The Community College Transfer Calculator©: Identifying the Course-Taking Patterns that Predict Transfer to a Four-Year Institution

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Introduction to Issues

Community colleges offer the “American dream” to many students who could not otherwise attend college (McCabe, 2000; Vaughn, 2006). Be it due to financial constraints, familial responsibilities, academic deficiencies, or any other host of reasons, the bottom line is that 11.6 million students, nearly half of all undergraduates, attend a community college to improve their opportunities for achieving a better future (American Association of Community Colleges, 2007). As compared to their four-year counterparts, community colleges attract high proportions of students of color, low income, and first-generation college students. For many underrepresented students, the community college is the main port of entry into postsecondary education. Consider, for example, the case of Latino students; almost sixty percent enroll in community colleges upon completion of high school (Digest of Education Statistics, 2005). Sadly, although large numbers of students attend community colleges, few achieve the goal of transfer and subsequent acquisition of a bachelor’s degree (Bradburn & Hurst, 2001; Dougherty & Kienzl, 2006; Horn & Lew, 2007).

Understanding what curricular patterns facilitate success in transferring from the two-year to the four-year sector may be instrumental in increasing transfer success and bachelor degree acquisition. Although there is evidence that the number of earned associate’s degrees has increased nationally,\(^1\) degree completion and transfer rates in many states and specific geographic locations have remained stagnant for many years. For example, in California, where approximately three-fourths of the state’s undergraduates attend a community college, transfer rates have been especially low and sluggish (Shulock & Moore, 2007). Examining earlier cohorts from 1984 to 1987, Cohen and Brawer reported a consistently low transfer rate of approximately 22 percent (1993).

Unfortunately, more recent studies have not reported marked improvements (Nora, 2000; Palmer, 2000). This problem is present throughout the country including both in rural and urban areas and thus is destined to play a major role in affecting the economic wellbeing of the nation. California has the largest system of colleges and universities in the world. The 109 California community college campuses collectively enroll almost twice as many students as the total enrollment in the University of California and California State University systems (California Community Colleges Systems Office, 2006; California State System, 2007; University of California System, 2007). A recent report from the Institute for Higher Education, Leadership and Policy (Shulock & Moore, 2007) at California State University at Sacramento indicated that community college graduation and transfer rates in California have been problematically low and threaten the economic future of the state. Similar situations occur in many other states including Arkansas, New Mexico, and Texas (Wellman, 2002).

It may be important to note that the dual outcome measures of community colleges--transfer and associate degree completion--are often grouped together as if they exist as a single

\(^1\) Associate degrees have increased 29% from 1994-95 to 2004-05 (National Center for Education Statistics, 2007)
entity or desired outcome. In fact, the two outcomes, while both important, are not the same. In many states students do not need to complete an associate degree to transfer. Furthermore, many students aim for the associate degree as a terminal destination. Adding complexity to an already muddy picture is the fact that some students, while stating a lifetime goal of a college degree, may choose to focus on a more “here and now” need of increasing skill levels to advance in their current workplace yet aspire for additional education at a later date. But for those students who aspire to the baccalaureate, the rate of transfer to four-year universities and colleges is notoriously low and sluggish (Grubb, 1991; Hagedorn, Cypers, & Lester, in press; Horn & Lew, 2007; Wellman, 2002) and there is significant confusion as to how to respond. Adding to this puzzlement is significant disagreement regarding the true measurement of transfer rates (Bradburn & Hurst, 2001; Spicer & Armstrong, 1996) and the related issue of the appropriate length of time to measure between first enrollment and subsequent transfer (Horn & Lew, 2007; Hagedorn, et al., in press). Historically, transfer rates have been reported using a three-year window. However, this time span is problematic. Most students take a much longer time due to predominantly part-time enrollments, needs for remedial/developmental coursework, and non-continuous enrollment patterns (Adelman, 2005). Palmer (2005) joined others in blaming measurement confusion on infrequent data collections from two-year colleges. Getting a clear picture of transfer requires longitudinal tracking between college systems and sometimes between states, an endeavor that is technically complex and costly to develop and maintain (Hagedorn & Kress, in press).

Transcript Analysis

In this paper we argue that community colleges already maintain an excellent source of information to better understand those student decisions and behaviors that enable transfer from the two-year sector to the four-year sector. We contend that community colleges may not need to collect additional data or engage in expensive practices to find ways to better counsel and advise their students regarding success in transfer. We posit that a policy to assist colleges to better guide their students can be gleaned from a careful examination of existing transcript data. The power of transcript data can be unleashed with careful analyses along with the use of analytical tools, templates, and guides to aid the process. For this reason, we have designed a measurement tool titled, The Community College Transfer Calculator ©.

Transcript analysis consists of a series of planned and systematic analyses of data routinely collected by community colleges that include 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. In 1999, Adelman demonstrated that transcript data were the raw material that provide answers to important questions as to what

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2 Three years is based on the 150% time that has been used in the IPEDS data collections.
matters to succeed in postsecondary education. In 2006, Adelman further argued that transcript analysis can track students’ progress or lack of progress as they proceed toward a degree. Throughout this paper we use the term “transcript analysis” to include the investigating, coding, and analysis of college records regardless of their type. Transcript analysis does not, however, include analysis of data derived from questionnaires or other voluntary and supplementary student data collection. Without a doubt, questionnaire data can be highly useful and can be used in conjunction with college data. However, for the purposes of this inquiry we chose to focus solely on the use of objective college-level data that are consistently collected by all community colleges. Unlike information collected via questionnaires, transcript data are not subject to student memory or truthfulness – they are the factual records of student accomplishment and actions that can inform policy analyses and enrollment management.

**Specific Issues/Questions Examined**

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

- 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 paper examines the types of measures that can be derived from transcript level data. It also 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. Here we introduce a tool that may not only be useful in its present mode, but can be made more powerful through the application of specific transcript data pertaining to a particular institution or district. *The Community College Transfer Calculator ©* may be customized by a campus’ institutional researcher or other personnel entrusted with campus research and subsequently used by community college advisors or others to better understand the factors that promote transfer. *The Community College Transfer Calculator ©* is currently calibrated with data from the Los Angeles Community College District (LACCD). While the calculator using the current data source is an accurate gauge of characteristics based on a specific cohort of students in Los Angeles, it may also be instructive to other large urban districts. Thus, once adapted by other community colleges or community college districts, the tool can be very powerful to better understand student enrollment behaviors and can be used to appropriately advise current and prospective students.

**The Community College Calculator © Design and Methodology**

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. Additionally, the calculator may be useful for use in college success courses and in student orientations. In both instances the calculator may be used to illustrate the power of enrolling in the courses that are more likely to result in student success. Policymakers will benefit from understanding aggregate findings of transcript analysis to create and promote policies that can better 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. Further, the calculator can be calibrated to include the course-taking patterns that promise to be especially promising in a certain location, campus, or community college system.

Although transcript analysis and The Community College Transfer Calculator can be powerful tools, we have not identified a “silver bullet” or an answer to lack of academic preparation. 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 first taking several remedial courses. Rather, we contend that The Community College Transfer 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. Use of the transfer calculator may aid colleges in understanding student progress in the aggregate and thus allow colleges to make informed, data-informed decisions.

In this paper we provide guidelines for constructing The Community College Transfer Calculator©, a manual for its use, examples of how it can be used, and the derived policy implications. We acknowledge that the technical aspects of the building and functioning of the calculator and the methodology of the data analyses may be more technical than appropriate for presentation to community college practitioners; nevertheless, we include the technical explanations for two reasons. First, it is assumed that if a college wants to create its own calculator, the technique must be carefully explained and the logic understood. Second, the analysis must be robust and open to examination by those who can judge it as sound. The building of a calculator would likely be done by the campus institutional researcher or other individual whose job description includes data analysis related to the college. The calculator builder must be conversant with statistical software such as SPSS or SAS and have a basic understanding of logistic regression. However, for the typical institutional research professional, the techniques we outline are within reach. We introduce a template plus a calculator interface/faceplate that is relatively easy to use and interpret. Therefore, to learn more about the construction, reliability, and customization of the calculator, we direct the reader to the appendices. We discuss hypothesized scenarios and implications derived from the use of the calculator in a later section of this paper entitled, Policy Implications—Using the Calculator.

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Community college success courses are typically non-credit bearing courses that have been specifically designed to assist students to navigate college and become successful and well-rounded. Typically these courses provide tips and strategies on topics such as time management, test-taking, note-taking, goal-setting, and study habits. Often they will include assignments such as creating a personal success plan or investigations to identify an occupational plan.
The design of *The Community College Transfer 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 was recognized by the national initiative, *Achieving the Dream: Community Colleges Count*. The initiative required each participating college to identify “gate keeping courses” and to report data on pass rates.4

Although the types of data used in our analyses are readily available at all community colleges, they are rarely used for enrollment management or as predictive tools (Hagedorn & Kress, in press). Multiple demands and lack of resources may prevent institutional researchers at the community colleges from unlocking the power of transcript analysis. Furthermore, we acknowledge that institutional researchers, especially those in small rural areas, may not have the training to manipulate data (Hagedorn, 2007; Hagedorn, in progress). For this reason, we intend to illustrate the use of transcript analyses to create a predictive tool as well as to answer policy questions related to the connection between course-taking patterns and transfer behavior. It is our contention that the transcript analysis approach and the resulting transfer calculator will be a powerful tool for academic/career counselors and others. The calculator will provide a “value added” to advising students and creating policy.

In the construction of the Transfer Calculator Template, it was necessary to first address the question, “What are the key markers of transfer for community college students?” As in any research project, the first steps involved knowledge of the literature and the identification of variables that proved to be important for the outcome of interest. A search of the extant literature 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, 2008);
- Course completion ratio (Calcagno et., al, 2007; Hagedorn, Cypers, & Lester, in press) or the proportion of courses in which a student enrolls that were successfully completed;
- Remedial/developmental needs (Boylan, 1995; Cabrera et., al, 2005; Calcagno et., al, 2006; 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, 1995); and
- Level of engagement (Calcagno, Crosta, Bailey, & Jenkins 2007; Driscoll, 2007; Laanan, 2007; McClenney, 2007; Tinto, 1975; 1987; 1993).

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4 At the time of this writing, the *Achieving the Dream Initiative* was working within 15 states at over 80 campuses. The initiative is funded by the following foundations: Lumina, Knowledge Works, Houston Endowment, Heinz Endowments, and College Spark.
Sample

We used data from the Los Angeles Community College District (LACCD). The 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--only $20 per credit unit.

We included all first-time students who indicated the goal of transfer and who also enrolled in a mathematics course at any one of the nine campuses in the fall 1997 semester. This selection criterion is consistent with research that taking mathematics is a powerful predictor of transfer (Adelman, 1999, 2007; Cabrera, Burkum, & LaNasa, 2005; Hagedorn, Maxwell, & Hampton, 2002). Furthermore, transfer hopeful students were advised to take mathematics during the first semester of enrollment. The final research pool consisted of 5,031 students, 30% of all entering students. Transcripts were analyzed to track these students over a time span of ten years, from fall 1997 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 ten-year span was also chosen based on previous research using these data that revealed the median time for transfer was eleven semesters of active enrollment (Hagedorn, Cypers, & Lester, in press). It is important to note that for some of the students semesters of active enrollment were interspersed with semesters of in-active or non-enrollment, meaning that the 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 records. These initial placements were not infrequently adjusted based on further examination and advice by the instructor of the initial course or by a counselor. Most significant, only 40% of those assessed in math prior to matriculating in fall 1997 chose to enroll in a math course in that first term.

We provide Tables 1 and 2 as a means of better understanding both the population and the sample. Table 1 provides demographic characteristics of all first-time college students entering in the fall of 1997 divided by whether or not the student enrolled in mathematics. Table 2 provides demographics of the studied sample disaggregated by math level.

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5 Often community college students will stop-out or not contiguously enroll. The number of active enrollment semesters is a count of the number of semesters in which enrollments occurred.
Table 1. Demographics of the Population of LACCD Entering Students, Fall 1997

<table>
<thead>
<tr>
<th></th>
<th>Enrolled in Math</th>
<th>Did Not Enroll in Math</th>
<th>All Students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Under 20</strong></td>
<td>64.3</td>
<td>36.3</td>
<td>44.7</td>
</tr>
<tr>
<td><strong>20 - 24</strong></td>
<td>19.3</td>
<td>24.4</td>
<td>22.9</td>
</tr>
<tr>
<td><strong>25 - 34</strong></td>
<td>11.1</td>
<td>20.7</td>
<td>17.8</td>
</tr>
<tr>
<td><strong>35 Plus</strong></td>
<td>5.3</td>
<td>18.6</td>
<td>14.6</td>
</tr>
<tr>
<td><strong>100%</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Asian</strong></td>
<td>12.5</td>
<td>12.3</td>
<td>12.4</td>
</tr>
<tr>
<td><strong>African</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>American</strong></td>
<td>15.7</td>
<td>15.1</td>
<td>15.3</td>
</tr>
<tr>
<td><strong>Latino</strong></td>
<td>50.1</td>
<td>45.9</td>
<td>47.2</td>
</tr>
<tr>
<td><strong>White</strong></td>
<td>14.9</td>
<td>20.4</td>
<td>18.7</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>3.0</td>
<td>2.2</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>Unknown</strong></td>
<td>3.8</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td><strong>100%</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>56.2</td>
<td>54.8</td>
<td>55.2</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td>43.8</td>
<td>45.2</td>
<td>44.8</td>
</tr>
<tr>
<td><strong>100%</strong></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2. Demographics of Fall Entrants by Math Level

<table>
<thead>
<tr>
<th></th>
<th>Transfer Level</th>
<th>1 Level Below Transfer</th>
<th>2 Levels Below Transfer</th>
<th>3 Levels Below Transfer</th>
<th>4 or More Levels Below</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Under 20</strong></td>
<td>14.6</td>
<td>22.8</td>
<td>32.5</td>
<td>13.2</td>
<td>16.7</td>
<td>100%</td>
</tr>
<tr>
<td><strong>20 - 24</strong></td>
<td>14.4</td>
<td>12.5</td>
<td>25.1</td>
<td>16.3</td>
<td>31.7</td>
<td>100%</td>
</tr>
<tr>
<td><strong>25 - 34</strong></td>
<td>9.2</td>
<td>6.8</td>
<td>21.0</td>
<td>20.6</td>
<td>42.4</td>
<td>100%</td>
</tr>
<tr>
<td><strong>35 Plus</strong></td>
<td>5.6</td>
<td>4.5</td>
<td>16.9</td>
<td>17.6</td>
<td>55.4</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Asian</strong></td>
<td>36.4</td>
<td>25.3</td>
<td>23.4</td>
<td>8.7</td>
<td>6.2</td>
<td>100%</td>
</tr>
<tr>
<td><strong>African</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>American</strong></td>
<td>8.9</td>
<td>7.1</td>
<td>21.8</td>
<td>21.2</td>
<td>41.1</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Latino</strong></td>
<td>7.1</td>
<td>17.0</td>
<td>32.4</td>
<td>14.4</td>
<td>29.1</td>
<td>100%</td>
</tr>
<tr>
<td><strong>White</strong></td>
<td>19.8</td>
<td>21.5</td>
<td>30.7</td>
<td>15.0</td>
<td>12.9</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>14.1</td>
<td>32.9</td>
<td>29.5</td>
<td>14.1</td>
<td>9.4</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Unknown</strong></td>
<td>16.9</td>
<td>28.6</td>
<td>24.9</td>
<td>15.3</td>
<td>14.3</td>
<td>100%</td>
</tr>
<tr>
<td><strong>100%</strong></td>
<td>13.5</td>
<td>18.1</td>
<td>29.0</td>
<td>14.9</td>
<td>24.5</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>10.5</td>
<td>16.3</td>
<td>29.4</td>
<td>16.1</td>
<td>27.7</td>
<td>100%</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td>17.3</td>
<td>20.4</td>
<td>28.5</td>
<td>13.3</td>
<td>20.5</td>
<td>100%</td>
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<tr>
<td><strong>100%</strong></td>
<td>13.5</td>
<td>18.1</td>
<td>29.0</td>
<td>14.9</td>
<td>24.5</td>
<td>100%</td>
</tr>
</tbody>
</table>
Community College Course-Taking Patterns

The subgroup enrolling in a math course was noticeably younger than the rest of the entering students. Females were not less likely to enroll in mathematics than their male counterparts. The ethnic distribution reflected the fact that younger students were more likely than older students to enroll in mathematics. Since the Latino subgroup of the LACCD population tended to be a younger group, Latinos were somewhat over-represented in the math subgroup.

Substantial differences emerged by age, ethnicity and gender in the distribution of the subgroup by math placement level. Almost one-third of students under 20 years of age were assessed at three courses or more below the mathematics transfer level, but a much higher proportion (69%) of those 35 years and over were in the same category. From an ethnicity view, 6% of Asian, 13% of non-Latino 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 (Appendix 1). The demographic file consisted of data from college applications—data that are collected by all colleges 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. Again, all colleges must maintain data on the courses in which students are enrolled and the grades that they earn. 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). Take for example the case of one student with the pseudonym of Mary Smith. Data such as name, address, gender, ethnicity and other demographic information pertaining to Mary would be included on one line in the demographic file. If Mary enrolled in four courses in 2000, two more in 2001, plus 10 more in 2003, Mary would have 16 lines of data in the enrollment file where enrollments are the unit of analysis. Understanding the difference between individual and course records is a necessary condition for successful transcript analyses. Success in merging individual data with transcript records presumes the aggregation of information from the transcript file to form a student measure that can subsequently be merged into the student demographic file.

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6 Students were identified by a code number. An identification number was mandatory to match students and their enrollment behaviors.

7 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 discussion, the final product would need to be merged with demographic data. Although many different structures may exist, in this paper we used a common structure often employed in colleges where the enrollment is the unit of entry.
Types of Measures Derived from Transcripts

The processes of data analysis allow the researcher to create specific measures that could 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). The final calculation is then performed by first deriving the product of the numerical grade and the number of credits for each class. Step two consists of summing together all of the products. This is followed by dividing the total by the simple sum of all of the credits earned from the courses.

Operationalizing (defining) 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 calculated 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). It is calculated as the sum of all credits earned with the grade of A, B, C, D, or P divided by the sum of all credits in which the student enrolled, regardless of the grade received. The CCR compares a student’s success against her/his enrollment behavior. In other words, the student acts upon academic plans by enrollment in courses. The CCR is the calculation of the proportion of the goal successfully completed. Using our previous example, if all of the 16 courses in which Mary Smith enrolled offered 3 credits and she finished 13 of the 16 courses, Mary’s CCR would be 39 credits/48 credits = .8125 or 81.25%.

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

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8 Grades of Withdrawn (W), Incomplete (I), Pass (P), Fail (F), and Retake without credit (R) were not included in the GPA calculation.

9 The mathematical formula for GPA is:

\[
\frac{\sum_{\text{all enrollments}} \text{(Numerical Grade)} \times \text{(Number of Credits)}}{\text{Sum of Credits}}
\]

10 The mathematical formula for course completion ratio is:

\[
\text{CCR} = \frac{\sum_{\text{credits completed with the grade of A, B, C, D, or P}}}{\sum_{\text{of all credits enrolled}}}
\]
Community College Course-Taking Patterns

• **Highest math taken.** We used the same coding as described above to record the highest math course in which the student enrolled.

• **Number of science courses.** This construct was operationalized through tagging all science courses and subsequently summing the number.\(^{11}\)

• **Grades.** The construct consisted of the calculated cumulative GPA.

• **Average credits per semester.** This construct served as a proxy for student involvement

*The Building of the Calculator*

The SPSS Syntax\(^{12}\) for selected measures is included as Appendix 2. 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 into the file that contained the demographic information. In this fashion we created a working file that used the student as the unit of analysis (Appendix 1). It is important to understand that in order for us to derive variables from the enrollment file (course as unit of analysis), we had to employ the SPSS aggregate command to create a NEW working file that transformed the unit of analysis to the student. This command basically allowed us to collapse multiple enrollments into course pattern measures that were matched at the student level. Subsequently, the derived variables were merged and matched by student reference or ID number, into the working file.

Transfer status was also merged into the working file. Transfer information was secured from the National Student Clearinghouse (NSC). The NSC is a non-profit organization that tracks student enrollments for purposes of academic verification. Its registry contains more than 80 million student records from 3,000 colleges, representing 91% of U.S. college students (National Student Clearinghouse, 2007). Like many community college districts, the LACCD subscribes to the NSC to verify student enrollment in four-year institutions. For each of the students in the dataset, a “1” was recorded if the student ID was defined as having enrolled in a four-year institution. Non-transfers were coded with a “0”. It is 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 was enrollment in a four-year institution.

*Estimation and model testing methods.*

After the data were appropriately coded, we created an equation using transfer as the dependent variable. The reader is referred to Appendix 3 for details regarding why logistic regression is an appropriate analytical method. The Appendix also describes our data exploration techniques, as well as the technical explanation of the estimation of the model, and provides details on the parameters and goodness of fit pertaining to our final model.

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\(^{11}\) 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.

\(^{12}\) The syntax or programming can be done in SAS or in another statistical program. We include only SPSS, as that was the program used by the authors. However, the logic of programming would be identical regardless of program.
After the model was designed and tested we transferred the calculated regression weights plus descriptive values to a specially formatted Microsoft Excel template (Appendix 4). Finally, we constructed a faceplate using the programming language of C# that would interface with the Excel spreadsheet that would work with the template to allow easy input of data and the specific values. The program language for the faceplate can be viewed at: http://c2ir.education.ufl.edu/calculator/calculatorsetup/index.html.

**Use of the Calculator**

The *Community College Transfer Calculator*© is available on the Internet at: http://c2ir.education.ufl.edu/calculator/. The “Likelihood of Transfer” percentages are based on logistic regression weights or b-values derived from data from the Los Angeles Community College District. In order to add institution-specific values to the calculator it is necessary to download the *Community College Transfer Calculator*© program. Directions to download the software and to customize it are provided in a later section of the paper entitled “How to Customize the Calculator Values.” Figure 1 provides a view of the Calculator faceplate.

![The Community College Transfer Calculator faceplate](image)

The *Community College Transfer Calculator*© is used to calculate the likelihood of transfer for a specific student type based on selected 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 boxes, and choosing the desired option from the drop down menu (Figure 3).

The 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) provides a visual of the different course options and reveals the power of the combination of English and mathematics as a predictor of transfer.

Figure 2. Supplementary Descriptions of Variables
Community College Course-Taking Patterns

Figure 3. Transfer Calculator Dropdown Menus

![Image of Transfer Calculator Dropdown Menus]

Figure 4. Matrix Version of the Community College Transfer Calculator

![Image of Matrix Version of the Community College Transfer Calculator]
In order to customize *The Community College Transfer Calculator*© with institution-specific data, the user must download the program from http://c2ir.education.ufl.edu/calculator/calculatorsetup/index.html. Appendix 5 provides detailed instructions on the installation process.

**How to Customize the Calculator Values**

Once the calculator is installed, the user can customize it by adding institution-specific factors and data. Of course it is necessary to extract specific data from a cohort of students and to include the outcome of transfer. The logistic regression weights or b-values and the constant must be calculated via a statistical program such as SPSS, SAS, or other software product.

There are several ways to enter the b-values into the *Community College Transfer Calculator*©. The most user friendly method is to click on the “Update b-Values” button above the calculator tabs (see Figure 11). 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 be derived based on the newly entered values (see Figure 12).

Another method of adding institution-specific values is by attaching a pre-formatted Excel Spreadsheet with the institution-specific values. This method not only allows the user to input regression b-values, but also to completely customize the template by adding new (institution-specific) variables or deleting the default variables. Begin this process by visiting the download site: http://c2ir.education.ufl.edu/calculator/calculatorsetup/index.html. Click on “Excel Template” and download the file being sure to save it onto the computer’s hard drive (Figure 13).

**Figure 11. Updating Logistic Regression b-Values**

![Figure 11. Updating Logistic Regression b-Values](http://example.com/image.png)
Once the Excel spreadsheet is open, a column for each of the following will be visible (Figure 14) as follows:

- **Variable Name**: This column contains the factors included in the calculator.
- **Variable Description**: This column provides the optional text for the “Description” links in the calculator. This text will only be seen by clicking the “Description” link.
- **Is Variable Visible**: This determines whether variables will be visible on the calculator interface or not. The default coding is 1=visible, and 0=not visible.
- **Options**: These are the options or value labels for each variable appearing in the drop down menus of the calculator.
- **Yes/No**: This column is controlled by the faceplate. Enter a “1” in this column for new or added variables.
B. Enter the logistic regression b-values for each option and variable as determined by the statistical program.

The template is able to accept additional variables and/or options by entering them in the table to the bottom of the list. Further, variables that are not used can be overwritten. For example, if a college does not wish to use “number of science courses” in their equation, but rather use, for example, “number of humanities courses,” the responsible party need only type over the existing phrase. It is important to note that when altering the table, a blank row must be left between the last variable and a new variable. This ensures the separation of variables on the calculator. The document must be saved. In order for the changes to be reflected on the calculator, the spreadsheet must be attached to the calculator (Figure 15). Click the “Import Template” button. When the dialog box appears, point to the location of the spreadsheet on the local computer. The calculator will now reflect the data entered in the spreadsheet.

Figure 14. The Excel Template
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 the curriculum in 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 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 in the math sequence through the 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 study. The calculator is also used to show how in addition to the math sequence, 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 that 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 Green, 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 members are convinced that their courses prepare students for their university experiences. To attract more students to enroll in the department’s offerings, the faculty began a campaign entitled “Humanities for All Humans.” They ask Sunnyvale’s institutional researcher to calculate the increase in likelihood of students transferring by taking one, two, or three humanities courses. Using the methods outlined in this paper, the number of humanities courses taken by a previous cohort of students is added to the customized *Community College Transfer Calculator*©. The results of the calculator are used in the campaign to describe the benefit of enrolling in humanities courses. The results are discussed not only in faculty meetings of the humanities program, but also among the executive administration at Sunnyvale.

**Album Scenario 6**

The Board of Trustees of Sunnyvale 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 IR department to add a variable to their customized calculator that indicates whether students attended orientation. The IR Director 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 determine 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.
Community College Course-Taking Patterns

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 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—Contingency Tables

Using the default data derived from the LACCD, we used the Community College Transfer Calculator© to develop a series of contingency tables (Appendix 6) 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 (in the direction of more advanced courses) increases the probability of transfer. Table A6-1 was derived for a young Asian female enrolling for nine or more credits and taking one science course. Note that depending on English entry level and final math course level, the probability of transfer ranges 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 A6-2 through A6-5 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.

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. Policymakers and others should be aware of these important relationships. In addition to increasing awareness among developmental students 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 A6-6 through A6-8 display the joint probabilities of math and science. Again, the probabilities step up horizontally and vertically. Using the Asian Female (Table A6-6) 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 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.

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 more academically able. However, one must be aware that the significance of these courses is noteworthy 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, 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
Community College Course-Taking Patterns

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 institutions can encourage a more disciplined student approach to course-taking.

Table A6-9 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 regardless of gender. Policies to encourage students to enroll more intensely appear appropriate.

Finally, tables A6-10 and A6-11 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 statistical support concerning the drastic consequences of dropping courses.

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-informed 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 informed 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 college administrators. 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 LACCD. 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 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 in their courses. Furthermore, 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

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13 Causal enrollment refers to non-contiguous semesters or any other type of enrollment pattern that is not planned and consistent.
appropriate. In other words, the Calculator Template can accept values for other dichotomous outcomes such as degree completion or completion of a vocational certificate. Therefore, the Community College Transfer Calculator© can be redesigned to become the Community College Associate Degree Calculator or be designed for another important dichotomous 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 attainment. 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 or more levels below transfer level math can increase the likelihood of transfer from 34.3% to 68.6% if that student perseveres through college level math. Further, this same student can increase the 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 a combination of science courses, along with different levels of remediation, maximizes 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 policymaker 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 and minorities). In short, we see the calculator both as a new means of communication between student actions and student outcomes, and a means for informing policy decisionmaking regarding course-taking practices.
References


Dougherty, K. J. & Kienzel, G. S. (2006). It’s not enough to get through the open door: inequalities by social background in transfer from community colleges to four-year colleges. Teachers College Record, 108(3), 452-487.


Hagedorn, L. S. (2007, February). Building a culture of evidence-based decision-making at the community college: Defining institutional research practitioners and their pathways to success. Presentation to the Florida Association for Institutional Research, Cocoa Beach, FL.


## Appendix 1 Data Files

### Figure A1-1. Demographic file

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### Table A1-1. Demographic File Fields

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<td>Sex</td>
<td>F=Female; M=Male</td>
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<td>Citizen</td>
<td>1=U.S. Citizen; 2=Permanent Resident; 3=Temporary Resident; 4=Refugee; 5=Student Visa; 6=Other Visa</td>
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<td>Primary Language</td>
<td>1=English; 2=Armenian; 3=Chinese; 4=Farsi; 5=Filipino; 6=Japanese; 7=Korean; 8=Russian; 9=Spanish; 10=Vietnamese; 11=Other</td>
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<td>1=Under 20; 2=20-24; 3=25-34; 4=35-54; 5=55 and over</td>
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<td>Ethnicity</td>
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Figure A1-2. Enrollment File

Table A-2. Enrollment File Fields

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- 27 -
Figure A1-3. Resulting Working File: Derived Variables Merged with Demographic File
Appendix 2: Selected SPSS Syntax Files

Syntax for Success Ratios

*Creating attempt variable in enrollment file and recoding letter grade to number.
Recode
grade
('A'=1) ('B'=1) ('C'=1) ('D'=1) ('F'=1) ('I'=1) ('W'=1) ('P' = 1) into attempts.
Variable labels att 'courses attempted total history (A,B,C,D,F,I,W,P)'.
Execute.

*Creating pass variable in enrollment file.
Recode
grade
('A'=1) ('B'=1) ('C'=1) ('D'=0) ('F'=0) ('I'=0) ('N'=0) ('W'=0) ('P'=1) into success.
Variable labels pass 'courses passed total history (A, B, C, P)'.
Execute.

*Aggregate pass and att.
Aggregate
/Outfile='C:\location.sav'
/Break=refnum
/attempts_sum = Sum(attempts) /success_sum = Sum(success).

*Compute a new variable sucr (success ratio)
Compute  Succ_ratio = success_sum/attempts_sum .
Execute.
******************************************************************************

Determining Science Courses

Compute science=0.
if (subabrv='ANATOMY') science=1.
if (subabrv='ANML SC') science=1.
if (subabrv='ASTRON') science=1.
if (subabrv='BIOLOGY') science=1.
if (subabrv='BOTANY') science=1.
if (subabrv='CHEM') science=1.
if (subabrv='CHEM T') science=1.
if (subabrv='CO SCI') science=1.
if (subabrv='EARTH') science=1.
if (subabrv='GEOLOGY') science=1.
if (subabrv='METEOR') science=1.
if (subabrv='OCEANO') science=1.
if (subabrv='PHYS SC') science=1.
if (subabrv='PHYSICS') science=1.
if (subabrv='PLNT SC') science=1.
if (subabrv='PHYSIOL') science=1.
Execute.
**********************************************************************

Calculating Cumulative GPA

*Calculating GPA in an enrollment file.

*Step 1 - recoding letter grades into numbers.

Recode
  grade
  ('A'=4) ('B'=3) ('C'=2) ('D'=1) ('F'=0)
into grade2 .
Variable labels grade2 'calculating GPA'.
Execute.

*Step 2 - Multiply Number of Units by the numerical grade value.

Compute grxunits = grade2 * unattmpt.
Variable labels grxunits 'multiplication of grade and units'.
Execute.

*Step 3 - Delete all cases in which the Grade is undetermined or units not calculated into GPA (ex Pass, No Pass, Withdrawals, In Progress).

Filter Off.
Use all.
Select if (grade2 >= 0).
Execute.

*Step 4- changing units in which F into 0.

If (grade = 'F') units = 0.
Execute.

*Step 5 - Aggregation of the sum of this product (grxunits) as well as the total number of units taken.

Aggregate
  /outfile=C:\location.sav
  /break=refnum
  /grxuni_1 = Sum(grxunits) /units_1 = Sum(unattmpt).

*Step 6 - Dividing (grxuni_1) by (units_1) to get GPA from the newly created file.

Compute GPA = grxuni_1 / units_1.
Execute.

*Step 7 - Recode GPA so that missing data means that person has 0 GPA.

Recode
  GPA (Sysmis=0).
Execute.

*Step 8 - Check your work by running a frequency of the variable you created
Remember that it should be from 0 to 4.

Calculating Average Credits per Semester

*Average credits per semester.
*Step 1 Eliminate withdrawn courses (grades of W).
Use sll.
Compute filter_$=(grade ne 'W').
Variable label filter_$ "grade ne 'W' (FILTER)".
Value labels filter_$ 0 'Not Selected' 1 'Selected'.
Format filter_$ (f1.0).
Filter by filter_.$.
Execute.

* Step 2 Sum credits per semester - aggregate by ID number and semester.

Aggregate
  /outfile=<path>.sav'
  /presorted
  /break=refnum sem
  /units_attempt_sum = sum(units_attempt).

* Step 3 --using file created in step 2, aggregate by student.

Aggregate
  /outfile='C:\<path>.sav'
  /break=refnum
  /units_attempt_sum_mean = Mean(units_attempt_sum).

*******************************************************************************
Logistic Regression

Logistic regression variables transfer
/method = enter gender ethnicity age_2cat avg_cred_sem_cat course_complete2_cat newmathhigh science3 GPA_cat First_English_rec
/contrast (gender)=indicator(1) / contrast (ethnicity)=indicator(1)
/ contrast (age_2cat)=l'indicator(1) / contrast (avg_cred_sem_Cat)=Indicator(1)
/contrast (course_complete2_cat)=indicator(1) /contrast (newmathhigh)=indicator(1) /contrast (science3)=indicator(1) / contrast (GPA_cat)=indicator(1) / contrast (first_English_rec)=Indicator(1)
/Save = pred lesid sresid zresid
/classplot
/print = goodfit
/criteria = pin(.05) pout(.10) iterate(20) cut(.5).
Appendix 3. Model Estimation, Exploration, and Testing

Estimation method

Since our outcome of interest, transfer, is dichotomous,\textsuperscript{14} we employed binary logistic regression to examine the relationship of personal characteristics and course-taking patterns with the probability of transferring (Cabrera, 1994; Hosmer & Lemeshow, 2000). Binary 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). Binary logistic regression uses a logarithmic transformation to overcome the assumption of linearity inherent in regression procedures (Field, 2005). Binary logistic regression 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. Binary logistic regression seeks to maximize the likelihood of observing the sample values.

For the purpose of the construction of the calculator, we originally investigated if the logistic regression method within Hierarchical Linear Modeling (HLM) program would be a more ideal technique. Especially in studies of the elementary/secondary schools, HLM has been shown to be especially powerful when analyzing student data across multiple schools. HLM assumes that students within a single institution share overall commonalities and a great deal of common experiences. Further, it is assumed that the measures of student experiences within a specific campus were correlated. HLM considers this “nestedness”\textsuperscript{15} of experiences within institutions (Hox, 2002) while examining the impact of student’s behaviors on particular outcomes. We argue, however, that the condition of nestedness among community college students differs drastically from that in the K-12 sector. Rather than correlated shared experiences, heterogeneity was the norm and the hallmark of the community college student (Cohen, 1994). Community college students do not share a common history with the institution (Adelman, 1999; 2005). Students typically spend very little time interacting with different institutional agents. Furthermore, for many community college students the only point of contact with the institution is the classroom (Tinto, 1997). Compounding this problem rests on the transient nature of the community college student. As noted by Adelman (1999), community college students often transfer to different community colleges—sometimes going to more than one college at the same time (Hagedorn & Castro, 1999). Students may not only be dually enrolled but may even return to the community college to take a course or two after they transferred to a four-year university. For these important reasons, coupled with results of a recent national survey of community colleges, institutional researchers that found that very few of the community college IR professionals had any experience with or use of HLM (Institute of Higher Education, 2007); logistic regression was a more appropriate method for our work.

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 high degree of skewness resulting from the low number of cases in some of the categories specifically in the areas of the scales making up entering math and reading levels. In some cases

\textsuperscript{14} 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.

\textsuperscript{15} Students are nested in classrooms, classrooms are nested in schools, schools are nested in districts, etc.
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 set of independent variables. 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.

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 binary logistic regression model. The $\chi^2$ (chi-squared) signifies the extent to which the variables as a group are associated with transfer. A statistically significant value indicates a good fit. The Classification Table, or PCC, reports the percentage of cases correctly classified by the model (Aldrich & Nelson, 1984; Hosmer & Lemeshow, 2000). Of course a perfect model would predict 100% of the cases. The -2 log likelihood cannot be interpreted alone (Menard, 2002). Rather, 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 statistically significant differences 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). Although the full logistic regression can be viewed via a link on http://c2ir.education.ufl.edu/calculator/ we include Table 1 below for convenience.

We transferred the calculated regression weights plus descriptive values to a specially formatted Microsoft Excel template (Appendix 4) where the likelihood of transfer could be calculated by entering 1’s (for yes) or 0’s (for no) to indicate specific values for each of the included factors. Despite the utility of the resulting template, we had to acknowledge that the spreadsheet was neither user-friendly nor aesthetically pleasing. And due to the nature of the categorization of the factors, manipulating the spreadsheet could also be confusing to someone not familiar with dummy variables. We therefore constructed a faceplate using the programming language of C# that would interface with the template allowing easy input of data and inputting of the specific values of the template factors.

---

16 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).
17 Cohen and associates (2003) suggested that VIF values of 10 or higher signify multicollinearity problems. They also indicate that tolerance levels of 0.10 or less are problematic.
18 PCC stands for percentage of cases correctly classified.
19 C# is a Microsoft object-oriented programming language using the .NET Framework.
Table 1. Measures of Goodness of Fit

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\chi^2$</td>
<td>121.915 (18) *</td>
</tr>
<tr>
<td>Classification Table (Percentage Cases Predicted or PCP)</td>
<td>81.7%</td>
</tr>
<tr>
<td>-2 Log Likelihood</td>
<td>2571.202</td>
</tr>
<tr>
<td>Hosmer and Lemeshow Test (df)</td>
<td>9.831 (8)</td>
</tr>
<tr>
<td>Cox &amp; Snell R-Square</td>
<td>.303</td>
</tr>
<tr>
<td>Nagelkerke R-Square</td>
<td>.448</td>
</tr>
<tr>
<td>P &lt; .001</td>
<td></td>
</tr>
</tbody>
</table>
# Appendix 4: Excel Template for Calculating Probability of Transfer

<table>
<thead>
<tr>
<th>Variables in the Equation</th>
<th>B</th>
<th>Mean Value</th>
<th>Yes/No</th>
<th>Probability</th>
<th>(P_0)</th>
<th>Beta</th>
<th>(L_0)</th>
<th>(L_1)</th>
<th>Delta-p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong> (male excluded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.080452597</td>
<td>0.562</td>
<td>1</td>
<td>0.0452144</td>
<td>0.185</td>
<td>0.080453</td>
<td>-1.4828</td>
<td>-1.4024</td>
<td>0.0124</td>
</tr>
<tr>
<td><strong>Ethnicity</strong> (White excluded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian Am</td>
<td>-0.181834795</td>
<td>0.134</td>
<td>1</td>
<td>-0.0243659</td>
<td>0.185</td>
<td>-0.18183</td>
<td>-1.4828</td>
<td>-1.6647</td>
<td>-0.0259</td>
</tr>
<tr>
<td>African Am</td>
<td>-0.422327467</td>
<td>0.166</td>
<td>1</td>
<td>-0.0701064</td>
<td>0.185</td>
<td>-0.42233</td>
<td>-1.4828</td>
<td>-1.9052</td>
<td>-0.0555</td>
</tr>
<tr>
<td>Hispanic</td>
<td>-0.58404337</td>
<td>0.541</td>
<td>1</td>
<td>-0.3159675</td>
<td>0.185</td>
<td>-0.58404</td>
<td>-1.4828</td>
<td>-2.0669</td>
<td>-0.0726</td>
</tr>
<tr>
<td><strong>Age</strong> (Older excluded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Younger</td>
<td>0.601678722</td>
<td>0.824</td>
<td>1</td>
<td>0.4957833</td>
<td>0.185</td>
<td>0.601679</td>
<td>-1.4828</td>
<td>-0.8812</td>
<td>0.1079</td>
</tr>
<tr>
<td><strong>Average credit per semester</strong> (0-3 excluded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-6</td>
<td>0.59086698</td>
<td>0.281</td>
<td>1</td>
<td>0.1660336</td>
<td>0.185</td>
<td>0.590867</td>
<td>-1.4828</td>
<td>-0.8920</td>
<td>0.1057</td>
</tr>
<tr>
<td>6-9</td>
<td>1.656796527</td>
<td>0.248</td>
<td>1</td>
<td>0.4108855</td>
<td>0.185</td>
<td>1.656797</td>
<td>-1.4828</td>
<td>0.1740</td>
<td>0.3584</td>
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<tr>
<td>Nine or more</td>
<td>2.417930813</td>
<td>0.174</td>
<td>1</td>
<td>0.42072</td>
<td>0.185</td>
<td>2.417931</td>
<td>-1.4828</td>
<td>0.9351</td>
<td>0.5331</td>
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<td><strong>Course completion</strong> (less than 80% excluded)</td>
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<tr>
<td>80% or more</td>
<td>0.590787217</td>
<td>0.323</td>
<td>1</td>
<td>0.1908243</td>
<td>0.185</td>
<td>0.590787</td>
<td>-1.4828</td>
<td>-0.8920</td>
<td>0.1057</td>
</tr>
<tr>
<td><strong>Highest Math Attained</strong> (2 levels or more excluded)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>One level</td>
<td>0.737083299</td>
<td>0.187</td>
<td>1</td>
<td>0.1378346</td>
<td>0.185</td>
<td>0.737083</td>
<td>-1.4828</td>
<td>-0.7457</td>
<td>0.1367</td>
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<tr>
<td>College Level</td>
<td>1.436252328</td>
<td>0.443</td>
<td>1</td>
<td>0.6362598</td>
<td>0.185</td>
<td>1.436252</td>
<td>-1.4828</td>
<td>-0.0466</td>
<td>0.3034</td>
</tr>
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</table>
### Community College Course-Taking Patterns

<table>
<thead>
<tr>
<th>Variables in the Equation</th>
<th>B</th>
<th>Mean Value</th>
<th>Yes/No</th>
<th>Probability</th>
<th>( P_0 )</th>
<th>Beta</th>
<th>( L_0 )</th>
<th>( L_1 )</th>
<th>Delta-( p )</th>
</tr>
</thead>
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<tr>
<td>Science courses</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(0 science courses</td>
<td>0.306004622</td>
<td>0.164</td>
<td>1</td>
<td>0.0501848</td>
<td>0.185</td>
<td>0.0506</td>
<td>-1.4828</td>
<td>-1.1768</td>
<td>0.0506</td>
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<tr>
<td>excluded)</td>
<td></td>
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<td></td>
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<td></td>
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</tr>
<tr>
<td>One</td>
<td>0.673439038</td>
<td>0.31</td>
<td>1</td>
<td>0.2087661</td>
<td>0.185</td>
<td>0.1230</td>
<td>-1.4828</td>
<td>-0.8094</td>
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<td>CC GPA</td>
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<tr>
<td>(Less than 2.0</td>
<td>0.688571877</td>
<td>0.432</td>
<td>1</td>
<td>0.2974631</td>
<td>0.185</td>
<td>0.1263</td>
<td>-1.4828</td>
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<td>excluded)</td>
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<td></td>
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<tr>
<td>2-3</td>
<td>0.988558914</td>
<td>0.272</td>
<td>1</td>
<td>0.268888</td>
<td>0.185</td>
<td>0.1939</td>
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<td>(3 levels or</td>
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<td></td>
</tr>
<tr>
<td>Two levels</td>
<td>0.773242989</td>
<td>0.316</td>
<td>1</td>
<td>0.2443448</td>
<td>0.185</td>
<td>0.1447</td>
<td>-1.4828</td>
<td>-0.7096</td>
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<tr>
<td>One Level</td>
<td>0.892979036</td>
<td>0.252</td>
<td>1</td>
<td>0.2250307</td>
<td>0.185</td>
<td>0.1717</td>
<td>-1.4828</td>
<td>-0.5899</td>
<td>0.1717</td>
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<tr>
<td>College ready</td>
<td>1.402170178</td>
<td>0.175</td>
<td>1</td>
<td>0.2453798</td>
<td>0.185</td>
<td>0.2948</td>
<td>-1.4828</td>
<td>-0.0807</td>
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<td>Constant</td>
<td>-6.248331977</td>
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<tr>
<td>Logit</td>
<td>-2.6151591</td>
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</tr>
<tr>
<td>Probability</td>
<td>0.0682</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 5. Installing the Community College Transfer Calculator©

Although the Internet version of the calculator is useful, the downloadable version can be customized and hence adds additional value.

1. To download the software go to http://c2ir.education.ufl.edu/calculator/calculatorsetup/index.html. Figure 5 illustrates the opening screen.

2. Click on “Calculator Installer” (see Figure 6).

3. When the dialog box appears, click “Run” (Figure 7).

4. When the Community College Transfer Calculator© Setup Wizard appears, follow directions and click “Next” in order to proceed with the installation (Figure 8).

5. The Community College Transfer Calculator© Setup Wizard will provide instructions. The program will automatically download after the user specifies the installation location and user privileges. Depending on computer speed and Internet connection, the download should take no longer than a few minutes (Figure 9).

6. When the installation is complete (Figure 10), the user is ready to fully utilize the Community College Transfer Calculator©.

Figure 5. Downloadable Version Screen
Figure 6. Calculator Installer

![Calculator Installer Image]

Figure 7. Download Message Box.

![Download Message Box Image]
Figure 8. The Calculator Wizard

Welcome to the Community College Transfer Calculator Setup Wizard

The installer will guide you through the steps required to install Community College Transfer Calculator on your computer.

WARNING: This computer program is protected by copyright law and international treaties. Unauthorized duplication or distribution of this program, or any portion of it, may result in severe civil or criminal penalties, and will be prosecuted to the maximum extent possible under the law.

Figure 9. Installing the Calculator

Installing Community College Transfer Calculator

Community College Transfer Calculator is being installed.

Please wait.
Figure 10. Installation of the Calculator Complete

Installation Complete

Community College Transfer Calculator has been successfully installed.

Click "Close" to exit.

Please use Windows Update to check for any critical updates to the .NET Framework.
### Table A6-1.

<table>
<thead>
<tr>
<th>Level of English Upon Entry</th>
<th>Highest Level of Math Attained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two Levels Below College Level</td>
</tr>
<tr>
<td>3 or More Levels Below College Level</td>
<td>19.28%</td>
</tr>
<tr>
<td>Two Levels Below College Level</td>
<td>34.07%</td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>36.84%</td>
</tr>
<tr>
<td>College Level</td>
<td>49.18%</td>
</tr>
</tbody>
</table>

**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 A6-2

<table>
<thead>
<tr>
<th>Level of English Upon Entry</th>
<th>Two Levels Below College Level</th>
<th>One Level Below College Level</th>
<th>College Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or More Levels Below College Level</td>
<td>22.3%</td>
<td>37.4%</td>
<td>54.64%</td>
</tr>
<tr>
<td>Two Levels Below College Level</td>
<td>38.32%</td>
<td>56.39%</td>
<td>72.27%</td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>41.22%</td>
<td>59.34%</td>
<td>74.63%</td>
</tr>
<tr>
<td>College Level</td>
<td>53.77%</td>
<td>70.77%</td>
<td>82.99%</td>
</tr>
</tbody>
</table>

**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 A6-3

<table>
<thead>
<tr>
<th>Level of English Upon Entry</th>
<th>Highest Level of Math Attained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Two Levels Below College Level</td>
</tr>
<tr>
<td>3 or More Levels Below College Level</td>
<td>15.84%</td>
</tr>
<tr>
<td>Two Levels Below College Level</td>
<td>28.95%</td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>31.5%</td>
</tr>
<tr>
<td>College Level</td>
<td>43.27%</td>
</tr>
</tbody>
</table>

**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 A6-4

<table>
<thead>
<tr>
<th>Level of English Upon Entry</th>
<th>Highest Level of Math Attained</th>
<th>Two Levels Below College Level</th>
<th>One Level Below College Level</th>
<th>College Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 or More Levels Below College Level</td>
<td>13.79%</td>
<td>24.97%</td>
<td>40.16%</td>
<td></td>
</tr>
<tr>
<td>Two Levels Below College Level</td>
<td>25.71%</td>
<td>41.87%</td>
<td>59.22%</td>
<td></td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>28.09%</td>
<td>44.84%</td>
<td>62.1%</td>
<td></td>
</tr>
<tr>
<td>College Level</td>
<td>39.32%</td>
<td>57.42%</td>
<td>73.11%</td>
<td></td>
</tr>
</tbody>
</table>

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 A6-5

<table>
<thead>
<tr>
<th>Highest Level of Math Attained</th>
<th>Number of Science Courses Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Two or More Levels Below College Level</td>
<td>46.38%</td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>64.29%</td>
</tr>
<tr>
<td>College Level</td>
<td>78.4%</td>
</tr>
</tbody>
</table>

**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 A6-6

<table>
<thead>
<tr>
<th>Highest Level of Math Attained</th>
<th>Number of Science Courses Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Two or More Levels Below College Level</td>
<td>41.85%</td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>59.96%</td>
</tr>
<tr>
<td>College Level</td>
<td>75.12%</td>
</tr>
</tbody>
</table>

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 A6-7

<table>
<thead>
<tr>
<th>Highest Level of Math Attained</th>
<th>Number of Science Courses Taken</th>
<th>None</th>
<th>One</th>
<th>Two or More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or More Levels Below College Level</td>
<td>36.19%</td>
<td>43.27%</td>
<td>52.32%</td>
<td></td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>54.14%</td>
<td>61.35%</td>
<td>69.55%</td>
<td></td>
</tr>
<tr>
<td>College Level</td>
<td>70.41%</td>
<td>76.19%</td>
<td>82.16%</td>
<td></td>
</tr>
</tbody>
</table>

**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 A6-8

<table>
<thead>
<tr>
<th>Highest Level of Math Attained</th>
<th>Number of Science Courses Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Two or More Levels Below College Level</td>
<td>32.52%</td>
</tr>
<tr>
<td>One Level Below College Level</td>
<td>50.07%</td>
</tr>
<tr>
<td>College Level</td>
<td>66.91%</td>
</tr>
</tbody>
</table>

**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 A6-9

<table>
<thead>
<tr>
<th>Gender</th>
<th>Less Than 3 Credits</th>
<th>Between 3 and 6 Credits</th>
<th>Between 6 and 9 Credits</th>
<th>9 Credits or More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>11.88%</td>
<td>19.29%</td>
<td>40.76%</td>
<td>59.46%</td>
</tr>
<tr>
<td>Female</td>
<td>12.73%</td>
<td>20.55%</td>
<td>42.68%</td>
<td>61.35%</td>
</tr>
</tbody>
</table>

**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 A6-10

<table>
<thead>
<tr>
<th>Course Completion Ratio</th>
<th>Less Than 3 Credits</th>
<th>Between 3 and 6 Credits</th>
<th>Between 6 and 9 Credits</th>
<th>9 Credits or More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completes Less Than 80% of Courses Enrolled</td>
<td>9.29%</td>
<td>15.37%</td>
<td>34.32%</td>
<td>52.7%</td>
</tr>
<tr>
<td>Completes 80% or More of Courses Enrolled</td>
<td>15.62%</td>
<td>24.71%</td>
<td>48.58%</td>
<td>66.82%</td>
</tr>
</tbody>
</table>

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 A6-11

<table>
<thead>
<tr>
<th>Course Completion Ratio</th>
<th>Less Than 3 Credits</th>
<th>Between 3 and 6 Credits</th>
<th>Between 6 and 9 Credits</th>
<th>9 Credits or More</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completes Less Than 80% of Courses Enrolled</td>
<td>8.64%</td>
<td>14.37%</td>
<td>32.56%</td>
<td>50.72%</td>
</tr>
<tr>
<td>Completes 80% or More of Courses Enrolled</td>
<td>14.6%</td>
<td>23.27%</td>
<td>46.61%</td>
<td>65.04%</td>
</tr>
</tbody>
</table>

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