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# Attrition Cost Model Instruction Manual

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# Attrition Cost Model Instruction Manual

## September 2012

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Commissioned by the Delta Cost Project

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# INTRODUCTION

This instruction manual explains in detail how to use the Attrition Cost Model program, which estimates the cost of student attrition for a state's higher education system. Programmed with SAS, this model allows users to instantly calculate the cost of attrition and the cumulative attrition rate that is based on the most recent retention and graduation behaviors of students. This document provides readers with a step-by-step guide to use this program while allowing them to learn the concept of attrition cost, its calculation method, and its policy implications.

## What is the "Cost of Attrition"?

The cost of student attrition is defined as the proportion of annual education and related higher education expenditures that is spent on undergraduate students who do not complete a degree at any institution.

## How is the "Cost of Attrition" Calculated?

The calculation of attrition cost begins with determining the cumulative attrition rate for each student level (e.g., freshmen, sophomore). An attrition rate is an inverse statistic of the sum of one-year retention and graduation rates, adjusted by the returning rate for students who have stopped attending higher education in that year. The model assumes that the one-year attrition rate for each student level will remain constant over time, calculating the longitudinal percentage of current-year students who will withdraw from the system over the next seven years (i.e., cumulative attrition rate). The model then multiplies the cumulative attrition rate by the annual cost of education and related expenses, producing the cost of attrition for the state's higher education system. Appendix A provides a detailed explanation of the calculation process that derives the attrition cost.

## Why is the Cost of Attrition Important?

An attrition cost is a conceptual figure, representing the estimated expenditures that will not result in "success," which is defined as obtaining a degree from any institution. Although calculated in a relatively straightforward fashion, attrition costs have implications for the efficiency of states' higher education systems in producing degrees. A lower attrition cost indicates greater efficiency, implying that investment in the higher education system yields a higher rate of success. It goes without saying, however, that any single indicator cannot fully explain the efficiency of a state's higher education system. Nevertheless, the cost of attrition sheds light on one aspect of system effectiveness—providing policymakers with a framework to better understand the financial efficiency of their higher education system.

## Technical Requirements

This program requires Base SAS 9.1 or above.

# BEFORE GETTING STARTED

In order to run the SAS program, users must prepare three comma-separated value (CSV) files (comma delimited): 1) Year 1 Enrollment file, 2) Year 2 Enrollment file, and 3) Degree file. Null values should not be included in these files.

## Year 1 Enrollment File and Year 2 Enrollment File

Users must prepare two separate enrollment data files for the most recent two academic years that data are available. The "Year 1 Enrollment" file must contain individual-level data for all undergraduate students for all terms of the first academic year. The "Year 2 Enrollment" file should include the same enrollment data for all terms of the subsequent academic year. For example, if the "Year 1 Enrollment" file contained enrollment data for academic year (AY) 2009–10, the "Year 2 Enrollment" file must have data for AY 2010–11. Graduate and high school students should not be included in either file. However, undergraduate students who took graduate-level courses before graduation must be included in the enrollment files.

Users can make a choice whether to include certificate-seeking students. If certificate-seekers were included in the enrollment files, the degree file also must include students who earned a certificate. Users can also choose whether to include non-degree-seeking students, but should be consistent in all files.

The enrollment files also include "FirstYear," which indicates the academic year when the student appeared in the state's database for the first time as a college student, regardless of his/her cumulative credit hours earned at the time of matriculation.

### Examples:

1. A student who enrolled in the state's higher education system in AY 2007–08 as a dually enrolled high school student and in AY 2008–09 as a college student.

   The first academic year of enrollment: AY 2008–09

   Entered in the file as "2008" (the calendar year of the fall term in the academic year in which the student enrolled)

2. A student transferred from an out-of-state institution in spring 2006. This student attended the out-of-state institution in fall 2003 as a first-time freshman.

   The first academic year of enrollment: AY 2005–06

   Entered in the file as "2005" (the calendar year of the fall term in the academic year in which the student enrolled)

These enrollment files, saved in CSV format (comma delimited), must include the following data elements as shown in Table 1. Users must use exactly the same field name as indicated in the table for each data element.

**Table 1. Data Elements in Enrollment Files (Years 1 and 2)**

| Field Name | Description | Format |
|---|---|---|
| AcademicYear | Four-digit academic year the student enrolled in college | Required. Four digits. Example: Academic Year 2010–11 ➡ 2010 |
| CalendarYear | Four-digit calendar year the student enrolled in college | Required. Four digits. Examples: Fall 2009 ➡ 2009; Spring 2008 ➡ 2008 |
| Term | One digit. The term the student enrolled in college. 1 = Summer, 2 = Fall, and 3 = Spring. For states with a quarter system, 1 = Summer, 2 = Fall, 3 = Winter, and 4 = Spring. | Required. One digit. |
| ID | Student's unique ID | Required. No dashes or hyphens. |
| TermCredit | Attempted credit hours during the term the student enrolled | Required. Numeric form. Up to two digits. |
| Overall_Earned | Cumulative credit hours earned at the beginning of the term the student enrolled | Required. Numeric form. Up to three digits. |
| FirstYear | First academic year of enrollment in the state's public higher education system | Required. Four digits. Examples: Academic Year 2005–06 ➡ 2005<br>Academic Year 2002–03 ➡ 2002 |

## Degree File

The degree file includes all undergraduate students who obtained a degree (associate's or bachelor's degree) during the same academic year for the "Year 1 Enrollment" file. If the enrollment files contained certificate-seeking students, the degree file must also include students who earned a certificate by the end of the same academic year. The degree file, saved as a CSV file, consists of the following data elements as shown in Table 2.

**Table 2. Data Elements in Graduation File**

| Field Name | Description | Format |
|---|---|---|
| AcademicYear | Four-digit academic year when the student received a degree | Required. Numeric. Four digits. |
| ID | Student's unique ID | Required. No dashes or hyphens. |

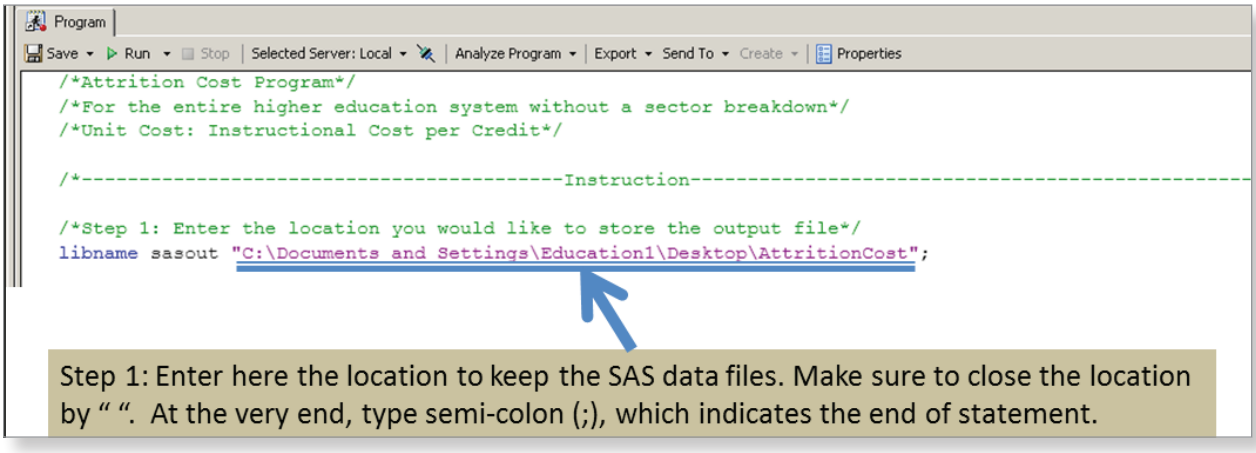
## Instructional Cost per Credit Hour

This program cannot run without an education and related expense per credit hour. Users may enter their own data, using state or institutional information that distinguishes cost by level of instruction. They may also enter an average education and related expense derived from the Delta Cost Project methodology, and available for each institution from the Trends in College Spending (TCS) online system (http://www.tcs-online.org). The program will derive the attrition cost based on the cost information entered by the user.

# GETTING STARTED

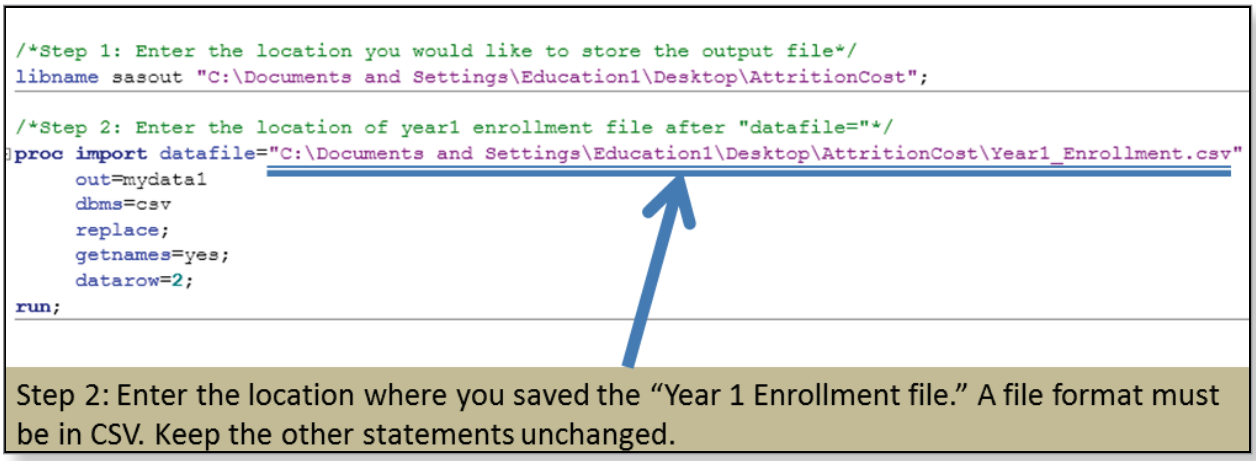
The SAS program calculates the attrition cost for the entire state higher education system. After saving the program, the user can open the program by double clicking it. The SAS program then appears on the screen, showing the instructions written in green at the top of the program. The instructions provide users with the steps to follow before running the program.

**Step 1:** Specify the file location where the SAS files, including the output report, will be saved.




**Steps 2–4:** Specify the location where you saved the CSV files (i.e., enrollment and degree files).

**"Year 1 Enrollment file"**



**"Year 2 Enrollment file"**

```
/*Step 3: Enter the location of year2 enrollment file after "datafile="*/
proc import datafile='C:\Documents and Settings\Education1\Desktop\AttritionCost\Year2_Enrollment.csv'
      out=mydata2
      dbms=csv
      replace;
      getnames=yes;
      datarow=2;
run;
```

Step 3: Enter the location where you saved the "Year 2 Enrollment file." A file format must be in CSV. Keep the other statements unchanged.

**"Degree file"**

```
/*Step 4: Enter the location of degree file after "datafile="*/
proc import datafile="C:\Documents and Settings\Education1\Desktop\AttritionCost\Degree_File.csv"
      out=mydata3
      dbms=csv
      replace;
      getnames=yes;
      datarow=2;
run;
```

Step 4: Enter the location where you saved the "Degree file." A file format must be in CSV.

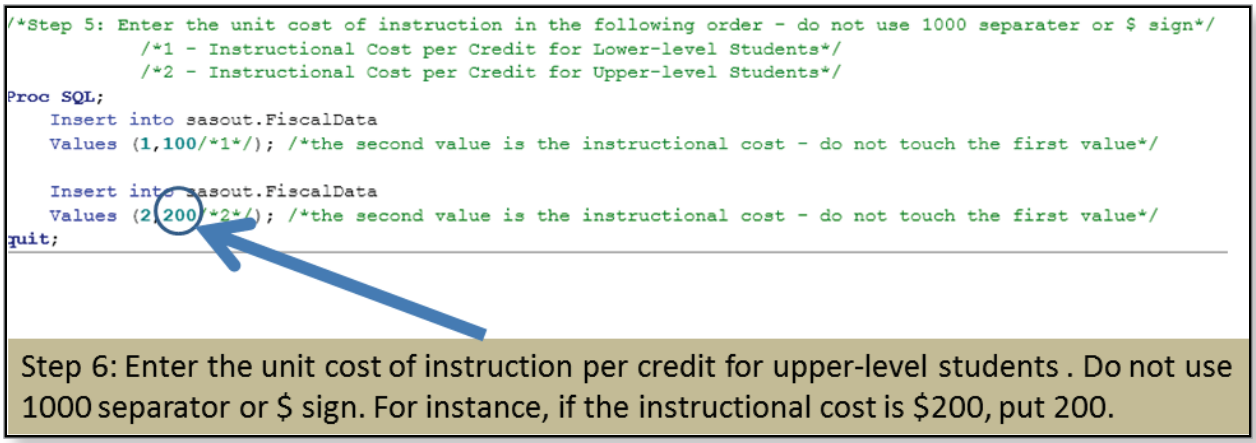
**Steps 5–6:** Enter the unit costs of instruction (per credit) for lower and upper level students that the user has prepared.

```
proc sql;
   create table sasout.FiscalData
        (StuLevel num format=best8. informat = best8.,
        UnitCost num format=best8. informat = best8.);
   run;

/*Step 5: Enter the unit cost of instruction in the following order - do not use 1000 separater or $ sign*/
           /*1 - Instructional Cost per Credit for Lower-level Students*/
           /*2 - Instructional Cost per Credit for Upper-level Students*/
Proc SQL;
    Insert into sasout.FiscalData
    Values (1,100/*1*/); /*the second value is the instructional cost - do not touch the first value*/

    Insert into sasout.FiscalData
    Values (2,200/*2*/); /*the second value is the instructional cost - do not touch the first value*/
quit;
```

Step 5: Enter the unit cost of instruction for lower-level students . Do not use 1000 separator or $ sign. For instance, if the instructional cost is $100, put "100".




**Step 7:** After entering all necessary information in the designated locations, click "run"; the SAS program will produce the results in a SAS output format.

# INTERPRETING THE OUTPUTS

The SAS program will generate the following outcomes in HTML form:

- Attrition Cost
- Cumulative Attrition Rate by Student Level
- Retention and Graduation Summary
- Enrollment Summary—Year 1 Students
- Enrollment Summary—Year 2 Students

## "Attrition Cost" Table

At the very top of the output report, the SAS program produces the primary outcome of the analysis as shown in Table 3. "Attrition Cost" is the proportion of annual higher education expenditures that go to pay for the instruction of students who never graduate. The next column ("Total Cost") represents the total annual higher education expenditures, yielded by multiplying the total attempted credit hours by the unit education and related cost per credit. Last, "Attrition Cost as a Percentage of Total Education and Related Instructional Cost" is calculated by dividing the attrition cost by the total cost and multiplying by 100. In the example below, the attrition cost is $10.2 million, equivalent to 61 percent of the total cost. An interpretation of the result is that 61 percent of the total cost was spent for the education of students who will never graduate.

**Table 3. Attrition Cost**

| Attrition Cost | Total Cost | Attrition Cost as a Percentage of Total Cost |
|---|---|---|
| $10,241,628 | $16,755,200 | 61% |

## "Cumulative Attrition Rate by Student Level" Table

The second table (Table 4) generated by the SAS program is the "Cumulative Attrition Rate by Student Level," providing supplemental information that may be useful to better understand factors driving state attrition cost. "Attrition Rate" is the cumulative percentage of students who will withdraw from the system over time without obtaining a degree. The data are broken down by "Student Level," which stands for the number of years passed since the initial year of enrollment. Student Level 1 corresponds to those who attended college for the first time, while Student Level 7 refers to students in their seventh year of enrollment. Students who have been in the state's higher education system for 10 years or more are included in Student Level 10. In the table below, Student Level 1 had the highest cumulative attrition rate, at 75 percent, followed by Student Levels 10 and 9, at 64 percent and 63 percent, respectively.

**Table 4. Cumulative Attrition Rate by Student Level**

| Student Level | Attrition Rate |
|---|---|
| 1 | 75% |
| 2 | 61% |
| 3 | 51% |
| 4 | 48% |
| 5 | 52% |
| 6 | 58% |
| 7 | 57% |
| 8 | 59% |
| 9 | 63% |
| 10 | 64% |

## "Retention and Graduation Summary" Table

Table 5 presents the data comprising the attrition rate, namely the retention rate, graduation rate, and an adjustment factor. It is important to note that the retention and graduation rates are defined differently than the Integrated Postsecondary Education Data System (IPEDS) retention and graduation rates that many readers may be familiar with. In this table, "Retention Rate" refers to the percentage of students (unduplicated) identified in the "Year 1 Enrollment" file who enrolled in college for at least one semester during the following academic year. "Graduation Rate" is the percentage of students in the "Year 1 Enrollment" file who obtained a degree by the end of the same academic year and did not enroll in college in the following academic year. Students who obtained an associate's degree and transferred to a 4-year institution are reflected in the retention rate. "Adjustment Factor" is a factor that smooths student attrition over time, represented by the ratio of nonfreshman students in the "Year 2 Enrollment" file who were not included in the "Year 1 Enrollment" file relative to total enrollment in the "Year 1 Enrollment" file. The adjustment factor accounts for "stop-out" students who leave for a year but return to college later. The model assumes the same adjustment rate across student levels. Appendix B provides a more detailed explanation of the concept of the adjustment factor.

**Table 5. Retention and Graduation Summary**

| Student Level | Retention Rate | Graduation Rate | Return Rate for Stop-out Students (Adjustment Factor) |
|---|---|---|---|
| 1 | 55% | 0.3% | 7% |
| 2 | 66% | 2% | 7% |
| 3 | 58% | 14% | 7% |
| 4 | 56% | 20% | 7% |
| 5 | 61% | 18% | 7% |
| 6 | 54% | 15% | 7% |
| 7 | 55% | 16% | 7% |
| 8 | 60% | 15% | 7% |
| 9 | 60% | 12% | 7% |
| 10 | 59% | 11% | 7% |

## "Enrollment Summary—Year 1 Students" and "Enrollment Summary— Year 2 Students" Tables

Tables 6 and 7 provide a summary of Year 1 and Year 2 enrollment files. Year 1 refers to the academic year for the Year 1 enrollment file, while Year 2 corresponds to the subsequent academic year. The "Enrollment" column shows the unduplicated student headcount in the academic year. The next column presents "Total Attempted Credits," which are the total credit hours attempted by students during the same academic year. Last, "Average Attempted Credits" is the division of total attempted credit hours by the unduplicated enrollment headcount in the same academic year.

**Table 6. Enrollment Summary—Year 1 Students**

| Student Level | Enrollment | Total Attempted Credits | Average Attempted Credits |
|---|---|---|---|
| 1 | 2,736 | 39,468 | 14.4254 |
| 2 | 1,242 | 25,149 | 20.2488 |
| 3 | 814 | 16,571 | 20.3575 |
| 4 | 658 | 12,484 | 18.9726 |
| 5 | 436 | 8,343 | 19.1353 |
| 6 | 272 | 4,443 | 16.3346 |
| 7 | 222 | 3,617 | 16.2928 |
| 8 | 205 | 3,183 | 15.5268 |
| 9 | 161 | 2,215 | 13.7578 |
| 10 | 643 | 7,999 | 12.4401 |

**Table 7. Enrollment Summary—Year 2 Students**

| Student Level | Enrollment | Total Attempted Credits | Average Attempted Credits |
|---|---|---|---|
| 1 | 2,738 | 37,793 | 13.8031 |
| 2 | 1,511 | 26,139 | 17.2991 |
| 3 | 861 | 15,394 | 17.8792 |
| 4 | 523 | 9,747 | 18.6367 |
| 5 | 427 | 7,554 | 17.6909 |
| 6 | 312 | 5,530 | 17.7244 |
| 7 | 196 | 3,089 | 15.7602 |
| 8 | 163 | 2,425 | 14.8773 |
| 9 | 162 | 2,514 | 15.5185 |
| 10 | 683 | 8,599 | 12.5900 |

# APPENDIXES

## Appendix A. How is the "Cost of Attrition" Calculated?

Tables A-1 through A-6 below provide a detailed description of how an attrition cost is calculated. First, Table A-1 shows fictitious data of undergraduate enrollment in academic year (AY) 2009–10 in State X. During that year, the state's total undergraduate enrollment was 97,175. The student level represents the number of year(s) passed since initial enrollment, treated as a "cohort" in this model. For instance, the state had 30,000 students at Student Level 1, meaning their first year of enrollment was AY 2009–10. As another example, the table shows 21,000 students at Student Level 2, indicating that they were in the system in AY 2008–09 for the first time and remained enrolled in AY 2009–10. Students who have been enrolled for more than 10 years are grouped into the student level of "10 or above."

Table A-1 also shows retention and graduation rates. It is important to note that these rates are different from the metrics that the public may be familiar with, such as the Integrated Postsecondary Education Data System (IPEDS) retention and graduation rates. In this model, retention rate refers to the percentage of AY 2009–10 students (including both full-time and part-time) who returned in AY 2010–11, while graduation rate is the percentage of AY 2009–10 students who exited the system with a degree by the end of the same academic year. Both rates are calculated for each cohort group. For instance, the retention and graduation rates for Student Level 4 were 55 percent and 30 percent, respectively. The interpretation of these rates is that 55 percent of 10,290 students in their fourth year of enrollment in AY 2009–10 remained enrolled in the next academic year, and 30 percent of them graduated by the end of AY 2009–10. Students who transferred from the state's 2-year sector into the 4-year sector with an associate's degree are reflected in the retention rate, not in the graduation rate, to avoid double counting. For the sector-level attrition cost model, however, such students are reflected in the graduation rate for the 2-year sector.

Not returning to college in the next year does not necessarily equate to complete withdrawal from college. Some students may stop attending college temporarily and return to school after a few years of absence. The model must account for such "stop-out" behaviors, otherwise it would overstate student attrition. This model is built on only two years of student data, thus it does not project the number of stop-out students. To address this technical limitation, the model employs an adjustment factor, which is the percentage of stop-out students in AY 2010–11 relative to total enrollment in AY 2009–10. The adjustment factor is a proxy measure that represents expected stop-out behaviors of students in the database. The model assumes the same adjustment rate across the cohorts. In AY 2010–11, the system enrolled 3,887 stop-out students, equivalent to 4 percent of total enrollment in AY 2009–10. Subtracting the sum of the retention, graduation, and adjustment rates from 1, the model yields the one-year attrition rate for each cohort group.

**Table A-1. Student Enrollment, Retention, Graduation, and Attrition Rates in AY 2009–10 and AY 2010–11 in State X**

| Student Level | 2009–10 | 2010–11 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Enrolled | Enrolled | Graduated | Adjustment | Retention Rate | Graduation Rate | Adjustment Rate | Attrition Rate |
| 1 | 30,000 | 24,000 | - | 1,200 | 80% | 0% | 4% | 16% |
| 2 | 21,000 | 17,430 | 1,050 | 840 | 83% | 5% | 4% | 8% |
| 3 | 14,700 | 12,054 | 1,470 | 588 | 82% | 10% | 4% | 4% |
| 4 | 10,290 | 5,660 | 3,087 | 412 | 55% | 30% | 4% | 11% |
| 5 | 7,203 | 3,602 | 2,521 | 288 | 50% | 35% | 4% | 11% |
| 6 | 5,042 | 2,269 | 1,714 | 202 | 45% | 34% | 4% | 17% |
| 7 | 3,529 | 1,518 | 1,271 | 141 | 43% | 36% | 4% | 17% |
| 8 | 2,471 | 1,186 | 766 | 99 | 48% | 31% | 4% | 17% |
| 9 | 1,729 | 865 | 605 | 69 | 50% | 35% | 4% | 11% |
| 10 or Above | 1,211 | 569 | 400 | 48 | 47% | 33% | 4% | 16% |
| **Total** | **97,175** | **69,153** | **12,884** | **3,887** | **71%** | **13%** | **4%** | **12%** |

Next, the model produces enrollment projections for AY 2010–11 students based on the retention and adjustment rates, estimating the number of students who will continue their enrollment from AY 2011–12 to AY 2017–18 (Table A-2). The model first produces an enrollment projection for each cohort group, then adds them up for total enrollment. For example, the model projects that the enrollment of Student Level 1 will decrease from 30,900 in AY 2010–11 to 25,956 in AY 2011–12. This projection resulted from multiplying the original student headcount of Student Level 1 in AY 2010–11 by the sum of the 1-year retention rate (80 percent) and the adjustment rate (4 percent). In the following year, 2012–13, the model projected a further decline in enrollment to 22,582, after multiplying the 25,956 students (those who remained enrolled in 2011–12) by the sum of the retention and adjustment rates for Student Level 2. The model repeats this calculation process seven times for all student cohort groups. Consequently, overall enrollment will decline from 100,091 in AY 2010–11 to 2,619 in AY 2017–18.

**Table A-2. Retained Enrollment in State X From 2011–12 to 2017–18, for AY 2010–11 Students**

| Student Level | 2010–11 | 2011–12 | 2012–13 | 2013–14 | 2014–15 | 2015–16 | 2016–17 | 2017–18 |
|---|---|---|---|---|---|---|---|---|
| | Enrolled | Retained Students | | | | | | |
| 1 | 30,900 | 25,956 | 22,582 | 19,420 | 11,458 | 6,187 | 3,032 | 1,425 |
| 2 | 21,630 | 18,818 | 16,184 | 9,548 | 5,156 | 2,526 | 1,187 | 617 |
| 3 | 15,141 | 13,021 | 7,683 | 4,149 | 2,033 | 955 | 497 | 268 |
| 4 | 10,599 | 6,253 | 3,377 | 1,655 | 778 | 404 | 218 | 111 |
| 5 | 7,419 | 4,006 | 1,963 | 923 | 480 | 259 | 132 | 67 |
| 6 | 5,193 | 2,545 | 1,196 | 622 | 336 | 171 | 87 | 45 |
| 7 | 3,635 | 1,709 | 888 | 480 | 245 | 125 | 64 | 32 |
| 8 | 2,545 | 1,323 | 715 | 364 | 186 | 95 | 48 | 25 |
| 9 | 1,781 | 962 | 491 | 250 | 128 | 65 | 33 | 17 |
| 10 or Above | 1,247 | 636 | 324 | 165 | 84 | 43 | 22 | 11 |
| **Total** | **100,091** | **75,229** | **55,402** | **37,576** | **20,883** | **10,830** | **5,321** | **2,619** |

Table A-3 displays the attrition rates for each student cohort group from AY 2011–12 to AY 2017–18. As students advance in projections, their attrition rate also changes with the number of years students within a cohort remain in school. For example, the attrition rate for Student Level 1 begins at 16 percent in AY 2011–12, falling to 8 percent in AY 2012–13 and 4 percent in 2013–14. This is because their relevant attrition rate moves with their progress in the student level. After 10 years of enrollment, the attrition rate will remain at 16 percent, the rate for the cohort of Student Level 10 or above.

**Table A-3. Projected Student Attrition Rate From AY 2011–12 to AY 2017–18 in State X**

| Student Level | 2010–11 | 2011–12 | 2012–13 | 2013–14 | 2014–15 | 2015–16 | 2016–17 | 2017–18 |
|---|---|---|---|---|---|---|---|---|
| | Enrolled | Attrition Rate | | | | | | |
| 1 | 30,900 | 16% | 8% | 4% | 11% | 11% | 17% | 17% |
| 2 | 21,630 | 8% | 4% | 11% | 11% | 17% | 17% | 17% |
| 3 | 15,141 | 4% | 11% | 11% | 17% | 17% | 17% | 11% |
| 4 | 10,599 | 11% | 11% | 17% | 17% | 17% | 11% | 16% |
| 5 | 7,419 | 11% | 17% | 17% | 17% | 11% | 16% | 16% |
| 6 | 5,193 | 17% | 17% | 17% | 11% | 16% | 16% | 16% |
| 7 | 3,635 | 17% | 17% | 11% | 16% | 16% | 16% | 16% |
| 8 | 2,545 | 17% | 11% | 16% | 16% | 16% | 16% | 16% |
| 9 | 1,781 | 11% | 16% | 16% | 16% | 16% | 16% | 16% |
| 10 or Above | 1,247 | 16% | 16% | 16% | 16% | 16% | 16% | 16% |

Using the attrition rates in Table A-3, Table A-4 projects student attrition from AY 2011–12 to AY 2017–18. Over time, the model estimated that the statewide cumulative attrition rate will be at 33 percent, with 33,430 out of 100,091 students withdrawing from the state's higher education system by 2017–18 without obtaining a degree. Each student cohort group has a different cumulative attrition rate, ranging from a high of 42 percent for Student Level 1 to a low of 27 percent for Student Level 3.

**Table A-4. Student Attrition From AY 2011–12 to AY 2017–18 in State X**

| Student Level | 2010–11 | 2011–12 | 2012–13 | 2013–14 | 2014–15 | 2015–16 | 2016–17 | 2017–18 | Total Attrition | Cum. Attrition Rate |
|---|---|---|---|---|---|---|---|---|---|---|
| | Enrolled | Attrition | | | | | | | | |
| 1 | 30,900 | 4,944 | 2,076 | 903 | 2,136 | 1,260 | 1,052 | 515 | 12,888 | 42% |
| 2 | 21,630 | 1,730 | 753 | 1,780 | 1,050 | 877 | 430 | 202 | 6,822 | 32% |
| 3 | 15,141 | 606 | 1,432 | 845 | 705 | 346 | 162 | 55 | 4,151 | 27% |
| 4 | 10,599 | 1,166 | 688 | 574 | 281 | 132 | 44 | 35 | 2,921 | 28% |
| 5 | 7,419 | 816 | 681 | 334 | 157 | 53 | 41 | 21 | 2,103 | 28% |
| 6 | 5,193 | 883 | 433 | 203 | 68 | 54 | 27 | 14 | 1,682 | 32% |
| 7 | 3,635 | 618 | 290 | 98 | 77 | 39 | 20 | 10 | 1,152 | 32% |
| 8 | 2,545 | 433 | 146 | 114 | 58 | 30 | 15 | 8 | 803 | 32% |
| 9 | 1,781 | 196 | 154 | 78 | 40 | 20 | 10 | 5 | 505 | 28% |
| 10 or Above | 1,247 | 200 | 102 | 52 | 26 | 13 | 7 | 4 | 404 | 32% |
| **Total** | **100,091** | **11,591** | **6,755** | **4,982** | **4,598** | **2,824** | **1,808** | **869** | **33,430** | **33%** |

Table A-5 shows the process in which the total attrition cost is estimated. First, total attempted credit hours during AY 2010–11 are calculated for each cohort, divided into two groups (i.e., lower level and upper level students) according to students' cumulative earned credit hours at the beginning of AY 2010–11. This model considers anyone who has earned a total of 60 or more credit hours an upper level student; all others are categorized as lower level students. During AY 2010–11, total credit hours attempted by lower level students were 1,449,583, while upper level students registered 992,280 credit hours.

Next, these credit hours are multiplied by the corresponding unit education and related expense per credit hour (which is prepared by the user). The model requires the user to input into the model two calculations of education and related costs: one for lower level students and another for upper level students. In Table A-5, the costs per credit hour were set at $150 for lower level students and $300 for upper level students. After multiplying the unit cost by the total credit hours within each student cohort, the model sums up the costs, estimating that the total education and related costs will be $217,437,487 for lower level students and $297,684,022 for upper level students. The grand total cost is $515,121,509.

**Table A-5. Student Credit Hours and Total Education and Related Expenses by Student Level in AY 2010–11 in State X**

| Student Level | 2010–11 | Credit Hours Attempted | | Unit Cost per Credit | | Total Cost of Instruction | | |
|---|---|---|---|---|---|---|---|---|
| | Enrolled | Lower Level Students | Upper Level Students | Lower Level Students | Upper Level Students | Lower Level | Upper Level | Grand Total |
| 1 | 30,900 | 593,280 | 154,500 | 150 | 300 | $88,992,000 | $46,350,000 | $135,342,000 |
| 2 | 21,630 | 363,384 | 162,225 | 150 | 300 | $54,507,600 | $48,667,500 | $103,175,100 |
| 3 | 15,141 | 181,692 | 189,263 | 150 | 300 | $27,253,800 | $56,778,750 | $84,032,550 |
| 4 | 10,599 | 101,748 | 158,981 | 150 | 300 | $15,262,128 | $47,694,150 | $62,956,278 |
| 5 | 7,419 | 71,223 | 111,286 | 150 | 300 | $10,683,490 | $33,385,905 | $44,069,395 |
| 6 | 5,193 | 49,856 | 77,900 | 150 | 300 | $7,478,443 | $23,370,134 | $30,848,576 |
| 7 | 3,635 | 34,899 | 54,530 | 150 | 300 | $5,234,910 | $16,359,093 | $21,594,003 |
| 8 | 2,545 | 24,430 | 38,171 | 150 | 300 | $3,664,437 | $11,451,365 | $15,115,802 |
| 9 | 1,781 | 17,101 | 26,720 | 150 | 300 | $2,565,106 | $8,015,956 | $10,581,062 |
| 10 or Above | 1,247 | 11,970 | 18,704 | 150 | 300 | $1,795,574 | $5,611,169 | $7,406,743 |
| **Total** | **100,091** | **1,449,583** | **992,280** | — | — | **$217,437,487** | **$297,684,022** | **$515,121,509** |

Last, the model multiplies the total education and related expenses in AY 2010–11 by the cumulative attrition rate, deriving the attrition cost for each cohort. Adding up the attrition cost of each cohort, the model estimates the total attrition cost at $168,869,165 compared with total education and related expenditures of $515,121,509 in AY 2010–11 (Table A-6).

**Table A-6. Total Cost of Education and Related Expenses, Cumulative Attrition Rate, and Attrition Cost by Student Level in AY 2010–11 in State X**

| Student Level | E&R Costs of Instruction | Cumulative Attrition Rate | Attrition Cost |
|---|---|---|---|
| 1 | $135,342,000 | 42% | $56,447,683 |
| 2 | $103,175,100 | 32% | $32,538,706 |
| 3 | $84,032,550 | 27% | $23,037,843 |
| 4 | $62,956,278 | 28% | $17,348,760 |
| 5 | $44,069,395 | 28% | $12,492,524 |
| 6 | $30,848,576 | 32% | $9,993,064 |
| 7 | $21,594,003 | 32% | $6,844,496 |
| 8 | $15,115,802 | 32% | $4,772,456 |
| 9 | $10,581,062 | 28% | $2,996,809 |
| 10 or Above | $7,406,743 | 32% | $2,396,824 |
| **Total** | **$515,121,509** | **33%** | **$168,869,165** |

# Appendix B. SAS Procedure Outline

This section elaborates on the process in which the SAS program calculates the attrition cost. The SAS procedure will undertake the following tasks in descending order:

a. Calculate unduplicated, undergraduate headcounts for the first academic year (hereafter referred to as "Year 1") by student level (hereafter referred to as "cohort"), as determined by the year of entry at college.

b. Calculate the percentage of undergraduate students in Year 1 who returned in the next academic year (hereafter referred to as "Year 2") at any time during Year 2 for each student cohort (i.e., retention rate).

c. Calculate the percentage of Year 1 students who graduated with any credential by the end of the same academic year for each student cohort (i.e., graduation rate). Students who earned an associate's degree and transferred to the 4-year sector in Year 2 were excluded from the graduation rates.

d. Calculate the statewide return rate (i.e., adjustment factor) for stop-out undergraduate students in Year 2 (i.e., nonfreshmen in Year 2 who did not enroll in Year 1). The return rate is defined as the percentage of stop-out students in Year 2 relative to total unduplicated, undergraduate enrollment in Year 1.

e. Calculate the second-year attrition rate using the retention, graduation, and return rates for each student cohort. (i.e., attrition rate = 1 – retention rate – graduation rate – adjustment factor).

f. Calculate the unduplicated, undergraduate headcount in Year 2 and group it by student cohort.

g. Apply the second-year attrition rates to Year 2 students to estimate the number of students who will withdraw in the following academic year.

h. Move the retained students to the following year in the projections. Subtract the students projected to withdraw from the retained students, and add a year to their student level. The program repeats this process seven times.

i. Add the results together to get estimates of total projected attrition for currently enrolled students by cohort.

j. Calculate the cumulative attrition rate, which is the projected cumulative number of withdrawals as a percentage of the unduplicated enrollment headcount in Year 2 by student cohort.

k. Calculate student full-time equivalents (FTEs) in AY 2010–11 by student cohort, and group them into the upper and lower divisions based on their cumulative credit hours earned. Multiply the total credit hours by the corresponding instructional cost per credit (as inputted by the user at the beginning) to get the estimate of the total instructional cost for each cohort.

l. Multiply the total education and related cost by the cumulative attrition rate for each student cohort. Aggregate each cohort's total education and related cost to get the grand total attrition cost.

m. Last, the outcome will be published through SAS output format.

# Appendix C. Assumptions and Limitations

This program assumes the following factors in projections:

- Students who graduated but remained enrolled for the next year are counted in the retention rate (e.g., obtained an associate's degree and transferred to a 4-year institution).
- Students who moved on to graduate school without completing a degree are counted in the retention rate.
- The returning rate for stop-out students is at the same level across cohorts.
- Note that the program cannot distinguish students who move to an institution not included in the data set from those who drop out of higher education. Therefore the results will be more accurate as more institutions (e.g., private, out-of-state) are included in the data.

## About the Delta Cost Project

The Delta Cost Project at American Institutes for Research provides data and tools to help higher education administrators and policymakers improve college affordability by controlling institutional costs and increasing productivity. The work is animated by the belief that college costs can be contained without sacrificing access or educational quality through better use of data to inform strategic decision making. For more information about the Delta Cost Project, visit **www.deltacostproject.org.**

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