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## The Design and Development of a Statistics Performance Support System: An Application of Behavioral Modeling and Case Based Reasoning

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THE DESIGN AND DEVELOPMENT OF A STATISTICS PERFORMANCE  
SUPPORT SYSTEM: AN APPLICATION OF BEHAVIORAL MODELING  
AND CASE BASED REASONING

By

Isaku Tateishi

A master's project submitted to the faculty of

Brigham Young University

in partial fulfillment of the requirement for the degree of

Master of Science

Department of Instructional Psychology and Technology

Brigham Young University

April 2009

BRIGHAM YOUNG UNIVERSITY  
GRADUATE COMMITTEE APPROVAL

of a project submitted by  
Isaku Tateishi

This project prospectus has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

\_\_\_\_\_  
Date

\_\_\_\_\_  
Paul Merrill, Chair

\_\_\_\_\_  
Date

\_\_\_\_\_  
Stephen Yanchar

\_\_\_\_\_  
Date

\_\_\_\_\_  
Russell T. Osguthorpe

BRIGHAM YOUNG UNIVERSITY

As chair of the candidate's graduate committee, I have read the project of Isaku Tateishi in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable to fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and its ready for submission to the university library.

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Date

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Paul Merrill  
Chair, Graduate Committee

Accepted for the Department

---

Andrew S. Gibbons  
Department Chair

Accepted for the College

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K. Richard Young  
Dean, David O. McKay School of Education

## ABSTRACT

### THE DESIGN AND DEVELOPMENT OF A STATISTICS PERFORMANCE SUPPORT SYSTEM: AN APPLICATION OF BEHAVIORAL MODELING AND CASE BASED REASONING

Isaku Tateishi

Department of Instructional Psychology and Technology

Master of Science

The following report is a description of the design, development, and evaluation of an online statistics performance support system. The target audience for the support system is students of Instructional Psychology and Technology (IP&T), especially those who have taken the IP&T 550 “Empirical Inquiry and Statistics” course. The product is designed to be used as a supplemental reference tool. The main purpose of the online performance support system is to help IP&T students select appropriate statistical procedures for their research and learn how to perform the necessary calculations using a statistics analysis software package called SPSS. This report summarizes the needs analysis, target audience analysis, instructional design process and the formative evaluation of the product. The results of the evaluation indicated that the users found great value in the product, that it was useful and effective in helping them select an appropriate statistical procedure, and that it helped them conduct the procedure in SPSS.

## ACKNOWLEDGEMENT

I want to express my sincere gratitude to my graduate committee chair, Dr. Paul Merrill. His kindness and passion for helping me complete this project I shall never forget. I would also like to give my thanks to Dr. Steven Yanchar and Dr. Russell T. Osguthorpe. Even with their busy schedule, they were always willing to help and provide their expert knowledge that truly enhanced the quality of the final product. A special thanks should also be given to all the IP&T students who participated in the evaluation. The final product was significantly improved through their feedback. Finally, I would like to give thanks to my family and wife for their indispensable prayer and encouragement.

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## Instructional Challenges

Most graduate programs require students to take statistics courses. Knowledge in statistics should be one of the fundamental characteristics for being a successful graduate student. For this reason, the Instructional Psychology and Technology Department (IP&T) at Brigham Young University (BYU) requires both masters and doctoral students to take a statistics course. Even though there are alternative courses, most students take IP&T 550 “Empirical Inquiry and Statistics” to meet the requirement.

Many students perceive university level statistics courses as difficult courses. They struggle to understand fundamental, yet demanding statistical concepts and ideas. Another major challenge for the students is to understand how to apply those concepts into real-life applications. Real-life applications require more than getting right answers to multiple-choice questions. They require students to (a) identify quantifiable objects of measurement, (b) collect appropriate data, (c) analyze the data with suitable statistical methods, and (d) properly interpret the results.

In addition to learning how to perform each of above mentioned steps, learning and conducting statistical calculations make it difficult for many students to complete their research. Due to the difficult and complex nature of statistical calculation methods, most statistics courses teach students to use statistical analysis software. This kind of software provides useful functions for organizing and analyzing research data. There are many statistical analysis software packages available for students. Each software package has different strengths and weaknesses, but one of the most popular statistics software packages is SPSS—Statistical Package for the Social Sciences. Students of IP&T 550 are asked to learn SPSS as part of the class.

Learning SPSS is a new experience for many students. In addition, class instruction on SPSS goes rather quickly because of the time needed for teaching other material. Due to the short exposure to the software, many students do not become confident about using SPSS. Also, since the use of SPSS is not a common activity, many students often forget the statistical procedures and how to use SPSS after the class is over. Therefore, when they need to use statistics for their doctoral dissertations or other academic activities later in their program, they need to re-learn statistics and SPSS from the beginning on their own. Some might simply avoid including statistical analysis in their academic work because they are not comfortable with SPSS.

According to Rossett (1997), the two problems mentioned above are common problems for traditional classroom-based instruction. Most often, traditional classroom instruction only emphasizes learning that occurs during the instruction period. In addition, students experience a high cognitive load of information (Sweller, 1988) because courses tend to pack considerable amount of materials in the relatively short time period. Therefore, many students binge on an excessive amount of information and purge it after class is over. As a result, knowledge retention is low among many students.

There are statistics and SPSS tutorials available in bookstores or via the Internet, which some might find as possible solutions to the problems stated above. However, most of the training manuals found in bookstores tend to be too comprehensive for beginners. On the other hand, the tutorials on the Internet only address certain functions of SPSS, are often designed for a specific target audience and their quality varies drastically. Since they are scattered all over the Internet, it also takes a long time for novice students to find the information that they need. In addition, most tutorials are text-based. Text-based software training is not an ideal solution for beginners because they have difficulty visualizing what is described in the text. Furthermore,

most tutorials do well in teaching how to perform certain functions in SPSS, but they do not effectively identify why and when learners should use those functions. In other words, the context for the statistical functions is missing.

### Solution

As Rossett (1997) suggests, one of the key solutions for the instructional challenges found in the IP&T 550 course (or many other statistics courses) can be found in the development of an effective Performance Support System (PSS). A Performance Support System is a tool for knowledge management. Such a system is designed to deliver information whenever needed. The concept for a PSS is not new. Cookbooks, telephone directories and training manuals have been quite popular forms of PSS for a long time. However, with the advancement of computer technology, more and more electronic forms of PSS are emerging. They are often referred to as EPSS (Electronic Performance Support System) or PST (Performance Support Tool) (McManus & Rossett, 2006).

A computer-based, electronic performance support system, especially one that utilizes the Internet, enables faster distribution, wider access (in time and place), and far better multimedia capacity than the traditional performance support system. Through a successful design, development, and implementation of an Internet-based PSS targeted for IP&T 550, students will receive the following benefits:

1. They can have a tool that will help them select appropriate statistical procedures for analyzing their research data.
2. Those who do not become proficient in using SPSS from classroom instructions can spend extra time in learning SPSS whenever and wherever they want as long as they have an access to the Internet.

3. Computer-based PSS can include video simulations that demonstrate how to perform various SPSS functions. This will allow students to easily visualize what they have to learn.

Considering the advantages listed above, I developed an online performance support system that accomplishes the following objectives:

1. It provides a systematic decision making assistant to help students select an appropriate statistical procedure.
2. It provides instruction that is centered on realistic contexts. This context should help students understand when and why they should select various statistical procedures.
3. It provides video simulations of how to use SPSS.
4. It provides instruction that can be used anytime and anywhere.

#### Target Audience Analysis

Past students of IP&T 550 are the main target audience for this project. The students of IP&T 550 come from various educational backgrounds, such as psychology, computer science, sociology, linguistics, or Fine Arts. The prior exposure to statistics varies from one student to the next. For some students, IP&T 550 is the first statistics course that they have taken. Many students take this course because it is a required course, but not all of them specialize in quantitative evaluation or measurement. This means that not all students are externally nor internally motivated to learn and retain what they learn in IP&T 550. Also, it's important to note that each student brings different computer aptitudes, and very few students have prior experience with any sort of statistic analysis software.

## Literature Review

Osguthorpe (1985) suggests that instructional designers should conduct a literature review prior to the development of an instructional product. The main reason for the review is not just to avoid the duplication of existing training programs, but to obtain useful information which will inform the development of the new product. Osguthorpe suggests conducting reviews in three major areas: existing materials, instructional content, and instructional theories. Based on Osguthorpe's recommendation, I conducted a literature review on the following areas.

1. Existing Statistics/SPSS Training Materials
2. Software Training Methods
3. Instructional Design and Development Principles

### *Existing Statistics/SPSS Training Materials*

According to Osguthorpe (1985), the purposes of reviewing existing materials are (a) to make sure that the proposed product has not been developed by someone else, and (b) to design and develop the proposed product based on a broad understanding of presently available materials. I utilized a conventional Internet search to identify presently available statistics training materials that teach how to use SPSS. When I was reviewing existing materials, I examined each product's instructional patterns, cost, and the possibility of it being used as a PSS in IP&T 550.

Using Google, the phrase 'SPSS Training' returned more than 200,000 results. None of the online training materials that I found were designed as a PSS. The training materials identified via the search can be broadly divided into text-based training with graphics or video-based training. For example, the department of humanities and the social science department at North Carolina State University (n.d.) and University Information Technology Services at

Indiana University (n.d.) each host a text/graphic based SPSS tutorial for students and faculty members. The Department of Mathematics at Central Michigan University (n.d.) and the Department of Statistics at Texas A&M University (n.d.) each provide video tutorial sites that teach SPSS.

There are some major weaknesses in the online training products that I identified. Most of the tutorials are created for a specific audience and emphasize different aspects of different versions of SPSS. So, it is hard for non-audience users to find their target information. These tutorials also suffer in quality. Tutorials don't need to be elaborate, but they need to be professional and updated. One video tutorial that I reviewed still used SPSS version 9 (the current version of SPSS is 17) and the computer operating system for which it was designed was Windows 2000 or 98. Some of the video tutorial sites had poor video quality and static noise in the audio. Most of the text and graphic-based tutorials weren't professionally designed.

Commercial training materials are, of course, nicely designed as far as in their appearance, and there are many materials available. Using amazon.com, I searched for SPSS related materials. As of March 22, 2008, it returned 48 different SPSS training books or books with CD-ROM. Their cost ranged from about \$10 to \$100. Also, SPSS, Inc. (the software company that produces SPSS) provides on-demand e-learning tutorials online. However, they are expensive. The basic training package is \$199 and the cost goes up to \$699 for more complete training solutions.

From my evaluation, it was apparent that most currently available materials are designed as stand-alone training materials and present SPSS procedural instructions in a sequential order. For example, the SPSS Survival Manual (Pallant, 2007) is one of the popular SPSS training manuals. This manual is 352 pages long and starts with introducing SPSS and goes on to teach



how to prepare data files, and then presents various statistical procedures in SPSS, such as T-test, ANOVA, and Regression. It is possible that experienced SPSS users could use the manual as a PSS because they would know how to navigate such training materials to find the desired information, but for novice users, it is a very difficult task. For instance, T-test and ANOVA both compare means from different data sets and analyze them to determine if there is significant difference between the means. However, most novice statistic students do not know what a T-test is used for or if they should use ANOVA over a T-test for mean comparison.

Just like any other software, SPSS has a Help system as a part of the application. This help system is designed as a PSS because it is supposed to help users find SPSS procedures when they need them. However, my impression of the Help system resonates with Pratt's (1998) evaluation of software help systems in general. Pratt (1998) argues that ironically, the software help systems are often not helpful for novice users and sometimes even increase their frustration. The help systems use software terminology that novice users are not familiar with and their navigation system requires moderate levels of understanding in how to define the search in order to find the desired information. Once again, if users are familiar with SPSS, they can use the help system as a PSS, but beginners often do not even know where to start their search. Based on my materials search, I could not find any appealing training materials that could be used as a PSS in IP&T 550.

### *Software Training Methods*

Unfortunately, not enough research has been done on SPSS training; however, since SPSS training goes under the software training category, the project can benefit from software training research in general.

### *Online Vs. In-Class Training*

Software training is often divided into two categories: Instructor-led classroom training and Internet-based online training. Many research studies show that there are no significant differences between classroom and online training in terms of learning outcomes (Coppola & Myre, 2002, Chen & Shaw, 2006, Piccoli, Ahmad, & Ives, 2001). However, there are some obvious advantages of online training over classroom training.

According to Shotsberger (1996), those advantages can be summarized as immediacy, convenience, and consistency. Online software training provides learners immediate access to the training. Because the training is available over the Internet, learners can learn about the software anytime and anywhere without the need of waiting for the next class period or an instructor to be available. Also, when the online training includes quizzes or tests, immediate scoring and feedback is available for the learners.

The immediacy can be also considered as a convenience. The fact that learners have flexible and immediate access to the training makes it a more convenient training solution than traditional classroom training. There is no need to travel to a classroom and students can even study using a hand-held electronic device like a cell phone that has Internet capability. Another convenient aspect of online training is better learner control. Advocates have been arguing that with better learner control students perform better in their learning (Chou & Liu, 2005). Users of online training can study the materials at their own pace, without worrying about missing information because the class is going too fast for them.

Online training provides better consistency than classroom training. The quality of classroom training varies from one instructor to another. However, with online training, we can

preserve and deliver consistent high quality instruction. Learners have access to the same quality instruction anytime and anywhere.

### *Behavioral Modeling*

If online training materials exhibit these technical advantages, what are the instructional methods that determine their effectiveness? Among various software training methods, only behavioral-modeling consistently proved its effectiveness (Chen & Shaw, 2006, Yi & Davis, 2003). In behavioral-modeling, learners observe an instructor performing a task and then attempt to perform the same task. The key elements are (a) Observation and (b) Modeling. Behavioral-modeling has been studied extensively for at least four decades. Albert Bandura showed how children learn through observation and modeling (Bandura, Ross, & Ross, 1961). Because current technology allows instructors to record their interactions with a software application, learners are able to later observe these interactions and then practice the same actions on their own.

### *Case-Based Teaching*

Since behavioral modeling is an effective software training methods, many researchers have spent considerable time studying about the ideal presentation patterns and sequences of software behavioral modeling. Although learning about the software procedure via observation and modeling is fundamental to learners, other research shows the importance of teaching general concepts behind those procedures. (Olfman & Mandviwalla, 1994). Learners need to understand not only how to perform certain actions, but why, and most importantly, when to perform such actions. In other words, learners should understand the contexts and reasons for the procedures.

Jonassen et al (2003) argue that the lack of realistic and applicable contexts in training is one of the major reasons why instructors and teachers fail to incorporate technology into their practices. Even though teacher's technology integration is not exactly the same as helping someone learn a software application, Jonassen et al present an important instructional principle that can be applied to the design of a performance support system. In their article, Jonassen et al report how they created an electronic library that contains technology integration stories. The purpose of this library is to help pre- and in-service teachers see how various technologies are used by different teachers in real teaching settings. They also try to use their library as a form of PSS. They propose that users can use the library when they are actually preparing their lessons. If a teacher is preparing a lesson and wants to integrate some blog technology, she can go to the library, find a story similar to her situation and create a lesson plan modeled after the story.

The instructional principle that uses a story as a major instructional method is known as case-based teaching (CBT). CBT is an instructional application of case-based reasoning (CBR): a memory theory developed by cognitive scientists like Janet Kolodner (1992) and Roger Schank (1990). This theory hypothesizes that people's knowledge is stored in memory as a form of story. CBT also argues that people learn a subject better when they learn with stories or experiences associated with the subject (Ferguson, Bareiss, Birnbaum, & Osgood, 1991). These stories and experiences serve as vicarious examples when learners apply the knowledge to similar stories. A story is an account of a person's experiences that has realistic and coherent context. When people encounter a new learning situation, they refer to their previous experiences or stories to understand the new information.

This process shares similarity with Piaget's theory on organization of cognitive schemes. In development of human cognition, Piaget believed that people adapt existing schema (old

experiences) through assimilation or accommodation (Woolfolk, 2008). Assimilation tries to fit new information into existing schemes and accommodation involves the modification of existing schemes to understand new information. The difference between Piaget and CBR's approach is that CBR treats schemes in a more information processing perspective and applies it to human learning.

### *Performance Support System*

As mentioned in the previous section, PSS is a learning support system that is designed to deliver instruction when the users need it. PSS is also one of the effective methods and tools of training people how to use certain software. According to Rossett (1997), PSS is an excellent instructional choice when,

1. Learners infrequently use learned behavior.
2. Learning requires complex, multi-step procedures.
3. Consequences of error are high.
4. Learned behavior relies upon a large body of information.
5. Learned behavior relies upon knowledge and procedures that change frequently.
6. There is little time or few resources for training.

Thus, the critical features of a PSS are the following.

1. The PSS stores complex information, reducing the need for extensive memorization.
2. The target audience can access the information when and where they need it.
3. The PSS allows non-sequential access to the desired information.

Since learning of new software often requires mastery of complex information, and not all of the features learned are used in a frequent basis, PSS provides great value to its users.

Combining advantages from behavioral modeling, case-based teaching and performance support systems, I believe one can produce an excellent software training product. Through the use of video simulations, students can learn the software procedures by observing and modeling. Providing example stories can help students understand when they should apply the procedures they learn from the video simulation. The performance support system structure can help students find information as quickly as possible. Thus, the proposed product will be designed to provide for the balanced development of procedural (how), declarative (what), and conditional (when) knowledge of the users. (Paris & Cummingham, 1996).

### *Instructional Design and Development Principles*

The principles of effective design and development inform instructional designers systematic approach to their design and development. Probably the most well-known instructional development approach is ADDIE (Analyze, Design, Develop, Implement, and Evaluate). Molenda (2003) states that ADDIE “seems not to have a single author, but rather to have evolved informally through oral tradition. It is not a specific, fully elaborated model in its own right, but rather an umbrella term that refers to a family of models that share a common underlying structure.”

The well-known descendant models of ADDIE include Mager’s Criterion Referenced Instruction (Mager, 1984), Tripp and Bichelmayer’s Rapid Prototyping Design Model (Tripp and Bichelmayer, 1990), Dick and Carey’s Systems Approach Model (Dick and Carey, 1996), and Dorsey, Goodrum and Schwen Model (Dorsey et al, 1997). Compared to the parent ADDIE model, those descendant models include much more detailed step-by-step procedures that provide general guidelines for sound instructional design. Although there is a movement to

reconceptualize these instructional design models with less restrictive, flexible models (Crawford, 2004), ADDIE still serves as a foundation for the new models.

The significance of ADDIE exists in the fact that the model simply outlines the fundamental steps of effective instructional design. And this simplicity allows a greater flexibility for instructional designers. For example, in the design phase of ADDIE, designers are free to use any instructional theories. One may decide to apply Gagné's (1977) nine events of instruction, Bloom's (Woolfolk, 2008) taxonomy, or any other theories to design their instruction and product based on the needs of the project. My project can benefit from Gagné's nine events of instruction. Gagné's nine events are (a) gain attention, (b) inform learners of objectives, (c) stimulate recall of prior learning, (d) present the content, (e) provide learning guidance, (f) elicit performance, (g) provide feedback, (h) assess performance, and (i) enhance retention and transfer to the job. Applying these nine events to my project provide a few useful guidelines. The proposed product should capture the attention of users by clearly communicating its learning objectives with its benefit to the user's academic life. SPSS instruction content needs to be similar to the one that students receive in IP&T 550. Video simulations can be used to present instructional content and provide guidance for students' learning, but the instruction also needs to provide practice and feedback to increase learner's retention of what they have learned. In this development project, I adjusted the ADDIE model and the Gagné's nine events to fit my project needs as follows:

1. Analysis and conceptual product design. In this phase, I conducted problem analysis, target audience analysis, objective analysis, conceptual product design, literature review, production scheduling/planning, and summarized my work in a formal project proposal.
2. Proposal evaluation. In this phase, experts reviewed and approved the proposal.

3. Product Prototype. In this phase, I created a simple product mockup that displayed the basic graphical design of the product and navigation system along with a sample lesson.
4. Expert evaluation. In this phase, experts reviewed and provided feedback for the low-fidelity prototype.
5. Product development with three one-to-one clinical evaluations. In this phase, I developed the actual product and conducted three one-to-one clinical evaluations along the way. Feedback from these one-to-one evaluations was used to revise the product.
6. Small-group evaluation. In this phase, a small group from the target audience (9 people) was used to determine the effectiveness of the final product.

Even using the ADDIE model, design and development of instructional products tends to be expensive. Creators and consumers of instructional products often expect high quality graphics and functions in their products. With this expectation, most productions and revisions of instructional products tend to require considerable cost, time, and technological knowledge. Molenda (2004) wrote, since not everyone can provide such resources, the requirement is often a limitation to the current technology to reach out to more people who can be benefited from technology-based instructional products. Therefore, a principle particularly important to my project was to use a faster and inexpensive development process. By doing so, I was able to validate that inexpensive and faster development is possible. Instructional products need to provide sufficient and effective instruction in a simple yet appealing visual design, but it can avoid elaboration that requires expensive resources. A more detailed explanation on how such production can be accomplished is provided in the next section.



## Product Overview

The product was designed to help users identify appropriate statistical procedures for their research and perform the necessary calculations in SPSS. The product is intended to supplement instruction given in IP&T 550 and it does not stand-alone since it does not teach any statistical concepts.

Users are able to access the product via the Internet. All program files needed to run the program have been uploaded to the IP&T student server. When users access the program using the Internet, they will see a short five-second animation that introduces the program. From the introduction page, users may go to an orientation page to watch an orientation video or they may go to a Decision Matrix page. The orientation video is about three minutes long and shows users how to use the program. The decision matrix page is the core of the program. The matrix was originally created by the instructor of IP&T 550, Dr. Stephen Yanchar. Dr. Yanchar created this matrix to help students choose appropriate statistical procedures based on the types of data and other statistical conditions relevant to the selection. I incorporated the matrix into the performance support system.

The decision matrix page shown in Figure 1 presents a menu of section headings. In general, people use SPSS to compare means, compare frequencies, analyze correlation, and run regression analysis. If a user wants to compare two means from scaled tests taken by two study groups, they would click on the Compare Means heading to access that portion of the Decision Matrix shown in Figure 2. For purposes of this project, only the Compare Means section has been completed. The other sections await future development.

## Decision Matrix

[Expand All](#)

Compare Means (DV is scaled data IV is categorical data)

Compare Frequency (IV is categorical data DV is frequency value)

Analyze Correlation (Strength and Direction of Variable Relationship)

Predict Data: Linear Regression (Both IV and DV should be scaled data)

Alternative to Ho Testing

Others

► Do you want to practice your selection skills? [Click Here.](#)

The logo image is created by Everaldo Coelho, and obtained from iconfinder.com

Figure 1. The Decision Matrix page

## Decision Matrix

[Expand All](#)

Compare Means (DV is scaled data IV is categorical data)

Name	Condition	Actions
Single Sample T-Test (One-Sample T-Test)	<ul style="list-style-type: none"> <li>Compares a sample mean with the population mean.</li> <li><math>\sigma</math> is unknown.</li> </ul>	<ul style="list-style-type: none"> <li>► Example</li> <li>► Watch</li> <li>► Practice</li> </ul>
BG T-Test (Independent-Samples T-Test)	<ul style="list-style-type: none"> <li>Compares the means from two different samples.</li> </ul>	<ul style="list-style-type: none"> <li>► Example</li> <li>► Watch</li> <li>► Practice</li> </ul>
RM T-Test (Paired-Samples T-Test)	<ul style="list-style-type: none"> <li>Compares two means from within the same sample.</li> </ul>	<ul style="list-style-type: none"> <li>► Example</li> <li>► Watch</li> <li>► Practice</li> </ul>
BG One-way ANOVA	<ul style="list-style-type: none"> <li>Compares multiple (two or more) means drawn from different samples.</li> <li>Unlike multiple t-test, this does not increase alpha level.</li> </ul>	<ul style="list-style-type: none"> <li>► Example</li> <li>► Watch</li> <li>► Practice</li> </ul>
RM One-way ANOVA	<ul style="list-style-type: none"> <li>Compares multiple (two or more) means drawn from the same sample.</li> <li>Unlike multiple t-test, this does not increase alpha level.</li> </ul>	<ul style="list-style-type: none"> <li>► Example</li> <li>► Watch</li> <li>► Practice</li> </ul>
Tukey HSD	<ul style="list-style-type: none"> <li>Identifies specific mean pair(s) that are statistically different when ANOVA shows a significant difference among multiple sample means (that is, a significant F statistic).</li> </ul>	<ul style="list-style-type: none"> <li>► Example</li> <li>► Watch</li> <li>► Practice</li> </ul>

Compare Frequency (IV is categorical data DV is frequency value)

Figure 2. The Decision Matrix page with an opened section

The decision matrix has three columns. The first column is a list of statistical procedures. The second column displays the conditions for selecting a given statistical procedure. Users can scan the conditions of each statistical procedure to find an appropriate procedure. The third column provides three links for each procedure. If users click the Example link in the Actions column, an example research scenario, where the corresponding procedure would be applicable, will be displayed as shown in Figure 3. By placing the mouse over any term in green color, users can read a brief explanation of the terms as shown in Figure 4.

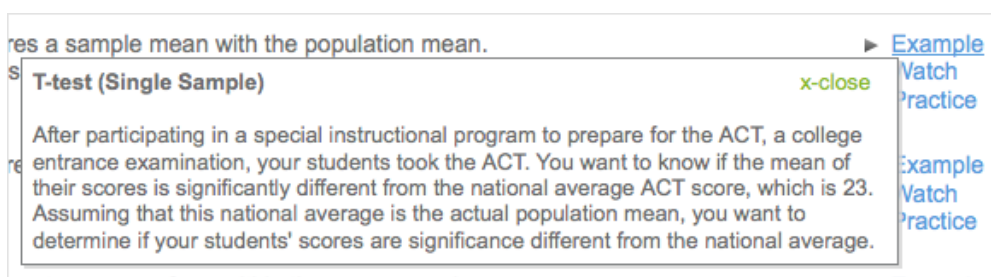


Figure 3. Example story

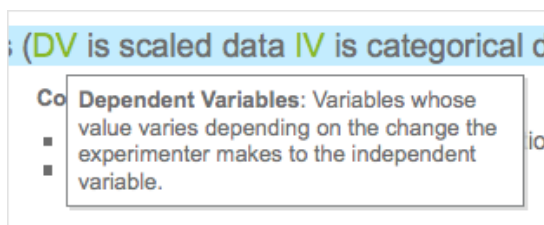


Figure 4. Pop up help

When users click on the Watch link, a video demonstration of how to perform the corresponding statistical procedures in SPSS will open in a separate window. Users can have this window open and imitate the procedures taught in the video in their own SPSS. For this project, six training videos were created. Each video explains how to perform a statistical procedure for comparing means by showing how to input data into SPSS, how to navigate SPSS to produce an output file, and how to read the output file to determine the statistical significance. A screenshot of one of the video demonstration is shown in Figure 5.

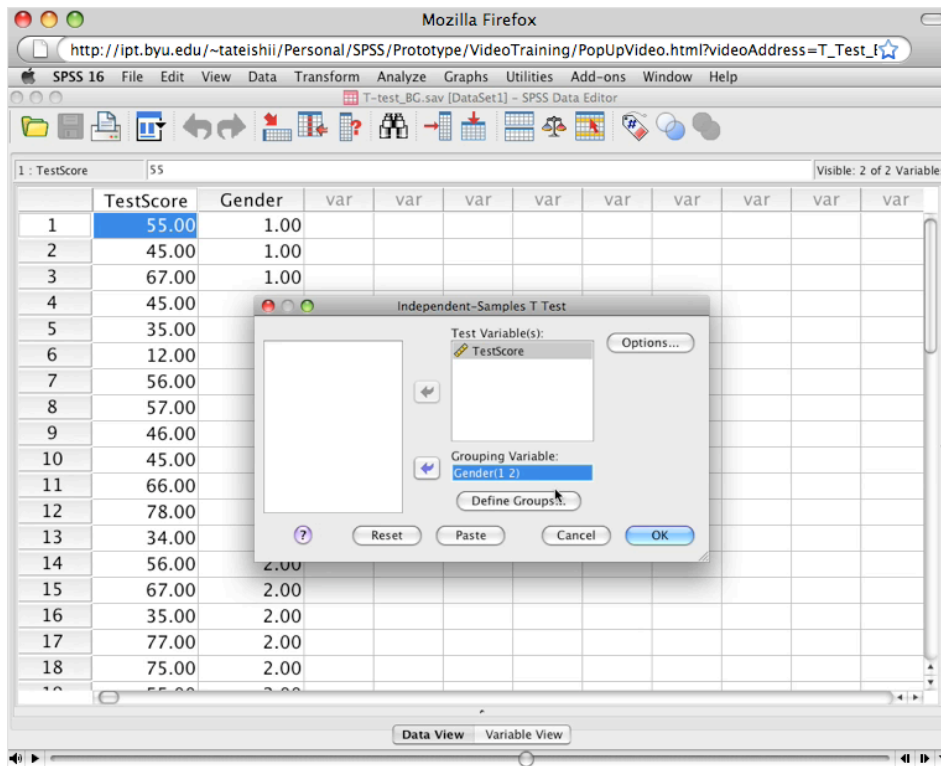


Figure 5. Video demonstration

Finally users have an option to practice what they have learned from the training video by clicking a Practice link. They will be provided with a research scenario and sample data and asked to analyze the data using the appropriate statistical procedure in SPSS. When they are ready to see an answer, they can click the answer heading and the answer will be displayed. A sample practice item with answer feedback is shown in Figure 6. Also, if users would like to practice selecting appropriate statistical procedures, they can go to the Selection Skill Practice page where they are given different research scenarios and asked to identify the correct procedure. A screenshot of the selection skills practice page is shown in Figure 7.

### T-test (Single Sample) Practice

After participating in a special instructional program to prepare for the GRE, your students took the GRE. You want to know if their scores are significantly different from the national average for GRE scores, which is 1037. The following are the test results for your students.

- ▶ **Scores:** 1056, 1078, 1090, 1095, 1067, 1077, 1054, 1090, 1090, 1098

Assuming that 1037 is the actual population mean, conduct a single sample t-test using SPSS to see if a significant difference exists between your students' scores and the national average. When you are ready, click on the answer heading below to see the answer to this problem.

### Answer

- ▶ **Mean and Standard Deviation (SD):** 1079.5, 15.91819
- ▶ **Mean Difference:** 42.5
- ▶ **Significant value (2-tailed):** 0.000014
- ▶ **Conclusion:** p-value is less than 0.05, so it is significant.

The logo image is created by Everaldo Coelho, and obtained from iconfinder.com

Figure 6. Practice page

### Selection Skill Practice

**Instruction:** For each research scenario, decide which statistical procedure should be used to analyze the data.

#### Scenario 1

Suppose you want to compare two teaching techniques in elementary school classrooms. Students in class A receive technique 1 while students in class B receive technique 2. You need to test for group differences on scaled measures of learning.

[Click here if you are ready for the answer](#)

#### Scenario 2

You want to see if adults in the intermountain west have a higher emotional intelligence score than U.S. adults in general (population mean is 50).

[Click here if you are ready for the answer](#)

#### Scenario 3

Figure 7. The Selection Skill Practice page

## Production Process

The framework for this program was created using popular web-programming languages, HTML (Hyper Text Markup Language), CSS (Cascading Style Sheets), JavaScript, and PHP (PHP: Hypertext Preprocessor). HTML provided the basic framework, and CSS was used to specify rules on appearance. Most of the functionalities, such as pop up windows, collapsing/opening of sections and pop up tooltips were written in JavaScript. PHP was used to dynamically create common web elements of all practice pages. The intro-animation was created in Adobe Flash and all other images were produced with Adobe Photoshop. Also, it is important to note that the designer downloaded a free icon from the Iconfinder.com for use as the main program icon. The video simulations were all created using a screen motion capture software package called ishowu. The reasons for selecting ishowu from among other screen motion capture software was its low-cost (\$20), its ease of use and its flexible and powerful configuration settings. It also quickly produces high-quality, yet small file size Quicktime movies. Ishowu was also used for audio recording. Apple QuickTime Pro was used to edit movies produced by ishowu. QuickTime Pro is simple, yet one of the most intuitive, quick and powerful movie editing software packages available at a very low price (\$30).

The main reason for this development tool selection was to make inexpensive and faster production possible as recommended by Modenda (2004). It would have been possible to use more elaborate software like Adobe Flash to create the video training, but using simple screen motion capture, video and audio editing software allowed faster and cheaper production that still produced a high quality product. In addition, since the production process is simple, it is much easier to teach non-technical persons how to create and upload updated video files to the server. In this way, Dr. Yanchar can easily maintain and update the content as needed.

## Evaluations

Most experts agree that evaluation is an indispensable and vital element of effective product design and development (Gagné et al, 1992, & Paas & Firssova, 2004). In instructional design, there are two important types of evaluation: formative and summative evaluation. Formative evaluation is used to improve the quality of the product during the actual production. On the other hand, summative evaluation is used to give an overall value of the product (Fitzpatrick et al, 2004). For this project, I conducted a formative evaluation of the product using an expert review, one-to-one evaluation and a small group evaluation.

Fitzpatrick et al (2004) argues that evaluation cannot be effective unless the evaluator incorporates evaluative criteria from stakeholders. There are three major groups of stakeholders for this project. They are (a) the instructor for IP&T 550, (b) the IP&T 550 students, and (c) the designer of the project. Using the information obtained from informal conversation with the stakeholders, the designer created the evaluation criteria. After specifying the criteria, the designer conducted an expert and one-to-one evaluation in the design and development phase, and a small-group evaluation after the completion of the product, as suggested by Dick, Carey, and Carey (1996).

### *Expert Evaluation*

In the design phase of the project, the designer asked three experts to evaluate the design of the product. Each expert evaluated the product based on his specialized area of expertise. The three areas of expert evaluation were (a) instructional content, (2) product usability, and (3) overall instructional effectiveness.

### *Instructional Content*

Dr. Stephen Yanchar was the statistics and SPSS subject matter expert (SME) for this project. As an instructor for IP&T 550, he has extensive knowledge in teaching statistic concepts and how to utilize SPSS to analyze statistical data. The designer first modified the organization of the decision matrix, which Dr. Yanchar have developed for his class, to enhance its ability to serve as a component of the Performance Support System. As a part of this modification, the example research scenarios for each statistical procedure were added. Then Dr. Yanchar and the designer met and discussed the modified decision matrix and example scenarios. In that meeting, we also reviewed the instructional objectives of the final product and a product prototype. Dr. Yanchar carefully reviewed the accuracy and usefulness of the decision matrix and example scenarios. As Dr. Yanchar made a comment or provided feedback, the designer instantly made changes to the Decision Matrix and the example scenarios.

After Dr. Yanchar approved the matrix and example scenarios, the designer started to work on the video training scripts and prepared SPSS data files needed for the video training. When the first draft of the training scripts were completed, Dr. Yanchar and the designer met a second time to evaluate the content of the scripts. At this time, the designer displayed the SPSS data files and demonstrated how the scripts explain the data, how to navigate SPSS to produce output files and how to interpret the output files to determine the statistical significance. Most of Dr. Yanchar's feedback was concerning problems in wording, including the improper use of statistical terminology. After the meeting, the designer revised the scripts in accordance with the feedback.



## *Product Usability*

In the evaluation used for this project, product usability refers to an easy-to-use graphical user interface and instructional effectiveness of the product. Dr. Paul Merrill served as a technology and instructional design expert in this evaluation. Dr. Merrill has a wide range of knowledge and experience in web-programming and the development of instructional materials. He was able to provide valuable feedback on the user interface and instructional effectiveness of the product. When the product prototype was completed, the designer met with Dr. Merrill to get feedback on the user interface. He suggested adding additional features to help users identify what they could do in the program, such as changing the color of section headings in the Decision Matrix when the cursor is hovered. These suggestions were implemented in the final product. When the product was near completion, the designer sent Dr. Merrill an email that contained an Internet link to the product. He reviewed the prototype and emailed back thirteen specific suggestions. We then met in person to discuss each feedback item. His feedback addressed the instructional quality of some videos and some wording or labeling in the Decision Matrix. He also recommended some additional features to enhance the instructional quality of the product. The following is a list of the changes that were made in the product.

1. Modified the names of statistical procedures to correspond with those used in SPSS and IP&T 550.
2. Re-created one of the videos because the speed of instruction was too rapid.
3. Removed one statistical procedure from the Compare Means section because it was a procedure that is hardly ever used by practitioners.
4. Changed some labels in the Decision Matrix to make them more intuitive to users.

5. Added a new section called Selection Skill Practice to allow users to practice selecting appropriate procedures for different research scenarios.
6. Revised the orientation video to reflect the above mentioned changes.

The designer made all necessary changes to the product and informed Dr. Merrill about the completion of the revision. He reviewed the product again and gave his final approval.

#### *Overall Instructional Effectiveness*

After the designer received the final approval from Dr. Merrill, Dr. Russell Osguthorpe was asked to review the finished product. As a veteran professor of Instructional design, Dr. Osguthorpe was a perfect person to provide additional feedback on the instructional effectiveness of the product. Dr. Osguthorpe provided enthusiastic feedback on the product, expressing his wish to see the product with all completed sections. He stated that the product would be a very beneficial tool to both faculty and students of the Brigham Young University. In his feedback, Dr. Osguthorpe mentioned that one of the videos was experiencing a long loading time. The designer quickly discovered the cause of this technical problem and fixed the loading issue.

#### *One-To-One Evaluation*

The one-to-one evaluation was carried out in the development phase of the project. In the one-to-one evaluation, student participants were presented with a specific task in order to determine how well the product helped participants to accomplish the task. The work of Rosson and Carroll (2002) provided the foundation for the evaluation. In their work, they emphasize the importance of evaluating learning performance, usability, and user satisfaction of the product. As Rosson and Carroll advocate, I used a scenario-based approach to the one-to-one evaluation.

As my development phase was divided into two phases, I conducted two one-to-one evaluations. In both cases, participants were presented with the prototype and asked to complete

several tasks. Each participant was first introduced to the introduction page of the prototype. From there they were asked to find a way to go to the Decision Matrix page. Once they were in the Decision Matrix page, they were given a certain research scenario. Their next task was to use the Decision Matrix to find an appropriate statistical procedure that was best suited for the scenario. As they decided on the procedure, they were asked to read an example story in the Decision Matrix to see if the story was helpful in their selection. They were then asked to click where they can watch the video training about the procedure. After they finished watching the training, they were asked to express their feeling on whether other users will be capable of conducting the statistical procedure for a similar, yet different search scenario. Finally, they were asked to go to a practice page to evaluate the usefulness of the practice pages. Both participants were current IP&T students, and they provided minor feedback to enhance the quality of the product.

The first one-to-one evaluation took place at an earlier stage of development. The designer personally met with the participant. In this evaluation, the participant was able to complete all of the required tasks without any troubles and did not provide any feedback for improvement. She mentioned that the final product would be an excellent tool for IP&T 550 students.

The second one-to-one evaluation was conducted at a later development stage. This time the designer used online videoconference technology to meet and communicate with the participant online. The participant was an IP&T student, but she had not taken IP&T 550. However, she had an advanced degree in statistics and she provided two suggestions for improving the product. The reason for selecting a participant who was not from the exact target audience was to determine if the product would be useful to students who have taken statistics

courses other than IP&T 550. Her first comment was on the volume of the audio in the program. She used a headphone to listen to the Intro-animation and other training videos and she mentioned that the audio volume was too loud. She also mentioned that some of the links could be a little more noticeable and gave several ideas on how to improve them. Just as the first one-to-one evaluation participant, she completed most of her tasks without any difficulty, but she sometimes struggled to understand specific terminology that was used in the Decision Matrix. However, the participant was pleased with the product and confirmed its usefulness.

In both one-to-one evaluations, there were no functional or technical problems reported. In addition, participants seemed to find it easy to navigate through the program and they both found the program very useful. Perhaps this can be attributed to the fact that the program was well thought out and designed in the early stage of development with the assistance of the experts.

### *Small-group Evaluation*

The purpose of the small-group evaluation was to determine if the final product accomplished the instructional objectives for which it was designed to accomplish (Dick, Carey, & Carey, 1996). This evaluation took place between December 2008 and January 2009. The evaluation was divided into two parts: product evaluation and performance evaluation. The participants only evaluated the completed sections of the product. As mentioned earlier, the scope of the product was limited to the completion of the Compare Means section due to the size of the project and the restrictions in production time.

### *Participants*

Evaluation requests were send out to multiple IP&T students via e-mail, but only eight completed both product and performance evaluation. One additional student just completed the

product evaluation. All participants were current IP&T students seeking their masters or doctoral degrees. Seven out of nine participants had taken IP&T 550, Empirical Inquiry and Statistics course, while the other two participants had not. However, these two had taken other statistics courses equivalent to IP&T 550. Eight out of nine participants had taken more than two statistics course equivalent to IP&T 550; but, only one participant indicated confidence in conducting statistical analysis, and none of the participants stated that they knew how to use SPSS well.

### *Instruments*

As mentioned, the small-group evaluation was divided into two parts: Product evaluation and performance evaluation. In the product evaluation, each participant was asked to interact with the product and provide feedback on the instructional effectiveness and overall quality of the product. In the performance evaluation, the participants are asked to perform certain tasks to see if the product actually helped them complete statistical analysis procedures. Evaluation instruments were developed for both evaluations.

For the product evaluation, a 24 item questionnaire was created to facilitate the evaluation of the product (see Appendix C). Questions were design to (a) obtain basic background information about the participants, (b) to evaluate the technical and functional quality of the product, (c) to assess the instructional effectiveness of the Decision Matrix, video training, and practice activities, and (d) to measure overall usability. The questionnaire elicited alternative (yes or no) responses, Likert scale responses (Strongly agree, Agree, Somewhat agree, Somewhat disagree, Disagree), and open-ended comments.

Five research scenarios and associated performance tasks were developed for the performance evaluation. For each scenario, participants were tested on their ability to (a) select

an appropriate statistical procedure, (b) explain how to input data properly in SPSS, (c) describe how to navigate in SPSS to produce a correct output file, and (d) identify the statistical significance from the output file. They were allowed to use the product during this evaluation. Each task was worth two points and there were four tasks for each of the five scenarios. Thus, a maximum of 40 points was possible for the performance test.

### *Process*

As mentioned before, multiple IP&T students were asked to participate in the evaluation, but only nine responded. The nine participants were sent a link to the Statistics Online Support Center, the instruction, and the evaluation forms via email. All participants are asked to access and evaluate the program via the Internet. After going through the program, they were asked to download the product evaluation form, fill out the form, and send the form back to the designer. As described in the Instruments for Evaluation section of this report, the product evaluation consisted of 24 questions and was designed to obtain basic information about the participants, evaluate the technical and functional quality of the product, assess the instructional effectiveness of the Decision Matrix, video training, and practice activities and measure overall usability.

After the participants completed the product evaluation, they were given two options to complete their performance evaluation. For the first option, participants could set a schedule with the designer to conduct their performance evaluation over the telephone. In that option, the designer presented five research scenarios that were found in the performance evaluation form, and asked four associated questions for each scenario. Participants would use the Statistics Online Support site to find answers, and their responses was recorded and graded by the designer. For the second option, participants downloaded the performance support form and using the

program, they wrote their answers to the performance evaluation questions. Their answers were back to the designer via Email. The designer then reviewed and graded their answers.

### *Product Evaluation Results and Discussion*

The following section will summarize the results of the product evaluation. For the complete evaluation results, refer to Appendix D.

*Technical Functionality.* No functional or technical problems were reported by any participants. This result validates the strenuous effort made by the designer to make sure that the program was free from any functional problems.

*User Interface.* The overall user interface received a positive review. Eight out of nine participants agreed that the user interface was well constructed and they had an easy time navigating through the program. One participant wrote, “[The user interface was] clean, crisp, no problems whatsoever. Everything was intuitive.” There were a few suggestions for improvement, but nothing was major. One participant suggested that the top navigation links could be more ostentatious. Implementing this suggestion would help users easily identify where they need to click to go to the main Decision Matrix page from a practice page or the initial orientation page.

*Orientation Video.* Participants responded positively to the instructional quality of the orientation video. When the instruction of the evaluation was sent via email, the purpose and functionalities of the product were not explained in detail. Thus, each participant was asked to watch the product orientation video before they started the evaluation. The orientation video briefly explained the purpose of the program and provided instruction on how to use it. One participant mentioned that the orientation went too rapidly, but other participants did not make

the same comment. At this point, it is safe to conclude that the objectives of the video orientation were successfully achieved.

*Decision Matrix.* Overall, participants responded positively concerning the usefulness of the Decision Matrix for selecting statistical procedures. However, there were a few good suggestions for improving the effectiveness of the matrix. First, the matrix could include additional statistical procedures that are frequently used in academic research, such as MANCOVA or MANOVA. Although, these advanced procedures are not taught in IP&T 550, a majority of participants have taken other statistics courses and have learned advanced procedures. It might not be feasible to include every advanced procedure, but it would be helpful to include some of the most common, frequently used procedures.

Second, some participants mentioned that they would like to see more detailed explanations of the statistical terms used in the matrix. Participants who had taken IP&T 550 a few years back had forgotten the meanings of the statistical terms. Even though users can see some of the terms' definitions by hovering the mouse cursor over the terms, it would be beneficial to include more statistical terms and provide a little more detailed explanations for those who forgot the terms. This way, users could quickly review what they have forgotten.

Finally, the Decision Matrix needs to be printable. Currently, the matrix cannot be printed properly. By providing a print option, users could have access to the matrix without the Internet connection.

*Video Training.* Since, it was assumed that most participants were not proficient in using SPSS, the video training was designed to include every step necessary to complete the statistical computations. The result of the evaluation validates this effort and all participants agreed that the video training was very helpful and effectively explained what they needed to do in SPSS. Also



the majority of participants were satisfied with the quality of the training videos. One participant stated that the quality was better than other websites that uses similar technology. Some participants mentioned that because the version of SPSS they were using was not the current version, which is used in the video training, the procedures taught in the video did not correspond perfectly to their SPSS. However, the differences were minor and the video training still provided useful information for them. Also, it was requested that the title of the movie be displayed in the video screen because for some reasons users forgot what movie they were watching.

*Practice Section.* Most of the constructive criticism was given about this section of the product. As mentioned before, the product provides exercises to practice what users learned from the video training and how to use the Decision Matrix to select appropriate statistical procedures. Overall, two people strongly agreed, four people agreed, two people somewhat agreed, and one person strongly disagreed that the practice sections helped them solidify what they learned from the video training and practice how to use the Decision Matrix to select appropriate statistical procedures.

Participants suggested that they would like to see more than one practice exercise per statistical procedure. It is true that it would take more than one practice exercise to truly master the process. Also, since most of the participants did not have their own copy of SPSS, they were asked to evaluate the practice sections assuming that they did have SPSS. However, participants mentioned that if most students do not own SPSS, it is not useful to provide practice that requires SPSS. Finally, the navigation system for the practice page should be modified to make it more intuitive. Two participants mentioned that clicking the Answer heading to see the answer was a good idea, but it took a while for them to figure out that is what they needed to do. The heading

label should be a little more descriptive of what users need to do. Also, the top navigation link was not obvious enough to let them know that they can click there to go back to the Decision Matrix page.

*Example Stories.* Participants did like the example scenarios. When users are not expert in statistics, reading about the conditions of different statistical procedures does not always make sense unless there is a real context where they can see a realistic application or example of the conditions. One participant mentioned that there should be more than one example per procedure. However, participants perceived the value of the example scenarios in the Decision Matrix.

*Overall Usefulness.* Overall usefulness and value of the product was measure by asking participants if they would consider the product useful and beneficial when using SPSS to analyze their own research data. They were also asked to provide qualitative comments. Eight out of nine participants answered that they consider the product useful and beneficial and would use the product when they were conducting their own research. The one participant who answered negatively praised the high quality and usefulness of the product. It is assumed that that particular participant indicated that he would not use the product because the person is not going to conduct statistical analysis in general. Also, all of the quantitative comments about overall product usefulness were very positive, and everyone seemed to love the idea and the direction of the product. One participant wrote, “My knowledge of statistics is very superficial despite having taken (and endured with great agony) IP&T 550 and STATS 511. So this program of yours is impressive in how it explains terms clearly and concisely. I would like to use this when it comes time for me to do my own statistical analyses for my dissertation work.”

### *Performance Evaluation Results and Discussion*

The main purpose of the performance evaluation was to determine if the product actually helped users select appropriate statistical procedures for a certain research situation and use SPSS to conduct the procedure. As stated above, each participant was presented with five research scenarios and asked to (a) select a statistical procedure, (b) explain how to input the data in SPSS, (c) describe how to navigate SPSS to produce an output file, and (d) specify how to read the output file to identify the statistical significance. The overall result of the performance evaluation indicates that the product was extremely helpful in assisting users perform tasks they were asked to complete. The total available points of the performance evaluation was 40 points, and six participants scored 100 percent, one participant missed one point for an incomplete description, and the last participant missed 2 points for miss-selecting a statistical procedure. On average, participants were able to complete the required tasks with 96.25 percent accuracy.

Despite this highly successful result, the task's authenticity could be challenged for two reasons. First, the research scenarios were given to the participants; however, the real purpose of the product is to help users find an appropriate statistical procedure for their own research. It would be ideal if the participants were asked to come up with their own research scenarios and see if they could use the product to select the procedures. But since only a few modules were completed, it was difficult to design the evaluation that way.

The second issue is that the evaluation did not require participants to use SPSS to actually input data and produce the output files. Initially, the evaluation was designed to ask participants to use SPSS; however, a few critical problems were found in this approach. First of all, most of the participants did not have their own copy of SPSS and the only way for them to access SPSS was to actually go to a computer lab. The second problem was the time required to complete the

evaluation. The actual evaluation took an average of one hour to complete both the product and performance evaluation. However, if participants had been required to use SPSS, it was estimated that they would have had to find access to SPSS and spend about two to three hours to complete both evaluations. When multiple email invitations were sent out to IP&T students requesting their participations, quite a few students declined to participate because of this time requirement. Since the product was developed as a Performance Support System, what users needed to do was to identify the statistical procedures using the Decision Matrix, watch the video training and enter data in SPSS. It was determined that it was best not to require participants to use SPSS. However, it is important to note that almost all participants were able to demonstrate their ability to select a statistical procedure and describe how to use SPSS to conduct statistical analysis using the product. This alone provides a good indication of the actual effectiveness of the product since most of participants were not previously proficient in conducting statistical analysis or using SPSS.

### Self-Evaluation

#### *Product*

Personal evaluation of the product aligns with the overall results from the product and performance evaluation. In the initial design phase, it was expected that the combined application of Performance Support System, Case Based Teaching and Behavioral Modeling would enable the development of a product that would effectively help users select an appropriate statistical procedure and review how to conduct the procedure in SPSS. Although not all sections of the Decision Matrix were completed, users responded positively about the help they could receive by using the product. Users seemed to appreciate the simple and intuitive organization and explanation of the Decision Matrix. Example scenarios were also appreciated

because they provided a realistic context that helped users validate their selection. Users felt that the video training effectively provided step-by-step instructions on how to perform statistical procedures in SPSS. Although the initial learning objectives of the product were successfully accomplished, there are improvements that could make the product more useful.

The product could include multiple example scenarios and practice problems so that users could understand how each procedure is used in various situations. The Decision Matrix could include more explanation for statistical terms that most users need to review when they decide to conduct a statistical analysis. Also, the product could include more advanced statistical procedures that are commonly used in academic research. Of course, these advanced procedures are not taught in IPT 550; however, the Decision Matrix could simply indicate when those procedures are used and provide example scenarios. Even though those procedures are not taught in class, users might easily learn when those procedures are used and find out how to conduct the procedures in SPSS. Currently, the product only shows how to conduct statistical procedures in SPSS because it was used in IP&T 550, but SPSS is not the only statistical analysis software available for students. It might be beneficial to select one or two other popular statistical analysis software packages and create video training on how to perform the same procedure in different software. It is also important to note that ubiquitous Microsoft Excel could be used to conduct many statistical procedures. It might be useful to include video training about how to use Excel to conduct statistical computation. This would allow almost all students to conduct statistical analysis without purchasing SPSS.

#### *Overall Design, Development, and Evaluation Process*

For the design and development phase of the product, knowledge and skill were required in graphic design, web programming, and video production. Since the designer had knowledge

and skill in each of those areas, the design and development phase of the project was efficient. The total amount of time required for the product design and technical development of the program was less than a week. This even includes the production of the six training videos. Even with this short design and production period, the quality of the product did not suffer. This quick yet quality production was made possible by using technology that allows faster production of quality products. For example, software such as Adobe Flash could be used to create more elaborate quality video training with much more user interactivity; however, by using screen capture software, the production time was reduced dramatically, while maintaining high quality. The part of production that required a large amount of time was developing the actual training content. The designer had taken IP&T 550 about two years ago, but had forgotten most of the content taught in the class. The designer had to review course materials and other external materials that teach about Statistics and SPSS to write out the actual training script and prepare SPSS data files for the video. This took considerable amount of time. The scripts and data files were then reviewed by the SME and modified again to reflect the feedback given by the SME. The process could have been completed more quickly if the SME was more involved in writing the training scripts, but the circumstances did not allow for that to happen.

Perhaps, the most challenging part of the project was conducting the evaluation. The evaluation instruments were developed rather quickly with the help of the project committee advisor; however, finding people that would actually complete the evaluation took a lot more effort than expected. Since the main target audience of the evaluation was former IP&T 550 students, the evaluation could not be conducted in a classroom setting. Multiple invitations were sent out, but, only nine people agreed to participate in the evaluation, and it took a month and half for everyone to return their evaluation. On average, the evaluation only took one hour to

complete, so if everyone finished the evaluation in the same week that they received the evaluation materials, it would have been completed within a week. Perhaps participants procrastinated completing the evaluation because the deadline for the evaluation was not explicitly stated. The instruction was given to complete the evaluation as soon as possible, and follow-up emails were sent to those who had taken more than two weeks to complete the evaluation; however, a deadline was not given to them. Establishing a deadline would not have forced everyone to complete on time, but it might have reduced the time spent for getting everyone's evaluation back. If the project had more time and available funds, I would have paid each participant for participating in the evaluation, thus providing an additional incentive. Also, I could have selected a few dates for the performance evaluation and asked participants to come to a scheduled computer lab on one of those days. In this way, every participant would have had access to SPSS in their performance evaluation.

#### Production Schedule

Table 1 delineates the estimated and actual delivery dates for major stages of the project. The estimates were made based on the author's personal experience in completing a similar project in the past. As shown in Table 1, the estimated final delivery date was October 10, 2008; however, the actual completion date was 12 days later. The major reason for this delay was because the designer underestimated the time needed for developing and scripting the training content. Researching statistical procedures took more time than anticipated, but the time for the expert reviews also exceeded initial expectation.

Table 1

*Estimated and Actual Project Schedule*

Project Stage	Estimated Delivery Date	Actual Delivery Date
Instructional Content Outline	August 22, 2008	August 22, 2008
Interface and Visual Design	August 29, 2008	August 29, 2008
Low-fidelity Prototype <ul style="list-style-type: none"> <li>• Develop interface</li> <li>• Script one SPSS training</li> <li>• Create one training video</li> <li>• Conduct expert evaluation</li> <li>• Conduct one-to-one evaluation</li> </ul>	September 12, 2008	September 5, 2008
Middle-fidelity Prototype <ul style="list-style-type: none"> <li>• Revise interface</li> <li>• Script two SPSS training</li> <li>• Create training videos</li> </ul>	September 26, 2008	September 29, 2008
High-fidelity Prototype <ul style="list-style-type: none"> <li>• Revise interface</li> <li>• Script two SPSS training</li> <li>• Create training videos</li> <li>• Conduct expert evaluation</li> <li>• Conduct one-to-one evaluation</li> </ul>	October 3, 2008	October 19, 2008
Product Completion <ul style="list-style-type: none"> <li>• Finalize interface</li> <li>• Create Orientation Video</li> </ul>	October 10, 2008	October 22, 2008

## Production Budget

As shown in Table 2, most of the budget was allocated for the designer/developer. The author served in both roles and provided the majority of the labor. The pay rate for the position was determined by the equivalent rate the author is receiving as an instructional designer in his current employment. However, the author did not receive any wages for his work on the project. The pay rate for subject-matter experts was calculated using information provided by the BYU Office of Research and Creative Activities (ORCA). Other pay rates were determined based on the author's estimates of the appropriate pay range for each position. When payments were



required, the author provided the funds. The project also required computer software for production. Necessary software included a computer screen motion capture tool, simple video editing software, web-development software, and of course, SPSS. Material cost estimates are accurate, and prices for SPSS and Abode CS3 are educational prices. Adobe CS3 is a software bundle package that contains useful web production software like Illustrator, Photoshop, Flash, and Dreamweaver. The author used personal funds to purchase all software.

Table 2

*Production Costs*

Resource Title	Hours Worked	Pay Rate	Estimated Cost
Designer/Developer	100 hours	\$20	\$2,000.00
Voice Actor	2 hours	\$10	\$20.00
Subject Experts	10 hours	\$25	\$250.00
Evaluation Participants	10 hours	\$12	\$120.00
Editor	3 hours	\$15	\$45.00
SPSS			\$199.00
Screen Video Capture Software (ishowu)			\$20.00
QuickTime Pro			\$29.99
Abode CS 3 Design Premium			\$329.00
<b>Total</b>	<b>125 hours</b>		<b>\$3,012.99</b>

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## Appendix A

### Decision Matrix and Example Stories

#### Compare Means (DV is scaled data IV is categorical data)

Name	Condition	Action
<b>Z-Test (Single Sample)</b>	<ul style="list-style-type: none"> <li>▪ Compares a sample mean with the population mean to see if a statistically significant difference exists.</li> <li>▪ Sigma is <i>known</i>.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<p><u>Example</u></p> <p>You want to determine whether the BYU senior class has a higher IQ than the general population of graduating college seniors (population mean = 105, population standard deviation = 15), and whether the difference (if it exists) is statistically significant.</p>		
<b>T-Test (Single Sample)</b>	<ul style="list-style-type: none"> <li>▪ Compares a sample mean with the population mean.</li> <li>▪ Sigma is <i>unknown</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<p><u>Example</u></p> <p>After participating in a special instructional program to prepare for the ACT, a college entrance examination, your students took the ACT. You want to know if the mean of their scores is significantly different from the national average ACT score, which is 23. Assuming that this national average is the actual population mean, you want to determine if your students' scores are significance different from the national average.</p>		
<b>T-Test (BG)</b>	<ul style="list-style-type: none"> <li>▪ Compares the means from two different samples.</li> <li>▪ Sigma is <i>unknown</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<p><u>Example</u></p> <p>You want to look for differences between BYU males and females on a scaled test of compassion.</p>		
<b>T-Test (RM)</b>	<ul style="list-style-type: none"> <li>▪ Compares two means from within the same sample.</li> <li>▪ Sigma is <i>unknown</i></li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<p><u>Example</u></p> <p>You want to compare two techniques for teaching 2nd grade reading. The same students spend their first semester exposed to technique 1, and their second semester exposed to technique 2. Assuming the data are scaled, test for a significant difference.</p>		
<b>BG One-way ANOVA</b>	<ul style="list-style-type: none"> <li>▪ Compares multiple (two or more) means drawn from different samples.</li> <li>▪ Unlike a multiple t-test, this does not increase alpha level.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<p><u>Example</u></p> <p>You want to test for differences between seniors graduating from elementary education programs at three different universities (University A, University B, and University C) on a scaled test of educational</p>		

leadership.		
<b>RM One-way ANOVA</b>	<ul style="list-style-type: none"> <li>▪ Compares multiple (two or more) means drawn from the same sample.</li> <li>▪ Unlike a multiple t-test, this does not increase alpha level.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<u>Example</u> <p>You want to look at how well international students develop their ability to communicate in English as a second language during their university education. You administered a scaled test at the beginning of each of four consecutive academic years to the selected international students.</p>		
<b>Tukey HSD</b>	<ul style="list-style-type: none"> <li>▪ Identifies specific mean pair(s) that are statistically different when ANOVA shows a significant difference among multiple sample means (that is, a significant F statistic).</li> </ul>	<ul style="list-style-type: none"> <li>▪ Example</li> <li>▪ Watch</li> <li>▪ Practice</li> </ul>
<u>Example</u> <p>You tested for differences between seniors in elementary education programs at Universities A, B, and C on a scaled test of educational leadership. When you conducted a BG one-way ANOVA, it showed significance. Now you want to identify which means differ significantly. To see how to conduct Tukey HSD, please refer to BG and RM one-way ANOVA.</p>		

## Appendix B

### Video Training Scripts

#### **Orientation**

Welcome to Statistics online support center. This webpage is designed to help you select an appropriate statistical procedure for your research, and to help you learn or review how to perform the procedures in SPSS. Please note that the site requires you to know the basic statistical concepts and procedures taught in IP&T 550, Empirical Inquiry and Statistics, or an equivalent statistics course.

Now I will explain how this site works. Once you finish this orientation, you can enter the Decision Matrix page by clicking [here](#). You will need to look at the headings in order to identify what you are going to do. Are you comparing means, comparing frequencies, or analyzing correlations? Let's say you are comparing two means from scaled tests taken by two groups. Since you are comparing means, click on the Compare Means. Now you need to scan the conditions of each procedure to find one that is appropriate for your data. In this case, you are comparing two means from different groups, so a t-test or ANOVA would apply. Since data come from different groups, it's not a repeated measure, so you could use a between-group ANOVA or a T-test. For this example, let's use a T-test.

If you are still not sure if the procedure you picked is correct after reading the condition in the matrix, you can read the example and see if your research is similar to the example you read here. By the way, if you hover over anything in green it will show you detailed explanation of the term.



When you click on the Watch link, you can watch a video demonstration of how to perform Between group T-test in SPSS. As you can see, a separate window will open. You can have this window open and imitate the procedures taught in the video in your own copy of SPSS.

You also have an option to practice what you have learned from the training video by clicking the Practice link. There you will be provided with a problem, and you will be asked to resolve the problem by using the information obtained from the video training. When you are ready to see an answer, click Answer, and the answer will be displayed. To go back to the Matrix page, click here.

Finally, if you would like to practice selecting appropriate statistical procedures, click here. You can read different research scenarios and see if you can identify right procedures.

Well, this was a quick orientation to Statistics online support center, and I hope you found it useful.

### **Single Sample T-Test**

After participating in a special instructional program to prepare for the ACT, a college entrance examination, your students took the ACT. You can see their scores on the screen. You want to know if the mean of these scores is significantly different from the national average score on the ACT, which is 23. If you assume that this national average is the actual population mean, you can determine statistical significance using a One-sample T-test. Go to Analyze > Compare Means and One-sample T-test. Move your Score data into the Test Variable box, and enter the ACT national average in the Test Value field. When you are ready, click OK. This will generate the output file.

In the output file, you can see the mean of your student scores, and it looks like the mean score of the students is 5.3 points higher than the national average. The p-value (sig.) is less than .05. So the result is statistically significant.

### **Between-Group T-Test**

As a researcher, you wanted to test for differences between BYU males and females on a scaled test of compassion. The test results are shown on the screen. In the Gender column, number one refers to male, and two refers to female. In the Test Score column, you can see individual test scores. To see if a significant difference exists between male and female, go to Analyze > Compare Means and Independent-Samples T-test. Move Test Score data to the Test Variable box and the gender data in the Group Variable box. Now click the Define Group button. Put one for Group 1, and two for Group 2, and click Continue. When you are ready, click OK.

After an output file is generated, you can see how many males and females took this compassion test, and their test averages. It looks like females scored 14 points higher than males. Now let's see if this difference is significant or not. Ignore the Equal variances not assumed row, and just look at the significance level here. Since the p-value (sig.) is not less than .05, statistically, the difference is not significant.

### **Repeated Measure T-Test**

You want to compare two techniques for teaching 2nd grade reading. The same group of students spent their first semester exposed to technique one, and their second semester exposed to technique two. At the end of the each semester, you administered a scaled test of their reading ability. The 1<sup>st</sup> Semester column shows the test results from the first semester, and the 2<sup>nd</sup>

Semester column shows the test results from the second semester. To see if a significant difference exists in these two scores, go to Analyze > Compare Means > Paired-Sample T-test. Click on the first test score, and while holding down the shift key, click on the second test score. Now use the arrow button to move them into the Paired variables box. Then click OK.

When the output file is generated, you can see the means of both scores. The mean difference of the test scores is 7.4. It looks like the students did score higher in the 1<sup>st</sup> semester than the 2<sup>nd</sup> one. However, in the Paired Sample Table you can see that p-value (sig.) is .072, which is not less than .05. So it means that scores are not significantly different.

### **Between Group One-way ANOVA**

You want to test for differences in the scores of a scaled test of educational leadership between seniors who are graduating from elementary education programs at three different universities. In the University column, 1 represents the first University, 2 represents the second University, and 3 represents the third University. You can see the test scores in the Test Score column.

To see if significant differences exist among these three groups, go to Analyze > Compare Means > One-way ANOVA. Move the test score data set to the Dependent List box, and the university data set into the Factor box. Now click on the Post Hoc button. Check the Tukey check box. You want to select a Post Hoc Tukey test so that you can know which pairs of means differ significantly from each other. If you desire to change the significance level, you can do so in the significance level field. Click Continue. If you wish to include standard statistics, like mean and standard deviation, click the Options button, and check the Descriptive check box. Hit Continue, and then click OK to produce the final output.

SPSS generates an output file. Here you can see basic information like sample size, mean, standard deviation, minimum score, and maximum score for each university. It looks like University 3 has the highest scores, followed by Universities 1 and 2. To see if there are any significant differences between the three universities, look at the Sig. column in the ANOVA table. It looks like the F-value is less than .05, so it means that in at least one pair, the means differed significantly from each other. To see the exact number, first double click on the table, and then double click on the number. Now you can see the exact number. You can look at the Post Hoc test table to see which mean pair actually differed significantly. In this case, you can see that there were significant differences between universities 1 and 3, as well as universities 2 and 3, but not between Universities 1 and 2.

### **Repeated Measure One-way ANOVA**

You want to see how international college students improve their ability to communicate in English as they go through their college education. You administered a scaled test at the beginning of each academic year, for 4 consecutive years, and now you want to compare the differences in these scores. Each column represents scores from different academic years.

To see if significant differences exists in these scores, go to Analyze > General Linear Model > Repeated Measures. Give a name to the independent variable. In this example, we will call it Academic Year. Next, indicate how many levels are in Academic Year. Here, each year is considered a level, so type 4, and click Add. Click the Define button. In the Within-Subject Variables box, you can see 4 levels of independent variable, so let's indicate to SPSS which data set belong to which level. Simply move First Year to 1, Second Year to 2, Third Year to 3, and Fourth Year to 4. Click on the Options button. Highlight Academic Year in the Factor and Factor

Interactions box, and use the arrow button to move it to the Display Means For box. Click Compare Main Effects. Before we move on, check the Descriptive statistics box to get standard statistical data like sample size, mean, and standard deviation. Also click Estimates of Effect Size. You can change the significance level in the significance level field. Click Continue. If you are ready, click OK.

Once the report is generated, you will find a table called Test of Within-Subjects Effects. In the table, look for Sphericity Assumed, and its significance level. Let's double click on the table and then double click the number to see the exact value. As you can see, the value is below .05, so there is a significant difference between at least one pair of means in this test.

You might think Post Hoc or Tukey HSD is necessary to identify which mean pair actually displays significant difference. Although what you are thinking is true, there is no ideal way to conduct Post Hoc for RM ANOVA in SPSS. So what you need to do for a repeated-measure One-way ANOVA test is to conduct a Repeated- Measures t-test for each combination of mean pairs, and use a Bonferroni correction to determine your alpha level. This is necessary because multiple T-tests will increase the alpha level. So if you were using an alpha level of .05 and each score is compared with 3 other scores, as in this example, you will need to divide .05 by 3. The resulting alpha level is .0167. So instead of using an alpha level of .05, you will use an alpha level of .0167 to determine the statistical significance while conducting multiple t-tests.

## Appendix C

### Product Evaluation Form

## PRODUCT EVALUATION

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Instruction: Please respond to the following questionnaire items.

1. Have you taken IPT 550 – Empirical Inquiry and Statistics?  Yes  No
2. Have you taken a statistics course other than IPT550?  Yes  No
3. How confident are you in conducting statistical analysis?  
 Very Confident  
 Somewhat Confident  
 Not Confident
4. How much do you know about SPSS?  
 I know SPSS well.  
 I know SPSS okay.  
 I don't know much about SPSS.
5. When you used the Statistics Online Support program, did it function properly?  
 Yes  No
6. Please describe any problems you encountered with the program in the space provided below:
7. The user interface of the program was well constructed and I had an easy time navigating through the program.  
 I strongly agree.  
 I agree.  
 I somewhat agree.  
 I somewhat disagree.  
 I strongly disagree.
8. Please provide specific suggestions of how to improve the user interface in the space provided below:

9. The video orientation was very helpful and informed all the information I needed to know.

- I strongly agree.
- I agree.
- I somewhat agree.
- I somewhat disagree.
- I strongly disagree.

10. Please provide specific suggestions of how to improve the video orientation in the space provided below:

11. The picture and audio quality of the video training was excellent.

- I strongly agree.
- I agree.
- I somewhat agree.
- I somewhat disagree.
- I strongly disagree.

12. Please provide specific suggestions of how to improve the picture or audio quality of the video training in the space provided below:

13. The conditions of the Decision Matrix really helped me identify an appropriate statistical procedure.

- I strongly agree.
- I agree.
- I somewhat agree.
- I somewhat disagree.
- I strongly disagree.

14. Please provide specific suggestions of how to improve the conditions of the Decision Matrix in the space provided below:

15. The video training was very helpful and well explained what I need to do in SPSS.

- I strongly agree.
- I agree.
- I somewhat agree.
- I somewhat disagree.

- I strongly disagree.
16. Please provide specific suggestions of how to improve video training in the space provided below.
17. The practice pages helped me solidify what I learned from the video training.
- I strongly agree.  
 I agree.  
 I somewhat agree.  
 I somewhat disagree.  
 I strongly disagree.
18. Please provide specific suggestions of how to improve practice pages in the space provided below.
19. The example stories helped me clearly understand the conditions of the Decision Matrix.
- I strongly agree.  
 I agree.  
 I somewhat agree.  
 I somewhat disagree.  
 I strongly disagree.
20. Please provide specific suggestions of how to improve the example stories in the space provided below.
21. The selection skill practice helped me use the Decision Matrix to identify an appropriate statistical procedure.
- I strongly agree.  
 I agree.  
 I somewhat agree.  
 I somewhat disagree.  
 I strongly disagree.
22. Please provide specific suggestions of how to improve the selection skill practice page in the space provided below.

(Please continue to the last page.)



23. If the other sections of the program were completed, do you consider the program useful and beneficial when you use SPSS to analyze your research data?

Yes  No

24. Please provide any other comments or feedback you wish to provide.

## Appendix D

### Product Evaluation Results

Question	Response
1. Have you taken IPT 550 – Empirical Inquiry and Statistics?	Yes – 7 out of 9 No – 2 out of 9
2. Have you taken a statistics course other than IPT550?	Yes – 8 out of 9 No – 1 out of 9
3. How confident are you in conducting statistical analysis?	Very Confident – 1 out of 9 Somewhat Confident – 5 out of 9 Not Confident – 3 out of 9
4. How much do you know about SPSS?	I know SPSS well. – 0 out of 9 I know SPSS okay. – 6 out of 9 I don't know much about SPSS. – 3 out of 9
5. When you used the Statistics Online Support program, did it function properly?	Yes – 9 out of 9 No – 0 out of 9
6. Please describe any problems you encountered with the program in the space provided below:	
7. The user interface of the program was well constructed and I had an easy time navigating through the program.	I strongly agree. – 5 out of 9 I agree. – 3 out of 9 I somewhat agree. – 1 out of 9 I somewhat disagree. – 0 out of 9 I strongly disagree. – 0 out of 9
8. Please provide specific suggestions of how to improve the user interface in the space provided below:	<p>Comment 1 It would be nice if there were more back buttons, although I really like that the menu is always present. I had to go back and watch the orientation a second time to find the selection skill practice scenarios. Maybe that can be included in the main menu too.</p> <p>Comment 2 After the introduction video, it may be helpful to have some links in the same big window to take you into the matrix. It took me a minute to find the links in the top right of the window.</p> <p>Comment 3</p>

	<p>I think the Intro Orientation Matrix on the top could be more obvious or repeated. It might be nice to have tabs/buttons down the left had side as well.</p> <p>Comment 4 The top-right navbar uses “Matrix” to describe the main feature of the program. When I first saw the navbar, it was not obvious to me which of the options was the “real” program. I had to go through a process of elimination, knowing that orientation and intro were not what I wanted, so by default “Matrix” but be the link that contained the real program. I wonder if another term would be better? Or maybe even use “Decision Matrix”. Also, why does there have to be a link to the intro? Will anyone need to see that again?</p> <p>Comment 5 Very Well Done. It was easy to navigate and understand what I needed to do.</p> <p>Comment 6 I think the user-interface is easy to use.</p> <p>Comment 7 Honestly, it rocked. Clean, crisp, no problems whatsoever. Everything was intuitive.</p>
<p>9. The video orientation was very helpful and informed all the information I needed to know.</p>	<p>I strongly agree. – 5 out of 9 I agree. – 3 out of 9 I somewhat agree. – 1 out of 9 I somewhat disagree. – 0 out of 9 I strongly disagree. – 0 out of 9</p>
<p>10. Please provide specific suggestions of how to improve the video orientation in the space provided below:</p>	<p>Comment 1 The orientation went too fast for me, and I couldn’t keep up with the different clicks that are happening. I needed some triggers (a circle, flash, glow, etc.) as well to remember the different steps I needed to take. Maybe multiple videos in the orientation may be better. It would allow us to repeat a section we didn’t understand, and could be accessed individually when needed in the future. I like</p>

	<p>the kind manner in which it was presented. The video said that it was significant because the p value was below .05, but it never said that we had chosen .05 instead of .01 or some other number.</p> <p>Comment 2 The only distracting thing was that it was read by a non-English native. Everything was understandable but it was clear this person was not an actor and was a non-English Native. It sounded a little like the script was being read as well, thus the actor comment. It was better than what I have been able to do in the past.</p> <p>Comment 3 In the beginning when the title was the only thing on the screen, I was worried that my browser wasn't playing the video properly, but it turned out that's all that was supposed to be on the screen. . . . maybe you could have some other pictures in there so it doesn't show the same image for such a long time?</p>
<p>11. The picture and audio quality of the video training was excellent.</p>	<p>I strongly agree. – 8 out of 9 I agree. – 1 out of 9 I somewhat agree. – 0 out of 9 I somewhat disagree. – 0 out of 9 I strongly disagree. – 0 out of 9</p>
<p>12. Please provide specific suggestions of how to improve the picture or audio quality of the video training in the space provided below:</p>	<p>Comment 1 The audio and picture quality are excellent.</p> <p>Comment 2 It was really clear and I was able to hear it and see it really well.</p> <p>Comment 3 I thought it was great. Better than other websites I have encountered with similar technology.</p>
<p>13. The conditions of the Decision Matrix really helped me identify an appropriate statistical procedure.</p>	<p>I strongly agree. – 3 out of 9 I agree. – 6 out of 9 I somewhat agree. – 0 out of 9 I somewhat disagree. – 0 out of 9</p>

	I strongly disagree. – 0 out of 9
14. Please provide specific suggestions of how to improve the conditions of the Decision Matrix in the space provided below:	<p>Comment 1 Maybe a break of some kind in the phrase: DV is scaled data, IV is categorical data (the comma). I think that a little statistical training might be nice as well, something that teaches about DV and IV for example—video, text, or some other media (more than just definition). I really like the Decision Matrix though. It is much like Dr. Yanchar’s sheet, but in a place we could find it in the future.</p> <p>Comment 2 Put the phrase “alpha level” in green and define it like you do the other terminology.</p> <p>Comment 3 Obviously more complete information for all sections (and not just “Compare Means” would be helpful).</p> <p>Comment 4 I wish there were a way I could print this out as an easy reference. This was very helpful and I would love to use it but I don’t want to have to go to the website again. This was a very helpful thing.</p> <p>Comment 5 I think the Decision Matrix is very good. You could always improve by covering more esoteric situations &amp; corresponding statistical procedures, but I don’t think that is necessary.</p> <p>Comment 6 I haven’t even thought about stats since the last time I took it...last winter. If I really needed to do a statistical analysis using SPSS, I think slightly more explanation would have been better. The screen with the various tests seemed brief. One of the most difficult aspects that I recall was the identification of the proper test to run given a certain data set. It is that that could use extra, if anything, explanation.</p>

<p>15. The video training was very helpful and well explained what I need to do in SPSS.</p>	<p>I strongly agree. – 5 out of 9  I agree. – 4 out of 9  I somewhat agree. – 0 out of 9  I somewhat disagree. – 0 out of 9  I strongly disagree. – 0 out of 9</p>
<p>16. Please provide specific suggestions of how to improve video training in the space provided below.</p>	<p>Comment 1  It would be great if during the video there was permanent title that tells you which video you are watching.</p> <p>Comment 2  I felt like it covered the basic steps very well.</p> <p>Comment 3  I would like a written up version of the steps as well as the video. You may want to have different versions of SPSS, the student version and the regular version for some of the tests (I had the student version in class and it was different from Dr. Yanchar’s version, but only for ANOVA and some other tests.)</p> <p>Comment 4  On the RM One-way ANOVA video clip, you need more visuals toward the end to illustrate what you’re talking about. Right now the user is looking at the same screen for the last two minutes of the presentation with no illustration of what results are being discussed.</p> <p>Comment 5  I don’t have SPSS, so I was unable to truly test whether or not I could perform the actions demonstrated in the film.</p> <p>Comment 6  I don’t know that I would be able to apply the things there to other situations unless I was watching the video. This is always a problem for me. I loved when the video helped you to understand why you were clicking certain boxes like the Tukey Test etc. This seemed to me to be very helpful and I wish there were a little more of that. I guess there is a balance that you need to ensure that the video isn’t too</p>

	<p>long either. I think I would add a little more explanation.</p> <p>Comment 7 It's super easy to follow.</p>
<p>17. The practice pages helped me solidify what I learned from the video training.</p>	<p>I strongly agree. – 2 out of 9 I agree. – 4 out of 9 I somewhat agree. – 2 out of 9 I somewhat disagree. – 0 out of 9 I strongly disagree. – 1 out of 9</p>
<p>18. Please provide specific suggestions of how to improve practice pages in the space provided below.</p>	<p>Comment 1 Besides directing the user to click on the Answer heading you might want to include a “click here” prompt to remind people that the Answer is clickable.</p> <p>Comment 2 Eventually, even more practice might be nice. But as a start, I really liked the practice exercises.</p> <p>Comment 3 I would like even more practices. I also thought that it would be great to have an SPSS spreadsheet of the example already attached. I think it needs to be more obvious that you can click the word ANSWER, but I really like the ability to open up the answer. There needs to be a way back to the previous matrix page from the practice. It sent me to the main matrix page. “You want to look for differences between BYU males and females on a scaled test of compassion,” should be you want to look to see if there is a statistically significant difference...</p> <p>Comment 4 In order to actually “practice” these steps, you need to run the information in SPSS. In the orientation, please specify that the user must have SPSS to do the practices.</p> <p>Comment 5 Again, since I do not have SPSS, I could not</p>

	<p>really test the effectiveness of the practice exercises.</p> <p>Comment 6 I didn't have SPSS so I couldn't do them, but I love the idea. Maybe a link to download a trial version of SPSS would be helpful.</p> <p>Comment 7 I think it would if I had a copy of SPSS to practice with.</p> <p>Comment 8 Provide more than one per link.</p>
19. The example stories helped me clearly understand the conditions of the Decision Matrix.	<p>I strongly agree. – 6 out of 9 I agree. – 2 out of 9 I somewhat agree. – 1 out of 9 I somewhat disagree. – 0 out of 9 I strongly disagree. – 0 out of 9</p>
20. Please provide specific suggestions of how to improve the example stories in the space provided below.	<p>Comment 1 It would be great if there were more than one example story provided for each test.</p> <p>Comment 2 I think that it would be nice to have added details, and maybe even an additional info, like which is the DV and IV (maybe in a drop down like the ANSWER does).</p>
21. The selection skill practice helped me use the Decision Matrix to identify an appropriate statistical procedure.	<p>I strongly agree. – 2 out of 9 I agree. – 4 out of 9 I somewhat agree. – 2 out of 9 I somewhat disagree. – 0 out of 9 I strongly disagree. – 1 out of 9</p>
22. Please provide specific suggestions of how to improve the selection skill practice page in the space provided below.	<p>Comment 1 It would be nice if the selection skill practice page provided some rationale for the correct answer and maybe a short video of how to do the test on SPSS. A little more information on the selection skill practice. Although, the objective might only be to help people select the right test and not necessarily on how to carry it out.</p>



	<p>Comment 2 It may be helpful to be able to more easily toggle between the matrix and the skill practice page. Maybe just a little button right after the scenario that will take the user to the matrix and then a back button. The buttons at the top are good, but it might be easier for the user to have it within the question. I realize this adds more to the programming, but it would have been helpful to me.</p> <p>Comment 3 I didn't even notice it was there until this question—maybe if it stood out a little more. I think that page is really important.</p> <p>Comment 4 In order to actually “practice” these steps, you need to run the information in SPSS. In the orientation, please specify that the user must have SPSS to do the practices.</p> <p>Comment 5 I don't understand what the difference is between the “selection skill practice” and the “practice pages” referred to in questions 17 and 18.</p>
<p>23. If the other sections of the program were completed, do you consider the program useful and beneficial when you use SPSS to analyze your research data?</p>	<p>Yes – 8 out of 9 No – 1 out of 9</p>
<p>24. Please provide any other comments or feedback you wish to provide.</p>	<p>Comment 1 I think this is a great project and I would definitely use it. It is a great way to remember what I learned in 550 and refresh my memory. I know all the material but it is not easy to keep it all in my mind and this project makes it easy to remember what each test was and when to choose each one. Excellent work.</p> <p>Comment 2 I think it would be useful to finish the rest of the program because it was useful. I hope I can remember the site when I do more of my own</p>

	<p>statistics.</p> <p>Comment 3 It would be nice to have even more complicated procedures like factor analysis, mancova, manova, and other items that we didn't cover in the class. I really like the idea. I think it's a very helpful idea!</p> <p>Comment 4 The videos were very helpful (and it's good that they open in a separate window). The chart with examples is also helpful since I can help users match their situation to the appropriate category.</p> <p>Comment 5 My knowledge of statistics is very superficial despite having taken (and endured with great agony) IP&amp;T 550 and STATS 511 so this program of yours is impressive in how it explains terms clearly and concisely. I would like to use this when it comes time for me to do my own statistical analyses for my dissertation work.</p> <p>Comment 6 This was more helpful than anything else I have seen for using SPSS. I am very impressed. It is a great idea and well thought out!!!</p> <p>Comment 7 It rocked...wished we had the finished product last year...seriously.</p>
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## Appendix E

### Performance Product Form

## PERFORMANCE EVALUATION

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**Instruction:** Five research scenarios are presented below. By using the Decision Matrix and video training, answer the following questions for each scenario:

1. Which statistical procedure do you use for this research scenario? (2 pts)
2. How would you input the data in SPSS? (2 pts)
3. How do you navigate SPSS to perform the statistical procedure? (2 pts)
4. Where do you look to determine the statistical significance once the output file is generated? (2 pts)

### Scenario 1

You want to test for mean differences between college freshmen from four different majors (Psychology, Biology, Mechanical Engineering, and English) on a scaled test of academic writing skills.

### Scenario 2

After participating in a special instructional program to prepare for the LSAT, the Law School Admission Test, your students took the test. You want to know if the mean of their scores is significantly different from the national mean of LSAT score, which is 150. Assuming that this national average is the actual population mean, you want to determine if your students' scores are significantly different from the national average.

### Scenario 3

You are asked by your school district to develop a new curriculum to improve the quality of science instruction. You tested the students at the beginning of the year, and then implemented a new curriculum. At the end of the year, the same students were tested for their learning achievement. Now you want to examine the effect of a new curriculum on the students.

### Scenario 4

You want to look at how well high school students develop their ability to write academic papers as a result of their education. Samples were randomly selected and they were administered a scaled test on academic writing skills at the beginning of three consecutive academic years.

### Scenario 5

You want to look for mean differences between religious and non-religious students on a scaled test of learning strategy.

## Appendix F

### Performance Evaluation Result

#### Participant One

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Total: 40/40 pts.					

#### Participant Two

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Total: 40/40 pts.					

#### Participant Three

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	1 pts.	7 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Total: 39/40 pts.					

#### Participant Four

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.

Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
					Total: 40/40 pts.

#### Participant Five

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
					Total: 40/40 pts.

#### Participant Six

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
					Total: 40/40 pts.

#### Participant Seven

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	0 pts.	2 pts.	2 pts.	2 pts.	6 pts.
					Total: 38/40 pts.

Participant Eight

	Procedure Identification (2 pts.)	Data Input (2 pts.)	SPSS Navigation (2 pts.)	Output File Reading (2 pts.)	Total
Scenario 1	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 2	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 3	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 4	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
Scenario 5	2 pts.	2 pts.	2 pts.	2 pts.	8 pts.
					Total: 40/40 pts.