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ABSTRACT

A new, objective measure of departmental performance--rate of publication in key journals--is described and shown to be highly correlated with the American Council on Education (ACE) ratings of quality. Updated rankings of mathematics, physics, and chemistry departments based on this index are presented. The analyses indicate that the ACE rankings favored larger departments, a finding consistent with previous research. In the future, the use of multiple objective indices, including this productivity measure, would insure a more complete profile of the nation's science departments. (Author)

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EVALUATING SCIENCE DEPARTMENTS: A NEW INDEX

by

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The Rand Corporation
Santa Monica, California 90406

The question of quality in graduate education is of broad and continuing importance to the academic world and the scientific community at large, as is evidenced by the attention given to the ratings of graduate departments conducted on two occasions by the American Council on Education (1, 2). These evaluations--based on peer ratings of the quality of graduate faculty--not only have been widely used to establish an academic pecking order but also have become points of reference among federal officials, university administrators, and scientists to infer growth and change in the capabilities of specific science departments. Moderate correlations have been found between the essentially subjective ACE ratings and objective measures of departmental performance. In this paper, we propose a new objective measure of departmental research capability--rate of publication in key journals--and document its unusual success in predicting the ACE ratings. As part of the analysis, updated rankings of mathematics, physics, and chemistry departments are presented. Finally, we discuss the implications of these findings with respect to the strengths and weaknesses of the ACE ratings and suggest that multiple objective indices, including our productivity measure, could serve as an alternative to the existing ratings.

Background

In view of the impressionistic nature of the ACE ratings, it is not surprising that several investigators have addressed themselves to discovering their objective correlates. Indeed, the first of the two ACE studies included some material on the relationship between the ratings and various objective measures. For example, Cartter calculated an "article equivalent **index**" (based **on publication** in five political science journals over a four year period) for each rated political science department and compared it with the department's faculty quality ratings. Though he presents no summary statistics, the curve he obtained in plotting the data closely resembles those found in this study (1, pp. 100-01).

Using data drawn primarily from a questionnaire administered to a large sample of scientists, Hagstrom found that his publication measure (geometric mean per department) and his citation measure were about equally correlated with departmental quality as measured by Cartter, the correlations for publications being slightly higher than those for citations (3). Elton and Rodgers, working with a large subsample of the Cartter-rated departments in mathematics, physics, chemistry, and geology, used a multiple discriminant function analysis to predict the ACE ratings rather successfully on the basis of six variables; they concluded that the ACE ratings confounded quality and quantity in that each of the key predictor variables reflected departmental size in one form or another (4). Still more recently, Beyer and Snipper, working with even smaller subsets of the Cartter-rated departments, achieved very high prediction rates with a pool of 14 independent variables (5). They found substantial differences among fields with respect to the key predictor variables and stated: "No objective measure is linearally, or monotonically, related to the Cartter ratings across fields" (5, p. 541).

The research reported here differs from these previous studies in certain crucial ways. First, they used only some of the Cartter-rated departments in a field; we used all. Second, they used the integer, categorical Cartter values (1, 2, 3, 4, 5); we used the computed mean ratings available from the raw data and thus had access to richer data. Third, they maximized predictability by using multiple regression or discriminant function analysis (i.e., they drew upon many predictors); we focused on only one (a predictor which we found to be monotonically related to the Cartter ratings in the particular fields we studied). Fourth, the previous studies that examined publication rates derived their data from the responses of a sample of the faculty to a questionnaire. We directly counted publication rates in leading journals by all faculty in a department. Finally, we achieved a higher level of predictability than any of the previous studies except for one analysis by Beyer and Snipper. As they themselves acknowledge, however: "This is not particularly impressive because the number of independent variables (11) is still large compared to the sample size (n equals 20 departments per field) (5, p. 550).

This small corpus of research on the objective correlates of the ACE ratings constitutes one part of the background of this study. In addition, an ever-increasing literature within the sociology of science deals with the analysis of publication and citation rates. Publication rates are a straightforward index of productivity, whereas citation rates indicate the impact of an author's publications upon professional colleagues. Studies of these two indices have yielded new knowledge about factors related to scientific productivity and about patterns of communication within the sciences.

In a 1966 assessment of the strengths and weaknesses of the standard citation measure, Bayer and Folger found that the measure correlated significantly with departmental prestige (6). Since then, Jonathan and Steven Cole have carried out a series of studies in this area. For instance, after tracing the publication careers of a sample of scientists, the Coles concluded that citations and publications correlate closely: Those scientists whose early works are heavily cited tend subsequently to publish more than do their colleagues, which suggests that "when a scientist's work is used by his colleagues he is encouraged to continue doing research and that when a scientist's work is ignored, his productivity will trail off" (7, p. 389). They also noted that the correlation between quantity and quality is stronger in the nation's top departments than in the mediocre ones.

In another notable study, the Coles argued that the citation pattern in science indicates that each field is dominated by a relatively small elite who make the major discoveries and who are frequently cited by others (8). This argument stands in opposition to the so-called Ortega hypothesis that progress in science is built on the efforts of a large number of lesser-known researchers. Consistent with the Coles, Diana Crane maintains that scientific progress takes place in a social structure characterized by a small elite (the "invisible college") that plays a key role in the communication of knowledge (9). Similarly, Derek DeSola

Price has advanced the thesis that each scientific field has an "in" group whose thinking and research dominate (10).

Price's work has also led him to believe that "there is a reasonably good correlation between the eminence of a scientist and his productivity of papers" (11, p. 40). In the same book, he discusses some of the implications of Lotka's findings that the rate of production of papers by authors is an inverse square function: That is, for every 100 scholars producing a single paper, 25 produce two papers, 11 produce three, and so forth.

In a Rand Corporation study, Grace Carter (12) used citation information in an assessment of the NIH peer review process. Among her findings: Citations to work performed under an initial grant correlate better with peer judgments on renewal applications than do the original judgments about the initial application.

Thus, the use of citation rates as a proxy for quality (whether of individuals, departments, or journals) is a notion that has been endorsed by the Coles, Kenneth Clark (13), and Bayer and Folger (6). In the present study, however, the time lag involved in citations effectively ruled out the direct use of citation rates as an index of departmental prestige; instead, they were used as the basic criterion for selecting the key journals in each field we investigated. In view of our focus on quality, we felt it would be a mistake to analyze faculty productivity simply by looking at publication in the full array of scientific journals; rather, it made more sense to look at publication in leading, most often cited, journals in each field. The body of literature on citation rates supports the notion that faculty productivity, as measured by rate of publication in these same leading journals, could be an important indicator of quality, one that would correlate highly with many other measures of individual and departmental excellence (14).

Methods

The analysis reported here are based on a data file created while the authors were with the National Board on Graduate Education in Washington, working on an evaluation study of the National Science Foundation's Science Development (SD) program (15). This funding program, which had as its twin goals a dramatic upgrading in the science capabilities of second-tier universities and a wider geographical distribution of scientific talent throughout the nation, awarded over $230 million to selected universities during the 1960s. To assess the program's impact, the evaluation study used quantitative analyses of longitudinal data, supplemented by site visits (16).

In isolating the unique effects of SD, several technical decisions were made at the outset. First, wherever possible, the data gathered covered the 15 years from 1958 through 1972. Second, all (nonfunded) doctorate-producing universities in the country were used as controls. Third, the three science fields that received the largest share of SD funds--mathematics, physics, and chemistry--were analyzed, as was the nonfunded control field of history. Finally, to operationalize the concept of science quality and to characterize departments in American graduate schools, the following multiple indicators (i.e., multiple criteria) were used:

1. Faculty size
2. Faculty research productivity (publication rates)
3. Graduate student enrollment size
4. Graduate student quality (test scores and baccalaureate origins)
5. Ph.D. production
6. Characteristics of institutions at which Ph.D.'s got their first jobs.

In short, as a result of the technical decisions just described, we developed a data base, which included information on each of the above measures covering a 15-year period, on all departments rated by Roose and Andersen in the disciplines we studied.

Cartter, in the initial ACE survey, produced departmental rankings both of faculty quality (research) and of effectiveness of the graduate program (teaching). Our research focused on the former--research capabilities of the faculty--which also drew most attention from other researchers and administrators. The relative neglect of teaching quality in the literature is deplorable but reflects in part the lack of a good objective measure of teaching effectiveness. We will discuss below some of the implications of the emphasis on research; in addition, our analyses included a crude attempt at measuring the impact of the faculty on graduate students.

Our measure of research productivity was the publication rate of faculty in leading journals in each field. About 20 journals per field were used. They were selected in the following way.

In 1969, the Institute of Scientific Information, Inc. (ISI), a commercial firm in Philadelphia, rank-ordered 1,000 leading journals in science both by number of publications and by number of citations. A third ranking, more closely suiting the needs of our research, took into consideration an "impact factor": the ratio of citations to source articles. Thus, journals ranking high on this list were those whose articles were most frequently cited, indicating that the impact of an article in that journal would be great.

Between acquiring the ISI list and selecting the journals for our analyses, a number of more finely tuned decisions were required. For instance, we decided to eliminate from consideration foreign language journals, as well as English language periodicals published in countries other than the U.S., Canada, Great Britain, and Holland, and to include multifield journals, assigning an equal impact factor for both fields. Inhaber, in his study of physics journals, relied on citation rates provided by ISI to select key journals but took the opposite route: including foreign language periodicals and excluding multifield periodicals (17). In addition, abstracts and bibliographical journals were excluded, as were journals that began publication after December 31, 1962. The impact factor for English language journals published outside the U.S. was adjusted to reflect the percentage of American authors publishing in the journal (18).

Once the key journals in mathematics, physics, and chemistry had been selected, our next task was to examine the rate at which faculty published in these journals during the period 1958 through 1972. The sources involved both data from magnetic tape provided by ISI and data retrieved clerically from journals in libraries.

The ISI data were available for the period 1965 through 1972. The ISI retrieves considerable information about each article published in each significant science journal every year and from this information develops several files: a source file, a citation file, and--most relevant to this study--a "corporate index" file, which records the institutional affiliation (or "corporate address") of the author. A corporate address is entered into the file just once for each article, even if more than one of the authors came from that institution. The file is, of course, sorted by corporate address. Thus, by analyzing the corporate addresses, we were able to count the total number of articles published in influential journals each year by faculty at each institution. This count constituted our basic measure.

Data for the earlier years (1958-1964) had to be collected by simply going through journals in libraries. To assure strict continuity, library retrieval was carried out in conformance with the somewhat idiosyncratic procedures used by ISI.

Results

The basic analytic technique consisted of simply computing linear correlations between our objective index--faculty publication rate--and the Cartter ratings of faculty quality. Mathematics was the pilot field for all analyses. Replication over time was possible with the Roose-Andersen ratings; replication across fields provided a further test of the strengths of the relationships uncovered. To learn whether it would be efficacious to develop journal clusters, a factor analysis of the publication data was carried out.

First, the correlations of publication in specific mathematics journals with the Cartter ratings for mathematics departments were studied. Table 1 lists the 20 math journals selected for this research along with their correlations, by year, with the Cartter ratings. Note that the strength of the relationship exhibited varies considerably from journal to journal, the highest correlation in a given year being with either the Bulletin or the Transactions of the American Mathematical Society. In fact, one could predict fairly accurately the ACE math ratings using only one of these two journals.

Table 1 also shows the correlations, by year, of the Cartter ratings with the sum of publications in all 20 journals. This index was calculated simply by adding the counts from each of the separate journals. This procedure increases the predicitive accuracy somewhat.

Additional analyses revealed that the correlation produced by combining five selected journals, or ten, would be either smaller or somewhat greater than that for all 20 combined--depending on which journals happened to be selected. A case can be made, however, for using all 20 journals in that this provides a more stable measure than does a combination of five or ten. In addition, the more journals used, the more likely a given department will have an entry. When only one or two journals are considered, many departments are unrepresented: i.e., the curve is greatly skewed toward zero. The larger journal sample also compensates for the proclivity of some university departments toward publication in certain journals.

Expanding the number of years considered results in a further improvement in prediction. The final column of Table 1 presents the correlation between the Cartter ratings and each journal summed over the four years (1960-1963) and ends with a comparable figure for the sum of the 20 journals. The correlation for each journal is improved noticeably by the use of this "journal tally"; for instance, the correlation for the Bulletin of the American Mathematical Society is now .85. The correlation of all 20 journals summed over the four years is .87, a further improvement over the figures for each year separately.

Since the journals had been selected on the basis of their impact factor--i.e., citations per article--we hypothesized that the predictions would be improved dramatically if each journal tally were weighted by this factor (as opposed to a simple sum, with an implied weight of 1 per journal). This hypothesis proved false: Such a weighting slightly increased the predictive power (to .88). The key factor in predicting the ACE ratings appears to be the sheer bulk of publications, a fact which militates against increasing the prediction through any *a priori* weighting procedure. (We shall have more to say about the implications of this finding.)

In a final search for the best method of weighting individual journals, a special factor analysis, using the four-year tallies for each journal, was performed. The factor analysis of these 20 items yielded three factors. The first accounted for most of the variance and was the only one which correlated strongly with the ACE ratings. The eigenvalue and eigenvector for this factor are presented in Table 2. Note that the factor loadings are roughly equivalent, further evidence that equal weights are about as effective as any other measure. In fact, the factor scores based on this analysis correlated .99 with the scores computed by simply summing all 20 journals. As might be expected, the factor scores produced no improvement in the correlation (.87) with the ACE ratings. Thus, this analysis further substantiated the finding that weighting each journal did not significantly improve the prediction.

The graph shown in Figure 1 was produced by plotting the journal data (the sum of the 20 journals summed over the four years) against the Cartter ratings. Inspection of Figure 1 indicates that the relationship was essentially nonlinear. Further, it is clear that this was an inverse exponential curve due, in part, to the ceiling imposed by the Cartter ratings (a score of 5 being the highest possible). That is, the curve took the form: $x_2 = 5 - 5e^{-bx_1}$ (where x_2 = the ACE rating and x_1 = the number of publications). Applying this transformation to linearize the data (see Figure 2), we find one final improvement in the predictability: A correlation of .91 is now achieved (19).

Table 3 presents comparable data for physics and mathematics. Table 4 shows the results of using publication information for the years 1965 through 1968 to predict the Roose-Andersen ratings. Note that both these replications prove the robustness of this productivity measure as a predictor of the ACE ratings.

For substantive reasons, the focus of our analysis has been on the productivity measure, but the Science Development Study also yielded a number of other indices of departmental excellence. In Table 5, the correlations of some of these other indices with the ACE ratings are presented. Note that two of the measures, federal science support to the institution and Ph.D. production, also correlate highly with the ACE ratings.

Given the size of the relationships uncovered and their demonstrated robustness, a strong case could be made for using the most recent publication data available to predict what the departmental rankings would have been if the ACE had undertaken another survey in 1973. Tables 6-8 show the results of this analysis. To maintain comparability from 1964 to 1969 to 1973, only the departments ranked by Cartter are included. Thus, many departments that have achieved excellence during the past decade (e.g., the Mathematics Department of Rockefeller University) are not represented here. On the tables, departments in each of the three fields are listed according to their final (predicted) rankings; then, the actual ACE scores and rankings are shown, followed by the publication count (total from the 20 journals summed over the four preceding years), and the predicted scores and ranks.

Discussion

The results reported here would certainly seem to refute those critics who have charged that the ACE ratings, being strictly subjective, bear no relation to objective reality. The correlations of the ACE ratings and our publication index, as well as other measures developed for the Science Development study, indicate that the ACE ratings provide a fairly accurate index of some kinds of quality.

Why does our publication index yield much higher correlations with the ACE ratings than did the publication measures of previous researchers such as Hagstrom? We believe the most plausible explanation is as follows: When scholars in the field assess the quality of faculty in other departments, they do so on the basis of a generalized halo effect which is a function of their having noted the department referenced a number of times in a high-quality context. Thus, a mathematician who sees the University of Michigan given as the institutional affiliation of the author of an article in the Bulletin of the American Mathematical Society is likely to elevate his assessment of that department a bit, albeit subconsciously. If, on the other hand, he sees the author and department listed in a rather obscure journal with a poor reputation, he does not raise his subjective judgment of the department.

One point should be underscored: Although the initial judgment of a department's excellence depends on its being referenced in a quality arena, once having entered that arena, the institution's reputation seems to grow cumulatively: i.e., quantitatively, with no further quality assessments being made. This point is supported by our failure to achieve higher predictability through weighting the journals with an impact factor or by factor analysis. The thrust of our findings was that, given a set of journals defined as being of high quality, the way to maximize correlations with the subjective ACE ratings was simple accumulation--across journals and across years--not further refinement on the basis of quality. In short, the ACE ratings are not a pure quality measure but are contaminated by quantity, a conclusion consistent with the previous Elton and Richards findings (20).

As further evidence of this point, when publications per faculty member, as opposed to overall departmental publication rate, was used as a predictor, much lower correlations resulted. That is, a hypothetical department of 50 people who produced two articles each would receive a much higher ACE rating than another hypothetical department of five people who produced ten articles each. Thus, the ACE ratings seem to confound quality with departmental size so that a larger department is likely to receive a higher rating than a small department of comparable quality (21).

Currently, the issues of measuring quality and of finding appropriate indices for departmental evaluation are much debated in graduate education circles. Under funding from the National Science Foundation, the Council of Graduate Schools is trying to develop possible measures of excellence. We believe that assessing graduate programs by means of multiple objective indices would be of much more value than current procedures, both in terms of defining an academic pecking order and in terms of providing output measures for research. In particular, we feel that the results yielded by our publication index warrant its inclusion, as an objective measure of the scholarly productivity of academic departments, in any such set of objective indices.

Although our measure predicts the ACE ratings well, it can be argued that rankings based on per-person productivity would provide a measure of research quality less contaminated by faculty size. Moreover, as we shall discuss below, measures of the departmental environment as experienced by the students are greatly needed.

Much could be learned by computing productivity ratings for every major academic field. Not only would such an effort update the ACE ratings, but also it would allow investigation of a host of methodological and substantive problems which must be explored if such ratings are to be used in the future. Among those questions: Is a productivity index based on publication in key journals as appropriate for the social sciences, where much of the scholarly output is in book form, as it is for the natural sciences? What time lag is necessary to detect the impact of major changes in a department's structure upon ratings of quality? What mathematical functions best describe the relationships between productivity and prestige in each field?

A final comment about teaching: Many people would argue that the raison d'être of graduate education is to educate graduate students. While research productivity is vital to the nation and to higher education, the relative disregard that many graduate educators manifest toward their students is deplorable. Ideally, any evaluation of graduate programs would include an objective measure of faculty's teaching performance. (As noted earlier, both the Cartter and the Roose-Andersen volumes did include departmental ratings based on a (subjective) measure of the effectiveness of the graduate program.) As a final analysis, we constructed an indirect objective measure of teaching performance, using data that had been assembled for possible use in the Science Development study. Mathematical Abstracts from two years (1965 and 1966) were searched to locate all publications by Ph.D.'s from Cartter-rated mathematics departments in 1964. Then, measures of total publications per department (by 1964 Ph.D.'s) and of publications per person were constructed. In short, we created an index based on the assumption that those departments with the most effective teaching programs would produce graduates who, after receiving their Ph.D.'s, had higher publication rates. The correlations of each of these two measures with the ACE ratings were lower than those reported above (22). In addition, the overall department measure yielded a much higher predictive correlation (.710) than did the per-person measure (.133), again underscoring the importance of quantity as opposed to quality in the ACE ratings.

To repeat: assessment of graduate education should include some measure of how well graduate students are educated. Our results indicate that it is much easier to predict the ACE ratings from research measures than from an index of teaching effectiveness. We must admit, however, that even our "education index" has a research component built in, of necessity, and that this contamination is unfortunate. After all, many well-educated and productive Ph.D.'s choose to focus on teaching and thus do not publish research articles.

Perhaps the strongest need in the assessment of graduate education is for a useful measure of teaching performance which is objective and comparable from institution to institution.

Summary

A new, objective measure of departmental performance--rate of publication in key journals--has been described and shown to be highly correlated with the ACE ratings of quality. Updated rankings of mathematics, physics, and chemistry departments based on this index have been presented. Our analyses indicate that the ACE rankings favored larger departments, a finding consistent with previous research. In the future, the use of multiple objective indices, including this productivity measure, would insure a more complete profile of the nation's science departments.

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12. G. M. Carter, *Peer Review, Citations and Biomedical Research Policy: NIH Grants to Medical School Faculty* (The Rand Corporation, Santa Monica, 1974).
13. K. Clark, *American Psychologists: A Survey of a Growing Profession* (American Psychological Association, Washington, D. C., 1957).
14. Citation measures have sometimes been criticized, usually on the following grounds: They fail to differentiate between favorable and unfavorable citations; researchers sometimes attempt to generate a "halo" effect by citing the major names in their field rather than the lesser-known people whose work may actually be more directly linked to their own; some profound work that has had a powerful

effect on all subsequent research is so taken for granted that scientists often do not bother to cite it.

15. The Science Development Study was supported in its entirety by the evaluation unit of the National Science Foundation under contract C310, task order 263. Drew was project director of the study; Karpf was project programmer. We are indebted to the other project staff members who contributed to this current effort--Margo Jackson, Edward Dolbow, Marilyn Block, James Bliffen, and Carol Cini--and to the professional colleagues--William Commins, Bernard Khoury, Charles Kidd, and John Millett--who commented on early drafts of this paper, which was edited by Laura Kent.

16. For a complete description of the study, see D. E. Drew, Science Development: An Evaluation Study (National Academy of Sciences, Washington, D. C., 1975).

17. H. Inhaber, Physics Today 27, 39 (1974).

18. For a complete discussion of these technical decisions, see Appendix B of Drew, 1975. The journals selected in each field are also listed in that Appendix, along with associated statistics on their citation rate, impact factor, number of source articles, etc. Use of the ISI citation file involved some additional technical problems. For example, because of the structure of those files, work by two scientists with the same last name and first initial are indistinguishable.

19. An alternative method of linearizing the relationship between the ACE ratings and the publications was to regress the ratings on the counts for each of the 20 journals. This 20 variable regression yielded a multiple correlation coefficient of .928 (with, of course,

a corresponding loss of 20 degrees of freedom). Since the goal of these analyses was to shed light on substantive relationships, not merely to inflate the correlation through statistical games, there is little to recommend 20 variable regressions in predicting the ACE ratings for other years and other fields.

20. This observation probably explains why some departments universally considered excellent and located in prestigious (private) universities are ranked comparatively low by our methods. While the per-person productivity is probably very high, these private elite universities grew at a slower rate than their public competitors; thus, to the degree that professional visibility is a function of size, their rating will have decreased during the period.

21. Since many journals do not give departmental affiliations of authors, strictly speaking these counts reflect publication rates in leading journals by all scholars in an institution. For example, the publication count in mathematics for Princeton might include not only faculty in the mathematics department but also scholars elsewhere in the University (e.g., the statistics department) who publish an article in one of these key journals. Had it been possible to limit the counts to those officially listed as faculty in the mathematics department, the correlations reported here might have been higher. But more likely they would have been lower, since an observer's rating of the department at Princeton would probably go up when he noted Princeton referenced in a leading journal, whether or not the author was actually housed in that department. This can be viewed as part of the "halo" effect discussed in connection with the ACE ratings.

22. Two methodological caveats should be made. First, we were limited in this analysis to use of the ACE "faculty quality" rating and were not able to employ the ACE "graduate program" score. However, the two ACE ratings are highly correlated, probably reflecting a "halo" effect. Second, our results might have been different had we acquired data on publications by recent Ph.D.s in a time period longer than two years.

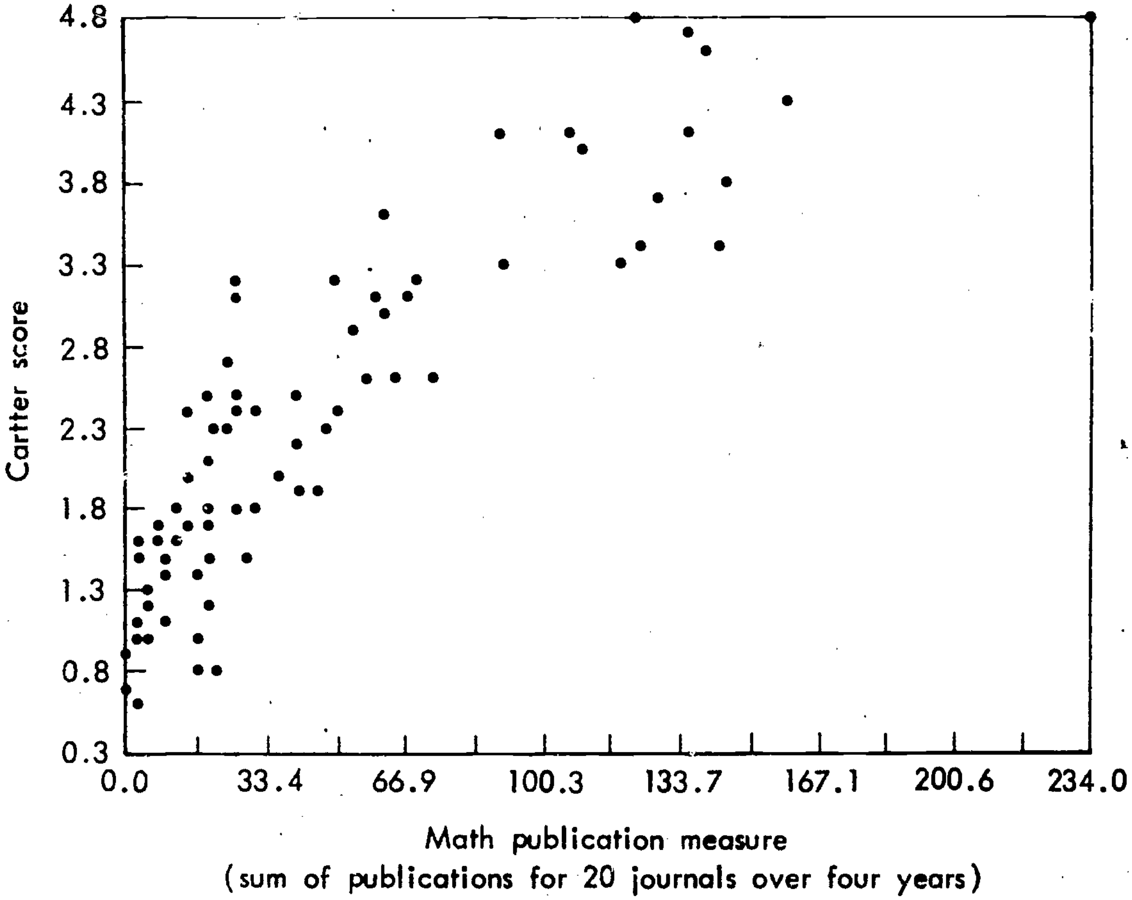
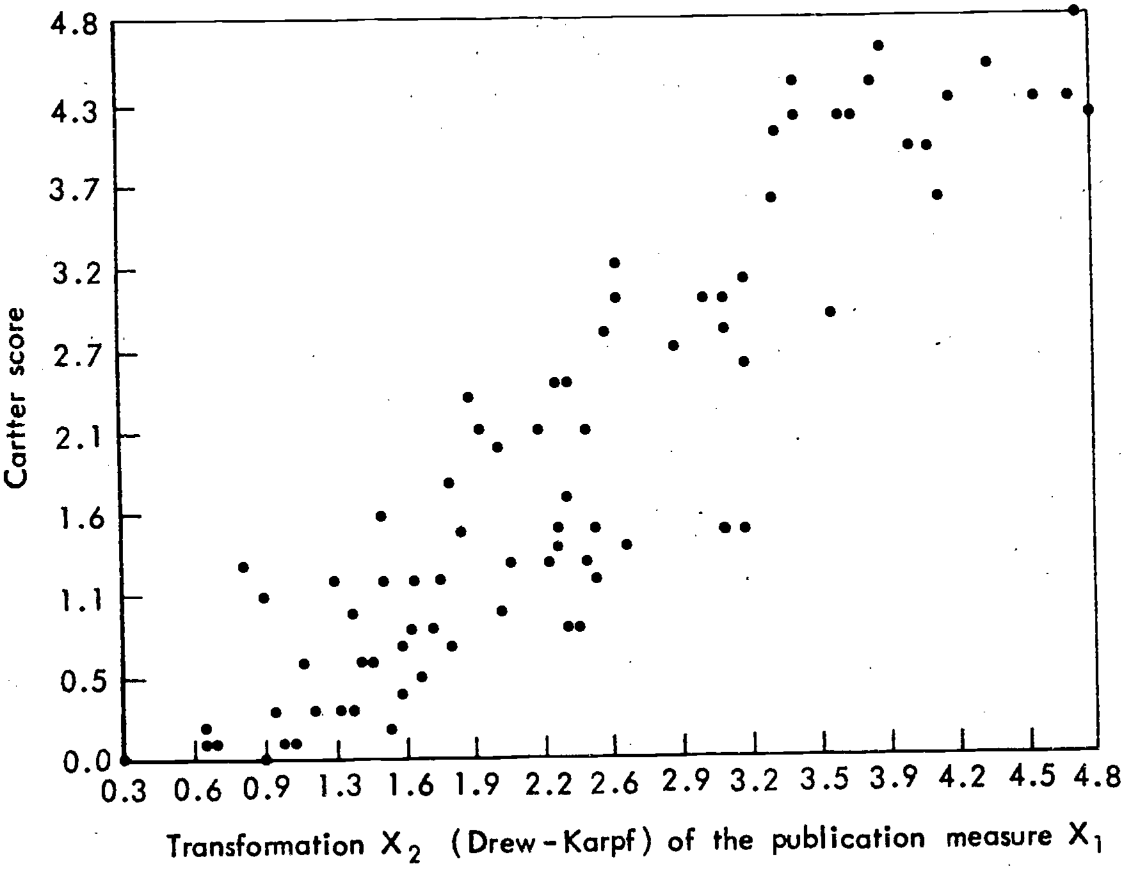


Fig. 1—Plot of Cartter ratings vs. publication index



$X_2 = 5 - 5e^{-bX_1}$, with parameter b = 0.014225

Fig. 2—Plot of Cartter ratings vs. transformed publication index

Table 1

CORRELATIONS OF PUBLICATION IN SPECIFIC MATH JOURNALS
WITH THE CARTTER RATINGS

	Journal	1960	1961	1962	1963	Sum[2]
1	American Journal of Mathematics	.54	.49	.56	.61	.72
2	Annals of Mathematics	.53	.57	.65	.64	.65
3	Annals of Mathematical Statistics[1]	.46	.51	.39	.56	.52
4	Journal of the American Statistical Association	.45	.42	.41	.32	.49
5	Archives of Rational Mechanics and Analysis	.42	.29	.41	.36	.42
6	Biometrika	.06	.14	.32	.25	.30
7	Bulletin of the American Mathematical Society	.59	.67	.74	.74	.85
8	Communications on Pure and Applied Mathematics	.36	.43	.20	.33	.51
9	Duke Mathematical Journal	.29	.14	.29	.53	.37
10	Illinois Journal of Mathematics	.58	.46	.58	.54	.65
11	Indiana University Math Journal	.55	.57	.48	.42	.59
12	Journal of Math Analysis and Applications	.40	.55	.45	.49	.65
13	National Bureau of Standards Journal	.05	.05	-.03	.05	.05
14	Mathematics of Computation	-.02	-.03	.12	.04	.03
15	Michigan Math Journal	.29	.17	.29	.38	.34
16	Pacific Journal of Mathematics	.47	.53	.58	.49	.62
17	Proceeding of the American Math Society	.59	.60	.67	.61	.74
18	Transactions of the American Math Society	.73	.65	.78	.72	.81
19	Technometrics	.23	.22	.23	.21	.28
20	Applied Scientific Research	.29	.07	.19	.16	.24
	Sum of 20 Math Journals	.84	.82	.86	.86	.87

[1] Also includes total from Annals of Probability and the Annals of Statistics.

[2] Sum is the sum for each journal over the 4 years 1960 through 1963.

Table 2

FACTOR ANALYSIS OF INDIVIDUAL JOURNAL DATA

SUMMED OVER FOUR YEARS

	Journal	Eigenvector Number 1
1	American Journal of Mathematics	0.29
2	Annals of Mathematics	0.25
3	Annals of Mathematical Statistics	0.23
4	Journal of the American Statistical Association	0.22
5	Archives of Rational Mechanics and Analysis	0.17
6	Biometrika	0.20
7	Bulletin of the American Mathematical Society	0.33
8	Communications on Pure and Applied Mathematics	0.21
9	Duke Mathematical Journal	0.12
10	Illinois Journal of Mathematics	0.27
11	Indiana University Math Journal	0.23
12	Journal of Math Analysis and Applications	0.28
13	National Bureau of Standards Journal	0.01
14	Mathematics of Computation	-0.01
15	Michigan Math Journal	0.16
16	Pacific Journal of Mathematics	0.24
17	Proceeding of the American Math Society	0.29
18	Transactions of the American Math Society	0.32
19	Technometrics	0.14
20	Applied Scientific Research	0.10

Eigenvalue Number 1 = 7.695

Table 3

CORRELATIONS BETWEEN THE CARTTER RATINGS AND SUM OF (20) JOURNALS FOR INDIVIDUAL YEARS AND FOR THE SUM OF FOUR YEARS

	1960	1961	1962	1963	60-63
Math	.84	.82	.86	.86	.87
Physics	.80	.83	.84	.84	.84
Chemistry	.84	.82	.80	.76	.86

Table 4

CORRELATIONS BETWEEN THE ROOSE-ANDERSEN RATINGS AND THE SUM OF (20) JOURNALS FOR INDIVIDUAL YEARS AND FOR THE SUM OF FOUR YEARS

	1965	1966	1967	1968	65-68
Math	.78	.70	.75	.71	.76
Physics	.80	.82	.84	.84	.83
Chemistry	.86	.81	.87	.83	.87

Table 5

CORRELATION OF OTHER OBJECTIVE INDICES OF DEPARTMENTAL QUALITY WITH THE CARTTER RATINGS

	Cartter Ratings
Federal Science Aid to Universities[1]	.769
Ph.D. Production[2]	.726
Graduate Enrollment[2]	.452
Faculty Size[3]	.327
Sum of 20 Journals[2]	.872

[1] Measured in 1963

[2] 1960-1963

[3] 1958, 1962

Table 6

DEPARTMENTAL RANKINGS: MATHEMATICS

	1964					1969					1973		
	Cartter			Drew-Karpf		Roose-Andersen			Drew-Karpf		Drew-Karpf		
	Score	Rank	Publ. 1960-63	Score	Rank	Score	Rank	Publ. 1965-68	Score	Rank	Score	Rank	Publ. 1969-72
Wisconsin	3.88	10	176	3.53	2	4.00	9	271	4.24	2	4.54	1	341
Cal Berkeley	4.81	2	233	4.02	1	4.88	1	354	4.58	1	4.44	2	314
UCLA	3.46	16	123	2.88	11	3.72	14	210	3.84	3	4.34	3	291
Illinois	3.74	12	128	2.95	9	3.80	12	202	3.78	4	4.28	4	278
Michigan	3.85	11	141	3.13	5	3.88	11	182	3.59	5	3.79	5	203
Purdue	3.14	22	66	1.84	20	3.32	21	171	3.48	7	3.74	6	198
Minnesota	3.47	15	142	3.14	4	3.47	19	180	3.58	6	3.58	7	180
NYU	4.10	8	108	2.65	15	4.11	8	135	3.05	11	3.50	8	173
Mich State	2.40	36	49	1.45	27	2.74	30	79	2.12	20	3.48	9	171
Rutgers	1.95	47	40	1.22	31	2.56	38	65	1.82	27	3.42	10	165
Stanford	4.19	6	134	3.04	8	4.25	6	164	3.41	8	3.40	11	163
MIT	4.38	5	161	3.37	3	4.52	5	129	2.97	12	3.38	12	162
Cornell	3.70	13	128	2.95	9	3.79	13	137	3.08	10	3.32	13	156
Wash Seattle	3.38	17	119	2.82	13	3.51	18	159	3.35	9	3.22	14	148
Fla State	1.84	50	31	0.97	35	2.28	48	81	2.16	19	3.14	15	142
Chicago	4.60	4	140	3.12	6	4.62	4	73	1.99	25	3.08	16	137
North Carolina	2.60	28	73	1.99	18	2.52	41	102	2.55	17	2.97	17	129
Northwestern	3.20	21	70	1.93	19	3.23	22	75	2.04	23	2.94	18	127
Yale	4.13	7	90	2.33	16	4.15	7	114	2.74	15	2.85	19	121
Carnegie-Mellon	2.33	39	45	1.35	29	2.51	42	52	1.52	31	2.71	20	112
Cal Tech	3.65	14	59	1.69	23	3.61	15	74	2.02	24	2.69	21	111
Virginia	3.12	24	26	0.83	38	3.21	24	47	1.40	34	2.65	22	108
Indiana	3.02	25	63	1.78	22	3.06	25	40	1.22	40	2.65	22	108
Princeton	4.78	3	136	3.06	7	4.77	3	129	2.97	12	2.60	24	105
Florida	1.82	51	12	0.40	62	1.96	56	28	0.89	56	2.56	25	103
Kentucky	1.30	67	5	0.17	69	2.00	55	1	0.03	79	2.56	25	103
Louisiana St	1.86	49	26	0.83	38	2.42	43	54	1.57	30	2.55	27	102
Maryland	2.88	26	50	1.47	26	2.92	26	103	2.56	16	2.48	28	98
Missouri	1.61	57	12	0.40	62	1.80	63	40	1.22	40	2.40	29	97
VPI	0.84	77	21	0.68	46	1.02	76	38	1.16	45	2.39	30	93
Penn State	2.33	39	25	0.80	42	2.53	39	76	2.06	22	2.37	31	92
Rice	2.54	31	19	0.62	50	2.90	27	37	1.14	47	2.35	32	91
Southern Cal	2.40	36	14	0.47	58	2.68	32	46	1.37	35	2.29	33	88
Harvard	4.85	1	123	2.88	11	4.87	2	120	2.83	14	2.22	34	84
Iowa State	1.94	48	45	1.35	29	2.03	52	48	1.42	33	2.20	35	83
Texas	2.44	35	13	0.43	60	2.39	44	30	1.16	45	2.18	36	82
Iowa	2.04	46	15	0.50	56	2.26	49	41	1.24	39	2.14	37	80
Pennsylvania	3.14	22	58	1.06	24	3.47	19	78	2.10	21	2.12	38	79
Case WRU	1.25	69	18	0.59	52	2.34	46	44	1.32	37	2.12	38	79
Johns Hopkins	3.22	20	48	1.42	28	3.23	22	63	1.78	29	2.04	40	75

Table 6

DEPARTMENTAL RANKINGS: MATHEMATICS (continued)

	1964					1969					1973		
	Cartter			Drew-Karpf		Roose-Andersen			Drew-Karpf		Drew-Karpf		
	Score	Rank	Publ. 1960-63	Score	Rank	Score	Rank	Publ. 1965-68	Score	Rank	Score	Rank	Publ. 1969-72
Tulane	2.59	30	58	1.66	24	2.86	29	39	1.19	42	1.97	41	72
Colorado	2.09	44	20	0.65	47	2.53	39	19	0.62	61	1.93	42	70
SUNY Buffalo	1.07	72	2	0.07	76	1.95	59	32	1.00	52	1.93	42	70
Oregon	2.48	34	40	1.22	31	2.88	28	35	1.08	50	1.89	44	68
Tennessee	1.51	61	28	0.89	37	1.79	64	36	1.11	48	1.76	45	62
Brown	3.36	18	90	2.33	16	3.56	16	72	1.97	26	1.76	45	62
Columbia	4.01	9	110	2.68	14	3.93	10	95	2.42	18	1.76	45	62
Syracuse	2.24	43	40	1.22	31	2.31	47	50	1.47	32	1.69	48	59
Utah	1.49	62	19	0.62	50	2.15	50	39	1.19	42	1.69	48	59
New Mexico	1.62	56	13	0.43	60	1.92	61	34	1.06	51	1.57	50	54
Notre Dame	2.38	38	30	0.94	36	2.63	36	26	0.83	57	1.52	51	52
Rochester	2.54	31	26	0.83	38	2.67	33	39	1.19	42	1.50	52	51
Ohio State	2.68	27	24	0.77	44	2.66	34	45	1.35	36	1.47	53	50
Duke	2.60	28	65	1.82	21	2.66	34	65	1.82	27	1.42	54	48
Nebraska	1.40	64	10	0.34	64	1.39	71	13	0.43	67	1.32	55	44
Yeshiva	2.49	33	20	0.65	47	2.72	31	36	1.11	48	1.32	55	44
Kansas	2.30	42	20	0.65	47	2.39	44	32	1.00	52	1.30	57	43
Wayne State	2.05	45	37	1.14	34	2.01	54	32	1.00	52	1.30	57	43
Wash State	1.47	63	9	0.30	66	1.87	62	12	0.40	69	1.27	59	42
Lehigh	1.75	53	14	0.47	58	2.05	51	23	0.74	59	1.24	60	41
Arizona	1.67	54	8	0.27	67	1.95	59	18	0.59	63	1.06	61	34
NC State	1.38	65	16	0.53	54	1.58	67	18	0.59	63	1.00	62	32
Pittsburgh	1.56	59	3	0.10	73	1.51	68	13	0.43	67	0.94	63	30
Brooklyn Poly	1.30	67	25	0.80	42	1.78	65	11	0.37	71	0.94	63	30
Brandeis	3.23	19	26	0.83	38	3.56	16	44	1.32	37	0.94	63	30
Catholic	0.96	75	15	0.50	56	1.20	73	15	0.50	66	0.92	66	29
Ore State	1.66	55	16	0.53	54	1.96	56	20	0.65	60	0.92	66	29
Texas A&M	0.66	79	1	0.03	78	0.76	78	24	0.77	58	0.83	68	26
Wash St Louis	2.33	39	24	0.77	44	2.60	37	30	0.94	55	0.80	69	25
Vanderbilt	1.05	73	2	0.07	76	1.40	70	19	0.62	61	0.74	70	23
Oklahoma	1.58	58	7	0.24	68	1.71	66	6	0.20	76	0.68	71	21
RPI	1.34	66	4	0.14	70	2.03	52	10	0.34	72	0.65	72	20
Okla State	1.11	71	10	0.34	64	1.20	73	10	0.34	72	0.62	73	19
Ill Inst Tech	1.80	52	17	0.56	53	1.96	56	12	0.40	69	0.62	73	19
Cincinnati	1.55	60	3	0.10	73	1.48	69	7	0.24	74	0.56	75	17
Geo Washington	1.16	70	4	0.14	70	0.96	77	16	0.53	65	0.50	76	15
Boston U	1.00	74	4	0.14	70	1.13	75	2	0.07	78	0.37	77	11
Alabama	0.64	80	3	0.10	73	0.75	79	7	0.24	74	0.27	78	8
St Louis	0.92	76	0	0.0	80	1.25	72	4	0.14	77	0.24	79	7
American	0.71	78	1	0.03	78	0.63	80	0	0.0	80	0.20	80	6
Geo Peabody	0.29	81	0	0.0	81	0.20	81	0	0.0	81	0.0	81	0

Table 7

DEPARTMENTAL RANKINGS: PHYSICS

	1964					1969					1973		
	Cartter			Drew-Karpf		Roose-Andersen			Drew-Karpf		Drew Karpf		
	Score	Rank	Publ. 1960-63	Score	Rank	Score	Rank	Publ. 1965-68	Score	Rank	Score	Rank	Publ. 1969-72
MIT	4.45	6	626	4.94	2	4.54	5	1447	5.00	2	5.00	1	2093
Cal Berkeley	4.78	1	918	4.99	1	4.84	1	1432	5.00	1	5.00	2	1533
Illinois	4.10	8	393	4.68	6	4.15	8	812	4.98	4	5.00	3	1242
Chicago	4.00	10	545	4.89	3	4.06	10	985	4.99	3	5.00	4	1018
Stanford	4.47	5	322	4.47	9	4.52	6	812	4.98	4	4.99	5	973
Cal Tech	4.77	2	500	4.85	4	4.76	2	765	4.98	6	4.99	6	870
Princeton	4.60	4	311	4.43	10	4.71	4	682	4.96	8	4.98	7	827
Cornell	4.07	9	325	4.48	8	4.11	9	660	4.95	9	4.98	8	798
Harvard	4.71	3	400	4.69	5	4.75	3	713	4.97	7	4.97	9	755
UCLA	3.12	19	238	4.05	11	3.40	17	398	4.69	14	4.93	10	608
Iowa State	2.85	29	159	3.35	20	2.97	27	410	4.71	13	4.93	11	603
Texas	2.50	37	153	3.28	21	2.96	28	218	3.91	29	4.90	12	563
Maryland	3.35	16	197	3.73	16	3.59	15	433	4.76	12	4.90	13	560
Yale	3.77	11	196	3.73	17	3.89	11	366	4.61	16	4.86	14	511
Wisconsin	3.69	12	202	3.78	15	3.76	12	486	4.83	11	4.85	15	506
Colorado	2.80	31	123	2.88	26	3.00	25	237	4.04	28	4.83	16	486
Pennsylvania	3.37	15	150	3.24	22	3.71	13	370	4.62	15	4.80	17	465
Michigan	3.46	13	212	3.86	14	3.70	14	333	4.51	17	4.73	18	419
Columbia	4.32	7	385	4.66	7	4.20	7	518	4.87	10	4.73	19	418
Purdue	2.93	25	145	3.18	24	3.13	21	294	4.36	20	4.73	20	416
Wash Seattle	3.16	18	146	3.19	23	3.34	18	271	4.24	23	4.73	20	416
Rochester	3.46	13	121	2.85	28	3.51	16	283	4.31	22	4.70	22	403
Northwestern	2.85	29	119	2.82	29	2.81	37	247	4.11	26	4.64	23	377
Minnesota	3.31	17	227	3.97	12	3.33	19	329	4.50	18	4.57	24	352
Brown	2.72	33	98	2.48	30	3.08	24	256	4.16	24	4.42	25	309
Mich State	2.54	36	51	1.50	45	2.93	29	134	3.04	37	4.42	25	309
Johns Hopkins	3.12	19	178	3.56	18	3.09	22	304	4.40	19	4.38	27	300
Ohio State	2.75	32	94	2.40	32	2.72	40	243	4.08	27	4.36	28	295
Carnegie-Mellon	3.09	21	224	3.95	13	3.22	20	286	4.32	21	4.34	29	290
Pittsburgh	2.96	23	123	2.88	26	2.85	35	210	3.84	31	4.31	30	285
Penn State	2.24	46	124	2.89	25	2.59	43	250	4.13	25	4.24	31	271
Rutgers	2.42	42	53	1.55	42	2.84	36	128	2.95	40	4.11	32	248
Florida	1.97	49	47	1.40	49	2.52	45	141	3.13	36	4.05	33	238
Virignia	2.49	40	28	0.89	56	2.61	42	108	2.65	45	3.97	34	227
Case WRU	2.37	43	78	2.10	34	2.87	34	197	3.73	32	3.96	35	225
Indiana	2.89	27	95	2.42	31	2.92	30	127	2.94	41	3.88	36	215
NYU	2.67	34	168	3.45	19	2.90	31	215	3.88	30	3.85	37	211
Rice	2.87	28	51	1.50	45	2.88	32	171	3.48	33	3.84	38	210
Fla State	2.50	37	61	1.73	39	2.70	41	129	2.97	38	3.84	39	209

Table 7

DEPARTMENTAL RANKINGS: PHYSICS (continued)

	1964					1969					1973		
	Cartter			Drew-Karpf		Roose-Andersen			Drew-Karpf		Drew-Karpf		
	Score	Rank	Publ. 1960-63	Score	Rank	Score	Rank	Publ. 1965-68	Score	Rank	Score	Rank	Publ. 1969-72
Southern Cal	2.12	47	81	2.16	33	2.46	46	149	3.23	34	3.72	41	195
Louisiana St	1.64	64	27	0.86	57	1.98	55	78	2.10	54	3.64	42	187
Oregon	2.02	48	48	1.42	47	2.58	44	95	2.42	48	3.63	43	186
Texas A&M	1.71	61	24	0.77	59	1.93	62	61	1.73	60	3.43	44	166
Utah	1.97	49	57	1.64	40	2.41	48	77	2.08	55	3.40	45	163
Iowa	2.50	37	76	2.06	35	2.41	48	129	2.97	38	3.32	46	156
Syracuse	2.55	35	67	1.87	38	2.79	38	144	3.17	35	3.19	47	146
North Carolina	2.49	40	43	1.30	51	2.78	39	112	2.71	43	3.17	48	144
Missouri	1.52	72	18	0.59	65	1.67	71	64	1.80	59	3.14	49	142
Wayne State	1.75	57	29	0.92	55	1.96	57	66	1.84	58	3.13	50	141
Connecticut	1.29	76	24	0.77	59	1.92	65	85	2.24	51	3.06	51	136
Tennesee	1.82	56	16	0.53	68	1.97	56	48	1.42	66	3.02	52	133
Catholic	1.86	52	53	1.55	42	1.90	67	90	2.33	49	2.91	53	125
Georgia Tech	1.55	70	36	1.11	53	1.96	57	82	2.18	52	2.89	54	124
Duke	2.98	22	71	1.95	36	3.09	22	103	2.56	46	2.86	55	122
RPI	2.28	45	35	1.08	54	2.36	50	110	2.68	44	2.77	56	116
Kansas	1.84	54	48	1.42	47	2.22	51	81	2.16	53	2.77	56	116
Temple	1.19	80	10	0.34	72	1.95	59	29	0.92	70	2.63	58	107
SUNY Buffalo	1.50	74	7	0.24	75	2.06	53	70	1.93	57	2.61	59	106
Nebraska	1.66	63	19	0.62	63	1.92	75	51	.150	64	2.48	60	98
Wash St Louis	2.93	25	47	1.40	49	2.88	32	72	1.97	56	2.39	61	93
Brandeis	2.94	24	68	1.89	37	3.00	25	89	2.31	50	2.37	62	92
Ore State	1.75	57	14	0.47	70	2.02	54	56	1.62	61	2.31	63	89
Ill Inst Tech	1.86	52	52	1.52	44	1.95	59	99	2.49	47	2.31	63	89
VPI	1.21	78	1	0.03	83	1.48	75	15	0.50	78	2.27	65	87
Vanderbilt	1.83	55	25	0.80	58	2.19	52	40	1.22	67	2.06	66	76
Kentucky	1.59	67	7	0.24	75	1.64	73	1	0.03	82	1.99	67	73
Wash State	1.74	59	13	0.43	71	1.73	70	56	1.62	61	1.91	68	69
Kansas State	1.54	71	18	0.59	65	1.93	62	31	0.97	69	1.69	69	59
Tufts	1.90	51	17	0.56	67	1.90	67	49	1.45	65	1.66	70	58
Cincinnati	1.21	78	20	0.65	62	1.42	77	28	0.89	71	1.62	71	56
St Louis	1.60	66	21	0.68	61	1.43	76	28	0.89	71	1.52	72	52
Boston U	1.72	60	19	0.62	63	1.93	62	26	0.83	73	1.40	73	47
Lehigh	1.68	62	9	0.30	73	1.65	72	53	1.55	63	1.35	74	45
Oklahoma	1.59	67	40	1.22	52	1.80	69	38	1.16	68	1.22	75	40
NC State	1.49	75	2	0.07	79	1.95	59	25	0.80	74	1.19	76	39
Georgetown	1.06	81	16	0.53	68	1.20	80	14	0.47	79	1.14	77	37
Alabama	0.79	83	7	0.24	75	1.00	81	16	0.53	75	1.06	78	34
Geo Washington	1.62	65	2	0.07	79	1.35	78	7	0.24	81	0.97	79	31
Fordham	1.57	69	2	0.07	79	1.35	78	16	0.53	75	0.86	80	27
New Mexico	1.51	73	8	0.27	74	1.50	74	16	0.53	75	0.68	81	21
West Virignia	0.87	82	7	0.24	75	0.92	82	11	0.37	80	0.68	81	21
Bryn Mawr	1.24	77	2	0.07	79	0.85	83	1	0.03	83	0.14	83	4

Table 8

DEPARTMENTAL RANKINGS: CHEMISTRY

	1964					1969					1973		
	Cartter			Drew-Karpf		Roose-Andersen			Drew-Karpf		Drew-Karpf		
	Score	Rank	Publ. 1960-63	Score	Rank	Score	Rank	Publ. 1965-68	Score	Rank	Score	Rank	Publ. 1969-72
Cal Berkeley	4.67	3	380	4.65	1	4.74	3	570	4.91	1	4.98	1	788
Illinois	4.13	6	348	4.56	4	4.19	6	506	4.85	3	4.97	2	733
Wisconsin	4.00	7	357	4.59	3	4.04	8	552	4.89	2	4.95	3	671
MIT	4.54	4	369	4.62	2	4.47	5	481	4.83	4	4.92	4	591
Harvard	4.95	1	268	4.23	8	4.96	1	403	4.70	7	4.87	5	525
Ohio State	3.37	17	178	3.56	17	3.48	18	360	4.59	9	4.82	6	479
Iowa State	3.40	16	276	4.27	6	3.58	15	429	4.75	6	4.81	7	467
Cornell	3.77	11	270	4.24	7	3.98	11	481	4.83	4	4.78	8	446
Cal Tech	4.71	2	183	3.60	16	4.77	2	269	4.23	13	4.76	9	433
Purdue	3.36	18	288	4.33	5	3.58	15	268	4.23	14	4.75	10	427
Chicago	3.91	9	193	3.70	15	4.01	10	368	4.62	8	4.73	11	416
Texas	3.13	23	158	3.34	22	3.50	17	265	4.21	16	4.67	12	390
Northwestern	3.52	14	227	3.97	10	3.65	14	240	4.06	19	4.62	13	369
Carnegie-Mellon	2.77	36	214	3.88	11	3.06	30	318	4.46	10	4.61	14	367
UCLA	3.91	9	197	3.73	14	4.09	7	242	4.08	18	4.57	15	352
Princeton	3.67	13	201	3.77	13	3.77	13	267	4.22	15	4.49	16	326
Case WRU	2.25	55	87	2.27	41	3.06	30	254	4.15	17	4.49	16	326
Stanford	4.32	5	134	3.04	25	4.65	4	285	4.31	12	4.48	18	325
Penn State	3.12	24	153	3.28	23	3.18	24	220	3.92	21	4.47	19	322
Florida	2.68	41	110	2.68	32	2.96	35	199	3.75	23	4.46	20	318
Michigan	3.25	19	206	3.81	12	3.37	20	190	3.67	27	4.42	21	308
Mich State	2.79	34	100	2.51	36	3.20	23	175	3.52	28	4.36	22	295
Notre Dame	2.72	39	95	2.42	37	3.00	34	199	3.75	23	4.30	23	282
Minnesota	3.50	15	240	4.06	9	3.39	19	286	4.[illegible]	11	4.24	24	270
Utah	2.60	43	70	1.93	51	2.83	41	122	2.86	46	4.22	25	267
Indiana	3.23	20	82	2.18	44	3.37	20	156	3.32	33	4.20	26	262
Massachusetts	1.98	65	28	0.89	80	2.57	49	72	1.97	66	4.14	27	252
Pennsylvania	2.93	30	109	2.66	33	2.91	37	233	4.02	20	4.10	28	246
Wayne State	2.59	44	101	2.53	35	2.77	44	121	2.85	47	3.97	29	227
Yale	3.76	12	174	3.51	20	3.87	12	192	3.69	26	3.97	29	227
Columbia	4.00	7	178	3.56	17	4.02	9	219	3.91	22	3.93	31	221
Wash Seattle	3.17	21	124	2.89	27	3.23	22	162	3.38	31	3.93	31	221
Johns Hopkins	3.17	21	120	2.83	28	3.15	26	196	3.73	25	3.92	33	220
North Carolina	2.71	40	86	2.26	42	2.90	39	168	3.45	29	3.88	34	214
Fla State	3.06	26	80	2.14	45	3.15	26	158	3.34	32	3.87	35	213
Louisiana St	2.36	51	85	2.24	43	2.61	47	125	2.91	44	3.84	36	209
Texas A&M	1.66	79	34	1.06	72	2.19	65	80	2.14	61	3.83	37	208
Colorado	2.79	34	80	2.14	45	3.08	28	138	3.09	41	3.82	38	207
Oregon	2.87	31	45	1.35	65	3.06	30	102	2.55	54	3.70	39	193
Missouri	1.78	73	28	0.89	80	1.94	74	99	2.49	55	3.67	40	190
Cal Davis	2.54	47	89	2.31	40	2.78	43	123	2.88	45	3.66	41	189
Pittsburgh	2.56	45	150	3.24	24	2.53	53	141	3.13	37	3.65	42	188
Rutgers	2.42	50	72	1.97	49	2.40	56	117	2.79	48	3.61	43	184
Virginia	2.04	62	57	1.64	58	2.35	59	69	1.91	67	3.56	44	178
Syracuse	1.86	71	102	2.55	34	1.95	72	74	2.02	64	3.50	45	173
Arizona	2.22	56	46	1.37	64	2.47	54	141	3.13	37	3.47	46	170
Brown	3.02	28	59	1.69	56	2.96	35	139	3.10	40	3.47	46	170
Kansas State	2.13	60	117	2.79	30	2.24	63	103	2.56	52	3.47	46	170

Table 8

DEPARTMENTAL RANKINGS: CHEMISTRY (continued)

	1964					1969					1973		
	Cartter			Drew-Karpf		Roose-Andersen			Drew-Karpf		Drew-Karpf		
	Score	Rank	Publ. 1960-63	Score	Rank	Score	Rank	Publ. 1965-68	Score	Rank	Score	Rank	Publ. 1969-72
Maryland	2.36	51	75	2.04	48	2.42	55	131	2.99	42	3.41	49	164
Southern Cal	2.75	38	80	2.14	45	2.75	45	127	2.94	43	3.30	50	155
Brooklyn Poly	3.07	25	177	3.54	19	2.63	46	143	3.16	36	3.29	51	154
Ill Inst Tech	2.43	49	115	2.76	31	2.24	63	164	3.41	30	3.24	52	150
Kansas	2.81	33	120	2.83	28	2.91	37	155	3.30	34	3.14	53	142
Rice	3.06	26	31	0.97	75	3.16	25	104	2.58	51	3.06	54	136
Ore State	2.47	48	30	0.94	76	2.54	51	106	2.61	50	3.01	55	132
Buffalo	1.93	67	59	1.69	56	2.89	40	145	3.18	35	2.99	56	131
Rochester	2.96	29	165	3.42	21	3.01	33	83	2.20	59	2.98	57	130
NYU	2.27	54	94	2.40	38	2.39	57	107	2.63	49	2.91	58	125
Okla State	1.54	83	30	0.94	76	1.76	82	78	2.10	62	2.82	59	119
Vanderbilt	2.03	64	45	1.35	65	2.55	50	55	1.59	70	2.76	60	115
RPI	2.21	57	48	1.42	63	2.27	62	93	2.39	57	2.74	61	114
Georgia Tech	2.30	53	51	1.50	61	2.38	58	75	2.04	63	2.69	62	111
Delaware	2.04	62	91	2.35	39	2.17	67	82	2.18	60	2.68	63	110
Tennesee	1.91	69	65	1.82	52	2.07	68	74	2.02	64	2.68	63	110
Wash State	2.20	58	54	1.57	60	2.31	60	84	2.22	58	2.66	65	109
Brandeis	2.77	36	62	1.76	54	3.08	28	97	2.46	56	2.63	66	107
Duke	2.86	32	133	3.02	26	2.61	47	141	3.13	37	2.60	67	105
Connecticut	1.67	78	19	0.62	86	1.91	76	54	1.57	71	2.60	67	105
Iowa	2.56	45	61	1.73	55	2.54	51	103	2.56	52	2.56	69	103
Houston	1.21	90	18	0.59	87	1.96	71	30	0.94	84	2.33	70	90
Nebraska	2.18	59	71	1.95	50	2.30	61	52	1.52	73	2.29	71	88
Kentucky	1.47	85	37	1.14	69	1.73	84	1	0.03	95	2.20	72	83
VPI	1.01	93	22	0.71	83	1.97	69	54	1.57	71	2.16	73	81
Catholic	1.69	76	14	0.47	91	1.76	82	52	1.52	73	2.16	73	81
Alabama	0.61	95	13	0.43	92	1.09	95	28	0.89	86	2.14	75	80
Boston U	1.76	74	29	0.92	78	1.87	78	39	1.19	81	2.02	76	74
Temple	1.36	89	55	1.59	59	1.72	85	65	1.82	68	1.97	77	72
Lehigh	1.53	84	29	0.92	78	1.67	87	50	1.47	75	1.89	78	68
Wash St. Louis	2.65	42	49	1.45	62	2.82	42	41	1.24	78	1.87	79	67
Cincinnati	2.12	61	64	1.80	53	2.18	66	62	1.76	69	1.84	80	66
Oklahoma	1.55	82	40	1.22	68	1.78	81	38	1.16	83	1.73	81	61
St Louis	1.66	79	18	0.59	87	1.68	86	27	0.86	88	1.66	82	58
Arkansas	1.79	72	35	1.08	71	1.92	75	43	1.30	77	1.62	83	56
Tufts	1.87	70	21	0.68	84	1.91	76	39	1.19	81	1.40	84	47
Georgetown	1.41	87	23	0.74	82	1.86	79	28	0.89	86	1.32	85	44
Wyoming	1.06	92	2	0.07	95	1.62	90	17	0.56	92	1.30	86	43
Emory	1.95	66	36	1.11	70	1.95	72	41	1.24	78	1.30	86	43
West Virginia	0.95	94	21	0.68	84	1.42	91	41	1.24	78	1.16	88	38
Loyola	1.16	91	16	0.53	90	1.22	93	29	0.92	85	1.14	89	37
Tulane	1.92	68	32	1.00	74	1.97	69	44	1.32	76	1.08	90	35
New Mexico	1.46	86	17	0.56	89	1.63	89	18	0.59	91	1.03	91	33
Geo Washington	1.37	88	10	0.34	94	1.35	92	17	0.56	92	1.03	91	33
Fordham	1.68	77	33	1.03	73	1.66	88	27	0.86	88	0.86	93	27
Clark	1.56	81	43	1.30	67	1.13	94	21	0.68	90	0.56	94	17
Bryn Mawr	1.76	74	11	0.37	93	1.80	80	7	0.24	94	0.53	95	16