2006-349: LONGITUDINAL STUDY OF U.S. NEWS RANKINGS OF ENGINEERING PROGRAMS IN INSTITUTIONS WITHOUT DOCTORAL PROGRAMS IN ENGINEERING

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Longitudinal Study of U.S. News Rankings of Engineering Programs in Institutions without Doctoral Programs in Engineering

Abstract

One of the questions engineering educators are often asked by their various constituencies is "How does your program rank nationally?" For the subject group of engineering programs (those without doctoral programs in engineering at their institution), the highly publicized annual U.S. News rankings are often cited—or rationalized—depending on the most recent rankings. In the U.S. News survey, each respondent is asked to rate the listed programs from 5 (highest) to 1 (lowest). In this paper, the authors explore the variability of the U.S. News ratings and rankings of bachelor's degree programs in engineering in institutions that do not offer doctoral programs in engineering. Specifically, this paper explores the variation of these annual ratings and rankings from year to year, institution by institution (but without specific institutional identification, which is not the purpose of the paper) and provides graphical data that illustrates the amount and a discussion that indicates the reason for some of this variability.

Introduction

The context for this study is provided by the following paragraph quoted from a 2005 ASEE Annual Conference paper:

> "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. 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)." [1]

The current paper explores that observation with a longitudinal (temporal) analysis, with both temporal graphs and statistical measures of the rating and ranking results over a four-year period. The results illustrate the considerable variability of these ratings and rankings of engineering programs from year to year. If one grants the premise that the quality of most baccalaureate programs in engineering do not vary significantly from year to year, then much of this annual variability could be attributed to the method by which the rankings are determined. This perspective would then be important in the inferences, interpretations and judgments of the various constituencies that use these rankings.

This analysis may be of particular interest to those institutions that offer a multidisciplinary engineering baccalaureate program in engineering, general engineering, engineering physics, or engineering science, as many of these are institutions that do not offer doctoral programs in engineering and are therefore included in this list.

The U.S. News Methodology and Self-Description

The following heading and self-description were given by U.S. News for the most recent survey and report:

> "Methodology: Best undergraduate engineering programs"
>
> "The *U.S. News* rankings of undergraduate programs accredited by the Accreditation Board for Engineering and Technology are based solely on the judgments of deans and senior faculty who rated each program they are familiar with on a scale from 1 (marginal) to 5 (distinguished). The deans and faculty members were surveyed in spring 2005. We have separate rankings for schools that offer doctoral degrees in engineering and schools whose terminal degree in engineering is a bachelor's or master's. Research at the graduate level often influences the undergraduate curriculum, and schools that have doctoral programs in engineering tend to offer the widest possible range of offerings. Students who prefer a program focused on undergraduates can consult the list 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 whose terminal degree in engineering is a bachelor's or master's; 59 percent did so for the doctoral group. We also asked for nominations of the best programs in specialty areas; those receiving the most mentions in each appear here. Schools offering any courses in a specialty are eligible to be ranked in that specialty." [2]

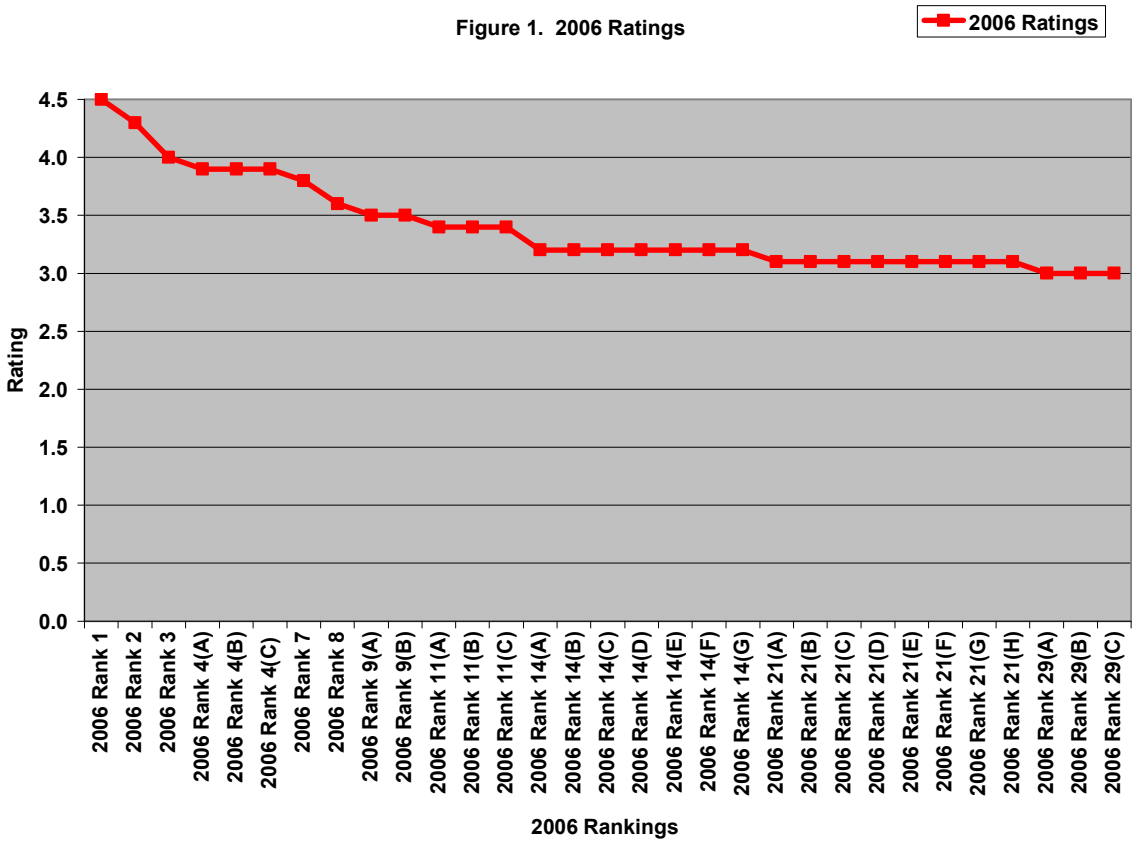
As indicated, the survey conducted each spring (say, spring 2005) is used to generate the next year's results (publicized as 2006 rankings).

U.S. News Rating and Ranking Data

In this temporal study, four ratings years, 2003 through 2006, are used. The four-year rating data (Table 1) and ranking data (Table 2) for the 31 programs ranked highest for 2006 are shown in the respective tables in the Appendix. Program names are not used. Rather, programs are labeled in the numerical order of their 2006 ratings (and, hence, rankings), with capital letters used to distinguish programs with the same rating (and, hence, ranking). For example, there were three programs tied at a rating of 3.9 for fourth ranking in the 2006 report and are labeled as 4(A), 4(B) and 4(C). No ranking or rating distinction is implied by these letters. Interestingly, two of the 31 programs, 14(F) and 21(D), rated 3.2 and 3.1, respectively, in 2006 did not appear on the list in the three prior years. These therefore show as blanks for those years in Table 1 and Table 2 and as missing points in the figures that follow.

Ratings for 2006

The top 31 ratings reported by U.S. News for the most recent rating year are shown in Figure 1. These 31 programs ranged from the reported 2006 average rating of 4.5 (highest) to 3.0. As illustrated, the ratings reported by U.S. News are rounded to the nearest 0.1, which leads to many "ties."



Analysis of Ratings Data

While Table 1 provides the actual ratings numbers (and, indeed, the rankings, which will be explored next), it may be more effective to view these data in graphical form. Accordingly, Figures 2-8 provide the rating data graphically for the four years (2003, 2004, 2005, 2006) for these 31 programs, grouped according to the 2006 ratings, as follows:

Figure 2	2006 ratings of 4.5, 4.3, 4.0	3 programs
Figure 3	2006 ratings of 3.9	3 programs
Figure 4	2006 ratings of 3.8, 3.6, 3.5	4 programs
Figure 5	2006 ratings of 3.4	3 programs
Figure 6	2006 ratings of 3.2	7 programs
Figure 7	2006 ratings of 3.1	8 programs
Figure 8	2006 ratings of 3.0	3 programs

The following observations are easily made from these Figures. For Figure 2, the three top-rated programs have varied in rating from year to year (but only by 0.1 each, reasonably within the one decimal round-off of the ratings calculation), but have remained in the same order over this four-year period. Figure 3 illustrates a converging (but non-monotonic) pattern, with three programs 0.3 apart in 2003 coming to the same 3.9 rating in 2006, with one program increasing monotonically from 3.5 in 2002 to 3.9 in 2006. Figure 4 illustrates again the ups-and-downs of individual programs, with one program increasing from 3.2 in 2005 to 3.5 in 2006. Figure 5

shows the interesting case of three programs that increased from 3.3 to 3.4 ratings over these four years, with equal ratings in 2003, 2004 and 2006, but with three distinct ratings in 2005.

As the rating curve in Figure 1 flattens (i.e., more programs at each rating), some more complex graphical results appear. Figure 6 shows the data for the seven programs that were rated at 3.2 in 2006. One appeared for the first time in 2006, while the other six began at 3.2 and 3.1 in 2003, were rated from 3.0 to 3.3 in 2004 and 2005, and followed a variety of paths to their common 3.2 rating in 2006. Figure 7 shows the history of 8 programs rated 3.1 in 2006, of which one was not rated until 2006 and the other seven began at ratings from 3.3 to 2.9, varied from 2.8 to 3.3 over the period and converged to the common 3.1 in 2006. Finally, the three programs in Figure 8 began at ratings from 3.1 to 2.9 and varied from ratings of 3.2 to 2.7 over the period before converging to the common 3.0 rating in 2006. Of particular note is a program that increased from 2.7 in 2005 to 3.0 in 2006.

Looking again at Table 1, the two rightmost columns give, respectively, the mean and the standard variation of each program's ratings from 2003 to 2006. The largest variation of any rating from the mean for any program is 0.22, for the program denoted "2006 Rank 4(A)." This is the program that increased monotonically from 3.5 to 3.9 over that period. The smallest variation from the mean was 0.0, by the program denoted "2006 Rank 14(E)" that held constant at its 3.2 rating over that period.

The standard deviations in Table 1 are also an interesting statistic. Of course, program 2006 Rank 14(E) has a 0.0 standard deviation for this period since it remained constant at its 3.2 rating. The highest standard deviation, of 0.17, was for the program denoted 2006 Rank 4(A) that had the monotonic increase from 3.5 to 3.9 over this period. Two programs had ratings standard deviations of 0.14 over this period. The program denoted 2006 Rank 9(A) varied from 3.2 to 3.5 over that period, while the program denoted 2006 Rank 29(C) varied from 2.7 to 3.0 over the period. The statistical mean and standard deviation data from Table 1 are shown graphically in Figure 9, which visually confirms the immediately preceding observations. On this common scale, the standard deviation values appear modest. Finally, Figure 10 compares the 2006 ratings (on an expanded vertical scale compared with Figure 1) with the corresponding mean ratings of each of these programs over the four years to represent graphically the amount of rating variation by program over this period. Another result of the individual variability is that, while the 2006 ratings graph is necessarily monotonic non-increasing, the mean rating graph clearly is not.

With the survey methodology of determining these ratings and assuming that most of these programs would not vary significantly from year to year, one could reasonably conjecture that most of these ratings should be relatively consistent from year to year--with some modest variation over time and an occasional stronger pattern of change that might in fact be based in some objective cause (winning some national competition, receiving some well publicized award, etc., or some equivalent negative situation). But, without further research, even this remains at most a conjecture.

Figure 2. 2004-2006 Ratings (2006 Rank 1-3)

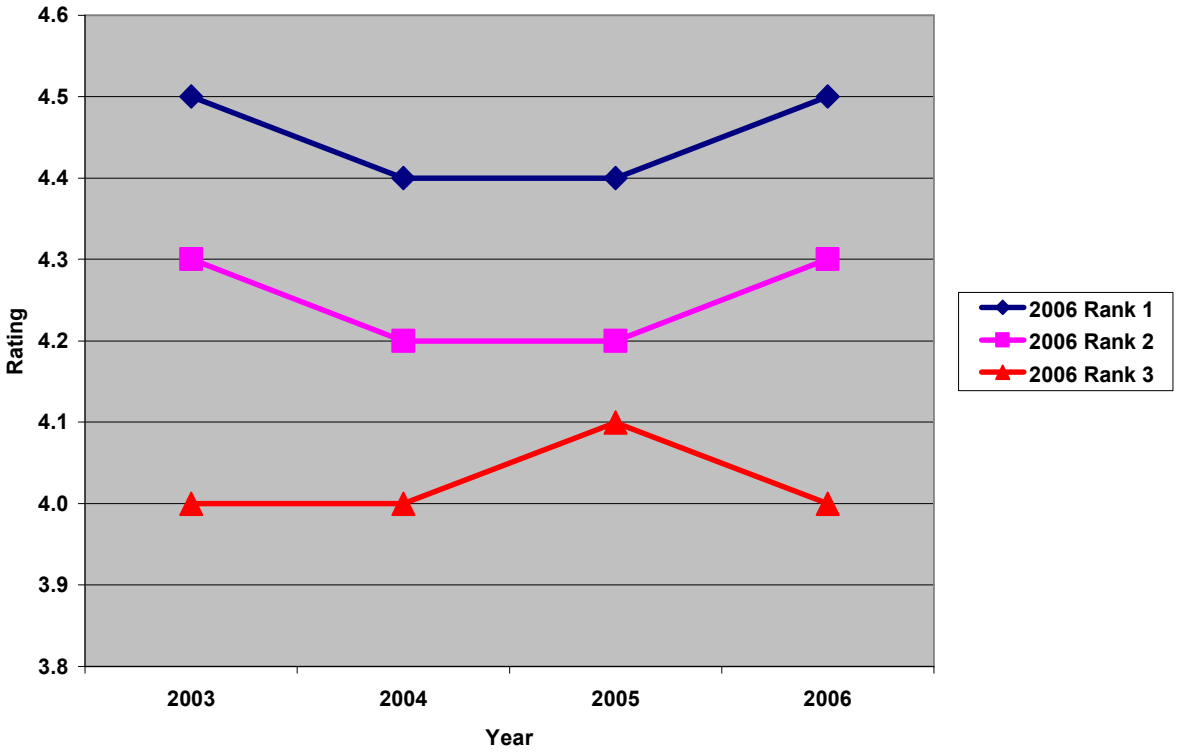


Figure 3. 2004-2006 Ratings (2006 Rank 4(A-C))

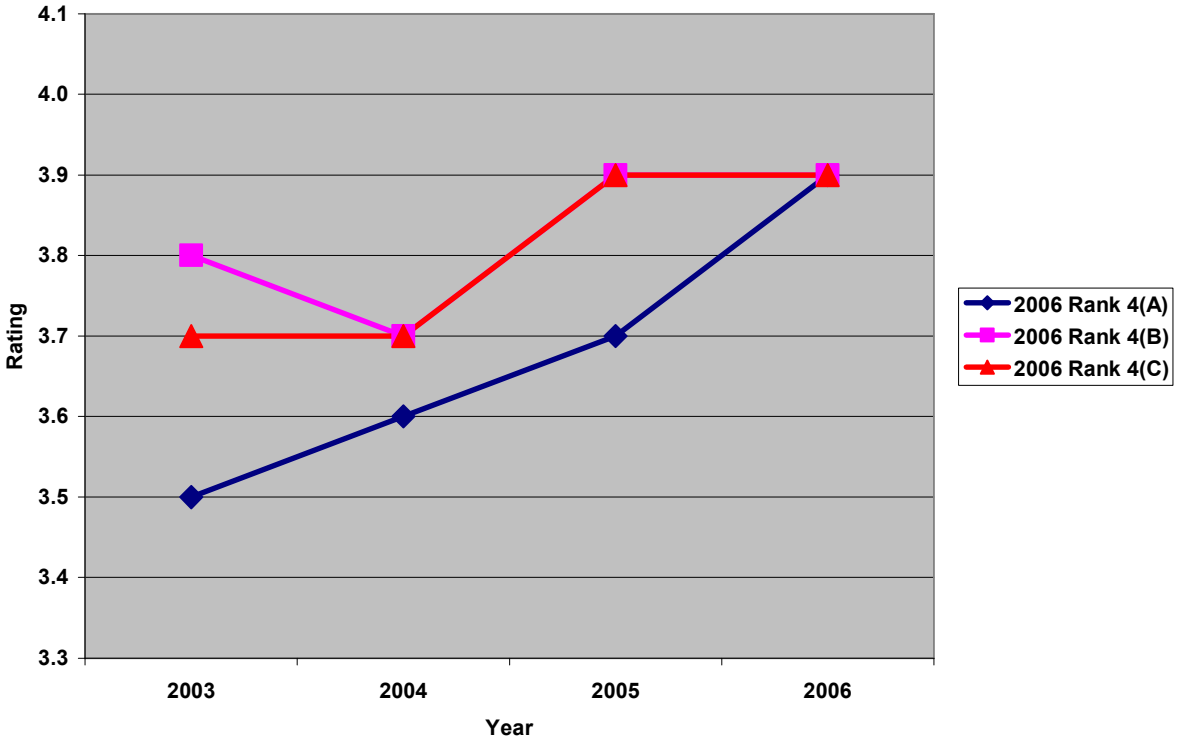


Figure 4. 2004-2006 Ratings (2006 Rank 7-9(A-B))

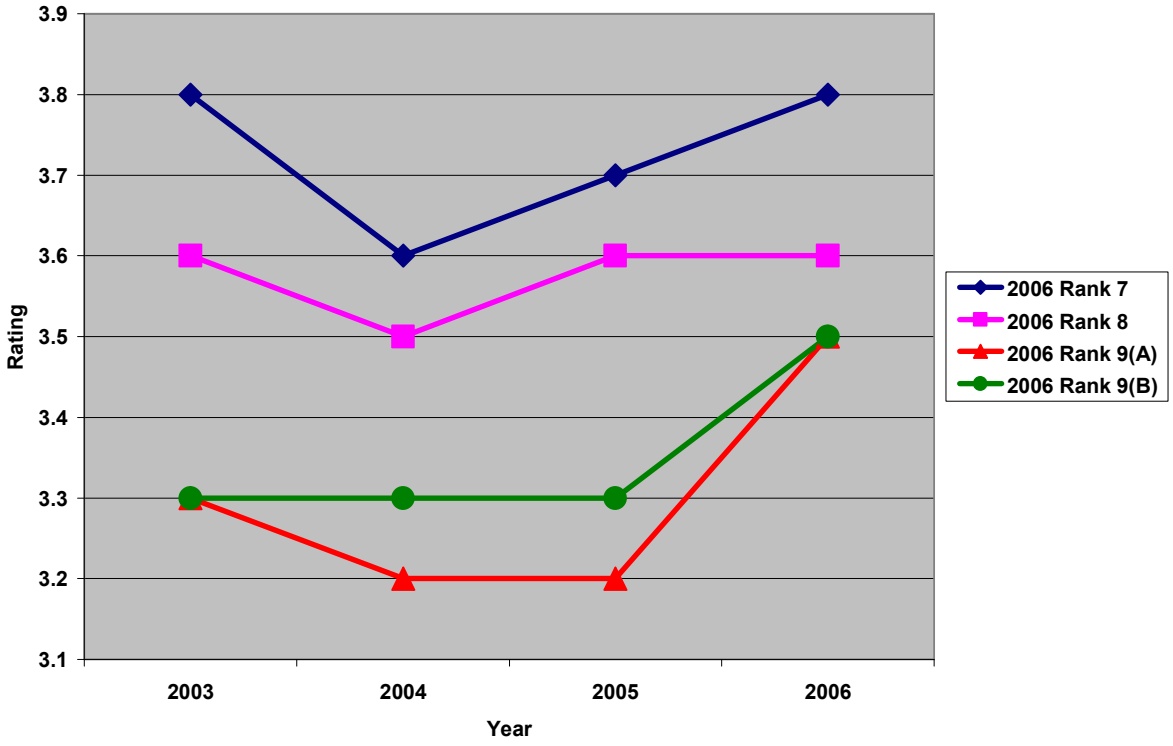


Figure 5. 2004-2006 Ratings (2006 Rank 11(A-C))

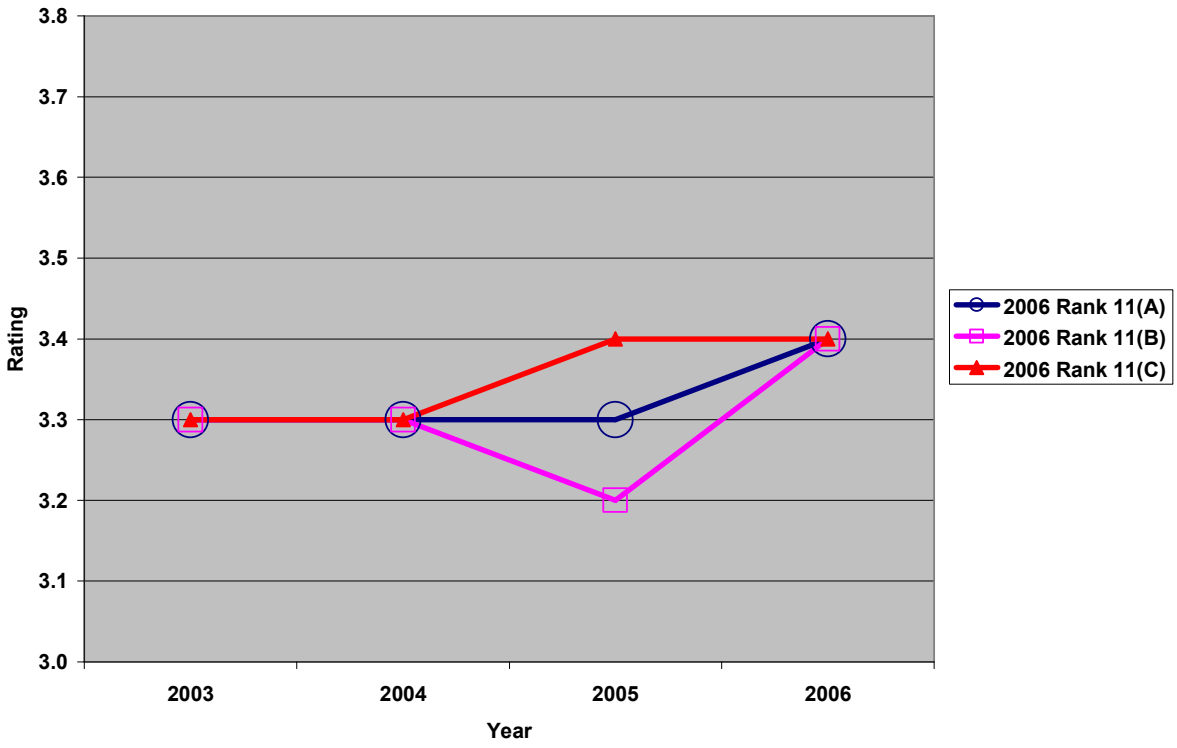


Figure 6. 2004-2006 Ratings (2006 Rank 14(A-G))

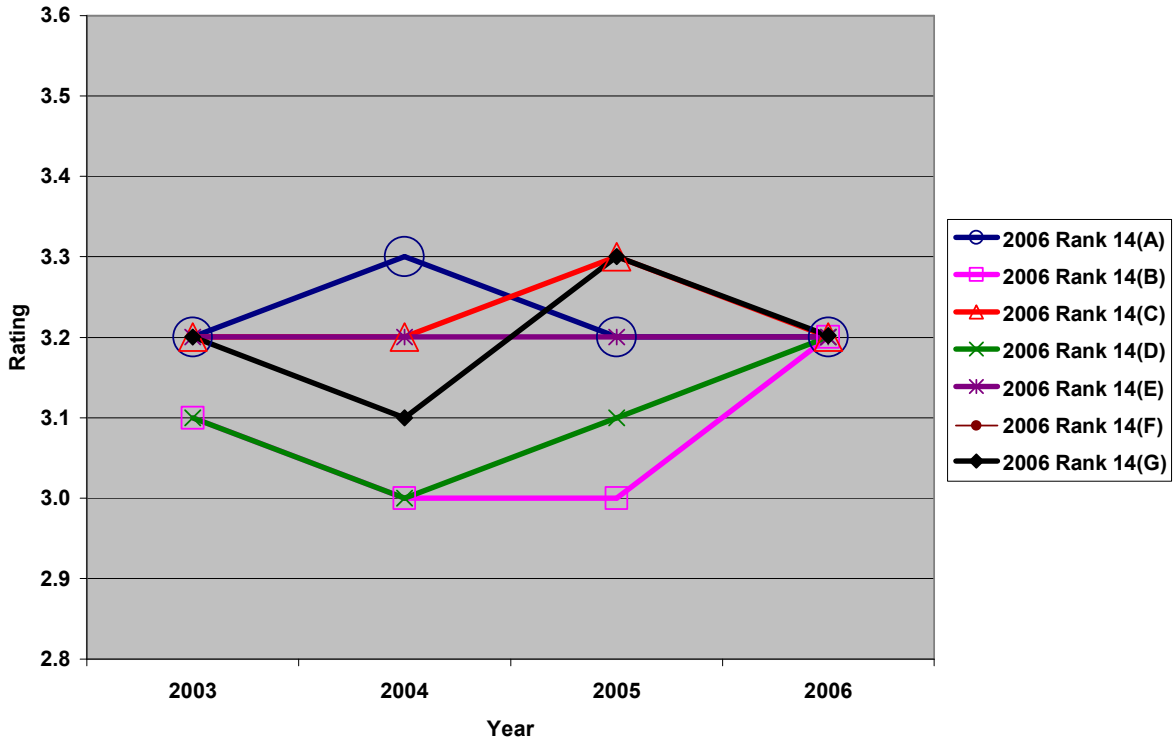


Figure 7. 2004-2006 Ratings (2006 Rank 21(A-H))

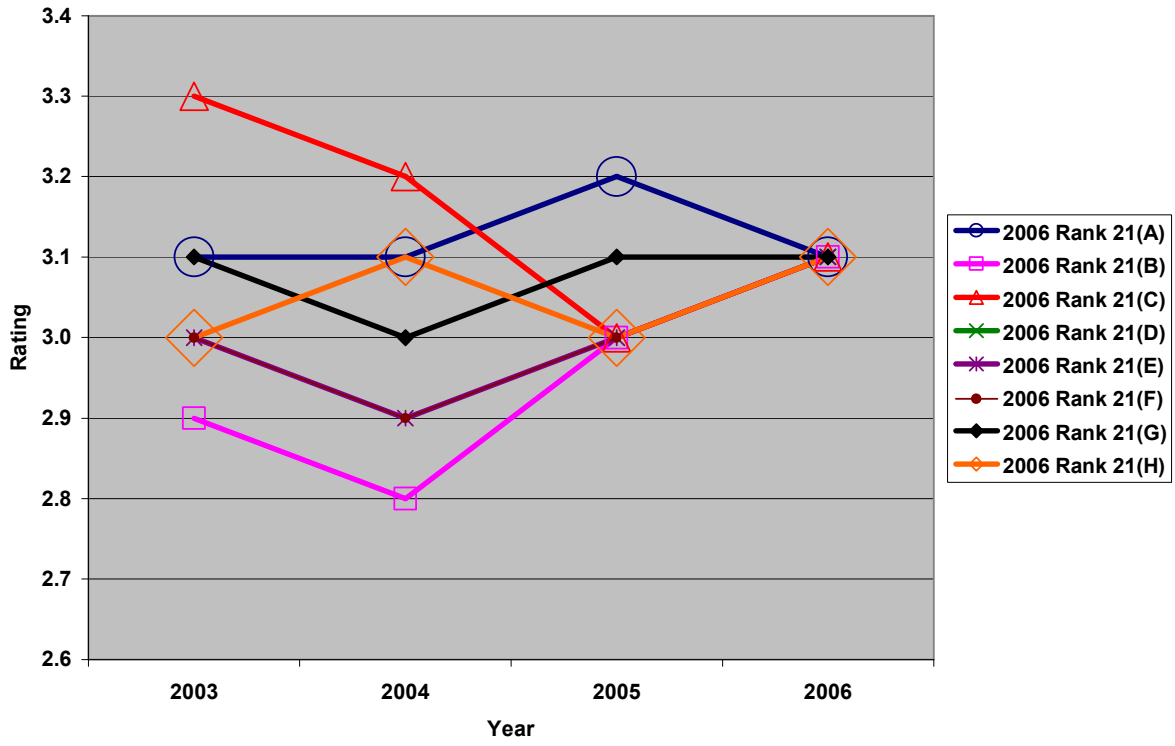


Figure 8. 2004-2006 Ratings (2006 Rank 29(A-C))

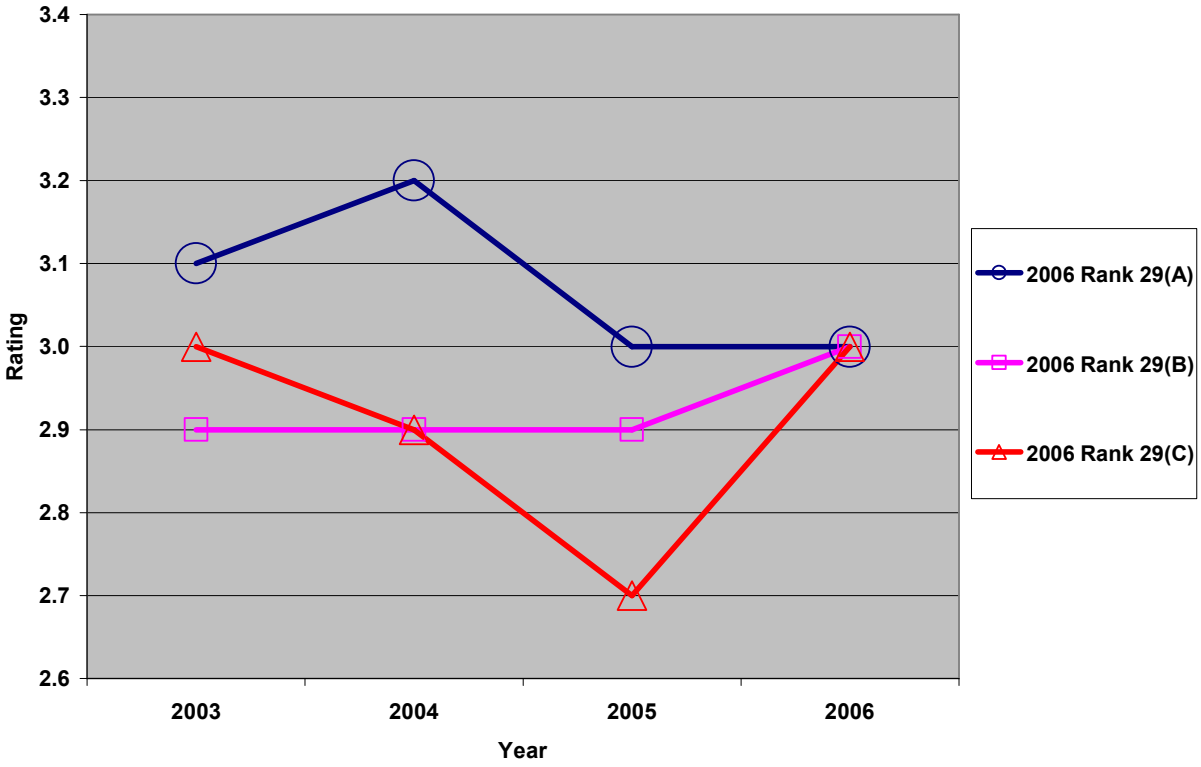
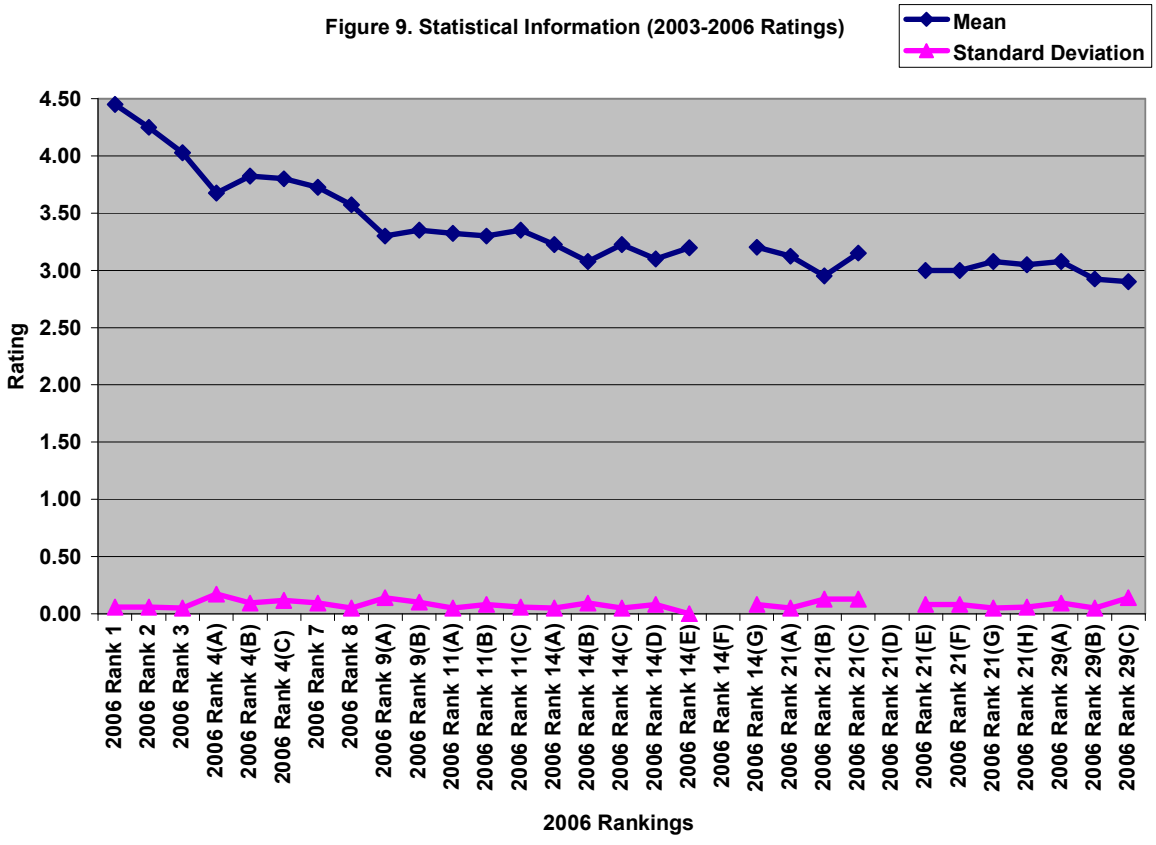
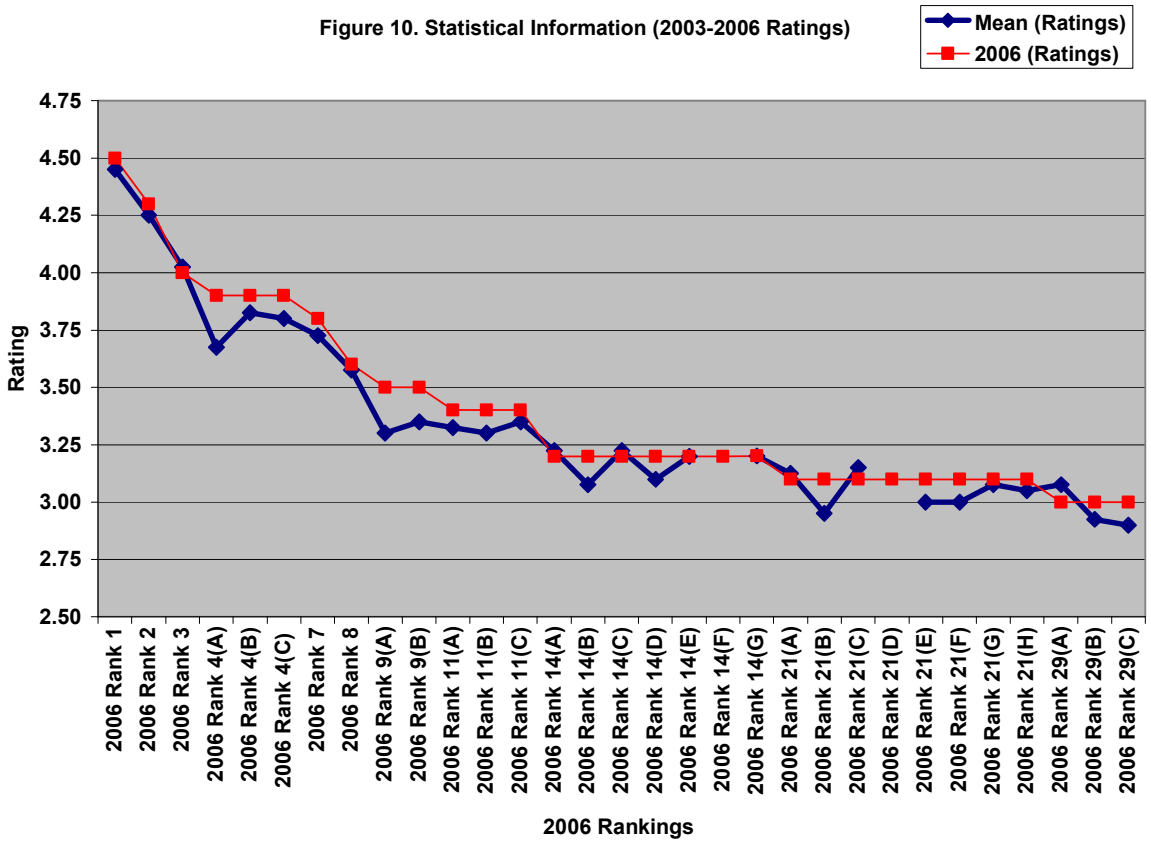


Figure 9. Statistical Information (2003-2006 Ratings)



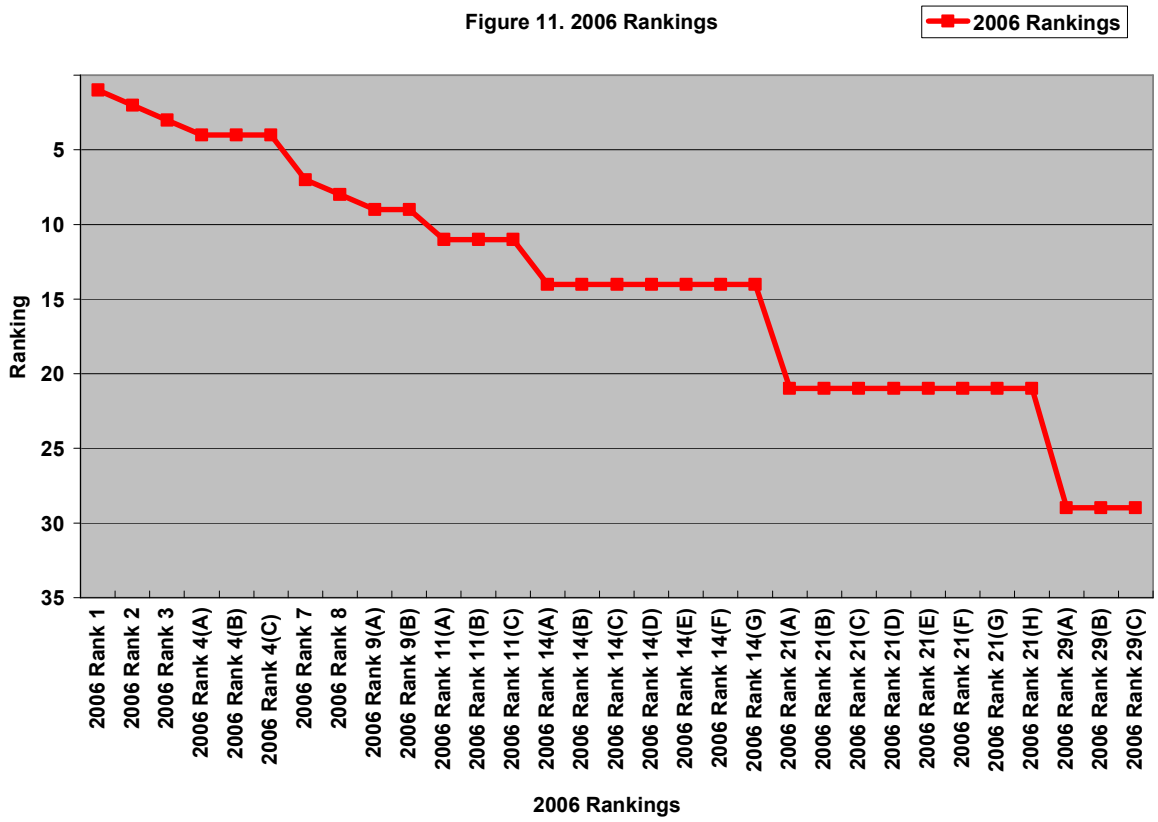


Rankings for 2006

The rankings for the programs with the top 31 ratings reported by U.S. News for the most recent rating year are shown in Figure 11. The program rankings range from 1 to a three-way tie for 29. The labeling of the individual programs for Figure 11, and elsewhere, is the same as in Figure 1.

Analysis of Rankings Data

While the ratings are the measured (or, at least, the original) data, the more commonly used information from this survey is the resulting rankings. While the rankings may provide a more understandable set of data for the general public, they can be no more accurate than the ratings from which they come. Given the relative consistency of the **ratings** in most cases, the next question is, statistically, "What do the more popularly used **rankings** reveal?"



The next set of graphs, shown in Figures 12-18, show the program rankings for the same set of program groupings as Figures 2-8 did for program ratings. Figure 12 simply shows that the three top rated programs have remained in the same ranking order (1-2-3) over this period. Figure 13 shows, as did Figure 3, that the next three converged to a common ranking over this period. The ranking impact of that convergence is that one of these three programs remained at fourth while another program climbed from ninth to a tie for fourth. Figure 14 represents the rankings for the four programs whose ratings are shown in Figure 4. The program denoted 2006 Rank 8 remained at that rank throughout this period. The program denoted 2006 Rank 7 dropped from rank 4 to rank 7, even though its rating was 3.8 in both 2003 and 2006. The programs identified as 2006 Rank 9(A) and 2006 Rank 9(B) followed very different trajectories from ranking 10 in 2003 to ranking 9 in 2006, with the program denoted 2006 Rank 9(A) dropping to fourteenth in between. Similarly, each of the three programs shown in Figure 15 tied for rank 10 in 2003 (with ratings of 3.3) went to rank 11 in 2006 (with ratings of 3.4), but the program denoted 2006 Rank 11(C) varied from ninth to fourteenth from 2004 to 2005.

Figure 16 shows the rankings of the seven programs whose ratings are shown in Figure 6. This figure shows quite graphically the increasing volatility of the program rankings as one moves further away from the top rankings, with programs that began the period with rankings of either sixteen (four) or twenty (two), having rankings as high as ninth and as low as twenty-second, and then all tying at fourteenth in 2006 rankings (one of which was only ranked in 2006). Perhaps even more dramatically, Figure 17 shows the results for eight programs that ranged from tenth to thirty-third over this period but tied at twenty-first in 2006 (again, one of these is only ranked in the final year), with their wide swings in rankings (one program had a ranking change of 12

positions in one year). Similarly, Figure 18 shows a set of three programs that started at rankings of 20, 25 and 30, ranged from fourteenth to thirty-ninth over this period, and tied for twenty-ninth ranking in 2006.

Corresponding to the rating statistics represented in Figure 9, Figure 19 shows the mean rankings and the ranking standard deviations for these 31 programs over this period. While the 2006 ranking graph shown in Figure 11 is necessarily monotonic non-decreasing, the average ranking in Figure 19 for these programs over the four years (in the 2006 ordering) clearly is not. Indeed, the comparison in Figure 20 of the 2006 rankings with the average rankings over this four-year period clearly shows the variability of the rankings from year to year, especially as the rankings become larger numbers. Both the 2006 rating graph in Figure 1 and the 2006 ranking graph in Figure 11, which are correlated relations, show basis for the increasing volatility of the "lower rating numbers/higher ranking numbers" programs, due to the relative flatness of the respective curves and especially the precisely flat portions.

Figure 12. 2004-2006 Rankings (2006 Rank 1-3)

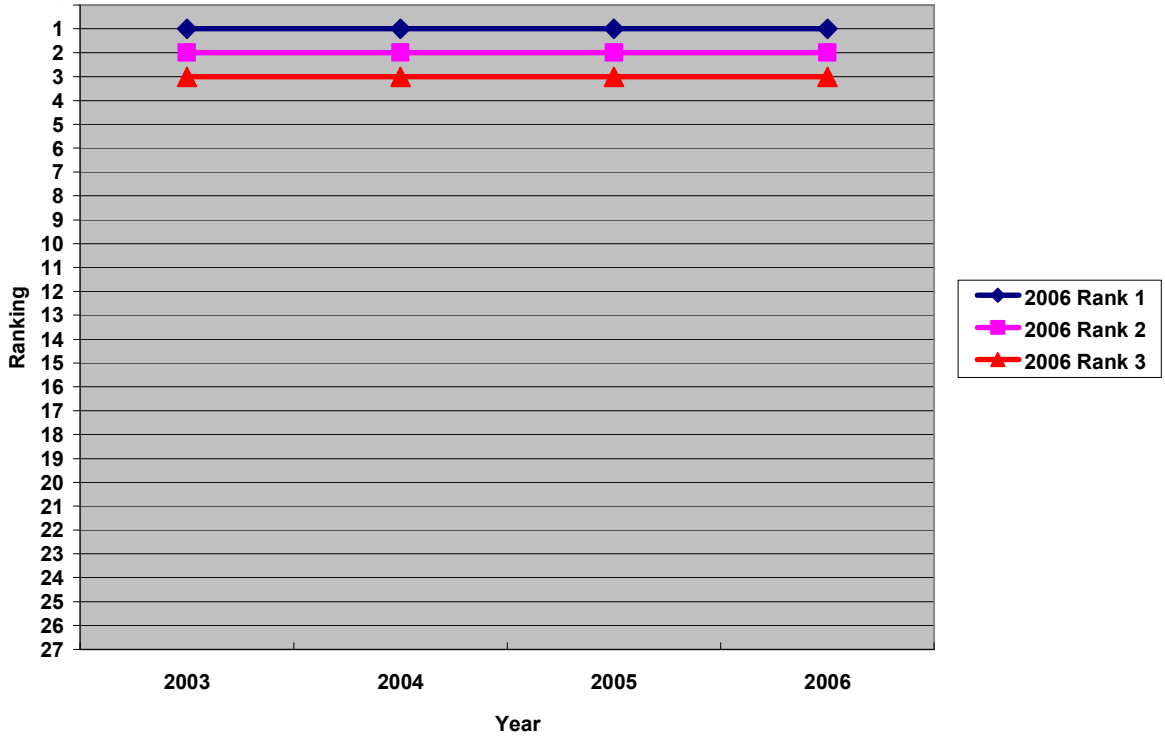


Figure 13. 2004-2006 Rankings (2006 Rank 4(A-C))

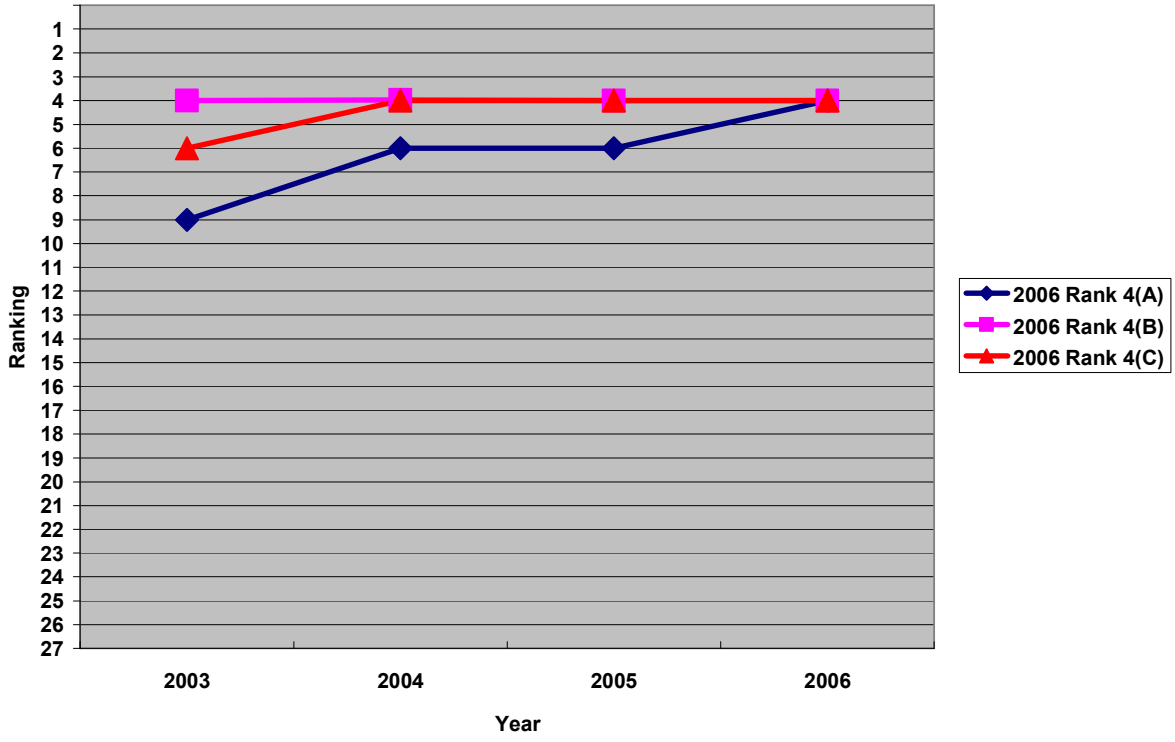


Figure 14. 2004-2006 Rankings (2006 Rank 7-9(A-B))

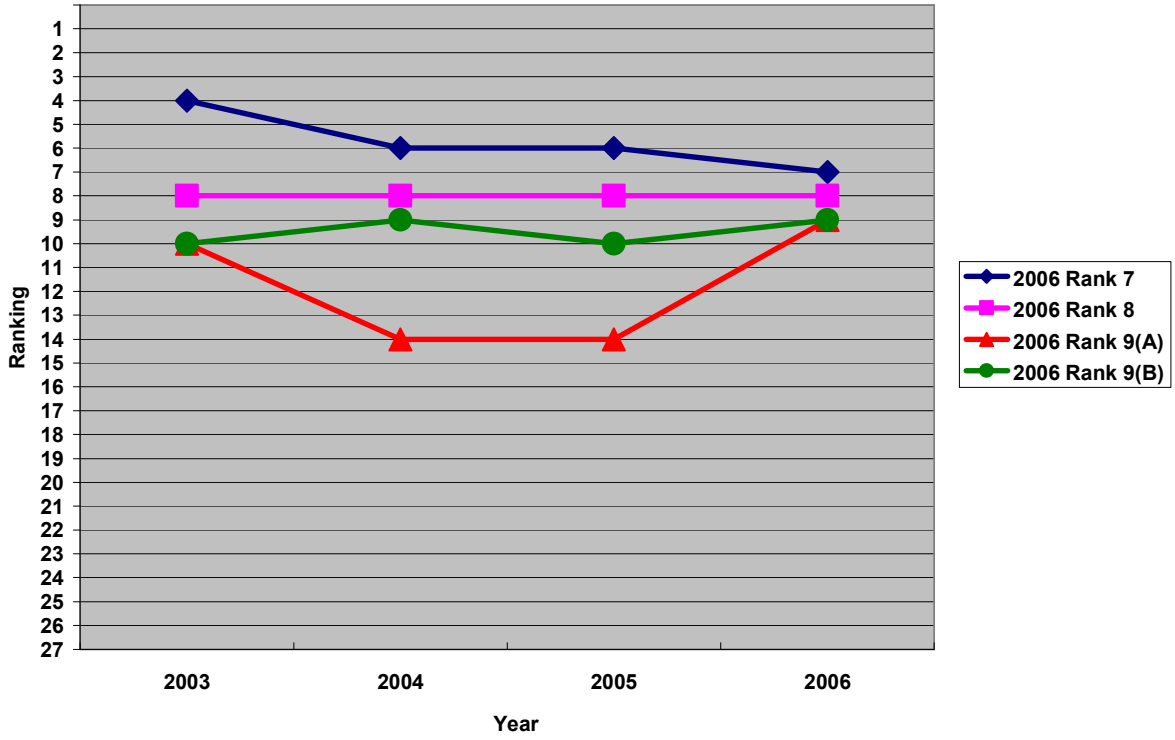


Figure 15. 2004-2006 Rankings (2006 Rank 11(A-C))

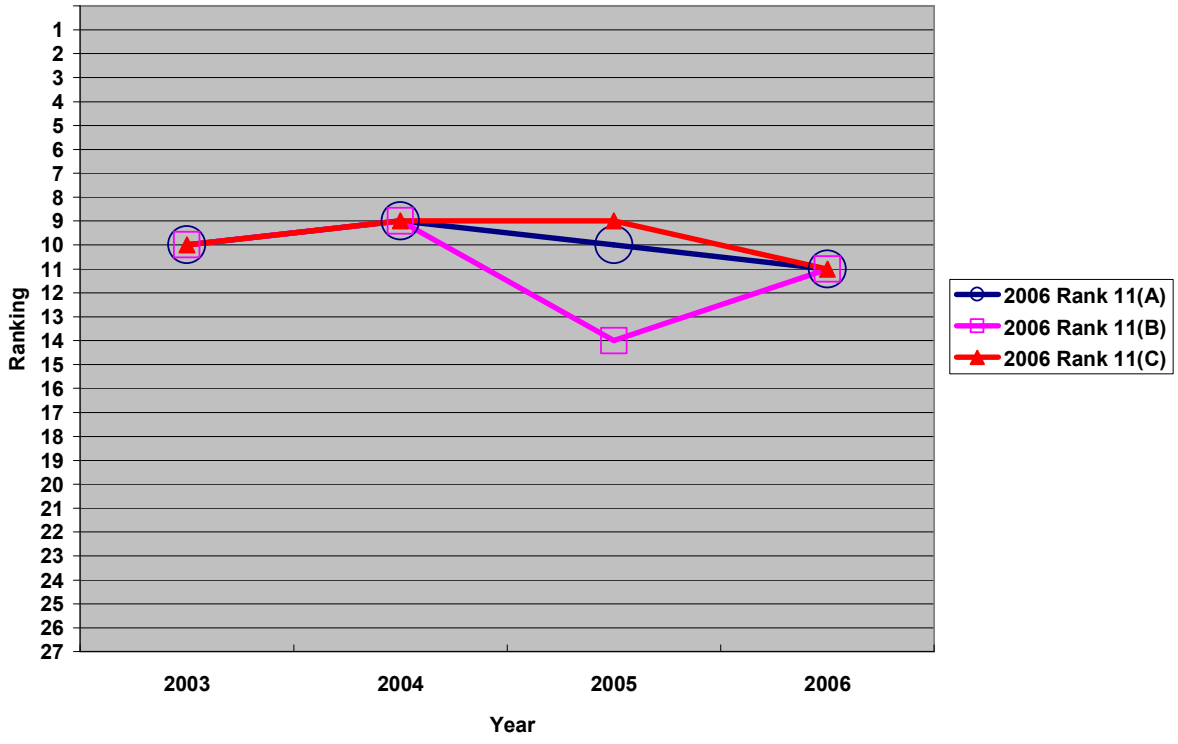


Figure 16. 2004-2006 Rankings (2006 Rank 14(A-G))

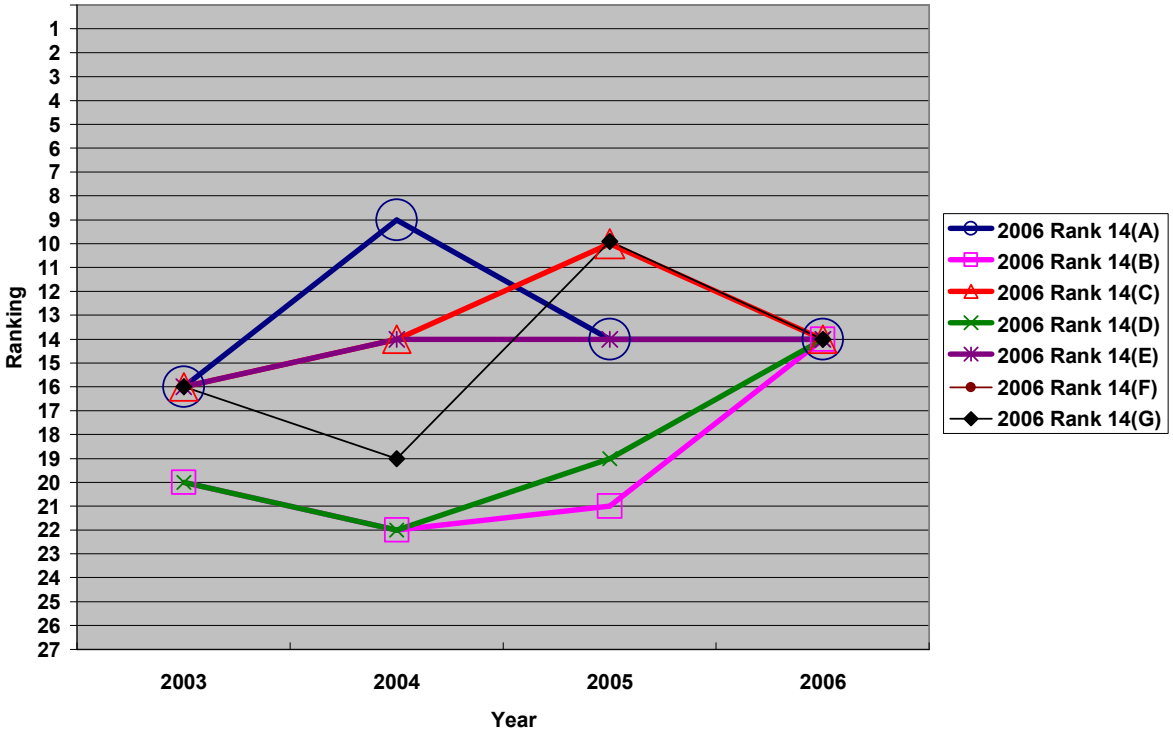


Figure 17. 2004-2006 Rankings (2006 Rank 21(A-H))

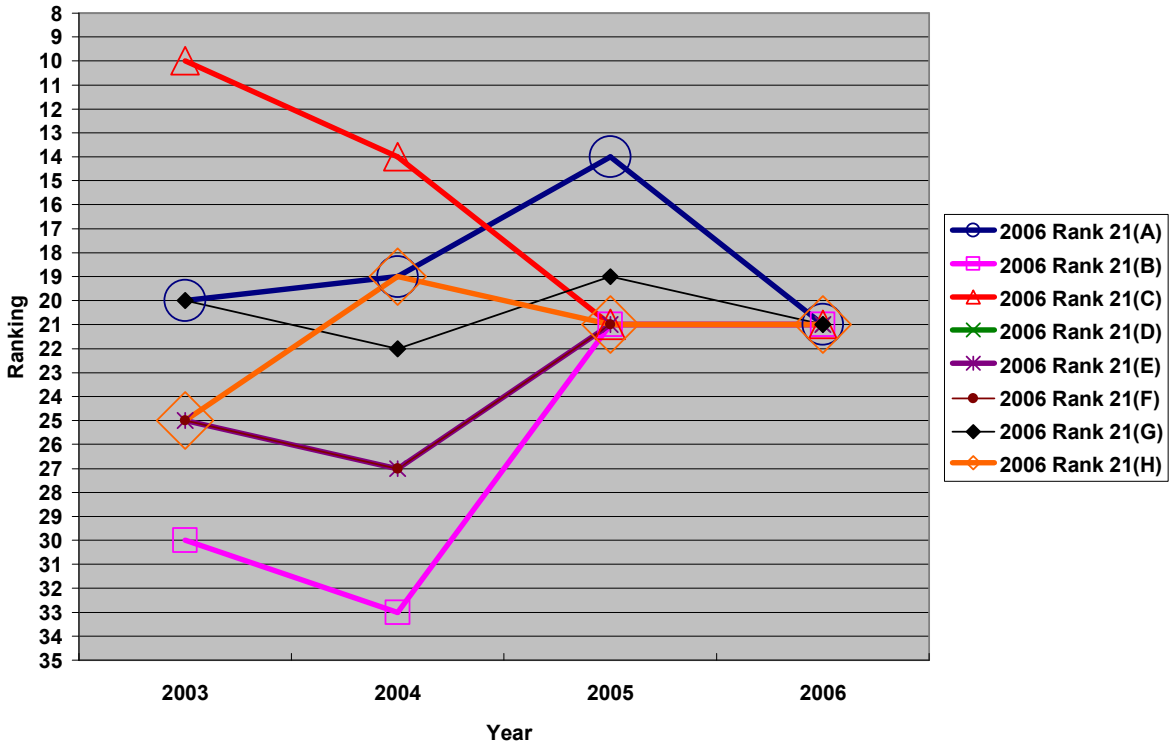


Figure 18. 2004-2006 Rankings (2006 Rank 29(A-C))

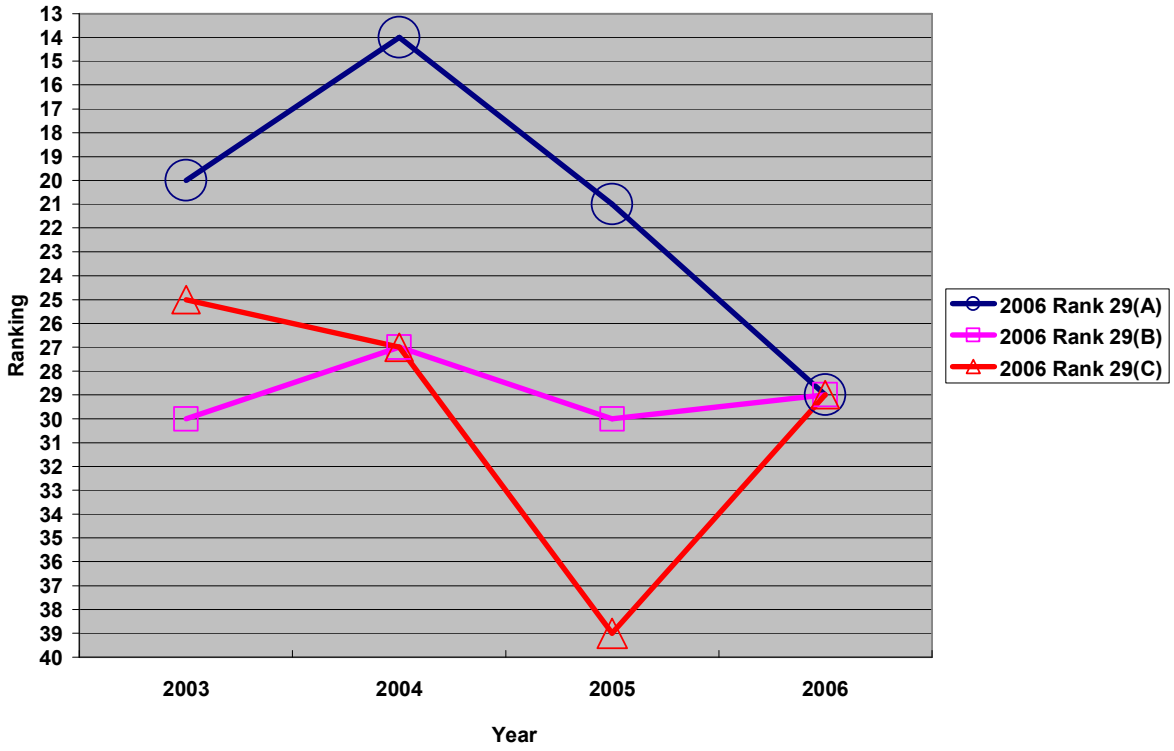
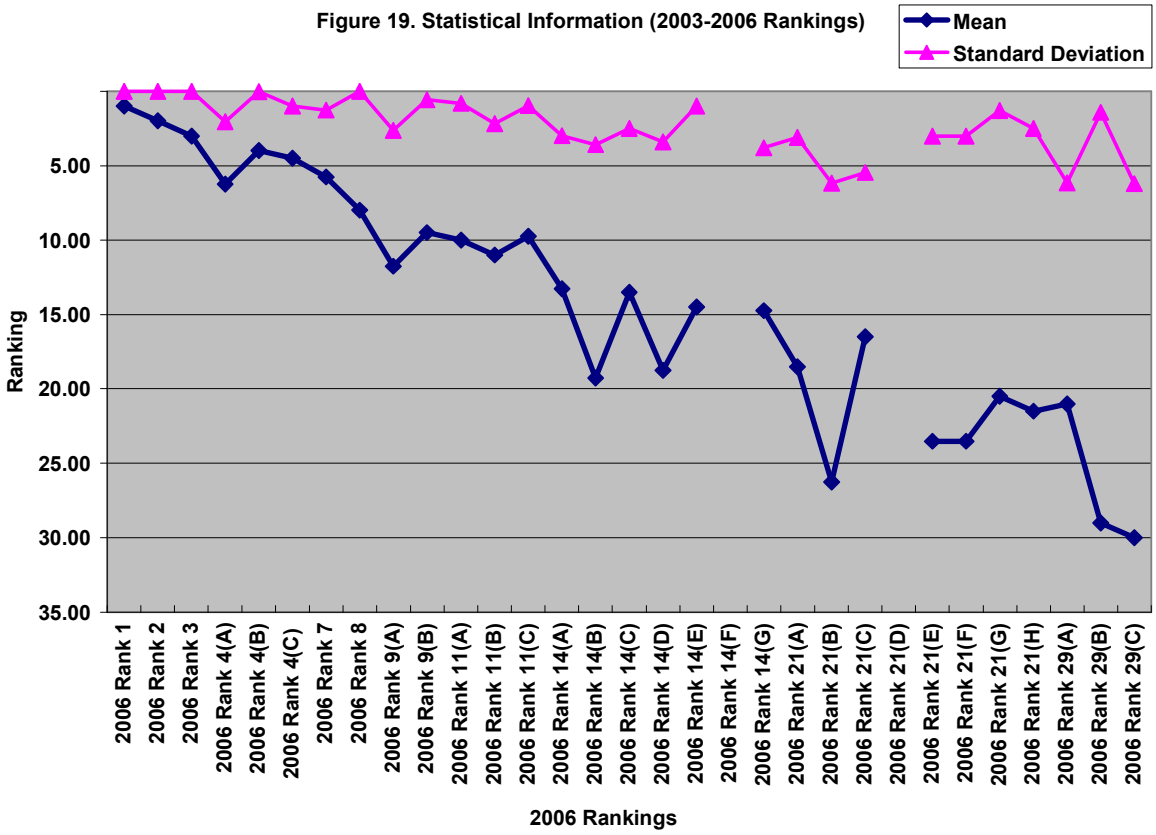
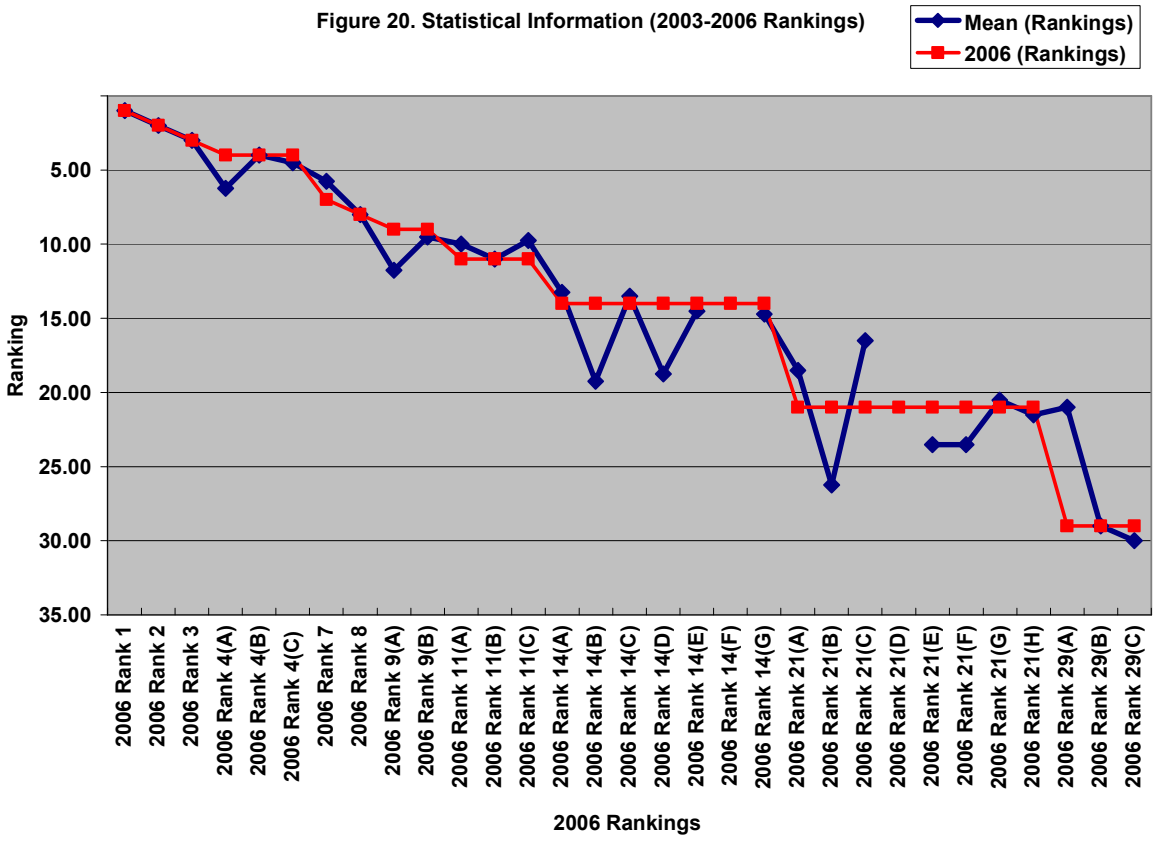


Figure 19. Statistical Information (2003-2006 Rankings)





Summary

The annual U.S. News ranking of engineering programs in institutions without doctoral programs in engineering, based as they are on the individual ratings from 1 to 5 by engineering educators/ administrators, are interesting and likely have some validity. On the other hand, the analysis presented in this paper documents the variability of those ratings and, especially, the rankings from year to year and provides some indications of the degree of variability from year to year. This annual variation is likely due more to the survey procedure than to significant changes in the quality of the respective programs. An interesting study would be to explore whether there are significant public program "events" that could be correlated in time with some of the larger swings in the results of this annual survey.

Bibliography

1. Jim Farison, "Some characteristics of highly ranked programs in the U.S. News &World Report ranking of engineering programs in institutions without doctoral programs," ASEE Annual Conference & Exhibition, (CD-ROM Proceedings, 12 pages), Portland, Oregon, June 12-15, 2005.
2. U.S. News web site, http://www.usnews.com/usnews/edu/college/rankings/about/06engmeth_brief.php, accessed January 18, 2006.

Appendix

Table 1. US News Best Undergraduate Engineering Program Ratings

	2003	2004	2005	2006	Mean	STD1
2006 Rank 1	4.5	4.4	4.4	4.5	4.45	0.06
2006 Rank 2	4.3	4.2	4.2	4.3	4.25	0.06
2006 Rank 3	4.0	4.0	4.1	4.0	4.03	0.05
2006 Rank 4(A)	3.5	3.6	3.7	3.9	3.68	0.17
2006 Rank 4(B)	3.8	3.7	3.9	3.9	3.83	0.10
2006 Rank 4(C)	3.7	3.7	3.9	3.9	3.80	0.12
2006 Rank 7	3.8	3.6	3.7	3.8	3.73	0.10
2006 Rank 8	3.6	3.5	3.6	3.6	3.58	0.05
2006 Rank 9(A)	3.3	3.2	3.2	3.5	3.30	0.14
2006 Rank 9(B)	3.3	3.3	3.3	3.5	3.35	0.10
2006 Rank 11(A)	3.3	3.3	3.3	3.4	3.33	0.05
2006 Rank 11(B)	3.3	3.3	3.2	3.4	3.30	0.08
2006 Rank 11(C)	3.3	3.3	3.4	3.4	3.35	0.06
2006 Rank 14(A)	3.2	3.3	3.2	3.2	3.23	0.05
2006 Rank 14(B)	3.1	3.0	3.0	3.2	3.08	0.10
2006 Rank 14(C)	3.2	3.2	3.3	3.2	3.23	0.05
2006 Rank 14(D)	3.1	3.0	3.1	3.2	3.10	0.08
2006 Rank 14(E)	3.2	3.2	3.2	3.2	3.20	0.00
2006 Rank 14(F)				3.2		
2006 Rank 14(G)	3.2	3.1	3.3	3.2	3.20	0.08
2006 Rank 21(A)	3.1	3.1	3.2	3.1	3.13	0.05
2006 Rank 21(B)	2.9	2.8	3.0	3.1	2.95	0.13
2006 Rank 21(C)	3.3	3.2	3.0	3.1	3.15	0.13
2006 Rank 21(D)				3.1		
2006 Rank 21(E)	3.0	2.9	3.0	3.1	3.00	0.08
2006 Rank 21(F)	3.0	2.9	3.0	3.1	3.00	0.08
2006 Rank 21(G)	3.1	3.0	3.1	3.1	3.08	0.05
2006 Rank 21(H)	3.0	3.1	3.0	3.1	3.05	0.06
2006 Rank 29(A)	3.1	3.2	3.0	3.0	3.08	0.10
2006 Rank 29(B)	2.9	2.9	2.9	3.0	2.93	0.05
2006 Rank 29(C)	3.0	2.9	2.7	3.0	2.90	0.14

Table 2. US News Best Undergraduate Engineering Program Rankings

	2003	2004	2005	2006	Mean	STD1
2006 Rank 1	1	1	1	1	1.00	0.00
2006 Rank 2	2	2	2	2	2.00	0.00
2006 Rank 3	3	3	3	3	3.00	0.00
2006 Rank 4(A)	9	6	6	4	6.25	2.06
2006 Rank 4(B)	4	4	4	4	3.99	0.02
2006 Rank 4(C)	6	4	4	4	4.50	1.00
2006 Rank 7	4	6	6	7	5.75	1.26
2006 Rank 8	8	8	8	8	8.00	0.00
2006 Rank 9(A)	10	14	14	9	11.75	2.63
2006 Rank 9(B)	10	9	10	9	9.50	0.58
2006 Rank 11(A)	10	9	10	11	10.00	0.82
2006 Rank 11(B)	10	9	14	11	11.00	2.16
2006 Rank 11(C)	10	9	9	11	9.75	0.96
2006 Rank 14(A)	16	9	14	14	13.25	2.99
2006 Rank 14(B)	20	22	21	14	19.25	3.59
2006 Rank 14(C)	16	14	10	14	13.50	2.52
2006 Rank 14(D)	20	22	19	14	18.75	3.40
2006 Rank 14(E)	16	14	14	14	14.50	1.00
2006 Rank 14(F)				14		
2006 Rank 14(G)	16	19	10	14	14.73	3.81
2006 Rank 21(A)	20	19	14	21	18.50	3.11
2006 Rank 21(B)	30	33	21	21	26.25	6.18
2006 Rank 21(C)	10	14	21	21	16.50	5.45
2006 Rank 21(D)				21		
2006 Rank 21(E)	25	27	21	21	23.50	3.00
2006 Rank 21(F)	25	27	21	21	23.50	3.00
2006 Rank 21(G)	20	22	19	21	20.50	1.29
2006 Rank 21(H)	25	19	21	21	21.50	2.52
2006 Rank 29(A)	20	14	21	29	21.00	6.16
2006 Rank 29(B)	30	27	30	29	29.00	1.41
2006 Rank 29(C)	25	27	39	29	30.00	6.22