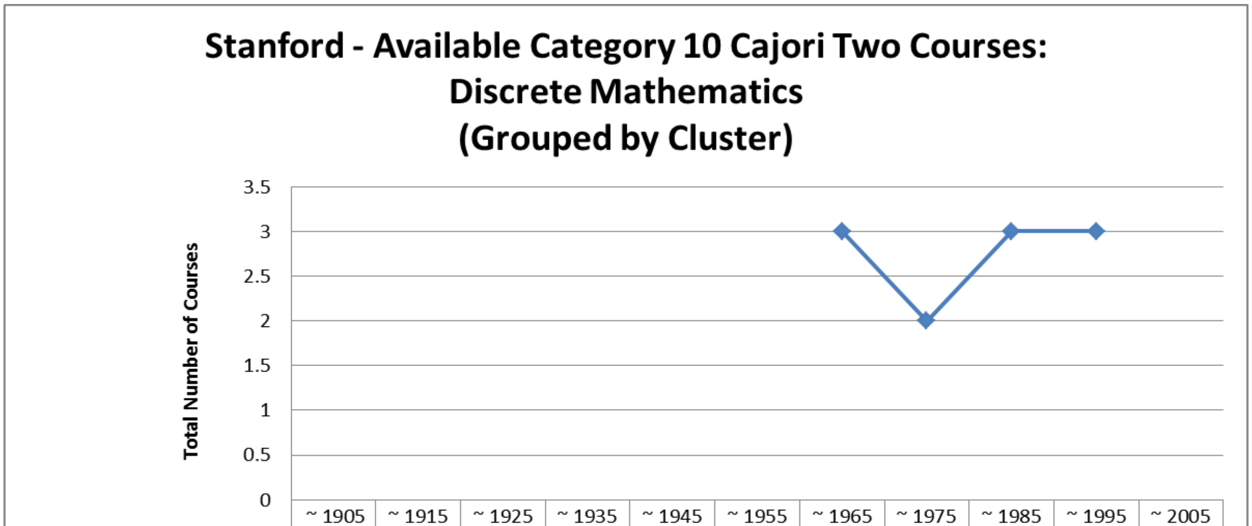
APPENDIX O – ALL GRAPHS OF CAJORI TWO CATEGORY 10 (CLUSTER 44)

CCNY - Available Category 10 Cajori Two Courses: Discrete Mathematics (Grouped by Cluster)

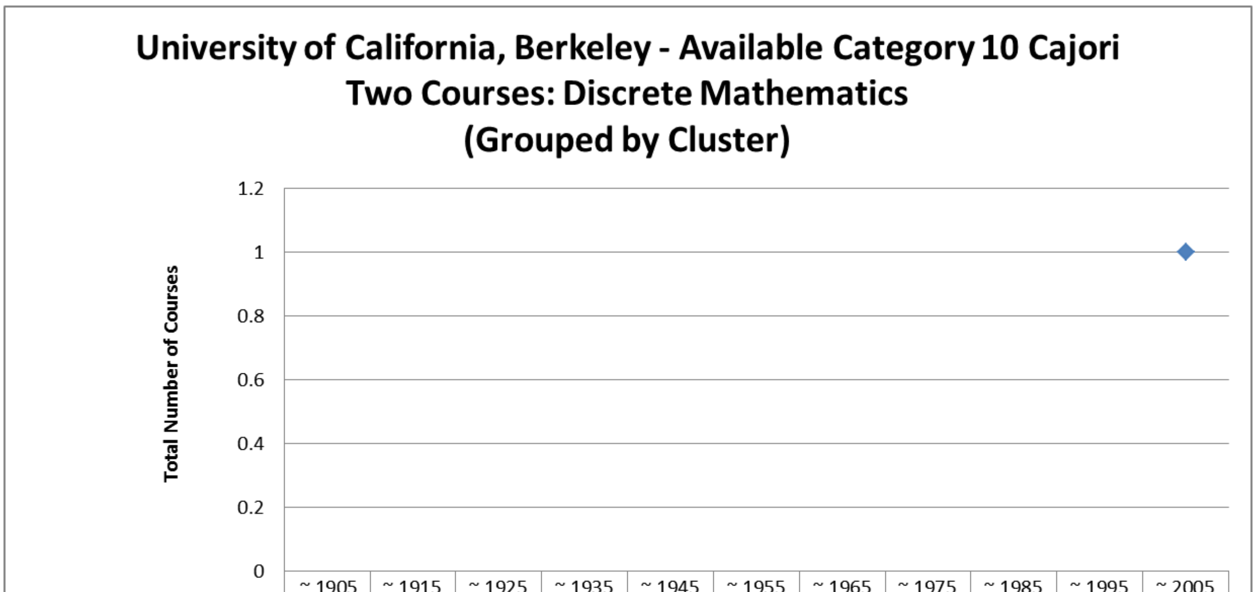
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Discrete mathematics											1

Colorado College - Available Category 10 Cajori Two Courses: Discrete Mathematics (Grouped by Cluster)

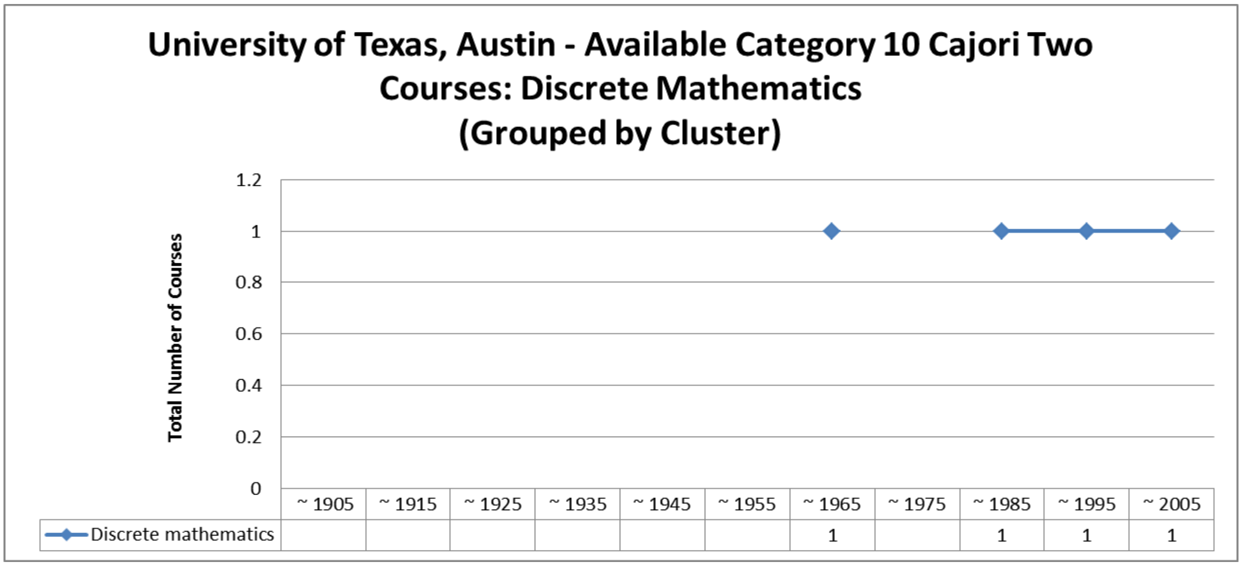
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Discrete mathematics										1	1

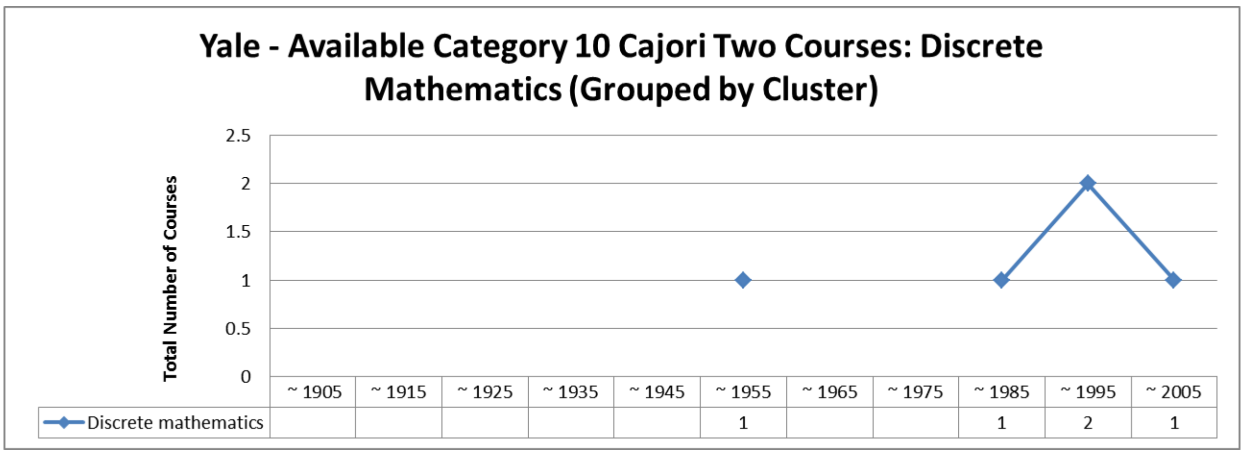


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Discrete mathematics							3	2	3	3	

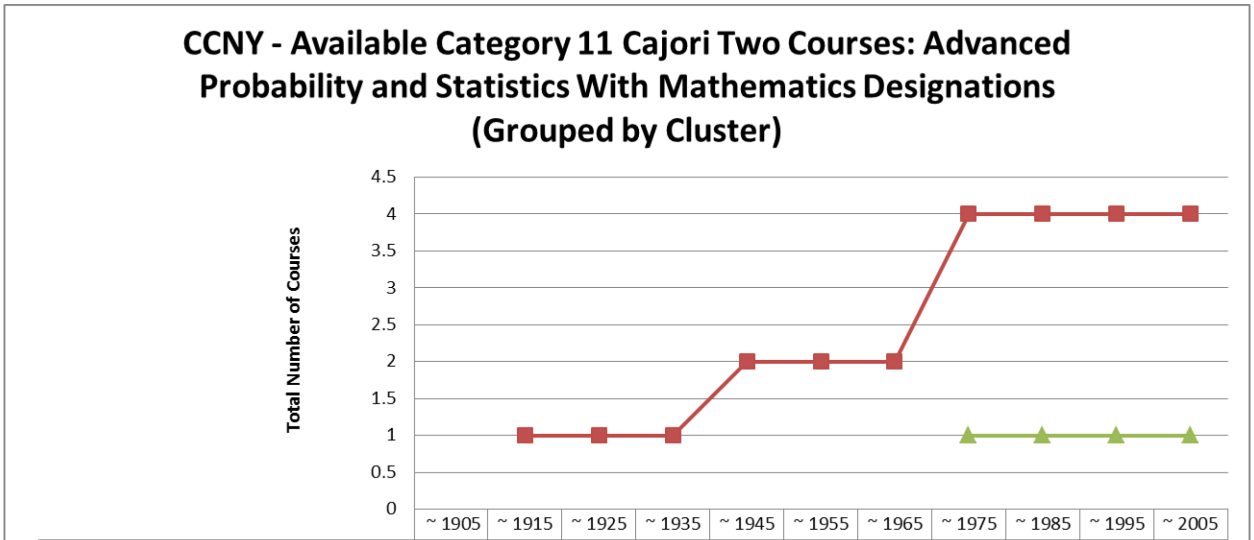


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Discrete mathematics											1

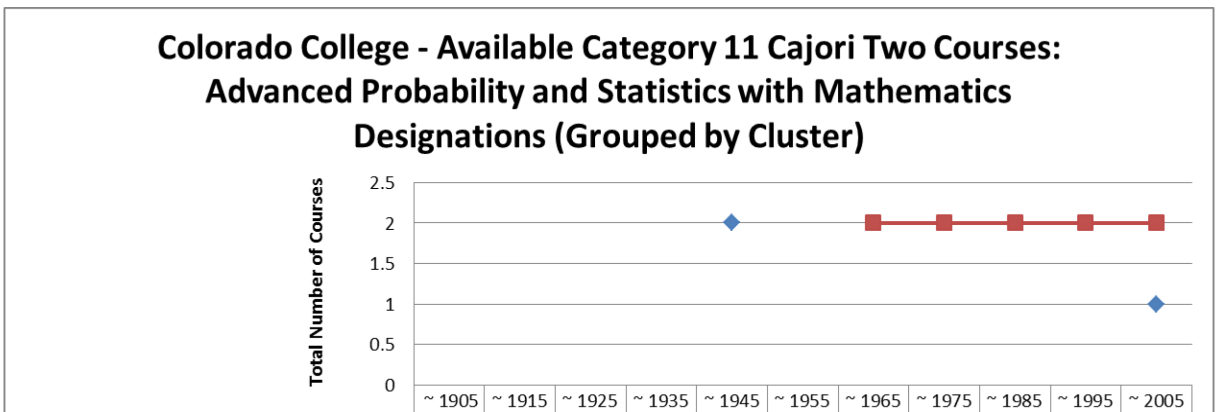

University of Texas, Austin - Available Category 10 Cajori Two Courses: Discrete Mathematics (Grouped by Cluster)
Total Number of Courses
1.2
1
0.8
0.6
0.4
0.2
0
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Discrete mathematics
1
1
1
1


Yale - Available Category 10 Cajori Two Courses: Discrete Mathematics (Grouped by Cluster)
Total Number of Courses
2.5
2
1.5
1
0.5
0
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Discrete mathematics
1
1
2
1

APPENDIX P – ALL GRAPHS OF CAJORI TWO CATEGORY 11 (CLUSTERS 45-47)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Applied Statistics											
Mathematical probabilitiy and statistics		1	1	1	2	2	2	4	4	4	4
Miscellaneous probability and statistics								1	1	1	1

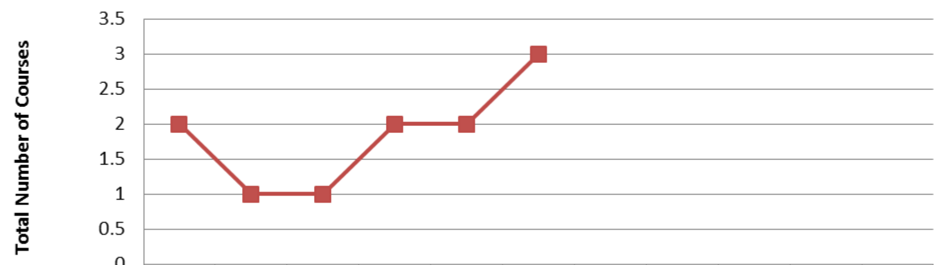


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Applied Statistics					2						1
Mathematical probabilitiy and statistics							2	2	2	2	2
Miscellaneous probability and statistics											

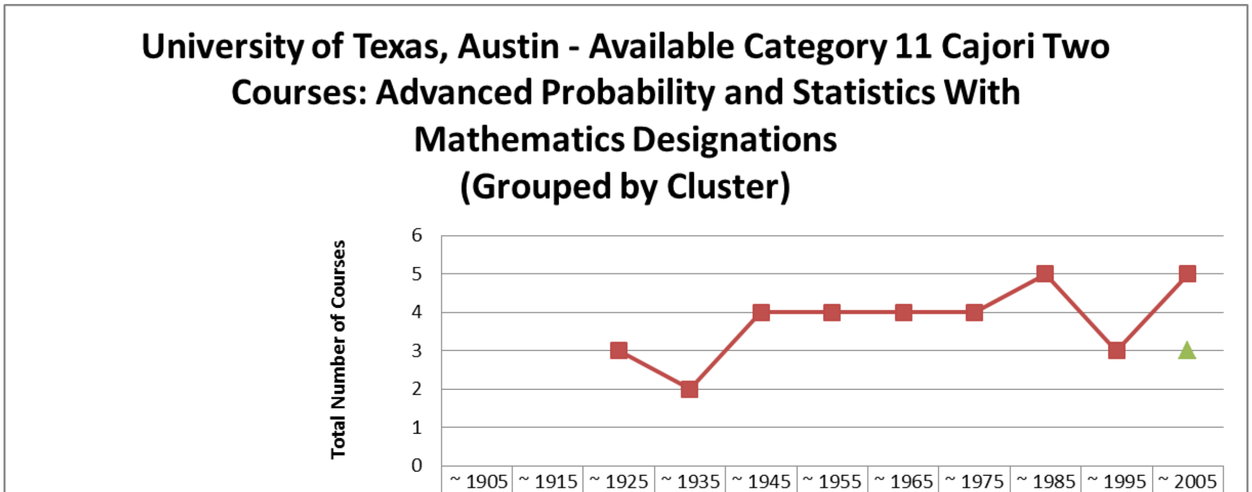
Stanford - Available Category 11 Cajori Two Courses: Advanced Probability and Statistics With Mathematics Designations (Grouped by Cluster)

	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Applied Statistics											
Mathematical probabilitiy and statistics				3	2	1	7	8	5	3	1
Miscellaneous probability and statistics							1	1	1	4	

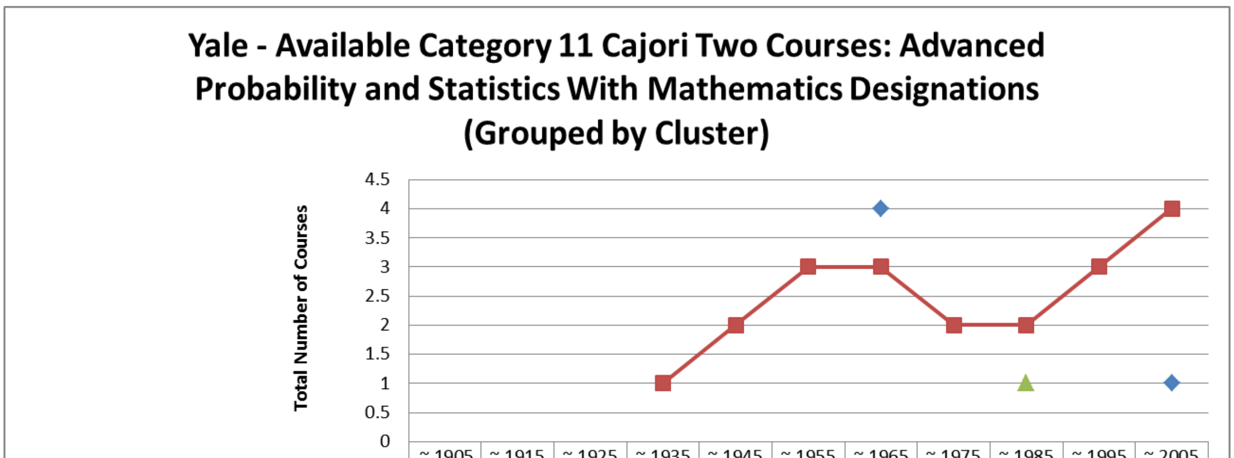
University of California, Berkeley - Available Category 11 Cajori Two Courses: Advanced Probability and Statistics With Mathematics Designations (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Applied Statistics											
Mathematical probabilitiy and statistics	2	1	1	2	2	3					
Miscellaneous probability and statistics											



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Applied Statistics											
Mathematical probabilitiy and statistics			3	2	4	4	4	4	5	3	5
Miscellaneous probability and statistics											3



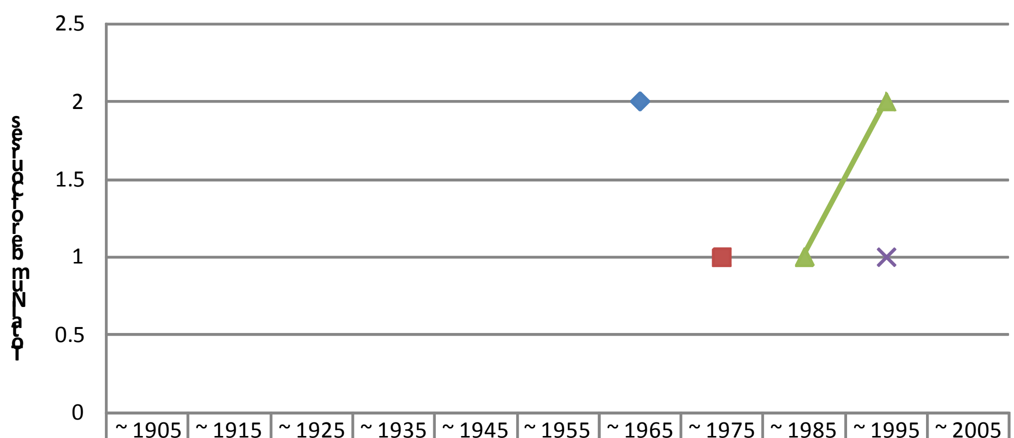
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Applied Statistics							4				1
Mathematical probabilitiy and statistics				1	2	3	3	2	2	3	4
Miscellaneous probability and statistics									1		

APPENDIX Q – ALL GRAPHS OF CAJORI TWO CATEGORY 12 (CLUSTERS 48-51)

CCNY - Available Category 12 Cajori Two Courses: Computer Science Courses with Mathematics Designations Or No Designation (Grouped by Cluster)

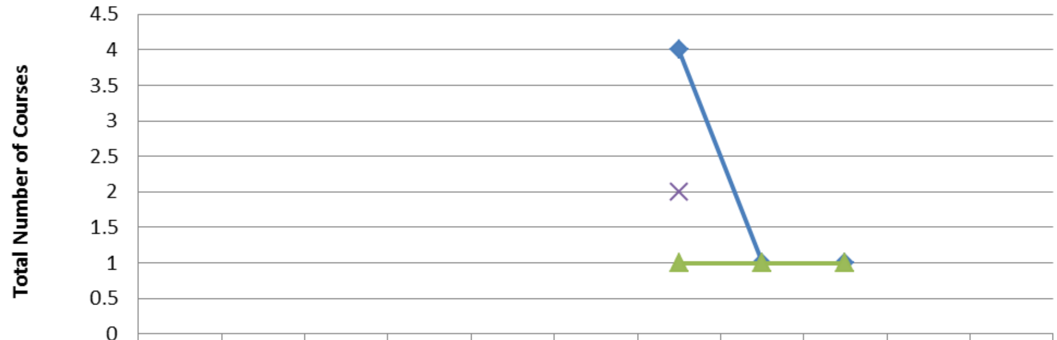
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Programming courses									1	1	
Systems											
Theory											
Applications											

Colorado College - Available Category 12 Cajori Two Courses: Computer Science Courses with Mathematics Designations Or No Designation (Grouped by Cluster)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Programming courses							2				
Systems								1			
Theory									1	2	
Applications										1	

Stanford - Available Category 12 Cajori Two Courses: Computer Science Courses with Mathematics Designations Or No Designation (Grouped by Cluster)

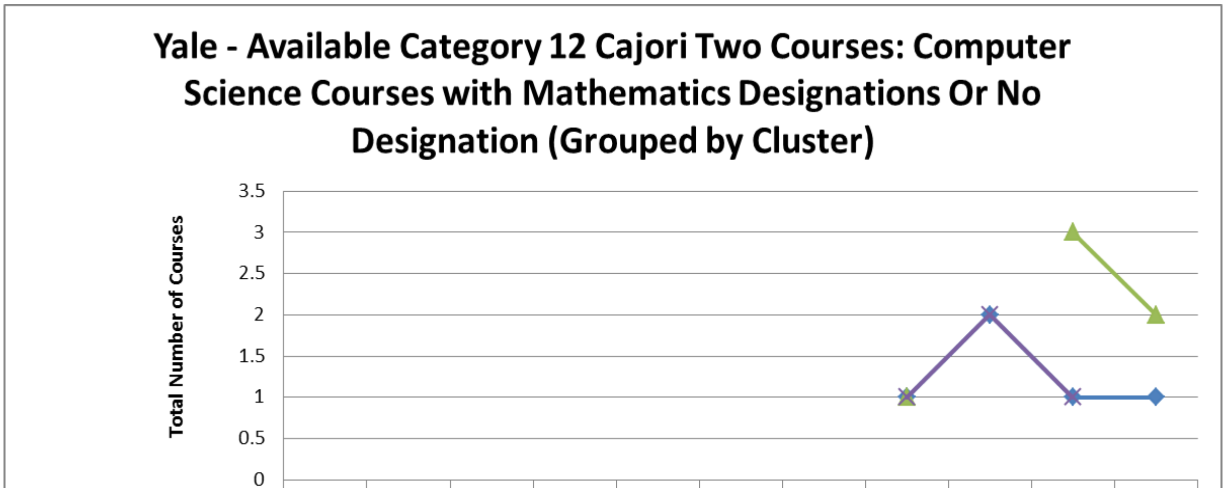


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Programming courses							4	1	1		
Systems											
Theory							1	1	1		
Applications							2				

(University of California, Berkeley - No Cajori Two Category 12 Courses: Computer Science Courses with Mathematics Designations or No Designation)

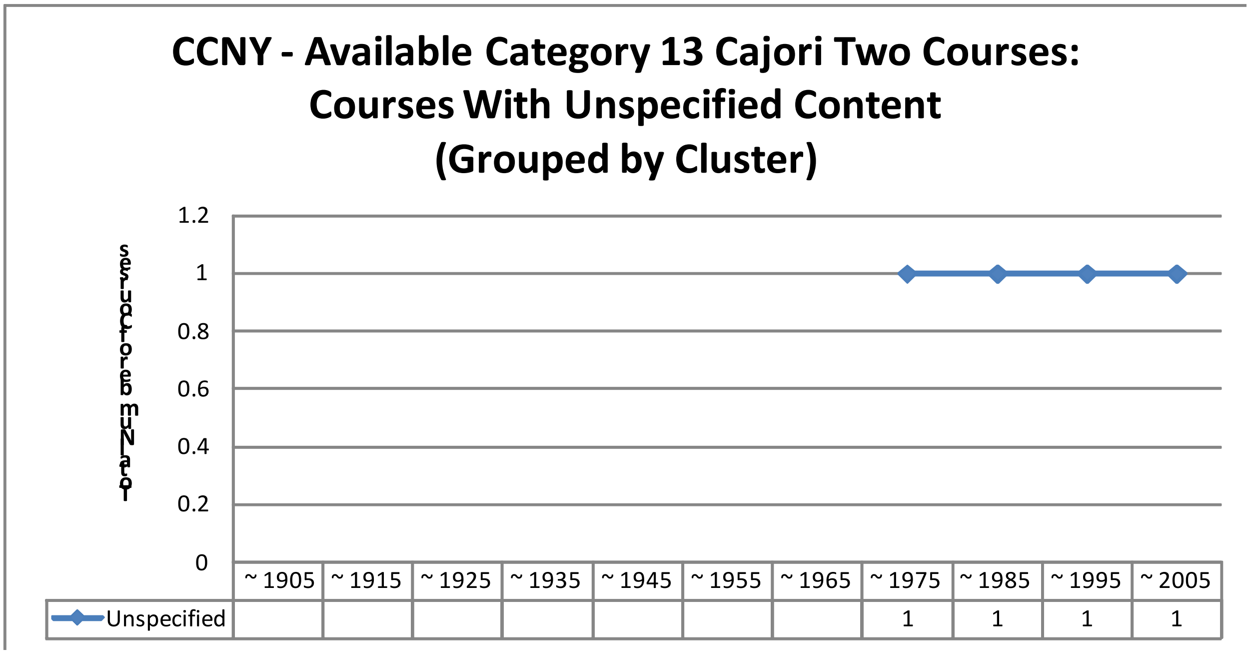
University of Texas, Austin - Available Category 12 Cajori Two Courses: Computer Science Courses with Mathematics Designations Or No Designation (Grouped by Cluster)

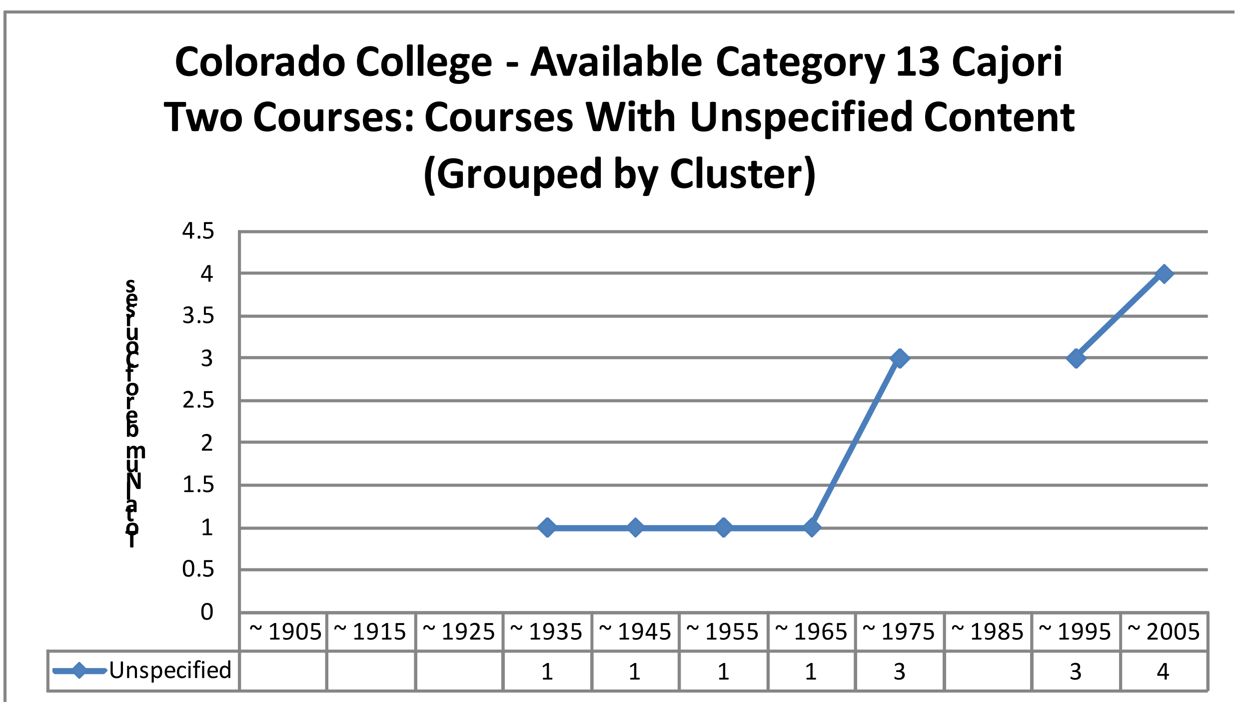
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Programming courses							1				
Systems											
Theory											
Applications							1				

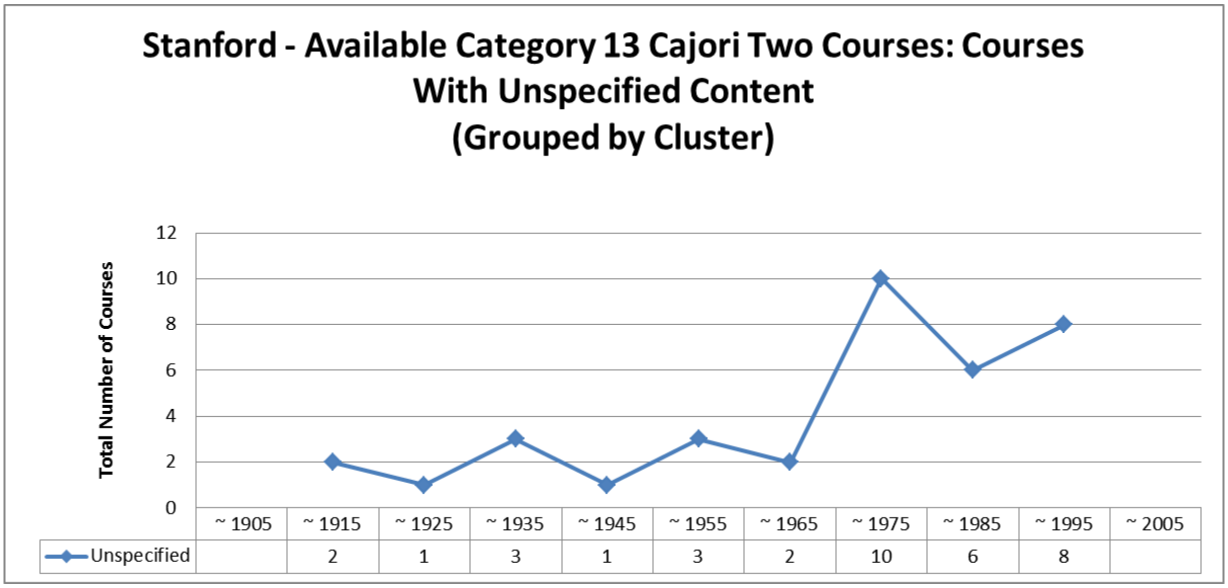


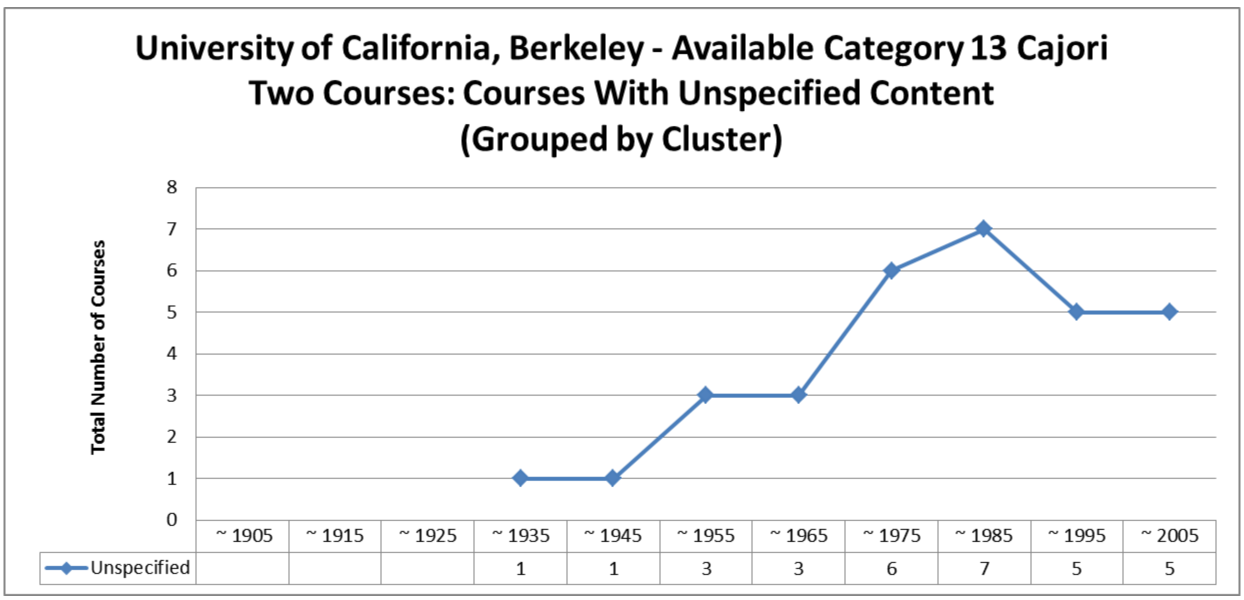
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Programming courses								1	2	1	1
Systems											
Theory								1		3	2
Applications								1	2	1	

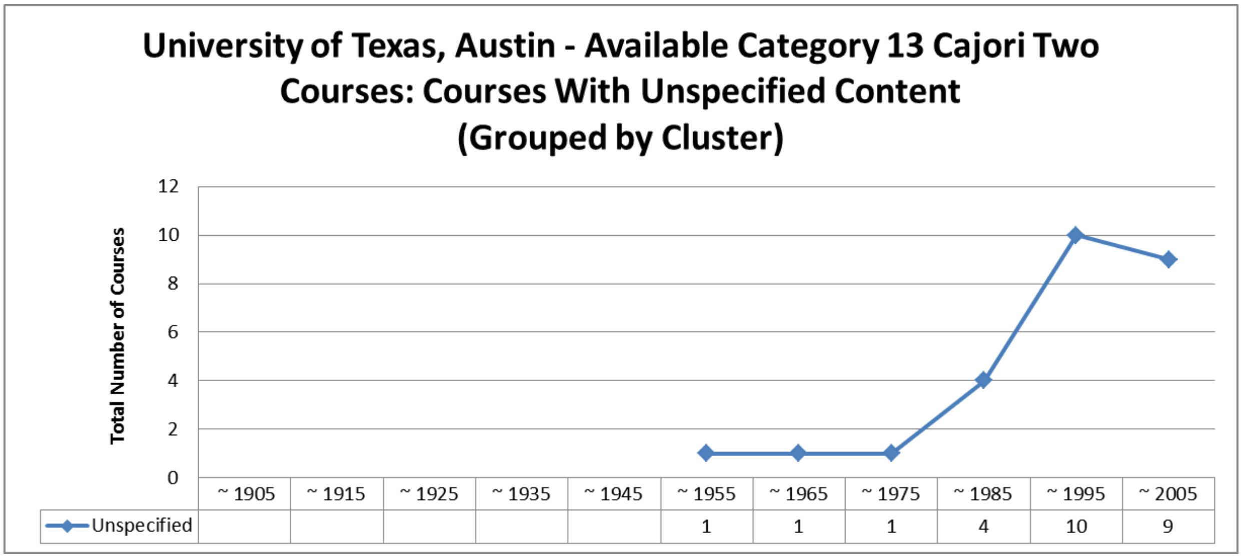
APPENDIX R – ALL GRAPHS OF CAJORI TWO CATEGORY 13 (CLUSTER 52)

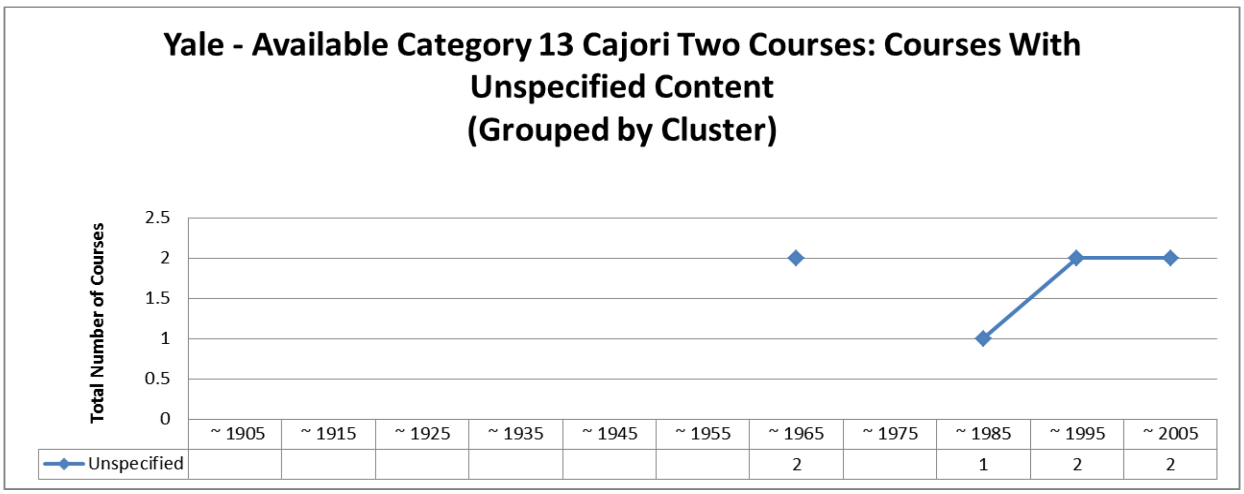




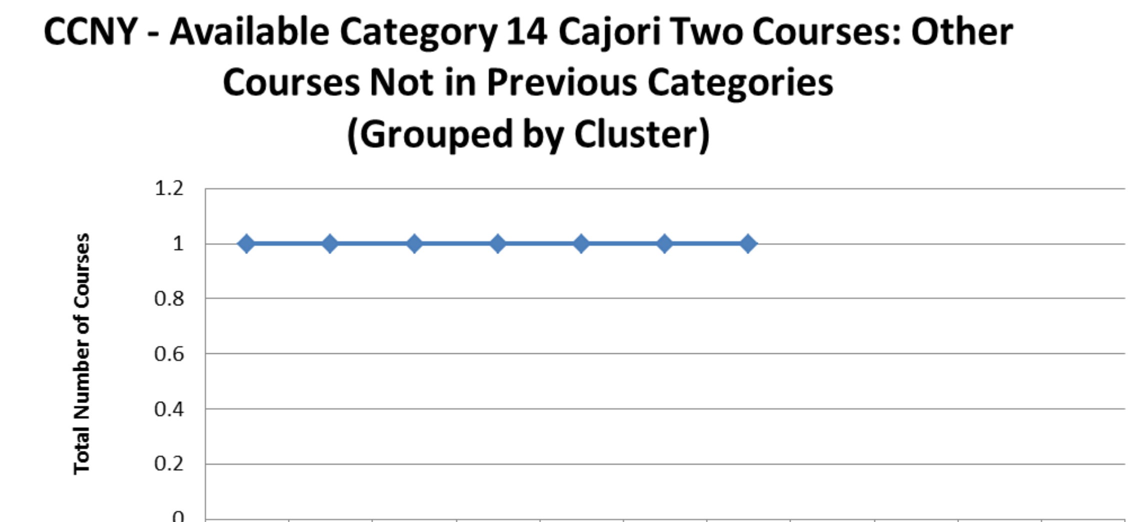

Stanford - Available Category 13 Cajori Two Courses: Courses With Unspecified Content
(Grouped by Cluster)
Total Number of Courses
0
2
4
6
8
10
12
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Unspecified
2
1
3
1
3
2
10
6
8


University of California, Berkeley - Available Category 13 Cajori Two Courses: Courses With Unspecified Content
(Grouped by Cluster)
Total Number of Courses
0
1
2
3
4
5
6
7
8
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Unspecified
1
1
3
3
6
7
5
5

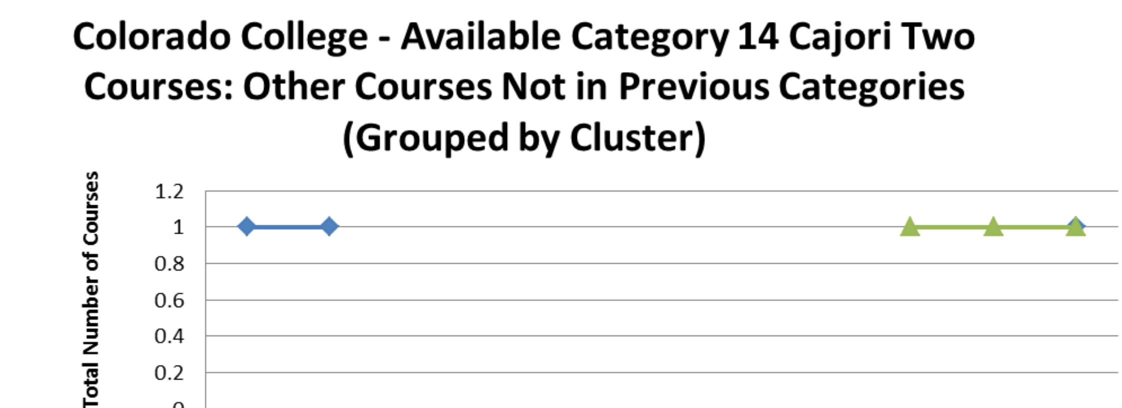

University of Texas, Austin - Available Category 13 Cajori Two Courses: Courses With Unspecified Content
(Grouped by Cluster)
Total Number of Courses
12
10
8
6
4
2
0
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Unspecified
1
1
1
4
10
9


Yale - Available Category 13 Cajori Two Courses: Courses With Unspecified Content
(Grouped by Cluster)
Total Number of Courses
2.5
2
1.5
1
0.5
0
~ 1905
~ 1915
~ 1925
~ 1935
~ 1945
~ 1955
~ 1965
~ 1975
~ 1985
~ 1995
~ 2005
Unspecified
2
1
2
2

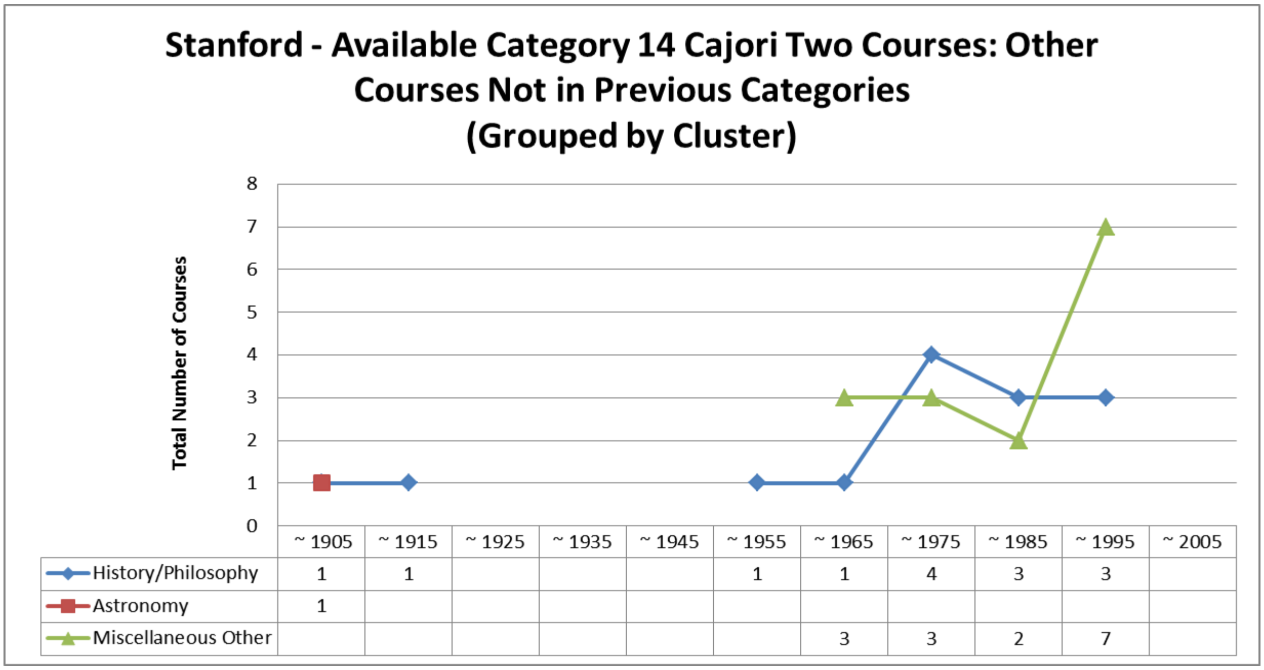
APPENDIX S – ALL GRAPHS OF CAJORI TWO CATEGORY 14 (CLUSTERS 53-55)



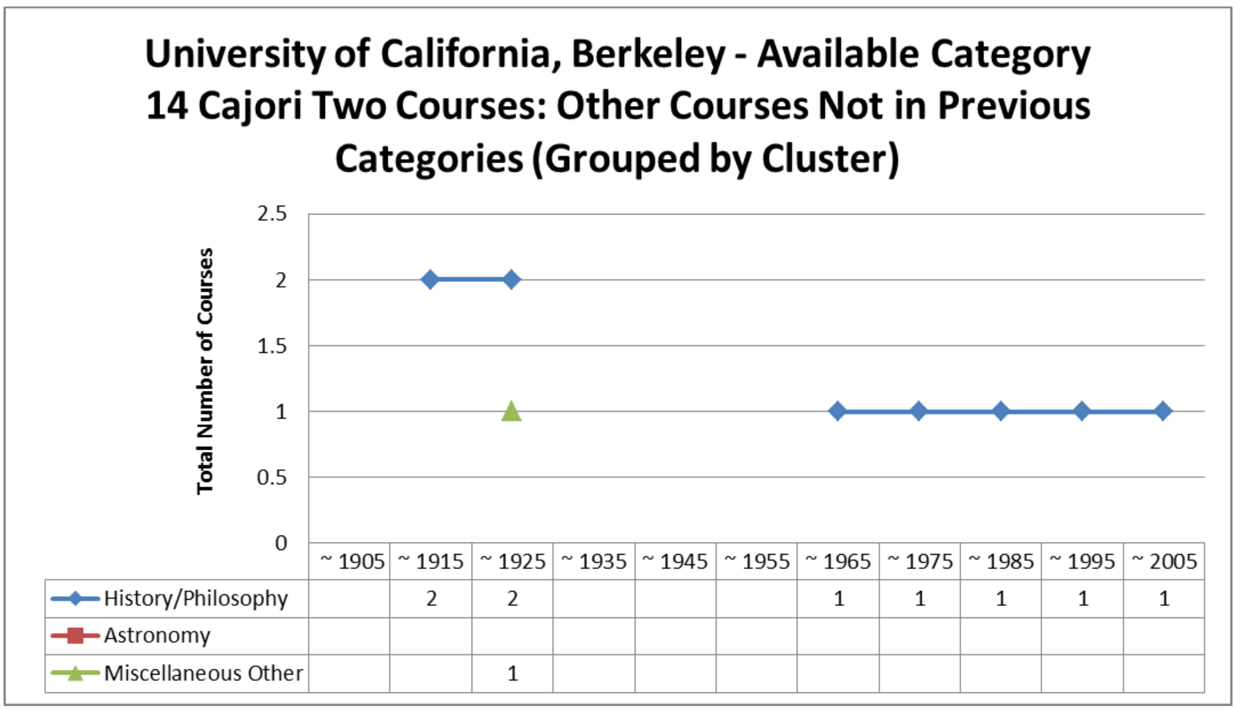
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
History/Philosophy	1	1	1	1	1	1	1				
Astronomy											
Miscellaneous Other											



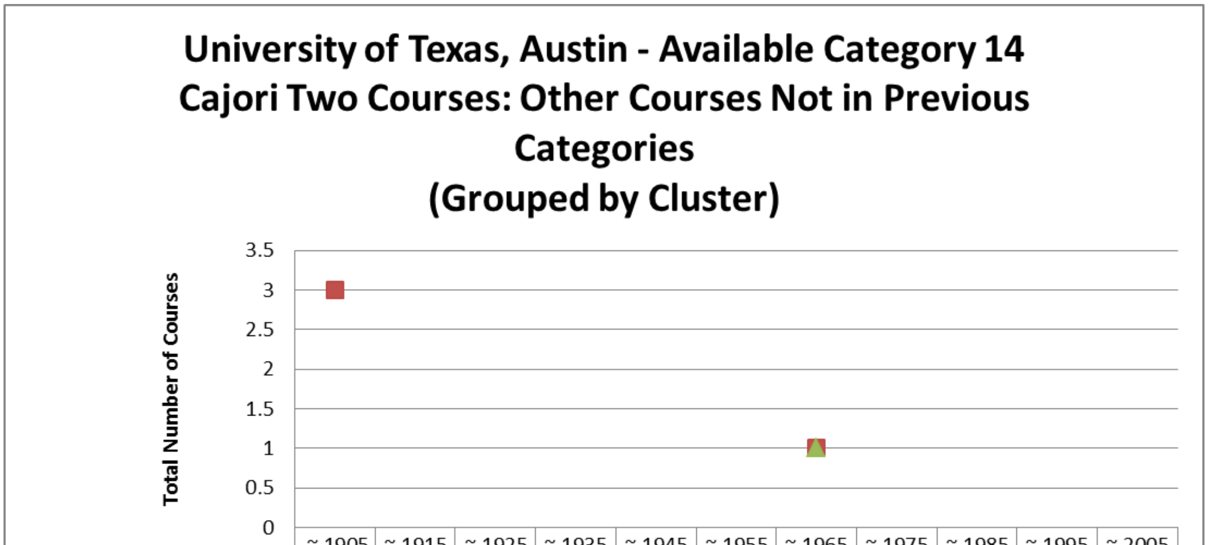
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
History/Philosophy	1	1									1
Astronomy											
Miscellaneous Other									1	1	1



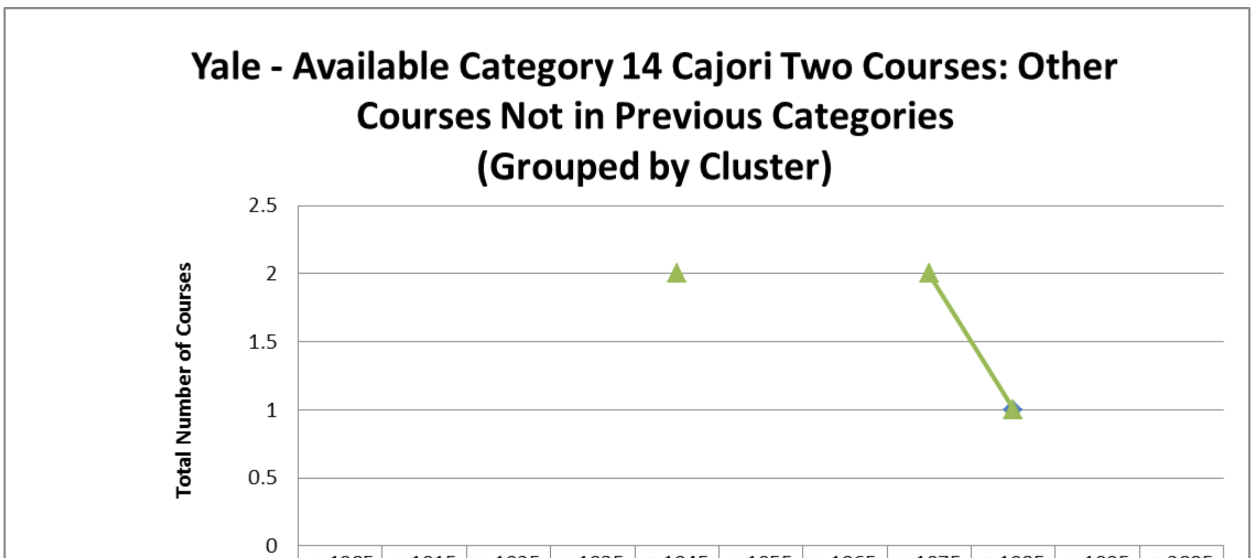
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
History/Philosophy	1	1				1	1	4	3	3	
Astronomy	1										
Miscellaneous Other							3	3	2	7	



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
History/Philosophy		2	2				1	1	1	1	1
Astronomy											
Miscellaneous Other			1								



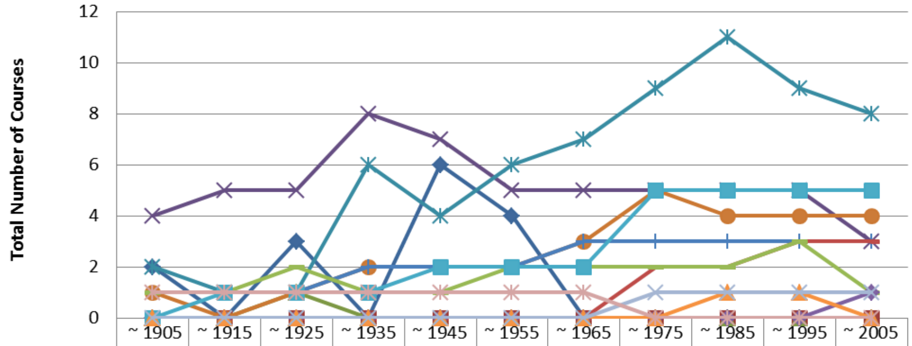
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
History/Philosophy											
Astronomy	3						1				
Miscellaneous Other							1				



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
History/Philosophy									1		
Astronomy											
Miscellaneous Other					2			2	1		

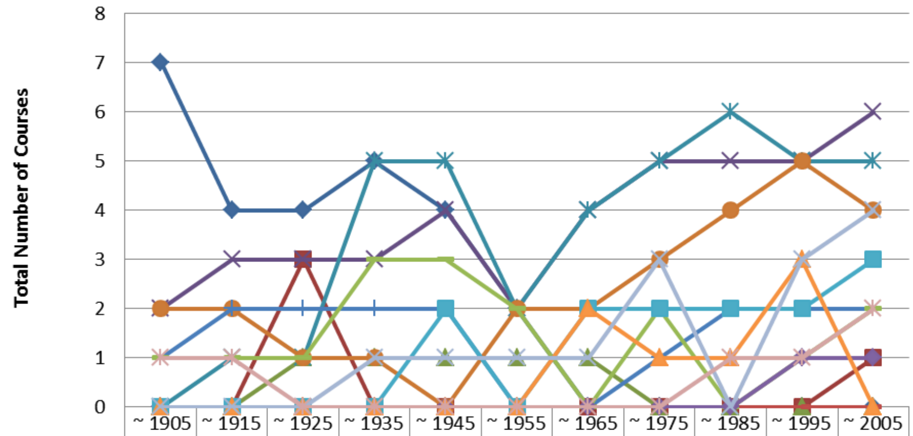
APPENDIX T – ALL GRAPHS OF COURSES GROUPED BY CAJORI TWO CATEGORIES

CCNY - Frequency of Courses from 1905-2005 (Grouped by Cajori Two Categories)



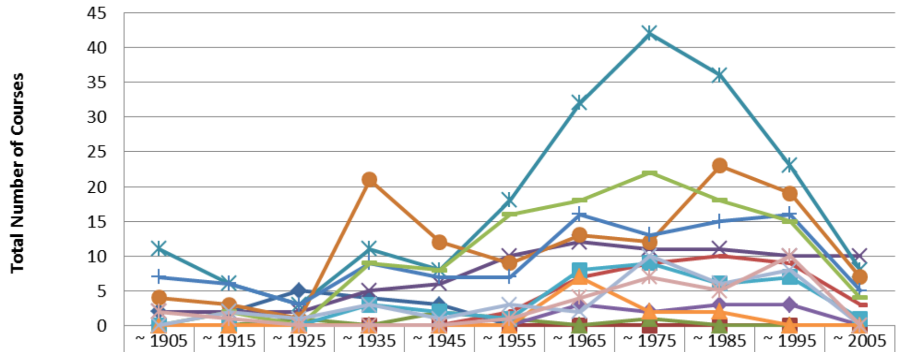
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	2	0	3	0	6	4	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	1	0	0	0	0	0	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	4	5	5	8	7	5	5	5	5	5	3
Cajori Two Category 5 - Analysis Following Basic Calculus	2	1	1	6	4	6	7	9	11	9	8
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	1	0	1	2	2	2	3	5	4	4	4
Cajori Two Category 7 - Advanced Geometry and Topology	1	1	1	2	2	2	3	3	3	3	3
Cajori Two Category 8 - Foundations	0	0	0	0	0	0	0	2	2	3	3
Cajori Two Category 9 - Advanced Applied Courses	1	1	2	1	1	2	2	2	2	3	1
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	0	0	0	0	1
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	1	1	1	2	2	2	5	5	5	5
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	0	0	1	1	0
Cajori Two Category 13 - Courses With Unspecified Content	0	0	0	0	0	0	0	1	1	1	1
Cajori Two Category 14 - Other Courses Not in Previous Categories	1	1	1	1	1	1	1	0	0	0	0

Colorado College - Frequency of Courses from 1905-2005 (Grouped by Cajori Two Categories)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	7	4	4	5	4	2	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	3	0	0	0	0	0	0	0	1
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	1	1	1	1	1	0	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	2	3	3	3	4	2	4	5	5	5	6
Cajori Two Category 5 - Analysis Following Basic Calculus	0	1	1	5	5	2	4	5	6	5	5
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	2	2	1	1	0	2	2	3	4	5	4
Cajori Two Category 7 - Advanced Geometry and Topology	1	2	2	2	2	0	0	1	2	2	2
Cajori Two Category 8 - Foundations	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 9 - Advanced Applied Courses	1	1	1	3	3	2	0	2	0	1	2
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	0	0	0	1	1
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	0	0	2	0	2	2	2	2	3
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	2	1	1	3	0
Cajori Two Category 13 - Courses With Unspecified Content	0	0	0	1	1	1	1	3	0	3	4
Cajori Two Category 14 - Other Courses Not in Previous Categories	1	1	0	0	0	0	0	0	1	1	2

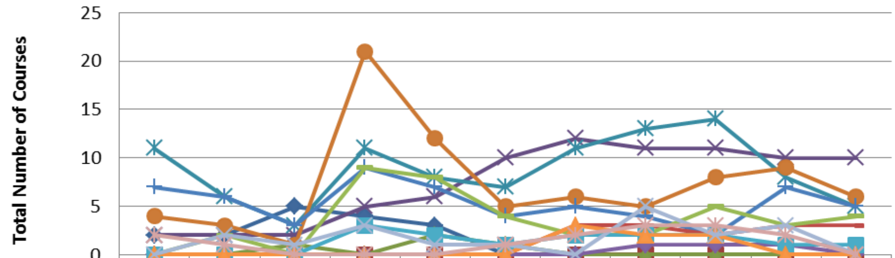
Stanford - Frequency of Courses from 1905-2005 (Grouped by Cajori Two Categories)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	2	2	5	4	3	0	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	1	0	2	1	0	1	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	2	2	2	5	6	10	12	11	11	10	10
Cajori Two Category 5 - Analysis Following Basic Calculus	11	6	3	11	8	18	32	42	36	23	8
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	4	3	1	21	12	9	13	12	23	19	7
Cajori Two Category 7 - Advanced Geometry and Topology	7	6	3	9	7	7	16	13	15	16	5
Cajori Two Category 8 - Foundations	0	0	0	0	0	2	7	9	10	9	3
Cajori Two Category 9 - Advanced Applied Courses	0	2	0	9	8	16	18	22	18	15	4
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	3	2	3	3	0
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	0	3	2	1	8	9	6	7	1
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	7	2	2	0	0
Cajori Two Category 13 - Courses With Unspecified Content	0	2	1	3	1	3	2	10	6	8	0
Cajori Two Category 14 - Other Courses Not in Previous Categories	2	1	0	0	0	1	4	7	5	10	0

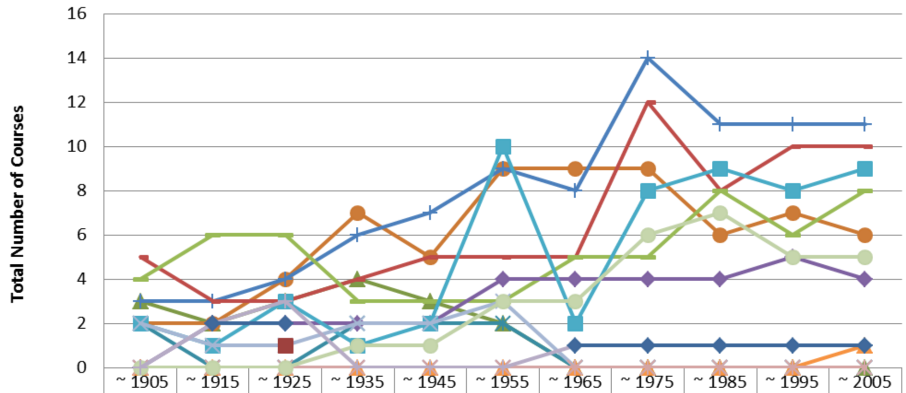
Note: The graduate mathematics courses are included here from 1955 – 1994 since they were recommended to undergraduates interested in pursuing graduate studies in mathematics.

Stanford - Frequency of Courses (NOT including those Primarily for Graduate Students) from 1905-2005 (Grouped by Cajori Two Categories)



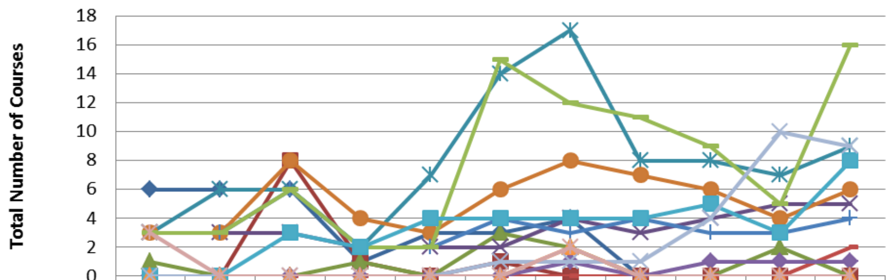
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	2	2	5	4	3	0	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	1	0	2	1	0	0	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	2	2	2	5	6	10	12	11	11	10	10
Cajori Two Category 5 - Analysis Following Basic Calculus	11	6	3	11	8	7	11	13	14	8	5
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	4	3	1	21	12	5	6	5	8	9	6
Cajori Two Category 7 - Advanced Geometry and Topology	7	6	3	9	7	4	5	4	2	7	5
Cajori Two Category 8 - Foundations	0	0	0	0	0	0	3	3	2	3	3
Cajori Two Category 9 - Advanced Applied Courses	0	2	0	9	8	4	2	2	5	3	4
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	0	1	1	1	0
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	0	3	2	1	2	2	2	1	1
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	3	2	2	0	0
Cajori Two Category 13 - Courses With Unspecified Content	0	2	1	3	1	1	0	5	2	3	0
Cajori Two Category 14 - Other Courses Not in Previous Categories	2	1	0	0	0	1	2	3	3	2	0

University of California, Berkeley - Frequency of Courses from 1905-2005 (Grouped by Cajori Two Categories)



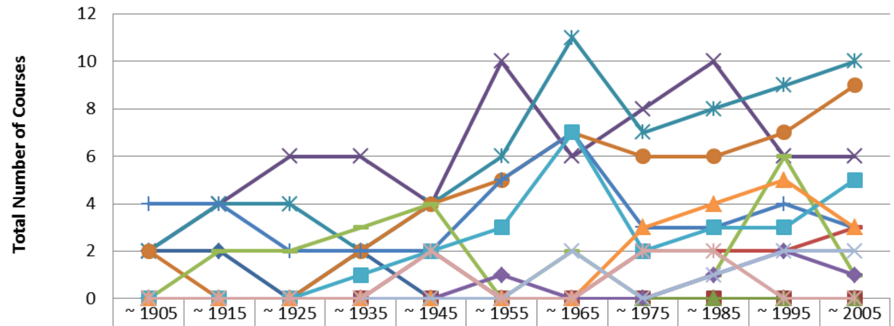
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	3	2	3	4	3	2	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	2	0	0	2	2	2	0	0	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	2	2	4	7	5	9	9	9	6	7	6
Cajori Two Category 5 - Analysis Following Basic Calculus	3	3	4	6	7	9	8	14	11	11	11
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	5	3	3	4	5	5	5	12	8	10	10
Cajori Two Category 7 - Advanced Geometry and Topology	4	6	6	3	3	3	5	5	8	6	8
Cajori Two Category 8 - Foundations	0	2	2	2	2	4	4	4	4	5	4
Cajori Two Category 9 - Advanced Applied Courses	2	1	3	1	2	10	2	8	9	8	9
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	0	0	0	0	1
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	2	1	1	2	2	3	0	0	0	0	0
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 13 - Courses With Unspecified Content	0	0	0	1	1	3	3	6	7	5	5
Cajori Two Category 14 - Other Courses Not in Previous Categories	0	2	3	0	0	0	1	1	1	1	1
History/Philosophy		2	2				1	1	1	1	1
Miscellaneous Other			1								

University of Texas, Austin - Frequency of Courses from 1905-2005 (Grouped by Cajori Two Categories)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	6	6	6	1	3	3	4	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	8	1	0	1	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	1	0	0	1	0	3	2	0	0	2	0
Cajori Two Category 4 - Basic Calculus Sequences	3	3	3	2	2	2	4	3	4	5	5
Cajori Two Category 5 - Analysis Following Basic Calculus	3	6	6	2	7	14	17	8	8	7	9
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	3	3	8	4	3	6	8	7	6	4	6
Cajori Two Category 7 - Advanced Geometry and Topology	3	3	6	2	2	4	3	4	3	3	4
Cajori Two Category 8 - Foundations	0	0	0	0	0	0	0	0	0	0	2
Cajori Two Category 9 - Advanced Applied Courses	3	3	6	2	2	15	12	11	9	5	16
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	1	0	1	1	1
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	3	2	4	4	4	4	5	3	8
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	2	0	0	0	0
Cajori Two Category 13 - Courses With Unspecified Content	0	0	0	0	0	1	1	1	4	10	9
Cajori Two Category 14 - Other Courses Not in Previous Categories	3	0	0	0	0	0	2	0	0	0	0

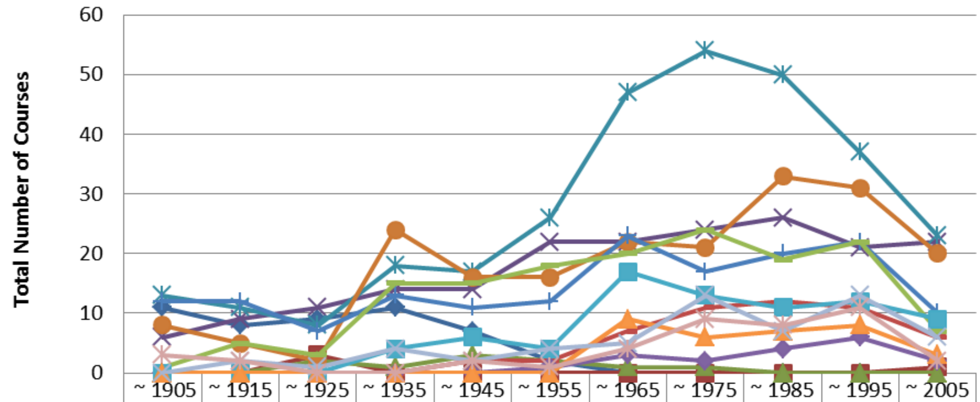
Yale - Frequency of Courses from 1905-2005
(Grouped by Cajori Two Categories)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	2	2	0	2	0	0	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	0	0	0	0	0	0	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	2	4	6	6	4	10	6	8	10	6	6
Cajori Two Category 5 - Analysis Following Basic Calculus	2	4	4	2	4	6	11	7	8	9	10
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	2	0	0	2	4	5	7	6	6	7	9
Cajori Two Category 7 - Advanced Geometry and Topology	4	4	2	2	2	5	7	3	3	4	3
Cajori Two Category 8 - Foundations	0	0	0	0	2	0	0	2	2	2	3
Cajori Two Category 9 - Advanced Applied Courses	0	2	2	3	4	0	2	0	1	6	1
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	1	0	0	1	2	1
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	0	1	2	3	7	2	3	3	5
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	0	3	4	5	3
Cajori Two Category 13 - Courses With Unspecified Content	0	0	0	0	0	0	2	0	1	2	2
Cajori Two Category 14 - Other Courses Not in Previous Categories	0	0	0	0	2	0	0	2	2	0	0

APPENDIX U – COMPARISON GRAPHS

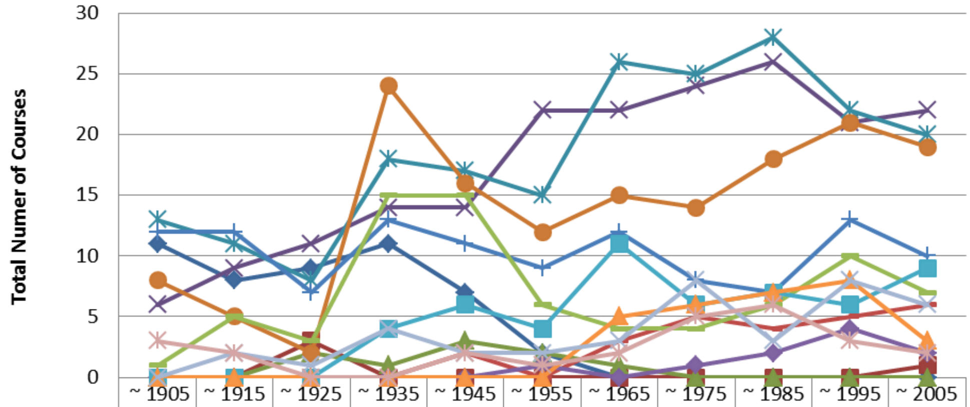
Private Colleges (Including the Graduate Courses at Stanford from 1955-1994*)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	11	8	9	11	7	2	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	3	0	0	0	0	0	0	0	1
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	2	1	3	2	1	1	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	6	9	11	14	14	22	22	24	26	21	22
Cajori Two Category 5 - Analysis Following Basic Calculus	13	11	8	18	17	26	47	54	50	37	23
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	8	5	2	24	16	16	22	21	33	31	20
Cajori Two Category 7 - Advanced Geometry and Topology	12	12	7	13	11	12	23	17	20	22	10
Cajori Two Category 8 - Foundations	0	0	0	0	2	2	7	11	12	11	6
Cajori Two Category 9 - Advanced Applied Courses	1	5	3	15	15	18	20	24	19	22	7
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	1	3	2	4	6	2
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	0	4	6	4	17	13	11	12	9
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	9	6	7	8	3
Cajori Two Category 13 - Courses With Unspecified Content	0	2	1	4	2	4	5	13	7	13	6
Cajori Two Category 14 - Other Courses Not in Previous Categories	3	2	0	0	2	1	4	9	8	11	2

* Stanford University allows, and even recommends, that students take the graduate courses during 1955-1994.

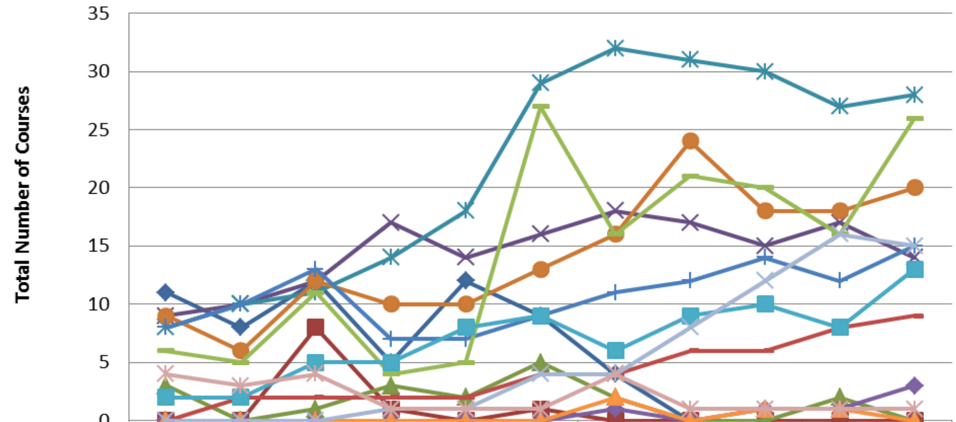
Private Colleges (NOT Including the Graduate Courses at Stanford from 1955-1994*)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	11	8	9	11	7	2	0	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	3	0	0	0	0	0	0	0	1
Cajori Two Category 3 - Mathematics Expressly for Teachers	0	0	2	1	3	2	1	0	0	0	0
Cajori Two Category 4 - Basic Calculus Sequences	6	9	11	14	14	22	22	24	26	21	22
Cajori Two Category 5 - Analysis Following Basic Calculus	13	11	8	18	17	15	26	25	28	22	20
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	8	5	2	24	16	12	15	14	18	21	19
Cajori Two Category 7 - Advanced Geometry and Topology	12	12	7	13	11	9	12	8	7	13	10
Cajori Two Category 8 - Foundations	0	0	0	0	2	0	3	5	4	5	6
Cajori Two Category 9 - Advanced Applied Courses	1	5	3	15	15	6	4	4	6	10	7
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	1	0	1	2	4	2
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	0	0	0	4	6	4	11	6	7	6	9
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	5	6	7	8	3
Cajori Two Category 13 - Courses With Unspecified Content	0	2	1	4	2	2	3	8	3	8	6
Cajori Two Category 14 - Other Courses Not in Previous Categories	3	2	0	0	2	1	2	5	6	3	2

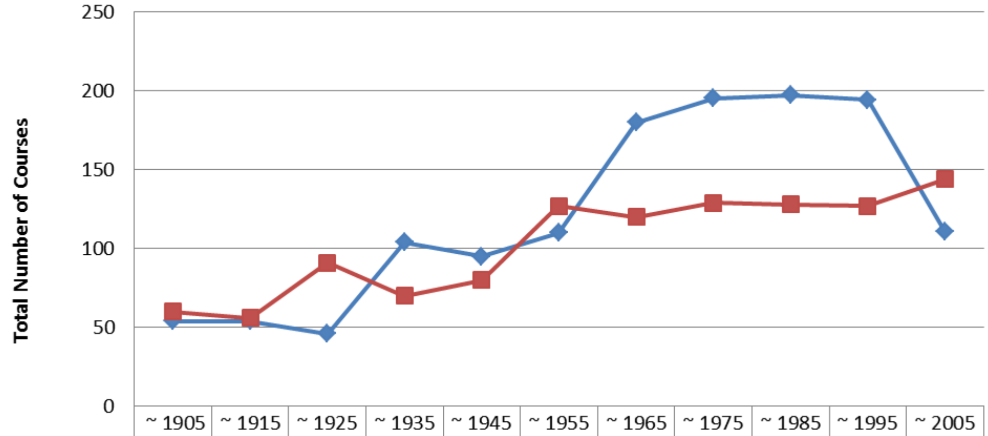
* Stanford University allows, and even recommends, that students take the graduate courses during 1955-1994.

Public Colleges



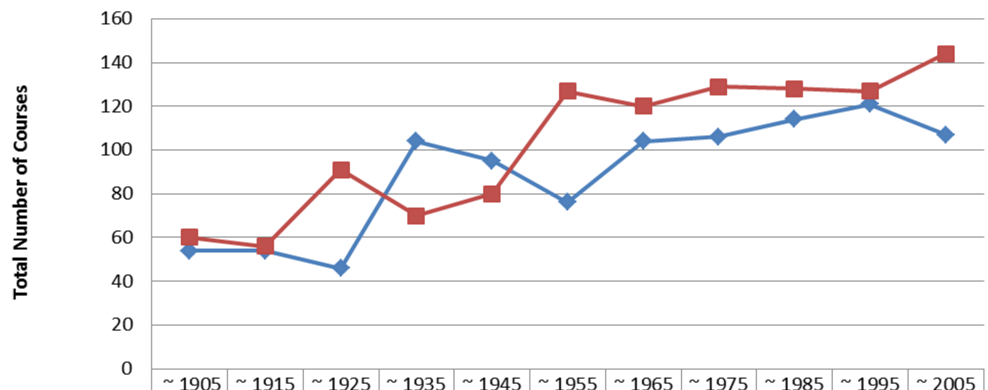
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Cajori Two Category 1 - Elementary Courses in Algebra, Geometry and Trigonometry	11	8	12	5	12	9	4	0	0	0	0
Cajori Two Category 2 - Elementary Service Plus General Education	0	0	8	1	0	1	0	0	0	0	0
Cajori Two Category 3 - Mathematics Expressly for Teachers	3	0	1	3	2	5	2	0	0	2	0
Cajori Two Category 4 - Basic Calculus Sequences	9	10	12	17	14	16	18	17	15	17	14
Cajori Two Category 5 - Analysis Following Basic Calculus	8	10	11	14	18	29	32	31	30	27	28
Cajori Two Category 6 - Higher and Abstract Algebra, Linear Algebra and Number Theory	9	6	12	10	10	13	16	24	18	18	20
Cajori Two Category 7 - Advanced Geometry and Topology	8	10	13	7	7	9	11	12	14	12	15
Cajori Two Category 8 - Foundations	0	2	2	2	2	4	4	6	6	8	9
Cajori Two Category 9 - Advanced Applied Courses	6	5	11	4	5	27	16	21	20	16	26
Cajori Two Category 10 - Discrete Mathematics	0	0	0	0	0	0	1	0	1	1	3
Cajori Two Category 11 - Advanced Probability and Statistics With Mathematics Designations	2	2	5	5	8	9	6	9	10	8	13
Cajori Two Category 12 - Computer Science Courses with Mathematics Designations Or No Designation	0	0	0	0	0	0	2	0	1	1	0
Cajori Two Category 13 - Courses With Unspecified Content	0	0	0	1	1	4	4	8	12	16	15
Cajori Two Category 14 - Other Courses Not in Previous Categories	4	3	4	1	1	1	4	1	1	1	1

Total Available Courses - Private vs. Public (with Stanford's Graduate Courses during 1955-1994)

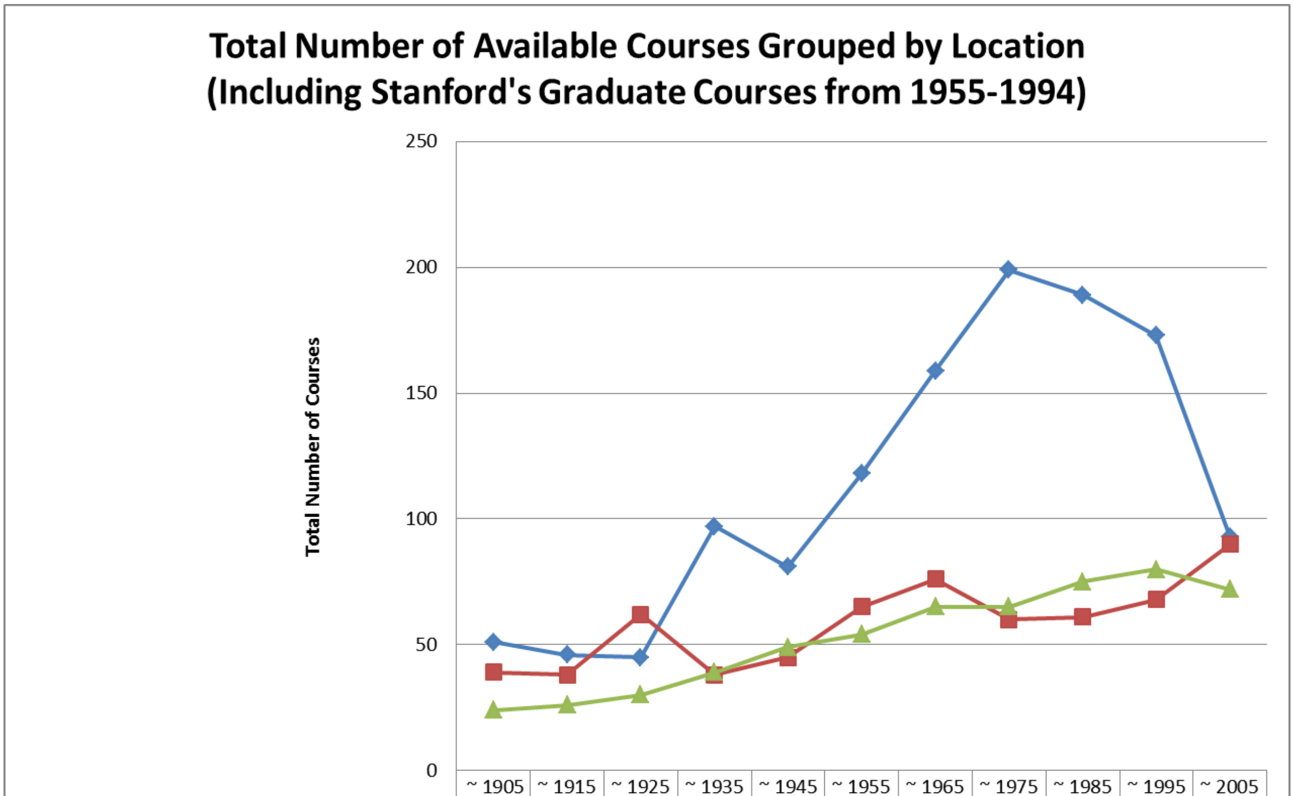


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Sum of Available Mathematics Courses at Private Colleges	54	54	46	104	95	110	180	195	197	194	111
Sum of Available Mathematics Courses at Public Colleges	60	56	91	70	80	127	120	129	128	127	144

Total Available Courses - Private vs. Public (without Stanford's Graduate Courses during 1955-1994)

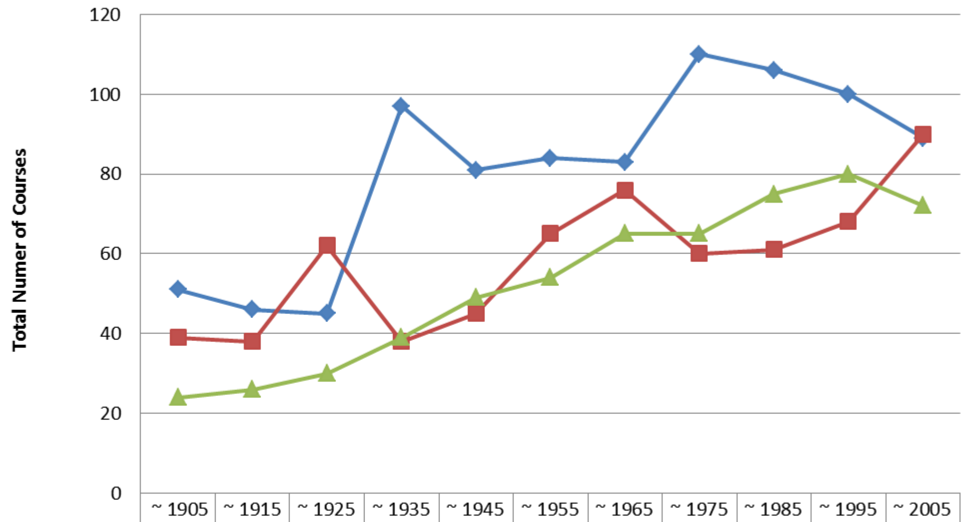


	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Sum of Available Mathematics Courses at Private Colleges	54	54	46	104	95	76	104	106	114	121	107
Sum of Available Mathematics Courses at Public Colleges	60	56	91	70	80	127	120	129	128	127	144



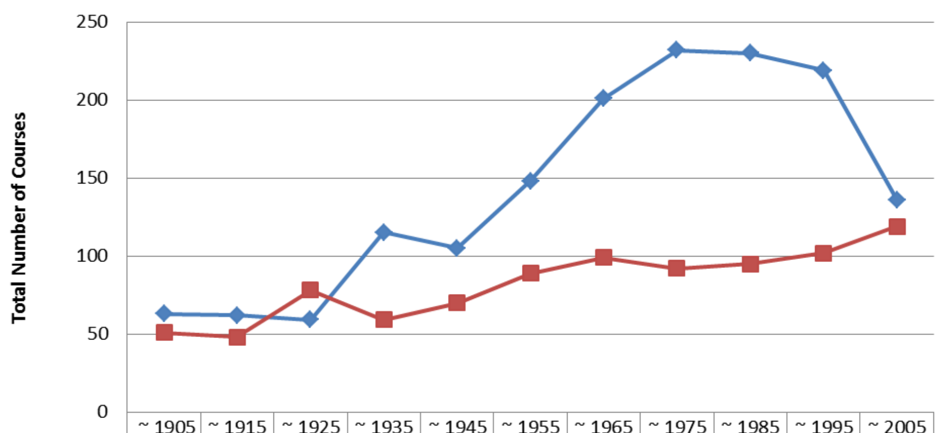
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Sum of Available Mathematics Courses at West Coast Colleges	51	46	45	97	81	118	159	199	189	173	93
Sum of Available Mathematics Courses at Middle America Colleges	39	38	62	38	45	65	76	60	61	68	90
Sum of Available Mathematics Courses at East Coast Colleges	24	26	30	39	49	54	65	65	75	80	72

Total Number of Available Courses Grouped by Location (NOT Including Stanford's Graduate Courses from 1955-1994)



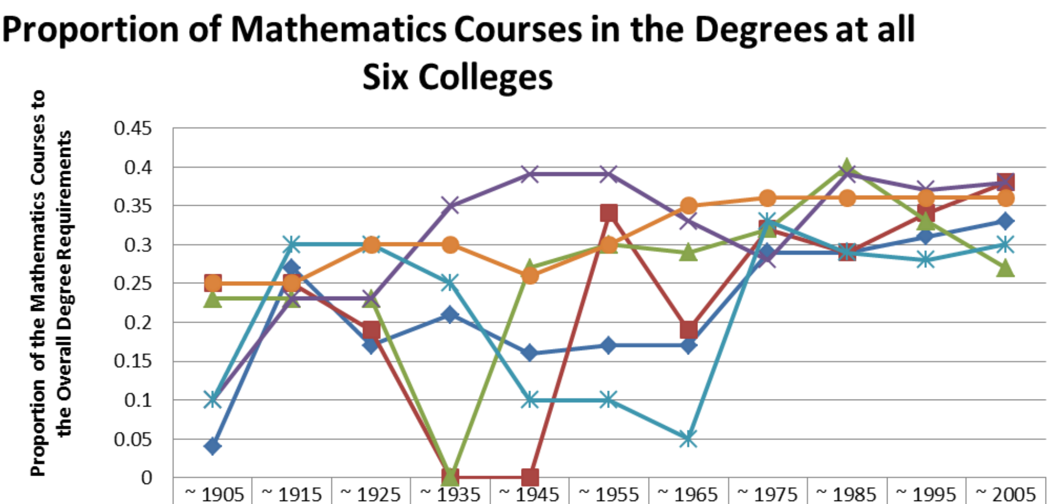
	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Sum of Available Mathematics Courses at West Coast Colleges	51	46	45	97	81	84	83	110	106	100	89
Sum of Available Mathematics Courses at Middle America Colleges	39	38	62	38	45	65	76	60	61	68	90
Sum of Available Mathematics Courses at East Coast Colleges	24	26	30	39	49	54	65	65	75	80	72

Comparison Between the Leading PhD Student Producing Colleges (Including Stanford's Graduate Courses from 1955-1994)



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
Sum of Available Mathematics Courses at Leading PhD Student Producing Colleges	63	62	59	115	105	148	201	232	230	219	136
Sum of Available Mathematics Courses at Non-leading PhD Student Producing Colleges	51	48	78	59	70	89	99	92	95	102	119

APPENDIX V – PROPORTION OF MATHEMATICS IN THE MATHEMATICS DEGREES



	~ 1905	~ 1915	~ 1925	~ 1935	~ 1945	~ 1955	~ 1965	~ 1975	~ 1985	~ 1995	~ 2005
CCNY	0.04	0.27	0.17	0.21	0.16	0.17	0.17	0.29	0.29	0.31	0.33
Colorado College	0.25	0.25	0.19	0	0	0.34	0.19	0.32	0.29	0.34	0.38
Stanford	0.23	0.23	0.23	0	0.27	0.3	0.29	0.32	0.4	0.33	0.27
University of CA, Berkeley	0.1	0.23	0.23	0.35	0.39	0.39	0.33	0.28	0.39	0.37	0.38
University of TX, Austin	0.1	0.3	0.3	0.25	0.1	0.1	0.05	0.33	0.29	0.28	0.3
Yale	0.25	0.25	0.3	0.3	0.26	0.3	0.35	0.36	0.36	0.36	0.36

Note: The degree requirements are **unknown** for Colorado College in 1935 and 1945, and also for Stanford in 1935.

APPENDIX W – TABLES OF REQUIRED AND ELECTIVE MATHEMATICS COURSES AT ALL SIX COLLEGES IN EACH DECADE (WITH CAJORI TWO COURSE CLUSTERS)

Table 2. City College: 1906 to 1907

College:	CCNY
Catalog Year:	1906 - 1907
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Prescribed Studies Toward a Classical A.B. (Arts I Sequence)
Total number of units to graduate:	144 counts
Total number of mathematics units required for the degree:	At least 6 counts
List of required courses and their respective units:	[1] Plane and Solid Analytic Geometry (2 counts – Cajori Two Course Cluster 2) [2] Plane and Solid Analytic Geometry (2 counts – Cajori Two Course Cluster 2) [3-4] Differential and Integral Calculus (Prescribed for Arts I as one term at 2 counts – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Students can choose 29 counts in free electives. Here are the mathematics course options: [5] Arithmetic (2 counts – Cajori Two Course Cluster 29) *(Textbook title is "College Algebra")* [6] History of Mathematics (2 counts – Cajori Two Course Cluster 53) [7] Advanced Differential and Integral Calculus (3 counts – Cajori Two Course Cluster 11) [8] Advanced Differential and Integral Calculus (3 counts – Cajori Two Course Cluster 11) [9] Ordinary Differential Equations (3 counts – Cajori Two Course Cluster 22) [10] Vector Analysis (3 counts – Cajori Two Course Cluster 19) [11] Differential Geometry (3 counts – Cajori Two Course Cluster 33) *(Textbook is German)* [12] Partial Differential Equations (3 counts – Cajori Two Course Cluster 37) [13] Theory of Functions (3 counts – Cajori Two Course Cluster 23)

Table 2. City College: 1906 to 1907 (continued)

Total number of required courses beyond freshman calculus:	7, considering courses [7] and [8] as part of the freshmen-level calculus sequence.
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1

Table 3. City College: 1915 to 1917

College:	CCNY
Catalog Year:	1915 - 1917
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Specialization in Mathematics, B.S. (Division III)
Total number of units to graduate:	127 to 129 credits
Total number of mathematics units required for the degree:	At least 34 credits
List of required courses and their respective units:	[1] Analytic Geometry and Calculus (5 credits – Cajori Two Course Cluster 11) [2] Calculus (5 credits – Cajori Two Course Cluster 11) [7] Advanced Differential Calculus (3 credits – Cajori Two Course Cluster 11) [9] Differential Equations (3 credits – Cajori Two Course Cluster 22) [8] Advanced Integral Calculus (3 credits – Cajori Two Course Cluster 11) [10] Vector Analysis (3 credits – Cajori Two Course Cluster 19) [11] Differential Geometry (3 credits – Cajori Two Course Cluster 33) *(Reading knowledge of German is required.)* [14] Theory of Probability (3 credits – Cajori Two Course Cluster 46) [12] Partial Differential Equations (3 credits – Cajori Two Course Cluster 37) [6] History of Mathematics (2 or 3 credits – Cajori Two Course Cluster 53) *(Noted in course descriptions as 2 credits, but as 3 credits in the outline of the specialization.)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	None.
Total number of required courses beyond freshman calculus:	6 (or at least 17 credits)
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1

Table 4. City College: 1923 to 1925

College:	CCNY
Catalog Year:	1923 - 1925
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Prescribed work leading to a B.S. with elective work in mathematics.
Total number of units to graduate:	128 credits
Total number of mathematics units required for the degree:	At least 22 credits
List of required courses and their respective units:	*If not presented upon admission:* *[1] Solid Geometry (3 credits - Cajori Two Course Cluster 2)* *[2] Trigonometry (3 credits – Cajori Two Course Cluster 1)* *[3] Advanced Algebra (3 credits – Cajori Two Course Cluster 3)* [4] Analytic Geometry and Calculus (5 credits – Cajori Two Course Cluster 11) [5] Calculus (5 credits – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	A student should choose at least 12 credits from one department, and so here are the mathematics electives: Prerequisite courses for all advanced courses: [11] Arithmetic (2 credits – Cajori Two Course Cluster 29) [12] History of Mathematics (2 credits – Cajori Two Course Cluster 53) [13] Advanced Differential Calculus (3 credits – Cajori Two Course Cluster 11) [14] Advanced Integral Calculus (3 credits – Cajori Two Course Cluster 11) [15] Ordinary Differential Equations (3 credits – Cajori Two Course Cluster 22) [16] Vector Analysis (3 credits – Cajori Two Course Cluster 19) [17] Differential Geometry (3 credits – Cajori Two Course Cluster 33) [18] Partial Differential Equations (3 credits – Cajori Two Course Cluster 37) [19] Theory of Probability (3 credits – Cajori Two Course Cluster 46) [120] Mathematical Theory of Investment (2 credits – Cajori Two Course Cluster 41) [212] Fundamental Concepts of Modern Mathematics (2 credits – Cajori Two Course Cluster 9) *(Note: Especially designed for students who intend to teach mathematics in high school.)*
Total number of required courses beyond freshman calculus:	At least 3 *(9 credits after [42])*

Table 4. City College: 1923 to 1925 (continued)

Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	2 *(There is one additional sequence, but that calculus sequence is not listed as a possible prerequisite for the advanced mathematics courses.)*

Table 5. City College: 1935 to 1936

<table>
<tr><td>College:</td><td>CCNY</td></tr>
<tr><td>Catalog Year:</td><td>1935 - 1936</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Specialization or Concentration Group in Mathematics, B.S. (A program plan for the 24 credits in the specialization group would have been created by the student and submitted to the Division of Natural Science.)</td></tr>
<tr><td>Total number of units to graduate:</td><td>128 credits</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 27 credits</td></tr>
<tr><td>List of required courses and their respective units:</td><td>Required for all degrees at the college:
[1] Elements of Analytic Geometry and Calculus (3 credits – Cajori Two Course Cluster 11)
[2] Elements or Analytic Geometry and Calculus (3 credits – Cajori Two Course Cluster 11)
<table>
<tr><td>[3] Differential Calculus (3 credits – Cajori Two Course Cluster 11)
[4] Integral Calculus (3 credits – Cajori Two Course Cluster 11)
[5] Calculus (3 credits – Cajori Two Course Cluster 11)

(Total of 9 credits)</td><td>OR</td><td>[7] Analytic Geometry and Calculus (5 credits – Cajori Two Course Cluster 14)
[8] Calculus (5 credits – Cajori Two Course Cluster 14)

(Total of 10 credits)
This sequence is recommended for students who wish to do elective work in mathematics.</td></tr>
</table>
</td></tr>
</table>

Table 5. City College: 1935 to 1936 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	Elective Concentration - choose at least 12 credits from (these are the courses with prerequisites of [5], [8], or similar): [11] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [12] History of Mathematics (2 credits – Cajori Two Course Cluster 53) [13] Advanced Differential Calculus (3 credits – Cajori Two Course Cluster 21) [14] Advanced Integral Calculus (3 credits – Cajori Two Course Cluster 21) [15] Ordinary Differential Equations (3 credits – Cajori Two Course Cluster 22) [16] Vector Analysis (3 credits – Cajori Two Course Cluster 19) [17] Differential Geometry (3 credits – Cajori Two Course Cluster 33) [18] Calculus of Variations (3 credits – Cajori Two Course Cluster 24) [19] Theory of Probability (3 credits – Cajori Two Course Cluster 46) [20] Mathematical Theory of Investment (2 credits – Cajori Two Course Cluster 41) *(Prerequisite is completion of prescribed mathematics)* [31] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 34) [32] Introduction to Modern Analysis (3 credits – Cajori Two Course Cluster 23) [33] Introduction to Modern Algebra (3 credits – Cajori Two Course Cluster28) [34] Theory of Functions of Real Variable (3 credits – Cajori Two Course Cluster 23)
Total number of required courses beyond freshman calculus:	At least 4 (or 12 credits)
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	2 (*There was an evening sequence with different course numbers, but it is the same as [7], [8]. There is also one more sequence, namely [77], [78] and [79] but [79], which is offered in the evening only and is not listed as an optional prerequisite for the advanced mathematics courses.)*

Table 6. City College: 1945 to 1946

<table>
<tr><td>College:</td><td>CCNY</td></tr>
<tr><td>Catalog Year:</td><td>1945 - 1946</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Specialization or Concentration Group in Mathematics, B.S.</td></tr>
<tr><td>Total number of units to graduate:</td><td>128 credits</td></tr>
<tr><td>Total number of <u>mathematics</u> units required for the mathematics degree:</td><td>At least 21 credits</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>If not taken in high school, [1] should be taken:
[1] Topics in College Algebra and Trigonometry (3 credits – Cajori Two Course Cluster 3)

[2] Elements or Analytic Geometry (3 credits – Cajori Two Course Cluster 2)
[3] Calculus, Part I (3 credits – Cajori Two Course Cluster 11)
[4] Calculus, Part II (3 credits – Cajori Two Course Cluster 11)

(Total of 9 credits)</td><td>OR</td><td>If not taken in high school [42] and [43] should be taken:
[42] Plane Trigonometry (3 credits – Cajori Two Course Cluster 1)
[43] College Algebra (3 credits – Cajori Two Course Cluster 1)

[7] Analytic Geometry and Calculus (5 credits – Cajori Two Course Cluster 11)
[8] Calculus (5 credits – Cajori Two Course Cluster 11)

(Total of 10 credits)
This sequence is recommended for students specializing in mathematics.</td></tr>
</table>
</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td>Elective Concentration: Choose at least 12 credits from:
[11] Theory of Numbers (3 credits – Cajori Two Course Cluster 28)
[12] History of Mathematics (3 credits – Cajori Two Course Cluster 53)
[13] Introduction to Higher Analysis, I (3 credits – Cajori Two Course Cluster 11)
[14] Introduction to Higher Analysis, II (3 credits – Cajori Two Course Cluster 11)
[15] Ordinary Differential Equations (3 credits – Cajori Two Course Cluster)
[16] Vector Analysis (3 credits – Cajori Two Course Cluster 19)
[17] Differential Geometry (3 credits – Cajori Two Course Cluster 33)
[18] Calculus of Variations (3 credits – Cajori Two Course Cluster 24)
[20] Mathematical Theory of Investment (2 credits – Cajori Two Course Cluster 41) (Prerequisite is only completion of prescribed mathematics)
[21] Mathematical Statistics, I (3 credits – Cajori Two Course Cluster 46)
[22] Mathematical Statistics, II (3 credits – Cajori Two Course Cluster 46)
[31] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 34)</td></tr>
</table>

Table 6. City College: 1945 to 1946 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units (continued)	[32] Theory of Functions of a Complex Variable (3 credits – Cajori Two Course Cluster 23) [33] Introduction to Modern Algebra (3 credits – Cajori Two Course Cluster 28) [34] Theory of Functions of Real Variable (3 credits – Cajori Two Course Cluster 23) [41] Solid Geometry (3 credits – Cajori Two Course Cluster 2) [44] Spherical Trigonometry with Applications to Navigation (3 credits – Cajori Two Course Cluster 2)
Total number of required courses beyond freshman calculus:	4 (or 12 credits)
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	2 (and there was an evening sequence with different course numbers, but it is the same as [7], [8])

Table 7. City College: 1955 to 1956

College:	CCNY
Catalog Year:	1955 – 1956
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Specialization or Concentration Group in Mathematics, B.S.
Total number of units to graduate:	128 credits
Total number of mathematics units required for the mathematics degree:	At least 22 credits
List of required courses and their respective units:	If necessary: [42]Plane Trigonometry (3 credits – Cajori Two Course Cluster 1) [43] College Algebra (3 credits – Cajori Two Course Cluster 3) And: [7] Analytic Geometry and Calculus (5 credits – Cajori Two Course Cluster 11) [8] Calculus (5 credits – Cajori Two Course Cluster 11) *(Total credits = 10-16)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose at least 12 credits from: [11] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [12] History of Mathematics (3 credits – Cajori Two Course Cluster 53) [13] Introduction to Higher Analysis I (4 credits – Cajori Two Course Cluster 11) [14] Introduction to Higher Analysis II (4 credits – Cajori Two Course Cluster 11) [15] Ordinary Differential Equations (3 credits – Cajori Two Course Cluster 22) [16] Vector Analysis (3 credits – Cajori Two Course Cluster 19) [17] Differential Geometry (3 credits – Cajori Two Course Cluster 33) [18] Calculus of Variations (3 credits – Cajori Two Course Cluster 24) [19] Actuarial Mathematics I (3 credits – Cajori Two Course Cluster 41) [21] Mathematical Statistics I (3 credits – Cajori Two Course Cluster46) [22] Mathematical Statistics II (3 credits – Cajori Two Course Cluster 46) [31] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 34) [32] Theory of Functions of a Complex Variable (3 credits – Cajori Two Course Cluster 23) [33] Introduction to Modern Algebra (3 credits – Cajori Two Course Cluster 28) [34] Theory of Functions of Real Variables (3 credits – Cajori Two Course Cluster 23) [35] Partial Differential Equations, Integral Equations, Boundary Value Problems (3 credits – Cajori Two Course Cluster 37) [41] Solid Geometry (3 credits – Cajori Two Course Cluster 2)

Table 7. City College: 1955 to 1956 (continued)

	[44] Spherical Trigonometry with Applications to Navigation (3 credits – Cajori Two Course Cluster 2) [113] Topics in Advanced Calculus for Students of Applied Sciences, Part I (3 credits – Cajori Two Course Cluster 21) [114] Topics in Advanced Calculus for Students of Applied Sciences, Part II (3 credits – Cajori Two Course Cluster 21)
Total number of required courses beyond freshman calculus:	4 (or at least 12 credits)
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1 (except there was an evening sequence with different course numbers, but it is the same as [7], [8])

Table 8. City College: 1965 to 1966

College:	CCNY
Catalog Year:	1965 - 1966
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Elective Concentration in Mathematics/ Mathematics Major, B.S.
Total number of units to graduate:	128 credits
Total number of mathematics units required for the mathematics degree:	At least 22 credits
List of required courses and their respective units:	[1] Analytic Geometry and Calculus I (3 credits – Cajori Two Course Cluster 11) [2] Analytic Geometry and Calculus II (3 credits – Cajori Two Course Cluster 11) [3] Analytic Geometry and Calculus III (4 credits – Cajori Two Course Cluster 11) *(Total of 10 credits)* OR [7] Analytic Geometry and Calculus (5 credits – Cajori Two Course Cluster 11) [8] Calculus (5 credits – Cajori Two Course Cluster 11) *(Total of 10 credits)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose at least 12 credits from: [11] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [12] History of Mathematics (3 credits – Cajori Two Course Cluster 53) [13] Introduction to Higher Analysis I (4 credits – Cajori Two Course Cluster 21) [14] Introduction to Higher Analysis II (4 credits – Cajori Two Course Cluster 21) [15] Ordinary Differential Equations (3 credits – Cajori Two Course Cluster 22) [17] Differential Geometry (3 credits – Cajori Two Course Cluster 33) [18] Calculus of Variations (3 credits – Cajori Two Course Cluster 24) [19] Actuarial Mathematics I (3 credits – Cajori Two Course Cluster 41) [21] Mathematical Statistics I (3 credits – Cajori Two Course Cluster 46) [22] Mathematical Statistics II (3 credits – Cajori Two Course Cluster 46) [26] Vector Spaces and Matrices (3 credits – Cajori Two Course Cluster 27) [28] Numerical Analysis (3 credits – Cajori Two Course Cluster 22) [31] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 34) [32] Theory of Functions of a Complex Variable (3 credits – Cajori Two Course Cluster 23) [33] Introduction to Modern Algebra (3 credits – Cajori Two Course Cluster 28) [34] Theory of Functions of Real Variables (3 credits – Cajori Two Course Cluster 23) [35] Partial Differential Equations, Integral Equations, Boundary Value Problems (3 credits – Cajori Two Course Cluster 37) [37] Topology (3 credits – Cajori Two Course Cluster 33)

Table 8. City College: 1965 to 1966 (continued)

Total number of required courses beyond freshman calculus:	4 (or at least 12 credits)
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	2 (and one more for non-mathematics majors such as biology or psychology)

Table 9. City College: 1975 to 1976

College:	CCNY
Catalog Year:	1975 - 1976
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Mathematics Major, B.A. or B.S. (Eligible for a B.S. if students complete two years of laboratory science)
Total number of units to graduate:	128 credits
Total number of mathematics units required for the mathematics degree:	At least 37 credits
List of required courses and their respective units:	[7] Analytic Geometry and Calculus A (5 credits – Cajori Two Course Cluster 11) [8] Analytic Geometry and Calculus B (5 credits – Cajori Two Course Cluster 11) *(Total of 10 credits)* OR [1] Analytic Geometry and Calculus I (3 credits – Cajori Two Course Cluster 11) [2] Analytic Geometry and Calculus II (3 credits – Cajori Two Course Cluster 11) [3] Analytic Geometry and Calculus III (4 credits – Cajori Two Course Cluster 11) *(Total of 10 credits)*
List of required courses and their respective units (continued)	[13] Introduction to Higher Analysis I (4 credits – Cajori Two Course Cluster 23) [14] Introduction to Higher Analysis II (4 credits – Cajori Two Course Cluster 23) *(Total of 8 credits)* OR [23] Introduction to Higher Mathematics (3 credits – Cajori Two Course Cluster 23) [24] Advanced Calculus II (3 credits – Cajori Two Course Cluster 23) [25] Advanced Calculus III (3 credits – Cajori Two Course Cluster 23) *(Total of 9 credits)* [26] Elements of Linear Algebra (3 credits – Cajori Two Course Cluster 27) OR [27] Linear Algebra (4 credits – Cajori Two Course Cluster 27) [30] Elements of Modern Algebra (4 credits – Cajori Two Course Cluster 28) OR [33] Introduction to Modern Algebra (3 credits – Cajori Two Course Cluster 28)

Table 9. City College: 1975 to 1976 (continued)

	Students who major in mathematics need to complete "either eight mathematics courses or a total of 27 credits in mathematics and collateral courses beyond the level of Mathematics 3 and 8"(CCNY Bulletin, 1975-1976, p. 221).
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose 3 to 4 courses, making a total of 27 credits beyond [7] and [8]: *(Recommended courses for students intending to move onto graduate (Ph.D) work.)* [10] Theory of Games and Mathematical Methods of Operations Research (3 credits – Cajori Two Course Cluster 42) [11] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [15] Ordinary Differential Equations (3 credits – Cajori Two Course Cluster 22) [17] Differential Geometry (3 credits – Cajori Two Course Cluster 33) [18] Calculus of Variations (3 credits – Cajori Two Course Cluster 24) [20] Mathematical Logic (3 credits – Cajori Two Course Cluster 35) [21] Probability Theory I (3 credits – Cajori Two Course Cluster 46) [22] Mathematical Statistics II (3 credits – Cajori Two Course Cluster 46) [29] Theory of Numerical Analysis (3 credits – Cajori Two Course Cluster 22) [31] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 32) [35] Partial Differential Equations, Integral Equations, Boundary Value Problems (4 credits – Cajori Two Course Cluster 37) [36] Set Theory (4 credits – Cajori Two Course Cluster 35) [37] Topology (4 credits – Cajori Two Course Cluster 33) [38] Probability Theory II (4 credits – Cajori Two Course Cluster 46) [40] Mathematical Statistics II (3 credits – Cajori Two Course Cluster 46) [80] Selected Topics in Pure Mathematics (4 credits – Cajori Two Course Cluster 52) [81] Selected Topics in Classical Analysis (4 credits – Cajori Two Course Cluster 25) [82] Selected Topics in Probability, Statistics, and Operations Research (4 credits – Cajori Two Course Cluster 47)
Total number of required courses beyond freshman calculus:	8 (or at least 27 credits)
Can undergraduate students take graduate courses?	Yes, as a four-year baccalaureate-master's program. "Within a four-year period, including summer study where necessary, a qualified student will be able to complete the requirements for both degrees" (CCNY Bulletin, 1975-196, p. 25). Furthermore, there is a Freshman Honors Program allows students to spend more time during their undergraduate studies on "advanced study," however, it does not state if one is allowed to take graduate courses (CCNY Bulletin, 1975, p. 25).
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	2 (and one for non-mathematics majors)

Table 10. City College: 1983 to 1985

<table>
<tr><td>College:</td><td>CCNY</td></tr>
<tr><td>Catalog Year:</td><td>1983 - 1985</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Mathematics Major, B.A. or B.S.</td></tr>
<tr><td>Total number of units to graduate:</td><td>128 credits</td></tr>
<tr><td>Total number of mathematics units required for the mathematics degree:</td><td>At least 37 credits</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[101] Analytic Geometry and Calculus I (3 credits – Cajori Two Course Cluster 11)

[202] Analytic Geometry and Calculus II (3 credits – Cajori Two Course Cluster 11)

[203] Analytic Geometry and Calculus III (4 credits – Cajori Two Course Cluster 11)

(10 total)</td><td>OR</td><td>[107] Analytic Geometry and Calculus A (5 credits – Cajori Two Course Cluster 11)

[208] Analytic Geometry and Calculus B (5 credits – Cajori Two Course Cluster 11)

(10 total)</td></tr>
</table>
<table>
<tr><td>[226] Introduction to Higher Analysis I (5 credits – Cajori Two Course Cluster 23)

[327] Introduction to Higher Analysis II (5 credits – Cajori Two Course Cluster 23)

(10 total)</td><td>OR</td><td>[223] Introduction to Higher Mathematics (Advanced Calculus I) (4 credits – Cajori Two Course Cluster 23)

[324] Advanced Calculus II (3 credits – Cajori Two Course Cluster 23)

[325] Advanced Calculus III (3 credits – Cajori Two Course Cluster 23)

(10 total)</td></tr>
</table>
[210] The Use of Computers in Mathematics (Only required for B.A. degree) (3 credits – Cajori Two Course Cluster 48)
[246] Elements of Linear Algebra (3 credits – Cajori Two Course Cluster 27)
<table>
<tr><td>[449] Introduction to Modern Algebra Groups (4 credits – Cajori Two Course Cluster28)</td><td>OR</td><td>[347] Elements of Modern Algebra (4 credits – Cajori Two Course Cluster 28)</td></tr>
</table>
</td></tr>
</table>

Table 10. City College: 1983 to 1985 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	"All students will be expected to complete a minimum of either 27 credits or 8 courses of mathematics and collateral courses beyond the level of Math 203 (or 208)" (CCNY Bulletin, 1985, p. 172). And at least 3 classes from: [275] Elements of Probability Theory (3 credits – Cajori Two Course Cluster 46) [291] Methods in Differential Equations (3 credits – Cajori Two Course Cluster 22) [328] Methods of Numerical Analysis (3 credits – Cajori Two Course Cluster 22) [345] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [360] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 32) [371] Theory of Games and Mathematical Methods of Operations Research (3 credits – Cajori Two Course Cluster 42) [376] Mathematical Statistics (4 credits – Cajori Two Course Cluster 46) [432] Theory of Functions of a Complex Variable (4 credits – Cajori Two Course Cluster 23) [434] Theory of Functions of Real Variables (4 credits – Cajori Two Course Cluster 24) [435] Partial Differential Equations, Integral Equations, Boundary Value Problems (4 credits – Cajori Two Course Cluster 37) [438] Calculus of Variations (4 credits – Cajori Two Course Cluster 24) [443] Set Theory (4 credits – Cajori Two Course Cluster 35) [444] Mathematical Logic (4 credits – Cajori Two Course Cluster 35) [461] Differential Geometry (4 credits – Cajori Two Course Cluster 33) [463] Topology (4 credits – Cajori Two Course Cluster 33) [477] Probability Theory II (4 credits – Cajori Two Course Cluster 46) [478] Mathematical Statistics II (3 credits – Cajori Two Course Cluster 46) [511] Selected Topics in Pure Mathematics (4 credits – Cajori Two Course Cluster 52) [512] Selected Topics in Classical Analysis (4 credits – Cajori Two Course Cluster 25) [513] Selected Topics in Probability, Statistics, and Operations Research (4 credits – Cajori Two Course Cluster 47)
Total number of required courses beyond freshman calculus:	8 (or at least 27 credits)
Can undergraduate students take graduate courses?	Yes. "Qualified students may take, with Departmental approval, any course available in the Master's Program in Mathematics of the first year of the Doctoral Program in Mathematics. These courses are described in their appropriate catalogs" (CCNY Bulletin, 1983-1985, p. 185). "With permission of the Vice-Chairman, students may participate in honors seminars or elect advanced work in the Master's level courses: 511, 512, 513, 1736, 1737, 1739, 1740, 1763, 1776, 1777" (CCNY Bulletin, 1983-1985, p. 172).

Table 10. City College: 1983 to 1985 (continued)

Are students required to take a computing course? If so, which ones.	Yes, but it is only required for the B.A. degree. The course is: [210] The Use of Computers in Mathematics (3 credits) Course Description: Rapid survey of Fortran programming; backtracking; Monte Carlo and simulation techniques; combinatorial and graph theoretic algorithms; applications to mathematical programs. Through work on projects, students will gain experience in the use of computers to solve elementary problems in areas of mathematics such as number theory, probability, games, queuing theory, and geometry. This course is required for all Math majors planning to graduate with a B.A. degree and is recommended for all who plan to do advanced work in mathematics. Prior knowledge of programming is not required.
How many different calculus sequences exist for a mathematics major?	3 (and one for biology and economic majors)

Table 11. City College: 1993 to 1995

<table>
<tr><td>College:</td><td>CCNY</td></tr>
<tr><td>Catalog Year:</td><td>1993 - 1995</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Mathematics Major, B.A. or B.S.</td></tr>
<tr><td>Total number of units to graduate:</td><td>128 credits</td></tr>
<tr><td>Total number of mathematics units required for the mathematics degree:</td><td>At least 40 credits</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[101] Analytic Geometry and Calculus I (3 credits – Cajori Two Course Cluster 11)

[202] Analytic Geometry and Calculus II (3 credits – Cajori Two Course Cluster 11)

[203] Analytic Geometry and Calculus III (4 credits – Cajori Two Course Cluster 11)

(10 total)</td><td>OR</td><td>[107] Analytic Geometry and Calculus A (5 credits – Cajori Two Course Cluster 11)

[208] Analytic Geometry and Calculus B (5 credits – Cajori Two Course Cluster 11)

(10 total)</td></tr>
</table>
[204] Bridge to Advanced Mathematics (Included because it is a prerequisite for [223]) (3 credits – Cajori Two Course Cluster 36)
223] Introduction to Higher Mathematics (Advanced Calculus I) (4 credits – Cajori Two Course Cluster 23)
[324] Advanced Calculus II (3 credits – Cajori Two Course Cluster 23)</td></tr>
<tr><td>List of required courses and their respective units (continued)</td><td>[325] Advanced Calculus III (3 credits – Cajori Two Course Cluster 23)
[210] The Use of Computers in Mathematics (Only required for B.A. degree) (3 credits – Cajori Two Course Cluster 48)
[246] Elements of Linear Algebra (3 credits – Cajori Two Course Cluster 27)
<table>
<tr><td>[449] Introduction to Modern Algebra Groups (4 credits – Cajori Two Course Cluster 28)</td><td>OR</td><td>[347] Elements of Modern Algebra (4 credits – Cajori Two Course Cluster 28)</td></tr>
</table></td></tr>
</table>

Table 11. City College: 1993 to 1995 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	"Students must complete a minimum of 27 credits or eight courses of mathematics and collateral courses beyond the level of Math 204" (CCNY Bulletin, 1993-1995, p. 158). And at least 2 classes from : [275] Elements of Probability Theory (3 credits – Cajori Two Course Cluster 46) [291] Methods in Differential Equations (3 credits – Cajori Two Course Cluster 22) [328] Methods of Numerical Analysis (3 credits – Cajori Two Course Cluster 22) [345] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [360] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 32) [370] Operations Research I (3 credits – Cajori Two Course Cluster 42) [371] Operations Research II (3 credits – Cajori Two Course Cluster 42) [376] Mathematical Statistics (4 credits – Cajori Two Course Cluster 46) [432] Theory of Functions of a Complex Variable (4 credits – Cajori Two Course Cluster 23) [434] Theory of Functions of Real Variables (4 credits – Cajori Two Course Cluster 24) [435] Partial Differential Equations, Integral Equations, Boundary Value Problems (4 credits – Cajori Two Course Cluster 37) [438] Calculus of Variations (4 credits – Cajori Two Course Cluster 24) [443] Set Theory (4 credits – Cajori Two Course Cluster 35) [444] Mathematical Logic (4 credits – Cajori Two Course Cluster 35) [461] Differential Geometry (4 credits – Cajori Two Course Cluster 33) [463] Topology (4 credits – Cajori Two Course Cluster 33) [477] Probability Theory II (4 credits – Cajori Two Course Cluster 46) [478] Mathematical Statistics II (3 credits – Cajori Two Course Cluster 46) [511] Master's Level Course - Selected Topics in Pure Mathematics (4 credits – Cajori Two Course Cluster 52) [512] Master's Level Course - Selected Topics in Classical Analysis (4 credits – Cajori Two Course Cluster 25) [513] Master's Level Course - Selected Topics in Probability, Statistics, and Operations Research (4 credits – Cajori Two Course Cluster 47)
Total number of required courses beyond freshman calculus:	8 (or at least 26 credits, since 2 of the required courses are 4 credits)
Can undergraduate students take graduate courses?	Yes, and there exists a combined Bachelor's and Master's degree program. "With permission of the Vice Chair, students may participate in honors seminars or elect advanced work in Master's level courses: 511, 512, 513, 1732, 1734, 1735, 1739, 1749, 1763, 1768, 1776, 1777, 1791" (CCNY Bulletin, 1993-1995, p. 160).

Table 11. City College: 1993 to 1995 (continued)

Are students required to take a computing course? If so, which ones.	Yes, but it is only required for the B.A. degree. The course is: [210] The Use of Computers in Mathematics (3 credits) Course Description: Rapid survey of FORTRAN programming; backtracking; Monte Carlo and simulation techniques; combinatorial and graph theoretic algorithms; applications to mathematical programs. Through work on projects, students will gain experience in the use of computers to solve elementary problems in areas of mathematics such as number theory, probability, games, queuing theory, and geometry. This course is required for all Math majors planning to graduate with a B.A. degree and is recommended for all who plan to do advanced work in mathematics. Prior knowledge of programming is not required.
How many different calculus sequences exist for a mathematics major?	2 (and one for Calculus II terminal students, such as biology or economic majors)

Table 12. City College: 2003 to 2005

College:	CCNY
Catalog Year:	2003 - 2005
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Mathematics Major, B.A. or B.S.
Total number of units to graduate:	120 credits
Total number of <u>mathematics</u> units required for the mathematics degree:	At least 39 credits
List of required courses and their respective units:	[20100] Calculus I (3 credits – Cajori Two Course Cluster 11) [20200] Calculus II (3 credits – Cajori Two Course Cluster 11) [20300] Calculus III (4 credits – Cajori Two Course Cluster 11) [30800] Bridge to Advanced Mathematics (3 credits – Cajori Two Course Cluster 36) [32300] Advanced Calculus I (4 credits – Cajori Two Course Cluster 23) [32400] Advanced Calculus II (3 credits – Cajori Two Course Cluster 23) [32500] Advanced Calculus III (3 credits – Cajori Two Course Cluster 23) [34600] Elements of Linear Algebra (3 credits – Cajori Two Course Cluster 27) [34700] Elements of Modern Algebra (4 credits – Cajori Two Course Cluster 28) OR [44900] Introduction to Modern Algebra (4 credits – Cajori Two Course Cluster 28)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>And at least 3 classes from :</u> [32800] Methods of Numerical Analysis (3 credits – Cajori Two Course Cluster 22) [34500] Theory of Numbers (3 credits – Cajori Two Course Cluster 29) [36000] Introduction to Modern Geometry (3 credits – Cajori Two Course Cluster 32) [36500] Elements of Combinatorics (4 credits – Cajori Two Course Cluster 44) [37500] Elements of Probability Theory (3 credits – Cajori Two Course Cluster 46) [37600] Mathematical Statistics (4 credits – Cajori Two Course Cluster 46) [39100] Methods of Differential Equations(3 credits – Cajori Two Course Cluster 22)

Table 12. City College: 2003 to 2005 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units (continued)	[43200] Theory of Functions of a Complex Variable (4 credits – Cajori Two Course Cluster 23) [43400] Theory of Functions of a Real Variable (4 credits – Cajori Two Course Cluster 24) [43500] Partial Differential Equations, Integral Equations, Boundary Problems (4 credits – Cajori Two Course Cluster 37) [44300] Set Theory (4 credits – Cajori Two Course Cluster 35) [44400] Mathematical Logic (4 credits – Cajori Two Course Cluster 35) [46100] Differential Geometry (4 credits – Cajori Two Course Cluster 33) [46300] Topology (4 credits – Cajori Two Course Cluster 33) [47700] Probability Theory II (4 credits – Cajori Two Course Cluster 46) [47800] Mathematical Statistics II (4 credits – Cajori Two Course Cluster 46) [51100] Selected Topics in Pure Mathematics (4 credits – Cajori Two Course Cluster 52) [51200] Selected Topics in Classical Analysis (4 credits – Cajori Two Course Cluster 25) [51300] Selected Topics in Probability and Statistics (4 credits – Cajori Two Course Cluster 47)
Total number of required courses beyond freshman calculus:	9 (or at least 30 credits, since 3 of the required courses are 4 credits)
Can undergraduate students take graduate courses?	Yes, but only if enrolled in the honors program. These students would follow a special course of study (not listed in the catalog) and be awarded Bachelor's and Master's degrees in four years.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1 (and one additional for non-mathematics majors)

Table 13. Colorado College: 1905 to 1906

College:	Colorado College
Catalog Year:	1905-1906
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Mathematics Major Subject
Total number of units to graduate:	60 hours
Total number of mathematics units required for the degree:	15 hours in a major subject
List of required courses and their respective units:	Prescribed Studies for all students: [A-1] Algebra (4 hours – Cajori Two Course Cluster 3) [A-2] Solid and Spherical Geometry (2 hours – Cajori Two Course Cluster 2) [A-3] Plane Trigonometry (4 hours – Cajori Two Course Cluster 1) Assumed as required for a mathematics major: [C-first semester] Calculus, Differential and Integral (3 hours – Cajori Two Course Cluster 11) [C-second semester] Calculus, Differential and Integral (4 hours – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Since 15 hours are required in a major subject, and 7 hours from Calculus are listed above, at least 8 more hours should be chosen: [A-4] Spherical Trigonometry (2 hours – Cajori Two Course Cluster 2) [B-1] Analytic Geometry (Elementary) (3 hours – Cajori Two Course Cluster 2) [B-2] Analytic Geometry (More Advanced) (3 hours – Cajori Two Course Cluster 2) [D] History and Logic of Mathematics (2 hours – Cajori Two Course Cluster 53) [E] Modern Methods in Geometry (3 hours – Cajori Two Course Cluster 34) [F] Theory of Equations (3 hours – Cajori Two Course Cluster 26) [H] Determinants (2 hours – Cajori Two Course Cluster 26) [J] Theoretical Mechanics (4 hours – Cajori Two Course Cluster 38) [I] Elementary Surveying (2 hours – Cajori Two Course Cluster 2) *(24 total available hours)*
Total number of required courses beyond freshman calculus:	Not easily determined, since the prerequisites for Calculus are not listed. It is assumed to be 3 courses if only the Calculus sequence (at 7 hours) counts towards the 15 hours required for a mathematics major.

Table 13. Colorado College: 1905 to 1906 (continued)

Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1

Table 14. Colorado College: 1915 to 1916

College:	Colorado College
Catalog Year:	1915-1916
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., with a major in mathematics
Total number of units to graduate:	120 hours
Total number of mathematics units required for the degree:	30 hours in a major subject (p. 34)
List of required courses and their respective units:	Prescribed Mathematics Courses for all students: [1] Algebra (3 hours – Cajori Two Course Cluster 3) [2] Solid and Spherical Geometry (Optional Course) (2 hours – Cajori Two Course Cluster 2) [3] Plane Trigonometry (3 hours – Cajori Two Course Cluster 1)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	[4] Analytic Geometry (Elementary) (3 hours – Cajori Two Course Cluster 2) [5] Analytic Geometry (More Advanced) (2 hours – Cajori Two Course Cluster 31) [6-first semester] Calculus, Differential and Integral (3 hours – Cajori Two Course Cluster 11) [6-second semester] Calculus, Differential and Integral (4 hours – Cajori Two Course Cluster 11) [7] History and Logic of Mathematics (2 hours – Cajori Two Course Cluster 53) [8] Projective Geometry (3 hours – Cajori Two Course Cluster 32) [9] Theory of Equations (3 hours – Cajori Two Course Cluster 26) [10] Differential Equations (2 hours – Cajori Two Course Cluster 22) [11] Determinants (2 hours – Cajori Two Course Cluster 26) [12] Theoretical Mechanics (3 hours – Cajori Two Course Cluster 38) [13] Vector Analysis (3 hours – Cajori Two Course Cluster 19) *(26 hours total in electives)*
Total number of required courses beyond freshman calculus:	6
Can undergraduate students take graduate courses?	Not mentioned.

Table 14. Colorado College: 1915 to 1916 (continued)

Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1

Table 15. Colorado College: 1925 to 1926

College:	Colorado College
Catalog Year:	1925-1926
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A.
Total number of units to graduate:	120 hours
Total number of <u>mathematics units required</u> for the degree:	At least 23 mathematics course hours (30 hours are required in a major subject, however, astronomy, business, graphics and physics electives can count towards the 30 hours.)
List of required courses and their respective units:	[1] Algebra (3 hours – Cajori Two Course Cluster 3) [3] Plane Trigonometry (3 hours – Cajori Two Course Cluster 1) [4] Analytic Geometry (Elementary) (3 hours – Cajori Two Course Cluster 2) [5] Analytic Geometry (More Advanced) (2 hours – Cajori Two Course Cluster 2) [6-first semester] Calculus, Differential and Integral (3 hours – Cajori Two Course Cluster 11) [6-seond semester] Calculus, Differential and Integral (4 hours – Cajori Two Course Cluster 11) *(18 total)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>Choose at least two of the following courses (or at least 5 hours):</u> [8] Projective Geometry (3 hours – Cajori Two Course Cluster 32) [9] Theory of Equations (3 hours – Cajori Two Course Cluster 26) [10] Differential Equations (2 or 3 hours – Cajori Two Course Cluster 22) [12] Mechanics (3 hours – Cajori Two Course Cluster 38) [13] Vector Analysis (3 hours – Cajori Two Course Cluster 19) [14] Solid Analytic Geometry (3 hours – Cajori Two Course Cluster 31) <u>Additional courses that can contribute towards the 30 hours required:</u> [20] Statistical Methods (3 hours – Cajori Two Course Cluster 5) [21] Statistical Methods (3 hours – Cajori Two Course Cluster 5) [7] Teachers' Course (2 hours – Cajori Two Course Cluster 9) (This is methods for teaching mathematics in secondary schools, which appears as an option for a mathematics major, so it is included.) <u>Additional Course From the Business Department, but listed in the Mathematics Course Descriptions:</u> Business [12] Mathematical Theory of Investment (3 hours – Cajori Two Course Cluster 5)

Table 15. Colorado College: 1925 to 1926 (continued)

Total number of required courses beyond freshman calculus:	At least 2, since courses from the astronomy, business, graphics and physics departments can count towards the 30 hours required for the mathematics major.
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1

Table 16. Colorado College: 1935 to 1936

<table>
<tr><td>College:</td><td>Colorado College</td></tr>
<tr><td>Catalog Year:</td><td>1935-1936</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.A.</td></tr>
<tr><td>Total number of units to graduate:</td><td>Approximately 128 semester hours. “In 1935, the graduation requirements had gotten rather loosey-goosey” (J. Randall, personal communication, March 29, 2011).</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>Last two years of study should have a field of concentration. (J. Randall, personal communication, March 29, 2011).</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[105] Elementary Mathematical Analysis (First semester – Cajori Two Course Cluster 3)
[106] Elementary Mathematical Analysis (Second Semester – Cajori Two Course Cluster 3)</td><td>[107] Mathematical Analysis (First Semester – Cajori Two Course Cluster 3)
[108] Mathematical Analysis (Second Semester – Cajori Two Course Cluster 3)</td><td>[122] Analytic Geometry (Half course – Cajori Two Course Cluster 2)</td></tr>
</table>

[203] Differential and Integral Calculus (First semester – Cajori Two Course Cluster 11)
[204] Differential and Integral Calculus (Second semester – Cajori Two Course Cluster 11)</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td><u>Students should take about half their coursework in mathematics, and semester hours are not given for the courses:</u>

[301] Mechanics (First Semester – Cajori Two Course Cluster 38)
[302] Mechanics (Second Semester – Cajori Two Course Cluster 38)
[303] Theory of Equations (Half course – Cajori Two Course Cluster 26)
[305] Differential Equations (First Semester – Cajori Two Course Cluster 22)
[306] Differential Equations (Second Semester – Cajori Two Course Cluster 37)
[308] Solid Analytic Geometry (Half course – Cajori Two Course Cluster 31)
[310] Projective Geometry (Half course – Cajori Two Course Cluster 32)
[311] Vector Analysis (Half course – Cajori Two Course Cluster 19)
[315] Advanced Calculus (First Semester – Cajori Two Course Cluster 21)
[316] Advanced Calculus (Second Semester – Cajori Two Course Cluster 21)
[401] The Teaching of Mathematics (Half course – Cajori Two Course Cluster 9)
[402] Reading in Mathematics (Half course – Cajori Two Course Cluster 52)
[409] Functions of a Complex Variable (First Semester – Cajori Two Course Cluster 23)
[410] Functions of a Complex Variable (Second Semester – Cajori Two Course Cluster 23)</td></tr>
</table>

Table 16. Colorado College: 1935 to 1936 (continued)

Total number of required courses beyond freshman calculus:	Not mentioned.
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	No.
How many different calculus sequences exist for a mathematics major?	1

Table 17. Colorado College: 1945 to 1946

College:	Colorado College
Catalog Year:	1945-1946
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A.
Total number of units to graduate:	Completion of the work in the School of Arts and Sciences and 64 semester hours in an advanced school.
Total number of mathematics units required for the degree:	To be determined by student and advisor.
List of required courses and their respective units:	[105] Elementary Mathematical Analysis I (5 hours – Cajori Two Course Cluster 3) [106] Elementary Mathematical Analysis II (5 hours – Cajori Two Course Cluster 3) OR [107] Mathematical Analysis III (5 hours – Cajori Two Course Cluster 3) [108] Mathematical Analysis IV (5 hours – Cajori Two Course Cluster 3) [203] Calculus I (4 hours – Cajori Two Course Cluster 11) [204] Calculus II (4 hours – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Courses in the School of Natural Sciences: [301] Analytical Mechanics I (2 hours – Cajori Two Course Cluster 38) [302] Analytical Mechanics II (2 hours – Cajori Two Course Cluster 38) [305] Differential Equations (First semester, 3 hours – Cajori Two Course Cluster 22) [306] Differential Equations (Second semester, 3 hours – Cajori Two Course Cluster 37) [308] Solid Analytic Geometry (First Semester, 4 hours – Cajori Two Course Cluster 31) [309] Solid Analytic Geometry (Second Semester, 4 hours – Cajori Two Course Cluster 31) [311] Vector Analysis (First semester, 4 hours – Cajori Two Course Cluster 19) [312] Vector Analysis (Second semester, 4 hours – Cajori Two Course Cluster 19) [315] Advanced Calculus (First semester, 3 hours – Cajori Two Course Cluster 21) [316] Advanced Calculus (Second semester, 3 hours – Cajori Two Course Cluster 21) [317] Advanced Mathematical Statistics (First semester, 3 hours – Cajori Two Course Cluster 45) [318] Advanced Mathematical Statistics (Second semester, 3 hours – Cajori Two Course Cluster 45) [401] The Teaching of Mathematics (4 hours – Cajori Two Course Cluster 9) [402] Readings in Mathematics (3 hours – Cajori Two Course Cluster 52) [409] Functions of a Complex Variable (First semester, 4 hours – Cajori Two Course Cluster 23) [410] Functions of a Complex Variable (First semester, 4 hours – Cajori Two Course Cluster 23) *(53 total hours listed)*

Table 17. Colorado College: 1945 to 1946 (continued)

Total number of required courses beyond freshman calculus:	Determined with advisor.
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	Not mentioned.
How many different calculus sequences exist for a mathematics major?	1

Table 18. Colorado College: 1955 to 1956

College:	Colorado College
Catalog Year:	1955-1956
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.S.
Total number of units to graduate:	128 semester hours
Total number of mathematics units required for the degree:	"44 semester hours must be earned in the major subject" (Colorado College Bulletin, 1955-1956, p. 24).
List of required courses and their respective units:	[105] Elementary Mathematical Analysis (First Semester, 4 hours – Cajori Two Course Cluster 3) [106] Elementary Mathematical Analysis (Second Semester, 4 hours – Cajori Two Course Cluster 3) [203] Calculus (First semester, 4 hours – Cajori Two Course Cluster 11) [204] Calculus (Second semester, 4 hours – Cajori Two Course Cluster 11) [301] Analytic Mechanics (First semester, 3 hours – Cajori Two Course Cluster 38) [302] Analytic Mechanics (Second semester, 3 hours – Cajori Two Course Cluster 38) [315] Advanced Calculus (First semester, 3 hours – Cajori Two Course Cluster 21) [316] Advanced Calculus (Second semester, 3 hours – Cajori Two Course Cluster 21) [401] The Teaching of Mathematics (3 years – Cajori Two Course Cluster 9) [402] Readings in Mathematics (3 hours – Cajori Two Course Cluster 52) [405] Modern Algebra (First Semester, 3 hours – Cajori Two Course Cluster 28) [406] Modern Algebra (Second Semester, 3 hours – Cajori Two Course Cluster 28) *(40 total credit hours listed, so there must be additional courses available to students in years before or after this bulletin.)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	None listed, since 44 semester hours are required in a major subject, but there are only 40 semester hours of mathematics to choose from in this bulletin.

Table 18. Colorado College: 1955 to 1956 (continued)

Total number of required courses beyond freshman calculus:	8
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	Not mentioned.
How many different calculus sequences exist for a mathematics major?	1

Table 19. Colorado College: 1965 to 1966

College:	Colorado College
Catalog Year:	1965-1966
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A. (or a B.S. if 40 to 44 hours in major)
Total number of units to graduate:	128 semester hours
Total number of mathematics units required for the degree:	24 to 44 semester hours in one department
List of required courses and their respective units:	[105] Analysis I (First semester, 4 hours – Cajori Two Course Cluster 11) [106] Analysis I (Second semester, 4 hours – Cajori Two Course Cluster 11) [203] Analysis II (First semester, 4 hours – Cajori Two Course Cluster 11) [204] Analysis II (Second semester, 4 hours – Cajori Two Course Cluster 11) [402] Readings in Mathematics (3 hours – Cajori Two Course Cluster 52)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	12 additional hours of 300 or 400 level courses: [315] Analysis III (First semester, 4 hours – Cajori Two Course Cluster 21) [316] Analysis III (Second semester, 4 hours – Cajori Two Course Cluster 21) [317] Mathematical Statistics (First semester, 3 hours – Cajori Two Course Cluster 46) [318] Mathematical Statistics (Second semester, 3 hours – Cajori Two Course Cluster 46) [319] An Introduction to Digital Computing (First semester, 2 hours – Cajori Two Course Cluster 48) [320] An Introduction to Digital Computing (Second semester, 2 hours – Cajori Two Course Cluster 48) [405] Modern Algebra (First semester, 3 hours – Cajori Two Course Cluster 28) [406] Modern Algebra (Second semester, 3 hours – Cajori Two Course Cluster 28) [409] Analysis IV (First semester, 4 hours – Cajori Two Course Cluster 21) [410] Analysis IV (Second semester, 4 hours – Cajori Two Course Cluster 21) [415] The Teaching of Mathematics (3 hours – Cajori Two Course Cluster 9)
Total number of required courses beyond freshman calculus:	At least 4
Can undergraduate students take graduate courses?	Not mentioned.

Table 19. Colorado College: 1965 to 1966 (continued)

Are students required to take a computing course? If so, which ones.	Not required, but some are available in the mathematics electives.
How many different calculus sequences exist for a mathematics major?	1

Table 20. Colorado College: 1975 to 1976

College:	Colorado College
Catalog Year:	1975-1976
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Mathematics Major
Total number of units to graduate:	34 units (one unit = 3.5 semester hours)
Total number of <u>mathematics units required</u> for the degree:	At least 11 units
List of required courses and their respective units:	[103] Introduction to Calculus (2 units – Cajori Two Course Cluster 12) OR [126] Calculus I (1 unit – Cajori Two Course Cluster 11) [128] Calculus 2 (1 unit – Cajori Two Course Cluster 11) [130] Calculus 3 (1 unit – Cajori Two Course Cluster 11) [205] Calculus 4 (1 unit – Cajori Two Course Cluster 11) [210] Linear Algebra (1 unit – Cajori Two Course Cluster 27) [215] Differential Equations (1 unit – Cajori Two Course Cluster 22) [321] Algebra I (1 unit – Cajori Two Course Cluster 28) [316] Advanced Calculus (1 unit – Cajori Two Course Cluster 21) *(Not offered this academic year)* OR [413] Complex Analysis (1 unit – Cajori Two Course Cluster 23)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>At least three other mathematics courses numbered 300 or above (excluding 399):</u> [300] Geometry (1 unit – Cajori Two Course Cluster 34) [307] Numerical Analysis (1 unit – Cajori Two Course Cluster 22) [308] Computer Science II (1 unit – Cajori Two Course Cluster 49) [313] Probability (1 unit – Cajori Two Course Cluster 46) [317] Mathematical Statistics (1 unit – Cajori Two Course Cluster 46) [371] Topics in Applied Mathematics I (1 unit – Cajori Two Course Cluster 37) [372] Topics in Applied Mathematics II (1 unit – Cajori Two Course Cluster 37) [411] Real Analysis (1 unit – Cajori Two Course Cluster 23) *(Not offered this academic year)* [414] Algebra II (1 unit – Cajori Two Course Cluster 28) *(Not offered this academic year)* [420] Special Topics (1 unit – Cajori Two Course Cluster 52) [430] Independent Study (1 unit – Cajori Two Course Cluster 52) [431] Independent Study (1 unit – Cajori Two Course Cluster 52)

Table 20. Colorado College: 1975 to 1976 (continued)

Total number of required courses beyond freshman calculus:	7 (This is the number of courses after Calculus 4)
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	[308] Computer Science II is an optional mathematics elective.
How many different calculus sequences exist for a mathematics major?	2 (one contains precalculus concepts too)
Math Entrance Exam?	Not mentioned.
Exiting Requirement?	Maybe. "During the last year of study for a bachelor's degree, candidates may be required, at the option of their major departments, to take a departmental comprehensive examination, and/or achieve a passing grade on the Graduate Record Advanced Test" (Colorado College Bulletin, 1975-1976, p. 46).

Table 21. Colorado College: 1985 to 1986

College:	Colorado College
Catalog Year:	1985-1986
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Mathematics Major
Total number of units to graduate:	34 units (one unit = 3.5 semester hours)
Total number of mathematics units required for the degree:	At least 10 units.
List of required courses and their respective units:	[125] Pre-Calculus and Calculus (2 units – Cajori Two Course Cluster 12) OR [126] Calculus 1 (1 unit – Cajori Two Course Cluster 11) [128] Calculus 2 (1 unit – Cajori Two Course Cluster 11) [130] Calculus 3 (1 unit – Cajori Two Course Cluster 11) [200] Number Theory (1 unit – Cajori Two Course Cluster 29) [205] Calculus 4 (1 unit – Cajori Two Course Cluster 11) [305] Introduction to Mathematical Analysis (1 unit – Cajori Two Course Cluster 23) [321] Abstract Algebra (1 unit – Cajori Two Course Cluster 28)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	At least three more mathematics courses numbered 300 or above (excluding 430): [300] Geometry (1 unit – Cajori Two Course Cluster 34) [308] Theory of Computation (1 unit – Cajori Two Course Cluster 50) [310] Topics in Advanced Calculus (1 unit – Cajori Two Course Cluster 21) [311] Topics in Advanced Calculus (1 unit – Cajori Two Course Cluster 21) [313] Probability (1 unit – Cajori Two Course Cluster 46) [315] Differential Equations (1 unit – Cajori Two Course Cluster 22) [317] Mathematical Statistics (1 unit – Cajori Two Course Cluster 46) [320] Linear Algebra (1 unit – Cajori Two Course Cluster 27) [400] Topology (1 unit – Cajori Two Course Cluster 33) [405] Real Analysis (1 unit – Cajori Two Course Cluster 23) *(Not offered this year)* [410] Complex Analysis (1 unit – Cajori Two Course Cluster 23) [420] Special Topics (1 unit – Cajori Two Course Cluster 55) [421] Advanced Abstract Algebra (1 unit – Cajori Two Course Cluster 28)
Total number of required courses beyond freshman calculus:	6 (This is the number of courses after Calculus 4)

Table 21. Colorado College: 1985 to 1986 (continued)

Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	Not mentioned, but computer science courses are offered by the mathematics department at the 200-level.
How many different calculus sequences exist for a mathematics major?	2, the main difference is that one has precalculus concepts included.

Table 22. Colorado College: 1995 to 1996

College:	Colorado College
Catalog Year:	1995-1996
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Mathematics Major
Total number of units to graduate:	32 units
Total number of <u>mathematics units required</u> for the degree:	At least 11 units
List of required courses and their respective units:	[125] Pre-Calculus and Calculus (2 units – Cajori Two Course Cluster 12) OR [126] Calculus 1 (1 unit – Cajori Two Course Cluster 11) [128] Calculus 2 (1 unit – Cajori Two Course Cluster 11) [203] Calculus 3 (1 unit – Cajori Two Course Cluster 11) [220] Linear Algebra (1 unit – Cajori Two Course Cluster 27) [251] Number Theory (1 unit – Cajori Two Course Cluster 29) [321] Abstract Algebra I (1 unit – Cajori Two Course Cluster 28) [375] Mathematical Analysis I (1 unit – Cajori Two Course Cluster 23) [322] Abstract Algebra II (1 unit – Cajori Two Course Cluster 28) OR [376] Mathematical Analysis II (1 unit – Cajori Two Course Cluster 23) OR [417] Mathematical Statistics (1 unit – Cajori Two Course Cluster 46)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>Three other 300-400 level one unit courses, excluding 355 and 455:</u> [300] Geometry (1 unit – Cajori Two Course Cluster 34) [308] Theory of Computation (1 unit – Cajori Two Course Cluster 50) *(Not offered this academic year)* [311] Vector Analysis (1 unit – Cajori Two Course Cluster 19) [312] Fourier Analysis (1 unit – Cajori Two Course Cluster 37) [313] Probability (1 unit – Cajori Two Course Cluster 46) [315] Differential Equations (1 unit – Cajori Two Course Cluster 22) [318] Numerical Analysis (1 unit – Cajori Two Course Cluster 22) *(Not offered this academic year)* [320] Linear Algebra (1 unit – Cajori Two Course Cluster 27) [325] Graph Theory (1 unit – Cajori Two Course Cluster 44) [340] Topics in Mathematics (1 unit – Cajori Two Course Cluster 52)

Table 22. Colorado College: 1995 to 1996 (continued)

	[341] Special Topics in Computer Science (1 unit – Cajori Two Course Cluster 51) [345] Research in Mathematics: An Introduction to the Nature of Mathematical Research (1 unit – Cajori Two Course Cluster 52) [399] Seminar in Mathematics (.5 unit – Cajori Two Course Cluster 52) [400] Topology (1 unit – Cajori Two Course Cluster 33) [407] Analysis of Algorithms (1 unit – Cajori Two Course Cluster 50) [410] Complex Analysis (1 unit – Cajori Two Course Cluster 23) [440] Special Topics (1 unit – Cajori Two Course Cluster 55)
Total number of required courses beyond freshman calculus:	8
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	It is optional as mathematics electives that can count towards the degree.
How many different calculus sequences exist for a mathematics major?	2 (One sequence includes precalculus)

Table 23. Colorado College: 2005 to 2006

<table>
<tr><td>College:</td><td>Colorado College</td></tr>
<tr><td>Catalog Year:</td><td>2005-2006</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.A., Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>32 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 12 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[125] Pre-Calculus & Calculus (2 units – Cajori Two Course Cluster 12)</td><td>OR</td><td>[126] Calculus 1 (1 unit – Cajori Two Course Cluster 11)</td><td rowspan="2">[127] Calculus 1 & 2 Review (1 unit – Cajori Two Course Cluster 17)</td></tr>
<tr><td colspan="3">[128] Calculus 2 (1 unit – Cajori Two Course Cluster 11)</td></tr>
</table>
[203] Calculus 3 (1 unit – Cajori Two Course Cluster 11)
[220] Linear Algebra (1 unit – Cajori Two Course Cluster 27)
[251] Number Theory (1 unit – Cajori Two Course Cluster 29)
[321] Abstract Algebra I (1 unit – Cajori Two Course Cluster 28)
[375] Mathematical Analysis I (1 unit – Cajori Two Course Cluster 23)
<table>
<tr><td>[322] Abstract Algebra II (1 unit – Cajori Two Course Cluster 28)</td><td>OR</td><td>[376] Mathematical Analysis II (1 unit – Cajori Two Course Cluster 23)</td><td>OR</td><td>[417] Mathematical Statistics (1 unit – Cajori Two Course Cluster 46)</td></tr>
</table>
</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td><u>Three other 300-400 level one unit courses (excluding 355 and 455):</u>
[300] Geometry (1 unit – Cajori Two Course Cluster 34)
[311] Vector Analysis (1 unit – Cajori Two Course Cluster 19)
[312] Fourier Analysis (1 unit – Cajori Two Course Cluster 37)
[313] Probability (1 unit – Cajori Two Course Cluster 46)
[315] Differential Equations (1 unit – Cajori Two Course Cluster 22)
[318] Numerical Analysis (1 unit – Cajori Two Course Cluster 22)
[325] Graph Theory (1 unit – Cajori Two Course Cluster 44)
[340] Topics in Mathematics (1 unit – Cajori Two Course Cluster 52)
[345] Research in Mathematics: An Introduction to the Nature of Mathematical Research (1 unit – Cajori Two Course Cluster 52)
[351] History of Mathematics (1 unit – Cajori Two Course Cluster 53)</td></tr>
</table>

Table 23. Colorado College: 2005 to 2006 (continued)

	[399] Seminar in Mathematics (.5 unit – Cajori Two Course Cluster 52) [400] Topology (1 unit – Cajori Two Course Cluster 33) [410] Complex Analysis (1 unit – Cajori Two Course Cluster 23) [440] Topics in Mathematics (1 unit – Cajori Two Course Cluster 55) And two other 200-level one unit courses (excluding 255. EC392 may count as a 200-level elective): [217] Probability and Statistical Modeling (1 unit – Cajori Two Course Cluster 5) [218] Analysis of Environmental Data (1 unit – Cajori Two Course Cluster 45) [240] Topics in Mathematics: Mathematical Modeling (1 unit – Cajori Two Course Cluster 52) [256] Mathematical Models in Biology (1 unit – Cajori Two Course Cluster 40)
Total number of required courses beyond freshman calculus:	10
Can undergraduate students take graduate courses?	Not mentioned.
Are students required to take a computing course? If so, which ones.	Not mentioned.
How many different calculus sequences exist for a mathematics major?	3

Table 24. Stanford University: 1906 to 1907

College:	Stanford University
Catalog Year:	1906-1907
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Bachelor of Arts (A.B.), Major in Mathematics
Total number of units to graduate:	120 units (Stanford University Bulletin, 1906-1907, p. 40)
Total number of mathematics units required for the degree:	It is not noted in the catalog. It is likely to be at least two more courses in the senior year, so it would be at least 27 units.
List of required courses and their respective units:	"For students whose major subject is Mathematics the following program of work is recommended [for the first three years of study]:" (Stanford University Bulletin, 1906-1907, p. 83) [3] Algebra (5 units – Cajori Two Course Cluster 3) [4] Co-ordinate Geometry (5 units – Cajori Two Course Cluster 2) [9, first semester] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11) [9, second semester] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11) [10, first semester] Modern Analytic Geometry (2 units – Cajori Two Course Cluster 31) [10, second semester] Modern Analytic Geometry (2 units – Cajori Two Course Cluster 31) [11] Advanced Calculus (3 units – Cajori Two Course Cluster 21) [12] Differential Equations (3 units – Cajori Two Course Cluster 22) [13, first semester] Theory of Equations (2 units – Cajori Two Course Cluster 26) [13, second semester] Theory of Equations (2 units – Cajori Two Course Cluster 26) *(30 total units)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	The work during fourth year should be selected from: [5] Determinants (2 units – Cajori Two Course Cluster 26) [6] Non-Euclidean Geometry (2 units – Cajori Two Course Cluster 32) [15, first semester] Differential Equations (3 units – Cajori Two Course Cluster 22) [15, second semester] Differential Equations (3 units – Cajori Two Course Cluster 22) [16] Definite Integrals (2 units – Cajori Two Course Cluster 25) [17, first semester] Theory of Functions (2 units – Cajori Two Course Cluster 23) [17, second semester] Theory of Functions (2 units – Cajori Two Course Cluster 23) [18, first semester] Plane Curves (2 units – Cajori Two Course Cluster 20) [18, second semester] Plane Curves (2 units – Cajori Two Course Cluster 20) [19] History of Elementary Mathematics (2 units – Cajori Two Course Cluster 53) [20] General Astronomy (2 units – Cajori Two Course Cluster 54) [21, first semester] Projective Geometry (2 units – Cajori Two Course Cluster 32)

Table 24. Stanford University: 1906 to 1907 (continued)

	[21, second semester] Projective Geometry (2 units – Cajori Two Course Cluster 32) [22, first semester] Elementary Theory of Groups (3 units – Cajori Two Course Cluster 22) [22, second semester] Elementary Theory of Groups (3 units – Cajori Two Course Cluster 22) [23] Theory of Numbers (2 units – Cajori Two Course Cluster 29) [24, first semester] Seminary – Solid Co-ordinate Geometry (2 units – Cajori Two Course Cluster 31) [24, second semester] Seminary – Solid Co-ordinate Geometry (2 units – Cajori Two Course Cluster 31) *(40 total units)*
Total number of required courses beyond freshman calculus:	At least 6, considering 2 would be taken in the senior year.
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 25. Stanford University: 1915 to 1916

<table>
<tr><td>College:</td><td>Stanford University</td></tr>
<tr><td>Catalog Year:</td><td>1915-1916</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Mathematics Major, degree type unknown</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 28 units, if at least 2 mathematics courses are required in the fourth year of study.</td></tr>
<tr><td>List of required courses and their respective units:</td><td>“For students whose major subject is Mathematics the following programme of work is recommended [in the first three years of study]:” (Stanford University Bulletin, 1915-1916, p. 75)

[3] Algebra (5 units – Cajori Two Course Cluster 3)
[4] Co-ordinate Geometry (5 units – Cajori Two Course Cluster 2)
[9, first semester] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11)
[9, second semester] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11)

<table>
<tr><td>[10, first semester] Advanced Co-ordinate Geometry (2 units – Cajori Two Course Cluster 31)
[10, second semester] Advanced Co-ordinate Geometry (2 units – Cajori Two Course Cluster 31)</td><td>OR</td><td>[21, first semester] Projective Geometry (2 units – Cajori Two Course Cluster 32)
[21, second semester] Projective Geometry (2 units – Cajori Two Course Cluster 32)</td></tr>
</table>

[11] Advanced Calculus (3 units – Cajori Two Course Cluster 21)
[12] Theory of Functions (3 units – Cajori Two Course Cluster 23)
[15] Differential Equations (3 units – Cajori Two Course Cluster 22)

(24 total units)</td></tr>
</table>

Table 25. Stanford University: 1915 to 1916 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	"Work during the fourth year… may be selected from the remaining courses, and from the Department of Applied Mathematics" (Stanford University Bulletin, 1915-1916, p. 75) [13] Non-Euclidean Geometry (3 units – Cajori Two Course Cluster 32) [14] Modern Co-ordinate Geometry (3 units – Cajori Two Course Cluster 31) [16] Definite Integrals (2 units – Cajori Two Course Cluster 25) *(Not given in 1915-1916)* [17, first semester] Advanced Theory of Functions (4 units – Cajori Two Course Cluster 23) [17, second semester] Advanced Theory of Functions (4 units – Cajori Two Course Cluster 23) [18, first semester] Theory of Equations (3 units – Cajori Two Course Cluster 26) *(Not given in 1915-1916)* [18, second semester] Theory of Equations (3 units – Cajori Two Course Cluster 26) *(Not given in 1915-1916)* [19, first semester] Reading Course (2 units – Cajori Two Course Cluster 52) [19, second semester] Reading Course (2 units – Cajori Two Course Cluster 52) [22] Classical Problems (3 units – Cajori Two Course Cluster 53) [23, first semester] Mathematics of Investment and Insurance (3 units – Cajori Two Course Cluster 41) *(Not given in 1915-1916)* [23, second semester] Mathematics of Investment and Insurance (3 units – Cajori Two Course Cluster 41) *(Not given in 1915-1916)* [25] Theory of Groups (3 units – Cajori Two Course Cluster 28)
Total number of required courses beyond freshman calculus:	Six, if at least two mathematics courses are required in the fourth year of study.
Can undergraduate students take graduate courses?	Fourth year courses are for undergraduates and graduate students. (Stanford University Bulletin, 1915-1916, p. 75).
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 26. Stanford University: 1923 to 1924

College:	Stanford University
Catalog Year:	1923-1924
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Mathematics Major, degree type unknown
Total number of units to graduate:	180 units
Total number of mathematics units required for the degree:	At least 41 (including trigonometry and solid geometry).
List of required courses and their respective units:	"Students intending to major in Mathematics should take" (Stanford University Bulletin, 1923-1924, p. 117): If not taken in high school one should take the following: [1] Trigonometry (4 units – Cajori Two Course Cluster 1) [2] Solid Geometry (3 units – Cajori Two Course Cluster 2) And: [10] Algebra (5 units – Cajori Two Course Cluster 3) [11, first semester] Coordinate Geometry (5 units – Cajori Two Course Cluster 2) [11, second semester] Coordinate Geometry (5 units – Cajori Two Course Cluster 2) [140, first semester] Differential and Integral Calculus (5 units – Cajori Two Course Cluster 11) [140, second semester] Differential and Integral Calculus (5 units – Cajori Two Course Cluster 11) [150] Differential Equations (5 units – Cajori Two Course Cluster 22) *(37 total units)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Three additional courses higher than [140]: [141] Advanced Calculus (5 units – Cajori Two Course Cluster 21) [155] Projective Geometry (5 units – Cajori Two Course Cluster 32) [160] Advanced Algebra (4 units – Cajori Two Course Cluster 28) [200a] Plane Geometry (5 units – Cajori Two Course Cluster 31) [200b] Teacher's Course in Algebra (5 units – Cajori Two Course Cluster 10) [200c] Non-Euclidean Geometry (4 units – Cajori Two Course Cluster 32) [205] Theory of Functions (5 units – Cajori Two Course Cluster 23) [210] Selected Readings (units not listed – Cajori Two Course Cluster 52)

Table 26. Stanford University: 1923 to 1924 (continued)

Total number of required courses beyond freshman calculus:	At least four
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 27. Stanford University: 1935 to 1936

<table>
<tr><td>College:</td><td>Stanford University</td></tr>
<tr><td>Catalog Year:</td><td>1935-1936</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Mathematics Major, degree type unknown</td></tr>
<tr><td>Total number of units to graduate:</td><td>Not available</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 45 units.</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[10] Analytical Geometry (3 units – Cajori Two Course Cluster 2)
[11] Analytical Geometry – Continuation of [10] (3 units – Cajori Two Course Cluster 2)
[21] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11)
[22] Differential and Integral Calculus – Continuation of [21] (3 units – Cajori Two Course Cluster 11)
[23] Differential and Integral Calculus – Continuation of [22] (3 units – Cajori Two Course Cluster11)

(15 total units)</td><td>OR</td><td>[41] Analytic Geometry (5 units – Cajori Two Course Cluster 2)
[42] Differential Calculus (5 units – Cajori Two Course Cluster 11)
[43] Integral Calculus (5 units – Cajori Two Course Cluster 11)

(15 total units)</td></tr>
</table>
[119] College Algebra (3 units – Cajori Two Course Cluster 3) (Group II)
[120] Advanced Algebra (3 units – Cajori Two Course Cluster 26) (Group II)
[112] Analytical Mechanics (4 units – Cajori Two Course Cluster 38) (Group II)</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td><u>A total of 30 units of credit from Group II – Courses Primarily for Upper Division and Graduate Students (20 more units are required since 10 units are above):</u>

[122] Selected Topics from Advanced Algebra (3 units – Cajori Two Course Cluster 30)
[123, first semester] Theory of Probability (3 units – Cajori Two Course Cluster 46)
[123, second semester] Theory of Probability (3 units – Cajori Two Course Cluster 46)
[125] Mathematical Statistics (3 units – Cajori Two Course Cluster 46)
[128] Interpolation and Numerical Integration (2 units – Cajori Two Course Cluster 22)</td></tr>
</table>

Table 27. Stanford University: 1935 to 1936 (continued)

	[130] Advanced Calculus I (3 units – Cajori Two Course Cluster 22) [131] Advanced Calculus II (3 units – Cajori Two Course Cluster 37) [132] Advanced Calculus III (3 units – Cajori Two Course Cluster 21) [140] Reading Courses (units not listed – Cajori Two Course Cluster 52) [142, first semester] Higher Geometry (3 units – Cajori Two Course Cluster 34) [142, second semester] Higher Geometry (3 units – Cajori Two Course Cluster 34) [150] Differential Equations (4 units – Cajori Two Course Cluster 22) [152, first semester] Theory of Numbers (2 units – Cajori Two Course Cluster 29) [152, second semester] Theory of Numbers (2 units – Cajori Two Course Cluster 29) [153, first semester] Theory of Groups (3 units – Cajori Two Course Cluster 28) [153, second semester] Theory of Groups (3 units – Cajori Two Course Cluster 28) [154, first semester] Fuchsian Groups (2 units – Cajori Two Course Cluster 28) [154, second semester] Fuchsian Groups (2 units – Cajori Two Course Cluster 28) [155] Projective Geometry (5 units – Cajori Two Course Cluster 32) [157] Non-Euclidean Geometry (4 units – Cajori Two Course Cluster 32) [160] Theory of Equations (3 units – Cajori Two Course Cluster 26) [164, first semester] Continued Fractions and Their Applications (3 units – Cajori Two Course Cluster 29) [164, second semester] Continued Fractions and Their Applications (3 units – Cajori Two Course Cluster 29) [170, first semester] Advanced Analytical Mechanics (2 units – Cajori Two Course Cluster 38) [170, second semester] Advanced Analytical Mechanics (2 units – Cajori Two Course Cluster 38) [180] Introduction to the Theory of Algebraic Numbers (3 units – Cajori Two Course Cluster 29) [205, first semester] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [205, second semester] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [206, first semester] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) [206, second semester] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) [207] Calculus of Variations (3 units – Cajori Two Course Cluster 24) [212] Seminar in Analysis (3 units – Cajori Two Course Cluster 25) [215, first semester] Analytic Theory of Numbers (3 units – Cajori Two Course Cluster 29) [215, second semester] Analytic Theory of Numbers (3 units – Cajori Two Course Cluster 29) [217] Quadratic Fields (2 units – Cajori Two Course Cluster 29) [218, first semester] Elliptic Functions (2 units – Cajori Two Course Cluster 37) [218, first semester] Elliptic Functions (2 units – Cajori Two Course Cluster 37) [218, second semester] Elliptic Functions (2 units – Cajori Two Course Cluster 37) [219, first semester] Applications of Elliptic Functions (3 units – Cajori Two Course Cluster 37) [219, second semester] Applications of Elliptic Functions (3 units – Cajori Two Course Cluster 37)

Table 27. Stanford University: 1935 to 1936 (continued)

	[220] Linear Associative Algebras (3 units – Cajori Two Course Cluster 27) [222] Geometry of Numbers (3 units – Cajori Two Course Cluster 33) [223] Integral Equations (3 units – Cajori Two Course Cluster 24) [225, first semester] Advanced Group Theory (3 units – Cajori Two Course Cluster 28) [225, second semester] Advanced Group Theory (3 units – Cajori Two Course Cluster 28) [228, first semester] Point-Set Theory (2 units – Cajori Two Course Cluster 33) [228, second semester] Point-Set Theory (2 units – Cajori Two Course Cluster 33) [229, first semester] Point-Set Theory – Continuation of [228] (3 units – Cajori Two Course Cluster 33) [229, second semester] Point-Set Theory – Continuation of [228] (3 units – Cajori Two Course Cluster 33) [240] Linear Groups (3 units – Cajori Two Course Cluster 28) [242, first semester] Continuous Groups (3 units – Cajori Two Course Cluster 30) [242, second semester] Continuous Groups (3 units – Cajori Two Course Cluster 30) [260, first semester] Advanced Reading and Research (units not listed – Cajori Two Course Cluster 52) [260, second semester] Advanced Reading and Research (units not listed – Cajori Two Course Cluster 52)
Total number of required courses beyond freshman calculus:	At least ten
Can undergraduate students take graduate courses?	Sort of - Group II courses are for upper division students and graduate students.
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	Two

Table 28. Stanford University: 1945 to 1946

<table>
<tr><td>College:</td><td>Stanford University</td></tr>
<tr><td>Catalog Year:</td><td>1945-1946</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Mathematics Major, degree type unknown</td></tr>
<tr><td>Total number of units to graduate:</td><td>180 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>48 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[10] Analytical Geometry (3 units – Cajori Two Course Cluster 2)

[11] Analytical Geometry – Continuation of [10] (3 units – Cajori Two Course Cluster 2)

[21] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11)

[22] Differential and Integral Calculus – Continuation of [21] (3 units – Cajori Two Course Cluster 11)

[23] Differential and Integral Calculus – Continuation of [22] (3 units – Cajori Two Course Cluster 11)

(15 total units)</td><td>OR</td><td>[41] Analytic Geometry (5 units – Cajori Two Course Cluster 2)

[42] Differential Calculus (5 units – Cajori Two Course Cluster 13)

[43] Integral Calculus (5 units – Cajori Two Course Cluster 13)

(15 total units)</td></tr>
</table>
New req: [24] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11)
New req: [130] Advanced Calculus I (3 units – Cajori Two Course Cluster 22) (Group II)
New req: [131] Advanced Calculus II (3 units – Cajori Two Course Cluster 37) (Group II)

[119] First Course in Higher Algebra (3 units – Cajori Two Course Cluster 26) (Group II)
[120] Second Course in Higher Algebra (3 units – Cajori Two Course Cluster 26) (Group II)

New req:[115] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23) (Group II) (Taught by Polya)</td></tr>
</table>

Table 28. Stanford University: 1945 to 1946 (continued)

	[112] Mathematical Fundamental Mechanics (3 units – Cajori Two Course Cluster 37) (Group II) (Taught by Polya) New req: [142] Higher Geometry (3 units – Cajori Two Course Cluster 32) (Group II)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	A total of 30 units of credit from Group II – Courses Primarily for Upper Division and Graduate Students (9 more units are required since 21 units are above): [110] Selected Topics from Elementary Geometry (3 units – Cajori Two Course Cluster 31) (Taught by Polya) [122] Modern Algebra (3 units – Cajori Two Course Cluster 28) [123] Theory of Probability (4 units – Cajori Two Course Cluster 46) (Increased one unit) [125] Mathematical Statistics (3 units – Cajori Two Course Cluster 46) [128] Interpolation and Numerical Integration (3 units – Cajori Two Course Cluster 22) (Increased one unit) (Taught by Polya) [129 (winter)] Elementary Mathematics from a Higher Point of View (3 units – Cajori Two Course Cluster 10) – New course [129 (spring)] Elementary Mathematics from a Higher Point of View (3 units – Cajori Two Course Cluster 10) – New course [132] Advanced Calculus III (3 units – Cajori Two Course Cluster 38) [143] Differential Geometry (3 units – Cajori Two Course Cluster 33) – New Course [152(winter)] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29) (Increased one unit) [152(spring)] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29) (Increased one unit) [153] Theory of Groups with Applications (3 units – Cajori Two Course Cluster 28) (Taught by Polya) [157] Non-Euclidean Geometry (5 units – Cajori Two Course Cluster 32) (Increased one unit) [205(winter)] Point-Sets and Real Functions (3 units – Cajori Two Course Cluster 33) [205(spring)] Point-Sets and Real Functions (3 units – Cajori Two Course Cluster 33) [206(autumn)] Introduction to the Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [206(winter)] Introduction to the Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [207] Calculus of Variations (3 units – Cajori Two Course Cluster 24) [208] Selected Topics from the Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) – New course [212(autumn)] Seminar in Analysis and Theory of Numbers (2 units – Cajori Two Course Cluster 30) (Decreased one unit) [212(winter)] Seminar in Analysis and Theory of Numbers (2 units – Cajori Two Course Cluster 30) (Decreased one unit) [212(spring)] Seminar in Analysis and Theory of Numbers (2 units – Cajori Two Course Cluster 30) (Decreased one unit) [215(winter)] Analytic Theory of Numbers (3 units – Cajori Two Course Cluster 29) [215(spring)] Analytic Theory of Numbers (3 units – Cajori Two Course Cluster 29) [218(autumn)] Elliptic Functions (2 units – Cajori Two Course Cluster 37) [218(winter)] Elliptic Functions (2 units – Cajori Two Course Cluster 37) [218(spring)] Elliptic Functions (2 units – Cajori Two Course Cluster 37)

Table 28. Stanford University: 1945 to 1946 (continued)

	219] Applications of Elliptic Functions (3 units – Cajori Two Course Cluster 37) [220] Linear Associative Algebras (3 units – Cajori Two Course Cluster 28) [222] Geometry of Numbers (3 units – Cajori Two Course Cluster 32) [223] Integral Equations (3 units – Cajori Two Course Cluster 24) [230] Partial Differential Equations of Physics and Engineering (3 units – Cajori Two Course Cluster 37) – New course [260] Advanced Reading and Research (units not listed – Cajori Two Course Cluster 52)
Total number of required courses beyond freshman calculus:	Ten
Can undergraduate students take graduate courses?	Division II courses are for undergraduates and graduate students.
Are students required to take a computing course? If so, which ones.	Not mentioned.
How many different calculus sequences exist for a mathematics major?	Two

Table 29. Stanford University: 1955 to 1956

<table>
<tr><td>College:</td><td>Stanford University</td></tr>
<tr><td>Catalog Year:</td><td>1955-1956</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Mathematics Major, Degree-type Unknown</td></tr>
<tr><td>Total number of units to graduate:</td><td>180 quarter units</td></tr>
<tr><td>Total number of mathematics units required for the degree:</td><td>At least 54 units.</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[10] Analytical Geometry and Calculus (3 units – Cajori Two Course Cluster 11)
[11] Analytical Geometry and Calculus – Continuation of [10] (3 units – Cajori Two Course Cluster 11)

[21] Analytical Geometry and Calculus – Continuation of [11] (3 units – Cajori Two Course Cluster 11)
[22] Differential and Integral Calculus – Continuation of [21] (3 units – Cajori Two Course Cluster 11)
[23] Differential and Integral Calculus – Continuation of [22] (3 units – Cajori Two Course Cluster 11)

(15 total units)</td><td>OR</td><td>[41] Analytic Geometry (5 units – Cajori Two Course Cluster 11)
[42] Differential Calculus (5 units – Cajori Two Course Cluster 11)
[43] Integral Calculus (5 units – Cajori Two Course Cluster 11)

(15 total units)</td></tr>
</table>
[24] Differential and Integral Calculus (3 units – Cajori Two Course Cluster – Cajori Two Course Cluster 14)
[100] Advanced Calculus I (3 units – Cajori Two Course Cluster 21) (Group II)
[114] Matrix Theory (3 units – Cajori Two Course Cluster 26) (Group II)
[120] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Group II)
[130] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) (Group II) (Autumn and Winter Quarters)
[131] Partial Differential Equations I (3 units – Cajori Two Course Cluster 37) (Group II)
[115] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23) (Group II)
</td></tr>
</table>

Table 29. Stanford University: 1955 to 1956 (continued)

<table>
<tr>
<td></td>
<td>[116] Fundamental Concepts of Analysis - Continuation of [115] (3 units – Cajori Two Course Cluster 23) (Group II)

<table>
<tr><td>[113] Vector Analysis (3 units – Cajori Two Course Cluster 19) (Group II)</td><td>OR</td><td>[106] Introduction to Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) – New course</td></tr>
</table>

<table>
<tr><td>[142] Higher Geometry (3 units – Cajori Two Course Cluster 32) (Group II)</td><td>OR</td><td>[143a] Differential Geometry (3 units – Cajori Two Course Cluster 33)</td></tr>
</table>

(45 total units)</td>
</tr>
<tr>
<td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td>
<td>“Enough courses from groups II or III to make a total of 36 units of credit” (Stanford University Bulletin, 1955-1956, p. 221) so 9 more credits are required:

Group II
[110] Selected Topics from Elementary Geometry (3 units – Cajori Two Course Cluster 10)
[111] Mathematical Models in Science (3 units – Cajori Two Course Cluster 37)
[121] Modern Algebra (3 units – Cajori Two Course Cluster 28)
[123] Theory of Probability (4 units – Cajori Two Course Cluster 46)
[129] Elementary Mathematics from a Higher Point of View (3 units – Cajori Two Course Cluster 53)
[132] Partial Differential Equations II (3 units – Cajori Two Course Cluster 37)
[137] Numerical Methods (3 units – Cajori Two Course Cluster 22) – New course
[138] Numerical Methods – Continuation of course [137] (3 units – Cajori Two Course Cluster 22) – New course
[143b] Differential Geometry – Continuation of course [143a] (3 units – Cajori Two Course Cluster 33)
[152a] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29)
[152b] Elementary Theory of Numbers – Continuation of course [143b] (3 units – Cajori Two Course Cluster 29)
[157] Non-Euclidean Geometry (3 units – Cajori Two Course Cluster 32) (Decreased by 2 units)
[170] Elementary Tensor Calculus (3 units – Cajori Two Course Cluster 37) – New Course
[190] Proseminar (3 units – Cajori Two Course Cluster 52)</td>
</tr>
</table>

Table 29. Stanford University: 1955 to 1956 (continued)

	Group III – Courses Mainly for Graduate Students (but available to Undergraduates) [200a, b] Advanced Course in Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) – New course, and only offered in the autumn quarter [201] Calculus of Variations (3 units – Cajori Two Course Cluster 24) – New course [203] Potential Theory (3 units – Cajori Two Course Cluster 38) – New course [204a] Integral Equations (3 units – Cajori Two Course Cluster 24) – New course [204b] Integral Equations (3 units – Cajori Two Course Cluster 24) – New course [205a] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) [205b] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) [205c] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) [206a] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [206b] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [207] Fourier Series (3 units – Cajori Two Course Cluster 37) [208a] Topology (3 units – Cajori Two Course Cluster 33) – New course [208b] Topology (3 units – Cajori Two Course Cluster 33) – Continuation of Course [208a] – New course [209a] Advanced Partial Differential Equations (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) [209b] Advanced Partial Differential Equations (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [209c] Advanced Partial Differential Equations (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [210] Galois Theory (3 units – Cajori Two Course Cluster 28) – New course [211] Theory of Sets (3 units – Cajori Two Course Cluster 35) – New course [212] Seminar (2 units – Cajori Two Course Cluster 52) [213] Mathematical Logic (3 units – Cajori Two Course Cluster 35) – New course [247] Calculus of Variations in the Large (3 units – Cajori Two Course Cluster 24) – New Course [251] Geometric Function Theory (3 units – Cajori Two Course Cluster 33) – New Course [252b] Orthogonal Polynomials (3 units – Cajori Two Course Cluster – Cajori Two Course Cluster 37) (Autumn Quarter) – New Course [252c] Orthogonal Polynomials (3 units – Cajori Two Course Cluster – Cajori Two Course Cluster 37) (Winter Quarter) – New Course [252a, b, c] Orthogonal Polynomials (3 units – Cajori Two Course Cluster – Cajori Two Course Cluster 37) (Spring Quarter) – New Course [253] Spectral Theory (3 units – Cajori Two Course Cluster 38) – New Course [254a] Continuous Groups (3 units – Cajori Two Course Cluster 28) (Autumn Quarter) – New Course [254b] Continuous Groups (3 units – Cajori Two Course Cluster 28) (Winter Quarter) – New Course [255] Analytic Theory of Numbers (3 units – Cajori Two Course Cluster 29) – New Course [256] Asymptotic Expansions (3 units – Cajori Two Course Cluster 37) – New Course [257] Advanced Topics in Calculus of Variations (3 units – Cajori Two Course Cluster 24) – New Course [258] Theory of Games (3 units – Cajori Two Course Cluster 42) – New Course [259] Seminar in Hydrodynamics and Partial Differential Equations (3 units – Cajori Two Course Cluster 38) – New Course [260] Advanced Reading and Research (units not listed – Cajori Two Course Cluster 52)

Table 29. Stanford University: 1955 to 1956 (continued)

Total number of required courses beyond freshman calculus:	12
Can undergraduate students take graduate courses?	Group II courses are for undergraduates and graduate students. Group III courses are primarily for graduate students but still available to undergraduates.
Are students required to take a computing course? If so, which ones.	Not mentioned
How many different calculus sequences exist for a mathematics major?	Two

Table 30. Stanford University: 1964 to 1965

College:	Stanford University
Catalog Year:	1964-1965
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.S., Mathematics Major
Total number of units to graduate:	180 quarter units
Total number of mathematics units required for the degree:	At least 52 units

Table 30. Stanford University: 1964 to 1965 (continued)

List of required courses and their respective units:	[10] Analytical Geometry and Calculus (3 units – Cajori Two Course Cluster 11) [11] Analytical Geometry and Calculus – Continuation of [10] (3 units – Cajori Two Course Cluster 11) [21] Analytical Geometry and Calculus – Continuation of [11] (3 units – Cajori Two Course Cluster 11) [22] Differential and Integral Calculus – Continuation of [21] (3 units – Cajori Two Course Cluster 11) [23] Differential and Integral Calculus – Continuation of [22] (3 units – Cajori Two Course Cluster 11) [44] Advanced Calculus I (3 units – Cajori Two Course Cluster 21) [45] Advanced Calculus II (3 units – Cajori Two Course Cluster 21) [46] Advanced Calculus III (3 units – Cajori Two Course Cluster 21) *(24 total units)*	OR	[41] Analytic Geometry and Calculus (5 units – Cajori Two Course Cluster 11) [42] Analytic Geometry and Calculus (5 units – Cajori Two Course Cluster 11) [43] Analytic Geometry and Calculus (5 units – Cajori Two Course Cluster 11) [44] Advanced Calculus I (*repeat* 3 units – Cajori Two Course Cluster 21) [45] Advanced Calculus II (*repeat* 3 units – Cajori Two Course Cluster 21) [46] Advanced Calculus III (*repeat* 3 units – Cajori Two Course Cluster 21) *(24 total units)*	OR	[44] Advanced Calculus I (*repeat* 3 units – Cajori Two Course Cluster 21) [45] Advanced Calculus II (*repeat* 3 units – Cajori Two Course Cluster 21) [46] Advanced Calculus III (*repeat* 3 units – Cajori Two Course Cluster 21) *(9 total units)*	OR	[41] Analytic Geometry and Calculus (*repeat* 5 units – Cajori Two Course Cluster 11) [52] Honors Calculus (3 units – Cajori Two Course Cluster 13) [53] Honors Calculus (5 units – Cajori Two Course Cluster 13) [54] Honors Calculus (3 units – Cajori Two Course Cluster 13) [55] Honors Calculus (3 units – Cajori Two Course Cluster 19) *(19 total units)*

Table 30. Stanford University: 1964 to 1965 (continued)

	[114a] Linear Algebra and Matrix Theory (3 units – Cajori Two Course Cluster 27) [120] Modern Algebra (3 units – Cajori Two Course Cluster 28) [130] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) [131] Partial Differential Equations I (3 units – Cajori Two Course Cluster 37) [115] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23) [116] Fundamental Concepts of Analysis – Continuation of [115] (3 units – Cajori Two Course Cluster 23) [142] Higher Geometry (units not listed – Cajori Two Course Cluster 32) [157] Non-Euclidean Geometry (3 units – Cajori Two Course Cluster 32) OR [217a] Differential Geometry (3 units – Cajori Two Course Cluster 33) [106] Introduction to Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) *(At least 36 total units)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Nine units of courses numbered 100 of above (i.e. Courses for Undergraduate and Graduate Students): [107] Theory and Applications of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [114b] Linear Algebra and Matrix Theory – Continuation of [114a] (3 units – Cajori Two Course Cluster 27) [117] Fundamental Concepts of Analysis – Continuation of [116] (3 units – Cajori Two Course Cluster 23) [121] Modern Algebra (3 units – Cajori Two Course Cluster 28) [123] Theory of Probability (3 units – Cajori Two Course Cluster 46) (Decreased one unit) [124] Theory of Probability – Continuation of [123] (3 units – Cajori Two Course Cluster 46) [132] Partial Differential Equations II (3 units – Cajori Two Course Cluster 37) [136] Use of Automatic Digital Computers (3 units – Cajori Two Course Cluster 48) (Cross listed with Computer Science 136) – New course [137] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 137) [138] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 138) [139] Intermediate Computer Programming (3 units – Cajori Two Course Cluster 48) (Cross listed as Computer Science 139) – New course [143] Topics in Geometry (units not listed – Cajori Two Course Cluster 34) [152a] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29) [152b] Elementary Theory of Numbers – Continuation of course [143b] (3 units – Cajori Two Course Cluster 29) [157] Non-Euclidean Geometry (3 units – Cajori Two Course Cluster 32) [160a] Symbolic Logic (3 units – Cajori Two Course Cluster 35) [160b] Symbolic Logic – Continuation of [160a] (3 units – Cajori Two Course Cluster 35)

Table 30. Stanford University: 1964 to 1965 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	[161] Introduction to Set Theory (3 units – Cajori Two Course Cluster 35) [162] Theory of Automata (3 units – Cajori Two Course Cluster 50) [195] Undergraduate Colloquium (3 units – Cajori Two Course Cluster 53) – New course [199] Undergraduate Honors (units not listed – Cajori Two Course Cluster 55) – New Course Courses intended Primarily for Graduate Students [205a] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Autumn Quarter) [205b] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Winter Quarter) [205c] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Spring Quarter) [206a] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Autumn Quarter) [206b] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Winter Quarter) [206c] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Spring Quarter) [210a] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Autumn Quarter) [210b] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Winter Quarter) [210c] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Spring Quarter) [212] Seminar (2 units – Cajori Two Course Cluster 52) (Increased one unit) [215] Algebraic Curves (3 units – Cajori Two Course Cluster 33) – New course [217a] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) [217b] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [217c] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Spring Quarter) [218a] Introduction to Differential Analysis (3 units – Cajori Two Course Cluster 22) (Winter Quarter) – New Course [218b] Introduction to Differential Analysis (3 units – Cajori Two Course Cluster 22) (Spring Quarter) – New Course [220a] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) – New Course [220b] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Winter Quarter) – New Course [220c] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Spring Quarter) – New Course [221a] Calculus of Variations (3 units – Cajori Two Course Cluster 24) – New Course [230a] Advanced Probability (3 units – Cajori Two Course Cluster 46) (Winter Quarter) – New Course [230b] Advanced Probability (3 units – Cajori Two Course Cluster 46) (Spring Quarter) – New Course [232a] Topics in Stochastic Processes (3 units – Cajori Two Course Cluster 46) (Autumn Quarter) – New Course [232b] Topics in Stochastic Processes (3 units – Cajori Two Course Cluster 46) (Winter Quarter) – New Course [232c] Topics in Stochastic Processes (3 units – Cajori Two Course Cluster 46) (Spring Quarter) – New Course

Table 30. Stanford University: 1964 to 1965 (continued)

	[236a] Advanced Computer Programming (3 units – Cajori Two Course Cluster 48) (Autumn Quarter) (Cross listed as Computer Science 236a) – New Course [236b] Advanced Computer Programming (3 units – Cajori Two Course Cluster 48) (Winter Quarter) (Cross listed as Computer Science 236b) – New Course [237a] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Autumn Quarter) (Cross listed as Computer Science 237a) – New Course [237b] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Winter Quarter) (Cross listed as Computer Science 237b) – New Course [237c] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Spring Quarter) (Cross listed as Computer Science 237c) – New Course [239] Computer Laboratory (units by arrangement – Cajori Two Course Cluster 51) (Cross listed as Computer Science 239) – New Course [242] Analytic Number Theory (3 units – Cajori Two Course Cluster 29) – New Course [249] Transform Theory (3 units – Cajori Two Course Cluster 37) – New Course [250a] Theory of Approximation (3 units – Cajori Two Course Cluster 26) (Autumn Quarter) – New Course [250b] Theory of Approximation (3 units – Cajori Two Course Cluster 26) (Winter Quarter) – New Course [251a] Fourier Analysis in Several Variables (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) – New Course [251b] Fourier Analysis in Several Variables (3 units – Cajori Two Course Cluster 37) (Winter Quarter) – New Course [252a] Orthogonal Polynomials (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) – New Course [252b] Orthogonal Polynomials (3 units – Cajori Two Course Cluster 37) (Winter Quarter) – New Course [253] Advanced Potential Theory (3 units – Cajori Two Course Cluster 38) [254a] Ordinary Differential Equations (units not listed – Cajori Two Course Cluster 22) (Quarter Unknown) [254b] Ordinary Differential Equations (units not listed – Cajori Two Course Cluster 22) (Quarter Unknown) [256a] Partial Differential Equations (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) [256b] Partial Differential Equations (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [256c] Partial Differential Equations (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [261a] Functional Analysis (3 units – Cajori Two Course Cluster 24) (Autumn Quarter) [261b] Functional Analysis (3 units – Cajori Two Course Cluster 24) (Winter Quarter) [261c] Functional Analysis (3 units – Cajori Two Course Cluster 24) (Spring Quarter) [272a] Topics in Fluid Dynamics (3 units – Cajori Two Course Cluster 38) (Spring Quarter) [272b] Topics in Fluid Dynamics (3 units – Cajori Two Course Cluster 38) (Summer Quarter) [273] Electromagnetic Theory (3 units – Cajori Two Course Cluster 55) – New Course [281a] Topology (3 units – Cajori Two Course Cluster 33) (Quarter Unknown) [281b] Topology (3 units – Cajori Two Course Cluster 33) (Quarter Unknown) [281c] Topology (3 units – Cajori Two Course Cluster 33) (Quarter Unknown)

Table 30. Stanford University: 1964 to 1965 (continued)

	[283a] Selected Topics in Topology (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) – New Course [283b] Selected Topics in Topology (3 units – Cajori Two Course Cluster 33) (Winter Quarter) – New Course [283c] Selected Topics in Topology (3 units – Cajori Two Course Cluster 33) (Quarter Unknown) – New Course [291a] Set Theory (units not listed – Cajori Two Course Cluster 35) (Quarter Unknown) [291b] Set Theory (units not listed – Cajori Two Course Cluster 35) (Quarter Unknown) [291c] Set Theory (units not listed – Cajori Two Course Cluster 35) (Quarter Unknown) [292a] Metamathematics (3 units – Cajori Two Course Cluster 25) (Autumn Quarter) – New Course [292b] Metamathematics (3 units – Cajori Two Course Cluster 25) (Winter Quarter) – New Course [292c] Metamathematics (3 units – Cajori Two Course Cluster 25) (Spring Quarter) – New Course [293a] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Autumn Quarter) – New Course [293b] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Winter Quarter) – New Course [293c] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Spring Quarter) – New Course [360] Advanced Reading and Research (units by arrangement – Cajori Two Course Cluster 52) [380] Seminar in Applied Mathematics (units by arrangement – Cajori Two Course Cluster 43) [381] Seminar in Analysis (units by arrangement – Cajori Two Course Cluster 25) [382] Seminar in Computer Science (units by arrangement – Cajori Two Course Cluster 51) [385] Seminar in Abstract Analysis (units by arrangement – Cajori Two Course Cluster 30) [386] Seminar in Geometry and Topology (units by arrangement – Cajori Two Course Cluster 34) [387] Seminar in Function Theory (units by arrangement – Cajori Two Course Cluster 55) [388] Seminar in Probability and Stochastic Processes (units by arrangement – Cajori Two Course Cluster 47) [389] Seminar in Mathematical Biology (units by arrangement – Cajori Two Course Cluster 40) [391] Seminar in Foundations of Mathematics (units by arrangement – Cajori Two Course Cluster 36)
Total number of required courses beyond freshman calculus:	15
Can undergraduate students take graduate courses?	Yes, 200-level courses are for undergraduate and graduate students. The 300-level are primarily for graduate students but are available to undergraduates.
Are students required to take a computing course? If so, which ones.	No, but they are available and can satisfy the mathematics electives requirement.

Table 30. Stanford University: 1964 to 1965 (continued)

How many different calculus sequences exist for a mathematics major?	Four

Table 31. Stanford University: 1975 to 1976

College:	Stanford University				
Catalog Year:	1975-1976				
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.S., Mathematics Major				
Total number of units to graduate:	180 (quarter) units				
Total number of mathematics units required for the degree:	At least 57 units				
List of required courses and their respective units:	[10] Analytical Geometry and Calculus (3 units – Cajori Two Course Cluster 11) [11] Analytical Geometry and Calculus – Continuation of [10] (3 units – Cajori Two Course Cluster 11) [21] Analytical Geometry and Calculus – Continuation of [11] (3 units – Cajori Two Course Cluster 11) [22] Analytic Geometry and Calculus – Continuation of [21] (3 units – Cajori Two Course Cluster 11)	OR	[41] Analytic Geometry and Calculus (5 units – Cajori Two Course Cluster 13) [42] Analytic Geometry and Calculus – Continuation of [41] (5 units – Cajori Two Course Cluster 13) [43] Analytic Geometry and Calculus – Continuation of [42] (5 units – Cajori Two Course Cluster 13) *(15 total units)*	OR	[41a] Calculus (5 units – Cajori Two Course Cluster 13) [42a] Calculus – Continuation of [41a] (5 units – Cajori Two Course Cluster 13) [43a] Calculus – Continuation of [41a] (3 units – Cajori Two Course Cluster 13) *(16 total units)*

Table 31. Stanford University: 1975 to 1976 (continued)

	[[23] Analytic Geometry and Calculus – Continuation of [22] (3 units – Cajori Two Course Cluster 11) *(15 total units)*		[
	[44] Advanced Calculus (3 units – Cajori Two Course Cluster 21) [45] Advanced Calculus – Continuation of [44] (3 units – Cajori Two Course Cluster 21) *(6 units total)*	OR	[54] Honors Calculus (4 units – Cajori Two Course Cluster 21) *(increase one unit)* [55] Honors Calculus – Continuation of [54] (4 units – Cajori Two Course Cluster 21) *(Increased one unit and can satisfy analysis requirement.)* [56] Honors Calculus – Continuation of [55] (4 units – Cajori Two Course Cluster 21) *(Increased one unit and can satisfy analysis requirement.)* *(12 total units)*
	[113] Linear Algebra and Matrix Theory (3 units – Cajori Two Course Cluster 27) [114] Linear Algebra and Matrix Theory – Continuation of [113] (3 units – Cajori Two Course Cluster 27) [115] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23) [116] Fundamental Concepts of Analysis – Continuation of [115] (3 units – Cajori Two Course Cluster 23)		
List of elective courses that could count towards the mathematics degree requirements and their respective units:	"Three courses in algebra of number theory, four courses in analysis, and two courses in geometry or topology. These will typically be chosen among the following:" (Stanford University Bulletin, 1975-1976, p. 416). <u>One from Algebra or Number Theory (since [113] and [114] are above):</u> [120] Modern Algebra (3 units – Cajori Two Course Cluster 28) [121] Modern Algebra – Continuation of [120] (3 units – Cajori Two Course Cluster 28) [152] Elementary Topics in Number Theory (3 units – Cajori Two Course Cluster 29) <u>Two Courses from Analysis (since [115] and [116] are above):</u>		
	[106] Introduction to Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)	OR	[206a] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)

Table 31. Stanford University: 1975 to 1976 (continued)

	[117] Fundamental Concepts of Analysis – Continuation of [116] (3 units – Cajori Two Course Cluster 23) [130] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) [131] Partial Differential Equations I (3 units – Cajori Two Course Cluster 37) [132] Partial Differential Equations II (3 units – Cajori Two Course Cluster 37)
	Two Courses from Geometry: [142] Higher Geometry (3 units – Cajori Two Course Cluster 32) [143] Topics in Geometry (3 units – Cajori Two Course Cluster 34) [159] Introduction to Topology (3 units – Cajori Two Course Cluster 33) [217a] Differential Geometry (3 units – Cajori Two Course Cluster 33) And five additional courses from 45 and 100 or above, and since 45 is recommended it is above and four more from this pool: [123] Theory of Probability (3 units – Cajori Two Course Cluster 46) [124] Introduction to Stochastic Processes (3 units – Cajori Two Course Cluster 46) [136] Introduction to Computing (4 units – Cajori Two Course Cluster 48) (Cross listed as Computer Science 136) [137a] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 137a) [137b] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 137b) [150] Introduction to Combinatorial Theory (3 units – Cajori Two Course Cluster 44) (Cross listed as Computer Science 150) [160a] Symbolic Logic (units not listed – Cajori Two Course Cluster 35) [160b] Symbolic Logic (units not listed – Cajori Two Course Cluster 35) [161] Introduction to Set Theory (units not listed – Cajori Two Course Cluster 35) [162] Theory of Automata (units not listed – Cajori Two Course Cluster 50) [190a] Perspectives in Mathematics (3 units – Cajori Two Course Cluster 52) [190b] Perspectives in Mathematics (3 units – Cajori Two Course Cluster 52) [192a] Topics in the History of Mathematics (units not listed – Cajori Two Course Cluster 53) [192b] Topics in the History of Mathematics (units not listed – Cajori Two Course Cluster 53) [195] Mathematics Workshop Consulting (3 units – Cajori Two Course Cluster 52) [196] Undergraduate Colloquium (3 units – Cajori Two Course Cluster 53) [197] Undergraduate Seminars (1-3 units – Cajori Two Course Cluster 52) [199] Independent Work (units not listed – Cajori Two Course Cluster 52) Courses intended Primarily for Graduate Students [205a] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Autumn Quarter) [205b] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Winter Quarter) [205c] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Spring Quarter)

Table 31. Stanford University: 1975 to 1976 (continued)

	[206b] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Winter Quarter) [206c] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Spring Quarter) [210a] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Autumn Quarter) [210b] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Winter Quarter)
	[210c] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Spring Quarter) [217b] Differential Geometry (3 units – Cajori Two Course Cluster 33) [220a] Methods of Mathematical Physics (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) [220b] Methods of Mathematical Physics (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) [220c] Methods of Mathematical Physics (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) [221a] Calculus of Variations (3 units – Cajori Two Course Cluster 24) [221b] Calculus of Variations (3 units – Cajori Two Course Cluster 24) [222] Asymptotic Expansions (3 units – Cajori Two Course Cluster 25) [230a] Advanced Probability (units not listed – Cajori Two Course Cluster 46) (Quarter Unknown) [230b] Advanced Probability (units not listed – Cajori Two Course Cluster 46) (Quarter Unknown) [232a] Topics in Stochastic Processes (units not listed – Cajori Two Course Cluster 46) (Quarter Unknown) [232b] Topics in Stochastic Processes (units not listed – Cajori Two Course Cluster 46) (Quarter Unknown) [232c] Topics in Stochastic Processes (units not listed – Cajori Two Course Cluster 46) (Quarter Unknown) [233] Stochastic Differential Equations (3 units – Cajori Two Course Cluster 46) [235a] Selected Topics in Ergodic Theory (units not listed – Cajori Two Course Cluster 37) [235b] Selected Topics in Ergodic Theory (units not listed – Cajori Two Course Cluster 37) [235c] Selected Topics in Ergodic Theory (units not listed – Cajori Two Course Cluster 37) [237a] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 237a) (Quarter Unknown) [237b] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 237b) (Quarter Unknown) [237c] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Cross listed as Computer Science 237c) (Quarter Unknown) [243a] Conformal Mapping (units not listed – Cajori Two Course Cluster 43) [243b] Conformal Mapping (units not listed – Cajori Two Course Cluster 43) [244a] Riemann Surfaces (3 units – Cajori Two Course Cluster 33) [245a] Theory of Functions of Several Complex Variables (3 units – Cajori Two Course Cluster 23) (Autumn Quarter) [245b] Theory of Functions of Several Complex Variables (3 units – Cajori Two Course Cluster 23) (Winter Quarter)

Table 31. Stanford University: 1975 to 1976 (continued)

	[245c] Theory of Functions of Several Complex Variables (3 units – Cajori Two Course Cluster 23) [249] Transform Methods (3 units – Cajori Two Course Cluster 37) [254a] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) [254b] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22)
	[256a] Partial Differential Equations (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) [256b] Partial Differential Equations (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) [256c] Partial Differential Equations (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) [258a] Linear Partial Differential Operators (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) – New Course [258b] Linear Partial Differential Operators (units not listed – Cajori Two Course Cluster 37) (Quarter Unknown) – New Course [261a] Functional Analysis (3 units – Cajori Two Course Cluster 24) [261b] Functional Analysis (3 units – Cajori Two Course Cluster 24) [261c] Functional Analysis (3 units – Cajori Two Course Cluster 24) [263a] Lie Algebras (3 units – Cajori Two Course Cluster 28) (Winter Quarter)– New Course [265a] Semigroups of Operators (units not listed – Cajori Two Course Cluster 24) (Quarter Unknown) – New Course [265b] Semigroups of Operators (units not listed – Cajori Two Course Cluster 24) (Quarter Unknown) – New Course [266a] Harmonic Analysis (3 units – Cajori Two Course Cluster 24) (Winter Quarter) – New Course [266b] Harmonic Analysis (3 units – Cajori Two Course Cluster 24) (Spring Quarter) – New Course [271a] Mathematics of Wave Motion (units not listed – Cajori Two Course Cluster 24) – New Course [271b] Mathematics of Wave Motion (units not listed – Cajori Two Course Cluster 24) – New Course [272a] Topics in Hydrodynamics (3 units – Cajori Two Course Cluster 38) [272b] Topics in Hydrodynamics (3 units – Cajori Two Course Cluster 38) [273] Electromagnetic Theory (3 units – Cajori Two Course Cluster 55) [277a] Mathematical Theory of Relativity (units not listed – Cajori Two Course Cluster 55) (Quarter Unknown) [277b] Mathematical Theory of Relativity (units not listed – Cajori Two Course Cluster 55) (Quarter Unknown) [281a] Topology (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) [281b] Topology (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [281c] Topology (3 units – Cajori Two Course Cluster 33) (Spring Quarter) [283a] Selected Topics in Topology (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) [283b] Selected Topics in Topology (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [284a] Differentiable Manifolds (units not listed – Cajori Two Course Cluster 33) [290a] Mathematical Logic (3 units – Cajori Two Course Cluster 35) (Autumn Quarter) - New Course

Table 31. Stanford University: 1975 to 1976 (continued)

	[290b] Mathematical Logic (3 units – Cajori Two Course Cluster 35) (Winter Quarter) - New Course [290c] Mathematical Logic (3 units – Cajori Two Course Cluster 35) (Spring Quarter) - New Course [291a] Topics in Model Theory (units not listed – Cajori Two Course Cluster 43) (Quarter Unknown) [291b] Topics in Model Theory (units not listed – Cajori Two Course Cluster 43) (Quarter Unknown) [292a] Topics in Recursion Theory (3 units – Cajori Two Course Cluster 44) [293a] Topics in Proof Theory (3 units – Cajori Two Course Cluster 25) (Autumn Quarter) – New Course [293b] Topics in Proof Theory (3 units – Cajori Two Course Cluster 25) (Spring Quarter) – New Course [294a] Topics in Set Theory (units not listed – Cajori Two Course Cluster 36) (Quarter Unknown) – New Course [294b] Topics in Set Theory (units not listed – Cajori Two Course Cluster 36) (Quarter Unknown) – New Course [296] Topics in Number Theory (units not listed – Cajori Two Course Cluster 30) [350] Directed Reading (units by arrangement – Cajori Two Course Cluster 52) [351] Seminar Participation (units by arrangement – Cajori Two Course Cluster 52) [352] Undergraduate Seminar Leadership (units by arrangement – Cajori Two Course Cluster 52) [355] Teaching Workshop (units by arrangement – Cajori Two Course Cluster 53) [356] Upper Division Teaching (units by arrangement – Cajori Two Course Cluster 10) [360] Advanced Reading and Research (units by arrangement – Cajori Two Course Cluster 52) [361] Seminar Participation (units by arrangement – Cajori Two Course Cluster 52) [380] Seminar in Applied Mathematics (units by arrangement – Cajori Two Course Cluster 43) [381] Seminar in Analysis (units by arrangement – Cajori Two Course Cluster 25) [383] Seminar in Function Theory (units by arrangement – Cajori Two Course Cluster 25) [385] Seminar in Abstract Analysis (units by arrangement – Cajori Two Course Cluster 30) [386] Seminar in Geometry and Topology (units by arrangement – Cajori Two Course Cluster 34) [387] Seminar in Algebra and Number Theory (units by arrangement – Cajori Two Course Cluster 30) [388] Seminar in Probability and Stochastic Processes (units by arrangement – Cajori Two Course Cluster 47) [389] Seminar in Mathematical Biology (units by arrangement – Cajori Two Course Cluster 43) [391] Seminar in Foundations of Mathematics (units by arrangement – Cajori Two Course Cluster 36)
Total number of required courses beyond freshman calculus:	At least 15

Table 31. Stanford University: 1975 to 1976 (continued)

Can undergraduate students take graduate courses?	Yes, the 200 and 300 level courses are available to undergraduates but are graduate-level courses.
Are students required to take a computing course? If so, which ones.	No, but they can count towards the mathematics degree requirements.
How many different calculus sequences exist for a mathematics major?	Four

Table 32. Stanford University: 1985 to 1986

College:	Stanford University
Catalog Year:	1985-1986
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.S. Mathematics Major
Total number of units to graduate:	180 (quarter) units
Total number of mathematics units required for the degree:	72 to 76 units
List of required courses and their respective units:	(see nested table below)

[19] Calculus and Analytical Geometry (3 units – Cajori Two Course Cluster 11) [20] Calculus and Analytical Geometry – Continuation of [19] (3 units – Cajori Two Course Cluster 11) [21] Calculus and Analytical Geometry – Continuation of [20] (3 units – Cajori Two Course Cluster 11) [22] Calculus and Analytical Geometry – Continuation of [21] (3 units – Cajori Two Course Cluster 11)	OR	[41] Calculus and Analytic Geometry (5 units – Cajori Two Course Cluster 11) [42] Calculus and Analytic Geometry – Continuation of [41] (5 units – Cajori Two Course Cluster 11) [43] Calculus and Analytic Geometry – Continuation of [42] (5 units – Cajori Two Course Cluster 11) [44] Calculus (*repeat* 3 units – Cajori Two Course Cluster 11)	OR	[41] Calculus and Analytic Geometry (*repeat* 5 units – Cajori Two Course Cluster 11) [42] Calculus and Analytic Geometry – Continuation of [41] (*repeat* 5 units – Cajori Two Course Cluster 11) [43H] Honors Calculus and Analytic Geometry (5 units – Cajori Two Course Cluster 13) *(Increased one unit)*

Table 32. Stanford University: 1985 to 1986 (continued)

<table>
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<table>
<tr><td>[23] Analytic Geometry and Calculus – Continuation of [22] (3 units – Cajori Two Course Cluster 11)

[44] Calculus (3 units – Cajori Two Course Cluster 11)

(18 total units)</td><td>OR</td><td>

(18 total units)</td><td>OR</td><td>

(15 total units)</td></tr>
</table>
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</tr>
<tr>
<td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td>
<td>
<u>Three courses from Algebra or Number Theory:</u>
<table>
<tr><td>[113] Linear Algebra and Matrix Theory (3 units – Cajori Two Course Cluster 27)

[114] Linear Algebra and Matrix Theory – Continuation of [113] (3 units – Cajori Two Course Cluster 27)</td><td>OR</td><td>[113S] Linear Algebra and Its Applications (3 units – Cajori Two Course Cluster 27)

[114S] Linear Algebra and Its Applications – Continuation of 113S (3 units – Cajori Two Course Cluster 27)</td></tr>
</table>
<table>
<tr><td>[120] Modern Algebra (3 units – Cajori Two Course Cluster 28)</td><td>OR</td><td>[120S] Modern Algebra and Its Applications (3 units – Cajori Two Course Cluster 28)</td></tr>
</table>
[121] Modern Algebra – Continuation of [120] (3 units – Cajori Two Course Cluster 28)
[152] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29)

<u>Four Courses from Analysis:</u>
<table>
<tr><td>[101] Advanced Calculus (3 units – Cajori Two Course Cluster 21)

[130] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22)

(6 total units)</td><td>OR</td><td>[44H] Honors Calculus – Continuation of [43H] (5 units – Cajori Two Course Cluster 13) (Increased one unit)

[45H] Honors Advanced Calculus (5 units – Cajori Two Course Cluster 21)

(10 total units)</td></tr>
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Table 32. Stanford University: 1985 to 1986 (continued)

[106] Introduction to Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)	OR	[206a] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)

[102] Advanced Calculus (no units listed – Cajori Two Course Cluster 21) (Given 1986-87)
[107] Theory and Applications of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)
[115] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23)
[116] Fundamental Concepts of Analysis – Continuation of [115] (3 units – Cajori Two Course Cluster 23)
[117] Introduction to Functional Analysis – Continuation of [116] (3 units – Cajori Two Course Cluster 24)
[131] Partial Differential Equations I (3 units – Cajori Two Course Cluster 37)
[132] Partial Differential Equations II (3 units – Cajori Two Course Cluster 37)

<u>Two Courses from Geometry, Topology or Foundations (At least one must be geometry or topology):</u>
[143] Topics in Differential Geometry (3 units – Cajori Two Course Cluster 33)
[159] Introduction to Topology (3 units – Cajori Two Course Cluster 33)
[160A] First-order Logic (4 units – Cajori Two Course Cluster 35)
[160B] Computability and Logic (4 units – Cajori Two Course Cluster 50)
[161] Axiomatic Set Theory (4 units – Cajori Two Course Cluster 35)

<u>Five additional courses numbered 100 or above:</u>
[123] Theory of Probability (3 units – Cajori Two Course Cluster 46)
[124] Introduction to Stochastic Processes (no units listed – Cajori Two Course Cluster 46) (Given 1986-87)

[126] Mathematical Models in Population Biology (no units listed – Cajori Two Course Cluster 40) (Given 1986-87)	OR	[226] Mathematical Models in Population Biology (no units listed – Cajori Two Course Cluster 40) (Given 1986-87)

[134 A,B] Honors Analysis (no units listed – Cajori Two Course Cluster 23) (Quarter Unknown) (Given 1986-87)
[135] Perturbation Methods in Mathematics and Physics (no units listed – Cajori Two Course Cluster 37) (Given 1986-87)
[136] Introduction to Computing (5 units – Cajori Two Course Cluster 48) (Cross listed as Computer Science 106)
[137A] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Autumn Quarter) (Cross listed as Computer Science 237a)
[137B] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Winter Quarter) (Cross listed as Computer Science 237b)
[137C] Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Spring Quarter) (Cross listed as Computer Science 237c)

Table 32. Stanford University: 1985 to 1986 (continued)

	[150] Introduction to Combinatorial Theory (3 units – Cajori Two Course Cluster 44) (Cross listed as Computer Science 264) [192a] Topics in the History of Mathematics (no units listed – Cajori Two Course Cluster 53) (Quarter Unknown) (Given 1986-87) [192b] Topics in the History of Mathematics (no units listed – Cajori Two Course Cluster 53) (Quarter Unknown) (Given 1986-87) [195] Teaching Practicum (3 units – Cajori Two Course Cluster 52) [196] Undergraduate Colloquium (3 units – Cajori Two Course Cluster 53) [199] Independent Work (units by arrangement – Cajori Two Course Cluster 52) "Students planning graduate study in mathematics are advised to include one or more 200 level courses in their programs" (Stanford University Bulletin, 1985-1986, p. 484). <u>Courses intended Primarily for Graduate Students</u> [205A] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Autumn Quarter) [205B] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Winter Quarter) [205C] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Spring Quarter) [210A] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Autumn Quarter) [210B] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Winter Quarter) [210C] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Spring Quarter) [217A] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [217B] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Spring Quarter) [220 A] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) [220B] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [220C] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [221A] Calculus of Variations (3 units – Cajori Two Course Cluster 24) (Autumn Quarter) [221B] Calculus of Variations (3 units – Cajori Two Course Cluster 24) (Winter Quarter) [224] Integral Equations (3 units – Cajori Two Course Cluster 24) [230A] Advanced Probability (3 units – Cajori Two Course Cluster 46) (Winter Quarter) [230B] Advanced Probability (3 units – Cajori Two Course Cluster 46) (Spring Quarter) [232] Introduction to Stochastic Integration (no units listed – Cajori Two Course Cluster 46) (Given 1986-87) [233] Stochastic Equations and Waves in Random Media (no units listed – Cajori Two Course Cluster 37) [235 A] Selected Topics in Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) [235B] Selected Topics in Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Winter Quarter)

Table 32. Stanford University: 1985 to 1986 (continued)

	[235C] Selected Topics in Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [237A] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Autumn Quarter) (Cross listed as Computer Science 337A) [237B] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Winter Quarter) (Cross listed as Computer Science 337B) [237C] Advanced Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Spring Quarter) (Cross listed as Computer Science 337C) [238A] Advanced Topics in Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Autumn Quarter) (Cross listed as Computer Science 338A) [238B] Advanced Topics in Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Winter Quarter) (Cross listed as Computer Science 338 B) [238C] Advanced Topics in Numerical Analysis (3 units – Cajori Two Course Cluster 22) (Spring Quarter) (Cross listed as Computer Science 338 C) [244A] Riemann Surfaces (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) [244B] Riemann Surfaces (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) [245A] Theory of Functions of Several Complex Variables (no units listed – Cajori Two Course Cluster 23) (Quarter Unknown) (Given 1986-87) [245B] Theory of Functions of Several Complex Variables (no units listed – Cajori Two Course Cluster 23) (Quarter Unknown) (Given 1986-87) [248A] Analytic Number Theory (no units listed – Cajori Two Course Cluster 29) (Quarter Unknown) (Given 1986-87) [248B] Analytic Number Theory (no units listed – Cajori Two Course Cluster 29) (Quarter Unknown) (Given 1986-87) [252A] Advanced Matrix Theory and Inequalities (no units listed – Cajori Two Course Cluster 28) (Given 1986-87 and cross listed with Statistics 314A) [254A] Ordinary Differential Equations (no units listed – Cajori Two Course Cluster 22) (Autumn Quarter) (Given 1986-87) [254B] Ordinary Differential Equations (no units listed – Cajori Two Course Cluster 22) (Winter Quarter) (Given 1986-87) [256A] Partial Differential Equations (no units listed – Cajori Two Course Cluster 27) (Quarter Unknown) (Given 1986-87) [256B] Partial Differential Equations (no units listed – Cajori Two Course Cluster 27) (Quarter Unknown) (Given 1986-87) [256C] Partial Differential Equations (no units listed – Cajori Two Course Cluster 27) (Quarter Unknown) (Given 1986-87) [261A] Functional Analysis (3 units – Cajori Two Course Cluster 24) (Autumn Quarter) [261B] Functional Analysis (3 units – Cajori Two Course Cluster 24) (Winter Quarter) [261C] Functional Analysis (3 units – Cajori Two Course Cluster 24) (Spring Quarter) [263A] Lie Groups and Lie Algebras (3 units – Cajori Two Course Cluster 28) (Autumn Quarter) [263B] Lie Groups and Lie Algebras (3 units – Cajori Two Course Cluster 28) (Winter Quarter) [267A] Harmonic Analysis (no units listed – Cajori Two Course Cluster 24) (Given 1986-87) [270] Perturbation and Asymptotic Methods with Applications (3 units – Cajori Two Course Cluster 37) – New Course [274] Wave Propagation (no units listed – Cajori Two Course Cluster 43) (Given 1986-87)

Table 32. Stanford University: 1985 to 1986 (continued)

	[275] Introduction to Nonlinear Continuum Mechanics (no units listed – Cajori Two Course Cluster 43) (Given 1986-87) – New Course [276] Theory of Viscoelasticity (no units listed – Cajori Two Course Cluster 38) (Given 1986-87 and cross listed with Mechanical Engineering 240A) [277A] Mathematical Theory of Relativity (no units listed – Cajori Two Course Cluster 55) (Quarter Unknown) (Given 1986-87) [277B] Mathematical Theory of Relativity (no units listed – Cajori Two Course Cluster 55) (Quarter Unknown) (Given 1986-87) [281A] Topology (no units listed – Cajori Two Course Cluster 33) (Quarter Unknown) (Given 1986-87) [281B] Topology (no units listed – Cajori Two Course Cluster 33) (Quarter Unknown) (Given 1986-87) [283A] Topics in Topology (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [283B] Topics in Topology (3 units – Cajori Two Course Cluster 33) (Spring Quarter) [284A] Differentiable Manifolds (3 units – Cajori Two Course Cluster 33) (Autumn Quarter) [284B] Differentiable Manifolds (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [286A] Topics in Differentiable Geometry (no units listed – Cajori Two Course Cluster 33) (Quarter Unknown) (Given 1986-87) [286B] Topics in Differentiable Geometry (no units listed – Cajori Two Course Cluster 33) (Quarter Unknown) (Given 1986-87) [287A] Topics in Algebra and Number Theory (no units listed – Cajori Two Course Cluster 29) (Quarter Unknown) (Given 1986-87) [287B] Topics in Algebra and Number Theory (no units listed – Cajori Two Course Cluster 29) (Quarter Unknown) (Given 1986-87) [290A] Model Theory (3 units – Cajori Two Course Cluster 36) (Winter Quarter) [290B] Model Theory (3 units – Cajori Two Course Cluster 36) (Spring Quarter) [291A] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Quarter Unknown) [291B] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Quarter Unknown) [292A] Set Theory (no units listed – Cajori Two Course Cluster 35) (Quarter Unknown) (Given 1986-87) [292B] Set Theory (no units listed – Cajori Two Course Cluster 35) (Quarter Unknown) (Given 1986-87) [293A] Proof Theory (3 units – Cajori Two Course Cluster 36) (Autumn Quarter) [293B] Proof Theory (3 units – Cajori Two Course Cluster 36) (Winter Quarter) [294] Topics in Logic (3 units – Cajori Two Course Cluster 36) [350] Directed Reading (units by arrangement – Cajori Two Course Cluster 52) [351] Seminar Participation (units by arrangement – Cajori Two Course Cluster 52) [360] Advanced Reading and Research (units by arrangement – Cajori Two Course Cluster 52) [361] Seminar Participation (units by arrangement – Cajori Two Course Cluster 52) [380] Seminar in Applied Mathematics (units by arrangement – Cajori Two Course Cluster 43) [381] Seminar in Analysis (units by arrangement – Cajori Two Course Cluster 25) [383] Seminar in Function Theory (units by arrangement – Cajori Two Course Cluster 25) [385] Seminar in Abstract Analysis (units by arrangement – Cajori Two Course Cluster 30) [386] Seminar in Geometry and Topology (units by arrangement – Cajori Two Course Cluster 34)

Table 32. Stanford University: 1985 to 1986 (continued)

	[387] Seminar in Algebra and Number Theory (units by arrangement – Cajori Two Course Cluster 30) [388] Seminar in Probability and Stochastic Processes (units by arrangement – Cajori Two Course Cluster 47) [389] Seminar in Mathematical Biology (units by arrangement – Cajori Two Course Cluster 43) [391] Seminar in Foundations of Mathematics (units by arrangement – Cajori Two Course Cluster 36)
Total number of required courses beyond freshman calculus:	At least 15
Can undergraduate students take graduate courses?	Yes, and it is recommended to take at least one graduate course if a student intends to pursue graduate study in mathematics.
Are students required to take a computing course? If so, which ones.	No, but it is available to count towards the mathematical requirements.
How many different calculus sequences exist for a mathematics major?	Three

Table 33. Stanford University: 1994 to 1995

<table>
<tr><td>College:</td><td>Stanford University</td></tr>
<tr><td>Catalog Year:</td><td>1994-1995</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.S. Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>180 quarter units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 60 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr>
<td>[19] Calculus (3 units – Cajori Two Course Cluster 11)

[20] Calculus – Continuation of [19] (3 units – Cajori Two Course Cluster 11)

[21] Calculus – Continuation of [20] (4 units – Cajori Two Course Cluster 11) (increased one unit)

[43] Calculus – Continuation of [42] or equivalent (i.e. [20]) (5 units – Cajori Two Course Cluster 11)

[44] Calculus – Continuation of [43] (3 units – Cajori Two Course Cluster 11)</td>
<td>OR</td>
<td>[41] Calculus (5 units – Cajori Two Course Cluster 11)

[42] Calculus – Continuation of [41] (5 units – Cajori Two Course Cluster 11)

[43] Calculus – Continuation of [42] (*repeat* 5 units – Cajori Two Course Cluster 11)

[44] Calculus – Continuation of [43] (*repeat* 3 units – Cajori Two Course Cluster 11)

[113] Linear Algebra and Matrix Theory (*repeat* 3 units – Cajori Two Course Cluster 27)</td>
<td>OR</td>
<td>[41] Calculus (*repeat* 5 units – Cajori Two Course Cluster 11)

[42] Calculus– Continuation of [41] (*repeat* 5 units – Cajori Two Course Cluster 11)

[43H] Honors Calculus (5 units – Cajori Two Course Cluster 13)

[44H] Honors Calculus – Continuation of [43H] (5 units – Cajori Two Course Cluster 13)

[45H] Honors Advanced Calculus (5 units – Cajori Two Course Cluster 13)</td>
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Table 33. Stanford University: 1994 to 1995 (continued)

<table>
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<tr>
<td>[113] Linear Algebra and Matrix Theory (3 units – Cajori Two Course Cluster 27)

[130] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22)

(24 total units)</td>
<td>OR</td>
<td>[130] Ordinary Differential Equations (*repeat* 3 units – Cajori Two Course Cluster 22)

(24 total units)</td>
<td>OR</td>
<td>(25 total units)</td>
</tr>
</table>

<u>The Three Recommended from Algebra or Number Theory for those intending to pursue graduate study in mathematics:</u>
[114] Linear Algebra and Matrix Theory – Continuation of [113] (3 units – Cajori Two Course Cluster 27)
[120] Modern Algebra I (3 units – Cajori Two Course Cluster 28)
[121] Modern Algebra II – Continuation of [120] (3 units – Cajori Two Course Cluster 28)

<u>Recommended from Analysis:</u>
<table>
<tr>
<td>[115] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23)</td>
<td>OR</td>
<td>Must have taken the honors sequence:
[171] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23)</td>
</tr>
</table>
</td>
</tr>
<tr>
<td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td>
<td>
<u>No more courses from Algebra or Number Theory since the honors sequence or [113] satisfies this requirement. (This category increased by one course.)</u>

<u>Two more Courses from Analysis (since four is required and one course is in the required pool):</u>
<table>
<tr>
<td>[106] Introduction to Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)</td>
<td>OR</td>
<td>[206a] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)</td>
</tr>
</table>

[131] Partial Differential Equations I (3 units – Cajori Two Course Cluster 37)
[132] Partial Differential Equations II (3 units – Cajori Two Course Cluster 37)
[134A] Honors Analysis (units not available – Cajori Two Course Cluster 23) (Winter Quarter) (Prerequisites are 45H, or 113 and 130, and 171)
[134B] Honors Analysis (units not available – Cajori Two Course Cluster 23) (Spring Quarter) (Prerequisites are 45H, or 113 and 130, and 171)
</td>
</tr>
</table>

Table 33. Stanford University: 1994 to 1995 (continued)

	[173] Analysis on Manifolds (3 units – Cajori Two Course Cluster 34) [175] Elementary and Functional Analysis (units not listed – Cajori Two Course Cluster 24) (Not given 1994-95) Two Courses from Geometry, Topology or Foundations (At least one must be geometry or topology): "Geometry – any of the courses numbered in the 140s" (Stanford Bulletin, 1994-1995, p. 575). [141] Higher Geometries (units not listed – Cajori Two Course Cluster 32) (Not given 1994-95) [143] Differential Geometry (3 units – Cajori Two Course Cluster 33) [145] Algebraic Geometry (units not listed – Cajori Two Course Cluster 33) (Not given 1994-95) [147] Differential Topology (units not listed – Cajori Two Course Cluster 34) (Not given 1994-95) [148] Algebraic Topology (3 units – Cajori Two Course Cluster 33) [160A] First-order Logic (4 units – Cajori Two Course Cluster 35) (Cross listed with Philosophy 160A) [160B] Computability and Logic (4 units – Cajori Two Course Cluster 35) (Cross listed with Philosophy 160B) [161] Set Theory (3 units – Cajori Two Course Cluster 35) *(decreased by one unit)* [162] Philosophy of Mathematics (units not listed – Cajori Two Course Cluster 53) (Not given 1994-95 and cross listed with Philosophy 162) Five additional courses numbered 100 or above: [103] Matrix Theory and its Applications (3 units – Cajori Two Course Cluster 26) [104] Matrix Theory and its Applications – Continuation of [103] (3 units – Cajori Two Course Cluster 26) [109] Modern Algebra and its Applications (3 units – Cajori Two Course Cluster 28) [124] Introduction to Stochastic Processes (no units listed – Cajori Two Course Cluster 46) (Not given 1994-95) [150] Introduction to Combinatorial Theory (3 units – Cajori Two Course Cluster 44) (Cross listed as Computer Science 264) [152] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29) [155] Geometrical Groups (no units listed – Cajori Two Course Cluster 32) (Not given 1994-95) [156] Group Representations (no units listed – Cajori Two Course Cluster 28) (Not given 1994-95) [176] Spectral Geometry (no units listed – Cajori Two Course Cluster 43) (Not given 1994-95) [181] Topics in the History of Mathematics: From Antiquity to the 17th Century (4 units – Cajori Two Course Cluster 53) (Cross listed as History 138D, History and Philosophy of Science 140, and Philosophy 140) [195] Teaching Practicum (3 units – Cajori Two Course Cluster 52) [197] Senior Honors Thesis (units not available – Cajori Two Course Cluster 52) [199] Independent Work (units by arrangement – Cajori Two Course Cluster 52)

Table 33. Stanford University: 1994 to 1995 (continued)

	"Students planning graduate study in mathematics are advised to include one or more 200 level courses in their programs, and to facilitate this, to complete 113, 114, and 115 or 171 as early as possible" (Stanford University Bulletin, 1994-1995, p. 575). Courses Intended Primarily for Graduate Students [200] Graduate Problem Seminar (no units listed – Cajori Two Course Cluster 52) (Not given 1994-95) [205A] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Autumn Quarter) [205B] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Winter Quarter) [205C] Theory of Functions of a Real Variable (3 units – Cajori Two Course Cluster 23) (Spring Quarter) [206B] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) [210A] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Autumn Quarter) [210B,C] Modern Algebra (3 units – Cajori Two Course Cluster 28) (Winter Quarter) [217A] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [217B] Differential Geometry (3 units – Cajori Two Course Cluster 33) (Spring Quarter) [220 A] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) [220B] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [220C] Methods of Mathematical Physics (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [221A] Calculus of Variations (no units listed – Cajori Two Course Cluster 24) (Not given 1994-95) [224] Integral Equations (no units listed – Cajori Two Course Cluster 24) (Not given 1994-95) [228A] Introduction to Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [228B] Introduction to Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [230A] Advanced Probability (no units listed – Cajori Two Course Cluster 46) (Not given 1994-95 and cross listed with Statistics 310A) [232] Mathematics of Diffusion (no units listed – Cajori Two Course Cluster 46) (Not given 1994-95) [234] Large Deviations (no units listed – Cajori Two Course Cluster 47) (Not given 1994-95) [235A] Selected Topics in Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Autumn Quarter) [235B] Selected Topics in Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [235C] Selected Topics in Ergodic Theory (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [236] Introduction to Stochastic Differential Equations (3 units – Cajori Two Course Cluster 47) [237] Asymptotic Analysis of Stochastic Equations (3 units – Cajori Two Course Cluster 47)

Table 33. Stanford University: 1994 to 1995 (continued)

	[242] Difference Equations (no units listed – Cajori Two Course Cluster 55) (Not given 1994-95) [244] Riemann Surfaces (3 units – Cajori Two Course Cluster 33) [245 A,B] Theory of Functions of Several Complex Variables (no units listed – Cajori Two Course Cluster 23) (Not given 1994-95) [247] Singularities of Smooth Mapping (3 units – Cajori Two Course Cluster 55) [248 A,B] Analytic Number Theory (no units listed – Cajori Two Course Cluster 29) (Not given 1994-95) [252A] Matrix Theory and Inequalities (no units listed – Cajori Two Course Cluster 28) (Not given 1994-95) [254 A,B] Ordinary Differential Equations (no units listed – Cajori Two Course Cluster 22) (Not given 1994-95) [255A] Dynamics on the Circle and Annulus (3 units – Cajori Two Course Cluster 55) (Autumn Quarter) [255B] Dynamics on the Circle and Annulus (3 units – Cajori Two Course Cluster 55) (Winter Quarter) [256 A] Partial Differential Equations (3 units – Cajori Two Course Cluster 27) (Autumn Quarter) [256B] Partial Differential Equations (3 units – Cajori Two Course Cluster 27) (Winter Quarter) [256C] Partial Differential Equations (3 units – Cajori Two Course Cluster 27) (Spring Quarter) [258] Symplectic Geometry and Topology (no units listed – Cajori Two Course Cluster 34) (Not given 1994-95) [259A] Pseudo-Differential Operators and K-Theory (3 units – Cajori Two Course Cluster 55) (Winter Quarter) [259B] Pseudo-Differential Operators and K-Theory (3 units – Cajori Two Course Cluster 55) (Spring Quarter) [260 A,B] Mathematical Methods of Classical Mechanics (no units listed – Cajori Two Course Cluster 38) (Not given 1994-95) [261 A,B] Functional Analysis (no units listed – Cajori Two Course Cluster 24) (Not given 1994-95) [263 A,B] Lie Groups and Lie Algebras (no units listed – Cajori Two Course Cluster 28) (Not given 1994-95) [267 A, B] Harmonic Analysis (no units listed – Cajori Two Course Cluster 24) (Not given 1994-95) [272 A,B] Topics in Partial Differential Equations (no units listed – Cajori Two Course Cluster 25) (Not given 1994-95) [274] Wave Propagation (3 units – Cajori Two Course Cluster 43) [276A] Dynamical Systems (3 units – Cajori Two Course Cluster 22) (Cross listed with Mechanical Engineering 233A) (Winter Quarter) [276B] Numerical Analysis of Dynamical Systems (3 units – Cajori Two Course Cluster 22) (Cross listed with Mechanical Engineering 233B) (Spring Quarter) [277] Mathematical Theory of Relativity (no units listed – Cajori Two Course Cluster 55) (Not given 1994-95) [281A] Introduction to Algebraic and Differential Topology (3 units – Cajori Two Course Cluster 33) (Autumn Quarter)

Table 33. Stanford University: 1994 to 1995 (continued)

	[281B] Introduction to Algebraic and Differential Topology (3 units – Cajori Two Course Cluster 33) (Winter Quarter) [283] Topics in Topology (no units listed – Cajori Two Course Cluster 34) (Not given 1994-95) [285A] Geometric Measure Theory (no units listed – Cajori Two Course Cluster 34) (Not given 1994-95) [290A] Model Theory (no units listed – Cajori Two Course Cluster 36) [291A] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Winter Quarter) [291B] Recursion Theory (3 units – Cajori Two Course Cluster 44) (Spring Quarter) [292A, B] Set Theory (no units listed – Cajori Two Course Cluster 35) (Not given 1994-95) [293A] Proof Theory (3 units – Cajori Two Course Cluster 36) (Autumn Quarter) [293B] Proof Theory (3 units – Cajori Two Course Cluster 36) (Winter Quarter) [294] Topics in Logic (3 units – Cajori Two Course Cluster 36) [295] Topics in the Philosophy of Mathematics (no units listed – Cajori Two Course Cluster 53) (Not given 1994-95) [350] Directed Reading (units by arrangement – Cajori Two Course Cluster 52) [351] Seminar Participation (units by arrangement – Cajori Two Course Cluster 52) [360] Advanced Reading and Research (units by arrangement – Cajori Two Course Cluster 52) [361] Seminar Participation (units by arrangement – Cajori Two Course Cluster 52) [380] Seminar in Applied Mathematics (units by arrangement – Cajori Two Course Cluster 43) [381] Seminar in Analysis (units by arrangement – Cajori Two Course Cluster 25) [383] Seminar in Function Theory (units by arrangement – Cajori Two Course Cluster 25) [385] Seminar in Abstract Analysis (units by arrangement – Cajori Two Course Cluster 30) [386] Seminar in Geometry and Topology (units by arrangement – Cajori Two Course Cluster 34) [387] Seminar in Algebra and Number Theory (units by arrangement – Cajori Two Course Cluster 30) [388] Seminar in Probability and Stochastic Processes (units by arrangement – Cajori Two Course Cluster 47) [389] Seminar in Mathematical Biology (units by arrangement – Cajori Two Course Cluster 43) [391] Seminar in Logic and the Foundations of Mathematics (units by arrangement – Cajori Two Course Cluster 36)
Total number of required courses beyond freshman calculus:	At least 15 courses
Can undergraduate students take graduate courses?	Yes, it is recommended.
Are students required to take a computing course? If so, which ones.	No, but it is available as a required elective.

Table 33. Stanford University: 1994 to 1995 (continued)

How many different calculus sequences exist for a mathematics major?	Three

Table 34. Stanford: 2005 to 2006

<table>
<tr><td>College:</td><td>Stanford University</td></tr>
<tr><td>Catalog Year:</td><td>2005-2006</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.S., Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>180 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>49 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[19] Calculus (3 units – Cajori Two Course Cluster 11)

[20] Calculus – Continuation of [19] (3 units – Cajori Two Course Cluster 11)

[21] Calculus – Continuation of [20] (4 units – Cajori Two Course Cluster 11)

(10 total units)</td><td>OR</td><td>[41] Calculus (5 units – Cajori Two Course Cluster 11)

[42] Calculus – Continuation of [41] (5 units – Cajori Two Course Cluster 11)

(10 total units)</td></tr>
</table>
</td></tr>
<tr><td></td><td>
<table>
<tr><td>[51] Linear Algebra and Differential Calculus of Several Variables (5 units – Cajori Two Course Cluster 11)

[52] Integral Calculus of Several Variables (5 units – Cajori Two Course Cluster 11)

[53] Ordinary Differential Equations with Linear Algebra (5 units 22)</td><td>OR</td><td>[51H] Honors Multivariable Mathematics (5 units – Cajori Two Course Cluster 13)

[52H] Honors Multivariable Mathematics (5 units – Cajori Two Course Cluster 13)

[53H] Honors Multivariable Mathematics (5 units – Cajori Two Course Cluster 13)</td><td>OR</td><td>[116] Complex Analysis (3 units – Cajori Two Course Cluster 23)

[113] Linear Algebra and Matrix Theory (3 units – Cajori Two Course Cluster 27)

[120] Modern Algebra (3 units – Cajori Two Course Cluster 28)

[171] Fundamental Concepts of Analysis (3 units – Cajori Two Course Cluster 23)</td></tr>
</table>
</td></tr>
</table>

Table 34. Stanford: 2005 to 2006 (continued)

	[205A] Real Analysis (3 units – Cajori Two Course Cluster 23) OR [210A] Modern Algebra (3 units – Cajori Two Course Cluster 28) OR [215A] Complex Analysis, Geometry, Topology (3 units – Cajori Two Course Cluster 25) OR [215B] Complex Analysis, Geometry, Topology (3 units – Cajori Two Course Cluster 25)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Nine or more of the following courses, including at least one from each group: Algebra Sequence: [114] Linear Algebra and Matrix Theory II (3 units – Cajori Two Course Cluster 27) [121] Modern Algebra II (3 units – Cajori Two Course Cluster 28) [152] Elementary Theory of Numbers (3 units – Cajori Two Course Cluster 29) [156] Group Representations (3 units – Cajori Two Course Cluster 28) Analysis Sequence: [131] Partial Differential Equations I (3 units – Cajori Two Course Cluster 37) [132] Partial Differential Equations II (3 units – Cajori Two Course Cluster 37) [135] Nonlinear Dynamics and Chaos (3 units – Cajori Two Course Cluster 22) [151] Introduction to Probability Theory (3 units – Cajori Two Course Cluster 46) [174A] Topics in Analysis and Differential Equations with Applications (3 units – Cajori Two Course Cluster 37) (Winter Quarter) [174B] Honors Analysis (3 units – Cajori Two Course Cluster 37) (Spring Quarter) [175] Elementary Functional Analysis (3 units – Cajori Two Course Cluster 24)
	Geometry/ Topology Sequence: [143] Differential Geometry (3 units – Cajori Two Course Cluster 33) [145] Algebraic Geometry (3 units – Cajori Two Course Cluster 33) (Not given in 2005-2006) [146] Analysis on Manifolds (3 units – Cajori Two Course Cluster 34) [147] Differential Geometry (3 units – Cajori Two Course Cluster 33) [148] Algebraic Topology (3 units – Cajori Two Course Cluster 33) Logic and Set Theory Sequence: [160A] First-Order Logic (4 units – Cajori Two Course Cluster 35) (Cross listed with PHIL 151/ 251) [160B] Computability and Logic (4 units – Cajori Two Course Cluster 36) (Cross listed with PHIL 152/ 252) [161] Set Theory (3 units – Cajori Two Course Cluster 35)

Table 34. Stanford: 2005 to 2006 (continued)

Total number of required courses beyond freshman calculus:	12 courses
Can undergraduate students take graduate courses?	Yes, and it is recommended for those intending to pursue graduate study.
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	2 sequences

Table 35. University of California, Berkeley: 1905 to 1906

College:	University of California, Berkeley
Catalog Year:	1905-1906
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Degree-type not available, Specialty in Mathematics
Total number of units to graduate:	120 hours
Total number of mathematics units required for the degree:	At least 12 hours, and "students should consult with the members of the department as early as possible" (Berkeley Bulletin, 1905-1906, p. 104).
List of required courses and their respective units:	[C] Plane and Spherical Trigonometry (3 hours – Cajori Two Course Cluster 1) [5] Plane Analytic Geometry (3 hours – Cajori Two Course Cluster 2) [8] Algebra (3 hours – Cajori Two Course Cluster 3) [9A] Differential Calculus (3 hours – Cajori Two Course Cluster 11) *(12 total hours)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	[9B] Integral Calculus (3 hours – Cajori Two Course Cluster 11) [11A] Determinants and Theory of Numerical Equations (3 hours – Cajori Two Course Cluster 26) [11B] Algebraic Theory of Equations (3 hours – Cajori Two Course Cluster 26) [12A] Advanced Analytic Geometry (3 hours – Cajori Two Course Cluster 31) [12B] Analytic Geometry of Three Dimensions (3 hours – Cajori Two Course Cluster 31) [13] Synthetic Projective Geometry (3 hours – Cajori Two Course Cluster 32) [14] Higher Plane Curves (3 hours – Cajori Two Course Cluster 31) [16, 1st half-year] Quaternions (3 hours – Cajori Two Course Cluster 26) [16, 2nd half-year] Quaternions (3 hours – Cajori Two Course Cluster 26) [17] Calculus of Finite Differences (2 hours – Cajori Two Course Cluster 26) [18, 1st half-year] Logic of Mathematics (3 hours – Cajori Two Course Cluster 10) [18, 2nd half-year] Logic of Mathematics (3 hours – Cajori Two Course Cluster 10) [19A] Differential Equations (3 hours – Cajori Two Course Cluster 22) [19B] Differential Equations (3 hours – Cajori Two Course Cluster 22) [20A] Theory of Probabilities; Elementary Course (2 hours – Cajori Two Course Cluster 46) [20B] Theory of Probabilities; Advanced Course (3 hours – Cajori Two Course Cluster 46)

Table 35. University of California, Berkeley: 1905 to 1906 (continued)

	[23] Partial Differential Equations (3 hours – Cajori Two Course Cluster 37) [24] Theory of Functions of a Complex Variable (3 hours – Cajori Two Course Cluster 23) [31] Theory of Numbers (3 hours – Cajori Two Course Cluster 29)
Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 36. University of California, Berkeley: 1915 to 1916

College:	University of California, Berkeley
Catalog Year:	1915-1916
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Degree-type not available, Mathematics Major
Total number of units to graduate:	120 units
Total number of mathematics units required for the degree:	At least 27 hours
List of required courses and their respective units:	[5] Plane Analytic Geometry (3 hours – Cajori Two Course Cluster 2) [6] Introduction to Projective Geometry (3 hours – Cajori Two Course Cluster 32) [8] College Algebra (3 hours – Cajori Two Course Cluster 3) [9] Differential Calculus (3 hours – Cajori Two Course Cluster 11) [109] Integral Calculus (3 hours – Cajori Two Course Cluster 11) [111] Determinants and Theory of Numerical Equations (3 hours – Cajori Two Course Cluster 26) [112] Analytic Geometry of Three Dimensions (3 hours – Cajori Two Course Cluster 31) [114] Analytic Geometry (3 hours – Cajori Two Course Cluster 31) [119] Introduction to Differential Equations (3 hours – Cajori Two Course Cluster 22) *(27 total hours)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Major Courses (Required elective hours for a mathematics major is not available): [101A] Elementary Geometry for Advanced Students (3 hours – Cajori Two Course Cluster 31) [101B] Elementary Geometry for Advanced Students (3 hours – Cajori Two Course Cluster 31) [102A] Elementary Algebra and Analysis for Advanced Students (3 hours – Cajori Two Course Cluster 53) [102B] Elementary Algebra and Analysis for Advanced Students (3 hours – Cajori Two Course Cluster 53) [110A] Advanced Calculus (2 hours – Cajori Two Course Cluster 20) [110B] Advanced Calculus (2 hours – Cajori Two Course Cluster 20) [113] Synthetic Projective Geometry (3 hours – Cajori Two Course Cluster 32) [115] Theory of Numbers (3 hours – Cajori Two Course Cluster 29) [116] Quaternions (3 hours – Cajori Two Course Cluster 26) (Not given in 1915-1916) [117] Calculus of Finite Differences (2 hours – Cajori Two Course Cluster 41) (Not given in 1915-1916) [118A] Algebra of Logic (3 hours – Cajori Two Course Cluster 35) [118B] Algebra of Logic (3 hours – Cajori Two Course Cluster 35) [120] Theory of Probabilities: Advanced Course (3 hours – Cajori Two Course Cluster 46)

Table 36. University of California, Berkeley: 1915 to 1916 (continued)

Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 37. University of California, Berkeley: 1925 to 1926

College:	University of California, Berkeley
Catalog Year:	1925-1926
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Degree-type not available, Mathematics Major
Total number of units to graduate:	120 units
Total number of <u>mathematics units required</u> for the degree:	At least 27 hours
List of required courses and their respective units:	[C] Trigonometry (3 units – Cajori Two Course Cluster 1) [5] Analytic Geometry (3 units – Cajori Two Course Cluster 2) [6] Introduction to Projective Geometry (3 units – Cajori Two Course Cluster 32) [8] College Algebra (3 units – Cajori Two Course Cluster 3) [9A] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11) [9B] Differential and Integral Calculus (3 units – Cajori Two Course Cluster 11) [111] Theory of Algebraic Equations and of Infinite Series (3 units – Cajori Two Course Cluster 26) [112] Analytic Geometry of Space (3 units – Cajori Two Course Cluster 31) [119] Differential Equations (3 units – Cajori Two Course Cluster 22) *(27 total hours)*
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>Upper Division Courses (Required elective hours for a mathematics major is not available):</u> [101] Elementary Geometry for Advanced Students (3 units – Cajori Two Course Cluster 31) [102] Elementary Algebra for Advanced Students (3 units – Cajori Two Course Cluster 30) [104A] History of Mathematics (2 units – Cajori Two Course Cluster 53) [104B] History of Mathematics (2 units – Cajori Two Course Cluster 53) [106] History of Physics (2 units – Cajori Two Course Cluster 55) [110A] Advanced Calculus (2 units – Cajori Two Course Cluster 20) [110B] Advanced Calculus (2 units – Cajori Two Course Cluster 20) [113] Synthetic Projective Geometry (3 units – Cajori Two Course Cluster 32) [114AH] Advanced Analytic Geometry (3-5 units – Cajori Two Course Cluster 31) [114BH] Advanced Analytic Geometry (3-5 units – Cajori Two Course Cluster 31) [115] Theory of Numbers (3 units – Cajori Two Course Cluster 29) [117] Calculus of Finite Differences (3 units – Cajori Two Course Cluster 41) [118A] Algebra of Logic (3 units – Cajori Two Course Cluster 35)

Table 37. University of California, Berkeley: 1925 to 1926 (continued)

	[118B] Algebra of Logic (3 units – Cajori Two Course Cluster 35) [120] Theory of Probability (3 units – Cajori Two Course Cluster 46) [122] Advanced Integral Calculus (3 units – Cajori Two Course Cluster 25) [124A] Vector Analysis (2 units – Cajori Two Course Cluster 19) [124B] Vector Analysis (2 units – Cajori Two Course Cluster 19) [125A] Analytic Mechanics (3 units – Cajori Two Course Cluster 38) [125B] Analytic Mechanics (3 units – Cajori Two Course Cluster 38)
Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 38. University of California, Berkeley: 1935 to 1936

<table>
<tr><td>College:</td><td>University of California, Berkeley</td></tr>
<tr><td>Catalog Year:</td><td>1935-1936</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Degree-type not available, Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 42 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
[C] Trigonometry (3 units – Cajori Two Course Cluster 1)
[E] Solid Geometry (2 units – Cajori Two Course Cluster 2)
<table>
<tr>
<td>[3A] Plane Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 2)

[3B] Plane Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 11)

(6 total units)</td>
<td>OR</td>
<td>[3AB] Plane Analytic Geometry and Calculus (6 units – Cajori Two Course Cluster 13)

(6 total units)</td>
<td>OR</td>
<td>[3AH] Plane Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 2)

[3BH] Plane Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 13)

(6 total units)</td>
</tr>
</table>
<table>
<tr>
<td>[4A] Solid Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 11)

[4B] Solid Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 11)

(6 total units)</td>
<td>OR</td>
<td>[4AH] Solid Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 13)

[4BH] Solid Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 13)

(6 total units)</td>
</tr>
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Table 38. University of California, Berkeley: 1935 to 1936 (continued)

<table>
<tr>
<td></td>
<td>[6] Introduction to Projective Geometry (3 units – Cajori Two Course Cluster 32)
[8] College Algebra (3 units – Cajori Two Course Cluster 26)

Upper Division Courses:
<table>
<tr><td>[111A] Algebra (3 units – Cajori Two Course Cluster 28)</td><td>OR</td><td>[111B] Algebra (3 units – Cajori Two Course Cluster 28)</td></tr>
</table>
<table>
<tr><td>[112A] Introduction to Higher Geometry (3 units – Cajori Two Course Cluster 31)</td><td>OR</td><td>[112B] Introduction to Higher Geometry (3 units – Cajori Two Course Cluster 31)</td></tr>
</table>
<table>
<tr><td>[119A] Advanced Calculus (3 units – Cajori Two Course Cluster 22)</td><td>OR</td><td>[119B] Advanced Calculus (3 units – Cajori Two Course Cluster 22)</td></tr>
</table>
<table>
<tr><td>[200A] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster) (Graduate Course 23)</td><td>OR</td><td>[200B] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Graduate Course)</td></tr>
</table>
</td>
</tr>
<tr>
<td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td>
<td>
<u>Upper Division Courses (24 total upper division units are required, so 12 more units):</u>
[101A] Elementary Mathematics for Advanced Students (3 units – Cajori Two Course Cluster 9)
[101B] Elementary Mathematics for Advanced Students (3 units – Cajori Two Course Cluster 9)
[110A] Advanced Calculus (2 units – Cajori Two Course Cluster 20)
[110B] Advanced Calculus (2 units – Cajori Two Course Cluster 20)
[115] Theory of Numbers (3 units – Cajori Two Course Cluster 29)
[120A] Probability and Statistics (3 units – Cajori Two Course Cluster 46)
[120B] Probability and Statistics (3 units – Cajori Two Course Cluster 46)
[121] Mathematical Introduction to Economics (3 units – Cajori Two Course Cluster 40)
[127A] Foundation of Mathematics (3 units – Cajori Two Course Cluster 35)
[127B] Foundation of Mathematics (3 units – Cajori Two Course Cluster 35)
[199] Special Study for Advanced Undergraduates (1-5 units – Cajori Two Course Cluster 52)</td>
</tr>
<tr>
<td>Total number of required courses beyond freshman calculus:</td>
<td>At least ten</td>
</tr>
<tr>
<td>Can undergraduate students take graduate courses?</td>
<td>Yes, [200] is recommended in the senior, undergraduate year.</td>
</tr>
</table>

Table 38. University of California, Berkeley: 1935 to 1936 (continued)

Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 39. University of California, Berkeley: 1944 to 1945

<table>
<tr><td>College:</td><td>University of California, Berkeley</td></tr>
<tr><td>Catalog Year:</td><td>1944-1945</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Degree-type not available, Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 47 units.</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
[C] Trigonometry (3 units – Cajori Two Course Cluster 1)
[E] Solid Geometry (2 units – Cajori Two Course Cluster 2)
<table>
<tr><td>[3A] Plane Analytic Geometry (3 units – Cajori Two Course Cluster 2)
[3B] Calculus (3 units – Cajori Two Course Cluster 11)</td><td>OR</td><td>[3] Plane Analytic Geometry (6 units – Cajori Two Course Cluster 11)</td></tr>
</table>
<table>
<tr><td>[4A] Solid Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 11)
[4B] Solid Analytic Geometry and Calculus (3 units – Cajori Two Course Cluster 11)</td><td>OR</td><td>[4] Solid Analytic Geometry and Calculus (6 units – Cajori Two Course Cluster 13)</td></tr>
</table>
[8] College Algebra (3 units – Cajori Two Course Cluster 26)
[9] Introduction to Projective Geometry (3 units – Cajori Two Course Cluster 32)

<u>Upper Division Courses:</u>
<table>
<tr><td>[111A] Algebra (3 units – Cajori Two Course Cluster 28)</td><td>OR</td><td>[111B] Algebra (3 units – Cajori Two Course Cluster 28)</td></tr>
</table>
</td></tr>
</table>

Table 39. University of California, Berkeley: 1944 to 1945 (continued)

	[112A] Advanced Analytic Geometry of the Plane (3 units – Cajori Two Course Cluster 31) OR [112B] Advanced Analytic Geometry of the Plane (3 units – Cajori Two Course Cluster 31) [119A] Differential Equations (3 units – Cajori Two Course Cluster 22) OR [119B] Differential Equations (3 units – Cajori Two Course Cluster 22) [201A] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster) (Graduate Course 23) OR [201B] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Graduate Course)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>Upper Division Courses (24 total upper division units are required, so 12 more units):</u> [101A] Elementary Mathematics for Advanced Students (3 units – Cajori Two Course Cluster 9) [101B] Elementary Mathematics for Advanced Students (3 units – Cajori Two Course Cluster 9) [110A] Advanced Calculus (2 units – Cajori Two Course Cluster 20) [110B] Advanced Calculus (2 units – Cajori Two Course Cluster 20) OR [110] Advanced Calculus: Double Course (4 units – Cajori Two Course Cluster 20) [115A] Theory of Numbers (3 units – Cajori Two Course Cluster 29) [115B] Theory of Numbers (3 units – Cajori Two Course Cluster 29) [116] Exterior Ballistics (3 units – Cajori Two Course Cluster 38) [120A] Probability (3 units – Cajori Two Course Cluster 46) [120B] Probability (3 units – Cajori Two Course Cluster 46) [121] Mathematical Introduction to Economics (3 units – Cajori Two Course Cluster 40) [127A] Foundation of Mathematics (3 units – Cajori Two Course Cluster 35) [127B] Foundation of Mathematics (3 units – Cajori Two Course Cluster 35) [199] Special Study for Advanced Undergraduates (1-5 units – Cajori Two Course Cluster 52)
Total number of required courses beyond freshman calculus:	At least ten
Can undergraduate students take graduate courses?	Yes

Table 39. University of California, Berkeley: 1944 to 1945 (continued)

Are students required to take a computing course? If so, which ones.	Not mentioned
How many different calculus sequences exist for a mathematics major?	One

Table 40. University of California, Berkeley: 1954 to 1955

<table>
<tr><td>College:</td><td>University of California, Berkeley</td></tr>
<tr><td>Catalog Year:</td><td>1954-1955</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Degree-type not available, Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 units</td></tr>
<tr><td>Total number of mathematics units required for the degree:</td><td>At least 47 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>[C] Trigonometry (3 units – Cajori Two Course Cluster 1)
[G] Solid Geometry (2 units – Cajori Two Course Cluster 2)

<table>
<tr><td>[3A] Analytic Geometry and Calculus, First Course (3 units – Cajori Two Course Cluster 11)

[3B] Analytic Geometry and Calculus, Second Course (3 units – Cajori Two Course Cluster 11)

(Total of 6 units)</td><td>OR</td><td>[3] Analytic Geometry and Calculus, First and Second Course (6 units – Cajori Two Course Cluster 13)

(Total of 6 units)</td><td>OR</td><td>[3A] Analytic Geometry and Calculus, First Course (*repeat* 3 units – Cajori Two Course Cluster 11)

[3H] Analytic Geometry and Calculus, Second Course (3 units – Cajori Two Course Cluster 13)

(Total of 6 units)</td></tr>
</table>
</td></tr>
</table>

Table 40. University of California, Berkeley: 1954 to 1955 (continued)

[4A] Analytic Geometry and Calculus, Third Course (3 units – Cajori Two Course Cluster 11) [4B] Analytic Geometry and Calculus, Fourth Course (3 units – Cajori Two Course Cluster 11) *(Total of 6 units)*	OR	[4] Analytic Geometry and Calculus, Third and Fourth Course (6 units – Cajori Two Course Cluster 13) *(Total of 6 units)*	OR	[4G] Analytic Geometry and Calculus, Third Course (3 units – Cajori Two Course Cluster 13) [4H] Analytic Geometry and Calculus, Fourth Course (3 units – Cajori Two Course Cluster 13) *(Total of 6 units)*

[8] Theory of Algebraic Equations (3 units – Cajori Two Course Cluster 26)
[9] Introduction to Projective Geometry (3 units – Cajori Two Course Cluster 32)

<u>Upper Division Courses:</u>

[111A] Algebra (3 units – Cajori Two Course Cluster 28)	OR	[111B] Algebra (3 units – Cajori Two Course Cluster 28)

[112A] Projective Geometry (3 units – Cajori Two Course Cluster 32)	OR	[112B] Metric Differential Geometry (3 units – Cajori Two Course Cluster 33)

[119A] Differential Equations (3 units – Cajori Two Course Cluster 22)	OR	[119B] Differential Equations (3 units – Cajori Two Course Cluster 22)

[150A] Theory of Functions, First Course (3 units – Cajori Two Course Cluster 23)	OR	[185] Introduction to the Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)	OR	[201A] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Graduate Course)

Table 40. University of California, Berkeley: 1954 to 1955 (continued)

<table>
<tr>
<td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td>
<td>
Upper Division Courses (24 total upper division units are required, so 12 more units):
[101A] Elementary Mathematics for Advanced Students (3 units – Cajori Two Course Cluster 10)
[101B] Elementary Mathematics for Advanced Students (3 units – Cajori Two Course Cluster 10)
[109A] Mathematical Logic (3 units – Cajori Two Course Cluster 35)
[109B] Mathematical Logic (3 units – Cajori Two Course Cluster 35)
<table>
<tr>
<td>[110A] Advanced Engineering Mathematics (2 units – Cajori Two Course Cluster 37)
[110B] Advanced Engineering Mathematics (2 units – Cajori Two Course Cluster 37)</td>
<td>OR</td>
<td>[110] Advanced Engineering Mathematics: Double Course (4 units – Cajori Two Course Cluster 37)</td>
</tr>
</table>
[113] Second Course in Probability and Statistics (3 units – Cajori Two Course Cluster 46)
[114] Introduction to the Theory of Potential (3 units – Cajori Two Course Cluster 38)
[115A] Theory of Numbers (3 units – Cajori Two Course Cluster 29)
[115B] Theory of Numbers (3 units – Cajori Two Course Cluster 29)
[117] Analysis of Mathematical Problems (2 units – Cajori Two Course Cluster 52) (Not given 1954-1955)
</td>
</tr>
<tr>
<td></td>
<td>
[118] Analysis of Mathematical Problems (2 units – Cajori Two Course Cluster 52) (Not given 1954-1955)
[120A] Theory of Probability and Statistics (3 units – Cajori Two Course Cluster 46)
[120B] Theory of Probability and Statistics (3 units – Cajori Two Course Cluster 46)
[121] Mathematical Introduction to Economics (3 units – Cajori Two Course Cluster 40) (Not given 1954-1955)
[127A] Foundation of Mathematics (3 units – Cajori Two Course Cluster 36)
[127B] Foundation of Mathematics (3 units – Cajori Two Course Cluster 36)
[128A] Numerical Analysis (3 units – Cajori Two Course Cluster 22)
[128B] Numerical Analysis (3 units – Cajori Two Course Cluster 22)
[142A] Life Contingencies (3 units – Cajori Two Course Cluster 41)
[142B] Life Contingencies (3 units – Cajori Two Course Cluster 41)
[142C] Laboratory Course in Life Contingencies (1 units – Cajori Two Course Cluster 41)
[142D] Laboratory Course in Life Contingencies (1 units – Cajori Two Course Cluster 41)
[144] Population Statistics (3 units – Cajori Two Course Cluster 41)
[150B] Theory of Functions, First Course (3 units – Cajori Two Course Cluster 23)
[199] Special Study for Advanced Undergraduates (1-5 units – Cajori Two Course Cluster 52)
[201B] Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23) (Note: this is a graduate course. The bulletin mentions this course forms a “desirable part of the program for students with facility for mathematics” (University of California, Berkeley, Bulletin, 1954-1955, p. 226))
</td>
</tr>
</table>

Table 40. University of California, Berkeley: 1954 to 1955 (continued)

Total number of required courses beyond freshman calculus:	At least ten
Can undergraduate students take graduate courses?	Yes
Are students required to take a computing course? If so, which ones.	No, but a course in numerical analysis is available as an elective.
How many different calculus sequences exist for a mathematics major?	Three
Math Entrance Exam?	Not mentioned
Exiting Requirement?	Not mentioned

Table 41. University of California, Berkeley: 1965 to 1966

<table>
<tr><td>College:</td><td>University of California, Berkeley</td></tr>
<tr><td>Catalog Year:</td><td>1965-1966</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Degree-type not available, Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 units</td></tr>
<tr><td>Total number of mathematics units required for the degree:</td><td>At least 39 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[1A] Calculus with Analytic Geometry, First Course (4 units – Cajori Two Course Cluster 11)

[1B] Calculus with Analytic Geometry, First Course (4 units – Cajori Two Course Cluster 11)

[2A] Calculus with Analytic Geometry, Second Course (4 units – Cajori Two Course Cluster 11)

[2B] Calculus with Analytic Geometry, Second Course (4 units – Cajori Two Course Cluster 11)

[104] Introductory Analysis (3 units – Cajori Two Course Cluster 11)

(19 total units)</td><td>OR</td><td>Honors Courses:
[H1A] Calculus with Analytic Geometry, First Course (4 units – Cajori Two Course Cluster 13)

[H1B] Calculus with Analytic Geometry, First Course (4 units – Cajori Two Course Cluster 13)

[H2A] Calculus with Analytic Geometry, Second Course (4 units – Cajori Two Course Cluster 13)

[H2B] Calculus with Analytic Geometry, Second Course (4 units – Cajori Two Course Cluster 13)

(16 total units)</td></tr>
</table>
[105] Integration (3 units – Cajori Two Course Cluster 24)
[113A] Abstract Algebra (3 units – Cajori Two Course Cluster 28)
<table>
<tr><td>[135A] Foundation of Mathematics (3 units – Cajori Two Course Cluster 36)</td><td>OR</td><td>[185] Introduction to Theory of Functions of a Complex Variable (3 units – Cajori Two Course Cluster 23)</td></tr>
</table>
<table>
<tr><td>[130A] Projective Geometry (3 units – Cajori Two Course Cluster 32)</td><td>OR</td><td>[140] Metric Differential Geometry (3 units – Cajori Two Course Cluster 33)</td></tr>
</table>
</td></tr>
</table>

Table 41. University of California, Berkeley: 1965 to 1966 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	Upper Division Courses (9 more units, since [105] is above): [112] Linear Geometry (3 units – Cajori Two Course Cluster 34) [113B] Linear Algebra (3 units – Cajori Two Course Cluster 27) [115A] Theory of Numbers (3 units – Cajori Two Course Cluster 29) [115B] Theory of Numbers (3 units – Cajori Two Course Cluster 29) [117] Analysis of Mathematical Problems (3 units – Cajori Two Course Cluster 52) [118] Analysis of Mathematical Problems (3 units – Cajori Two Course Cluster 52) [123] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) [125A] Mathematical Logic (3 units – Cajori Two Course Cluster 35) [125B] Mathematical Logic (3 units – Cajori Two Course Cluster 35) [126] Introduction to Partial Differential Equations (3 units – Cajori Two Course Cluster 37) [128A] Numerical Analysis (3 units – Cajori Two Course Cluster 22) [128B] Numerical Analysis (3 units – Cajori Two Course Cluster 22) [128C] Laboratory for Numerical Analysis (2 units – Cajori Two Course Cluster 22) [128D] Laboratory for Numerical Analysis (2 units – Cajori Two Course Cluster 22) [130B] Projective Geometry (3 units – Cajori Two Course Cluster 32) [131] Algebraic Curves (3 units – Cajori Two Course Cluster 33) [135B] Foundations of Mathematics (3 units – Cajori Two Course Cluster 36) [145] Theory of Boolean Algebras (3 units – Cajori Two Course Cluster 26) [160] History of Mathematics (3 units – Cajori Two Course Cluster 53) [175] Calculus of Variations (3 units – Cajori Two Course Cluster 24) [188] Mathematical Models in Physics and Engineering (3 units – Cajori Two Course Cluster 37) [199] Special Study for Advanced Undergraduates (1-5 units – Cajori Two Course Cluster 52)
Total number of required courses beyond freshman calculus:	At least eight
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No, but advice is given for “mathematics majors who expect to work I digital computing or to undertake further study in computer sciences” (University of California, Berkeley, Bulletin, 1965-1966, p. 439).
How many different calculus sequences exist for a mathematics major?	Two

Table 42. University of California, Berkeley: 1974 to 1975

<table>
<tr><td>College:</td><td>University of California, Berkeley</td></tr>
<tr><td>Catalog Year:</td><td>1974-1975</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>A.B. Degree, Major in Mathematics</td></tr>
<tr><td>Total number of units to graduate:</td><td>180 units</td></tr>
<tr><td>Total number of mathematics units required for the degree:</td><td>At least 50 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[1A] Calculus (4 units – Cajori Two Course Cluster 11)
[1B] Calculus (4 units – Cajori Two Course Cluster 11)
[1C] Calculus (4 units – Cajori Two Course Cluster 11)

(12 total units)</td><td>OR</td><td>[1S] Self-Paced Study in Introductory Calculus (2-12 units – Cajori Two Course Cluster 11)

(2-12 total units)</td><td>OR</td><td>Honors Course:
[H1A] Calculus (5 units – Cajori Two Course Cluster 13)
[H1B] Calculus (5 units – Cajori Two Course Cluster 13)
[H1C] Calculus (5 units – Cajori Two Course Cluster 13)

(15 total units)</td></tr>
</table>
</td></tr>
</table>

Table 42. University of California, Berkeley: 1974 to 1975 (continued)

[51A] Introduction to Linear Algebra (4 units – Cajori Two Course Cluster 27) [51B] Calculus of Vector Functions (4 units – Cajori Two Course Cluster 19) [51C] Differential Equations and Related Topics (4 units – Cajori Two Course Cluster 22) *(12 total units)*	OR	[H51A] Introduction to Linear Algebra (4 units – Cajori Two Course Cluster 27) [H51B] Calculus of Vector Functions (4 units – Cajori Two Course Cluster 19) [H51C] Differential Equations and Related Topics (4 units – Cajori Two Course Cluster 22) *(12 total units)*

[113A] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) [113B] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) *(8 total units)*	OR	[H113A] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) [H113B] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) (8 total units)

[104A] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23)	OR	[H104A] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23)

[104B] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23)	OR	[H104B] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23)	OR	[185] Introduction to Theory of Functions of a Complex Variable (4 units – Cajori Two Course Cluster 23)

[130] The Classical Geometries (4 units – Cajori Two Course Cluster 32)	OR	[140] Metric Differential Geometry (4 units – Cajori Two Course Cluster 33)	OR	[142]Elementary Algebraic Topology (4 units – Cajori Two Course Cluster 33)

[135] Introduction to the Theory of Sets (4 units – Cajori Two Course Cluster 35)

Table 42. University of California, Berkeley: 1974 to 1975 (continued)

<table>
<tr>
<td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td>
<td>
<u>36 Upper Division Units, so three more courses:</u>
[105] Integration (4 units – Cajori Two Course Cluster 24)
[112] Linear Algebra (4 units – Cajori Two Course Cluster 27)
<table>
<tr>
<td>[113C] Abstract Linear Algebra (4 units – Cajori Two Course Cluster 27)</td>
<td>OR</td>
<td>[H113C] Abstract Linear Algebra (4 units – Cajori Two Course Cluster 27)</td>
</tr>
</table>
[115A] Introduction to Number Theory (3 units – Cajori Two Course Cluster 29)
[115B] Topics in Number Theory (3 units – Cajori Two Course Cluster 29)
[117] Mathematical Problems Seminar (3 units – Cajori Two Course Cluster 52)
[120A] Analysis for Applied Mathematics (4 units – Cajori Two Course Cluster 37) (Not acceptable if course 185 was taken)
[120B] Analysis for Applied Mathematics (4 units – Cajori Two Course Cluster 37)
[120C] Analysis for Applied Mathematics (4 units – Cajori Two Course Cluster 37)
[121A] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37)
[121B] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37)
[123] Ordinary Differential Equations (4 units – Cajori Two Course Cluster 22)
[125A] Mathematical Logic (4 units – Cajori Two Course Cluster 35)
[125B] Mathematical Logic (4 units – Cajori Two Course Cluster 35)
[126] Introduction to Partial Differential Equations (4 units – Cajori Two Course Cluster 37)
[128A] Numerical Analysis (4 units – Cajori Two Course Cluster 22)
[128B] Numerical Analysis (4 units – Cajori Two Course Cluster 22)
[129A] Computational Algebra (4 units – Cajori Two Course Cluster 22)
[129B] Computational Analysis (4 units – Cajori Two Course Cluster 22)
[132] Topics in Geometry (4 units – Cajori Two Course Cluster 34)
[133] Algebraic Curves (4 units – Cajori Two Course Cluster 33)
[134] Number Systems (4 units – Cajori Two Course Cluster 35)
[145] Boolean Algebras (4 units – Cajori Two Course Cluster 26)
[151] Generalized Functions (Distributions) (4 units – Cajori Two Course Cluster 37)
[160] History of Mathematics (4 units – Cajori Two Course Cluster 53)
[163] Tutorial in Upper Division Mathematics (4 units – Cajori Two Course Cluster 52)
[175] Calculus of Variations (4 units – Cajori Two Course Cluster 24)
[188] Mathematical Models in Physics and Engineering (4 units – Cajori Two Course Cluster 37)
[191] Experimental Courses in Mathematics (units not listed – Cajori Two Course Cluster 52)
[195] Special Topics in Mathematics (4 units – Cajori Two Course Cluster 52)
[H196] Honors Thesis (4 units – Cajori Two Course Cluster 52)
[199] Supervised Independent Study and Research (1-5 units – Cajori Two Course Cluster 52)
</td>
</tr>
</table>

Table 42. University of California, Berkeley: 1974 to 1975 (continued)

Total number of required courses beyond freshman calculus:	At least 12
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	Students may count at most two mathematically theoretical courses in computer science towards the degree requirements.
How many different calculus sequences exist for a mathematics major?	Three

Table 43. University of California, Berkeley: 1985 to 1986

<table>
<tr><td>College:</td><td>University of California, Berkeley</td></tr>
<tr><td>Catalog Year:</td><td>1985-1986</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>A.B. Degree, Major in Mathematics</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 units</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 47 units</td></tr>
<tr><td>List of required courses and their respective units:</td><td>[1A] Calculus (4 units – Cajori Two Course Cluster 11)
[1B] Calculus (4 units – Cajori Two Course Cluster 11)
<table>
<tr><td>[50A] Sophomore Mathematics (4 units – Cajori Two Course Cluster 11)

[50B] Sophomore Mathematics (4 units – Cajori Two Course Cluster 11)

(8 total units)</td><td></td><td>[H50A] Honors Sophomore Mathematics (4 units – Cajori Two Course Cluster 13)

[H50B] Honors Sophomore Mathematics (4 units – Cajori Two Course Cluster 13)

(8 total units)</td></tr>
</table>
<table>
<tr><td>[104] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23)</td><td>OR</td><td>[H104] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23)</td></tr>
</table>
<table>
<tr><td>[185] Introduction to the Theory of Functions of a Complex Variable (4 units – Cajori Two Course Cluster 23)</td><td>OR</td><td>[H185] Introduction to the Theory of Functions of a Complex Variable (4 units – Cajori Two Course Cluster 23)</td></tr>
</table>
</td></tr>
</table>

Table 43. University of California, Berkeley: 1985 to 1986 (continued)

	[113A] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) [113B] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) *(8 total units)* OR [H113A] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) [H113B] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) *(8 total units)* [H117] Mathematical Problem Seminar (3 units – Cajori Two Course Cluster 52)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	One Course from Two of the following groups: I. Computing: [100] Computational Mathematics (3 units – Cajori Two Course Cluster 52) [128A] Numerical Analysis (4 units – Cajori Two Course Cluster 22) II. Geometry: [140] Metric Differential Geometry (3 units – Cajori Two Course Cluster 33) [141] Elementary Differential Topology (3 units – Cajori Two Course Cluster 34) [142] Elementary Algebraic Topology (3 units – Cajori Two Course Cluster 33) III. Logic and Foundations [125A] Mathematical Logic (3 units – Cajori Two Course Cluster 35) [135] Introduction to the Theory of Sets (3 units – Cajori Two Course Cluster 35) OR [H135] Introduction to the Theory of Sets (3 units – Cajori Two Course Cluster 35) At least eight upper division courses in all, so two more: IDS [103] Introduction to Mathematical Economics (units not listed – Cajori Two Course Cluster 40) [105] Integration (3 units – Cajori Two Course Cluster 24) [112] Linear Algebra (3 units – Cajori Two Course Cluster 27) [115] Introduction to Number Theory (3 units – Cajori Two Course Cluster 29) [120A] Analysis for Applied Mathematics (4 units – Cajori Two Course Cluster 37) [120B] Analysis for Applied Mathematics (4 units – Cajori Two Course Cluster 37) [121A] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37) [121B] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37) [123] Ordinary Differential Equations (3 units – Cajori Two Course Cluster 22) [125B] Mathematical Logic (3 units – Cajori Two Course Cluster 35)

Table 43. University of California, Berkeley: 1985 to 1986 (continued)

	[126] Introduction to Partial Differential Equations (3 units – Cajori Two Course Cluster 37) [128B] Numerical Analysis (3 units – Cajori Two Course Cluster 22) [130] The Classical Geometrics (3 units – Cajori Two Course Cluster 32) [132] Topics in Geometry (4 units – Cajori Two Course Cluster 34) [145] Boolean Algebra (3 units – Cajori Two Course Cluster 26) [160] History of Mathematics (3 units – Cajori Two Course Cluster 53) [163] Tutorial in Upper Division Mathematics (3 units – Cajori Two Course Cluster 52) [170] Linear Programming, Games, Models of Exchange (3 units – Cajori Two Course Cluster 42) (New course) [187] Senior Level Analysis (3 units – Cajori Two Course Cluster 25) (New Course) [188] Mathematical Models in Physics and Engineering (3 units – Cajori Two Course Cluster 37) [191] Experimental Courses in Mathematics (1-4 units – Cajori Two Course Cluster 52) [195] Special Topics in Mathematics (3 units – Cajori Two Course Cluster 52) [196] Honors Thesis (3 units – Cajori Two Course Cluster 52) [199] Supervised Independent Study and Research (1-4 units – Cajori Two Course Cluster 52) <u>Graduate Courses Recommended to Undergraduates:</u> [202A] Introduction to Topology and Analysis (4 units – Cajori Two Course Cluster 33) [202B] Introduction to Topology and Analysis (4 units – Cajori Two Course Cluster 33) [214] Differentiable Manifolds (3 units – Cajori Two Course Cluster 33) [228A] Numerical Solution of Differential Equations (4 units – Cajori Two Course Cluster 22) [228B] Numerical Solution of Differential Equations (4 units – Cajori Two Course Cluster 22) [250A] Groups, Rings and Fields (4 units – Cajori Two Course Cluster 28) [250B] Multilinear Algebra and Further Topics (4 units – Cajori Two Course Cluster 37)
Total number of required courses beyond freshman calculus:	Ten
Can undergraduate students take graduate courses?	Yes, it is recommended.
Are students required to take a computing course? If so, which ones.	It is available and recommended.
How many different calculus sequences exist for a mathematics major?	One

Table 44. University of California, Berkeley: 1995 to 1997

College:	University of California, Berkeley
Catalog Year:	1995-1997
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	A.B. Degree, Major in Mathematics
Total number of units to graduate:	120 units
Total number of mathematics units required for the degree:	44 units
List of required courses and their respective units:	[1A] Calculus (4 units – Cajori Two Course Cluster 11) Optional: [1AL] Calculus Computer Laboratory (1 unit – Cajori Two Course Cluster 11) [1B] Calculus (4 units – Cajori Two Course Cluster 11) Optional: [1BL] Calculus Computer Laboratory (1 unit – Cajori Two Course Cluster 11) [53] Multivariable Calculus (4 units – Cajori Two Course Cluster 11) OR [H53] Multivariable Calculus (4 units – Cajori Two Course Cluster 11) Optional [53L] Multivariable Calculus Computer Laboratory (1 unit – Cajori Two Course Cluster 11) [54] Linear Algebra and Differential Equations (4 units – Cajori Two Course Cluster 27) OR [H54] Linear Algebra and Differential Equations (4 units – Cajori Two Course Cluster 27) Optional [54L] Linear Algebra Computer Laboratory (1 unit – Cajori Two Course Cluster 27) [104] Introduction to Analysis (4 units – Cajori Two Course Cluster 23) OR [H104] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23) [110] Linear Algebra (4 units – Cajori Two Course Cluster 27) OR [H110] Linear Algebra (4 units – Cajori Two Course Cluster 27) [185] Introduction to Complex Analysis (4 units – Cajori Two Course Cluster 23) OR [H185] Introduction to Complex Analysis (4 units – Cajori Two Course Cluster 23)

Table 44. University of California, Berkeley: 1995 to 1997 (continued)

	[113] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) OR [H113] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) [H117] Honors Mathematical Problem Solving (3 units – Cajori Two Course Cluster 52)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	One Course from Two of the following groups: I. Computing: [128A] Numerical Analysis (5 units – Cajori Two Course Cluster 22) II. Geometry: [140] Metric Differential Geometry (3 units – Cajori Two Course Cluster 33) [142] Elementary Algebraic Topology (3 units – Cajori Two Course Cluster 33) III. Logic and Foundations [125A] Mathematical Logic (3 units – Cajori Two Course Cluster 35) [135] Introduction to the Theory of Sets (4 units – Cajori Two Course Cluster 35) At least eight upper division courses in all, so one more: [103] Introduction to Mathematical Economics (3 units – Cajori Two Course Cluster 40) [105] Second Course in Analysis (4 units – Cajori Two Course Cluster 23) [114] Second Course in Abstract Algebra (4 units – Cajori Two Course Cluster 28) [115] Introduction to Number Theory (4 units – Cajori Two Course Cluster 29) [119] Introduction to Applied Mathematics (4 units – Cajori Two Course Cluster 37) [121A] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37) [121B] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37) [123] Ordinary Differential Equations (4 units – Cajori Two Course Cluster 22) [125B] Mathematical Logic (4 units – Cajori Two Course Cluster 35) [126] Introduction to Partial Differential Equations (4 units – Cajori Two Course Cluster 37) [128B] Numerical Analysis (5 units – Cajori Two Course Cluster 22) [130] The Classical Geometries (4 units – Cajori Two Course Cluster 32) [160] History of Mathematics (4 units – Cajori Two Course Cluster 53) [170] Linear Programming, Games, Models of Exchange (4 units – Cajori Two Course Cluster 42) [187] Senior Level Analysis (4 units – Cajori Two Course Cluster 25) (New Course) [189] Mathematical Methods in Classical and Quantum Mechanics (4 units – Cajori Two Course Cluster 38) [191] Experimental Courses in Mathematics (1-4 units – Cajori Two Course Cluster 52) [195] Special Topics in Mathematics (4 units – Cajori Two Course Cluster 52) [196] Honors Thesis (4 units – Cajori Two Course Cluster 52) [199] Supervised Independent Study and Research (1-4 units – Cajori Two Course Cluster 52)

Table 44. University of California, Berkeley: 1995 to 1997 (continued)

	Graduate Courses Recommended to Undergraduates: [202A] Introduction to Topology and Analysis (4 units – Cajori Two Course Cluster 33) [202B] Introduction to Topology and Analysis (4 units – Cajori Two Course Cluster 33) [214] Differentiable Manifolds (4 units – Cajori Two Course Cluster 33) [225A] Metamathematics (4 units – Cajori Two Course Cluster 36) (New course) [225B] Metamathematics (4 units – Cajori Two Course Cluster 36) (New Course) [228A] Numerical Solution of Differential Equations (4 units – Cajori Two Course Cluster 22) [228B] Numerical Solution of Differential Equations (4 units – Cajori Two Course Cluster 22) [250A] Groups, Rings and Fields (4 units – Cajori Two Course Cluster 28) [250B] Multilinear Algebra and Further Topics (4 units – Cajori Two Course Cluster 37)
Total number of required courses beyond freshman calculus:	Nine
Can undergraduate students take graduate courses?	Yes, it is recommended.
Are students required to take a computing course? If so, which ones.	Yes, it is recommended.
How many different calculus sequences exist for a mathematics major?	One

Table 45. University of California, Berkeley: 2003 to 2005

College:	University of California, Berkeley
Catalog Year:	2003-2005
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A. Degree, Major in Mathematics
Total number of units to graduate:	120 units
Total number of mathematics units required for the degree:	At least 46 units
List of required courses and their respective units:	[1A] Calculus (4 units – Cajori Two Course Cluster 11) [1B] Calculus (4 units – Cajori Two Course Cluster 11) OR [H1B] Calculus (4 units – Cajori Two Course Cluster 13) [53] Multivariable Calculus (4 units – Cajori Two Course Cluster 11) OR [H53] Multivariable Calculus (4 units – Cajori Two Course Cluster 13) OR [53M] Multivariable Calculus with Computers (4 units – Cajori Two Course Cluster) (New Course 11) [54] Linear Algebra and Differential Equations (4 units – Cajori Two Course Cluster 27) OR [H54] Honors Linear Algebra and Differential Equations (4 units – Cajori Two Course Cluster 27) OR [54M] Linear Algebra and Differential Equations with Computers (4 units – Cajori Two Course Cluster 27) [104] Introduction to Analysis (4 units – Cajori Two Course Cluster 23) OR [H104] Introductory and Intermediate Analysis (4 units – Cajori Two Course Cluster 23) [110] Linear Algebra (4 units – Cajori Two Course Cluster 27) OR [H110] Linear Algebra (4 units – Cajori Two Course Cluster 27)

Table 45. University of California, Berkeley: 2003 to 2005 (continued

	[113] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) OR [H113] Introduction to Abstract Algebra (4 units – Cajori Two Course Cluster 28) [185] Introduction to Complex Analysis (4 units – Cajori Two Course Cluster 23) OR [H185] Introduction to Complex Analysis (4 units – Cajori Two Course Cluster 23)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Two "semi-electives." Select two courses from the following three categories: I. Computing: [128A] Numerical Analysis (4 units – Cajori Two Course Cluster 22) II. Geometry: [130] The Classical Geometries (4 units – Cajori Two Course Cluster 31) [140] Metric Differential Geometry (4 units – Cajori Two Course Cluster 33) [141] Elementary Differential Topology (4 units – Cajori Two Course Cluster 34) [142] Elementary Algebraic Topology (4 units – Cajori Two Course Cluster 33) III. Logic and Foundations: [125A] Mathematical Logic (3 units – Cajori Two Course Cluster 35) [135] Introduction to the Theory of Sets (4 units – Cajori Two Course Cluster 35) Two more upper division mathematics electives: [103] Introduction to Mathematical Economics (3 units – Cajori Two Course Cluster 43) [114] Second Course in Abstract Algebra (4 units – Cajori Two Course Cluster 28) [115] Introduction to Number Theory (4 units – Cajori Two Course Cluster 29) [118] Wavelets and Signal Processing (4 units – Cajori Two Course Cluster 24) (New course) [119] Introduction to Applied Mathematics (4 units – Cajori Two Course Cluster 37) [121A] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37) [121B] Mathematical Tools for the Physical Sciences (4 units – Cajori Two Course Cluster 37) [123] Ordinary Differential Equations (4 units – Cajori Two Course Cluster 22) [126] Introduction to Partial Differential Equations (4 units – Cajori Two Course Cluster 37) [127] Mathematical and Computational Methods in Molecular Biology (4 units – Cajori Two Course Cluster 40) [128B] Numerical Analysis (5 units – Cajori Two Course Cluster 22) [130] The Classical Geometries (4 units – Cajori Two Course Cluster 31) [160] History of Mathematics (4 units – Cajori Two Course Cluster 53) [170] Linear Programming, Games, Models of Exchange (4 units – Cajori Two Course Cluster 42) [172] Combinatorics (4 units – Cajori Two Course Cluster 44) (New Course) [187] Senior Level Analysis (4 units – Cajori Two Course Cluster 23)

Table 45. University of California, Berkeley: 2003 to 2005 (continued)

	[189] Mathematical Methods in Classical and Quantum Mechanics (4 units – Cajori Two Course Cluster 38) [191] Experimental Courses in Mathematics (1-4 units – Cajori Two Course Cluster 52) [195] Special Topics in Mathematics (4 units – Cajori Two Course Cluster 52) [196] Honors Thesis (4 units – Cajori Two Course Cluster 52) [198] Directed Group Study (1-4 units – Cajori Two Course Cluster 52) [199] Supervised Independent Study and Research (1-4 units – Cajori Two Course Cluster 52)
	<u>Graduate Courses Recommended to Undergraduates:</u> [202A] Introduction to Topology and Analysis (4 units – Cajori Two Course Cluster 33) [202B] Introduction to Topology and Analysis (4 units – Cajori Two Course Cluster 33) [214] Differentiable Manifolds (4 units – Cajori Two Course Cluster 33) [225A] Metamathematics (4 units – Cajori Two Course Cluster 36) (New course) [225B] Metamathematics (4 units – Cajori Two Course Cluster 36) (New Course) [228A] Numerical Solution of Differential Equations (4 units – Cajori Two Course Cluster 22) [228B] Numerical Solution of Differential Equations (4 units – Cajori Two Course Cluster 22) [250A] Groups, Rings and Fields (4 units – Cajori Two Course Cluster 28) [250B] Multilinear Algebra and Further Topics (4 units – Cajori Two Course Cluster 37)
Total number of required courses beyond freshman calculus:	Nine
Can undergraduate students take graduate courses?	Yes, it is recommended.
Are students required to take a computing course? If so, which ones.	It is recommended and there are optional computer laboratory courses.
How many different calculus sequences exist for a mathematics major?	Three, since multivariable calculus has three different options.

Table 46. University of Texas, Austin: 1905 to 1906

College:	University of Texas, Austin
Catalog Year:	1905-1906
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., No Specific Major
Total number of units to graduate:	20 full courses (60 thirds of courses)
Total number of mathematics units required for the degree:	At least 2 full courses
List of required courses and their respective units:	[1, fall] Introductory Mathematics – Solid Geometry (1/3 course – Cajori Two Course Cluster 2) [1, winter] Introductory Mathematics – Plane Trigonometry (1/3 course – Cajori Two Course Cluster 1) [1, spring] Introductory Mathematics - Algebra with Introduction to Analytical Geometry (1/3 course – Cajori Two Course Cluster 1) [3, fall] Calculus (1/3 course – Cajori Two Course Cluster 11) [3, winter] Calculus (1/3 course – Cajori Two Course Cluster 11) [3, spring] Calculus (1/3 course – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	[4, fall] Analytical Geometry (1/3 course – Cajori Two Course Cluster 2) [4, winter] Analytical Geometry (1/3 course – Cajori Two Course Cluster 2) [5] Analytical Geometry (1/3 course – Cajori Two Course Cluster 2) [6, fall] Algebra (1/3 course – Cajori Two Course Cluster 26) [6, winter] Algebra (1/3 course – Cajori Two Course Cluster 26) [6, spring] Algebra (1/3 course – Cajori Two Course Cluster 26) [7, fall] Popular Astronomy (1/3 course – Cajori Two Course Cluster 54) [7, winter] Popular Astronomy (1/3 course – Cajori Two Course Cluster 54) [8] Spherical Trigonometry and Astronomy (1/3 course – Cajori Two Course Cluster 54) [9] The Teaching of Elementary Mathematics (1/3 course – Cajori Two Course Cluster 10)

Table 46. University of Texas, Austin: 1905 to 1906 (continued)

	The following courses are for Undergraduates and Graduates and are only available to students who have completed two full courses in Mathematics: [10, fall] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [10, winter] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [10, spring] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [11, fall] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [11, winter] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [11, spring] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [12, fall] Theoretical Mechanics (1/3 course – Cajori Two Course Cluster 38) [12, winter] Theoretical Mechanics (1/3 course – Cajori Two Course Cluster 38) [12, spring] Theoretical Mechanics (1/3 course – Cajori Two Course Cluster 38)
Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Yes
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 47. University of Texas, Austin: 1914 to 1915

College:	University of Texas, Austin
Catalog Year:	1914-1915
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Mathematics Major
Total number of units to graduate:	20 Full Courses (60 thirds of courses)
Total number of mathematics units required for the degree:	Six Full Courses in Mathematics (this includes [1])
List of required courses and their respective units:	[1ega]: [1eg] Solid Geometry (2/3 course – Cajori Two Course Cluster 2) [1a] Plane Trigonometry (1/3 course – Cajori Two Course Cluster 1) *(1 Full Course)* OR [1abc]: [1a] Plane Trigonometry (1/3 course – Cajori Two Course Cluster *repeat*1) [1b] Advanced Algebra(1/3 course – Cajori Two Course Cluster 1) [1c] Introduction to Analytic Geometry(1/3 course – Cajori Two Course Cluster 2) *(1 Full Course)* OR [1acd]: [1a] Plane Trigonometry (1/3 course – Cajori Two Course Cluster *repeat*1) [1c] Introduction to Analytic Geometry (1/3 course – Cajori Two Course Cluster *repeat*2) [1d] Analytic Geometry (1/3 course – Cajori Two Course Cluster 2) *(1 Full Course)*
	[3, fall] Calculus (1/3 course – Cajori Two Course Cluster 11) [3, winter] Calculus (1/3 course – Cajori Two Course Cluster 11) [3, spring] Calculus (1/3 course – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Five Advanced Courses, so four more required. The following courses are for Undergraduates and Graduates: [6, fall] Algebra (1/3 course – Cajori Two Course Cluster 26) [6, winter] Algebra (1/3 course – Cajori Two Course Cluster 26) [6, spring] Algebra (1/3 course – Cajori Two Course Cluster 26) [10, fall] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31)

Table 47. University of Texas, Austin: 1914 to 1915 (continued)

	[10, winter] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [10, spring] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [11, fall] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [11, winter] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [11, spring] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [16, fall] The Calculus of Variations (1/3 course – Cajori Two Course Cluster 24) [16, winter] The Calculus of Variations (1/3 course – Cajori Two Course Cluster 24) [16, spring] The Calculus of Variations (1/3 course – Cajori Two Course Cluster 24) [19, fall] Actuarial Mathematics (1/3 course – Cajori Two Course Cluster 41) [19, winter] Actuarial Mathematics (1/3 course – Cajori Two Course Cluster 41) [19, spring] Actuarial Mathematics (1/3 course – Cajori Two Course Cluster 41)
Total number of required courses beyond freshman calculus:	Four
Can undergraduate students take graduate courses?	Yes
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 48. University of Texas, Austin: 1924 to 1925

<table>
<tr><td>College:</td><td>University of Texas, Austin</td></tr>
<tr><td>Catalog Year:</td><td>1924-1925</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.A., Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>20 full courses</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>Six Full Courses in Mathematics (this includes [1])</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[1]:

[1abc, fall] Plane Trigonometry, Algebra, and Analytic Geometry (1/3 course – Cajori Two Course Cluster 1)

[1abc, winter] Plane Trigonometry, Algebra, and Analytic Geometry (1/3 course – Cajori Two Course Cluster 2)

[1df, spring] Analytic Geometry (1/3 course – Cajori Two Course Cluster 2)

(1 Full Course)</td><td>OR</td><td>[1]:

[1bcd, fall] Algebra and Analytic Geometry (1/3 course – Cajori Two Course Cluster 1)

[1bcd, winter] Algebra and Analytic Geometry (1/3 course – Cajori Two Course Cluster 2)

[1df, spring] Analytic Geometry (1/3 course – Cajori Two Course Cluster 2)

(1 Full Course)</td></tr>
</table>

[3, fall] Calculus (1/3 Advanced Course – Cajori Two Course Cluster 11)
[3, winter] Calculus (1/3 Advanced Course – Cajori Two Course Cluster 11)
[3, spring] Calculus (1/3 Advanced Course – Cajori Two Course Cluster 11)</td></tr>
</table>

Table 48. University of Texas, Austin: 1924 to 1925 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	Five Total Courses in Mathematics, of which at least two shall be advanced (so four more, one being advanced, since Calculus counts as an advanced course): [9, fall] The Mathematics of Finance (1/3 course – Cajori Two Course Cluster 5) [9, winter] The Mathematics of Finance (1/3 course – Cajori Two Course Cluster 5) [9, spring] The Mathematics of Finance (1/3 course – Cajori Two Course Cluster 5) [115s] Solid Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [205ws, winter] Algebra (1/3 course – Cajori Two Course Cluster 26) [205ws, spring] Algebra (1/3 course – Cajori Two Course Cluster 26) [225fw, fall] Descriptive Geometry (1/3 course – Cajori Two Course Cluster 4) [225fw, winter] Descriptive Geometry (1/3 course – Cajori Two Course Cluster 4)
	The following courses are for Undergraduates and Graduates: [8, fall] Mathematical Statistics (1/3 course – Cajori Two Course Cluster 5) [8, winter] Mathematical Statistics (1/3 course – Cajori Two Course Cluster 5) [8, spring] Mathematical Statistics (1/3 course – Cajori Two Course Cluster 5) [10, fall] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [10, winter] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [10, spring] Introduction to Modern Analytic Geometry (1/3 course – Cajori Two Course Cluster 31) [19, fall] Actuarial Mathematics (Omitted 1925-1926) (1/3 course – Cajori Two Course Cluster 41) [19, winter] Actuarial Mathematics (Omitted 1925-1926) (1/3 course – Cajori Two Course Cluster 41) [19, spring] Actuarial Mathematics (Omitted 1925-1926) (1/3 course – Cajori Two Course Cluster 41) [106f] Elementary Number Theory (1/3 course – Cajori Two Course Cluster 29) [107f] Ruler and Compass Constructions (1/3 course – Cajori Two Course Cluster 31) [126s] Introduction to Foundations of Geometry (1/3 course – Cajori Two Course Cluster 32) [206ws, winter] Linear Transformations (1/3 course – Cajori Two Course Cluster 27) [206ws, spring] Linear Transformations (1/3 course – Cajori Two Course Cluster 27) [11, fall] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [11, winter] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [11, spring] Advanced Calculus (1/3 course – Cajori Two Course Cluster 23) [12, fall] Analytic Mechanics (1/3 course – Cajori Two Course Cluster 38) [12, winter] Analytic Mechanics (1/3 course – Cajori Two Course Cluster 38) [12, spring] Analytic Mechanics (1/3 course – Cajori Two Course Cluster 38) [20, fall] Probability (1/3 course – Cajori Two Course Cluster 46) [20, winter] Probability (1/3 course – Cajori Two Course Cluster 46) [20, spring] Probability (1/3 course – Cajori Two Course Cluster 46) [22, fall] Differential Equations and Applications (1/3 course – Cajori Two Course Cluster 22) [22, winter] Differential Equations and Applications (1/3 course – Cajori Two Course Cluster 22)

Table 48. University of Texas, Austin: 1924 to 1925 (continued)

	[22, spring] Differential Equations and Applications (1/3 course – Cajori Two Course Cluster 22) [136f] Finite Groups (1/3 course – Cajori Two Course Cluster 28) [236ws, winter] Algebraic Solvability (1/3 course – Cajori Two Course Cluster 26) [236ws, spring] Algebraic Solvability (1/3 course – Cajori Two Course Cluster 26)
Total number of required courses beyond freshman calculus:	Four Full Courses
Can undergraduate students take graduate courses?	Yes
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 49. University of Texas, Austin: 1933 to 1935

College:	University of Texas, Austin
Catalog Year:	1933-1935
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Mathematics Major
Total number of units to graduate:	120 semester hours
Total number of mathematics units required for the degree:	30 semester hours
List of required courses and their respective units:	[302f] Analytic Geometry (3 hours – Cajori Two Course Cluster 2) [13, fall] Calculus (3 hours – Cajori Two Course Cluster 11) [13, spring] Calculus (3 hours – Cajori Two Course Cluster 11) [315s] Theory of Equations (Not given in 1935-1936) (3 hours – Cajori Two Course Cluster 26)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Thirty total hours in mathematics, at least twelve must be in advanced courses. The following courses are for Undergraduates and Graduates: [21, fall] Advanced Calculus (3-6 hours – Cajori Two Course Cluster 23) [22] Differential Equations and Applications (3-6 hours – Cajori Two Course Cluster 22) [323f] Introduction to the Foundations of Algebra (3-6 hours – Cajori Two Course Cluster 28) [327f] Ruler and Compass Constructions (3-6 hours – Cajori Two Course Cluster 31) [328s] Descriptive Geometry (3-6 hours – Cajori Two Course Cluster 4) [30] Introduction to Modern Analytic Geometry (3-6 hours – Cajori Two Course Cluster 31) [333s] Teaching Problems in Mathematics (3-6 hours – Cajori Two Course Cluster 10) [336f] Elementary Number Theory (3-6 hours – Cajori Two Course Cluster 29) [337s] Topics in Modern Algebra (3-6 hours – Cajori Two Course Cluster 26) [41] Analytical Mechanics (3-6 hours – Cajori Two Course Cluster 38) [45] Probability (3-6 hours – Cajori Two Course Cluster 46) [46] Mathematical Statistics (3-6 hours – Cajori Two Course Cluster 46) [47] Actuarial Mathematics (3-6 hours – Cajori Two Course Cluster 41)
Total number of required courses beyond freshman calculus:	At least seven courses
Can undergraduate students take graduate courses?	Yes

Table 49. University of Texas, Austin: 1933 to 1935 (continued)

Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 50. University of Texas, Austin: 1941 to 1945

<table>
<tr><td>College:</td><td>University of Texas, Austin</td></tr>
<tr><td>Catalog Year:</td><td>1941-1945</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.A. Major in Mathematics</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 semester hours</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 12 hours</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[301] Plane Trigonometry (3 lectures/ week – Cajori Two Course Cluster 1)
[302] Analytic Geometry (3 lectures/ week – Cajori Two Course Cluster 2)</td><td>OR</td><td>[302] Analytic Geometry (*repeat*3 lectures/ week – Cajori Two Course Cluster 2)
[303] Analytic Geometry (3 lectures/ week – Cajori Two Course Cluster 2)</td></tr>
</table>
[13, first semester] Calculus (3 hours – Cajori Two Course Cluster 11)
[13, second semester] Calculus (3 hours – Cajori Two Course Cluster 11)</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td><u>Analysis:</u>
[21, first semester] Advanced Calculus (3 hours – Cajori Two Course Cluster 21)
[21, second semester] Advanced Calculus (3 hours – Cajori Two Course Cluster 21)
[22, first semester] Differential Equations and Applications (3 hours – Cajori Two Course Cluster 22)
[24, first semester] Introduction to Foundation of Analysis (3 hours – Cajori Two Course Cluster 22)
[24, second semester] Introduction to Foundation of Analysis (3 hours – Cajori Two Course Cluster 23)
[83]*
[83K]*
[84]*
[85]*
[86]*
[92]*
[93]*
[96]*</td></tr>
</table>

Table 50. University of Texas, Austin: 1941 to 1945 (continued)

	Algebra and Number Theory: [315] Theory of Equations (3 hours – Cajori Two Course Cluster 26) [323] Introduction to the Foundations of Algebra (3 hours – Cajori Two Course Cluster 28) [336] Elementary Number Theory (3 hours – Cajori Two Course Cluster 29) [37]* [380]* [381]* [82]* [82K]* [91]* Foundations of Mathematics and Point-Set Theory: [323] Introduction to Foundations of Algebra (*repeat* 3 hours – Cajori Two Course Cluster 28) [24, first semester] Introduction to Foundation of Analysis (*repeat*3 hours – Cajori Two Course Cluster 22) [24, second semester] Introduction to Foundation of Analysis (*repeat*3 hours – Cajori Two Course Cluster 22) [88]* [89]* [90]* Geometry: [327]* [328]* [30, first semester] Introduction to Modern Analytic Geometry (3 hours – Cajori Two Course Cluster 31) [30, second semester] Introduction to Modern Analytic Geometry (3 hours – Cajori Two Course Cluster 31) Probability: [45, first semester] Probability (3 hours – Cajori Two Course Cluster 46) [45, second semester] Probability (3 hours – Cajori Two Course Cluster 46) [46, first semester] Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [46, second semester] Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [47, first semester] Actuarial Mathematics (3 hours – Cajori Two Course Cluster 41) [47, second semester] Actuarial Mathematics (3 hours – Cajori Two Course Cluster 41) [83K]* * Note: These course titles and descriptions were not made available.

Table 50. University of Texas, Austin: 1941 to 1945 (continued)

Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Not available
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 51. University of Texas, Austin: 1953 to 1955

College:	University of Texas, Austin
Catalog Year:	1953-1955
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A., Major in Mathematics
Total number of units to graduate:	120 semester hours
Total number of mathematics units required for the degree:	At least 12 hours
List of required courses and their respective units:	[304] Plane Trigonometry (3 hours – Cajori Two Course Cluster 1) [305] Analytic Geometry (3 hours – Cajori Two Course Cluster 2) [613, fall] Calculus (3 hours – Cajori Two Course Cluster 11) [613, spring] Calculus (3 hours – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	[315] Theory of Equations (3 hours – Cajori Two Course Cluster 26) [316] Elementary Mathematical Statistics (3 hours – Cajori Two Course Cluster 5) [317] Higher Algebra (3 hours – Cajori Two Course Cluster 3) [219] Problems Course for Actuarial Examination, Part 2 (2 hours – Cajori Two Course Cluster 41) For Undergraduates and Graduates: [220] Problems Course for Actuarial Examination, Part 3 (hours unknown – Cajori Two Course Cluster 41) “Any of the following junior courses in mathematics may count as senior courses if preceded by six hours of advanced mathematics” (The University of Texas, Austin, Bulletin, 1953-1955, p. 131). [321K] Advanced Calculus (3 hours – Cajori Two Course Cluster 21) [321L] Advanced Calculus (3 hours – Cajori Two Course Cluster 21) [322K] Differential Equations and Applications (3 hours – Cajori Two Course Cluster 22) [322L] Differential Equations and Applications (3 hours – Cajori Two Course Cluster 22) [624, first semester] Introduction to the Foundations of Analysis (3 hours – Cajori Two Course Cluster 23) [624, second semester] Introduction to the Foundations of Analysis (3 hours – Cajori Two Course Cluster 23) [325] Advanced Calculus with Engineering Applications (3 hours – Cajori Two Course Cluster 21)

Table 51. University of Texas, Austin: 1953 to 1955 (continued)

	[326] Differential Equations with Engineering Applications (3 hours – Cajori Two Course Cluster 21) [327] Ruler and Compass Constructions (3 hours – Cajori Two Course Cluster 31) [330K] Advanced Analytic Geometry of the Euclidean and Projective Planes (3 hours – Cajori Two Course Cluster 31) [331] Introduction to the Foundations of Geometry (3 hours – Cajori Two Course Cluster 32) [333] Teaching Problems in Mathematics (3 hours – Cajori Two Course Cluster 10) [333K] Teaching Problems in Arithmetic and Algebra (3 hours – Cajori Two Course Cluster 10) [333L] Teaching Problems in Geometry (3 hours – Cajori Two Course Cluster 9) [340] Interpolation and Graphical Methods (3 hours – Cajori Two Course Cluster 22) [340L] Interpolation and Numerical Methods (3 hours – Cajori Two Course Cluster 22) [645, first semester] Probability (3 hours – Cajori Two Course Cluster 46) [645, second semester] Probability (3 hours – Cajori Two Course Cluster 46) [361] Theory of Functions of a Complex Variable (3 hours – Cajori Two Course Cluster 23) [662, first semester] Analytical Mechanics (3 hours – Cajori Two Course Cluster 38) [662, second semester] Analytical Mechanics (3 hours – Cajori Two Course Cluster 38) [364K] Vector and Tensor Analysis (3 hours – Cajori Two Course Cluster 37) [364L] Vector and Tensor Analysis (3 hours – Cajori Two Course Cluster 37) [367] Introduction to Modern Projective Geometry (3 hours – Cajori Course Cluster 32) [368] Advanced Numerical Analysis (3 hours – Cajori Two Course Cluster 22) [669, first semester] Mathematical Analysis for Advanced Physical Chemistry (3 hours – Cajori Two Course Cluster 37) [669, second semester] Mathematical Analysis for Advanced Physical Chemistry (3 hours – Cajori Two Course Cluster 37) [670, first semester] Fluid Dynamics (3 hours – Cajori Two Course Cluster 38) [670, second semester] Fluid Dynamics (3 hours – Cajori Two Course Cluster 38) [371K] Topics in Modern Algebra (3 hours – Cajori Two Course Cluster 30) [371L] Topics in Modern Algebra (3 hours – Cajori Two Course Cluster 30) [371M] Introduction to the Foundations of Algebra (3 hours – Cajori Two Course Cluster 28) [372] Boundary Value Problems (3 hours – Cajori Two Course Cluster 37) [373K] Introduction to Abstract Algebra and Number Theory (3 hours – Cajori Two Course Cluster 29) [373L] Introduction to Abstract Algebra and Number Theory (3 hours – Cajori Two Course Cluster 29) [374] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [374K] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [375] Conference Course (units not listed – Cajori Two Course Cluster 52) [676, first semester] Functions of Several Real Variables (3 hours – Cajori Two Course Cluster 23) [676, second semester] Functions of Several Real Variables (3 hours – Cajori Two Course Cluster 23) [678, first semester] Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [678, second semester] Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [679, first semester] Actuarial Mathematics (3 hours – Cajori Two Course Cluster 41) [679, second semester] Actuarial Mathematics (3 hours – Cajori Two Course Cluster 41)

Table 51. University of Texas, Austin: 1953 to 1955 (continued)

Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Yes, since there are courses listed for undergraduates and graduates
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 52. University of Texas, Austin: 1963 to 1965

<table>
<tr><td>College:</td><td>University of Texas, Austin</td></tr>
<tr><td>Catalog Year:</td><td>1963-1965</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.A. Mathematics Major</td></tr>
<tr><td>Total number of units to graduate:</td><td>120 semester hours</td></tr>
<tr><td>Total number of mathematics units required for the degree:</td><td>At least 6 hours</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[304] Plane Trigonometry (hours not listed – Cajori Two Course Cluster 1)

[305] Analytic Geometry (hours not listed – Cajori Two Course Cluster 2)

[613, first semester] Calculus (3 hours – Cajori Two Course Cluster 11)

[613, second semester] Calculus (3 hours – Cajori Two Course Cluster 11)</td><td>OR</td><td>[301] College Algebra (hours not listed – Cajori Two Course Cluster 3)

[304] Plane Trigonometry (*repeat* hours not listed – Cajori Two Course Cluster 1)

[808E, first semester] Calculus with Analytic Geometry (4 hours – Cajori Two Course Cluster 11)

[808E, second semester] Calculus with Analytic Geometry (4 hours – Cajori Two Course Cluster 11)</td></tr>
</table>
</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td>[304G] Introduction to Computer Science (hours not listed – Cajori Two Course Cluster 48)
[310K] First Course in Theory of Numbers (hours not listed – Cajori Two Course Cluster 29)
[310L] First Course in Theory of Numbers (hours not listed – Cajori Two Course Cluster 29)
[315] Theory of Equations (hours not listed – Cajori Two Course Cluster 26)
[318E] Advanced Calculus with Applications (hours not listed – Cajori Two Course Cluster 21)
[319E] Differential Equations with Applications (hours not listed – Cajori Two Course Cluster 22)

“Any of the following junior courses in mathematic may count as senior courses if preceded by six hours of advanced mathematics” (The University of Texas, Austin, Bulletin, 1963-1965, p. 144)</td></tr>
</table>

Table 52. University of Texas, Austin: 1963 to 1965 (continued)

	[620K, first semester] Mathematics of Astronomy (3 hours – Cajori Two Course Cluster 54) [620K, second semester] Mathematics of Astronomy (3 hours – Cajori Two Course Cluster 54) [321K] Advanced Calculus (hours not listed – Cajori Two Course Cluster 21) [321L] Advanced Calculus (hours not listed – Cajori Two Course Cluster 21) [322K] Differential Equations and Applications (hours not listed – Cajori Two Course Cluster 22) [322L] Differential Equations and Applications (hours not listed – Cajori Two Course Cluster 22) [624, first semester] Introduction to the Foundations of Analysis (3 hours – Cajori Two Course Cluster 23) [624, second semester] Introduction to the Foundations of Analysis (3 hours – Cajori Two Course Cluster 23) [325] Advanced Calculus with Engineering Applications (hours not listed – Cajori Two Course Cluster 21) [326] Differential Equations with Engineering Applications (hours not listed – Cajori Two Course Cluster 22) [330K] Advanced Analytic Geometry of the Euclidean and Projective Planes (hours not listed – Cajori Two Course Cluster 31) [333K] Teaching Problems in Arithmetic and Algebra (hours not listed – Cajori Two Course Cluster 9) [333L] Teaching Problems in Geometry (hours not listed – Cajori Two Course Cluster 9) [340] Interpolation and Graphical Methods (hours not listed – Cajori Two Course Cluster 41) [340L] Matrices and Matrix Calculations (hours not listed – Cajori Two Course Cluster 26) [645, first semester] Probability (3 hours – Cajori Two Course Cluster 46) [645, second semester] Probability (3 hours – Cajori Two Course Cluster 46) [355] High-Speed Computer Programming (hours not listed – Cajori Two Course Cluster 51) For Undergraduates and Graduates: [360P] Celestial Mechanics (hours not listed – Cajori Two Course Cluster 38) [361] Theory of Functions of a Complex Variable (hours not listed – Cajori Two Course Cluster 23) [361K] Introduction to Analysis (hours not listed – Cajori Two Course Cluster 23) [662, first semester] Analytical Mechanics (hours not listed – Cajori Two Course Cluster 38) [662, second semester] Analytical Mechanics (hours not listed – Cajori Two Course Cluster 38) [363] Linear Operators (hours not listed – Cajori Two Course Cluster 43) [364K] Vector and Tensor Analysis (hours not listed – Cajori Two Course Cluster 37) [364L] Vector and Tensor Analysis (hours not listed – Cajori Two Course Cluster 37) [366] Difference Methods (hours not listed – Cajori Two Course Cluster 44) [366K] Nonlinear Differential Equations and Applications (hours not listed – Cajori Two Course Cluster 22) [667, first semester] Introduction to Modern Projective Geometry (hours not listed – Cajori Two Course Cluster 32)

Table 52. University of Texas, Austin: 1963 to 1965 (continued)

	[667, second semester] Introduction to Modern Projective Geometry (hours not listed – Cajori Two Course Cluster 32) [368K] Numerical Analysis (hours not listed – Cajori Two Course Cluster 22) [368L] Numerical Analysis (hours not listed – Cajori Two Course Cluster 22) [669, first semester] Mathematical Analysis for Advanced Physical Chemistry (3 hours – Cajori Two Course Cluster 37) [669, second semester] Mathematical Analysis for Advanced Physical Chemistry (3 hours – Cajori Two Course Cluster 37) [371K] Topics in Modern Algebra (hours not listed – Cajori Two Course Cluster 30) [371L] Topics in Modern Algebra (hours not listed – Cajori Two Course Cluster 30) [372] Fourier Series and Boundary Value Problems (hours not listed – Cajori Two Course Cluster 37) [373K] Linear Algebra with Application (hours not listed – Cajori Two Course Cluster 27) Prerequisite includes a “certain aptitude for abstract mathematical thinking” (p. 147) [373L] Introduction to Abstract Algebra and Number Theory (hours not listed – Cajori Two Course Cluster 28) [374] Fourier and Laplace Transforms (hours not listed – Cajori Two Course Cluster 37) [374K] Fourier and Laplace Transforms (hours not listed – Cajori Two Course Cluster 37) [375] Conference Course (hours not listed – Cajori Two Course Cluster 52) [676, first semester] Functions of Several Real Variables (3 hours – Cajori Two Course Cluster 23) [676, second semester] Functions of Several Real Variables (3 hours – Cajori Two Course Cluster 23) [678, first semester] Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [678, second semester] Mathematical Statistics (3 hours – Cajori Two Course Cluster 46)
Total number of required courses beyond freshman calculus:	Not available
Can undergraduate students take graduate courses?	Yes
Are students required to take a computing course? If so, which ones.	No, but computing courses are available
How many different calculus sequences exist for a mathematics major?	One

Table 53. University of Texas, Austin: 1973 to 1975

College:	University of Texas, Austin
Catalog Year:	1973-1975
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.S. in Mathematics
Total number of units to graduate:	126 semester hours
Total number of mathematics units required for the degree:	41-45 semester hours
List of required courses and their respective units:	[808, first semester] Calculus I and II (3 hours – Cajori Two Course Cluster 11) [808, second semester] Calculus I and II (3 hours – Cajori Two Course Cluster 11) [311] Linear Algebra and Matrix Theory (3 hours – Cajori Two Course Cluster 27) [665a, first semester] Introduction to Analysis (3 hours – Cajori Two Course Cluster 23) [665b, second semester] Introduction to Analysis (3 hours – Cajori Two Course Cluster 23) [373K] Algebraic Structures I (hours not listed – Cajori Two Course Cluster 28)

Table 53. University of Texas, Austin: 1973 to 1975 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	Eighteen Additional Upper-Division Hours in Mathematics: [427K] Advance Calculus for Applications I (4 hours – Cajori Two Course Cluster 21) [427L] Advanced Calculus for Applications II (4 hours – Cajori Two Course Cluster 21) [328K] First Course in the Theory of Numbers (hours not listed – Cajori Two Course Cluster 29) [333L] Structure of Modern Geometry (hours not listed – Cajori Two Course Cluster 31) [340L] Matrices and Matrix Calculations (hours not listed – Cajori Two Course Cluster 26) [343K] Introduction to Algebraic Structures (hours not listed – Cajori Two Course Cluster 28) [361] Theory of Functions of a Complex Variable (hours not listed – Cajori Two Course Cluster 23) [362K] Probability I (hours not listed – Cajori Two Course Cluster 46) [362L] Probability II (hours not listed – Cajori Two Course Cluster 46) [362M] Introduction to Stochastic Processes (hours not listed – Cajori Two Course Cluster 46) [364K] Vector and Tensor Analysis I (hours not listed – Cajori Two Course Cluster 37) [364L] Vector and Tensor Analysis II (hours not listed – Cajori Two Course Cluster 37) [367K] Topology I (hours not listed – Cajori Two Course Cluster 33) [367L] Topology II (hours not listed – Cajori Two Course Cluster 33) [368K] Introduction to Numerical Analysis (hours not listed – Cajori Two Course Cluster 22) Cross-listed with Computer Science 368K [368L] Introduction to Numerical Linear Algebra (hours not listed – Cajori Two Course Cluster 27) Cross-listed with Computer Science 368L [669, first semester] Mathematical Analysis for Advanced Physical Chemistry (hours not listed – Cajori Two Course Cluster 37) [669, second semester] Mathematical Analysis for Advanced Physical Chemistry (hours not listed – Cajori Two Course Cluster 37) [370K] Differential Equations I (hours not listed – Cajori Two Course Cluster 22) [370L] Differential Equations II (hours not listed – Cajori Two Course Cluster 22) [372] Fourier Series and Boundary Value Problems (hours not listed – Cajori Two Course Cluster 37) [373L] Algebraic Structures II (hours not listed – Cajori Two Course Cluster 27) [374] Fourier and Laplace Transforms (hours not listed – Cajori Two Course Cluster 37) [374K] Fourier and Laplace Transforms (hours not listed – Cajori Two Course Cluster 37) [375] Conference Course (hours not listed – Cajori Two Course Cluster 52) [676, first semester] Methods of Applied Mathematics (hours not listed – Cajori Two Course Cluster 37) [676, second semester] Methods of Applied Mathematics (hours not listed – Cajori Two Course Cluster 37) [378K] Introduction to Mathematical Statistics (hours not listed – Cajori Two Course Cluster 46) [378L] Introduction to Decision Theory (hours not listed – Cajori Two Course Cluster 42) [378M] Statistical Methods (hours not listed – Cajori Two Course Cluster 42) [379K] Functions of Several Variables (hours not listed – Cajori Two Course Cluster 11) [379L] Introduction to Differential Geometry (hours not listed – Cajori Two Course Cluster 33)

Table 53. University of Texas, Austin: 1973 to 1975 (continued)

Total number of required courses beyond freshman calculus:	At least 9 courses
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	Not required, but they are available
How many different calculus sequences exist for a mathematics major?	One

Table 54. University of Texas, Austin: 1983 to 1985

<table>
<tr><td>College:</td><td>University of Texas, Austin</td></tr>
<tr><td>Catalog Year:</td><td>1983-1985</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.S. in Mathematics</td></tr>
<tr><td>Total number of units to graduate:</td><td>126 semester hours</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>At least 36 hours</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[808A] Calculus I (3 hours – Cajori Two Course Cluster 13)

[808B] Calculus II (3 hours) – Cajori Two Course Cluster 11)

(6 total hours)</td><td>OR</td><td>[608E] Calculus (3 hours – Cajori Two Course Cluster 11)

[318K] Calculus III (hours not listed – Cajori Two Course Cluster 11)

(6 total hours)</td></tr>
</table>
[311] Linear Algebra and Matrix Theory (3 hours – Cajori Two Course Cluster 27)
<table>
<tr><td>[427K] Advanced Calculus for Applications I (5 hours – Cajori Two Course Cluster 21)</td><td>OR</td><td>[370K] Differential Equations I (3 hours – Cajori Two Course Cluster 22)</td></tr>
</table>
[362K] Probability I (3 hours – Cajori Two Course Cluster 46)
[665A] Introduction to Analysis (first semester, 3 hours – Cajori Two Course Cluster 23)
[665A] Introduction to Analysis (second semester, 3 hours – Cajori Two Course Cluster 23)
[373K] Algebraic Structures I (3 hours – Cajori Two Course Cluster 27)
</td></tr>
</table>

Table 54. University of Texas, Austin: 1983 to 1985 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	At Least Twelve Additional Upper-Division Courses in Mathematics: [325K] Discrete Mathematics (Cross-listed with Computer Sciences 325, 3 hours – Cajori Two Course Cluster 44) [427L] Advanced Calculus for Applications II (5 hours– Cajori Two Course Cluster 21) [328K] First Course in the Theory of Numbers (3 hours – Cajori Two Course Cluster 29) OR [360.2] Topics in Modern Mathematics Number Theory (3 hours – Cajori Two Course Cluster 29) [333L] Structure of Modern Geometry (3 hours – Cajori Two Course Cluster 31) [350] Applied Linear Algebra (3 hours – Cajori Two Course Cluster 27) [361] Theory of Functions of a Complex Variable (3 hours – Cajori Two Course Cluster 23) [361K] Introduction to Analysis (3 hours – Cajori Two Course Cluster 23) [362L] Probability II (3 hours – Cajori Two Course Cluster 46) [362M] Introduction to Stochastic Processes (3 hours – Cajori Two Course Cluster 46) [364K] Vector and Tensor Analysis I (3 hours – Cajori Two Course Cluster 37) [364L] Vector and Tensor Analysis II (3 hours – Cajori Two Course Cluster 37) [665B] Introduction to Analysis (3 hours – Cajori Two Course Cluster 23) [367K] Topology I (3 hours – Cajori Two Course Cluster 33)
	[367L] Topology II (3 hours – Cajori Two Course Cluster 33) [368K] Numerical Mathematics for Applications (Cross-listed with Computer Science 368K, 3 hours – Cajori Two Course Cluster 22) [372] Fourier Series and Boundary Value Problems (3 hours – Cajori Two Course Cluster 37) [373L] Algebraic Structures II (3 hours – Cajori Two Course Cluster 27) [374] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [374K] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [175] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [275] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [375] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [475] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [676A] Methods of Applied Mathematics (3 hours – Cajori Two Course Cluster 37) [676B] Methods of Applied Mathematics (3 hours – Cajori Two Course Cluster 37) [377K] Mathematics for Life Sciences (3 hours – Cajori Two Course Cluster 40) [378K] Introduction to Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [378L] Introduction to Decision Theory (3 hours – Cajori Two Course Cluster 42) [378M] Statistical Methods (3 hours – Cajori Two Course Cluster 46)
Total number of required courses beyond freshman calculus:	At least ten

Table 54. University of Texas, Austin: 1983 to 1985 (continued)

Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	Yes
How many different calculus sequences exist for a mathematics major?	Two

Table 55. University of Texas, Austin: 1994 to 1996

College:	University of Texas, Austin
Catalog Year:	1994-1996
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.S. in Mathematics
Total number of units to graduate:	126 semester hours
Total number of mathematics units required for the degree:	At least 35 hours
List of required courses and their respective units:	[408C] Differential and Integral Calculus (3 hours + 2 discussions– Cajori Two Course Cluster 11) [408D] Sequences, Series, and Multivariable Calculus (3 hours + 2 discussions– Cajori Two Course Cluster 11) *(6 total hours)* OR [308K] Differential Calculus (Not Taught in Residence – Only Available for Transfer Credit – Cajori Two Course Cluster 17) [308L] Integral Calculus (3 hours – Cajori Two Course Cluster 17) [308M] Multivariable Calculus (3 hours – Cajori Two Course Cluster 17) [311] Linear Algebra and Matrix Theory (3 hours – Cajori Two Course Cluster 27) [325K] Discrete Mathematics (3 hours – Cajori Two Course Cluster 44) OR [328K] Introduction to Number Theory (3 hours – Cajori Two Course Cluster 29) [427K] Advanced Calculus for Applications I (5 hours– Cajori Two Course Cluster 21) [362K] Probability I (3 hours – Cajori Two Course Cluster 46) [365C] Real Analysis I (3 hours – Cajori Two Course Cluster 23) [373K] Algebraic Structures I (3 hours – Cajori Two Course Cluster 28)

Table 55. University of Texas, Austin: 1994 to 1996 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	Nine Additional Semester Hours of Upper Division Mathematics: [427L] Advanced Calculus for Applications II (5 hours– Cajori Two Course Cluster 21) [129S-929S] Topics in Mathematics (hours vary – Cajori Two Course Cluster 52) [329W] Cooperative Mathematics (4 hours– Cajori Two Course Cluster 52) [333L] Structure of Modern Geometry (3 hours – Cajori Two Course Cluster 32) [360K, Topic 2: Number Theory] Topics in Modern Mathematics I (3 hours – Cajori Two Course Cluster 10) [360K, Topic 3: Problem Solving] Topics in Modern Mathematics I (3 hours – Cajori Two Course Cluster 10) [360M] Mathematics as Problem Solving (3 hours – Cajori Two Course Cluster 52) [361] Theory of Functions of a Complex Variable (3 hours – Cajori Two Course Cluster 23) [361K] Introduction to Real Analysis (3 hours – Cajori Two Course Cluster 23) [362M] Introduction to Stochastic Processes (3 hours – Cajori Two Course Cluster 46) [364K] Vector and Tensor Analysis I (3 hours – Cajori Two Course Cluster 37) [364L] Vector and Tensor Analysis II (3 hours – Cajori Two Course Cluster 37) [365D] Real Analysis II (3 hours – Cajori Two Course Cluster 23) [367K] Topology I (3 hours – Cajori Two Course Cluster 33)
	[367L] Topology II (3 hours – Cajori Two Course Cluster 33) [368K] Numerical Mathematics for Applications (3 hours – Cajori Two Course Cluster 22) [372] Fourier Series and Boundary Value Problems (3 hours – Cajori Two Course Cluster 37) [373L] Algebraic Structures II (3 hours – Cajori Two Course Cluster 27) [374] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [374K] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [175] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [275] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [375] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [475] Conference Course (1-4 hours– Cajori Two Course Cluster 52) [175C] Computer Assisted Conference Course (hours not listed– Cajori Two Course Cluster 52) [375C] Computer Assisted Conference Course (3 hours – Cajori Two Course Cluster 52) [378K] Introduction to Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [379H] Honors Tutorial Course (3 hours – Cajori Two Course Cluster 52)
Total number of required courses beyond freshman calculus:	At least nine
Can undergraduate students take graduate courses?	Not mentioned

Table 55. University of Texas, Austin: 1994 to 1996 (continued)

Are students required to take a computing course? If so, which ones.	Yes, Computer Science 304P or the equivalent.
How many different calculus sequences exist for a mathematics major?	Two

Table 56. University of Texas, Austin: 2004 to 2006

<table>
<tr><td>College:</td><td>University of Texas, Austin</td></tr>
<tr><td>Catalog Year:</td><td>2004-2006</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>B.S. in Pure Mathematics</td></tr>
<tr><td>Total number of units to graduate:</td><td>126 semester hours</td></tr>
<tr><td>Total number of mathematics units required for the degree:</td><td>At least 38 hours</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[408C] Differential and Integral Calculus (3 hours + 2 discussions – Cajori Two Course Cluster 11)

[408D] Sequences, Series, and Multivariable Calculus (3 hours + 2 discussions – Cajori Two Course Cluster 11)</td><td>OR</td><td>[408K] Differential Calculus (3 hours + 2 discussions – Cajori Two Course Cluster 11)

[408L] Integral Calculus (3 hours + 2 discussions – Cajori Two Course Cluster 11)

[408M] Multivariable Calculus (3 hours + 2 discussions – Cajori Two Course Cluster 11)</td></tr>
</table>

Upper Division Courses:

<table>
<tr><td>[340L] Matrices and Matrix Calculations (3 hours – Cajori Two Course Cluster 26)</td><td>OR</td><td>[341] Linear Algebra and Matrix Theory (3 hours – Cajori Two Course Cluster 27)</td></tr>
</table>

[427K] Advanced Calculus for Applications I (5 hours– Cajori Two Course Cluster 21)
[361] Theory of Functions of a Complex Variable (3 hours – Cajori Two Course Cluster 23)
[362K] Probability I (3 hours – Cajori Two Course Cluster 46)
[365C] Real Analysis I (3 hours – Cajori Two Course Cluster 23)
[373K] Algebraic Structures I (3 hours – Cajori Two Course Cluster 28)
</td></tr>
</table>

Table 56. University of Texas, Austin: 2004 to 2006 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	At least thirty-two semester hours of upper division coursework in mathematics, so 12 more: One of the following two-course sequences: [427K] Advanced Calculus for Applications I (3 hours – Cajori Two Course Cluster 21) [372K] Partial Differential Equations and Applications (3 hours – Cajori Two Course Cluster 37) [358K] Applied Statistics (3 hours – Cajori Two Course Cluster 47) [378K] Introduction to Mathematical Statistics (3 hours – Cajori Two Course Cluster 47) [362K] Probability I (*repeat* 3 hours – Cajori Two Course Cluster 46) [339U] Actuarial Contingent Payments I (3 hours – Cajori Two Course Cluster 41) [362K] Probability I (*repeat* 3 hours – Cajori Two Course Cluster 46) [339J] Probability Models with Actuarial Applications (3 hours – Cajori Two Course Cluster 41)
	[348] Scientific Computation in Numerical Analysis (3 hours – Cajori Two Course Cluster 22) [368K] Numerical Methods for Applications (3 hours – Cajori Two Course Cluster 22) [365C] Real Analysis I (*repeat* 3 hours – Cajori Two Course Cluster 23) [365D] Real Analysis II (3 hours – Cajori Two Course Cluster 23) [367K] Topology I (3 hours – Cajori Two Course Cluster 33) [367L] Topology II (3 hours – Cajori Two Course Cluster 33) [373K] Algebraic Structures I (*repeat* 3 hours – Cajori Two Course Cluster 28) [373L] Algebraic Structures II (3 hours – Cajori Two Course Cluster 27) [343K] Introduction to Algebraic Structures (3 hours – Cajori Two Course Cluster 28) OR [361K] Introduction to Real Analysis (3 hours – Cajori Two Course Cluster 23) And [325K] Discrete Mathematics (3 hours – Cajori Two Course Cluster 44) [326K] Foundations of Number Systems (3 hours – Cajori Two Course Cluster 36) [427L] Advanced Calculus for Applications II (5 hours– Cajori Two Course Cluster 21) [328K] Introduction to Number Theory (3 hours – Cajori Two Course Cluster 29) [129S, 229S, … 929S] Topics in Mathematics (hours vary– Cajori Two Course Cluster 52)"This course is used to record credit the student earns while enrolled at another institution in a program administered by the University's Center for Global Educational Opportunities" p. 491) [329W] Cooperative Mathematics (3 hours – Cajori Two Course Cluster 52) [333L] Structure of Modern Geometry (3 hours – Cajori Two Course Cluster 32) [139S] Seminar on Actuarial Practice (1 hours – Cajori Two Course Cluster 43) [339V] Actuarial Contingent Payments II (3 hours – Cajori Two Course Cluster 41)

Table 56. University of Texas, Austin: 2004 to 2006 (continued)

	[343L] Applied Number Theory (3 hours – Cajori Two Course Cluster 40) [343M] Error-Correcting Codes (3 hours – Cajori Two Course Cluster 39) [344K] Intermediate Symbolic Logic (3 hours – Cajori Two Course Cluster 35) [346] Applied Linear Algebra (3 hours – Cajori Two Course Cluster 39) [449P] Actuarial Statistical Estimates (hours not listed– Cajori Two Course Cluster 41) [349T] Time Series and Survival-Model Estimation (3 hours – Cajori Two Course Cluster 46) [358K] Applied Statistics (hours not listed– Cajori Two Course Cluster 47) [360M] Mathematics as Problem Solving (3 hours – Cajori Two Course Cluster 52) [362M] Introduction to Stochastic Processes (3 hours – Cajori Two Course Cluster 46) [364K] Vector and Tensor Analysis I (3 hours – Cajori Two Course Cluster 37) [364L] Vector and Tensor Analysis II (3 hours – Cajori Two Course Cluster 37) [367L] Topology II (3 hours – Cajori Two Course Cluster 33) [372] Fourier Series and Boundary Value Problems (3 hours – Cajori Two Course Cluster 37) [374] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [374G] Linear Regression Analysis (3 hours – Cajori Two Course Cluster 46) [374K] Fourier and Laplace Transforms (3 hours – Cajori Two Course Cluster 37) [474M] Introduction to Mathematical Modeling and Industrial Mathematics (3 hours + 2 Lab hours– Cajori Two Course Cluster 43) [175] Course Conference (hours not listed - Cajori Two Course Cluster 52) [275] Course Conference (hours not listed - Cajori Two Course Cluster 52) [375] Course Conference (hours not listed - Cajori Two Course Cluster 52) [475] Course Conference (hours not listed - Cajori Two Course Cluster 52) [375C] Course Conference (Computer Assisted) (3 hours –Cajori Two Course Cluster 52) [376C] Methods of Applied Mathematics (3 hours – Cajori Two Course Cluster 37) [378K] Introduction to Mathematical Statistics (3 hours – Cajori Two Course Cluster 46) [379H] Honors Tutorial Course (3 hours – Cajori Two Course Cluster 52)
Total number of required courses beyond freshman calculus:	Ten
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	Two

Table 57. Yale: 1904 to 1905

College:	Yale
Catalog Year:	1904 - 1905
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	B.A. (Suggested scheme for students intending on pursuing graduate studies in mathematics.)
Total number of units to graduate:	60 hours
Total number of mathematics units required for the degree:	15 hours
List of required courses and their respective units:	[A1] Solid Geometry, Plane Trigonometry, and Analytical Geometry (3 hours – Cajori Two Course Cluster 2) [B1] Calculus (3 hours – Cajori Two Course Cluster 11) [B3] Analytical Geometry (2 hours – Cajori Two Course Cluster 31) [B4] Higher Algebra (2 hours – Cajori Two Course Cluster 26) [C1] Advanced Calculus (2 hours – Cajori Two Course Cluster 21) [C5] Projective Geometry (3 hours – Cajori Two Course Cluster 32)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	None suggested in addition to those above for those students intending to move on to graduate study in mathematics.
Total number of required courses beyond freshman calculus:	Four courses (or nine hours)
Can undergraduate students take graduate courses?	Yes. "In Senior year any hours not needed to complete the work for the degree of Bachelor of Arts, may be devoted to study in the professional schools" (Yale College Courses of Study, 1901-1907, p. v).

Table 57. Yale: 1904 to 1905 (continued)

Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	One

Table 58. Yale: 1914 to 1915

College:	Yale
Catalog Year:	1914 - 1915
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	60 hours
Total number of mathematics units required for the degree:	At least 15 hours
List of required courses and their respective units:	[A1] Algebra, Plane Trigonometry, and Analytical Geometry (3 hours – Cajori Two Course Cluster 3) [B9] Differential and Integral Calculus (3 hours – Cajori Two Course Cluster 11) OR [B7] Analytic Geometry and Calculus (3 hours – Cajori Two Course Cluster 11) [C17] Advanced Calculus (3 hours – Cajori Two Course Cluster 21) [C15] Mechanics (2 hours – Cajori Two Course Cluster 38)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Two courses from the following Division II group: [C19] Algebra and Analytic Geometry (3 hours – Cajori Two Course Cluster 31) [D23] Modern Analytic Geometry (2 hours – Cajori Two Course Cluster 31) [D25] Theory of Functions of a Complex Variable (2 hours – Cajori Two Course Cluster 23)
Total number of required courses beyond freshman calculus:	Four (at least nine hours)
Can undergraduate students take graduate courses?	Yes. “A graduate course may, by permission, be substituted for any course in Division II” (Yale Bulletin, 1914-1915, p. 193).

Table 58. Yale: 1914 to 1915 (continued)

Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	Two

Table 59. Yale: 1925 to 1926

College:	Yale
Catalog Year:	1925 - 1926
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	120
Total number of <u>mathematics units required</u> for the degree:	At least 36 hours
List of required courses and their respective units:	[10] Analytic Geometry and Calculus (6 hours – Cajori Two Course Cluster 11) OR [16] Elementary Mathematics (Computation, trigonometry, analytic geometry, and calculus) (6 hours – Cajori Two Course Cluster 12) [25] Sophomore Mathematics (6 hours – Cajori Two Course Cluster 11) [30] Advanced Calculus (6 hours – Cajori Two Course Cluster 21) [31] Mechanics (6 hours – Cajori Two Course Cluster 38) [32] Theory of Functions of a Complex Variable (6 hours – Cajori Two Course Cluster 23) [33] Projective and Differential Geometry (6 hours – Cajori Two Course Cluster 33)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	None
Total number of required courses beyond freshman calculus:	Four
Can undergraduate students take graduate courses?	Yes. "Any excess of hours above the one hundred and twenty credit hours required for the degree may be devoted by Seniors to courses in the professional schools" (Yale Bulletin, 1925-1926, p. 18).

Table 59. Yale: 1925 to 1926 (continued)

Are students required to take a computing course? If so, which ones.	No
How many different calculus sequences exist for a mathematics major?	Two

Table 60. Yale: 1934 to 1935

College:	Yale
Catalog Year:	1934 - 1935
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Mathematics, B.A.
Total number of units to graduate:	120 hours
Total number of mathematics units required for the degree:	At least 36 credit hours
List of required courses and their respective units:	[11] Trigonometry and Analytic Geometry (6 credit hours – Cajori Two Course Cluster 1 and 2) (For students who have not passed trigonometry for entrance.) [23] Differential and Integral Calculus (6 credit hours – Cajori Two Course Cluster 11) OR [12] Introduction to Calculus (6 credit hours – Cajori Two Course Cluster 13) [25] Sophomore Mathematics (6 credit hours – Cajori Two Course Cluster 13)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose 4 courses: [26] Higher Algebra (6 credit hours – Cajori Two Course Cluster 26) [27] Analytic Geometry (6 credit hours – Cajori Two Course Cluster 31) [28] Mathematics of Investment and of Statistics (6 credit hours – Cajori Two Course Cluster 41 and 46) [30] Advanced Calculus (6 credit hours – Cajori Two Course Cluster 21) [31] Mechanics (6 credit hours – Cajori Two Course Cluster 38)
Total number of required courses beyond freshman calculus:	Four
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	No

Table 60. Yale: 1934 to 1935 (continued)

How many different calculus sequences exist for a mathematics major?	Two

Table 61. Yale: 1945 to 1946

College:	Yale
Catalog Year:	1945 - 1946
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	120 hours (or 114 hours with senior essay)
Total number of mathematics units required for the degree:	At least 36 hours (or at least 30 hours with a senior essay)
List of required courses and their respective units:	[12a,b] Analytic Geometry and Calculus (hours to be arranged – Cajori Two Course Cluster 11) [25a,b] Sophomore Mathematics (6 hours – Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose 4 two-term courses with a senior essay, or 5 two-term courses (at least 24 hours): [26a,b] Higher Algebra (6 hours – Cajori Two Course Cluster 30) [27a] Analytic Geometry (3 hours – Cajori Two Course Cluster 31) [27b] Solid Analytic Geometry (3 hours – Cajori Two Course Cluster 31) [30a,b] Advanced Calculus (6 hours – Cajori Two Course Cluster 21) [34b] Functions of a Complex Variable (3 hours – Cajori Two Course Cluster 23) [35a] Theory of Numbers (3 hours – Cajori Two Course Cluster 29) [35b] Determinants and Matrices (3 hours – Cajori Two Course Cluster 26) [38] Probability (3 hours – Cajori Two Course Cluster 46) [39] Statistics (3 hours – Cajori Two Course Cluster 46) Courses listed in the bulletin as omitted this year: [28] Mathematics of Investment (Hours assumed as 3 - Cajori Two Course Cluster 41) [31] Theoretical Mechanics (Hours assumed as 3 - Cajori Two Course Cluster 38) [32a,b] Actuarial Mathematics (Hours assumed as 6 - Cajori Two Course Cluster 41) [34a] Differential Equations (Hours assumed as 3 - Cajori Two Course Cluster 22) [37a,b] The Foundations and Development of Mathematics (Hours assumed as 6 - Cajori Two Course Cluster 36) [40a,b] Introduction to Exact Science (Hours assumed as 6 - Cajori Two Course Cluster 55)
Total number of required courses beyond freshman calculus:	Four and a senior essay or 5 courses

Table 61. Yale: 1945 to 1946 (continued)

Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	Not mentioned
How many different calculus sequences exist for a mathematics major?	One (and one for science majors)

Table 62. Yale: 1954 to 1955

College:	Yale
Catalog Year:	1954 - 1955
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	40 term-courses (or 38-term courses with a senior essay) "A student who does not write a senior essay must take three courses each term in mathematics during the Senior year [instead of two]" (Yale Bulletin, 1954-1955, p. 126).
Total number of mathematics units required for the degree:	At least 12 term-courses.
List of required courses and their respective units:	[11] Mathematical Analysis (Two Term Course - Cajori Two Course Cluster 12) OR [12] Analytic Geometry and Calculus (Two Term Course - Cajori Two Course Cluster 11)
	[21] Calculus (Two Term Course - Cajori Two Course Cluster 11) [23] Second-Year Mathematics (Two Term Course - Cajori Two Course Cluster 11) OR [25] Sophomore Mathematics (Two Term Course - Cajori Two Course Cluster 11)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose at least 8 terms of courses (some are two-term): [34a] Differential Equations (One Term Course - Cajori Two Course Cluster 22) [36b] Functions of a Complex Variable (One Term Course - Cajori Two Course Cluster 23) [42] Statistics (Two Term Course - Cajori Two Course Cluster 46) [50] Higher Algebra (Two Term Course - Cajori Two Course Cluster 30) [52a] Theory of Numbers (One Term Course - Cajori Two Course Cluster 29) [54b] Probability (One Term Course - Cajori Two Course Cluster 46) [56b] Determinants and Matrices (One Term Course - Cajori Two Course Cluster 26) [58a] An Introduction to Modern Algebra (One Term Course - Cajori Two Course Cluster 28) [64a] Topology (One Term Course - Cajori Two Course Cluster 33) [66b] Differential Geometry (One Term Course - Cajori Two Course Cluster 33) Courses listed in the bulletin as omitted: [30] Advanced Calculus (Two Term Course - Cajori Two Course Cluster 21) [32] An Introduction to Function Theory (Two Term Course - Cajori Two Course Cluster 23) [44a] Calculus of Finite Differences (One Term Course - Cajori Two Course Cluster 44) [60a] Synthetic Projective Geometry (One Term Course - Cajori Two Course Cluster 32) [62] Analytic Geometry (Two Term Course - Cajori Two Course Cluster 31)

Table 62. Yale: 1954 to 1955 (continued)

Total number of required courses beyond freshman calculus:	Eight term-courses (or equivalent)
Can undergraduate students take graduate courses?	Not mentioned
Are students required to take a computing course? If so, which ones.	Not mentioned
How many different calculus sequences exist for a mathematics major?	Four combinations

Table 63. Yale: 1964 to 1965

College:	Yale
Catalog Year:	1964 - 1965
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	Eight terms of study at 5 courses each term, so 40 term courses. (Some courses are two-term and some are only one term long.)
Total number of <u>mathematics units required</u> for the degree:	At least 14 term-long courses (or the equivalent)
List of required courses and their respective units:	[10a] [10b] Introductory Analytic Geometry and Calculus (One Term Course - Cajori Two Course Cluster 11) [15a] [15b] Analytic Geometry and Calculus (One Term Course - Cajori Two Course Cluster 11) [27] Intensive Mathematics I *(Not offered this year)* (Two Term Course - Cajori Two Course Cluster 13)
	[20a] [20b] Intermediate Analytic Geometry and Calculus (One Term Course - Cajori Two Course Cluster 11) [22a] [22b] Linear Algebra and Analytic Geometry (One Term Course - Cajori Two Course Cluster 27) [37] Intensive Mathematics II *(Covers material of [22] and [30] and part of [31a])* (Two Term Course - Cajori Two Course Cluster 19]
List of elective courses that could count towards the mathematics degree requirements and their respective units:	<u>Choose Ten Terms of Courses:</u> [30b] Advanced Calculus (One Term Course - Cajori Two Course Cluster 19) [31a] Introduction to Analysis (One Term Course - Cajori Two Course Cluster 23) [32b] Real Analysis (One Term Course - Cajori Two Course Cluster 24) [36a] Functions of a Complex Variable (One Term Course - Cajori Two Course Cluster 23) [41a] Introduction to Statistics (One Term Course - Cajori Two Course Cluster 46) [42b] Mathematical Statistics (One Term Course - Cajori Two Course Cluster 46) [43a] [43b] Analytical Methods *(Omitted this year)* (One Term Course - Cajori Two Course Cluster 37) [45] Laboratory in Statistics (Two Term Course - Cajori Two Course Cluster 45) [46a] [46b] Elements of the Theory of Differential Equations (One Term Course - Cajori Two Course Cluster 22) [48b] Topics in Advanced Calculus (One Term Course - Cajori Two Course Cluster 21) [52a] Theory of Numbers (One Term Course - Cajori Two Course Cluster 29)

Table 63. Yale: 1964 to 1965 (continued)

	[54b] Probability (One Term Course - Cajori Two Course Cluster 46) [56b] Linear Algebra *(Omitted this year)* (One Term Course - Cajori Two Course Cluster 27) [58a] An Introduction to Modern Algebra (One Term Course - Cajori Two Course Cluster 28) [60a] Synthetic Projective Geometry *(Omitted this year)* (One Term Course - Cajori Two Course Cluster 32) [62b] Advanced Analytic Geometry (One Term Course - Cajori Two Course Cluster 31) [64a] General Topology (One Term Course - Cajori Two Course Cluster 33) [65b] Combinatorial Topology (One Term Course - Cajori Two Course Cluster 33) [66b] Differential Geometry *(Omitted this year)* (One Term Course - Cajori Two Course Cluster 33) [90] Senior Mathematical Seminar (Two Term Course - Cajori Two Course Cluster 52) Students in the Intensive Major can take to the following courses: [100] Modern Algebra (Two Term Course - Cajori Two Course Cluster 28) [107a] Theory of Fields (One Term Course - Cajori Two Course Cluster 28) [121a] Measure and Integration (One Term Course - Cajori Two Course Cluster 24) [122a] Functions of a Complex Variable I (One Term Course - Cajori Two Course Cluster 23) [124b] Functions of a Complex Variable II (One Term Course - Cajori Two Course Cluster 23) [126b] Fourier Series and Fourier Integrals (One Term Course - Cajori Two Course Cluster 37) [127a] Hilbert Spaces and Banach Spaces (One Term Course - Cajori Two Course Cluster 24) [144] Topology I (Two Term Course - Cajori Two Course Cluster 33) [164] Mathematical Methods in Statistics (Two Term Course - Cajori Two Course Cluster 45) Stipulation: Students must take at least two term courses in three of the four fields: Algebra (Math 52a, 56b, 58a) Analysis (Math 30 (a or b), 31a, 32b, 37, 54b) Applied Mathematics (Math 41a, 42b, 43a, 44b, 46 (a or b) 48b) Geometry (Math 60a, 62b, 64a, 65b, 66b)
Total number of required courses beyond freshman calculus:	Ten term courses (or the equivalent if two-term courses are taken)
Can undergraduate students take graduate courses?	Yes, if they are in the intensive major
Are students required to take a computing course? If so, which ones.	Not mentioned
How many different calculus sequences exist for a mathematics major?	Two

Table 64 Yale: 1974 to 1975

College:	Yale
Catalog Year:	1974 - 1975
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	General requirement is at least 36 term courses (Yale Bulletin, p. 435)
Total number of mathematics units required for the degree:	At least 13 term-long courses (or the equivalent if two-term courses were taken.)
List of required courses and their respective units:	[11a] Introduction to Calculus (One-Term Course - Cajori Two Course Cluster 12) [14a] [14b] Topics in Calculus (One-Term Course - Cajori Two Course Cluster 12) — or — [12a] [12b] Calculus of Functions of One Variable I (One-Term Course - Cajori Two Course Cluster 11) [15a] [15b] Calculus of Functions of One Variable II (One-Term Course - Cajori Two Course Cluster 11) [20a] [20b] Calculus of Functions of Several Variables (One-Term Course - Cajori Two Course Cluster 11) *[27] Vector Calculus and Linear Algebra I (Two-Term Course - Cajori Two Course Cluster 19) — or — [22a] [22b] Linear Algebra and Analytic Geometry (One-Term Course - Cajori Two Course Cluster 27) [47a] Vector Analysis (One-Term Course - Cajori Two Course Cluster 19)

Table 64 Yale: 1974 to 1975 (continued)

List of elective courses that could count towards the mathematics degree requirements and their respective units:	Choose at least eight more terms of courses from 22 or higher (instead of the stated ten since [27] or [22a]/[22b] and [47a] would have already been taken): *[31a] Mathematical Analysis I (One-Term Course - Cajori Two Course Cluster 23) *[32b] Mathematical Analysis II (One-Term Course - Cajori Two Course Cluster 23) *[36b] Functions of a Complex Variable (One-Term Course - Cajori Two Course Cluster 23) [38a] Measure Theory and Integration (One-Term Course - Cajori Two Course Cluster 24) [39b] Introduction to Functional Analysis (One-Term Course - Cajori Two Course Cluster 24) [41a] Probability and Its Applications (One-Term Course - Cajori Two Course Cluster 46) [42b] Theory of Statistics (One-Term Course - Cajori Two Course Cluster 46) [46a] Elements of the Theory of Differential Equations (One-Term Course - Cajori Two Course Cluster 22) [48b] Topics in Advanced Calculus (One-Term Course - Cajori Two Course Cluster 21) *[50a] An Introduction to Abstract Algebra (One-Term Course - Cajori Two Course Cluster 28) [52a] Number Theory (One-Term Course - Cajori Two Course Cluster 29) [53b] Theory of Finite Groups (One-Term Course - Cajori Two Course Cluster 28) *[58b] Fields and Galois Theory (One-Term Course - Cajori Two Course Cluster 28) [62b] Geometric Algebra *(Omitted this year)* (One-Term Course - Cajori Two Course Cluster 30) *[64a] General Topology (One-Term Course - Cajori Two Course Cluster 33) [65b] Combinatorial Topology *(Omitted this year)* (One-Term Course - Cajori Two Course Cluster 33) *[66b] Differential Geometry (One-Term Course - Cajori Two Course Cluster 33) *[70a] Set Theory (One-Term Course - Cajori Two Course Cluster 35) *[71b] Introduction to Mathematical Logic (One-Term Course - Cajori Two Course Cluster 35) * "Any student interested in mathematical research as a career is urged to take Mathematics 27, 31a, 32b, 36b, 50a, and 58b. A sample program in mathematics for such a student might consist of these courses plus three from Mathematics 64a, 66b, 70a, and 71b" (Yale Bulletin, 1974-1975, p. 299). Mathematics E.C. I is Mathematical Analysis is designed for a small group of prospective mathematics majors and must be take concurrently with [27] (Two-Term Course - Cajori Two Course Cluster 55 Students must take at least two term courses in three of the following categories (p. 298): Analysis (Math 27, 30-39, and 47a) Statistics and Applied Mathematics (Math40-49, except 47a) Algebra and Number Theory (Math 22a, 22b, 50-59) Geometry and Topology (Math 60-69) Logic and Foundations (70-79) Mathematics majors were urged to take at least one of the following (p. 298): Computer Science 21a, 43b, or 46a which may be counted as a term course in applied mathematics.

Table 64 Yale: 1974 to 1975 (continued)

Total number of required courses beyond freshman calculus:	Ten term courses (or the equivalent if two-term courses are taken)
Can undergraduate students take graduate courses?	Yes, if they are in the intensive major. They are expected to complete two terms of graduate coursework. (p. 299)
Are students required to take a computing course? If so, which ones.	Yes, at least one of: [21a][21b] Introduction to Computer Science (One-Term Course - Cajori Two Course Cluster 48) [43b] Numerical Computation I (One-Term Course - Cajori Two Course Cluster 51) [46a] Analysis of Algorithms; Combinatorial Complexity (One-Term Course - Cajori Two Course Cluster 50) Note: The Cajori Two Course Inventory was still used to classify these courses, even though the inventory states this category to be "Computer Science Courses with Mathematics Designations."
How many different calculus sequences exist for a mathematics major?	Two

Table 65. Yale: 1984 to 1986

<table>
<tr><td>College:</td><td>Yale</td></tr>
<tr><td>Catalog Year:</td><td>1984 - 1986</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Major in Mathematics, B.A.</td></tr>
<tr><td>Total number of units to graduate:</td><td>Four years of study, or at least 36 term-courses. A program plan was to be created by each student and then approved by a dean and adviser at the college. (p. 15-16)</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>13 terms of courses (or the equivalent if two-term courses were taken)</td></tr>
<tr><td>List of required courses and their respective units:</td><td>
<table>
<tr><td>[111a] Calculus I (One-Term Course - Cajori Two Course Cluster 12)
[114b]Calculus II (One-Term Course - Cajori Two Course Cluster12)</td><td>[112a]Calculus of Functions of One Variable I (One-Term Course - Cajori Two Course Cluster 11)
[115a] Calculus of Functions of One Variable II (One-Term Course - Cajori Two Course Cluster 11)</td><td>[116a]Calculus I: Theory and Applications (One-Term Course - Cajori Two Course Cluster 16)
[117b] Calculus II: Theory and Applications (One-Term Course - Cajori Two Course Cluster 16)</td></tr>
</table>
[120a] Calculus of Functions in Several Variables (One-Term Course - Cajori Two Course Cluster 11)
[222a] [222b] Linear Algebra and Matrix Theory (One-Term Course - Cajori Two Course Cluster 27)
*[230] Vector Calculus and Linear Algebra (Two-Term Course - Cajori Two Course Cluster 19)
[250a] Vector Analysis (One-Term Course - Cajori Two Course Cluster 19)</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td><u>Choose six term-courses numbered 222a or b or higher (not ten, which is stated in the bulletin since four terms of courses are listed above) (p. 271):</u>
[241a] Probability Theory (One-Term Course - Cajori Two Course Cluster 46)
[242b] Theory of Statistics (One-Term Course - Cajori Two Course Cluster 46)
[246a] [246b] Ordinary Differential Equations (One-Term Course - Cajori Two Course Cluster 22)
[260b] Analytical Methods (One-Term Course - Cajori Two Course Cluster 21)
*[270a] Set Theory (One-Term Course - Cajori Two Course Cluster 35)
*[301a] Introduction to Analysis (One-Term Course - Cajori Two Course Cluster 23)
*[305b] Real Analysis (One-Term Course - Cajori Two Course Cluster 23)
*[310a] Introduction to Complex Analysis (One-Term Course - Cajori Two Course Cluster 23)
[315b] [515b] Intermediate Complex Analysis (One-Term Course - Cajori Two Course Cluster 23)</td></tr>
</table>

Table 65. Yale: 1984 to 1986 (continued)

	[320a] [520a] Measure Theory and Integration (One-Term Course - Cajori Two Course Cluster 24) [325b] [525b] Introduction to Functional Analysis (One-Term Course - Cajori Two Course Cluster 24) *[350a] An Introduction to Abstract Algebra (One-Term Course - Cajori Two Course Cluster 28) [353b] [653b] Representation of Finite Groups (One-Term Course - Cajori Two Course Cluster 28) [354b] Number Theory *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 29) *[370b] Fields and Galois Theory (One-Term Course - Cajori Two Course Cluster 28) [400a] Introduction to Mathematical Mechanics (One-Term Course - Cajori Two Course Cluster 38) *[430b] An Introduction to Algebraic Topology *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 33) *[435b] Differential Geometry (One-Term Course - Cajori Two Course Cluster 33) *[450b] Introduction to Mathematical Logic (One-Term Course - Cajori Two Course Cluster 35) [456b] [955b] Recursive Function Theory *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 44) [460a] Philosophical Foundations of Mathematics (One-Term Course - Cajori Two Course Cluster 53) [470a] [470b] Individual Studies (One-Term Course - Cajori Two Course Cluster 52) * Note: "Any student interested in mathematical research as a career is urged to take Mathematics 230, 301a, 305b, 310a, 350a, and 370b. A sample program of mathematics for such a student might consist of these courses plus three from Mathematics 430b, 435b, 270a, and 450b" (Yale Bulletin, 1984-1985, p. 272). <u>Computer Science Courses (Considered Applied Mathematics) (Note: The Cajori Two Course Inventory is still used to code these courses even though it is outside of the mathematics department):</u> [221a] [221b] Introduction to Computer Science (One-Term Course - Cajori Two Course Cluster 48) [235a] Linear Programming and Extensions (One-Term Course - Cajori Two Course Cluster 48) [440a] [540a] Numerical Computation I (One-Term Course - Cajori Two Course Cluster 51) [441b] [541b] Numerical Computation II (One-Term Course - Cajori Two Course Cluster 51) Mathematics E.C. I is Mathematical Analysis is designed for a small group of students "interested in serious study of mathematics" (Yale Bulletin, 1984-1985, p. 274). This course counts towards the major. Must be taken concurrently with Mathematics 230. (Two-Term Course - Cajori Two Course Cluster 55) <u>Students are expected to take at least two term courses in three of the following categories:</u> Analysis (Math 250a, 300-349) Statistics and Applied Mathematics (Math 241-260, except 250a) Algebra and Number Theory (Math 222a, 222b, 350-399) Geometry and Topology (Math 400-449) Logic and Foundations (450-269, and 270a)

Table 65. Yale: 1984 to 1986 (continued)

Total number of required courses beyond freshman calculus:	Ten term courses in Mathematics numbered 222a or b or higher.
Can undergraduate students take graduate courses?	Yes, if they are in the intensive major. They are expected to complete two terms of graduate coursework. Some suggested as "basic" graduate courses are: [501a] Modern Algebra (One-Term Course - Cajori Two Course Cluster 28) [544a] Algebraic Topology (One-Term Course - Cajori Two Course Cluster 33) [600a] Advanced Probability (One-Term Course - Cajori Two Course Cluster 47) Note: The Cajori Two Course Inventory was still used to classify these courses, even though the inventory states this category to be "Computer Science Courses with Mathematics Designations."
Are students required to take a computing course? If so, which ones.	Not required, but courses in computer science are considered applied mathematics and can satisfy the mathematics major 10 term course requirement. "All mathematics majors are urged to take at least one of each Computer Science 221a or b or 440a, which may be counted as a term course in applied mathematics" (Yale Bulletin, 1984-1985, p. 272).
How many different calculus sequences exist for a mathematics major?	Three sequences

Table 66. Yale: 1994 to 1995

<table>
<tr><td>College:</td><td>Yale</td></tr>
<tr><td>Catalog Year:</td><td>1994 - 1995</td></tr>
<tr><td>Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:</td><td>Major in Mathematics, B.A.</td></tr>
<tr><td>Total number of units to graduate:</td><td>At least 36 course credits (p. 33) (Each term-long course is one credit.)</td></tr>
<tr><td>Total number of <u>mathematics units required</u> for the degree:</td><td>13 term-long courses (or the equivalent if two-term courses are taken).</td></tr>
<tr><td>List of required courses and their respective units:</td><td>[112a] [112b] Calculus of Functions of One Variable I (One-Term Course - Cajori Two Course Cluster 11)
[115a] [115b] Calculus of Functions of One Variable II (One-Term Course - Cajori Two Course Cluster 11)
[120a] [120b] Calculus of Functions in Several Variables (One-Term Course - Cajori Two Course Cluster 11)
<table><tr><td>*[230] Vector Calculus and Linear Algebra (Two-Term Course - Cajori Two Course Cluster 19)</td><td>[222a] [222b] Linear Algebra and Matrix Theory (One-Term Course - Cajori Two Course Cluster 27)
[250a] Vector Analysis (One-Term Course - Cajori Two Course Cluster 19)</td></tr></table>
“Each student is expected to take either Mathematics 230 or its equivalent: Mathematics 222a or b and 250a” (Yale Bulletin, 1994-1995, p. 310).</td></tr>
<tr><td>List of elective courses that could count towards the mathematics degree requirements and their respective units:</td><td><u>The bulletin states to choose 10 terms of courses of 222a or b or higher, but students are expected to take 2 above, so they should only choose 8 more:</u>
[241a] Probability Theory (One-Term Course - Cajori Two Course Cluster 46)
[242b] Theory of Statistics (One-Term Course - Cajori Two Course Cluster 46)
[244a] Discrete Mathematics I (New this year) (One-Term Course - Cajori Two Course Cluster 44)
[245b] Discrete Mathematics II (New this year) (One-Term Course - Cajori Two Course Cluster 44)
[246a] [246b] Ordinary Differential Equations (One-Term Course - Cajori Two Course Cluster 22)
[260b] Analytical Methods (One-Term Course - Cajori Two Course Cluster 24)
[270a] Set Theory (One-Term Course - Cajori Two Course Cluster 35)
[300b] Topics in Analysis (One-Term Course - Cajori Two Course Cluster 23)</td></tr>
</table>

Table 66. Yale: 1994 to 1995 (continued)

	*[301a] Introduction to Analysis (One-Term Course - Cajori Two Course Cluster 23) *[305b] Real Analysis (One-Term Course - Cajori Two Course Cluster 23) *[310a] Introduction to Complex Analysis (One-Term Course - Cajori Two Course Cluster 23) [315b] Intermediate Complex Analysis (One-Term Course - Cajori Two Course Cluster 23) [320a] Measure Theory and Integration (One-Term Course - Cajori Two Course Cluster 24) [325b] Introduction to Functional Analysis (One-Term Course - Cajori Two Course Cluster 24) *[350a] An Introduction to Abstract Algebra (One-Term Course - Cajori Two Course Cluster 28) [353b] Representation of Finite Groups (One-Term Course - Cajori Two Course Cluster 28) [354b] Number Theory (One-Term Course - Cajori Two Course Cluster 29) [355b] Geometric Algebra *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 33) *[370b] Fields and Galois Theory *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 28) [380a] Algebra I (One-Term Course - Cajori Two Course Cluster 28) [381b] Algebra II *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 28) [400a] Introduction to Mathematical Mechanics *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 38) [425b] Computational Algebraic Geometry *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 33) [430b] An Introduction to Algebraic Topology *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 33) [435b] Differential Geometry (One-Term Course - Cajori Two Course Cluster 33) [454b] Foundations of Logic Programming *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 51) [456b] Recursive Function Theory *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 36) [470a] [470b] Individual Studies (One-Term Course - Cajori Two Course Cluster 52) [480a] [480b] Senior Seminar: Mathematical Topics (One-Term Course - Cajori Two Course Cluster 52) *Note: "Any student interested in a Ph.D. degree in pure mathematics is strongly urged to include the [noted] courses in his or her program… It is also recommended to take one or more graduate-level courses" (Yale Bulletin, 1994-995, p. 311). <u>Courses from the Computer Science Department (Considered Applied Mathematics)</u> Computer Science [201a] [201b] Introduction to Computer Science (One-Term Course - Cajori Two Course Cluster 48) Computer Science [365b] Design and Analysis of Algorithms (One-Term Course - Cajori Two Course Cluster 50) Computer Science [366a] Models of Computation (One-Term Course - Cajori Two Course Cluster 50) Computer Science [440b] Numerical Computation I (One-Term Course - Cajori Two Course Cluster 50)

Table 66. Yale: 1994 to 1995 (continued)

	Math Courses from Other Departments: Applied Mathematics [333a] Methods in Applied Mathematics (One-Term Course - Cajori Two Course Cluster 37) E. & A.S. [194a] [194b] Ordinary and Partial Differential Equations with Applications (One-Term Course - Cajori Two Course Cluster 37) E. & A.S. [396b] Advanced Ordinary and Partial Differential Equations with Applications (One-Term Course - Cajori Two Course Cluster 37) E. & A.S.[496a] Probability and Stochastic Processes (One-Term Course - Cajori Two Course Cluster 46) Operations Research [235a] Optimization I (One-Term Course - Cajori Two Course Cluster 42) Operations Research [237b] Stochastic Models (One-Term Course - Cajori Two Course Cluster 42) Students are expected to take at least two term courses in three of the following categories: Analysis (Math 230, 246a or 250a, 300-349) Statistics and Applied Mathematics (Math 241-249, 260b, 400a, and certain courses in Applied Mathematics, Computer Science, Engineering and Applied Science, and Operations Research) Algebra and Number Theory (Math 222a, 222b, 230, 350-399) Geometry and Topology (Math 425b, 430b, 435b) Logic and Foundations (270a, 450-469)
Total number of required courses beyond freshman calculus:	Ten term courses in Mathematics numbered 222a or b or higher.
Can undergraduate students take graduate courses?	Yes, especially if they are in the intensive major. They are expected to complete two terms of graduate coursework.
Are students required to take a computing course? If so, which ones.	"All mathematics majors are urged to take at least one of either Computer Science 201a or b, or 440b, which may be counted as a term course in applied mathematics" (Yale Bulletin, 1994-1995, p. 310).
How many different calculus sequences exist for a mathematics major?	One sequence

Table 67. Yale: 2006 to 2007

College:	Yale
Catalog Year:	2006-2007
Title of the curriculum one would follow in order to advance to a doctoral degree in mathematics:	Major in Mathematics, B.A.
Total number of units to graduate:	At least 36 term courses
Total number of mathematics units required for the degree:	At least 13 term courses (or the equivalent if two-term courses are taken)
List of required courses and their respective units:	[112a] [112b] Calculus of Functions of One Variable I (One-Term Course - Cajori Two Course Cluster 11) [115a] [115b] Calculus of Functions of One Variable II (One-Term Course - Cajori Two Course Cluster 11) [120a] [120b] Calculus of Functions in Several Variables (One-Term Course - Cajori Two Course Cluster 11) [230] Vector Calculus and Linear Algebra (Two-Term Course - Cajori Two Course Cluster 19) *This course counts as one term course in the analysis category (p. 444) OR [250a]Vector Analysis (One-Term Course - Cajori Two Course Cluster 19) [222a] [222b] Linear Algebra with Applications (One-Term Course - Cajori Two Course Cluster 27) / [225b] Linear Algebra and Matrix Theory (One-Term Course - Cajori Two Course Cluster 27) [480a] [480b] Senior Seminar: Mathematical Topics (One-Term Course - Cajori Two Course Cluster 52)
List of elective courses that could count towards the mathematics degree requirements and their respective units:	The courses below are strongly recommended for those students "interested in pursuing further study in pure mathematics" (Yale Bulletin, 2006-2007, p. 442). It is also recommended to take one or more graduate-level courses. [301a] Introduction to Analysis (One-Term Course - Cajori Two Course Cluster 23) [305b] Real Analysis (One-Term Course - Cajori Two Course Cluster 23) [310a] Introduction to Complex Analysis (One-Term Course - Cajori Two Course Cluster 23) [350a] Introduction to Abstract Algebra (One-Term Course - Cajori Two Course Cluster 28) [370b] Fields and Galois Theory (One-Term Course - Cajori Two Course Cluster 28)

Table 67. Yale: 2006 to 2007 (continued)

[430b] An Introduction to Algebraic Topology *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 33)	[435b] Differential Geometry (New course) (One-Term Course - Cajori Two Course Cluster 33)

Choose at least one additional term-course from Mathematics 222a or b or higher:

[235b] Introductory Data Analysis (New course) (One-Term Course - Cajori Two Course Cluster 45)

[241a] Probability Theory (One-Term Course - Cajori Two Course Cluster 46)

[242b] Theory of Statistics (One-Term Course - Cajori Two Course Cluster 46)

[244a] Discrete Mathematics (One-Term Course - Cajori Two Course Cluster 44)

[246a] [246b] Ordinary Differential Equations (One-Term Course - Cajori Two Course Cluster 22)

[250a] Vector Analysis (One-Term Course - Cajori Two Course Cluster 21)

[251b] Stochastic Processes (New course) (One-Term Course - Cajori Two Course Cluster 46)

[260b] Basic Analysis in Function Spaces (One-Term Course - Cajori Two Course Cluster 24)

[270a] Set Theory (One-Term Course - Cajori Two Course Cluster 35)

[290b] Fractal Geometry: Concept and Applications (New course) *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 34)

[300b] Topics in Analysis (One-Term Course - Cajori Two Course Cluster 23)

[315b] Intermediate Complex Analysis (One-Term Course - Cajori Two Course Cluster 23)

[320a] Measure Theory and Integration (One-Term Course - Cajori Two Course Cluster 24)

[325b] Introduction to Functional Analysis (One-Term Course - Cajori Two Course Cluster 24)

[330b] Advanced Probability (New course) (One-Term Course - Cajori Two Course Cluster 46)

[353b]Representation of Finite Groups (One-Term Course - Cajori Two Course Cluster 28)

[354b] Number Theory (One-Term Course - Cajori Two Course Cluster 29)

[360a] Introduction to Lie Groups *(Not offered this year)* (One-Term Course - Cajori Two Course Cluster 28)

[380a] Modern Algebra I (One-Term Course - Cajori Two Course Cluster 28)

[381b] Modern Algebra (One-Term Course - Cajori Two Course Cluster 28)

[470a] [470b] Individual Studies (One-Term Course - Cajori Two Course Cluster 52)

Computer Science Courses (Considered Applied Mathematics) (Note: The Cajori Two Course Inventory is still used to code these courses even though it is outside of the mathematics department):

[201a] [201b] Introduction to Computer Science (One-Term Course - Cajori Two Course Cluster 48)

[365b] Design and Analysis of Algorithms (One-Term Course - Cajori Two Course Cluster 50)

[440b] Numerical Computation I (One-Term Course - Cajori Two Course Cluster 50)

Mathematics Courses from Other Departments (The Cajori Two Course Inventory is still used to code these courses even though it is outside of the mathematics department):

Operations Research [235a] Optimization I (One-Term Course - Cajori Two Course Cluster 42)

Philosophy [267a] Mathematical Logic I (One-Term Course - Cajori Two Course Cluster 35)

Philosophy [268b] Mathematical Logic II (One-Term Course - Cajori Two Course Cluster 35)

Table 67. Yale: 2006 to 2007 (continued)

	Students are expected to take at least two term courses in three of the following categories: Analysis Statistics and Applied Mathematics Algebra and Number Theory Geometry and Topology Logic and Foundations
Total number of required courses beyond freshman calculus:	Ten term courses in Mathematics numbered 222 or higher
Can undergraduate students take graduate courses?	Yes, especially if they are in the intensive major. They are expected to complete two terms of graduate coursework.
Are students required to take a computing course? If so, which ones.	It is recommended, but not required
How many different calculus sequences exist for a mathematics major?	One sequence