What Do We Know About Our Entering Students and How Does It Impact Upon Performance?

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Abstract

Besides their average SAT scores and possibly their high school rank, engineering faculty and administrators typically know little about their entering freshmen. This limited knowledge hinders both placement in and content of first year courses. For example, how many entering students took calculus in high school? For how many semesters? What grades did they earn? How does their math background correlate with their college boards or college placement testing? How much have they retained? What was their performance in first semester math courses? How many students have had three or more years of foreign languages? Do they continue that in college? Does that motivate them to study abroad? Where there is a common freshman year, how many students select a different major program than the one they initially were interested in at the time of application? By having the answers to these and similar questions, faculty and administration may be able to change curriculum, advising and support services to better support student learning and success.

At the University of Pittsburgh School of Engineering we have been collecting such information about our incoming students' attitudes, math knowledge, academic history, first year academic performance, retention, and general background through a variety of survey instruments, inventories and placement examinations. These data are maintained in a large database, which allows us to easily extract specific information for assessment or monitoring purposes. This enables us to answer questions about our students and use the information to make more informed curriculum and policy decisions. We present a number of examples here including information on entering student attributes, language and math background, departmental choice and performance.

Introduction

How much do we really know about our students? ABET has now provided a strong incentive through its new accreditation criteria for faculty to obtain a better understanding about their undergraduate student body in order to improve the learning process. While this may require the collection of additional data, with a systematic process it can be done in an efficient manner. In particular, a large number of institutions participate in UCLA's Cooperative Institutional Research Program (CIRP), especially its Freshman Survey which yields normative data on entering students[1]. Such data not only provides valuable insights about the entering students but, when combined with other information, may enable advisers to better place students into appropriate math and writing courses.

At the University of Pittsburgh, we not only use the CIRP to provide insight into our freshman engineering class, but we also have been using our Pittsburgh Freshman Attitudes Survey © since 1995[2,3]. This latter instrument has not only enabled us to learn much about the attitudes of our entering students, but through its adoption by other engineering programs, it has enabled us to make cross-institutional comparisons[4,5]. Three years ago we introduced a "Math Inventory" Assessment survey modeled after a similar such instrument developed and used by LeBold and Budny at Purdue[6]. We currently administer both instruments as well as an Algebra and Trigonometry placement test, a Calculus placement test[1] and an English Writing Placement Test online to entering freshmen prior to their first term registration[7,8]. These instruments, combined with the CIRP data provide our freshman advisers with a considerable amount of valuable information. In addition, this information has enabled us to develop predictive models to further improve placement in the critical first mathematics course[9] and to identify those students who have a relatively high probability of being placed on first term probation.

Once matriculated, our freshman engineering students have a common first year. At the end of that year, they then choose their major program. We devote a considerable amount of effort during the first year in helping the freshmen make an informed selection. Is that effort justified? We now have data that enables us to address this question.

What We Have Learned About Our Freshmen

The 2002 entering freshman class at the University of Pittsburgh School of Engineering (394 students) was academically well qualified – slightly over half graduated in the top 10% of their high school class; SAT scores averaged 1260 (Math 659 and Verbal 601). Women accounted for 23.4% of the class; 97.5% were native English speakers; 98.1% were US Citizens and another 1.4% permanent residents. African-Americans comprised 9.5% of the class, the largest of the minority groups represented. All but three of the entering freshmen graduated from high school in 2002 (two had deferred a year; one did not graduate high school). While 44.9% live within 50 miles of campus; 43.8% live between 101 to 500 miles; and 5.2% live more than 500 miles away. A relatively small number (3.3%) reported some form of disability, half of whom had a learning disability.

In spite of being apparently well-qualified, a number of students felt that they needed remedial work. Specifically, 17.2% reported on their CIRP survey that they needed remedial help with mathematics and 12.3% with science. We were able to identify a large portion of these students and will discuss in later in this paper the relationship between perceived need for assistance, assistance sought or provided, and results in first math course.

In addition to the relatively large number of students indicating a need for help with mathematics, 9.8% reported that they needed remedial help with writing, 8.7% with English, 3.3% with reading and 3.5% with a foreign language. Such information if known at the time of registration should enable advisors to better assist students. Also of interest is the students' perception of their

[1] All students with Math SAT below 650 take the Algebra and Trigonometry test; students whose Math SAT is 650 or above take a Calculus placement test unless they have not had Calculus in high school.

abilities relative to their peers as shown in Table 1. Interestingly, while almost a third felt that their math ability was among the highest 10%, less than 15% felt that their computer skills were at the same level.

Even before they arrived on campus, a substantial number (18.1%) had already earned some college credit - 2/3rds at Pitt – indicating that this might be one way to recruit students. In addition, 61.8% had taken two or more advanced placement courses; 5.2% had taken seven or more.

Interestingly, 81.5% of students came from a family with both parents living together. Further, 62% of their fathers had earned a college degree and 24.6% also had earned a graduate degree. Similarly, 56% of their mothers had earned a college degree and 17.2% also had earned a graduate degree. However, only 14.6% of fathers' and 0.8% of mothers' occupation was considered to be engineering. In fact, 25.4% of fathers' and 12.4% of mothers' occupation was listed as business and 16% of mothers and 4.7% of fathers were K-12 teachers. Hence, only a small portion of students came from families where at least one parent was an engineer.

Table 1: Perception of Abilities (Percentage)

Ability	Lowest 10%	Below Ave.	Average	Above Ave.	Highest 10%
Academic			4.6	57.2	38.1
Math ability		.8	12.0	54.5	32.7
Drive to Achieve	.3	3.3	22.3	43.3	30.8
Persistence		2.2	24.1	50.4	23.3
Intellectual Self-confidence		3.3	23.8	50.5	22.4
Leadership ability		7.6	28.3	43.6	20.4
Cooperativeness	.3	1.6	27.0	52.9	18.3
Creativity	.3	6.8	31.6	43.6	17.7
Computer Skills	.3	5.7	36.0	43.3	14.7
Social self-confidence	1.9	12.0	36.5	36.2	13.4
Understanding of others	.3	4.9	37.3	44.7	12.8
Risk taking	1.1	10.6	42.5	36.5	9.3
Public speaking	3.3	19.6	39.0	29.2	9.0
Writing ability	.8	15.0	40.1	35.1	9.0
Popularity	2.5	10.1	51.1	29.2	7.1
Artistic	9.5	28.6	36.2	20.4	5.2

Median estimated family income was just under $75,000 per year. Hence, it is not surprising that 67.6% had concerns about financing their education including 9.3% with major concerns. Over two-thirds of the students had loans to finance their first year, with almost a fifth borrowing $6,000 or more. Further, 44.5% indicated that there was a very good chance that they would get a job to pay expenses and 39.0% stated that there was some chance they would get a job. Certainly, advisers need to be aware of the amount of time students may feel that they need to work in order to pay for their education.

It was gratifying to learn from the CRIP survey that the University of Pittsburgh was the first choice for 73.5% of the entering class and the second choice for another 21.3%. In fact, 22.5% applied to no other institution while 51.7% applied to one to three other colleges and 8.8% applied to six or more. Table 2 gives the relative importance of various reasons for choosing the University of Pittsburgh. It is also gratifying that the majority of students (60.8%) considered academic reputation to be an important reason for their selection.

However, when asked to indicate the most important reasons for enrolling at the University, 93.5% cited academic reputation, followed by 80.5% indicating affordability; 67% cited the availability of their major of choice; 48.8% indicted the University being close to home was a major factor; 45.7% cited a personal recommendation (counselor, parent, family friend or relative); 40.4% indicated receiving an academic scholarship; and 31.7% noted the availability of the Honors College.

Table 2 Reasons for Choosing Pitt/Engineering (Percent)

Reason	Not Important	Somewhat Important	Very Important
Academic Reputation	1.4	37.8	60.8
Offered Financial Aid	38.3	25.7	36.1
Size of College	26.4	47.7	25.9
Social Reputation	20.2	54.9	24.9
Offered Special Programs	37.4	39.6	23.0
Low Tuition	31.3	48.8	19.9
Wanted to live near home	54.2	28.1	17.7
Rankings in National Magazine	44.8	43.7	11.5
Information on Website	48.8	42.8	8.4
Not offered Aid by first choice	81.9	11.0	7.1
Early Admission Action	84.7	9.6	5.7
Reputation for campus safety	59.1	36.0	4.9
Advice of Guidance Counselor	75.7	21.0	3.3
Recruited by athletic department	95.9	2.5	1.6
Advice of Private Counselor	94.6	4.9	0.5

As a class, half have ambitions of obtaining advanced degrees - 45.6% plan on getting a MS and 24.3% plan on getting a doctorate; 3.6% are interested in medical school and 1.2% are interested in law. However, not all are completely committed to engineering - 4.6% entered with a very good chance of changing major field and 34.3 % with some chance of switching, suggesting that retention may remain a problem. Likewise, 7.9% indicated there was a very good chance of changing their career choice and 39.5% felt there was some chance of a career change.

Almost a fourth (22.4%) indicated there was a very good chance that they would participate in study abroad; 34.7% felt there was some chance. Table 3, summarized from our Math Inventory instrument, shows that 62% of the class had at least three years of one foreign language, and 30.7% had four or more years. The most popular language was Spanish, followed by French and German. A few students had studied Japanese in high school. This is important, because we have recently been emphasizing study abroad as an important educational option for our students and

encouraging freshmen to continue with language education. (One result is that we have 17 students studying Chinese.)

Table 3: 2003-1 - High School Language Instruction: Students with At Least:

Language	½ Year	1 Year	2 Years	3 Years	4 Years	5 Years
At least one	98.9%	97.2%	77.9%	62.0%	30.7%	5.0%
Spanish	52.0	50.8	40.2	31.8	14.5	2.5
French	29.9	29.9	22.1	17.0	10.1	1.4
German	13.4	12.6	8.9	7.0	3.1	0.8
Latin	6.4	6.1	5.3	5.0	2.5	0.6
Japanese	1.1	1.1	0.6	0.3	0.3	0
Other	2.8	2.5	1.7	1.1	0.6	0

Math Ability

Table 4 below provides information on the number of freshmen who took calculus in high school. Of the ones who completed this portion of the Math Inventory, 87.5% indicated that they had at least one semester of high school calculus (including "college-in-high school calculus"). Of the 53 who did not indicate on their survey whether or not they had calculus, it can be assumed that all of those students who placed into Calculus 2 or higher also had calculus in high school, as well as a substantial portion of the students placed in Calculus 1. Slightly over a fourth of the incoming students were placed in an advanced calculus course, while 8.9% (35 students) were placed in Pre-Calculus, including at least 14 who had one or two semesters of calculus in high school.

Table 4: Calculus in High School vs. First Math Course at Pitt

Semesters of HS Calculus	Pre-Calc	Calc 1	Calc 2	Honors Calc 2[2]	Calc 3	Diff EQ	Grand Total
None	10	38	1				49
1	3	15	3	1			22
2	13	169	38	19	8		247
3		1	1	1	2		5
4		4	3	4	3	1	15
5		1					1
Unknown	9	28	11	4	1		53
Grand Total	35	256	57	29	14	1	392

Table 5 gives the resultant average grade in these courses as a function of the number of semesters of high school calculus[3]. At the University of Pittsburgh we use a 4.0 system with +-grades. Where an A- is 3.75, B+ is 3.25, B is 3.00, B- is 2.75, etc. Not surprisingly, students that had one semester of high school calculus averaged almost a letter grade higher (B+/A- vs. C+/B-)

[2] Honors Calculus is an accelerated course that reviews Calculus 1 and covers Calculus 2. Students who get a C or above in Honors Calculus are then given advanced placement for Calculus 1.

[3] Note that A = 4, A- = 3.75, B+ = 3.25, B = 3, etc.

than those students who did not take calculus in high school. However, those students who had two semesters of calculus in high school did slightly worse than those with one semester – most likely because the stronger students with a full year of high school calculus were placed in an advanced calculus course. Note that those students with one year of calculus who did the best were placed in either Honors Calculus 2 or Calculus 3.

Table 6 gives the relationship between the students' Math SAT score and the grade earned in the first math course. Not surprising, those with higher Math SAT scores tended to do better in Calculus 1. A similar pattern is noted for Honors Calculus, although the cell sizes are smaller. However for Calculus 2 and Calculus 3, there is no apparent trend, but, again, the cell sizes are relatively small.

Table 5: First Math Course Grade at the University of Pittsburgh vs. Number of Semesters of High School Calculus

Semesters of HS Calculus	Pre-Calc	Calc 1	Calc 2	Honors Calc 2	Calc 3	Diff EQ
None	2.43	2.52	1.00			
1	1.67	3.50	1.92	0.00		
2	2.40	3.20	2.99	3.79	3.66	
3		0.00	1.00	4.00	3.38	
4		3.38	3.00	4.00	3.50	4.00
5		4.00				
Unknown	2.72	2.80	2.77	3.81	4.00	

Table 6: First Math Course Grade at the University of Pittsburgh vs. Math SAT

Math SAT	Pre-Calc	Calc 1	Calc 2	Honors Calc 2	Calc 3	Diff EQ
500 or less	2.00 (1*)	2.00 (1)				
501 – 549	2.25 (5)	3.06 (4)	3.75 (1)			
550 - 599	2.50 (14)	2.62 (41)	3.25 (1)		3.75 (1)	
600 – 649	2.48 (14)	3.01 (72)	2.75 (5)			
650 – 699	2.00 (1)	2.98 (86)	2.65 (26)	3.20 (5)	4.00 (2)	
700 – 749		3.65 (39)	2.50 (15)	3.60 (12)	3.56 (4)	
750 – 800		3.84 (11)	3.58 (6)	4.00 (12)	3.75 (6)	4.00 (1)

* Number in cell

Predictive Models for Math Placement

As noted, we utilize math placement tests in combination with the Math Inventory, SAT scores and high school class rank as part of a modeling effort to more accurately determine whether a student is prepared to begin calculus or should start in the Pre-Calculus course[10]. To do this we used both neural networks and regression analyses. A Learning Vector Quantization (LVQ) neural network model yielded the best results, and was selected as the standard model. The resultant network was composed of four input nodes representing: gender, score for the fifth

section (most difficult) of a six part Algebra-Trigonometry Placement exam, student attitude towards math, and background in differential calculus[4] as reflected from that section of the Math Inventory.

Two output classes - good (C or better) and poor (C- or lower) performance in Calculus 1 were used and three models resulted. The actual predicted math performance was then based on a "majority vote" (at least two out of the three results) from three different competitive networks. These models were first implemented as part of the advising/testing process for the 2001-02 entering Freshman Class. Advisers used the LVQ model predictions in combination with another model that predicted the probability of the student being placed on first term probation and the adviser's own review of the math placement results. If all three indicators suggested that the student should be placed in Pre-calculus rather than Calculus, then the student was so advised. In cases where the predictive models indicated conflicting results; e.g., "Pre-Calculus," but not "first-term probation," then placement was at the adviser's discretion, using all six Algebra-Trigonometry sections as a final determinant. As a result, the number of freshmen placed into Pre-Calculus doubled from 25 the prior year to 48, even though the quality of the incoming class was comparable or slightly higher to the previous years as measured by SAT scores (no significant difference), high school class rank (slightly better), and percent of students in top 10% of high school graduating class (51% vs. 46%).

The results of that model's predictions and the actual placements were quite encouraging. It predicted and advisers concurred that 116 students were ready for Calculus; of these 109 performed satisfactorily or better (94%); the model also made correct predictions for 49 other students who were place in Pre-Calculus and incorrect predictions for 17 additional students. In total, the model was judged to be correct for 158 of 182 students (87%). Given this encouraging result, the models were refitted with the two years data (2000 and 2001) using logistic regression. The most significant change was the substitution of integral calculus concept for differential calculus. The new model by itself (unaccompanied by the first term probation prediction model) was used to place incoming 2002 freshmen. As shown in Figure 1, results were even better than for the first year.

Figure 1 indicates that there were 86 correct placements in Calculus and 25 in Pre-calculus out of 124 total placements or 89.5% correct decisions (and 10.5% incorrect). This does not include two students who were recommended by the model to be placed in Calculus, but took Pre-calculus instead and performed satisfactorily; i.e., the model's correctness can not be evaluated for these two students.

Placement into Calculus 2 is done either by taking the Calculus placement test (equivalent to a Calculus 1 final examination) or by receiving AP (advanced placement) credit for Calculus. Students were able to download the placement test from the web as part of their online admissions testing. They were given instructions which warned them about the consequences of cheating on the test or giving it to someone else. (Five different tests were randomly assigned to students as another way of eliminating an academic integrity incident.) Table 7 gives the relationship between placement score and grade in Calculus 2. A score of 15 was required to

[4] Differential Calculus was the only section of the Math Inventory that appeared to yield significant results.

place into Calculus 2 unless the student had AP credit; a score of 17 was needed to place into Honors Calculus 2. Note that over half of the students (31 out of 57) scored below the passing grade, but were placed into Calculus 2 based on receiving AP credit for Calculus 1. The data suggests that the test is at best a reasonable predictor at the lower end – of the 13 students who received a grade below C (or withdrew), 9 either did not take the placement test, or scored below 15 (passing) as did 6 of the 7 who received a C+ or C and 10 of the 15 who received grades in the B range. However 13 of the 22 students who received an A+, A or A- in Calculus 2 either didn't pass or did not take the placement examination.

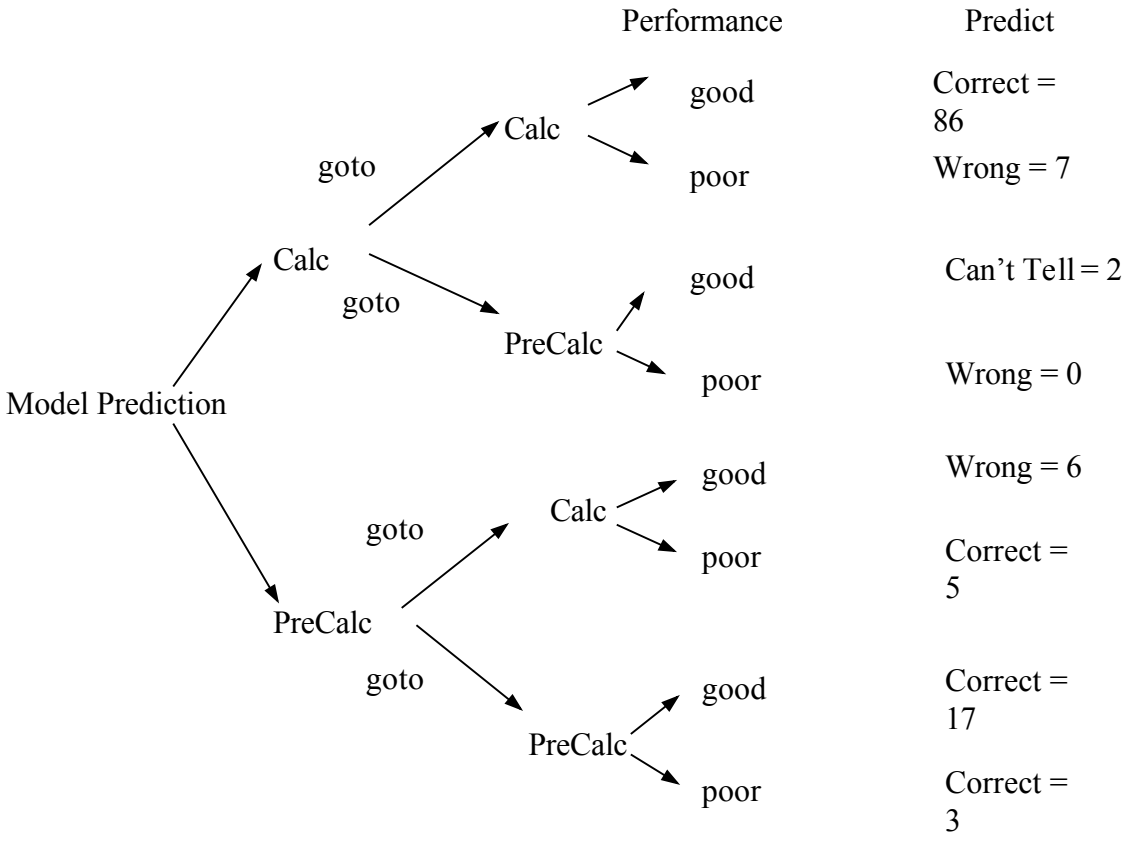

Figure 1: Prediction of Freshman Math Placements

Table 8 examines the same group of 57 students, but this time comparing Math SAT to performance. The data does not suggest a pattern; the few students with low SATs who got into the course through Advanced Placement and/or satisfactory performance on the placement examination tended to do reasonable. Of the six students with high SATs (750 to 800), five received an A or A- and one a C+; in contrast only five of the 15 students who had 700 to 740 Math SATs received a grade in the A range.

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Table 7: Calculus 2 Performance versus Placement Score

Calculus Placement Score	A+	A	A-	B+	B	B-	C+	C	C-	D	F or W	Grand Total
AP Only		2	1	1						3		7
5										1		1
9			1									1
10			2								1	3
11		1		1								2
12					1		2			1		4
13		1	1	1	1	1			1			6
14	1	1	2	2	2		3	1		2		14
Calculus 2 - 15	1		4	2	1						2	10
16		1						1		1		3
Honors - 17					1					1		2
18	1											1
19	1	1		1								3
Grand Total	4	7	11	8	6	1	5	2	1	9	3	57

Table 8: Calculus 2 Performance versus Math SAT Score

Calculus Placement Score	A+	A	A-	B+	B	B-	C+	C	C-	D	F or W	Grand Total
No Results	1	2										3
540			1									1
550 - 590				1								1
600 - 640				2	1		1	1				5
650 - 690	2	3	3	2	4	1	3	1		5	2	26
700 – 740	1		4	3	1				1	4	1	15
750 - 800		2	3				1					6
Grand Total	4	7	11	8	6	1	5	2	1	9	3	57

Recall that 17.2% of the freshman class indicated on the CIRP survey that they needed remedial help with mathematics. How did these students do? We were able to identify 46 of the group. (The others either did not provide their student ID number on the CIRP form or did not give the University permission to release it.) As shown in Table 9, not all of these students were placed in Pre-Calculus (13); the majority (31) was placed into Calculus 1 and two were placed into Calculus 2. That is, 13 of the 39 students who were placed in Pre-calculus thought that they needed remedial help prior to registration[5]. Of the five engineering students who received a D or F in Pre-calculus, three had indicated on the CIRP that they needed help. In contrast, 24 engineering students failed Calculus 1, but only five of these had indicated on the CIRP that they needed help; one other student withdrew from Calculus 1 (most likely due to poor performance).

[5] It is possible that some of the others also indicated that they needed help but didn't provide or would not release their student ID number.

Further, two students who earned an A+ in Pre-calculus and two students who earned an A+ in Calculus 1 also indicated they needed remedial help.

In checking our tutoring records for the fall term, only 18 of these 46 students participated in tutoring – eight who were required to do mandatory tutoring as provisional admits; the remainder on a volunteer basis. However, most of the volunteer students only went to one tutoring session. Table 10 summarizes these results. Of the eight for whom tutoring was mandatory, five were placed in Pre-calculus. Overall, these eight had an average first term mathematics grade of 2.66 (or slightly below B-). In contrast, for the ten students who sought tutoring voluntarily, the majority was placed in Calculus 1 (or 2); however, their average grade was 2.13 (slightly below C+). Finally, for the group who initially indicated they needed help, but did not seek it, over 80% were placed into Calculus, and, collectively this cohort did quite well with an average grade of 3.37 (or above A-). These results suggest that approximately half of the students who had indicated that they need remedial help may have underestimated their abilities upon entering the University.

Table 9: Students who Indicated a Need for Remedial Math Help on the CIRP

First Math Course	A+	A	A-	B+	B	B-	C+	C	C-	D	F, W	Total
Pre-Calculus	2			1	3	3		1		1	2	13
Calculus 1	2		7	4	7	2		3			6	31
Calculus 2				1						1		2
Total	4		7	6	10	5		4		2	8	46

Table 10: Performance of Students who had Indicated a Need for Remedial Math Tutoring

Tutoring	Pre-calc	Calc 1	Calc 2	Total	Ave. Grade
Mandatory	5	3	0	8	2.66
Volunteer	3	6	1	10	2.13
None	5	22	1	28	3.37
Total	13	31	2	46	2.97

Program Choice

Like a number of engineering schools, we have a common freshman year. All students take the same curriculum and do not choose a department until the end of their second term. A number of activities and assignments have been incorporated into the first year to enable students to make an informed department choice. These include library projects, departmental visits, and presentations[11,12]. How does this impact upon departmental choice? Although a number of students enter with an idea of what they would like to study, we have found that there is considerable amount of change during the year. Table 11 shows the relationship between choice when entering and final choice for the 2001 freshman class. Of the 378 freshmen, 265 (70%)

entered having indicated a major. However, by the end of the first year, slightly over half of these (142) actually chose that program. Of the remaining who had indicated a choice upon entering, approximately 60% selected a different major with the rest either transferring out of engineering (24%) or remaining in the freshman program for another year (16%) due to academic difficulties. The total number who changed preferences or had no preference initially (188) was more than the number who remained with their initial choice, further justifying our decision to have a common first year.

Table 11: Major Preference at Admission vs. Choice at End of First Year

Selection @ End of First Year	Undec.	BioE	CE	ChE	CoE	EE	EPHY	IE	ME	MSE	Total
Fresh Program	8	2	3	2	5	2		1	4		27
BioE	9	27		2			1		2		41
CE	18	2	19			2	1		2		44
ChE	7	2	2	14	1				1		27
CoE	7			1	40	3					51
EE	13		1	2	9	15			1		41
EPHY	1			1	2	1				1	6
IE	14	6	3	1	4	1		5	4		38
ME	13	4	3			4	1		21		46
MSE	2			1					1	1	6
Transfer out	21	8	4	2	6	3	2		2	1	51
Total	113	51	35	28	67	31	5	6	38	3	378

Conclusion

We have demonstrated how much one can learn about their students by using a combination of national and local instruments. We have learned that a national survey like the CIRP can provide valuable insight into students' perceived weaknesses if such information can be captured prior to registration rather than waiting until it is usually available at the end of the first semester. Consequently, we are developing a process to obtain such information at an appropriate time.

We have also found that there are a number of the CIRP factors that may differentiate students who are placed on first term probation, the key term for success in the engineering curriculum. As shown in Table 12, the levels of these factors were significantly different when comparing students placed on first term probation (GPA < 2.00) to students in good academic standing after the first term (GPA ≥ 2.00) for at least one of the last three freshmen engineering classes. While few consistent patterns appear in this data, with the exception of "frequently came to class late last year" and "perception of academic ability," these factors do suggest that they could be used to identify students who may require additional academic and advising support during their first semester. Consequently, we plan to more fully analyze these data in the future and continue to build predictive models that may enable us to better identify students at risk.

Table 12: CIRP Factors that may Differentiate Students Placed on First Term Probation (p value**)**

Factor	Fall 2000	Fall 2001	Fall 2002
Need tutoring or remedial work in writing	NS*	0.063	0.012
Frequently attended religious services past year	NS	0.016	NS
Frequently bored in class past year	0.084	NS	0.055
Frequently participated in protests past year	0.057	NS	NS
Frequently smoked cigarettes past year	NS	0.002	NS
Frequently drank beer past year	0.044	NS	NS
Frequently felt depressed past year	0.034	NS	NS
Frequently played musical instruments past year	NS	0.046	NS
Frequently asked a teacher for advice past year	NS	0.017	NS
Voted in student elections past year	NS	0.013	NS
Frequently came late to class past year	0.065	0.008	0.025
Frequently performed community service	NS	NS	0.085
Perception of academic ability	NS	0.000	0.000
Perception of computer skills	NS	NS	0.063
Perception of cooperativeness	NS	0.053	NS
Perception of drive to achieve	NS	0.009	NS
Perception of math ability	NS	0.002	0.101
Perception of persistence	NS	NS	0.009
Perception of public speaking ability	NS	NS	0.037
Perception of religiousness	NS	0.012	NS
Perception of intellectual self-confidence	NS	NS	0.065
Perception of social self-confidence	NS	0.070	NS
Perception of spirituality	0.074	NS	NS
Perception of writing ability	NS	NS	0.002
Frequently spent time partying past year	0.070	NS	NS
Frequently spent time playing video games	0.006	NS	NS
Good chance of working full-time in college	0.074	NS	NS
Good chance of dropping out of college	NS	0.054	NS

* Not Significant

We have also seen that our emphasis on more informed placement of students in their first math course appears to be successful. Our neural network models which utilize data from our Mathematics Inventory in combination with placement test data and demographic information have proven to be a valuable advising tool in determining whether a student is ready for calculus or should take Pre-Calculus. This is particularly important since Budny, LeBold, and Bjedov have shown that correct placement in the first math course is a key determinant of success in an engineering program[13]. Nevertheless, in spite of the fact that 87.5% of our students had calculus in high school, and even the ones who did not take high school calculus should have been prepared, we still placed 10% into a Pre-Calculus course. In addition, we again demonstrated that Math SAT score alone is not a very good predictor of success in a mathematics course.

Finally, we have examined whether or not students are prepared to choose an engineering major when entering as freshmen. Our data supports the contention that they are not and are, in fact,

better served by participating in a common freshman year, since approximately half of the students ended up in a different program than they initially had indicated. This includes 30% of the class who entered undecided. Hence, our decision to devote a substantial amount of effort to enable our freshmen to make an informed choice of a major appears to be well justified.

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