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ABSTRACT

One of the enduring questions in health administration concerns the transferability of management expertise from industry to the health enterprise. Some observers hold that the efficiencies associated with industry reflect methods and skills that are widely applicable and somehow lacking in the health field. Thus, the task force responsible for this report was charged with studying the use of quantitative methods within the curriculum for health administrators. The specific charge of the task force was: (1) to examine the existing curriculum pattern; (2) to develop a concept of what exposure to the area is indicated; and (3) to develop materials that assist the graduate programs in teaching effectively in the curriculum area. This report suggests that quantitative methods, one of the key management skill areas, has been underrepresented in the curriculum in terms of potential value to health management. (Author/HS)

The Curriculum in Quantitative Methods: A Task Force Report

Association of University Programs in Hospital Administration

Association of University Programs in Hospital Administration

REPORT OF THE TASK FORCE ON QUANTITATIVE METHODS

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FOREWORD

One of the enduring questions in health administration concerns the transferability of "management expertise" from industry to the health enterprise. Some observers hold that the efficiencies associated with industry reflect methods and skills which are widely applicable and somehow lacking in the health field. This report suggests that at least one of the key management skill areas, quantitative methods, has been underrepresented in the curriculum, in terms of potential value to health management. At the same time, however, it appears only slightly behind the most progressive schools of administrative science in this effort. Many graduate programs in hospital and health administration now have well-developed sequences of quantitatively oriented management skills courses. The problem has been to define the area well and provide a basis of reference for curriculum development and evaluation.

The essential work of AUPHA is carried on by task forces in specific curriculum areas. The task forces are composed of program faculty members and others with specific interest in the curriculum area under consideration. In addition to quantitative methods, there are several other curriculum task force areas: medical care, financial management, hospital organization and administration, comprehensive health planning and long-term care.

The general charge of each task force is the same: (1) to examine the existing curriculum pattern, (2) to develop a concept of what exposure to the area is indicated, and (3) to develop materials which assist the graduate programs in teaching effectively in the curriculum area. The task force is encouraged to "imagineer" any appropriate device, media or material necessary to assist the graduate faculties. The result has been an increasing flow of teaching materials to the programs and a variety of institutes and other meetings.

The boundary lines of task force concern are drawn arbitrarily, with the understanding that concerns of the various areas will overlap in many cases. The Quantitative Methods Report underscores the essential unity of the Association curriculum development efforts by highlighting the broad applicability of an expanded quantitative armamentarium.

This report is an important contribution. It is very timely and merits the serious consideration of all faculties.

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CHAPTER I

INTRODUCTION

Goal of the Task Force

In hospitals and other health enterprises, the principal applications of quantitative techniques can be broadly classified into three areas. These are demand analysis and forecasting, resource allocation, and quality and productivity control. The efforts of the Quantitative Methods Task Force have been directed toward the teaching material appropriate to these three areas. While the details of applications in each of these areas are likely to differ substantially from those of other industries, the general framework is essentially the same. For example, an airline might speak of marketing and demand forecasting, scheduling, and cost and quality control. A hospital would talk about bed and facility needs, scheduling of admissions and nursing, and utilization review and quality control. The techniques to approach the problems remain essentially the same.

The goal of the Task Force has been to identify the components that can be fruitfully incorporated in educational programs at the master's level, to describe how these components can be taught, and to assign priorities to their desirability that can assist individual faculties in making their decisions. In this report, stress has been placed upon two specific courses, one in statistics and the other in operations analysis, that provide an appropriate basic package for hospital administration education. Appropriateness has been considered both in the light of application to the management of hospitals and related institutions and also in the light of presentations sufficiently thorough to be self-contained and complete as educational offerings.

Method of Procedure

The Task Force began its activities by planning and presenting the 1968 San Antonio Institute on Quantitative Decision-Making. Papers at this institute stressed the utility of the subject for hospital administration, the general definition of the subject and its parts, summaries and examples of research applications in the health field, and some of the difficulties of incorporating the subject in management education. After the Institute, the Task Force's activities included a solicitation of AUPHA member programs for descriptions of all potentially relevant course materials. Initial review of these data and response to the institute showed both a widespread interest in the subject and a diversity of relevant course work. Consideration of the responses reinforced the selection of two broad topic areas, statistics and operations analysis, for detailed study. Six consultants involved in the actual teaching of these two areas were identified from the member programs. The consultants and the Task Force delineated and established the priorities of the subject material in discussions at Tulane University, February 21 and 22, 1970.

Rational for the Teaching of Quantitative Methods

Evidence is almost overwhelming that any educational program for management in the U.S. and Canada in the 1970's must reach a deliberate decision about the inclusion of quantitative management techniques. The success of applications in industry and government since World War II has compelled careful evaluation of their potential contribution to all forms of organization. Clearly, the case for quantitative management is being made convincingly in a growing number of situations. The subject area is now a keystone of graduate education in industrial engineering. It is almost always a part of master's programs in business administration and is receiving increasing attention in public administration. Among the member programs of the AUPHA in 1969 more than half were offering specific courses in the subject area.

Among the driving forces behind this trend have been the increasing complexity of production of goods and services, the increasing costs of making a bad decision, the success of early examples of use of techniques, and the decreasing cost of both analytic models and computer services. When costs of doing business are rising and the costs of forecasting analyzing, and controlling the business are falling, rapid spread of the use of these techniques is inevitable. Health applications are just emerging from the expensive and tedious initial development phase, but subsequent applications generally cost less than initial ones. There is reason to believe that health care applications will follow a pattern similar to industrial and military uses. Education for the future health administrator should prepare him to work effectively in a world where these techniques are important.

The Task Force has found that the principal argument in support of inclusion of this material is the promise of present research and development. Health Services Research is a journal whose material is almost entirely within the domain of this subject matter. Articles detailing hospital applications appear with increasing frequency in such journals as Management Science, Operations Research and AIIE Transactions. An even larger volume of work is revealed in informally published reports and doctoral dissertations noted by Abstracts of Hospital Management Studies. Federal policy for some years has been to sponsor research in this area. The current policy of the National Center for Health Services Research and Development encourages research, demonstration, and growth of skilled manpower in operations research with interests in the health area. While what has been done varies substantially in the immediacy of its applicability as well as the level of sophistication achieved, the Task Force reached two conclusions: work to date shows high and increasing promise, and, despite skepticism in some quarters as to the value to date of attempted applications, the coming years will see an increasing number of applications of direct value in health management.

Some of the hospital management applications of quantitative techniques are included in other courses. The general subject of quality measurement, for example, must be included in a course in Medical Care Organization. Similarly, courses in financial management can include capital investment decision making. Planning courses may include forecasting and demand analysis and techniques for deciding the size of facilities, such as the number of beds necessary to meet given levels of demand. Courses in economics also include analysis of demand, while courses describing techniques of general administration may discuss any of these areas as well as other resource allocation problems such as nurse staffing and admission scheduling.

Because of the conceptual similarity of the analyses, the Task Force is recommending that the technical aspects of all of these questions be presented in a single course in quantitative methods. This approach implies revision of other courses. The best result will occur when other courses build upon and re-enforce the quantitative material. It is probably less desirable to drop the overlapping references than it is to continue them with recognition of the overlap. The teachers in the non-quantitative courses can incorporate the quantitative techniques and move beyond them to problems of practical application and of limitations of quantitative solutions. In this way, one might hope to produce a student who is at ease with quantitative technology and familiar enough with both its power and its shortcomings to apply it meaningfully in his professional career.

The Task Force has encountered two arguments against the inclusion of the material. First, since the nature of the material is technical, it, like the technology of medicine or nursing or architecture, will not be the responsibility of the administrator. Second, even though the material is relevant, its value does not balance the cost of other parts of the curriculum that might have to be dropped. Hospitals, the anti-technology argument points out, are not now making extensive use of the results of current research; if hospitals should decide to implement these technical improvements, either consultants or trained personnel on the staff will be employed to do so. The administrator's job will remain essentially what it has been, one of political, social, and non-technical manipulation of the system.

While the premise might be true that administration is not a technical field, technology nevertheless has long been incorporated into management education, and, in fact, the teaching of social and political manipulation is often a minor component of curricula for the master's degree in management. Even curricula less oriented to formal management techniques have long incorporated technology in the form of statistics, research methodology, accounting, and epidemiology. The addition of a major new field of technical assistance for the administrator has not made political and social skills or styles unimportant, but the Task Force believes whether the administrator is described as a manipulator or a decision maker he will not in the future be able to perform satisfactorily without an understanding of and a use of quantitative language and quantitative techniques.

The argument of the relative cost of teaching quantitative management versus teaching some other course material is one that can be answered only by the individual faculty, considering the least valuable content of their present course work. There are, of course, opportunities to minimize the loss by improved efficiency of teaching and by the careful selection and interrelationship of curriculum material. Many programs have already made the decision to invest their students' time in quantitative management education. The Task Force believes for these schools its proposals may provide an improvement in teaching efficiency, and in general other schools can afford such trade-offs as may be involved in the adoption of the subject matter. Considering the evidence and arguments, pro and con, the Task Force urges firm commitment to the teaching of quantitative methods on the part of all member programs.

Implementation of the Goals

We approached the subject in terms of two specific courses principally because of problems of faculty availability. This stress on self-contained course work, both the separation of courses in quantitative methods from other parts of the curriculum and the division of the subject into statistics and operations analysis, may be a pedagogic error. While it would undoubtedly be more desirable to integrate these subjects with others in the curriculum, this can be done only when nearly all members of the faculty feel equally comfortable with the material.

Also, there are the limitations inherent in the Task Force's assumptions about the extent of the subject area. These go in two directions. First, it is clear that the Task Force has not included all the uses of numbers in hospital management. Two broad areas have been deliberately excluded. These are accounting and finance and the appreciation and conduct of research. Many programs presently incorporate one or both of these subject areas. The Task Force recognized the relevant contribution of these subjects, but felt that they were somewhat peripheral to its main charge. (However, some Task Force recommendations, it should be noted, may require minor adjustments in these courses.) Second, it is clear that some faculties will wish to make a much heavier investment in the areas of direct interest than is described in this report. While the utility of such an investment appears promising, it raises still further questions about the total length of the master's program and the trade-offs with other subject areas. The Task Force has considered these questions to be outside its charge. The Task Force's recommendations comprise the components of minimal or basic knowledge, cast in a framework of a two course sequence that appears, from review of present offerings, to be within reach of all the accredited graduate programs.

Definitions of "Statistics" and "Operations Analysis"

Data reported from member programs showed that material relevant to quantitative management is taught in courses in economics, accounting, finance, experimental design and research, data processing, operations management, and epidemiology as well as courses under the specific headings selected. The difficulty is that any subject area which attempts to apply the scientific method to any form of business or health decision-making automatically relates to the subject matter of particular concern to the Task Force. In addition, certain analytic techniques have proven especially fruitful for certain disciplines and as a result have been incorporated in their educational offerings. (i.e. Finance courses may devote considerable time to forecasting.) While the Task Force realized its debt to these varied fields, it elected to define and label the two areas of statistics and operations analysis based upon the topics and sub-topics shown in Figure 1. The remaining two chapters of the Task Force report develop each of these areas.

The content of quantitative methods in the health care field can be seen in each of the three principal applications mentioned at the beginning. Demand analysis includes techniques for long-range and short-range forecasts, and for identifying health needs that have not been translated into demand. Most of these techniques are based upon various kinds of statistical analysis and upon an understanding of probability. Resource allocation techniques come principally from the fields of operations research and economics. They include inventory control models, cost benefit analysis, simulation, and various techniques for staffing, scheduling, and deciding the appropriate size of facilities and services. Quality and productivity control involves the application of statistical techniques to generate exception reports on changes in organizational performance.

FIGURE 1

COMPONENT TOPICS OF QUANTITATIVE MANAGEMENT EDUCATION

1. Statistics.

   a. Statistical communication--the presentation of numerical data: tabulations, charts, index numbers, percentages, measures of central tendency and measures of dispersion.

   b. Probability--the meaning of uncertainty and the likelihood definition of probability, ways of manipulating probabilities, certain distributions of practical interest.

   c. Sampling theory--sampling, confidence limits, and hypothesis testing.

   d. Decision theory--decision making under uncertainty, utility, Bayes' theorem, stochastic decision models.

   e. Measures of association--regression and analysis of variance.

2. Operations Analysis.

   a. Generalized systems approach--concepts of optimization, sub-optimization, cybernetic models and programmed and non-programmed decision making with careful attention to health and hospital applications.

   b. Methods improvement and work measurement--flow process charting, task analysis, work sampling, standard data and other work measurement techniques.

   c. Forecasting--the differences between stochastic and deterministic models and techniques for forecasting stochastic variables including regression analysis and time series.

   d. Engineering economics--including total value analysis and inventory optimization problem.

   e. Simulation and heuristic decision models.

   f. Mathematical programming models.

   g. Sequencing models--PERT and critical path methods.

   h. Cost benefit analysis.

The one theme which has recurred most often in the Task Force's deliberations has been the need to lead the student from a deterministic view of the world to a probabilistic one, a distinction which underlies large classes of hospital management decisions. The student who clearly grasps the distinction and its implications will have no trouble understanding the analyses for these decisions, while the student who misses this distinction generally will never grasp the implications of much of the health applications. For example, the distinction is fundamental to understanding such questions as whether a hospital should have three delivery rooms or four, and whether the rate of removal of normal tissue has changed. Questions such as the desirability of variable nurse staffing also require facility with this concept, and specific proposals for variable nurse staffing cannot be understood without it. While this theme is not constantly before the student, it is always under consideration in the teaching of statistics and can be repeatedly reinforced in the teaching of operations analysis.

Conceptual and even practical understanding of quantitative techniques is not in itself enough for a management education. Successful application of any technique to health management problems can occur only if managers understand the values and environment which constitute the decision situation. Managers must supplement data with relevant non-quantitative comment and in so doing insure that appropriate priorities and significance are assigned to the quantified elements of each problem. The belief of the Task Force is that health care managers must now be familiar with the means of collecting and analyzing data as part of the management process. This report with its recommendations for a two course sequence in quantitative techniques is directed toward that goal.

CHAPTER II

THE TEACHING OF STATISTICS

Introduction

Statistics is generally recognized as one of the foundations of quantitative knowledge and virtually every program in hospital administration includes some courses in this area. The fifteen programs offering courses in operations analysis generally appear to regard statistics as a prerequisite to these courses. Despite this widespread agreement on the importance of statistics, the Task Force had great difficulty identifying and classifying the content and objectives of the various statistical courses. The difficulties appear to be related in part to scholarly ferment on the approaches to statistical decision making affecting the content of introductory courses. From the Task Force's consultations with its statistical consultants, Dr. Benjamin King of the University of Chicago, Dr. Robert Serfling of Tulane University, and Dr. Vernon Weckwerth of the University of Minnesota, it appears that although the discussions within the field have not terminated they are approaching closure. The pattern of the coming years should be one of increasing consensus at least at a philosophic level, but teaching techniques and portions of the detailed subject matter will still vary with individual faculties.

Purposes of a Course in Statistics

The growing philosophic consensus in regard to elementary statistical courses is in the direction of conceptual rather than technical understanding. Professor King enunciated this most clearly in his statement:

> "Our principal goal should be to impart to the student the ability to recognize uncertainty in the world around him and to accustom him to the idea of coping with that uncertainty by means of the formal specification of models of random processes and examination of the implications of these models."

While Professor King's position was perhaps the most advanced of the three consultants, it was not disputed. None of the consultants placed great stress on the teaching of statistics as a "bag of tricks", i. e., sets of techniques relevant to specific problems. The emphasis now is in favor of the conceptual ability. The current level of the argument seems to be on the question of how much specific technology is to remain in the elementary course.

Models dealing with a spectrum of possible outcomes having differing probabilities and utility are of increasing importance. The null hypothesis model which is dichotomous in that the result of analysis is either the acceptance or rejection of the specific single hypothesis is no longer the sole focus of statistical thought. The newer models tend to have their applications in management rather than research decisions. Stress upon these models, their proponents argue, equips the student better for management decisions. At the same time they give him a conceptual framework that permits not only rapid learning of any specific technique (such as the t-test or the chi-square test) for the null hypothesis but also better understanding of the dangers inherent in the use of both specific tests and the null hypothesis model. Within the field of statistical education this approach has come to be called statistical decision theory, as contrasted to the older sampling theoretic approach with its emphasis on the null hypothesis. An area of statistical thought described as Bayesian is within the concept of statistical decision theory. In crude terminology, the Bayesian position is that all estimates of likelihood can be modified sequentially as relevant new information is obtained.

There is a dearth of empirical evidence that emphasis on either the decision theoretic or the sampling theoretic approach produces a superior student. As is frequently the case in education, consensus develops principally upon individual judgment and only secondarily on specific studies. The decision theoretic approach has made considerable headway in recent years and is now generally accepted. With this has come acceptanc of the Bayesian notions.

Present Practices of Member Programs

Requests for data on current teaching in statistics and quantitative methods generally were sent to 33 full and associate member programs in March of 1969. Replies of some sort were received from 27 programs, of which 22 identified specific courses in statistics. Two programs indicated that basic statistics was a prerequisite, and three programs indicated they could not give detailed replies because their curriculum was undergoing substantial revision.

The diversity of course content and the lack of specific information such as assigned readings made understanding of the detailed course content difficult. However, it appeared that the most common form of course is in the area of the sampling theoretic approach with varying amounts of time spent on the use of graphs, tables and other devices for communication. Only three programs appear to be heavily invested in statistical decision theory. About two-thirds of the programs include material on vital statistics or make some effort to show health applications. The most common length of the course was three credit hours (one semester), although several programs offer advanced work as electives and a few require four or six credit hours. A variety of departments offers the courses. Eleven of the required courses are taught by faculty in health-related schools or departments.

The subcommittee of the Task Force that prepared the analysis of statistics courses made a number of subjective observations based on their review of the courses reported to them. These were:

--A great deal of emphasis is placed on inferential (that is, sampling theoretic) statistics and somewhat less on descriptive statistics (that is, the preparation of statistics for communications).

--Although 14 schools are attempting proficiency in techniques, this does not mean that the graduates are expected to be proficient in all the topics covered in the course. The number of topics covered in the limited number of hours in 18 out of 25 courses suggest that proficiency could not be obtained in all areas.

--Of the seven courses appearing to be concentrated in content, two are descriptive and five are inferential. The two descriptive courses are taught by health departments, and the five inferential courses are taught by statistics or business departments.

--As might be expected a direct relationship appears to exist between health applications and the hospital administrative or related health department teaching the course.

--There appears to be no relationship between the department teaching the subject and the level of knowledge desired.

To summarize the survey findings, nearly all schools appear to offer or require some course in statistics, the course usually concentrates on sampling theoretic approach, and as in most cases the course is at least three credits long. Emphasis on decision theory is limited to a few schools. Varying amounts of time are invested in topics more or less ancillary to the sampling theoretic approach, such as the use of statistics for communications, and vital statistics, examples in applications from health, and probability theory.

A Proposed Basic Course in Statistics for Health Services Management

After review of available data on present practices of graduate programs and detailed review of the basic courses taught by the consultants from Minnesota, Chicago, and Tulane, the Task Force undertook a topic by topic review of subject matter. It attempted to assign priorities and reasonable expectations of the length of time required for each of the topics. Consensus was advanced by noting that the use of statistics for communication is independent of the decision theoretic/sampling theoretic debate. Also, many authorities have come to view the knowledge of probability as central to either approach. The following topics, which are not necessarily discrete units in the syllabus and need not be approached in the sequence listed below, were discussed:

Statistical Communication.

Any administrator must know how to prepare numerical data in a reasonable manner and to understand and identify distortions introduced by the preparation or presentation of data. The subject includes the preparation of tables and graphs and the calculation of indexes and percentages. The Task Force felt skill in this subject area comes with practice, once a few elementary concepts have been presented and grasped by the students. Only a few sessions on the subject seem to be necessary, if the student is given references and encouraged to use them in preparation of papers and reports in other courses. Programmed texts have been attempted but the consultants were not encouraged by those currently available. Reference books such as Huff's How to Lie with Statistics,[1] or Say It With Figures by Zeisel[2] appear to be adequate. This subject is also incorporated in many general texts.[3] The subject is a natural one with which to begin a course in statistics, and the teaching can be reinforced later in the course and in other courses.

The concept of association of two or more statistical variables can be easily introduced into the discussion of statistical communication. Doing so, showing two- and three-way tables and methods of constructing indexes, rates, and percentages is desirable. In addition to its innate importance, it aids later discussions of correlation, regression, and analysis

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1. Huff, D., How To Lie with Statistics, W. W. Norton, New York, 1954.

2. Zeisel, Hans, Say It With Figures, Revised Fourth Edition, Harper and Brothers, New York, 1957.

3. c.f. Wallis, W. A., and Roberts, H.V., Statistics: A New Approach, The Free Press, Glencoe, 1956.

of variance. These subjects would not be covered in the basic statistical course because of lack of time. The student should have sufficient background, however, for him to understand these concepts when they are introduced in the later course, operations analysis.

Probability.

The concept of probability and the intuitive understanding of stochastic processes (that is, those that have probabilistic components) is the central goal of a first level course in statistics for those students who are not interested in extensive work in the subject. This appears to be agreed upon by proponents of both sampling theory and decision theory. Consistent with its importance, the introduction and development of the subject will take six to eight weeks (assuming three hours of classwork per week), and the concepts must be reinforced by later elements in the course.

With the teaching of probability some of the primary pedagogic difficulties appear. Students vary substantially in their ability to grasp the notions of probability. The variation is intensified if students interested in advanced work in statistics are included in the basic course, but remains troublesome even if these students are removed. It appears to be related in part, although not entirely, to the amount and quality of prior mathematical education. Engineering students and others who have had undergraduate mathematics through calculus tend to master the subject very quickly. At the other extreme, students with nonmathematical professional and preprofessional undergraduate education such as nurses and premedical students tend generally to have substantial difficulties.

Many educators believe that improved mathematics teaching in elementary and secondary schools will reduce the variation and improve the general level of student performance. The "new math," it is true, places more emphasis on probability and related concepts than was the case up until ten years ago. However, the first students given thorough exposure to these concepts will not begin to reach graduate school until the mid-70's, and uniform preparation will be many years beyond that. At the present time, it is not even proven that the "new math" will have the desired result.

A sound basic course for nonstatisticians must begin with elementary illustrations and experiments to improve the students' intuitive knowledge. Thus, the use of coins, colored marbles, and poker chips are very much a part of the basic course. It should be noted that some of the data used to demonstrate the principles of statistical communication can be used as well as to illustrate notions of randomness. Also, there is some experimentation with on-line computers in the classroom for this purpose. The Dartmouth faculty has reported some success in this direction.[4] It may be possible and is probably desirable to use data on stochastic processes from hospitals and health applications, since one of the pedagogic problems is to assist the student in perceiving the relevance of the subject.

The usual approach is from classroom experiments to the identification of Bernoulli trials, then to the binomial distribution, and finally to the normal as an extension of the binomial. Elementary set theory has been found pedagogically useful. The concepts of a random variable, a sampling space, and a probability density function are useful, but over-emphasis on formal mathematical analysis is probably best avoided. It also appears to be more important to introduce the notion of models and their utility, and to show that histograms and theoretical probability distributions are models of real life situations, than to gain skill in manipulating binomial expansions or conditional probabilities.

Consultants to the Task Force felt only two theoretical distributions, the normal and the binomial, were basic to the course. On the other hand, coverage of the Poisson distribution is important as preparation for the course on operations analysis. Other distributions should be mentioned but not explored in detail. The approach which was favored seems to be represented well by Freund and Williams' Elementary Business Statistics: The Modern Approach, in Chapter V.[5]

Sampling Theory.

Given the inclusion of an introduction to statistical communication and the careful development of an understanding of probability, about 40 percent of a three hour per week, one semester course remains. The Task Force and its consultants concluded this time period could be spent either in sampling theory or in decision theory. Given the weak mathematical background of some students, it would be unwise to attempt both. Given the subject matter in either case, a certain minimum time is necessary to gain understanding. If this is not available, there is reasonable danger that the student will complete the course with erroneous as well as incomplete information.

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4. Kemeny, J. G., and T. E. Kurtz, "Dartmouth Time Sharing," Science October, 1968, pp. 223-228.

5. Freund, John E., and Williams, F. J., Elementary Business Statistics: The Modern Approach, Prentice-Hall, Inc., Englewood Cliffs, N. J., 1964.

In sampling theory the student will study:

--The nature of random sampling and some elementary sampling techniques.

--The notion of confidence limits and the estimation of means, variances and, proportions.

--Formulation of the null hypothesis.

--Testing of the null hypotheses using the normal distribution and the t distribution.

In addition, the instructor may cover the chi-square test for goodness of fit and for independence, and possibly a few elementary non-parametric test statistics. The student should be given sufficient exercises that he may become capable of performing these elementary tests. By using electronic calculators and other devices to reduce the amount of arithmetic, the student will be able to attack a larger number of problems and, hopefully, learn more. There are a number of textbooks relevant to sampling theory, but the content envisioned is essentially that of Chapters VII, VIII, and IX of Freund and Williams.[6]

Statistical Decision Theory

Alternative to sampling theory, the course can proceed from an introduction to probabilities to a study of decision making in a probabilistic world. As Dr. King phrased it:

> "If students can be taught to look upon problems of choice in their own experience as games, involving the selection of deterministic acts by the decision maker, countered by the random selection of events by chance, then they will develop a greater appreciation of the need for esoteric concepts such as probability and utility and apply themselves to understanding these concepts because they are prerequisites for coherent action in the face of uncertainty."

This material is actually integrated into the basic course continuously from the outset.

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6. Freund and Williams, op. cit.

A standard point of departure for decision theory is the "newsboy problem," where a street vendor has an opportunity to buy a high profit but perishable item like corsages for, say, 50¢ and sell them for $2.[7] Unfortunately, the corsages must be purchased early in the morning and those that are not sold the same day must be discarded as a total loss. Sales vary, and it is impossible to predict exactly what they will be in any given day. The question is the selection of an optimum number to purchase. In order to solve the problem one must estimate the probabilities of various levels of demand and calculate the profit for each level under varying assumptions about purchases. The profits can be weighted by the probabilities assigned to each demand level. The optimum purchase is the one that yields the highest weighted profit.

A number of variations and complications can be built upon the newsboy problem and others like it. These include illustrations of the use of Bayes' rule, which permits the newsboy to alter his expectations about the sale of corsages, if for example he learns on the way to work that there is 50 percent probability of snow. In addition, decision theory leads to marketing strategies in the face of competition and some other considerations from game theory.

The newsboy problem can be translated to hospital terms very easily by considering the staffing of an emergency room. The hospital "buys" staff like the newsboy buys corsages, setting the costs in advance before the actual demand is known. If staffing is too high, unnecessary costs occur in idle time. If it is too low, there will be costs in the form of inadequate care. The problem has two parts - proper forecasting and optimum staffing for it. Both can be understood if one appreciates the newsboy problem.

It has been argued that decision theory is not relevant to hospital management because it has never been used in hospital management. This actually is not so. Blumberg and Thompson, among others, made specific

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7. Freund, John E., and F. J. Williams, Op. cit., Chapter VI has an elementary discussion of decision theory and discusses problems like the newsboy problem. More advanced material is included in Schlaifer, R., Introduction to Statistics for Business Decisions, McGraw-Hill Book Co., New York, 1961, and Mosteller, F., R. E. K. Rourke, and G. B. Thomas, Probability with Statistical Applications, Addison-Wesley Publishing Co., Reading, Massachusetts, 1961. Although the book by Freund and Williams appears to include at least elementary discussions of all of the topics of interest the authors note in the preface, "The book contains more than enough material for a one semester or two quarter course...." Therein lay the Task Force's problem.

reference to probability distributions of demand and costs associated with inadequate facilities in the early 1960's.[8] The Task Force also noted that the argument of irrelevance to current practice could really be placed against sampling theory as well, although it may be less accurate now than it was a few years ago. Further, it is not unreasonable to assume that the growth of reliance upon sampling theory as a formal method in the health care field might in fact be related to its inclusion in the professional curriculum. A similar result might accrue from more extensive teaching of statistical decision theory.

Selection Between Sampling and Decision Theories

To recapitulate, advantages cited for decision theory are: it actually approaches management decisions in a more realistic manner than sampling theory (which is aimed principally at research decisions), it develops students' skills in probability and modeling, and an understanding of decision theory allows the relevant parts of sampling theory to be learned at high speed and with less risk of misuse of techniques than occurs if the sampling theory is taught alone. Arguments for the sampling theoretic approach are its practical relevance, and the fact that there are more available faculty as well as more good textbooks and teaching materials. Proponents of sampling theory are defending a known, well-tested curriculum, while decision theory advocates must justify experimentation and change. The selection of one alternative or the other is one of the critical decisions of curriculum design that must be faced by the individual faculties. The Task Force prefers and recommends the decision theoretic approach.

For the programs in hospital administration, one key question should be the ability to follow up and reinforce the notions taught in the course. If no succeeding courses involve extensive quantitative studies, or if they concentrate exclusively upon research applications, sampling theory is obviously more appropriate. Decision theory is not likely to be retained by the students without reinforcement. If a succeeding course concentrates heavily on operations research and systems analysis, it will reinforce the notions of decision theory. Such a two course sequence appears to promise substantially greater total learning on the part of the student. The Task Force feels the gain is substantial enough to justify a minimum of six credits, three in decision theoretic statistics and three in operations analysis regardless of total program length.

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8. Blumberg, M. S., "DPF Helps Predict Bed Needs," The Modern Hospital, December 1961, and Thompson, J. D., O. W. Avant, and E. D. Spiker, "How Queuing Theory Works for the Hospital," The Modern Hospital, March 1960.

Teaching Methods and Problems

Variation in Incoming Students

Possibly the most severe problem in the teaching of basic statistics is the wide variation in the interest and skills of the entering students. The variation is probably more a matter of training than aptitude. For a typical entering class it ranges from students who dropped mathematical studies at the first available opportunity (usually the 10th grade) to those who have used mathematics steadily throughout their academic career. The study of mathematics, physics, engineering, and some aspects of economics contributes to the rapid understanding of statistics. Most other subjects do not contribute.

There is enough difference in the learning rate between those who have concentrated in the contributory subjects and those who have studiously avoided them to make it almost impossible to avoid boredom on the one hand and confusion on the other. The first step toward reducing the variation is to establish separate classes for those students who wish to pursue statistical and quantitative studies either as a field of concentration or as background for doctoral work. This has an additional advantage of removing from the basic course the need to master formal material which becomes meaningful only in the context of advanced studies. The second step towards reducing variation is the use of some form of remedial or prerequisite course. The simplest requirement is for at least a one quarter prerequisite course in college algebra. The most elaborate is probably a two quarter course sequence in business mathematics covering analytic geometry, linear algebra, elements of calculus, and set theory in a context of modeling business decisions.

There seems to be little question that efforts in the direction of basic mathematical education both speed and improve learning of statistics and other quantitative subjects at the professional level. While evidence is small, the returns appear to be roughly proportional to the investment made at the professional school. That is, a course in college algebra taken at late adolescence four to ten years prior to graduate studies costs nothing to the professional school and is worth very little. On the other hand, a lengthy, professionally oriented sequence of courses produces a homogeneous student body with good grounding for the basic statistics course, but it is an extremely costly solution. The typical statistics teacher would probably argue for at least a short remedial course to refresh the student on algebra, cover some rudiments of analytic geometry, and introduce the notions of the derivative and the integral. Elements of set theory, which are useful in teaching probability, are usually included in basic statistics textbooks and can be handled within the basic course.

The Task Force did not attempt to reach a recommendation in this area because of the wide variation in the availability of time and resources for remedial courses among the member programs. The matter must be decided by local faculties based on their experience and resources.

Faculty for the Basic Course

Most of the programs rely upon specialists in statistics to teach their basic course. The courses are generally under the supervision of faculty with Ph. D. training in some area of statistics, although the sub-specialization varies widely. It appears that the instructors are usually not familiar with the problems of hospitals and delivery of health services. Where their field is biostatistics, they have little background in management applications, and where it is business management, little knowledge of the health field.

The Task Force's recommendation is to concentrate first on statistical and teaching competence, and to attempt to meet deficiencies in hospital management applications by concurrent and follow-up reinforcement. This is based principally on the technical rigor of the subject. Even if the material is to be taught in an intuitive style, the teaching demands a thorough comprehension of the underlying mathematics. Otherwise an accidental misstatement or a chance student question can result in substantial confusion and lost time in the learning process. It also should be noted that the course content at this level is largely devoid of application specificity. While health and hospital applications are useful in showing the initial relevance, the discussion moves rapidly to a level of abstraction where the source of the data is extraneous.

The principal counterargument is that separate statistics departments may be inflexible when they consider courses that are services to other groups and are aimed at goals they may not fully appreciate. Several negative reactions are possible: unwillingness to abandon formal mathematical approaches, to separate students who are not future statisticians, or even to consider variations in a basic course which has large enrollment and substantial organizational problems. There are several potential solutions to this problem. Developing quid pro quo's in research, doctoral student assistance, or direct financial support is one avenue. Developing alliances with other nonstatistical areas such as business, political science, or medical care is another. In large universities, several departments can usually be approached, and their attitudes may differ. Difficult as these avenues are, the Task Force finds them preferable to attempting to find statisticians for full time appointment to programs in hospital administration.

New Teaching Methods Within the Basic Course

Consensus on the course goal of understanding and dealing with uncertainty has come only recently. Ability to measure the achievement of the goal is still limited, and because of this it is difficult to evaluate teaching methods and innovations. It is not uncommon to grasp the principles of probability and even Bayesian decision theory intuitively. Successful horse players and crap shooters rarely take any course work in their subject. At the same time, it has been demonstrated that the rigorous mathematical material can be mastered by memory without conceptual understanding. One occasionally encounters students who have completed formal course work far beyond that contemplated by the Task Force without achieving the basic goal.

Admitting our opinion is largely subjective, the Task Force and its consultants lean heavily towards a pedagogical structure building upon the student's intuition and limiting formal mathematics to what is necessary for efficient communication of elementary techniques. The approach relies upon empirical demonstrations rather than mathematical proofs, stresses realism in exercises, uses tangible and visible devices to illustrate abstractions, and encourages the student to accept without excessive questioning a relatively large number of mathematical rules, statements, functions, and conclusions. Its only advantage is its apparent pragmatism. The Task Force consultants and others who have tried it are generally convinced that it gains more of the basic goal within the very limited time frame available. Its principal disadvantages are that it does not efficiently equip the student to go on to advanced work in quantitative studies per se (although there are those who claim that it provides a very strong and useful educational base for a student who wishes to repeat the basic course on a formal level), and it may trap a student into errors of oversimplification as he attempts to use his skills. In addition, it appears to be difficult and possibly even painful for some statisticians to teach in this manner. Particularly the acceptance of various notions without rigorous proof violates the philosophy of mathematical thought.

Various semiabstract experiments and devices have been developed for the teaching of probability, sampling, confidence limits, and association. The most flexible and promising of these appears to be the on-line computer terminal. With proper programming, it is possible to identify data from a random variable, examine it both graphically and arithmetically, draw repeated samples from it, and test various generalizations about it. What the computer contributes is speed. A much larger number of experiments and investigations can be attempted in the same time period either as a classroom exercise or as an individual student exercise. It is not necessary for the student to have any mastery of programming in order to use the computer in this way. A very substantial investment in the development of the exercises is required, however. As noted, some statistics departments have already begun work on these possibilities. A not insignificant part of the appeal of the computer is the ability to use realistic problems and data drawn directly from the health care field.

The Need for Reinforcement

The experience of the Task Force and the consultants indicates two kinds of reinforcement of the basic statistics course are necessary for permanent learning. First, during the course itself, serious problems of student motivation result from the students' inability to perceive the relevance to the health field. Although the reliance on intuitive rather than formalistic teaching will help overcome this problem, it does not appear to be sufficient in itself. There is a good deal of anecdotal evidence to support the contention that the student does not perceive even obvious applications to health care until these are pointed out to him. Often the investment in time can be very small, only enough to point out, for example, that the incidence of disease can be viewed as a random process, that some diseases and conditions fit theoretical models of purely random processes very nicely, or that sampling is a very efficient way to measure effectiveness of utilization or accuracy of laboratory tests. A few hours or even a few minutes of discussion of relevance by the health care administration faculty concurrent with the statistics course is extremely valuable. This is, of course, made easier if the students take the statistics course as a cohort. The illustrations of relevance can be built either into courses taught by the health faculty concurrently with statistics or into special seminars for the cohort members.

The second aspect of reinforcement follows the statistics course. Even with concurrent illustrations of health relevance, the student cannot be expected to understand how the concepts and techniques he has learned can fit into the management of hospitals unless he is given specific exercises and opportunities to learn this. The thesis is one of the traditional tools for doing this, but it often requires close and careful guidance by a faculty member versed in statistics. Course work in research or research appreciation can also be used for this purpose, as can deliberate attention to methodological problems in reading assigned principally for specific subject content. The most fruitful of these subject areas is, of course, the general area of operations research or systems analysis, which is discussed in Chapter III.

Summary

As a result of its studies the Task Force targeted a basic course in probability and statistics as the first of a two course sequence in quantitative methods necessary for basic minimum understanding in this subject area. After review of the offerings of graduate programs and extensive discussion with consultants who are statisticians and teach the basic courses at Minnesota, Chicago, and Tulane, the Task Force identified the goal of the course as being the development of an understanding of the concept of uncertainty on an intuitive rather than a formal basis. Working on the approximate framework of a 45 hour sequence, the Task Force identified two component areas of study, the uses of statistics for communication and an introduction to probability, as fundamental to a well structured course. To present and develop these elements in a meaningful manner would take slightly more than half of the course time.

The remainder of the course can be devoted either to the conventional notions of sampling, confidence limits and testing the null-hypothesis, called the sampling theoretic approach, or to newer notions involving the use of probability and utility in decision making, called the decision theoretic approach. While decision theory is gaining support among statisticians and educators, it is not the common approach of the graduate programs at the present time. Its utility depends in part upon the ability of the program to provide appropriate follow-up to the discussions. This in turn depends upon the resources and philosophies of the programs. While the Task Force prefers and recommends the decision theoretic approach, it recognizes decision theory and sampling theory as alternatives for individual faculty decision.

The Task Force believes the appropriate approach to teaching should build upon the student's intuitive knowledge. To the extent practical, the wide variation in incoming students should be reduced by prerequisites and remedial courses, and in any case students who do not plan extensive studies in statistics and mathematics should be separated from those who do. Responsibility for the course should normally rest with a competent member of a department of statistics. Teaching methods should rely on examples and illustrations and avoid formal mathematics except as necessary for efficient communication. The use of the on-line computer terminal in the classroom appears extremely promising as a teaching device.

Both concurrent and retrospective reinforcement of the teaching is necessary. Concurrent reinforcement should be done by the health care administration faculty but may be limited to efforts to show the relevance of the concepts being presented. Retrospective reinforcement should be incorporated into the students' following course work, the thesis, and particularly the second level course in operations analysis.

While the Task Force does not intend to endorse or imply thorough study of the many textbooks available in this field, certain commonly cited references are noted in the chapter discussion to provide the amplification of the content the Task Force suggests.

CHAPTER III

THE TEACHING OF OPERATIONS ANALYSIS

Introduction

Partly because of its newness, a wide variety of terms to describe this field are in common use. Rather serious semantic difficulties result from use of words such as production management, operations research, systems analysis, systems engineering, and management sciences, all of which have different meanings to different people.

For the purpose of clarification, the Task Force adopted the phrase "operations analysis" for common use. The phrase puts emphasis on the application of quantitative techniques to problem solving and decision making related to the management of any operation, including a hospital.

Hospital applications of operations analysis can be divided into three classes, as outlined in Chapter I of this report:

Demand analysis - e.g., short and long range forecasting, identification of health needs

Resource allocation - e.g., cost-benefit analysis, staffing, scheduling, selection of services, sizing of facilities

Quality and Productivity control - e.g., assessment and control of medical and hospital care.

Purposes of a Course in Operations Analysis

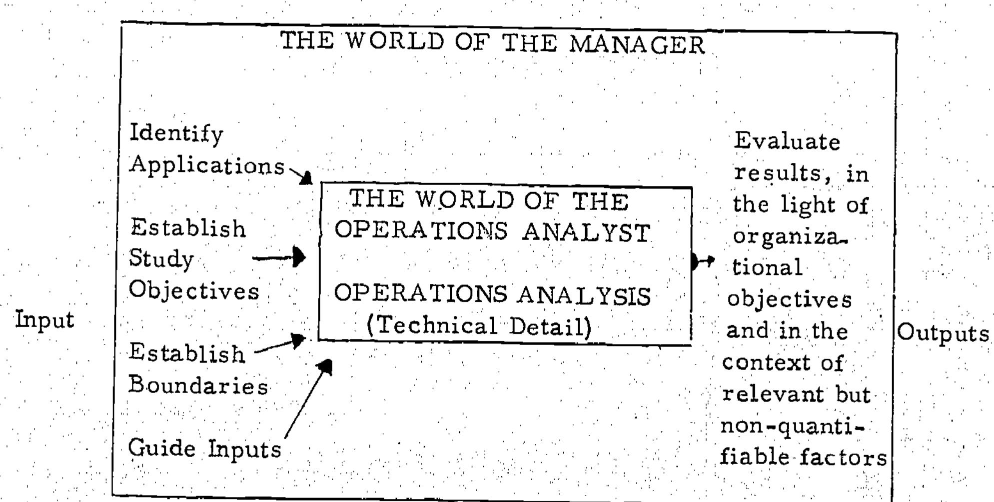
As discussed in Chapter I, there is general agreement that management is moving toward more objective decision making. This trend has been established in industry and has been reflected in the last decade in business administration curricula. Similar opportunities appear in the realm of hospital administration.

Yet, while the use of operations analysis in hospital administration is increasing, there is little consensus on the amount and type of knowledge hospital administrators should have of this subject. Clearly, the administrator can benefit in his job by acquiring knowledge in areas such as economics, sociology, law, political science, and accounting. Obviously, he cannot be an expert in all of these. The question, therefore, becomes one of balance between fields of relevance. Considering the present and potential value of operations analysis in hospital affairs, the Task Force concluded the subject should occupy a basic position, i.e., at least one course, in the curriculum of graduate programs in hospital administration.

The purpose of such instruction should not be the acquisition of technical proficiency, but rather a basic understanding and familiarity sufficient to support the hospital administrator's position as a sophisticated and involved consumer of operations analysis techniques. The administrator should have sufficient familiarity to identify problem areas which could benefit from the services of various kinds of operations analysts. He should be able to formulate these problems, at least conceptually. He should have enough understanding in the realm so that he can communicate with the analyst. And he should be able to evaluate the quality of his work. This general level of understanding is represented by the following model.

FIGURE II

HOSPITAL PROBLEM-SOLVING AND DECISION-MAKING



This objective for teaching in hospital administration is based on some fundamental assumptions about learning. One assumption is that the student (and subsequently the administrator) can appreciate and make use of a discipline without knowing its technical detail. The purpose of teaching remains essentially conceptual. The tools are not ends in themselves; the underlying concepts are what is important.

On the other hand, there is a risk of limiting exposure to operations analysis to such a superficial level that a true grasp of the underlying concepts is not obtained. The student has so little confidence in his ability to evaluate the techniques, the investment of curriculum time is not warranted.

After reviewing several courses and curricula, the Task Force found a worthwhile compromise: the student is asked to deal in a limited manner with several of the technical models used in operations analysis, always studying them in the context of underlying principles of management science. By developing at least a limited understanding of the technical detail that is the stock-in-trade of the operations analyst, the student gains not only an appreciation of concepts, but, as a byproduct, also gains both specific knowledge of the state of the science in the field and increased confidence in his ability to exploit the technology in a useful way.

Present Practices of Member Programs

The Task Force surveyed 33 member programs concerning course teaching in operations analysis. Responses from 15 schools were received, as compared to 27 responses concerning courses in statistics. This lower response in relation to courses in statistics suggests less emphasis on operations analysis as a general subject.

Some findings of the survey, with comments, are as follows:

(1) Concerning intent of courses, a large proportion of university offerings included material on operations analysis techniques, but only approximately half of these offerings used such models to illustrate general concepts. The generalist in hospital management should, most importantly, understand concepts. The inclusion of techniques may be a sound pedagogic method for illustrating concepts, but the Task Force concluded that the teaching of pure technique to generalists is questionable.

(2) Concerning course content, there was major emphasis on problems and processes of resource allocation, and a noticeable paucity of approaches to quality determination and control. This is undoubtedly a reflection of the difficulties of applying quantitative measures to essentially

qualitative matters, as well as the production management orientation of many operations analysis models. Nonetheless, for institutions dealing in health and medical care as their "product", increased course emphasis on the application of quantitative techniques to qualitative topics, without ignoring value considerations, seems warranted.

(3) Concerning the format of courses, there is a strong preference for presentation of operations research models usually with some categorization as to type of problem to which the various models might be applied. The Task Force and its consultants spent considerable time discussing the proposition that, given most students' preparation for positions in general administration, a reversal of the typical course format should be considered; namely, presentation and discussion of underlying operational problems, followed by available and applicable models.

(4) Concerning areas of application and department teaching, the teaching of courses by "inside" faculty members obtains for students the desired orientation and demonstrated relevancy to health and hospitals, but often at the expense of faculty depth in operations analysis. Conversely, use of "outside" courses may expose students to better prepared faculties in operations analysis, but often in contexts not germane to hospitals. The survey indicated that few graduate programs in hospital administration have been able to solve this dilemma, either by "co-opting" faculty members with basic skills in operations analysis, or by persuading "outside" faculties to provide special course offerings (or special emphasis in existing courses) for the health field.

(5) Concerning credit hours, most required courses in operations analysis are limited to one semester or quarter. There was little indication of what elective opportunities might be available in the various graduate programs, for students with special talents or interests.

A Curriculum in Operations Analysis

The Task Force considered three aspects of curriculum design for the teaching of operations analysis:

Prerequisites
Course work in operations analysis
Follow-up experience

Prerequisites

A course in statistics, of the type described previously in this report, is an essential prerequisite. Preferably, the course should emphasize decision theoretic material. Minimally, it should include material on probability.

Further, it is highly desirable that a graduate program's curriculum design obtain careful coordination between courses in statistics and operations analysis. The Task Force observed a tendency in graduate programs for the two subjects to be treated as unrelated packages, resulting in serious reduction in opportunities for synergistic effect. (For instance, it is difficult for a one quarter or semester course in statistics to include regression analysis. Yet, the subject is important, and can be taught as part of a course in operations analysis dealing with forecasting.) Without such integration between the two course subjects, an instructor in operations analysis is obliged to spend additional class time covering basic statistical concepts and techniques. While a certain amount of review is useful, the necessity of introducing new statistical concepts unduly burdens the limited course time available for operations analysis subjects.

In rare cases it might be possible to fully integrate the two subjects in one carefully sequenced package taught by a single faculty member. However, as a practical matter, this is often impossible, due to the separate faculties often teaching the two subjects.

A Course in Operations Analysis

As previously stated, the Task Force concluded operations analysis can be properly taught in a single quarter or semester course of full weight. Two basic strategies were identified as ways of bringing the subject matter to graduate students in hospital administration. One option, "alternative A," is to enroll students in a basic course taught by another school or department of the university. Such courses are commonly available in business schools, and tend to have a production management orientation. A second strategy, "alternative B," is to develop a special course in operations analysis for students in hospital administration (and related fields). The Task Force concluded that it was not in a position to recommend one approach over the other. However, hospital administration faculties should seriously consider the implications of each strategy.

Alternative A maximizes the use of basic campus faculties. It reduces or eliminates the need for a faculty member of similar qualifications in hospital administration, which is viewed by many universities as redundant. However, such a "basic" course cannot stand alone; it must be augmented by examples and applications in the health field. This is so because (1) student motivation is clearly greater when examples are drawn from the area of their professional preparation, (2) the value system of the health field and production industries is different, and (3) some characteristics of hospitals make the application of industrial-based operations analysis techniques difficult or inappropriate and the relative emphasis on certain topics should be modified. Preferably, such field relevancy is developed through some form of team or joint teaching, where health applications are introduced concurrently (the Task Force reviewed examples of such teaching at Cornell and the University of California, Berkeley).

If concurrent application is not possible, then sequential development of health content is satisfactory. (Again, the Task Force noted courses at several graduate programs that are intended to integrate and apply concepts from several theoretical streams.) Other graduate programs include practicum courses where students are offered field experiences in which to apply and test basic concepts.

Concerning Alternative B, the advantage of a course oriented specifically to graduate students in hospital administration seems obvious: problems of relevancy, integration of health content, and supervision of field experience are reduced.

The main drawback lies in recruitment and retention of qualified faculty. The Task Force concluded such faculty must be properly qualified in the basic discipline of operations analysis, and, preferably, have experience in the health field. Such faculty positions are enhanced by the opportunity for research. Also, financial support for such faculty positions can sometimes be obtained by sharing responsibility with related disciplines. (This opportunity exists particularly in schools of public health.)

A suggested one quarter/semester course is as follows:

SUBJECT	LENGTH OF TIME (in weeks) QUARTER	SEMESTER
INTRODUCTION: Concepts and Application to Health and Hospitals	1	2
General systems approach; programmed and nonprogrammed decision-making; suboptimization, etc.		

SUBJECT	LENGTH OF TIME (in weeks) QUARTER	SEMESTER
METHODS IMPROVEMENT WORK MEASUREMENT	1	1
Time standards, attitude measurement, quality control measurement, etc.		
FORECASTING	2	3
Deterministic and stochastic models, regression analysis, time series.		
INVENTORY AND TOTAL VALUE MODELS	1	2
SIMULATION AND COMPUTER SEARCH	2	2
Strengths and weaknesses.		
MATHEMATICAL PROGRAMMING	1	1-1/2
Demonstration of optimal solution under constraints; emphasis on linear model, with stress on graphic illustrations.		
CRITICAL PATH TECHNIQUES	1/2	1/2
QUALITY AND PRODUCTIVITY CONTROL	2	2
TOTALS	10-1/2	14

The subject of cost-benefit analysis was considered to be an important subject, requiring up to four weeks of class attention. The Task Force concluded the topic should receive full development in a course in financial management or managerial accounting; however, brief reference and introduction should be included in the course in operations analysis.

Concerning most of the above subjects, the various time periods proposed (typically, several class sessions) are necessary in order to cover basic concepts. The Task Force feels the relative times devoted to the various subjects are optimal given the one semester time constraint. Where programs wish to go beyond one quarter semester, the proportions given above do not necessarily hold. Different topics have different utilities for expansion and new topics might be added.

The topics presented could easily comprise a list of the technical models with which the typical operations researcher is usually equipped. The Task Force feels, however, that such topics should not be presented in the manner of solution techniques in search of hospital applications. Rather, the teaching format should first identify real hospital operating problems and then respond to these problems with the appropriate techniques. Such an approach requires some familiarity with the health field on the part of instructors. Some programs may face a difficulty in arranging for such instructors, yet the approach can make the difference between enthusiastic reception by students and complaints of lack of relevance.

Follow-up Experience

Operations analysis is a subject to which follow-up practical experience is highly desirable. Reinforcement of classroom material can be obtained, as well as further understanding of concepts, strengths, and weaknesses.

The detailed nature, scope, and sequence of such exposures will vary widely among graduate programs; this is desirable in order to permit further experimentation. Some possible patterns are as follows:

The inclusion of operations analysis in a formal course on research methods.

A distinct follow-up course, taught by the same faculty member(s) as described above, dealing in the application of operations analysis concepts and models.

Individual tutorials, involving student-initiated operations analysis projects.

Residency experience in hospitals with well-developed operations analysis departments headed by qualified staff personnel.

Use of operations analysis in other course work.

Inclusion of operations analysis in master's thesis research.

Concerning all field exposure courses or projects, the Task Force concluded operations analysis follow-up and application should be deliberately and carefully guided by faculty. Otherwise, essential reinforcement is not likely to take place.

Summary

Management in all fields is moving toward more objective decision making. This trend can and should be reflected in the curricula of graduate programs in hospital administration. Since these programs are aimed at the education of generalists in health services and hospital management, rather than specialists, the purpose of courses in operations analysis should be that of basic understanding of concepts, not technical proficiency. The intent is to make the potential administrator an effective consumer and manager of operations analysis, not a "doer."

In order to accomplish this end, the Task Force recommends the inclusion of a one quarter/semester course in operations analysis, followed by opportunity for guided field experience in the conduct of operations analysis. Subjects that are recommended for inclusion in the course are methods improvement and work measurement, forecasting, inventory, simulation, mathematical programming, critical path techniques, and measurement of quality and productivity. Follow-up experience will vary widely among graduate programs, depending on curriculum sequence, whether or not there is a residency, and other variables. Though the setting may vary, deliberate and careful guidance by faculty is important.

Course work in operations analysis is dependent on prior knowledge of statistics (as discussed in Chapter II). Without an introduction to statistics, preferably of the decision theoretic type, a course in operations analysis is severely compromised. Conversely, operations analysis represents an excellent way to apply basic statistics; the relevance and application of statistics is made obvious in operations analysis.

Concerning the faculty for teaching operations analysis, graduate programs have two choices: One is to enroll students in a basic course taught by another school or department of the university; and the other is to develop a special course for students in hospital/health services administration. Again, circumstances and opportunities will vary among graduate programs, and the Task Force does not recommend one approach over the other. There are important advantages and disadvantages to each, however, and these should be carefully weighed by each graduate program. In particular, if the first alternative is chosen, there is a strong need for concurrent follow-up effort by the hospital administrative faculty to show application and demonstrate relevancy of operations analysis to the health field. Readings pertaining to operations analysis follow in Appendix I.

APPENDIX I

SUGGESTED READINGS IN OPERATIONS ANALYSIS

Texts dealing with the philosophy and theory of systems:

Bogushaw, R., The Utopians, Prentice-Hall, Englewood, 1965.
Bross, I. D., Design For Decisions, MacMillan, New York, 1964.
Churchman, C. W., The Systems Approach, Delacorte Press, New York, 1968.
Simon, H. A., The New Science of Management Decision, Harper, New York, 1960.

Texts dealing with the management of systems:

Bursk, E. C., and Chapman, J. F., New Decision Making Tools For Managers, Cambridge, Harvard University Press, 1963. (Paperback: Mentor, New York)
Cleland, D. I., and King, W.R., Systems Analysis and Project Management, McGraw-Hill, New York, 1968.
Fisk, G., The Analysis of Business Systems, Gleerup Pub., Lund, Sweden, 1968.
Johnson, Kast and Rosenzweig, The Theory and Management of Systems, McGraw-Hill, New York, 1963
Kast, F. E., and Rosenzweig, J. E., Organization and Management, McGraw-Hill, New York, 1970.
Shuchman, Scientific Decision Making in Business, Holt, Rinehart, Winston, New York, 1963.
Young, S., Management: A Systems Analysis, Scott Foresman, Glenview, Ill., 1966.

Texts dealing with operations research techniques:

Ackoff, R. L., and Sasiemi, Fundamentals of Operations Research, Wiley, New York, 1968.
Churchman, Ackoff and Arnold, Introduction to Operations Research, Wiley, New York, 1958.
Flagle, Huggins and Roy, Operations Research and Systems Engineering, Johns Hopkins Press, Baltimore, Md., 1960.
Hillier, F. F., and Lieberman, Introduction to Operations Research, Holden-Day, San Francisco, 1967.
Miller, D. W., and Starr, M. K., Executive Decisions and Operations Research, Prentice-Hall, Englewood, 1969.
Schellenberger, R. E., Managerial Analysis, Richard D. Irwin, Inc., Homewood, Illinois, 1969.

Texts dealing with operations research techniques: (continued)

Theil, Boot and Klosk, Operations Research and Quantitative Economics, McGraw-Hill, New York, 1965.

Wagner, H. M., Principles of Operations Research, Prentice-Hall, Englewood Cliffs, 1969.

Texts dealing with operations research in the health field:

Smalley, H. E., and Freeman, Hospital Industrial Engineering, Reinhold, New York, 1966.

Journals:

General, Technical --

Management Science, Journal of The Institute of Management Sciences.

Operations Research, Journal of the Operations Research Society of America.

Health Field --

Health Services Research, quarterly of the Hospital Research and Education Trust.

Abstracts:

General --

International Abstracts in Operations Research.

Health Field --

Abstracts of Hospital Management Studies, published quarterly by Cooperative Information Center, University of Michigan.