The Community College Transfer Calculator: Identifying the Course-Taking Patterns that Predict Transfer

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Introduction to Issues

Transfer is a necessary component of retention for community college students seeking a baccalaureate. Transfer, therefore, can be viewed as a form of system persistence. The Center for the Study of Community Colleges studied transfer rates from 1984 to 1987 and found a consistent transfer rate of approximately 22 percent (Cohen & Brawer, 2003), a proportion that has remained relatively static through time (Nora, 2000; Palmer, 2000, 2005; Spicer & Armstrong, 1996). Although transfer rates have been problematically low for most community colleges, the problem may be more crucial in the state of California based on its very large community college student enrollments. California Community Colleges, the subject of this chapter, enroll almost twice as many students as the total sum in the University of California and California State University systems (California State System, 2007; University of California System, 2007). A recent report indicated that California's low graduation and transfer rates the may actually threaten the future of the state (Shulock & Moore, 2007).

In this chapter we provide information on the *Community College Transfer Calculator*©, a web-based application initially calibrated for the Los Angeles Community College District, but customizable for other colleges, districts, or states. Currently the "Calculator" is an accurate gauge of characteristics based on a former cohort of students in Los Angeles but may also be instructive to other large urban districts. The "Calculator" is designed to be a tool to assist students to understand the pathway to transfer and thus encourage success.

Transcript Analysis

Throughout this chapter we use the term "transcript analysis" to include the investigating, coding, and analysis of college records regardless of their type. Transcript analysis consists of a series of planned and systematic analyses of data routinely collected by community colleges including enrollment files, college application data, financial aid records and other state and federally mandated files. Simply put, records kept at the colleges record demographic information that can be merged with academic data such as the courses in which students enroll, the grades they earn, the courses they drop, the sequence of enrollments they follow, and general course-taking patterns. Unlike information collected via questionnaires, transcript data are not subject to student memory or truthfulness – they are the true records of student accomplishment and actions that can inform policy analyses and enrollment management (Adelman, 1996).

Specific issues/Questions examined

The research questions driving the construction of the *Community College Transfer Calculator*© are:

- What are the key markers of transfer for community college students?

- How is the likelihood of transfer affected by the successful completion of various types of courses?
- How is the likelihood of transfer affected by grades and successful completion of all courses?
- What types of factors or measures can be derived from transcript level data?
- How can transcript level data be transformed into a useful and user-friendly tool?

In response, this chapter examines the types of measures that can be derived from transcript level data and illustrates how these measures can be constructed and subsequently utilized in a model that predicts the likelihood of transfer of specific students under conditions of common enrollment patterns. We introduce a tool that may not only be useful in its present mode but made more powerful through the application of specific transcript data pertaining to a particular institution or district.

What is the Community College Transfer Calculator?

The *Community College Transfer Calculator©* is a downloadable tool based on transcript analysis of a longitudinal cohort of transfer-aspiring community college students. The tool is calibrated to a logistic regression equation that predicts the impact of key variables on transfer. The tool allows the user to enter student-specific data using pull-down menus and to instantly calculate the result of specific course-taking on the probability of transfer.

The "Calculator" is a tool that can be useful to different audiences. Academic advisors may use the tool to not only understand the effect, powerful in some cases, of taking a specific course pattern, but may also use it to individually advise students to take the courses that may be of most value for the transfer goal. Instructors of college success courses as well as those leading student orientations may find the "Calculator" especially useful in illustrating the power of enrolling in the courses that are more likely to result in student success. Policy makers may benefit from understanding aggregate findings of transcript analysis to create and promote policies that will assist students to achieve their goals. The "Calculator" can also be used to test the extent to which course-taking policies produce the intended results of enhancing transfer. It can also easily assess the impact of simulating course-taking patterns within different levels of academic readiness in English.

Although transcript analysis and the Community College Calculator can be powerful tools, we have not identified a "silver bullet" or answer to students who come to college ill-prepared for the academic rigor necessary to prepare for the four-year university. Indeed, while it may be intuitive to tell a student that "taking transfer level math will increase the likelihood of transfer," in reality many students do not have the math preparation to enroll in the course without several remedial courses. Rather, we contend that the "Calculator" can provide clear evidence of the value of persevering through the necessary developmental math sequence as a step in reaching a transfer goal. The techniques examined and presented will demonstrate the power of courses and academic successes in the likelihood of transfer.

"Calculator" Design and Methodology

The design of the "Calculator" stressed specific community college courses known from the literature to be related to student transfer and success. The design stressed mathematics, English, and science courses because previous studies have indicated these specific course types are powerful enablers of transfer to the four-year sector (Adelman, 1999, 2005; Cabrera, Burkum & LaNasa, 2005). Moreover, the predictive power of these types of courses has been recognized by the national initiative *Achieving the Dream: Community Colleges Count.* The initiative has required each college to identify "gatekeeping courses" and to report data on pass rates[1].

In the construction of the "Calculator" Template, it was necessary to first address the question "what are the key markers of transfer for community college students?" The literature has identified the following items as important predictors of transfer:

- Demographics including age, gender, and ethnicity (Cabrera, Burkum & LaNasa, 2007; Calcagno, Crosta, Bailey, & Jenkins, 2007; Dougherty & Kienzl, 2006; Melguizo, 2006);
- Course completion ratio (Calcagno et., al, 2007; Hagedorn, Cypers, & Lester, in press) or the proportion of courses in which a student enrolls that is successfully completed;
- Remedial/developmental needs (Boylan, 1995; Cabrera et., al, 2005; Calcagno et., al, 2007; Dougherty, 1994; Townsend, McNerny & Arnold, 1993);
- Highest level of math completed (Adelman, 1999; Calcagno et., al, 2007; Cabrera, Burkum & LaNasa, 2005);
- Number of science courses completed (Cabrera, Burkum and LaNasa, 2005);
- College grades (Adelman, 2006);
- Level of engagement (Calcagno, Crosta, Bailey, & Jenkins 2007; Driscoll, 2007; Laanan, 2007; McClenney, 2007; Tinto, 1975; 1987; 1993).

Sample

The Los Angeles Community College District is comprised of nine colleges and serves a geographic area covering more than 36 cities across more than 882 square miles (LACCD, 2007). In the fall of 2006, the district recorded a total enrollment of 114,777 students that reflected the diversity of the surrounding communities. The district classified approximately 80% of all students as "minority" while 40% were non-native English speakers (LACCD, 2007). Like all districts in the state of California, the LACCD tuition costs are among the lowest in the country.

We included all first-time transfer-hopeful students enrolling in any one of the nine campuses in the Fall 1997 semester who enrolled in a Mathematics course and followed them longitudinally through their transcript records for 10 years. This selection criterion is consistent with research showing that taking mathematics is a powerful predictor of transfer (Adelman,

[1] At the time of this writing, the Achieving the Dream Initiative is working within 15 states with over 80 campuses.

1999, 2006; Cabrera, Burkum & LaNasa, 2005; Hagedorn, Maxwell, & Hampton, 2002). Furthermore, transfer hopeful students are advised to take mathematics in the first semester of enrollment. The result was a group of 5,031 individuals, 30% of all entering students who could be followed via transcripts, through the spring 2007 term. The extended time span recognized and acknowledged the transient nature of the students who attend community colleges and at the same time provided adequate time to determine transfer with some certainty. The 10 year span was also chosen based on previous research using these data that revealed the median time for transfer was 11 semesters of active enrollment (Hagedorn, Cypers, & Lester, in press). However, for many of the students, semesters of enrollment were interspersed with semesters of non-enrollment meaning that in actuality, the time between first and last enrollments may be chronologically distant. Students were initially placed at a particular level of Mathematics based on their scores on an assessment examination in combination with their high school math record. These initial placements are not infrequently adjusted based on further examination and advice by the instructor of the initial course or by a counselor. .

Substantial differences emerged by age, ethnicity and gender in the distribution of the subgroup by their math placement level. Almost 33% of those under 20 were assessed at three courses or more below the Mathematics transfer level, but 69% of those 35 over were so placed. Over 35% of those under 20 were assessed at one course below the transfer level, technically not a basic skills course, or higher. But, only 12% of those 35 plus achieved this placement. Similarly, 6% of Asian, 13% of white, 29% of Latino and 37% of African-American students were assessed at three levels below transfer or lower. In the same manner, 62% of Asian, 40% of white, 22% of Latino and 15% of African-American students were placed in the highest two levels. By gender, 27% of females but only 20% of males were in the lower grouping, while 25% of females and 36% of males were in the highest categories of placement.

The Data

We began with two data sets from the district. The demographic file consisted of data from college applications such as gender, age, and ethnicity. The second file, called the enrollment or transcript file, consisted of a listing of all enrollments with details on the semester, the grade earned, and the credits accrued. It is important to note how these two files differ. The demographic file uses the student as the unit of analysis (one line per student). On the other hand, the enrollment file structure uses the enrollment or course as the unit of analysis (one line per enrollment creating multiple lines per student). Understanding the difference between records coded for the individual and records coded for courses is a necessary condition for successful transcript analyses. Success in merging individual data with transcript records presumes aggregation of information from the transcript file to form a student measure that can subsequently be merged into the student demographic file[2].

[2] Different districts, colleges, or state structures may employ a different structure. For example, a unit may use a structure where the student's enrollment is recorded by a time structure (such as semester or trimester). In this arrangement, the researcher would need to vector by courses. While the exact extraction of data may differ from our

Types of Measures Derived from Transcripts

The processes of data analysis allow the researcher to create specific measures that can be later utilized in more complex models to study student phenomena. A common example of a measure derived or calculated from transcript data is grade point average (GPA). Whereas the transcript file provides the individual grade earned from a specific course, GPA requires the calculation of an aggregated measure across multiple enrollments and over multiple semesters. To calculate a student GPA each course in which a student enrolls must be coded for the number of credits it provides and the letter grade converted to a numerical value (A= 4; B=3; C=2; D=1, F=0)[3]. GPA is then calculated as:

$$\frac{\sum_{\text{all enrollments}} (\text{Numerical Grade}) * (\text{Number of Credits})}{\text{Sum of Credits}}$$

Operationalizing the variables of interest.

The process we outline requires the careful design and construction of the identified measures through manipulation of the enrollment file. The variables used in the analyses were operationalized as follows:

- Course completion ratio. The course completion ratio (CCR) is defined as the proportion of credits successfully completed (grade of A, B, C, D, or Pass) calculated as:

$$\text{CCR} = \frac{\sum \text{credits completed with the grade of A, B, C, D, or P}}{\sum \text{of all credits enrolled}}$$

  The CCR compares a student's success against enrollment behavior. In other words, the student acts upon academic plans by enrollment in courses. The CCR then computes the proportion of the goal successfully completed.

- Developmental needs. We operationalized remedial or developmental needs by coding the level of the first Math and English courses taken. The LACCD employs a hierarchical structure organized by level and pre-requisites first categorizing transfer level (college proficiency) and compares other courses by the number of levels below college proficiency; extending to 4 levels below transfer. Transfer level math courses

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discussion, the final product would need to be merged with demographic data. Although many different structures may exist, in this manuscript we are using a common structure often employed in colleges where the enrollment is the unit of entry.

[3] Grades of Withdrawn (W), Incomplete (I), Pass (P), Fail (F), Retake without credit (R) are not included in the GPA calculation.

were initially coded with a "1" while those below transfer level were coded by the number of levels below transfer (-4, -3, -2,-1).

- Highest math taken. We used the same coding as described above to record the highest math course in which the student enrolled.
- The number of science courses taken was operationalized through tagging all science courses and subsequently summing the number of courses[4].
- Grades were operationalized by calculating the cumulative GPA.
- Involvement or time on campus was calculated as the average credits per semester

The Building of the "Calculator"

When calculating a student level variable from the enrollment file, the file was aggregated by student reference number and the item of interest calculated. The aggregated values by student were then merged back into the file that contained demographic information. In this fashion we created a working file that used "the student" as the unit of analysis.

Also merged into the working file was transfer status. Transfer information was secured from the National Student Clearinghouse (NSC). For each of the students in the dataset, a "1" was recorded if the student had enrolled in a four-year institution. Non-transfers were coded with a "0". It may be important to note that enrollment in a four-year college or university does not indicate successful completion of the baccalaureate or in some cases even successful completion of a full semester of courses. The definition of transfer for our calculator is merely enrollment in a four-year institution.

Estimation method.

Since our outcome of interest, transfer, is dichotomous[5], we employed logistic regression to examine the relationship of personal characteristics and course taking patterns with the probability of transferring (Cabrera, 1994; Hosmer& Lemeshow, 2000). Logistic regression is especially useful for predicting in which of two categories (i.e., transferred or not transferred) a person is likely to fall given certain characteristics or factors (Field, 2005). Logistic regression uses a logarithmic transformation to overcome the assumption of linearity (Field, 2005) and seeks to obtain the best-fitting model to describe the relationship between the dependent variable (in this case, transfer) and the set of independent measures derived from the data.

Data exploration

Prior to testing a prediction model, we examined the data using several screening criteria. We first paid attention to the distribution of the variables. For some of the variables we noted a

[4] A course was recorded if the student successfully completed it with a grade of A, B, C, D, or P. Science courses that were not successfully completed (grade of W, I, or F) were not included in the count.

[5] Dichotomous variables are those that exhibit only two levels--for example gender (M/F). Transfer is dichotomous because students either transfer or they do not.

high degree of skewness resulting from the low number of cases in some of the categories. In some cases we collapsed values when variability was very low. Next we examined the degree of collinearity among variables. In so doing we first examined the correlations among the selected predictors[6]. We noted a high level of correlation between lowest math course and highest math (.818). A very high level of correlation indicates that these two variables essentially provide the same information and should not be used simultaneously in the estimation of the transfer model. Accordingly, we decided to use the high math variable and to remove the low math from the equation. Subsequently, we examined the variance inflation factor (VIF) and tolerance indices. Both types of indexes fell within the acceptable ranges.[7]

Model Testing.

All of the variables were entered into the logistic regression equation using a forced entry (1-block) method. Several measures of goodness of fit were used to appraise the transfer logistic regression model. The χ_2 (chi-squared) signifies the extent to which the variables as a group are associated with transfer. A significant value indicates a good fit. The classification Table, or PCC, reports the percentage of cases correctly classified by the model[8] (Aldrich & Nelson, 1984; Hosmer & Lemeshow, 2000). While the -2 log likelihood cannot be interpreted alone, it is useful as a measure of comparing one model to another. In our case, we compare our model to a baseline model using only the calculated constant. The Hosmer and Lemeshow Test compares the models and tests for significant difference between the observed and predicted values of the dependent variable. Thus for this test a non-significant value implies that the model estimates fit the data at an acceptable level. The Cox & Snell and Nagelkerke R^2 values are similar in interpretation to an R^2 in multiple regression. In other words, these R-statistics provide measures of the partial correlation between the dependent variable and each of the predictor variables. The two measures use a different computation and hence the results differ. However, together they provide a "gauge of the significance of the model" (Field, 2005, p. 223). Table 1 provides selected measures of goodness of fit.

We constructed the "Calculator" faceplate using the programming language of C# that could provide an interface with our output and allow a method of inputting the specific values of the template factors.

-----Insert Table 1 About Here ---

[6] These correlations were estimated using the asymptotic distribution free procedures contained in PRELIS version 8.8 (Joreskog & Sorborm, 2006). PRELIS is suited for estimating correlations among categorical and ordinal variables as is the case in this study (Finney & DiStefano, 2006; Joreskog, 2004).

[7] Cohen and associates (2003) suggest that VIF values of 10 or higher signify multicollinearity problems. They also indicate that tolerance levels of 0.10 or less are problematic.

[8] PCC stands for **P**ercentage of Cases Correctly **C**lassified.

Use of the "Calculator"

The Community College Transfer Calculator was made available on the Internet to the Los Angeles Community College District. Figure 1 provides a view of the "Calculator" faceplate.

-----Insert Figure 1 About Here -----

The Community College Transfer Calculator© is used to calculate the likelihood of transfer for a specific student-type based on specific academic and course variables. The "Calculator" provides several options as well as a helpful description. The Likelihood of Transfer percentage changes as the variable options are altered. By clicking on the link "Description" the user is provided with directions on how to choose the most applicable variable for the student of interest (see Figure 2).

Variable options are changed by clicking on the right hand corner of the options box, and choosing the desired option from the drop down menu (Figure 3).

The Community College Calculator also includes a matrix version that can be viewed by clicking on the tab labeled "Matrix Version" at the top of the "Calculator" window. The variables, options, and descriptions are the same as described earlier. The Matrix version provides a visual display of the likelihood of transfer based on entry level of English and highest level of mathematics completed. The Matrix version (see Figure 4) allows a visual of the different course options and reveals the power of the combination of English and Mathematics.

-----Insert Figures 2, 3, and 4 About Here -----

As indicated, the calculator is currently calibrated for the Los Angeles Community College District but was designed to be customizable to other sites. Once the calculator is installed, the user can customize it by adding institution-specific factors and data. The logistic regression weights or b-values and the constant, calculated via a statistical program such as PASW, SAS, or other software product can be entered by first clicking on the "Update b-Values" button above the "Calculator" tabs (see Figure 5). The results can be transferred to the "Calculator" template by entering the regression b-values and subsequently clicking on the "Update b-Values" button. A window will appear containing a column of variables, options, and values. In order to change values, simply click within the white box next to the desired variable option and enter the derived b-values specific for the institution. When done, simply click "Save" at the bottom of the window. The calculator will be updated and "Likelihood of Transfer" will now be derived based on the newly entered values.

-----Insert Figure 5 About Here -----

Policy Implications—Using the "Calculator"

The calculator can be used in a variety of situations including in individual and group settings such as in private advising sessions, orientation sessions or as part of a college success course. Through an "album" of scenarios we provide examples of appropriate usage of the "Calculator" at a hypothetical college; Sunnyvale Community College.

Album Scenario 1

Sunnyvale Community College has recently instituted a mandatory college success course (SCC 100) for all first-time college students. The course is designed to assist students to accrue knowledge about how to be a successful college student. The course is focused on clarifying values, setting goals, and making sound decisions. The instructors use *the Community College Transfer Calculator* in a lesson on creating program plans, persevering through the curriculum, and avoiding dropping courses. Students are provided access to the "Calculator" and while working in small groups create contingency tables to illustrate the importance of persistence through the math sequence.

Album Scenario 2

Sunnyvale College advisor, Mr. John Jones, is advising a young Asian male who is currently placed in both developmental English and mathematics. In the private advising section, Mr. Jones demonstrates that through perseverance through the math sequence all the way through transfer level the young man can increase his likelihood of transfer from 28.6% to 62.7%. Mr. Jones also recommends additional courses for the student's program of studies. The "Calculator" is also used to show how in addition to the math sequence, the addition of two science courses can add significantly to the likelihood of success to transfer.

Album Scenario 3

An older African American woman on a very slow credit-accruing track meets with her advisor to discuss the course offerings for the next semester. Due to family and employment constraints, the mature student can only enroll in one course per semester. The "Calculator" can be used to indicate that by increasing her academic engagement and involvement to a two-course per semester rate, the likelihood of transfer doubles (from 14.6% to 33.0%). The advisor also points out the by increasing the intensity of enrollments, transfer can occur more quickly. The advisor assists the student to find sources of financial aid that will compensate for her reduced employment schedule.

Album Scenario 4

Elaine Brown, a recruiter for Sunnyvale is attending the local high school's "College Night" to talk to groups of students and their parents interested in attending Sunnyvale prior to transfer to a four-year university. Ms. Green demonstrates the importance of enrolling in the

high school's college preparatory courses such as college algebra and English literature while in high school so that students will be ready to enroll in college-level courses when they are students at Sunnyvale Community College. Ms. Green uses the "Calculator" in her demonstration to emphasize the importance of early planning for the complete college and university experience.

Album Scenario 5

Sunnyvale's humanities faculty are convinced that their courses prepare students for their university experiences. To attract more students to enroll in the department's offerings, the faculty have begun a campaign entitled "Humanities for All Humans". They ask Sunnyvale's institutional researcher to calculate the increase in likelihood of students transferring by taking 1, 2, or 3 humanities courses. The college's institutional researcher adds the number of humanities courses taken by a past cohort of students and adds the variable to their customized *Community College Transfer Calculator*. The results of the "Calculator" are used in the campaign to add benefit to enrolling in humanities. The results are discussed not only in faculty meetings of the Humanities faculty, but also among the upper administration at Sunnyvale.

Album Scenario 6

The Board of Trustees of Sunnyvale has asked the College to consider mandatory orientation sessions for all incoming first-time students. Sunnyvale's President has convened a special committee to look into the matter and to suggest a curriculum. The committee first asks the Director of Institutional Research to add a variable to their customized "Calculator" that indicates if students have attended orientation. The Director of Institutional Research notes that for the incoming class of 1998, the academic advisors kept lists of attendees to the then voluntary orientation. Using the directions and templates for the *Community College Transfer Calculator*, IR creates a custom design that includes not only transfer status but also if the student attended orientation. The "Calculator" is then used to illustrate for the former cohort, the difference in likelihood of transfer depending on attendance at the orientation session. The "Calculator" is further used in the committee's discussions to see the course-taking patterns that also made a difference in likelihood of transfer. This information is made a part of the orientation session's curriculum.

Album Scenario 7

The state university in close proximity to Sunnyvale offers graduate degrees in education. A professor of Counselor Education has designed a new course entitled Seminar in Counselor Education to help doctoral students in the Department of Counselor Education achieve understanding of, insight into, and effective planning for the work, roles, and responsibilities of being a counselor at a community college or university. With permission from Sunnyvale, the professor will be using the Community College Transfer Calculator in her unit on community college transfer.

Interpreting the Community College Transfer Calculator Results—Interpreting Contingency Tables

Using the default data derived from the LACCD, we used the *Community College Transfer Calculator*© to develop a series of contingency tables to illustrate the power of taking specific courses on the probability of transfer. It is interesting to note the "stepping stone" nature of the probabilities. Each step horizontally (to the right) and vertically (down) increases the probability of transfer. Table 2 was derived for a young Asian female enrolling in 9 or more credits taking 1 science course. Note that depending on English entry level and final math the probability of transfer varies from 19.28% to 80.23%. Obviously, student level of initial enrollment makes a difference. Although students must begin in the English level in which they were assessed, persevering through the math sequence is extremely powerful. Tables 2 through 6 are similar but differ by the ethnicity of the student. Although the exact values fluctuate, it is clear that the power of taking college level math holds regardless of ethnicity.

-----Insert Tables 2 through 6 About Here -----

While it may be intuitive to conclude that starting in a higher level of English and/or taking transfer level mathematics is conducive to transfer, the *Community College Transfer Calculator*© provides strong evidence of the power of course-taking and academic success for community college students. Policy makers and others should be aware of these important relationships. In addition to making developmental students aware of the need to take the full math sequence, colleges may consider forming learning communities, mandatory tutoring sessions, and other forms of supplemental instruction for transfer-hopeful students struggling in mathematics.

Tables 7 through 9 display the joint probabilities of math and science. Again, the probabilities step up horizontally and vertically. Using the Asian Female (Table 7) as an example indicates that the probability of transfer can fluctuate from 41.85% to 85.38%. The contingency tables indicate the importance and value of successfully enrolling in transfer level courses. Although multiple science courses may not be appropriate for all students in all academic disciplines, the use of science in our data indicates reflects the transfer readiness policy in California that includes courses in physical and biological sciences. Thus, as displayed by the "Calculator", students in line with the readiness standards are more likely to transfer.

-----Insert Tables 7 through 9 About Here -----

Like all of the findings, the results of enrolling and completing science courses must be interpreted in conjunction with all of the other findings. It may be argued, for example, that students enrolling in science courses may be more disciplined and/or be more academically able.

However one must be aware that the significance of these courses remains despite the inclusion of math level and GPA in the model (serving as controls). Further, while we do not infer causality, it may be that more disciplined students are more apt to transfer. Or, in reverse it may be that the discipline of science relates to transfer. In other words, we posit that students following a more disciplined path consisting of mathematics and science, may be more successful in transfer. The "Calculator" indicates that enrolling in a disciplined manner may be advisable. Thus, discipline in this sense is not just an attribute internal to the student but also an attribute of the instructional map. Our controls of initial math level and GPA certainly suggest that following the instructional map closely leads to greater student success. We do feel that further research that can distinguish the student's internal discipline from the discipline of the instructional system is needed, not only to provide additional control to our results, but even more significantly to be able to understand how the institution can encourage a more disciplined student approach to course taking.

Table 10 highlights gender and enrollment. This table breaks out the difference in probability between part time and full-time enrollment for men and women. While many community college students have familial and work-load issues that prevent them from taking a heavier load, the fact remains that casual enrollment threatens the probability of transfer for both genders. Policies to encourage students to enroll more intensely appear appropriate.

-----Insert Table 10 About Here -----

Finally tables 11 and 12 are included to demonstrate the joint effect of successfully completing courses and enrollment intensity for females and males respectively. While it is intuitive that students who do not complete the majority of their courses are less likely to transfer, the contingency tables provide sound evidence of the drastic consequences of dropping courses.

-----Insert Tables 11 and 12 About Here -----

Recommendations to improve practice for community college leaders, practitioners and policymakers

Community colleges have been accused of operating without the benefit of enrollment management data. Further, it has been assumed that data driven decisions require colleges to invest in costly data collections and analyses, most of them involving surveys and questionnaires that are difficult to collect due to the transient nature of the community college student. We contend that the use of transcript analyses allows colleges to make data-driven decisions using data already mandated, collected, and stored. Furthermore, we have demonstrated that it is possible to describe the results of analyzing transcript data in ways that are easily understood by

faculty, academic advisors, and others. Our construction of the *Community College Transfer Calculator*© is a tool to make the process a bit easier and more straightforward.

We want to emphasize that colleges should use *their own* data. While we have constructed a working "Calculator" that accurately reports transfer probabilities, the results only truly reflect the population from which the data were derived- the Los Angeles Community College District. Community colleges are all unique in that they reflect their own communities with their distinctive brand of students. To expect that data derived from Los Angeles can accurately predict the likelihood of transfer of a student enrolled in a community college in New York, Montana, or Texas may not be realistic. Further, national data, while informative and useful, can only provide general benchmarks while not taking into consideration the unique community that that a college serves. Therefore we emphasize the need for each college to look at its own data and to examine the course taking patterns of the students who enroll for their courses. Each college should isolate the measures of success that are important to their students. Since outcomes such as transfer, graduation, and degree acquisition are dichotomous, the technique we demonstrate is generally appropriate. Further, the "Calculator" Template can accept values for other dichotomous outcomes. Thus, the *Transfer "Calculator"* can become the *AA Calculator* or other outcome of interest.

Academic advisors and others should counsel students to design their academic programs and then to adhere to the courses. Unfortunately many students enroll in community colleges ill-prepared for college level work. They must take remedial/developmental coursework prior to transfer and/or degree. Although students in need of deep remediation are less likely than their counterparts who require little or no remediation to transfer, students can be successful if they persevere and climb the developmental ladder. As indicated by our LACCD "Calculator", a full-time student who begins study at one level below transfer level English and two of more levels below transfer level math can increase her likelihood of transfer from 34.3% to 68.6% if she perseveres and climbs the developmental ladder through college level math. Further, this same student can increase her likelihood of transfer by about 12% by taking two science courses.

The transfer "Calculator" can translate student course-taking behaviors into measures of curricular impact. One of those impacts relates to articulation agreements between community colleges and four-year institutions. The "Calculator" could be used to examine the extent to which several course-taking patterns at the community college result in transfer rates consistent with the expectations that guided the original articulation agreements. In other words, the "Calculator" can isolate those course-taking patterns that create obstacles and stumbling blocks and may need revision. Another course-taking impact that can be examined is the extent to which combination of science courses along with different levels of remediation maximize a student's likelihood to transfer. Finally, the course-taking "Calculator" can be used to examine the undocumented impact of students' choices in the timing and kind of courses they take at the community college. The policy maker may be unaware of the combination and patterns of courses and their relative effectiveness in facilitating or even inhibiting transfer across particular student populations (e.g., older students, minorities). In short, we see the "Calculator" as a new

means of communication between student actions and student outcomes while informing policy decision making regarding course-taking practices.

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Table 1. Measures of Goodness of Fit

Measure	Value
χ^2	121.915 (18) *
Classification Table (Percentage Cases Predicted or PCP)	81.7%
-2 Log Likelihood	2571.202
Hosmer and Lemeshow Test (df)	9.831 (8)
Cox & Snell R-Square	.303
Nagelkerke R-Square	.448

P <.001

Table 2.

	Highest Level of Math Attained			
Level of English Upon Entry		Two Levels Below College Level	One Level Below College Level	College Level
	3 or More Levels Below College Level	19.28%	33.2%	50.05%
	Two Levels Below College Level	34.07%	51.82%	68.44%
	One Level Below College Level	36.84%	54.83%	70.99%
	College Level	49.18%	66.82%	80.23%

Holding Constant:
Gender=Female
Ethnicity=Asian
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Number of Science Courses=1
Community College GPA=Mostly A's and B's (3.0 to 4.0)

Table 3.

	Highest Level of Math Attained			
Level of English Upon Entry		Two Levels Below College Level	One Level Below College Level	College Level
	3 or More Levels Below College Level	22.3%	37.4%	54.64%
	Two Levels Below College Level	38.32%	56.39%	72.27%
	One Level Below College Level	41.22%	59.34%	74.63%
	College Level	53.77%	70.77%	82.99%

Holding Constant:
Gender=Female
Ethnicity=White
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Number of Science Courses=1
Community College GPA=Mostly A's and B's (3.0 to 4.0)

Table 4.

	Highest Level of Math Attained			
Level of English Upon Entry		Two Levels Below College Level	One Level Below College Level	College Level
	3 or More Levels Below College Level	15.84%	28.15%	44.13%
	Two Levels Below College Level	28.95%	45.88%	63.09%
	One Level Below College Level	31.5%	48.9%	65.86%
	College Level	43.27%	61.35%	76.19%

Holding Constant:
Gender=Female
Ethnicity=African American
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Number of Science Courses=1
Community College GPA=Mostly A's and B's (3.0 to 4.0)

Table 5.

	Highest Level of Math Attained			
Level of English Upon Entry		Two Levels Below College Level	One Level Below College Level	College Level
	3 or More Levels Below College Level	13.79%	24.97%	40.16%
	Two Levels Below College Level	25.71%	41.87%	59.22%
	One Level Below College Level	28.09%	44.84%	62.1%
	College Level	39.32%	57.42%	73.11%

Holding Constant:
Gender=Female
Ethnicity=Hispanic
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Number of Science Courses=1
Community College GPA=Mostly A's and B's (3.0 to 4.0)

Table 6.

	Number of Science Courses Taken			
Highest Level of Math Attained		None	One	Two or More
	Two or More Levels Below College Level	46.38%	53.77%	62.6%
	One Level Below College Level	64.29%	70.77%	77.7%
	College Level	78.4%	82.99%	87.53%

Holding Constant:
Gender=Female
Ethnicity=White
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of English Upon Entry=College Level

Table 7.

	Number of Science Courses Taken			
Highest Level of Math Attained		None	One	Two or More
	Two or More Levels Below College Level	41.85%	49.18%	58.2%
	One Level Below College Level	59.96%	66.82%	74.35%
	College Level	75.12%	80.23%	85.38%

Holding Constant:
Gender=Female
Ethnicity=Asian
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of English Upon Entry=College Level

Table 8.

	Number of Science Courses Taken			
Highest Level of Math Attained		None	One	Two or More
	Two or More Levels Below College Level	36.19%	43.27%	52.32%
	One Level Below College Level	54.14%	61.35%	69.55%
	College Level	70.41%	76.19%	82.16%

Holding Constant:
Gender=Female
Ethnicity=African American
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion=Completes 80% or More of Courses Enrolled
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of English Upon Entry=College Level

Table 9.

	Number of Science Courses Taken			
Highest Level of Math Attained		None	One	Two or More
	Two or More Levels Below College Level	32.52%	39.32%	48.25%
	One Level Below College Level	50.07%	57.42%	65.99%
	College Level	66.91%	73.11%	79.64%

Holding Constant:
Gender=Female
Ethnicity=Hispanic
Age=24 Years or Younger
Average Credits per Semester=9 Credits or More
Course Completion Ratio=Completes 80% or More of Courses Enrolled
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of English Upon Entry=College Level

Table 10.

	Average Credits Per Semester				
Gender		Less Than 3 Credits	Between 3 and 6 Credits	Between 6 and 9 Credits	9 Credits or More
	Male	11.88%	19.29%	40.76%	59.46%
	Female	12.73%	20.55%	42.68%	61.35%

Holding Constant:
Ethnicity=African American
Age=24 Years or Younger
Course Completion Ratio=Completes 80% or More of Courses Enrolled
Highest Math Attained=One Level Below College Level
Number of Science Courses=One
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of Entry English=College Level

Table 11.

	Average Credits Per Semester				
Course Completion Ratio		Less Than 3 Credits	Between 3 and 6 Credits	Between 6 and 9 Credits	9 Credits or More
	Completes Less Than 80% of Courses Enrolled	9.29%	15.37%	34.32%	52.7%
	Completes 80% or More of Courses Enrolled	15.62%	24.71%	48.58%	66.82%

Holding Constant:
Gender=Female
Ethnicity=Asian
Age=24 Years or Younger
Highest Math Attained=One Level Below College Level
Number of Science Courses=One
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of Entry English=College Level

Table 12.

	Average Credits Per Semester				
Course Completion Ratio		Less Than 3 Credits	Between 3 and 6 Credits	Between 6 and 9 Credits	9 Credits or More
	Completes Less Than 80% of Courses Enrolled	8.64%	14.37%	32.56%	50.72%
	Completes 80% or More of Courses Enrolled	14.6%	23.27%	46.61%	65.04%

Holding Constant:
Gender=Male
Ethnicity=Asian
Age=24 Years or Younger
Highest Math Attained=One Level Below College Level
Number of Science Courses=One
Community College GPA=Mostly A's and B's (3.0 to 4.0)
Level of Entry English=College Level

Figure 1. The Community College Transfer Calculator

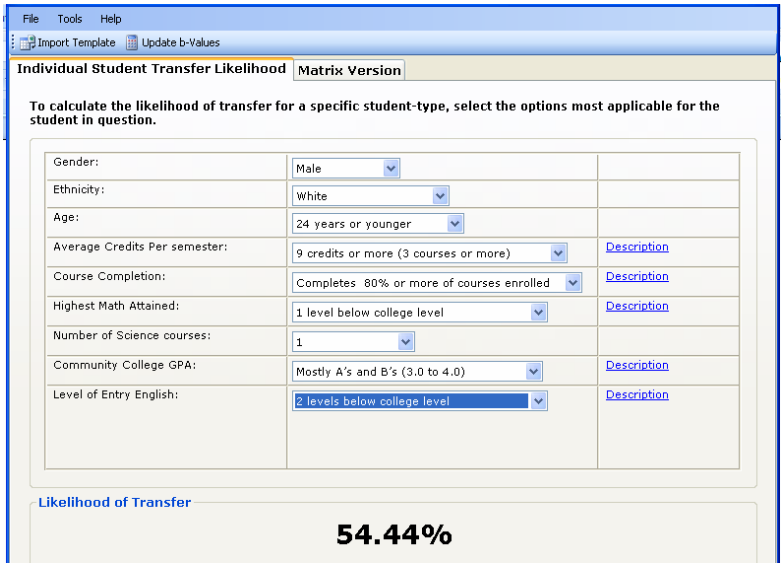

Figure 2. Supplementary Descriptions of Variables

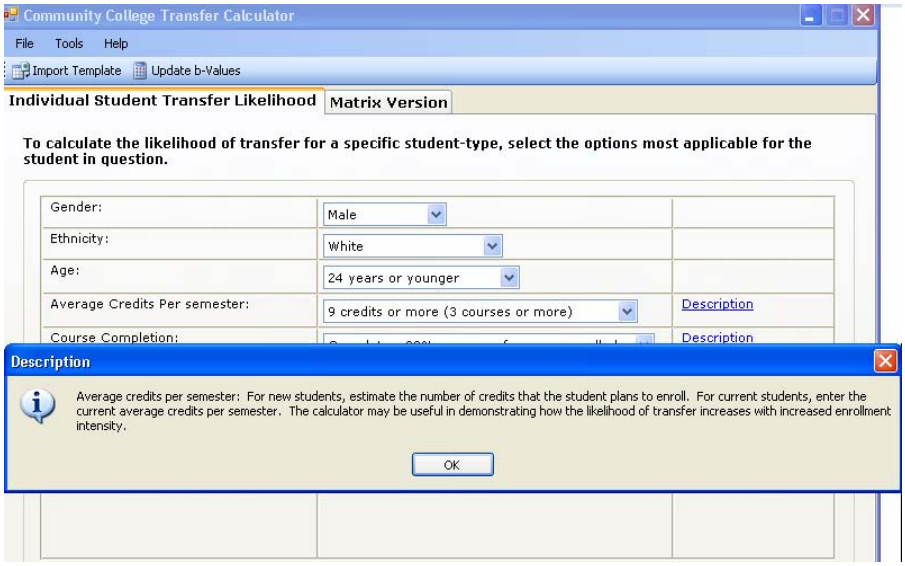

Figure 3. Transfer Calculator Dropdown Menus

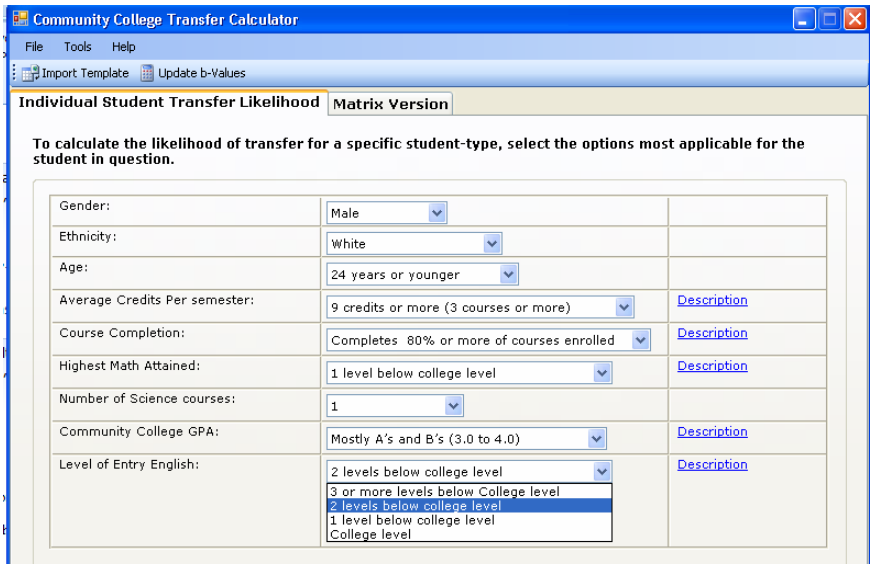

Figure 4. Matrix Version of the Community College Transfer Calculator

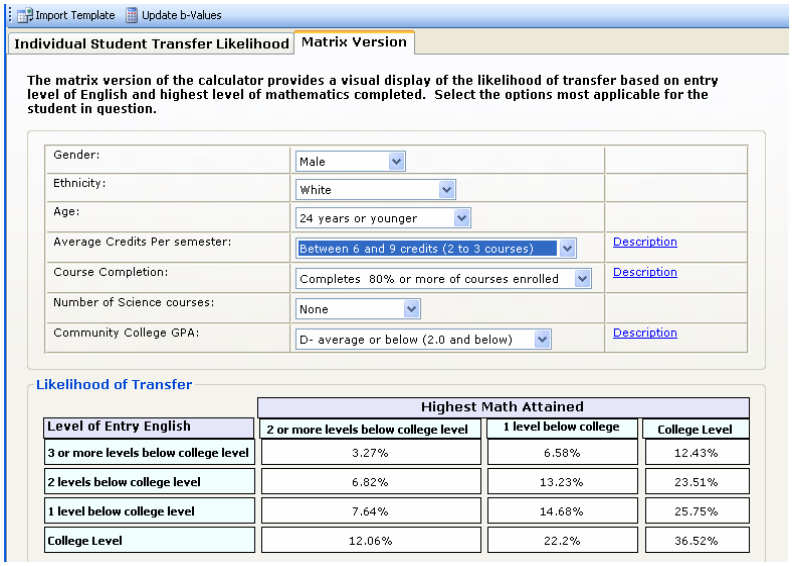

Figure 5 Updating b-Values on the Downloaded “Calculator”