Some Characteristics of Highly Ranked Programs in the U.S. News &World Report Ranking of Engineering Programs in Institutions without Doctoral Programs

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Abstract

Many prospective engineering students and engineering educators and the schools they serve are aware of the U.S. News & World Report rankings. A distinct set of U. S. News & World Report rankings is the ranking of the undergraduate engineering programs in institutions without doctoral programs in engineering. While many observers point out the subjective and variable nature of these rankings, many also wait eagerly for the next ranking. This paper reviews the procedure by which these rankings are obtained and gives special focus to the characteristics of those engineering programs that are highly ranked. Features such as age, size and nature of the institutions and of the engineering programs in those institutions are described. Some observations about the characteristics of highly ranked programs are offered, and some potential hypotheses about correlations between program characteristics and rankings are suggested.

Introduction

In varying schedules starting about a decade ago, but annually in recent years, U.S. News & World Report has published a "ranking" of undergraduate engineering programs in institutions that do not offer doctoral programs in engineering. This ranking is distinct from the rankings of engineering programs at institutions with doctoral programs in engineering.

Here, from the current U.S. News webpage[1] (copied February 28, 2005), is their introduction to the most recent rankings (released in 2004):

> **"Best Undergraduate Engineering Programs**
> Think your future lies in engineering? On these pages, you'll find the *U.S. News* rankings of undergraduate programs accredited by the Accreditation Board for Engineering and Technology. The rankings are based solely on a peer survey of deans and senior faculty that asked them to rate each program they are familiar with on a scale from 1 (marginal) to 5 (distinguished). On the following page are programs at schools that offer doctorates, which often means a wider range of offerings at the undergraduate level, too. Students who prefer a program focused on undergraduates can consult the list below of top programs at schools whose terminal degree is the bachelor's or master's. Fifty percent of those surveyed returned ratings of the group below; 60 percent did so in the doctorate group. Respondents were also asked to nominate the best programs in specialty areas; the five schools receiving the most mentions in each category appear here."

For the purposes of this paper, several aspects of this statement are worthy of emphasis:

Only institutions with ABET-accredited programs are included.

The rankings are based solely on a peer survey of deans and senior faculty that were asked to rate each program they are familiar with on a scale from 1 (marginal) to 5 (distinguished).

Fifty percent of those surveyed returned ratings of the group below.

The 145 eligible engineering programs listed in the 2004 U.S. News survey sent to "deans and senior faculty" are listed by the institutions' names. These institutions may have one or several separately designated engineering programs, and may have both accredited and non-accredited programs. The respondents apparently must use some aggregate as the basis for the rating. As indicated, respondents select a number (5, 4, 3, 2, 1) for each school they chose to mark. These numbers are averaged for each school, and rounded to the nearest one-tenth. That number is the school's rating. The rankings are then determined by ordering those ratings. As a distinct component of the ratings, respondents are also asked to provide a response concerning the institutions with the best engineering program in several specific areas of engineering.

Most Recent Ratings and Rankings

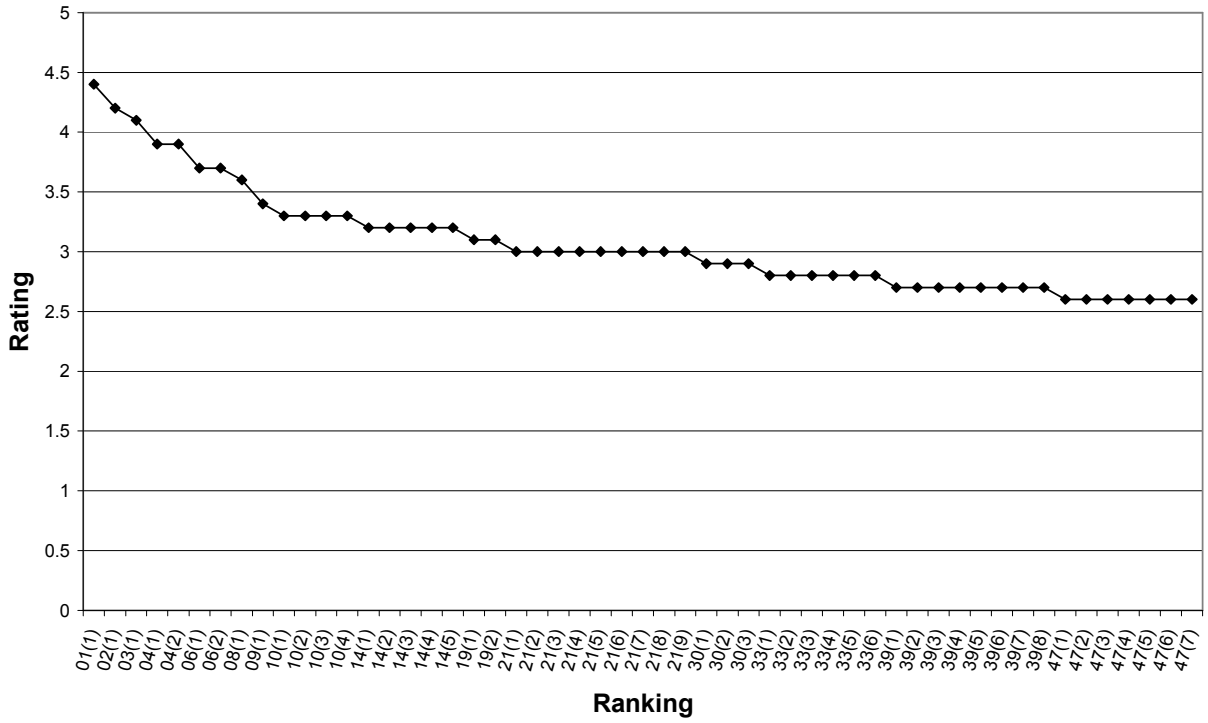
For the most recent ranking reported in 2004, the U.S. News website lists the top three programs, with ratings of 4.4, 4.2 and 4.1 on the five-point scale. An additional set of rankings is available for purchase from U.S. News, and includes the top 53 programs this year (concluding with the set of seven programs tied at rank 47 with a rating of 2.6). In this paper, these 53 programs are identified only by their ranking rather than the name of the institution, as the purpose of this paper is to focus solely on the characteristics of those programs.

Figure 1 shows the U.S. News & World Report ranking (with average ratings from 4.4 to 2.6) for the 53 top-rated engineering programs, according to the 2004 survey results. Institutions are not identified, but are represented by their respective ranking. Even though rating may more properly be considered the independent variable in this (and subsequent) graphs, ranking is used as the variable on each of the following figures, as illustrated in Figure 1, because ranking is the term most used in referring to the results. E.g., the ranking of the nine programs (institutions) with the rating of 3.0 are shown as 21(1) through 21(9) throughout. With the relative flatness of the curve, one can easily see that a small change in rating could mean a considerable change in ranking. Indeed, since the rating is based on the average to one decimal, a one-hundredth difference in the average of the participants' ratings could mean a one-tenth change in rating. This, in turn, could mean no change or a jump of up to nine positions in the resulting ranking (e.g., from 30 to 21, or vice versa).

Selected Characteristics of Highly Ranked Programs

Engineers and educators (and others) may be prone to inquire about the basis of the ratings from which these rankings result. Put another way, can one reverse engineer the results to infer what criteria, albeit perhaps subconsciously, the "deans and senior faculty" used to form their program evaluations into one of five quantitative (integer) rating levels? This paper presents an initial investigation of several characteristics of the 53 top-ranked (or rated) programs that one might

Figure 1. U.S. News & World Report Rating 2004



hypothesize to be factors that contribute to the peer ratings and subsequent rankings. The reader is advised not to expect any dramatic revelations or high correlations. Nonetheless, there is some very interesting and possibly useful information to be shown in the following discussion. Primary sources of data about the institutions other than the U.S. News rankings are taken from three readily available sources: a dictionary,[2] an ASEE publication[3] and the ABET website,[4] and are identified with each figure. In a few cases, missing data were obtained from an institutional website.

Institutional Data

A potential source of peer rating variation could be the influence of the reputation of the university hosting the program. The significant variations among the institutions in which these programs reside make many desirable factors unavailable for direct (or even quantitative) comparison. However, all institutions have a length of history and a current enrollment size that are publicly available.

Figure 2 shows the founding date of these 53 institutions. While there is significant variation throughout, one can visualize the trend of a modest increase in the number of years since the founding date as the rankings increase; that is, the age of the institution has some correlation with the ranking. Said more directly, the age of the institution has some limited correlation: longer history, higher ranking. However, there are more cases of conspicuous exceptions than that fit the rule.

Figure 2. Founding Date of Institution (NW Dictionary)

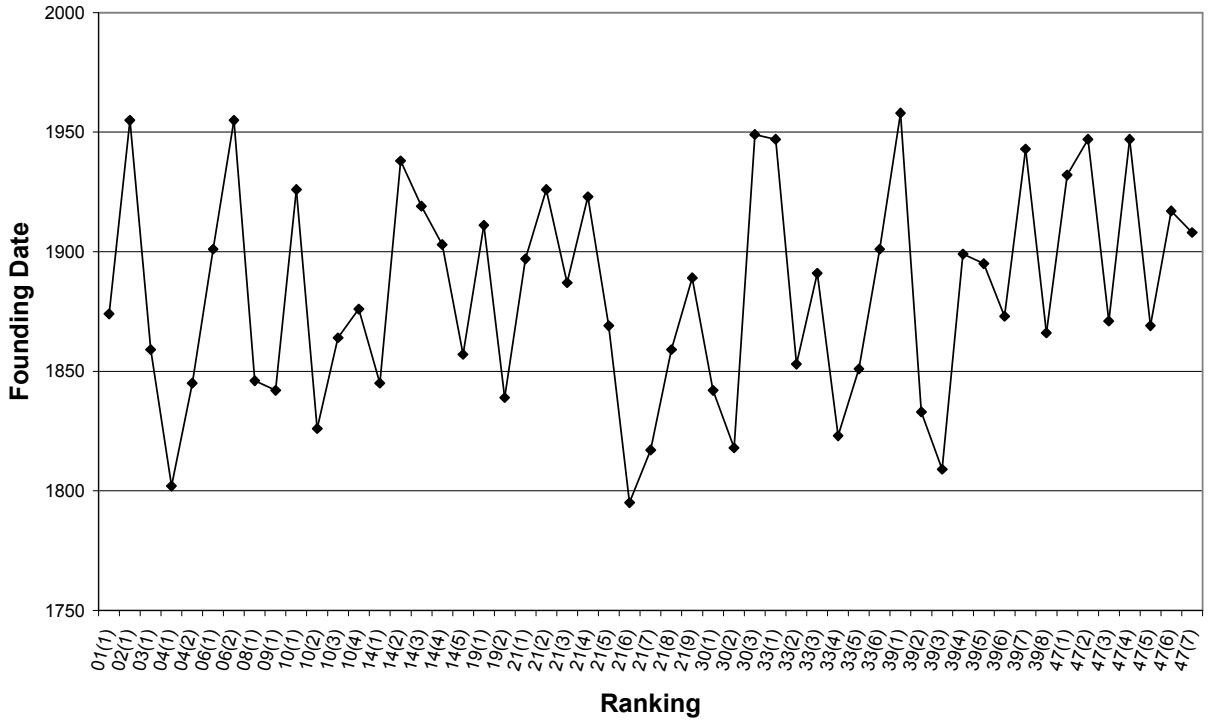


Figure 3 shows the relationship between institutional enrollment and program rankings. Regrettably, the enrollment for the indicated period was not available through the primary source for six of these institutions (and is shown as 0 on the graph). Again, one can see some correlation, with a modest trend of increased enrollment corresponding to lower rankings.

An hypothesis that could explain at least some of this trend in the relationship is that engineering programs in smaller institutions receive more institutional emphasis. Again, the reader is reminded that all of these results are for institutions with baccalaureate and possibly masters, but not doctoral, programs in engineering (although the institution may have doctoral programs in other disciplines).

A third institutional variable is its public or private status. There are also five U.S. military institutions in the list that are identified as a third group. Since these classifications are not numerical, they were assigned numbers to facilitate the visualization. Solely because the highest ranked programs followed that order, but otherwise arbitrarily, the numerical assignment shown in Figure 4 is: 3 = private, 2 = military, and 1 = public. Based on the relatively frequency of occurrence, one could say that the private and military institutions dominate the higher rankings. An interesting aspect of this graph is whether any of this effect is related to the relative numbers of private and public institutions, or to the percentage of each that have doctoral programs in engineering and are therefore not on this list.

Figure 3. Total Institutional Enrollment Fall 2003 (ASEE)

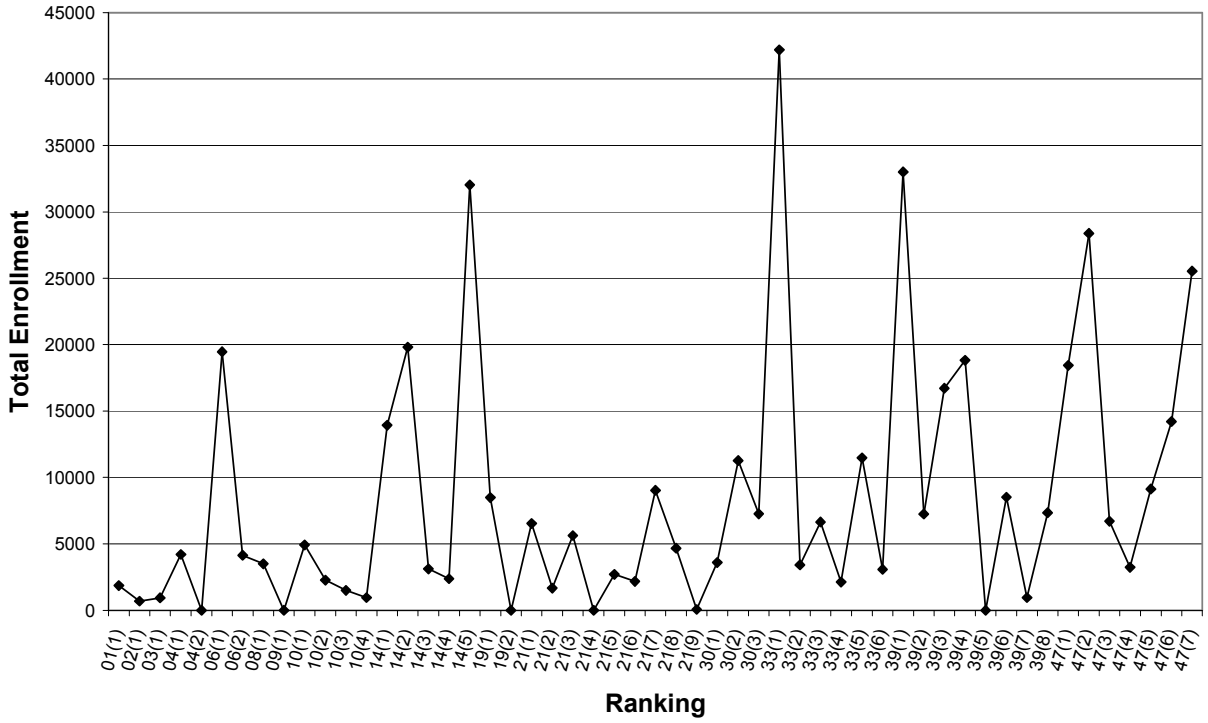
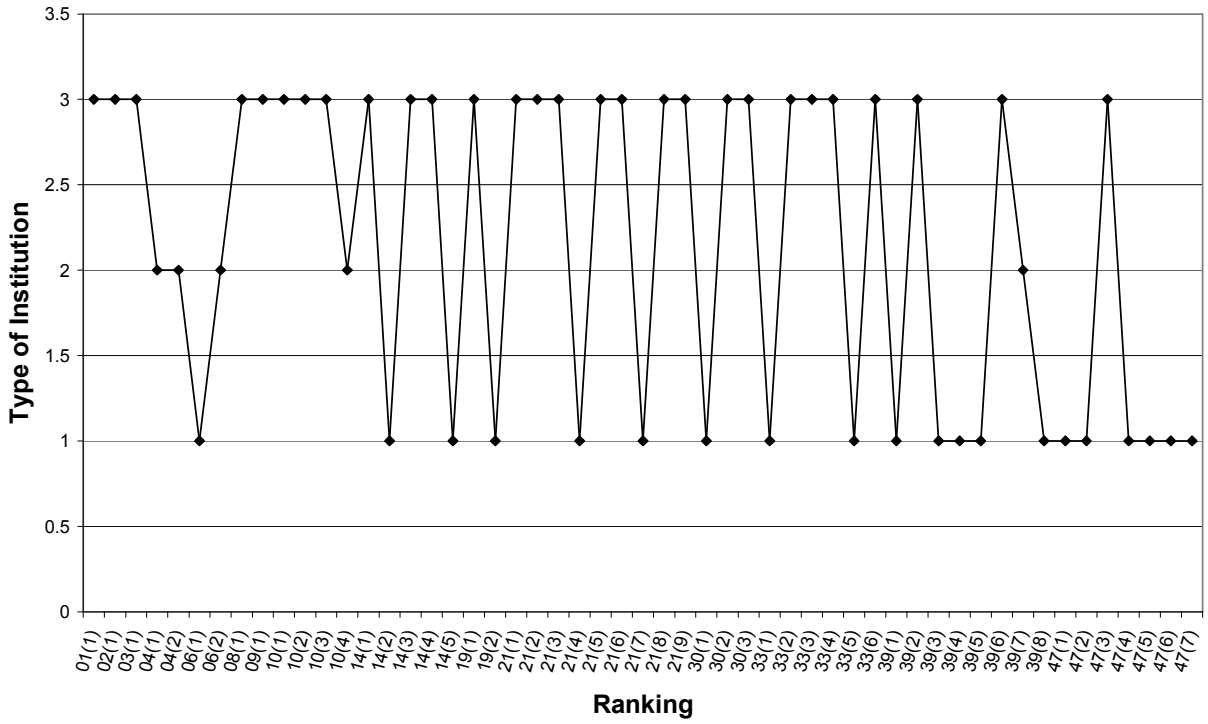


Figure 4. Type of Institution (3=Private, 2=U.S. Military, 1=Public)

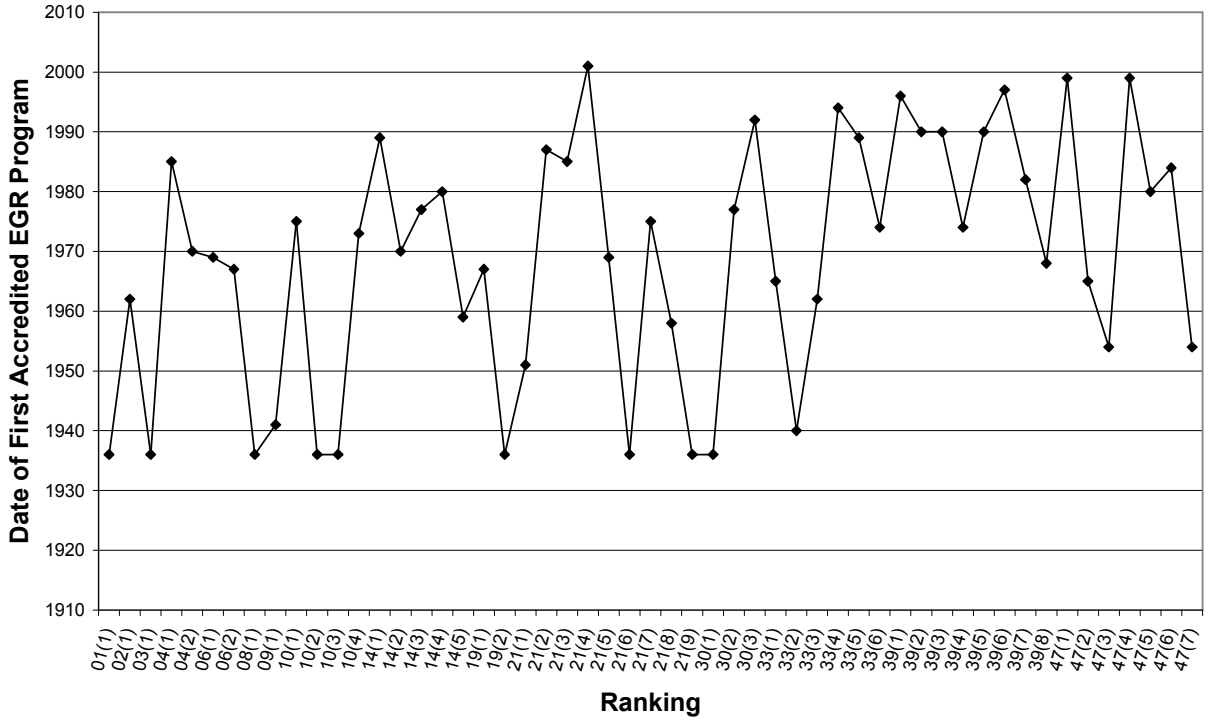


Engineering Program Data

Again, several areas come to mind about an engineering program that might be factors in its national peer rating, including the following that are readily available: age, number of accredited programs, size of program, and the presence (or absence) of a masters' program. These areas are explored in this section.

Figure 5 shows the year of first ABET accreditation of a continuing engineering program vs. its 2004 ranking. As for the age of the institution, there is considerable variation but a noticeable upward sloped linear trend. Interpreted, this corresponds to higher rankings for programs of greater age. The dramatic number of programs with first accreditation about 1936 is due to the establishment about that time of the national professional accreditation of engineering programs under the Engineers Council for Professional Development (ECPD), forerunner to the current ABET.

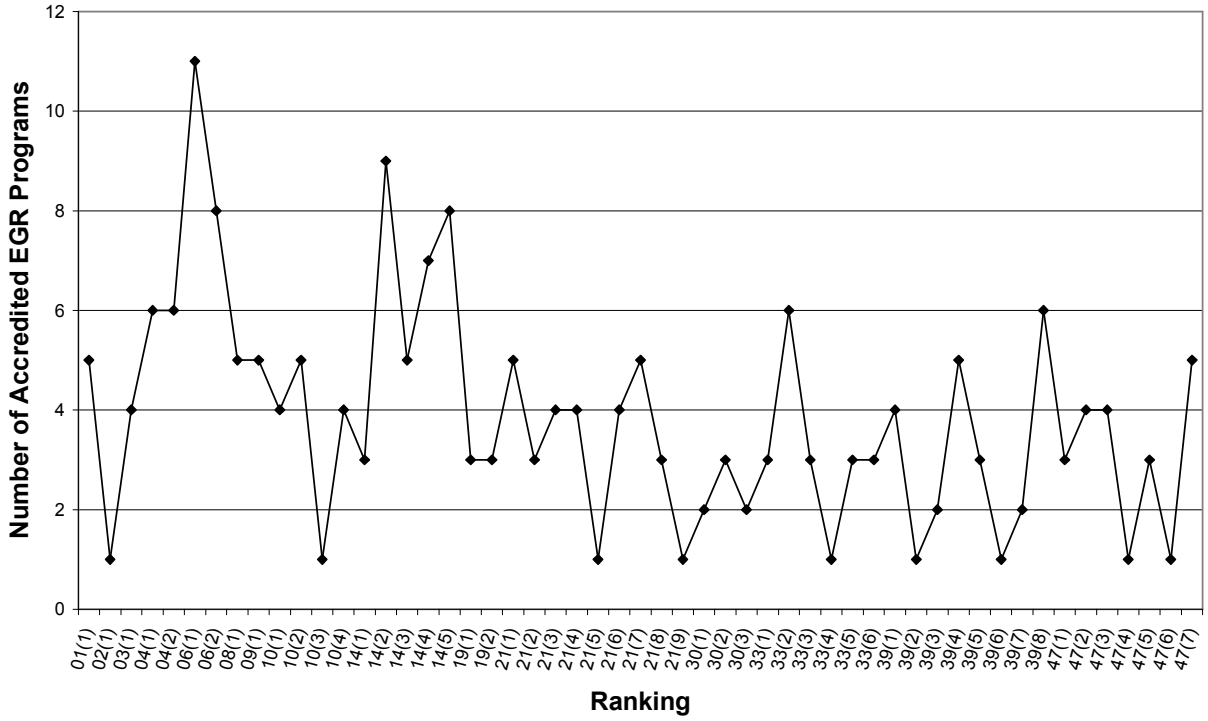
Figure 5. Date of First Accredited Engineering Program (ABET)



The number of engineering programs at a particular institution varies for a number of important reasons, including institutional mission and type (private, U.S. military or public), size, age and philosophy of the institution. One might be inclined naturally to expect that institutions with more engineering programs would attract more engineering students, but wonder if that would also translate into a higher peer rating. Figure 6 shows the number of currently accredited engineering programs vs. program ranking for the 53 institutions included in these data, and suggests some trend to the data. Specifically, the tendency, as always subject to considerable

variation, is clearly toward higher ranking for institutions with a greater number of accredited programs. Interestingly, the number of accredited programs at these 53 institutions varies from one to 11, with the largest number (11 institutions) having 3 programs.

Figure 6. Number of Accredited Engineering Programs (ABET)



The number of 2002-2003 engineering B.S. graduates from these programs is shown in Figure 7, and exhibits a very wide range. Of the 12 institutions with 200 or more engineering B.S. graduates, 10 are above the rank of 19. This suggests the generalization, with exceptions, that more highly ranked programs are frequently larger. Which variable is the result of the other is not part of the graph.

The size (strength) of the engineering faculty, as measured by the number of full-time faculty members, is shown in Figure 8. This number was not available for two of these institutions (which are shown as zero). There appears very little trend in these data, but there is perhaps a slight correspondence between higher ranking and more full-time faculty.

The preceding two engineering program comparisons, based on B.S. degrees awarded and full-time faculty, invite the calculation of the B.S. degrees per full-time faculty member within the engineering program. These calculated data are shown in Figure 9. After mentally removing the two zero values from the graph (due to lacking data), and without much more sophisticated analysis, Figure 9 suggests a significant impression. There is very little (at least visual) difference in this "student faculty ratio" across the top 53 ranked programs, but with perhaps a slightly higher ratio for the more highly ranged program than at the lower ranked programs.

Figure 7. Engineering Bachelor's Degrees Awarded 2002-2003 (ASEE)

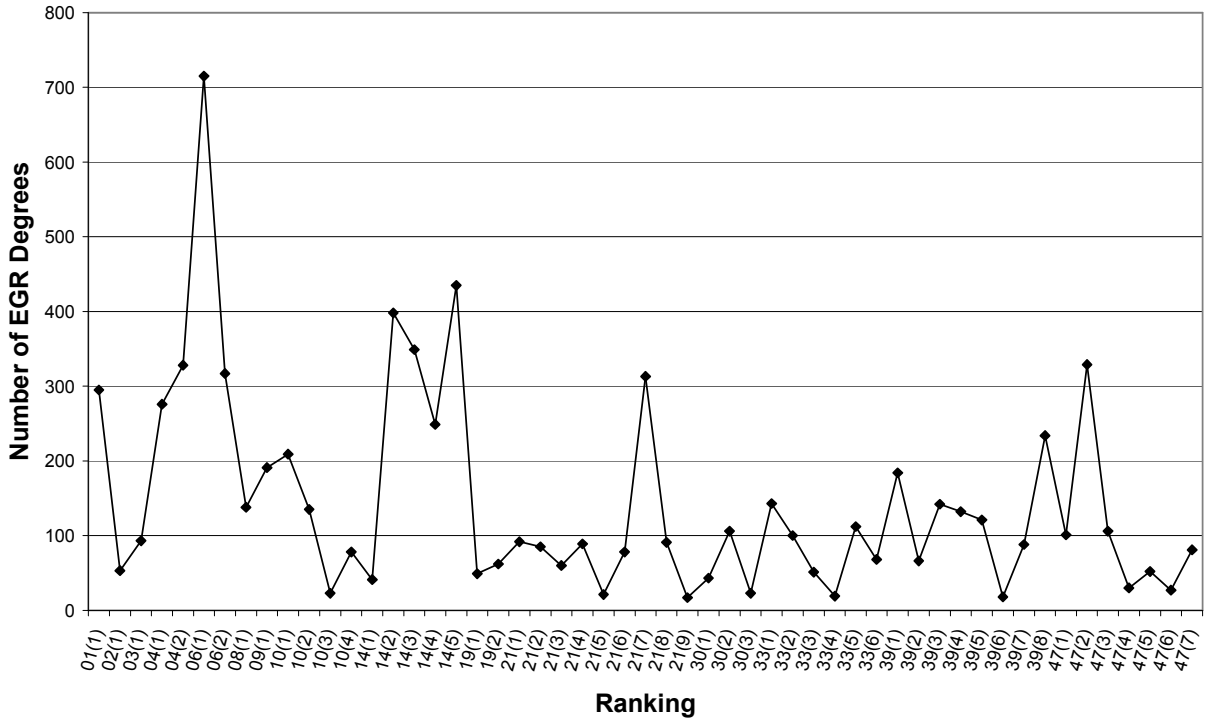


Figure 8. Full Time Engineering Faculty Fall 2003 (ASEE)

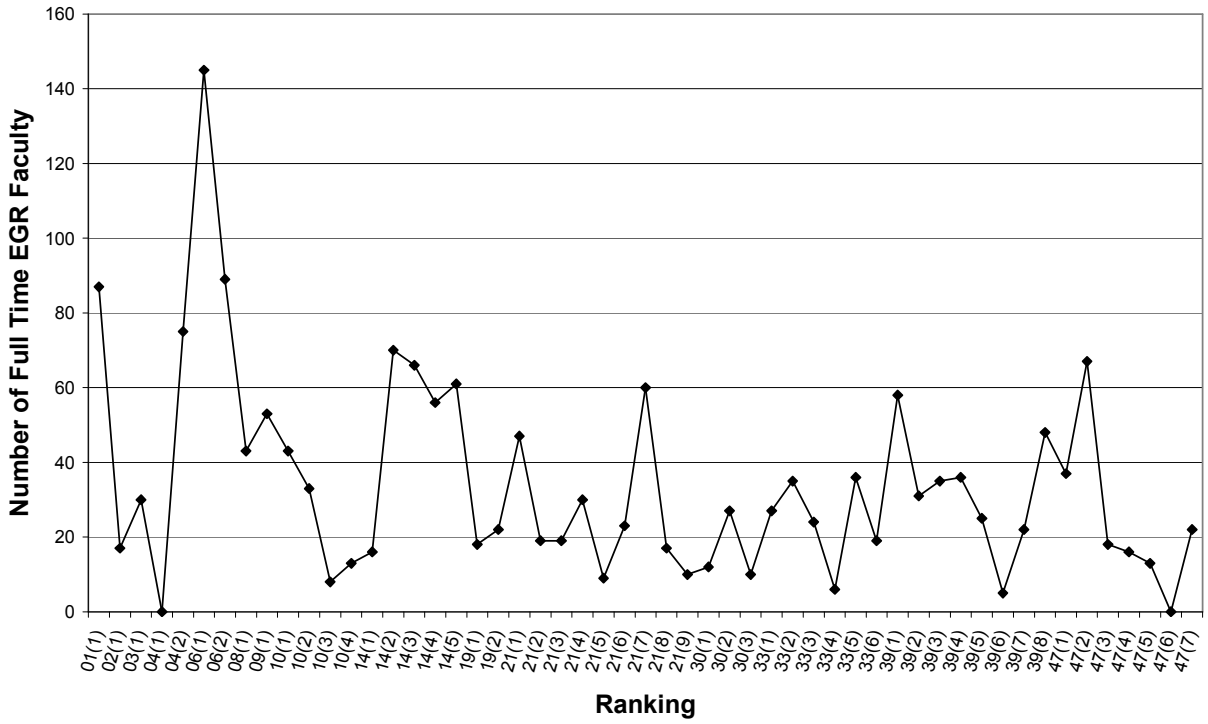
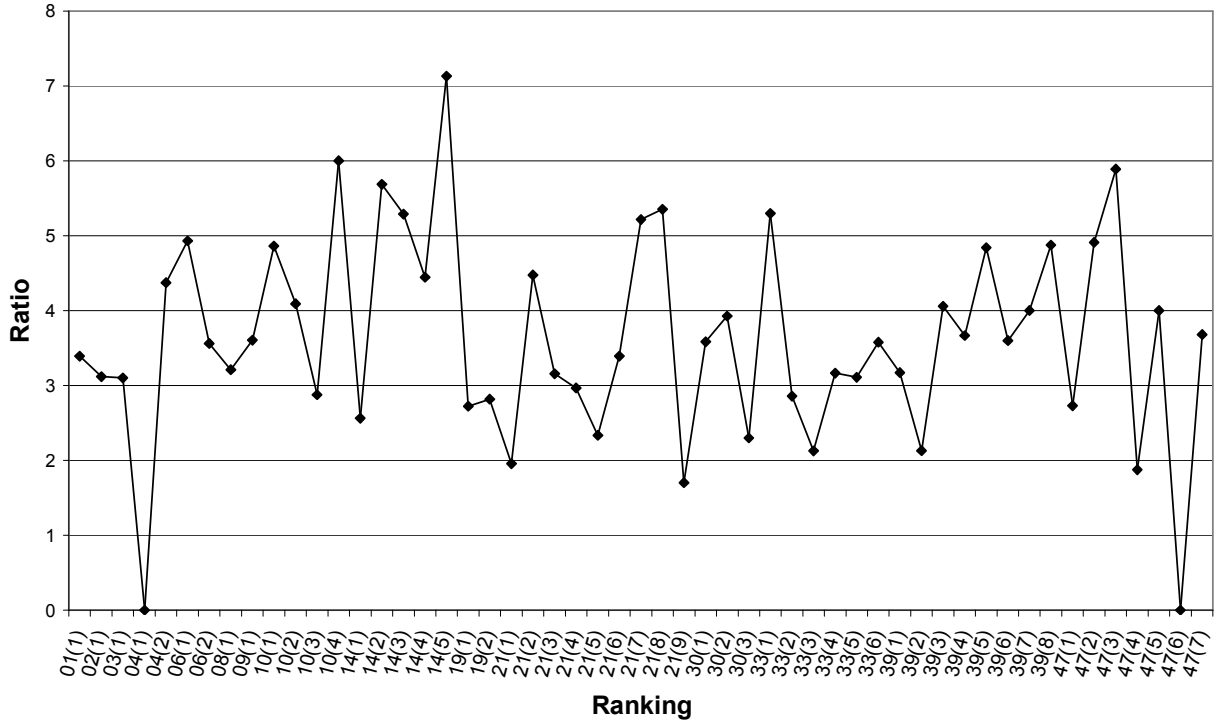


Figure 9. Ratio of BS EGR Degrees Awarded to Full Time EGR Faculty 2002-2003 (ASEE)



Another variable of interest among these engineering programs without doctoral programs is those that have masters programs. This information in reflected in Figure 10, which shows M.S. degrees awarded in 2002-2003 and indicates that 22 of the 53 top-ranked programs had M.S. graduates that year. No particular trend in the data is evident.

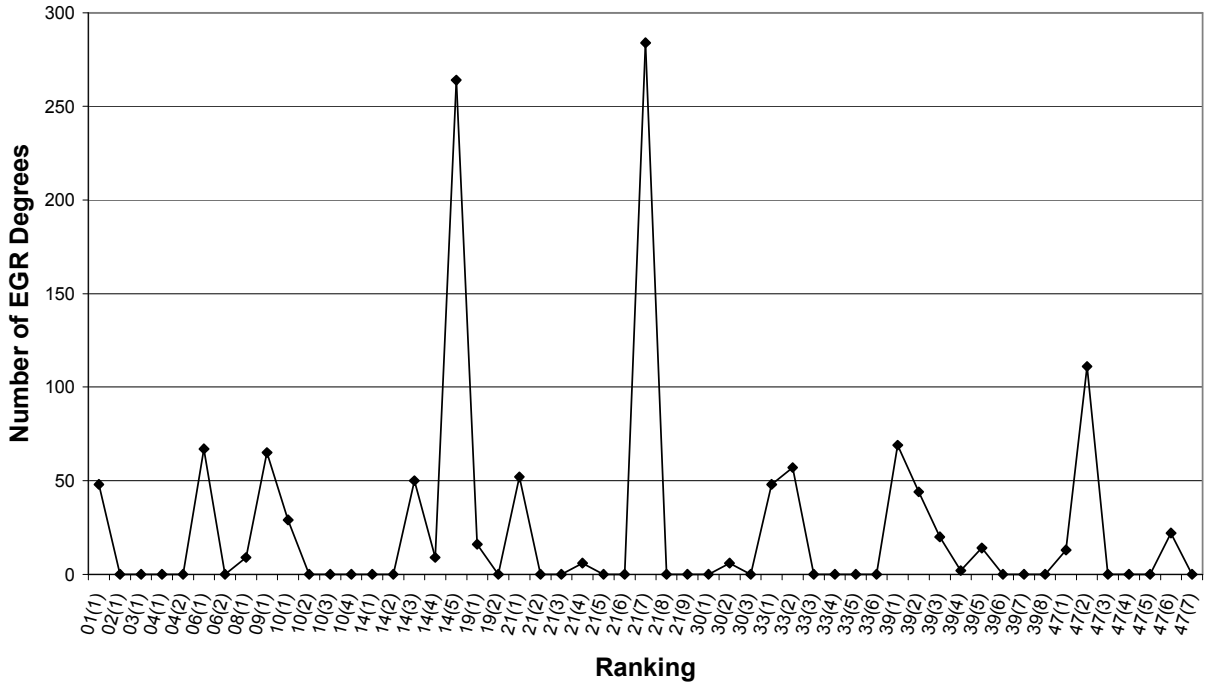
Student Cost Data

A reasonable conjecture about more highly ranked programs is that they might cost more per student because of the program amenities that they provide. The in-state and out-of state cost differential for state institutions leads to two sets of cost data, shown in Figure 11 for state residents and in Figure 12 for non-residents. Maintaining the single source of financial data led to having six institutions for which no in-state cost data were available, and eight for which no out-of-state data were available. Mentally removing the missing data points (shown as zero) from the graphs, there appears a noticeable trend (with notable exceptions as in other graphs) for both in-state and out-of-state costs to be higher for the more highly ranked programs.

Summary

The following observations collected from the several graphs presented in this initial study are summarized here, and with the repeated disclaimers that this "analysis" is visual not mathematical and is based on graphical patterns without implying anything about cause and

Figure 10. Engineering Master's Degrees Awarded 2002-2003 (ASEE)



effect relationships. They are based on the 2004 "rating" data collected using the U.S. News annual survey of "deans and senior professors" about the engineering programs in institutions with one or more ABET accredited B.S. programs in engineering and without doctoral programs in engineering. As illustrated by the nine graphs (Figures 2-10), the more highly ranked programs appear (literally, from the appearance of the respective graphs) also to have a tendency toward the following characteristics:

Figure	Institutional Characteristics
2	longer institutional history
3	lower total institutional enrollment
4	private or U.S. military identity

Figure	Engineering Program Characteristics
5	longer program history
6	more accredited programs
7	larger program (number of graduates)
8	larger full-time faculty
9	little difference in student faculty ratio
10	little difference with an M.S. program
11	higher tuition

In summary, one might conclude from this limited study that the rating by deans and senior professors has some correlation with the age and size of the institution and engineering program

Figure 11. Estimated In-State Expenses Fall 2003 (ASEE)

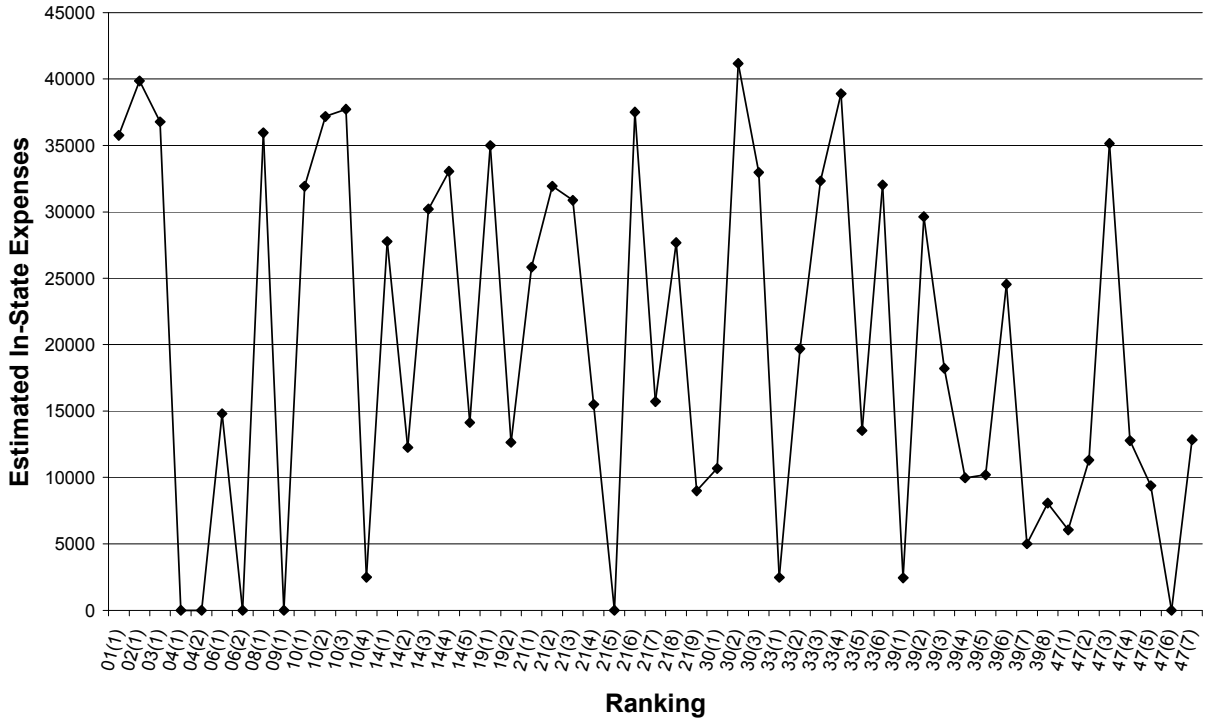
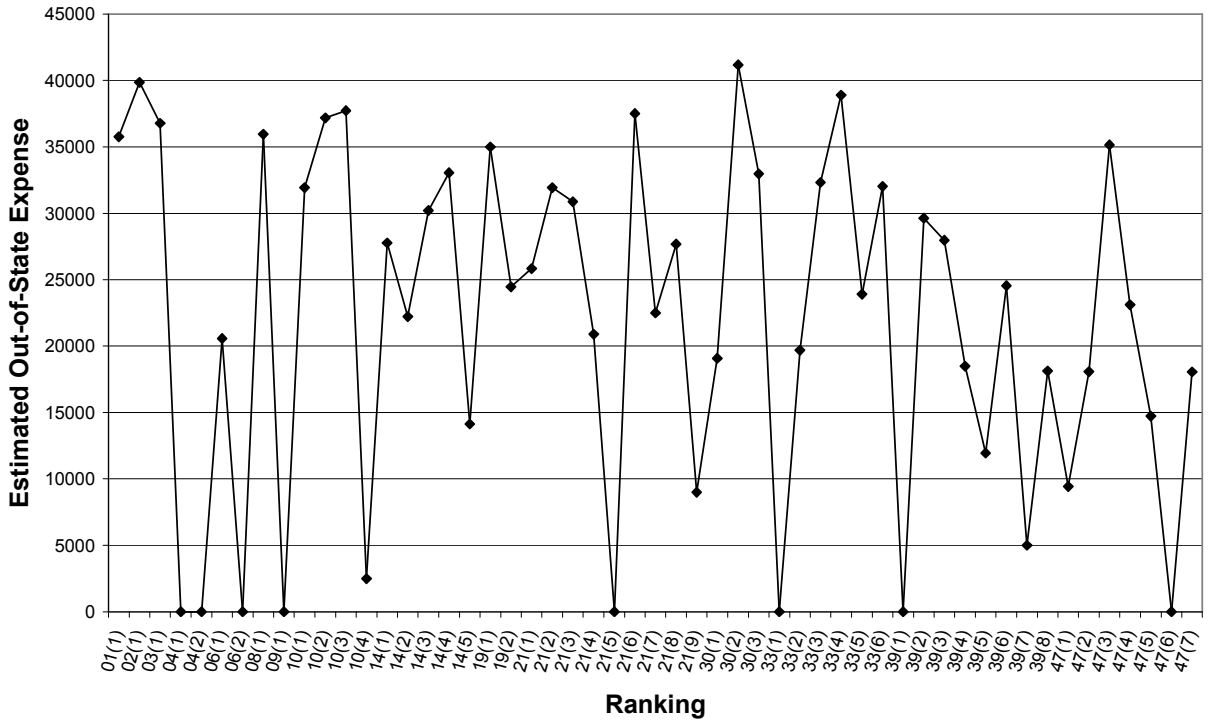


Figure 12. Estimated Out-of-State Expenses Fall 2003 (ASEE)



that one might also describe as the likely general awareness of the program. However, even to the extent that this may be an influence in the results, this still leaves open the more fundamental questions related to why those institutions and programs are larger. More importantly, none of the analysis in this paper has attempted to establish cause and effect, only coincidence of characteristics and ranking.

Areas for Future Study

It seems clear that further work would be required to identify the specific characteristics of highly ranked programs that distinguish them from less highly ranked programs. Two areas for extension of this study are: 1) identifying and exploring other likely characteristics of interest and for which objective data can be obtained, 2) quantifying the extent of correlation between the ranking and the characteristics (and between and among characteristics). A third area of further study that may be of greater interest and importance is seeking to identify cause and effect relations; i.e., what characteristics of an engineering degree program in an institution without a doctoral program in engineering underlie the perception by professional colleagues of high quality for the program. A fourth area of interest would be a temporal study of the ratings and resulting rankings, with consideration of the consistency of ratings from year to year and of any trends (and their causes) that might occur for specific programs.

Author Disclosure

The engineering program with which the author is affiliated is included in the 2004 U.S. News list of engineering programs discussed herein.

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