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ABSTRACT

Community colleges must often analyze and report rates for outcomes, such as transfer to four-year colleges. A single, summary rate may be an invalid measure of its achievement in the transfer goal if the summary rate ignores the real difference in enrollment composition at different institutions. California's community colleges embody a very diverse set of local environments. This diversity presents a challenge to the analyst who must compare a specific institution to others in the system. If the analyst does not control for "confounding" variables in the environment, an analysis may draw invalid conclusions about a specific, hypothesized cause-and-effect relationship of concern. This paper presents a method for adjusting a college's outcome rate to compensate for differences in enrollment composition. This method, known as standardization of rates, has two methods of calculation, the direct method and the indirect method. A college will benefit from standardization if: (A) it has an enrollment composition that diverges from the statewide composition; and (B) the college's outcome rates vary meaningfully between the strata of the adjustment variable. Both A and B should exist to make standardization worthwhile. However, even with A and B in effect, standardization will probably give only a partial remedy to the problem of invalid summary outcome measures. (NB)

Standardization of Rates To Adjust for Differences in Enrollment Composition

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Abstract

Community colleges must often analyze and report rates for outcomes, such as transfers to four-year schools. A single, summary rate for a college's performance may be an invalid measure of its achievement in the transfer goal (or any other selected goal, for that matter) if the summary rate ignores the real differences in enrollment composition at different institutions.

This paper presents a method for adjusting a college's outcome rate to compensate for differences in enrollment composition. This method, known as standardization of rates, has two methods of calculation, the direct method and the indirect method.

For didactic purposes, both methods are demonstrated here on data for transfers and age composition at one California community college. Some general guidelines for the use of standardization are covered.

Introduction

College administrators and college researchers have a growing need to analyze the process and outcome data for their institutions. Two major purposes of such analysis are:

- To advance our understanding of causal forces and
- To implement accountability programs.

These two purposes share a common thread. They must rely upon valid comparisons of data in order to draw conclusions about individual institutions.

California's community colleges embody a very diverse set of local environments. The diversity of environments presents a challenge to the analyst who must compare a specific institution to others in the system. If the analyst does not control for "confounding" variables in the environment, an analysis may draw invalid conclusions about a specific, hypothesized cause-and-effect relationship of concern.

The control of confounding variables matters a great deal for causal analysis. If the analyst concludes that no relationship between an intervention and an outcome exists, when the environmental variables have simply hidden the relationship, then a college may unfortunately abandon an intervention that really would have worked.

The control of confounding variables matters a great deal for accountability programs as well. If a college's performance evaluation uses an inequitable comparison, comparing unlike colleges as if they were truly equivalent in environments, then again one may reach an invalid conclusion about how well that college's administration has done. With an invalid comparison of college outcomes, a college may receive either undeserved blame or undeserved credit. Neither result is desirable.

Over the decades, analysts have used a number of statistical methods to adjust data for the confounding bias that demographic characteristics have upon outcome measures. The method known as standardization is one of these tools to produce data that permit a valid comparison between specific subunits of a system, such as colleges. This method standardizes college-specific data to counteract the confounding of "extraneous" variables in a causal process under review. The discussed method has had a long tradition of use in the fields of health research and demography. For researchers who have worked in these fields, the method is a fairly common tool in their analysis and reporting.

Note that standardization is unnecessary if a college can report outcome rates for specific strata in its enrollment population. This level of detail enables a college to state precisely how a difference in enrollment composition relates to a difference in outcome rate. Unfortunately, many users of such outcome data prefer the use of summary measures, rather than arrays of tables, so that they can make simple comparisons across many different units, or levels, of service delivery.

The Method

In general, standardization works by producing an outcome rate that we assume would occur if a college had the same enrollment composition as the group with which we compare it. The group with which we want to compare a college is called the standard population.

For community colleges, we might use any of the following as the standard population, depending upon the goal of our comparison.

1. State-wide total enrollment at community colleges
2. Another college
3. The total enrollment for a college's district
4. A college's enrollment at a chosen time period

The standard populations given in #1, #2, and #3 above specify differing levels of aggregation for college data, but the data are for a common time period in each case. For example, we would use the statewide total enrollment (#1) as our standard population if we wanted to compare outcomes from all of the state's colleges. Or a district administrator might use the district's total enrollment as a standard population if the administrator were to want a comparison between colleges within the district.

The standard population in #4 differs from the others because it has a unique, but valuable, use. If we want to see how, or if, a college's outcome rate has changed over the years, then we would choose the college's enrollment composition for a given year as the standard population and adjust the rates for all of the other years of outcome data. This can be an important use of standardization, especially where (a) a college wants to compare a rate over many years or (b) meaningful change in enrollment composition at the college has occurred between the time periods used in the comparison. However, for brevity's sake, we will focus on the statewide total enrollment as our standard population in the following demonstration of standardization.

In standardization, we call the raw, unstandardized rate the crude rate. The outcome rate that we have standardized is called the adjusted rate (or the standardized rate). If we were to standardize a rate for the variable gender, we would call the resulting rate a gender-adjusted rate. (Historically, researchers have used the phrase "sex-adjusted rate.")

In an ideal situation, we would have complete outcome data for each stratum (or grouping or level) of the adjustment variable that we suspect will make a difference in the outcome rate. For instance, in a comparison of a college's transfer rate with the statewide transfer rate, we would need the following data to adjust for a difference in age composition:

- The college's transfer rate (the crude rate) for each stratum of the age variable and
- The proportion of the state's enrollment that is in each stratum of the age variable.

This amount of data lets us use the method called direct standardization. If we lack the college's outcome data for the strata under consideration, we can still produce an adjusted rate by using the method called indirect standardization. This second method is less preferred because it tends to be slightly less precise than the direct method. To show how we would calculate standardized rates, with either method, a demonstration using real data is our next section.

Demonstration

For didactic purposes, we will use transfer data for Mission College in this demonstration. Figure 1 displays the two major steps in direct standardization. It is preferable to have count data from which to calculate the proportions and rates at both the college level and the statewide level. The volume of cases in each stratum will help you decide if the standardization is usable. If counts are too small for certain strata (or if zeroes appear), you may need to consider collapsing (that is, combining) similar strata or skipping standardization as a method. Without counts for the strata, we cannot collapse strata as described above because we would not know what weight to give each stratum's transfer rate.

In this demonstration, we dichotomized the age variable into (a) students who were under 25 years of age at the start of the cohort period or into (b) students who were 25 or more in age at the start of the cohort period. This is a simplification that works in this situation. In health research and demography, the age variable usually has strata intervals of ten years in length. Ten-year intervals would not work here because we would have many strata with few or no cases in them.

The calculations were done in Microsoft Excel but analysts may do them with hand calculators almost as easily. Note also that the rate is in a format of cases per thousand students. This format is a convention in the standardization practice to eliminate the need, and inconvenience, of reading a set of long decimal numbers in the tables.

Direct standardization in this example indicates that Mission College's transfer rate closely matches the statewide rate. Thus, when we adjust for age, Mission College's transfer performance is better than we might initially believe, given the lower figure represented by the commonly used crude rate. This example also indicates that age composition is a meaningful variable in estimating transfer performance at Mission College. If the age-adjusted rate had been very close (or the same as) to the crude rate, we would tend to believe that age composition is not a meaningful variable in transfer performance at this college.

Figure 1. Example of Direct Standardization

Example of Calcuation to Adjust Transfer Rate for Age Composition*

Step 1: Assemble Needed Data* for "Crude Rates"

Mission College

	count	proportion
Under 25 age	1252	0.4791
age 25 or more	1361	0.5209
total	2613	

	transfers	tran.rate
Under 25 age	138	0.1102
age 25 or more	18	0.0132
total	156	0.0597

"Standard Population" of State's CC's

	count	proportion
Under 25 age	224836	0.6521
age 25 or more	119966	0.3479
total	344802	

	transfers	tran.rate
Under 25 age	24775	0.1102
age 25 or more	2686	0.0224
total	27461	0.0796

Step 2: Apply State Proportion to College's Data to Find the "Adjusted Rate."

transfer rate adjusted for age composition of a college:

	A: raw transfer rate at a college	B: proportion in "standard population"	**A x B** (or adjusted rate)
Under 25 age	0.110224	0.6521	0.071874
age 25 or more	0.013226	0.3479	0.004602

sum of **AxB** for age groups:	0.076475	or in terms of rate per 1,000 students:	76.48
state-level rate:	0.079643	or in terms of rate per 1,000 students:	79.64
college's crude rate:	0.059701	or in terms of rate per 1,000 students:	59.70

If we had no transfer rate data for the age strata at a college, we could resort to indirect standardization. Figure 2 on the next page shows how to calculate an age-adjusted rate with this alternative method. To simulate the absence of the data used in the direct standardization calculation (Figure 1), "unknown" appears in the table of data for Step 1 of Figure 2.

The big difference in Figure 2 is the use of an "expected transfer count" as a substitute for the missing data. Note that indirect standardization still requires stratum-level counts for the age variable at the college. Without the stratum-level counts, we could not do an indirect standardization to adjust for age composition.

In this example, the standardized rate with the indirect method still shows a higher outcome rate than the crude rate for Mission College. However, it is slightly lower than the rate found with the direct method. We can summarize the results of this demonstration in Table 1.

The ratio of the adjusted rate to the crude rate gives us a rough measure of the effect of adjusting for age. In this case, the effect with direct standardization is 76.475 divided by 59.701, or 1.28. Because this ratio is greater than one, the adjustment has an increasing effect. If it had been less than one, the adjustment would be a decreasing effect. This ratio can be used to evaluate the relative effect that different variables have in the standardization method.

The ratio can also indicate, in a gross manner, the relative difference between enrollment composition variables in their inferred effect on an outcome rate. But this inference is a tenuous one; multivariate statistical analysis is much more suitable to address the quantification of relative effect upon an outcome rate.

Table 1. Summary of the Results of the Demonstration

1. Mission's rate by indirect method:	0.073764 or in terms of rate per 1,000 students:	73.76435
2. Mission's rate by direct method:	0.076475 or in terms of rate per 1,000 students:	76.47537
3. state-level rate:	0.079643 or in terms of rate per 1,000 students:	79.64281
4. Mission's crude rate:	0.059701 or in terms of rate per 1,000 students:	59.70149

Step 1: Assemble Needed Data for "Crude Rates"

Mission College

	count	proportion
Under 25 age	1252	0.4791
age 25 or more	1361	0.5209
total	2613	

	transfers	tran.rate
Under 25 age	unknown	unknown
age 25 or more	unknown	unknown
total	156	0.0597

"Standard Population" of State's CC's

	count	proportion
Under 25 age	224836	0.6521
age 25 or more	119966	0.3479
total	344802	

	transfers	tran.rate
Under 25 age	24775	0.1102
age 25 or more	2686	0.0224
total	27461	0.0796

Step 2: Apply State Proportion to College's Data to Find the "Expected Transfer Count."

	A: standard population's transfer rate per group	B: count of students per group at a college	A x B (or "expected transfers")
Under 25 age	0.1102	1252	137.9597
age 25 or more	0.0224	1361	30.47235
sum of **AxB** for age groups:			168.432

Step 3: Use Expected Transfer Count to Calculate College's Adjusted Transfer Rate

College's Adjusted Rate = (total transfers at a college/ college's total expected transfers) x state's rate

= (156 / 168.432) X 0.0796

= 0.073764

rate with indirect standardization: 0.073764 or in terms of rate per 1,000 students: 73.76435

*Data as found by 2/29/2000 query on the 1994 Expanded Student-Right-To-Know database

Figure 2: Example of Indirect Standardization

Guidelines

Someone who wants to get a complete grasp of standardization should consider the works listed in the References section at the end of this paper. In the meantime, there are some relatively simple guidelines to note. Below are things to remember in using standardization, whether the outcome is transfer rate or some other event.

A. Standardization of rates can help you in two common types of comparisons.

- A comparison of a college's rate to the rate(s) of one or more colleges in one time period.
- A comparison of a college's rate in different time periods.

B. To help the first-time user of standardization here are the basic steps to follow.

1. Select the outcome rate to standardize.
2. Select the variable for which you need to adjust.
3. Select a "standard population."
4. Check the consistency of the data for the different levels in the analysis. (Is data captured in the same manner for each college and for each group in the adjustment variable?)
5. Select an appropriate grouping for the adjustment variable.
6. Assemble data in the chosen format.
7. Calculate the adjusted rate.
8. Compare the adjusted rate to the unadjusted (or "crude") rate to see if the adjusted rate differs in a meaningful way.
9. If you use the adjusted rate, document your calculation of it.
10. When you use the adjusted rate, label it appropriately.

Figure 3 summarizes general considerations in the use of direct standardization. Figure 4 summarizes additional considerations in the use of indirect standardization.

Figure 3. Some points to remember about direct standardization.

1. The adjusting variable should be one that has relevance to the causal process measured.
2. If you adjust for a "continuous" variable, the grouping interval can make a difference.
3. The standard population may be any one you choose; the state total is used here because I attempt to compare colleges against the system as a whole.
4. This method becomes awkward when you need to adjust for more than a couple of variables.
5. If the data you adjust are sample data, then calculate the confidence intervals.
6. The method can adjust for compositional differences of the same data elements from differing time spans, not just across geographically differing reporting units.

Figure 4. Additional points for indirect standardization.

1. Useful if stratum-specific transfer rates are unavailable.
2. Useful if stratum-specific transfer rates are very small, hence unreliable.
3. Less preferred to direct standardization because of slightly less accuracy.

Conclusion

Not every college will benefit by standardizing one or more of its outcome rates. A college will benefit from the method if (a) it has an enrollment composition that diverges from the statewide composition and (b) the college's outcome rates vary meaningfully between the strata of the adjustment variable. Both (a) and (b) should exist to make standardization worthwhile.

Second, the finding of a large difference between a standardized rate and a crude rate is limited evidence of a relationship between the adjustment variable (also called the "controlled" variable) and an outcome measure. The adjustment variable may only have a statistical correlation with the outcome measure. As we should all remember, statistical correlation between two variables is necessary, but not sufficient, evidence of a causal relationship between these variables.

In closing, remember that even with (a) and (b) in effect, standardization will probably give only a partial remedy, if any, to the problem of invalid summary outcome measures. Validity is rarely an "all-or-nothing" issue; standardization to adjust for a relevant variable will make a summary measure relatively more valid than no adjustment at all. If the standardized rate still contains the effect of one or more major confounding variables, then someone will need to do more analysis, perhaps with more sophisticated methods, to produce a more valid outcome measure.

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