A MULTIVARIATE APPROACH TO THE ASSESSMENT OF QUALITY IN AMERICAN DOCTORAL INSTITUTIONS: IMPLICATIONS FOR PUBLIC POLICY

By

Jeane Crouse Vinsonhaler

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ABSTRACT

A MULTIVARIATE APPROACH TO THE ASSESSMENT OF QUALITY IN AMERICAN DOCTORAL INSTITUTIONS: IMPLICATIONS FOR PUBLIC POLICY

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Assessment of academic quality in institutions of higher education is the number one issue confronting policy and decision-makers in the United States today. This study used a personal computer, associated software, meta-analytical and indicator methodologies, and public extant data bases to create an inexpensive Higher Education Computer-Based Information System (HECBIS) for research and decision-making on the population of one hundred and seventy-one American doctoral institutions. The HECBIS consists of a Personal Computer System (PCS) and a Doctoral Institution Data Base (DIDB). The PCS was based on Apple II/IIc personal computers and readily available software. Data used were the most comprehensive, relevant, and accurate available from government data centers and major studies of academic quality. Included were thirty-eight quantitative measures organized into eight categories or domains: Students, Degrees, Faculty, Compensation, Assets, Revenue, Expenditures, and Quality.

Five analyses were performed on the data base using personal computer software. 1) Descriptive Analysis. Commonly used descriptive statistics and ranking methods yielded much the same results as in other studies. 2) Cluster Analysis. Inter-correlations among the thirty-eight quantitative variables were very high, many ranging above 0.80, suggesting that each domain could be represented by a single variable. A cluster analysis of variables by domain indicated that only eight "key variables" were necessary--one variable for each domain. 3) Regression Analysis. Multiple correlations for predicting the key quality variable from the other seven key variables ranged from 0.89 to 0.91, indicating that about 80% of the variance was predictable. 4) Profile Analysis. Graphic displays of institutions and groups of institutions were used to show institutional status on the eight key variables relative to the national average. Profiles yielded very promising results. Single university profiles isolated different decision-making approaches. Multiple institutional profiles uncovered previously unreported relationships, including markedly different profiles for different types of institutions, for example, Midwestern versus Far Western institutions. 5) Structure Analysis. Factor analysis indicated four latent dimensions of doctoral institutions: institution size, academic quality, faculty compensation, and graduate education. A retrospective analysis of changes in academic quality rankings suggests that the quality of a doctoral institution is not fixed, but is alterable by institutional decisions.

To American Public Higher Education

This study is dedicated to American public higher education which afforded to me the opportunity to attain its highest degree offering entirely on a part-time basis over a period of years, while maintaining other responsibilities. It is hoped that this research study on academic quality will, in some small way, help to extend the frontiers of knowledge about the academy and, thus, benefit all those who come after.

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CHAPTER I

THE PROBLEM

INTRODUCTION

During the 1960s and 1970s, frequently termed the "golden age of American higher education," higher education was in a period of growth and expansion. The primary goal was increased access and there was something for everyone. Institutions requested and received resources needed for program expansion and powerful local and regional interests were served by the creation of new institutions. But a number of demographic, economic, political, and social forces in the late 1970s and early 1980s have now brought this growth to a standstill. With the demise of growth, attention has now turned to the demonstrated effectiveness of institutions in meeting quality goals. Quality implies making judgments and maintaining standards. If standards are set high, then some students will not measure up, some institutions will be judged mediocre, some programs will be found lacking, and some research and development efforts will be less effective. Where quality goals determine the allocation of limited resources, there are winners and losers (Eyler, 1984, 57-58).

Thus, the critical issue for higher education today is the identification and assessment of the quality of higher education institutions. Some maintain, however, that "quality simply cannot be defined or measured because the activities of institutions are too complex and varied, because different institutions have different objectives, because the outcomes of higher education are too subtle, because methodological problems are insurmountable," and so forth. However, this view "fails to recognize that judgments about quality in higher education are made every day. And these judgments .... form the basis for important life decisions. Students deciding which college or graduate school to attend, prospective professors deciding where to apply for a job, officials of federal agencies or philanthropic foundations deciding where to award grants, and state budget officers deciding how to allocate resources among various institutions within a system--all are making quality assessments" (Astin, 1980).

The few carefully conducted national assessments of quality in graduate education since 1964, such as those of: Keniston (1959), Cartter (1966), Roose-Andersen (1970), and Jones, Lindzey, and Coggeshall (1982) have strongly demonstrated the reliability and validity of multivariate quality assessments. However, the questions of what measures to use to assess academic quality and of an appropriate assessment methodolgy still remain.

A major reason for the lack of progress has been the difficulty and expense involved in the collection and processing of accurate and timely data in a usable form. However, there exists, a vast amount of reliable, consistent, and timely data relating to the characteristics of doctoral institutions in "extant data bases" in the public domain, but knowledge of how to obtain, organize, and use it has limited its usefullness for the typical higher education decision maker.

Thus, there is a clear and compelling need for reliable, valid, inexpensive, accessible, and centrally organized empirical data specific to the characteristics of doctoral institutions to assist higher education decision makers in making rational and timely decisions. This can best be achieved, this researcher believes, through state-of-the-art personal computer technology, meta-analytic and indicator methodologies, and established sophisticated statistical techniques. Further, there is a need for identification and understanding of those key characteristics which underlie academic quality and for normative data against which doctoral institutions can measure themselves. Finally, there is a need to begin developing an empirically sound classification system of doctoral institutions so that higher education policy makers can more accurately assess the nature of these institutions and the potential effect of their decisions.

Therefore, the central focus of this dissertation is on the examination of a multivariate approach to the assessment of academic quality in higher education. Academic quality, as used within the context of this dissertation, is an evaluation or assessment which assists potential students and faculty members, decison and policy makers, and others in making important judgments about doctoral institutions, such as the selection of an institution: for education by a student, for employment by a faculty member, for recognition as an important contributor to academic knowledge, as an important training place for the transmission of such knowledege, or for the allocation of funds.

Most past studies of academic quality have treated quality as an unidimensional attribute of a discipline, only rarely aggregating the information for institutions as a whole. Recently a new approach has been proposed: a multidimensional or multivariate approach to academic quality. In this approach, a set of variables is used to define academic quality. From this view, any single quality variable offers only part of the information necessary to make quality-oriented decisions. For example, consider the assignment of state appropriations. Suppose several public institutions within a state have been qualitatively ranked on faculty achievements. Further suppose that the state has only limited funding available and, thus, is faced with the problem of trying to decide how much to allocate to each of the institutions, each of which is asserting great financial distress and warning of a severe loss of "quality" if its requests are not granted.

In order to make a good decision, state decision makers would need to know more than simply the traditional budget data and unsupported estimates of institutional quality. For example, it would also be helpful to know from a national, regional, and state perspective how each of the institutions "measure up" on the important correlates of academic quality, such as: 1) faculty measures (for example, faculty number and compensation by rank); 2) institutional size measures (for example, numbers of students, faculty, and degrees granted); and 3) financial measures (for example, assets, revenues from various sources, and expenditures by type). Further, it would be useful to have information on the relationship among these important institutional characteristics for each of the institutions under consideration. For example: 1) Do institutional assets and revenues appear sufficient to support the size of the student body? and 2) What are institutional priorities, not in some vague verbal sense, but in terms of the way the institution actually spends its money?

Thus, the multivariate quality argument asserts that a single measure of academic quality is seldom adequate for real-world decision making. While many other studies of academic quality have taken a multivariate approach, none has performed a comprehensive re-thinking of all aspects of academic quality from a multivariate point of view--from a description of the population to the reporting of quality to the examination of theories of academic quality. Thus, the purpose of this dissertation is to perform a comprehensive study of academic quality in all of its aspects from the multivariate point of view on a population never before studied in this manner: the one hundred and seventy-one doctoral institutions in the United States.

In the following section, the problem will be restated in terms of sub-problems or objectives. For each objective, a set of literature review and empirical research questions will be stated. Additionally, one research hypothesis will also be stated.

Before proceeding, however, two definitions are in order. The first definition is a multivariate definition of academic quality which is simplicity itself: In the multivariate approach, academic quality is defined in terms of a set of variables, rather than as a single variable. This set is composed of variables which are either closely related to academic quality or which highly correlate with academic quality, that is, they potentially are important in decision making about academic quality. These variables can include both subjective judgments, such as ratings, as well as quantitative measures.

The second definition is of the aspects of academic quality research which must be re-examined from the point of view of our definition of multivariate academic quality. The first aspect concerns a description of the population of doctoral institutions. The description must include, to the degree possible, all of the important observable categorical and quantitative characteristics of doctoral institutions which assist people in comprehending the description. Further, the quantitative variables which are similar to each other should be grouped into sub-sets, usually referred to as domains in measurement theory. Thus, the total number of students, the number of full-time-equivalent (FTE) students, and the total number of graduate students might be combined into a domain called "student characteristics."

The second aspect concerns the comprehensability of a multivariate description. That is, we need to determine which of the highly correlated quantitative variables within a domain is the most important or "key variable" and, therefore, could represent all of the others. In this manner, the entire set of quantitative variables can be replaced with a relatively few key variables which would greatly reduce decision complexity.

The third aspect concerns the relationship between the key quality variable and the other key quantitative variables. This is important so that there will be no major loss in the ability to predict quality when the number of descriptive variables is reduced. That is, the key quality variable should be highly predictable from the other key variables.

The fourth aspect concerns the reporting of the results of the multivariate representations of academic quality. Univariate studies of academic quality usually report findings in terms of relative ranking on a univariate measure of quality. Even in those cases where several variables have been studied, the results for each variable have usually been separately ranked and reported. In a true multivariate definition of academic quality, some other representation of academic quality must be used. In some fields, such as medicine, educational psychology, and criminology standardized profiles are frequently used to represent a multivariate description. For example, in medicine the "vital signs" are "charted" in terms of the above and below normal values of pulse, temperature, and respiration. Statistically based standardized profiles, as discussed here, should be differentiated from other "descriptive profiles" which are sometimes inappropriately used for decision making.

Finally, the fifth aspect concerns the theoretic interpretation of a multivariate description of academic quality in doctoral institutions. That is, the theory must be re-stated in terms of a set of non-observable variables which underlie the observable quantitative variables used to describe American doctoral institutions.

Each of these five aspects can be re-stated in terms of the five basic research objectives of the study which are discussed in the following section.

PURPOSE OF THE STUDY

The major purpose of this research study is to perform a comprehensive assessment of the population of American doctoral institutions from the point of view of a multivariate definition of academic quality. The study population consists of the one hundred and seventy-one institutions of higher education in the United States classified as "doctoral-level" by the National Center for Education Statistics (NCES). Data consists of forty-nine variables which characterize American doctoral institutions. Included are: 1) demographic, such as state, region, status, and calendar system; 2) size, such as student, degree, and faculty; 3) faculty compensation; 4) financial, such as assets, revenues, and expenditures; and 5) quality, such as faculty and program variables. All data were obtained from existing public primary data sources and were for the 1981-1982 academic year. The medium of study is a computer-based information system, the Higher Education Computer-Based Information System (HECBIS), designed specifically for this study but intended to serve future analytical, policy making, and reporting purposes.

The problem of a multivariate assessment of doctoral institutions can be analyzed into five major sub-problems which comprise the specific objectives of the present study. These five objectives are presented below.

> Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

This objective is the first step involved in re-thinking academic excellence from the multivariate point of view. The set of variables selected must include identification variables and the most important demographic or categorical variables, as well as available quantitative variables which characterize or describe the population of American doctoral institutions. It should be noted here that ratings of academic quality, although qualitatively based, are, in fact, quantitative measures.

> Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

This objective is the second step in the multivariate assessment. It provides a smaller and more comprehensible description of each doctoral institution without significant loss of information. It involves first organizing the larger set of thirty-eight quantitative variables into eight domains or smaller sets of common variables and, then, statistically determining which of the variables within each of these domains is the most important or "key variable" and, thus, can represent all the others within the domain.

> Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

This objective is designed to ensure that no valuable information on academic quality is lost through the data reduction process. Ideally, a multiple regression analysis with a few key variables should produce correlations nearly as high as the reliability of the total set of variables used to define academic quality.

> Objective 4: To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.

A "profile" denotes a graphic display of the key descriptor variables stated as standard scores so that direct comparisons can be made between institutions or groups of institutions. Each institution is represented, not by a single variable, but by a set of graphically displayed key variables or "indicators."

<u>Objective 5:</u> To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.

In multivariate studies, theories are usually stated in terms of latent non-observable factors which account for the observable correlations. Theory, then may be described as a model composed of latent variables, their relationships, and their potential causal relationships. Another aspect of this objective is the hypothesis that more than one factor underlies the observable correlations (that is, that doctoral institution quality is a multivariate construct) and that the number of factors is less than or equal to the number of domains used in the reduced set of variables.

RESEARCH QUESTIONS AND THE HYPOTHESIS

The following section summarizes the set of research questions addressed by the study. As shown, several research questions are associated with each of the study objectives stated above. The research questions include eleven shaping the literature review and five addressed directly by the empirical research study. One hypothesis is also tested. These research questions and the hypothesis are summarized below in conjunction with the associated objectives. It should be noted in the following summary that the eleven questions related to the literature review are numbered L1 to L11 and the five questions related to the empirical research study are numbered R1 to R5 to provide clarity for the reader in the remaining sections of the dissertation.

Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

L1. What groups similar to the population of doctoral institutions have been described in prior studies?

L2. What research methods, variables, and statistics have been used to measure academic quality?

L3. What methods have been used in the development of research data bases?

R1. What characterizes the population of one hundred and seventy-one American doctoral institutions?

Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

L4. Were the correlations among the descriptive variables in prior studies sufficiently high to permit a reduction in the number of variables?

L5. What groupings or domains of variables have been used in prior studies?

R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

L6. What research methods and variables have been used to measure academic quality in prior studies?

L7. What variables seemed to best measure and predict academic quality in prior studies?

R3. Can the key quality variable be predicted without loss from the other seven key variables?

Objective 4: To generate graphic displays or "profiles" of doctoral institutions or groups of doctoral institutions based upon the eight key variables.

L8. What problems have occurred in the use of rankings of institutions of higher education?

L9. What major non-ranking methods can be used for analytical and descriptive purposes?

R4. What findings can be obtained with profile, rather than ranking, reports?

Objective 5: To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.

L10. What are the current major theories of academic quality?

L11. What factor analytic structures underlying doctoral institutions have been observed?

E5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?

<u>Empirical Study Hypothesis</u>

The number of common factors underlying the observable quantitative characteristics of American doctoral institutions is greater than one (the univariate case) and less than or equal to eight (the number of domains used in the original description).

DEFINITION OF TERMS

There were a number of specialized or technical terms which were used throughout the study. They are defined below for easy reference. Other specialized terms, which relate to specific aspects of the study, are defined within the context of use, as they occur.

<u>Algorithm</u>. A computational procedure.

<u>Attribute</u>. A property capable of further division; a quantitative variable or unidimensional continuum.

<u>Average</u>. A single value (for example, a mean or median) that summarizes or represents a general set of unequal values.

Categorical Variable. A variable which assigns numbers in an arbitrary manner, that is, the size of the number carries no significance and changing the value does not change the meaning of the variable.

Characteristic. Something that distinguishes or identifies an entity.

Cluster. A number of variables or attributes collected or grouped into homogeneous subsets on the basis of similarity across entities.

Common factor. A hypothetical underlying variable common to two or more observed variables.

Communality. A number between 0.00 and 1.00 that measures the generalities of individual differences in an observed variable, that is, the common variance among the variables. In an orthogonal factor model, it is equal to the sum of its squared factor coefficients.

Computer-Based Information System (CBIS). An interactive computer-based system that provides a versatile medium for researchers and decision makers to analyze data, formulate ideas, structure arguments, and build models.

Correlation. A measure of the degree of association between two variables, for example, the Pearson product-moment correlation.

Correlation Coefficient. The traditional index of similarity of a variable with another variable which takes the value of +1.00 if the correspondence is perfect; 0.00 if there is no generality; and -1.00 if the correspondence is perfect, but inverse, that is, high values on one attribute correspond to low values on the other.

Criterial Variable. A variable that is predicted. In a regression analysis, the criterial variable is the dependent variable that is predicted from one or more other independent variables.

Criterion. That which we wish to predict, that is, the dependent variable that is to be predicted from a set of independent predictors.

Data. Factual material, such as a quantity or code, which arises out of observation and measurement and which is used as the basis for discussion or decision.

Data Bank. A collection of data relating to a given set of entities.

<u>Data Base</u>. A collection of inter-related data stored together with controlled redundancy to serve one or more applications. The data are stored so that they are independent of programs which use the data and a common and controlled approach is used in adding new data and in modifying and retrieving existing data within the data base.

<u>Data Base Management System</u>. A collection of software required for developing and using a data base.

<u>Data Element</u>. The smallest unit of data that has meaning in describing information.

<u>Data Matrix</u>. A rectangular set of observations.

<u>Decision Support System</u>. An interactive microcomputerized system that helps decision makers solve relatively unstructured problems.

<u>Demographic</u>. Of or relating to the statistical study of populations, especially with reference to size and density, distribution, and vital statistics.

<u>Descriptive Statistics</u>. Statistics which simply describe an observable set of data, for example, the mean, median, range, and standard deviation.

Doctoral Institutions (or doctoral-level institutions). Those higher education institutions characterized by a significant level and breadth of activity in, and commitment to, doctoral-level education, as measured by the number of doctorate recipients and the diversity of doctoral-level offerings. Included in the category are institutions, not considered specialized schools, which grant a minimum of thirty degrees. These degrees must be granted in three or more program areas, or, alternatively, the institution must have an interdisciplinary program at the doctoral-level. Also classified as doctoral-level are institutions which meet all criteria except the number of doctoral-level offerings, but grant only doctoral degrees.

Domain. A collection of data elements of the same type.

Eigenvalue. A measure of variance (that is, the length of the eigenvector) accounted for by a given principal component or principal axis.

Eigenvector. The latent vector associated with each eigenvalue. When normalized, these vectors become principal components. The vector's coordinates specify its direction.

Entity. A person or object of experience that possesses quantitative or qualitative properties, for example, doctoral institutions. Entity refers to the elements of the set being classified.

Extant Data. Currently or actually existing data.

Extant Data Base. A currently or actually existing data base.

Factor. A weighted composite of variables which is intended to explain what is common to a set of attributes.

Factor Analysis. Several mathematical procedures for analyzing the relations among a set of variables and explaining them in terms of a reduced set of hypothetical unmeasured variables.

Factor Loading. The coefficient of the common factors in a factor pattern matrix or the correlations of each variable with each factor given in a factor structure. When the factors are uncorrelated, the two definitions are identical.

Factor Score. An estimate of an underlying factor formed from a weighted linear combination of observed variables.

File. A set of similarly constructed records.

Identification Variable. A property of a variable which identifies an entity or data concerning that entity.

Indicator. A statis''''''tic which lends itself to aggregation and disaggregation and whose trend tells us consistently whether things are getting better or worse. Consistency implies comparability across all institutions and regions.

Information. Data that have been combined and given a form and which is used to reduce uncertainty.

Information System. A system in which the data stored will be used in spontaneous ways, which are not fully predictable in advance, for obtaining information.

Key Variable. A primary variable used in prediction, for example, academic quality in this study.

Knowledge. Information that has been confirmed.

Latent Variable. A variable which is present and capable of becoming, although not now, visible or active.

Least-Squares Solution. A solution that minimizes the squared deviations between the observed values and the predicted values.

Linear Regression. A procedure for finding a set of optimum weights for a set of variables to predict some dependent variable (criterion). The least-squares regression line is found by minimizing the errors of estimates.

List (Listing). An ordered set of data items, for example, a ranking.

Maintenance of a file. The periodic reorganization of a file to better accomodate items that have been added or deleted.

Meta-Analysis. The use of statistical methods to describe the results of a number of research studies.

Multiple Correlation. The maximum correlation to be expected between a dependent variable and a linear additive combination of independent variables.

Multiple Regression Analysis. A system of data analysis used whenever a quantitative variable is to be studied as a function of a set of independent quantitative or qualitative variables.

Norm. The computed or estimated average of performance of a significantly large group or class.

Q Analysis. A dimensional analysis of an N x N matrix of correlations among entities across n attributes. The analysis isolates r entity factors.

Observation. The value assigned to a variable of an entity. For example, the study is based upon one hundred seventy-one observations on forty-nine variables of the population of doctoral institutions.

Orthogonal. Statistically independent; uncorrelated.

Orthogonal Factors. Vectors which lie at right angles to each other; oblique factors lie at acute or obtuse angles to each other. Orthogonal factors are uncorrelated, whereas, oblique factors are correlated.

Outlier. A case in a relation that is not part of the majority of cases; it lies well below, above, or outside the relation.

Pattern. A clear and detailed archtype or prototype.

Population. A group of entities which share one or more attributes. The more attributes shared, the more restrictive the population.

Predictive Variables or Predictors. Independent variables used in a regression analysis to predict another variable.

Primary Data Source. The collector or processor of data.

Principal Components. Linear combinations of observed variables such that each is orthogonal to every other one and each accounts for the maximum amount of variance in the matrix.

Profile. A pattern of values or scores determined by statistical measures or ratings that characterize an entity in terms of a multiple set of descriptive variables or attributes.

Quantitative. Of, relating to, or involving the measurement of quantity (measureable or amount).

Quantitative Variable. A variable to which values or numbers are assigned which reflect the amount of some attribute. Changing the values or numbers of the quantitative variables changes the relationship.

Rank of a Matrix. The number of linearly independent columns or rows of a matrix.

Ratings. Values based on people's opinions.

Raw Data Value or Score. An absolute measure that is statistically independent of other values of the entity and independent of the values of other individuals or objects, for example, the number of students in a doctoral institution. Such values are not referred to any normative group.

Record. A group of related fields of information treated as a unit by an application program.

Secondary Analysis. An examination of a pool of directly comparable raw data which has been obtained from one or more studies and combined for re-analysis in a single large statistical analysis.

Set. A collection of entities considered together as a whole.

Simple Structure. A factor structure with certain properties: each variable is defined by only a few of the common factors and each common factor is defined by only some of the variables.

Statistic. A number chosen to represent a set of numbers, for example, the mean.

Statistics. A branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data.

<u>System</u>. A network of structures and channels used for recording, retrieving, analyzing, and transferring data and information.

<u>Table</u>. A collection of data suitable for quick reference, each item being uniquely identified either by a label or by its relative position.

<u>Theoretical Model</u>. The logical structure of a data schema based upon a hypothetical set of facts, principles, and circumstances which can be used as an example for imitation or emulation.

<u>Theory</u>. A model composed of latent variables, their relationships, and their potential causal relationships.

<u>Uniqueness of a variable</u>. The difference between the communality and 1.00.

<u>V Analysis</u>. A dimensional analysis of an n x n matrix of correlations among attributes across N entities. The analysis yields the coordinates of the N attributes or N coordinate axes.

<u>Variable</u>. A property of an entity or object that distinguishes or identifies it and, with respect to which, the entities vary from each other and, on the basis of which, we differentiate them from each other.

Variance. A measure of the dispersion of values or scores on a variable which is obtained by summing the squared deviations from the mean and dividing by the number of cases.

Varimax. A method of orthogonal rotation that simplifies the factor structure by maximizing the variance of the squared loading of each of the columns of the factor pattern matrix.

Vector. A quantity having both magnitude (length) and direction. It may be represented as an arrow and defined by a set of coordinates in attribute space or entity space.

Vital Statistics. Statistics relating to births, deaths, health, or disease.

SIGNIFICANCE OF THE STUDY

This study is important for several reasons. First, it is the only large-scale multivariate study ever done which looks at academic quality from the institutional point of view.

Second, this study is the first large-scale study encompassing the population of American doctoral institutions and provides a basis for generalizations about this largely unknown population which, although representing only about 6% of all institutions of higher education in the United States, exerts influence greatly disproportionate to its size. Knowledge of this small group of elite institutions and of their quality is imperative because of the unique responsibility these institutions have for educating and training future leaders of the United States, as well as those of many countries throughout the rest of the world. Further, the policies of these prestigious institutions have a domino effect on institutions of lesser status which emulate them. The importance of these institutions is further demonstrated by the fact that Education Secretary William J. Bennett recently announced the appointment of an assistant whose purpose is to serve as a liaison to higher education and who will emphasize the major issues confronting these elite institutions (Palmer, 1986).

Third, this study greatly expands earlier work on the type, sources, and uses of multidimensional measures of academic quality and it increases the credibility of quality assessment techniques.

A fourth value of the study lies in its methodology which integrates computer technology, meta-analysis, extant data, indicator research, and sophisticated statistical procedures into a computer-based information system which can be inexpensively updated or expanded and which will facilitate both real-time decision making and research on American doctoral institutions.

Fifth, the study is of theoretical importance since it attempts to understand and statistically demonstrate the meaning of academic quality.

Finally, the study also has great practical significance in that it provides readily available information specific to each doctoral institution which can be used by decision and policy makers for management and quality improvement. Such information can also be used by state and federal officials and others as a basis for resource allocation, a use which is bound to evoke considerable controversy.

ASSUMPTIONS OF THE STUDY

Three major assumptions delimited the study. First, although several classifications of doctoral institutions are possible, it was assumed that the true population of doctoral institutions is composed of those institutions designated as "doctoral-level" in the amended 1981-1982 National Center for Education (NCES) classification structure. Second, it was assumed that the 1981-1982 academic year, which was selected as the time period for the study because it was the latest year that complete data were available at the time the study was begun, is representative of other possible time periods. Third, it was assumed that the forty-nine data variables selected for study appropriately represent the important dimensions of doctoral institutions and that they were accurately measured and reported.

LIMITATIONS OF THE STUDY

Several factors affect the validity of the study. First, although only thoroughly respected primary data sources were utilized in the study, the accuracy and consistency of the data, in the final analysis, was dependent on the providers of the data. Second, the measures of academic quality used in the present study, which were obtained from three major studies of academic qualiity, are all reputational measures of academic quality. Other types of quality measures might have yielded different results. Third, the correlation, factor, and regression analyses performed in the study were limited by the number and type of variables used in the study. Given a different number and/or mix of variables, other results might have occurred. Finally, institution "size" has been treated in the same manner in the present study as it was in the major empirical studies of academic quality which will be discussed in Chapter II, that is, the studies by Cartter (1966), Roose-Andersen (1970), and the Associated Research Council (Jones, Lindzey, and Coggeshall, 1982). Thus, unless a variable was averaged in the original study data base, the variable includes a size factor. That is values are not divided by number of students, faculty, and so forth. Accordingly, the only averaged variables in the present study are the three faculty compensation variables: COMPPRFA, COMPASCA, and COMPASTA (see Chapter III and Appendix B for additional information about variables and associated definitions). One might argue that "size" has contributed to many correlations and may have given large doctoral institutions an advantage. This argument has merit. However, the variables in the present study were not averaged for two reasons. First, this study, was an attempt to extend prior research on academic quality and prior research, for the most part, did not average variables. Second, a study of averaging was performed as a corollary to the present study, but did not result in any single normalizing procedure which was uniformly applicable and defensible. Dividing by two or three different values yielded clear measurement artifacts. In short, the averaging problem seems worthy of a future study in its own right.

OVERVIEW OF THE DISSERTATION

Chapter I has presented a rationale for the study of academic quality in American doctoral institutions. Chapter II develops the literature which forms the theoretical basis for the study of academic quality. Publications and research in the field of higher education were reviewed relative to: computer-based information systems, meta-analysis of extant data, and indicators as background for the HECBIS. Research was also reviewed relative to data characteristics, the major quality assessment methods used, the major quality assessment studies performed, the research and statistical methods employed, and the current theories of academic quality. Chapter III describes the research design, the research methods and procedures used, including the nature of the study population and the data, and the statistical techniques employed. Chapter IV presents study findings in statistical, graphic, and narrative form. The graphic forms or "profiles" demonstrate some practical uses of this powerful communication device for university policy and decision makers for quality assessment and improvement. The narrative form discusses the interpretations to be drawn from the statistics and the profiles. Chapter V presents a summary and conclusions and implications of the study, along with recommendations for further study. The Appendices contain: an amended alphabetical listing of the population of one hundred and seventy-one doctoral institutions; a listing of the forty-nine data variables, along with their definitions and data sources; and rankings of the eight key variables identified in the study.

CHAPTER II

RELATED LITERATURE

INTRODUCTION

The major research objectives, research questions, and hypothesis to be addressed in this dissertation were introduced in Chapter I. A review of the objectives and the eleven research questions which will be discussed in relation to the literature review will serve as the introduction to this chapter.

Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

L1. What groups similar to the population of doctoral institutions have been described in prior studies?

L2. What research methods, variables, and statistics have been used to measure academic quality?

L3. What methods have been used in the development of research data bases?

Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

L4. Were the correlations among the descriptive variables in prior studies sufficiently high to permit a reduction in the number of variables?

L5. What groupings or domains of variables have been used in prior studies?

<u>Objective 3:</u> To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

L6. What research methods and variables have been used to measure academic quality in prior studies?

L7. What variables seemed to best measure and predict academic quality in prior studies?

<u>Objective 4:</u> To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.

L8. What problems have occurred in the use of rankings of institutions of higher education?

L9. What major non-ranking methods can be used for analytical and descriptive purposes?

<u>Objective 5:</u> To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.

L10. What are the current major theories of academic quality?

L11. What factor analytic structures underlying doctoral institutions have been observed?

These eleven research questions were used as a basis for the literature search and as an organizational base for the literature review. Each of the topics presented here relates to one or more of the research questions. These questions are periodically referred to in the discussion which follows in order to guide the reader's perspective and understanding of the literature.

RESEARCH METHODS USED IN THE STUDY OF LARGE COMPLEX ORGANIZATIONS

Introduction

Three research methods from fields other than higher education were found to be useful in answering two of the research literature questions in the present study:

L3. What methods have been used in the development of research data bases?

L9. What major non-ranking methods can be used for analytical and descriptive purposes?

These three research methods, which provide the foundation for the study, will be briefly discussed in this section. They are: 1) Computer-Based Information Systems, 2) Meta-Analysis of Extant Data, and 3) Indicators. The more traditional aspects of the study methodology, such as research procedures and statistical models and techniques, are extensively discussed in Chapter III.

Computer-Based Information Systems

Computer-Based Information Systems (CBISs) as tools for management decision making have evolved rapidly from the early 1950s to the present time. Brinkman (1984) traces their development as follows. First, in the 1950s, came Electronic Data Processing (EDP) systems which were data oriented. They were primarily used for recording, storing, maintaining, and recalling data. In the early 1960s, Management Information Systems (MIS) appeared which were oriented to information, rather than data. They emphasized the organization of data and information sources and were primarily used by middle management to solve routine well-structured problems and to coordinate operations. Data Based Management Systems (DBMS) appeared in mid-1970. They were a type of MIS, in that they enhanced data entry and maintenance functions, but they also responded to new demands for ad hoc retrieval of information. Decision Support Systems (DSS) which appeared in the late 1970s also were similar to MIS, but they were more directed to senior management needs for solving relatively unstructured poorly-defined problems. These types of problems can change quickly and frequently require data external to the organization. The emphasis is on strategic, rather than operational or tactical, problem-solving. Today, the emphasis is on systems which use microcomputers to perform the previously described data and informational functions, but more directly support decision making by aiding the cognitive or knowledge processes. Thus, Brinkman concludes that a good CBIS in the mid-1980s ahould be able to do three things: 1) provide access to much of the data and information needed for making decisions and for understanding the workings of an organization; 2) provide a medium, or set of alternative media, that allows data and information to be assembled, manipulated, analyzed, and reported; and 3) provide support for the thought processes, for the relating of assumptions, concepts, facts, rules of thumb, and so on that are required for policy and managerial understanding and decision making.

Meta-Analysis of Extant Data

Until recently, higher education has been generally described in terms of its "condition," that is, in terms of enrollments, earned degrees, and expenditures. The condition is usually reflected in collections of statistics on: trends in applications, admissions, and degrees awarded; attrition; student credit hours; costs per student; and various cost ratios or cost trends. These statistics, which are usually simply aggregated and reported, merely provide a base for policy analysis. Usually, there is little, if any, systemmatic analysis of this statistical data to assess higher education policies or strategies.

Probably, the main reason for this lack of assessment has been due to the high costs, in terms of people, time, and money required for large-scale data collection, which was believed to be a necessary part of such assessments. Large-scale data collection is invariably expensive, time-consuming, and highly technical and labor-intensive, requiring a vast array of highly knowledgeable and broadly trained staff. For example, a typical effort might require: staff experienced in research design and research methodologies, staff with expertise in sample design and execution, staff with technical expertise in the development of large-scale data bases, staff experienced in response processing and editing, and staff equipped with highly sophisticated analytical and writing skills (Myers and Rockwell, 1984, 22).

There is, however, a low-cost alternative frequently overlooked by researchers, "meta-analysis of extant data." Meta-Analysis is the use of statistical methods to describe the results of a number of research studies. "Secondary analysis," which is the method used here, is the simplest form of meta-analysis

(Hedges, 1984, 26). It is an examination of a pool of directly comparable raw data which has been obtained from one or more studies and combined for re-analysis in a single large statistical analysis. The data set may also include newly collected primary data.

Secondary analysis is becoming increasingly useful to researchers. Some of its uses include: 1) investigating methodological problems in analyses of field-based research data; 2) conducting meta-evaluations and alternative analyses of evaluative data; 3) studying policy implications and alternatives; 4) extending data archives to new problem areas; and 5) synthesizing evaluation and research on a given topic or problem (Fortune and McBee, 1984, 27-28).

Secondary analysis usually involves nine research steps: 1) identifying a problem of interest; 2) designing a study of interest; 3) finding appropriate data bases; 4) negotiating access to the data bases; 6) preparing the required data file or files; 7) accessing the variables of interest; 8) analyzing the data; and 9) reporting the results. These nine steps require a multiplicity of tasks, involving research methodologies, logistics, and computer mechanics (Fortune and McBee, 1984, 28).

Although the secondary analysis method looks reasonably simple on its face, many difficulties and complexities are usually encountered. Fortune and McBee (1984) describe more than twelve different preparation processes and seven associated pitfalls (that is, sample skews, merger mortality, non-response noise, variant variables, aggregate anomalies, time tangles, and mechanical measures) which may be encountered in using secondary analysis.

Extant or existing data obtained from public extant data bases can include both original data with software or data sets. The major collector and disseminator of extant data bases is the United States government which maintains the largest survey apparatus in the world. According to Turner and Martin, (1981), the government annually conducts more than two hundred surveys and censuses, requiring more than five million interviews and absorbing one million hours of respondents' time. Even more surveys, ranging from public opinion polls to market surveys, are conducted each year outside government. Some of these surveys also produce large-scale data bases. Some examples of these are: 1) the Institute for Social Research (ISR) at the University of Michigan; 2) the Inter-University Consortium for Policy and Social Research (ICPSR); 3) the National Opinion Research Center (NORC); 4) the

Research Triangle Institute (RTI); 5) Westat; 6) the Cooperative Institutional Research Program (CIRP); and 7) the Educational Testing Service (ETS). The data bases derived from these surveys and censuses conducted by these and other organizations are generally made available to researchers at little cost (Myers and Rockwell, 1984, 5).

Important features of extant data bases are: 1) they are available to the public without restrictions, 2) they are disseminated in a form that can be used by a computer, 3) the samples are large enough so that national parameters can be estimated, and 4) they contain data useful in policy and evaluation research (Myers and Rockwell, 1984, 6).

Although these data bases have enormous potential for policy analysis and evaluation research in a wide range of fields, they are little used. The reason for this lack of use is usually attributed to ignorance of their existence and to the technical and logistical difficulties involved in locating and using them.

The present study used both the secondary analysis method and data obtained from extant data bases, principally that maintained by the National Center for Education Statistics collected through the Higher Education General Information Survey (HEGIS). The data are thoroughly described in Chapter III which follows.

Indicators

Until recently, the use of indicators in higher education was primarily limited to financial indicators, such as expenditure/student ratios, which were used to measure financial condition. However, there is increasing interest in the use of indicators in the management of higher education institutions themselves through the overall assessment of the condition of higher education, including assessments of problems and opportunities. This use of indicators or "key variables" has an analogy in economics. The work of Sir Richard Stone, Professor Emeritus of Finance and Acccounting at Cambridge University and winner of the 1984 Alfred Nobel Memorial Prize in Economic Science, and James Meade, a 1977 Nobel Laureate, is worthy of mention. During the 1940's, Stone and Meade, helped John Maynard Keynes sift through and organize billions of transactions comprising economic behavior into key statistics which profiled the state of the British economy. This work enabled Britain's leaders to accurately assess its resources and, thus, helped to ensure the country's ultimate success in World War II (Greenwald, 1984).

Reasons for this new interest in the use of indicators in higher education have both positive and negative aspects. On the positive side, there is growing recognition that external factors, such as demographics and inflation, are dramatically affecting institutional decisions and that information on the condition of higher education needs to be improved. This has increased the willingness of institutions to learn from each other. On the negative side, institutions are interested in the use of indicators to justify their problems, that is, to indicate that others are suffering the same fate, and as surrogates for funding formulas to persuade others to give more support.

Some of the specific uses of indicators in the management of higher education institutions according to Kramer (1981) are:

1) To provide a reasonable set of assumptions for meeting institutional commitments.

2) To suggest solutions to problems, rather than merely registering improvement brought about by their solution.

3) To assist in making internal management decisions, indicating areas of relative strength and weakness and even suggesting remedial strategies.

4) Using knowledge of the status of an institution on certain measures, that is, how well or badly it is doing, to help improve its relative standing on those measures.

5) To determine the relative institutional need for public or private aid.

Summary

The literature reviewed above addressed two research questions. The literature findings are briefly summarized below in reference to the research questions.

L3. What methods have been used in the development of research data bases?

The most relevant research method for the technical aspects of the present study seems to be a CBIS which combines data from national extant data bases (for example, the National Center for Education Statistics) and published reports (for example, the Associated Research Councils Study) on a personal computer system. Also relevant are application software, statistical software, and computer utilities designed for literature searching. Such a system could serve as a basis for the present study, as well as for future studies.

L9. What major non-ranking methods can be used for analytical and descriptive purposes?

The most appropriate method for analysis in the present study seems to be the meta-analytic method of secondary analysis of extant data. The most relevant method for description seems to be profiles based upon a set of key variables or indicators of quality selected to represent a much larger set of informational variables. These profiles can provide a simultaneous multivariate display for desciption and analysis of institutions of higher education.

QUALITY ASSESSMENT METHODS

Introduction

The research reported in this section addressed one of the literature questions relevant to the prediction of academic quality:

L6. What research methods and variables have been used to measure academic quality in prior studies?

The literature indicates that dozens of methods have been employed in the hundreds of quality ratings of American higher education which have been published since the first one was published in 1910. Many of these quality assessment methods have been used only once. However, in the last twenty years, eight methods have been used with some frequency. Three are based on the accomplishments of faculty: 1) reputational studies; 2) citations in citation indexes; and 3) faculty awards, honors, and prizes and membership in honorific organizations. Two are based on the accomplishments of students: scores of entering students on standardized tests and student achievements in later life. Of the final three methods, one is based on "institutional affluence," one is based on the "value-added" (that is, on the "products" of institutions), and the third, the "multivariate," employs two or more of these methods simultaneously.

These methods are also frequently categorized to reflect the various "views" of academic quality: 1) the reputational view, 2) the resources view, 3) the outcomes view, 4) the value-added view, and 5) the multivariate view. However, it should be noted that there is considerable overlap in the use of these methods in quality studies, since few studies are methodologically "pure," but simultaneously involve more than one of these methods to various degrees. For example, a single study can survey faculty reputation and also collect one or more resource measures. Similarly, there is considerable overlap in the categorization of the various methods attributed to each of these views. For example, the reputation of faculty can be ascribed, both to the reputational view and to the resources view.

These eight methods, reflecting the various views of quality, have been discussed extensively by a number of scholars in a variety of publications. However, Webster (1983) and Astin (1980; 1985) probably have described them best. The following is a summary of their descriptions of the important types of studies using each of these methods, with the major advantages and disadvantages usually attributed to them, set within the context of the views of academic quality which they reflect.

Reputational

This method reflects the reputational view of academic quality which defines institutional quality on the basis of a consensus of opinion, that is, quality is whatever knowledgeable people "think" it is. Although these studies represent only a small number of the quality assessment studies, they are probably the best known of the multi-disciplinary studies. The first national study of graduate education using this approach was published by Raymond M. Hughes in 1925. Other later major national studies of importance were published by Hughes (1934); Keniston (1959); Cartter (1966); Roose and Andersen (1970); Jones, Lindzey, and Coggeshall (1982); and Gourman (1983). Two national reputational studies of quality in undergraduate education are also of importance, one by Astin and Solmon (Astin and Solmon, 1981; Solmon and Astin, 1981) and one by Gourman (1983). These studies are important to the present study and are discussed later in this chapter. The studies by Jones, Lindzey, and Coggeshall; Gourman; and Astin and Solmon could also be considered to be multidimensional studies.

The advantage of reputational studies is that the raters are those who supposedly know the most about academic quality in each discipline. These rankings, of all the major types of quality rankings, also produce results with the most face validity (that is, they match most closely what the educated general public considers the higher education university hierarchy to be).

These studies also have several major potential disadvantages: they are subjective in nature; they can effectively rate only departments whose members have substantial research reputations; they are subject to "halo effects" (that is, the overall reputation of an institution may influence, for better or worse, raters' assessment of a particular department they are being asked to rate); they reinforce the hierarchical structure of the higher education system; they lag several years behind reality; they are useful only for ranking the best or better institutions; and they use scholars from the nation's leading institutions in disproportionally large numbers as raters and these scholars tend to rank high those departments of the same type and emphasis as their own, while ranking lower "innovative or different" departments. A high quality institution of this type would probably have highly selective admissions, large enrollments and faculty size, and large graduate facilites.

The next four methods reflect the resources view of academic quality, that is, academic quality is equated with an institution's educational resources, such as: highly trained and prestigious faculty, highly trained students, and institutional affluence. These resources also have traditionally provided the principal empirical basis for institutional accreditation.

Citations in Citation Indexes

These studies view faculty as one of the resources of an institution and they assess the quality of that resource in terms of faculty publications. The most typical method used to assess faculty publications is through articles listed in citation indexes. A citation index is an annual list of a scholar's work which appears in journals and periodicals covered by the index in a particular year. Citation studies usually count: the number of citations, an aggregation of citations (for example, over some time period), or citations per capita. Their advantages are: they are useful in assessing, not just the volume of publications, but the influence and importance of faculty members (that is, researchers with many mediocre publications are not cited often) and they reflect the present or very recent influence of a department's faculty. Their disadvantages are: they are greatly influenced by the number of scholars who are currently publishing in a particular field and whether the field is expanding or contracting; they fail to take into account who is doing the citing; and they are subject to manipulation (for example, a researcher can cite his own studies).

Faculty Awards, Honors, and Prizes and Membership in Honorific Organizations

These studies also share the resource view of quality, but assess faculty quality, not in terms of faculty publications, but in terms of the prestige of faculty members, as measured by faculty awards, honors, and prizes and membership in honorific organizations. The major advantage of these studies is supposed to be their objectivity, however, as Allan Cartter has pointed out, they are really "subjective ratings once removed." These studies are usually criticized for: focusing only on a small group of "elite" faculty members, rather than on all faculty members; being more useful for ranking the best and better institutions; and for being either years behind or ahead of reality.

Scores of Entering Students on Standardized Tests

These studies also reflect the resource view of academic quality as reflected in the students entering an institution. These studies frequently use such tests as the Scholastic Aptitude Test (SAT) or the American College Test (ACT) to assess the level of training or "quality" of students. The advantages of these studies are: the data are current, easily obtainable, and available for a great many institutions (not for just research institutions) and the scores are available on all entering students, not just a special group of students (for example, only those winning awards or graduating). Disadvantages are: the studies are based on the academic abilities of students before they enter an institution and fail to consider what institutions do to educate them (what Alexander Astin calls the "value added" effect); institutional admission policies play a large role in determining students' scores on standardized tests; and schools with smaller enrollments may be rated higher.

Institutional Affluence

These studies also reflect the resource view of academic quality in terms of institutional assets, revenues, and expenditures. They frequently employ such measures as: the number of library volumes or library resources; revenues from specific sources (for example, research grants); various types of educational expenditures; and ratios, such as faculty/student. Advantages of these studies include: all institutions can be compared, not just some; data are current and relatively easy to obtain; and the studies provide information on what students experience during their stay on campus, not before or after they leave. The major disadvantages usually cited for these studies is that they measure what resources are "available," not "how beneficially students use" the resources.

Student Achievements in Later Life

These studies reflect the "outcomes" view of institutional quality which defines institutional quality, not on the basis of an institution's reputation or in its resources, but, rather, on how many "distinguished alumni" or "distinguished scientists" institutions produce. Astin also refers to this view of quality as a "poor-man's value-added approach." Institutional quality of this type is usually found by determining the proportion of an institution's graduates who: win graduate fellowships, go on to get doctorates, or who subsequently appear in "Who's Who In America" or "American Men and Women of Science." Other outcome measures used include the persistence rates of undergraduates and the lifetime earnings of an institution's alumni. From 1910 to the 1960s, when they were largely discredited, these studies were the most frequently published type of quality rating. The major advantage of this type of study was their universality, that is, one could effectively rank order all American colleges and universities, not just the research institutions, because they all had "achievement of graduates." Two major disadvantages of these studies are usually mentioned: the rankings are inevitably thirty years or more behind the time and the achievements of an institution's graduates depend more on the ability of the students it attracts than on the quality of the institution (that is, institutions that "attract" superior freshmen "produce" high achieving graduates).

Value-Added

Studies, using the value-added method, which is closely identified with Alexander Astin, view institutional quality in terms of educational impact or value-added (in economic terms). This view of quality states that "true" quality resides in the institution's ability to affect its students favorably, that is, to make a positive difference in their intellectual and personal development. Thus, in this view, the highest-quality institutions are those that have the greatest impact or "add the greatest value" to the student's knowledge, personality, and career development. Astin argues that an advantage of these studies is that they have already changed thinking on matters, such as: the optimal size of an institution, the value of the residential experience, and the relative merits of four-year versus two-year colleges. Major disadvantages of these studies usually mentioned are: they are extremely time-consuming and expensive to conduct (that is, they require extensive files of multivariate and longitudinal student data collected from large numbers of students and institutions); they are difficult for an institution to conduct by itself; and they attract little financial support from funding agencies.

Multidimensional

Studies using this method measure, not just one, but many characteristics of colleges and universities.

The major advantage of this method is that it reflects recent quality assessment research which has overwhelmingly indicated that academic quality is not unidimensional in nature, but rather, that it is multidimensional with many correlates. The major disadvantages associated with this method are: determining just which of the many characteristics used to describe colleges and universities are the key indicators of quality; the relative importance of each indicator; and the high cost of collecting and processing the data. One major purpose of the present study was to find ways of overcoming these serious disadvantages.

Summary

The literature reported above addressed the following literature question:

L6. What research methods and variables have been used to measure academic quality in prior studies?

The literature indicates that a total of eight major methods have been used most frequently in the last twenty years to assess academic quality in higher education. This set of methods evaluates academic quality on the basis of the characteristics of students, faculty, institutional resources, institutional products, or on some combination of characteristics.

EMPIRICAL QUALITY ASSESSMENT STUDIES

Introduction

Most of the literature questions were directly addressed by ten empirical quality assessment studies. Specifically, these ten studies answered the following eight research questions:

L1. What groups similar to the population of doctoral institutions have been described in prior studies?

L2. What research methods, variables, and statistics have been used to measure academic quality?

L4. Were the correlations among the descriptive variables in prior studies sufficiently high to permit a reduction in the number of variables?

L5. What groupings or domains of variables have been used in prior studies?

L7. What variables seemed to best measure and predict academic quality in prior studies?

L8. What problems have occurred in the use of rankings of institutions of higher education?

L10. What are the current major theories of academic quality?

L11. What factor analytic structures underlying doctoral institutions have been observed?

The ten empirical studies have been organized into three groups: 1) Early Empirical Studies: the First Hughes Study (1925), the Second Hughes Study (1934), and the Keniston Study (1959); 2) Major Empirical Studies: the Cartter Study (1966), the Roose-Andersen Study (1970), and the Associated Research Councils (ARC) Study (1982); and 3) Other Empirical Studies: the Council of Graduate Schools-Educational Testing Service (CGS-ETS) Study (1978), the Higher Education Research Institute (HERI) Study (1979), and the Gourman Graduate and Undergraduate Studies (1982).

These studies also provide the historical perspective essential to an understanding of the major issues involved in any assessment of academic quality. The six studies comprising the early and major empirical studies all relate to quality assessment in graduate education, which is the focus of the present study. The three early empirical studies, which were conducted prior to 1964, are briefly reported for historical background purposes only.

The three major empirical studies, all sponsored by the American Council on Education (ACE), are highly significant to the present study. Thus, they are reported in great detail. These three studies covered a broad range of disciplines in engineering, the hamanities, and the sciences and were based on the opinions of knowledgeable individuals in the program areas covered. The most recent of the three studies, the ARC Study, is often described as the "Rolls Royce" of academic quality studies. It provided three of the four graduate quality measures used in the present study.

The other four studies are all multidimensional studies which relate to quality assessment in both graduate and undergraduate education. The CGS-ETS Study is a pilot study of reputational ratings in graduate education. It was included because of its importance to the methodology used in the present study.

The HERI Study, by Astin and Solmon, is an assessment of quality in undergraduate education. Although it is smaller-in-scale than the other studies described, which were published since 1964, it was included because it demonstrates the reliability between graduate and undergraduate quality assessments and also because it represents an alternative theoretical approach to the interpretation of academic quality in institutions of higher education.

The two Gourman studies (one assessing graduate and the other assessing undergraduate education) provided the final two quality measures used in the present study. The Gourman quality measures were included, in spite of the often-mentioned Gourman study methodological defects, for several reasons. First, the Gourman quality measures are contemporary with the ARC quality measures. Second, the Gourman quality measures are a composite based on multiple dimensions, whereas the ARC quality measures are unidimensional measures. Third, the Gourman quality measures are available by institution, which is the focus of the present study, (the ARC quality measures had to be laboriously aggregated). Finally, the Gourman quality measures are available for both graduate and undergraduate education, so they can be used to test both the stability (the graduate measure) and the reliability (the undergraduate measure) of the present study's ARC institutional quality ratings.

Early Empirical Studies

Introduction

The earliest empirical studies of academic quality in graduate education are best described as small unidimensional studies which primarily used reputational measures and unsophisticated experimental methods to assess academic quality. However, many of the major findings obtained in these studies have been replicated in later investigations.

First Hughes Study (1925)

The first published reputational study of quality in American graduate schools was conducted in 1924 by Raymond Hughes (1925) while president of Miami University in Ohio. Hughes, concerned about the guidance of Miami undergraduates, evaluated the quality of graduate instruction in 38 of the 65 universities then offering a Ph.D. degree. He surveyed 20 graduate disciplines in 5 major fields of knowledge: Humanities (6), Social Sciences (5), Biological Sciences (3), Education (1), and Physical Sciences (5). He used a questionnaire to query a panel of experts (that is, distinguished national scholars in the 20 disciplines) selected by his faculty at Miami. He reported a response rate of approximately 50%. The findings were reported in 1925 at the annual meeting of the Association of American Colleges (AAC) and subsequently published. Hughes ranked the top universities as follows: 1) Chicago, 2) Harvard, 3) Columbia, 4) Wisconsin, 5) Yale, 6) Princeton, 7) Johns Hopkins, 8) Michigan, 9) California, 10) Cornell, 11) Illinois, 12) Pennsylvania, 13) Minnesota, 14) Stanford, 15) Ohio State, 16) Iowa, 17) Northwestern, 18) North Carolina, and 19) Indiana (Keniston, 1959, 119). It should be noted that Hughes reported only departmental ratings in his findings.

Therefore, the institutional rankings (based on quality points) by Keniston, which were reported above, will vary somewhat from those reported by other researchers (for example, Webster, 1983, 23) who may have used somewhat different methods to determine overall institutional rankings.

This study was strongly criticized for: 1) being non-representative, because only "experts" (ranging from 20 to 60 for each discipline) were used as respondents and 2) for bias (in favor of region, alma mater, and current institution), because the majority of the experts were both trained and employed in the Northeast and Midwest. Not considered, however, was the fact that most of the distinguished universities in 1925 were in those geographic areas.

Second Hughes Study (1934)

The second major national study of graduate quality, also by Raymond Hughes (1934), was conducted in 1934 while Hughes was serving as President of Iowa State College. This study was a similar, but expanded version, of the 1925 study. It is also noteworty because it was the first study, in a long tradition of national assessments of graduate quality, pioneered by the American Council on Education (ACE). This second study surveyed 35 disciplines in 6 major fields of knowledge: Agriculture (2), Biological Sciences (9), Education (1), Engineering (6), Humanities (6), Physical Sciences (5), and Social Sciences (6) in 59 institutions of higher education. The procedure was as follows. Hughes developed a list of institutions offering doctoral programs in each discipline from reports of deans, supplemented by study of catalogs. Next, he asked the secretary of the national learned society in each discipline to provide a list of 100 well-known scholars from among all the various specialities within the discipline. These scholars became the raters. They were sent the institutional list and a list of the respective graduate staffs in the disipline. Raters were asked to: 1) check those institutions which, in their judgment, had an adequate staff and equipment to prepare candidates for the doctorate and 2) "star" the departments of highest rank (roughly the highest 20%). Returns were summarized and graduate departments were classified into two categories: 1) "Starred" group (those institutions accorded a star by the majority voting) and 2) "Adequately staffed" group (those institutions checked by a majority, but failing of a majority of stars). The reported response rate in the second study was approximately 71%, substantially higher than the approximately 50% reported by Hughes in his first study. In general, the rankings for the top institutions were similar to those reported by Hughes in his first study.

Keniston Study (1959)

The third early study was conducted in 1957 by Hayward Keniston (1959) as part of a comparative self-study at the University of Pennsylvania. Keniston's purpose was to determine Pennsylvania's position relative to similar senior universities. Twenty-five (25) leading "doctorate producing" institutions were selected on the basis of: 1) membership in the AAU, 2) number of Ph.D.'s awarded in recent years, and 3) geographic distribution. The study, thus, consisted of findings obtained from queries of the 25 department chairmen in 24 disciplines in 4 fields of knowledge: Biological Sciences (3), Humanities (10), Physical Sciences (5), and Social Sciences (6) in these institutions. The chairmen were provided a list of the 25 institutions and were asked to rate, on an accompanying sheet, the strongest departments in his discipline, arranged roughly as the first five, the second five, and if possible, the third five, on the basis of the quality of their Ph.D. work and the quality of the faculty as scholars. There was a reported response rate of about 80%. Keniston calculated scores for each department by weighting inversely the rank order assigned by a respondent (that is, if ranked first, the score was 15; if ranked second, the score was 14, and so forth). He then tabulated and compiled the weighted ratings and ranked the departments according to the totals. Resulting rankings and quality points for the top 20 departments in each of the 24 disciplines in this study, as well as those from the 1925 Hughes Study, were then reported by discipline, field of knowledge, and institution in an appendix to the study of graduate education at the University of Pennsylvania. The 1925 Hughes Study results were included so one could determine "what changes have taken place in the course of a generation" (Keniston, 1959, 116). Results indicated, as before, that primarily the same institutions received the highest rankings.

Keniston's raters were criticized for the following reasons: 1) chairmen are frequently not the most distinguished scholars in their departments; 2) the average age of the chairmen was considerably above that of the faculties, thus, time lag may have been built into the sample; and 3) chairmen tend to be traditionalist in hiring, overly favoring a few major universities that have turned out the largest number of distinguished Ph.D.'s in the past (Cartter, 1966, 6).

Keniston was also criticized for the small number of universities used.

Major Empirical Studies

Introduction

These three empirical studies comprise the best and most complete empirical studies ever performed on academic quality. They may be characterized as large nationally representative studies of academic quality in graduate education. The studies all used a multivariate approach, although the use of the term "multivariate study" and the recognition of the significance of this approach did not immediately appear in the reports. Criteria for academic quality included: reputational, faculty publication rates, faculty salaries and compensation, other faculty achievements, student achievements, and institutional affluence. None of the studies used the value-added approach. Experimental design sophistication was high in these studies, especially in the last investigation (the 1982 ARC Study) which answered nearly all of the earlier methodological criticisms. Further, the ARC Study included more institutions and programs than have ever been included in any other study of academic quality.

Cartter Study (1966)

Introduction

The Cartter (1966) Study, conducted in 1964, was the largest, best, and most expensive national assessment of academic quality in graduate education ever conducted up to that time. It was the second study sponsored by the American Council on Education. Financial support was provided by the National Science Foundation, the National Institutes of Health, and the United States Office of Education. This study was similar to the earlier studies in that it was essentially subjective, but it was designed to avoid some of their shortcomings. It elicited responses similar in nature to those asked by Hughes and Keniston and, thus, partially duplicated their studies. At the same time, it provided broader coverage of both respondents and institutions. It reported results only by discipline, with one exception--it reported the average scores of the "top universities" by the five fields of knowledge (Cartter, 1966, 107).

Methodological Concerns

There were several major methodological problems brought up by critics of earlier studies which Cartter attempted to correct in his study. The most important of these are indicated below.

Problems in Selection of Raters and with Rating Procedures--Critics argued that prior panels of raters were either: 1) too small; 2) lacked expertise (for example, the raters included only distinguished national scholars or department chairmen); or 3) were not representative (for example, in relation to particular geographic areas of the country, institutions of own highest degree, specialities within a subject field, age and rank, size and eminence of present universities, and knowledge of the general academic scene).

They also argued that ratings were subject to "halo effects" (for example, assigning a high rank to the quality of teaching because of high faculty accomplishment) and were not separated sufficiently (for example, there was no distinction made between the quality of the faculty and the quality of the degree programs).

Specific corrections were attempted by Cartter to address these problems, such as: a larger and better balanced set of raters; improved sampling procedures, instructions, and rating forms; and by conducting reliability tests relating to the qualifications of the raters and to the extent of the agreement among them.

Problems of Rating Reliability and Content Validity--Critics argued that the ratings were simply gossip. To determine the reliability of the ratings (that is, whether the ratings consistently measured what they purported to measure), Cartter performed an internal consistency test of the measuring instrument by dividing the raters into two groups and correlating the two groups of ratings. To determine the content validity of the ratings (that is, the degree to which the ratings measured what they purported to measure), Cartter correlated them with other more "objective" measures of quality, for example, faculty publication rates, faculty salaries, faculty compensation, faculty and student honors and awards, and library resources.

Problem of Aggregation of Department Ratings--Finally, critics argued that aggregating the ratings of departments to provide university-wide ratings (as was done by Keniston) was an invalid procedure for ranking universities. To correct for this, Cartter provided ratings only by department (except in the case noted above). His justification for this was: 1) there is no equitable way to aggregate ratings of disciplines; 2) overall ratings would involve (implicitely or explicitely) some judgment about how the various disciplines should be weighted; and 3) many institutions don't offer work in all of the disciplines under review and aggregating ratings would unreasonably penalize such schools.

Objectives

The Cartter Study had three major objectives: 1) to bring earlier quality studies of graduate education up to date; 2) to widen the scope of the assessment to include all major universities in the United States; and 3) to study the validity of the subjective rating scale approach by examining the methodological problems relating to it and by comparing it with more objective measures which reflect institutional quality, such as faculty publications and compensation and library resources. Thus, this was the first major national attempt to determine academic quality using multidimensional measures, which is the method used in the present study.

Sampling Methods and Procedures

To meet many of the criticisms of earlier studies, Cartter used a more careful method for selecting institutions, disciplines, and raters to provide a more comprehensive basis for the survey. The sample was selected on the basis of two criteria: 1) to provide overlap with the earlier surveys and 2) to include most of the disciplines in the Arts and Sciences.

Institutions Included--The survey included 106 institutions of which 100, in 1961, formed the Council of Graduate Schools (CGS) in the United States and 6 which, although not belonging to CGS, had granted 100 or more doctorates spread over 3 or more fields during the 1953-1962 period. Together, these institutions produced more than 95% of all doctorates awarded per year during that period.

Fields, Disciplines, and Programs Included--Cartter's Study included 1,663 programs in 29 academic disciplines in 5 academic fields of knowledge: Biological Sciences (8), Engineering (4), Humanities (7), Physical Sciences (5), and Social Sciences (5). These programs produced three-fourths of all of the Ph.D. degrees granted during the decade, 1954-1964.

Participating Judges or Raters--To meet the criticism that the individuals comprising the group of raters were not representative, Cartter devised an elaborate procedure to ensure representativeness. The procedure used is as follows. First, since the intent was to collect "informed opinions" of persons in various age and rank levels, three major groups were included as raters: department chairpersons, distinguished senior scholars, and knowledgeable junior scholars who had completed their formal training not more than ten years earlier. Second, graduate deans of the 106 institutions included in the study were asked to provide names of faculty who were in these three groups and who were in residence in the spring of 1964.

Ninety-nine percent (99%) of the Deans responded and the raters were selected from the lists provided. Next, sample size was weighted by university size as follows: four participants were included for departments which granted 2% or more of the degrees granted in a particular field of study; three were included for departments granting 0.5 to 2% of the degees; two for departments granting less than 0.5% of the degees; and one participant was included for those departments granting no degree, but which offered graduate courses in the field. Finally, 5,367 questionnaires were mailed. Of the 4,256 (79%) questionnaires returned, 4,008 (75%) were useable and, thus, constituted the sample.

The Questionnaire and Rating Scale--To meet the criticism that the questionnaire did not separate faculty ratings from program ratings, Cartter provided a revised questionnaire and rating form. He asked each participant to select from several terms the one that best described his judgment of: 1) the quality of the graduate faculty, 2) the effectiveness of the doctoral program, and 3) the degree of expected change in the relative position of departments in as many of the major institutions offering doctoral study in his discipline as he felt competent to rate. To determine the representativeness of the raters, the questionnaire also requested basic biographical information.

Rating Procedure--The raters were provided an alphabetized list of the 106 institutions and asked to rate the doctoral programs in their own discipline on two components: 1) Quality of the graduate faculty with seven response categories: "Distinguished," "Strong," "Good," "Adequate," "Marginal," "Not sufficient to provide acceptable doctoral training," and "Insufficient information" and 2) Effectiveness of the doctoral program with five response categories: "Extremely attractive," "Attractive," "Acceptable," "Not attractive," and "Insufficient information." A third question with four response categories, "Relative improvement," "Same relative position," "Relative decline," and "Insufficient information" was asked regarding the expected change in the relative positions of departments in the field in the next five to ten years. To each term describing the quality of the faculty and the effectiveness of the program, Cartter assigned a numerical weight. He then calculated average scores for each question for each department at each institution.

Results

Study results, including ratings and a discussion of the relationship of the scores to other factors assumed to contribute to high-quality graduate education, were published by Cartter in 1966. Those results relating to departmental ratings, rating reliability, and content validity are important for the present study and are discussed below in some detail.

Departmental Quality Ratings--Specific departmental ratings are of much less importance to the present study than are the correlations indicating reliability and validity and, thus, they will not be discussed here. However, two major points should be made regarding them. First, in reporting the results to the first two questions regarding the quality of the faculty and the quality of the program, only the results for the top two score categories were reported, that is, in the case of faculty, those rated "Distinguished" (with scores ranging from 4.01 to 5.00) and those rated "Strong" (with scores ranging from 3.01 to 4.00) and, in the case of programs, those rated "Very Attractive" (with scores ranging from 2.01 to 3.00) and those rated "Attractive" (with scores ranging from 1.51 to 2.00) were listed in rank order. The categories of "Good" (2.51 to 3.00) and "Adequate plus" (2.00 to 2.50), in the case of faculty, and "Acceptable plus" (.75 to 1.50), in the case of programs, were listed alphabetically. Universities rated "Not sufficient to provide adequate doctoral training" (below 2.00), in the case of faculty, or "Not attractive" (below .75), in the case of programs, were not reported.

Second, comparison of Cartter's rating results with those of Hughes (1925) and Keniston (1959) indicates that, although there was some change in the relative position of some of the institutions, for example, Stanford went up (a giant leap) and Chicago and John Hopkins (a dramatic decline) went down, the same ten to twenty universities consistently appeared as the highest ranking universities, regardless of the discipline. This finding has occurred in nearly all of the studies of academic rankings of quality.

Reliability of Raters and Ratings--Results of the numerous reliability tests made by Cartter relating to the: 1) qualifications of the raters (that, is, expertise and representativeness); 2) extent of the agreement among the raters; and 3) measuring instrument or ratings all showed very high reliability. Specific results are presented below. It should be noted that in these reliability tests, Cartter used both the original body of respondents representing all of the study disciplines, as well as a selected set of four disciplines: econonmics, English, physics, and political science which was used for special studies.

1) Qualifications of Raters--To explore the expertise of the raters, Cartter selected small panels (12 to 15 raters on each) of experts from the four selected disciplines with the advice of the appropriate professional associations. These raters were selected on a different basis than were the raters in the original body of respondents and attention was given to regional and institutional balance. The experts were then mailed the same questionnaire used with the original body of respondents and asked to rate the top departments in their disciplines. The ratings of the experts were then correlated with the ratings of the main body of respondents. Results indicated small differences in the ratings between the two groups, which Cartter attributed to the small number of respondents on each panel, rather than to any positive difference in the pattern of judgments. Additionally, Cartter determined that a minimum of 50 knowledgeable persons are required for reliability.

To explore the representativeness of the raters, Cartter performed tests relating to: geographic area, age and rank, institutional background, and specialities within a discipline. Cartter felt that each of these sampling problems could be corrected by a balanced sample. Further, he felt that he had drawn such a balanced sample in his study. The most important results of each of these tests are summarized below.

a) Geographic Area--Geographic variations indicated a high degree of consistency in most ratings, but were fairly marked in some departments which underlined the necessity for achieving a relatively equitable balance of respondents from all parts of the country.

b) Age and Rank-Rankings for the top departments in each of the disciplines studied were tabulated separately for department chairmen, senior scholars, and junior scholars. Little was found to distinguish the ratings obtained from the three groups. Interestingly, senior scholars appeared to be the most reliable predictors of overall scores and the chairmen the least reliable, although the differences were not great.

c) Institutional Background--Quite marked biases were found in favor of Ph.D., alma mater, and current institutions in the panel of experts, but the manner of selection for the Cartter Study appears to have satisfactorily compensated for this. Cartter also looked at differences between quality ratings of the original sample and those of alumni, employees, and those without institutional ties. No significant differences were found.

d) Specialities within a Discipline--Several notable differences among specialities were found in English where the test was conducted. However, Cartter concluded that a broad-based sample that includes scholars of various age and rank categories would correct for the differences.

2) Extent of Agreement Among the Raters--To determine the consensus among the raters, Cartter compared rankings obtained from each of the three subgroups: department chairmen, senior scholars, and junior scholars within the total sample. Additionally, he compared the rankings for the four selected disciplines by these subgroups, by respondents employed in four regions of the country, and by the small panels of experts. A high degree of consensus was found in all of these tests among respondents grouped by age and rank. Differences were greater, but still minor, among regional groups.

In an additional test, Cartter compared results for political science obtained from political scientists in his 1964 survey with those obtained by Somit and Tanenhouse (1963) in a similar study. The latter survey used a much larger sample drawn randomly from all members of the American Political Science Association without regard to age, rank, or scholarly achievement. The two surveys produced almost identical results.

3) Measuring Instrument or Ratings--To test the reliability of the measuring instrument or ratings, Cartter performed a split-half reliability test of the mean departmental ratings. Split-half correlations give an indication of the overall reliability of the

academic ratings in each discipline and for each measure. For this test, Cartter divided the raters in each of the disciplines into two groups (odds and evens) using the unit position of an arbitrary identification number assigned earlier to each rater. Mean ratings were then computed separately for the odds and evens. Finally, the independent pairs of ratings for each field were correlated with each other. The resulting mean ratings of the departments in each discipline showed, without exception, an extraordinarily high degree of reliability. Uncorrected estimates ranged from 0.94 to 0.99 with a median uncorrected reliability of 0.98. The corrected median (that is, corrected by the Spearman-Brown formula which yields estimates of reliability based on all of the raters, rather than on only half) reliability estimate was 0.99.

Content Validity of Ratings--Cartter also made a considerable effort to evaluate the validity of the methodology used. He used various "objective" criteria, such as: 1) faculty publication rates, 2) faculty salaries, 3) faculty compensation, 4) faculty and student honors and awards, and 5) library resources for comparison with faculty quality at both the departmental and institutional levels. Again, Cartter used both the original body of respondents and the experts from the four selected disciplines, which were used in the reliability tests, to perform the validity tests. Results of all of these comparisons were gererally consistent with the ratings of quality obtained from the subjective responses to the questionnaire. Some of the specific content validity results at the departmental level are indicated below.

1) Faculty Publication Rates.--In this test at the departmental level, Cartter tested the accuracy of the subjective evaluations of faculty quality for three of the four selected disciplines (that is, economics, English, and political science) with the publication records of scholars in those disciplines. The procedure involved searching major journals in various fields in each speciality for articles and professional book reviews for books published by faculty during the 1960-1964 period. Simple counting or more complex scoring schemes were then used to estimate faculty publications. Results indicated that, although there was a wide variation within a single department, academic ranking in general was strongly related to the number of publications. Further, Cartter found that publications appeared to be highly concentrated in the top departments on the one hand (for example, in economics, 56% of all the publications were produced by only ten departments, of which nine were among the ten

highest rated), while on the other hand, a sizable number of doctoral departments had few or no publications.

2) Faculty Salaries--A second test of the validity of departmental quality ratings was conducted in the selected field of economics where information was available on faculty salaries in the leading departments. In this test, a multiple correlation was used to determine the relationship between faculty quality and the six salary levels of the forty-five leading economics departments. Faculty quality was used as the dependent variable and the six salary levels were used as the independent variables. Results indicated that the quality of the graduate faculty was closely related (0.85) to the mean salaries of the top two academic ranks. Further, it was found that the correlations declined systematically with decreasing professional status and rank (that is, "superior full professor" 0.79, "full professor" 0.75, "superior associate professor", 0.47, "associate professor" 0.36, and "assistant professor" 0.18).

The most important results of the content validity tests comparing overall institutional quality to objective measures are described below.

1) Faculty Compensation--The first of these institutional validity tests was conducted with the

original sample. It compared the average overall academic quality ratings for each university with average faculty compensation (salary and benefits) as reported by the American Association of University Professors (AAUP). A high positive correlation (0.87) was found between institutional ratings and compensation, attributed mainly to the compensation of Professors and Associate Professors. No significant correlation was found with compensation for Assistant Professors and Instructors.

2) Faculty and Student Honors and Awards--The measures used in this test were two Bowker (1965) rankings of universities on "indices of faculty quality and indices of attractiveness." The first measure, the Bowker Humanities-Social Science Index, was based on: the number of Woodrow Wilson fellows attending an institution (1961-62) and the number of former Woodrow Wilson fellows (1961-62), Guggenheim fellows (1961-63), and American Council of Learned Societies awardees (1958-63) on the faculty. The second measure, the Bowker Science Index, was based on: the number of National Science Foundation Fellows (1962-63) attending an institution and the number of Nobel Prize Winners (1940-63) and National Academy of Science members (1963) on the faculty. In these measures, as in other measures, there was a close relationship between the

rank order of universities in the two Bowker ratings and the 1964 ACE survey ratings.

3) Library Resources--In this institutional test, Cartter correlated the faculty quality rating with the library resources index (that is, a combination of total volumes, volumes added annually, and current periodicals) of the Association of College and Research Libraries (ACRL). A correlation of 0.79 was found between faculty quality (as measured by the first question in the questionnaire) and the library index.

Correlations between academic quality and other measures of expenditures, such as cost per student and size of institution, were not reported due to: inconsistencies in the manner in which universities reported expenditure data; the lack of a reliable measure for converting part-time student data into full-time-equivalents; and enrollment "mix" problems (for example, graduate and undergraduate and proportions of students by discipline).

Roose-Andersen Study (1970)

Introduction

The Roose-Andersen (1970) Study, conducted in 1969, was also sponsored by the ACE. It is sometimes described as a replication of the Cartter Study. However, although the methodology is essentially the same in both studies, the Roose-Andersen Study was much larger in scope (that is, it included 7 new disciplines and 25 additional institutions) than the earlier study and also differed in its format and emphases. Further, Roose-Andersen did not attempt to investigate the content validity question since they felt that Cartter had already established the validity of academic ratings.

Methodological Concerns

There were three major methodological concerns addressed by Roose-Andersen. First, they made a careful effort to include more programs (963 more) than were rated in the 1966 Cartter Study. Second, they tried to de-emphasize the "pecking-order relationships inherent in most scoring systems" by not presenting scores for individual institutions and also by presenting no institutional ratings. However, they continued the Cartter quality reporting practice of ranking only the top two categories. Third, although Cartter had already determined the high degree of internal consistency or reliability of the raters in his 1966 study, Roose-Andersen further investigated Cartter's finding by also comparing the ratings of the same three categories of raters in their study. Finally, Roose-Andersen wanted to determine the stability of the quality ratings over the five-year period by correlating Cartter's rating results with their own.

Objectives

The Roose-Andersen study had three basic objectives: 1) Extend the Cartter Study to include more, especially new, programs in United States graduate education; 2) Provide ratings by discipline and program, rather than by university; and 3) Determine the changes in graduate faculty and program ratings and statistics from 1964 to 1969.

Sampling Methods and Procedures

Institutions Included--The Roose-Andersen Study included 130 institutions versus the 106 institutions included in the Cartter Study. Thus, the number of institutions increased by 24 institutions or 23% over the 5 year period.

Fields and Disciplines Included--The same 5 fields of knowledge were used in both the Cartter and Roose-Andersen studies. Roose-Andersen also used the exact same method for selecting disciplines in 1969 as Cartter had used in 1964. This method dealt with the minimum numbers of graduates in the disciplines. Thus, in the 1969 study, all disciplines were included that had awarded a doctorate in the discipline during the

1957-58 to 1966-67 period. However, this same method yielded more disciplines and programs in 1969 than in 1964 because of the increase in the number of Ph.D. degrees granted and because of the creation of new fields of study. The fields and number of disciplines included in 1969 are as follows: Biological Sciences (10), Engineering (4), Humanities (10), Physical Sciences (5), and Social Sciences (7). Of this total of 36 disciplines, 29 were the same (that is, the "common disciplines") as in Cartter's 1964 study. The 7 additional disciplines were either disciplines which had not been sampled in 1964 (for example, art, humanities, and music) or were new disciplines which had developed in the five years between 1964 and 1969 (for example, Molecular Biology and Population Biology).

Table 1 below shows the number and percentage increase of disciplines surveyed by geographic region.

Table 1. Number and Percentage Increase of Disciplines Surveyed by Geographic Region, 1969

Region	Disciplines		Increase	
	1964	1969	No.	%
Northeast	10	11	1	10%
East	27	29	2	7%
Midwest	26	28	2	8%
South	26	35	9	35%
West	17	27	10	59%
All Regions	106	130	24	23%

As indicated in Table 1, there were increases in the number of disciplines surveyed in all geographic regions, with the greatest increases in the West (59%) and South (35%).

Academic Programs Included--The number of academic programs sampled in the disciplines also increased substantially from 1964 to 1969. For example, the increase in programs in the 29 common disciplines was 566 or 34% (from 1,663 to 2,229), while the increase in programs in all 36 disciplines was 963 or 58% (from 1,663 to 2,626). Table 2 below shows the number and percentage increases in the programs by field of knowledge.

Table 2. Number and Percentage Increase of Programs by Field of Knowledge, 1964-1969

	Number of Disciplines		Programs Surveyed		Increase 1964-1969	
Field of Knowledge	1964	1969	1964	1969	No.	%
Biological Sciences	7	10	429	880	451	105%
Engineering	4	4	197	287	90	46%
Humanities	6	10	287	500	213	74%
Physical Sciences	5	5	334	444	110	33%
Social Sciences	7	7	416	515	99	24%
Total	29	36	1663	2626	963	58%

As can be seen from Table 2, the largest increase in the number of programs was in the biological sciences. However, there were substantial increases in all fields of knowledge (Roose-Andersen, 1970, 5-7).

It is also interesting to note that 566 (59%) of the 963 "new" programs surveyed in 1969 were "old" programs in the sense that the programs had been previously surveyed in 1969 in other institutions, while 397 (41%) were "new" programs in the sense that none of these programs had ever been surveyed before.

Participating Judges or Raters--Roose-Andersen in 1969 used similar selection procedures and the same three categories of raters (that is, department chairmen, distinguished senior scholars, and knowledgeable junior scholars) as had been used by Cartter in his 1964 study.

The Questionnaire and Rating Scale--The 1969 study included three questions on the questionnaire as did the 1964 study. The first two questions (Quality of Faculty and Effectiveness of Program) were identical in both studies. The third question concerned the raters' opinion of, not the future changes expected in quality (as in the Cartter Study), but rather an opinion of the change that had actually occurred in quality during the past five years, 1964-1969. Roose-Andersen mailed out 8,074 questionnaires with two follow-ups. Of the 6,325 (78%) questionnaires returned, 6,093, (75% of the total questionnaires mailed) were useable and, thus, constituted the sample. The 75% returned and useable questionnaire rate was exactly the same for both the 1964 and 1969 studies.

Results

The major value and interest of this study was in the comparison of its findings with those of the 1964 Cartter Study. The change in the number and type of programs in graduate schools in the United States from 1964 to 1969 has already been discussed. The major results relating to the academic quality ratings and reliability (internal consistency and stability) are as follows.

Quality Ratings for Faculty and Programs--In their report, Roose-Andersen presented ranges of scores, rather than "absolute" raw departmental scores and omitted the word "quality" from the title, substituting, instead, the word "rating." A comparison of the 1964 and 1969 results indicates that the average faculty and program quality ratings changed very little regardless of the discipline. And again, the top universities predominantly came from the same small group of 10 to 20 universities.

The significant change occurred in the general improvement in the average ratings of faculty and programs from 1964 to 1969. For example, three-fourths of all of the 1,663 common programs showed increases in the quality of their graduate faculty ratings. In 1964, 1161 (70%) of the rated faculties achieved an "Adequate plus" (2.0) or better rating. By 1969, the number had increased to 1306 (80%). The number of programs receiving the highest two rankings for programs and faculty (that is, either "Distinguished" or "Strong") also increased substantially. Moreover, the concern in 1964 that few institutions would be able to rise into the "Strong" or "Distinguished" categories proved unwarranted. For example, almost 17% of those faculties rated "Good" or "Adequate plus" in 1964 were rated "Strong" in 1969. More than 25% of those rated "Good" in 1964 were rated "Strong" in 1969. About 2% of those rated "Strong" in 1964 were rated "Distinguished" in 1969.

Of significance also is the fact that many faculties and programs not previously rated (both "new" graduate programs at previously rated institutions and "new" graduate programs at previously unrated institutions) achieved scores equivalent to the "Adequate plus" or higher ratings. However, despite the general improvement of established programs and the emergence of a substantial number of new highly rated programs in the common disciplines, the proportion of all faculties at or above the "Adequate plus" level in 1969 was 70%, essentially unchanged from 1964.

Further, the increases were not uniform and fewer than 50% of the faculties rated for the first time in 1969 received above minimum quality ratings. Improvement in faculty quality ratings was also found by region, particularly in the South, where those faculties rated "Adequate plus" or "Strong" in 1964 increased by 14% over the five-year period.

Reliability of Quality Ratings--The high degree of consistency of the faculty quality ratings among different groups of raters found by Cartter in 1964 was confirmed by Roose-Andersen (1970, 34). Roose-Andersen correlated the average faculty quality ratings of all the raters with the ratings of the different categories of scholars with the following results: chairmen 0.99, distinguished senior scholars 0.98, and knowledgeable junior scholars 0.95.

Stability of the Quality Ratings--Another way of viewing the reliability of quality ratings is to examine the correlations of faculty quality ratings across academic ranking studies. If the correlations are high, it may be argued that quality ratings measure the same thing with consistency or have stability over time. The analyses of the mean inter-correlations of the faculty quality ratings between the Cartter and Roose-Andersen studies was 0.94. Thus, Roose-Andersen determined that the faculty quality ratings were stable over the five-year period.

Conclusions and Recommendations

Several major conclusions were drawn by Roose-Andersen. They are as follows:

1) The proportion of programs in the top range remained constant or dropped and the proportion of programs in the lowest range increased more frequently than it declined.

2) Relative standings of the universities on the faculty and program ratings did not show marked gains from 1964 to 1969, although change did occur in some universities.

2) Overall increases in faculty and program quality ratings occurred from 1964 to 1969, but many new programs were of poor quality. Roose-Andersen attributed this to the duplication of identical programs at more than one state university within a given state.

3) The reliability of the ratings continued to be close to 1.00.

4) Faculty quality ratings remained stable over the five-year period.

Roose-Andersen made several recommendations: 1) more state-wide planning be used in higher education; 2) new programs be more carefully monitored; and 3) below minimum programs be eliminated.

Associated Research Councils Study (1982)

Introduction

This assessment of quality in graduate programs was sponsored by the Conference Board of the Associated Research Councils (hereinafter referred to as "the ARC Study" or "the Jones, Lindzey, Coggeshall Study") whose members are drawn from: the American Council of Learned Societies, the American Council on Education, the National Research Council, and the Social Science Research Council. Financial support was provided by the Andrew W. Mellon Foundation, the Ford Foundation, the Alfred P. Sloan Foundation, the National Institutes of Health, and the National Science Foundation. The assessment was conducted over a period of several years. It was initiated in 1980, the data were collected in 1981, and the results, edited by Jones, Lindzey, and Coggeshall, were published in five separate reports in 1982.

This study, according to Webster (1983) is the "Rolls-Royce of academic quality rankings" and "is by far the biggest, best, most expensive, most thoughtfully conceived and carefully carried out academic quality ranking ever done."

In part, the ARC Study was conducted in answer to the many criticisms leveled at the Cartter (1966) and

Roose-Andersen (1970) studies. However, the ARC Study had its own objectives, as well.

Methodological Concerns

Both Carter and Roose-Andersen were criticized for their reliance mainly on reputational measurement which was described by the critics as being "narrow and elitist." Other criticisms of reputational ratings were that they: 1) were out of date; 2) yielded an institutional "halo effect;" and 3) emphasized the largest programs at the expense of smaller, less well-known institutions.

It was also argued that the rating scales used did not reflect the true complexity of graduate programs and emphasized the traditional values (for example, faculty achievement) that are related to institutional size and wealth. Thus, it was argued that ratings should be more comprehensive, sensitive to different program purposes, and appropriate at any time by individual departments and universities (Jones, Lindzey, and Coggeshall, 1982, 5-6).

Finally, it was argued that few, if any, of the raters could be familiar with all of the programs and, thus, the raters may have misranked the programs because of a lack of knowledge about the size of the programs and of the particular faculty responsible for the programs.

Objectives

The objectives of the ARC Study were related, both, to the need for a better and more comprehensive study, as well as to the methodological criticisms mentioned above. In particular, the ARC Study had the following specific objectives:

1) To improve the methods used in prior studies by meeting previous criticisms through the careful study by planners of the methods used in the prior studies.

2) To focus only on programs awarding research-doctorates and their effectiveness in preparing students for careers in research, while admitting the importance of other foci for programs which were beyond the scope of the study.

3) To provide a multidimensional approach by examining a variety of different indices that may be relevant to program quality.

4) To provide evaluators with the names of faculty members involved in each program to be rated and with the number of research-doctorates awarded during the previous five years.

It is important to note that this study, for the first time, attempted to obtain a comprehensive view of each program by using multivariate statistical measures in addition to reputational ratings. This is the method followed by the present dissertation, that is, progressing from mainly reputational ratings for universities to a composite multivariate "picture" of the programs and universities.

Sampling Methods and Procedures

Institutions Included--Of the 243 institutions solicited as participants in the ARC study, only 15 (6%) declined to participate or failed to provide information required by the study. None of the 15 had received "Distinguished" or "Strong" ratings in prior national studies. Thus, the sample included 228 institutions versus the 106 institutions in the Cartter Study and the 130 institutions in the Roose-Andersen Study.

Fields and Disciplines Included--The same 5 fields of knowledge included in the earlier Cartter and Roose-Andersen studies were included in the ARC Study. The number of disciplines, however, declined from the 36 surveyed in the Roose-Andersen Study to 32 because of the emphasis in the ARC Study on only programs awarding research-doctorates rather than simply doctorates. The number of disciplines by academic field of knowledge included in the study are as follows: the Biological Sciences (6), Engineering (4), the Humanities (9), Mathematical & Physical Sciences (6), and the Social & Behavioral Sciences (7).

The methods used in the selection of the disciplines included in the study were slightly different for each of the five academic fields of knowledge. The methods reported here are those which, in this researcher's judgment, best describe the overall methods. Specifics are available in the five-volume report (Jones, Lindzey, and Coggeshall, 1982).

The ARC committee of study planners decided that no more than 30 disciplines from the 5 academic fields of knowledge could be adequately studied with available funds. However, 32 disciplines were eventually studied instead of the 30 originally planned. The committee based its selection of disciplines from the 5 fields, primarily, on the total number of doctorates awarded nationally in "recent" years. Accordingly, aggregate counts of doctoral degrees earned in FY 1976-1978 were taken from the Educational Testing Service and the National Research Council.

Programs Included--A total of 2,699 programs which awarded a total of 75,401 doctorates during FY 1976-80 were selected for evaluation from the 32 disciplines. The selection of the research doctorate programs to be included in the study were selected in two stages. First, any program meeting one of the following criteria was selected for consideration: 1) more than a specified number of degrees granted in 1976-1978 (the number necessary to include at least 90% of all doctorates awarded in a program), or 2) more than one-third of the degrees granted in FY 1979, or 3) an average rating of 2.0 or higher (Strong or Distinguished) in the Roose-Andersen Study. Second, a list of the nominated programs at each institution was sent to a designated individual (usually the graduate dean) who had been appointed by the university president to serve as the coordinator for the institution. The coordinators were asked to: 1) review the list, 2) eliminate programs no longer offering research-doctorates or not belonging in the list, and 3) include other programs "of uncommon distinction" which awarded no fewer than two doctorates over the past two years.

Measures Used in the Study--Since the study was intended to be multidimensional in nature, data were collected on sixteen separate measures or variables for all fields except humanities in which only the first twelve measures were used. The measures included both reputational ratings and quantitative measurements. The sixteen measures are summarized below, along with definitions and information about their data sources.

Program Size (Measures 1-3)--Reported number of: 1) Program faculty members in the program who were holding academic appointements (typically at the rank of assistant, associate, and full professor) as of December 1, 1980 and who participated significantly in doctoral education. (Based on data provided to the committee by the university appointed study coordinators.) 2) Program graduates for FY 1975-79. (Data were obtained by matching the names of program graduates from faculty lists provided to the committee by the university appointed study coordinators against the names of dissertation advisors compiled from a National Research Council survey.) 3) Total numbers of full-time and part-time graduate students enrolled in the program as of December 1, 1980 who intend to earn doctorates. (Based on data provided to the committee by the university appointed study coordinators.)

Characteristics of Graduates (Measures 4-7)--4) Proportion of program graduates receiving national fellowship or training grant support during their graduate education. 5) Median number of years to completion of doctorate degree. (In reporting standard scores and correlations with other variables, a shorter time to Ph.D. was assigned a higher score.) 6) Proportion of program graduates making definite commitments for post-graduate employment. 7) Proportion of program graduates making definite commitments for post-graduate employment in Ph.D.-granting universities. (All four measures were based on data compiled in the National Research Council's Survey of Earned Doctorates for FY 1975-79.)

Reputational Survey Results (Measures 8-11)--8) Mean rating of the scholarly quality of program faculty. 9) Mean rating of the effectiveness of the program in educating research scholars/scientists. 10) Mean rating of improvement in program quality in the past five years. 11) Mean rating of the evaluators' familiarity with the work of the program's faculty. (All four measures were based on responses to the committee's survey conducted in April 1981. Survey questions and rating scales are provided below.)

University Library Size (Measure 12)--Composite index of the library size in the university in which the program is located (scale = -3 to +3). (Based on 1979-80 data compiled by the Association of Research Libraries on ten library characteristics: volumes held; gross volumes added; microfilm units held; current serials received; expenditures for library materials, binding, total salaries, and wages; other operating expenditures; number of professional and non-professional staff; and related measures. The index was only available for 89 of the 228 universities surveyed, which, according to the authors "tend to be among the largest institutions.")

Research Support (Measures 13-14)--13) Proportion of program faculty members holding research grants during FY 1978-80 from: the National Institutes of Health; the National Science Foundation; or the Alcohol, Drug Abuse, and Mental Health Administration. (Based on lists of faculty obtained by matching faculty names provided by institutional coordinators with the names of research grant awardees from computerized data files of the National Science Foundation and the National Institutes of Health. The proportion of faculty in each program who had received any research grants from these agencies during this period was used as the measure.) 14) Total FY 1979 expenditures (in thousands of dollars) of funds from both federal and non-federal sources reported by the university for research and development activities in the specified disciplines. (Based on data provided to the National Science Foundation by the universities. The authors identified two problems with this data: 1) universities use different practices for categorizing and reporting expenditures and 2) the data are available only for aggregate expenditures in the Biological Sciences and are not available for expenditures in the individual disciplines. Thus, the value reported for an individual program represents the total university's expenditures in the Biological Sciences.)

Publication Records (Measures 15-16)--15) Number of FY 1978-79 published articles attributed to the doctoral program (for example, articles authored by the faculty). (Based on data on published articles collected from computerized indexes, such as the Science Citation Index. Some disciplines also obtained measures based upon the number of books reviewed in major journals.) 16) Estimated "overall influence" of published articles attributed to the program. (Based on the data collected in measure 15 above, but weighted to reflect the "influence" of the articles or books. For example, some disciplines used only articles in very frequently cited journals. Other disciplines used the number of articles in a journal weighted by the mean number of citations for each article in the journal: the more frequent the citation, the higher the weight.)

Selection of judges or raters--A total of 8,220 (about 15%) faculty members were selected as evaluators or raters in the study from the total of 55,515 names of faculty members supplied on the lists provided by the study coordinators at the 228 universities covered in the assessment. The number of evaluators was chosen on the basis of the number of faculty in the program and the number of doctorates awarded in the program in the previous five years, FY 1976-80 (a total of 75,401 doctorates were awarded during this period)--with the stipulation that at least one evaluator was selected from every program covered in the assessment. Of the 8,220 faculty members to whom questionnaires were sent, 5,019 (61%) responded. This response rate was approximately 17 to 18 percentage points lower than the rates reported by Cartter (79%) and Roose-Andersen

(78%). Jones, Lindzey, and Coggeshall hypothesized that this might be due to: the fact that follow-up survey forms were not sent to non-respondents on the first mailing due to financial constraints and 2) growing dissatisfaction in recent years with educational assessments based on reputational measures. The 5,019 respondents used as evaluators in the study represented about 9% of the total faculty (55,515) from the coordinators' lists.

<u>The Questionnaire and Rating Scale (Measures 8-11)</u>--The questionnaire for each program included four questions, each with a separate rating scale. They are summarized below.

8) <u>Scholarly Quality of the Program Faculty</u> in terms of scholarly competence and achievements rated as:

5 Distinguished
4 Strong
3 Good
2 Adequate
1 Marginal
0 Not sufficient for doctoral education
X Don't know well enough to evaluate

(It was suggested that no more than five programs be designated as "Distinguished.")

9) <u>Effectiveness of the Program in Educating Research Scholars-Scientists</u> in terms of: accessibility of faculty, the curricula, the instructional and research faculties, the quality of the graduate students, the performance of graduates, and other factors that contribute to the effectiveness of the research-doctorate program rated as:

3 Extremely effective
2 Reasonably effective
1 Minimally effective
0 Not effective
X Don'd know well enough to evaluate

10) Change in Program Quality in Last Five Years in the research-doctorate program in terms of improvement in both the scholarly quality and the effectiveness of the program in educating research scholars/scientists (not the change in the program's relative standing among the other programs in the field) rated as:

2 Better than five years ago
1 Little or no change in last five years
0 Poorer than five years ago
X Don't know well enough to evaluate

11) Familiarity with the Work of the Program Faculty rated as:

2 Considerable familiarity
1 Some familiarity
0 Little or no familiarity

Rating Procedure--Each evaluator was asked to consider a stratified (by the number of faculty members associated with each program) random sample of 50 research-doctorate programs in his or her discipline. Every program was included on 150 survey forms. The 50 programs to be evaluated were listed in random order, preceded by an alphabetized list of all programs in that discipline that were being included in the study. No evaluator was asked to consider a program at his or her own institution. Ninety percent (90%) of the survey sample group of judges were provided with the names of the faculty in each of the 50 programs to be evaluated along with data on the total number of doctorates awarded in the last five years. For purposes of comparison with previous studies, 10% of the judges (randomly selected in each discipline) were furnished no information other than the names of the programs. As was indicated above, one question (measure 11) was included to measure the raters' familiarity with the work of the faculty in each program.

Results

The results of primary import to the present dissertation concern the results of the reputational ratings, the reliability of the ratings, the comparability of the ratings across fields of knowledge, the content validity of the ratings, and the stability of the ratings across studies.

However, prior to beginning, a major problem relating to the reporting of the results of the ARC Study should be mentioned. That is, there was no systematic coverage of the findings on an across discipline basis in the hundreds of pages of analysis provided. Each of the five fields of knowledge is reported separately. Further, the schools in each discipline are listed, not in descending order from highest to lowest ranked according to one, some, or all of its "quality" measures, but rather in alphabetical order. Webster (1983) describes the problem with the report as follows.

> "It lists the name of every university it covers in each discipline in alphabetical order. Next to each school's name, spread over two broad pages, appear up to sixteen columns of figures--double columns actually, for almost every column displays a raw score and a standard score. Then come four more columns listing the standard errors for the scores on the reputational survey. The net effect is that for clarity, convenience, and ease of use, the five volumes, taken together, can be compared to the Manhattan telephone directory.
>
> By publishing endless columns of figures for institutions in each discipline it covers, without summarizing, combining, or averaging these figures, or ranking the institutions in any way, this most reluctant of all academic quality rankings is like the Bible for some religious sects, of which anyone is welcome to make any interpretation he or she wishes.
>
> What should the committee have done? At the very least, ... it should have taken one of its reputational measures, either for the faculty's 'scholarly quality' or the program's 'effectiveness,' and ranked all programs in each discipline according to this measure. Doing so would have allowed useful comparisons of programs with each other and of how programs rate today with how they ranked in earlier rankings."

The argument for the reporting procedure followed was that aggregating measures by disciplines would lead to an overall ranking of universities which would lead to storms of criticism and protest as had been the case with earlier studies. From a research perspective, however, some type of cross-discipline synthesis is required for any type of generalization. Accordingly, the results which follow represent a cross-discipline synthesis of the ARC disciplinary results prepared by the present author.

Reputational Ratings (Measures 8 and 9)--Although Jones, Lindzey, and Coggeshall (1982) reported all results separately for each discipline and did not aggregate them for universities, one can easily see that these results are highly similar to the findings of Cartter (1966) and Roose-Andersen (1970). There are very clear trends across the disciplines. The same universities generally received the highest ratings across nearly all of the disciplines (that is, the programs receiving the highest ratings were from the same set of no more than 10 to 20 universities). The mean reputational ratings were also very similar across all the disciplines as can be seen by the following:

1) Faculty Quality (Measure 08)--Mean ratings for the 32 disciplines ranged between 2.0 ("Adequate") and 3.0 ("Good") with an average of 2.7 for all disciplines.

2) Program Quality (Measure 09)--Mean ratings ranged between 1.0 ("Minimally effective") and 2.0 ("Reasonably effective") with an overall average of 1.6 for all disciplines.

3) Change in Program Quality (Measure 10)--Mean ratings ranged between 0.0

("Poorer than five years ago") and 1.0 ("Little or no change in last five years") with a mean rating of 1.1).

4) Familiarity with Program (Measure 11)--Mean ratings ranged between 0.0 ("Little or no familiarity") and 1.0 ("Some familiarity") with an average of 0.90 for all disciplines.

Reliability--A number of analyses were performed by Jones, Lindzey, and Coggeshall to attempt to assess the reliability of: 1) the rating responses and 2) the academic ratings in answer to several criticisms of the methodologies used in earlier studies. The most important results of these analyses are indicated below.

1) Reliability of Rating Responses--First to be considered are five reliability tests relating to the reliability of rating responses due to effects of: a) Raters' Familiarity with the Program, b) Names versus No Names, c) Geographic Proximity, d) Alumni versus Non-Alumni Status, and e) Raters' Research Interest. The most important results of each of these tests are summarized below.

a) Raters' Familiarity with the Program--The response rate of the raters' was higher if the raters were familiar with the programs (that is: "Considerably familiar" 99.9%, "Some familiarity" 97.4%, and "Little familiarity" 24.5%). Likewise, the mean ratings of faculty quality were higher for faculty whose work was "Considerably familiar" versus "Some or

Little familiarity." However, familiarity had little overall effect on the ratings. For example, the correlation between the mean ratings supplied by respondents claiming "Considerable familiarity" versus those indicating "Some or Little Familiarity" with a particular program was 0.90. Further, in a subsequent analysis, the researchers eliminated evaluations provided by raters confessing "Little or No Familiarity" and recalculated the mean ratings. The mean correlation of the ratings with the original ratings was within the limits of reliability. One reason for this is that few raters rated programs which were unfamiliar to them. In short, the relative standing of programs on faculty quality was not greatly influenced by admixing low familiarity ratings.

b) Names versus No Names--As noted in the methods section, 90% of the raters were given forms which included the names of faculty members associated with the department, while 10% received forms without names. The correlation between Names versus No Names ratings was 0.86 over all disciplines. Thus, the use of Names also had little effect on the faculty quality ratings.

c) Geographic Proximity--A similar result (0.92) was obtained of ratings by geographic closeness ("Nearby" versus "Outside" regions based on nine national geographic regions).

d) Alumni versus Non-alumni Status--Findings support the earlier finding that alumni provide generous ratings. However, this had little overall effect on the survey results due to the design of the study which precluded very few raters from evaluating their alma mater or a nearby program.

e) Raters' Research Interest--Findings here also suggest little effect.

To summarize, most of the methodological criticisms of previous studies relating to the reliability of rating responses were examined by Jones, Lindzey, and Coggeshall. While effects of: familiarity with the program, knowledge of faculty names, geographic proximity, alumni status, or the research interest of the evaluator were demonstrable, Jones, Lindzey, and Coggeshall concluded that these effects contributed little bias to the ratings of faculty and program quality, probably partly due to the very careful design of the study.

2) Reliability of Academic Ratings--Next to be considered are three analyses of the four reputational measures (measures 8-11) which were performed to test the reliability or consistency of the academic ratings: a) Estimated Standard Errors; b) Split-half Correlations; and c) Two Survey Administrations. The results of each of these analyses are presented below for the faculty quality measure (Measure 08).

a) Estimated Standard Errors--Analysis of the estimated standard errors associated with the mean ratings of every program indicated some variation in the magnitude of the standard errors in every discipline. However, they rarely exceeded 0.15 (0.20 for the Biological Sciences and Engineering) for any of the disciplines and they typically ranged from 0.05 to 0.10 (0.10 to 0.15 for the Biological Sciences). For programs with higher mean ratings, the estimated errors associated with these measures were generally smaller. This is consistent with the fact that survey respondents were more likely to furnish evaluations for programs with high reputational standing (Jones, Lindzey, and Coggeshall: Biological Sciences, 1982, 177; Engineering, 1982, 124; Humanities, 1982, 191; Mathematical & Physical Sciences, 1982, 173; and Social & Behavioral Sciences, 1982, 190).

b) Split-half correlations--In this analysis, individual ratings of each program were randomly divided into two groups (A and B) and a separate mean was then calculated for each group for each discipline for each of the four reputational measures. Uncorrected correlations between the mean program ratings were then run. The degree of consistency in the raters' judgments, as indicated by the results, was very high (0.97) for faculty quality (measure 08) and somewhat lower, but, still high, for program quality (measure 09) and program familiarity (measure 11), 0.93 and 0.94 respectively. Not surprisingly, the reliability coefficient for ratings of program improvement in the past five years (measure 10) was considerably lower (0.72). Although this represents tolerable reliability, it is evident that the responses to this question were not as reliable as the responses to the other three questions.

c) Two survey administrations--The final test of reliability of the academic ratings was a comparison of the overall results obtained in two survey administrations. This test was performed using eleven selected mathematics programs. Of the 178 individuals surveyed a second time, 116 (65%) responded and were used in the analysis. Results indicated an average absolute observed difference of less than 0.1 in the two sets of mean ratings obtained for each of the four measures which demonstrates the consistency of the

> ratings for each of the eleven programs (Jones, Lindzey, and Coggeshall, Mathematical & Physical Sciences, 1982, 176-177).

Thus, the ARC Study further confirmed the high degree of reliability of the academic ratings found earlier in both the Cartter and Roose-Andersen studies. It should also be noted that the results of all these tests suggest that the reliability of the rating scales used to assess academic quality is higher than that of most psychological measurement devices, including many measures of achievement.

Content Validity of the Ratings--Like the present dissertation, the ARC Study undertook a multidimensional study of academic quality. In fact, a total of sixteen separate measures, assumed to be related to academic quality and which were described above, were used. From this point of view, quality is a characteristic which can be measured or viewed from many perspectives, including both reputational ratings and more "objective" characteristics, such as publications, research support, library size, and so forth. Thus, the relationships among the quality measures and the "objective" measures is of great importance to the present dissertation. One problem in all of this, however, is that the sheer size of an institution will impact all of these correlations.

Thus, to some extent, the larger institutions will tend to have more students and more faculty, and, all other things being equal, more faculty publications, more research grants, and a larger library. On the other hand, it is reasonable to also argue that an institution with twenty highly ranked programs is, in fact, a better intellectual resource than an institution with two highly ranked departments. Still, the question remains of how much institution size contributes to these validity coefficients.

The following table (See Table 3 below) summarizes the mean correlations of the faculty quality measure (measure 8) with the other fifteen measures (that is, measures 1-7 and 9-16) of academic quality studied by Jones, Lindzey, and Coggeshall. The values are mean inter-correlations taken across the discipline fields. The overall results can be seen by examining the total means in the right most column.

Table 3. Summary of Mean Inter-Correlations of Associated Research Councils Faculty Quality Measure with Other Measures

Measure	Biolog. Scis.	Engr.	Humans.	Math.& Phys. Scis.	Soc.& Behav. Scis.	Total
Program Size						
1	.53	.66	.50	.57	.63	.58
2	.49	.75	.53	.69	.63	.62
3	.48	.67	.43	.62	.51	.54
	.50	.69	.49	.63	.59	.58
Graduate Students						
4	.54	.11	.20	.20	.53	.32
5	.19	.32	.29	.40	.22	.28
6	.28	.12	.12	.25	.26	.21
7	.44	.19	.42	.42	.54	.40
	.36	.19	.26	.32	.39	.30
Reputation						
9	.96	.98	.98	.97	.98	.97
10	.31	.26	.29	.18	.21	.25
11	.91	.95	.96	.94	.96	.94
	.73	.73	.74	.70	.72	.72
Library Size						
12	.60	.51	.56	.61	.68	.59
Research Support						
13	.60	.58	NA	.59	.59	.59
14	.62	.53	NA	.54	.42	.53
	.61	.56	NA	.57	.51	.56
Pubs.						
15	.69	.69	NA	.76	.76	.73
16	.71	.65	NA	.79	.48	.66
	.70	.67	NA	.78	.62	.69
Field Ave.	.58	.56	.51	.60	.59	.57

Source: Jones, Lindzey, and Coggeshall: Biological Sciences, 1982, 170; Engineering, 1982, 116; Humanities, 1982, 187; Mathematical & Physical Sciences, 1982, 166; and Social & Behavioral Sciences, 1982, 182).

The key results of Table 3 can be seen from a listing of the results of the six measure categories in the order (from high to low) of their correlation with the faculty quality rating: 1) Program Reputation .72; 2) Publications .69; 3) Library Size .59; 4) Program Size .58; 5) Research Support .56; and 6) Graduate Students .30. Thus, superficially at least, the results suggest strong support of faculty reputational ratings as a measure of academic quality for the following reasons. First, the faculty quality ratings have high inter-correlations with most of the other measures, except for the four graduate student measures (measures 4 through 7) and measure 10. For example, a total of nearly 50% of the total variance in publications can be predicted by the faculty quality ratings. Second, several of these measures (for example, publications, library size, and research support) all have marked "face validity" (that is, the measures almost define the popular concept of a great research university).

It is also interesting to note the consistency of the average correlations across the fields, that is, they range from .51 for Humanities to .60 for the Mathematical & Physical Sciences, with an average correlation of .57 across all five fields.

Stability of the Quality Ratings--The analyses of the mean inter-correlations of ratings in the Roose-Andersen and Associated Research Councils studies are summarized in Table 4 below. In the table, mean correlations across disciplines are shown for each of the study disciplines and for all five fields. The overall mean correlation is shown at the bottom of the table.

Table 4. Summary of Mean Inter-Correlations of Faculty Quality Ratings in the 1970 Roose-Andersen and 1982 Associated Research Councils Studies

Biological Sciences	
Biochemistry	.92
Botany	.82
Cellular/Molecular Biology	.87
Microbiology	.87
Physiology	.78
Zoology	.83
	.85

Mathematical & Physical Sciences	
Chemistry	.93
Geological Sciences	.85
Mathematics	.94
Physics	.96
	.92

Engineering	
Chemical Engineering	.89
Civil Engineering	.91
Electrical Engineering	.92
Mechanical Engineering	.93
	.91

Social & Behavioral Sciences	
Anthropology	.90
Economics	.94
Geography	.79
History	.94
Political Science	.93
Psychology	.93
Sociology	.86
	.90

Humanities	
Art History	.92
Classics	.89
English Language & Literature	.91
French Language & Literature	.83
German Language & Literature	.91
Linguistics	.78
Music	.94
Philosophy	.86
Spanish Language & Literature	.86
	.88

Overall Mean Correlation = .89

Source: Jones, Lindzey, and Coggeshall: Biological Sciences, 1982, 191-196; Engineering, 1982, 136-139; Humanities, 1982, 181-215; Mathematical & Physical Sciences, 1982, 187-190; and Social & Behavioral Sciences, 1982, 203-209).

As may be seen from Table 4, the mean inter-correlations in each discipline range from .78 to .96, with an average overall inter-correlation of .89 across all disciplines. Clearly, the two measures of faculty quality on the two rating scales are highly similar and very consistent across two independent studies performed at an interval of over ten years.

Summary and Conclusions

The ARC Study was the capstone of the present view of academic quality ratings. As one of the strongest critics of academic quality ratings admits, the reliability and validity data are too complete and too consistent to debate (Astin, 1983). What is in debate is, "Why?" Astin argues that the results are produced by academic folklore in which some schools are deemed excellent on the basis of reputation. On the other hand, Jones, Lindzey, and Coggeshall (1982) and others argue that academic quality exists, but it is determined multidimensionally, that is, it is affected by many factors, such as: faculty salary, resources for research, a high level of respect for academic achievement, and so forth. The rating scales are simply a good means for having knowledgeable people synthesize all these measures into a single number. Rating scales are not quality, but simply a global measure correlated with the real determiners of quality. The present writer tentatively accepts the Jones, Lindzey, and Coggeshall view as the better reflection of the experimental results which are reported in Chapter IV of this dissertation. A good deal more will be said on these theories in the final summary of the present study of academic quality.

Other Empirical Studies

Introduction

As indicated earlier, four other recent multidimensional studies of academic quality have special relevance to the present study and must also be reviewed. To summarize, the CGS-ETS Study has important methodological implications for the present study. The HERI Study demonstrates the high correlation between graduate and undergraduate ratings of academic quality, in addition to providing an alternative theoretical approach to the meaning of academic quality. Finally, the two Gourman studies provide the two institutional quality measures (one graduate and one undergraduate) used in the present study of academic quality. They were included in the present study in order to test the stability (the graduate measure) and the reliability (the undergraduate measure) of the ARC academic quality ratings.

CGS-ETS Study (1978)

This "pilot" study of reputational ratings of doctoral programs was jointly sponsored and conducted by the Council of Graduate Schools (CGS) and the Educational Testing Service (ETS) (Hartnett, Clark, and Baird, 1978). The purpose of this study was to explore ways of assessing quality by identifying dimensions of quality and potential sources of data. With input from 60 graduate deans, 30 dimensions of quality were identified (for example, research activity, student academic ability at entrance, and library resources). A detailed follow-up study was conducted of 73 departments in the 3 disciplines of: psychology (24), chemistry (24), and history (25) which led to a methodology for producing a "department profile" in which the department's relative standing on each of the 30 dimensions was plotted. It was suggested that the profile be used to feed information back to departments for diagnostic purposes and to use in improving and strengthening their work. Five major findings emerged:

1) Dependable and useful information about program characteristics related to educational quality can be obtained at reasonable cost and convenience.

2) Thirty especially promising dimensions of quality were identified.

3) The quality dimensions seemed to be generally applicable across diverse disciplines.

4) Two clusters of measures emerged: a) research-oriented indicators (including, department size, reputation, and physical and financial resources; student academic ability; and faculty publications) and b) educational experience indicators concerned with: the educational process and academic climate (neither of which are usually considered in quality studies), faculty interpersonal relations, and alumni ratings of dissertation experiences.

5) The variables within the cluster closely correlated with each other and the variables from the "research-oriented cluster" significantly correlated with the variables from the "educational experiences cluster."

Higher Education Research Institute Study (1979)

Introduction

The Higher Education Institute (HERI) Study (Astin, 1979; Solmon and Astin, 1981; Astin and Solmon, 1981; Astin, 1985) was a "large-scale pilot study" of the reputation of undergraduate departments in seven selected disciplines in four states designed "to rectify major limitations in previous reputational studies by focusing on the undergraduate level and by using more diverse rating criteria" (Solmon and Astin, 1981, 24). The selection of both the disciplines and the states was meant to reflect the diverse range of the American undergraduate system and of academic specializations.

Methodological Concerns

Earlier studies of quality in undergraduate education had been criticized for omitting departments of merit or by failing to probe or promote excellence in dimensions other than scholarly productivity. Popular college guides and other studies, such as Gourman's 1977 undergraduate study, had also been criticized for rating undergraduate departments in an uncontrolled and inconsistent manner.

Objectives

Astin has been one of the most vocal critics of ratings as measures of academic excellence (Astin, 1985, 24-59), Thus, a major intent of the study was to search for differences among various existing quality ratings of undergraduate institutions. Specific objectives of the study were as follows:

1) Quantify the subjective judgments of undergraduate departmental quality on multiple dimensions.

2) Investigate a number of other elements in assessing undergraduate quality through the reputational approach, such as the association of ratings on different criteria and for different types of institutions, the relationship of ratings to other measures of human and material resources at the undergraduate level, and the association of ratings with educational impact.

3) Examine the validity of ratings.

4) Determine the effects on undergraduate ratings of the type of rater, rating criteria, domain of the system assessed, and the unit of analysis.

Sampling Methods and Procedures

Institutions Included--Two lists of institutions were developed for each of the seven disciplines, a "state" list and a "national" list. Both lists were developed from data obtained from the 1977 Higher Education General Information Survey (HEGIS). The state list for each discipline included all institutions within a state which had awarded at least five bachelor's degrees in the discipline during 1977. The national list included "about 100 of the most visible institutions" in a given discipline. An institution was included on the list if: 1) it awarded bachelor's degrees in the discipline and 2) if it were among the top thirty departments on at least one of the following criteria: total bachelor's degrees granted in the discipline; popularity among high ability students, as measured by the college preferences of secondary students (Astin, Christian, and Henson, 1978); popularity among students who attended college outside their home state; the most often selected schools by all students, regardless of major or out-of-state status; the schools most often selected by high ability students where frequency of selection is adjusted to take account of college size; and the top institutions rated by Gourman in 1977 (Solmon and Astin, 1981).

Fields and Disciplines Included--Seven disciplines from five fields of knowledge were surveyed in the study. They are as follows: Biological Sciences (biology), Business (business), Humanities (English and history) Mathematical & Physical Sciences (chemistry), Social and Behavioral Sciences (economics and sociology).

Participating Judges or Raters--The investigators used the Education Directory to obtain the names of 15,000 faculty members from the seven study disciplines. Raters were all members of the departments in the seven disciplines in the four-year colleges and universities within the four states of: California, Illinois, New York, and North Carolina.

The Questionnaire and Rating Scale--Respondents used a rating form with six criteria:

1) Overall quality of undergraduate education.
2) Preparation of students for graduate or professional school.
3) Preparation of students for employment after college.
4) Faculty commitment to undergraduate teaching.
5) Scholarly or professional accomplishments of the faculty.
6) Innovativeness of curriculum and pedagogy.

Respondents were asked to rate the departments using a 5-point scale: "Outstanding," "Superior," "Average," "Marginal," and "Poor" with an additional "No Information" category.

Rating Procedure--Each faculty respondent was asked to rate institutions in both a state and national list according to the six criteria.

Results

Study procedures which required faculty raters to rate large numbers of departments on the six criteria indicated problems with both response rate and with the study materials which accompanied the questionnaire. In regards to response rate, Solmon and Astin (1981, 24) indicated that the task "proved too onerous" for many potential respondents who cited such reasons as a "burdensome time commitment" and "lack of knowledge about departments other than their own." The "onerous" task resulted in a "low response," although the proportion of raters who actually returned the completed questionnnaires was not reported.

In regards to materials, Solmon and Astin (1981, 24) state that:

> "Some were disconcerted by simultaneous juxtapositions of different types of institutions, their placements on a national or state list and rating criteria .... others wondered about specific omissions (other than our errors occurring in biology and business in some states)."

Obviously, the procedures followed in this study, as far as can be determined from the HERI reports, were probably not as well controlled as in the careful designs of the ACE and ARC studies. Thus, minor differences in findings obtained by the HERI study may or may not be due to the use of undergraduate, rather than graduate, institutions. In fact, the results differed only marginally from those of the graduate studies.

A further problem was that only ratings obtained from the national lists were reported. Ratings by faculty members of national institutions in their home states were omitted, according to the authors, in order to "avoid prejudicial evaluations of local institutions" (Solmon and Astin, 24).

Solmon and Astin averaged the ratings separately for each institution by each of the seven disciplines and six rating criteria (with "No Information" ratings excluded), producing 861 different correlations which were used in subsequent factor and regression analyses. It should be noted during the following discussion that Astin and Solmon's discussion of their analyses and results sometimes lacked clarity and specificity (for example, the method of factor analysis or the criteria for selecting the number of factors was not given).

The major results of these analyses are presented below.

1) Analysis of Disciplines--Analysis of the twenty-one correlations among the "overall quality" ratings of the seven disciplines indicated considerable redundancy (that is, the correlations ranged from 0.73 to 0.96 with a median of 0.86). A factor analysis of these correlations yielded a single "overall quality" factor, a finding which was consistent with similar analyses performed with Cartter's 1966 ratings of different graduate departments.

Analysis of a factor analysis of the mean ratings on each of the seven disciplines indicated that quality differences among departments at a given institution tended to be minimal and that ratings of one department could suffice as an estimate of quality in the other departments at a university. A second factor analysis of the grand quality rating for each discipline across the six quality criteria confirmed the results of the first factor analysis.

2) Analysis of Rating Criteria-- Results of a factor analysis of the mean ratings on each of the six rating criteria produced two distinct quality dimensions: a) "scholarly excellence of faculty" and b) "commitment to teaching." The first factor was most closely associated with the mean rating of "scholarly

and professional accomplishment of faculty." Three of the other six rating criteria were also closely reflected in this factor: "preparation of students for graduate or professional school," "preparation of students for employment after college," and "overall quality of undergraduate education." The second factor was most closely associated with the mean rating of "faculty commitment to undergraduate teaching" and, to a lesser extent, with "innovativeness of curriculum and pedagogy." From this, Solmon and Astin concluded that: a) "scholarly excellence of the faculty" is "characteristic of large, prestigious institutions that tended to receive high ratings in the Cartter and Roose-Andersen assessments of graduate program quality" and b) "commitment to undergraduate teaching" is "characteristic of relatively small institutions with selective undergraduate admissions policies."

3) Analysis of the Relative Standing of Institutions--Institutions were ranked from highest to lowest in all those disciplines in which its departments were "highly ranked." The results showed that "those institutions that have consistently occupied the top echelons of the Cartter, Roose-Andersen, and similar ratings of graduate programs .... again were judged to be among those having the best undergraduate departments" (Solmon and

Astin, 1981, 26). The authors attributed this finding to: "Either those institutions that excel in graduate education also provide exemplary training at the undergraduate level" or that they are the result of a "halo effect" (that is, the raters assumed that renowned graduate schools also provided excellent undergraduate training.

In any case, Solmon and Astin decided, rather than duplicating the earlier Cartter and Roose-Andersen lists by presenting their lists with similar results, to present different lists of top-ranked departments. Although the procedure is not entirely clear from the report, it appears that the authors first developed a list of the top-ten ranked undergraduate departments by each of the six criteria and then they excluded all departments which had been on the Roose-Andersen list. They were left with a group of departments highly ranked by faculty in the field, but which were not ranked among the best departments at the Ph.D. level. The authors characterized their list by the criterion, "faculty commitment to undergraduate education." In fact this criterion was the most frequent reason (75 departments) for qualifying as a top undergraduate department on their list. Their list contained well-known institutions, such as: Amherst, Dartmouth (actually a doctoral-level institution), Reed, Smith, Swarthmore, and the United States Naval Academy, along with less well-known institutions, such as: Colby, Davidson, Hamline, Harvey Mudd, and Ripon. The authors concluded with the comment that, "of course these institutions are themselves renowned as undergraduate institutions" (emphasis added).

The authors appear to attribute these results to some sort of undergraduate teaching factor. Of course, the results could also be attributed to other causes, such as the following. First, the question on the commitment to undergraduate training was never asked of the raters in the American Council on Education studies. In fact, the raters were never asked about undergraduate training at all. Second, many of the institutions sampled in the HERI Study were not even present in the American Council on Education or Associated Research Councils Studies, specifically because they are not graduate institutions. Third, the HERI Study procedure for selecting institutions which are highly rated, but which are not highly rated on graduate training (either because they have no graduate programs or because their programs lack quality), is highly questionable. What conclusions can be drawn from this "finding" is somewhat unclear, at least to the present author.

5) Content Validity of the Ratings--Objective data on a variety of measures, including: student/faculty ratios, total enrollment size, percentage of graduate students, per student expenditures for various purposes (educational and general, library, and so forth), control (private versus public), denominational versus non-denominational, the percentage of baccalaureates awarded in various fields (for example, engineering, and biology), geographic region, selectivity (mean admissions test scores of freshmen), and prestige (an interaction between size and selectivity) were correlated with mean quality ratings separately for each of the seven disciplines. Results indicated that: a) measures of prestige and selectivity had substantial correlations with mean "overall quality" ratings in all seven disciplines (that is, the median correlation was 0.78 for prestige and 0.73 for selectivity) and b) most of the per student financial measures, that is, expenditures for libraries, physical plant, and so forth) also produced substantial correlations with the overall quality ratings (the median correlation of 0.56 for per student expenditures for educational and general purposes was the highest).

6) Regression Analyses--Stepwise multiple regression analyses were also conducted to determine

how accurately each quality measure could be estimated from these objective data. Results indicated that: a) it is possible to obtain a multiple correlation of 0.90 or higher with only two variables: prestige (weighted positively) and size (weighted negatively) and b) the size of the institution did not show substantial relationships to the overall quality ratings (median r = -0.13), although the median partial correlation of size was substantial (-.67) once the effects of institutional prestige were controlled.

The 0.90 multiple correlation was interpreted to mean that: a) quality ratings are unnecessary since they can be predicted from characteristics of the university and b) this finding provides confirmation that the inter-correlations are heavily influenced by "halo" effects. In point of fact, however, no special significance should be attached to the fact that size and prestige predict ratings since, in a tightly correlated cluster of a few variables (seven), most variables can be predicted from any two other variables. With regard to the inference of a halo effect from these results, one can only point out the old rule, "correlation does not imply causation," a principle which the authors seem to ignore with unbounded enthusiasm.

Summary and Conclusions

The finding most apparent from the HERI Study seems to be that most of the findings of studies of graduate quality also hold for undergraduate studies. Despite the authors' sometimes heroic attempts to prove otherwise, the special results they interpret as unique to undergraduate institutions can also be attributed to differences in procedures between the HERI and the ACE/ARC studies of graduate education. Two findings, however, are of considerable interest: a) the negative correlation between size and quality (-0.13) and b) the usefulness of size with prestige in predicting quality ratings. The meaning of these results, however, are far from clear. Interesting, but puzzling.

Gourman Graduate and Undergraduate Studies (1983)

The Gourman Graduate Study (Gourman, 1983), under consideration here, is a revised version of Gourman's second study of graduate education which was conducted in 1982. Gourman's first study of graduate education was conducted in 1980. The 1983 revised study is a multidimensional assessment of 540 graduate and professional programs in American and International universities. Gourman, unlike Cartter; Roose-Andersen; and Jones, Lindzey, and Coggeshall reported his rating results both by department and by the institution as a whole. The multiple criteria upon which the composite ratings are based is described by Gourman as follows:

1) Qualifications, experience, intellectual interests, attainments and professional productivity of faculty;
2) Standards and quality of instruction (faculty effectiveness);
3) Faculty research;
4) Scholastic work of students;
5) Curriculum;
6) Records of graduates in graduate study and in practice;
7) Attitude and policy of administration toward teaching, research, and scholarly production;
8) Administration areas;
9) Administration research;
10) Non-departmental levels;
11) Library.

The Gourman Undergraduate Study (Gourman, 1983) is a revised version of the fourth (1982) in a series of similar multidimensional assessments of undergraduate education also conducted by Gourman (earlier studies were conducted in 1967, 1977, and 1980). The revised fourth study looked at undergraduate programs in 1,845 American and international colleges and universities. For the most part, the same criteria and methods, which were described above, were also used by Gourman in this study.

Webster (1984) has carefully researched all eight of Gourman's reports on his studies and describes the strengths and weaknesses of the studies as follows: 1) the reports amass a great deal of census data which appears to be accurate; 2) the 1967 undergraduate report and the two 1983 ratings are three of the few attempts ever made to sum up the academic quality of an entire university with a single number which has made them irrestible to many scholars studying the relationship between academic quality and other variables; 3) it is impossible to ascertain what information, if any, was used and how, if at all, it was analyzed; 4) the 1967 report, although it appears to be an honest attempt to rate colleges and universities has major flaws; and 5) the remaining Gourman reports do not represent a serious attempt to rank schools.

The major flaws described by Webster include:

1) There are serious questions about data and data information sources used. For example, the reports are exceptionally vague about data sources and mysterious about who supplied the data. A number of institutional presidents have indicated that no one at their institutions supplied any data.

2) There is very little explanation about the methodology used in arriving at the ratings and the ranking criteria are idiosyncratic at times.

3) A single number purporting to indicate "overall quality" is assigned to the most heterogeneous possible assortment of institutions, that is: major doctoral-granting universities; schools that don't offer the doctorate, but do award

hundreds of master's degrees a year in many different fields; schools that confer a handful of master's degrees each year; and an immense variety of very specialized schools.

4) In calculating institutional-wide ratings, aspects of colleges and universities that most knowledgeable people would consider of very different degrees of importance (for example, alumni association, library, public relations department, curriculum, plant efficiency, and faculty effectiveness) are indiscriminately lumped together and weighted equally.

5) The numerical ranges are not continuous. For example, they skip from 2.99 to 3.01 and from 3.99 to 4.01.

6) The same exact "grade" is often assigned to every single department rated at an institution.

7) The ratings appear to favor large institutions with many courses and instructors over smaller ones.

Webster concludes that the rating reports are non-authoritative, represent shoddy research, and raise serious questions about the value of the ratings and of the credibility of the author as a rater. He further concludes that Gourman is "not a responsible arbiter of educational quality" (Webster, 1983, 55).

Summary

This section summarizes the results of the quality assessment studies in terms of their relevance to the eight specific literature research questions. These eight questions were presented at the beginning of the section on the review of empirical quality assessment studies. A later section will consider the findings in a less formal and more narrative form.

L1. What groups similar to the population of doctoral institutions have been described in prior studies?

L2. What research methods, variables, and statistics have been used to measure academic quality?

The population of doctoral institutions per se has never before been studied. However, prior studies have included some or most of the doctoral institutions. The various studies overall have used from 30 to 50 variables. The statistics most commonly used to measure academic quality were: means, standard deviations, correlations, and standard scores. Factor and regression analyses have also been used for analysis and prediction.

L4. Were the correlations among the descriptive variables in prior studies sufficiently high to permit a reduction in the number of variables?

Correlations between variables, for the most part, have been positive and high to very high. Thus, the set of variables could probably be represented by a much smaller set of key variables.

L5. What groupings or domains of variables have been used in prior studies?

Variables have most commonly been grouped into the following five information domains: 1) Demographic, 2) Student, 3) Faculty, 4) Institutional Resources, and 5) Quality.

L7. What variables seemed to best measure and predict academic quality in prior studies?

The faculty quality ratings seem to have been the best single indicator of academic quality for both graduate and undergraduate education. However, quality per se is probably a multivariate characteristic which is not measured by any single variable. Characteristics closely associated with academic quality include: student, faculty, compensation, and institutional resources.

L8. What problems have occurred in the use of rankings of institutions of higher education?

Almost all of the recent studies refused to provide overall rankings of universities for two major reasons: 1) The rankings were highly criticized by many in higher education as being biased and unfair and 2) The rankings displayed only a univariate measure of quality, whereas, quality is probably a multivariate characteristic which can only be adequately portrayed with several measures. This finding is the one most centrally responsible for the use of multivariate profiles in the present description of doctoral institutions. Such profiles permit the simultaneous display of all key variables for any given individual or group of doctoral institutions.

L10. What are the current major theories of academic quality?

Although, this point was not addressed specifically in the studies, two major theories seem to be implied: 1) the theory that "true" academic quality is not measured by rating scales and 2) the theory that academic quality is a multivariate characteristic which is partially captured by reputational rating studies. Much more will be said on this subject in the next section.

L11. What factor analytic structures underlying doctoral institutions have been observed?

No factor analytic study of the structure of doctoral institutions has been performed. The few studies reported were on sub-groups and included significant potential methodological flaws. Among the factors which have been observed are: faculty and program quality, size, and commitment to education. Given the formal review of the findings, let us now turn to a more general discussion of the results.

THE QUESTION OF ACADEMIC QUALITY: SOME CONCLUSIONS AND IMPLICATIONS

Introduction

As was suggested in the previous section, the present dissertation draws upon the research on academic quality in three basic ways: 1) The general empirical findings from the quality studies were used in the selection and treatment of the variables to be studied. 2) The methods used in quality studies were used to decide upon major types of data analyses to be performed. 3) The theories of the nature of academic quality were used to interpret the results. Each of these concepts is considered in more detail below.

Empirical Findings From Quality Studies

Reputational ratings of quality are remarkably consistent across disciplines, procedures, and studies (Magoun, 1966; Drew and Karpf, 1981; Webster, 1983; Astin, 1985). For example, the results consistently show that certain universities are rated repeatedly as the best in terms of faculty accomplishments, program quality, student preparation, and so forth. The correlations (in the 0.90's) seem also to suggest that "medium and poor quality" universities are also ranked consistently. (Here, "medium and and poor quality" are relative terms since most studies ranked only the best institutions in terms of faculty or programs.)

There is also exhaustive evidence that these ratings are reliable (that is, around 0.90), stable, and that they correlate highly with other "objective" measures of quality (for example, faculty publications, library size, and research funds).

It is also clear that other "non-quality related" measures also correlate with quality ratings. The most significant of these appears to be "size," as measured by total numbers of students, degrees, faculty, and so forth. The effect of size is enhanced by such things as "prestige" (for example, the selection of the university by highly talented students). Thus, size is large if quality is high. The notion seems to be that a good large university with many top departments is better than a good small university with a few top departments.

Finally, meta-analytic studies show that the rating of a university can change markedly over time. For example, Webster (1983) compared rankings over a period of fifty-seven years. He found that: 1) some universities (for example, Yale) have pretty much maintained the same ranking over the entire period; 2) while others (for example, Stanford who made a giant leap) have made rank gains, and 3) still others (for example, John Hopkins who had a dramatic decline) have suffered rank losses.

These empirical findings are important to the dissertation in two ways. First, the results suggest that, as a practical matter, reputational quality ratings are reliable and valid enough to warrant their use as measures of academic quality. The important point to consider is, not whether ratings actually measure quality, but, that they correlate very highly with most more objective measures that, together, might be considered almost a definition of "academic quality" (for example, faculty publications, faculty and student honors and awards, research grants, and library resources).

Second, the empirical results indicate both the types of variables which should be included in a comprehensive description of doctoral institutions and also the probable relationships of these variables in the results. For example, the major studies of academic quality have consistenly included variables that can be grouped into the following categories: 1) Demographic (geographic location and institution classification, such as four-year or graduate institution); 2) Student (total number of students and students by type, level, and time status); 3) Degree (total number of degrees granted and number of degrees granted by level of student, such as Master's or Doctor's degree level); 4) Faculty (total number of faculty and number of faculty by status and rank; 5) Compensation of Faculty (salary and benefits); 6) Resources (including assets, such as library volumes, revenues, and expenditures); and 7) Quality (faculty and program). Clearly, the present study must include these types of variables to provide a comprehensive picture of doctoral institutions.

The probable relationship to be expected among these variables would generally be positive correlations with very high positive correlations among measures of quality. Further, some variables are likely to yield high correlations with quality. Thus, high correlations are to be expected.

Methods Used in Quality Studies

Many of the studies suggest that the best way to study academic quality in institutions of higher education is by multivariate measurements. Drew and Karpf (1981) indicate that one major weakness in descriptive studies is the lack of a multivariate approach. In fact, the value of multivariates seems to be agreed upon by most authors (Cartter, 1966; Jones, Lindzey, and Coggeshall, 1982; and Astin, 1985).

Many of the data analysis techniques used in the quality studies have been adopted in this dissertation. For example, the use of standard scores with a mean of 50 and a standard deviation of 10 was used in the ARC Study. Calculating mean ratings across fields and departments for a given university was widely employed in the rating studies and in subsequent meta-analytic studies (for example, Webster, 1983).

Correlations have proved to be a satisfactory method of stating relationships in the quality studies and were selected by experts in the field of statistical data analysis in the ARC Study. This method also has been adopted in this study. Factor analysis and multiple regression analysis was chosen for use in this dissertation, partially, because of their obvious help to quality researchers (Astin and Solmon, 1981). Finally, presentation of multivariate results graphically, as profiles, which was suggested by the CGS-ETS Study, was also used in the present study.

However, in the present study an attempt was made to exercise greater care in the selection of variables and in the description and interpretation of the results of the data analyses than was done by many of the earlier quality researchers. Further, the development of a computerized system for study was also an important goal of the present study.

Theories of Academic Quality

Introduction

As indicated before, most higher education researchers of reputational quality ratings seem to agree on the findings. They frequently disagree, however, on the interpretation of the findings. For example, the early researchers assumed that if you asked a knowledgeable person to rate the quality of university faculty or programs, he could and would do exactly that. Whatever quality is, at least, people could recognize it. This, perhaps naive, assumption was greeted with an avalanche of criticism, especially by those whose departments scored at the lower end of the rating scales. Well-intentioned critics identified numerous problems with the rating methods and procedures which were discussed above. Over the years patient researchers eliminated many of these methodological deficiences. The results, however, did not change.

At present, there appears to be two major theories about the relationship of academic ratings to the "true" academic quality of graduate research faculty and programs. These theories shall be referred to as: The Folklore Theory and the Multivariate Theory.

The Folklore Theory

The Folklore Theory of academic quality is best represented by its most outspoken proponent, Alexander Astin, who summarized it in his most recent book (Astin, 1985). In his book, Astin argues that academic ratings do not measure "true" quality, that high ratings are the result of what he calls "academic folklore." The definition of folklore according to Webster (Woolf, 1977, 446) is "a widely held unsupported, specious notion or body of notions." Astin argues that all rating results are based upon false beliefs in the academic community about the high quality of certain well-known colleges and universities. The high correlation of ratings with more objective criteria are attributed to the "halo effect" of reputational quality. That is, Harvard professors get more articles published, not because the articles are better, but because they are Harvard professors.

There are several problems with the Folklore Theory. First, it is a circular argument. It can not be disproved. Thus, suppose one points out that many journals do not include the author's name or affiliation in the referee's manuscript. Supporters of the Folklore Theory could easily explain that--"The reviewers can tell from the contents who wrote the paper."

Second, the theory does not account for changes in the reputational ratings of institutions over time. Thus, some institutions, such as Stanford University, have improved their ratings over the years. Others, such as Johns Hopkins University, have had a decline in the ratings. How could this happen if we accept the Folklore argument? Similarly, the correlations with more objective measures of quality seem to be too high and too stable to be due only to a "specious unsupported body of notions."

Finally, the theory accounts only for correlations for the highly ranked universities which are well-known to all raters. But the rating correlations (for example, across studies) are too high to be due only to agreement on the top twenty percent of universities. Correlations of 0.95 require agreement among raters on the middle and bottom institutions as well.

However, the above weaknesses clearly do not imply that the rating measure is a perfect predictor of "true" academic quality. Probably undeserved reputation per se does, in fact, account for some part of the rating phenomena.

<u>The Multivariate Theory</u>

Jones, Lindzey, and Coggeshall (see Biological Sciences, 1982, 188-189) have stated this point of view very clearly in their discussion of the findings of the ARC Study:

> "The reputational results .... among all of the measures, seem to address quality in an overall or global fashion. While most recognize that 'objective' program characteristics (i.e., publication productivity, research funding, or library size) have some bearing on program quality, probably no one would contend that a single one of these measures encompasses all that need be known about the quality of research-doctorate programs. Each is obviously no more than an indicator of some aspect of program quality. In contrast, the reputational ratings are global from the start because the respondents are asked to take into account many objective characteristics and to arrive at a general assessment of the quality of the faculty and the effectiveness of the program. This generality has self-evident appeal.
>
> On the other hand, it is wise to keep in mind that these reputational ratings are measures of perceived program quality rather

> than of 'quality' in some ideal or absolute sense. What this means is that, just as for all of the more objective measures, the reputational ratings represent only a partial view of what most of us would consider quality to be; hence, they must be kept in careful perspective."

The Mulitvariate Theory of academic quality basically holds the view that "true" quality is obtained in many ways by a research university. Many variables contribute, but none are, by themselves alone, a measure of "true" quality. The Multivariate Theory seems to be less circular, more reasonable in the light of empirical findings, and better able to predict, or at least to explain, changes in academic ratings over time. For example, the increase in ratings for Stanford University can be attributed to a real growth in quality due to: careful selection of students and faculty, a supportive environment (for example, in terms of compensation and academic resources for faculty and financial aid for students), a large endowment, a determination to become a quality research institution, and so on for all the other correlates of quality.

<u>A Reprise on the Meaning of Academic Quality</u>

What has happened to the concept of academic quality in higher education seems similar to events in the measurement of intelligence. Historically, intelligence was first thought to be a single trait measurable by general intelligence tests. Researchers worked for years to develop a test for the "G-Factor" (that is, the General Intelligence Factor). However, gradually, over time, patient researchers found that the G-Factor was separable into "verbal" intelligence and "quantitative" intelligence and these, in turn, could be further separated into even more abilities. Finally, the factor analysts gave up on the G-Factor and recognized that "intelligence" tests were really general ability tests measuring some of the factors related to the performance of an individual in school-like situations. Intelligence tests were still highly practical because intelligence was viewed as a global measure of important abilities which, together, could be used to predict success in certain situations.

Much the same thing seems to be happening to the definition of academic quality in higher education. Higher education researchers are beginning to recognize that quality is complex and can be achieved in a number of different ways. For example, providing higher compensation or more research time may attract more skilled researchers as faculty. These skilled researchers might then attract better students, more research grants, a better reputation, and eventually higher ratings. Another method of gaining the same end might be to create "special resources," such as particle accelerators or super computers. The point is that _academic quality ratings are not measures of academic quality_, but are, rather, _indicators of academic quality_, that is, they provide a synthesis of some of those _characteristics which, in combination, reflect "true" academic quality_.

The data and analyses used in this dissertation have been interpreted, using this multivariate model of academic quality, but generalized to sets of characteristics called "domains." A domain is a set of highly inter-related variables which share many characteristics and which may represent a latent common factor. For example, a set of variables which seem to represent academic quality have been collected. If these variables correlate highly, it will be assumed that: 1) together, they reflect one type of academic quality (but, perhaps, not others) and 2) a key quality variable, along with key variables from other domains, can provide the basis for a comprehensive view of the nature or structure of American doctoral institutions.

More will be said later about this multivariate model. Here, it is important merely to note that the model has an important historical base in the research on academic quality.

CHAPTER III

RESEARCH DESIGN AND METHODS OF ANALYSIS

INTRODUCTION

As was indicated earlier, the five objectives and associated research questions and hypothesis to be answered by the present empirical study are as follows:

Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

R1. What characterizes the population of one hundred and seventy-one American doctoral institutions?

Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

R3. Can the key quality variable be predicted without loss from the other seven key variables?

<u>Objective 4:</u> To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.

R4. What findings can be obtained with profile, rather than ranking, reports?

<u>Objective 5:</u> To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.

R5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?

<u>Empirical Research Study Hypothesis</u>
The number of common factors underlying the observable quantitative characteristics of American doctoral institutions is greater than one (the univariate case) and less than or equal to eight (the number of domains used in the original description).

These objectives, research questions, and hypothesis required a comprehensive data base of information about the population of American doctoral institutions and the use of a wide variety of analytical methods, ranging from simple descriptive analysis to rather complex statistical procedures. Therefore, it is important to describe the research design and the data base and to demonstrate the research methods and procedures prior to discussing the results.

RESEARCH DESIGN

This study is a classic correlational research paradigm, using means, standard deviations, and correlational statistics as described by Borg and Gall (1971). Both categorical or demographic and quantitative variables were used in the study. The categorical variables are based upon normative scales, hence, only appropriate tabulation statistics were used in their analysis. The quantitative variables are based upon simple counting, without the assumptions of non-observable variables. Thus, they provide the internal scale required for parametric statistics. The major differences between this study and other correlational studies are that: 1) a personal computer system, developed in this study to support higher education research and decision making, was used as the basis for the entire research study; 2) the study was meta-analytical in nature, involving secondary analysis methods and data from extant data bases; and 3) the results were presented, primarily, in graphic form.

The usual procedures for correlational studies and secondary analysis were followed in the study: 1) a problem of interest was identified; 2) a set of clear objectives was prepared; 3) a set of appropriate variables on which population data was available was selected; 4) appropriate data sources and extant data bases were identified; 5) access to data was secured; 6) appropriate data files were prepared; 7) variables of interest were accessed; 8) a set of statistical analytical methods was selected; 9) data analysis was performed in accordance with study objectives; and 10) results were reported.

The study involved six major phases, each corresponding to one or more of the five study objectives. Phase 1 involved the development of the Higher Education Computer-Based Information System (HECBIS), consisting of a personal computer system and a data base, which was used to support all five study objectives. Phase 2 involved the descriptive analyses of the data base required for objective one (describing American doctoral institutions in terms of a comprehensive set of forty-nine observable variables). Phase 3 involved the use of cluster, correlation, and factor analysis to reduce the number of thirty-eight quantitative variables to a more manageable set of eight key variables as required by study objective two (reducing the thirty-eight quantitative variables to a smaller set of eight "key" variables). Phase 4 involved the use of regression analysis to determine the degree to which the key academic quality variable could be predicted from the reduced set of seven key variables developed from objective three. Phase 5 involved the profile analyses of the data base needed for objective four (providing graphic displays of the eight key characteristics of doctoral institutions). Phase 6 involved the use of factor analysis to perform a structural analysis of doctoral institutions required by objective five (determining potential underlying factors responsible for the inter-correlations among the observable quantitative variables describing doctoral institutions). Each of these phases is treated in detail in the following sections of this chapter. Figure 1 below summarizes the study research design and the procedures used.

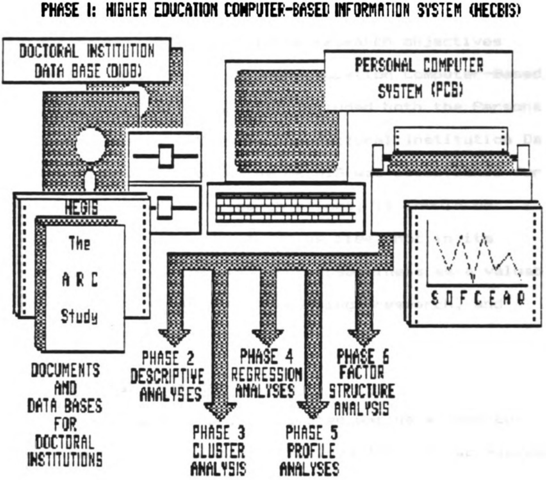

Figure 1. Overview of the Research Design and Procedures

RESEARCH METHODS AND PROCEDURES

The Higher Education Computer-Based Information System

Introduction

The first phase of the study was necessary in order to meet all five of the research objectives specified above. The Higher Education Computer-Based Information System (HECBIS) included both the Personal Computer System (PCS) and the Doctoral Institution Data Base (DIDB). Although the HECBIS was established for use in the present research effort, it should be stressed that its primary value lies, not in its current use, but in its future usefulness as a valuable tool for higher education teaching, research, and decision making.

The Personal Computer System

The Personal Computer System was developed to provide technical support required for: 1) access to relevant published documents; 2) establishment of the data base; 3) statistical analysis of the data base (that is, descriptive analyses and cluster, correlation, factor, and regression analyses); and 4) preparation of narrative and graphic reports.

The Personal Computer System is based on the Apple IIe and IIc microcomputers. Cost was a major consideration in the selection of the Apple hardware over the IBM, but availability of hardware and software was also germane. The Apple II line is extremely inexpensive, currently costing approximately $1,500 complete, and it is ubiquitous. The Apple IIc has the additional value of portability.

The software chosen were the AppleWorks integrated package, the A-STAT 83 statistical system, GraphWorks, and Sideways. AppleWorks provides a capability for the integration of three major computer processing functions: data base management, spread sheeting, and word processing. In this study, AppleWorks was used for: 1) data base management functions, such as establishing the data base and sorting variables for listings; 2) spread sheeting functions, such as calculating medians, ranges, skewness, range to standard deviation ratios, and Z-scores and P-scores for profile analysis; and 3) word processing functions, such as preparing listings, routine tables, rough drafts, and the final report. The A-Stat 83 software package was used to statistically analyze the data base of quantitative data in the study, that is, means and standard deviations and for performing the correlation, factor, and regression analyses. GraphWorks was used to generate the profiles and Sideways was used for generation of oversized tables.

Since integrated packages, like AppleWorks, A-Stat 83, and GraphWorks are also available for the IBM PC, in addition to the Apple II series, the future usefulness of the data base should be greatly enhanced.

The network accessed for relevant documents was the BRS Late Night Service. Again, low cost and wide availability were the main considerations. BRS provides access to the major psychological and higher education literature. There is an initial one-time cost of $75.00 and a monthly minimum charge of $12.00, with on-line charges applied against this minimum. Since modems are available as options on Apple II computers, the current HECBIS utilized such a modem for this communication function.

Finally, a portable Scribe and an Epson printer were used to generate the hard copy output of the report. These printers were chosen on the same basis as the APPLE, that is, low cost and wide usage.

The Doctoral Institution Data Base

Two major constraints governed the establishment of the Doctoral Institution Data Base: 1) the data must be as comprehensive as possible, given the limits of the study, and 2) the data base should be "open-ended" in the sense that it can be updated and/or expanded with new or revised information periodically.

The various studies and extant data bases which describe doctoral institutions in the United States were carefully studied prior to data selection. All data selected for the data base were chosen for their accuracy, consistency, reliability, and availability. All data is for 1981-1982 (academic or fiscal year). The 1981-82 study period was used because it was the latest time-period for which all data elements were available when the study was initiated.

The Population--The study population consisted of the one hundred and seventy-one institutions of higher education in the United States classified by the National Center for Education Statistics (NCES) as "doctoral-level" (Broyles and Fernandez, 1984). The NCES bases its classification of higher education institutions on the number and type of degrees awarded. Thus, under the NCES classification system, doctoral-level institutions are institutions characterized by a significant level and breadth of activity in and, a commitment to, doctoral-level education, as measured by the number of doctorate recipients and the diversity of doctoral-level program offerings. It should be noted that the 1981-1982 population was amended to reflect the 1983-1984 NCES listing of doctoral-level institutions. This was done in order to reflect necessary classification adjustments (both additions and deletions) made by the NCES to correct inaccuracies inherent in a revision of the classification system, which was implemented during the 1981-1982 study year. The amended alphabetical listing of the 1981-1982 study population of doctoral institutions may be found in Appendix A.

The Data--Three major types of data (that is, the data attributes or variables) which characterize the doctoral institution population are included in the data base. 1) Identification data (two data variables): the doctoral institution name (INST) and the Federal Interagency Committee on Education (FICE) code were used simply to identify the doctoral institutions within the population. 2) Categorical or demographic data (nine data variables), including STATE, AFFIL, and SEX were used to restructure the population for analytical study purposes. 3) Quantitative data (thirty-eight data variables) consisting of measurements (thirty-three data variables) and quality ratings (five data variables) were used to describe the important measureable characteristics of doctoral institutions.

The primary source of the data in the data base was the National Center for Education Statistics (NCES), whose major purpose is to collect and disseminate statistics and other data which reflect the condition of education in the United States. The majority of this data was in the form of hard copy "dumps" from computer tapes produced by the NCES from self-reported raw data collected from doctoral institutions via the Higher Education General Information Survey (HEGIS). Hardcopy data dumps were selected over computer tapes because of overall cost and time constraints.

The HEGIS survey is a comprehensive nation-wide system of basic data on higher education which includes all accredited institutions of higher education in the United States. The data have been collected on a regular basis under standardized conditions since 1966 so data terminology, definitions, and procedures are well-established. Seven separate surveys comprise HEGIS XVI (1981-82) and HEGIS XVII (1982-83) for the 1981-82 study year. They are indicated below:

- Institutional Characteristics
- Fall Enrollment
- Earned Degrees
- Salaries
- Libraries
- Finance
- Residence and Migration

Five of the surveys listed above: Institutional Characteristics, Fall Enrollment, Earned Degrees, Salaries, and Finance are administered annually and were used extensively in this study. The surveys on

Libraries and Residence and Migration of College Students are conducted on a non-annual basis. Of these two, only the survey of Libraries was used in the study.

Data relating to faculty compensation, although collected in the HEGIS survey of Salaries, was incomplete and, thus, was not used in the study. pInstead, compensation (salaries and benefits) data was obtained from the American Association of University Professors (AAUP) who produce a completed and revised form of HEGIS academic salary/benefit data. Likewise, data relating to libraries was selected from that collected in the HEGIS survey of Libraries, but which was processed and published by the Association of College and Research Libraries (ACRL).

Data relating to the "academic quality" of institutions was selected from three major sources. The first source was the five volume assessment of graduate education sponsored by The Conference Board of the Associated Research Councils (Jones, Lindzey, and Coggeshall, 1982) which was described in detail in Chapter II. The final two sources were the two revised rating reports by Jack Gourman (1983) on graduate and undergraduate education.

Additionally, one categorical variable, AAUYR, relating to the membership status of doctoral institutions in the American Association of Universities (AAU), was obtained from a membership listing published by the AAU and incorporated into the data base.

File Organization and Contents--The Doctoral Institution Data Base consists of two computerized files, DI DemSDFC and DI AREQ. Each file contains a data record for each of the one hundred and seventy-one doctoral institutions in the United States in the study population. The data records in each file are arranged in alphabetical sequence according to the name of the institution. In addition to the institution name, each data record contains observations on important characteristics of doctoral institutions.

The identification and categorical data in the data base were arbitrarily assigned file space. The quantitative data was organized into eight clusters or domains based on the "relatedness" implicit in both the HEGIS survey and in the higher education literature. They are as follows:

1) S - Student
2) D - Degree
3) F - Faculty
4) C - Compensation
5) A - Asset
6) R - Revenue
7) E - Expenditure
8) Q - Quality

Each domain contains from three to six variables. Each variable has been assigned an "intelligent" alpha code of from three to eight capital letters for identification purposes. The codes for the categorical variables are easily identifiable (for example, STATE and AFFIL), since they are either identical to the variable name or are an abbreviated form of it. For the quantitative variables, the first letter in the variable code identifies the domain of the variable and, in many cases, also the first letter of the key word in the definition. The remaining letters convey, as briefly and as accurately as possible, the meaning of the variable. For example, DEGSTOT indicates that the variable is in the Degree domain and represents total degrees granted and AGE indicates that the variable is in the Asset domain and represents the age of the institution. The data variable structure, type, code, number, and file location, along with the number of respondents (that is, institutions providing data for each variable), are presented in Table 5 below. A listing of data variables with definitions and data sources of the forty-nine study variables is presented in Appendix B.

Table 5. Data Variable Structure, Type, Code, Number, and File Location with Number of Respondents

Data Variable Structure/ Type/Code/Number	File Location	Respondents
I. Identification (2)		
INST	DI DemSDFC 1	
	& DI AREQ 1	171
FICE	DI DemSDFC 2	171
II. Categorical (9)		
STATE	DI DemSDFC 3	171
REGION	DI DemSDFC 4	171
AFFIL	DI DemSDFC 5	171
STATUS	DI DemSDFC 6	171
LNDGRNT	DI DemSDFC 7	171
AAUYR	DI DemSDFC 8	171
CALNDR	DI DemSDFC 9	171
SEX	DI DemSDFC 10	171
RACE/ETH	DI DemSDFC 11	171
III. Quantitative (38)		
S - Student (4)		
STDHDCT	DI DemSDFC 12	171
STDFTE	DI DemSDFC 13	171
SGHDCT	DI DemSDFC 14	171
SGHDCTFT	DI DemSDFC 15	171
D - Degree (4)		
DEGSTOT	DI DemSDFC 16	171
DEGSMAS	DI DemSDFC 17	171
DEGSDOC	DI DemSDFC 18	171
DEGSFP	DI DemSDFC 19	171
F - Faculty (5)		
FACTOT	DI DemSDFC 20	169
FACTEN	DI DemSDFC 21	169
FTENPRF	DI DemSDFC 22	169
FTENASC	DI DemSDFC 23	169
FTENAST	DI DemSDFC 24	169
C - Compensation (3)		
COMPPRFA	DI DemSDFC 25	157
COMPASCA	DI DemSDFC 26	157
COMPASTA	DI DemSDFC 27	156
A - Asset (6)		
AGE	DI AREQ 2	171
AENDOW	DI AREQ 3	171
ABLDG	DI AREQ 4	171
AEQUIP	DI AREQ 5	171
ALVOLS	DI AREQ 6	168
ALSUBS	DI AREQ 7	164

Table 5 (Cont'd.).

Data Variable Structure/ Type/Code/Number	File Location			Respondents
R - Revenue (5)				
RTOT	DI	AREQ	8	171
RGVTGC	DI	AREQ	9	171
RPRVGGC	DI	AREQ	10	171
RTUITFE	DI	AREQ	11	171
RAPPROP	DI	AREQ	12	171
E - Expenditure (6)				
EINSTR	DI	AREQ	13	171
EACADSP	DI	AREQ	14	171
EPLNT	DI	AREQ	15	171
ERES	DI	AREQ	16	171
ESTDSVC	DI	AREQ	17	171
ESCHFEL	DI	AREQ	18	171
Q - Quality (5)				
QARCFAC	DI	AREQ	19	162
QARCPRG	DI	AREQ	20	162
QARCN	DI	AREQ	21	162
QGRMNG	DI	AREQ	22	169
QGRMNUG	DI	AREQ	23	163

Total = 49 variables

Note: DI = Doctoral Institution; DemSDFC = Identification and Demographic data and data from the Student, Degree, Faculty, and Compensation Domains; AREQ = Data from the Asset, Revenue, Expenditure, and Quality Domains.

Phases two through six describe the research methods and procedures used to achieve the five study objectives described earlier. In each phase, the objective is briefly restated and the research and statistical methods and procedures which were used to achieve the objective are described. In several instances, a particular statistical method (that is, correlation, factor, and regression analysis) was used to achieve more than one objective. In such cases, the method will be fully described only upon its first use and simply referenced later.

The following table (see Table 6 below) will be useful to the reader to keep in mind the statistical symbols and definitions used in the discussion of the descriptive analyses which follows. These symbols will also be referred to periodically in Chapter 4.

Table 6. Symbols and Definitions Used in the Descriptive Analyses

Symbol	Definition
i	The institution, $i = 1, 2, \ldots N$.
N	The number of institutions, 171 in most cases.
j	The observed variable, $j = 1, 2, \ldots, n$.
n	The number of variables, that is 38.
X_{ij}	The data value for institution i on variable j.
μ_j	The population mean for variable j.
σ_j	The population standard deviation for variable j.
Md_j	The median of variable j.
I	The interval in which the median is located.
LLI	The lower real limit of the interval in which the median is located.
f	The frequency in the interval in which the median is located.
cf	The cumulative frequency up to the interval in which the median is located.

Table 6 (Cont'd.).

Symbol	Definition
Z_{ij}	The standardized value (Z-score) of institution i on variable j.
P_{ij}	The transformed form of Z_{ij} or the profile score or P-score of institution i on variable j.
Sk_j	The skewness of the distribution of values of variable j.

It should be noted that two types of data values or scores were used in the statistical analyses and reporting: 1) the raw data values and 2) converted or transformed standard score forms of those values, Z-scores. Raw data values were used, and are the values reported, in the descriptive analyses of the categorical variables and in those descriptive analyses dealing with ordered listings of institutions (that is, rankings), as well as in the summary statistics (that is, the median, mean, standard deviation, range, range to standard deviation ratio, and skewness) for each variable. Transformed forms of the data values were used in all formulas relating to the correlation, factor, and regression analyses and are the data values reported in the profiles.

The necessity for the transformation of the data values is apparent when one observes, upon inspection, that the data values, as collected, are not comparable (that is, they have no common metric). For example, STDHDCT is a count of students measured numerically on a scale from 49 to 65,184; AENDOW is a quantity measured in dollars on a scale from $0.00 to $1,701,229,475; and QARCFAC is a rating measured numerically in points ranging from 0 to 15,890. Therefore, standardization was necessary for the comparison of institutions in statistical analysis and reporting. The conversion of the raw data values to Z-scores was automatically handled in the A-Stat 83 software. However, for the profile analysis, they were calculated with the AppleWorks spread sheet program. The transformation procedure used will be fully described below.

The Descriptive Analyses

Introduction

The major purpose of Phase 2, the descriptive analyses, was to meet study objective one. Objective one and its associated research question are as follows:

> Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

R1. What characterizes the population of one hundred and seventy-one American doctoral institutions?

Such comprehensive descriptive analyses are important since they provide information about some of the basic statistical characteristics of this powerful group of institutions, which educate, not only the leaders of the United States, but indeed, many of the leaders throughout the entire world. The descriptive analyses also serve to set the stage for later, more complex, analyses. Two types of descriptive analyses were performed, one for categorical variables and one for quantitative variables.

Categorical Variables

Analysis of the nine categorical variables consisted of the preparation of listings for each variable sorted alphabetically by institution name within variable sub-categories. In most cases, frequency tables were also prepared to summarize variable information. The listings and frequency tables were prepared with AppleWorks by sorting each variable in the data base and then transferring the results to the word processing program for reporting.

Quantitative Variables

Introduction

Analysis of the quantitative variables was based upon the thirty-eight quantitative variables described earlier. The data matrix used included the one hundred and seventy-one institutions (denoted as i) and the thirty-eight quantitative variables (denoted as j) or a matrix with 171 rows and 38 columns. Two major types of descriptive analyses of the thirty-eight quantitative variables were performed: 1) summary statistics and 2) rankings or ordered listings. Each of these types of analyses is discussed in detail below.

Summary Statistics

Summary statistics were used to obtain information about the population of doctoral institutions as a whole and about the relationship of the variables to each other. Six summary statistics were calculated for each of the thirty-eight quantitative variables to determine the three major properties of the distributions or groups of data values: 1) central tendency (the median and the mean), 2) variability (the range, standard deviation, and range to standard deviation ratio), and 3) symmetry (skewness).

The median and the mean are measures of the central tendency (that is, the central value or "size") of each variable. Measures of central tendency describe the size or concentration of a group of values on a number scale, but they disregard the differences that exist among the separate values. Multiple measures were used for central tendency in the present study due to the fact that no single measure of central tendency adequately describes all the values in a group.

The first measure of central tendency used, the median, is defined as the 50th percentile in a group of values. It is the value that divides the ranked values into halves, such that half of the values are larger and half of the values are smaller than the median value. Medians were computed on the ungrouped raw data values. The formula (Glass and Stanley, 1970, 60) used for computing the median is as follows:

$$Md_j = LLI + I \frac{(N/2) - cf)}{f}$$

where j is the variable (j = 1, 2, ..., n), n is the number of variables (38), I is the interval in which the median is located (that is, the median interval), LLI is the lower real limit of I, N is the number of institutions, cf is the cumulative frequency up to I, f is the frequency in I, and Md_j is the median of variable j.

The second measure of central tendency, the average or mean (μ or mu) value of a group of values in a population is found by summing all values and dividing them by their number. The formula (White, 1973, 38) used in the calculation of the population mean is as follows:

$$\mu_j = \frac{\sum_{i=1}^{N} X_{ij}}{N}$$

where i is the institution (i = 1, 2, ..., N), N is the number of institutions (171), j is the variable (j = 1, 2, ..., n), n is the number of variables (38), X_{ij} is the value of institution i on variable j, and μ_j is the population mean of variable j.

When interpreting the median and mean, it should be remembered that the median is not affected by the size of the extremely "large" and "small" values above or below it. The mean, on the other hand, is affected by the individual values of every value in the set of data. Changing even one value can affect the value of the mean, sometimes dramatically so. The mean is especially affected by "outliers," that is, values which lie far from the center of a group of values.

The range, standard deviation, and range to standard deviation ratio measure the variability (that is, the scattering, dispersion, heterogeneity, or "spread") of a set of data values of a variable. The range (that is, the difference between the largest and smallest values in a group of values) simply measures the full distance along the number scale over which the values vary. Ranges are presented in the results section, along with the minimum and maximum values for each variable. Because the range is determined by just two values in a group of values, it ignores the spread of all values, except the largest and smallest. Thus, its designation as the crudest measure of variability that is commonly employed is apparent. In this study, the range shows the maximum difference possible among doctoral institutions on each variable.

The standard deviation (that is, the positive square root of the variance) is a measure of the variability of each data value within the group of values comprising each variable. A standard deviation was calculated for each of the thirty-eight quantitative variables using A-Stat 83. The usual standard deviation population formula (White, 1973, 41) was used for calculation:

$$\sigma_j = \frac{\sum_{i=1}^{N} (X_{ij} - \mu_j)^2}{N}$$

where i is the institution (i = 1, 2, ..., N), N is the number of institutions (171), j is the variable (j = 1, 2, ..., n), n is the number of variables (38), X_{ij} is the value for institution i on variable j, μ_j is the population mean of variable j, and σ_j is the population standard deviation of variable j.

Additionally, a range to standard deviation ratio (that is, the value of the length of the range in standard deviation units) was calculated with the expectation that the ranges of the distributions would fall within the usual 3 to 6 standard deviation area. In interpreting the ratio, it should be remembered that the larger the value, the more extensive the range.

Skewness (sk) was used to measure the degree of asymmetry of the distributions of the thirty-eight quantitative variables. Asymmetry is one of the more important properties of a distribution since it reflects deviation from the normal curve. This particular statistic can be used to compare the skewnesses of different distributions (that is, of the variables) because division by the standard deviation (σ) makes the measure independent of the variability of a specific distribution. The formula (Glass and

Stanley, 1970, 90) used for calculating skewness is as follows:

$$Sk_j = \frac{3(\mu_j - Md_j)}{\sigma_j}$$

where j is the variable (j = 1, 2, ..., n), n is the number of variables (38), μ_j is the population mean of variable j, Md_j is the median of variable j, σ_j is the population standard deviation of variable j, and Sk_j is the skewness of variable j.

The skewness of a distribution usually falls between -3 and +3. A distribution is said to be symmetrical when the mean and median are identical (Sk = 0). When the mean is greater than the median (that is, when the values pile up toward the lower values and the upper tail is extended), the distribution is said to be positively skewed and when the median is greater than the mean (that is, the values pile up at the higher end and the lower tail is extended), the distribution is said to be negatively skewed.

Rankings

Rankings were also used in the study. Rankings of institutions by some variable (for example, number of students, library volumes, and government grant and contract revenue) are probably the most frequently used measures of institutional standing. This type of analysis (that is, ordering from high to low in this case) was performed for each of the thirty-eight quantitative variables in the study. Rankings are valuable only to the extent that they convey some general perspective of status relative to a group. As a basis for decision making, however, they leave much to be desired.

Reduction of the Data Base

Introduction

The purpose of Phase 3 was to meet study objective two, which is stated below, along with its associated research question.

> Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."
>
> R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

Reduction of the data base was done for two reasons. First, the initial number of thirty-eight quantitative variables, although greatly reduced from the number actually available and collected, is simply too large for an individual researcher or decision maker to rapidly assimilate because of the amount of information processing required. Studies of cognition indicate that the maximum amount of information that can be processed by people without "chunking" is about seven (that is, the magic number of five, plus or minus two). A second reason is that factor analytic studies have repeatedly shown that most of the meaning contained in a large set of variables can be captured by only a few of the variables.

Data reduction in the present study was achieved through five steps: 1) formulation of a theoretical model of the key factors or domains underlying the observable measures, that is, estimating the number of underlying factors and providing a general description of the types of variables which define the domains; 2) grouping the variables into clusters, one for each domain or factor; 3) assessing the similarity or high correlation of the variables within each domain through correlation analysis; 4) reducing the number of variables within each domain through factor or dimensional analysis; and 5) selecting one "key" variable from each domain which best represents the domain. The first two steps in the data reduction method described above are usually referred to as a type of "cluster analysis." Both of these steps will be described in the discussion of cluster analysis which follows.

The Cluster Analysis

Cluster analysis refers to a wide variety of techniques used to group objects or entities (O analysis) or attributes or variables (V analysis) into subsets (that is, clusters or domains) on the basis of similarity in order to define dimensions or factors (Lorr, 1983, 11). The cluster analytic technique used in the present study (V analysis) is sometimes also referred to as "theory-directed factor analysis," because the clustering of the attributes or variables is based on theoretical a priori decisions of what the factors are and how many are necessary (Mulaik, 1972, 361-363).

The theory used to establish the clusters in the present study was to adopt the seven domain theory implicit in the higher education literature and the HEGIS classification of higher education institution data and to add to that an additional cluster for institution quality. The variables selected to form each cluster were then taken directly from the HEGIS surveys and from among the available measures of academic quality. This a priori theoretical model of the eight domains or factors underlying the thirty-eight quantitative variables in the study are shown below in Table 7 (See also Table 5 in this chapter and Appendix B for additional information).

Table 7. Eight-Factor Theoretical Model Underlying the Thirty-eight Quantitative Variables

Domain	Variables Defining Domain
S - Student	Total and FTE students and total and full-time graduate students.
D - Degree	Total, master's, first professional, and doctor's degrees granted.
F - Faculty	Total full-time academic year faculty, tenured faculty, and tenured faculty by rank (that is, full, associate, and assistant professor).
C - Compensation	Average academic year compensation (salary and benefits) of tenured faculty by rank (that is, full, associate, and assistant professor).
A - Asset	Age (as a reflection of resources), endowment, buildings, equipment, and library volumes and subscriptions.
R - Revenue	Revenue (during the study period): total revenue and revenue by source (government grants and contracts; private gifts, grants and contracts; tuition and fees; and appropriations).
E - Expenditure	Expenditures (during the study period) for: instruction; academic support; plant; research; student services; and scholarships and fellowships.
Q - Quality	Quality rating points for faculty and programs and the number of programs from the Associated Research Councils survey and Gourman graduate and undergraduate quality ratings.

As can be seen, this a priori cluster analysis method avoids the central problem of the number of common factors or clusters and the number of variables in each cluster by predicting them from some theoretical base. Thus, the contributions due to factors unique to the variable or due to error are not treated per se, because it is assumed that no cluster selection will ever be perfect and that the investigator is interested in what can be predicted from his or her cluster theory.

The Correlation Analyses

The third step in data reduction was to assess the similarity of the variables within each domain through correlation analysis, using the Pearson product-moment correlation procedure. The symbols and definitions used in the discussion of the correlation analyses which follows are summarized in Table 8 below.

Table 8. Symbols and Definitions Used in the Correlation Analyses

Symbol	Definition
i	The institution, i = 1, 2, ... N.
N	The number of institutions, 171 in most cases.
j	The first observed variable, j = 1, 2, ..., n.
k	The second observed variable, k = 1, 2, ..., n.
n	The number of variables, that is, 38.

Table 8 (Cont'd.).

Symbol	Definition
Z_{ij}	The standardized value (Z-score) of institution i on variable j: $$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j}$$
Z_{ik}	The standardized value (Z-score) of institution i on variable k: $$Z_{ik} = \frac{X_{ik} - \mu_k}{\sigma_k}$$
N_{jk}	The number of institutions having values on both variables j and k.
ρ_{jk}	The inter-correlation between two variables, j and k, within a domain.

Correlation analysis deals with two basic questions: 1) does a relationship exist between two variables and, if so, 2) what is the nature and the extent of the relationship? The Pearson product-moment correlation coefficient is used to measure the strength of the relationship between the numeric values of the variables and is completely independent of what these numeric values represent in a particular situation. The formula (Weinberg and Goldberg, 1979, 100) for this statistic (ρ or rho in a population) is as follows:

$$\rho_{jk} = \frac{\sum_{i=1}^{N_{jk}} Z_{ij} \cdot Z_{ik}}{N_{jk}}$$

where i is the institution (i = 1, 2, ..., N), N is the number of institutions, j is the jth variable and k the kth variable (j and k = 1, 2, ..., 38), N_{jk} is the number of institutions having values on both variables j and k, Z_{ij} and Z_{ik} are the standardized values (Z-scores) of institution i on the jth and kth variables, and ρ_{jk} is the correlation between variables j and k.

The A-Stat 83 correlation procedure utilized is a very accurate procedure based on the provisional means algorithms of C. Herraman (1968). It uses "pairwise" deletion for missing data (that is, correlations are computed on the basis of pairs of cross-products available for each institution). Thus, means used during calculation are based on the number of institutions for each variable, not for each cross-product. This implies a more stable mean, but the actual correlations vary slightly from correlations based only on means for cases available for each correlation which occurs if listwise deletion (that is, any case with missing data for any of the variables is deleted) is used (Grandon, 1983, 9.15-9.2).

The correlation coefficients are reported in the usual matrix form. Since the matrix is symmetric ($\rho_{jk} = \rho_{kj}$), only the top triangle matrix is shown. The lower triangle matrix indicates the number of data points used for each correlation (that is, N_{jk} equals the number of institutions in which both variable j and variable k had values). Usually, $N_{jk} = 171$. When $N_{jk} < 171$ (for example, $N_{jk} = 169$), it indicates that two institutions in the population had missing data.

Some general guidelines for interpreting the correlation coefficient suggested by Weinberg and Goldberg (1979, 105-107) are: 1) When interpreting the correlation coefficient, consideration should be given to the situation in which the correlation was computed (that is, whether it is two measures of the same variable taken at different points in time or whether the measures are from two different measures (as in the present study); 2) A positive (or direct) systematic linear relationship is assumed to exist between two variables when high scores on one variable are paired with high scores on another variable or low scores on one variable are paired with low scores on another variable; 3) The plus (+) or minus (-) sign of the correlation indicates whether the relationship between the variables is direct (+) or inverse (-); 4) The values of rho vary from -1 (a perfect negative correlation) to +1 (a perfect positive correlation) with a value of 0 (zero) indicating statistical independence; 5) Strong, moderately strong, moderate, moderately weak, and weak are used to indicate the strength of a relationship independent of the circumstances under which it was obtained. In general, Pearson correlation individual values are interpreted to be strong (0.80 to 1.00 or -0.80 to -1.00), moderately strong (0.60 to 0.79 or -0.60 to -0.79), moderate (0.40 to 0.59 or -0.40 to -0.59), moderately weak (0.20 to 0.39 or -0.20 to -0.39), or weak (0.00 to 0.19 or -0.00 to -0.19). Perhaps the most practical interpretation is that p_{jk}^2 equals the proportion of variance on variable j that is predictable from k with a linear equation.

The Factor Analyses

The fourth step in data reduction was to reduce the number of variables within each domain through factor analysis. The symbols and definitions used in the discussion of the factor analyses which follows are summarized in Table 9 below.

Table 9. Symbols and Definitions Used in the Factor Analyses

Symbol	Definition
i	The institution, i = 1, 2, ..., N.
N	The number of institutions, 171 in most cases.
j	The first observed variable, j = 1, 2, ..., n.
k	The second observed variable, k = 1, 2, ..., n.
n	The number of variables, that is, 38.

Table 9 (Cont'd.).

Symbol	Definition
p	The common factors, $p = 1, 2, \ldots, m$.
m	The number of common factors.
a_{jp}	The factor loading or weight of variable j on common factor p. In this study, the correlation of variable j with common factor p.
$\hat{\rho}_{jk}$	The correlation between variables j and k predicted from the common factors. Thus: $\hat{\rho}_{jk} = \sum_{p=1}^{m} a_{jp}a_{kp}$ (Note that the method used assumes the orthogonal case, that is, where the correlations between the factors, F_{pi}'s, are all zero.)
F_{pi}	The value of common factor score p for institution i.
Z_{ij}	The standardardized value (Z-score) of institution i on variable j predicted from the common and unique factors: $Z_{ij} = \sum_{p=1}^{m} a_{jp}F_{pi} + d_jU_{ji}$
h_j^2	The communality ($\sum_{p=1}^{m} a_{jp}^2$) or sum of the squared factor coefficients, that is, the portion of the variance on variable j that is predictable from the m common factors.
d_jU_{ji}	Specificity and error, that is, that part of the observed score (Z_{ij}) that is due to the unique factors in variable j.

Note: Factor analysis is a procedure that uses matrix algebra to calculate a_{jp} and F_{pi} from the observed value which minimizes the squared differences between Z_{ij} and $\hat{Z}_{ij}$.

Factor analysis is a statistical technique in wide use in the behavioral and social sciences which accounts for the linear relationships that exist between observed variables (Mulaik, 1972, 96). Factor analysis assumes that the relationships between variables are linear and that the variables to be analyzed have non-zero correlations existing between them. If such correlations do not exist, the observed variables themselves are the only sufficient set of variables to account for the relationship. If such correlations do exist among some of the observed variables, then a hypothetical set of component variables can be derived mathematically from the observed variables that may make it possible to explain their inter-relationships. These hypothetical component variables have the following properties: 1) They form a linearly independent set of variables. 2) They can be divided into two basic kinds of components (common factors and unique factors), which are distinguished by the patterns of differential weights in the linear equations which derive the observed variables from the hypothetical component variables. 3) Common factors are always assumed to be uncorrelated with unique factors. Unique factors are also usually assumed to be mutually uncorrelated, but common factors may or may not be correlated. In this analysis it is assumed that the common factors are uncorrelated. 4) It is generally assumed that there are fewer common factors than observed variables and that the number of unique factors is equal to the number of observed variables.

Factor analysis is usually used for three major purposes: 1) to generate hypotheses regarding the number and kinds of dimensions; 2) to reduce data (as in the present case); and 3) to test or confirm some hypothetical structure (as used in Phase 6 of the study).

The general procedure in factor analysis is as follows: 1) select the variables; 2) compute the matrix of correlations of the variables; 3) extract the unrotated factors; 4) rotate the factors; and 5) interpret the rotated factors.

The selection of the variables and the computation of the matrices of inter-correlations of the variables have already been discussed in detail above. To summarize, the variables were selected from HEGIS and other data sources based on the a priori Eight-Factor theoretical model during the cluster analysis procedure. The inter-correlation matrices for the eight domains were then computed, using the Pearson product-moment correlation procedure.

The factor analysis model was used to extract the unrotated factors in this study. This model, according to Lorr (1983, 48), hypothesizes that each variable derives from three sources of variation: 1) common factor variance (the variance that a variable shares with other variables); 2) specific factor variance (the specific aspects of a variable not shared by other variables); and 3) error variance (random error or unreliability). The variance due to a given variable, the combined specific and error variance, constitutes the unique factor variance. Since each observed variable is describable in terms of m common factors and r unique factors, the aim is to find the smaller set of common factors and to remove the unique variance. The factors are summarized in an n x m matrix (that is, the number of variables times the number of common factors) of factor coefficients. The model is stated as follows:

$$Z_{ij} = \sum_{p=1}^{m} a_{jp}F_{pi} + d_jU_{ji}$$

where i is the institution (i = 1, 2, ... N), N is the number of institutions (171), j is the observed variable (j = 1, 2, ... n), n is the number of variables (38), p is the common factor (p = 1, 2, ... m), m is the number of common factors, a_{jp} is the factor loading or weight of variable j on common factor p (that is, the correlation of variable j with common factor p), F_{pi} is the value of common factor score p for institution i, $a_{jp}F_{pi}$ reflects the communality (h_j^2) or that portion of the observed variance of the Z-scores predictable from the m common factors, d_jU_{ji} reflects that part of the variance due to the unique factors in the variables (that is, specificity and error), and Z_{ij} is the standardized value (Z-score) for institution i on variable j.

Thus, the model assumes: 1) that the common factors represent the hypothetical independent variables that explain the correlations between variables in terms of processes that generated the observed data and 2) the observed variables are linear combinations of one or more hypothetical variables.

There are two major problems in common factor analysis: 1) the problem of the number of common factors (m) and 2) the determination of the communalities (h_j^2). These problems relate to the basic indeterminacy that is characteristic of factor analysis. That is, the communalities (h_j^2) can't be calculated until the common factors (m) are defined. However, the number of common factors can't be calculated until the communalities are known. The problem is that neither of these values is known empirically. Hence, other criteria must be used to estimate either m or the h_j^2. One procedure is to hypothesize that the number of common factors (m) equals a specific value. The other procedure is to use an estimate for commonality, for example, setting the h_j^2 equal to the squared multiple correlation of each variable (j) with all of the other variables and to iterate (repeat the factor analysis) until the estimated communality stabilizes. Then, to take as the number of common factors, the smallest number which is necessary to reproduce the estimated communality. Thus,

$$h_j^2 = \sum_{p=1}^{m} a_{jp}^2$$

A final technical problem in common factor analysis is the problem of establishing a criterion for fitting the factor coefficients and factor scores to a correlation matrix, since many possibilities exist for any given correlation matrix. The usual criterion for selecting the weights, a_{jp}, and the factors, F_{pi}, is the least-squares best fit criterion. This criterion basically states that when the sum of squares of the elements of the residual matrix is as small as possible for m common factors, then we can presume that the residual matrix is as much like a diagonal matrix as possible, at least as far as an unweighted-squares criterion is concerned. (Harman, 1967, 189; Mulaik, 1972, 149-151). The equation for the least-squares best fit "MIN RES" criterion is as follows:

$$LS = \sum_{j=1}^{n} \sum_{k=1}^{n} (p_{jk} - \hat{p}_{jk})^2 \quad \text{where } j \neq k$$

The mathematical procedure used for the extraction of the unrotated factors, using the common factor analysis model, can be generally described as follows. First, use the matrix of correlations of the variables, with communalities in the principal diagonal cells, to define the first dimension or factor (this composite is taken to be either a subset of the factors or the total set of factors with a designated pattern of weights attached to the variables). Next, define a new matrix, "the first factor residual matrix," by partialling out (that is, by a special form of adjustment) the values on the first factor composite from each of the correlations in the matrix. Then, define a second matrix, "the second residual matrix," by a newly weighted composite of the variables, the values of which are partialled out of the first residual matrix. The procedure is continued until a final residual matrix is formed of entries that are of trivial magnitude (that is, a matrix in which the values are so small as to be infinitesimal).

After all the unrotated factors were extracted, the factors were then rotated, using the Kaiser varimax rotation procedure, in order to achieve "simple structure" in the factor matrix. Simple structure was introduced by Thurstone (1935) as a criterion for determining the final rotational transformation of the factors around the origin of an n dimensional space in order to obtain meaningful factors that are as consistent as possible from analysis to analysis. In the unrotated factor matrix, the first factor accounts for the largest amount of variance and subsequent factors account for decreasing amounts of variance. In a rotated factor matrix, on the other hand, the variance is more evenly distributed across all factors. Additionally, the variables in a rotated matrix are usually highly loaded on only a few factors, while the variables in an unrotated factor matrix are usually highly loaded on many factors (Tatsuoka, 1971, 144).

The final step in the factor analysis was the interpretation of the factors generated through the procedure. The usual method was used which was to review the factor loadings or a_{jp}'s (that is, the correlation of each variable with each of the commom factors) for each of the variables, applying the same interpretation to the individual a_{jp} correlation values as was used above in relation to the Pearson product-moment correlation coefficient.

Selection of the Key Variables

The fifth and final step in data reduction was to select the most representative or "key" variable from each of the eight domains for further analysis. Two separate sets of key independent variables were selected for this step in order to maximize the predictability of the key variables. The first set of eight key variables was determined, using only a single criterion, high factor loading. The second set of key variables was determined, using dual criteria, high factor loading in conjunction with the inter-correlation of each variable with the dependent quality variable. Each of these two sets of variables were then used in the regression analyses, a discussion of which follows.

Predicting Quality With Key Variables

Introduction

The purpose of Phase 4 was to achieve objective three of the research study. As before, the objective is restated, along with the associated research question to be answered. It is as follows:

Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

R3. Can the key quality variable be predicted without loss from the other seven key variables?

The Regression Analyses

The above described cluster analysis would be of limited value if the variables chosen were not related to the quality of the institutions. To determine this relationship, a multiple regression analysis was performed using the two sets of eight key variables selected in Phase 3 to represent the eight clusters or domains. The symbols and definitions used in the discussion of regression analysis which follows are summarized in Table 10 below.

Table 10. Symbols and Definitions Used in the Regression Analyses

Symbol	Definition
i	The institution, i = 1, 2, ..., N.
N	The number of institutions, 171 in most cases.
Y	The observed key dependent variable or criterion selected to represent the quality domain.
k	The observed key independent or predictor variables selected to represent the other domains, k = 1, 2, ..., n.
n	The number of key independent or predictor variables, seven in this case.

Table 10 (Cont'd.).

Symbol	Definition
B_k	The partial regression coefficients or Beta-weights (that is, the standardized regression weights) used for combining the seven independent variables.
X_{ki}	The value of the key independent or predictor variable k for institution i, that is in this study, X_{ki} = SGHDCTFT, ..., X_{ni} = EINSTR.
A	The difference between the mean of the observed dependent variable and the means of the independent variables.
$\hat{Y}_i$	The value of the quality key dependent variable for institution i predicted from the composite of seven independent variables.
ρ_{yk}	The correlation of the observed dependent variable Y with each independent variable k.
R_{yy}	The multiple correlation between the observed dependent variable (Y) and the composite of the independent variables ($\hat{Y}$).
R^2	The square of $R_{y\hat{y}}$.

Multiple regression (or correlation) is the correlation between one variable and the sum of two or more variables (that is, a composite of independent variables that are combined by weightings that maximize the correlation (Peatman, 1963, 117-120). Regression analysis requires not only the means and standard deviations of each variable, but also all of the Pearson inter-correlations among the variables.

The model for multiple regression is similar to that for factor analysis except that, in multiple regression, all variables are observable. The regression model assumes that the predicted dependent variable is a linear composite of other independent variables (Bhattacharyya and Johnson, 1977, 385-395). The customary form of the linear multiple-regression equation is as follows:

$$\hat{Y}_i = B_k X_{ki} + \ldots + B_n X_{nN} + A$$

where i is the institution (i = 1,2, ..., N), N is the number of institutions (171), k is the observed key independent variable (k = 1, 2, ..., n), n is the number of independent key variables (7), $B_k \ldots B_n$ are the partial regression coefficients or Beta-weights (that is, the standardized regression weights) used for combining the seven independent variables, $X_{ki} \ldots X_{nN}$ are the values of the key independent variables, A is the difference between the mean of the observed dependent variable and the means of the independent variables, and $\hat{Y}_i$ is the value of the predicted criterion key variable (quality) for institution i. These estimates are the best possible by the least squares criterion, that is, if the error in estimating an entity's (that is, an institution's) status is measured by the discrepancy between actual status (Y) and status as estimated by the equation $(\hat{Y})$, the sum of these squared errors $(Y - \hat{Y})^2$ would be smaller than by any other set of constants. The maximum correlation of a criterion with a set of n predictors is expressed by the multiple correlation coefficient, R.

The A-Stat procedure used for regression analysis first calculates the Beta-weight from the dependent variable for each of the independent variables, and then calculates the overall R-Square (R^2).

It should be noted that the number of independent variables can range from one to the maximum number of variables. Thus, the values of predictors can be studied individually, in pairs, in triplets, and so forth by performing separate regression analyses. Further, it should be noted that the relationship mentioned above also holds true when only a single independent variable is used. In this study, seven independent variables were used against the dependent quality variable.

Four statistics are used in interpreting the regression analysis: the Beta-weight or coefficient (B), the Simple R (r), the multiple correlation coefficient (Multiple R or R), and the squared multiple correlation coefficient (R^2). The Beta-weight of each variable is a measure of the contribution of each of the independent variables in the composite of independent variables to the correlation with the criterion value. The Simple R is the product-moment correlation of the observed dependent variable with each independent variable, R is the product-moment correlation between the observed dependent variable and the composite of independent variables, and R^2 is the square of R or that proportion of the dependent variable's variance "explained" by the joint contribution of the independent variables.

In the present study, both sets of eight key independent variables (that is, the first set selected on the basis of factor loading alone and the second set selected on the basis of factor loading and inter-correlation with the dependent quality key variable) were analyzed using regression analysis to determine the best set of key variable predictors of quality in doctoral institutions.

Graphic Analysis of the Data Base

Introduction

The purpose of Phase 5, graphic analysis of the data base, was to meet study objective four. The objective and research question to be answered are stated below.

Objective 4: To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.

R4. What findings can be obtained with profile, rather than ranking, reports?

A profile analysis represents each institution as a profile or line graph drawn over the eight key variables or indicators described above. The importance of such graphic profiles is that they provide an immediate intuitive summary of the nature of individual institutions or groups of institutions or as Tukey (1977) has noted, they "force us to notice what we never expected to see." The symbols and definitions used in the discussion of the profile analyses which follow are summarized in Table 11 below.

Table 11. Symbols and Definitions Used in the Profile Analyses

Symbol	Definition
i	The institution, $i = 1, 2, \ldots, N$.
N	The number of institutions, 171 in most cases.
j	The observed key variable, $j = 1, 2, \ldots, n$.
n	The number of key variables, eight in this case.
g	A given group institutions, $g = 1, 2, \ldots, M$.
M	The number of institutions in group g.
μ_j	The population mean for variable j.

Table 11 (Cont'd.).

Symbol	Definition
σ_j	The population standard deviation for variable j.
Z_{ij}	The standardized value (Z-score) of institution i on variable j.
P_{ij}	The transformed form of Z_{ij} or the profile score or P-score for institution i on variable j.
Z_{gj}	The standardized value (Z-score) of group g on variable j.
P_{gj}	The transformed form of Z_{gj} or the profile score or P-score for group g on variable j.

The Profile Analyses

The method used in the profile analyses was straight forward. First, the raw observed data values or scores for each institution were converted to a standard value for each of the eight key variables, using the following formula:

$$Z_{ij} = \frac{X_{ij} - \mu_j}{\sigma_j}$$

where i is the institution (i = 1, 2, ..., N), N is the number of institutions (171), j is the key variable (j = 1, 2, ... n), n is the number of key variables (8), X_{ij} is the raw data value of institution i on key variable j, μ_j is the population mean of key variable j, σ_j is the population standard deviation of key variable j, and Z_{ij} is the standard value (Z-score) for institution i on key variable j.

Second, a conversion was made to change the standard value to a new scale value with a mean of 50 and a standard deviation of 10 (in order to avoid carrying plus and minus signs on an institution's key variable values). Thus, the formula for the transformed standard value or Profile score (P-score) for institution i on variable j is:

$$P_{ij} = 50 + 10\ Z_{ij}$$

where i is the institution (1, 2, ..., N), N is the number of institutions (171), j is the key variable (1, 2, ..., n), n is the number of key variables (8), and Z_{ij} is the Z-score for institution i on key variable j, and P_{ij} is the profile score or P-score for institution i on variable j.

The P-score is somewhat more easily grasped than the Z-score. Thus, the national average is 50 for all variables and the standard deviation is 10 for all variables. Similarly, for any institution i (1, 2, ..., 171) and variable j (1, 2, ..., 8):

Pij = 60 means that institution i is one standard deviation above the national average on variable j and

Pij = 40 means that institution i is one standard deviation below the national average on variable j.

This interpretation relating to the average remains the same even if some other group is used for comparison, such as state, NASULGC members, or Big 10 institutions.

To represent groups of institutions, the mean P-score is used. It is calculated as follows:

$$\bar{P}_{gj} = \frac{\sum_{i \subset g}^{M} Z_{ij}}{M}$$

where i is the institution (i = 1, 2, ..., N), N is the number of institutions (171), g is a given group of institutions (g = 1, 2, ..., M), M is the number of institutions in the group, j is the key variable (j = 1, 2, ..., n), n is the number of key variables (8), Z_{ij} is the standardized value (Z-score) of institution i on variable j, and $\bar{P}_{gj}$ is the transformed form of Z_{gj} or the P-score for group g on variable j.

The particular profiles or graphs selected for presentation in the study are merely representative. Profiles can be generated on demand using the spread sheet and line graph options on the data base management system, that is, by selecting rows (institutions) of the data matrix and inputting them to GraphWorks, the graphics program. Line graphs for groups can be generated by using the @AVG function to calculate group P-scores for inclusion into the profile spread sheet.

The Underlying Structure of the Data Base

Introduction

The purpose of Phase 6, the factor structure analysis, was to meet study objective five which is restated below, along with the research question and study hypothesis to be answered.

> Objective 5: To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.
>
> R5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?
>
> Empirical Research Study Hypothesis
> The number of common factors underlying the observable quantitative characteristics of American doctoral institutions is greater than one (the univariate case) and less than or equal to eight (the number of domains used in the original description).

Thus, the purpose of this analysis was to consider another approach to determining the key variables underlying the data base than the cluster analytic method described previously. In the cluster analysis, it may be remembered, it was assumed that a total of eight factors (unobservable variables) were necessary to account for the correlation matrix. In the present analysis, frequently termed "confirmatory factor analysis," the factor analytic model was applied so as to permit the number and nature of the factors to be set empirically. Such an analysis is important for several reasons. First, the analysis will provide an empirical check on the cluster analytic approach. If similar results are obtained with both methods, then the results would seem more trustworthy. Second, the analysis may show that more than one or fewer than eight underlying factors are necessary to reproduce most of the inter-correlations among the variables. As was noted above, empirical factor analysis frequently yields fewer common factors than do a priori theories since the clusters are often highly correlated with each other and can be combined to further reduce complexity without loss of information about the variables. Third, the empirical factor analysis may yield a better set of independent variables for regression analysis than those obtained with the cluster analysis.

The Factor Structure Analysis

The method used in the factor structure analysis was to perform the same common factor analysis on a reduced correlation matrix of thirty (30) variables.

Thus, the first step was to reduce the original matrix of thirty-eight quantitative variables in order to eliminate those variables which most poorly represent the domains (that is, variables with low factor loadings and low correlations with the dependent quality variable). In reducing the original matrix, care was taken to ensure that each domain in the resulting reduced matrix included a minimum of three variables.

Next, A Pierson product-moment correlation analysis was performed. Since three different types of Pierson product-moment correlation analyses have now been discussed: 1) the domain correlation analyses which were used for data reduction in Phase 3; 2) the correlation analyses across domains for the two sets of key variables used as part of the regression analyses in Phase 4; and 3) the correlation analysis of the reduced matrix of thirty variables used in the present discussion, a summary table (see Table 12 below) has been prepared to facilitate understanding.

Table 12. Summary of the Three Types of Inter-Correlation Results Reported in the Study

Symbol	Definition
ρ_{jk}	The subset of inter-correlations among the variables within a single domain, S, D, .. Q.
ρ_{SD}	The subset of inter-correlations among the variables in two different domains, for example, between domains S (Student) and D (Degree).
ρ_{TT}	The inter-correlations among the entire reduced matrix of 30 variables, that is, all inter-correlations, ρ_{ij}, where i = 1, 2, ..., 30 and j = 1, 2,..., 30. (Note: when i = j, ρ_{ij}= 1.00).

<u>Note:</u> The submatrices are simply partitionings of the ρ_{TT} matrix into subsets.

The final step in the factor structure analysis was to again apply the common factor analysis procedure described above to the matrix of inter-correlations among the thirty variables in the reduced matrix.

SUMMARY

A convenient method for summarizing the various procedures described above is to simply match the procedures to the five major study objectives and empirical study questions.

<u>Objective 1:</u> To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

R1. What characterizes the population of American doctoral institutions?

The method used to describe the population of American doctoral institutions in the present study was to generate both descriptive statistics for medians, means, ranges, standard deviations, range to standard deviation ratios, and skewnesses and listings of institutions from the data base of forty-nine data characteristics selected from the literature.

Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

To perform this function, all of the observable quantitative variables were grouped on an a priori basis into similar groups or "domains" for which within-group correlations were expected to be very high, indicating similarity, and across domain correlations were expected to be very low, indicating dissimilarity. To ensure against loss of information, a common factor analysis of each domain was performed. The number of factors required for each domain was expected to be only one--which would exhaust the commonality for the cluster, (that is, the proportion of commonality to be accounted for would be near 100%). Two sets of eight key variables were selected. One set was based on high factor loading alone. The second set was based on high factor loading in conjunction with the inter-correlation of each variable with the dependent quality variable.

> Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.
>
> R3. Can the key quality variable be predicted without loss from the other seven key variables?

The method used for prediction was multiple regression analysis with the two sets of eight key variables. The set of eight key variables yielding the highest multiple correlation (R) was then used for the analyses in the remainder of the study. R was expected to be near the reliability level of the quality variable (for example, R 0.90) for prediction based on the eight key variables.

> Objective 4: To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.
>
> R4. What findings can be obtained with profile, rather than ranking, reports?

The method for this objective was to present the Doctoral Institution Data Base with questions not possible with unitary lists--and then to determine if the questions were answered by the profiles generated by the CBIS.

> Objective 5: To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.
>
> R5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?

The multivariate description of academic quality would be supported if more than one common factor were required and if the quality variables were loaded on more than one factor. The factor matrix analyzed was the reduced set of thirty variables obtained from the original set of thirty-eight observable quantitative variables. A multiple regression analysis of variables representing these factors was then performed in order to compare the predictability of the variables obtained from this procedure with the predictability obtained from the earlier a priori procedure.

CHAPTER IV

RESULTS OF THE STUDY

INTRODUCTION

The research design and the various research methods and procedures used to achieve the five stated study objectives were thoroughly described in Chapter III. The results of these methods and procedures are discussed in this chapter in relation to the study objectives and research questions and hypothesis. Again, following the earlier organizing procedure seen in Chapters II and III, the five study objectives and associated empirical research questions and hypothesis, will be first stated here as an introduction to the chapter. They will subsequently be restated in the relevant chapter section and in the chapter summary.

Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

R1. What characterizes the population of one hundred and seventy-one American doctoral institutions?

Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

R3. Can the key quality variable be predicted without loss from the other seven key variables?

Objective 4: To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.

R4. What findings can be obtained with profile, rather than ranking, reports?

Objective 5: To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.

R5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?

Empirical Research Study Hypothesis

The number of common factors underlying the observable quantitative characteristics of American doctoral institutions is greater than one (the univariate case) and less than or equal to eight (the number of domains used in the original description).

THE DESCRIPTIVE ANALYSES

Introduction

The descriptive analyses were used to meet the first study objective:

> Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.
>
> R1. What characterizes the population of one hundred and seventy-one American doctoral institutions?

In the context of the present study, descriptive analyses are taken to mean a set of statistics which accurately describe the most important characteristics of American doctoral institutions. Such a statistical census is important for several reasons. First, these statistics will provide higher education researchers and decision makers with an accurate reference group or "norm" against which to compare institutions. Second, the statistics can affirm correct assumptions and disconfirm incorrect assumptions about doctoral institutions (for example, "Everyone knows that all the best schools are on the coasts" and "Private institutions are higher in quality in comparison to public institutions because private institutions are richer"). Third, these basic statistics are clear

<u>indicators</u> of the long-term policies and decisions made about doctoral institutions by institution presidents, Boards of Regents, state legislators, and faculty and students themselves.

Results of the descriptive analyses performed in the study, along with relevant tables and figures, are reported for the forty-seven (47) study variables (excluded are the two identification variables) in the following three sections. First, results for each of the nine (9) categorical variables are discussed in detail. Second, summary statistics of the thirty-eight (38) quantitative variables are discussed. Third, a brief summary of the results of the rankings for each of the variables is presented by domain.

Categorical variables

Introduction

Categorical variables, it may be recalled, are the nine variables which are qualitative, rather than quantitative, for example, STATE, REGION, STATUS, and CALNDR. These variables represent important demographic characteristics of doctoral institutions. The results of the analysis of these variables are presented separately below by variable.

STATE--Doctoral institutions are unevenly distributed geographically. A summary of doctoral institutions by state (see Table 13) indicates that doctoral institutions are unevenly distributed geographically, with a few states having many doctoral institutions (that is, ten or more) and a few having none. For example, Table 13 indicates that doctoral institutions are located in forty-seven of the fifty states and in the District of Columbia, with the number per state ranging from 0 to 18. Three states: Alaska, Maine, and Montana have no doctoral institution. Fourteen (14) states have more than the 3.4 average number of institutions per state: New York (18); California (16); Ohio (10); Illinois and Texas (9); Massachusetts (8); Pennsylvania (7); the District of Columbia and Michigan (5); and Colorado, Florida, Indiana, Missouri, and North Carolina (4), while the remaining 37 states have less than the average number of institutions per state.

Table 13. Number and Percentage of Doctoral Institutions By State, 1981-1982

State	Institution Number	Institution %
Alabama	3	1.7%
Alaska	0	0.0
Arizona	2	1.2
Arkansas	1	.6
California	16	9.4
Colorado	4	2.3
Connecticut	2	1.2
District of Columbia	5	2.9
Delaware	1	.6
Florida	4	2.3
Georgia	3	1.7
Hawaii	1	.6
Idaho	1	.6
Illinois	9	5.3
Indiana	4	2.3
Iowa	2	1.2
Kansas	2	1.2
Kentucky	2	1.2
Louisiana	2	1.2
Maine	0	0.0
Maryland	2	1.2
Massachusetts	8	4.7
Michigan	5	2.9
Minnesota	1	.6
Missouri	4	2.3
Mississippi	3	1.7
Montana	0	0.0
Nebraska	1	.6
Nevada	1	.6
New Hampshire	2	1.2
New Jersey	3	1.7
New Mexico	2	1.2
New York	18	10.5
North Carolina	4	2.3
North Dakota	1	.6
Ohio	10	5.8
Oklahoma	2	1.2
Oregon	2	1.2
Pennsylvania	7	4.1
Rhode Island	2	1.2
South Carolina	2	1.2
South Dakota	1	.6
Tennessee	3	1.7
Texas	9	5.3
Utah	3	1.7

Table 13 (Cont'd.).

State	Institution Number	%
Vermont	1	.6
Virginia	3	1.7
Washington	2	1.2
West Virginia	1	.6
Wisconsin	3	1.7
Wyoming	1	.6
Total	171	100.0%

Average number of institutions per state = 3.4

Looking at Table 14 below, we see that: 1) 3 or about 6% of the states have no doctoral institutions; 2) 41 or about 80% of the states have from 1 to 5 doctoral institutions each or about 55% of all the doctoral institutions; 3) 5 or about 10% of the states have 6 to 10 doctoral institutions each or about 25% of all the doctoral institutions; and 4) 2 or about 4% of the states have 11-20 doctoral institutions each or about 20% of all the doctoral institutions.

Table 14. Summary of Doctoral Institutions per State, 1981-1982

State		Institution			
		Per			Cumulative
Number	%	State	Total	%	%
3	5.8%	0	0	0.0%	0.0%
12	23.5	1	12	7.0	7.0
14	27.4	2	28	16.4	23.4
8	15.7	3	24	14.1	37.5
5	9.8	4	20	11.7	49.2
2	3.9	5	10	5.8	55.0
1	2.0	7	7	4.1	59.1
1	2.0	8	8	4.7	63.8
2	3.9	9	18	10.5	74.3
1	2.0	10	10	5.8	80.1
1	2.0	16	16	9.4	89.5
1	2.0	18	18	10.5	100.0
51	100.0%		171	100.0%	

Or to put it another way (looking again at Tables 13 and 14), we see that 77 or 45.0% of all doctoral institutions are located in only 7 or 13.9% of the states: Pennsylvania (7 or 4.1%), Massachusetts (8 or 4.7%), Illinois (9 or 5.3%), Texas (9 or 5.3%), Ohio (10 or 5.8%), California (16 or 9.4%), and New York (18 or 10.5%).

<u>REGION--Most doctoral institutions are located in the Mid East, Great Lakes, and Southeast OBE (Office of Business Economics) regions</u>. Analysis of doctoral institutions by OBE region indicates that approximately half (47.9 %) of all doctoral institutions are located in the eastern part of the United States (New England,

Mid East, and Southeast regions), with the remaining half (52.1%) approximately evenly distributed between the mid-west (Great Lakes and Plains regions) and west (Southwest, Rocky Mountains, and Far West regions). The Mid East region has the largest number of doctoral institutions (36 institutions or 21.0%), while the Rocky Mountains region has the smallest number (9 institutions or 5.3%). Doctoral institutions and states are summarized by OBE region in Table 15 below.

Table 15. Summary of Doctoral Institutions and States by OBE Region, 1981-1982

	Institution		State	
Region	Number	%	Number	%
New England	15	8.8%	6	11.8%
Mid East	36	21.0	6	11.8
Great Lakes	31	18.1	5	9.8
Plains	12	7.0	7	13.7
Southeast	31	18.1	12	23.5
Southwest	15	8.8	4	7.8
Rocky Mountains	9	5.3	5	9.8
Far West	22	12.9	6	11.8
Total	171	100.0%	51	100.0%

If we look at the average number of doctoral institutions per state by region (see Table 16 below), we find that the Great Lakes region has the largest number of doctoral institutions per state (6.2 institutions), with the Mid East region (6.0 institutions) a close second, and the Rocky Mountains

(1.8 institutions) and Plains (1.7 institutions) regions have the smallest number.

Table 16. Average Number of Doctoral Institutions per State by OBE Region, 1981-1982

Region	Institution	State	Average Number of Institution/State
New England	15	6	2.5
Mid East	36	6	6.0
Great Lakes	31	5	6.2
Plains	12	7	1.7
Southeast	31	12	2.6
Southwest	15	4	3.8
Rocky Mountains	9	5	1.8
Far West	22	6	3.7
Total	171	51	3.4

<u>CONTROL--Most doctoral institutions are publicly controlled</u>. One hundred nine (109) or 63.7% of all doctoral institutions are publicly controlled, while 62 or 36.3% are privately controlled. Twelve (12) or 7.0% of doctoral institutions are religiously affiliated, representing only three denominations: Latter Day Saints, Roman Catholic, and United Methodist. Roman Catholic institutions have the greatest representation with 8 (75%) of the 12 religiously affiliated institutions or 4.7% of all doctoral institutions. Table 17 below summarizes institutional control and religious affiliation.

Table 17. Summary of Doctoral Institutions by Type of Control and Affiliation, 1981-1982

Type of Control/Affiliation	Institution Number		%	
Public Control				
State	104		60.8%	
State Related	4		2.3	
State/Local	1		.6	
		109		63.7%
Private Control				
Independent Non-Profit	50		29.2	
Religious Affiliation				
Latter Day Saints	1		.6	
Roman Catholic	8		4.7	
United Methodist	3		1.8	
	12		7.1	
		62		36.3
Total		171		100.0%

STATUS--Most doctoral institutions are individually controlled single-campus institutions. Over one-half (90 or 52.6%) of all doctoral institutions are individual institutions. Of the remaining, 51 or 29.9% are multi-campus institutions and 30 or 17.5% are institutional systems. Table 18 below summarizes the institutional status of doctoral institutions.

Table 18. Summary of Doctoral Institutions by Institutional Status, 1981-1982

Status	Number		%	
Individual		90		52.6%
Multi-Campus				
Main Campus	23		13.5%	
Other Campus	12		7.0	
Designated Main Campus	16		9.4	
		51		29.9
System				
Individual	25		14.6	
Main Campus	5		2.9	
		30		17.5
Total		171		100.0%

CALNDR--Most doctoral institutions operate on a semester calendar system. Almost two-thirds (121 or 70.8%) of all doctoral institutions operate on a semester calendar system and approximately another fifth (37 or 21.7%) operate on a quarter system. Of the remaining institutions, 4 (2.3%) have a trimester system, 4 (2.3%) have a 4/1/4 system, and the remaining 5 (2.9%) have other calendar systems. (It should be noted that post 1981-1982 figures would indicate that additional institutions have changed their calendar system from quarter to semester, for example, the University of California system). Table 19, which is presented below, summarizes the calendar systems of doctoral institutions.

Table 19. Summary of Doctoral Institutions by Calendar System, 1981-1982

System	Number	%
Semester	121	70.8%
Quarter	37	21.7
Trimester	4	2.3
4/1/4	4	2.3
Other	5	2.9
	171	100.0%

LNDGRNT--Only about a quarter of all doctoral institutions are landgrant institutions, but over half are members of NASULGC. As can be seen in Table 20 below, 48 or 28.1% of all doctoral institutions are landgrant institutions and all are members of the National Association of State Universities and Land Grant Colleges (NASULGC). Another 44 (25.7%) of the 123 non-landgrant institutions are also members of NASULGC, making a total of 92 (53.8%) doctoral institutions that are members of NASULGC.

Table 20. Summary of Doctoral Institutions by Landgrant and NASULGC Membership Status, 1981-1982

	Total		NASULGC		Non-NASULGC	
Landgrant	Number	%	Number	%	Number	%
Landgrant	48	28.1%	48	28.1%		
Non-Landgrant	123	71.9	44	25.7	79	46.2%
	171	100.0%	92	53.8%	79	46.2%

AAUYR. About one-third of all doctoral institutions belong to the AAU. Of the one hundred and seventy-one doctoral institutions in the population, approximately one-third (51 institutions or 29.8%) are members of the American Association of Universities (AAU), while approximately two-thirds (120 or 70.2%) are non-members. It should be noted that the study AAU membership figure counts Cornell U twice (once as Cornell U Endowed Colleges and once as Cornell U Statutory Colleges) and does not include two foreign (Canadian) universities, McGill University and the University of Toronto. It should also be noted that four other universities in the doctoral institution population: the University of Arizona, Brandeis University, the University of Florida, and Rice University are not included in the AAU figure, since they became AAU members in 1985, after the study period.

SEX. Almost all doctoral institutions have coeducational student bodies. The student bodies of American doctoral institutions are predominantly coeducational in nature as is indicated by the self-designation of 168 or 98.2% of the 171 institutions in the study. Of the three remaining institutions, two (1.2%), Bryn Mawr College and Texas

Woman's University, designated themselves as predominantly female institutions and the third, Yeshiva University, designated itself as Coordinate indicating that the institution has separate colleges for men and women.

RACE/ETH. Almost all doctoral institutions have predominantly white student bodies. One hundred and sixty-seven (167) or 97.7% of American doctoral institutions indicate that the predominant race/ethnic group on campus is White (Non-Hispanic Other) and that the White group constitutes 50% or more of total enrollment. Two (2 or 1.2%) other institutions, the University of Detroit and United States International University, indicate that the White group is also the predominant group on campus, but that it constitutes less than 50% of total enrollment. Of the remaining two institutions, 1 (.6%), the University of Hawaii at Manoa, indicates that the Asian/Pacific Islander group is the predominant race/ethnic group, while the other (also 1 or .6%), Howard University, indicates the Black group. These latter two institutions also indicate that the predominant campus group (that is, Asian/Pacific Islander or Black) constitutes 50% or more of total enrollment.

Summary

In summary, American doctoral institutions may be demographically described as predominantly public, non-landgrant, non-AAU, geographically unevenly distributed single-campus NASULGC-member institutions with semester calendar systems and white coeducational student bodies.

Quantitative Variables

Introduction

The quantitative variables are the thirty-eight measures of quantifiable characteristics of American doctoral institutions. These variables include such characteristics as number of students, degees granted, and compensation of faculty. One approach to understanding these characteristics is to provide a review of the data value distributions (that is, the summary statistics) for each variable in terms of: 1) central tendency, 2) variability, and 3) symmetry (that is, deviation from the normal curve or skewness).

Summary Statistics

Analysis of the measures of central tendency (the median and the mean), variability (the range, standard deviation, and range to standard deviation ratio), and symmetry (skewness) of the thirty-eight quantitative variables provides a perspective of the doctoral institution population as a whole and of the relationship of the variables to each other. First, we can obtain a composite view of the average American doctoral institution in the 1981-82 study year by looking at the median and the mean in Table 21 below. For example, a review of the medians indicates that the typical doctoral institution: 1) was 112 years old; 2) enrolled about 16,400 total students (14,300 or 87% full-time-equivalent students), of which approximately 12,400 were undergraduates (76%) and 4,000 (24%) were graduates (slightly more than half of whom were full-time); 3) granted about 3,100 degrees, of which about 800 (25%) were master's, 150 (5%) were first professional, and 120 (4%) were doctor's degrees; 4) employed about 700 full-time instructional faculty, of which about 500 (66%) were tenured (250 or 53% Professors, 160 or 34% Associate Professors, and 20 or 4% Assistant Professors); 5) granted compensation (salary and benefits) of approximately $43,000 to Professors, $32,000 to Associate Professors, and $26,000 to Assistant Professors; 6) managed an endowment of $17.5 million, building assets of $134 million, equipment assets of $48 million, and a library of 1.3 million volumes and 12,000 periodicals; 7) received $152 million in total revenue ($20 million from government grants and contracts; $6 million from private gifts, grants, and contracts; $27 million from tuition and fees; and $42 million from appropriations); 8) spent $45 million for instruction, $10 million for academic support, $11 million for plant maintenance, $18 million for research, $4.5 million for student services, and $5 million for scholarships and fellowships; and 9) had 14 graduate programs rated by the Associated Research Councils (ARC) at 3,200 quality points for faculty and 2,100 quality points for programs and Gourman quality ratings of 3.66 for graduate and 4.03 for undergraduate education.

Table 21. Median and Mean of the Thirty-Eight Quantitative Variables by Domain

Domain/Variable	Median	Mean
S - Student		
STDHDCT	16420	17778
STDFTE	14297	15080
SGHDCT	3980	4730
SGHDCTFT	2078	2650
D - Degree		
DEGSTOT	3107	3514
DEGSMAS	776	886
DEGSFP	152	207
DEGSDOC	122	168
F - Faculty		
FACTOT	723	781
FACTEN	476	504
FTENPRF	251	292
FTENASC	162	182
FTENAST	20	27
C - Compensation		
COMPPRFA	42851	43265
COMPASCA	31950	32217
COMPASTA	25850	25885
A - Asset		
AGE	112	113
AENDOW	17512869	90019081
ABLDG	133844382	160037175
AEQUIP	48229341	61249270
ALVOLS	1273527	1589189
ALSUBS	11932	16448
R - Revenue		
RTOT	152209779	199757954
RGVTGC	19579978	30833406
RPRVGGC	6176604	11048987
RTUITFE	27166664	34830485
RAPPROP	41732224	55210458
E - Expenditure		
EINSTR	44876279	56310224
EACADSP	9859912	12549733
EPLNT	10867174	13605444
ERES	17954919	28237345
ESTDSVC	4492870	5486853
ESCHFEL	4963925	7118120
Q - Quality		
QARCFAC	3243	4256
QARCPRG	2117	2525
QARCN	14	16
QGRMNG	3.66	3.74
QGRMNUG	4.03	4.10

Next, looking at <u>variability</u>, we see that both the ranges (see Table 22 below) and the standard deviations (see Table 23 below) appear to be extremely large for most variables. For example, from Table 22 we see that the total number of students at doctoral institutions (STDHDCT) ranges from 49 to 65,184; total degrees granted (DEGSTOT) from 1 to 10,714; and total revenue (RTOT) from $311,390 to $795,389,490. Thus, it appears that the population of doctoral institutions is very diverse, but the degree of diversity can not be determined from these measures alone. One way that we can assess the degree of diversity relative to other studies is to estimate the length of the range in standard deviation units by calculating the <u>range t standard deviation ratio</u> for each variable. The results of this analysis are also presented in Table 23 below. They show, for example, that thirty of the thirty-eight quantitative variables have range to standard deviation ratios within the expected 3 to 6 standard deviation area. Only, eight variables exceed 6 standard deviations: ALSUBS 6.03, DEGSMAS 6.05, SGHDCT 6.13, AGE 6.68, RPRVGGC 6.72, ALVOLS 7.10, EACADSP 7.60, and AENDOW 7.74. Interestingly, four of these eight variables lie in the Asset domain (that is, ALSUBS, AGE, ALVOLS, AND AENDOW) and one relates to the academic support of faculty (EACADSP).

Table 22. Range of the Thirty-Eight Quantitative Variables by Domain

Domain/Variable	Minimum	Maximum	Range
S - Student			
STDHDCT	49	65184	65135
STDFTE	49	49148	49099
SGHDCT	49	19436	19387
SGHDCTFT	49	11687	11638
D - Degree			
DEGSTOT	1	10714	10713
DEGSMAS	0	3887	3887
DEGSFP	0	962	962
DEGSDOC	1	712	711
F - Faculty			
FACTOT	4	2253	2249
FACTEN	0	1636	1636
FTENPRF	0	1091	1091
FTENASC	0	578	578
FTENAST	0	137	137
C - Compensation			
COMPPRFA	32300	64000	31700
COMPASCA	25600	40600	15000
COMPASTA	21000	32900	11900
A - Asset			
AGE	12	346	334
AENDOW	0	1701229475	1701229475
ABLDG	405198	604211133	603805935
AEQUIP	44063	236031032	235986969
ALVOLS	0	10409228	10409228
ALSUBS	0	102265	102265
R - Revenue			
RTOT	311390	795389490	795078100
RGVTGC	0	201434000	201434000
RPRVGGC	1177	93313000	93311823
RTUITFE	0	162829000	162829000
RAPPROP	0	261080481	261080481
E - Expenditure			
EINSTR	202404	212170941	211968537
EACADSP	21797	78876126	78854329
EPLNT	40480	56099000	56058520
ERES	0	152466000	152466000
ESTDSVC	0	23805050	23805050
ESCHFEL	0	37728000	37728000
Q - Quality			
QARCFAC	0	15890	15890
QARCPRG	0	8850	8850
QARCN	1	38	37
QGRMNG	2.47	4.95	2.48
QGRMNUG	2.64	4.95	2.31

Table 23. Summary of the Variability of the Thirty-Eight Quantitative Variables: Standard Deviation, Range/Standard Deviation Ratio, and Skewness

Domain/Variable	Std. Dev.	Range/Std. Dev. Ratio	Sk
S - Student			
STDHDCT	11037	5.90	.37
STDFTE	9452	5.19	.25
SGHDCT	3165	6.13	.71
SGHDCTFT	2236	5.20	.77
D - Degree			
DEGSTOT	2197	4.88	.56
DEGSMAS	643	6.05	.52
DEGSFP	214	4.50	.77
DEGSDOC	143	4.97	.97
F - Faculty			
FACTOT	437	5.15	.40
FACTEN	309	5.29	.27
FTENPRF	200	5.46	.62
FTENASC	116	4.98	.52
FTENAST	29	4.72	.72
C - Compensation			
COMPPRFA	5662	5.60	.22
COMPASCA	2754	5.45	.29
COMPASTA	2077	5.73	.05
A - Asset			
AGE	50	6.68	.06
AENDOW	219677093	7.74	.99
ABLDG	109774871	5.50	.72
AEQUIP	49923364	4.73	.78
ALVOLS	1465319	7.10	.65
ALSUBS	16957	6.03	.80
R - Revenue			
RTOT	155696327	5.11	.92
RGVTGC	34386020	5.86	.98
RPRVGGC	13892552	6.72	1.05
RTUITFE	28835997	5.65	.80
RAPPROP	57975218	4.50	.70
E - Expenditure			
EINSTR	39947664	5.31	.86
EACADSP	10369657	7.60	.78
EPLNT	10175286	5.51	.81
ERES	31224741	4.88	.99
ESTDSVC	4006462	5.94	.74
ESCHFEL	7099622	5.31	.91
Q - Quality			
QARCFAC	3646	4.36	.83
QARCPRG	2100	4.21	.58
QARCN	10	3.70	.60
QGRMNG	.65	3.82	.37
QGRMNUG	.51	4.53	.41

Finally, looking at skewness (that is, deviation from the normal curve), we see that the mean is larger than the median for all thirty-eight quantitative variables (see Table 21 above), indicating that the distributions for all the variables are non-normal and positively skewed (that is, the values are piled up toward the lower values and the upper tail is extended). We can see the amount of asymmetry or deviation of the distributions by looking at the skewness values (Sk) in Table 23 above. As Table 23 shows, skewness values for all variables fall within the expected -3 to +3 range, with specific values ranging from .05 for COMPASTA (which indicates an almost perfectly symmetrical distribution) to 1.05 for RPRVGGC (which indicates moderate skewness). It should also be noted that more than half of all of the Sk values are .70 and above. Thus, our summary statistics show that, although diversity does exist in the doctoral institution population, statistically it would appear that it is not as great as it first appeared to be.

Rankings

Another way of providing an overview of the quantitative characteristics of doctoral institutions is to form listings or rankings, ordered from high to low. For example, rankings are frequently prepared to compare institutions on enrollment, faculty salaries, tuition and fees, or appropriations. Such rankings were prepared for each of the thirty-eight quantitative variables in the present study. However, due to the large volume of output generated in this procedure (that is, about one hundred and fifty pages), complete ranking results are presented for only the eight key variables identified in Phase 3 of the study. They may be found in Appendix C.

To further demonstrate the use of ranking, another ranking analysis is presented below. In this ranking analysis, the highest and lowest values of the population of doctoral institutions on each of the thirty-eight quantitative variables are summarized by domain. Missing values are indicated if appropriate. Otherwise each variable is assumed to have values for all one hundred and seventy-one institutions. Michigan State University's ranking is also presented for all variables to demonstrate this descriptive statistic's application to a particular institution. All rankings were generated by the Personal Computer System.

Student--The University of Minnesota of Minneapolis Saint Paul had the largest number of students on three of the four variables measured: 65,184 student headcount (STDHDCT), 49,184 full-time equivalent student headcount (STDFTE), and 11,687 full-time graduate student headcount (SGHDCTFT), while New York University had the largest number (19,436) of graduate students (SGHDCT). The Rand Graduate Institute of Policy Studies had the fewest students (49) in all four categories.

Michigan State University ranked fourth on both STDHDCT (44,887) and STDFTE (39,342), twelfth (10,307) on SGHDCT, and twenty-second on SGHDCTFT (4,681).

Degree--In terms of degrees granted, Michigan State University conferred the most (10,714) degrees (DEGSTOT), New York University conferred the most (3,887) master's degrees (DEGSMAS), Georgetown University conferred the most (962) first professional degrees (DEGSFP), and the University of California-Berkeley conferred the most (712) doctor's degrees (DEGSDOC).

The fewest total degrees (1 degree) and the fewest doctor's degrees (1 degree) were conferred by the Rand Graduate Institute of Policy Studies. Three institutions: the Rand Graduate Institute of Policy Studies, Rockefeller University, and the Union for

Experimenting Colleges and Universities granted the fewest (0) master's degrees. Fifty-three (53) or 31.0% of all doctoral institutions granted the fewest (0) first professional degrees.

Michigan State University ranked seventh (2,239) on DEGSMAS, forty-eighth (307) on DEGSFP, and sixth (488) on DEGSDOC.

Faculty--Michigan State University ranked first, out of the 169 institutions reporting (International College and the Rand Graduate Institute of Policy Studies provided no faculty data), in the number (2,253) of full-time instructional faculty (FACTOT) and in the number (1,091) of full-time tenured Professors (FTENPRF), while the University of Illinois-Urbana Campus ranked first (1,636) in the number of full-time tenured instructional faculty (FACTEN) and in the number (578) of full-time tenured Associate Professors (FTENASC), and Ohio State University Main Campus ranked first (137) in the number of full-time tenured Assistant Professors (FTENAST).

The Union for Experimenting Colleges and Universities had both the fewest total faculty (4) and the fewest tenured faculty (0) and, along with the University of Toledo, also had the fewest tenured Professors (0). Harvard University joined Union and Toledo in having the fewest Associate Professors (0), while 39 or 23.1% of the 169 doctoral institutions reporting indicated that they had no (0) Assistant Professors.

Michigan State University ranked second (1,612) on FACTEN, fourth (473) on FTENASC, and thirty-fifth (48) on FTENAST.

Compensation--Rockefeller University ranked first ($64,000), out of 157 institutions reporting, on the compensation of Professors (COMPPRFA), while the California Institute of Technology ranked first ($40,600), also out of 157 institutions reporting, on the compensation of Associate Professors (COMPASCA), and first ($32,900), out of 156 institutions reporting, on the compensation of Assistant Professors (COMPASTA).

The University of South Dakota Main Campus ranked last (0) on compensation for Professors, while the University of Northern Colorado ranked last on compensation for both Associate ($25,600) and Assistant ($21,000) Professors.

Michigan State University ranked seventy-secondth ($43,200) in COMPPRFA, forty-fifth ($33,800) in COMPASCA, and twentieth ($28,400) in COMPASTA.

Asset--In terms of age (AGE), Harvard University was the oldest doctoral institution in the United States at 346 years and International College and the Rand Graduate Institute of Policy Studies were the youngest at 12 years (years are based on the 1981-82 study year).

In terms of other assets, the University of Texas at Austin had the largest ($1,701,229,475) endowment (AENDOW), while thirteen or 80% of the institutions had no (0) endowment. The University of Minnesota of Minneapolis Saint Paul had the largest ($604,211,133) building assets (ABLDG), while the City University of New York Graduate School and University Center had the smallest ($405,198). The University of Texas at Austin had the largest ($236,031,032) equipment assets (AEQUIP), while the Rand Graduate Institute of Policy Studies had the smallest ($44,063). Harvard University had the largest number (10,409,228) of library volumes (ALVOLS), out of the 169 reporting institutions, while the University of California-Berkeley had the largest number (102,265) of periodical subscriptions (out of 164 institutions). International College and the Union for Experimenting Colleges and Universities had the fewest (0) in both categories.

Michigan State University ranked fifty-third (127 years) in AGE, eighty-ninth ($16,376,678) in AENDOW, sixth ($409,761,476) in ABLDG, eighteenth ($122,343,972) in AEQUIP, thirty-first (2,099,099) in ALVOLS, and seventy-fifth (13,525) in ALSUBS.

Revenue--The University of California-Los Angeles had the largest ($795,389,490) and the Rand Graduate Institute of Policy Studies had the smallest ($311,390) total revenue (RTOT). Stanford University ranked first ($201,434,000) in revenue received from government grants and contracts (RGVTGC), while four institutions: Brigham Young University, International College, the University of the Pacific, and the Rand Graduate Institute of Policy Studies ranked last with zero (0) dollars. The Massachusetts Institute of Technology ranked first ($93,313,000) in private gifts, grants, and contracts (RPRVGGC) and International College ranked last ($1,177). New York University ranked first ($162,829,000) in revenue received from tuition and fees (RTUITFE), while Rockefeller University ranked last, receiving no (0) revenue from this source. Finally, the University of California-Los Angeles ranked first ($261,080,481) in revenue received from appropriations (APPROP), while thirty-seven institutions ranked last with no (0) dollars received from appropriations. It is interesting to note that the thirty-seven institutions reporting no income from appropriations only represent 59.7% of the 62 private doctoral institutions. Thus, twenty-five or 40.3% of private doctoral institutions receive some form of federal, state, or local subsidy.

Michigan State University ranked twenty-third on both RTOT ($393,754,741) and RGVTGC ($62,351,114), thirty-second ($18,009,070) on RPRVGGC, nineteenth ($70,939,364) on RTUITFE, and fourteenth ($142,379,219) on RAPPROP.

Expenditure--The University of California-Los Angeles ranked first ($212,170,941 and $78,876,126 respectively) and the Rand Graduate Institute of Policy Studies ranked last ($202,404 and $21,797 respectively) on both expenditures for instruction (EINSTR) and expenditures for academic support (EACADSP). Harvard University ranked first on both expenditures ($56,099,000) for plant (EPLNT) and expenditures ($37,728,000) for scholarships and fellowships (ESCHFEL). The Rand Graduate Institute of Policy Studies ranked last (0 dollars) on EPLNT and also last, along with Rockefeller University, on ESCHFEL (also 0 dollars). The University of California-Berkeley ranked first ($23,805,050) on expenditures for student services (ESTDSVC), while again, the Rand Graduate Institute of Policy Studies and Rockefeller University tied for last place with no (0) dollars expended. Finally, Stanford University spent the most money on research ($152,466,000), while five institutions: International College, the Rand Graduate Institute of Policy Studies, the University of the Pacific, United

States International University, and the Union for Experimenting Colleges and Universities spent no (0) money on research.

Michigan State University ranked eleventh ($133,108,720) on EINSTR, forty-seventh ($15,140,974) on EACADSP, twenty-first ($25,146,544) on EPLNT, twenty-secondth ($57,879,304) on ERES, twenty-third ($9,515,778) on ESTDSVC, and twenty-eighth ($11,348,482) on ESCHFEL.

Quality--The University of California-Berkeley ranked first, out of the 161 doctoral institutions rated by the Associated Research Councils study, in the quality (15,890 points) of the faculty (QARCFAC), the quality (8,850 points) of the program (QARCPRG), and, along with Ohio State University Main Campus, on the number (38) of programs rated (QARCN). New Mexico State University Main Campus ranked last (0) on QARCFAC and also last (also 0), along with the University of Detroit and the University of Nevada-Reno, on QARCPRG. The University of Detroit and the University of Nevada-Reno again ranked last (with 1 program), along with the University of North Carolina at Greensboro, the University of Northern Colorado, and Yeshiva University on QARCN. Harvard University ranked first (4.95) and United States International University ranked last (2.47), out of 169 institutions rated, on the Gourman graduate quality rating (QGRMNG), while Princeton University ranked first (4.95) and Texas Woman's University ranked last (2.64), out of 163 institutions rated, on the Gourman undergraduate quality rating (QGRMNUG).

Michigan State University ranked twenty-ninth (7,631 points) on QARCFAC, twenty-third (4,713 points) on QARCPRG, twenty-second (28 programs) on QARCN, thirty-fourth (4.43) on QGRMNG, and forty-fifth (4.51) on QGRMNUG.

Summary

In summary, it seems clear that traditional descriptive statistics on quantitative data of doctoral institutions, as reported above in the summary statistics and in the rankings of doctoral institutions, provide interesting pieces of unrelated information, but little in the way of useful systematic knowledge applicable to total institutional functioning. About the safest conclusion that could be drawn from the descriptive statistics is that doctoral institutions are highly diverse institutions and that institutional size appears to be important. Thus, the remaining study results presented try to empirically demonstrate a better way.

REDUCTION OF THE DATA BASE

Introduction

This section describes the results of the correlation and factor analyses of the eight domains or clusters which were used to meet the second study objective:

> Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."
>
> R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

As indicated earlier, the clusters were based upon the Eight-Domain Theoretical Model described in Chapter III. In line with this theory, eight domains were created on an a priori theoretical basis suggested by the higher education quality literature and the seven-variable National Center for Education Statistics (NCES) model. Two questions need to be addressed regarding this model. First, is the model sufficient to provide an empirically sound basis for the regression analysis and, hence, for the profile analyses? Second, is the model necessary and sufficient to the regression analysis? We shall consider in this section only the sufficiency question. The second question is addressed in Objective 5 (that is, a further study of the Eight-Domain Model). In the following two sections, the results of the a priori theoretical model are given for the eight domain correlation and factor analyses.

Domain Correlation Analyses

After the eight domains were established, a Pearson product-moment correlation analysis was performed on each domain to determine the similarity of the variables within each domain and to provide a basis for the factor analyses. Table 24 below shows the results of the eight domain correlation analyses.

Table 24. Inter-correlations of the Thirty-eight Quantitative Variables by Domain

Domain/Variable

<u>S - Student</u>

	STDHDCT	STDFTE	SGHDCT	SGHDCTFT
STDHDCT	1	.98	.78	.68
STDFTE	171	1	.74	.69
SGHDCT	171	171	1	.84
SGHDCTFT	171	171	171	1

<u>D - Degree</u>

	DEGSTOT	DEGSMAS	DEGSEFP	DEGSDOC
DEGSTOT	1	.81	.47	.79
DEGSMAS	171	1	.58	.76
DEGSFP	171	171	1	.46
DEGSDOC	171	171	171	1

<u>F - Faculty</u>

	FACTOT	FACTEN	FTENPRF	FTENASC	FTENAST
FACTOT	1	.97	.92	.90	.39
FACTEN	169	1	.95	.91	.41
FTENPRF	169	169	1	.75	.20
FTENASC	169	169	169	1	.49
FTENAST	169	169	169	169	1

<u>C - Compensation</u>

	COMPPRFA	COMPASCA	COMPASTA
COMPPRFA	1	.87	.72
COMPASCA	157	1	.85
COMPASTA	156	156	1

<u>A - Asset</u>

	AGE	AENDOW	ABLDG	AEQUIP	ALVOLS	ALSUBS
AGE	1	.41	.38	.17	.51	.30
AENDOW	171	1	.42	.29	.65	.47
ABLDG	171	171	1	.80	.73	.69
AEQUIP	171	171	171	1	.64	.68
ALVOLS	168	168	168	168	1	.89
ALSUBS	164	164	164	164	164	1

<u>R - Revenue</u>

	RTOT	RGVTGC	RPRVGGC	RTUITFE	RAPPROP
RTOT	1	.83	.73	.59	.53
RGVTGC	171	1	.79	.54	.28
RPRVGGC	171	171	1	.57	.11
RTUITFE	171	171	171	1	-.05
RAPPROP	171	171	171	171	1

Table 24 (Cont'd.).

Domain/Variable						
E - Expenditure						
	EINSTR	EACADSP	EPLNT	ERES	ESTDSVC	ESCHFEL
EINSTR	1	.82	.86	.76	.72	.65
EACADSP	171	1	.73	.73	.73	.61
EPLNT	171	171	1	.81	.68	.67
ERES	171	171	171	1	.52	.67
ESTDSVC	171	171	171	171	1	.52
ESCHFEL	171	171	171	17	171	1
Q - Quality		QARCFAC	QARCPRG	QARCN	QGRMNG	QGRMNUG
QARCFAC		1	1.00	.94	.83	.77
QARCPRG		162	1	.96	.82	.77
QARCN		162	162	1	.75	.71
QGRMNG		162	162	162	1	.91
QGRMNUG		157	157	157	163	1

As can be seen in Table 24, the inter-correlation coefficients in each domain, for the most part, are highly similar: 22 are strong, ranging from +.80 to +1.00; 29 are moderately strong, ranging from +.60 to +.79; 15 are moderate, ranging from +.40 to +.59; 6 are moderately weak, ranging from +.20 to +.39; and 3 are weak, ranging from -.05 to +.19. Looking at each domain separately, we note the following relationships.

Student

In the student domain, an almost perfect (.98) relationship exists between STDHDCT/STDFTE, while a still strong, but comparatively weaker relationship, exists between SGHDCT/SGHDCTFT (.84). Relationships between STDHDCT/SGHDCT (.78) and STDHDCT/SGHDCTFT (.68) and between STDFTE/SGHDCT (.74) and between STDFTE/SGHDCTFT (.69) are all moderate.

Degree

In the degree domain, the relationship between DEGSTOT/DEGSMAS is strong (.81), the relationships between DEGSTOT/DEGSDOC (.79) and DEGSMAS/DEGSDOC (.76) are moderately strong, and the relationships between DEGSFP and all other degree variables are moderate (that is, .47 with DEGSTOT, .58 with DEGSMAS, and .46 with DEGSDOC). These latter lower correlations are most likely due to the fact that a substantial number (53 or 31.0%) of all doctoral institutions do not grant first professional degrees.

Faculty

Very strong relationships exist in the faculty domain between FACTOT/FACTEN (.97), FACTOT/FTENPRF (.92), FACTOT/FTENASC (.90) and between FACTEN/FTENPRF (.95) and FACTEN/FTENASC (.92), while a moderate relationship exists between FTENPRF/FTENASC (.75). Relationships between FTENAST and all faculty domain variables are moderate or moderately weak: FTENAST/FACTOT (.39), FTENAST/FACTEN (.41), FTENAST/FTENPRF (.20), and FTENAST/FTENASC (.49). Again, these lower inter-correlations are probably due to the fact that a substantial number of doctoral institutions (that is, 39 or 23.0% of the 169 reporting) have no tenured Assistant Professors.

Compensation

In the compensation domain, the relationship between COMPPRFA/COMPASCA (.87) and between COMPASCA/COMPASTA (.85) are strong, while the relationship between COMPPRFA/COMPASTA (.72) is moderate.

Asset

In the asset domain, strong relationships exist between ALVOLS/ALSUBS (.89) and between ABLDG/AEQUIP (.80). Moderately strong relationships exist between: ALVOLS/AENDOW (.65), ALVOLS/ABLDG (.73), ALVOLS/AEQUIP (.64), ALSUBS/ABLDG (.69), and ALSUBS/AEQUIP (.68). Moderately weak relationships exist between AENDOW/AGE (.41), AENDOW/ABLDG (.42), AENDOW/ALSUBS (.47), and ALVOLS/AGE (.51) and between AGE/ABLDG (.38), AGE/ALSUBS (.47), and AENDOW/AEQUIP (.29). Finally, a weak relationship exists between AGE/AEQUIP (.17).

Revenue

In the revenue domain, there is a strong relationship between RTOT/RGVTGC (.83) and a moderately strong relationship between RPRVGGC/RTOT (.73) and RPRVGGC/RGVTGC (.79). Moderate relationships exist between RTUITFE/RTOT (.59), RTUITFE/RGVTGC (.54), RTUITFE/RPRVGGC (.57), and between RAPPROP/RTOT (.53). A moderately weak relationship exists between RAPPROP/RGVTGC (.28), and a weak relationship exists between RAPPROP/RPRVGGC (.11) and RAPPROP/RTUITFE (-.05). This latter relationship is the only negative relationship reported, but it is not unexpected.

Expenditure

Three strong relationships exist in the expenditure domain: EINSTR/EPLNT (.86), EINSTR/EACADSP (.82), and ERES/EPLNT (.81). Ten moderately strong relationships exist: EINSTR/ERES (.76), EINSTR/ESTDSVC (.72), EINSTR/ESCHFEL (.65), EACADSP/EPLNT (.73), EACADSP/ERES (.73), EACADSP/ESTDSVC (.73), EACADSP/ESCHFEL (.61), EPLNT/ESTDSVC (.68), ESCHFEL/ERES (.67), and ESCHFEL/EPLNT (.67). Only two moderately weak relationships exist in the expenditure domain, ESTDSVC/ERES (.52) and ESTDSVC/ESCHFEL (.52).

Quality

The quality domain, with all relationships ranging from .75 to 1.00, exhibits the highest overall inter-correlations of any domain. In this domain, four relationships are very strong: QARCFAC/QARCPRG (1.00 or almost perfect correlation), QARCFAC/QARCN (.94), QARCPRG/QARCN (.94), and QGRMNG/QGRMNUG (.91). Two relationships are strong: QARCFAC/QGRMNG (.83) and QARCPRG/QGRMNG (.82). Finally, four relationships are moderately strong: QARCFAC/QGRMNUG (.77), QARCPRG/QGRMNUG (.77), QARCN/QGRMNG (.75), and QARCN/QGRMNUG (.71).

Domain Factor Analyses

Informal perusal of the correlation matrices is not a sufficient basis for selecting the eight key variables. Factor analysis provides a much better method for examining the within-domain inter-correlations to select the eight key variables. By factoring each domain, we can: 1) establish that one, and only one, factor is sufficient to represent each domain and 2) determine which of the variables within the domain best represents the domain. Thus, factor analysis of each domain can be used to test the "cohesiveness" of the domain. If all variables are closely related, the domain should yield only one factor each, even if the factor analytic computer program is permitted to consider any number of factors. Further, the variable within each domain with the highest factor loading can be selected to represent the entire domain. The results of the domain Varimax factor analyses are shown in Table 25 below.

Table 25. Varimax Factor Analyses of the Thirty-eight Quantitative Variables by Domain

Domain/Variable	Factor
S - Student	Factor 1 (Student)
STDHDCT	.95
STDFTE	.94
SGHDCT	.89
SGHDCTFT	.83
D - Degree	Factor 1 (Degree)
DEGSTOT	.88
DEGSMAS	.89
DEGSFP	.58
DEGSDOC	.84
F - Faculty	Factor 1 (Faculty)
FACTOT	.97
FACTEN	.99
FTENPRF	.92
FTENASC	.94
FTENAST	.49
C - Compensation	Factor 1 (Compensation)
COMPPRFA	.88
COMPASCA	.96
COMPASTA	.85
A - Asset	Factor 1 (Asset)
AGE	.47
AENDOW	.59
ABLDG	.84
AEQUIP	.76
ALVOLS	.95
ALSUBS	.88
R - Revenue	Factor 1 (Revenue)
RTOT	.94
RGVTGC	.89
RPRVGGC	.82
RTUITFE	.64
RAPPROP	.35
E - Expenditure	Factor 1 (Expenditure)
EINSTR	.92
EACADSP	.87
EPLNT	.91
ERES	.84
ESTDSVC	.76
ESCHFEL	.73
Q - Quality	Factor 1 (Quality)
QARCFAC	.98
QARCPRG	.98
QARCN	.93
QGRMNG	.90
QGRMNUG	.85

As can be seen from Table 25, the eight domain factor analyses support the Eight-Domain Model. All eight domain factor analyses resulted in only one factor per domain. Thus, in each of the analyses one factor was sufficient to account for at least 98% of the inter-correlations (that is, the communality). Further, most variables within each domain had high factor loadings. The notable exceptions were: DEGSFP (.58), FTENAST (.49), AGE (.47), AENDOW (.59), RTUITFE (.64), and RAPPROP (.35).

Selection of the Key Variables

The final step in reduction of the thirty-eight quantitative variables to eight key variables was to use two methods to determine the most representative variable from each domain: 1) the factor loading of each variable alone and 2) the factor loading in conjunction with the inter-correlation of each variable with the criterion quality variable. Since the quality variable was to serve both as the dependent variable and as one of the criteria for selection of the other key variables, it was selected first. Two quality variables, QARCFAC and QARCPRG, were almost equally representative of the quality domain and were thus difficult to distinguish as can be seen from Tables 24 and 25 above (that is, they both had factor loadings of

.98 and they inter-correlated +1.00 with each other). QARCFAC was selected for two reasons: 1) it had slightly higher overall inter-correlations with other study variables and it had the highest reliability with previous quality studies. A summary of the factor loadings and QARCFAC coefficients are presented in Table 26 below.

Table 26. Summary of Factor Loadings and QARCFAC Coefficients of the Thirty-Eight Quantitative Variables by Domain

Domain/Variable	Factor Loading	Correlation With QARCFAC
S - Student		
STDHDCT*	.95	.42
STDFTE	.94	.47
SGHDCT	.89	.55
SGHDCTFT+	.83	.77
D - Degree		
DEGSTOT	.88	.56
DEGSMAS*	.89	.54
DEGSFP	.58	.40
DEGSDOC+	.84	.86
F - Faculty		
FACTOT	.97	.55
FACTEN*	.99	.57
FTENPRF+	.92	.72
FTENASC	.94	.33
FTENAST	.49	-.21
C - Compensation		
COMPPRFA+	.88	.55
COMPASCA*	.96	.43
COMPASTA	.85	.49
A - Asset		
AGE	.47	.33
AENDOW	.59	.47
ABLDG	.84	.73
AEQUIP	.76	.69
ALVOLS*+	.95	.79
ALSUBS	.88	.79

Table 26 (Cont'd.).

Domain/Variable	Factor Loading	Correlation With QARCFAC
R - Revenue		
RTOT*+	.94	.77
RGVTGC	.89	.74
RPRVGGC	.82	.60
RTUITFE	.64	.51
RAPPROP	.35	.40
E - Expenditure		
EINSTR*+	.92	.74
EACADSP	.87	.71
EPLNT	.91	.74
ERES	.84	.77
ESTDSVC	.76	.61
ESCHFEL	.73	.70
Q - Quality		
QARCFAC*+	.98	1.00
QARCPRG	.98	1.00
QARCN	.93	.94
QGRMNG	.90	.83
QGRMNUG	.85	.77

* Indicates the key variable selected from each domain on the basis of factor loading alone.

+ Indicates the key variable selected from each domain on the basis of factor loading and correlation with QARCFAC.

As can be seen from Table 26, two different sets of eight key variables were selected. The first set, denoted by an asterisk, was selected strictly on the basis of high factor loading. In addition to QARCFAC, they are: STDHDCT, DEGSMAS, FACTEN, COMPASCA, ALVOLS, RTOT, and EINSTR. The second set of eight key variables was selected in order to maximize the quality aspect of the set of variables selected for prediction of academic quality which is the intent of the present study. In the second set of eight key variables, only four key variables were different from those selected by factor loading alone: SGHDCTFT, DEGSDOC, FTENPRF, and COMPPRFA. Further, these four variables also appear to relate more closely to graduate education, which is the focus of the present study, than do those in the first set.

PREDICTING QUALITY WITH KEY VARIABLES

Introduction

Regression analysis was used to meet the third study objective:

> Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.
>
> R3. Can the key quality variable be predicted without loss from the other seven key variables?

The results of the effectiveness of the two sets of seven key variables as predictors of academic quality which were tested in the study are presented in Tables 27 and 28 below.

The Regression Analyses

The First Set of Eight Key Variables

The first set of eight key variables was selected on the basis of high domain factor loading alone. The multiple regression equation solved for this set of variables is as follows:

QARCFAC = STDHDCT + DEGSMAS + FACTEN + COMPASCA
+ ALVOLS + RTOT + EINSTR

The results of the regression analysis are shown in Table 27.

Table 27. Regression Analysis of the First Set of Eight Key Variables

Dependent Variable = QARCFAC

Domain/Variable	Beta	Simple R
S - STDHDCT	-.26	.42
D - DEGSMAS	-.15	.54
F - FACTEN	.41	.57
C - COMPPRFA	.23	.43
A - ALVOLS	.50	.79
R - RTOT	.17	.77
E - EINSTR	.15	.72

Multiple R = .89
R-Squared = .79

Since the Beta-weights indicate the relative contribution of each independent variable to the inter-correlation with the dependent variable, they can be used to interpret the results. Thus, the variables contributing the most to the inter-correlation were: ALVOLS (.50), FACTEN (.41), and COMPPRFA (.23). RTOT (.17) and EINSTR (.15) also contributed to the inter-correlation, but to a lesser degree. The negative Beta-weights for STDHDCT (-.26) and DEGSMAS (-.15) suggest that doctoral institution size is negatively related to faculty quality, that is, large schools tend to receive somewhat lower ratings on faculty quality than do smaller schools.

The Simple R indicates that three of the seven independent variables have moderately strong inter-correlations with the dependent variable, QARCFAC: ALVOLS (.79), RTOT (.77), and EINSTR (.72), while the remaining four independent variables have moderate inter-correlations: FACTEN (.57), DEGSMAS (.54), COMPASCA (.43), and STDHDCT (.42). The Multiple Correlation (R = .89) is very high, indicating that the seven independent variables together are excellent predictors of academic quality as measured in this study. The squared Multiple Correlation (R^2 = .79) indicates that 79% of the variance in QARCFAC can be predicted from the seven key variables.

The Second Set of Eight Key Variables

The second set of eight key variables was selected on the basis of both high domain factor loading and high inter-correlation with the quality variable, QARCFAC. The multiple regression equation solved for this second set of key variables is as follows:

QARCFAC = SGHDCTFT + DEGSDOC + FTENPRF + COMPPRFA + ALVOLS + RTOT + EINSTR

The results of this second regression analysis are shown in Table 28 below.

Table 28. Regression Analysis of The Second Set of Eight Key Variables

Dependent Variable = QARCFAC

Domain/Variable	Beta	Simple R
S - SGHDCTFT	-.17	.77
D - DEGSDOC	.51	.86
F - FTENPRF	.12	.72
C - COMPPRFA	.22	.56
A - ALVOLS	.27	.79
R - RTOT	.18	.77
E - EINSTR	-.04	.74

Multiple R = .91
R-Squared = .83

Looking at the Beta-weights in the second regression analysis, we first see that DEGSDOC contributed the most (.51) to the inter-correlation with the criterion value, QARCFAC, followed by ALVOLS (.27), COMPPRFA (.22), RTOT (.18), and FTENPRF (.12). Negative contributions were made by SGHDCTFT (-.17) and EINSTR (-.04) again suggesting a negative relationship between institutional size and faculty quality.

The Simple Rs indicate that six of the seven predictor variables had strong (DEGSDOC .86) to moderately strong (ALVOLS .79, SGHDCTFT .77, RTOT .77, EINSTR .74, and FTENPRF .72) inter-correlations with the criterion variable, QARCFAC, while only one predictor variable (COMPPRFA .56) showed a moderate relationship.

The Multiple R (R = .91) indicates a strong correlation between QARCFAC and the seven predictor variables comprising the composite variable. Finally, the Squared Multiple Correlation (R^2 = .83) indicates that we can predict QARCFAC with increased accuracy by using this second set of seven key independent variables.

Summary

In the subsequent analyses, the second set of eight key variables was used as the eight study key variables, for several reasons. First, both sets of key variables are excellent representatives of the domains. All have very high within-domain factor loadings. Second, given the first point, it would seem reasonable to use as a second selection criteria, the simple correlation of each variable with the quality measure, QARCFAC. This would give the profiles the highest validity. Third, the second set of key variables has lower negative loadings than were present in the first set, thus yielding a slightly higher Multiple Correlation coefficient (.91 versus .89). Finally, the second set of eight key variables has measures which are more characteristic of doctoral institutions, and thus, are more relevant to the present study.

GRAPHIC DISPLAYS OF THE DATA BASE

Introduction

The generation of graphic displays or "profiles" of the data base were used to meet the fourth study objective:

> Objective 4: To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.
>
> R4. What findings can be obtained with profile, rather than ranking, reports?

The second set of eight key variables are presented in the profile analyses which follow. These profile analyses are merely demonstrative of the potential use of this powerful technique for all those interested in understanding American doctoral institutions, such as: policy makers (for example, institution presidents and officers; members of Boards of Trustees; and federal and state political and educational leaders), researchers, faculty, students, and the public. The profile examples include: 1) comparison of a single doctoral institution (the University of California-Berkeley) and the national average doctoral institution; 2) comparison of two doctoral institutions (Michigan State University and the University of Michigan-Ann Arbor); 3) two comparisons of groups of doctoral institutions (public and private and landgrant and non-landgrant); 4) comparison of the average of all of the doctoral institutions within a state (Michigan) and the national average doctoral institution; 5) two comparisons of two groups of doctoral institutions (the Great Lakes and Far West regions and the national average doctoral institution); and 6) comparison of a single doctoral institution (Michigan State University) and a group of doctoral institutions (the "Big Ten" institutions). Additionally, a number of <u>other profiles of interest may be found in Appendix D</u>.

However, prior to beginning, a summary of the key variables and their definitions is presented in Table 29 below to guide interpretation of all the profile analyses which follow.

Table 29. Summary of the Eight Key Variables Used in the Profile Analyses with their Definitions

Domain	Variable	Definition
S	SGHDCTFT	Student Headcount (Full-time Graduate)
D	DEGSDOC	Doctor's Degrees Granted
F	FTENPRF	Faculty (Full-time Tenured Professors)
C	COMPPRFA	Compensation (Salary and Benefits) of Professors (Average Annual Academic)
E	EINSTR	Expenditures on Instruction (Annual)
R	RTOT	Revenue (Total Annual)
A	ALVOLS	Assets (Library Volumes)
Q	QARCFAC	Quality (Faculty)

The Profiles

Profile 1. Comparison of a Single Doctoral Institution (The University of California-Berkeley) and the National Average Doctoral Institution.

The first profile analysis (illustrated in Figure 2 below) compares a single doctoral institution, the University of California-Berkeley, to the United States average doctoral institution.

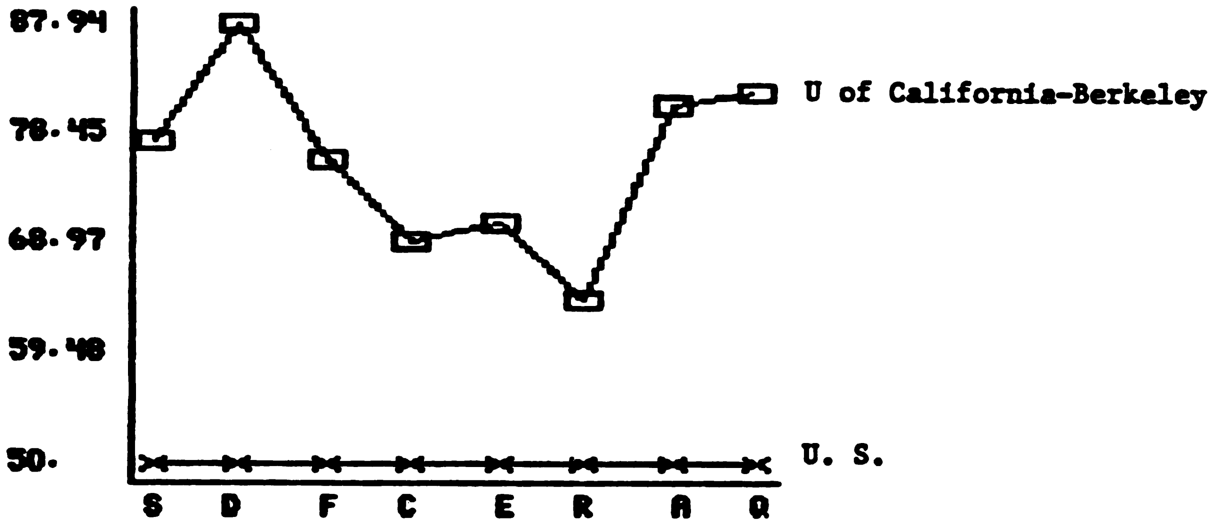

Figure 2. Profile of The University of California-Berkeley and the United States Average Doctoral Institution, 1981-1982

Looking at Figure 2, we note that the eight key variables or the "vital signs" of American doctoral institutions are presented across the horizontal axis or bottom of the graph, while the values (P) of the key variables for the institution (in this case, a single institution, the University of California-Berkeley) are plotted on the vertical axis (that is, on the left of the graph). The values (P) are standard values with a mean of 50 and a standard deviation of 10. The straight line (P = 50) indicates the national average for each of the eight key variables.

This profile of the University of California-Berkeley might be interpreted as follows. The institution is one or more standard deviations above the national doctoral institution average on all eight key variables. The institution is especially characterized by the large number of doctor's degrees granted, DEGSDOC (the maximum granted by any institution); its excellent assets, ALVOLS (the number of library volumes); and its very high faculty quality rating, QARCFAC, (the highest rating achieved by any doctoral institution). On the negative side, money was a problem in 1981-1982, as is indicated by the lower P value on RTOT (total revenue). However, the effect of this on faculty compensation was blunted, to some degree, as is indicated by the somewhat higher, but still relatively low P value (that is, in relation to the other key variables) on COMPPRFA.

Profile 2. A Comparison of Two Doctoral Institutions (Michigan State University and the University of Michigan-Ann Arbor).

The second profile, presented in Figure 3 below, shows a comparison of two doctoral institutions, Michigan State University (MSU) and The University of Michigan-Ann Arbor (U of M), both plotted on the same profile. The national doctoral institution average (that is, the straight line at 50) was not included in this profile and in several of the following profiles in the interest of clarity, but is assumed.

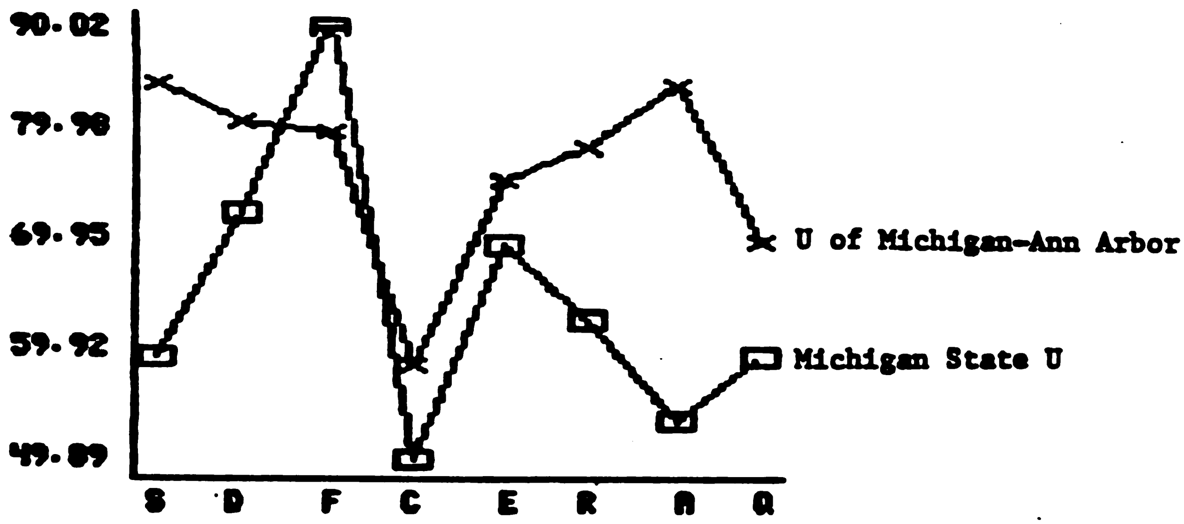

Figure 3. Profile of Michigan State University and the University of Michigan-Ann Arbor, 1981-1982

Looking at Figure 3, we note that since both institutions are scored on the same standard value (score) dimension (that is, P with a mean of 50 and a standard deviation of 10), direct comparisons of the two institutions can be made. For example, it can be seen that the University of Michigan-Ann Arbor scores higher than Michigan State University on seven of the eight key variables (that is, all except for the number of tenured Professors). Thus, it may be said that the University of Michigan-Ann Arbor has a great many more full-time graduate students (S), grants more doctor's degrees (D), and has higher total revenue (R) and substantially more library volumes (A) than Michigan State Uniyersity. The University of Michigan-Ann Arbor also spends more money on instruction (E), part of which goes to compensating (C) fewer, but higher quality (Q) tenured professors (F), better.

Profile 3. Comparison of Two Groups of Doctoral Institutions (Public and Private).

The third profile presented (see Figure 4 below) compares two different groups of institutions, public and private institutions. Since the plotted values are mean standard values (that is, means calculated within each group) for these two groups, direct comparisons can again be made.

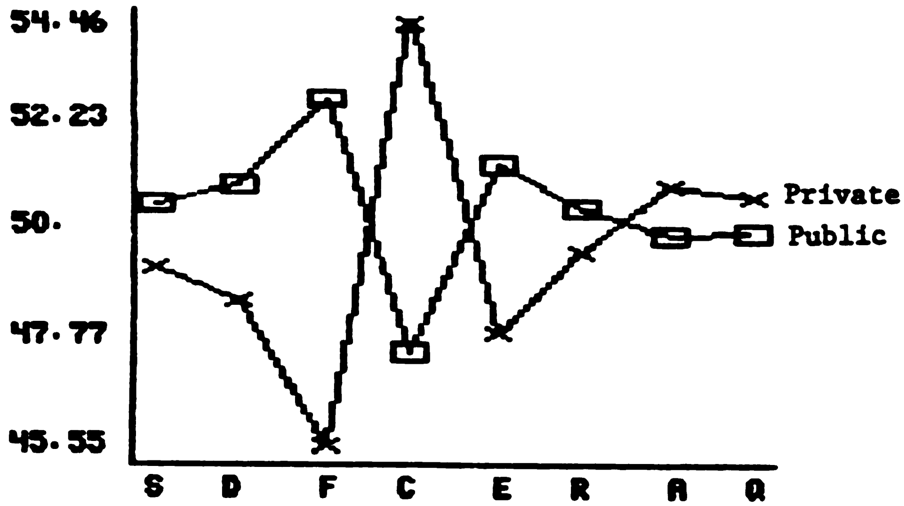

Figure 4. Profile of Public and Private Doctoral Institutions, 1981-1982

As can be seen from Figure 4, the profiles of the two groups are almost mirror images. As can also be seen, public institutions are higher in five of the eight dimensions measured: full-time graduate students (S), doctor's degrees granted (D), number of tenured Professors (F), expenditures on instruction (E), and total revenue (R). These dimensions all strongly reflect institution size. Private institutions are higher on three dimensions: compensation of tenured professors (C), library volumes (A), and faculty quality (Q). Surprisingly, the two groups are closer together on the quality dimension than might be expected considering the size difference.

Other similar profiles of individual or groups of doctoral institutions can be generated by the Personal Computer System from the Doctoral Institution Data Base to answer specific research, policy, or management questions. The following set of five profiles is representative of this type of application.

Profile 4. Comparison of Two Groups of Doctoral Institutions (Landgrant and Non-Landgrant).

This profile, shown in Figure 5 below, again compares two different groups of doctoral institutions to answer a specific question: How do landgrant institutions compare to non-landgrant institutions?

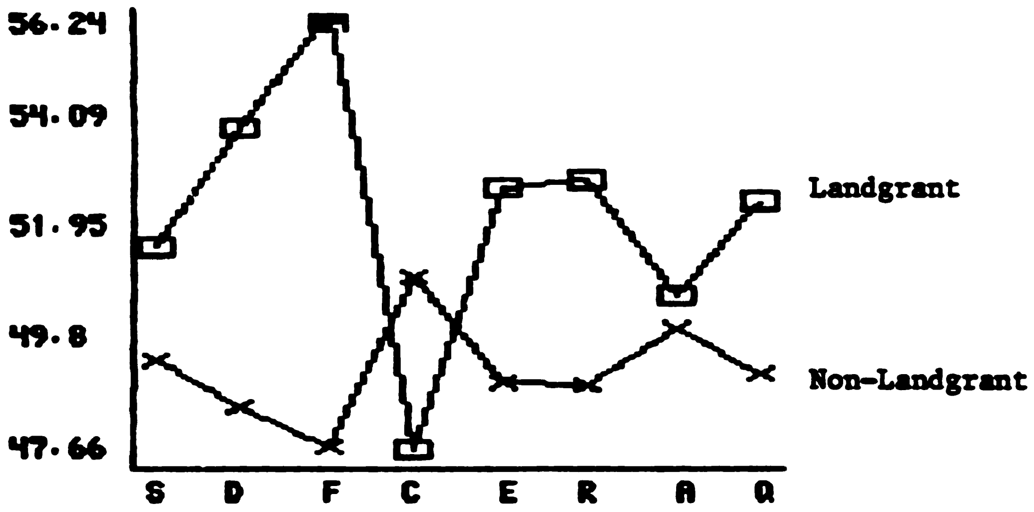

Figure 5. Profile of Landgrant and Non-Landgrant Doctoral Institutions, 1981-1982

As can be seen from Figure 5, this profile indicates specific differences between the two groups. First, non-landgrant doctoral institutions are below the national average on all domains, except compensation of tenured Professors. Second, the average landgrant doctoral institution: has more full-time graduate students (S); grants far more doctor's degrees (D); has substantially more tenured Professors (F) who are compensated at a lower rate (C); spends more on instruction (E); has more total revenue (R); has slightly more library volumes (A); and has a higher quality faculty (Q) than do non-landgrant institutions. This profile should be of particular interest to advocates of American public higher education.

Profile 5. Comparison of the Average of all of the Doctoral Institutions within a state (Michigan) and the National Average Doctoral Institution.

This profile (see Figure 6 below) compares the state and national averages of doctoral institutions to answer the question: How do Michigan doctoral institutions compare to the average United States doctoral institution?

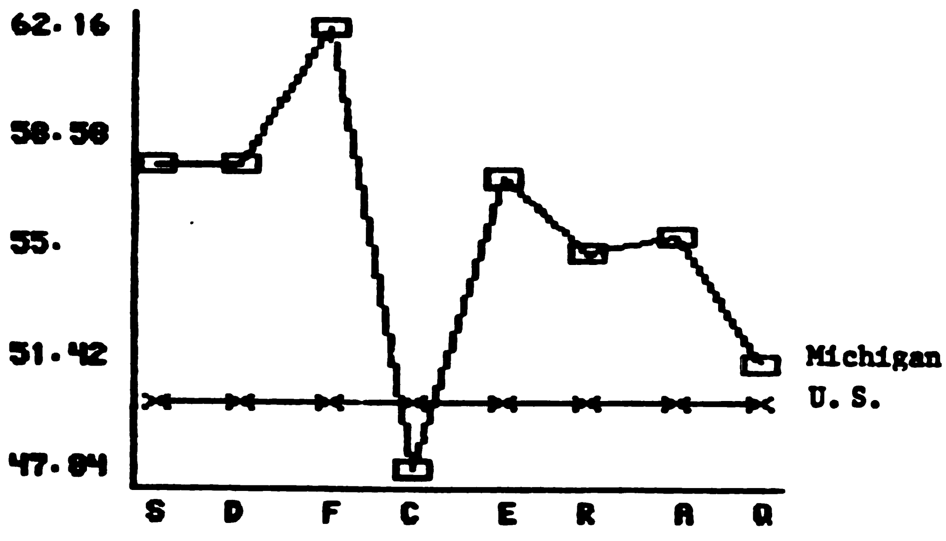

Figure 6. Profile of Doctoral Institutions in Michigan and the United States, 1981-1982

As can be seen from Figure 6, the average of the five Michigan doctoral institutions: Michigan State University, the University of Michigan-Ann Arbor, the University of Detroit, Wayne State University, and Western Michigan University is above the average of American doctoral institutions on all of the key variables, except on the compensation of tenured professors (C). It should also be noted that, of the seven above average variables, the faculty quality variable (Q) is the lowest, closly approximating the national average. The highly discrepant relationship among numbers of faculty, faculty compensation, and the quality rating of faculty raises serious questions about decisions made in those areas which warrant further study.

Profile 6. Comparison of Two Groups of Doctoral Institutions (the Great Lakes region and the national average doctoral institution).

This profile, shown in Figure 7 below, answers the question: How do doctoral institutions in the Great Lakes region compare to the average United States doctoral institution?

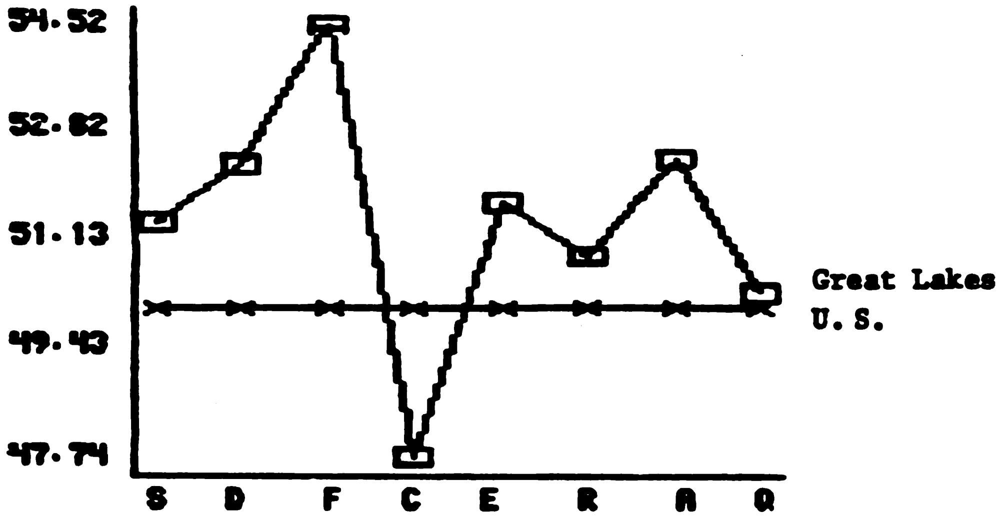

Figure 7. Profile of Doctoral Institutions in the Great Lakes Region and the United States, 1981-1982

As can be seen from Figure 7, the results for the Great Lakes region are highly similar to the previous state of Michigan profile (Figure 6), that is, all variables are higher than the national average except for the compensation variable (C). The major difference here appears to be a slightly less pronounced difference between faculty compensation (C) and faculty quality (Q). Thus, it appears that Michigan doctoral institutions are representative of the entire Great Lakes region since a similar profile pattern is reflected in both profiles.

Profile 7. Comparison of Two Groups of Doctoral Institutions (the Far West Region and the National Average Doctoral Institution).

This profile, as can be seen in Figure 8 below, is similar to the preceding profile and allows across region comparison.

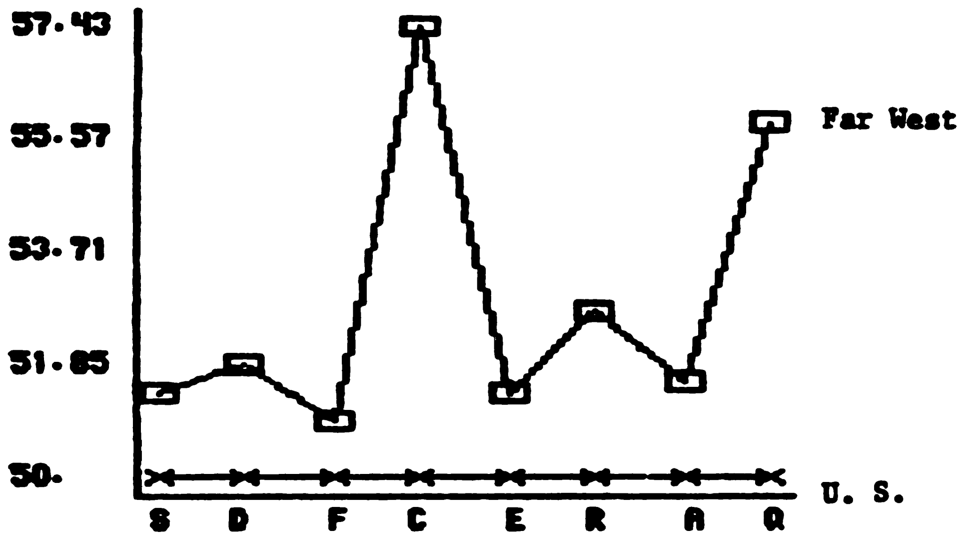

Figure 8. Profile of Doctoral Institutions in the Far West Region and the United States, 1981-1982

As can be seen from Figure 8, doctoral institutions in the Far West region present a very different profile from doctoral institutions in the Great Lakes region (Figure 7). Far West doctoral institutions are above the national average on all eight key variables, the highest of which are the compensation (C) and the quality (Q) of faculty, the two variables which were the lowest in the profiles of both the state of Michigan and the Great Lakes Region. The Far West profile, thus, has six variables (S, D, F, E, R, and A) slightly above the national average and two variables, C and Q almost one standard deviation above the national average. Policy differences appear to be highly different in regards to doctoral institutions in these two regions of the country.

Profile 8. Comparison of a Single Doctoral Institution (MSU) and a group of Doctoral Institutions (The Big Ten).

This profile (see Figure 9 below) might be used to answer the question: How does Michigan State University Compare with the Big Ten Doctoral Institutions in the key variables?

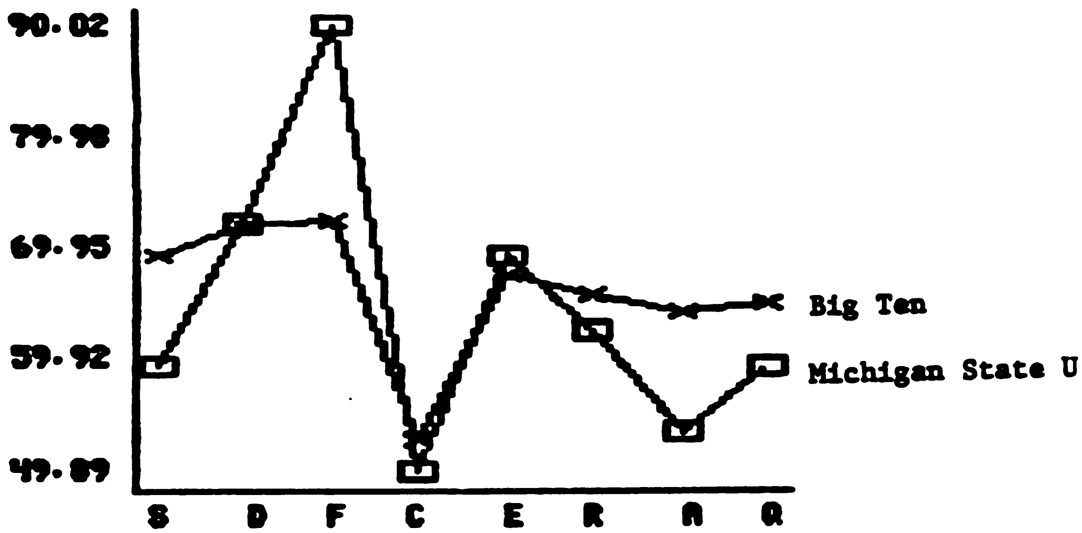

Figure 9. Profile of Michigan State University and the Big Ten Doctoral Institutions, 1981-1982

As can be seen from Figure 9, Michigan State University, in comparison to the average Big Ten doctoral institution, has fewer graduate students (S), substantially more faculty (F), slightly less revenue R), and fewer library volumes (A). MSU also grants about the same number of doctor's degrees (D), spends about the same amount on instruction (E), compensates (C) its faculty about the same, and has a slightly lower faculty quality rating (Q). More interestingly, this same basic profile, that is, above average on all key variables except compensation (C) of faculty, was also reflected in Figures 6 (Michigan) and 7 (Great Lakes region) above.

Summary

It seems clear from the profile results that many important questions can be asked and answered with the Doctoral Institution Data Base implemented on a personal computer. Further, a series of questions can uncover interesting relationships among doctoral institutions (for example, the Great Lakes versus the Far West regional pattern). Errors of interpretation can also be avoided, for example, the finding that the landgrant institutions are higher in faculty quality than are the non-landgrant institutions.

A systematic study of all of the possible profiles is beyond the scope of the present study. At present, it was only possible to simply display some of the more interesting profiles and use these to illustrate the potential of the Doctoral Institution Data Base. In the final chapter (Chapter V), some suggestions are given for systematic study of the profiles.

THE UNDERLYING STRUCTURE OF THE DATA BASE

Introduction

The purpose of this final analysis was to meet the fifth study objective:

> Objective 5: To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.
>
> R5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?
>
> Empirical Research Study Hypothesis
> The number of common factors underlying the observable quantitative characteristics of American doctoral institutions is greater than one (the univariate case) and less than or equal to eight (the number of domains used in the original description).

In other words, the purpose of this analysis was to determine if an empirical factor analysis would support the underlying Eight-Factor model of the data base assumed in the earlier cluster analysis.

The Factor Structure Analysis

The first step in determining the underlying structure of doctoral institutions was to reduce the original matrix of thirty-eight observable quantitative variables to a set of thirty variables which most clearly measures the domains. The criteria for variable deletion was low domain factor loading (.76 or less) in combination with a low inter-correlation with the dependent variable, QARCFAC. Table 30 below summarizes the variables deleted.

Table 30. Variables Deleted from the Original Matrix of Thirty-Eight Quantitative Variables

Variable	Domain Factor Loading	Correlation With QARCFAC
DEGSFP	.58	.40
FTENAST	.49	-.21
AGE	.47	.33
AENDOW	.59	.47
RTUITFE	.64	.51
RAPPROP	.35	.40
ESTDSVC	.76*	.61
ESCHFEL	.73	.70

* Two other variables (AEQUIP and QGRMNUG) also had a .76 domain factor loading, but they were retained due to higher inter-correlation with QARCFAC.

Table 31 below compares the variables of the full matrix of thirty-eight quantitative variables with those of the reduced matrix of thirty variables. As can be seen, all domains in the reduced matrix retained a minimum of three variables with high factor loadings on the domain.

Table 31. Comparison of Quantitative Variables Used in the Full and Reduced Matrices

Domain/Variable	Full Matrix	Reduced Matrix
S - Student		
STDHDCT	X	X
STDFTE	X	X
SGHDCT	X	X
SGHDCTFT	X	X
D - Degree		
DEGSTOT	X	X
DEGSMAS	X	X
DEGSFP	X	
DEGSDOC	X	X
F - Faculty		
FACTOT	X	X
FACTEN	X	X
FTENPRF	X	X
FTENASC	X	X
FTENAST	X	
C - Compensation		
COMPPRFA	X	X
COMPASCA	X	X
COMPASTA	X	X
A - Asset		
AGE	X	
AENDOW	X	
ABLDG	X	X
AEQUIP	X	X
ALVOLS	X	X
ALSUBS	X	X
R - Revenue		
RTOT	X	X
RGVTGC	X	X
RPRVGGC	X	X
RTUITFE	X	
RAPPROP	X	
E - Expenditure		
EINSTR	X	X
EACADSP	X	X
EPLNT	X	X
ERES	X	X
ESTDSVC	X	
ESCHFEL	X	

Table 31 (Cont'd.).

Domain/Variable	Full Matrix	Reduced Matrix
Q - Quality		
QARCFAC	X	X
QARCPRG	X	X
QARCN	X	X
QGRMNG	X	X
QGRMNUG	X	X

Once the matrix was reduced, the resulting thirty variables were analyzed through a Pearson product-moment correlation analysis, prior to the factor analysis. The results of the correlation analysis are shown below in Table 32.

Table 32. Inter-Correlations of the Reduced Matrix of Thirty Quantitative Variables

Variable	STDHDCT	STDFTE	GHDCT	GHDCTFT	DEGSTOT	DEGSMAS	DEGSDOC	FACTOT	FACTEN	FTENPRF	FTENASC
STDHDCT	1	.98	.78	.68	.93	.69	.65	.9	.88	.8	.85
STDFTE	171	1	.74	.69	.94	.66	.69	.93	.91	.84	.86
GHDCT	171	171	1	.84	.82	.92	.75	.71	.69	.7	.58
GHDCTFT	171	171	171	1	.76	.79	.85	.69	.68	.78	.48
DEGSTOT	171	171	171	171	1	.81	.79	.91	.9	.88	.81
DEGSMAS	171	171	171	171	171	1	.76	.67	.66	.7	.51
DEGSDOC	171	171	171	171	171	171	1	.72	.73	.84	.51
FACTOT	169	169	169	169	169	169	169	1	.97	.92	.9
FACTEN	169	169	169	169	169	169	169	169	1	.95	.91
FTENPRF	169	169	169	169	169	169	169	169	169	1	.75
FTENASC	169	169	169	169	169	169	169	169	169	169	1
COMPPRFA	157	157	157	157	157	157	157	157	157	157	157
COMPASCA	157	157	157	157	157	157	157	157	157	157	157
COMPASTA	156	156	156	156	156	156	156	156	156	156	156
ABLDG	171	171	171	171	171	171	171	169	169	169	169
AEQUIP	171	171	171	171	171	171	171	169	169	169	169
ALVOLS	168	168	168	168	168	168	168	166	166	166	166
ALSUBS	164	164	164	164	164	164	164	162	162	162	162
ATOT	171	171	171	171	171	171	171	169	169	169	169
AGVTGC	171	171	171	171	171	171	171	169	169	169	169
APRVGGC	171	171	171	171	171	171	171	169	169	169	169
EINSTR	171	171	171	171	171	171	171	169	169	169	169
EACADSP	171	171	171	171	171	171	171	169	169	169	169
EPLNT	171	171	171	171	171	171	171	169	169	169	169
ERES	171	171	171	171	171	171	171	169	169	169	169
QARCFAC	162	162	162	162	162	162	162	162	162	162	162
QARCPRG	162	162	162	162	162	162	162	162	162	162	162
QARCN	162	162	162	162	162	162	162	162	162	162	162
QGRMNG	169	169	169	169	169	169	169	168	168	168	168
QGRMNUG	163	163	163	163	163	163	163	163	163	163	163

Table 32 (Cont'd.).

Variable	COMPPRFA	COMPASCA	COMPASTA	ABLDG	AEQUIP	ALVOLS	ALSUBS	RTOT	RGVTGC	RPRVGGC
STDHDCT	-.09	-.03	.17	.72	.68	.44	.47	.58	.32	.25
STDFTE	-.07	-.02	.2	.74	72	.48	.52	.6	.34	.26
GHDCT	.2	.2	.31	.71	.59	.59	.56	.7	.54	.46
GHDCTFT	.38	.3	.42	.83	.71	.79	.78	.85	.72	.66
DEGSTOT	.03	.08	.23	.78	.71	.58	.6	.65	.44	.35
DEGSMAS	.21	.17	.25	.68	.53	.65	.6	.66	.54	.5
DEGSDOC	.39	.31	.43	.78	.7	.76	.75	.78	.69	.58
FACTOT		.02	.22	.76	.74	.54	.59	.65	.44	.36
FACTEN	-.01		.22	.74	.75	.53	.59	.64	.43	.31
FTENPRF	.14	.1	.31	.81	.79	.67	.71	.73	.58	.46
FTENASC	-.15	-.06	.12	.56	.61	.27	.37	.43	.19	.08
COMPPRFA	1	.87	.72	.31	.21	.45	.4	.45	.51	.54
COMPASCA	157		.85	.24	.18	.22	.22	.41	.41	.41
COMPASTA	156	156	1	.37	.37	.31	.38	.54	.45	.4
ABLDG	157	157	156	1	.8	.73	.69	.85	.7	.61
AEQUIP	157	157	156	171	1	.64	.68	.77	.57	.42
ALVOLS	154	154	153	168	168	1	.89	.72	.68	.66
ALSUBS	150	150	149	164	164	164	1	70	63	.53
RTOT	157	157	156	171	171	168	164	1	83	.73
RGVTGC	157	157	156	171	171	168	164	171	1	.79
RPRVGGC	157	157	156	171	171	168	164	171	171	1
EINSTR	157	157	156	171	171	168	164	171	171	171
EACADSP	157	157	156	171	171	168	164	171	171	171
EPLNT	157	157	156	171	171	168	164	171	171	171
ERES	157	157	156	171	171	168	164	171	171	171
GARCFAC	153	153	152	162	162	159	155	162	162	162
GARCPRG	153	153	152	162	162	159	155	162	162	162
GARCN	153	153	152	162	162	159	155	162	162	162
GGRMNG	157	157	156	169	169	166	162	169	169	169
GGRMNUG	152	152	152	163	163	161	157	163	163	163

Table 32 (Cont'd.).

Variable	EINSTR	EACADSP	EPLNT	ERES	QARCFAC	QARCPRG	QARCN	QGRMNG	QGRMNUG
STOHDCT	.73	.58	.69	.44	.42	.43	.51	.22	.15
STDFTE	74	.61	.7	.49	.47	.48	.56	.26	.21
GHDCT	.82	.66	.77	.53	.55	.54	.58	.41	.32
GHDCTFT	.9	.82	.86	.75	.77	.76	.73	.64	.57
DEGSTOT	.8	.65	.75	.55	.56	.57	.61	.37	.3
DEGSMAS	.77	.62	.74	.53	.54	.53	.52	.41	.31
DEGSDOC	.8	.71	.83	.75	.86	.85	.83	.67	.58
FACTOT	.77	.64	.73	.58	.55	.56	.62	.33	.28
FACTEN	.74	.64	.7	.57	.57	.59	.63	.34	.3
FTENPRF	.8	.71	.78	.71	.72	.73	.73	.51	.47
FTENASC	.57	.46	.5	.32	.33	.35	.45	.13	.1
COMPPRFA	.34	.32	.41	.47	.55	.53	.43	.7	.63
COMPASCA	.28	.23	.52	.38	.43	.42	.35	.57	.48
COMPASTA	.41	.36	.45	.5	.49	.49	.42	.56	.46
ABLDG	.85	.74	.89	.76	.73	.73	.71	.63	.56
AEQUIP	.77	.66	73	.69	.69	.7	.7	.56	.49
ALVOLS	.74	.72	.78	.69	.79	.78	.69	.66	.59
ALSUBS	.72	.74	73	.69	.79	.78	69	61	.56
RTOT	.89	.77	.84	84	.77	.77	.72	68	.61
RGVTGC	.74	.72	.74	90	74	.73	.63	67	.61
RPRVGGC	.65	.56	.7	76	60	.59	.48	.62	.55
EINSTR	1	.82	86	76	.74	.73	.73	.6	.52
EACADSP	171	1	73	.73	.7	.7	.66	.54	.5
EPLNT	171	171	1	.81	.74	.73	.68	.62	.55
ERES	171	171	171	1	.77	.76	.68	.66	.61
QARCFAC	162	162	162	162	1	1	.94	.83	77
QARCPRG	162	162	162	162	162	1	.96	82	.77
QARCN	162	162	162	162	162	162	1	75	.71
QGRMNG	169	169	169	169	162	162	162	1	.91
QGRMNUG	163	163	163	163	157	157	157	163	1

After the correlation analysis of the thirty quantitative variables was completed, a Varimax common factor analysis was performed, using the correlation matrix. The procedure for the factor analysis was as follows. First, a common factor analysis was performed using the multiple correlations as the estimated communalities. The maximum number of factors was set at thirty (that is, the number of variables) and factoring was set to halt when the eigenvalues (related to the number of possible common factors) dropped below 1.00, the generally recommended value for confirmatory factor analysis. A total of fifty iterations was used to improve communality estimates. A Varimax rotation, which is the recommended procedure for uncorrelated factors, was then performed. The results of the Varimax factor analysis resulted in four factors which are shown below in Table 33.

Table 33. Varimax Factor Analysis of the Reduced Matrix of Thirty Quantitative Variables

Variable	Factor 1	Factor 2	Factor 3	Factor 4
S - Student				
STDHDCT	.94*	.07	-.00	-.24
STDFTE	.94*	.15	-.02	-.21
SGHDCT	.67	.08	.17	-.59
SGHDCTFT	.52	.42	.18	-.64*
D - Degree				
DEGSTOT	.88	.21	.02	-.33
DEGSMAS	.59	.11	.10	-.64*
DEGSDOC	.55	.55	.19	-.45
F - Faculty				
FACTOT	.90*	.26	-5E-03	-.23
FACTEN	.91*	.32	-.03	-.17
FTENPRF	.77	.47	.02	-.30
FTENASC	.94*	.09	-.02	.04
C - Compensation				
COMPPRFA	-.18	.39	.77*	-.28
COMPASCA	-.06	.19	.94*	-.13
COMPASTA	.15	.23	.83*	-.15
A - Asset				
ABLDG	.58	.45	.14	-.51
AEQUIP	.61	.51	.10	-.28
ALVOLS	.27	.61	.04	-.60
ALSUBS	.36	.61	.06	-.47
R - Revenue				
RTOT	.43	.46	.30	-.61
RGVTGC	.15	.50	.25	-.69*
RPRVGGC	.05	.37	.27	-.72*
E - Expenditure				
EINSTR	.60	.38	.18	-.60
EACADSP	.45	.45	.10	-.54
EPLNT	.53	.39	.22	-.62
ERES	.30	.54	.24	-.59
Q - Quality				
QARCFAC	.31	.83*	.26	-.33
QARCPRG	.32	.84*	.25	-.30
QARCN	.43	.78*	.21	-.20
QGRMNG	.09	.74	.45	-.30
QGRMNUG	.04	.76	.36	-.23

* Indicates the variables selected to define each factor, that is, the variables within each factor with the three highest factor loadings on the factor.

The Four Key Variables

This factor analysis resulted in only four factors, rather than eight as before. Thus, four factors were sufficient to account for one hundred percent (100%) of the inter-correlations in the matrix. Clearly, then, the earlier assumption of eight domains is not supported by the confirmatory factor analysis, that is, solutions as good as the Eight-Factor model are possible. Interpretation of each factor was based on the "defining variables" within each factor. That is, the variables within each factor with the three highest factor loadings were used to represent the factor. The defining variables are indicated with an asterisk in Table 33 above. Interpretation of each of the four factors, which is shown below, clarifies, to some degree, what happened.

Factor 1: Institution Size Factor--Factor 1 has the highest factor loadings on the S-Student and F-Faculty size dimensions (STDHDCT .94, STDFTE .94, and FTENASC .94). The remaining two defining variables are also faculty size dimensions (FACTEN .91 and FACTOT .90). Further, all three of the variables in the D-Degree domain, although not definers of the factor, are also size dimensions and make important contributions to the factor. Interestingly, only two variables have negative factor loadings on this factor

(COMPPRFA -.18 and COMPASCA -.06), indicating that Professors and Associate Professors in large institutions probably tend to fare less well in compensation than their peers in smaller institutions.

Factor 2: Academic Quality Factor--The defining variables on this factor (QARCFAC .83, QARCPRG .84, and QARCN .78) are all members of the a priori Quality domain. In fact, all five of the variables with the highest factor loadings on this factor lie within this domain (that is, also including, QGRMNG .74 and QGRMNUG .76).

Factor 3: Faculty Compensation Factor--The defining variables for Factor 3 (COMPASCA .94, COMPASTA, .83, and COMPPRFA .77) are all in the Compensation domain. Additionally, all three of these variables were used previously a priori in defining the domain. Again, we also see the negative relationship between institutional size and compensation of the faculty in that five variables highly associated with institution size (that is, STDHDCT, STDFTE, FACTOT, FACTEN, and FTENASC) have negative factor loadings.

Factor 4: Graduate Education Factor. This factor is more difficult to interpret. First, we note that the two highest defining variables (RPRVGGC -.72 and RGVTGC -.69) are both external revenue sources in the R-Revenue domain which are frequently associated with graduate research institutions, while the remaining two definers are associated with size aspects of graduate education (SGHDCTFT -.64 and DEGSMAS -.64). Second, we note that the remaining six of the ten highest variables, in terms of factor loading, relate strongly to institutional size (that is, EPLNT, RTOT, ALVOLS, and EINSTR) and the financial/resource aspects of graduate education (that is, SGHDCT and ERES). Finally, we note that two other financially-related domains (A-Asset and E-Expenditure) have no defining variables, although they make important contributions to both factors one (institutional size) and four (graduate education). Thus, we can conclude that Factor 4 is primarily a graduate education factor with strong size and financial aspects.

Notice also that all factor loadings in Factor 4, except one (FTENASC .04), are negative. This indicates that the values on this factor are reversed, that is, values are low on this factor when they are high on the other three common factors (that is, institutional , size, academic quality, and faculty compensation). It should also be remembered that inverting the values to positive would not change the interpretation of the factor in terms of the defining variables (Harman, 1967, 195-199).

Summary

In summary, the factor structure analysis seems to have uncovered four major factors defining the structure of American doctoral institutions: Institution Size (principally the Student and Faculty domains), Academic Quality (the Quality domain), Faculty Compensation (the Compensation domain), and Graduate Education (principally, the Student, Degree, and Revenue domains). The remaining two domains (that is, A-Asset and E-Expenditure) make important contributions to factors one, two, and four. Hence, the factor analysis supports the Eight-Factor model, but indicates that some of the domains are highly inter-correlated (for example, the number of students, degrees, and the number of faculty and the financial factors) and, as a result, these domains are combined together by the factor analysis program into the same factor to support the assumption that all factors are uncorrelated with each other. Thus, the factor analysis supports the Eight-Factor model, but reduces it to a Four-Factor model by combining some of the domains. This may indicate, as suggested by the multiple regression analysis in Objective 3 (reported in Table 28), that fewer than seven domains are necessary to adequately predict academic quality.

To follow up on the possibility of good prediction of QARCFAC (Factor 2), using only three variables representing the three factors uncovered by the factor analysis of the reduced matrix, a new regression analysis was run. This regression analysis used the three variables with the highest Beta-weights from the earlier regression analysis (Table 28): DEGSDOC (.51) was used to represent the size factor (the S-student, D-degree, and F-faculty domains), COMPPRFA (.22) was used to represent the Compensation factor (the C-compensation domain), and ALVOLS (.27) was used to represent the graduate education factor (principally, the financially-related A-Asset, R-revenue, and E-Expenditure domains). The results of this regression analysis are shown in Table 34 with the regression model stated as follows:

QARCFAC = DEGSDOC + COMPPRFA + ALVOLS

Table 34. Regression Analysis of the Four Key Variables

Dependent Variable = QARCFAC

Domain/Variable	Beta	Simple R
D - DEGSDOC	.58	.86
C - COMPPRFA	.22	.56
A - ALVOLS	.26	.79

Multiple R = .90
R-Squared = .82

A comparison of the regression analyses using the second set of eight key variables (Table 28) and the four key variables (Table 34) is shown in Table 35 below.

Table 35. Comparison of Regression Analyses of the Eight and Four Key Variables

Dependent Variable = QARCFAC

Domain/Variable	Table 28 Beta	Table 34 Beta	Simple R
S - SGHDCTFT	-.17		.77
D - DEGSDOC	.51	.58	.86
F - FTENPRF	.12		.72
C - COMPPRFA	.22	.22	.56
A - ALVOLS	.27	.26	.79
R - RTOT	.18		.77
E - EINSTR	-.04		.74
Multiple R =	.91	.90	
R-Squared =	.83	.82	

As can be seen from Table 35, the Four-Factor theory yields prediction at the same general level as the Eight-Factor model, that is, in the latter the Squared Multiple Correlation was .82 versus .83 in the former. In summary then, the Four-Factor model seems to be a useful approach to predicting quality in doctoral institutions and, thus, worthy of further study.

A SUBSEQUENT ANALYSIS

Introduction

During the literature review in Chapter II (see page 66), it was mentioned that Keniston, in his report (Keniston, 1959, 119), provided institutional faculty quality points for the twenty top-ranked graduate institutions in his study, as well as for the nineteen top-ranked institutions in Hughes' 1925 study (although Hughes did not himself provide institutional faculty quality points in his original report). This was done, according to Keniston, so that direct comparisons could be made regarding American's top-ranked institutions over the approximately thirty-four years separating the two studies. It was also mentioned (see pages 141-142) that Webster (1983) had performed a meta-analysis of institutional faculty quality rankings in graduate education over the fifty-seven year period from 1925-1982. In his analysis, Webster looked at seven multi-disciplinary reputational rankings of graduate departments: Hughes (1925); Hughes (1934); Keniston (1959); Cartter (1966); Roose-Andersen (1970); Ladd-Lipset (1979); and the Associated Research Councils or ARC Study (1982). All of these studies, except that of Ladd and Lipset, were carefully reviewed in the present study.

A major problem with Webster's analysis, however, is that he used several different methods for combining departmental rank orders into institution-wide scores because of the very different ways in which the various studies ranked departments. Thus, Webster determined institutional faculty quality rankings for each of the studies as follows:

Hughes (1925) - He added together weighted departmental rankings to get an institution-wide total.

Hughes (1934) - He assigned each institution two points for each starred department and one point for each listed department and then aggregated points for an institution-wide total.

Keniston (1959) - He used the institution-wide scores aggregated from departmental scores as published by Keniston.

Cartter (1966) - Since Cartter had ranked the highest rated departments in each discipline and then grouped together several schools, without distinguishing among them, as having "Good" or "Adequate plus" graduate faculties, Webster used an aggregation method devised by Raymond Ewell. That is, an institution was given five points each time its graduate faculty was rated "Adequate plus" and ten points for each "Good" rating. A numerical rank was given as many points as its inverse rank, plus fourteen (for example, a school listed as first of fifteen in a discipline would get fifteen points plus an automatic fourteen points or a total of twenty-nine points, and so on). The points for each discipline were then aggregated for an institution-wide total.

Roose-Andersen (1970) - Since the Roose-Andersen Study was essentially a replication of the Cartter Study, the same method used for the Cartter Study was used here.

Ladd-Lipset (1977) - Webster used a method devised by George Callcott which gave an institution ten points for a first rank in a discipline, nine points for a second rank, and so on to one point for a tenth rank. Again, points were then aggregated for an institution-wide score.

ARC Study (1982) - Webster credited an institution with two points for each program rated with a standard score of 70 or over and one point for each rated 60-69. Points were then aggregated by program to obtain an institution-wide score.

Because of the questionable comparability of Webster's institutional rankings, as can be seen from the above, and, because institution-wide faculty quality points aggregated across disciplinary programs which directly correspond to those of Hughes (1925) and Keniston (1959) were developed during the present study, a new fifty-seven year meta-analysis of America's top-rated graduate institutions was performed. This meta-analysis, thus, used aggregated quality points, without estimation or conversion. The first period of the analysis (1925-1959) consisted of about thirty-four years, while the second period (1959-1982) consisted of about twenty-three years. Thus, change over approximately two generations was directly compared.

Further, the 1959-1982 period also closely approximates the "golden age of higher education" in which great public resources became available to large numbers of public graduate institutions. The very close relationship between the faculty quality ratings for publicly and privately controlled institutions and the higher faculty quality rating for Landgrant institutions versus Non-Landgrant institutions as shown in the profiles (pages 269 and 271 respectively), also, lead us to suspect that public institutions may have made substantial ranking gains over private institutions during the fifty-seven year period, particularly during 1959-1982. Therefore, since both demographic data and faculty quality ratings aggregated by institution were also available for all doctoral institutions from the present study, the results were also analyzed as to publicly and privately controlled doctoral institutions in order to determine if any significant impact occurred.

The Meta-Analysis

Faculty quality rankings of the top-rated American graduate institutions from 1925-1959, 1959-1982, and from 1925-1982, based on an aggregation of quality points across programs and disciplines, are presented in Tables 36, 37, and 38 below.

Table 36. Faculty Quality Rankings of America's Top-Rated Doctoral Institutions, 1925-1959

Doctoral Institution	1925 Hughes	1959 Keniston	34 Yr. Change
Chicago*	1	6	-5
Harvard*	2	1	+1
Columbia*	3	3	0
Wisconsin	4	8	-4
Yale*	5	4	+1
Princeton*	6	7	-1
Johns Hopkins*	7	16	-9
Michigan	8	5	+3
California-Berkeley	9	2	+7
Cornell+	10	9	+1
Illinois	11	10	+1
Pennsylvania*	12	11	+1
Minnesota	13	12	+1
Stanford*	14	13	+1
Ohio State	15	18	-3
Iowa	16		
Northwestern*	17	17	0
North Carolina	18		
Indiana	19	15	+4
California-Los Angeles		14	
New York U*		19	
Washington		20	

Blank - Public Control
* Private Control
+ Public/Private Control
++ Public Related Control (Considered as Public Control in this analysis.)

Table 37. Faculty Quality Rankings of America's Top-Rated Doctoral Institutions, 1959-1982

Doctoral Institution	1959 Keniston	1982 ARC	23 Yr. Change
Chicago*	6	5	+1
Harvard*	1	14	-13
Columbia*	3	13	-10
Wisconsin	8	3	+5
Yale*	4	4	0
Princeton*	7	11	-4
Johns Hopkins*	16	24	-8
Michigan	5	9	-4
California-Berkeley	2	1	+1
Cornell+	9	10	-1
Illinois	10	7	+3
Pennsylvania*	11	15	-4
Minnesota	12	8	+4
Stanford*	13	2	+11
Ohio State	18	16	+2
Iowa		32	
Northwestern*	17	19	-2
North Carolina		18	
Indiana	15	21	-6
California-Los Angeles	14	6	+8
New York U*	19	40	-21
Washington	20	12	+8
Texas at Austin		17	
Pittsburgh++		20	

Blank - Public Control
* Private Control
\+ Public/Private Control
++ Public Related Control (Considered as Public Control in this analysis.)

Table 38. Faculty Quality Rankings of America's Top-Rated Doctoral Institutions, 1925-1982

Doctoral Institution	1925 Hughes	1982 ARC	57 Yr. Change
Chicago*	1	5	-4
Harvard*	2	14	-12
Columbia*	3	13	-10
Wisconsin	4	3	+1
Yale*	5	4	+1
Princeton*	6	11	-5
Johns Hopkins*	7	24	-17
Michigan	8	9	-1
California-Berkeley	9	1	+8
Cornell+	10	10	0
Illinois	11	7	+4
Pennsylvania*	12	15	-3
Minnesota	13	8	+5
Stanford*	14	2	+12
Ohio State	15	16	-1
Iowa	16	32	-16
Northwestern*	17	19	-2
North Carolina	18	18	0
Indiana	19	21	-2

Blank - Public Control
* Private Control
\+ Public/Private Control
++ Public Related Control (Considered as Public Control in this analysis.)

Results

The Top-Ten Doctoral Institutions

From Tables 36 and 37, we can see that six doctoral institutions have consistently been ranked among the top-ten doctoral institutions since 1925. Three of the institutions are publicly controlled (California-Berkeley, Michigan, and Wisconsin), two are privately controlled (Chicago and Yale), and one is both publicly and privately controlled (Cornell).

The Top-Twenty Doctoral Institutions

Also from Tables 36 and 37, we see that sixteen doctoral institutions have consistently been ranked among the top-twenty doctoral institutions since 1925. In addition to the six institutions mentioned in the top-ten above, they are: Harvard, Columbia, Princeton, Illinois, Pennsylvania, Minnesota, Stanford, Ohio State, Northwestern, and North Carolina. As can be seen from the tables, seven of the sixteen institutions are publicly controlled, eight are privately controlled, and one is both publicly and privately controlled. Four doctoral institutions (two publicly controlled and two privately controlled) were in the top-twenty in 1925 and/or 1959: Johns Hopkins, Iowa, Indiana, and New York University. However, none of these four institutions was in the top-twenty in 1982. The decline in ranking has been fairly consistent for Johns Hopkins and Iowa, while that of Indiana and New York University has been variable (that is, they both made gains from 1925 to 1959, but showed major declines from 1959 to 1982).

Winners

There have been eight "winners" among America's top doctoral institutions (in terms of rank gains) during the fifty-seven year study period, as is shown in Tables 36, 37, and 38. Four have been "big winners." That is, Stanford gained twelve ranks, while California-Berkeley, California-Los Angeles, and Washington each gained eight ranks (the latter two institutions gained the eight ranks in the twenty-three years between 1959-1982 alone). These gains were also consistent in the sense that the four institutions made gains during each of the three measuring periods. Interestingly, also, three (75%) of the four big winners are publicly controlled and all four (100%) are located in the Far West.

Of the four "winners," Minnesota (five ranks) and Illinois (four ranks) both gained consistently and had their greatest gains during the 1959-1982 period. Wisconsin (one rank) lost ground during the 1925-1959 period, but recovered and gained five ranks from 1959-1982. Yale, also with one rank gain, remained remarkably stable in ranking over the fifty-seven years. Cornell and North Carolina, were ranked the same in both 1925 and 1982 (tenth and eighteenth respectively) and, also, were remarkably stable in rank over the fifty-seven year period.

Losers

There have also been twelve "losers" among the top doctoral institutions over the fifty-seven year period. Five of these instititutions were "big losers" (that is, losing from ten to twenty-one ranks each): New York University (twenty-one ranks), Johns Hopkins (seventeen ranks), Iowa (sixteen ranks), Harvard (twelve ranks), and Columbia (ten ranks). Four (80%) of the five big losers are both privately controlled and located in the eastern part of the United States (New York University, Johns Hopkins, and Columbia in the Mid East region and Harvard in the New England region). Only Iowa, which is a "Big 10" institution located in the Plains region, is publicly controlled. New York University, which was the biggest loser, lost the twenty-one ranks in only the twenty-three years from 1959-1982 (New York University was not among the top nineteen institutions in 1925 and, thus, was not available for comparison from 1925-1959). Johns Hopkins consistently declined in rank during the fifty-seven year period (that is, from seventh, to sixteenth, to twenty-fourth), while Harvard and Columbia declined only in the twenty-three years from 1959-1982 (Harvard gained one rank from 1925-1959, while Columbia maintained the third rank position).

Seven other doctoral institutions were "losers" (that is losing between one and five ranks each): Princeton (five ranks), Chicago (four ranks), Pennsylvania (three ranks), Northwestern and Indiana (two ranks each), and Michigan and Ohio State (one rank each). Of these seven institutions, three or 43% (Indiana, Michigan, and Ohio) are publicly controlled. Five or 71% (Chicago, Northwestern, Indiana, Michigan, and Ohio State) are located in the Great Lakes region, the last four of which are also "Big Ten" institutions. Only Princeton (privately controlled) was a consistent loser during the entire period. Three of the public institutions: Pennsylvania (one rank), Indiana (four ranks), and Michigan (three ranks), showed rank gains during the 1925-1959 period, but showed greater rank losses during the 1959-1982 period (four, six, and four ranks respectively). Two of the remaining three institutions (one publicly controlled and one privately controlled), showed a reverse pattern (that is, Chicago and Ohio State lost rank during the 1925-1959 period, but gained rank during the 1959-1982 period. Northwestern remained stable in rank from 1925-1959, but lost two ranks from 1959-1982.

Comers

Two doctoral institutions (both publicly controlled) can be described as "comers" since they only achieved top-twenty status in 1982, Texas at Austin (seventeenth) and Pittsburg (twentieth).

Other Top-Rated Doctoral Institutions

Two institutions remained relatively stable in rank over the fifty-seven year period. Cornell was ranked tenth in 1925, ninth in 1959, and tenth again in 1982. North Carolina was ranked eighteenth in 1925, did not make the top-twenty list in 1959, but again was ranked eighteenth in 1982.

Public versus Private Control

To determine the relationship between publicly and privately controlled doctoral institutions during the fifty-seven year period, Table 39 was developed. It is shown below.

Table 39. Publicly and Privately Controlled Top-Ten and Top-Twenty Ranked Doctoral Institutions, 1925-1982

Type of Control	Top-Ten #	Top-Ten %	Top-Twenty #	Top-Twenty %
1925				
Public	2	25%	10	56%
Private	6	75	8	44
Total	8	100%	18	100%
1959				
Public	4	44%	10	53%
Private	5	56	9	47
Total	9	100%	19	100%
1982				
Public	6	67%	11	58%
Private	3	33	8	42
Total	9	100%	19	100%

Note: Cornell is both publicly and privately controlled and, thus, was not included in the comparison.

As can be seen from Table 39, publicly controlled doctoral institutions have supplanted privately controlled doctoral institutions in the top-ten ranking. In 1925, privately controlled institutions enjoyed a three to one advantage over publicly controlled institutions in the top-ten ranking. By 1982, however, the pattern had almost totally reversed, with the publicly controlled doctoral institutions enjoying a two to one advantage over the privately controlled doctoral institiutions.

There has been more stability in rank in the top-twenty ranking list. Publicly controlled doctoral institutions have been in the majority during the entire fifty-seven years, but the advantage has varied from 25% in 1925, to 11% in 1959, to 38% in 1982. The big increase (38% from 1959 to 1982) again coincides with the "golden age" of higher education.

Looking at it another way, however, six (6%) of the one hundred and nine publicly controlled doctoral institutions versus three (5%) of the sixty-two privately controlled doctoral institutions were rated in the top-ten in 1982. Likewise, in 1982, eleven (10%) of publicly controlled versus eight (13%) of privately controlled doctoral institutions were ranked in the top-twenty. Thus, the advantage of publicly controlled doctoral institutions relative to that of privately controlled doctoral institutions is somewhat diminished if one looks at the entire population.

In summary, publicly controlled doctoral institutions overall have showed gains in faculty quality ranking at the expense of privately controlled doctoral institutions during the fifty-seven year period from 1925 to 1982, particularly among the top-ten institutions. This, however, does not mean, as has been pointed out by several other researchers, that privately controlled doctoral institutions have declined, but simply that publicly controlled doctoral institutions have gotten better. Further, in terms of period of gain, public institutions gained consistently over the entire fifty-seven year period, but gains were accelerated somewhat during the 1957-1982 period. Thus, the golden age of higher education was especially golden for American public education.

Michigan

As indicated above, the University of Michigan-Ann Arbor, is one of six doctoral institutions in the nation whose faculty have consistently been ranked among the top-ten in quality (eighth, fifth, and ninth respectively) during the fifty-seven years between 1925 and 1982. However, it should also be noted that the University of Michigan also: 1) showed a significant decline during the 1959-1982 period (four ranks) and 2) was the only institution of the top six which showed a significant decline during that period (the only other institution in the top six which showed a decline was Cornell, which declined one rank).

It should also be noted that Webster, using his somewhat questionable ranking technique, showed Michigan State University ranking twenty-fourth in 1970 (the Roose-Andersen Study) and the Vinsonhaler 1982 ARC analysis shows Michigan State University ranking twenty-ninth. Thus, it would appear that both major public doctoral institutions in Michigan show the same pattern, that is, declining during the "golden age of higher education," which runs counter to the expected trend. This raises serious allocation and program questions for Michigan policy and decision makers. For example, should Michigan maintain and even improve the already existing high-quality doctoral institutions, possibly at the expense of other potentially high quality institutions or should other ways be found to ensure quality programs in all of Michigan's higher education institutions, perhaps, by limiting the number of programs at the various institutions?

Discrepancies Between the Webster (1983) and Vinsonhaler Faculty Quality Rankings

Table 40 below shows the faculty quality rankings for 1925 and 1982, as determined by both the Webster and Vinsonhaler methods (Keniston's 1959 rankings were not included since both researchers used the same method).

Table 40. Comparison of Webster and Vinsonhaler Faculty Quality Rankings, 1925 and 1982

	Webster		Vinsonhaler	
Doctoral Institution	1925	1982	1925	1982
Chicago	1	7	1	5
Harvard	2	3	2	14
Columbia	3	11	3	13
Wisconsin	5	8	4	3
Yale	4	3	5	4
Princeton	6	6	6	11
Johns Hopkins	7	30	7	24
Michigan	8	8	8	9
California-Berkeley	9	1	9	1
Cornell	10	11	10	10
Illinois	11	13	11	7
Pennsylvania	12	14	12	15
Minnesota	13	16	13	8
Stanford	14	2	14	2
Ohio State	15		15	16
Iowa	16		16	32
Bryn Mawr	17			93
Cal Tech	18	15		60
MIT	19	5		25
Northwestern	20	23	17	19
North Carolina		20	18	18
Indiana	24	21	19	21
California-Los Angeles		8		6
New York U		21		40
Washington		19		12
Texas at Austin		16		17
Pittsburg	23			20

As can be seen from Table 40, the two methods yielded substantially different results for some institutions. The most notable differences are the following: 1) Cal Tech, MIT, New York U, Harvard, and Princeton, in which the Webster method is subtantially more favorable (five to forty-five ranks higher), and 2) Minnesota, Washington, Johns Hopkins, Columbia, and Northwestern in which the Vinsonhaler method is somewhat more favorable (four to eight ranks higher).

Summary

In summary, the meta-analysis of fifty-seven years of change in faculty quality rankings of American doctoral institutions described above yielded some interesting results. First, it confirmed the results obtained by other researchers who found relatively little change in the top-ranked American doctoral institutions over time. Second, it also further demonstrated that change (both up and down) in faculty quality rankings does occur. Third, it demonstrated that America's publicly controlled doctoral institutions have greatly benefitted from the public trust and public monies bestowed upon them, particularly during the "golden age" of American higher education. Finally, it demonstrated that some meta-analytic methods (for example, those of Webster), as well as some popular conceptions of high-quality doctoral institutions may be unwarranted (for example, Harvard).

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS FOR FURTHER RESEARCH

INTRODUCTION

This chapter will present three major topics. First, a summary is given of the results with conclusions about the major research objectives, questions, and hypothesis. Second, the practical, policy, and theoretical implications of the study for higher education will be discussed. Third, recommendations for further reseach will be made.

SUMMARY AND CONCLUSIONS

Introduction

After first looking at the study methodology, this section will be presented by summarizing the study results and conclusions for each of the five major objectives and research questions and the hypothesis presented in Chapter I in the statement of the problem.

Methodology

The study methodology used, which employed a Computer-Based Information System (CBIS), secondary analysis, extant data, and indicators, in conjunction with traditional research procedures and sophisticated statistical techniques, proved to be a highly effective and inexpensive methodology for higher education quality assessment research.

A Higher Education Computer-Based Information (HECBIS), consisting of a Personal Computer System (PCS) and a Doctoral Institution Data Base (DIDB) was developed for use in the present study, as well as for use in many future research studies.

The study population consisted of the one hundred and seventy-one institutions of higher education in the United States classified as doctoral-level by the National Center for Education Statistics (NCES).

Three major types of data which characterize the doctoral institution population were included in the DIDB: 1) Identification data (two data variables): the doctoral institution name (INST) and the Federal Interagency Committee on Education (FICE) code were used simply to identify the doctoral institutions within the population. 2) Categorical or demographic data (nine data variables), including STATE, AFFIL, and SEX were used to restructure the population for analytical study purposes. 3) Quantitative data (thirty-eight data variables) consisting of thirty-three data measurements, including student, degree, faculty, and financial characteristics of doctoral institutions and five academic quality ratings. The academic quality ratings included: a) QARCFAC which is a judgment by approximately 8,200 faculty from 228 universities included in the 1982 Associated Research Councils (ARC) Study as to the scholarly competence and achievement of faculty based on a six-point rating scale (Distinguished, Strong, Good, Adequate, Marginal, and Not Sufficient for Doctoral Education); b) QARCPRG which is a judgment, also from the ARC Study, as to the effectiveness of doctoral programs in educating research scholars/scientists based on a four-point scale (Extremely Effective, Reasonably Effective, Minimally Effective, and Not Effective); c) QARCN which indicates the total number of disciplinary programs rated in each institution in the ARC Study; d) QGRMNG which is a 1982 multidimensional assessment of quality in graduate instituions based on a seven-point scale (Very Strong, Strong, Good, Acceptable Plus, Adequate, Marginal, and Needs to Improve) by Jack Gourman; and e) QGRMNUG which is a 1982 multidimensional assessment of quality in undergraduate institutions based on a five-point scale

(Strong, Good, Acceptable Plus, Adequate, and Marginal), also by Jack Gourman.

The study demonstrated that it is possible for a single knowledgeable researcher, using such a methodology, to do a massive meta-analytical research study, both efficiently and cost-effectively, within a reasonable period of time. The study further demonstrated the usefullness of the methodology for policy analysis and decision making.

Study Results--The Descriptive Analyses

Objective 1: To describe the population of one hundred and seventy-one American doctoral institutions, using a comprehensive set of forty-nine observable variables.

R1. What characterizes the population of one hundred and seventy-one American doctoral institutions?

Categorical Variables

In terms of the categorical variables, American doctoral institutions are unevenly distributed geographically. They are located in forty-seven of the fifty states and in the District of Columbia. Seventy-seven (45%) of all doctoral institutions are located in only seven (14%) states: California, Illinois, Massachusetts, New York, Ohio, Pennyslvania, and Texas. Regionally, eighty-two (48%) doctoral institutions are located in the eastern part of the

United States, with the remaining 99 (52%) approximately evenly distributed in the mid-west and west. The typical doctoral institution is a publicly controlled, single campus, semester-based, non-landgrant, non-AAU, coeducational, and predominantly white organization.

Quantitative Variables

Summary Statistics--In terms of the quantitative variables, the typical doctoral institution in 1981-1982:

1) Was 112 years old.

2) Enrolled 16,400 total students (14,300 or 87% full-time-equivalent students), of which approximately 12,400 were undergraduates (76%) and 4,000 (24%) were graduates (slightly more than half of whom were full-time).

3) Granted 3,100 degrees, of which about 800 (25%) were master's, 150 (5%) were first professional, and 120 (4%) were doctor's degrees.

4) Employed 700 full-time instructional faculty, of which about 500 (66%) were tenured (250 or 53% Professors, 160 or 34% Associate Professors, and 20 or 4% Assistant Professors).

5) Granted compensation (salary and benefits) of approximately $43,000 to Professors, $32,000 to Associate Professors, and $26,000 to Assistant Professors.

6) Managed an endowment of $17.5 million, building assets of $134 million, equipment assets of $48 million, and a library of 1.3 million volumes and 12,000 periodicals.

7) Received $152 million in total revenue ($20 million from government grants and contracts; $6 million from private gifts, grants, and contracts; $27 million from tuition and fees; and $42 million from appropriations).

8) Spent $45 million for instruction, $10 million for academic support, $11 million for plant maintenance, $18 million for research, $4.5 million for student services, and $5 million for scholarships and fellowships.

9) Had 14 graduate programs rated by the Associated Research Councils (ARC) at 3,200 quality points for faculty and 2,100 quality points for programs and Gourman institutional quality ratings of 3.66 for graduate and 4.03 for undergraduate education.

However, as was noted in Chapter IV, these averages, which are based on the median, do not give an accurate picture of the population, since the standard deviations and ranges are very large as was demonstrated by the summary statistics.

<u>Rankings</u>--In terms of rankings, no clear picture emerged from the full set of rank ordered listings. That is, the same doctoral institutions were not ranked similarly on all thirty-eight of the quantitative variables. Some exceptions to this were the rankings based on the following variables: full-time graduate student headcount (SGHDCTFT), doctor's degrees granted (DEGSDOC), total academic year instructional and tenured faculty headcounts (FACTOT and FACTEN), library

volumes (ALVOLS) and library subscriptions (ALSUBS), total revenue (RTOT), expenditures on instruction (EINSTR), and faculty quality (QARCFAC) on which many of the doctoral institutions were ranked similarly. This was evidenced by the high inter-correlations of these variables. In short, although the rankings showed many similarities among the doctoral institutions, they also showed that doctoral institutions are also highly diverse as a group.

To examine the types of decisions which can be supported by the rankings on variables, let us look at three example problems in which a question is asked, a solution is attempted using the ranking lists, and a comment is made regarding the adequacy of the ranking list in answering the question.

PROBLEM 1. How does MSU rank in relation to other doctoral institutions on the number of Professors and on their quality?

Answer. MSU ranks second among doctoral institutions on the number of tenured Professors (FTENPRF) and twenty-ninth on their quality (QARCFAC).

Comment. This type of question is easily answered.

PROBLEM 2. How adequate is the pay of MSU Professors in comparison to that of Professors at other doctoral institutions?

Answer. MSU ranks seventy-secondth among doctoral institutions on the compensation of Professors. As to compensation adequacy, one answer might be, "MSU Professors earn only about $400 less than Professors at Indiana University Bloomington, a similar school in the "Big Ten." Another answer might be, "MSU Professors earn over $5,700 less per year than Professors at Northwestern University, a similar school in the "Big Ten."

Comment. Comparative rankings have no base line for comparison.

PROBLEM 3. In general, how does MSU "stack up" against other doctoral institutions?

Answer. One answer might be, "MSU ranks first in total degrees granted and in the number of tenured professors and sixth in building assets." A second answer might be, "MSU ranks twenty-ninth in faculty quality, seventy-secondth in faculty compensation, and eighty-ninth in endowments."

Comment. In an open-ended question, there is no set of common variables on which to base the analysis.

In summary, for decision problems involving only single variables selected by the problem solver, the ranking list seems adequate as long as no attempt is made to evaluate the listing against comparison universities or groups of universities.

For decision problems involving relative ranking, including understanding of the relative importance of a single univariate rank, rankings do not provide a fixed answer. Results depend on the particular comparison made. Further, the larger the number of variables to be taken into account, the more difficult the problem.

Study Results--Reduction of the Data Base

Objective 2: To reduce the number of thirty-eight observable quantitative variables used to describe the population of doctoral institutions to a smaller set of eight "key variables."

R2. Can the large set of thirty-eight quantitative variables used to describe doctoral institutions be replaced with a smaller set of eight key variables without a major loss of information?

The thirty-eight quantitative variables were organized on an a priori basis into eight clusters or domains and tested for similarity through correlation and factor analysis. Results for all domains indicated high within domain similarity and only one factor per domain. Thus, in all of the eight domains, one common factor was sufficient to exhaust almost 100% of the commonality--indicating that all of the variables could be replaced with one of the variables loaded very highly on the factor (that is, correlation with the factor) or by a single latent factor. Of course, this does not preclude the fact that other specific factors may also underlie the variables, as well, and that this specificity is indeed lost. However, the intent of the present study was to determine the shared attributes of the thirty-eight quantitative variables from the one hundred and seventy-one doctoral institutions defining the population, not to determine attributes unique to each variable.

Study Results--Predicting Academic Quality with Key Variables

Objective 3: To determine the degree to which the key academic quality variable can be predicted from the other seven key quantitative variables.

R3. Can the key quality variable be predicted without loss from the other seven key variables?

Two different sets of eight key variables or indicators were analyzed in regression analyses in order to determine the predictability of academic quality. The first set of key variables was selected on the basis of high factor loading alone. The second set was based on dual criteria, high factor loading and high inter-correlation of the domain variables with the faculty quality variable, QARCFAC. Results indicated that faculty quality (the dependent variable) could be predicted with 79% accuracy, using the first set of key variables and with 83% accuracy, using the second set. Thus, the second set of eight key variables (that is,

SGHDCTFT, DEGSDOC, FTENPRF, COMPPRFA, ALVOLS, RTOT, EINSTR, and QARCFAC) was used in all subsequent analyses.

Study Results--Graphic Displays of the Data Base

Objective 4: To generate graphic displays or "profiles" of doctoral institutions and groups of doctoral institutions based upon the eight key variables.

R4. What findings can be obtained with profile, rather than ranking, reports?

Graphic displays of the Doctoral Institution Data Base (DIDB) in the form of "standardized profiles" were used for analysis and reporting. A complete analysis of the potential for profiles and implications for higher education policy were beyond the limits of the present study. However, it was possible to determine and demonstrate some of the types of problems in higher education for which profiles are especially useful. In this regard, however, it should be remembered that multivariate quality is defined as a set of variables or characterisitcs which aids in decision making about academic quality in doctoral institutions.

The most significant results from the sample profiles presented were: 1) the higher quality rating of faculty in landgrant versus non-landgrant doctoral institutions, 2) the strong regional differences displayed in the Great Lakes and Far West profiles, and 3) the almost mirror-image profiles of publicly and privately controlled doctoral institutions. These results strongly suggest major policy differences in the governance of American doctoral institutions.

To further consider the role of profiles in institutional decision making, let us again consider the same three problems previously addressed to the ranking reports, but use profiles to answer the questions.

PROBLEM 1. How does MSU rank in relation to other doctoral institutions on the number of Professors and on their quality?

Answer. Using the Profile in Figure 10 below to answer the question, we can say that in relation to the national average (the average score of 50), MSU ranks about four standard deviations above on the number of tenured Professors and about one standard deviation above on their quality.

Comment. One gets quite a different perspective on the problem using the profile, rather than the rankings.

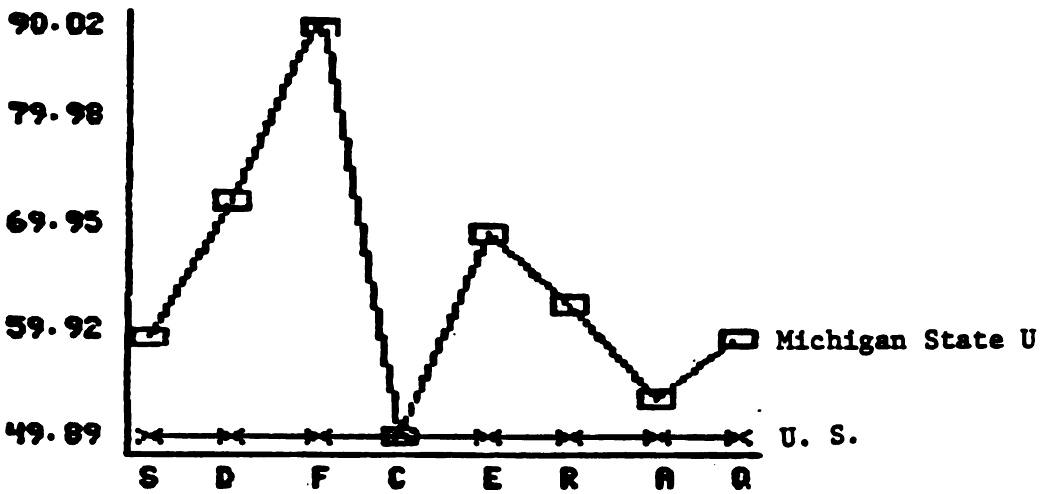

Figure 10. Profile of Michigan State University and the United States Average Doctoral Institution, 1981-1982

PROBLEM 2. How adequate is the pay of MSU Professors in comparison to that of Professors at other doctoral institutions?

Answer. Again using Figure 10 (see above) to answer the question, we note that MSU ranks slightly below the national average of doctoral institutions on compensation of Professors.

Comment. Only one answer is possible here, since the national average is always used as the base line.

PROBLEM 3. In general, how does MSU "stack up" against other doctoral institutions?

Answer 1. Once again using Figure 10 above, we note that compared to the national average doctoral institution, MSU has more full-time graduate students, grants far more doctor's degrees, and has substantially more tenured Professors, who are rated somewhat higher in quality, but who are compensated about the same as the national average. MSU also has higher total revenue, spends far more on instruction, and has slightly more library volumes than the national average.

Comment. More than one answer is possible here as can be seen from Answer 2 based on Figure 11 below.

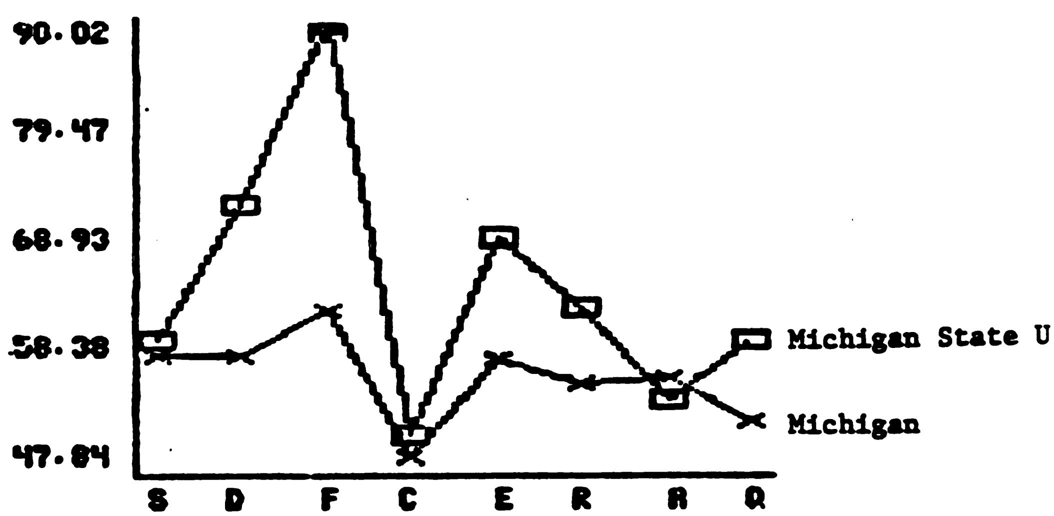

Figure 11. Profile of Michigan State University and the State of Michigan Average Doctoral Institution, 1981-1982

Answer 2. Compared to the average Michigan doctoral institution, MSU has about the same number of full-time graduate students, grants more doctor's degrees, has far more tenured Professors who are rated somewhat higher in quality, but who are paid about the same. MSU also has somewhat higher revenue, but fewer library volumes than the average Michigan doctoral institution.

<u>Comment</u>. Although we can obtain a more precise answer regarding the key characteristics from a profile, it is still necessary to be specific about the population or group about which inferences are to be made.

In summary, it is clear that a profile analysis does uncover important findings which are masked by ranking reports. Profiles seem to yield the most improvement when: 1) a multivariate problem is presented, that is, the problem requires the analysis of more than a single variable and 2) a comparison between institutions or groups of institutions is necessary.

To complete the discussion, let us, briefly, re-examine the problem posed in the original statement of the research problem (see Chapter I, pages 5-6). Suppose a state, for example, Arizona, is trying to determine its annual fund allocation for each of its two doctoral institutions. How would a profile help? To begin with, state decision makers would need to generate a profile comparing the two doctoral institutions on the key quality indicators. Such a profile is shown in Figure 12 below).

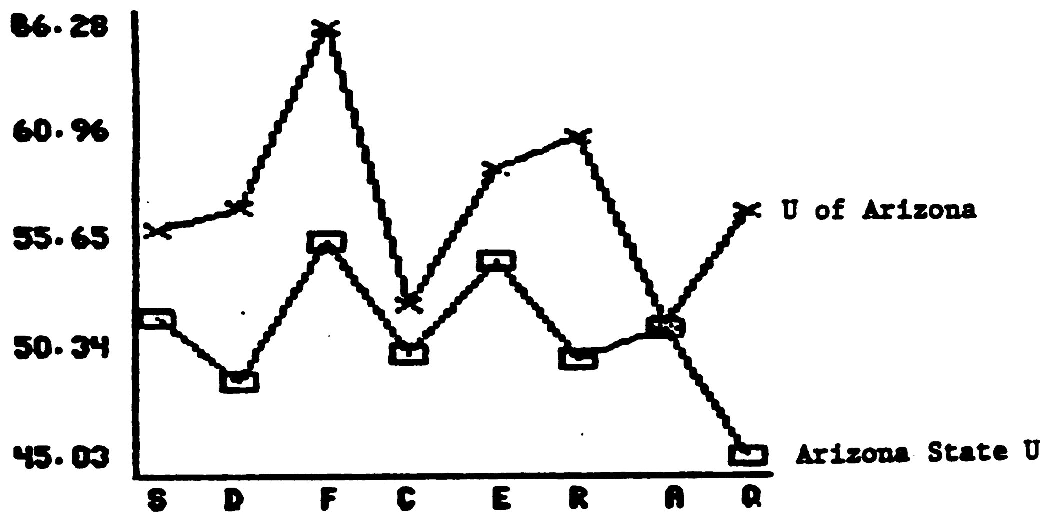

Figure 12. Profile of Arizona State University and the University of Arizona, 1981-1982

Next, decision makers would need to analyze the profile, noting such things as the following:

1) Arizona State University ranks slightly above the national average on two of the eight key quality indicators (FTENPRF and EINSTR), approximately average on four inidicators (DEGSDOC, COMPPRFA, RTOT, and ALVOLS), and below average on one indicator (QARCFAC).

2) The University of Arizona ranks above the national average on all eight of the key indicators. FTENPRF is approximately 1.5 standard deviations above average; SGHDCTFT, DEGSDOC, EINSTR, RTOT, and QARCFAC are from

0.5 to 1.0 standard deviations above average, and COMPPRFA and ALVOLS are very close to average.

3) The University of Arizona ranks higher than Arizona State on all indicators except ALVOLS, on which they rank approximately the same. The two institutions are about 0.5 standard deviations apart on SGHDCTFT, DEGSDOC, and EINSTR, about 1.0 standard deviations apart on FTENPRF and RTOT, and about 1.5 standard deviations apart on QARCFAC. Additionally, they pay their tenured Professors (FTENPRF) about the same.

3) Arizona State's profile, overall, is relatively consistent in relation to the national average, except, perhaps, for graduating two few doctoral students, and having a higher than average faculty/student ratio. The most serious problem appears to be faculty quality.

4) The University of Arizona, has a somewhat less consistent profile. Problem areas seem to be a higher than average number of tenured Professors, and potentially very serious faculty compensation and library resource problems, which, if not corrected, could potentially affect its faculty quality rating.

It is clear that Arizona state decision makers would want to seek out more information than that given in this example profile but, given the right variables, a profile seems to serve better than a simple rank listing of institutions by providing a more comprehensive basis for decision making. Further, a profile can trigger "potential problem areas" which can be further researched and, perhaps, satisfactorily resolved.

Thus far, consideration has only been given to university specific questions addressed mainly to the understanding of particular doctoral institutions. The profile analyses can also be used as a valuable research tool. The following two examples are indicative of this potential use.

1) What are the important differences between the "Comer" universities and the "Loser" universities?

Determining the key characteristics which differentiate those universities which improved their standing during the fifty-seven year period from 1925-1982 versus those which lost standing might provide some important information to assist universities in quality improvement. Steps required for solving this research problem would consist of selecting the universities comprising the two groups, calculating averages for each group, plotting the P-scores on a profile, and then analyzing the profile results.

2) What characterizes universities with large federal research grants and contracts from those with low levels of government funding?

This research question might be used by funding agencies to determine allocations or by universities wanting to improve their "grant-getting" ability. In this case, the top and bottom group of universities would first be selected from the RGVTGC variable. Averages would then be calculated for each group and the P-scores for each group plotted on a profile. Finally, the results would be analyzed as before.

Study Results--The Underlying Structure of the Data Base

Objective 5: To examine more closely the underlying structure of doctoral institutions which might account for the inter-correlations among the observable quantitative variables used in the study.

R5. What theory of academic quality is supported by factor analytic study of the data characteristics of doctoral institutions?

Empirical Research Study Hypothesis
The number of common factors underlying the observable quantitative characteristics of American doctoral institutions is greater than one (the univariate case) and less than or equal to eight (the number of domains used in the original description).

If one accepts the univariate academic quality approach, then clearly the second factor (Quality) in the factor analysis of the thirty quantitative variables is that factor. However, note (see Table 33, page 287) that variables selected to define other factors, for example, government grant and contract revenue (RGVTGC), full-time graduate student headcount (SGHDCTFT), and compensation of Professors (COMPPRFA) also have reasonably high loadings on this factor. Hence, it would appear that this factor is only part of the best definition of academic quality.

The multivariate academic quality approach is clearly supported if one is willing to consider variables other than academic quality ratings as a basis for defining academic quality. In this case, at least three factors are necessary to define academic quality: 1) the size of the institution, as indicated, primarily, by the number of students, degrees, and faculty; 2) the quality factor; and 3) the compensation of faculty. A fourth factor (Graduate Education) may also be important.

In summary, then, the multivariate approach seems to be the most plausible theory underlying academic quality in American doctoral institutions when academic quality is defined as information necessary to make decisions about an institution's academic quality.

Thus, the study hypothesis was clearly supported in the study in that four common factors (rather than one) were found to underlie the thirty-eight observable quantitative variables.

IMPLICATIONS OF THE STUDY

This study has many clear practical, theoretical, research, and public policy implications for education, as well as for other fields. In terms of methodology, this study clearly demonstrated, through the use of a Computer-Based Information System, extant data bases, and indicators a highly cost-effective methodology for individual researchers, policy analysts, decision makers, and students.

In terms of higher education practice, the study demonstrated that multivariate assessment of academic quality is not only easily and inexpensively possible, but that such assessment also has a sound theoretical base and is highly reliable, valid, and predictable. It also demonstrated that there are many different ways for an institution to achieve academic quality. That academic quality, or the lack thereof, is determined by numerous day-to-day decisions, which together create *de facto institutional policies* which are reflected as measureable characteristics which describe an institution.

The study also demonstrated that all institutional characteristics are not of equal importance. That only a very small number of characteristics or "key indicators" (probably only three or four) dramatically impact academic quality and, thus, should be given primary attention. This should greatly assist reform efforts in higher education because, according to John DiBiaggio (1986), President of Michigan State University, complex issues and shallow notions receive equal time too often.

In terms of theoretical implications, the study presented a strong reasoned argument for a multivariate theory of academic quality which was supported by past research in the field, as well as by the findings in the present study.

In terms of public policy, this study also has several implications. First, it demonstrated that, in the past half-century, public graduate institutions have made dramatic gains in academic quality in relation to private graduate institutions. Second, it demonstrated that a small number of key policy decisions are necessary for academic quality. Finally, it demonstrated that periodic assessment of graduate education is a first, but very necessary step, in the improvement of graduate education and, thus, should be continued.

RECOMMENDATIONS FOR FURTHER RESEARCH

The present study was viewed, not as an end in itself, but, rather, as a foundation for many important future research studies. The following studies, presented in no special order, would qppear to be the first priorities.

Profiles of the Remaining Variables

Only eight of the thirty-eight observable quantitative variables were graphically presented in the profiles due to the study's focus on the "key" quality indicators. The remaining thirty variables, however, would be of great importance in understanding institutional functioning, as well as in diagnosing and remediating institutional problems. The variables could be presented in several different ways, such as by domain or relationship groupings (for example, by: size variables, faculty-related or student-related variables, or financial variables).

Replication of the Present Study

A replication of this multivariate study should be performed using updated (probably 1984-85) data values for thirty-five of the thirty-eight observable quantitative variables used in the study. Since updated data values would not be available for the three 1982 ARC quality variables, the same 1982 values used in the present study could once again be used. This replicated study would not only give increased credibility to existing reliability and validity data relating to quality assessment studies, but, more importantly, it would provide supporting evidence for the present study methodology and results.

Predictive Study

This proposed study would use 1984-85 updated data values for the three key variables, DEGSTOT, COMPPRFA, and ALVOLS, obtained in the final regression analysis (see Table 34), along with their associated Beta-weights, to predict 1984-85 faculty quality (QARCFAC) values for American doctoral institutions.

Study of Insititutional Size

As was obvious from the study results presented in Chapter IV, some doctoral institutions have many more students than other doctoral institutions. Correspondingly, it would be expected, that these institutions would also have more faculty members, grant more degrees, have more buildings, spend more money, and so forth than would doctoral institutions with fewer students. Thus, one way of analyzing the data would be to try to eliminate institutional size by dividing the raw data variables by some appropriate base variable, for example, total student headcount (STDHDCT).

Averaging was not used in this inital study for several reasons. First, size is an important characteristic of doctoral institutions. If a large doctoral institution has more quality points assigned to it because it has a larger pool of faculty from which distinguished faculty can be identified, this should not detract from its quality rating. For example, suppose that institution A has ten departments, each of which is given a rating of 400 points, while institution B has only one department, which is also given a rating of 400 points. If size is eliminated by dividing the number of quality points by some measure of institutional size, such as number of departments, then both institutions A and B would appear identical in faculty quality, as is demonstrated below:

Doctoral Institution	Number of Departments	Total Q Points	Average Q Points
A	10	4000	400
B	1	400	400

Thus, in this example we have lost the fact that institution A is both very good and very large.

Second, it is very difficult to determine the best averaging base to be used as the measure of institutional size for each variable. That is, for some variables, such as total number of degrees granted (DEGSTOT) or total revenue (RTOT), student headcount (STDHDCT) might be the most appropriate base, while for others, such as number of tenured Professors (FTENPRF), the total number of tenured faculty (FACTEN) might be the most appropriate base. However, using different bases might introduce artifacts into the data.

Third, the present study is only the initial investigation of the data. Other studies are already underway, including one dealing with "averaged" data. The researcher judged that the initial study should be "close" to the original empirical results without using transformations which might yield highly questionable findings.

O-Analysis

Another potential study, and probably the most difficult and significant of all, would be to perform an O-Analysis (that is, an object or entity analysis) of the data base. It may be remembered from Chapter III that the data matrix used in the present study consisted of observations on thirty-eight observable quantitative variables on one hundred and seventy-one doctoral institititutions (objects or entities). The resulting data matrix had the one hundred and seventy-one institutions (objects) in the rows and the thirty-eight quantitative variables in the columns. This was the form of the Variable or V-Analysis performed in the present study. Reversing the matrix, that is, having the thirty-eight quantitative variables in the rows and the one hundred and seventy-one institutions (objects) in the columns would be an Object or O-Analysis. This type of analysis would group similar doctoral institutions, rather than similar variable values, as was done in the V-Analysis.

A major difficulty presented in the O-Analysis would be the highly discrepant size difference between the number of data elements in the horizontal (38) and vertical (171) axes. However, this problem is solvable, but would require considerable study and effort. The value of such a study, however, would be immeasureable--it would lay the foundation for a true classification of doctoral institutions based on similarities which would greatly aid both our understanding of them and also our decision making related to them.

APPENDICES

APPENDIX A

AMENDED ALPHAPETICAL LISTING OF DOCTORAL INSTITUTIONS, 1981-1982

Appendix A. Amended Alphabetical Listing of Doctoral Institutions, 1981-1982*

Doctoral Institution
Adelphi U
Akron MC U of
Alabama in Birmingham U of
Alabama the U of
American U
Arizona State U
Arizona U of
Arkansas MC U of
Auburn U MC
Ball State U
Boston College
Boston U
Bowling Green State U MC
Brandeis U
Brigham Young U MC
Brown U
Bryn Mawr College
California Institute of Technology
California-Berkeley U of
California-Davis U of
California-Irvine U of
California-Los Angeles U of
California-Riverside U of
California-San Diego U of
California-Santa Barbara U of
California-Santa Cruz U of
Carnegie-Mellon U
Case Western Reserve U
Catholic U of America
Chicago U of
Cincinnati MC U of
City U of New York Graduate School & U Center
Claremont Graduate School
Clark U
Clemson U
Colorado at Boulder U of
Colorado State U
Columbia U Main Division
Connecticut U of
Cornell U Endowed Colleges
Cornell U Statutory Colleges

Appendix A (Cont'd.).

Doctoral Institution
Dartmouth College
Delaware U of
Denver U of
Detroit U of
Drew U
Duke U
Emory U
Florida State U
Florida U of
Fordham U
George Washington U
Georgetown U
Georgia State U
Georgia U of
Harvard U
Hawaii at Manoa U of
Houston-U Park U of
Howard U
Idaho U of
Illinois at Chicago U of
Illinois Institute of Technology
Illinois State U
Illinois-Urbana Campus U of
Indiana U Bloomington
International College
Iowa State U of Science & Technology
Iowa U of
Johns Hopkins U
Kansas MC U of
Kansas State U of Agriculture & Applied Science
Kent State U MC
Kentucky U of
Lehigh U
Louisiana State U & A & M College Baton Rouge
Louisville U of
Loyola U of Chicago

Appendix A (Cont'd.).

Doctoral Institution
Marquette U
Maryland College Park Campus U of
Massachusetts Amherst Campus U of
Massachusetts Institute of Technology
Memphis State U
Miami U of
Miami U Oxford Campus
Michigan State U
Michigan-Ann Arbor U of
Minnesota of Minneapolis Saint Paul U of
Mississippi MC U of
Mississippi State U
Missouri-Columbia U of
Missouri-Kansas City U of
Nebraska-Lincoln U of
Nevada-Reno U of
New Hampshire U of
New Mexico MC U of
New Mexico State U MC
New School for Social Research
New York U
North Carolina at Chapel Hill U of
North Carolina at Greensboro U of
North Carolina State U at Raleigh
North Dakota MC U of
North Texas State U
Northern Colorado U of
Northern Illinois U
Northwestern U
Notre Dame U of
Ohio State U MC
Ohio U MC
Oklahoma Norman Campus U of
Oklahoma State U MC
Oregon State U
Oregon U of
Pacific U of the
Pennsylvania State U MC
Pennsylvania U of
Pittsburgh MC U of
Princeton U
Purdue U MC

Appendix A (Cont'd.).

Doctoral Institution
Rand Graduate Institute of Policy Studies
Rensselaer Polytechnic Institute
Rhode Island U of
Rice U
Rochester U of
Rockefeller U
Rutgers the State U of New Jersey New Brunswick Campus
Saint John's U
Saint Louis U MC
South Carolina at Columbia U of
South Dakota MC U of
South Florida U of
Southern California U of
Southern Illinois U at Carbondale
Southern Methodist U
Southern Mississippi U of
Stanford U
State U of New York at Albany
State U of New York at Binghamton
State U of New York at Buffalo MC
State U of New York at Stony Brook MC
Syracuse U MC
Temple U
Tennessee at Knoxville U of
Texas A&M U MC
Texas at Austin U of
Texas at Dallas U of
Texas Tech U
Texas Woman's U
Toledo U of
Tufts U
Tulane U of Louisiana
Union for Experimenting Colleges & Universities
United States International U
Utah State U
Utah U of
Vanderbilt U
Vermont & State Agricultural College U of
Virginia Commonwealth U
Virginia MC U of
Virginia Polytechnic Institute & State U

Appendix A (Cont'd.).

Doctoral Institution
Washington State U
Washington U
Washington U of
Wayne State U
West Virginia U
Western Michigan U
Wisconsin-Madison U of
Wisconsin-Milwaukee U of
Wyoming U of
Yale U
Yeshiva U

* The NCES 1981-82 listing of doctoral institutions is amended as of 1983-84 to reflect necessary adjustments made to the newly implemented NCES classification structure of 1981-82.

(Source: Broyles, Susan G. and Fernandez, Rosa M. 1983-84 Education Directory: Colleges and Universities. Washington, D.C.: National Center for Education Statistics, 1984.)

APPENDIX B

LISTING OF DATA VARIABLES WITH DEFINITIONS AND DATA SOURCES

Appendix B. Listing of Data Variables with Definitions and Data Sources

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Identification Variables

INST. Name of institution or branch. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

FICE. Unique Federal Interagency Committee on Education code for each institution. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

Categorical Variables

STATE. State in which institution is located. Includes 50 states and the District of Columbia. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

REGION. Department of Commerce, Office of Business Economics Regions: 1) New England (Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont), 2) Mid East (Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania), 3) Great Lakes (Illinois, Indiana, Michigan, Ohio, Wisconsin), 4) Plains (Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota), 5) Southeast (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia), 6) Southwest (Arizona, New Mexico, Oklahoma, Texas), 7) Rocky Mountains (Colorado, Idaho, Montana, Utah, Wyoming), and 8) Far West (Alaska, California, Hawaii, Nevada, Oregon, Washington). (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

CONTROL. Indicates type of control or affiliation as reported by the institution. Public institutions are those under State, State-Related, or State and Local (State/Local) control. Private institutions are reported as Independent Non-Profit or by Religious Affiliation (that is, Latter Day Saints, Roman Catholic, or United Methodist). (Source: National Center for Education Statistics. "Fall Enrollment in

Appendix B (Cont'd.).

Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

STATUS. Identifies the type of institution: 1) Individual Institution, 2) Institutional System (Individual Institution or Main Campus), or 3) a Multi-Campus Institution (Main Campus, Designated Main Campus, or Other Campus). An Institutional System is a complex of two or more institutions of higher education, each separately organized or independently administered, under the control of a single administrative body. A Multi-Campus Institution is an organization resembling an institutional system, but clearly designated as a single institution with either of two organizational structures: a) an institution having two or more campuses responsible to a central administration (which may or may not be located on one of the administratively equal campuses) or b) an institution having a main campus (MC) with one or more branch campuses (Other or OC). In those institutions composed of a main campus and one or more branch campuses, the main campus (sometimes called the parent institution) is usually the location of the core, primary, or most comprehensive program. (The main campus is understood to be the location of the central administrative office unless the institution-wide or central administrative office is reported to be at a different location.) When an institution indicates that all branch campuses are equal, one campus (usually the largest) is designated as the main campus (DMC). (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

LNDGRNT. Indicates whether institution is a landgrant institution or not and whether it is a member of the National Association of Land-Grant Colleges and Universities (NASULGC) or not. The LNDGRNT categories are: Landgrant and Non-Landgrant. The four categories of NASULGC are: NASULGC/Landgrant, NASULGC/Non-Landgrant, All NASULGC, and Non-NASULGC. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format and National Association of State Universities and Land-Grant Colleges, "Members," Washington, D.C., 1986, 27-29.)

Appendix B (Cont'd.).

AAUYR. Indicates whether institution is a member of the American Association of Universities (AAU) or not. "Year" indicates AAU membership and the year of membership; "No" indicates non-membership. (Source: American Association of Universities, Membership Listing, 1982.)

CALNDR. Indicates major calendar system of an institution. Calendar system categories are: Semester, Quarter, Trimester, 4/1/4 (months), and Other (that is, the calendar system is not classifiable by the four designated categories). (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

SEX. Indicates sex designation of the student body: Male, Female, Coed (male and female), or Coordinate (separate colleges for males and females). (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

RACE/ETH. Indicates the predominant race/ethnic designation of the student body. Categories B (Black Non-Hispanic), A/PI (Asian or Pacific Islander), and W (White Non-Hispanic Other) indicate that the designated minority group (B, A/PI, or W) is the predominant race/ethnic group on campus and that the group is 50% or greater of the total enrollment. Category W<50% indicates that the predominant group (White Non-Hispanic Other) is the largest single group, but that it is less than 50% of the total enrollment. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

Quantitative Variables

STDHDCT. Indicates the Fall 1981 total student headcount (undergraduate, first-professional, graduate, and unclassified). Includes both full-time (that is, students whose academic load of course work or other required acitivity is at least 75% of the institution's normal full-time load) and part-time enrolled students. (Source: National Center for Education Statistics.

Appendix B (Cont'd.).

"Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

STDFTE. Indicates the Fall 1981 total full-time equivalent (FTE) students. Includes all full-time students (as defined in STDHDCT above) and part-time students converted into full-time equivalents by one of the following methods: 1) a method already employed in an institution to compute FTE's for some other purpose; 2) summing the credit hours for part-time students and dividing by the normal full-time credit hour load, usually determined by dividing the total number of credits required for completing the program by the number of terms normally required to obtain them (for most institutions, this is 15 credit-hours); or 3) assigning a fractional value of full-time to each part-time student appropriate to the institution, such as, 1/4, 1/3, or 1/2. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

SGHDCT. Indicates the Fall 1981 total graduate student headcount. Graduate students include: (1) first-professional students (that is, students who are enrolled in a professional school or program, such as, medicine, law, or theology, which requires at least two academic years of college work for entrance and a total of at least six years for a degree); (2) all enrolled students who already hold the bachelor's or first-professional degree, or the equivalent, and who are working toward a master's or doctor's degree; and (3) Unclassified post-baccalaureate level students, including, but not limited to, "special" and other students who are not candidates for a degree or other formal award, but who are taking first-professional or graduate courses for credit in regular classes with other students. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

SGHDCTFT. Indicates the Fall 1981 total graduate student headcount (as defined in SGHDCT above), who are full-time (that is, whose academic course load is at least 75% of an institution's normal full-time load). (Source: National Center for Education Statistics.

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"Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

DEGSTOT. Indicates the total number of master's, first-professional, and doctor's degrees conferred between July 1, 1981 and June 30, 1982. (Source: National Center for Education Statistics. "Degrees and Other Formal Awards Conferred Between July 1, 1981 and June 30, 1982," ED Survey, HEGIS XVII.)

DEGSMAS. Indicates the total number of master's degrees conferred between July 1, 1981 and June 30, 1982 in liberal arts and sciences. The degree is customarily granted upon successful completion of at least one, but not more than two, years of work beyond the bachelor's degree. Includes those degrees required in fields, such as Library Science, Hospital Administration, and Social Work and for employment at the professional level, as well as, the Education Specialist degree. (Source: National Center for Education Statistics. "Degrees and Other Formal Awards Conferred Between July 1, 1981 and June 30, 1982," ED Survey, HEGIS XVII.)

DEGSFP. Indicates the total number of first-professional degrees conferred between July 1, 1981 and June 30, 1982 in the following ten National Center for Education Statistics (NCES) recognized fields: Dentistry (D.D.S. or D.M.D.), Medicine (M.D.), Optometry (O.D.), Osteopathic medicine (D.O.), Pharmacy (D.Phar.), Podiatry (Pod.D. or D.P.) or podiatric medicine (D.P.M.), Veterinary medicine (D.V.M.), Chiropractic, (D.C. or D.C.M.), Law (LL.B. or J.D.), and Theology (B.D., M.Div., M.H.L., or other general theological degrees). Such degrees meet the following criteria: 1) signify the completion of the academic requirements to begin practice in the profession; 2) are based on a program which requires at least two years of college work prior to entrance; and 3) require a total of at least six years of college work to complete the program, including prior required college work plus the length of the professional curriculum itself. (Source: National Center for Education Statistics. "Degrees and Other Formal Awards Conferred Between July 1, 1981 and June 30, 1982," ED Survey, HEGIS XVII.)

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DEGSDOC. Indicates the total number of doctor's degrees (for example, Doctor of Education, Doctor of Juridical Science, Doctor of Public Health, and the Ph.D. degree in any field (for example, Agronomy, Food Technology, Education, Engineering, Public Administration, Ophthalmology, and Radiology) conferred between July 1, 1981 and June 30, 1982. (Source: National Center for Education Statistics. "Degrees and Other Formal Awards Conferred Between July 1, 1981 and June 30, 1982," ED Survey, HEGIS XVII.)

FACTOT. Indicates the total number of full-time 1981-82 academic year instructional faculty (that is, faculty whose major regular assignment is instruction), as defined by each institution. Full-time denotes both faculty who teach on a 9-month (that is, two semesters, three quarters, two trimesters, two four-month sessions, or the equivalent) or 12-month (that is, the entire year which usually consists of eleven months of teaching and one month of vacation) basis. Includes faculty who are on released time for research, on sabbatical leave (but, not their replacements), or on leave without pay and chairmen of departments (if they have no other administrative title and hold a faculty rank). Does not include instructional faculty: who are in preclinical and clinical medicine; whose services are valued by bookkeeping entries (rather than by full cash transactions, such as members of religious orders); who are members of military organizations and who are paid on a different salary scale than civilian employees; who are administrative officers (for example, Dean of Instruction, Academic Dean, Dean of Faculty, Dean of Students, Librarian, Registrar, and Coach), even though they may devote part of their time to classroom instruction; or who are undergraduate or graduate students assisting in the instruction of courses (for example, teaching assistants, teaching associates, and teaching fellows). (Source: National Center for Education Statistics. "Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty, 1981-82," Sal. Survey, HEGIS XVI, Unpacked-data not suppressed.)

FACTEN. Indicates the total number of full-time 1981-82 academic year instructional faculty (as defined in FACTOT above) who are tenured. (Source: National Center for Education Statistics. "Salaries, Tenure,

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and Fringe Benefits of Full-Time Instructional Faculty, 1981-82," Sal. Survey, HEGIS XVI, Unpacked-data not suppressed.)

FTENPRF. Indicates the total number of full-time 1981-82 academic year tenured instructional faculty (as defined in FACTEN above) who hold the academic rank of Professor. (Source: National Center for Education Statistics. "Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty, 1981-82," Sal. Survey, HEGIS XVI, Unpacked-data not suppressed.)

FTENASC. Indicates the total number of full-time 1981-82 academic year tenured instructional faculty (as defined in FACTEN above) who hold the academic rank of Associate Professor. (Source: National Center for Education Statistics. "Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty, 1981-82," Sal. Survey, HEGIS XVI, Unpacked-data not suppressed.)

FTENAST. Indicates the total number of full-time 1981-82 academic year tenured instructional faculty (as defined in FACTEN above) who hold the academic rank of Assistant Professor. (Source: National Center for Education Statistics. "Salaries, Tenure, and Fringe Benefits of Full-Time Instructional Faculty, 1981-82," Sal. Survey, HEGIS XVI, Unpacked-data not suppressed.)

COMPPRFA. Indicates the average 1981-82 academic year (9-month) compensation (salary plus benefits) of tenured professors. (Source: American Association of University Professors. "The Annual Report on the Economic Status of the Profession, 1981-82," Academe O, Special Issue, July-August, 1982.)

COMPASCA. Indicates the average 1981-82 academic year (9-month) compensation (salary plus benefits) of tenured Associate Professors. (Source: American Association of University Professors. "The Annual Report on the Economic Status of the Profession, 1981-82," Academe, Special Issue, July-August, 1982.)

COMPASTA. Indicates the average 1981-82 academic year (9-month) compensation (salary plus benefits) of tenured Assistant Professors. (Source: American Association of University Professors. "The Annual

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Report on the Economic Status of the Profession, 1981-82," Academe, Special Issue, July-August, 1982.)

AGE. Indicates the age (in years) of an institution as calculated by subtracting the year an institution was established from the year, 1982. (Source: National Center for Education Statistics. "Fall Enrollment in Institutions of Higher Education, 1981," Fe Survey, HEGIS XVI, in unpacked format.)

AENDOW. Indicates the market value, or, if unavailable, the value assigned by an institution in reporting market values in the annual financial report, of all endowment assets at the end of Fiscal Year 1981-82. Endowment assets are the amounts of gross investments of endowment, term endowment, and quasi-endowment (funds functioning as endowment). (Source: National Center for Education Statistics. "Financial Statistics of Institutions of HigherEducation for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

ABLDG. Indicates the total book value (that is, the dollar amount of value as shown on institutional accounting records) of all buildings owned, rented, or utilized by an institution at the end of Fiscal Year 1981-82. Includes amounts for buildings, not kept on the books of account of the institution, but which are kept in the records of another organization or agency for the institution (for example, when building records of a state school are maintained by a state agency). Does not include building values which are a part of endowment or other capital fund investments in real estate or construction in progress (completed buildings are added when accepted). (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

AEQUIP. Indicates the total book value (that is, the dollar amount of value as shown on institutional accounting records) of all equipment owned, rented, or utilized by an institution at the end of Fiscal Year 1981-82. Includes amounts for equipment, not kept on the books of account of the institution, but which are kept in the records of another organization or agency

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for the institution (for example, when equipment records of a state school are maintained by a state agency). Does not include building values which are a part of endowment or other capital fund investments in real estate. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

ALVOLS. Indicates the total number of library volumes or bookstock held by an institution at the end of Fiscal Year 1981-82. Includes government documents (not in separate collections) and bound periodicals. Does not include microforms. (Source: Association of College & Research Libraries. ACRL University Library Statistics 1981-1982, Chicago, Illinois, 1983.)

ALSUBS. Indicates the total number of titles of current periodical subscriptions held by an institution in Fall 1982. (Source: Association of College & Research Libraries. ACRL University Library Statistics 1981-1982, Chicago, Illinois, 1983.)

RTOT. Indicates all current funds revenues, including all unrestricted gifts and other unrestricted revenues earned during Fiscal Year 1981-82 and restricted current funds (to the extent that such funds were expended for Fiscal Year 1981-82 operating purposes). (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

RGVTGC. Indicates all revenue received (including reimbursable expenditure amounts) during Fiscal Year 1981-82 for specific research projects or other types of programs (for example, training programs and similar activities) from restricted and unrestricted federal, state, and local government grants and contracts. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

RPRVGGC. Indicates all revenue received during Fiscal Year 1981-82 from private restricted and unrestricted gifts, grants, and contracts that are directly related

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to instruction, research, and public service (for example, moneys from a foreign government). Private gifts and grants include revenues from private donors for which no legal consideration is involved. Private contracts include those funds for which specific goods and services must be provided to the funder as stipulation for receipt of the funds. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

RTUITFE. Indicates all revenue earned from tuition and fees assessed against students for Fiscal Year 1981-82 operating purposes. Includes tuition and fee remissions or exemptions, even though there is no intention of collecting them from the student, and tuitions and fees which are remitted to states as an offset to state appropriations. Does not include charges for room, board, and other services rendered by auxiliary enterprises. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

RAPPROP. Indicates all revenue (including revenue received through state channels) received during Fiscal Year 1981-82 from Federal State, and Local government appropriations. Includes all amounts received from or made available to an institution through acts of a legislative body (except grants or contracts) which are for the purpose of meeting current operating expenses and not for specific projects or programs (for example, Federal land-grant appropriations and Federal revenue sharing). (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

EINSTR. Indicates all Fiscal Year 1981-82 unrestricted and restricted current funds expenditures for instruction (that is, for both credit and non-credit activities). Includes expenditures of colleges, schools, departments, and other instructional divisions of an institution and expenditures for departmental research and public service which are not separately budgeted. Examples are expenditures for general academic instruction, occupational and vocational instruction, special session instruction, community education, preparatory and adult basic education, and remedial and tutorial instruction conducted by a teaching faculty for an institution's students. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

EACADSP. Indicates all Fiscal Year 1981-82 unrestricted and restricted current funds expenditures for academic support (that is, for support services that are an integral part of the institution's primary missions of instruction, research, and public service). Includes expenditures for museums, galleries, audio/visual services, academic computing support, ancillary support, academic administration, personnel development, and course and curriculum development. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

EPLNT. Indicates all Fiscal Year 1981-82 unrestricted and restricted current funds expenditures for operation and maintenance of an institution's plant (that is, expenditures for operations established to provide service and maintenance related to campus grounds and facilities used for educational and general purposes). (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

ERES. Indicates all Fiscal Year 1981-82 unrestricted and restricted current funds expenditures for research (that is, expenditures for activities specifically organized to produce research outcomes and commissioned by an agency, either external to an institution, or separately budgeted by an organizational unit within an institution). Does not include research sponsored programs, such as training programs. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for

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Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

ESTDSVC. Indicates all Fiscal Year 1981-82 unrestricted and restricted current funds expenditures for student services. Includes expenditures for admissions, registrar activities, and activities whose primary purpose is to contribute to students' emotional and physical well-being and to their intellectual, cultural, and social development outside the context of the formal instruction program. Examples are career guidance, counseling, financial aid administration, student health services (if not operated as a self-supporting auxiliary enterprise) and the administrative allowance for Pell Grants. (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

ESCHFEL. Indicates all Fiscal Year 1981-82 unrestricted and restricted current funds expenditures for scholarships and fellowships (that is, moneys given in the form of outright grants and trainee stipends to individuals enrolled in formal coursework, either for credit or not). Includes aid to students in the form of tuition or fee remissions and Pell Grants. Excludes remissions granted because of faculty or staff status (which are charged to staff benefits) and College Work Study program expenses (which are reported where the student serves, for example, in the dining halls). (Source: National Center for Education Statistics. "Financial Statistics of Institutions of Higher Education for Fiscal Year Ending 1982," Fin. Survey, HEGIS XVII, Signed Version, Final Tape.)

QARCFAC. Indicates the 1981 faculty quality rating of an institution obtained by aggregating Associated Research Councils (ARC) disciplinary program raw data values. The values are a measure of scholarly competence and achievement based on the following scale:

5 Distinguished
4 Strong
3 Good
2 Adequate

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1 Marginal
0 Not sufficient for doctoral education

(Source: Conference Board of Associated Research Councils. "An Assessment of Quality-Related Characteristics of Research-Doctorate Programs in the United States," Survey of Program Evaluators, Measure 08, Hardcopy of Computer TP 148-150, 1981.)

QARCPRG. Indicates the 1981 program quality rating of an institution obtained by aggregating Associated Research Councils (ARC) disciplinary program effectiveness raw data values. The values are a measure of the effectiveness of a program in educating research scholars/scientists based on the following scale:

3 Extremely effective
2 Reasonably effective
1 Minimally effective
0 Not effective

(Source: Conference Board of Associated Research Councils. "An Assessment of Quality-Related Characteristics of Research-Doctorate Programs in the United States," Survey of Program Evaluators, Measure 09, Hardcopy of Computer TP159-161, 1981.)

QARCN. Indicates the total number of disciplinary programs of an institution rated in the 1981 Associated Research Councils (ARC) study obtained by aggregating the individual disciplinary programs in QARCPRG above.

QGRMNG. Indicates the 1982 Gourman graduate quality rating of an institution based on the following scale:

4.51-4.99 Very Strong
4.01-4.49 Strong
3.61-3.99 Good
3.01-3.59 Acceptable Plus
2.51-2.99 Adequate
2.01-2.49 Marginal
1.01-1.99 Needs to improve

(Source: Gourman, Jack. The Gourman Report: A Rating of Graduate and Professional Programs in American and International Universities, Second Edition (Revised).

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Northridge, California: National Education Standards, 1983).

QGRMNUG. Indicates the 1982 Gourman undergraduate quality rating of an institution based on the following scale:

4.41-4.99	Strong
4.01-4.40	Good
3.51-3.99	Acceptable Plus
3.01-3.50	Adequate
2.01-2.99	Marginal

(Source: Gourman, Jack. The Gourman Report: A Rating of Undergraduate Programs in American and International Universities, Fourth Edition (Revised). Northridge, California: National Education Standards, 1983.)

APPENDIX C

RANKINGS OF THE EIGHT KEY VARIABLES

Appendix C1. Ranking of Full-Time Graduate Student Headcount, 1981-1982

Rank	Doctoral Institution	Number
1.	Minnesota of Minneapolis Saint Paul U of	11687
2.	California-Los Angeles U of	11258
3.	Michigan-Ann Arbor U of	10306
4.	Wisconsin-Madison U of	9058
5.	Ohio State U MC	9043
6.	Harvard U	9024
7.	California-Berkeley U of	8873
8.	Texas at Austin U of	8527
9.	Columbia U Main Division	8275
10.	Pennsylvania U of	7944
11.	New York U	7650
12.	Washington U of	7339
13.	Illinois-Urbana Campus U of	6323
14.	Florida U of	5708
15.	Boston U	5372
16.	Pittsburgh MC U of	5261
17.	Iowa U of	5209
18.	Stanford U	4970
19.	California-Davis U of	4959
20.	Southern California U of	4761
21.	Northwestern U	4714
22.	Michigan State U	4681
23.	Virginia MC U of	4648
24.	Yale U	4614
25.	Wayne State U	4592
26.	Indiana U Bloomington	4560
27.	Temple U	4524
28.	Chicago U of	4440
29.	Massachusetts Institute of Technology	4406
30.	North Carolina at Chapel Hill U of	4355
31.	Georgetown U	4273
32.	Arizona U of	3996
33.	Pennsylvania State U MC	3900
34.	George Washington U	3710
35.	Purdue U MC	3671
36.	Georgia U of	3618
37.	State U of New York at Buffalo MC	3599
38.	Cincinnati MC U of	3584
39.	Texas A&M U MC	3578
40.	Case Western Reserve U	3452
41.	Missouri-Columbia U of	3446
42.	Howard U	3442
43.	Tennessee at Knoxville U of	3429
44.	Duke U	3371
45.	Cornell U Endowed Colleges	3192

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Rank	Doctoral Institution	Number
46.	Louisiana State U & A & M College Baton Rouge	3162
47.	Colorado at Boulder U of	3127
48.	Houston-U Park U of	3126
49.	Arizona State U	3061
50.	Oregon U of	3021
51.	Kansas MC U of	2948
52.	South Carolina at Columbia U of	2891
53.	Tulane U of Louisiana	2870
54.	Connecticut U of	2858
55.	Miami U of	2824
56.	Emory U	2816
57.	Vanderbilt U	2809
58.	Syracuse U MC	2801
59.	Washington U	2798
60.	Maryland College Park Campus U of	2786
61.	Kentucky U of	2783
62.	Florida State U	2700
63.	Louisville U of	2660
64.	Hawaii at Manoa U of	2648
65.	Virginia Polytechnic Institute & State U	2621
66.	Johns Hopkins U	2611
67.	City U of New York Graduate School & U Center	2599
68.	California-Irvine U of	2469
69.	Virginia Commonwealth U	2458
70.	Yeshiva U	2456
71.	Massachusetts Amherst Campus U of	2426
72.	California-San Diego U of	2408
73.	Brigham Young U MC	2406
74.	Rutgers The State U of New Jersey New Brunswick Campus	2377
75.	Iowa State U of Science & Technology	2372
76.	Loyola U of Chicago	2331
77.	Georgia State U	2273
78.	Colorado State U	2271
79.	Alabama in Birmingham U of	2198
80.	Texas Tech U	2179
81.	West Virginia U	2164
82.	Saint Louis U MC	2118
83.	New Mexico MC U of	2084
84.	Rochester U of	2084
85.	Nebraska-Lincoln U of	2082
86.	Oklahoma Norman Campus U of	2078
87.	California-Santa Barbara U of	2077
88.	Missouri-Kansas City U of	2038
89.	Tufts U	2022

Appendix C1 (Cont'd.).

Rank	Doctoral Institution	Number
90.	Utah U of	1976
91.	Washington State U	1972
92.	Boston College	1892
93.	North Texas State U	1818
94.	Fordham U	1810
95.	Oregon State U	1796
96.	American U	1790
97.	Ohio U MC	1784
98.	Catholic U of America	1772
99.	State U of New York at Stony Brook MC	1761
100.	Cornell U Statutory Colleges	1753
101.	Oklahoma State U MC	1745
102.	Pacific U of the	1727
103.	State U of New York at Albany	1693
104.	Alabama The U of	1620
105.	Notre Dame U of	1609
106.	Arkansas MC U of	1549
107.	Akron MC U of	1543
108.	Kansas State U of Agriculture & Applied Science	1531
109.	Kent State U MC	1528
110.	Southern Methodist U	1527
111.	Denver U of	1512
112.	Princeton U	1485
113.	Illinois at Chicago U of	1473
114.	Marquette U	1433
115.	Rensselaer Polytechnic Institute	1353
116.	Southern Illinois U at Carbondale	1347
117.	South Florida U of	1338
118.	Brown U	1331
119.	California-Riverside U of	1325
120.	Wisconsin-Milwaukee U OF	1254
121.	Illinois Institute of Technology	1183
122.	Bowling Green State U MC	1181
123.	State U of New York at Binghamton	1173
124.	North Carolina State U at Raleigh	1167
125.	Detroit U of	1129
126.	Carnegie-Mellon U	1124
127.	Western Michigan U	1124
128.	Delaware U of	1106
129.	Saint John's U	1104
130.	Texas Woman's U	1095
131.	Rice U	1092
132.	Auburn U MC	1088
133.	Rhode Island U of	1079
134.	Toledo U of	1079
135.	Adelphi U	1060

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Rank	Doctoral Institution	Number
136.	Wyoming U of	1032
137.	Mississippi MC U of	993
138.	Memphis State U	949
139.	North Dakota MC U of	930
140.	California Institute of Technology	888
141.	Idaho U of	876
142.	New Mexico State U MC	864
143.	Mississippi State U	833
144.	Texas at Dallas U of	832
145.	United States International U	830
146.	Clemson U	829
147.	Dartmouth College	803
148.	Southern Mississippi U of	803
149.	South Dakota MC U of	786
150.	Miami U Oxford Campus	783
151.	Vermont & State Agricultural College U of	778
152.	Northern Colorado U of	763
153.	Northern Illinois U	698
154.	North Carolina at Greensboro U of	690
155.	Utah State U	685
156.	Ball State U	676
157.	Brandeis U	662
158.	New Hampshire U of	610
159.	Nevada-Reno U of	577
160.	Lehigh U	576
161.	California-Santa Cruz U of	484
162.	New School for Social Research	457
163.	Union for Experimenting Colleges & Universities	433
164.	Illinois State U	389
165.	Claremont Graduate School	386
166.	International College	318
167.	Bryn Mawr College	309
168.	Clark U	279
169.	Drew U	186
170.	Rockefeller U	96
171.	Rand Graduate Institute of Policy Studies	49

Appendix C2. Ranking of Doctor's Degrees Conferred, 1981-1982

Rank	Doctoral Institution	Number
1.	California-Berkeley U of	712
2.	Wisconsin-Madison U of	690
3.	Michigan-Ann Arbor U of	605
4.	Ohio State U MC	586
5.	Illinois-Urbana Campus U of	567
6.	Michigan State U	488
7.	California-Los Angeles U of	481
8.	Stanford U	469
9.	Harvard U	462
10.	Minnesota of Minneapolis Saint Paul U of	459
11.	Indiana U Bloomington	448
12.	New York U	435
13.	Pittsburgh MC U of	426
14.	Texas at Austin U of	418
15.	Massachusetts Institute of Technology	416
16.	Pennsylvania U of	396
17.	Pennsylvania State U MC	389
18.	Purdue U MC	377
19.	Columbia U Main Division	371
20.	Washington U of	368
21.	Southern California U of	365
22.	Maryland College Park Campus U of	364
23.	Chicago U of	349
24.	Rutgers The State U of New Jersey New Brunswick Campus	340
25.	Florida State U	316
26.	Iowa U of	315
27.	Boston U	314
28.	Massachusetts Amherst Campus U of	298
29.	Yale U	292
30.	Northwestern U	287
31.	Georgia U of	282
32.	North Carolina at Chapel Hill U of	280
33.	Arizona U of	270
34.	Vanderbilt U	267
35.	Texas A&M U MC	253
36.	Iowa State U of Science & Technology	249
37.	State U of New York at Buffalo MC	238
38.	Wayne State U	238
39.	Florida U of	237
40.	Temple U	237
41.	Kansas MC U of	236
42.	Tennessee at Knoxville U of	234
43.	Princeton U	230
44.	Missouri-Columbia U of	229
45.	Virginia Polytechnic Institute & State U	227

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Rank	Doctoral Institution	Number
46.	United States International U	226
47.	Colorado at Boulder U of	218
48.	Cornell U Endowed Colleges	217
49.	Oregon U of	215
50.	California-Davis U OF	204
51.	City U of New York Graduate School & U Center	203
52.	Virginia MC U of	202
53.	Nebraska-Lincoln U of	201
54.	North Carolina State U at Raleigh	191
55.	Johns Hopkins U	187
56.	Oklahoma State U MC	187
57.	Duke U	182
58.	Cincinnati MC U of	181
59.	Utah U of	181
60.	Catholic U of America	169
61.	Connecticut U of	168
62.	Cornell U Statutory Colleges	166
63.	Rochester U of	164
64.	George Washington U	163
65.	California-San Diego U of	159
66.	Colorado State U	156
67.	South Carolina at Columbia U of	155
68.	Brigham Young U MC	153
69.	Southern Illinois U at Carbondale	152
70.	Arizona State U	151
71.	Syracuse U MC	151
72.	Washington U	151
73.	State U of New York at Stony Brook MC	150
74.	Kansas State U of Agriculture & Applied Science	148
75.	Case Western Reserve U	144
76.	Washington State U	141
77.	Alabama The U of	139
78.	California-Santa Barbara U of	138
79.	Brown U	137
80.	Kent State U MC	137
81.	North Texas State U	136
82.	Oregon State U	136
83.	Houston-U Park U of	134
84.	West Virginia U	130
85.	Arkansas MC U of	122
86.	Louisiana State U & A & M College Baton Rouge	122
87.	Saint Louis U MC	122
88.	California Institute of Technology	121
89.	Fordham U	121

Appendix C2 (Cont'd.).

Rank	Doctoral Institution	Number
90.	Oklahoma Norman Campus U of	120
91.	Drew U	117
92.	New Mexico MC U of	114
93.	Claremont Graduate School	112
94.	Kentucky U of	112
95.	Hawaii at Manoa U of	111
96.	Northern Colorado U of	111
97.	State U of New York at Albany	111
98.	Georgia State U	106
99.	Delaware U of	105
100.	Union for Experimenting Colleges & Universities	105
101.	Auburn U MC	101
102.	California-Riverside U of	100
103.	Carnegie-Mellon U	99
104.	California-Irvine U of	92
105.	Southern Mississippi U of	92
106.	Miami U of	91
107.	Mississippi State U	91
108.	Texas Tech U	91
109.	Ohio U MC	90
110.	American U	86
111.	Emory U	86
112.	Northern Illinois U	85
113.	Boston College	84
114.	Denver U of	84
115.	Loyola U of Chicago	83
116.	Yeshiva U	82
117.	Rensselaer Polytechnic Institute	81
118.	Mississippi MC U of	80
119.	Brandeis U	76
120.	Rice U	75
121.	Utah State U	74
122.	Georgetown U	72
123.	Notre Dame U of	70
124.	Texas Woman's U	67
125.	Rhode Island U of	65
126.	Wyoming U of	64
127.	Illinois at Chicago U of	61
128.	Virginia Commonwealth U	61
129.	Akron MC U of	60
130.	Bowling Green State U MC	60
131.	International College	60
132.	State U of New York at Binghamton	60
133.	Ball State U	58
134.	North Carolina at Greensboro U of	57
135.	Saint John's U	56

Appendix C2 (Cont'd.).

Rank	Doctoral Institution	Number
136.	Howard U	54
137.	Tulane U of Louisiana	50
138.	Miami U Oxford Campus	46
139.	Idaho U of	44
140.	New School for Social Research	44
141.	Bryn Mawr College	43
142.	California-Santa Cruz U of	43
143.	Memphis State U	43
144.	Southern Methodist U	42
145.	Lehigh U	41
146.	South Florida U of	41
147.	Western Michigan U	41
148.	Toledo U of	40
149.	Illinois Institute of Technology	39
150.	Marquette U	39
151.	Tufts U	38
152.	Adelphi U	37
153.	Louisville U of	35
154.	New Hampshire U of	35
155.	Wisconsin-Milwaukee U OF	35
156.	Clark U	33
157.	Clemson U	33
158.	New Mexico State U MC	31
159.	North Dakota MC U of	31
160.	South Dakota MC U of	31
161.	Texas at Dallas U of	31
162.	Dartmouth College	30
163.	Illinois State U	30
164.	Alabama in Birmingham U of	28
165.	Missouri-Kansas City U of	26
166.	Nevada-Reno U of	24
167.	Vermont & State Agricultural College U of	21
168.	Pacific U of the	20
169.	Detroit U of	19
170.	Rockefeller U	15
171.	Rand Graduate Institute of Policy Studies	1

Appendix C3. Ranking of Full-Time Academic Year Tenured Professors, 1981-1982

Rank	Doctoral Institution	Number
1.	Michigan State U	1091
2.	Illinois-Urbana Campus U of	1011
3.	Wisconsin-Madison U of	888
4.	Michigan-Ann Arbor U of	881
5.	Minnesota of Minneapolis Saint Paul U of	860
6.	California-Berkeley U of	814
7.	Washington U of	781
8.	Ohio State U MC	768
9.	Texas at Austin U of	725
10.	Florida U of	713
11.	California-Los Angeles U of	704
12.	Arizona U of	617
13.	Massachusetts Amherst Campus U of	570
14.	Indiana U Bloomington	556
15.	North Carolina at Chapel Hill U of	536
16.	Purdue U MC	528
17.	Massachusetts Institute of Technology	516
18.	Pennsylvania State U MC	493
19.	Stanford U	489
20.	Pennsylvania U of	488
21.	Colorado at Boulder U of	480
22.	Connecticut U of	478
23.	Harvard U	472
24.	Kansas MC U of	469
25.	Rutgers The State U of New Jersey New Brunswick Campus	466
26.	Nebraska-Lincoln U of	459
27.	Temple U	458
28.	New York U	448
29.	Columbia U Main Division	444
30.	Iowa State U of Science & Technology	441
31.	Iowa U of	427
32.	Georgia U of	425
33.	Chicago U of	419
34.	Hawaii at Manoa U of	413
35.	Louisiana State U & A & M College Baton Rouge	411
36.	Kentucky U of	410
37.	Colorado State U	408
38.	Maryland College Park Campus U of	406
39.	Arizona State U	403
40.	Texas A&M U MC	403
41.	Pittsburgh MC U of	401
42.	Tennessee at Knoxville U of	400
43.	Northwestern U	393
44.	Florida State U	386

Appendix C3 (Cont'd.).

Rank	Doctoral Institution	Number
45.	California-Davis U OF	385
46.	Missouri-Columbia U of	384
47.	Utah U of	380
48.	Cornell U Endowed Colleges	378
49.	Syracuse U MC	374
50.	Yale U	367
51.	Virginia Polytechnic Institute & State U	365
52.	Ball State U	354
53.	Cincinnati MC U of	347
54.	Oklahoma State U MC	337
55.	Wayne State U	337
56.	Northern Illinois U	334
57.	Arkansas MC U of	324
58.	Brigham Young U MC	324
59.	State U of New York at Buffalo MC	324
60.	California-Santa Barbara U of	317
61.	Kansas State U of Agriculture & Applied Science	314
62.	Southern California U of	310
63.	North Carolina State U at Raleigh	306
64.	Houston-U Park U of	304
65.	Princeton U	304
66.	South Florida U of	301
67.	Virginia MC U of	297
68.	Boston U	296
69.	Western Michigan U	290
70.	Washington State U	289
71.	West Virginia U	287
72.	Texas Tech U	284
73.	Rhode Island U of	276
74.	Oklahoma Norman Campus U of	272
75.	Oregon U of	270
76.	Illinois at Chicago U of	269
77.	Brown U	268
78.	Mississippi State U	267
79.	Oregon State U	264
80.	Southern Illinois U at Carbondale	263
81.	State U of New York at Stony Brook MC	262
82.	California-San Diego U of	258
83.	Illinois State U	253
84.	Washington U	253
85.	South Carolina at Columbia U of	251
86.	New Mexico MC U of	248
87.	Ohio U MC	248
88.	Wyoming U of	247
89.	Johns Hopkins U	245
90.	Bowling Green State U MC	244

Appendix C3 (Cont'd.).

Rank	Doctoral Institution	Number
91.	Kent State U MC	244
92.	George Washington U	241
93.	Delaware U of	240
94.	Miami U of	240
95.	Wisconsin-Milwaukee U OF	239
96.	Auburn U MC	237
97.	Clemson U	237
98.	State U of New York at Albany	237
99.	North Texas State U	235
100.	Alabama The U of	234
101.	Georgia State U	218
102.	Louisville U of	217
103.	Vanderbilt U	213
104.	Howard U	209
105.	Case Western Reserve U	206
106.	Northern Colorado U of	201
107.	Rochester U of	201
108.	Miami U Oxford Campus	199
109.	Memphis State U	192
110.	New Mexico State U MC	185
111.	Utah State U	184
112.	Carnegie-Mellon U	181
113.	California Institute of Technology	176
114.	Notre Dame U of	176
115.	Rice U	171
116.	Cornell U Statutory Colleges	169
117.	Lehigh U	169
118.	Missouri-Kansas City U of	169
119.	State U of New York at Binghamton	165
120.	California-Irvine U of	164
121.	Akron MC U of	162
122.	Vermont & State Agricultural College U of	162
123.	Southern Methodist U	161
124.	American U	156
125.	Idaho U of	153
126.	Pacific U of the	152
127.	Rensselaer Polytechnic Institute	152
128.	Dartmouth College	151
129.	Tulane U of Louisiana	149
130.	Saint Louis U MC	147
131.	Emory U	146
132.	New Hampshire U of	143
133.	Virginia Commonwealth U	139
134.	California-Riverside U of	138
135.	Denver U of	137
136.	North Carolina at Greensboro U of	130
137.	California-Santa Cruz U of	127

Appendix C3 (Cont'd.).

Rank	Doctoral Institution	Number
138.	Loyola U of Chicago	123
139.	Mississippi MC\U of	123
140.	Fordham U	122
141.	Brandeis U	121
142.	Saint John's U	119
143.	Alabama in Birmingham U of	118
144.	Georgetown U	118
145.	Boston College	116
146.	North Dakota MC U of	112
147.	Nevada-Reno U of	110
148.	Tufts U	107
149.	Marquette U	103
150.	Southern Mississippi U of	93
151.	Adelphi U	90
152.	Duke U	89
153.	South Dakota MC U of	85
154.	Illinois Institute of Technology	79
155.	Detroit U of	74
156.	Catholic U of America	72
157.	Yeshiva U	61
158.	Texas Woman's U	59
159.	Bryn Mawr College	51
160.	Rockefeller U	51
161.	Texas at Dallas U of	51
162.	Clark U	48
163.	Drew U	46
164.	City U of New York Graduate School & U Center	40
165.	Claremont Graduate School	27
166.	New School for Social Research	20
167.	United States International U	12
168.	Toledo U of	0
169.	Union for Experimenting Colleges & Universities	0
170.	International College	Na
171.	Rand Graduate Institute of Policy Studies	Na

Appendix C4. Ranking of Average Academic Year Compensation of Professors, 1981-1982

Rank	Doctoral Institution	Dollars
1.	Rockefeller U	64000
2.	Harvard U	59200
3.	California Institute of Technology	56500
4.	Stanford U	55300
5.	Massachusetts Institute of Technology	54200
6.	California-Berkeley U of	54000
7.	Pennsylvania U of	53500
8.	California-Los Angeles U of	52800
9.	Columbia U Main Division	52300
10.	Yale U	52300
11.	Johns Hopkins U	52200
12.	City U of New York Graduate School & U Center	52100
13.	Chicago U of	51700
14.	California-San Diego U of	51400
15.	State U of New York at Buffalo MC	51200
16.	Princeton U	51100
17.	State U of New York at Albany	51000
18.	State U of New York at Stony Brook MC	50900
19.	California-Irvine U of	50500
20.	California-Santa Barbara U of	50200
21.	New School for Social Research	50200
22.	California-Davis U of	49800
23.	New York U	49800
24.	State U of New York at Binghamton	49600
25.	California-Riverside U of	49500
26.	Claremont Graduate School	49400
27.	Virginia MC U of	49400
28.	California-Santa Cruz U of	49200
29.	Northwestern U	48900
30.	Southern California U of	48800
31.	Tufts U	48700
32.	Georgetown U	48600
33.	Cornell U Endowed Colleges	48200
34.	Cornell U Statutory Colleges	48200
35.	Lehigh U	48200
36.	Pittsburgh MC U of	48200
37.	Michigan-Ann Arbor U of	48100
38.	Brown U	47300
39.	North Carolina at Chapel Hill U of	47300
40.	Texas A&M U MC	47300
41.	Delaware U of	47100
42.	Dartmouth College	47000
43.	Duke U	46900
44.	Rensselaer Polytechnic Institute	46700
45.	Purdue U MC	46600

Appendix C4 (Cont'd.).

Rank	Doctoral Institution	Dollars
46.	Texas at Austin U of	45600
47.	Ohio State U MC	45400
48.	George Washington U	45100
49.	Connecticut U of	44800
50.	Washington U	44800
51.	Arizona U of	44700
52.	Cincinnati MC U of	44700
53	Houston-U Park U of	44700
54.	Illinois-Urbana Campus U of	44700
55.	Notre Dame U of	44700
56.	Boston College	44500
57.	Case Western Reserve U	44500
58.	North Carolina State U at Raleigh	44400
59.	Texas at Dallas U of	44400
60.	Illinois Institute of Technology	44300
61.	Washington U of	44200
62.	Maryland College Park Campus U of	44100
63.	Rice U	44100
64.	Wayne State U	44000
65.	Clark U	43800
66.	Pennsylvania State U MC	43600
67.	Iowa U of	43500
68.	Syracuse U MC	43500
69.	Vanderbilt U	43400
70.	Arizona State U	43300
71.	Emory U	43200
72.	Michigan State U	43200
73.	North Carolina at Greensboro U of	43200
74.	Temple U	43200
75.	Virginia Polytechnic Institute & State U	43200
76.	Illinois at Chicago U of	43000
77.	Wisconsin-Milwaukee U OF	43000
78.	Utah U of	42900
79.	Wyoming U of	42900
80.	Indiana U Bloomington	42800
81.	Wisconsin-Madison U of	42600
82.	Clemson U	42500
83.	Marquette U	42300
84.	Georgia U of	42000
85.	Oregon U of	41900
86.	Southern Methodist U	41900
87.	American U	41800
88.	South Carolina at Columbia U of	41800
89.	Adelphi U	41700
90.	Minnesota of Minneapolis Saint Paul U of	41700
91.	Boston U	41500
92.	Hawaii at Manoa U of	41500

Appendix C4 (Cont'd.).

Rank	Doctoral Institution	Dollars
93.	Howard U	41400
94.	Alabama in Birmingham U of	41200
95.	Georgia State U	41200
96.	Kentucky U of	41000
97.	Akron MC U of	40900
98.	Louisiana State U & A & M College Baton Rouge	40900
99.	Oklahoma Norman Campus U of	40900
100.	Oregon State U	40900
101.	Drew U	40600
102.	Miami U Oxford Campus	40400
103.	Iowa State U of Science & Technology	40300
104.	Oklahoma State U MC	40100
105.	Auburn U MC	39800
106.	Bowling Green State U MC	39800
107.	Toledo U of	39800
108.	New Mexico State U MC	39700
109.	Louisville U of	39600
110.	Nevada-Reno U of	39400
111.	Tulane U of Louisiana	39400
112.	Washington State U	39400
113.	Bryn Mawr College	39300
114.	New Mexico MC U of	39200
115.	Texas Woman's U	39000
116.	Rhode Island U of	38900
117.	Vermont & State Agricultural College U of	38900
118.	Loyola U of Chicago	38800
119.	North Texas State U	38800
120.	Miami U of	38700
121.	Texas Tech U	38700
122.	New Hampshire U of	38500
123.	Kansas MC U of	38400
124.	Utah State U	38400
125.	Colorado State U	38100
126.	Nebraska-Lincoln U of	38000
127.	Arkansas MC U of	37800
128.	Western Michigan U	37800
129.	Florida U of	37700
130.	Missouri-Columbia U of	37700
131.	Northern Illinois U	37700
132.	Southern Illinois U at Carbondale	37600
133.	West Virginia U	37500
134.	Massachusetts Amherst Campus U of	37300
135.	Pacific U of the	37300
136.	Alabama The U of	37200
137.	Detroit U of	37100

Appendix C4 (Cont'd.).

Rank	Doctoral Institution	Dollars
138.	Florida State U	37100
139.	Colorado at Boulder U of	37000
140.	Missouri-Kansas City U of	37000
141.	North Dakota MC U of	36900
142.	Kansas State U of Agriculture & Applied Science	36800
143.	Ohio U MC	36800
144.	Virginia Commonwealth U	36700
145.	Kent State U MC	36400
146.	Illinois State U	36100
147.	Ball State U	35900
148.	Saint Louis U MC	35900
149.	Idaho U of	35800
150.	Tennessee at Knoxville U of	35800
151.	Mississippi MC U of	35500
152.	South Florida U of	35300
153.	Southern Mississippi U of	34800
154.	Mississippi State U	34400
155.	Memphis State U	33700
156.	Northern Colorado U of	33300
157.	South Dakota MC U of	32300
158.	Brandeis U	Na
159.	Brigham Young U MC	Na
160.	Carnegie-Mellon U	Na
161.	Catholic U of America	Na
162.	Denver U of	Na
163.	Fordham U	Na
164.	International College	Na
165.	Rand Graduate Institute of Policy Studies	Na
166.	Rochester U of	Na
167.	Rutgers The State U of New Jersey New Brunswick Campus	Na
168.	Saint John's U	Na
169.	Union for Experimenting Colleges & Universities	Na
170.	United States International U	Na
171.	Yeshiva U	Na

Appendix C5. Ranking of Library Volume Assets, 1981-1982

Rank	Doctoral Institution	Number
1.	Harvard U	10409228
2.	Yale U	8178741
3.	Michigan-Ann Arbor U of	6561427
4.	Illinois-Urbana Campus U of	6240615
5.	California-Berkeley U of	6117424
6.	California-Los Angeles U of	5269667
7.	Columbia U Main Division	5192448
8.	Texas at Austin U of	4846764
9.	Stanford U	4658033
10.	Chicago U of	4565591
11.	Wisconsin-Madison U of	4184038
12.	Minnesota of Minneapolis Saint Paul U of	3945397
13.	Ohio State U MC	3554217
14.	Cornell U Endowed Colleges	3552452
15.	Princeton U	3430242
16.	Indiana U Bloomington	3403309
17.	Duke U	3106259
18.	Pennsylvania U of	3054234
19.	Washington U of	3035229
20.	North Carolina at Chapel Hill U of	3032509
21.	Northwestern U	2889402
22.	New York U	2698879
23.	Virginia MC U of	2466773
24.	Iowa U of	2412577
25.	Johns Hopkins U	2260219
26.	Florida U of	2231509
27.	Southern California U of	2180580
28.	Georgia U of	2141617
29.	Kansas MC U of	2117187
30.	Missouri-Columbia U of	2117156
31.	Michigan State U	2099099
32.	Pittsburgh MC U of	2026135
33.	Syracuse U MC	2010009
34.	Louisiana State U & A & M College Baton Rouge	1965311
35.	Hawaii at Manoa U of	1947481
36.	Colorado at Boulder U of	1927699
37.	State U of New York at Buffalo MC	1917656
38.	Wayne State U	1904207
39.	Massachusetts Institute of Technology	1869173
40.	Arizona U of	1821120
41.	Brown U	1804982
42.	Southern Illinois U at Carbondale	1792266
43.	Arizona State U	1771204
44.	Washington U	1769409

Appendix C5 (Cont'd.).

Rank	Doctoral Institution	Number
45.	Connecticut U of	1768943
46.	Case Western Reserve U	1764213
47.	Oklahoma Norman Campus U of	1758096
48.	California-Davis U OF	1753214
49.	Temple U	1713890
50.	Pennsylvania State U MC	1691727
51.	Rochester U of	1659076
52.	Tulane U of Louisiana	1624255
53.	Nebraska-Lincoln U of	1602671
54.	Tennessee at Knoxville U of	1585250
55.	Rutgers The State U of New Jersey New Brunswick Campus	1573361
56.	Oregon U of	1540340
57.	Florida State U	1524196
58.	Brigham Young U MC	1521010
59.	Maryland College Park Campus U of	1516990
60.	California-San Diego U of	1507875
61.	Purdue U MC	1503098
62.	Notre Dame U of	1499252
63.	Delaware U of	1495035
64.	Emory U	1492028
65.	Vanderbilt U	1483438
66.	Dartmouth College	1475654
67.	California-Santa Barbara U of	1473308
68.	South Carolina at Columbia U of	1466548
69.	Iowa State U of Science & Technology	1447350
70.	Kent State U MC	1437457
71.	Miami U of	1411297
72.	Massachusetts Amherst Campus U of	1407147
73.	Boston U	1395964
74.	Kentucky U of	1387027
75.	Wisconsin-Milwaukee U of	1362635
76.	North Texas State U	1359044
77.	Fordham U	1349362
78.	Texas A&M U MC	1346181
79.	Georgetown U	1343971
80.	Virginia Polytechnic Institute & State U	1334979
81.	Colorado State U	1315520
82.	Houston-U Park U of	1311174
83.	Oklahoma State U MC	1307732
84.	Washington State U	1304500
85.	Howard U	1242553
86.	Alabama The U of	1220000
87.	Southern Methodist U	1206827
88.	Cincinnati MC U of	1197647
89.	Auburn U MC	1167324

Appendix C5 (Cont'd.).

Rank	Doctoral Institution	Number
90.	State U of New York at Stony Brook MC	1137098
91.	Rice U	1109797
92.	Ball State U	1108663
93.	Catholic U of America	1106381
94.	New Mexico MC U of	1086529
95.	California-Riverside U of	1075123
96.	Northern Illinois U	1070149
97.	Denver U of	1056037
98.	North Carolina State U at Raleigh	1047980
99.	State U of New York at Binghamton	1036440
100.	Texas Tech U	1024816
101.	California-Irvine U of	1023518
102.	Arkansas MC U of	1022665
103.	West Virginia U	1012984
104.	State U of New York at Albany	994901
105.	George Washington U	953485
106.	Oregon State U	938643
107.	Louisville U of	932060
108.	Saint Louis U MC	924665
109.	South Florida U of	922316
110.	Miami U Oxford Campus	921304
111.	Boston College	914804
112.	Illinois State U	912444
113.	Kansas State U of Agriculture & Applied Science	891108
114.	Yeshiva U	884729
115.	Ohio U MC	876794
116.	Western Michigan U	838761
117.	Memphis State U	827557
118.	New Hampshire U of	818949
119.	Vermont & State Agricultural College U of	793771
120.	Illinois at Chicago U of	792239
121.	Lehigh U	772260
122.	Cornell U Statutory Colleges	767786
123.	Loyola U of Chicago	767583
124.	Alabama in Birmingham U of	752269
125.	Wyoming U of	737985
126.	Rhode Island U of	731489
127.	Bowling Green State U MC	710614
128.	Missouri-Kansas City U of	709201
129.	Nevada-Reno U of	705533
130.	New Mexico State U MC	701960
131.	Saint John's U	700884
132.	Marquette U	699801
133.	Georgia State U	698305
134.	California-Santa Cruz U of	678725

Appendix C5 (Cont'd.).

Rank	Doctoral Institution	Number
135.	Brandeis U	674290
136.	Mississippi State U	651560
137.	Utah State U	638100
138.	Virginia Commonwealth U	634426
139.	Idaho U of	625833
140.	Tufts U	619616
141.	North Dakota MC U of	615527
142.	North Carolina at Greensboro U of	612448
143.	Bryn Mawr College	585878
144.	Toledo U of	572580
145.	Texas Woman's U	566260
146.	Mississippi MC U of	565485
147.	Clemson U	560906
148.	Southern Mississippi U of	548660
149.	American U	531610
150.	South Dakota MC U of	490146
151.	Detroit U of	466224
152.	Northern Colorado U of	447681
153.	Clark U	410365
154.	Drew U	407924
155.	Adelphi U	391230
156.	Pacific U of the	362115
157.	California Institute of Technology	354701
158.	Rand Graduate Institute of Policy Studies	332076
159.	Texas at Dallas U of	328366
160.	Rensselaer Polytechnic Institute	310408
161.	Carnegie-Mellon U	289340
162.	Rockefeller U	203149
163.	Illinois Institute of Technology	189441
164.	United States International U	188656
165.	City U of New York Graduate School & U Center	159780
166.	New School for Social Research	129191
167.	International College	0
168.	Union for Experimenting Colleges & Universities	0
169.	Akron MC U of	Na
170.	Claremont Graduate School	Na
171.	Utah U of	Na

Appendix C6. Ranking of Total Current Funds Revenues, 1981-1982

Rank	Doctoral Institution	Dollars
1.	California-Los Angeles U of	795389490
2.	Minnesota of Minneapolis Saint Paul U of	702562675
3.	Chicago U of	669122303
4.	Stanford U	637860000
5.	Michigan-Ann Arbor U of	635852614
6.	Ohio State U MC	576512493
7.	Pennsylvania U of	575318366
8.	New York U	544241000
9.	Wisconsin-Madison U of	539904563
10.	Massachusetts Institute of Technology	518676000
11.	Harvard U	493428000
12.	California Institute of Technology	479576046
13.	Johns Hopkins U	474006032
14.	Washington U of	456676704
15.	Florida U of	425258388
16.	California-Davis U OF	418465327
17.	California-Berkeley U of	416522001
18.	California-San Diego U of	407284207
19.	Illinois-Urbana Campus U of	405449002
20.	Columbia U Main Division	404077000
21.	Texas A&M U MC	402017439
22.	Texas at Austin U of	394228505
23.	Michigan State U	393754741
24.	Iowa U of	387337170
25.	Arizona U of	366986125
26.	Pennsylvania State U MC	353808845
27.	North Carolina at Chapel Hill U of	350840263
28.	Southern California U of	348836576
29.	Cincinnati MC U of	334741344
30.	Yale U	334634495
31.	Temple U	325844142
32.	Alabama in Birmingham U of	316079127
33.	Virginia MC U of	309102851
34.	Rochester U of	304114634
35.	Purdue U MC	300909443
36.	Kentucky U of	294236639
37.	Pittsburgh MC U of	291733894
38.	Emory U	289359269
39.	Missouri-Columbia U of	288693287
40.	Indiana U Bloomington	283232312
41.	Virginia Commonwealth U	282029139
42.	Iowa State U of Science & Technology	277933206
43.	California-Irvine U of	272505613
44.	Utah U of	270641617
45.	Howard U	268563312

Appendix C6 (Cont'd.).

Rank	Doctoral Institution	Dollars
46.	Duke U	264971286
47.	Georgetown U	261132000
48.	Vanderbilt U	254998971
49.	Washington U	254569513
50.	Boston U	253568042
51.	Princeton U	253299000
52.	Georgia U of	252897365
53.	Miami U of	252320504
54.	Louisiana State U & A & M College Baton Rouge	247692606
55.	George Washington U	245485739
56.	Cornell U Endowed Colleges	243722703
57.	Maryland College Park Campus U of	240861332
58.	Northwestern U	232813055
59.	Rutgers The State U of New Jersey New Brunswick Campus	221694150
60.	Virginia Polytechnic Institute & State U	212951941
61.	West Virginia U	212031000
62.	North Carolina State U at Raleigh	205562743
63.	Loyola U of Chicago	203109444
64.	Wayne State U	200309978
65.	Massachusetts Amherst Campus U of	198727610
66.	Arizona State U	197206121
67.	Hawaii at Manoa U of	188856712
68.	Syracuse U MC	184734875
69.	State U of New York at Buffalo MC	183061844
70.	Nebraska-Lincoln U of	181705444
71.	Oklahoma Norman Campus U of	180591508
72.	Tennessee at Knoxville U of	178291108
73.	Washington State U	176798279
74.	Colorado at Boulder U of	175560022
75.	Southern Illinois U at Carbondale	174797269
76.	Tulane U of Louisiana	174779809
77.	State U of New York at Stony Brook MC	174178136
78.	Colorado State U	172009070
79.	Yeshiva U	168241818
80.	Oregon State U	166187124
81.	Oklahoma State U MC	165093734
82.	Connecticut U of	158592794
83.	Auburn U MC	155838826
84.	California-Santa Barbara U of	153039268
85.	Houston-U Park U of	152566799
86.	Delaware U of	152209779
87.	Saint Louis U MC	146074379
88.	Louisville U of	142897733

Appendix C6 (Cont'd.).

Rank	Doctoral Institution	Dollars
89.	Kansas State U of Agriculture & Applied Science	142185472
90.	South Carolina at Columbia U of	139865985
91.	South Florida U of	139645517
92.	Case Western Reserve U	138392430
93.	Florida State U	138350645
94.	Cornell U Statutory Colleges	135082031
95.	Texas Tech U	134048050
96.	Mississippi State U	133548759
97.	Kansas MC U of	133505798
98.	Clemson U	133327342
99.	Brigham Young U MC	131243832
100.	New Mexico MC U of	130561047
101.	New Mexico State U MC	123510626
102.	Arkansas MC U of	122733171
103.	Notre Dame U of	120322619
104.	Northern Illinois U	119667836
105.	Wisconsin-Milwaukee U OF	113196840
106.	Alabama The U of	113190257
107.	Tufts U	112477170
108.	Brown U	112292258
109.	Dartmouth College	111972000
110.	State U of New York at Albany	111116957
111.	Vermont & State Agricultural College U of	110824000
112.	Rhode Island U of	110718927
113.	Illinois at Chicago U of	107850427
114.	Western Michigan U	106501000
115.	Carnegie-Mellon U	106413046
116.	Utah State U	104752034
117.	Boston College	103582802
118.	Kent State U MC	101682910
119.	Oregon U of	101250582
120.	Ball State U	99749410
121.	Ohio U MC	99451854
122.	New Hampshire U of	98344426
123.	Bowling Green State U MC	98057585
124.	Illinois State U	98010591
125.	North Dakota MC U of	94138844
126.	Miami U Oxford Campus	93407683
127.	North Texas State U	92597361
128.	California-Riverside U of	91811562
129.	Akron MC U of	84319136
130.	Wyoming U of	83184773
131.	Rensselaer Polytechnic Institute	83005000
132.	Southern Methodist U	82878846
133.	Idaho U of	79820381

Appendix C6 (Cont'd.).

Rank	Doctoral Institution	Dollars
134.	California-Santa Cruz U of	78857017
135.	Georgia State U	74912188
136.	Memphis State U	74898392
137.	Denver U of	74693259
138.	State U of New York at Binghamton	74142676
139.	Toledo U of	73188492
140.	Marquette U	73063795
141.	Lehigh U	71211751
142.	Rice U	69355000
143.	Nevada-Reno U of	69295161
144.	American U	68553000
145.	Missouri-Kansas City U of	68048403
146.	Mississippi MC U of	67885038
147.	Southern Mississippi U of	66885675
148.	Brandeis U	65659138
149.	Saint John's U	65498278
150.	Rockefeller U	65466664
151.	Fordham U	63027312
152.	Pacific U of the	58034000
153.	Adelphi U	55331406
154.	Northern Colorado U of	54957776
155.	Catholic U of America	52950898
156.	North Carolina at Greensboro U of	51616526
157.	Illinois Institute of Technology	50561233
158.	Texas Woman's U	45043741
159.	Texas at Dallas U of	39878601
160.	Detroit U of	39098931
161.	South Dakota MC U of	38118830
162.	City U of New York Graduate School & U Center	31380065
163.	Bryn Mawr College	25288590
164.	Clark U	25027271
165.	New School for Social Research	21800534
166.	Drew U	20786355
167.	United States International U	12931230
168.	Claremont Graduate School	9283093
169.	Union for Experimenting Colleges & Universities	2747036
170.	International College	1853818
171.	Rand Graduate Institute of Policy Studies	311390

Appendix C7. Ranking of Expenditures for Instruction, 1981-1982

Rank	Doctoral Institution	Dollars
1.	California-Los Angeles U of	212170941
2.	Minnesota of Minneapolis Saint Paul U of	192442210
3.	Ohio State U MC	165177565
4.	Columbia U Main Division	162370000
5.	Michigan-Ann Arbor U of	156514778
6.	New York U	154905000
7.	Florida U of	152186062
8.	Southern California U of	146086724
9.	Washington U of	144208416
10.	California-Berkeley U of	138886045
11.	Michigan State U	133108720
12.	Harvard U	131079000
13.	Wisconsin-Madison U of	130986641
14.	Johns Hopkins U	126935550
15.	North Carolina at Chapel Hill U of	119731369
16.	Texas at Austin U of	119347034
17.	Washington U	111437461
18.	Yale U	110685499
19.	Pennsylvania U of	109912476
20.	Texas A&M U MC	105003734
21.	California-Davis U OF	104010895
22.	Illinois-Urbana Campus U of	101326891
23.	Chicago U of	101134205
24.	Purdue U MC	100669919
25.	Temple U	98963451
26.	Pennsylvania State U MC	98574751
27.	Stanford U	96809000
28.	Northwestern U	95810293
29.	Pittsburgh MC U of	95294737
30.	Iowa U of	94261346
31.	Arizona U of	92933533
32.	Cincinnati MC U of	88049313
33.	Indiana U Bloomington	86250361
34.	Wayne State U	84203125
35.	Boston U	81145775
36.	California-San Diego U of	78921097
37.	State U of New York at Buffalo MC	78768450
38.	Rutgers The State U of New Jersey New Brunswick Campus	78603237
39.	Maryland College Park Campus U of	77572018
40.	Missouri-Columbia U of	75914837
41.	Kentucky U of	75315000
42.	Howard U	75189783
43.	Georgia U of	75101226
44.	Arizona State U	74617009

Appendix C7 (Cont'd.).

Rank	Doctoral Institution	Dollars
45.	Miami U of	74586995
46.	Southern Illinois U at Carbondale	73446795
47.	Alabama in Birmingham U of	72595348
48.	Virginia Polytechnic Institute & State U	65550742
49.	California-Irvine U of	65163705
50.	Tennessee at Knoxville U of	64694380
51.	Cornell U Endowed Colleges	63833103
52.	Massachusetts Institute of Technology	63749000
53.	Hawaii at Manoa U of	62629657
54.	State U of New York at Stony Brook MC	62445214
55.	Iowa State U of Science & Technology	62345535
56.	Utah U of	62328238
57.	South Florida U of	61819093
58.	Virginia MC U of	60846869
59.	Delaware U of	60836906
60.	Virginia Commonwealth U	60830000
61.	Syracuse U MC	60443083
62.	North Carolina State U at Raleigh	57582663
63.	Massachusetts Amherst Campus U of	57334365
64.	Emory U	57113853
65.	Florida State U	56683308
66.	South Carolina at Columbia U of	56311136
67.	Duke U	55748144
68.	Houston-U Park U of	55700247
69.	Georgetown U	55053000
70.	Louisiana State U & A & M College Baton Rouge	54706389
71.	Rochester U of	51868690
72.	Colorado at Boulder U of	51694259
73.	George Washington U	51413011
74.	Louisville U of	51193329
75.	West Virginia U	50982000
76.	California-Santa Barbara U of	50382144
77.	Nebraska-Lincoln U of	49917707
78.	Kansas MC U of	49582696
79.	Wisconsin-Milwaukee U of	49345252
80.	Case Western Reserve U	49143223
81.	Colorado State U	49095957
82.	Connecticut U of	48689377
83.	Tulane U of Louisiana	48526971
84.	Brigham Young U MC	46557551
85.	Washington State U	46464081
86.	State U of New York at Albany	44876279
87.	Oklahoma Norman Campus U of	44868771
88.	Auburn U MC	44346043
89.	Alabama The U of	43794644

Appendix C7 (Cont'd.).

Rank	Doctoral Institution	Dollars
90.	Oklahoma State U MC	42728893
91.	Oregon State U	42463879
92.	Loyola U of Chicago	42165728
93.	Northern Illinois U	41603527
94.	Ohio U MC	41261318
95.	Saint Louis U MC	40950589
96.	Kansas State U of Agriculture & Applied Science	39336107
97.	Western Michigan U	39194000
98.	New Mexico MC U of	38596779
99.	Yeshiva U	37714506
100.	Bowling Green State U MC	37630422
101.	Akron MC U of	37548300
102.	Georgia State U	37509695
103.	Wyoming U of	37409646
104.	Oregon U of	37098897
105.	Illinois at Chicago U of	36165010
106.	Ball State U	36094894
107.	North Dakota MC U of	35897766
108.	Kent State U MC	35653836
109.	Texas Tech U	35623557
110.	North Texas State U	35607583
111.	Princeton U	35362425
112.	Boston College	35251363
113.	Miami U Oxford Campus	34968247
114.	Clemson U	34437196
115.	Memphis State U	34110761
116.	Toledo U of	33118002
117.	Illinois State U	32943751
118.	Tufts U	32879283
119.	Brown U	32653876
120.	Vanderbilt U	32530081
121.	Notre Dame U of	32322096
122.	Vermont & State Agricultural College U of	31918000
123.	Rhode Island U of	31451097
124.	California Institute of Technology	31426175
125.	Dartmouth College	31011000
126.	Missouri-Kansas City U of	30934823
127.	Carnegie-Mellon U	30901271
128.	State U of New York at Binghamton	30191312
129.	Cornell U Statutory Colleges	29377255
130.	Arkansas MC U of	28176306
131.	Adelphi U	27271418
132.	Southern Mississippi U of	27123286
133.	Mississippi State U	26157840
134.	Saint John's U	25819206

Appendix C7 (Cont'd.).

Rank	Doctoral Institution	Dollars
135.	California-Santa Cruz U of	25739335
136.	California-Riverside U of	25475726
137.	New Mexico State U MC	24996222
138.	American U	24995000
139.	Utah State U	24876938
140.	Rensselaer Polytechnic Institute	24574000
141.	Marquette U	24071678
142.	Denver U of	23679654
143.	Fordham U	23317714
144.	Southern Methodist U	23273081
145.	New Hampshire U of	23224286
146.	North Carolina at Greensboro U of	22916272
147.	Pacific U of the	22349000
148.	Idaho U of	22320909
149.	Rice U	21339000
150.	Nevada-Reno U of	20300771
151.	Mississippi MC U of	20186283
152.	Catholic U of America	20049796
153.	Northern Colorado U of	20015585
154.	Texas Woman's U	19950358
155.	City U of New York Graduate School & U Center	19559702
156.	Lehigh U	18148998
157.	Brandeis U	17692335
158.	Texas at Dallas U of	15821292
159.	Illinois Institute of Technology	14077221
160.	South Dakota MC U of	13081969
161.	Detroit U of	12304707
162.	New School for Social Research	9147902
163.	Clark U	8781882
164.	Bryn Mawr College	7264395
165.	Drew U	4701627
166.	Claremont Graduate School	4263134
167.	United States International U	3314818
168.	Rockefeller U	1091233
169.	Union for Experimenting Colleges & Universities	833849
170.	International College	782948
171.	Rand Graduate Institute of Policy Studies	202404

Appendix C8. Ranking of Faculty Quality Rating, 1981-1982

Rank	Doctoral Institution	Points
1.	California-Berkeley U of	15890
2.	Stanford U	13732
3.	Wisconsin-Madison U of	12511
4.	Yale U	12475
5.	Chicago U of	12319
6.	California-Los Angeles U of	12245
7.	Illinois-Urbana Campus U of	12208
8.	Minnesota of Minneapolis Saint Paul U of	11941
9.	Michigan-Ann Arbor U of	11360
10.	Cornell U Endowed & Statutory Colleges	11329*
11.	Princeton U	10858
12.	Washington U of	10663
13.	Columbia U Main Division	10601
14.	Harvard U	10576
15.	Pennsylvania U of	10537
16.	Ohio State U MC	10466
17.	Texas at Austin U of	10323
18.	North Carolina at Chapel Hill U of	9509
19.	Northwestern U	8948
20.	Pittsburgh MC U of	8821
21.	Indiana U Bloomington	8631
22.	Pennsylvania State U MC	8625
23.	Rutgers The State U of New Jersey New Brunswick Campus	8019
24.	Johns Hopkins U	7992
25.	Massachusetts Institute of Technology	7925
26.	Brown U	7867
27.	California-Davis U OF	7750
28.	California-San Diego U of	7701
29.	Michigan State U	7631
30.	Virginia MC U of	7583
31.	Duke U	7422
32.	Iowa U of	7358
33.	Massachusetts Amherst Campus U of	7208
34.	Kansas MC U of	7074
35.	State U of New York at Buffalo MC	7062
36.	Southern California U of	7060
37.	Washington U	7059
38.	Maryland College Park Campus U of	6968
39.	Arizona U of	6794
40.	New York U	6758
41.	Colorado at Boulder U of	6505
42.	Connecticut U of	6307
43.	Rochester U of	6257
44.	Purdue U MC	6242
45.	Oregon U of	6142

Appendix C8 (Cont'd.).

Rank	Doctoral Institution	Points
46.	City U of New York Graduate School & U Center	6102
47.	Vanderbilt U	6036
48.	California-Santa barbara U of	5981
49.	Florida U of	5743
50.	Kentucky U of	5671
51.	Iowa State U of Science & Technology	5625
52.	Missouri-Columbia U of	5618
53.	California-Irvine U of	5612
54.	Syracuse U MC	5505
55.	Boston U	5290
56.	Rice U	5087
57.	State U of New York at Stony Brook MC	5053
58.	Oklahoma Norman Campus U of	4866
59.	Cincinnati MC U of	4680
60.	California Institute of Technology	4589
61.	Texas A&M U MC	4534
62.	Tennessee at Knoxville U of	4518
63.	Georgia U of	4504
64.	Utah U of	4474
65.	North Carolina State U at Raleigh	4459
66.	Case Western Reserve U	4435
67.	Virginia Polytechnic Institute & State U	4190
68.	Hawaii at Manoa U of	4177
69.	Florida State U	4080
70.	Carnegie-Mellon U	4054
71.	Tulane U of Louisiana	4026
72.	California-Riverside U of	4021
73.	Nebraska-Lincoln U of	3923
74.	Wayne State U	3866
75.	Notre Dame U of	3808
76.	Brandeis U	3792
77.	Oregon State U	3596
78.	Colorado State U	3464
79.	Louisiana State U & A & M College Baton Rouge	3426
80.	Oklahoma State U MC	3330
81.	Temple U	3156
82.	Washington State U	3132
83.	Delaware U of	3126
84.	State U of New York at Albany	2928
85.	New Mexico MC U of	2840
86.	Houston-U Park U of	2721
87.	Emory U	2618
88.	Rensselaer Polytechnic Institute	2608
89.	Kansas State U of Agriculture & Applied Science	2527

Appendix C8 (Cont'd.).

Rank	Doctoral Institution	Points
90.	Southern Illinois U at Carbondale	2489
91.	Catholic U of America	2483
92.	Arizona State U	2444
93.	Bryn Mawr College	2444
94.	Illinois at Chicago U of	2404
95.	West Virginia U	2342
96.	Wisconsin-Milwaukee U of	2291
97.	State U of New York at Binghamton	2288
98.	Rockefeller U	2248
99.	Auburn U MC	2192
100.	Georgetown U	2130
101.	Miami U of	2085
102.	Rhode Island U of	2021
103.	Claremont Graduate School	1937
104.	South Carolina at Columbia U of	1764
105.	Illinois Institute of Technology	1614
106.	George Washington U	1600
107.	Kent State U MC	1592
108.	Loyola U of Chicago	1565
109.	Texas Tech U	1539
110.	Saint Louis U MC	1494
111.	New Hampshire U of	1418
112.	Clemson U	1366
113.	Tufts U	1354
114.	Southern Methodist U	1341
115.	Lehigh U	1276
116.	Fordham U	1266
117.	Brigham Young U MC	1226
118.	Denver U of	1201
119.	Wyoming U of	1198
120.	Miami U Oxford Campus	1191
121.	Ohio U MC	1140
122.	Virginia Commonwealth U	1121
123.	Louisville U of	1117
124.	Utah State U	1106
125.	Boston College	1094
126.	North Dakota MC U of	1076
127.	Howard U	997
128.	North Texas State U	986
129.	American U	978
130.	Alabama in Birmingham U of	964
131.	New School for Social Research	950
132.	South Florida U of	939
133.	Vermont & State Agricultural College U of	923
134.	Bowling Green State U MC	799
135.	Clark U	792
136.	Akron MC U of	778

Appendix C8 (Cont'd.).

Rank	Doctoral Institution	Points
137.	California-Santa Cruz U of	778
138.	Northern Illinois U	754
139.	Dartmouth College	719
140.	Arkansas MC U of	706
141.	Texas at Dallas U of	688
142.	Alabama The U of	666
143.	Marquette U	660
144.	Idaho U of	619
145.	Mississippi State U	592
146.	Western Michigan U	519
147.	Georgia State U	374
148.	Mississippi MC U of	318
149.	Ball State U	299
150.	Toledo U of	292
151.	Missouri-Kansas City U of	277
152.	South Dakota MC U of	273
153.	Adelphi U	216
154.	North Carolina at Greensboro U of	208
155.	Southern Mississippi U of	163
156.	Yeshiva U	158
157.	Nevada-Reno U of	91
158.	Detroit U of	84
159.	Northern Colorado U of	81
160.	Texas Woman's U	64
161.	New Mexico State U MC	0
162.	Drew U	Na
163.	Illinois State U	Na
164.	International College	Na
165.	Memphis State U	Na
166.	Pacific U of the	Na
167.	Rand Graduate Institute of Policy Studies	Na
168.	Saint John's U	Na
169.	Union for Experimenting Colleges & Universities	Na
170.	United States International U	Na

* Cornell U Endowed Colleges and Cornell U Statutory Colleges were not separately rated in the ARC Study. Therefore, they are shown combined in the ARC faculty quality rating.

APPENDIX D

OTHER PROFILES OF INTEREST

Appendix D. Other Profiles of Interest

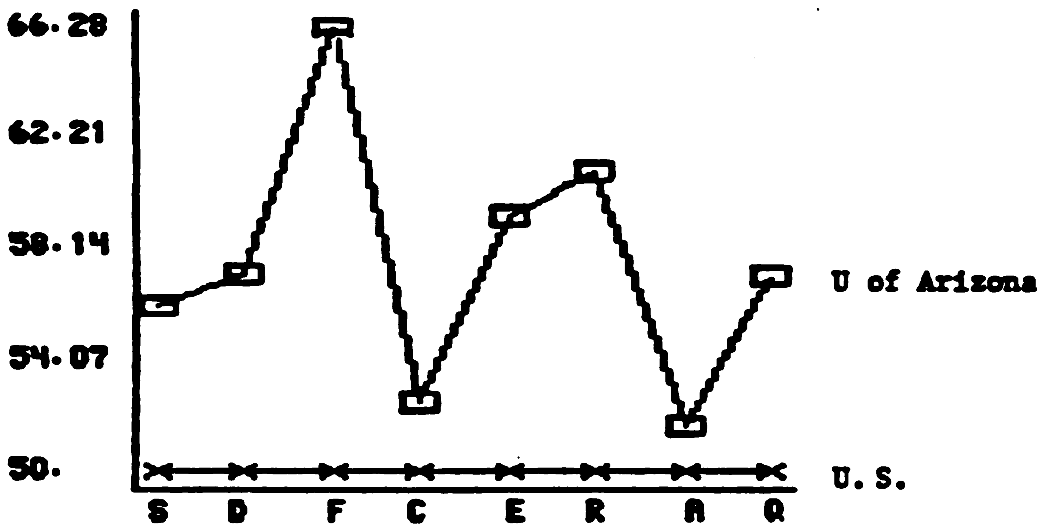

Figure 13. Profile of the University of Arizona and the United States Average Doctoral Institution, 1981-1982

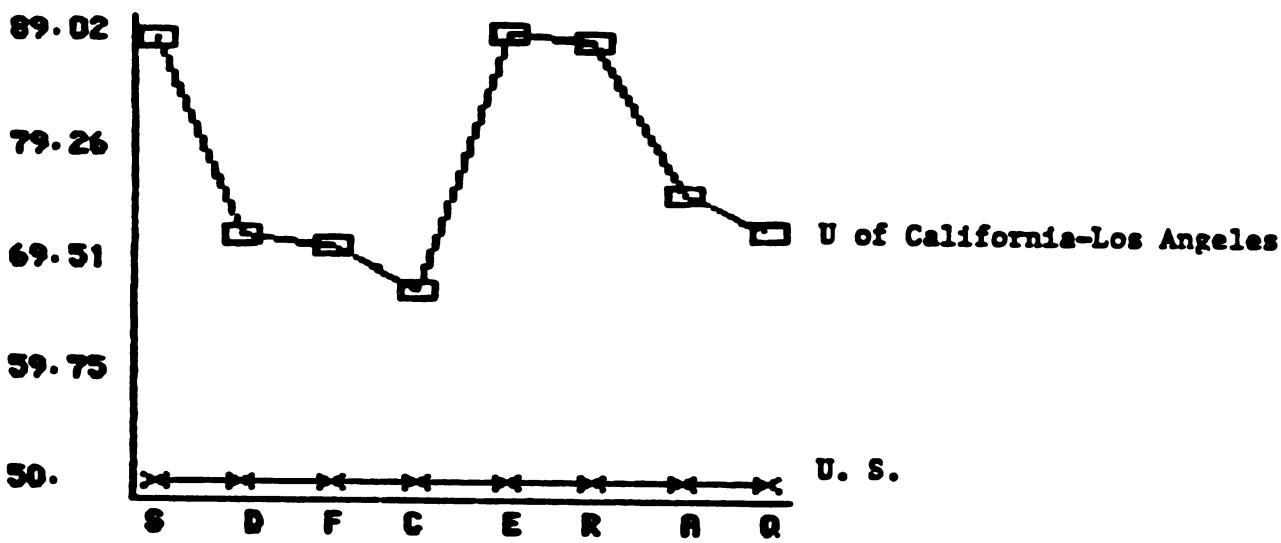

Figure 14. Profile of the University of California-Los Angeles and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

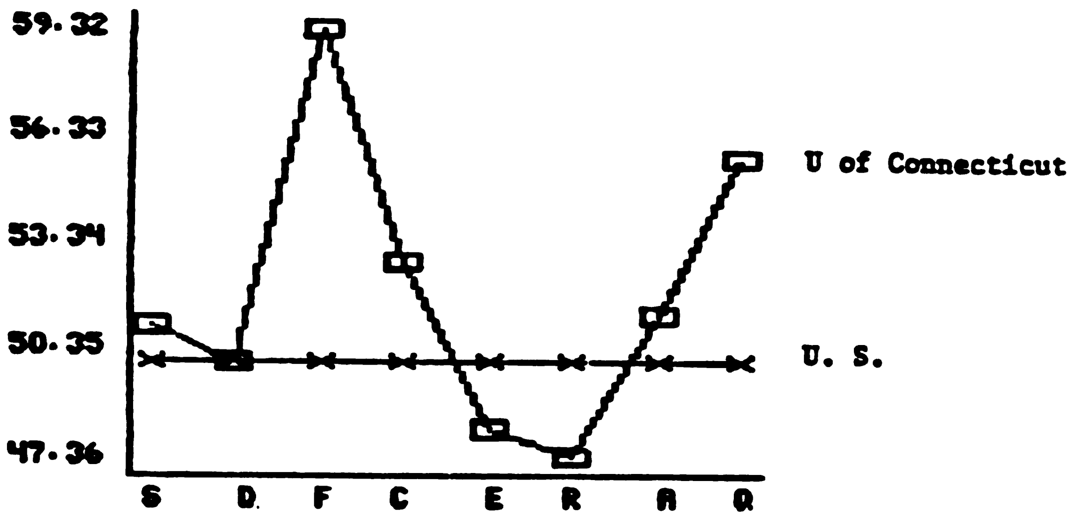

Figure 15. Profile of the University of Connecticut and the United States Average Doctoral Institution, 1981-1982

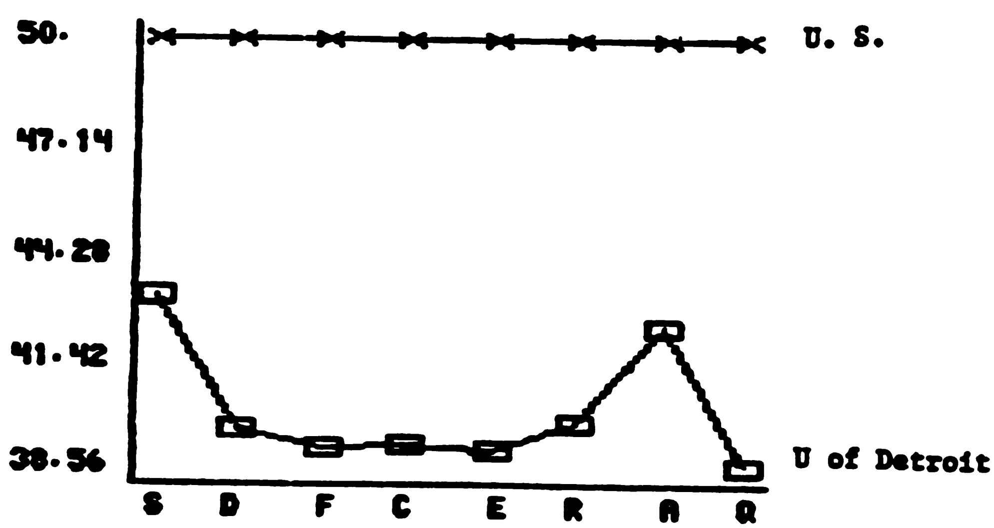

Figure 16. Profile of the University of Detroit and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

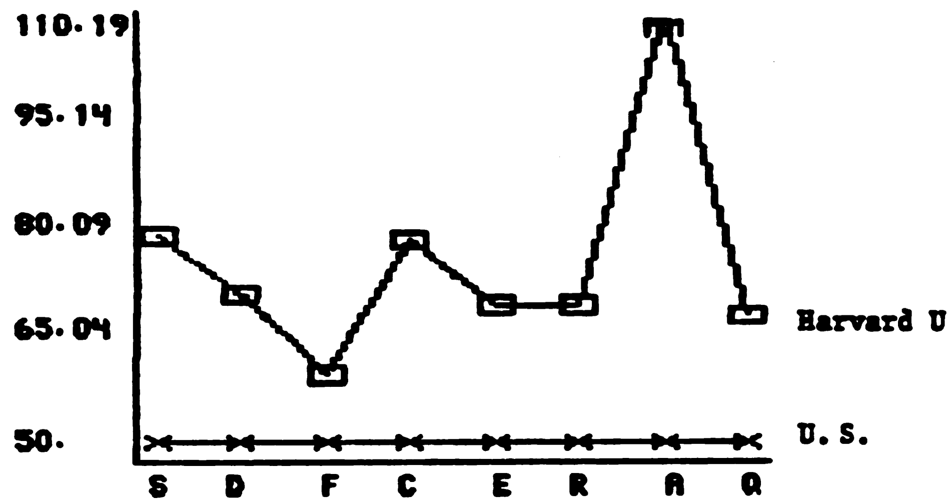

Figure 17. Profile of Harvard University and the United States Average Doctoral Institution, 1981-1982

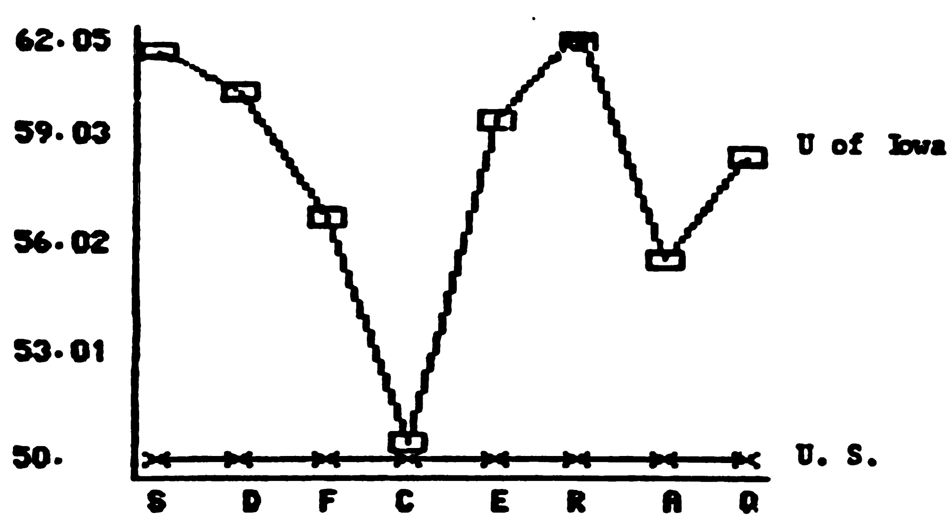

Figure 18. Profile of the University of Iowa and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

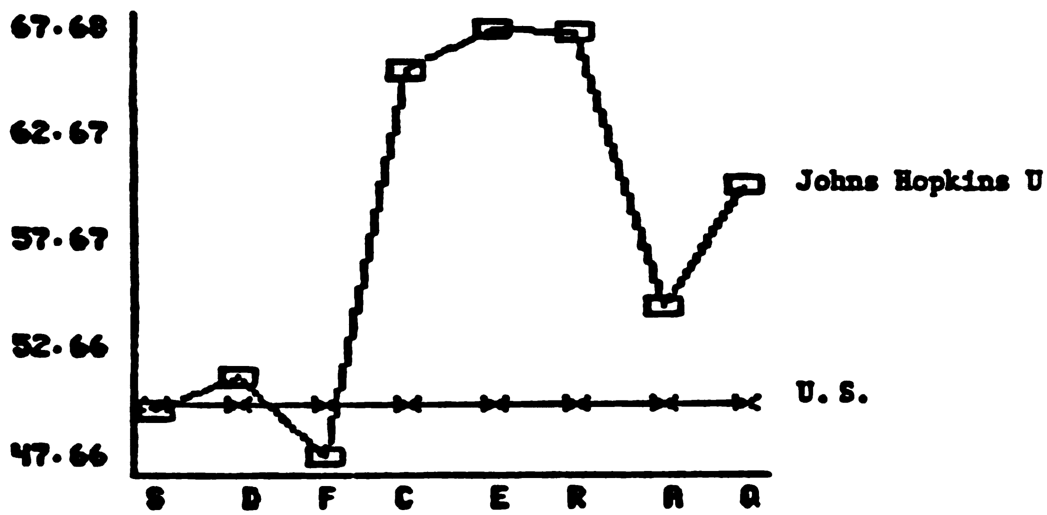

Figure 19. Profile of Johns Hopkins University and the United States Average Doctoral Institution, 1981-1982

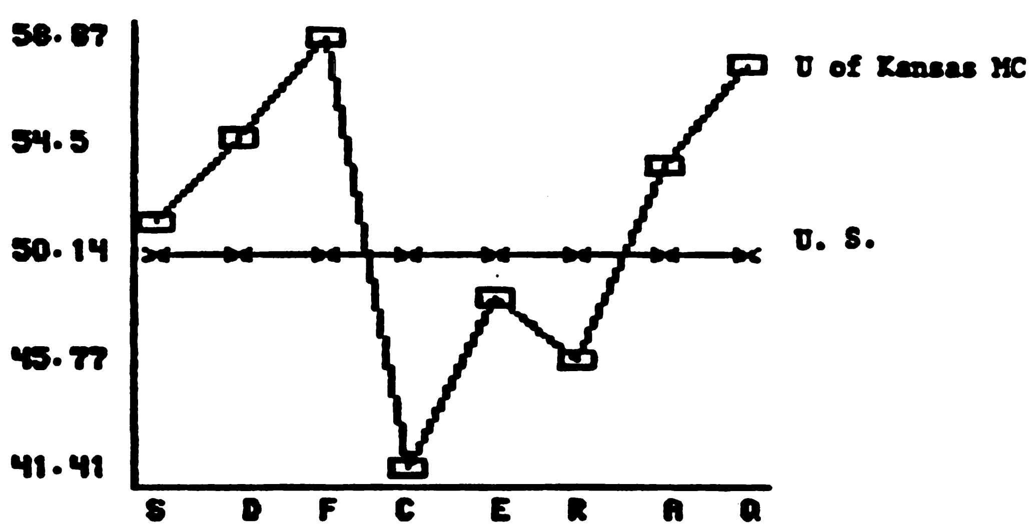

Figure 20. Profile of the University of Kansas MC and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

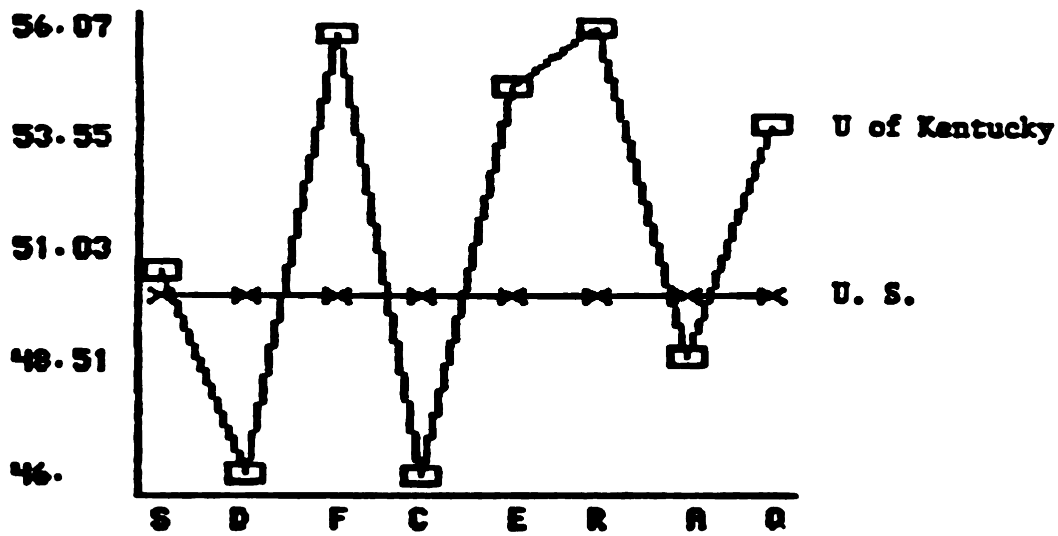

Figure 21. Profile of the University of Kentucky and the United States Average Doctoral Institution, 1981-1982

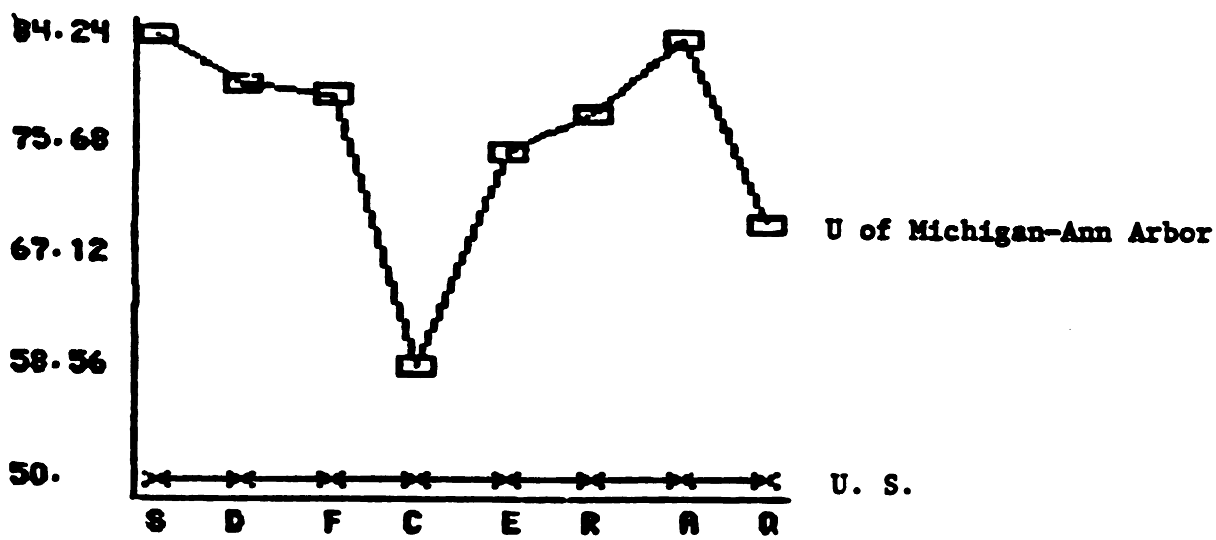

Figure 22. Profile of the University of Michigan-Ann Arbor and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

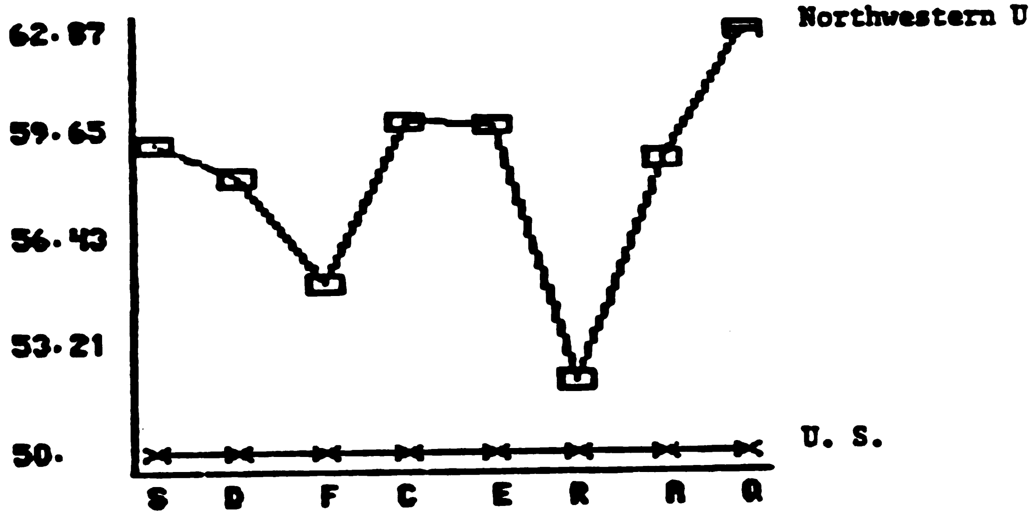

Figure 23. Profile of Northwestern University and the United States Average Doctoral Institution, 1981-1982

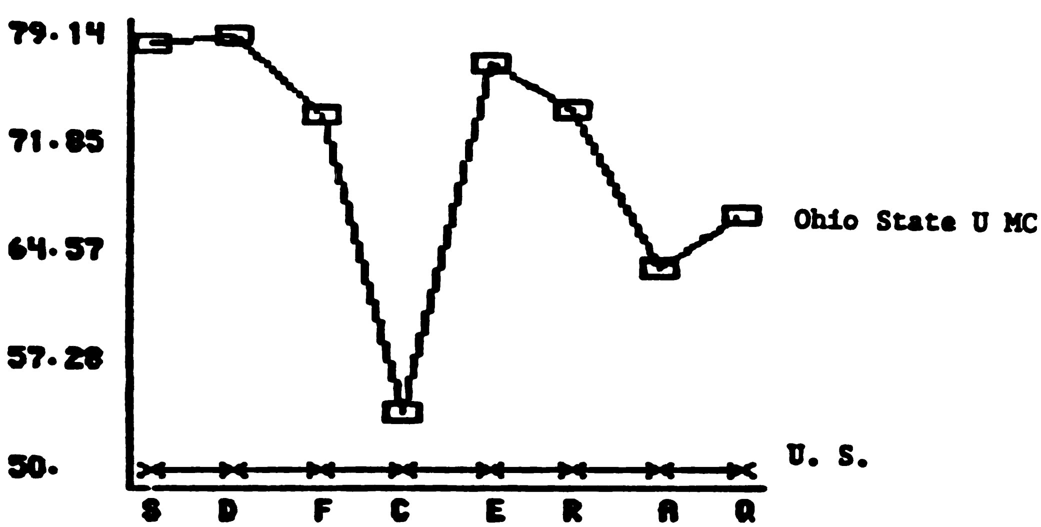

Figure 24. Profile of Ohio State University MC and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

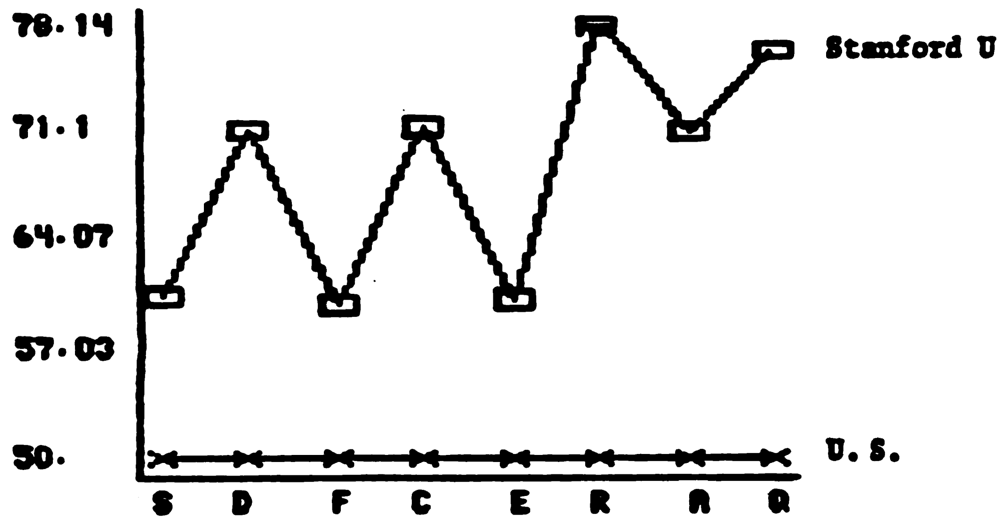

Figure 25. Profile of Stanford University and the United States Average Doctoral Institution, 1981-1982

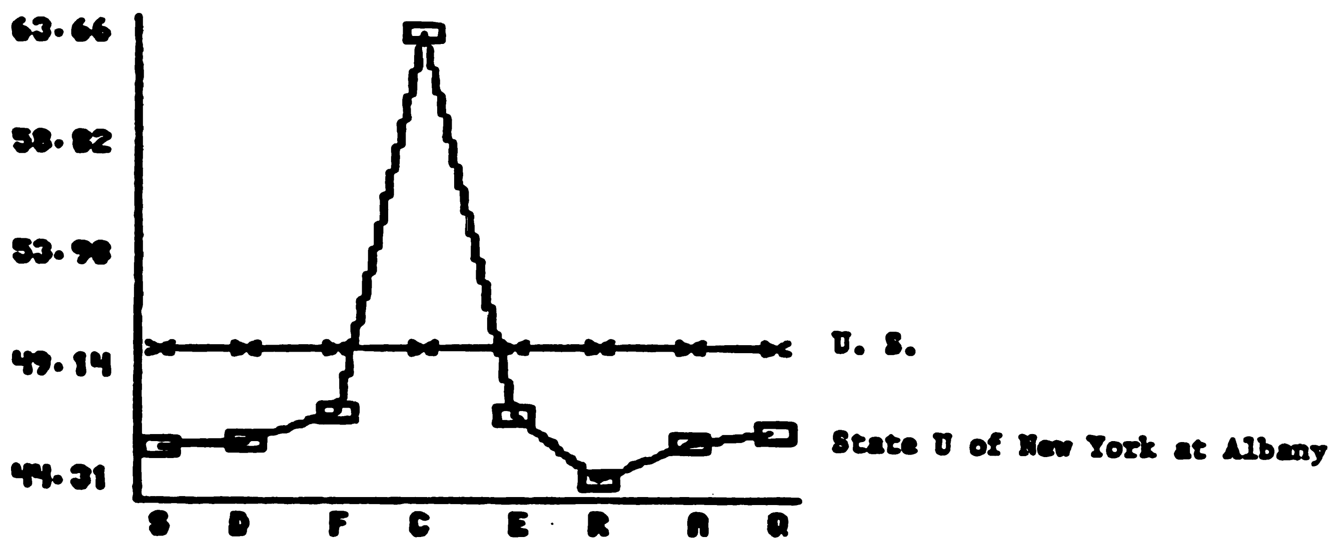

Figure 26. Profile of the State University of New York at Albany and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

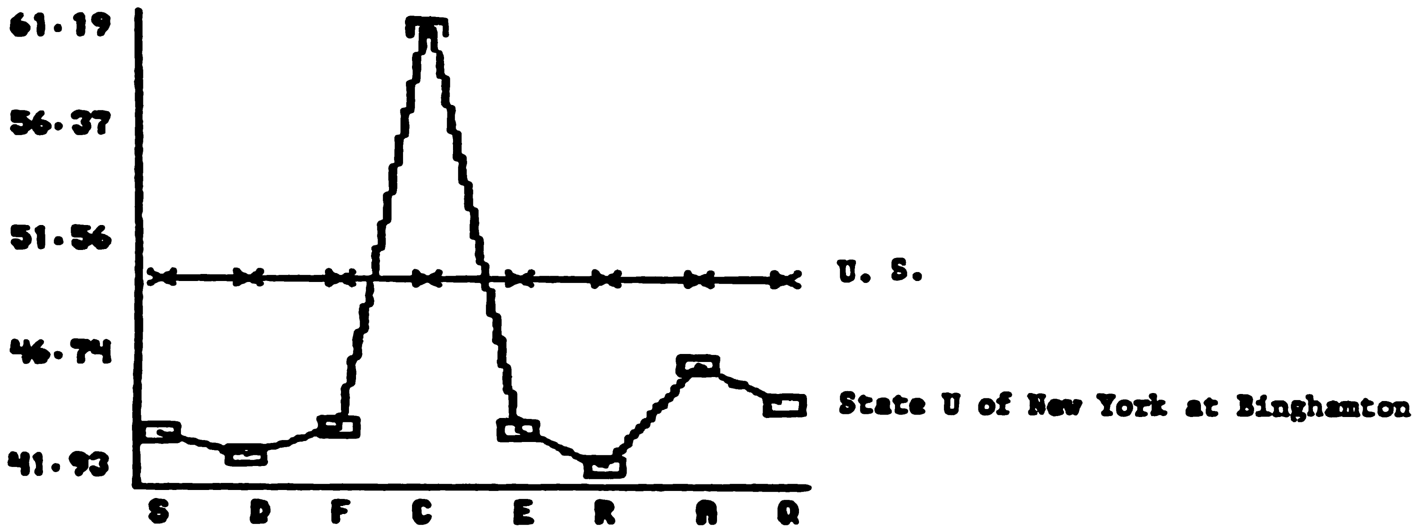

Figure 27. Profile of the State University of New York at Binghamton and the United States Average Doctoral Institution, 1981-1982

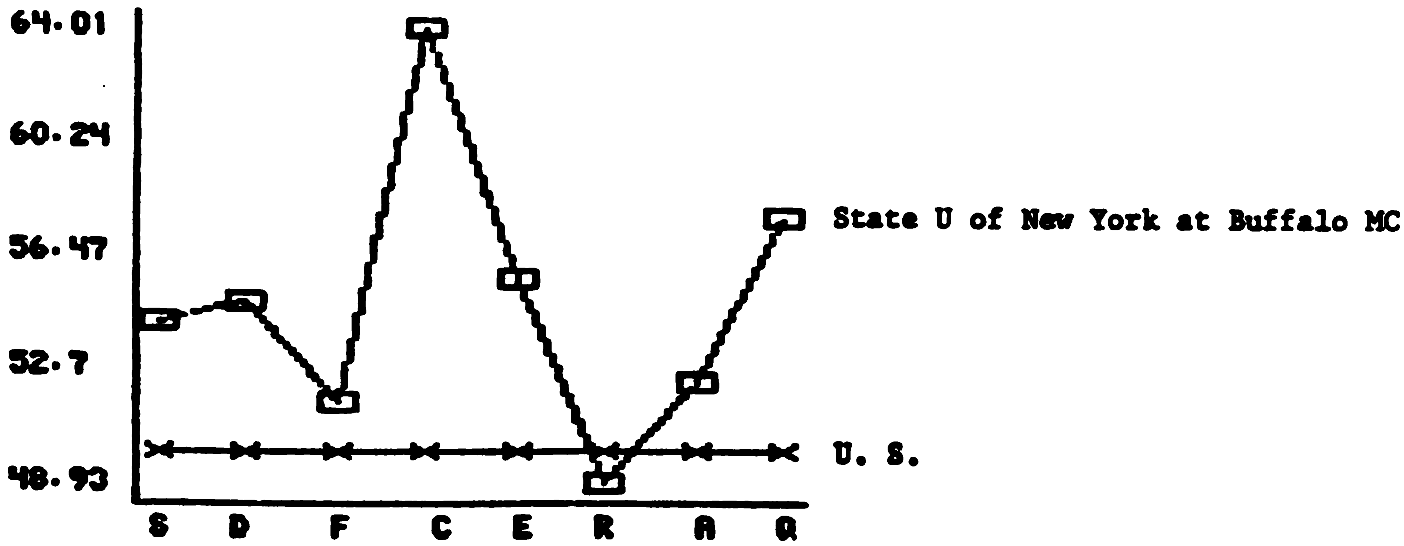

Figure 28. Profile of the State University of New York at Buffalo MC and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

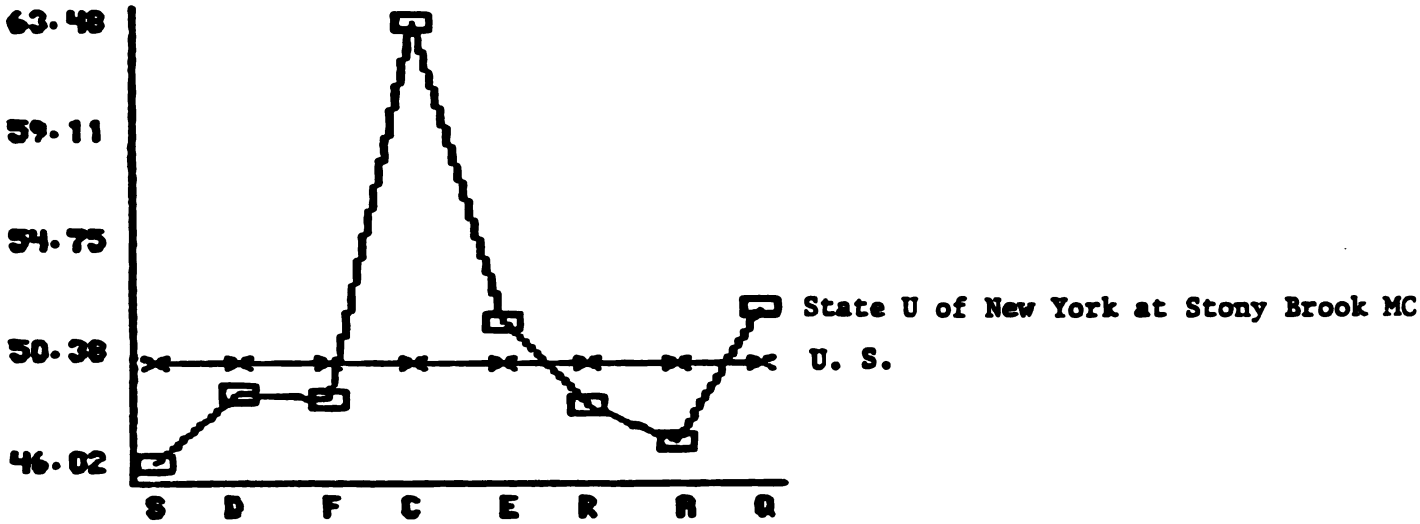

Figure 29. Profile of the State University of New York at Stony Brook MC and the United States Average Doctoral Institution, 1981-1982

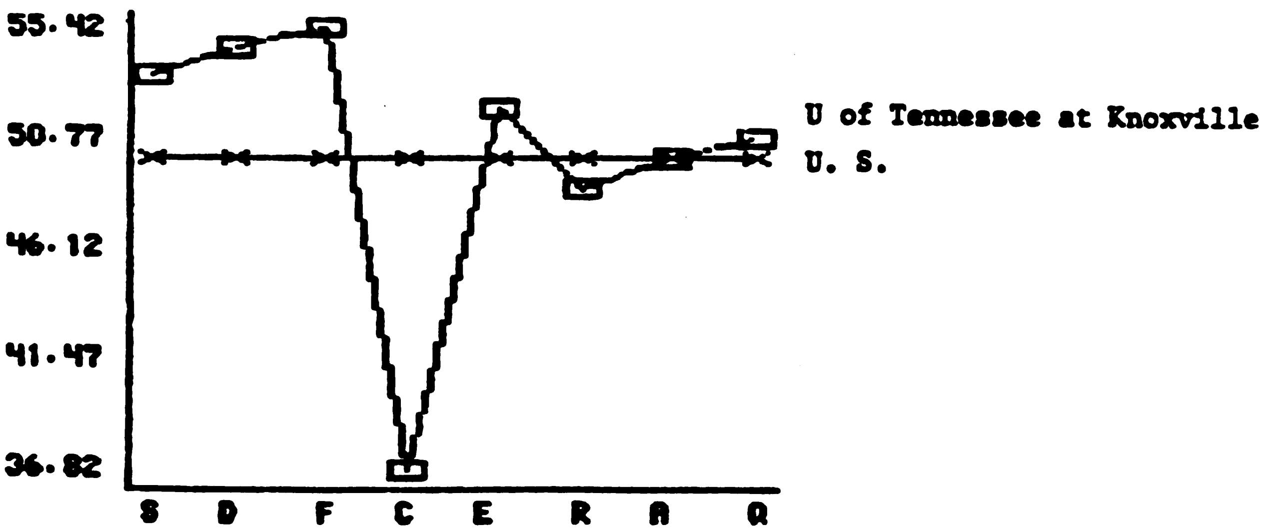

Figure 30. Profile of the University of Tennessee at Knoxville and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

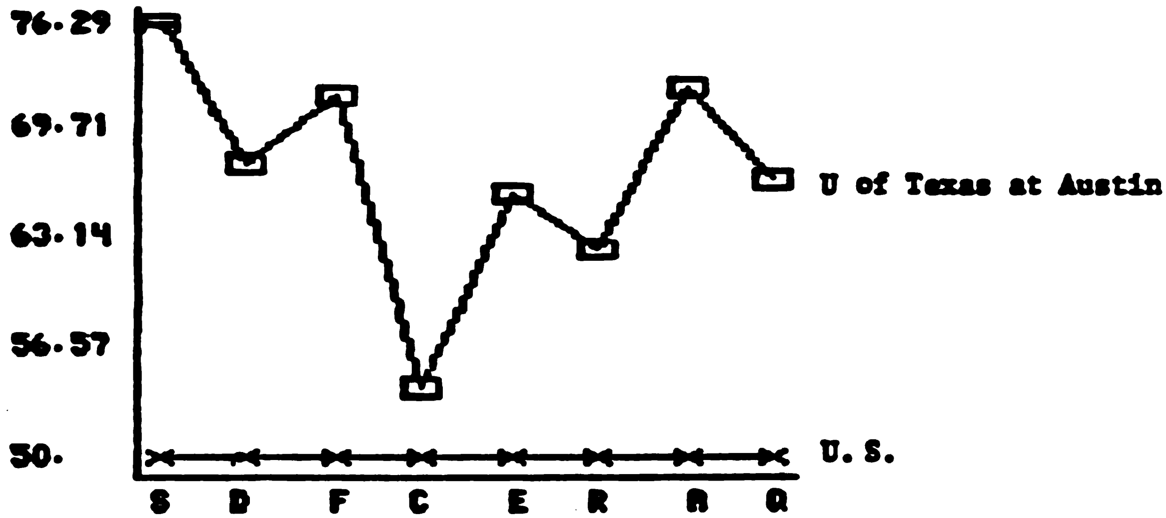

Figure 31. Profile of the University of Texas at Austin and the United States Average Doctoral Institution, 1981-1982

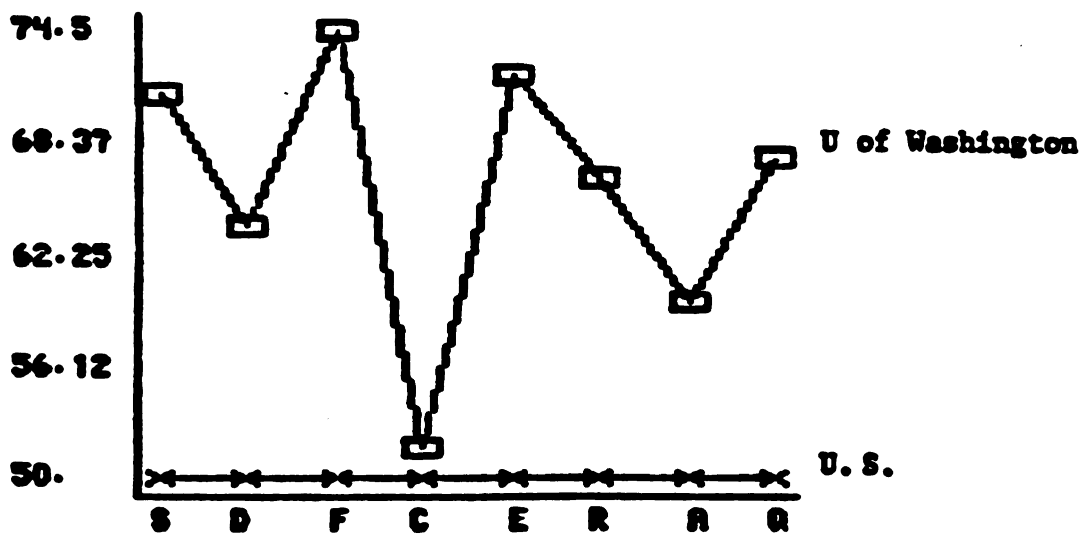

Figure 32. Profile of the University of Washington and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

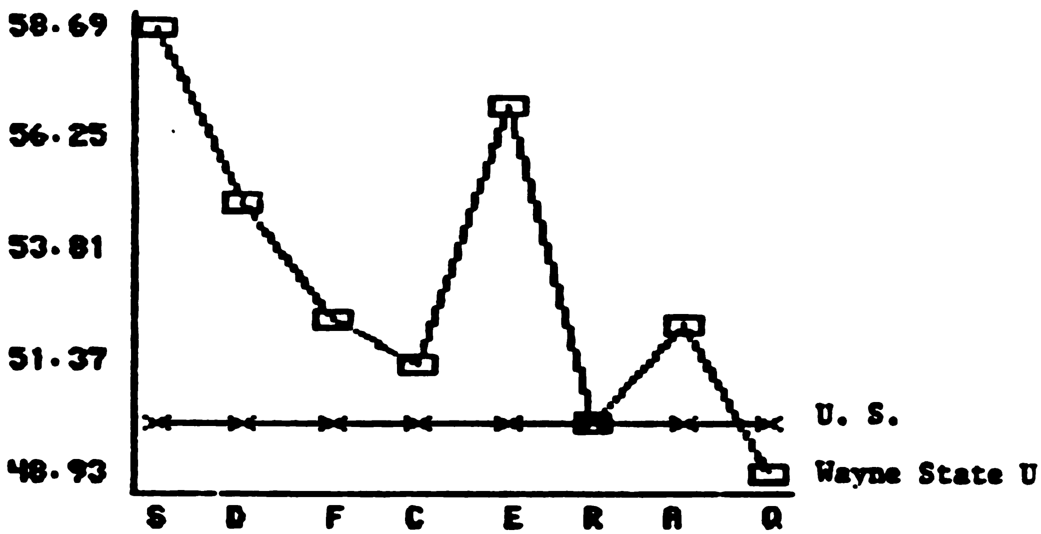

Figure 33. Profile of Wayne State University and the United States Average Doctoral Institution, 1981-1982

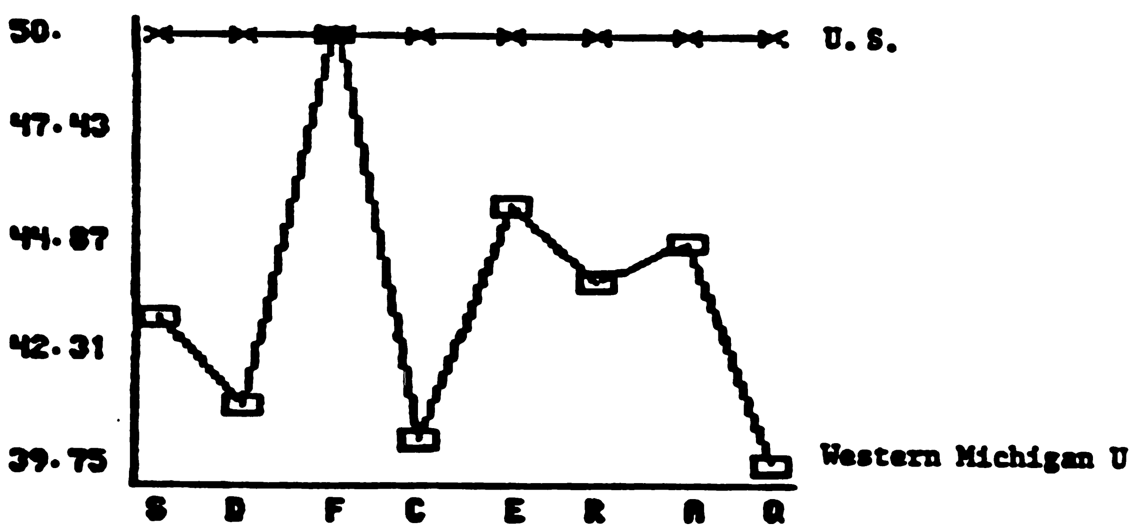

Figure 34. Profile of Western Michigan University and the United States Average Doctoral Institution, 1981-1982

Appendix D (Cont'd.).

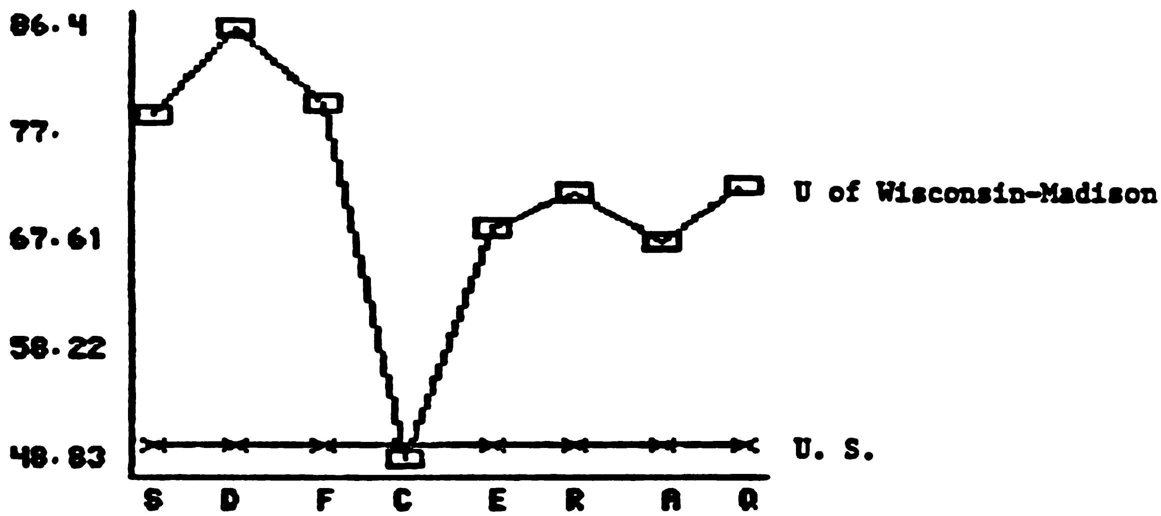

Figure 35. Profile of the University of Wisconsin-Madison and the United States Average Doctoral Institution, 1981-1982

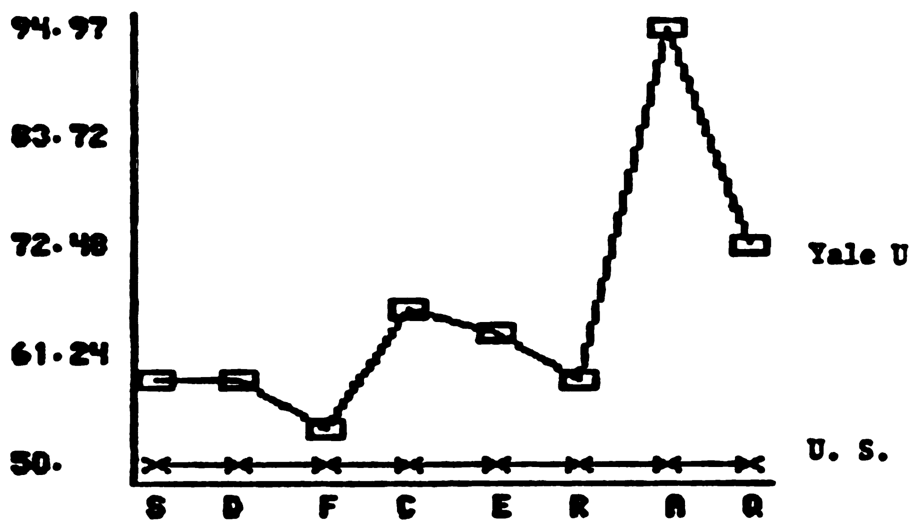

Figure 36. Profile of Yale University and the United States Average Doctoral Institution, 1981-1982

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