AC 2011-1416: RETENTION: QUANTIFYING THE APPLES AND ORANGES

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Retention: Quantifying the Apples and Oranges

Abstract

During the past decade, the paths of students into and out of engineering degree programs have become more complex. Higher education institutions have attempted to address this increasing complexity with student retention models that attempt to generalize student paths.

While the engineering education literature is replete with studies on student retention, many or most studies consider only a cohort of incoming freshmen who declare an engineering major at the time of matriculation, or complete a common first-year engineering program. However, some large public universities use a two-tiered admission system, where admission to the college of engineering occurs at some later time, and student movement during the early years may be in both directions—into and out of engineering.

This paper presents a very general model of student movement into and out of engineering, and proposes a taxonomy of definitions of retention that can be used for more meaningful comparisons of groups within institutions and across institutions. To develop the model, information on retention modeling and major retention issues in engineering was gathered from a sample of large and small public and private engineering schools. To test the model, it has been applied to the case of large, public institutions with similar retention issues. While not presented in this paper, the general model could be applied to institutions with large or small, public or private characteristics.

The research for this paper is part of an ASEE discussion on the issue of engineering student retention: A recently formed an Undergraduate Experience Committee under the auspices of the Engineering Dean's Council has identified retention (or persistence) of engineering students as a high priority topic.

Introduction

ASEE recently formed an Undergraduate Experience Committee under the auspices of the Engineering Dean's Council. Its mission is to foster discussion, collaboration and action for the benefit of the undergraduate experience. A high priority topic identified by the committee is retention (or persistence) of engineering students.

The engineering education literature is replete with studies on retention, with the overwhelming majority of these studies focusing on measuring and comparing retention rates among various demographic groups, assessing reasons for staying or leaving, and developing predictive models that attempt to explain these rates and reasons. However, a large number of these publications

- consider a limited cohort of those who have matriculated into engineering as incoming freshmen or at the end of a common first-year pre-engineering curriculum,
- consider that other, later entry points to engineering have small populations that may be negligible,
- quantify retention over a relatively long time increment, such as through the eighth semester, or to graduation within six years

These studies provide important information for engineering educators for the questions they address; however, there remain at least two shortcomings. First, students' paths to engineering program admission and to graduation can be much more complex. For example, universities and engineering schools have a wider variety of entry paths than those typically reported, and entry to engineering majors at other time points is not always negligible. Secondly, it can be of considerable interest to Deans, Associate Deans and Principal Investigators of funded retention projects to have shorter-term measures to assess the real-time effectiveness of interventions intended to increase retention. For example, the NSF STEM Talent Expansion Program (STEP) provides funding for a five year period, with a three year interim review to assess progress toward goals.

Representatives of the ASEE Undergraduate Experience Committee will be involved in addressing the broad topic of retention by clarifying what retention means, how it is measured and identifying best practices. As a starting point, it becomes clear that quantifying retention in a meaningful manner is a non-trivial problem that must be addressed, due to the variety of ways in which students come to engineering programs.

In this paper, methods for defining and calculating retention will be reviewed, in light of the variety of admission and enrollment management systems. While it is not likely that a single definition and approach will ever be universally adopted, the authors propose a taxonomy of definitions and methods that could better serve the assessment of retention. The paper makes no attempt to explore or assess reasons for entering, staying or leaving; the intent is solely to define a measurement framework for such studies which may follow.

Previous Studies and the Common Retention Metric

Models for calculating retention of students in institutions, overall, and within engineering programs range from broad, simpler calculations mandated by federal and state reporting to more detailed, nuanced models that attempt to account for the significant variety of student entry and exit patterns. The Student Right to Know and Campus Security Act, signed in 1990, requires higher education institutions to publish both graduation and retention rates using very simple calculations. Retention rates are calculated as the percentage of students entering an institution as full time, first time, degree or certificate seeking undergraduates of a particular cohort in the Fall of a given year and who are still enrolled in the following Fall. Graduation rates are calculated using the percentage of first time, full time bachelor's degree seeking students earning a formal award (degree) within 150 percent of the normal time to completion, usually within 6 years.[1]

The NCES model[1] does not take into account transfers, those who enter at times other than first-time, full time freshmen, or returning students. Models in the literature on engineering retention address the many patterns of student entry and exit into and out of engineering degree programs. Figure 1 shows the model widely used to quantify engineering retention in publications of the past decade (Ohland, et. al.[2]).

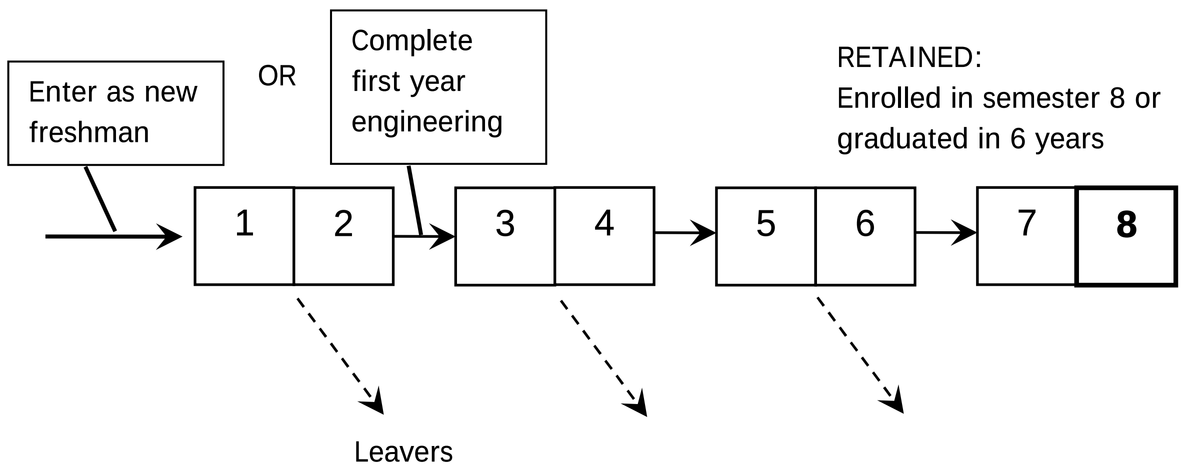


Figure 1. Common Model for Quantifying Engineering Retention

For example, Zhang, et. al.[3], in studying GPA effects on retention for students from nine universities in the SUCCEED longitudinal database, used a cohort of *Matriculated Engineering Students* who "either directly matriculated in a specific engineering discipline or a general engineering degree program first and then transitioned to a specific engineering major one or more semesters later." They also identified an *Excluded Population* who "matriculated in another field but later entered engineering."

In a widely cited paper, Ohland, et. al.[2], studied persistence, engagement and migration within engineering programs using the large and longitudinal MIDFIELD data set, but noted "while MIDFIELD also contains records for many non-first-time students, these were excluded from this study primarily because those students can differ from first-time students in many ways that are not tracked in student records." They go on to perform their studies based only on cohorts of students who first matriculated in engineering. The measured persistence (retention) through the eighth semester (designated PG8 for persistence in the group through semester 8) was used as it permitted an earlier look at the data, and it was known that this measure closely tracks the more traditional measure of graduation within six years. The use of PG8 rather than six year graduation is reiterated by Ohland, et. al.[4] Their findings include observations that "students who matriculate as 'undeclared' do not select STEM fields," and "(engineering) has the lowest rate of affinity for students matriculating in other major groups."

Nearly all research on engineering retention cites the landmark study by Seymour and Hewitt[5], *Thinking About Leaving: Why Undergraduates Leave the Sciences.* Yet it too is primarily cast in terms of matriculation major. On page 19, they state that "the level of transfer into S.M.E. (STEM) majors from all majors defined as 'non-S.M.E.' (including those who enter as 'undecided') is modest (6.2%)" and " Engineering gains 13.1 percent of switchers from the computer and technical fields." As the book title reflects the emphasis on the broad group of all STEM majors, it also does not provide a detailed accounting of multiple entry paths to engineering. However, when the focus switches to the dynamics of entry and exit to and from an engineering program, the numbers of those who switch to engineering from the sciences or elsewhere requires consideration, as will be discussed later.

An exception to the practice of assuming that migration into an engineering major is negligible is noted by Donaldson and Sheppard[6], who found a 25% rate of inward migration at a private research university. They propose three hypotheses for this: 1) undergraduates may matriculate into science fields without much initial familiarity with the engineering professions, but find it later, 2) other matriculaters may be attracted to "hybrid" engineering majors, such as those related to management or product design, and 3) incoming engineering students may simply be like those in other majors in starting college without firm intentions and then exploring majors.

An addition to the common cohort of first-time matriculators is considered by Mendez, et. al.[7] In developing a model for retention in the STEM fields in general, they consider a cohort of two components: 1) those who declared a STEM major upon matriculation, and 2) those who did not, but enrolled in at least one introductory STEM course required for a STEM major (e.g., calculus, physics, biology, chemistry). In doing so, they recognize that interest in pursuing a STEM major may extend beyond those who explicitly declare one at matriculation. However, if doing a parallel analysis for engineering only, the list of considered introductory courses should likely be narrowed.

Hence, Figure 1 could be made more general by adding entry arrows for two additional groups: 1) those who migrate into engineering majors at later times, and 2) those who take one or more introductory engineering courses, at a time when not declared in the major. Note that these groups are not independent, as the second group may include students who then join the former. Some members from each of these groups can be expected to proceed to graduation, meaning that total numbers of graduates would be underpredicted from the "common model," and percentages of students retained could be underpredicted as well, as one might expect these later deciders to be more sure of their majors.

Considering these additional entry points, however, introduces a significant complication in computing a retention percentage: the additional "joiners" may enter Figure 1 at a number of different points in time, and may have matriculated to the institution at different points in time. Calculating a retention percentage requires a defined starting cohort and a defined end point in time; leavers can leave at any time, but simultaneous joiners and leavers distributed within the time span makes calculation of a percentage ambiguous.

A More General Picture of Entry to and Exit from Engineering

The actual situation at some large public universities is more complex and must be considered in meaningful calculations of retention. Two-tier admission systems are used in some universities (including Michigan State University and the University of Wisconsin-Madison) and the situation can be generalized as follows:

1. In some schools, incoming university matriculators are first admitted to the University (as opposed to the College of Engineering) and may freely declare any major, including engineering majors. This system is intended to allow students flexibility and avoid the complications of locking them into a major before they have the knowledge and experience to make this decision. However, declaring an engineering major is not equivalent to "matriculation to engineering" as implied in other publications; later admission to a degree-granting program in the college is required to access upper level courses. Alternatively, they may be admitted to Engineering, but not yet to any specific major. Finally, in some schools, students not "close" to having qualifications for engineering may be required to first declare a holding-pattern major. Where early major changing is not restricted, students changing into engineering majors prior to college admission can be as large as 20 percent of the number of incoming engineering freshmen. This is not negligible, but close to that cited by Donaldson and Sheppard.[6]
2. Based on time and intended major, criteria for admission to the college may reflect both available resources (e.g. seats in classes and labs) and/or demonstrated ability to succeed in a number of early required STEM courses. The criteria typically includes successful completion of prescribed classes and number of credits, resident credits or resident semesters.
3. Depending on Advanced Placement credit, the incoming matriculators may have class codings ranging from freshman through junior. (For brevity, first-time college matriculators will be hereafter referred to as new freshmen regardless of class coding).
4. Depending on placement scores and Advanced Placement results, new freshmen may start at a wide variety of math courses. The time at which a student completes courses required for engineering admission can vary by several years within a new freshman cohort.

5. Additional students may be admitted in January. A very small additional number may start in summer.
6. Students who first matriculated at other schools, including community colleges, may transfer to the university and enter engineering either directly (secondary admission) or prior to completing college admission requirements.
7. In some institutions, students initially denied admission to an engineering degree granting program may change to an "open" major and apply again at a later time if they still have lower level courses to take or need to improve performance in certain courses. If admitted later, these students literally make "round trips" out of engineering and back in, and a retention percentage that decreases with time from matriculation can actually rebound.
8. Similar to that assumed by Mendez, et. al.[7], some early students in other majors may seek permission to enroll in the first-year engineering design "cornerstone" course required for engineering majors in order to "try out" the major. These could be considered a cohort of their own, or a component of a more encompassing cohort ("freshmen intenders" will be described later)

The overall picture has become much more fluid than typically depicted in the literature. Students may be entering and leaving engineering majors somewhat continuously in their first year or two. Nevertheless, administrators are often asked the common question "what is your retention rate?" by parents, employers and other stakeholders. This question no longer has a simple answer. When funded projects are focused on retention, it becomes clear that the common approach of tracking a first-matriculator cohort does not fully represent the situation, as it counts those who leave the cohort, but completely ignores those who enter later, or leave and return.

How Do Engineering Colleges Define Retention?

The authors conducted a cursory and unscientific survey of a number of Associate Deans with whom they had prior professional contact, both to see how they replied to retention percentage question, and to identify any other circumstances that may be missing from the enumeration above. Of theten respondents, six clearly focused only on the incoming freshmen cohort, essentially relying on the NCES standard calculations for retention and graduation rates mandated by federal reporting requirements. Several explicitly noted the shortcomings implied by not counting transfers or internal major changers into engineering. Three of the four remaining had mixed replies, primarily using the NCES approach but also indicating that they may do analysis of other cohorts.

Defining a Taxonomy of Retention Metrics

It is clear that the concept of calculating retention based on a cohort of only freshman matriculators ignores “early joiners” where institutional policies permit and thus provides a lower bound when predicting total numbers of persisters or graduates. A crude upper bound for the more general problem, including late joiners, could be calculated by considering the number of freshmen in a fall class and comparing this to the number of graduates in an academic year starting three or four years later. While this does not provide any accounting for individuals or their characteristics, it might be considered a general measure of an institutions ability to produce engineering graduates. Approaches between these two bounds may

- be helpful in addressing more specific questions about subpopulations
- afford institutions with various admission policies and practices a way to put the meaning of their retention numbers into context, and
- facilitate comparison of retention rates within an institution or across institutions.

As suggested by the paper title, this would put the apples with the apples and the oranges with the oranges.

Where students are simultaneously joining and leaving an engineering program over a span of time, the problem is similar to an unsteady flow problem in engineering. It is helpful to define some problem boundaries analogous to the control volume in mass balance problems or the free body in statics. The general task of quantifying retention of any cohort requires two components:

1. Defining the population of students entering the cohort (e.g. new freshmen, incoming major changers, transfer students, etc.) in a defined time window, and
2. Defining a later milestone and time window (e.g., enrollment in a succeeding academic year, graduation within so many years, admission to the college of engineering within three years, etc.).

Then, for those who enter the space defined in item 1, retention is calculated as those who attain the milestone defined in item 2.

For the purposes herein, the time window will be taken as an academic year, starting on the first day of fall classes, and ending the day before the start of fall classes in the following year. While the concept could be extended to other windows, an academic year is sufficiently long to capture the variety of student entry points, and represents a natural timeframe before and after which students may “take stock” of their plans to enter or leave a major.

Figure 2 presents a generalized summary of the flow of students into and out of engineering majors over the first three academic years. Emphasis will be on the early years as it has been widely documented that both joiners and leavers are most active in this period, and interventions to enhance retention are often focused on this period.

Academic year 2005-06 starts with Fall Matriculators (FM-05), who may be joined by Incoming Major Changers who also matriculated in 2005 (IMC-05), Spring Matriculators (SM-05) and new Transfer Students (TS-05). By the end of the academic year, these students may be retained and return in fall 2006, may be outgoing major changers (OMC-05), or Leavers (L-05) who do not return to the university.

In the 2006-07 academic year, all of those remaining are Fall Progressors (FP-06), but they again may be joined by Incoming Major Changers (IMC 05, IMC 06), and new Transfer Students (TS-06). The pattern may repeat in future years.

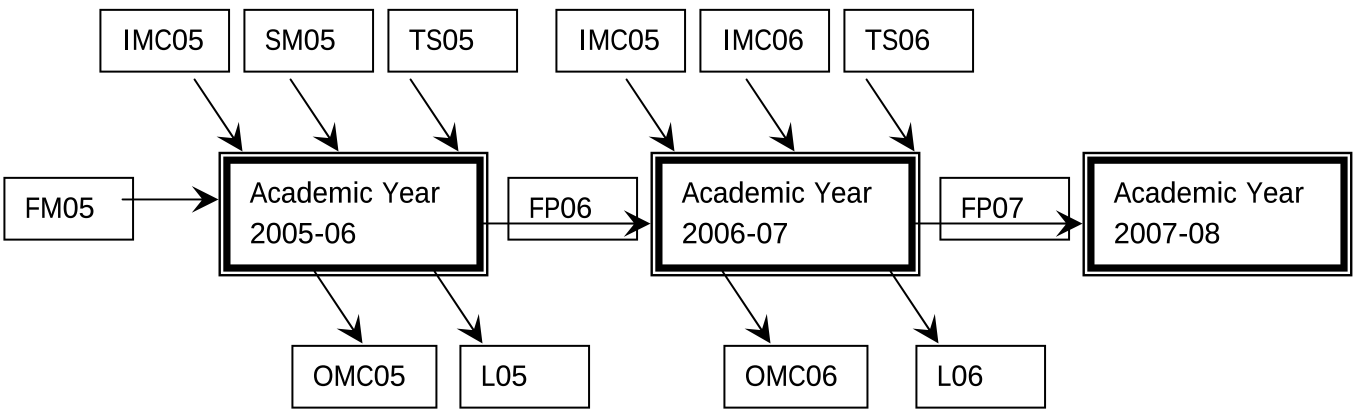


Figure 2. General Model of Students Entering and Leaving Engineering

Working from this diagram, retention can be defined using a cohort and a lag time, denoted as

Ret (cohort / lag time)

For example, one could define the retention of fall matriculators of 2005 six years later as

Ret (FM05 / +6) = number of FM05 students graduated or still enrolled in Fall 2011.

As this ignores those first year students of 2005 who joined an engineering program later in the academic year, one could define *Freshman Intenders* (FI05) as

FI05 = FM05 + IMC05 + SM05 + TS05

and then define the six year retention of these freshman intenders as

Ret(FI05 +6) = number of FI05 students graduated or still enrolled in Fall 2011.

This second measure may be a more meaningful starting cohort, as all of these students arguably made a decision to pursue an engineering degree in their first academic year. It *may* also give a slightly higher retention figure, but this is yet to be determined.

On a side note, the definition of Freshman Intenders requires some further restriction as follows: the group TS05 should include only those whose matriculation at the previous institution occurred in Fall 2005 or Spring 2006, or who present college transfer credits less than that required for sophomore standing.

Following on the suggestion of Mendez, et. al.[7], the FI cohort could be expanded to include those non-majors opting to take an introductory engineering design course in their first year:

FI05 = FM05 + IMC05 + SM05 + TS05 + CT05

Where CTO5 refers to course takers in the 2005-06 academic year.

A further refinement of the notation would be to add one or more “attribute” fields in the notation to further limit the cohort to those with a specific attribute, such as ethnicity, gender, major, ACT score, starting math class, etc.:

Ret (cohort / attribute / attribute … / lag time)

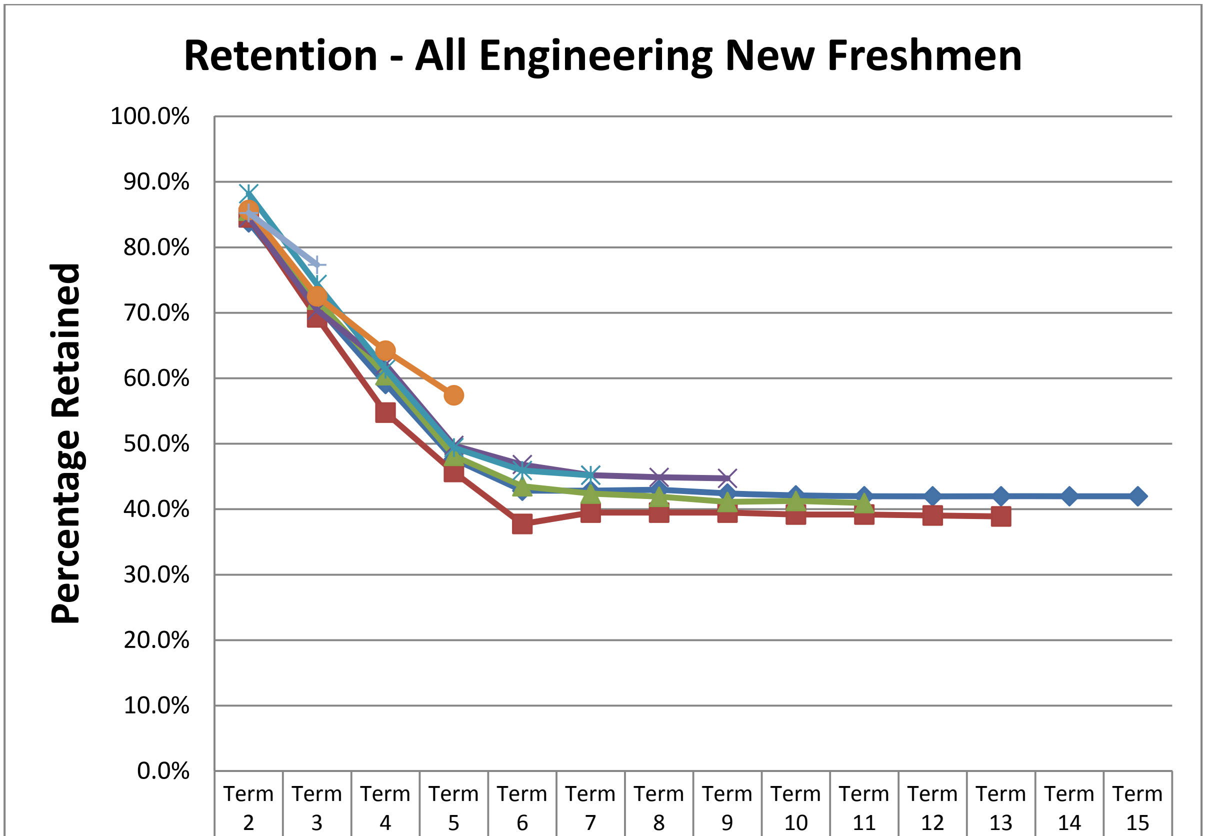
For example, the three year retention of the 2005-06 freshmen intenders who start in Calculus I would be denoted as:

Ret (FI05 / Calc I / +3)

As retention has been observed to vary significantly with math preparedness, such additional refinement can be useful in developing intervention measures.

Tracking Retention Progress: A Series of Examples

Having developed a system of notation to define retention percentages by cohort, attributes and lag time, shorter term progress toward improving retention can be viewed by plotting the retention of a cohort (with attributes) over successive lag times, and comparison across groups can be easily made. For example, Figure 3 shows the progressive retention rate of the FM0x cohorts over time at Michigan State University. It is observed that the greatest decline occurs in the first four semesters, but this partly reflects a university requirement of admission to a college by 56 credits. Notable also is that retention may not be monotonically decreasing; the rise for FS04 data for semester 7 reflects those who did not gain admission by the required entry limit, but did so later after improving their performance. The long-term retention averages in the range of 40% to 50% are lower than the 57% reported for the MIDFIELD data[2], but this reflects institutional factors including 1) significant numbers of FM0x starting below (or well below) Calculus I, 2) the fact that the cohort is not the larger cohort of FI0x, and 3) possibly the "culture" of the institution, which places some value on early exploration of majors.

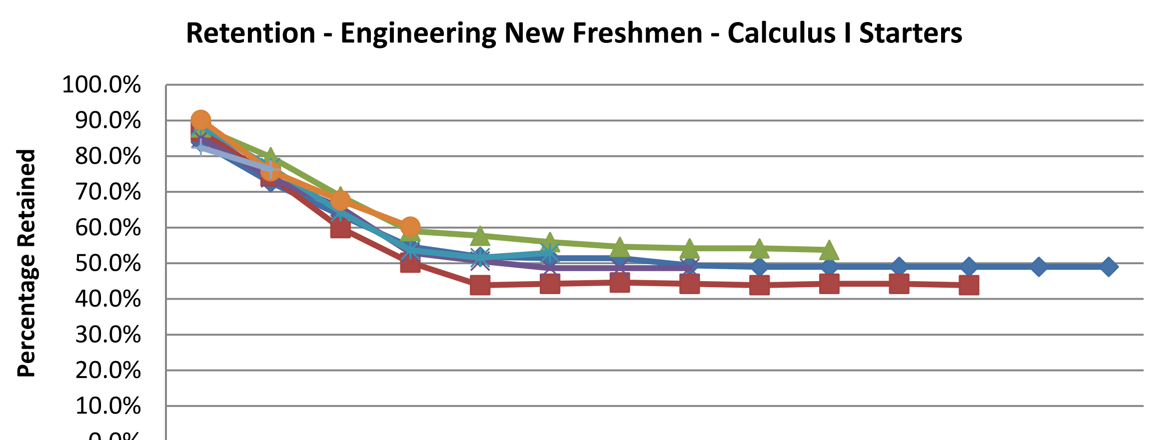


	Term 2	Term 3	Term 4	Term 5	Term 6	Term 7	Term 8	Term 9	Term 10	Term 11	Term 12	Term 13	Term 14	Term 15
FS03	83.8%	71.1%	59.1%	47.7%	42.8%	42.8%	43.0%	42.4%	42.1%	42.0%	42.0%	42.0%	42.0%	42.0%
FS04	84.6%	69.3%	54.8%	45.7%	37.8%	39.5%	39.5%	39.5%	39.2%	39.2%	39.0%	38.9%		
FS05	85.6%	72.0%	60.5%	48.2%	43.5%	42.4%	41.9%	41.1%	41.3%	41.0%				
FS06	84.6%	70.4%	62.1%	49.8%	46.8%	45.2%	44.9%	44.7%						
FS07	88.2%	74.3%	61.4%	49.4%	45.9%	45.2%								
FS08	85.7%	72.5%	64.2%	57.4%										
FS09	85.3%	77.3%												

Figure 3. Retention with time of FM0x Cohorts at Michigan State University

It is significant to note that retention rates have in general been trending upward in recent years, raising questions as to who and why, which in turn leads to consideration of further attributes.

Adding to the cohort of Figure 3 the attribute of the students' first math course being Calculus I (not lower and not higher), the results in Figure 4 are obtained. Students do not access computing or physics courses until enrollment in, or completion of, Calculus I. It is observed that overall retention rates run about five percentage points above the larger cohort, but recent trends are more mixed. The overall increase in retention is not closely associated with this group.

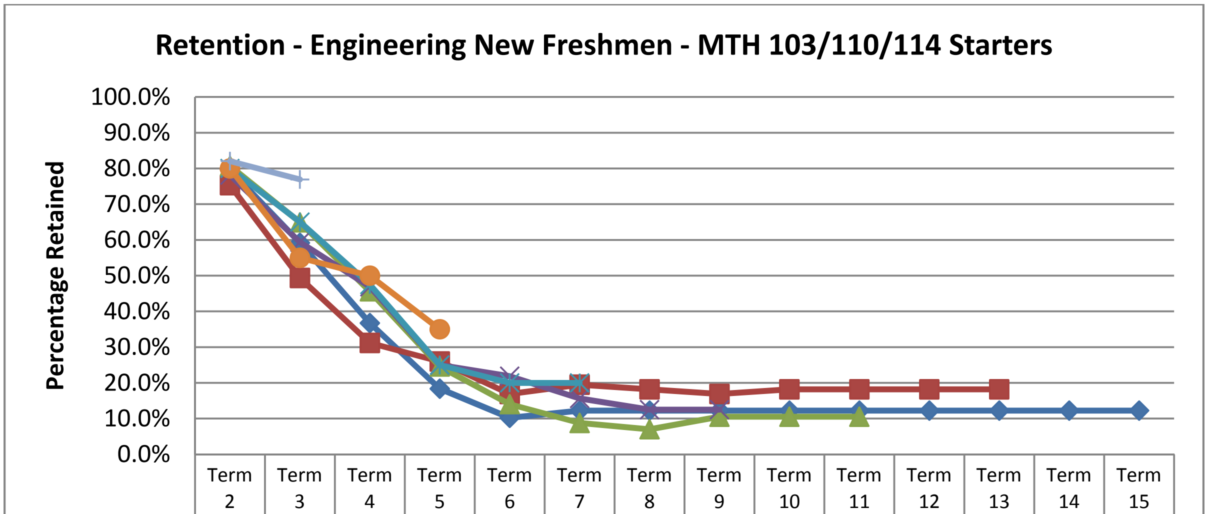


	Term 2	Term 3	Term 4	Term 5	Term 6	Term 7	Term 8	Term 9	Term 10	Term 11	Term 12	Term 13	Term 14	Term 15
FS03	83.9%	72.7%	63.5%	54.6%	51.8%	51.4%	51.4%	49.4%	49.0%	49.0%	49.0%	49.0%	49.0%	49.0%
FS04	87.0%	74.3%	59.9%	50.2%	43.9%	44.2%	44.6%	44.2%	43.9%	44.2%	44.2%	43.9%		
FS05	88.1%	79.7%	68.7%	59.0%	57.7%	55.9%	54.6%	54.2%	54.2%	53.7%				
FS06	85.0%	73.9%	65.6%	53.0%	50.6%	48.6%	48.6%	48.6%						
FS07	88.6%	76.8%	64.4%	53.6%	51.6%	52.9%								
FS08	90.2%	75.8%	67.6%	60.2%										
FS09	82.4%	76.3%												

Figure 4. Retention with time of (FM0x / Calculus I) Cohorts at Michigan State University

Figure 5 shows the retention rate progression for those starting either in stand-alone College Algebra (with Trigonometry to follow separately) or in Trigonometry (having been granted credit or a waiver for stand-alone College Algebra). These courses are considered "lower" starting points than a combined Algebra and Trigonometry course, and more underprepared students start with them. While the long-term retention rates remain quite low (10 to 20 percent), it is noted that early retention rates are displaying a significant uptrend, suggesting that recently increased interventions may bear fruit with larger numbers of these students attaining college admission and graduating.

Also notable in Figure 5 is another example of an uptick in retention at a later time, in this case as late as semester 9, beyond the eighth semester time frame often considered. This indicates a "return trip" from and back to engineering. Underprepared students who need additional math classes prior to Calculus I inherently take longer to progress toward admission and graduation based on academics, and an additional factor is that these students correlate with more adverse economic conditions, leading to pursuit of fewer credits per semester. (The tuition model, e.g. block tuition or ala carte payment, is another factor in progression toward degree deserving of further exploration).



	Term 2	Term 3	Term 4	Term 5	Term 6	Term 7	Term 8	Term 9	Term 10	Term 11	Term 12	Term 13	Term 14	Term 15
FS03	79.6%	59.2%	36.7%	18.4%	10.2%	12.2%	12.2%	12.2%	12.2%	12.2%	12.2%	12.2%	12.2%	12.2%
FS04	75.3%	49.4%	31.2%	26.0%	16.9%	19.5%	18.2%	16.9%	18.2%	18.2%	18.2%	18.2%		
FS05	80.7%	64.9%	45.6%	24.6%	14.0%	8.8%	7.0%	10.5%	10.5%	10.5%				
FS06	78.1%	59.4%	46.9%	25.0%	21.9%	15.6%	12.5%	12.5%						
FS07	80.0%	65.0%	47.5%	25.0%	20.0%	20.0%								
FS08	80.0%	55.0%	50.0%	35.0%										
FS09	82.1%	76.9%												

Figure 5. Retention with time of (FM0x / College Algebra or Trig) Cohorts at Michigan State University

Where capabilities may not be readily available to track individual students in a complex system of student movement, a rough upper bound retention figure might be determined by comparing the total numbers of students in a class (e.g. juniors) at some later point in time to those in the beginning cohort year. Defining this as "enrollment factor" rather than retention, we could define

EF (JR07/FR05) = Number of juniors in Fall 07 / Number of freshmen in Fall 05

Or

EF (JR07/FM05) = Number of juniors in Fall 07 / Number of new freshmen in Fall 05

While this does not directly track individual students, it accounts for incoming students replacing the leavers, and provides some indication of how the program is moving students toward graduation.

The Next Big Question

Having proposed a taxonomy for defining retention figures by cohort, attributes and time span, many calculations are possible. However, this only leads to a more difficult question: What is a good or acceptable retention figure? While some would set “near 100 percent” as a goal, or say “as high as possible,” those with a background in student services are aware that students are unique individuals, each with their own goals, capabilities and passions, and some are unduly influenced by the goals set for them by others.

We could think of students in a four box space, and speculate on some target figures:

- **Those who are in engineering and “should” be.** They have selected the major for reasons such as passion for innovation and problem solving, perhaps directed to the better good of humankind. They have both the capability and the perseverance to succeed in their courses. A retention goal of 90 percent or more might be reasonable for these students, reflecting losses only due to very extenuating circumstances, such as illness.
- **Those who are not in engineering and “should” be.** This would seem to be a group for whom we might focus more effort. They may share the capabilities and passion of those in the previous group, but may not be fully aware of the opportunities in engineering, or may be cautious about entering due to perceptions about the culture and lack of role models. If one can succeed in inducing them to enter the major, a similar goal of 90 percent might be reasonable.
- **Those who are in engineering and “shouldn’t” be.** This is a harshly worded heading, and should be further qualified by subdividing into two groups. For those who are underprepared, or underperforming due to lack of motivation or other personal challenges, a quantitative goal could perhaps be identified over time by tracking retention as various academic interventions are provided to the population. The retention rate would then reflect successful changes in the attributes that placed the student in this category. For those who are engineering in order to satisfy the goals of others (e.g. parents) but have true passions elsewhere (e.g. professional music), student development practitioners might propose assisting them to pursue their passion (retention equals zero).
- **Those are not in engineering and “shouldn’t” be.** These are those whose passions lie elsewhere, and represent our future attorneys, health care providers, skilled trades persons, etc. We would be remiss to expend efforts to induce them to study engineering if driven only by reports claiming a need for more engineers.

Summary and Conclusions

Deeper understanding and modeling retention of students in engineering programs is important for several reasons. Students and their parents are better able to evaluate the effectiveness of an institution's education. An institution is better able to invest the appropriate resources in processes and programs that address the needs of engineering degree seeking students. Moreover, federal, state, and private funding could be better directed in support of student completion of engineering degree programs.

The Undergraduate Experience Committee of the Engineering Deans' Council has identified retention as a primary subject of interest for further conversation and sharing of best practices. Discussions among members, and confirmed by the informal survey described herein, suggests that strict disciplinary paths are becoming less prevalent with students increasingly searching for the right career path and customizing their education.

Due to the variety of admission and enrollment management policies and practices across institutions, the flow of students into and out of engineering majors is a complex problem and simplifications can cloud the true retention picture. Current federal mandated measures of retention are insufficient for understanding or modeling student retention in engineering degree programs. In addition, many past studies on retention have focused on identifying reasons for staying or leaving, and have necessarily adopted simple cohorts and time frames.

Anecdotal evidence at our universities suggest that entry and exit from engineering majors is more fluid than in the past and that traditional taxonomies for retention in the literature are becoming inadequate for reporting retention for some situations. A new taxonomy has been proposed to provide improved clarity for retention comparisons and discussion of appropriate levels of retention . Given such a taxonomy and considering a number of increasing lag times, shorter term progress of retention interventions can be assessed by education administrators.

Is this approach useful? Or too complex to be useful? The first intent is to raise awareness of the complexity of student movement among majors. The second intent is to provide a straight-forward taxonomy and notation for use in retention analysis that concisely communicates the considered populations. Only time will tell.

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