2006-766: TO BE OR NOT TO BE - REVISITING AN ANALYTICAL METHOD USING DEMOGRAPHIC DATA TO PREDICT ASEE STUDENT CHAPTER VIABILITY

Carol Mullenax, Tulane University

Carol Mullenax is finishing up a Doctorate in Biomedical Engineering at Tulane University while also employed by Bastion Technologies as a project manager on the NASA Non-Exercise Physiological Countermeasures Project in Houston, Texas.

To Be or Not To Be – Revisiting an Analytical Method Using Demographic Data to Predict ASEE Student Chapter Viability

Introduction/purpose:
American Society for Engineering Education (ASEE) student chapters have formed at several universities in recent years. The original paper developed an analytical method to predict ASEE student chapter viability from environmental conditions at an institution. The goal of this paper was to revisit the output of the original equation using current demographic and student chapter information, and determine if the given analysis is still applicable.

Materials/methods:
In the original study, a regression equation was generated which related university demographic data to successful student chapter metrics.[1] Data were gathered for the academic year 2004-2005 based on the ASEE college profiles and direct inquiry of current chapter officers and the ASEE membership office. Comparison was made between original and current outcomes.

Demographic data were updated for the original candidate schools and for all schools listed as having an ASEE student chapter on the ASEE website.[2-19] Categories included student population and composition, average residency, student funding type, and number of competing campus professional organizations. Chapter-specific inputs were solicited from eleven universities with student chapters. Seven schools responded with data including the number of student members, number of meetings, number of events, number of event attendees, and number of attendees at the ASEE annual meeting (Figure 1).

Type	Variable name	Description
Student Chapter	*STLOC*	number of local (not national) student members at the school
	STCONF	number of student members attending the last ASEE annual conference
	MTGS	number of student chapter meetings and events per year
	AVGATT	average attendance at meetings/events
	AWARDS	number of awards sponsored by the student chapter
University	*TOTFAC*	total number of faculty in the school of engineering
	PCTFMEM	percentage of engineering faculty members who are ASEE members
	GDTOT	total number of engineering graduate students
	PCTGDFT	percentage of engineering graduate students who are full-time students
	PCTPHD	percentage of engineering graduate students who are PhD students
	PCTADMIT	percentage of applicants who are admitted for graduate engineering study
	AVGRES	average number of years a graduate student is at the school (calculated)
	PCTTA	percentage of engineering graduate students supported by teaching assistantship
	CLUBS	number of engineering professional clubs/organizations at the school
	STASEE	number of national ASEE student members at the school

Figure 1: Regression variable names and descriptions

Many things have changed in the five years since the original analysis, hence the interest in seeing if the original analysis is still valid. The number of active ASEE student chapters has increased from five to eleven, according to the ASEE website. Of these, five chapters were formed (Northern Illinois University, University of Texas – El Paso, Iowa State University, University of South Carolina) or resurrected from dormancy (Purdue University) within the past two years. An additional undergraduate chapter has formed (Austin Community College). The four remaining chapters are mature, active ASEE student sections located at Northwestern University, University of Michigan, University of Texas, and University of Wisconsin. Two dormant ASEE student sections remain for the State University of New York at Buffalo, and Virginia Polytechnic Institute & State University. All universities in the original and current analyses are listed in Figure 2.

	Original (2001)	**Current (2006)**
Active chapters	Univ. of Michigan – Ann Arbor	Univ. of Michigan – Ann Arbor
	Univ. of Texas – Austin	Univ. of Texas – Austin
	Univ. of Wisconsin – Madison	Univ. of Wisconsin – Madison
	Broome Community College	Broome Community College
		Northwestern Univ.
New chapters	Northwestern Univ.	Purdue Univ.
		Iowa State Univ.
		Northern Illinois Univ.
		Univ. of South Carolina
		Univ of Texas – El Paso
		Austin Community Collge
Dormant chapters	State Univ. of New York – Buffalo	State Univ. of New York – Buffalo
	Virginia Polytechnic Inst. & State Univ.	Virginia Polytechnic Inst. & State Univ.
	Purdue Univ.	
Candidate schools	California Institute of Technology	California Institute of Technology
	Georgia Institute of Technology	Georgia Institute of Technology
	Michigan Technological Univ.	Michigan Technological Univ.
	Ohio State Univ.	Ohio State Univ.
	Pennsylvania State Univ.	Pennsylvania State Univ.
	Stanford Univ.	Stanford Univ.
	Tulane Univ.	Tulane Univ.
	Univ. of Illinois, Urbana-Champaign	Univ. of Illinois, Urbana-Champaign
	Univ. of Oklahoma	Univ. of Oklahoma

Figure 2: Universities in analyses

The "chapter survival index" (CSI), a weighted sum of student chapter characteristics/activities, was constructed as before for existing, mature student sections:

$$CSI=0.5*(STLOC+STCONF)+STASEE+2*MTGS+0.2*AVGATT+10*AWARDS$$

Designed range for CSI was 0-100, with 50 intended as the minimum threshold to indicate a successful chapter.

For dormant chapters, which have no chapter activities by definition, CSI values were assigned according to the number of years of prior activity:

CSI=20+3*(*active years*)

Linear regression in the initial study generated coefficients relating the input variables to the CSI for the three mature student sections. To maintain mathematical validity in the regression, only combinations of two variables were calculated. The originally-proposed composite regression equation was a simple average of four two-variable equations, and it yielded results with a standard error of 13.7 index points:

CSIR=0.0176**GDTOT*+0.0898**PCTTA*-0.0173**CLUBS*+2.2165**STASEE*-1.3930**AVRES*+0.0689**PCTPHD*

Results:

To avoid mathematical issues of similar variables included in the regression, correlation coefficients were calculated for all input variables and input cases. Variables with a correlation coefficient (*r*) higher than 0.997 (corresponding to a p=0.05 level of statistical significance in correlation for one degree of freedom by t-test) were considered to be redundant; such variable pairings would cause problems if run simultaneously in any regression equation. Obtained correlated variable pairs for both data sets are shown in Figure 3, along with the calculated correlation coefficients.

Analysis	Variable #1	Variable #2	r
original (2001)	TOTFAC	PCTGDFT	-0.998
	TOTFAC	AVGRES	-0.998
	PCTFMEM	STASEE	-1.000
	PCTADMIT	CLUBS	1.000
current (2006)	TOTFAC	GDTOT	1.000
	TOTFAC	STASEE	0.999
	GDTOT	STASEE	0.998

Figure 3: Highly correlated regression input variables

A quick review of the regression equation obtained in the initial study reveals two highly correlated variables (STASEE and GDTOT), which would raise concern regarding the mathematical validity of the regression except that this combination is present only in the composite equation. The regression itself did not contain correlated variables. Since only the composite equation did, the underlying mathematics remain valid.

Using the regression coefficients from the original study, CSIR (CSI from regression) values were calculated for all schools of interest using current demographic data. A bar graph showing obtained values for all schools of interest for both data sets is shown as Figure 4. Schools with currently active ASEE student chapters are listed to the left side of the plot and have values for all four indices only if the chapter existed when the original study was run. Dormant chapters are located in the middle, and candidate schools are listed to the right.

Data are plotted for the original values versus the current values for all schools containing both sets in Figure 5, along with a 1-to-1 reference line and linear curve fits for both CSI and CSIR.

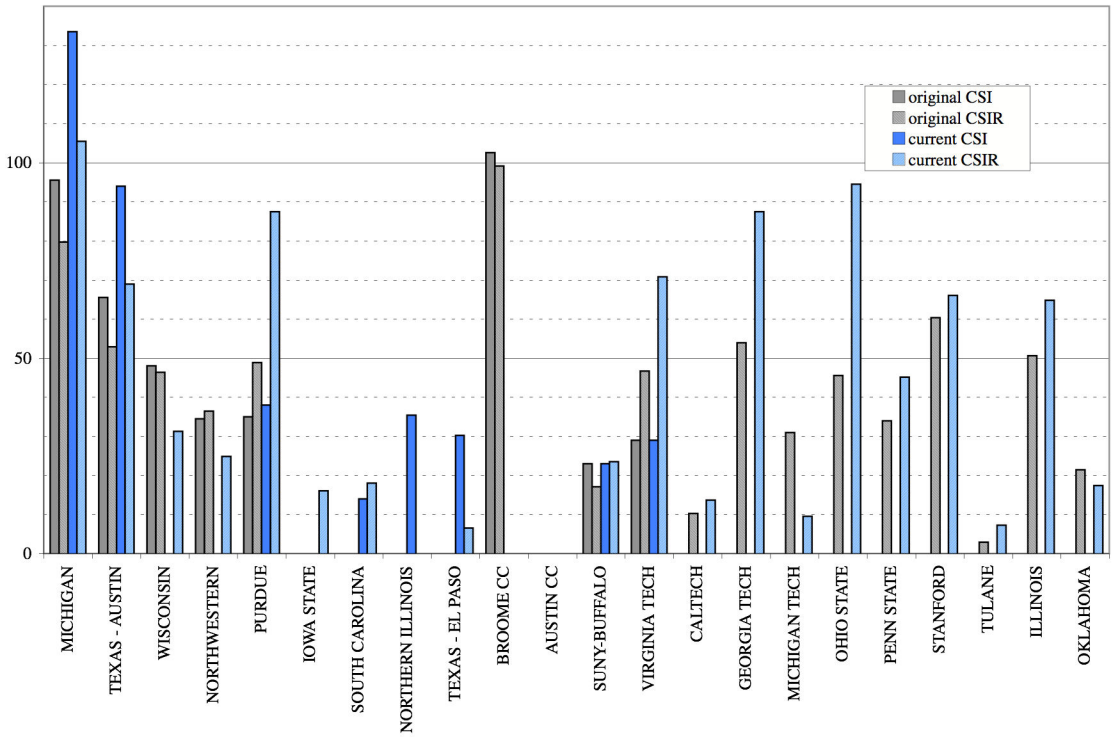

Figure 4: Chapter Survival Index values for all schools of interest

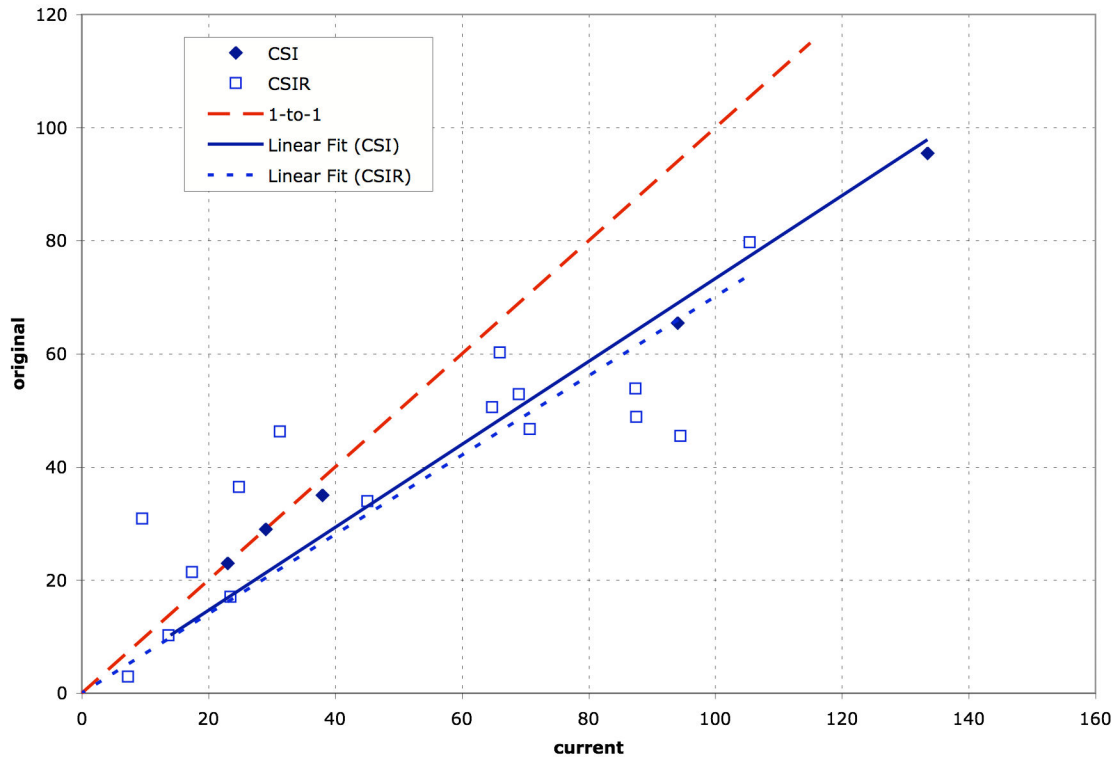

Figure 5: Original versus current Chapter Survival Index values for all available schools

The standard error for the regression equation applied to the current data set is 32.6 index points.

Conclusions:
The multivariable equation obtained by regression in the original study accurately calculated an index of ASEE student chapter activity level based solely on university characteristics which were relatively easy to obtain. There are some noticeable differences between the 2001 and 2006 data sets, though.

The differences in the obtained pairs of highly correlated variables highlights the differences in the demographic data between the two analyses, at least for the four mature chapter schools for which this correlation was calculated. This change suggests that a full regression run on the current data set might result in vastly different coefficients.

The obtained index values for the current data set do not match as well between CSI and CSIR as in the original study, as evidenced by the almost threefold increase in standard error with the current data set. This is not a complete surprise since the current data set was not involved in the regression, but it does indicate a different relationship between chapter activities and school demographics than is given by the prior regression equation.

Values are not in general consistent from the original to the current study. Current values tend to be higher than original values, as shown by the linear fits of CSI and CSIR in Figure 5 having lesser slope than the red 1-to-1 reference line. Most of this change is due to a general increase in graduate population at the schools in the study during the past five years (GDTOT), which results in a higher CSIR value through the regression calculation. Whether this indicates a true improvement in the environment to sustain a student chapter remains to be seen. The increase in CSI value for Michigan is due in large part to an increase in the number of sponsored awards from one to five, since awards were deemed high effort and high value in the original analysis. If the index is indeed to range from 0-100, its definition must change.

Initial hopes were that obtained index values could be used (1) to indicate locations for potential successful student chapter creation, (2) to point out existing chapters that may require outside intervention to survive, and (3) to avoid wasting effort trying to start a chapter in an environment that is not conducive. Anecdotal evidence suggests that the recently formed student chapters did no such analysis, and in fact these chapters may be more faculty-run than student-formed so they may not conform to this model at all. Obtained CSIR values are all lower than the originally predicted minimum threshold to denote a supportive environment for student chapter formation at the schools with newly formed chapters – new chapter performance in the near term should provide an indicator for the validity of the CSIR assessment.

Apparently, this approach is still a work in progress. To provide a more accurate and current assessment, regression equation generation should be repeated on a regular basis to allow for changing demographics at the schools. Increased accuracy may be possible after yet more active, mature student chapters are in existence and more data are available.

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