REPORT ON THE
AMERICAN STATISTICAL ASSOCIATION CONFERENCE
ON TRANSFER OF METHODOLOGY
BETWEEN ACADEMIC AND GOVERNMENT STATISTICIANS

MARCH 8-10, 1978

RESTON, VIRGINIA, U.S.A.

AMERICAN STATISTICAL ASSOCIATION

806 - 15TH STREET, N.W., WASHINGTON, D.C. 20005

NOTE:

This report is based on work and a Conference supported by the National Science Foundation under Grant No. Soc77-13982.

Any opinions, findings, conclusions or recommendations are those of the participants in this undertaking and do not necessarily reflect the views of the National Science Foundation.

The report is published by the American Statistical Association to bring the findings and recommendations to the attention of concerned agencies and organizations, scholars in the field, and the general public.

TABLE OF CONTENTS

TABLE OF CONTENTS - (Continued)

PREFACE

Official statistics, collected and disseminated by governments, are playing a growing role in all countries. In the industrially developed countries as well as in the developing countries, governments increasingly have a need for timely data covering a wide field of social and economic activity. Censuses, sample surveys, and administrative records are being called upon to meet continuing and new needs. In many instances governmental statistical activities have continued in long established ways, almost impervious to changing needs. In others there have been efforts to develop needed data, without an adequate base of trained personnel and without the advantage of newer techniques for the accumulation and utilization of basic data.

Statistics as a field for advanced study has also had a rapid development. Making effective use of available data and improving the collection of data have been long time concerns of academic statisticians. But increasing specialization in the several branches of the field has too often led to a lack of communication among statisticians. This has resulted in the situation that the contributions of newer developments in statistical theory have not been adequately applied in governmental statistical work, even when allowance is made for the normal lag between the development of a new theoretical insight and its application to ongoing statistical programs. Much of the government's statistical work must be on a relatively large scale in order to reflect conditions and developments throughout the country. Continuity of practices and of series are often given a very high priority. Hence change might provoke controversy. In that situation numbers are

sometimes surrounded with an aura of finality, and any discussion of error structures would be treated as heresy.

The International Statistical Institute has drawn attention to the growing "gap" in communication, especially between workers in theoretical statistics and those who produce the official data. That Institute, as well as the American Statistical Association, has devoted much effort to finding ways of increasing communication, for it is believed that all statistical development would benefit from mutual understanding of the theoretical contributions as well as the problems faced by workers in the various subareas of statistics.

The Conference which led to this report was an effort to explore ways and means for improving communication among statisticians. It was in a full sense a working Conference, for every participant assumed a task in facilitating the discussions which took place and in the preparation of this report. Certainly there was no lack of communication among the governmental and the academic statisticians who were assembled in Reston, Virginia in March 1978. Their observations, conclusions, and recommendations are offered as one step in the continuing efforts to make the statistical enterprise more effective, and thus a greater contribution to the public welfare.

A single conference can help to highlight some of the elements in a continuing effort to improve the contributions of statistics to the society. The International Statistical Institute is going forward with its Committee on Integration of Statistics. Several members of the Committee participated in the Reston Conference and the Committee's report in early 1979 is expected to carry through many of the suggestions made in this report. It is expected that national statistical societies will use this report and

the forthcoming report to strengthen their own activities toward common goals.

The report presented here includes the results of the discussions, the background papers, as given by the authors without additional editing, and a summary of the suggestions and recommendations which emerged. No formal votes were taken and it is unlikely that all participants would agree to every statement or recommendation which is included in this report. The participants were there in their personal capacities and expressed their own points of view.

We are grateful to the National Science Foundation of the United States for their generous support which made it possible to hold the Conference and to disseminate the findings and recommendations. We hope that others will find these observations helpful in their efforts for improvement.

Washington, D.C.

CHAPTER I RECOMMENDATIONS

INTRODUCTION

Professional associations have a longstanding tradition of serving as communicators among the various branches of their respective professions. Nearly all professions are characterized today by growing levels of specialization with the consequence that it is increasingly difficult to assure adequate communication among these specialized branches.

In their Presidential addresses, both Petter Jakob Bjerve of the International Statistical Institute and Leslie Kish of the American Statistical Association expressed concern over what they viewed as inadequate communication among the several branches of statistics. They reported that the recent growth of statistics had been accompanied by a lack of adequate communication among specialists. This lack of communication was felt to be especially serious in relation to the large body of statistical information being produced by governments, and the academicians who are developing statistical methodologies and theories. It was felt that in many instances government statisticians were not adequately informed about new methods which could significantly improve the statistical information which is the output of government statistical agencies. Conversely, it was pointed out that frequently the development of statistical theories is not adequately oriented to the types of problems that arise in the production of official data.

Improving the quality of statistical work is a major objective of the International Statistical Institute, as well as of national statistical organizations. Their publications and their periodic conferences provide a meeting ground for the discussion of common interests and problems. However,

the degree of specialization which has occurred has tended to impede rather than enhance communication among the diverse specialties. Leaders in the field have talked about the need to "build bridges" across the gap in communications between those who are developing statistical theory and the practitioners in applied statistics.

Leaders in governmental statistics have expressed the view that much of academic training is not relevant to the work for which they are responsible. On the other hand, when graduates of advanced training are employed in government statistical agencies they often report that the work to which they are assigned does not provide adequate scope for the application of skills they acquired in their university training.

The International Statistical Institute has established a Committee on the Integration of Statistics which is charged with an examination of the nature of the gap in communications and an exploration of means for dealing effectively with it. In November 1976 the Asian Statistical Institute arranged a panel discussion on communication and cooperation between theoreticians and practitioners.

The American Statistical Association has also been concerned with ways of fostering more effective communication among the several specialties which have developed. As one means of fostering better communication it proposed to the National Science Foundation that a conference be arranged to consider the transfer of methodology between academic and government statistics. In its proposal it stated:

> "The growing specialization in scientific disciplines has created increasing problems of communication. These affect persons in different disciplines, and even those in separated branches of the same discipline. The gap in communication is often especially marked as between the specialists who are concerned with theory and those who work primarily in applications to real life situations.

"Statistics has not escaped this communication gap. There is a growing lack of understanding between the applied statisticians in government or private endeavors, and those who are engaged in more academic pursuits. The supervisors of applied statistical work often complain that they must spend time retraining individuals with a good academic background. In the academic world there is growing a subtle, but discernible, attitude that applied work is somehow of a lesser order of value and that the most competent people should not become deeply involved in it."

A grant by the National Science Foundation to the American Statistical Association made it possible to convene a conference including U.S. and international experts in the area. It met in Reston, Virginia, U.S.A. on March 8-10, 1978. The director of the Conference was Conrad Taeuber. The findings of that Conference are summarized in this report, which has been prepared by Conrad Taeuber, Fred C. Leone and Joseph Duncan.

The Conference arrangements provided a designated responsibility and role for each of the participants. Background papers were distributed in advance. The background papers and authors were:

Academic Training Required for Government Statistical Work - Ivan Fellegi

In-Service Training for Statisticians - Marie Eldridge

Exchanges of Statisticians - I. Richard Savage

Standardization of Procedures for the Evaluation of Data: Measurement errors and statistical standards in the Bureau of the Census - Morris Hansen et al.

Advisory Committees - from a report of the Joint Ad Hoc Committee on Government Statistics

Cooperative Arrangements between Governmental and Non Governmental Statistical Organizations - Miloš Macura

Other Conference members served as chairs of the discussion sessions, rapporteurs, and related tasks.

The rapporteurs' reports and the background papers are contained in separate chapters of this report. This first section presents the general

findings and recommendations which emerged from the discussions.

A paper, University Teaching for Future Official Statisticians by Edmond Maulinvaud, president-elect of the ISI, was included among the background papers, although Mr. Malinvaud was unable to take part in the Conference. Also included is a paper by Dr. M. N. Murthy entitled Statistical Education, Training and Research and Their Utilization.

Mr. Vincent P. Barabba, former Director of the U.S. Bureau of the Census, was invited to address the members of the Conference at an evening session. His address, Building a Bridge to Effectiveness is included in these proceedings and is given as Chapter VIII.

GENERAL FINDINGS

Transferring new methodology from academic research into practical use in the government is important for the continued and healthy development of national statistical services. During the Conference a number of examples of useful transfers of methodology were cited.

The American Statistical Association and the U.S. Bureau of the Census are currently sponsoring a three year project, entitled: "A Research Program to Improve the Social Science Data Base." Its purpose is to develop a program of research at the forefront of statistical techniques applied to the social sciences and to supplement both the experience of senior social scientists and training of graduate students in statistics, economics, demography and related areas by exposing them to real-world statistical problems encountered in a large data collection agency, the Bureau of the Census. This unique experience brings together the personnel of a government agency and researchers in the social sciences, and it is a joint effort of academic and government statisticians and social scientists for advancing scientific knowledge.

The Conference participants discussed a wide range of techniques that can be used to assure (1) closer working relations between academic and government statisticians, (2) sustained professional development of government statisticians, and (3) methods for introducing practical problems into academic problems.

In summarizing the Conference, Sir Claus Moser, Chief Statistician for Great Britain, noted that he was impressed by the fact that while this is a fundamental problem, there are many things which can be done to improve the exchange between government and academic statisticians. He underscored

the fact that many of the suggestions made during the Conference had placed responsibility on three sectors:

1. Professional Statistical Associations,
2. Universities, and
3. Government Statistical Offices.

He stressed that the statistical associations, both national and international, are especially well placed to have a major impact on solving the problem and implementing the recommendations of the Conference.

It was also concluded that wide dissemination of the findings and recommendations of the Conference would make a substantial contribution by calling attention to the problems that were cited.

Since this Conference was primarily organized by the American Statistical Association, and its principal dissemination will be through the Association, the conclusions and recommendations are organized by first focusing on what the national and international statistical associations can do. This is followed by discussion of suggestions to academic institutions and to government statistical offices, in that order.

THE ROLE OF NATIONAL AND INTERNATIONAL STATISTICAL ASSOCIATIONS

The professional statistical associations have traditionally been a major factor in shaping university curricula by providing the forum for exchange of information on new and developing curricula and research programs at the universities. The associations do this through their national meetings and publications. The Conference stressed that the nature of university training is an important factor in building mechanisms for improved integration of statistical activities between theoretical and applied work. There was full agreement that only a small proportion of university graduates will be directly employed by government statistical offices. Therefore the view prevailed that university training should provide the basic tools relating to both statistical methodology and the subject matter of government statistical work. It was agreed that there is a need for more subject-matter training of statisticians who are likely to have careers in applied statistical work.

An essential step in improving communication among different branches of statistical work is to find common definitions of the problems to be addressed by the statistical programs. This requires basic understanding of the information needs of the societies which the public and private statistical agencies are committed to serve. In addition, there is a need to define more precisely in operational terms the design of information gathering and disseminating mechanisms. It is not enough to produce needed statistical data. To be useful, statistics need to be conveyed in understandable form to the decision makers at all levels of society.

In the United States, and in some other countries, university teaching of statistics is not the exclusive responsibility of the statistics departments. The Social Science departments often teach and do research in

statistical areas of specific concern to the statistical agencies. The recommendations regarding statistical training are addressed to all university departments which carry on statistical teaching programs.

RECOMMENDATIONS TO NATIONAL STATISTICAL ASSOCIATIONS

Curricula

The Conference proposed that national statistical societies, such as the American Statistical Association, the Royal Statistical Society, and The Indian Statistical Institute, survey university curricula and seek to find ways to insure that potential employees of government statistical agencies will have appropriate training in the subject disciplines.

The Conference reviewed several suggestions for improving the academic training required for statistical work. In particular, there was an extended review of the extent to which statistics courses should include fundamental applied training on such topics as principles of sampling and survey design, survey methods, organization, analysis, construction of tables, graphic methods, data analysis, and methods of measurement in social and economic statistics. Training in a subject matter field involving the application of statistics, econometrics for example, would be desirable. While there was some disagreement as to the additional topics to be included in university training for government statisticians, there was general agreement concerning the topics listed above, and that opportunities for practical data analysis and compilation would be helpful.

Teaching Materials

National Statistical Associations should seek to encourage the development of data sources which can be used in university curricula to give experience in practical statistical education. (See related recommendation under Government Statistical Offices.)

Exchange of Personnel

National Statistical Associations should develop a compilation of existing exchange opportunities and arrange for distribution throughout the

profession. In the discussion concerning exchange programs, it was noted that they can provide many benefits, especially if there is adequate planning and preparation by the receiving agency and if proper account is taken of the costs to the individual in terms of changing geographic location, breaking continuity of employment, and potential risks for advancement. (This problem, from the academic point of view, is discussed under Academic Organizations.)

National Applied Training Institute

The large national statistical associations should consider the development of a National Applied Training Institute which will reach out to universities for faculty and to government and business organizations for students. It could be a national center for training and applied research in statistics.

Conferences

National statistical associations are encouraged to hold national conferences to study the issues raised at this conference and to develop functional mechanisms or entities to focus on the more effective application of modern statistical procedures in the production and dissemination of statistical information. Such conferences should assure that diverse perceptions and views are represented and that recommendations and the reports of discussions reflect a real synthesis of what initially may have been widely different positions.

Advisory Committees

The National Statistical Associations should seek to develop advisory groups which will review and offer suggestions to Government Statistical Offices. A number of situations have demonstrated the value of organized

advisory councils' input to government agencies. The independence of such advice is important.

Other Association Actions

Organize seminars and workshops for the consideration of problems of official statistics.

Work toward the improvement of standards for statistical personnel and for statistical practice.

Work closely with social scientists who use statistical data and methods in their research and/or teaching.

Monitor statistical practice in official statistics and develop standards for the presentation of statistics and their error structure.

Promote continuing examination of the concepts underlying statistical series and the modification of series which are found to be inconsistent with their objectives.

Stimulate the abolition of series which have outlived their usefulness, and the development of new series which are needed to fill serious gaps.

Assure that statistical journals devote attention and space to problems encountered in official statistics.

RECOMMENDATIONS TO THE INTERNATIONAL STATISTICAL INSTITUTE

International Exchange

The International Statistical Institute should examine and develop opportunities for joint international programs through national professional associations.

Other ISI Actions

Continue to support the Committee on the Integration of Statistics of the ISI in its efforts to improve communication and cooperation between theoreticians and practitioners.

Encourage the Statistics Education Committee of the ISI to develop programs for the training of professionals who will be primarily concerned with the production of statistics.

Cooperate with existing and prospective international statistical training institutions which are oriented to the training of statisticians in the public service of their countries.

Promote upgrading of officials in the statistical service of their countries both through the development of standards for such personnel and through appropriate training programs.

Continue to enhance its program for the development of standards for the collection and dissemination of statistical data and collaborate with the United Nations Statistical Office and other international bodies in regard to standards for statistical work.

RECOMMENDATIONS TO UNIVERSITIES AND OTHER EDUCATIONAL INSTITUTIONS

The Conference participants noted that there are several factors in universities which inhibit faculty members from undertaking extensive applied work. These factors include such matters as promotion criteria, peer group pressure concerning publications, and refereeing guidelines relating to technical journals.

There is some limitation on the extent to which universities can undertake all of the inservice-type training which is desirable for continuing education of applied statisticians. While universities should be encouraged to develop such programs, there is also a potential role for the National Statistical Associations.

At the same time it was noted that the declining enrollment in universities combined with the large supply of Ph.D. trained statisticians suggests that universities must begin to reorient their focus from training future teachers to training future workers in applied fields. This suggests that the universities seek methods for providing greater emphasis on applications work.

Joint Appointments

Universities could establish joint appointments with government and business statisticians so that the practical experience and applications work of these individuals can be integrated into the curriculum.

Recognition for Applied Work

Promotion criteria should be expanded to give due credit for work accomplished under consulting agreements or exchange programs. Participation in ad hoc training institutes should be given appropriate recognition when the work of University staff is reviewed.

Curriculum

Universities are urged to develop integration of subject disciplines within statistical training. This may be accomplished by joint programs with subject-matter departments or by introducing subject-matter examples into statistical work. If improved data sources can be made available, expecially by government statistical offices, and casebook materials be developed concerning practical problems, university curricula could be revised to take account of these materials.

Universities should be encouraged to review independently their curricula to determine if improvements can be made in applied work. Consideration should be given to creating masters-level programs which are applied in character and which meet the needs of statistical offices in business and government.

RECOMMENDATIONS TO GOVERNMENT STATISTICAL OFFICES

Government statistical offices are often criticized for not using the latest methodology or for inadequately examining and analyzing aspects of statistical data collection. It was noted that some statistical agencies do well in this regard, but additional opportunities exist for generating closer relationships with universities. In particular, it was noted that work on statistical standards and methodology offer opportunities in this area. Further, it was noted that many problems, such as inadequate professional standards, exist in the smaller statistical offices.

Methodology Groups

Government statistical offices should establish methodology groups to focus on the theoretical issues associated with government statistical programs. These groups can become a natural communication link with the university statistical departments.

Standards

The establishment of statistical standards is a good meeting ground for academic and government statistical interests. Consequently, government agencies should seek academic involvement in the development of standards for statistical work.

Government statistical offices, like businesses and other enterprises, need to establish well planned programs for continuing professional development of the staff. Exchange programs with universities offer some possibility for bringing government statisticians into closer contact with newer statistical concepts.

Inservice Training

Government statistical offices should develop inservice training programs

designed to bring in university professors to provide introductions to new methodological developments within the statistical profession. Efforts should be made to work with the universities in developing applications programs for continuing education which may be held either in government organizations or at the universities themselves.

Useful guidelines to the merging of theoretical and applied training have been developed in such programs as Operations Research and Systems Analysis. Through such efforts students and faculty have been sensitized to the needs of the "practical world," the contributions which theoretical insights and developments can make, as well as to the needs that remain unfilled.

Several participants in the Conference stressed that government agencies frequently fail to identify or define the types of problems which need attention in university research.

Collaborative Undertakings

Government agencies should foster opportunities for collaboration with academic statisticians through such procedures as the employment of consultants, temporary exchanges of personnel with academic institutions, and study leaves for senior and junior staff members. The preparation of statistical monographs should be encouraged. This applies to those dealing with specific substantive topics and those dealing with statistical methodology. The preparation of monographs should involve members of the governmental statistical staffs, as well as members of the academic community and other nongovernmental specialists. Specific arrangements for such collaboration will vary with the topics and the organization for the preparation and dissemination of monographs.

Case Studies

Government statistical offices should develop materials to describe vexing problems with which they are faced. Government statistical offices should also develop data packages which simulate practical governmental applications such as case studies. These materials can be used as training materials in universities.

Access

Government statistical offices should develop procedures for increasing access of university researchers to government statistics so that appropriate research can be undertaken. Such research can lead to government-university collaboration and is likely to result in suggestions for improvement of the data.

The academic representatives suggested that access to government data bases is often delayed or limited in appropriate detail, making it difficult for academic research to carry out analyses of the data.

Advisory Committees

Government agencies are urged to cooperate in the establishment of advisory committees and ad hoc groups as may be needed to improve official statistical programs. The purpose and function of each committee should be specified very clearly, and the necessary preparation should be required both by the agency and the committee members.

Conrad Taeuber
Fred C. Leone
Joseph Duncan

CHAPTER II STATISTICAL STANDARDS FOR GOVERNMENT SERVICE

Report on Statistical Standards for Government Service

Joseph Waksberg summarized the Hansen-Hurwitz-Pritzker paper on standardization that had been distributed before the meeting. He recapitulated the Hansen et al decomposition of error into four components: (1) random sampling and measurement error, (2) bias of the survey in its own terms, (3) bias of relevance of the survey to the underlying concept, and (4) the interaction of (2) and (3). (3) and (4) are especially difficult to deal with and it is not clear whether the statistician or the subject matter specialist (or both) should be primarily responsible. Controls and minimum performance standards were touched on, as was the need for research on rational allocation of resources in large statistical programs. In addition, there were discussions of standards for presentation of error structure, for documentation of survey design and execution, etc. Four major areas of concern were sketched: (i) communication among the relevant groups, (ii) development of evaluation procedures, (iii) wide and frank discussion of inadequacies, and (iv) the division of resources between data collection and presentation on the one hand, and research on the other.

M. N. Murthy summarized his paper, "A Note on Statistical Standards for Government Service."* He listed twelve areas needing standardization ranging from concepts to presentation of results. Work toward standardization has been carried forward by the United Nations and the related specialized agencies and in some individual countries. There is a need for periodic review of prevailing statistical standards, taking into account the differing requirements of different nations. There is need also for

---

*Not included in this report. Copies available from Dr. Murthy.

unified treatment of problems of standardization.

A widely ranging general discussion then began--a great deal of it related to statisticians vs. subject matter specialists in statistical agencies. Who is the statistician and who the subject matter specialist (e.g., economist, psychologist, sociologist)? What are their respective roles in agencies, especially in setting standards and introducing new technology? Is the distinction really a sharp one? The statisticians themselves may perhaps be conveniently divided into the theorists and the data collectors. There are many interfaces or gaps over which bridges are helpful, but it must be remembered that separation of discipline and specialization can also be helpful in the sense of division of labor.

Academics who are not statisticians frequently have been helpful to agencies on problems of substantive analysis (e.g., crucial role of economists on the concept of unemployment). Academic statisticians have been helpful not only on the technical statistical side of agency work but also in developing methods for measurement and analysis, such as factor analysis, clustering, scaling, etc.

Discussions of standards are useful in bringing together different types of statisticians, in sharpening their respective roles, and perhaps also in aiding coordination among different kinds of institutions: universities, national and international agencies, research institutes, etc.

One example of transfer of methodology between universities and government was the application of demographic methods, as developed by Ansley Coale, to analyze undernumeration in the Census of Population. Another is the Chandrasekhar-Deming approach to adjusting a cross-classified sample when the true marginals were effectively known. The Gladys Palmer approach to the labor force concept was suggested also as an example. Two

potential examples at different stages of current development are (1) the use of randomized questions on delicate matters, and (2) development of methods to permit more rational establishment of statistical priorities. Mahalanobis' technique of interpreting subsamples for estimating sampling errors in composite estimates, as well as certain nonsampling errors was also cited.

Relationships with the public and with legislatures were discussed, especially in connection with the Hansen et al suggestion that a quarter to a third of a statistical budget be devoted to research, experimental studies, quality control, and evaluation. Some felt this was excessive or unrealistic; others wished to discuss tactics in the stated direction. It was pointed out that in the past infusions for research type activities tended to come after some problem had come forcefully to the attention of a legislative body or the public, especially if the problem was one of the quality of the data. A related discussion dealt with public disclosure of limitations and errors since such disclosure, itself highly meritorious scientifically, could lead ironically to public criticism. A third topic in this general rubric was that of the distinction between measures of data accuracy to which statisticians are accustomed and measures tailored to the direct needs of users.

Another theme dealt with the development of important new methodological results within official statistical agencies as well as in universities and other sites outside the agencies. It was pointed out that the agency people present were from those agencies with the highest reputations and best scientific histories. In contradistinction, there are other official agencies that have major statistical problems and do not even

recognize them as such. There is a wide spectrum of quality among agencies and sub-agencies.

There were one or two comments - for which time did not permit development - about fundamental philosophical approaches to statistical inference and relationships between those approaches and the setting of standards Another set of remarks dealt with complex statistical research by econometricians, psychometricians, and others, often without reference to closely related activity by those primarily identified as statisticians.

At several times the question arose of what was really meant by the term "statistician." Perhaps it is appropriate to end this summary by giving one brief reply to which no one took exception. "A statistician," said one of the participants, "is a person who really cares about understanding error."

Recommendations:

1. Government agencies should seek academic involvement in the development of standards, especially since this is a good meeting ground with academic statisticians.

2. Government statistical agencies should have clearly defined sets of standards for the documentation of data, presentation of errors, and for access to micro-data. This would make for more effective use of the data by government and non-government users and lead to more contacts between them.

Prepared by William Kruskal

STANDARDIZATION OF PROCEDURES FOR THE EVALUATION OF DATA: MEASUREMENT ERRORS AND STATISTICAL STANDARDS IN THE BUREAU OF THE CENSUS*

1. INTRODUCTION

In this paper we shall concentrate primarily on quality and its evaluation. We shall start the discussion of standardization of procedures for the evaluation of statistical surveys by introducing some statistical concepts and defining some terms.

Statistical Surveys

Basic to the definition of a statistical survey are the notions of a defined population (people, business establishments, bank accounts, farms, etc.) and of a set of measurements made on individual elements of the defined population: The measurements may be made on a sample or census of the defined population, and may be recorded responses to questions, transcripts from records, physical measurements, or any other way of assigning values to characteristics of individual elements of a population.

We shall view a statistical survey from three perspectives--requirements, specifications, and operations. First, there is a set of requirements imposed by a problem. Presumably these requirements are identified by the subject-matter specialists concerned with the problem (or by an official, an administrator, or a statistician acting as a subject-matter specialist). These requirements define the desired (relevant) population, types of measurements needed, space and time dimensions, frequency of collection, the needed functions of the measurements (statistics), etc. Second, there is a set of specifications for the collection, compilation, and presentation

---

*This is excerpted from Proceedings of the 36th session of the International Statistical Institute, Sydney, 1967. Volume XLII, Book 1

of the survey data. Third, there are the actual operations of collection, compilation, and presentation in which, again, the essential feature is that measurements are made (i.e., data are collected) on individual elements in a census or a sample of a defined population.

This view leads us to conceive of three factors relevant to evaluating the outcomes (statistics) of a statistical survey--the ideal goals which are defined or implied by the purposes to be served by the survey, the defined goals, which may be more operationally feasible, and the expected values of the operations actually carried out. Thus, we conceive, first, of a set of statistics that would have been produced had all of the requirements been precisely defined and rigorously met. This set, (Z) constitutes the ideal goals of the statistical survey. Second, in practice we often define as our specific survey goals something less or different from achieving the ideal goals. Thus, we conceive that the specifications actually set forth for the statistical survey, if carried out precisely and rigorously, would yield the defined goals--a set of statistics (Y). Third, actual performance rarely achieves fully the goals set for it, and the survey as actually conducted yields a set of statistics (x). We shall refer to the statistics (x) as estimates. We conceive of a large number of possible repetitions of the survey (independent replicates of the survey all conducted under the same essential conditions), and we regard the survey we actually take as a sample of one from this set of conceived replicates. The hypothetical averages of the replicates are a set of average values (X) of the various statistics which we conceive of as the expected values of the survey procedures.

The General Concept of a Mean-square Error of a Survey Estimate

We are now in a position to define some concepts which may help clarify our discussion of statistical standards. For a particular statistic, x, we can conceive of its mean-square error:

$$MSE(x) = E\,(x - Z)^2$$

$$= E\{(x - X) + (X - Y) + (Y - Z)\}^2$$

$$= E\{\underbrace{(x - X)^2}_{I} + \underbrace{(X - Y)^2}_{II} + \underbrace{(Y - Z)^2}_{III} + \underbrace{2(X - Y)\,(Y - Z)}_{IV}\}$$

where 'E' in the expressions above represents the average of the hypothetical replicates over repeated trials.

This overall mean-square error provides one means of conceptualizing the question: How well did the statistical survey attain its goals? Each numbered term of the mean-square error provides a conceptual measure or means for evaluating various aspects of the sources of error or inadequacy in a survey estimate, as follows:

I--Variance, both sampling and nonsampling. This is a measure of the variability of the survey results over repeated trials under the same essential conditions.

II--The square of the bias of the actual survey operations as related to the specifications that have been laid down. The bias includes the combined impact of any sampling bias and of any measurement bias, and also reflects the average effect of other failures to achieve survey specifications in the actual operations.

III--Relevance of the survey specifications as related to the requirements.

IV--The interaction between terms II and III, the measures of bias and relevance. This term is zero if either of the terms II or III is zero.

We use the term accuracy to refer to the extent to which the survey estimates meet the explicitly defined goals of the survey. Thus, accuracy is measured by the combined contributions of terms I and II in the mean-square error.

There is a long, untravelled road for statistical surveys in general between actual practice and the evaluation of the mean-square error as we have defined it, although sometimes we do reasonably well in estimating the first two terms, and occasionally the third term. In any event, the mean-square error provides a basis for discussion and clarification of some concepts.

We shall now turn to a discussion of various aspects of procedures and standards for the evaluation of surveys, and shall make use of the mean-square error and its components in an effort to help clarify some of the discussion. We shall also call attention to the substitutes that we have used for the mean-square error to ensure minimum performance standards.

2. STANDARDS OF RELEVANCE AND RESPONSIVENESS OF A STATISTICAL SURVEY TO INFORMATION NEEDS

There are some instances when the defined goals, (Y), are the same as the ideal goals, (Z); for example, simple statistics on age and sex. Often, however, the ideal and the defined goals are necessarily different. For example, they differ where ideal goals cannot reasonably be translated to a set of operations that conform to the requirements. In some extreme cases the ideal goal may be expressed as some more or less vague set of intentions, and thus the definitions adopted for the survey may be somewhat arbitrary and have only limited relevance. The requirements for a survey of public opinion or of housing quality may be of this type. There is a gradation in the adequacy of the statements of requirements ranging from vague intention to precise definition. The requirements that can be met in a survey of unemployment are less precise than those for a survey of age but more precise than those for a survey of public opinion.

A second situation where the ideal and the defined goals differ is where there is a requirement that some function of the observations be constructed that will serve to predict the future or as a complex index intended to provide a measure of some current phenomenon not directly measured in a given survey. In this case the set (Z) consists of the true values of the quantities to be predicted or of the index.

The evaluation activities conducted at the Bureau of the Census have paid little formal attention to estimating the requirement term in the mean-square error. However, a great deal of attention has been given to the relevance of various measures in the design of surveys to meet the needs of various programs. We have been guided in determining the requirements for our statistical programs by the approaches and considerations such as those set forth in the paper by Hansen and Voight to be presented at these meetings. (2) *

A promising approach to the assessment of the adequacy of a statistical survey from the standpoint of relevance and responsiveness to a particular need has been developed by Moore and Shiskin. (3) Their approach is that of the explicit assignment of point scores to various aspects of a statistical survey. Moore and Shiskin are concerned with requirements for surveys designed to produce statistics that will serve as economic indicators. Their method of evaluation is to assign weights to the requirements and scores to the surveys themselves with respect to how well they fulfilled the requirements. The weights and the scores represent judgments made after consultation with experts in the field. The scoring system is not limited to an evaluation of relevance but is heavily weighted in that direction.

---

*See original paper for this and other references.

3. THE ACCURACY OF SURVEY RESULTS-- STANDARD PROCEDURES FOR CONTROL OF VARIANCE AND BIAS

Achieving Acceptable Accuracy Standards Through Appropriate Design

Good survey design calls for reasonably effective control of the accuracy of survey results through appropriate specifications for survey procedures and adequate control of the operations--that is, through proper design of the total system. In principle, the criterion of effectiveness that is to be used is that of the minimization of mean-square error per unit of cost while meeting other requirements such as timeliness of results. The analysis of the system then comes down to an examination of alternatives, rationally and experimentally. This examination itself constitutes a challenge in making effective use of available resources. Many types of resources may be available to be examined and explored, including administrative or other records, that may provide directly the desired measures or may facilitate sampling. Other resources include theory, equipment, personnel (including procedures for their selection and training), etc.

Survey design has a role not only in the choice among alternatives but also in the means for control of operations that are finally specified. There is a danger of both over-control of a survey and of inadequate control. Where the accuracy requirements are modest and where large errors do not have costly consequences, controls can be relaxed. But where there are high requirements on accuracy, the losses can be great if the operations are not reasonably controlled to achieve the desired levels of accuracy, at least to the extent feasible within the present knowledge of measurement processes. Meeting high standards of accuracy may call for limiting the choices to probability sampling methods and to tested and evaluated measurement procedures. It also calls for introducing adequate control operations,

including formal quality plans, in order to ensure reasonable conformance to specifications. Surveillance of the controls is required to ensure that the controls are being carried out.

Limiting the choice of methods to procedures that can be reasonably well controlled may also mean making sacrifices in choosing statistics that are somewhat less relevant than desired, in order to have measurement methods that can be controlled reasonably well in actual operations. Thus, we may sacrifice something in the definition of income to make it more measurable. We cannot choose almost wholly irrelevant statistics just to make them measurable--but may need to compromise relevance to some degree in order to define measurements for which accuracy can be controlled.

We conclude that in areas where measurement methods are understood and under control, the function of design is to keep the bias term contributions (term II in the MSE) to a level near zero, and to allow sampling and response variance to contribute to the first term at expected levels. This approach calls for a knowledge of sampling and measurement variances, and a type of design to achieve low variance per unit of cost. This is an approach by which desired standards can be achieved in survey design, if our state of knowledge and resources is such that the desired standards are achievable.

We attempt to achieve this kind of control in design and operation in important surveys in the Census Bureau. We use formal quality control programs in the various aspects of surveys (in the field collection of information, and in the processing operations). (4,5) We also try to restrict ourselves to designs that are subject to reasonably effective control. In some areas we still have much to learn, in others we do reasonably well.

Role of Research and Evaluation Programs

In practice we can only incorporate effective methods into the survey design by continuing research and evaluation programs, and by appropriate feedback from these programs to ongoing and future survey designs. Research and evaluation studies are the basis for trying to understand the consequences of methods that have been used and that are considered for use. Some of the research relevant to this discussion involves extensive evaluation studies, including efforts at estimating various contributions to the mean-square error. (A number of references are given at the end of this paper.)

Estimation of the Variance and Bias of Survey Estimates and of Contributions to Them

The problem of measurement in social and economic surveys is more difficult than is commonly understood. We must recognize that in general truth is unknown to us and unknowable. We can, however, know the results of a particular set of measurement operations that are carried out under more or less effective control. Often, we have a tendency to believe that by more intensive measurement, that is by simply collecting more detailed information, we can at least approach more closely to some underlying truth, and there is evidence to confirm this view. But some experience shows that reliance on this approach is not necessarily justified. Generally, our experience shows us that there is no easy road and that we must be wary of unwarranted conclusions.

Estimates of total sampling variance for important statistics are relatively simple and are made more or less routinely in our surveys. The estimation of various contributions to sampling variances and how these would vary under alternative designs is sometimes routine but often requires

special analyses and studies. Such information is needed to guide future improvement in design.

More difficult is the estimation of response variances and variances contributed by other aspects of the survey process, including variance contributions from editing and coding, and other procedures. Particularly difficult is the estimation of biases in the measurement processes.

The results of alternative and intensive measurement procedures not only provide some inferences about accuracy of a measurement system--but also can be used directly to introduce corrections and to provide improved statistics.

Some of the methods we have used in an effort to measure response (of measurement) variances and biases include repeated interviews or observations under essentially the same conditions as the original measurements were obtained, use of more intensive remeasurement methods through reinterview or direct observation, checking of records, studies that match the results of one measurement system and another, and attempting to reconcile or account for differences, and analytical studies of the internal consistency of results.

We have developed mathematical models that have guided us in the design and interpretation of such studies. Such studies are exceedingly helpful but sometimes difficult to carry through and often rather expensive. The discussion of details appears elsewhere. (3) Such studies are essential if measurement results are to be increasingly understood and accuracy standards established and achieved.

We have sometimes designed experiments for the estimation of variance and bias components independent of ongoing jobs. However, we have found

that costs can be appreciably reduced if our research efforts are tied to ongoing projects. Usually designs involving the randomization of various types of work assignments are involved, and also the replications of measurements, and reconciliation of discrepancies. While the introduction of experimental designs into ongoing projects does divert effort and costs from the immediate objectives of the project, in our judgment the payoffs in terms of understanding the measurement processes and in learning how to improve them have far more than offset the inconvenience and the increased costs.

The results of various studies, and some of the theory, are published and may be helpful to others. (Note: For a Spanish summary of some of this work see (6).) A pioneer in this work is P.C. Mahalanobis of the Indian Statistical Institute, where interpenetrating sample designs have been widely used. (7)

We encourage international cooperation. We have had some real benefit from cooperative work with the Canadians, who have done some of their work to build on what we have learned, and to verify or extend it. Similarly, we have been able to benefit from and build on some of their experimental work. (8)

4. OTHER MEASURES OF PERFORMANCE-- MINIMUM PERFORMANCE STANDARDS

Efforts at estimation of the various components of the mean-square error are generally limited, and in our experience, most often are introduced as evaluation studies to guide improvement of future programs rather than to control the quality of an ongoing study although there are some important exceptions. A common procedure for the control of quality is the development of various types of measures of performance or of standards used to control survey operations. Illustrations of such measures are noninterview

rates, item-nonresponse rates, editing-failure rates, and error rates in clerical and card-punching work. Other illustrations are the qualifications of interviewers, the amount of training given to interviewers or other staff and supervisor-interviewer ratios.

Such measures are frequently used in applying formal quality-control methods in the actual conduct of surveys. They are also used as substitutes for direct estimates of various contributions to the mean-square error, based on a belief that there is a correlation between such performance standards and some of the contributions to the mean-square error.

Such considerations often lead to the specification of minimum performance standards in an effort to control the quality of work in various operations and thus the accuracy of survey results. A related type of minimum standard is a specification that a probability sample be used.

We use probability sampling in most of our surveys. Exceptions in general are in certain industry surveys where a relatively few establishments account for a high proportion of the value of shipments. We also impose minimum performance standards. We do not and in our opinion should not attempt to reduce performance rates, such as noninterview rates, to zero. We have more or less arbitrarily looked upon a noninterview rate of less than 2 percent as sufficiently low for almost any survey, a rate of up to 5 percent as acceptable for most surveys, and a 5 to 10 percent noninterview rate as bordering on being serious, and sometimes much larger than tolerable. We do not always achieve these standards. Much more work needs to be done on standards for noninterview rates. Obviously tolerance levels should depend on accuracy requirements, errors introduced by imputation, and the consequences of errors in the results especially in important surveys. (9)

The approach of specifying minimum standards, if it is to be useful, must recognize feasible standards. One must be prepared in important surveys to pay the price for achieving them, and provide procedures for reporting on achievement. Moreover, the fundamental problem arises again: What specifications do yield the desired types of quality assurance? We have encountered cases where the standards imposed to improve quality may have actually had the effect of reducing it. Often we do not understand the measurement process well enough and the assumed consequences may not occur.

Nevertheless, the approach of using minimum standards is to be strongly encouraged. We need more research on how to improve the effectiveness of such controls and to identify the types of controls that prove particularly effective.

5. STANDARDS OF UNIFORM PRACTICES

Here, we have in mind such standards as a standard commodity classification system, a standard geographic coding system, and conventions for recording data on paper, on punch cards, or on computer tape. As indicated above, these standards are specifications for surveys, set down in the attempt to achieve uniformity of practice. There is no necessary implication that a particular standard is superior to a number of alternatives.

Such standards must be consistent with the requirements for a survey, i.e., must pass whatever tests of accuracy and relevance are available. However, since they are designed for application in many surveys conducted under a variety of circumstances, they may sometimes entail the sacrifice of some degree of effectiveness for specific uses in order to achieve other advantages such as comparability from survey to survey and case of under-

standing of the statistical results. This usage, however, does imply that such an adopted standard is effective or useful for some important purposes, although certainly not for all purposes.

The attempt to specify uniform procedures may introduce some undesirable rigidities. Statistical surveys whose purposes cannot be reasonably served by the adoption of a standard definition or classification system or a standard collection or processing system should depart from even widely accepted standards. Perhaps a desirable balance can be struck between the view that standards do not provide an adequate and reasonably flexible guide to action and that they inhibit creativity, and the view that adherence to standards is essential in order to provide for and guarantee comparability of results over time or in different studies. Thus, one kind of standard procedure for evaluation of quality of performance in a survey is to determine whether the standards of uniformity had been observed to the proper extent. As a general rule, observing such standards is highly desirable and important, and departures are to be avoided.

6. SOME CONCLUDING REMARKS

We believe that recent work in developing standards for the evaluation of statistical surveys is in the mainstream of scientific progress. We would assert that some of our measurement efforts are achieving the same kind of evaluation of precision and accuracy as is being accomplished in the physical sciences. But there are many large gaps and problems.

To what, then, should statistical agencies devote their efforts, over the next five to ten years, to make further progress in improving standards? Perhaps first and foremost is fuller communication with our colleagues in the social and economic sciences who are the users of statistics. Ultimately the standards for evaluation and the standardized practices will be

determined by social sciences needs. Official statistical agencies need to provide the leadership in understanding, advancing, and applying effective standards in measurement processes and evaluation procedures. Also they need to provide leadership in encouraging universities and other research organizations to take a strong interest and role in the development of procedures and standards for evaluating statistical data, and they need to be responsive to such developments.

Perhaps one of the most effective methods we have for involving the social scientist lies in reporting frankly and openly what we have learned about the deficiencies and problems of our statistical methods. As a very minimum we must stop the practice of presenting estimates of sampling error as if they were estimates of total error in the instances when measurement error is a relatively large contributor to variance or bias. We must make it quite clear to those who use our statistics that sampling error is but one component of a total mean-square error.

It is to be emphasized that the absence of published limitations of data does not necessarily imply that the data are free of limitations. More likely, the producers of the data did not invest the necessary resources to determine the limitations, or with the methods used it was very difficult or impossible to measure them. Even more serious in some instances known limitations may not be presented.

In addition to involving the social scientist to a much greater degree than heretofore in the development of statistical standards, we must also increase the level and quality of our own efforts along several lines. For example, we need to provide some guides on the allocation of resources for research for improving standards in relation to the total cost of a statistical program. It will be a long time before we can make <u>scientific</u> decisions

about such allocations. We would agree that certain types of routine statistical activities need very little input for the improvement of standards. Thus, we would not insist that a uniform standard be adopted so that an evaluation program be made part of every statistical activity.

For the purpose of discussion let us consider a continuing (weekly, monthly, quarterly, or annual) statistical survey, the results of which are relevant to important problems, and in which there may be substantial problems of measurement. For such a survey we would suggest as a basis for further discussion that a quarter to a third of the total budget be allocated for experimental studies, quality control, and evaluation and research studies.

Money, however, by itself will not solve any problems in this area. One issue is what criterion should govern our use of resources. We would suggest a very general one for surveys that produce important basic statistical measures: any activity that would make a survey conform substantially more to the standards of scientific investigation is a worthwhile use of resources. By this we mean we must strive to introduce standards that will give us reproducible results along with measurements of error of these results. This means substituting, wherever we can, direct measurement for the opinion of an analyst, probability samples for purposive ones, and new systems of quality control for outmoded methods of verifications such as those that concentrate almost exclusively on making the cells in tables add correctly to row and column totals.

Finally, in order to get our colleagues in the social sciences to cooperate with us as statisticians and in order to increase the effectiveness of our own work, we need to take two additional steps. We require

more systematic methods to learn the needs of users and to translate them into statistical requirements. We need a much fuller exchange of information on survey methods and research and evaluation studies and results than now exists. We in the U.S. Census Bureau are initiating the publication of a guide to our published and unpublished research memoranda and reports. Also useful would be exchange arrangements and some international libraries to which very detailed descriptions and evaluations may be given. The United Nations has made a beginning in these directions.

There should be two outcomes from this joint effort. We should develop more common international standards for evaluation and better inputs for these standards; namely, improved principles of social and economic measurement and values of sampling error and response-error parameters. We need to know a great deal more about sampling and response variances, intra-class correlations, and other parameters for a wide variety of methods of data collection and in a wide variety of subject matter contexts. A recent paper by Kish (11), as well as a number published by the U.S. Census Bureau, makes contributions in this area.

In developing standards we can perhaps improve our image as statisticians, but take some risk in diminishing our effectiveness. This can happen if we impose rigid standards where the situation calls for flexible ones.

Morris Hansen
William N. Hurwitz
Leon Pritzker

CHAPTER III ACADEMIC TRAINING FOR GOVERNMENT STATISTICAL WORK

Report on Academic Training Required for Government Statistical Work

The purpose of the discussion was to consider, first the nature of the work done by government statisticians, second the type of university education normally experienced by those who become government statisticians, third the gap between the two, and finally where the required teaching and training should take place and who should do it.

The papers by Fellegi and Malinvaud approach the topic from different directions. Whereas Fellegi considers the knowledge and skills, over and above those normally provided in university courses, that a government statistician should have in order to do his job effectively and deduces from this the details of what should be taught (leaving aside the question where these should be taught and by whom), Malinvaud's concern is with the basic university education that a prospective government statistician should have before he embarks on the task of acquiring specific skills.

It was pointed out that the details of some of the topics Fellegi includes are not the business of the university; students should either acquire knowledge of them through experience on the job or through in-service training. On the other hand the feeling was expressed that most university courses in statistics are too remote from reality and that the introduction of courses covering the topics mentioned by Fellegi would bring about a substantial improvement in the university teaching of statistics. Fellegi explained that what he had tried to do was indicate areas of statistical knowledge which a student generally does not acquire at the university but which he needs later on in order to do his job

properly as a government statistician. It was pointed out that university courses are already congested because of the growth in the number of topics that need to be covered in a degree in statistics, so that if some of Fellegi's suggestions were to be accepted for inclusion in university courses, some topics would have to be deleted. It was questioned whether Fellegi's suggested inclusions were really more valuable from the standpoint of the basic education of a statistician than some of the topics that would have to be taken out.

It was pointed out that in various parts of the world outside Europe and North America there were already a number of courses taught outside and inside universities that approached the teaching of the subject from Fellegi's standpoint. However, it had been found in one instance that where courses on details of actual statistical operations were taught side-by-side with courses on underlying principles, the latter were found more interesting by the student.

One speaker indicated that in order to make a practice-oriented course more interesting, he had developed a statistical operations course in which he covered the principles underlying all the processes needed to produce a statistical series starting with the design of the questionnaire and finishing with the published tables. Another suggested that a course on the theory of statistical systems might be found more intellectually challenging to students than a catalog of practical details.

There was substantial support for the suggestion that a university program in statistics intended to be useful for the education of prospective government statisticians should include the following topics:

1. Principles of sampling and survey design

2. Survey methods, organization and analysis

3. Construction of tables, graphical methods, and data analysis

4. Methods of measurement in social and economic statistics.

It was emphasized that a government statistician needed to be more than a specialist in statistical methodology; he also should have a deep understanding of and interest in the subject-matter to which the statistical analysis was being applied. To develop such interest it was suggested that government statisticians should be encouraged to carry out more subject-matter analysis than is common at present. Indeed one government statistician said that he had come to believe that a good government statistician should be a social scientist first and a statistician second.

From this standpoint, there was strong support for Malinvaud's contention that a prospective government statistician's education should have a substantial subject-matter content, preferably in economics or, when suitably taught, sociology. The inclusion of other topics mentioned by Malinvaud, notably time series and econometrics, was well supported.

The suggestion was made that in the U.S. a national institute, possibly a summer institute, should be set up on methods of official statistics. This could be a means of bringing government and academic statisticians together.

Other specific suggestions were that in various countries a review should be undertaken of the extent to which existing university statistics programs meet the desiderata referred to in the discussion, and that government statistical offices should prepare packages containing applications of statistics which can be used by university teachers of statistics in their teaching.

Summing up, Fellegi said that of course he recognized that university education should be more concerned with the teaching of underlying disciplines than with extensive coverage of details. He felt that on examination there was little real conflict between Malinvaud's paper and his own and he felt that the discussion had gone a long way towards identifying the outline of a program that would meet his requirements. As well as the topics mentioned above, this should include modeling together with what might be called the sociology of government statistical systems. Finally he pointed out that the inclusion of the kind of topics he favored was important not only for government statisticians but also for those statisticians outside government service who made use of the data that governments produce.

Recommendations

1. The university education of a student who proposes to become a government statistician working in the social and economic fields should contain a substantial subject-matter content from the social sciences, preferably including economics.

2. Topics appropriate for inclusion in university statistics programs suitable for students who propose to become government statisticians working in the social and economic fields are:

   a. Sampling theory and principles of survey design and analysis
   b. Practical aspects of survey methods, organization and analysis
   c. Construction of tables, graphical methods and data analysis
   d. Time series analysis
   e. Econometrics
   f. Social modeling

3. National statistical societies should investigate how far recommendations (1) and (2) are met and should make appropriate specific recommendations.

Prepared by James Durbin

SOME THOUGHTS ON TRAINING NEEDED FOR GOVERNMENT STATISTICAL WORK

1. Introduction

I certainly welcome the opportunity to participate in the present seminar. Although I was asked to prepare a paper on academic training needed for government statistical work, I think it would be presumptuous of me to attempt to comply with the request as stated. I will be glad to share my thoughts, however, on the type of background knowledge which, in my opinion, renders a government statistician most useful. The extent to which academic curricula can be fashioned in universities to impart this type of background is a question I do not consider myself qualified to discuss. Without explicitly mentioning it further, it is assumed as basic that the student trainee has successfully completed at least an elementary statistics course (one year) and a course on sampling which also includes a treatment of non-sampling errors (one year).

2. Highlights of the System of Official Statistics

Most statisticians, particularly at the beginning of their career, are likely to work with one or a few surveys, typically in one of its operational stages: design and development, continuing operation, or data analysis. Nevertheless, a basic knowledge of the highlights of the system of official statistics would often render their work more meaningful to themselves as well as to their employer. It would enable them to exercise good judgment earlier in their career and would facilitate their mobility. Without becoming experts in all of these fields, they should be aware of the major requirements for different types of statistics (economic, demographic, social, agricultural) and how these may change over time due to external conditions. A basic familiarity with the major sources of information (surveys, censuses,

administrative files) in each of these fields would be highly desirable. The relationships within the statistical system should be emphasized, particularly the nature of the System of National Accounts, the way it is fed by economic statistics, and the rudiments of index numbers of prices and quanta.

3. The Survey Process

While not every government statistician is directly involved in the initiation and conduct of surveys, most would fundamentally benefit from an understanding of the survey process. Such an understanding can be acquired (apart from direct work experience) through a proper balance of lectures, workshops, seminars and some small-scale operations carried out by the students/trainees.

Clearly, separate papers (or even books) could and have been written about most of the items listed below; I will only touch upon each.* Some understanding by government statisticians of each topic would be useful, although not more than an overview can be expected. Minimum knowledge could be regarded as the level at which the junior (or even more experienced?) government statistician realizes when he should consult a textbook or expert.

a. The objectives of the survey and their translation into statistically measurable terms. Using a hypothetical or concrete example, one could start with some national policy concern and attempt to identify the extent to which the corresponding information needs can be met by a survey, the main concepts that would have to be measured, the detail in which the main estimates have to be disaggregated, the required reliability of the estimates, timeliness needs.

---

*Some of the topics listed were drawn from a course outline prepared by the Asian Statistical Institute.

b. Considerations related to the choice of broad collection methodologies. The emphasis is on the word broad. Strategies involved might include such questions as the use of mail, telephone or personal interviews, mixed collection strategies, availability and location of relevant information in the case of business surveys, the admissibility of proxy respondents in the case of household surveys, etc. Considerations to be reviewed should include the following partial list:

i. Review of existing administrative and survey files and their potential for satisfying the information requirements;

ii. Review of potential major sources of response and non-response errors under alternative collection strategies;

iii. Need for pilot surveys and/or experiments;

iv. The impact of budgetary restrictions as they affect the choice of broad alternatives;

v. Compromises necessary between the reliability and timeliness of national, regional and small area estimates;

vi. Available frames, the enormous overall impact of frames on the efficiency of sample designs and on the applicability or validity of estimates, problems of constructing lists (particularly for business and agriculture surveys).

c. Design of questionnaire content, wording and format. Included

should be considerations related to explanatory and/or instructional material, methods to ensure that every respondent can fit himself/herself unambiguously into one of the pre-coded categories, methods to ensure codability of free-form answers, skip patterns, impact of wording on the resulting statistics, the potential benefits for subsequent editing and imputation of a degree of redundancy, problems related to skip patterns, formatting.

d. Design the key tables to be filled out by estimates from the survey. This should be done as a check on whether the questionnaire includes all the required variables, and as an input to the determination of sample sizes (where applicable).

e. Design of collection, follow-up and control procedures. Included here, in at least an overview form, are considerations related to sampling and methods of collection, including logistics and quality control.

f. Design and control of processing operations. The major blocks of processing are considered here in a form such as flow-charting, including a discussion of the editing and imputation as well as the quality control operations.

g. Assessment of human resources required. A list of the types of human resources required, problems of recruitment or access to them, likely type of training needed for new employees.

h. Brief list of topics required for training manuals of new employees.

i. Problems related to coding. Some understanding of the most commonly used standard codes (industry, occupation, geography, etc.),

problems in applying them, degree of detail at which they can usefully be applied in different circumstances, problems of establishing new coding structures.

j. Use of pretests of instruments and methods of evaluating the pretests.

k. Some training and experience in actual interviewing.

l. Common data conversion methods, their quality control, implications for questionnaire design.

m. Methods of assessing the quality of survey data and presenting measures of quality.

4. Issues Related to Coordination and Integration

A government statistician ought to have a broad appreciation of why and how official statistics are used and particularly ought to know which governmental policies or socio-economic hypotheses currently require firm empirical evidence. Accordingly, a government statistician will have, in addition to his understanding of technical matters relating to statistical measurements, an understanding of a particular area of sociology or economics. Such an understanding will help him to foresee which sets of statistics are likely to be used in conjunction with each other for a particular purpose.

A government statistician should also know that the search for empirical evidence can be made considerably more difficult if statistical series which are related through well known theoretical propositions (e.g. disposable income of persons and consumer expenditure on goods and services) seemingly contradict each other and such contradictions result entirely from the failure to apply consistent conceptual frameworks or operational techniques.

In order to avoid such contradictions from occurring, there is a range of integrating instruments with which a government statistician should be thoroughly familiar. For example, he should know of standard classifications, of the ways in which business or household registers (alternatively, household survey frames) are assembled and maintained, as well as of their major applications. He should also know of standard definitions and realize the importance of applying them in a systematic and consistent way.

In addition to the partial or complete integration of statistics, a government statistician must also appreciate the need to have a suitably coordinated statistical program. This is a more practical or more program oriented notion than that of integration. Coordinating a statistical program implies several things. Vis-a-vis the respondent, it implies not burdening him through failure to rationalize surveys or questionnaires. Vis-a-vis the user, it implies providing a well balanced array of statistics, devised so as to answer as wide a generality of problems as possible and as usefully as possible. Proper administrative tools, a sense of practicalities, and astute trade-offs (studied through examples) are essential components of what the government statistician should know under this heading.

5. Issues Related to Data Dissemination

Notwithstanding the advances made by statistical offices in rendering tabulatable micro data accessible to users (subject, of course, to confidentiality restrictions), the main method of dissemination for most official statistics is still the presentation of aggregates in tabular or graphic form. Basic elements of good and bad practices should be known by government statisticians.

They should also be knowledgeable about other current issues involving dissemination: how do (or should) statistical agencies provide an overview to outside users of their data holdings (catalogs, data dictionaries); how can the reliability and limitations of data most meaningfully be conveyed, particularly in the case of very large publications or data holdings; unavoidable restrictions imposed on the dissemination of aggregates by confidentiality requirements; how can micro data be rendered "anonymous."

The advantages and disadvantages of the main dissemination vehicles should be dealt with: the timely publication of brief highlights (bulletins); the main printed publications; periodic compendia; user newsletters; micro data files in machine readable form; summary data in machine readable or micro form; comprehensive data banks (possibly on-line) of aggregate statistics.

6. Time Series and Cross-sectional Data Analysis

Some knowledge of time series analysis is highly desirable, with special emphasis on the meaning of, and techniques for, seasonal adjustment. However, many, perhaps most phenomena which are measured with a periodicity greater than once a year are subject to seasonal effects, hence "underlying trends" can best be analyzed using the seasonally adjusted series. The "irregular component" can also reveal important signals and this needs some emphasis.

Basic techniques of cross-sectional analysis are often included in elementary statistics courses. Far too often, however, these are treated as abstract techniques, illustrated perhaps with a few artificial examples--artificial because of the scale involved and because the examples are contrived (or assumed) to satisfy the theoretical prerequisites of the particular techniques considered. As Tukey points out in his book on

Exploratory Data Analysis, "The best way to understand what can be done is no longer--if it ever was--to ask what things could, in the current state of our skill techniques, be confirmed (positively or negatively). Even more understanding is lost if we consider each thing we can do to data only in terms of some set of very restrictive assumptions under which that thing is best possible--assumptions we know we cannot check in practice." The point is particularly valid for the type of data typically encountered in government statistical work: the underlying populations are always finite, simple random sampling is practically never used, etc. The development of a "feel" for data and what they show should be a goal. It can be achieved only by forcing students and/or trainees to cope with data. This should be done using both manual methods (such as those proposed in Tukey's book), as well as through an exposure to analytical software packages (such as SPSS) with very conscious emphasis on their limitations.

7. The Social Context and Concerns Within Which Statistical Offices Operate

The relevant legal framework within which statistical offices operate must be understood by government statisticians: the nature of acts (where they exist) guiding collection (compulsory and voluntary surveys), confidentiality and dissemination (privacy acts, freedom of information type acts). The manner in which the relevant acts are administered should also be discussed, with particular emphasis on how the compulsory collection aspects are enforced, what legal and other safeguards and techniques exist for the preservation of the confidentiality of individual responses (and their limiting impact on dissemination), the machinery in place to satisfy individual requests arising from "privacy" and "freedom of information" legislation.

The extent to which society is sensitized to privacy considerations should be discussed. This discussion would, of necessity, be brief because of the great dearth of concrete information on the topic. However, at least exploratory surveys have been carried out in Sweden and the U.S.A. indicating public sensitivity in those countries to certain types of household surveys (telephone appears to be least acceptable from the privacy point of view) and certain types of questions (income is particularly sensitive).

The role of confidentiality practices, apart from legal considerations, should be discussed in as much length as is necessary to get the main issues communicated: its importance for maintaining the integrity of statistical reporting, the concept of identifiable individual records, the distinction between statistical and administrative uses of data and the potential for this distinction to induce a degree of duplication of collection within the overall information system of which the statistical system is a part.

Finally, the notion of response burden should be touched upon, available information (usually very little!) on its magnitude by type of respondent should be presented, and current efforts to reduce or more equitably distribute the burden should be highlighted (use of administrative records, use of sampling, sample rotation, distribution of response burden through the use of registers for this purpose, etc.).

8. Conclusion

As indicated in the introduction, the above has not been structured either in the form of an explicit outline for university curricula or for in-house training courses. It might, however, be considered as a checklist of some of the most important topics of which government statisticians

should at least have a general knowledge. As such, it might serve a useful purpose in fostering discussion between those in charge of preparing university curricula and in-house training courses so as to ensure that no topic of importance falls between the cracks.

Ivan Fellegi

UNIVERSITY TEACHING FOR FUTURE OFFICIAL STATISTICIANS

In speaking at a meeting of the International Statistical Institute about the type of teaching students need for a career in the senior ranks of official statisticians, I shall not describe French practice, which makes sense only in the very particular context of the whole system of higher education in France. To dwell on its merits would take me beyond my subject; moreover, were I to refer to it at all, I should have to point out some of its serious defects.

My first purpose, is rather, to outline the general principles which must govern any endeavour to train students for senior posts in a country's official statistical services. The next question is how to translate these principles into a coherent curriculum, due account being taken of the present state of the disciplines which should be part of it.

I shall bear in mind especially the needs of offices which have to organize and coordinate a national system of statistics, or to collect and process data, or to present statistical information on economic and social matters to the public and to users of very diverse kinds. Obviously, these statistical offices will have to work out synthetic indices which throw light upon some important aspect or other of the current situation and its changes. Nowadays this means, in particular, that they will be in charge of drawing up the national accounts and the system of social indicators. In some countries, as in France, the official statistical services take part in national planning for the short, the medium or the long term; in this connection they have to define and calculate sets of projections corresponding to different variants of economic policy or of the environment within which it will operate. I shall occasionally mention the needs

of statistical offices with planning responsibilities, but in what follows have no intention of paying any further attention to them.

My personal experience with the organization of teaching leads me always to keep in mind one essential limitation of any endeavour to teach students before their entry into working life. In studies lasting two, three or four years students can assimilate only somewhat formalized bodies of knowledge, each having a certain degree of unity, and they will assimilate knowledge the more readily as the number of such subjects is small--one or two, or at most three. It is courting failure to work out a curriculum intended to impart to students all the knowledge that may be useful, or indeed necessary, to them in their chosen profession. A person's training is a continuous process which does not come to an end at the beginning of working life, and there is knowledge which cannot be acquired prior to a little professional experience. This essential limitation explains why I shall not speak of certain aspects of a statistician's work, important though I know them to be. For example, I do appreciate that senior staff will have to organize the work of others, but I shall not suggest that training in team leadership should be part of the curriculum for students of statistics.

1. The Statistician

I should like to start with a formal proposition which I firmly believe to be true, but which I do not recall ever having seen written down. Yet it is not a very original one. Here it is.

An official statistician is a person in possession of a technique and of an intellectual culture. These are the two "legs" enabling him to walk. The curriculum for future official statisticians, therefore, must consist

of two parts, each designed to develop one of the two legs.

That a statistician has a technique, and that it has to be learned, is undisputed. It is a truism about which I will say no more. On the other hand it is worth giving a little more thought to the notion that the official statistician has a particular culture, which too requires some effort of assimilation and which can in large part be assimilated in the course of studies preceding a student's professional life.

In modern societies statisticians are expected to provide a measurement of the multiple aspects of economic and social phenomena. They have to conceptualize their fellow citizens' concern with these phenomena. They have to find out how best such phenomena can be classified and by what magnitudes they can best be expressed. They have to discover or collect the data which furnish the measurements so defined, and finally to set out the result of their observations. Because they are observers, and sometimes indeed judges, statisticians must at all times seek to be objective and must never be dogmatic.

What enables a statistician to play his part well is precisely his educational background. A person who has learned to think in depth about economic and social matters, and whose thinking is governed by the search for truth, has a natural protection against the risk of prejudice.

In fields upon which a statistician brings his observation to bear, his competence must exceed that of most of his fellow citizens, even the best educated, because he must keep ahead of their concerns and go beyond the predominant ideas of public opinion.

Just because a statistician needs to be capable of searching thought and of being in advance of the most common notions of public opinion,

students must be offered generous opportunities to acquire the necessary background. So far as the social sciences are concerned, this means appreciating both their scope and their fundamental difficulties.

On the basis of this proposition, I shall discuss first the technical training and then the intellectual culture a future statistician needs to be given. I shall make the assumption that the students for whom a curriculum is to be devised already possess an excellent general, scientific and literary background, and that they intend to make their career as senior staff of official statistical services. This assumption works better in some countries than in others, but it is the most convenient one for considering the problems here under discussion. It is, moreover, a reasonable enough assumption even where staff is recruited on the basis of university degrees, for it highlights the type of higher studies most appreciated in the selection of candidates.

2. Technical Training

It is obvious that the students concerned need a good grounding in mathematical statistics. But there remains the question how much they should be taught about the techniques of statistical production, such as computer science and others.

a. Mathematical statistics

The chiefs of official statistical services can often be heard nowadays to complain about the turn taken by the university teaching of statistics. Their dissatisfaction stems not solely from their regret at being outdistanced in a science to which they devoted several years of their youth, but to which they can no longer make any contribution for lack of time. A frequent cause for complaint is that the most active

research in mathematical statistics is no longer concerned with the organization of surveys, nor with the inferences relating to social phenomena. What, then, should be the content of the teaching in mathematical statistics provided for future official statisticians?

In my view, instruction should be organized around four main courses: data analysis, foundations and principal methods of mathematical statistics, econometric methods, finally theory of sampling and experimental design.

Descriptive statistics has always had a place in first-year courses, but it was often held in some contempt as being elementary or arbitrary. Consequently, the subject went into a decline, so much so that students nowadays are sadly unskilful in handling numerical data. But the general use of computers has greatly broadened the field of application of descriptive procedures. Some mathematicians have even begun to take an interest in data analysis. Thus teachers found it difficult to keep students interested in descriptive statistics just at a time when the spread of new calculation methods multiplied the opportunities for applied exercises. Now there is a danger that the relevant courses may concentrate on only a small part of the questions involved, namely those allowing of the best mathematical contributions. This danger is to be avoided, for in fact the number of questions to be treated is very large. They include in particular the representation of multivariate distributions (having qualitative or quantitative characteristics), the use of principal components, correspondence analysis for the study of contingency tables typological classification, measures for inequalities and concentrations, the descriptive analysis of time series, transition matrices and their

limit distributions, and so on and so forth. There is no reason why a course in descriptive statistics should not introduce mathematical models, possibly of a random type, whenever this gives relatively direct significance to the descriptive process in question (as in the last example mentioned above).

The foundations of inductive statistics must obviously be taught as a basis for the two remaining courses, but also as part of the statistician's background. They should include the principles of sampling inspection and their application to tests and estimators. The simplest cases on which statistical theory is built will have to be treated in the fullest possible manner. The principles of Bayesian statistics and their application in certain simple contexts should be so set out that the students are led to think about the most fundamental difficulties of induction and about the position of the statistician as a neutral and objective expert. Likewise, students will have to be acquainted with non-parametric procedures.

The course on foundations will be the longest of the four I have suggested, but it should not be weighed down with presentation of the most difficult and advanced mathematical theories and need not strive for the "greatest generality."

I hope I am not being misled by my own work when I say that the teaching of econometrics is more helpful than any other in preparing students for the application of inductive statistics in the social sciences. In my view, a course in econometrics can be so designed as to have sufficient unity for good assimilation and offer an opportunity for introducing all the statistical techniques most commonly used not only by economists, but also by specialists in other social sciences. The course must be so

balanced as to take account of its function in training senior staff for official statistical services. This means that pride of place must be given to regression theory and to the inductive treatment of time series. Less time need be devoted to such matters as the treatment of bidimensional samples (time series of cross-sections) and to the estimation of simultaneous equation models (with emphasis on the phenomenon of simultaneity and with resistance against the temptation of giving a catalog of closely similar methods). There should be an introduction to the study of cases less frequent in economics than in other social sciences, and some discussion of errors in variables models and of the treatment of situations where the variables to be explained are discrete or subject to constraints.

A course on the theory of sampling needs no other justification than that senior official statisticians obviously must know how to select the units they are to observe. For the same reason I suggest that part of the course should be devoted to experimental design. There may be something to be said for breaking the course up into two separate, smaller parts, on the argument that the basic theoretical models are quite different, but I am inclined to think that, if the two theories are combined in one course, there is less danger of neglecting a number of problems which arise when both contexts are present and which are fairly important in practice.

b. Techniques of statistical production

The techniques of statistical production have become much more complicated in recent decades. In the past, data were processed along a linear chain of successive elementary operations. Nowadays a much more elaborate structure is common, partly because of the greater wealth of data to be extracted and partly because they often come from different

sources (especially in the case of administrative data). The general use of computers presupposes highly technical skills. The very conception of the statistical system demands a clear appreciation of the respective roles of various sources of information, of their reciprocal connections and of the manner in which they complement one another.

To be taught the correct approach to the statistical system and to the processing of data is clearly useful for future official statisticians. What is less clear is how to design courses which make a real contribution to their training.

Instruction in the use of computers is a case apart, and one, incidentally, on which I am no expert. There should be no major difficulty in tailoring the course to the needs of future statisticians, since the choice of material and the teaching methods can draw on the experience of teaching computer use for scientific and management purposes.

For the rest, I suggest that the required course can be given pedagogical unity by organizing it around the idea of "system analysis for statistical production." But the course must have a precise content and guard against the danger of gratuitous formalism. It should be illustrated with a great many examples, having to do both with statistical processing and with the conception and organization of the statistical system. I have not thought out in detail how such a course should be designed, and cannot speak about it with assurance. But I will make the attempt.

First, the notion of system will have to be explained in terms of a set of cells each having its own function; at this stage such other aspects should be involved as the time needed for an operation in one cell,

transmission of information among cells, errors in operation or transmission, final output of the system, control of the system, etc. One by one, the logical problems involved in the working of the system will then have to be discussed, such as the overall response time depending on elementary response times and on the structure of the system (not forgetting the case of random elementary response times), the reliability of the final output in terms of the reliability of the elementary operations and of the structure of the system, optimization of a centrally controlled system (not forgetting the choice of techniques or of the sources of information to be used), decentralization of control among cells, and the degree of autonomy to be accorded each cell (theory of teams).

A course on the above lines would, however, seem to neglect a number of questions which are important for statistical production, notably those having to do with the human problems encountered in statistical offices. I do not think that these questions can usefully be treated in a separate course, but they should be referred to frequently in the examples used to illustrate the course on system analysis for statistical production. The teacher, therefore, will have to be proficient in two fields, a combination which I hope not to be impossible to find: he will have to have experience of statistical work; he will also need to be thoroughly conversant with certain new branches of applied mathematics.

3. Intellectual Culture

I have said that university students preparing for a career as senior official statisticians should acquire an appropriate culture. By this I mean that they should learn to think carefully about economic and social phenomena, and to be experts in the analysis of at least some of

them. Courses designed to this end must at once have sufficient breadth and depth to give students an overall knowledge of how the social sciences work and to make them aware of the need for scrupulous precision in their grasp of the realities with which they work.

Nowadays, a curriculum centered on economics seems the only adequate answer, but the ultimate aims will have to be kept in mind in deciding how to design it and what other subjects to bring in.

a. Why teach statisticians economics?

There are many reasons for singling out economics as the mainstay of a future statistician's general educational background.

In the first place, economics is the most developed of the social sciences. It possesses analytical methods, conceptual systems and theories which, while no doubt not entirely satisfactory in all respects and in need of further refinement, are undeniably sound and mature. Economics has a sufficiently broad range and at the same time operational tools for dealing with some of the many problems involved in the conduct of a modern economy.

The study of economics thus offers a wealth of opportunities to reflect upon the working of a world made up of many units acting with varying degrees of independence within an institutional framework defining their reciprocal relations; in other words, it often forces students to consider life as it is in human societies. The study of economics is also conducive to a better understanding of the questions to which the social sciences are supposed to provide an answer, it demonstrates the existence of a continuously growing body of objective knowledge, and it shows how, with reference to a certain number of problems, observation and analysis

can so reinforce each other that it becomes possible to construct models predicting the consequences of alternative decisions and thus helpful in the choice among them.

Secondly, a knowledge of economics is indispensable for many of those who will have to work in the statistical services. Just because economics is the most advanced and the most operational of the social sciences, the statistician must have a thorough grounding in economics in order to build up certain economic statistics (business or financial statistics, for instance), draw up national accounts, give a synthetic description of economic developments in the past, analyse short-term economic conditions and construct projection models.

Given that a large proportion of future statisticians will have to devote a major part of their university studies to economics anyway, there is much to be said for making it the basis of the general educational background to be imparted to statisticians.

A third reason is that none of the other social sciences offers the desired range. Demography, which some statisticians certainly will have to know well, has some of the required features; it is a mature science working with well defined concepts, and to some extent it lends itself to model-building and yields operational results. But unless demography borrows much from economics or sociology, its range remains somewhat narrow. The phenomena it studies are few in number, and so, therefore, are the questions to be treated. Faced with the enormous multiplicity of economic and social phenomena, demographers pure and simple naturally feel ill-equipped and, reluctant to venture into fields in which they are not competent, tend to stick to their own, narrow specialty. Moreover, since

the concepts and models with which demography works can claim to remain close to what are simple realities, its study is not conducive to thought about the more serious difficulties encountered by other social sciences where any enrichment of knowledge demands great simplifications, so that different aspects of reality have to be considered successively.

Sociology, in its turn, must still be regarded as a science in its infancy and as such is not very suitable for the purpose in view. While there has been much progress in conceptualization, a wealth of ambitious and competing broad theories contrasts with a relative scarcity of specific results. There is no certainty about the means of a systematic accumulation of knowledge, and the sociologist's often purely critical attitude leads only exceptionally to methods helpful in decision-making.

In these circumstances I would think it premature to suggest that sociology be placed at the centre of the future statistician's educational background, at any rate when teaching has to be organized in courses designed for a fairly large number of students.

b. How to teach statisticians economics?

All this being said, the fact remains that there are some drawbacks in relying exclusively on economics as providing the intellectual culture of future statisticians. Mindful of these drawbacks, teachers will give preference to certain branches of economics, and will also include in the curriculum supplementary, perhaps optional, courses in other social sciences.

The first drawback of economics in this context stems from its very maturity as a science. Unless their teachers forewarn them, students may well regard economics as a fully developed science giving a perfect account

of economic realities. Since a sustained effort is required of students in order to assimilate basic theories of some complexity and to learn to use rigorously refined methods, there is a danger that too little thought may be given to the nature and meaning of the underlying concepts. Curricula should, therefore, make room for less advanced branches, so as to make students aware of the limitations of economics and of its status as a social science in process of extending the frontiers of knowledge.

A second drawback is that economics does not introduce students to concerns that are outside its own field, but some of which are of great interest to people nowadays. Intensive teaching necessarily demands selection, and is bound to neglect some of the fields which students will have to deal with in their professional life. This does not matter very much so long as students are well equipped to learn quickly what they need to know. But are students with a predominantly economic background properly equipped to observe social phenomena of a demographic or sociological kind? Everything depends, I think, on what sort of training in economics they have received.

Economics aims largely at global purposes: to ensure full employment and economic growth, to check inflation and to this end maintain or re-establish balance in foreign trade and external payments, etc... Economics is on firmer ground in the study and control of short-term fluctuations than of long-term trends and the structural changes they entail. Sociology, by contrast, concerns itself with disparities, with the relations between individuals and groups, with structures and their renewal from generation to generation as well as their transformation which, in the absence of social revolution, is bound to be slow.

These differences of perspective must be allowed for in the teaching of economics for future statisticians, which means that some attention will have to be devoted to concerns analogous to those of sociologists. There can be no question, of course, of neglecting the full exposition of theories aimed at formalizing the main economic phenomena. This would be a mistake for two reasons: first because statisticians need to know these theories, and second because it is precisely the careful study of fundamentals which requires thought on such questions as the role of disparities and the relation between individual units and social structures.

What is necessary, rather, is to adjust the balance of the curriculum by abridging some parts and so making room for particular emphasis on certain branches of economics which would not necessarily receive much attention in teaching other economists.

When I speak of abridgment, I have in mind especially all those subjects which on the contrary must occupy pride of place in business economics, such as the micro-economic theory of the optimum, the foundations of economic calculation or management techniques. The same applies to courses on financial institutions, both public and private. I am not suggesting that these subjects should be cut out altogether. Future statisticians certainly need to know how the management of public and private affairs is organized, if only because in an increasing number of cases statistical information is drawn from management records, such as accounts, identification registers, etc. But if room is to be made for an introduction to the study of social phenomena, some sacrifice will have to be made elsewhere.

By contrast, I would suggest that emphasis should be placed on the positive study of economic growth, with a special reference to examples

from modern economic history, to the relationship between demographic and economic phenomena, and to the nature and role of structural transformations and of social mobility.

Similarly, in applied economics room should probably be made to introduce a course on the economics of labour, for this is a field where increasingly refined and interdisciplinary analysis is applied to very concrete questions. A second best alternative might be a course on the decisions of individuals and family units (choice of schools and training to acquire, choice of occupation, marriage, choices regarding where to live, how many children to have and at what intervals, etc.).

- - - - - -

I believe, then, that the aim in teaching future senior staff for official statistical services should be to combine technical training with an appropriate education in social sciences. I have tried to outline the content of such teaching. To go into more detail would be futile in addressing an international audience; for in each country the best choice depends upon local circumstances.

Edmond Malinvaud

STATISTICAL EDUCATION, TRAINING AND RESEARCH AND THEIR UTILIZATION

1. INTRODUCTION

In the last three decades, statistics has been internationally promoted as a key technology with a considerable amount of success. With the realization of the immense utility of statistics in social and economic development, conscious efforts have been made to create the necessary facilities for statistical education, training and research in universities and statistical institutes in a number of countries. The United Nations and its Specialized Agencies have played a pivotal role in extending technical assistance in developing statistical systems, particularly in the developing countries, in coordinating internationally the statistical activities in the member countries and in standardizing the concepts, definitions, procedures and tabulation plans of major statistical efforts in the world and disseminating the statistical information to the users. The present paper aims to identify some of the problems that have arisen in the four mutually dependent areas of education, training, research and their utilization in statistics and to suggest possible solutions. The emphasis throughout the paper is on the conditions obtaining in the developing countries in general and in the countries of Asia and the Pacific in particular.

While technical assistance and training in statistics have to a large extent been promoted by the United Nations and its Specialized Agencies, the International Statistical Institute (ISI) and the UNESCO have been concerning themselves with the promotion of statistical education and research. The universities in different countries have developed the necessary facilities for higher education and research in statistics. This division of work has

evolved over a period of three decades, without any conscious effort at proper coordination of education, training, research and their utilization. The lack of coordination in these efforts has resulted in some gaps and imbalances.

In this paper we are considering statistical education and training as complementary parts of a system, since there is interdependence between them. In fact, in a report submitted to the United Nations Statistical Commission at its fourth session (United Nations, 1949), it is mentioned "It may be recognized in practice, ..., that statistical education and training merge. Indeed, it may be true that in the promotion of improved statistics in statistically underdeveloped countries, education and training will be virtually indistinguishable. Even though education and training may fuse into a single problem, and even though it be recognized that these two activities merge with each other in the middle ranges, there is use in maintaining the distinction for the purpose of defining the nature and immediacy of the interest of the United Nations in each."

The aspirations and the frustrations of the ISI in its efforts to promote and develop statistics have been forcefully brought out by Zarkovich (1976). UNESCO (1974) in collaboration with the ISI has brought out a directory of the facilities available for statistical education, training and research in the developing countries as a sequel to its earlier report (Mahalanobis, 1957). The Education Committee of the ISI has been actively engaged in discussing the problems involved in statistical education and the Fourth Round Table Conference of the ISI was on the topic of teaching of statistics in schools (Breny, 1976).

A review of the efforts in promoting statistical education and training has been given by Montenegro (1973). This review refers to reports of

various Committees and Conferences on statistical education and training including the reports of the Council of the Royal Statistical Society (1947), United States National Research Council's Committee on Applied Mathematical Statistics (1947), Committee on the Teaching of Statistics of the Institute of Mathematical Statistics (1948), Inter-American Statistical Conferences (1947-72), UN Statistical Commission (United Nations, 1949, 1959) and ISI's Round Table Discussion on the University Teaching of Statistics in Developing Countries (ISI, 1969). The problems involved in statistical education and training have also been discussed by Cox (1957), Dedrick (1952), Goudswaard (1959, 1964), Mahalanobis (1951a, b).

Though much work has been done in promoting statistics and in training statisticians in the last three decades, it is to be noted that many of the problems encountered and discussed in various Committees and Conferences have not passed the discussion stage. This is possibly due to the fact that many of the Committees are set up on an ad hoc basis without any funds and support for carrying out their recommendations. The Round Table Conferences and the Meetings of the Directors of International Statistical Institutes sponsored by the ISI are also tending to become discussion sessions without a built-in mechanism for giving a concrete shape to their recommendations. If the Committees on education, training and research in statistics are to be effective, it is important to follow up their recommendations in a substantive manner through organization of task forces, working groups, workshops, etc.

2. OBJECTIVES

The general objectives of statistical education, training and research can be taken to include the following:

i. Developing a statistical sense with a view to understanding natural and physical phenomena through statistics and to facilitating working with statistics for decision making;

ii. Teaching the methodology needed to produce appropriate statistics economically and to analyze and use them meaningfully;

iii. Imparting the necessary skills in organizing and conducting statistical investigations with a view to meeting the growing needs for statistical data, keeping the cost and the errors at acceptable levels;

iv. Promoting research in production and analysis of statistics with a view to developing methodologies needed to solve present and potential problems in designing statistical investigations, data collection, processing, analysis and interpretation of statistical results; and

v. Being responsive to the changing needs of the practical world so that persons passing through the educational system could fit in statistical systems and become innovative and efficient producers and users of statistics.

In this paper statistical education is taken to mean formal teaching of statistical theory and methodology with an orientation towards developing a statistical sense with a view to understanding socio-economic situations and natural and physical phenomena through statistics. The first two objectives mentioned above can be considered to be the aims of statistical education. Objective iii is that of training in statistics by which is meant the imparting of special skills required to plan and undertake statistical

operations necessary in producing and analyzing statistics.

The objective of research should be more broad-based than at present and should emphasize data production aspects in addition to statistical analysis. The fifth objective is important as any system which is not responsive to the practical world will tend to become alienated from the trends in life and become isolated and in course of time irrelevant to the practical situations.

3. TEACHING OF STATISTICS IN SCHOOLS

Statistics has come to be accepted as a powerful tool with applications in a wide range of fields and elements of statistical education will be useful as a background knowledge for all to comprehend and respond meaningfully to the demands of life. Statistics education can be considered at two levels: school and university or college. There is an increasing demand from statisticians to introduce statistics at school level. The International Statistical Institute and the UNESCO have been promoting the teaching of statistics in schools. The Committee on Teaching of Statistics in University and University Colleges (1947) set up by the Countil of the Royal Statistical Society had expressed support for teaching of statistics in schools as early as 1947. Mahalanobis (1951a) discussed the role of mathematical statistics in secondary education.

Teaching of statistics in schools has many problems and as yet no mechanism has been evolved to come up with solutions of these problems. Introduction of statistics in schools requires the development of acceptable standard text books and training of teachers. The situation is akin to the one obtaining before the introduction of modern mathematics in schools. But owing to the concerted efforts of some educationists and mathematicians in

some countries, standard text books have been developed and tried out in a number of schools, with the result that teaching of modern mathematics in schools is gaining ground in many countries.

There is some controversy as to what to teach and how much to teach in statistics in schools. It seems desirable to teach principles of statistics in schools preferably as part of a science course instead of as a part of a mathematics course, so that students from the beginning see statistics as an inductive subject and not as a deductive subject. The objective of school education in statistics should be to develop a statistical sense and interest in statistics among the children without bogging them down with too many abstract concepts or with masses of data. For instance, the concept of variation should be explained through live examples such as number of petals in flowers, height of students, number of peas in pea-pods, etc. Probability can be introduced through the frequency approach with practical illustrations instead of the axiomatic approach.

If teaching of statistics in schools is to be taken seriously, standard text books will have to be developed through the organization of task forces and these will have to be tried out in some selected schools with the help of trained teachers. Needless to say, the text books should be simple, illustrated with pictures and numerical examples and should bring out clearly the role of statistics in data production and inference. A concerted effort should be made to train the teachers through modification of the syllabus of the degree courses in education in the colleges and the universities.

4. UNIVERSITY EDUCATION IN STATISTICS

College or university education in statistics has rapidly expanded during the last three decades and has been the main source of producing statisticians

needed in statistical offices in government, industry and business and in statistics departments of the universities for teaching and research. University education in statistics has developed into a well-knit and organized system with well-defined syllabi and a built-in mechanism to produce teachers and research scholars. Thus the system developed has been a self-perpetuating one, though with an element of inbreeding.

Statistics being basically an applied subject, it is unfortunate that the teaching of statistics in universities and colleges has tended to be highly theoretical with a mathematical orientation. This situation has come to pass mainly because originally teaching of statistics was taken up in many universities in mathematics departments. With the growth of teachers and students and the importance of statistics, statistics departments were gradually separated from mathematics departments, but they retained more or less the earlier syllabus with its mathematical bias.

It is interesting to note that in a changing world, the syllabus of statistics in some universities has basically remained unchanged for the last two to three decades with its emphasis on the theoretical and mathematical aspects of statistical analysis. The result is that statistics is taught as a part of mathematical discipline instead of as a practical subject with applications to real life problems. Because of this situation, the students coming out of this system find it difficult to fit into statistical offices, where the emphasis is more on data production than on statistical analysis. Further, there is considerable variation in standards of education in statistics from university to university, which, of course, is a general problem and not specific to statistics. Universities will have to develop a new outlook in the teaching of statistics and in developmental research, if they are to be

reponsive to the needs of the practical world.

The gap that exists between formal education in statistics and the needs of practical work has been clearly brought out in the Report of the United Nations Inter-regional Seminar on Statistical Organization held at Ottawa in 1973 (United Nations, 1973), wherein it is stated, "....in most cases the curricula at universities were too abstract, too compartmentalized, and consequently not always relevant to the training of producers of statistics. In this connection, it was pointed out that universities do not always adapt to new ideas and that conventional courses may thus be alienated from the real problems of the statistician." In this context it may be mentioned that considerable concern has recently been shown on the widening gap between theoreticians and practitioners and that between theoretical developments and practical applications in statistics, (Bjerve, 1976; Zarkovich, 1976; Murthy, 1977; Murthy and Khan, 1977). It is important to find methods of evolving a system of education, training and research in statistics which will facilitate greater communication and cooperation between theoreticians and practitioners with a view to reducing the gap between theoretical developments and practical applications and that between the subject matter of teaching and research in universities and the practical problems in statistics.

Lately, as has been brought out in the directory of statistical courses by UNESCO (1974), some universities even in the developing countries are offering courses in applied statistics and statistics is also being taught as a subsidiary subject in courses on other subjects such as economics, management, agronomy, demography, etc. Though this is a very welcome development, a closer look at the syllabi of these courses reveals that even

these applied courses have tended to become theoretical in nature with a mathematical orientation without a strong connection with the practical world. Some universities have introduced project work as part of the curriculum, but usually this activity is not given much emphasis.

Use of theoretical framework and mathematical treatment in university education in statistics serves a very useful purpose by developing a mental discipline of clear and exact thinking among the students. This undoubtedly is a major contribution of the university education in the development of statistics. However, emphasis on theoretical aspects of statistical analysis with a mathematical orientation at the expense of teaching data production including designing statistical investigations, data collection, processing, presentation and interpretation is to be gradually shifted if the university education is to feed the statistical services and be responsive to their needs. Of course a balance will have to be struck in university syllabi on statistics between designing statistical investigations, data collection, processing of data and statistical analysis. Statistics should be considered a profession like medicine and engineering and hence the students should not only be given theoretical background but also practical training using live examples.

The need for modifications in the university syllabi in statistics to include the data production aspects is all the greater because the facilities presently available for post-graduate training are too meager to enable a substantial portion of the graduates to go through training courses before taking up active statistical work in statistical offices. The available meager training facilities should better be utilized for training trainers and for more specialized training. This matter is discussed later in Sections 5 and 8. A concerted effort on the part of the

international organizations such as the United Nations and the ISI and the University Commissions in different countries will be required to effect revision of the syllabi of statistics courses in universities incorporating the necessary changes. However, change of syllabi raises the problem of teachers needed to teach according to the revised system with reasonable emphasis on the data production aspects and this problem can be solved at least in the interim period by accepting statistical practitioners and trainees trained in professional institutions in statistics on the university teaching staff, breaking the present inbreeding system. This process of making the university education in statistics responsive to practical needs is bound to take time and in the meantime the training needs of the statistical offices will have to be met through ad hoc arrangements as at present.

5. STATISTICAL TRAINING

Since the university education in statistics did not meet the immediate requirements of statistical offices, efforts were made nationally and internationally to set up professional institutions in statistics and training cells to impart the required statistical training with orientation towards data production. There are 17 international training institutes to meet the professional training needs of statistical offices. Moreover, many countries have training facilities in their statistical offices to train primary level statistical staff. The training facilities presently available are rather meager and do not meet all the present and potential training needs of statistical offices. In view of the shortage of trained statistical personnel, the training courses being conducted by the statistical institutes, training cells and the international organizations are

generally of an ad hoc and 'instant' type with the limited objective of imparting a particular skill to the trainees. Because of its 'instant' nature of training, these courses usually do not produce teachers in the fields taught and the multiplier effect is minimal unlike the universities where the system is self-perpetuating. If this situation is to be remedied, the statistical institutes should aim at training trainers by tailoring their courses to this objective and the training cells in statistical offices should be encouraged to take over the training at primary and intermediate levels in statistics.

There is a wide field, not covered in formal education in statistics, which is of considerable importance to statistical offices and this field includes practical aspects of statistical methods, sample surveys, design of experiments and quality control, agricultural statistics, demographic statistics, social statistics, national accounting statistics, economic statistics, data processing systems and data banks, statistical organization, statistical operations, statistical management, etc. The present training facilities are not adequate to cover all these topics with a view to providing professional level statisticians in these fields. The Statistical Institute for Asia and the Pacific (SIAP, formerly Asian Statistical Institute) was offering a ten-month package course on agricultural statistics, demographic and social statistics, economic accounting statistics, economic statistics and statistical methods and sampling. Because of various reasons, the duration of the course had to be reduced to six months and with pressing needs for a course on statistical operations, the earlier course had to be restructured to emphasize statistical operations. Incidentally, though statistical operations is a subject of

considerable interest to practitioners and commonly practiced, there is very little by way of documentation for the course and this work is being undertaken by the SIAP practically from scratch.

Further, the trainers in many of the statistical institutions and training cells of the statistical offices did not have the opportunity of formal training which could have helped them in their training efforts. This, coupled with the fact that even the documentation for training in particular fields is either not available or far from satisfactory, makes the situation worse. Usually the training institutions and the training cells do not attract professional teachers from the academic institutions, as they are basically oriented towards theory and mathematics and statistical training has to be geared towards practical and applied aspects of statistics. The teachers for imparting training are generally drawn from statistical offices and usually have considerable practical experience in specific statistical operations. However, since these persons may not have any formal training in teaching or experience in teaching,they may not necessarily have the aptitude and the interest needed for teaching and training work. This problem is further aggravated due to lack of adequate documentation.

The United Nations and its Specialized Agencies have come out with handbooks on a number of topics such as household surveys, population and housing census, agricultural census, system of national accounts, etc. These are essentially meant for practitioners having a general background and experience in their own fields. The Short Manual of Sampling (United Nations, 1972) and the Manual on training of Statistical Personnel at Primary and Intermediate Levels (United Nations, 1964) can, of course, be

considered as documents meant for use in training. For purposes of teaching and training, lecture notes, workshop assignments, points for discussion, prompt lists and other hand-outs need to be prepared based, of course, on the documents of the United Nations and its Specialized Agencies and other national and international organizations. This work is an important one, but at the same time difficult and time-consuming. Further, the training documents should be made interesting to the audience at hand by using local examples and illustrations reflecting the conditions under which statistical work is actually done.

If the universities are prepared to shoulder gradually the responsibility of the above mentioned courses, they should accelerate the present trend of offering different types of statistical courses with varying emphasis with a view to producing statisticians who could be readily absorbed in statistical offices without any further training. University statistics departments and statistical offices should collaborate, with the latter becoming the laboratory for practical training. This would result in a two-way traffic between the staff of the statistical offices and the faculty of the university departments. It will have an overall beneficial effect both on the university teaching and statistical work in offices. Statistical education and training should be considered in a unified way so that a system could be developed which would meet the needs of statistical research and practical work in statistics within the present limitations of funds and personnel.

6. RESEARCH IN STATISTICS

This is another field where the statistical departments of the universities and some other statistical institutions have contributed tremendously

to generate a wealth of research results which have found applications in wide ranging fields including medicine, agriculture, industry, business, education, economics, space research, nuclear technology, communications, etc. However, the orientation of research has gradually tended towards mathematics, and statistical research in due course became divorced to a considerable extent from the practical needs of statistical offices. Partly because of the 'instant' nature of the training courses referred to in Section 5 and partly because of the nature of their work, the statisticians in many statistical offices have, on their part, tended to do things mechanically in a routine manner, without making much use of the results of statistical research in academic institutions. The result is a widening gap in communication and cooperation between theoreticians and practitioners and a gap between theoretical developments and practical applications, referred to in Section 4. It is to be mentioned that some statistical offices have encouraged a small band of professional statisticians to keep in touch with modern developments in statistics by supporting research in applied work and communication with theoreticians, and these statistical organizations in their individual capacities have contributed much to developmental research in applications of statistics.

The problem of gap has been forcefully brought out by Zarkovich (1976, p. 23) when he states:

> "The statistical theory develops mainly at universities and various research centers. With little or no access at all to practical problems it largely moved in the direction of an abstract science. Another strong contribution to its course in this sense has come from its mathematical orientation. Parallel

to this moves the world of statistical practice with the government data collection as its center. These two worlds speak different languages and face in their daily involvement quite different problems. The world of the theory and the world of practice live their independent lives. They do not have much in common. Their knowledge about each other is very thin. They almost ignore each other. Each of them has very serious doubts as to the nature of the other one. The practitioners are afraid of the theoretically minded statisticians as a source of complications. They consider the representatives of the theory as people deprived of sense of reality. On the other hand, the world of the theory considers the practitioners as people who are unable to see problems let alone their ability to solve problems. The practitioner is for them a man of simplifications and common sense approaches. He wants to keep all the statistical work at that level as this is the only approach he can use."

A conscious effort will have to be made to develop research facilities in statistical offices with a view to identifying and formulating problems for possible solution by their own personnel or by research workers at academic institutions. There should be frequent national and international meetings, conferences and question-and-answer workshops where practitioners with formulated problems can consult the theoreticians on their possible solutions. The Panel Discussion on Communication and Cooperation between Theoreticians and Practitioners held in Tokyo in November 1976 (Murthy and Khan, 1977) recommended, among other things, the following:

"A spirit of research should be introduced in the statistical offices by setting up one or more applied research cells and by assigning or recruiting qualified staff to work in these cells. The staff of these cells should be given freedom to (i) work on methodological problems which might have relevance to present or future work of the statistical offices; (ii) publish their results in established journals; and (iii) attend seminars, professional meetings, etc.

"The statistical offices should seek the cooperation of non-official theoreticians and subject matter specialists by inviting them to participate in their standing committees on a continuing basis so that the practitioners could get the benefit of the knowledge of the theoreticians and the subject matter specialists and the latter could get acquainted with the practical limitations and difficulties involved in statistical work of data collection, analysis and interpretation.

"Professional journals should review and modify their editorial policy to encourage publication of practical results of methodological interest and formulation of practical problems for possible solution by theoreticians. Further, the editorial boards and referee panels should be enlarged to include practitioners and subject matter specialists to ensure publication of papers with a practical bias.

"To promote better communication between theoreticians and practitioners, subject matter dictionaries should be prepared and published explaining not only the meaning of the terms involved but also the relevant concepts, theories and procedures."

The development of research activities in the statistical offices and at least partial reorientation of the research aims of the academic institutions will be possible only if a major effort is made jointly by the international organizations such as the United Nations and its Specialized Agencies and the international professional bodies such as the ISI, International Association of Survey Statisticians, etc. As mentioned by Zarkovich (1977), in this program each of the possible partners has to have its own share that corresponds to its line. One single partner, no matter what its authority and resources might be, will not be able to cope successfully with the problems that arise. The ISI and its Sections with a large body of professional statisticians as members, and the United Nations and its Specialized Agencies with their contacts with the governments of the member countries, should together be able to discuss the problems involved in statistical education, training and research with a view to coming up with possible practical solutions.

7. DOCUMENTATION OF EXPERIENCE

As mentioned in Section 5, one of the major difficulties encountered in teaching of the applied aspects of statistics with illustrations and examples from real life situations has been the lack of proper documentation of experience for use in training courses. During the last three decades considerable experience has been gained by many countries of the world in applying statistical methods to production, analysis and interpretation of data. Partly due to the emphasis on day to day activities of statistical offices and partly due to the inherent difficulties in documenting experience, the necessary course materials with emphasis on case studies bringing out the successes and the failures encountered in applying statistics to

practical situations have not yet been developed. Needless to say, there are many situations where we could learn much from past mistakes.

The difficulties encountered in the practical world and the line dividing the theoreticians and the practitioners have been well brought out by Babbie (1975, P.ix) when he states, "In my own experience as a student and as an instructor, I have found it much easier to understand the logic of science than to bring that understanding across the bridge into the real world of actually doing research. On one side of the bridge, things are perfectly neat, logical and 'scientific.' On the other side, chaos reigns: there are only incomplete lists to sample from, subjects don't show up for experiments, interviewers make mistakes and lost questionnaires, people lie and misunderstand, and nothing correlates 'well enough' with anything else."

An example of documenting experience is provided by the effort the author has made in 1969 to crystallize the experience of the field staff of the Indian National Sample Survey (NSS) accumulated over a period of twenty years (Murthy, 1971). In developing countries, usually the schedule approach is used for data collection, where the concepts and definitions of what to collect are clearly explained to the interviewers and the actual method of data collection is generally left to the field staff after adequate instruction and training. How exactly the data are collected is of considerable importance in assessing and controlling the quality of data. To find out this in the NSS, a seminar on data collection techniques was organized by the Indian Statistical Institute in Calcutta in 1969 in collaboration with the Government of India and the proceedings, consisting of three sections (i) data collection techniques,

(ii) inspection and supervision, and (iii) training of investigators, have brought out more or less the experience of the NSS accumulated over two decades. Recent attempts in India to evaluate the data base of the Indian economy through seminars are also efforts in documenting the experience (Rao, 1972; Dandekar and Venkataramiah, 1975). Technical papers brought out by some statistical offices such as the U.S. Bureau of the Census, Statistics Canada and the NSS are all basically documentation of practice. Recently considerable amount of very useful documentation of experience has resulted from the World Fertility Survey, an effort of the ISI.

One important source for documenting experience is seminars and working groups which are nationally and internationally organized. Many of the United Nations handbooks and manuals are outcomes of the deliberations of seminars and working groups. It is desirable to shift the emphasis in these meetings from the preparation of final reports to coming up with documentation based on the working papers considered with a view to bringing together the experience of the participants for wider dissemination. The shift away from the report is being suggested mainly because it tends to turn out to be an innocuous document without much substance owing to the general insistence on agreement on the points mentioned therein.

One way of tackling the problem of communicating experience is possibly through the action learning program strongly advocated in the field of management by Revans (1977, p.3): "A successful action learning program demands that participants shall attack real life problems to which no answers are known, but to each of which some answer, even a partial one, is urgently needed. There must be genuine motivation among the management in the field to see the participant, with their help, tackle the

difficulty, not merely make recommendations about it, since the essence of the managerial task is not sophisticated recommendation but responsible action." In the process of action learning, the emphasis is on sharing the experience of successes and failures between the participants so that the more experienced can pass on at least part of their experience to the less experienced. In this process, it is possible to document experience and this will help in developing course material for future training courses with the necessary lecture notes, examples, illustrations and exercises. If this is done on a wide scale, sufficient documents and course material on case studies will develop to facilitate writing of standard books on practical applications of statistics in a more meaningful way with relevance to real life situations. Further, if documentation of experience and re-orientation of research towards practical problems are to be given effect, it is important to implement seriously the recommendation of the Panel Discussion cited in Section 6 on providing adequate facilities for publishing practical problems and their solutions.

8. UTILIZATION

The statistical education system, even with all the modifications suggested in the earlier sections, will be able to serve its purpose only if it can attract the right type of students and if the statisticians coming out of this system are given an opportunity to utilize their knowledge in the on-going and/or projected statistical programs. It is normally assumed that the primary aim of the academic and professional institutions is to impart education and training and what happened to the candidates later is not generally followed up except as a matter of curiosity. In view of the limitations of funds and teaching personnel, it is important

to give careful thought as to who should be educated and trained and how the education and the training are to be utilized.

Though in the earlier stages the statistics courses in the universities used to attract bright students, lately, as has been pointed out by Montenegro (1973) in his review of recruitment and training of statistical personnel, statistics degree courses have tended to become as unpopular as mathematics courses and are regarded as relatively unattractive compared to other courses which are better known or offer greater social prestige. This is possibly due to the fact that the statistics degree courses have continued to remain theoretical and mathematics oriented without being responsive to practical needs. It is hoped that with appropriate modifications in the syllabi of these courses to include data production aspects and with offering of more specialized courses in different fields of statistics, the universities will be able to get out of the stereotyped courses and thereby attract better students.

The selection of candidates for university courses does not present as serious a problem as the selection of trainees for training courses in statistics. Since statistical training is at present outside the formal education in statistics and since it is generally available only at international statistical institutes or workshops internationally arranged, there is keen competition for the seats in the training courses. Normally this would have been considered fortunate as there would be competition and hence better scope for selecting most suitable candidates. Unfortunately, this is not so, as the selection of the candidates is basically done by the statistical offices and the selection is based on considerations extraneous to the training such as seniority, signing of

service contract, position in the services, etc. This possibly happens owing to the dominance of the bureaucratic system even in statistical services. Thus there is a paradoxical situation of a large number of persons needing training, but persons, not necessarily the most suitable, turning up for training. Though in principle the training institutions and workshop organizers are supposed to have the right to choose the candidates, in practice the choice becomes very restricted because of the limited number of nominations received.

Thus the primary problem in making statistical education and training effective is to get the right type of candidates for the statistical courses. This problem can possibly be solved only by diversification of the courses in universities by including data production aspects and applications of statistics in different fields and by seeking the understanding and cooperation of the statistical services in the countries. From a long-range point of view, the statistical services in the countries should be encouraged to create the necessary training facilities in collaboration with the universities and the statistical institutions.

Another aspect which hinders proper utilization of statistical education and training is the administrative system of transfers between unrelated services in some countries. It should be impressed upon the countries that statistics is a profession and it is important to create and maintain a statistical service as a close-knit professional group. This has many advantages as the statistical education, training and experience of the staff members are retained and the statistical service will benefit from the learning effect resulting from the accumulated experience.

To benefit fully from statistical training, the statistical services

should sponsor only the candidates who are presently working on or are expected to work on projected programs and ensure that after the completion of the training the candidates are put in positions where they can utilize effectively the skills learned by them. Further, a country should send for training only as many persons in statistics as its infrastructure can easily absorb. Training more persons than the present and expected projects could absorb will certainly result in wastage of the training efforts. In fact, it has been observed that a statistics graduate tends to unlearn quite fast what he learned in the university, as he generally works in some stage of the data production process and is unable to use his university education with its emphasis on theoretical and mathematical aspects of statistical analysis.

The unlearning of the university education in statistics can to some extent be tolerated in the hope that even if the candidate unlearns the details of the statistical education he would still retain the statistical mental discipline he had acquired. However, in the case of training programs which are of ad hoc and 'instant' nature, the training imparted is of a specific type and is wasted if not utilized for this purpose.

Because of the gap that has developed between theoreticians and practitioners in statistics, the utilization of research results in data production and analysis has been rather minimal. This is mainly owing to research being conducted in university statistical departments with its orientation towards theory and mathematical dominance and bulk of the practical work and applications of statistics being undertaken in statistical offices with little facilities for research. There is no existing mechanism which could bring the theoreticians and the practitioners to-

gether to promote mutual understanding, communication and cooperation among themselves. Thus the problems on which research work is done by theoreticians are divorced to a large extent from the practical problems being faced by practitioners.

9. CONCLUDING REMARKS

The problems raised in this paper in the field of statistical education, training, research and their utilization are of considerable importance and are complex in nature and it would be difficult to find appropriate solutions and to implement them. Actually the momentum generated in the late forties and early fifties in the promotion and the development of statistics is gradually being lost and data production is tending to become mechanical and repetitive without the necessary research input in terms of innovative methods of data production, analysis and error control. As has been mentioned earlier in this paper, the situation can only be remedied if it is tackled on a global basis with the cooperation and collaboration of different organizations such as the universities, the United Nations and its Specialized Agencies, the ISI and its Sections and other national and international organizations active in the field of statistics. Efforts are necessary to bring these organizations and theoreticians and practitioners in statistics together with a view to facilitating better communication between them and making them work in close collaboration towards statistical development in the world.

10. ACKNOWLEDGEMENT

The author wishes to thank Mr. J. G. Miller, Director, Statistical Institute for Asia and the Pacific, and other colleagues in the Institute for their valuable comments and suggestions on an earlier draft of this paper.

M. N. Murthy

11. REFERENCES

Babbie, E.R. (1975): The Practice of Social Research: Wadsworth Publishing Co., Belmont, California

Bjerve, P.F. (1976): Presidential Address presented to the fortieth session of the International Statistical Institute held at Warsaw, September 1975, Bulletin of the ISI, XLVI, Book 1, 41-48.

Breny, H. (edited by) (1976): The Teaching of Statistics in Schools: Proceedings of the fourth ISI Round Table Conference on Teaching of Statistics, International Statistical Institute, Voorburg.

Council of the Royal Statistical Society (1947): Report on the teaching of statistics in universities and university colleges: Journal of the Royal Statistical Society, 110, 51-57.

Cox, G.A. (1957): Statistical frontiers: Journal of American Statistical Association, 53, 1-12.

Dedrick, C.L. (1952): Training of statistical agency personnel: Paper No. 232, presented at the International Seminar on Statistical Organization, 13-31 October 1952, Ottawa, Canada.

Dandekar, V.M. and Venkataramiah, P. (1975): Data Base of Indian Economy Vol. II: Statistical Publishing Society, Calcutta.

Goudswaard, G. (1959): The education and training of official statisticians:Conference of European Statisticians, 104.

Goudswaard, G. (1964): A re-appraisal of the statistical education programme of the International Statistical Institute: Review of the ISI, 37, (1), 88-103.

Institute of Statistical Mathematics (1948): The teaching of statistics - a Report of the Committee on Teaching of Statistics, Annals of Mathematical Statistics, 19, 95-115.

Inter-American Statistical Institute (1947-72): Reports of the Conferences of Pan-American Union, Washington, D.C.

International Statistical Institute (1969): Round-Table Discussion on the University Teaching of Statistics in Developing Countries: Review of the ISI, 37, (1), 86-98.

Mahalanobis, P.C. (1951a): Role of mathematical statistics in secondary education: Bulletin of the ISI, 33, (5), 323-334.

Mahalanobis, P.C. (1951b): Professional training in statistics: Bulletin of the ISI, 33, (5), 335-342.

Mahalanobis, P.C. (edited by) (1957): The University Teaching of Social Sciences - Statistics: ISI and UNESCO, Paris.

Montenegro, T.H. (1973): Recruitment, preparation and status of statistical personnel: Inter-regional Seminar on Statistical Organization, 3-12 October 1973, Ottawa, Canada.

Murthy, M.N. (edited by) (1971): Proceedings of the Seminar on Data Collection Techniques in the National Sample Surveys: Cabinet Secretariat, Government of India, New Delhi.

Murthy, M.N. (1977): Communication and cooperation between theoreticians and practitioners in statistics - some problems and possible solutions: Proceedings of the Panel Discussion, Occasional Paper No. 6, 55-63, Asian Statistical Institute, Tokyo.

Murthy, M.N. and Khan, T.M. (edited by) (1977): Proceedings of the Panel Discussion on Communication and Cooperation between Theoreticians and Practitioners; Occasional Papers No. 6, Asian Statistical Institute, Tokyo.

Rao, C.R. (edited by) (1972): Data Base of Indian Economy Vol.I: Statistical Publishing Society, Calcutta.

Revans, R.W. (1977): An Action Learning Trust: Journal of European Industrial Traning, 1, (1), 2-5.

United Nations (1949): An international programme for education and training in statistics: UN Document E/CN.3/56.

United Nations (1959): Programme appraisal, 1959-64 - Work of the United Nations in the Economic, Social, Human Rights and Related Fields: UN Document E/3260.

United Nations (1964): Manual of Training of Statistical Personnel at Primary and Intermediate Levels: New York.

United Nations (1972): A Short Manual on Sampling: Statistical Series, F, No.9, Rev.1, New York.

UNESCO (1974): A Survey of Statistics Teaching in Developing Countries: Paris.

United States National Research Council (1947): Personnel and training problems created by the recent growth of Applied Statistics in the United States - A report by the Committee on Applied Mathematical Statistics: No. 128, Washington, D.C.

Zarkovich, S.S. (1976): Further Promotion of Statistical Development: Second Draft, Belgrade.

Zarkovich, S.S. (1977): Circular letter forwarding the publication "Further Promotion of Statfstical Development."

CHAPTER IV IN-SERVICE TRAINING FOR STATISTICIANS

Report on In-Service Training for Statisticians

1. Definition

In-service training refers to any type of training after the employee is employed by the organization. This training could be carried on within the organization or outside. It is a continuing education, not leading generally to a degree or certification.

2. Aims of In-Service Training

a. The major purpose of the in-service training is to complement and supplement the education in statistics as taught in universities. University education by the various modules used, does not prepare a person fully to cope with the duties he would be called on to perform--so the need for in-service training.

b. In-service training tries to keep employees acquainted with new techniques and new developments.

c. As rotation of staff, either within the organization or between organizations, is recommended, in-service training intends also to retrain people for new jobs, new skills.

3. Who Should be Trained?

The training should include practically each member of the organization, though the type and content of the training will vary for various levels and categories.

The group of new professional employees coming fresh from universities and schools should be the first to be trained in-service. But the statisticians (mathematical and others), the non-statisticians, the subject

matter personnel, in various levels, should be part of the training program.

Special training is directed towards enumerators, coders, in terms of their statistical operations. This training was not discussed in the meeting.

4. What Training Should be Given?

The type of training varies according to the purpose of training, the level and type of employees to be trained, etc.

There is a need for complementing the statistical education of statisticians with other subjects not covered in the statistical curriculum (i.e., subject matter fields like economics, demography, management, modeling) while the education of non-statisticians should be complemented by some statistical training (i.e., an introductory course on survey design and operation).

As some statisticians will be moving to managerial jobs, it was felt that training should prepare them also for such jobs. They should be acquainted with tools of administration (i.e., accounting principles, budgeting, etc.).

On the other hand, managers in statistical organizations should be given some understanding of the use, by policy makers, of information collected so they could appreciate better the clients' needs for data to help better plan collection.

Some knowledge of computer use, including the use of some advanced language, is an important part of the training for many categories of statisticians.

5. Method of Training

a. The trainers should be, as far as possible, specialized

trainers. The best professional statisticians are not necessarily the best teachers. Teaching calls for expertise, and requires time and effort which professional statisticians cannot provide in most cases. The trainers should be selected, from universities and sometimes from the organization, on the basis of their knowledge and ability to teach. Professional statisticians from the organization should be called upon to teach the very specialized problems in which they are the experts.

b. The difficulty of transmitting experience by teaching was pointed out, as against the structured courses for the theoretical topics which are easier to transfer.

c. The method used by industry, by which some university teachers are invited for series of lectures, was recommended. Such lectures could develop new ideas and tools. In such encounters the specific problems of the organization could be discussed with the academic expert.

d. The lack of material for training in the applied fields was stressed. While many books on theory exist, very limited material on practice is available for such teaching. The statistical national societies and the I.S.I. can help in initiating such training materials, drawing on the materials and data found in internal courses in some agencies.

e. The length of the training varies (i.e., summer courses, evening courses over longer periods, weekly sessions, etc.).

Where Should Training be Carried?

a. Using university courses (regular courses with or without certification; summer courses like those offered in the Survey Research Center at Michigan, extension courses).

b. Outside agencies offering various courses, special program seminars, etc. (Such are provided by the Civil Service Commission, Department of Agriculture in the U.S.A.; some programs with the help and participation of the various professional societies - as the A.S.A. - such seminars as organized by Maurice Kendall, etc.). Some of these courses could be organized within the organization.

c. Within the agency in a special training department (or school, training institution) or ad hoc seminar courses. The possibility of providing this internal training would depend on the size of the organization.

d. A number of regional Statistical Institutes provide such practical training (i.e., the Indian Statistical Institute in Calcutta, the Statistical Institute for Asia and the Pacific in Tokyo, etc.) for official statisticians from various countries.

e. For higher level professionals the work in another agency (i.e., within a sabbatical, fellow appointees, etc.) can provide the best preparation for higher positions.

f. An experiment carried within the Center for Educational Statistics in the U.S.A. was described. This calls on persons interested in studying a specific problem to transmit

proposals to the agency. These general ideas are evaluated and some are approved to be presented as concrete detailed research proposals. The people are given the time and facilities to implement their analysis, using data from within the agency.

7. How Should We Evaluate Training Needs?

The training needs of different individuals in the organization differ. Information obtained from a survey of these needs can provide valuable inputs to a training program. The survey should find out the particular training needs of the individual based on previous education, on the likely future career, interests, etc. Some people prefer to work in the technical aspects and not move to the managerial jobs. The training should take these aspirations into account.

It was proposed that some career paths could be identified and, for each such career path, the appropriate training requirement would be described. The training could be a combination of various modules, taken partly in universities, in in-house courses, etc. This task of preparing training programs for various career paths could be taken by the national statistical societies and the ISI.

8. Categorization of Training

A categorization of the various types of training was proposed, based on the following variables:

a. The type of people to be trained (statistician and non-statistician.
b. The level (high level and low level personnel).
c. Place of training (intra-mural and extra-mural).
d. Type of education (developing new skills or broader philosophy of statistics).

Based on the combination of these categories the specific subjects and ways of training could be identified for each cell.

RECOMMENDATIONS

1. Statistical organizations should complement the education their employees received in universities by some method of in-service training, so as to bridge the gap between university training and actual needs of the organization.

2. As the type of complementary education needed by each individual will vary with previous experience and training, future planned career, the specific needs of individuals should be identified. Some typical "career paths" should be outlined and the special training programs defined (composed of various modules).

3. Statistical offices and organizations should invite university teachers to participate in teaching in the in-service courses. This could also help bring some new methods and ideas to the organization and acquaint the academic person with practical problems.

4. National and international societies and institutions should develop and expand their training programs designed to meet the needs of applied statisticians (i.e., survey operations, use of computers, management, etc.).

5. National and international societies should initiate the preparation of training material and examples for teaching in the applied subjects. This could be accomplished by collecting the material from available courses, encouraging the preparation of practical examples, by providing grants to people in the applied fields to devote time for writing such material.

6. Official statisticians, especially in the higher level, should be encouraged to work for some time in other agencies, as part of their training.

Prepared by Moshe Sicron

IN-SERVICE TRAINING FOR STATISTICIANS

As I began to look into the question of in-service training for statisticians in the Federal government, and sought some stimulating theme around which to build a talk, I became aware that in-service training could be reduced to a simple, repetitious, one-dimensional subject. An even greater difficulty was that I also became aware that the subject has been discussed, researched, and written about, any number of times in recent years. Thus, I was faced with the same dilemma that must have been faced by John Warner when he finally decided to propose to Elizabeth Taylor. Your know your subject and you know how you want the discussion to come out, but the difficulty is in finding a new "twist" that your listener hasn't heard before.

The facts of in-service training in statistics and facts as to what quantities of training are being given by which agencies, were all well covered by Alva Finkner and Beulah Washabaugh in their Education and Training of Domestic and Foreign Government Statisticians in the United States. I assume that you do not want those statistics quoted to you again.

Also, I will spare you any detailed discussion of the ASA programs, such as the joint program with the Statistical Reporting Service, the joint program of the Census Bureau which is partly funded by the National Science Foundation, and the joint program with Yale University, proposed by Savage, which would meet some of our needs for better ability to handle the large data sets that we have in the Federal government.

Within the government we are apparently trying to provide adequate statistical training. (There are undoubtedly exceptions in individual agencies.) The Bureau of Training of the Civil Service Commission provides statistics courses and in FY 1977 there was a total of 832 enrollments in 9 statistics courses given by the bureau. In the fall of that year the

Department of Agriculture also offered 9 courses in which there were 152 enrollments by government employees. But these are only a small part of the enrollments. The Department of Commerce regularly sends its professional statisticians out to attend area schools in Washington, D.C. The Bureau of the Census does the same thing, although they do offer a few in-house courses of specialized training for statisticians. So, as of September of 1977, the latest date for which the Civil Service Commission has data, there were 2,243 statisticians and 913 mathematical statisticians employed by the government. Thus, apparently, a high percentage of government statisticians are enrolled in some kind of statistical training at all times.

The recommendations of the Office of Statistical Policy (OSP) probably reflect the broad government reaction to all the recommendations which have been made to date. So before moving into a discussion of my own recommendations, which are quite different, but hopefully complementary, I will spend a few moments reviewing the OSP posture on training.

OSP has recommended that junior level statisticians should be rotated within a statistical agency and be required to participate in seminars and intensive courses in the applied statistical techniques.

OSP recommended that intermediate level statisticians should have 3 to 5 year rotational assignments among the major agencies, while also participating in seminar series.

It was also recognized that the senior level managers needed to develop supervisory skills and OSP recommended that rotation at that level be limited within the agency. It is anticipated that the senior level manager would increase his/her ability to handle assignments of increased responsibility within that agency. While I do not disagree with the concept of

rotation, I do not believe it is enough. And as a basis for that disagreement, I'd like to quote from Leslie Kish's magnificent Presidential Address before the ASA last August.

> "Statistics differs fundamentally from other sciences. The data of other scientists come chiefly from their own disciplines... though they may also take side trips into other fields. In stark contrast, statisticians have no field of their own from which to harvest their data. Statisticians get all their data from other fields, and from all other fields, wherever data are gathered. Because we have no field of data of our own we cannot work without others, but they also cannot do without us - or not very well, or for very long."

It is from this thought that I progress logically to my belief that, in addition to the traditional in-service statistical training, there are two additional categories of training which are generally not recognized, or at least not provided adequately. The two areas are non-statistical training for statisticians and statistical training for non-statisticians who interface with, or require the assistance of, statisticians. I will develop these two ideas further.

I am firmly convinced that the senior level statistician who has advanced to higher management levels needs more than merely to develop supervisory skills. Any manager at that level needs formalized training in accounting, budgeting, organization structure, personnel administration (beyond just supervision), and interpersonal and interagency relations. Particularly I would not agree that the rotation of the senior level managers should be limited to the single agency. It has long been my belief that the statistician is much like the bee who can move from flower to flower and from flowerbed to flowerbed and be equally industrious. I deliberately used the analogy of the bee, rather than the butterfly, since the profession of statistics more resembles the buzzing industry of the bee

rather than the fluttery beauty of the butterfly. However, it is of paramount importance that the people with whom we work perceive our full capability. Without this capability it is impossible to expose the best "men" to the top of the agency.

And having told you where I come out, I would like you to examine with me the subject of in-service training for the statistician from this different view. I would like to break out of the constraint on our thought that would bid us look only at training statisticians to be better statisticians with an increased ability to apply statistical techniques. Actually, the most important and exciting training of statisticians these days is in non-statistical training. And this is what I would like to discuss, together with some comment on the statistical training of non-statisticians.

Before I proceed to that discussion, I would like to illustrate just how broad and fulfilling in-service training can be. It seems that an elderly lady bought a female parrot. When she got it home she became very upset. The parrot said only one thing: 'Hi, Honey, I'm a swinger;" Well, she went to her priest and complained, "Father, the parrot says, 'Hi, Honey, I'm a swinger.' It's embarrassing when the ladies come to tea." The priest understood the problem immediately, and offered a solution. He told her, "I have two male parrots. They have been with me for a year, and I've taught them the rosary. You give me your bird for one week and your bird will have religion." He took the female parrot home and put it on the perch with the two male birds. She looked about her and said, 'Hi, Honey, I'm a swinger." One male turned to the other and said, "Drop the beads, Charlie; our prayers have been answered."

Now, with that dramatic illustration of non-technical in-service

training, let us discuss the non-statistical training of the statistician. It was a popular catch phrase in the 1930's and 1940's to say that the experts should "be on tap, not on top." By this was meant that the technical expert, such as the statistician, should not be given line responsibilities or authority, but should be available only for reference of technical questions in his field. This was the attitude of the administrative generalist, the professional manager and administrator. Statisticians, having at that time a very weak professional self-image, indeed, being sort of a poor relation of the mathematicians, knew no better than to submit to this rigid second class segregation. We have to remember that in the United States the first official Department of Statistics was not organized until 1940, and that the first graduate degree in statistics was not conferred until 1945.

But since that time we have burnished our self-image and our public image. We have moved and participated in, a dramatic evolutionary process. We may date the start of the process from the first department of statistics in 1940 and we may see that it is still going on. In some respects, only now as we look back, are we becoming fully aware that it has happened. We may look at the fact that there are currently more than 150 universities with one or more departments of statistics located in almost every State. These universities now grant hundreds of baccalaureate, thousands of masters, and hundreds of Ph.D. degrees in statistics. Academic programs in statistics are now so wide-spread, so popular, so productive, that Federal government subsidies have been significantly curtailed and you know how long government subsidies tend to continue after the need has passed.

This low status statistician of 1940 has gradually increased in importance and influence over the ensuing 38 years. As the Federal government's

role in the American economic mechanism and in the social system has grown, it has become increasingly necessary for the government to have information, that is, hard, factual information -- statistics. At first, the manager and administrator began to learn to handle the statistics and could interpret the meaning of the data they were given. They became, in effect, middlemen between statisticians and the policy makers. However, as the statistical volume has grown and as it has become more complicated and more esoteric, the generalist has had increasing difficulty in simply keeping the technician "on tap." The generalist has been less and less able to fully understand and re-state the conclusions to which the statistics point. More and more the policy maker has broken through to contact the statistician directly and to ask for the meaning of the quantities that the statistician reports. At the same time, there has been an increasing willingness to permit the statistician to select those quantities for acquisition and analysis that will be most useful for a given problem, for management of a given program, or for the development of policy in a given area. As the statistician inched toward this new role, it has been largely unnoticed. Today, however, we look at the various statistical agencies, and we see that they are now headed by statisticians who have moved into the managerial arena. This is not inconsistent with the observation of R.E.D. Woolsey of the Colorado School of Mines, who said,

> "I have discovered the interesting fact from experience that on many real world problems, people with experience can beat an elegant theoretical method all the time. If one were to accept this as truth, heresy though it may be, one would be driven to an ever more embarrassing conclusion that maybe the way to do some things better is to ask the experienced people and then simulate them."

In spite of all this, I am not ready to dispense with the manager, the administrative generalist. None of us would wish that all administrative

positions which utilize statistics, or relate to statisticians should be filled by statisticians. Besides the skewed, inbred kind of management that this would bring about, we have to consider the fact that there simply are not enough statisticians to do this, anyway. Therefore, what I would like to propose is that there should also be in-service training for the manager who is not a statistician. At this point, if you are wondering how I can weave this into a talk on in-service training for statisticians, may I remind you that the preposition is "for" which can mean "to the benefit of." There is no doubt in my mind that statistical training for the non-statistician is to the benefit of the statistician. When the manager needs to interact with, and utilize statistics, the answer should not be, in every case, to replace that manager with a statistician/manager, but to provide sufficient training to that manager so that he can understand and evaluate what the statistical operation is providing to him. After all, somewhere along the line, between the expert who acquires the data and make them meaningful and the public at one extreme, and the President and the Congress at the other extreme, there must be knowledgeable people who can understand the conclusions drawn from statistics, and who can have sufficient knowledge to be willing to rely on the statistics. Every manager should have an amount of statistical training sufficient to make for such understanding. This may be only a survey or introductory (in the academic sense) course, like the college science courses for the student not majoring in that science. But it must be sufficient to permit the non-statistician to understand the language, perhaps even speak it to a limited extent, and to know enough about the concepts and techniques to have confidence in them. I can give you the one example that causes us all trouble -

convincing the non-statistician that a set of results derived from a sample are as valid, sometimes more valid, than results derived from a universe survey.

With the increasing tendency of statisticians to move into managerial positions, a matter of real concern to the profession should be that we do not become victims of the Peter Principle. We must guard against moving the effective, superior, functioning statistician into administrative positions he or she is not equipped to handle, and thus rendering him or her less effective and less useful. The in-service training that the statistician needs at this point in his career when he is moving up, is not further training in statistics, but training in management, administration, budgeting, etc. One area that often requires particular attention, and this is probably more acute because of our mathematical orientation, is the awareness of interpersonal relationships. These elementary things are easy to say, but I believe are very difficult to accomplish in light of the competing demands on our time. At the same time we must reconcile ourselves to the fact that we will, undoubtedly, lose much of our "hands on" statistical skills, but at the senior levels it is questionable as to how much time we should spend in training to retain those skills. I am reminded that when Henry Ford I was twitted for lacking engineering skills, he responded that he had no need to acquire those skills because he could hire an engineer in five minutes who would know more engineering than Mr. Ford could ever learn. Many of us in this room have a rightful claim to be called statisticians, but many of the younger statisticians in this room could challenge us on the newest developments in methods and procedures, and in simple exercise of some of the higher level skills.

If we are honest, we would admit that they would beat us at such a game. Were we to re-enter the technical areas of the younger generation we would discover that we are not as smart as we think we are. However, on the other hand, it seems that our universities sometimes try to teach the student too much fact, and as a consequence he learns too little about the general concepts that underlie and make possible our science. And we do not really zero in on the intellectual and social skills that are needed in all fields of endeavor.

Lest we lose our perspective and being to get some "Tomorrow the World" ideas, we should remember that this process of the specialist rising to the managerial ranks has taken place in many fields. Forty years ago, the generalist was predominant in almost every field. The liberal arts graduate supplied the leadership in business, government, the university, and whatever leadership opportunities presented themselves. However, increasingly, their places have been taken by persons trained in engineering, accounting, business administration, and statistics. In some special cases we see that hospitals are managed by doctors and now, in government, social agencies are being headed by social activists.

It is not unusual today to find among our most effective administrators, persons whose basic training has been in physics, engineering, chemistry, psychology, or even education or statistics. How did they acquire the necessary skills to transfer their field of activity so effectively? The answer, usually, is: most inefficiently. Some are self-taught, some have been exposed to a series of crash courses, which are very much in favor today and can be effective if the student has the capability and background to quickly assimilate what is being taught, most have

had to learn by trial and error. It is this inefficiency that I would dispense with, by recognizing that we must be deliberate and logical in providing in-service training, not to train a person to do what he already does well, but to train him to do what he cannot yet do well, but is expected to do.

What has happened to the statistician is almost parallel with the manner in which labor-saving devices have freed the housewife from the drudgery of household chores and freed her for a more activist role in society. In both cases, there are many who deplore the development. But there is truly a serious parallel there.

In reviewing the change in the status and function of statisticians and in looking at the reasons, we must not overlook or underestimate the role of the sophisticated high-speed computer. Many of the functions of the statistician, that used to consume long hours of time, have been taken over by the computer programmers, by the statistical software packages like SPSS and Bio-Med, and by reusable routine analytical formulas. (Think, for a moment -- when was the last time you used a slide rule? And for those of you who have never used a slide rule, I can only say that you are probably too young to appreciate much of what I am saying here today, anyway.) Those marvelous technological developments, instead of making the statistician less necessary, have freed us to think, to develop, to speculate, to theorize, but most importantly, it has freed us to manage, and to apply, knowledgeably, the data whose acquisition, manipulation and analysis we have planned and initiated.

I would like to close with two thoughts. First, Bernoulli's famous quote: "One must not decide upon the value of human actions from their

outcomes, since the most stupid actions sometimes enjoy the best successes, and, on the other hand, the most prudent actions occasionally enjoy the worst success." And finally, I want to relate to you how the new religion of the orthodox bureaucrat has incorporated an ancient Irish blessing. They believe that when you die, your soul goes to Washington, D.C., where it gets lost in the paperwork before the devil even finds out you're dead.

Marie D. Eldridge

CHAPTER V EXCHANGES OF STATISTICIANS

Report on Exchanges of Statisticians

The paper by Richard Savage discusses benefits and costs of exchanges of statisticians between universities and government agencies from the point of view of the participants and of the institutions involved, enumerates various characteristics of exchanges, and suggests the importance of such exchanges, especially for high-level, upwardly mobile statisticians.

Early in the discussion of the paper stress was laid on the importance of personal interactions, not only books and papers, as a way of bridging the gap between university and government statisticians. An exchange that involves a university statistician spending a year with a government statistics agency enriches the agency with recent advances in theory, broad research interests, and additional technical capabilities. The exchange may also benefit the university and its students when the statistician returns better acquainted with government problems and with possibly a heightened interest in applied research. The opposite movement, of a government statistician to a university campus, similarly offers an opportunity to benefit both institutions.

During the wide-ranging discussion, the following types of exchanges were identified:

1. Personal exchanges of work settings for a reasonably extended period -- six months, a year, or more. Such exchanges may be arranged by individuals, organizations, or through fellowship programs. In the United States, for example, there are, among others, an Intergovernmental Personnel Act affecting exchanges of personnel between federal, state and local govern-

ments, a program of White House Fellows run by the national government, and of Congressional Fellows run by a group of professional associations.

2. Monograph programs in which university statisticians or social scientists are invited to analyze government data, either as sole authors, or as joint authors with one or more staff members of the statistics agency and publish research monographs. The university scientist obtains access to data more quickly, possibly with research funding, and with supporting services such as computer time, documentation, technical advice from agency personnel, and publication arrangements. The agency benefits from additional use of the data it produces in more research-oriented modes, and possibly receives leads or suggestions for methodological or substantive improvements in its future program. Authors of monographs require the support of adequate computer time and other services. Some experiences have been successful; in others, the authors have not performed or have been inordinately slow in preparing reports.

In a variant, usually located in a university setting, a statistician may be commissioned to present a short course on the condition that he prepare a monograph on a major aspect of theory (for example, the Conference Board of the Mathematical Sciences has considered several topics relevant to statistical theory).

3. Professional association-sponsored personnel exchange programs in which the national statistical association acts as a

broker between the government statistical agency and the academic community.

4. International exchanges, arranged on an individual basis, through international statistical agencies, or professional societies, or, for selected developing countries, using counterpart funds required to be spent in India, Egypt and a few other countries as a result of former American assistance (PL-480 funds).

5. Split appointments in which the same individual works simultaneously for a government agency and a university.

6. Consultants, who advise on an intermittent basis for a short or long period. These are more likely to be subject matter specialists than statisticians. Sometimes the contacts may be on a very informal basis initially in order to establish confidence in the relationship.

7. Statistician-in-residence programs in universities may invite government statisticians to participate. This provides an opportunity to introduce the students to a broader range of practical problems.

The discussion supported the author's view that:

> "From the national viewpoint, exchanges have important long-range values. The exchange process develops a group of workers with broad technical and organizational experience. These individuals have the potential of being interested in and able at administrative and policy tasks. Further, their broad experience allows them to use a variety of techniques

to solve major problems. Successful exchanges can result in the development of new interests both for academic and government groups."

A number of considerations for successful exchanges were noted. It was suggested that full-time exchanges for a year or more are to be preferred.

Government agencies need to attract outstanding theorists interested in working on new applications and bringing a longer-run view of problems and possible solutions. If persons in the forefront of theory are to be effective, the receiving organization must be receptive to new, forward-looking ideas. The receiving organization must spend time to assure that the exchange person has sufficient contact and interaction with staff to benefit both. Furthermore, the receiving agency must have staff counterparts able to absorb and communicate the knowledge and experience of the visitor.

Budget problems prevent as much exchange as would be desirable. Two-way interchanges might be an answer, but some commented that the reverse flow of government personnel to universities is even harder to arrange on a full-time basis. Recently, there has been difficulty in motivating young people to move when their chief objective has been to obtain tenure in a university post.

The exchange program should not be judged solely on the immediate effects of new theories or methods developed or adopted, but on the long-range advantage of getting university members involved in official statistical problems and carrying these back to the university setting.

The importance of exchanges of personnel with industry as well as

the universities was noted. Industry personnel can bring the point of view of data providers to government, and government statisticians placed in industrial environments can learn much about business record keeping.

The group endorsed the three recommendations in the Savage paper:

---That a catalog of exchange opportunities should be prepared and well publicized by the national statistical organization;

---That the national statistical organization should work to promote additional exchanges to help develop a strong senior civil service of statisticians. The statistical organization might seek and arrange funding, and recruit and screen applicants;

---That government statistical agencies be assisted by the national statistical organization perhaps working with research-oriented foundations, in developing the skilled administration needed to develop basic research programs. Stimulating basic research requires special skills, sophisticated methods.

The group also recommended that a number of national professional organizations and institutions join with the International Statistical Institute in developing broader schemes of interchanges across national boundaries. The Royal Statistical Society, the Indian Statistical Institute, and the American Statistical Association were all mentioned in this connection.

Finally, it was suggested that an effort be made to document the benefits of exchanges, to obtain empirical data concerning the benefits, and the circumstances surrounding successful exchanges.

Prepared by Margaret E. Martin

EXCHANGES OF STATISTICIANS

0. Introduction

The possibility of individuals exchanging one work setting for another is appealing. In particular, we shall comment on the social mobility of statisticians between organizations. The situation for statisticians appears different from that of other professionals such as lawyers, economists, or psychologists. But the universal aspects of statistics are declining in this age of specialization and the other professions continue to develop cross-cutting interests such as lawyers with confidentiality and privacy, economists with information, and psychologists with attitude measurement.

The fee for preparing this document did not provide for extensive data collection. So much of what appears are my impressions from a limited sample. The appended documents do give the views of generous colleagues.

1. Benefits and Costs

We are talking about a variety of activities from the government employee taking a course in a local university to a professor becoming the director of a statistical agency. The exchanges that I will tend to focus on will involve extended periods (usually at least a year) and professional work in contrast to education.

First consider the individual. If he has the ability and opportunity for exchange, then he has the satisfaction of professional recognition and security of employment. The current structure of professional employment makes it almost necessary to consider change of employer after reaching a senior position but before retiring from the work force; this seems particularly relevant for the career civil servant. Thus it is important for

the statistician's career to develop so that he/she has alternative opportunities.

For the individual there is the pleasure that can be obtained for himself and his family when moving to a new job. When one goes on a year's leave, a part of the reward should be the choice of a good place to visit. Although hard work will be expected by all from the visitor, he/she should be burdened with much less of the mundane work activities. Thus an exchange is a precious opportunity both personally and professionally.

The activities during an exchange will increase the professional strength of the employee. No doubt a large part of the visitor's activity is what he/she does at home but more so. The visitor is likely to have larger blocks of time for concentrated work. He/she might have better access to computers, to data files, or to libraries than at home, or find the opportunities to write up accumulated research and to read up in neglected areas. But it is the extras of visiting that have longer-range value. Visiting broadens knowledge of problems, people, techniques, and organizations. Visiting can require one to look at old problems in a new light. The best of statistical theory and methods will blossom when brought from a pure research arena to the serious field of application. It is one thing to understand and use statistics and another to present them coherently in a stimulating lecture.

Visiting costs the visitor. He/she must be prepared to disrupt routine and often a family will be torn from friends. The expenses of a visit are seldom met from the employer and thus the visitor is often faced with either a financial loss or some awkward living arrangements. Visiting always involves a good bit of uncertainty which requires emo-

tional cost. New colleagues make new challenges. New situations require intense learning periods just to get along.

Institutions want exchanges for a variety of reasons. Supplying opportunities for exchange is an important way to maintain the morale of a professional staff. (Presumably, good morale helps productivity.) Bringing people in on exchange enlivens the intellectual atmosphere at the receiving group which improves the morale and makes the group all the more attractive. The receiver also sometimes needs the exchange to support current activities which cannot be locally staffed; this includes teaching, consulting, and research.

From the national viewpoint exchanges have important long-range values. The exchange process develops a group of workers with broad technical and organizational experience. These individuals have the potential of being interested in and able at administrative and policy tasks. Further, their broad experience allows them to use a variety of techniques to solve major problems. Successful exchanges can result in the development of new interests both for academic and government groups.

The institutional costs of exchanges can be normal costs such as employing a person at a university after the person has been in the Civil Service. When exchanges are for short (one year) visits the specific costs of visiting are often considerable; these being costs not concerned with the primary function -- teaching and production -- of the organization. There are also costs of the hosts in arranging and planning visits and costs of disruption at both institutions. (As usual, costs are more easily measured than benefits, which suggests serious efforts should be made to assess the benefits.)

II. Types of Exchanges

A. Method of selection -- that is how one goes from where to where.

1. Labor market

a. When graduating or completing a training program.

b. When looking for a new job.

c. When changing fields of interest.

d. When retiring from a position.

e. Leave without pay to take up special assignments.

i. Office of Naval Research overseas scientific offices.

ii. Council of Economic Advisors.

2. Prize or reward

a. General competition with limited responsibility or specification of duty.

i. Fulbright.

ii. Center for Advanced Study in the Behavioral Sciences.

b. General competition with responsibility.

i. National Science Foundation

ii. NSF - RANN.

c. Specific competition with responsibility.

i. Census/ASA research fellowships and trainees.

ii. Antioch College work-study exchanges.

iii. Mills College - IBM work experience.

d. Sabbatical leave as reward for work done.

i. From universities.

ii. From industries.

iii. From governments.

3. Special sponsorship for advanced training.

a. Support by paid leave of individual employees to attend as full-time students.

i. Industry.

ii. Government.

b. Special education programs where most students would already have a professional competence and the students would often have an employer sponsor.

i. Census Bureau training for non-U.S.A. assignments.

ii. National Center for Health Statistics.

iii. IBM school for own employees.

c. Advanced work experience programs.

i. Nieman fellowship.

ii. White House Fellows.

iii. Congressional Fellows.

iv. Inter-Government Personnel Act.

v. Research Associates in Federal Laboratories.

B. Types of Activity in Exchanges.

1. Study.

a. Full or part-time.

b. Advanced work in a field of expertise or new areas.

2. Research.

a. Structured versus unstructured.

b. Individual versus group.

3. Production.

a. Teaching.

b. Applied research.

c. Assigned tasks.

C. Purposes of Exchange.

1. Development of personnel.

   a. Different parts of career.

   b. Unusual specializations.

   c. Unusual breadth.

2. Accomplish tasks.

   a. Research, pure and applied.

   b. Teaching and training.

   c. Production.

3. Fringe benefits.

4. Locating potential employees.

5. General enrichment of programs.

D. Duration of exchange.

1. Short.

   a. Consultants.

   b. Short courses.

2. Intermittent.

   a. Committee membership such as National Research Council (NRC) or Census Advisory.

   b. Teaching part-time as a second job.

3. Normal - 1 year.

4. Long term.

E. Funds for Exchange.

1. Operating budgets.

2. Endowments.

3. Foundations.

4. Special appropriations.

III. Undertried Exchanges in Statistics.

A. Substantial group efforts to attack major problems - Manhattan project. Office of Federal Statistical Policy and Standards - framework for the'80's is probably underfinanced. "Correcting" the Census has been nibbled but would require a large extended effort if useful results are to emerge - presuming the effort is made when the time for progress has arrived.

B. Professional education for government and industrial statistical situations. There appears to be an effort to train statistical generalists; biostatistics appears to be the only well organized training of specialists. There are some resources directed towards training in survey research. (Many of the specialized programs do not seem to be well articulated with the theoretical programs.) The Florida State environmental-statistical program appears to fill a real need. In any case, specialized training programs should involve exchanges of students and teachers.

C. The exchange program when used carefully can have a major impact in the development of senior personnel. This can involve exchanges between and within organizations, such as the U.S. Government, American Telephone & Telegraph, the larger states, and the universities. One does not sense that the U.S. Civil Service Commission or other agencies have taken an adequate role.

D. Various national or regional statistical centers can be envisioned which would involve a variety of exchange activities. Data centers for opinion surveys, economic material, historical data are increasing and should use exchanges. Centers specializing in training and performance of specialized tasks should be considered. For examples, centers for the

development of skills in handling large data sets, (additional) centers for training and use of survey techniques. Such activities must make a large use of exchanges.

E. International exchanges of statisticians should be encouraged at all levels. There are statistical practices outside the U.S. that should become familiar to a large constituency in the U.S. Some topics that come to mind are centralization of government statistical agencies, collection of data on internal migration, de jure vs. de facto census, and extensive data linkages.

F. Much of this document has been written as if statistics (exchanges) could be discussed in isolation from other activities such as computing and the social sciences. This isolation is not intended. Consideration should be given to use of exchanges for developing teams, as has been done in operations research. The purposes of these teams include the handling of current problems, training, and providing a resource which is available when needed.

IV. Drawbacks to Exchanges.

In addition to the costs mentioned in Secion I, there are other potential unfavorable aspects of exchanges. (I will not elaborate the probability that an exchange program could have bad management.)

A. An exchange program can result in the weakening or lack of development of the permanent professional staff. If outsiders are brought in to handle the unusual, then the insiders will fail to develop. Contracting work out is an extreme form of this.

B. The need for exchange might result from poor housekeeping. If an agency tends to develop a mountain of in-house know-how that it cannot

communicate, then workers must come to the agency and spend considerable effort on familiarization either to use the resources of the agency or to help with agency work. Lack of documentation and communication should not be used as a need for exchange.

C. Exchanges can be used as a delaying tactic or as a method of not taking on responsibility. At times the National Research Council appears to be used in this manner.

D. People managing exchange programs might have special interests or lack a broad view of the situation. Particularly when a sponsor selects topics for research the situation is prejudged, the competition is reduced, and management will feel free to intervene in the research project.

V. How Good Are Exchange Programs?

I have not attempted to find the evaluation literature which I imagine is limited. Some scholarship programs are so well respected -- Guggenheim -- that one feels the money must be well spent. Some programs are very well established -- sabbatical leaves -- so that they become the expected.

Being a big country with a big government we have a great variety of programs with limited coordination. One senses a lack of standards for these programs. Perhaps there are more failures or half successes than necessary. It is hard to tell if program designers have well specified objectives and that they develop mechanisms to obtain the objectives. In particular we do not see a concerted effort to develop a class of senior civil servants.

VI. Recommendation.

The above has been written as a discussion paper with no effort to document remarks. Although I have attempted to provoke discussion, I

have tried not to be misleading. Thus the following recommendations are based on weak ground. They need discussion and perhaps replacement.

1. The American Statistical Association should prepare a catalog of exchange programs. The catalog should include information about the origin, operation and evaluation of the program.

1.1. The results of this catalog should be well distributed so that a broad audience would be able to participate in appropriate programs.

1.2. The catalog should be studied to see what kinds of programs appear successful and what kinds of programs are missing.

1.3. Study of the catalog should help in learning methods to co-ordinate programs.

2. The three main objectives of exchange appear to be (1) Development of senior staff; (2) Increasing the audience interested in the research problems of government and industry; (3) Providing employment opportunities and fringe benefits.

2.1. The ASA should work directly with the Civil Service Commissions and major employers of statisticians to develop exchange programs in support of providing senior civil servants of outstanding abilities.

2.2. In providing methods for getting people interested in research within specialized topics, it is important not to confuse production with research. The National Science Foundation and the National Institutes of Health have moderately good techniques and resources to help in this effort. Most government units do not have the ability to stimulate good research. Thus, it is recommended that work on stimulating research interests be channeled through the basic science divisions of

NSF or similar places. The ASA could take an active advisory role to carry out this recommendation.

2.3. Employment opportunities and fringe benefits are likely to flourish if the other recommendations are followed. Of course the ASA should keep its members well informed on these matters. And when situations arise where these matters need attention, the ASA should take a leadership role.

I. Richard Savage

APPENDIX

A number of persons were asked to comment on experience with Exchanges. Excerpts from their replies are given below.

A Professor of Management and Statistics

I was on leave from the University of Minnesota to spend a year at the Census Bureau doing research on non-sampling errors. I personally found the year spent in Washington most helpful since I was able to conduct research that I could not have done away from the Census Bureau. I also believe that the Census Bureau found the research helpful, since it led to a method of obtaining recall information that is now widely used in such surveys as the consumer expenditures survey and the crime survey. I do think that it is very important that plans be made in advance so that the academic person can spend a productive year at the government agency.

A Staff Member of the Bureau of Labor Statistics

The exchanges that have occurred have been beneficial to the BLS, and, I have been told, to the visitors as well. In my opinion, a major element of this success is that we selected our visitors on the basis of strong mutual interests--the visitors were interested in working on research that was of major interest to some BLS program, and we could provide facilities, and the kind of staff environment, that facilitated research objectives of the academic visitors. In that regard, it is essential to note that the BLS has several small specialized research units whose function is (in part) to assure that a communications gap does not open between the statistical agency and relevant academic research. All the academic visitors have been located within these units. Thus, although having academic visitors does help us to keep a communications gap from opening, I think it fair to note that a major reason why our academic exchanges have been successful is

that we have succeeded in keeping lines of communications open. A successful academic exchange program and a closed (or relatively small) communications gap do go together, in other words, but the direction of causation is not entirely one way.

A Staff Member of the National Bureau of Standards

(1) Postdoctoral Research Associateships. Offered in scientific fields by many Federal laboratories, administered through NAS-NRC. This is a formal competitive "program" with one-year appointments (renewable to 2 years), intended as I understand it to provide some new blood and turnover at the beginning research level for the host laboratories while exposing the academic community to the research needs of the government. Experience has shown that it is important for NBS to exercise its "advance veto" to screen out applicants whose research proposals give no evidence of potential for useful contributions to the practice of applied mathematics in the physical and engineering sciences at the NBS. Candidates who show an interest in how statistics is put to work are heartily encouraged. Of four past incumbents in Statistics, three are now in universities and one recently left a university for a position in a Federal agency. This program works well on the whole, and is different from those below.

(2) Intergovernmental Personnel Act. This law provides for astoundingly flexible exchange arrangements. The paperwork (on the government side at least) is unbelievably simple. Arrangements are made for each individual case, and costs are shared as appropriate. The NBS Applied Mathematics Division has supported several academic visitors. The Intergovernmental Personnel Act provides for exchanges between the Federal government and state or local government agencies including any university, public or private, and the opportunities are limited only by the necessity that somebody have funds. For example, this law would make possible university-supported or jointly supported "internship" experience in federal or other government agencies for statistics students, especially if a faculty member had a continuing relationship with a government agency. We are using this mechanism to have a series of "Visiting Mathematical Scientists," people who collaborate with NBS projects that require specialties not covered in sufficient depth by the permanent staff in mathematics. In one case, a visiting mathematical scientist came from a university that was launching an NSF-supported new program in applied mathematics.

Flexible mechanisms exist for a wide variety of exchange arrangements. But it is not easy to identify problems that can be fruitfully worked on in a short-term in-and-out mode. Orientation for a visitor is costly in terms of time spent by already overpressed government staffs, and the effort pays off only if the visitors and the problems are well matched in advance. In my opinion, an exchange visit cannot be really satisfactory unless its duration is at least a year (exceptions admitted).

A Former Chief Statistician at Statistics Canada

In Canada I can think of two significant cases. One was the Royal

Commission on Government Organization which in 1962 submitted a report which enormously accelerated the growth and effectiveness of the Dominion Bureau of Statistics, of which I was then head. Behind this, however, lay an initial breakdown in which an academic who was hired by the Commission to look at the statistical system, demonstrated a total failure to grasp the role of the statistical function in public and private decision making. In many respects the initial results corresponded to the final results of President's Commission on Statistics. Fortunately in the Canadian case the Royal Commission sensed impending disaster and simply removed the academic incumbent. He was replaced by another academic who knew the Dominion Bureau of Statistics and who in short order, because there was very little time left, produced a brief and highly significant report. The overall score on this episode (one failure, one success) was not decisive but it does emphasize the obvious fact that not all academics are very good at recognizing major institutional phenomena and needs.

The other case with which I have had some experience was the use of academics to write "census monographs" - major interpretive studies. Results have been spotty. In many cases the burden on permanent officers of the Bureau of Statistics was considerable and where we selected authors with limited experience the results were often mediocre. The successes were from a group of proven and experienced researchers. Conclusion? Nothing very novel, except that academic seniority and distinction needs to be supplemented by some administrative tastes and skills to meet the deadlines and profit from the (generous) opportunities provided by a government agency. Where we failed, it was because we did not recognize that academic rigour is intellectual and abstract, while business and governmental rigour in addition involves disciplined structural restraints and expectations. This is not to say that the two groups cannot work together, but that there need to be some pre-conditions and attitudes in order to build a successful bridge between the two. I have a feeling that these facts often are not sought out and clearly identified before the contract is signed.

A Statistical Agency Administrator

Several scholars and scientists have taken university leave and spent up to two years working in the Center either as Service Fellows or as IPA (Intergovernmental Personnel Act) appointees. Also, university scholars from abroad have worked in the Center as WHO Senior Fellows. On the other hand, members of the Center staff have taken government leave to teach or conduct research at universities, and have taught at local universities in the evenings and on weekends.

We have made other types of arrangements that may be of interest to you. For instance, we have an active university training program which encourages and supports our staff to return to the university for gratuate study. We have also provided summer jobs to graduate students so that they can get on-the-job experience by working in the Center.

Finally, I might mention our arrangements for interchange of lecturers. Several years ago we had arrangements with selected universities to

interchange lecturers on a one-for-one basis. At the present time, we have the University Visitation Program which makes Center staff available for seminars and lectures to about 40 universities. About 15 university seminars are presented annually by Center staff.

The Executive Director of the American Statistical Association

1. The Inter-Governmental Personnel Act. This has been in effect for about six or eight years I believe, and has been used rather spottily in various agencies of the Federal Government. I believe that, for example, two years ago there was a geographer who worked at the Bureau of the Census. I believe it is a very effective mechanism and some agencies may have used it well.

2. The Fulbright Program. Even though a Fulbright Professorship involves an academician in the U.S. spending up to a year or more at a foreign university, often this includes a relationship with federal agencies and at times federal agencies of a foreign country. The Fulbright Professor is sometimes called upon as a consultant either in an official or unofficial capacity. My own experience in Sao Paulo, Brazil leads me to believe that a Fulbright professor is hardly used up to the full capacity of his/her ability and influence. It was not until I was in my last month there that I was able to set up a rather brief set of visits at the University at which I would present a lecture and consult with members of the department.

3. There are a number of federal agencies outside Washington in which a person has both an academic and a position with the Federal Government at the same time. I believe that examples of this exist with EPA or NIEHS at Research Triangle and possibly at Sandia or Los Alamos. You may be familiar with some of these.

4. Untried types of exchanges which might prove worthwhile are situations where a team of researchers from a government agency may spend several months, perhaps a semester at a particular university. Another configuration might be to go in the opposite direction. For example, suppose two or three members of a statistical department might spend, say, a summer at one of the statistical agencies either at the federal or perhaps even at a state level.

5. The whole area of continuing education might be explored. Some program, like a seminar at a particular federal agency or a consortium of federal agencies in which they would invite professors from various universities to look at their entire program and work on particular projects with them, could be arranged. This could be over a period of possibly one or two summer months. How this would be arranged and who would pay for it is a detail for the future, but I think there are some possibilities in this area.

CHAPTER VI STATISTICAL ADVISORY COMMITTEES

Report on Statistical Advisory Committees

Statistical advisory committees, by which we mean committees of outside experts assembled to advise statistical agencies of government, exist in a number of forms, as indicated on the attached diagram. As a means of bringing together academic statisticians and government agencies to resolve important issues, they are an excellent medium and deserve to be used more widely. From the point of view of academics interested in broadening their experience they are attractive, since they usually relate to important and well-defined issues, and provide lasting contacts with both government officials and other academics. The members take back to their universities a wider and more meaningful understanding of statistical applications, which enriches their careers and usefulness.

From the point of view of the official statistical agency, the existence of properly selected and serviced committees has many advantages. Not only do they provide critical and detached appraisal of government programs, but they are of advantage generally in making government statistical activities more open, more sympathetically received and better understood. This is appropriate because statistics are inherently outward-oriented; they are not an internal end in themselves, but are a means for assembling facts about the environment and transferring this material back outward to users as a basis for decision making.

The functions of advisory committees resemble those of consultants and both have an important role to play. The consultant is normally on something approaching a full-time basis, while the committee is more broadly-based and is much less expensive.

Types

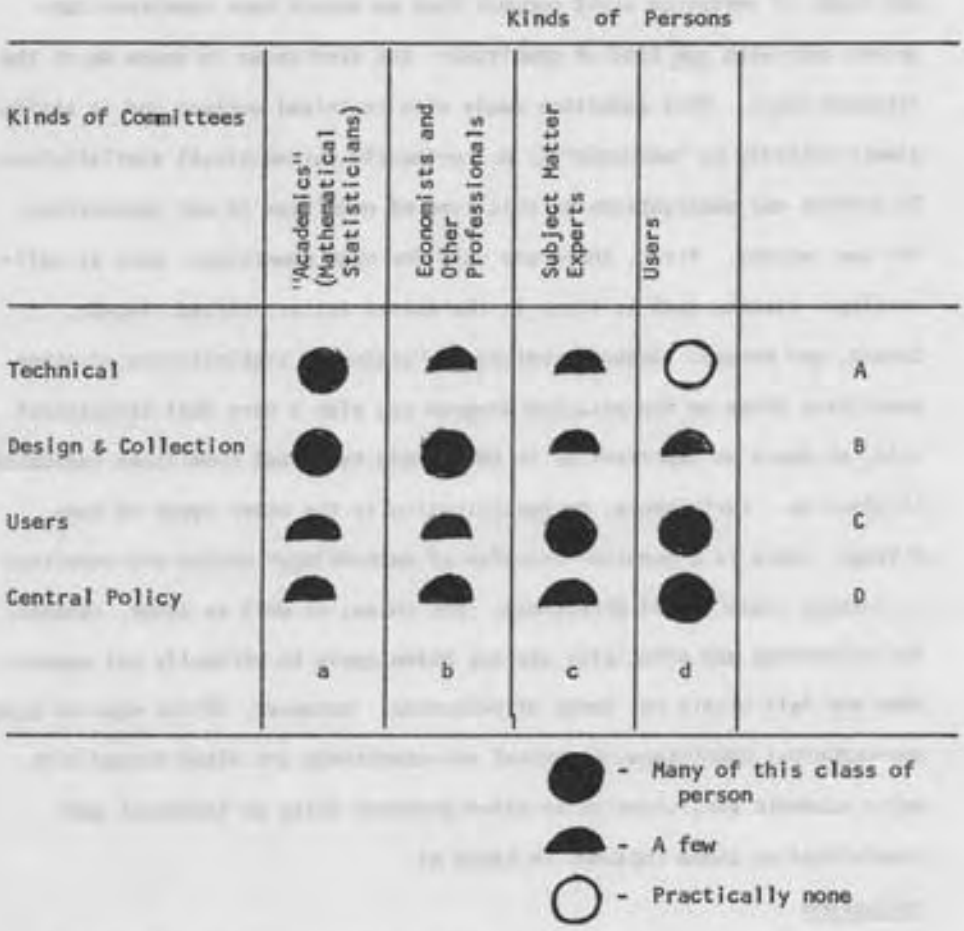
There are several broad classes of committee and strict adherence to our terms of reference might suggest that we should have concerned ourselves only with one kind of committee: the kind shown in space Aa of the attached chart. This committee deals with technical matters and is staffed almost entirely by "academic" (i.e., primarily mathematical) statisticians. To confine our observations to this type of committee is not appropriate for two reasons. First, there are very few such committees, even in well-developed systems such as those in the United States, United Kingdom, Canada, and Norway. Second, individual "academic" statisticians on other committees shown on the attached diagram can play a very full statistical role, at least as important as in the purely technical committees indicated in block Aa. Furthermore, by participating in the other types of committees, there is a genuine "transfer of methodology" within the committee on a large scale in all directions. For these, as well as other, reasons, the objectives and principles set out below apply to virtually all committees and fall within our terms of reference. Moreover, in the case of many non-technical committees, technical sub-committees are often formed with major academic participation to solve problems fully as technical and specialized as those included in block Aa.

Innovation

It has been noted that the history of statistical development and innovation contains many instances in which the presence of gifted statisticians, as members of an interdisciplinary group confronted by new and challenging problems, were stimulated to develop new and important techniques which would probably not have been discovered otherwise.

ADVISORY COMMITTEES

ACADEMIC STATISTICIANS AND OTHERS



This diagram is intended to illustrate, in broad and simplified terms, the classes of committees set up by statistical agencies. For example, in the Design and Collection category, there will normally be numerous mathematical statisticians, quite a number of economists and other professionals, and relatively few subject matter experts or users.

Statistical theorists and methodologists also participate in committees set up by other kinds of agencies, but these are beyond our terms of reference.

Trends

The use of committees of outside experts has generally grown significantly in recent years, with the exception of the federal level in the U.S.A. where the trend has been arrested and reversed, perhaps temporarily, by the action of the federal government, through legislation (Federal Advisory Committee Act of 1974) and administrative policy, to abolish a number of committees and reduce the freedom of action of others. This appears to have been a reaction to the self-serving role of some non-statistical committees, but it has nevertheless adversely affected statistical work.

The underlying trend in most countries is to utilize such committees freely, often in response to need for technical support in obtaining data for decision-making in new or complex fields, and sometimes as part of a desire by legislators for critical appraisal of certain programs of official agencies. Increasing sophistication of the user public and increased complexity and precision in data measurement creates a need for such interdisciplinary planning and monitoring of statistical programs. Finally, the committee approach provides flexibility and economy in securing highly-skilled and specialized help, usually by simply paying expenses. It is important not to adopt a cynical view of the generosity and public spirit of most of those who donate their time to these committees.

Appointment

The U.S. legislation mentioned earlier specifies selection of members by government departments, but prior to this legislation and in other countries there is a mixture of procedures, often with support from statistical associations. An effort should be made to broaden membership,

and not depend unduly on selection repeatedly from the same small group of proven experts.

Although the individuals would not "represent" the association, some feed-back, in the form of regular reports, would be desirable. In the U.S. situation the existing inadequate number of advisory committees might be supplemented by an initiative by the American Statistical Association in appointing committees of its own to offer (unsolicited) advice. There is already at least one example in the Joint Ad Hoc Committee on Government Statistics.

Chairmanship and Agenda

If competent chairmen can be drawn from within the committees, this is probably desirable, but in some cases chairmanship may have to come from government to ensure continuity and survival of the committee. The terms of reference of the committee should be clear and in writing. Too wide a mandate can lead to disinterest on the part of some members. The agenda for the following meeting should be discussed at the close of each meeting, and, if prepared by the governmental organization, should be discussed well in advance with the chairman.

The agenda, conduct of the meeting, and recommendations should carefully avoid the impression that the committee exists simply to support the statistical agency, otherwise distinguished membership will be hard to maintain.

Membership

The downgrading of membership to accommodate political, regional or other unqualified persons is very quickly self-defeating. Also a staggered system is desirable, with a reasonably long membership, say 2 or 3 years, to permit comprehension of complex issues. Longer membership or re-appointment

may be desirable. The objective of periodic replacement is to keep the committee in touch with current issues, to replace less effective members, to adapt to a changing pattern of requirements, and, finally, to draw in a balanced fashion on what may be a large group of potential members. On the other hand, there may be topics or countries where there is not a broad supply of potential candidates - hence these suggestions may have to be extensively modified.

Financing

It is probably inevitable that servicing and expenses should be provided by government departments despite danger of undesirable influence, any appearance of which should be carefully avoided.

Committees by Mail

Fairly large committees can be consulted by mail, and could supplement the conventional type of committee. They lack, however, the interpersonal exchange of ideas with its stimulating and innovative results.

Committees in the Immediate Future

A combination of government disillusionment and excessive expectations by users is likely to make life difficult for statistical offices over the next few years. In this situation, committees are likely to be sought to a greater extent to resolve what are, or what are believed to be, difficult problems of statistical systems or series. The tensions and public concern surrounding the circumstances of the time mean that committees will have to exercise particular care to preserve their impartiality, and by doing so, to retain their influence among frustrated or over-demanding users.

Central Policy Committees

The typical statistical agency may find it useful to develop a governing body or a policy advisory group to guide it in its internal planning, and also where it seems useful, to defend the agency against unwarranted external attack. Such a committee should not attempt to have, within itself, the diversity of interests that would enable it to deal with detailed subject matter or technical topics. An effort to do so would produce low-quality advice and would induce boredom among many desirable members. Such details should be handled by specialized committees, leaving the top group to deal almost exclusively with high policy and very senior personnel matters.

Recommendations

Throughout this section, there have been numerous suggestions for the use of committees. A few of these are sufficiently basic to qualify as formal recommendations as follows:

1. In view of the willingness of competent and impartial persons from the universities to act on statistical advisory committees, it is recommended that such bodies be more widely used, and that legislative and administrative obstacles not be placed in their way.
2. In anticipation of increased use of statistical advisory committees, both statistical agencies and statistical associations should consciously develop appropriate policies and procedures in the appointment and operation of such committees.
3. While recognizing the convenience and efficiency of drawing on persons of proven experience and performance who have already been utilized as committee members, an effort should be made to recruit from as broad a group as possible.

Prepared by W. E. Duffett

STATISTICAL ADVISORY COMMITTEES*

The statistical agencies of the federal government have had a limited number of advisory committees in the past. The Joint Ad Hoc Committee on Government Statistics believes that, despite the recent steps by the present administration to reduce that number, there is a compelling need for such committees. The integrity, quality and relevance of our nation's statistical information system depends in large part on the input of such committees. They provide for continuous interchange of information and views, and aid in making government activities more open. They ca· contribute significantly to the credibility of the federal statistical system through the continuous review of needs, concepts, procedures and products. In many instances, representatives of users of the statistical product also represent the organizations which supply the original data. Thus they can advise on both the utility and feasibility of proposed data collection. Statistical agencies need continuing stimulation from such committees if they are to be responsive to the information and statistical needs of all segments of the nation, as well as those of the federal government.

The advisory committee mechanism helps inform the statistics user community of the status of current statistical programs, and plans for new or expanded programs. It also provides informed comment on those programs. Among other actions, advisory committees have focused attention upon the need for obtaining specific types of information; the reporting burden on respondents; definitions and concepts; the utilization of sample surveys and administrative records; and the length of proposed questionnaires.

---

*This statement on Advisory Committees is taken from the report of the Joint Ad Hoc Committee on Government Statistics. The Committee was established by a number of professional associations in the United States. The full report of the Committee was issued in 1978.

Technical advisory committees bring together independent experts to advise on technical issues and give the government access to technical expertise which is difficult to employ on a continuing basis. Research on new techniques of sampling, and on data collection and analysis is often carried on in universities and private research organizations. Without the interaction between agency staff and expert advisers, the governmental statistical agencies are unlikely to gain the benefit of such research as quickly or as fully as would be desirable from the point of view of effective functioning of the statistical system. Experience with such committees has shown another benefit in that the committee members who are doing important research often have had their attention called to significant problems in their specialized areas, and have thereby been assisted in making contributions of immediate practical value. Programs for interchange of personnel between government agencies and the research community have provided for similar contributions on a very limited scale. However, they normally do not involve the more senior research scholars who can be recruited for service on technical committees.

Many top professionals, who are much in demand, would not otherwise be available to government agencies. In the open market these experts often command a high price as consultants. Even if some of them were willing to become paid consultants at the nominal government rate, it is unlikely that the agencies could count on a regular and continuing relationship such as is supplied through continuing committees which develop a basis for the necessary understanding of long-range programs. Members of advisory committees of the type included here serve without fee, receiving only travel and per diem costs.

The President's Commission on Federal Statistics in its report emphasized the value of advisory committees. They stated: "To get the most out of modern statistics, however, requires that users be brought more explicitly into the coordination process. Basically, producers' activities cannot be coordinated meaningfully in the absence of an understanding of the needs of the users." [1]

Advisory committees perform a variety of functions. Some are intended primarily to provide liaison between the statistical agencies and the community of users; some deal primarily with broad issues of policy relating to statistical activities; some are technical committees concerned with technical issues that arise in relation to an agency's work. While these functions should be clearly distinguished, in practice some advisory committees may perform two or all three of these functions.

In considering the roles of advisory committees, it might be useful to distinguish among statistical activities undertaken by the government primarily for one or another of the following reasons:

1. Statistics intended primarily for use by the federal government to plan, monitor and evaluate its own activities, or to serve particular, legislated functions.

2. Statistics on federal programs and their effects for joint use by the federal government and non-federal users specially affected by or otherwise interested in these programs; e.g., on taxation and regulation of the private sector.

---

[1] Federal Statistics, Report of the President's Commission on Federal Statistics, Volume 1, 1971, p. 122.

3. Statistics produced by or in cooperation with the federal government, which provide a neutral source of authoritative data for a variety of social and economic activities; for example, state and local planning, the setting of pay scales, etc.

4. Statistics produced for broad, general-purpose use as the basic demographic and economic data resource file of the nation; notably basic census series.

5. Statistics which serve as the key economic and social indicators of the "state of the nation" and are of equal interest to the public and the framers of public policy.

Admittedly, programs often involve admixtures of purposes without sufficiently clear weighting of each to permit the assignment of the program to one of the above as the primary class.

The Joint Ad Hoc Committee recognizes that statistical advisory committees have not always been as effective as they could be. It believes that a number of steps can and should be taken to strengthen the relations between the professional associations and the members of these committees. It is recognized that in most cases the members of these committees serve in their individual capacities rather than as organization representatives. Nonetheless, they occupy a unique position in that they can improve communication between the producers of the statistics and the users who are concerned with content, quality, timeliness, and accessibility of the data produced.

In relation to the statistics producing agencies, the committee recommends that the management of advisory committees to statistical agencies be improved significantly. Some agencies are already doing an effective job

of such management. Others can profit from their experience. Specifically:

a. Primary consideration in the selection of members should be in terms of the technical competence and knowledge of the specific areas of concern of the advisory committee. The access requirements of the Privacy Act may have the salutary effect of reducing clearances of prospective advisory committee members. Political clearance should no longer be employed.

b. The functions of the committee should be clearly specified. The effort to combine user and technical advisory functions in the same group has disadvantages. Few individuals could adequately fill both roles and a group would be handicapped in terms of data and analyses needed to arrive at valid judgments. An attempt to combine these functions also makes it difficult to organize agenda for greatest effectiveness.

c. The agenda for a committee meeting should be relevant to current programs, problems and issues, and should be prepared with prior consultation with the chairperson of the advisory committee. Materials to be presented should be made available well in advance of a committee meeting, and oral presentations by the staff during the meeting should be limited to summaries and answers to questions.

d. Committees should be encouraged to make specific and explicit recommendations to the agencies. Agencies should supply written responses to the recommendations made, at the time the minutes of the meeting are sent to members of the committee.

e. At the conclusion of each meeting, members of the advisory

committee should be encouraged to put forward proposals for items for the agenda of the next meeting.

f. Under certain circumstances, members of the committee, or task forces established by the chair, should be permitted to carry on needed work between meetings. Any travel or communications costs which are needed to do such work should be met by the agency sponsoring the committee.

g. The agency's staff should be responsible for monitoring the work of the committee, assuring that necessary documentation is made available on a timely basis; that recommendations which need to go beyond the agency are transmitted to the appropriate recipient; and that the committee is informed of actions taken in response to their recommendations as well as reasons for decisions not to accept recommendations. Staff should also be responsible for periodically reviewing the structure and functions of the committee and making recommendations for changes when these are warranted, including termination of a committee that is no longer needed.

h. Terms of service of committee members should be sufficiently long to provide adequate familiarity with the problems of the agency and its mode of operation. No fixed length of service can be set in advance; this will vary with the needs of the programs under consideration. There should be provision for bringing in new members on a regular basis. An advisory committee which is primarily concerned with a long-range program should be viewed differently in this respect from one which is dealing with ongoing programs or a short-term project.

The interaction of the different points of view which are to be found in a typical advisory committee makes for a more effective product than the sum of individual statements. Discussion often clarifies points that are ambiguous when first presented, and it often provides a basis for reconciling views which appear to be in conflict when originally presented. The interchange between the advisors and members of the staff often serves to clarify apparent differences. Such interchanges frequently provide a basis for reconciling the "real world" and the institutional setting in which decisions are made and actions are taken.

There are, however, occasions when another approach may be useful for securing advice from interested members of the professions. As developed by one agency the procedure is as follows:

> Several times a year a package of material -- plans, draft questionnaires, program options, and so forth -- is sent to a mailing list of over a hundred individuals known to have a more than ordinary interest in the agency's statistical product. The recipients are urged to write letters of comment, criticism, and advice about the materials or any other aspect of the agency's statistical program, and apparently they do -- often replying in thoughtful detail.
>
> The mailing list is designed to represent a diversity of user types and needs, but the only requirement for being on the mailing list is a willingness to reply to at least some of the requests for advice. Letters of advice are all acknowledged. Continued nonresponse to the mailings leads to the dropping of the name from the list.

The Joint Ad Hoc Committee views this approach as a supplement to, rather than a substitute for, ongoing advisory committees.

This committee recommends that professional associations develop procedures by which members may bring their concerns and suggestions to the attention of members of the appropriate advisory committees. This may involve the use of newsletters to inform association members of significant

developments and problems in federal statistics and of issues under discussion by advisory committees, together with information identifying the advisory committee members. It may involve regular liaison of advisory committee members with the association's governing body or with an appropriate committee of the association. Programs at annual meetings can be developed to provide information on major new developments, and time can be reserved for this purpose at regional meetings.

This recommendation for more effective liaison is made with the clear recognition that members of advisory committees to government statistical agencies are appointed in their individual capacities.

CHAPTER VII COOPERATIVE ARRANGEMENTS BETWEEN GOVERNMENTAL AND NON-GOVERNMENTAL ORGANIZATIONS

Report on Cooperation Between Governmental and Non-Governmental Organizations

James Bonnen opened the session by noting the difficulties of the topic. The difficulties arise, he said, from the fact that the topic presents questions of the relationships among institutions as well as among different kinds of professionals. The non-governmental sector involves many different kinds of actors and roles, and this presents questions of (1) who the actors are, (2) the ends toward which their cooperation is desired, and (3) the appropriate institutional fabric for cooperation.

Milos Macura summarized his paper, which had been distributed in advance, and the discussion was an elaboration of several of the themes he developed in his presentation:

1. The nature of the statistical community has changed enormously since World War II, due to the growth of non-governmental organizations engaged in the production and analysis of statistical data. The statistical community now includes, in addition to government, large numbers of commercial, financial, and industrial institutions, associations of these institutions, university departments of statistics, economics, and other social sciences, university-based survey centers, private research centers and polling organizations, professional societies, councils of social science research, international organizations both public and private, and many others.

2. This "powerful new companion" consists of organizations which are important producers both of statistics and of new statistical methodology. Their effect may be seen in the feedback of their

work on statistical theory and data production.

3. It is essential that adequate means be developed for the participation of these organizations in the building, modifying, and coordinating of national systems of statistical information.

4. The utilization of statistics outside government has outstripped even the rapid growth in the production of statistics, making it essential that major users, whether or not they are producers as well, play a fuller role in the design of government-operated data systems.

5. In the relating of all these interests, there is a key role to be played by professional associations and other groups suited to the fostering of scientific and technical exchange.

The "powerful new companion"

The contributions of non-governmental analysis were illustrated by the development of national income accounting, input-output analysis, seasonal adjustment, time-use studies, and demographic measures such as cohort fertility, all of which, and more, have been taken over by government statistical agencies after their development outside government. The role played by non-governmental producers of statistics was underlined by one participant's surmise that in the United States more interviews are conducted by non-governmental than by governmental survey organizations. The modal way in which government users obtain single-time survey data is to secure the services of non-governmental survey organizations.

There was some discussion of the circumstances under which government statistical agencies assume responsibility for data series developed outside government. A government participant suggested that this happens

when the intellectual power of a theory makes it a self-evident necessity for government to have reliable measures of the quantities embodied in it.

Statistical Standards

There was considerable discussion of the problems that a multiplicity of statistics producers, especially outside government, present for the development of a statistical portrayal of what is happening in the economy and society that is both coherent and of reasonable quality. The discussion came to focus on the need both for statistical standards and for standardization of statistics. It was noted that a statement of the quality problem in non-governmental statistics was presented by Otis Dudley Duncan to the 1972 meetings of the American Statistical Association, entitled "Federal Statistics--Non-federal Statisticians." One source of the current problem of public confidence was said to be the necessity for the government to rely on estimates of reserves of natural gas which were compiled by the American Gas Association.

One participant said that there is a need for standards, especially for non-governmental surveys, and that this is important to government because of the threat of public disbelief in surveys of all kinds. The problem, he said, is lack of an enforcement mechanism for the non-governmental sector. The existence of standards in the code of ethics of the American Association for Public Opinion Research was noted. As for enforcement, it was noted that AAPOR's Ethics Committee had recently chastized a private survey organization for introducing clearly biased questions into a survey. It was suggested that the research of Bailar and Lanphier, who are studying the quality of surveys under the auspices of the American Statistical Association, with funding from the National Science Foundation, was the most promising effort yet toward the improvement of

survey standards. 1/

The Standardization of Statistics

On the need for standardization, Milos Macura noted the difficulties in preparing regional accounts comparable with the national accounts because of varying definitions, classifications, and methods of data collection, and the difficulties in dealing with educational data where not even the age categories are consistent from one data set to the next. To promote both ease of comparison and ease of secondary analysis, he urged highly detailed disaggregation of data. It was pointed out that a high degree of detail in basic data files would permit varying forms of summarization.

One participant said that the way was not open for the adoption of definitive actions toward the standardization of statistics produced outside the government. The approach, he suggested, should be to encourage desirable processes. The pressure for standardization will come when the need for it becomes self-evident, and that will happen through analysis--through the confrontation of data. The government should lead, not legislate, in this area. It should achieve the needed standardization of its own statistical practices and hope for the best, in the confidence that it is for the best that there be room for innovation, and hence for nonstandardization, in the private sector.

Participation in Planning

In light of the tremendous growth of non-governmental analysis of government data, it is essential that major users participate in the planning of government programs. They should have influence, he said, at the critical stages of the planning of large multi-purpose surveys and especially in the review and modification of statistical five-year plans.

In the discussion it was suggested that the contribution of social scientists to the development of social indicators will depend in part on their access to the planning process and on the readiness of government planners to alter data systems at the margin so that they serve the needs of social indicators research. The point was illustrated by the need to collect data on consumer expenditures for legal services, which may provide an important social indicator even though legal services are too small a fraction of family expenditures to interest those responsible for the Consumer Price Index.

Finding Forums for Cooperation

The cooperation needed between governmental and non-governmental statistical activities could be accomplished in part through panels of experts which could suitably be convened by the professional associations. The typical bureaucratic consultation with experts and advisory groups is characterized by an imbalance of power, whereas in the professional associations the producers and users meet on an equal footing. Fred Leone was asked to comment on the role the American Statistical Association (ASA) has played in this regard. He mentioned expert seminars and workshops convened by ASA and described an activity in which ASA collaborated with the Society of Toxicology in a group which also included representatives of a section of the American Bar Association. He also described the ASA project mentioned earlier in which Barbara Bailar and Michael Lanphier have completed pretesting a study of the quality of surveys, covering federal, state and local government, private-for-profit, and private not-for-profit surveys, and have applied for a grant to conduct the full study. Other organizations were mentioned as providing a suitable forum for

cooperation, including, in the United States, the Committee on National Statistics, the Committee of Professional Associations on Federal Statistics (now being organized), and the Social Science Research Council, which has published the recommendations of a working group assigned to develop standard ways of asking background questions in household surveys. The World Fertility Survey was cited as an instance of successful research collaboration between an international organization (the U.N.) and national statistical offices, fostered by an international scientific academy, the International Statistical Institute.

Concluding Comments

Asked for his comments, Milos Macura said he thought that the remaining problem was the development of effective links between the non-governmental producers of statistics and the governmental producers. If the institutional links were developed, the links between individual professionals might take care of themselves.

There was comment on this emphasis. One participant said that the question of cooperation between governmental and non-governmental producers of statistics is not troublesome where the non-governmental producers are making methodological advances which benefit statistical science as a whole, and they are not troublesome where the non-governmental producers are "making bricks;" i.e., producing statistics that add to the common fund of information. The problems arise, he said, when the non-governmental and the governmental producers are in competition with one another. The government of the U.K., for example, produces data on wages. But in wage matters, the government is a party to the dispute, so the trade unions produce their own wage data. Similarly, industry, as well as government,

produces statistics on profits. On these topics as on others, there is competition. It is troublesome and the prospect is for more and more competing producers of statistics on critical topics.

Findings and Recommendations

1. Means must be provided for the participation of the non-governmental statistical community in the planning, design, modification, and coordination of national systems of statistical information, public and private.
2. Of special importance is the participation of non-governmental organizations in the design of government-operated data systems and in efforts designed to foster the development and application of quality standards and the standardization of methods and procedures.
3. The accessibility of government data to non-governmental institutions must be improved.
4. Measures to achieve these objectives in the United States should be undertaken, as appropriate, by the Office of Federal Statistical Policy and Standards, by the American Statistical Association and other professional societies of producers and users of statistics, and by the Committee on National Statistics, the Committee of Professional Associations on Federal Statistics, and the Social Science Research Council.
5. Such efforts should draw upon the interest and resources of government, non-governmental statistics producers, universities, and funding agencies.

6. Analogous efforts should be mounted by appropriate bodies in other countries.

Prepared by Robert Parke

1/ Bailar, Barbara A. and C. Michael Lanphier, Development of Survey Methods to Assess Survey Practices. American Statistical Association, Washington, D.C., 1978.

COOPERATIVE ARRANGEMENTS BETWEEN GOVERNMENTAL AND NON-GOVERNMENTAL STATISTICAL ORGANIZATIONS

1. In his 1975 Presidential Address, Bjerve rightly identified three broad categories of statistical work, viz. development of statistical theory, production and dissemination of statistical data, and application of subject matter theory, statistical theory and data for analysis of subject-matter problems. He observed that, owing to the specializations, a division of labor has been established among statisticians along the three lines. We should add that, mutatis mutandis, the same is true for organizations which are in one way or another substantially involved in statistical work.

2. Traditional pattern of relationship among the three categories was, perhaps, rather simple: development of theory and training of statisticians was a matter of university, application of theory to data as well as coordination and production of data - a matter of governmental statistical agency, while utilization of data was generally simple requiring crude rather than sophisticated methods. However, with the quantity and diversity of data available today, with the perplexity of issues which require statistical documentation, with the progress of statistical and subject-matter theory, and the multiplicity of organizations using statistics for their specific purposes, the relationship grew more complex.

3. The complexity of the current situation is of both organizational and technical nature: it is due to large numbers of organizations involved in production and utilization of data, as well as to the sophistication and modernization of statistical work in general. On the producers' side there are, in addition to the government statistical agency (or agencies),

university statistical departments, and also non-governmental specialized research organizations engaged in collection and dissemination of data. On the consumers' side, besides government administration and planning agencies, there are a variety of non-governmental research institutions, subject-matter departments of universities, industries, banks and other economic units, and the general public. Finally, associations of statisticians and, sometimes, other professional associations are organizations with quite specific roles in statistics.

4. Typical of the technical aspects of the current situation is the large-scale production of statistics accompanied by the massive use of data not only by the government and the general public (who were traditionally the main users), but also by institutionalized research in a variety of units which are strictu sensu non-statistical organizations. The advancement of statistical theory and computer technology makes it possible for the governmental statistical agency and other producers to produce large quantities of statistics. But it also significantly extends the capacity of users to absorb and digest the data. Statistical expertise, which is a traditional requisite for data production, is currently also an indispensible component of research, information and decision making in the non-statistical organizations. Amalgamation of statistical theory and the subject-matter theory tends to expand and diversify the volume of statistical methodology. Moreover, as a by-product of the users' statistical work, new kinds of statistics of composite nature are often generated.

5. Thus, along with the specialization and division of labor referred to earlier, we also see an intensification of statistical analysis requiring its own promotion and development. Work done by Leontief on input-output analysis; by Bourgeois-Pichat, Coale and Brass, on application

of stable population theory to demographic data; by many sociologists in the field of social indicators; or by Kendall and his associates in the area of multivariate analysis, is characteristic of that development. It is not surprising that this work is relevant to almost all stages of statistical procedure: collection, evaluation and correction of data; classification and tabulation; as well as estimation of relationships and modeling. Consequently, there seems to exist a significant feed-back effect of analytic work on statistical theory and data production, implications of which are known yet not fully understood.

6. It is, therefore, appropriate to reconsider the roles of statistical and non-statistical organizations in statistical development as well as their relationships, insofar as they affect the flows of data and statistical methodology. The objective is to establish appropriate linkages among all the parties concerned, with the view of optimizing the ratio of demand to the supply of data by maximizing the use of available methodological knowledge.

7. An optimal demand-supply ratio has to satisfy traditional requirements concerning the availability, reliability and utility of data, and the more recent requirements regarding the integration of data in appropriate systems of statistical information, as well as the critical issue of dissemination. It should count on primary data produced, and those generated by analytic work both in statistical and non-statistical organizations irrespective of whether it flows through the national system of statistical information or not. As far as the maximization of knowledge is concerned, it may be achieved by transferring methodology from all organizations where it is generated to the producers and users of statistics, whether governmental or non-governmental.

8. A prerequisite for this is a more adequate participation of non-governmental organizations in the process of building and modifying national systems of statistical information. In fact, interest of all organizations taking part in statistical work is to optimize the quantity and diversity of data, of course with due regard to its quality. Yet, the question is whether it would be feasible for the government statistical agency, with the machinery currently available to it, to get the organizations concerned together, to coordinate the flows of data, and to absorb the methodology developed in a number of non-governmental organizations. This is a time consuming and expensive undertaking which would call for additional coordination and methodological facilities. On the other side, the question is whether the non-governmental organization would be ready to take part in the process, especially in view of the fact that transfer of methodology requires both time and resources.

9. Participation of non-governmental organizations in the process of building and modifying national systems of statistical information has another advantage, which has its own merits. It could provide for additional flexibility of the government's statistical work and make it less bureaucratic and less rigid. Systematic review and critical examination of routine statistical practice, with due regard to usages and methods applied, is highly desirable in many respects. But the question is whether the government and its statistical agency would be willing to give up some of the prerogatives they enjoy today, and to what extent would they be ready to listen to the technicians who use their produce.

10. Optimization of data production and the maximal use of available methodology is obviously a complex technical, financial and legislative

problem. But it is also a psychological problem, for it involves motivation and active participation of statisticians who work for governmental and non-governmental organizations. It is here, in this delicate area where the professional association of statisticians can interfere, and provide facilities needed to stimulate debate, the collaboration of statisticians from different organizations, and ultimately the interactions between the three categories of statistical work. This is indeed an old, established function of statistical associations, but in order to be effective and more productive it requires systematic approach, additional vigor and appropriate funding. In this context, the question is whether the governmental and non-governmental organizations would be able to share the cost and the expertise through facilities provided by organizations of individuals.

11. One could visualize many areas in which an extended cooperation between governmental and non-governmental organizations, either producers or users of statistical data, could be productively applied. But there are at least ten specific practical issues whose treatment make such cooperation an indispensible condition for further statistical development:

i. Preparation of annual and long-term plans of statistical inquiries, with due regard to inquiries conducted by non-governmental organizations;

ii. Programming of large-scale multi-purpose statistical inquiries, for a variety of uses which are difficult to anticipate;

iii. Detection and correction of error in data by analytic methods;

iv. Increase in utility of data by multiple classification and tabulation with special regard to micro and macro analysis;

v. Provision of data for large-scale multi-purpose or specific modeling;

vi. Early appreciation and study of the impact of new theory and analytic methods on collection and processing of data;

vii. Study of methods and procedures applicable to standardization of statistics produced by governmental and non-governmental organizations;

viii. Assessment of data with special regard to change in the real-life situation, and the advancement of statistical and subject-matter theory;

ix. The issue of dissemination and utility of data in relation to the particular needs of research and analysis.

There are other important subjects which deserve appropriate attention, too, such as the problem of confidentiality, protection of privacy, or the moral aspects of statistics. Being of a different nature, these are not listed above for obvious reasons.

12. Hope should be expressed that a more appropriate coordination between the governmental and non-governmental agencies engaged in the categories of statistical work would help in closing the circle of statistical work. It would perhaps help the integration of a national system of statistical information, at least at the critical points allowed by the modern statistical process.

Miloš Macura

CHAPTER VIII BUILDING A BRIDGE TO EFFECTIVENESS

When I received the invitation to present this talk I was asked if I was aware of the purpose of the conference. At that point I stated I was aware of the conference and in fact nearly a year ago I had been asked to evaluate the American Statistical Association proposal requesting National Science Foundation sponsorship.

I mentioned this to the gentleman offering the invitation because I thought he should be aware that I had not enthusiastically endorsed the proposal. I then briefly identified my reservations which I had forwarded to the NSF.

Before I start my talk let me share with you some comments from my proposal rating sheet to the NSF.

"The proposal as it now stands is a good one. I would, however, raise some questions:

1. Given limited resources:

   --Available funds

   --Time resources of key agency personnel

   Is the need to close the gap in communications between statistical agencies and those concerned with the development of statistical theory and methods more important than closing the gap in communications between the information statistical agencies' produce and the information requirement of society's decision makers who are trying to apply existing theory and methods to existing problems?

2. Assuming that the answer to the above question is yes, then is the traditional approach to conferences adequate to

the task? Or is a more innovative approach required to deal with an age-old problem?"

I share these comments with you to give you some insight for what is to follow. Stated another way, I thought it fair to identify my biases early in the presentation.

Well, in spite of my confessions, the invitation stood -- and here I am.

Problems caused by communications gaps are not new. Neither are the communication gaps between those who develop theories and those who utilize them. And it is the continued outpouring of papers about these subjects that has led to this conference.

I have reviewed many of the papers prepared for this conference, and for the panel discussion sponsored by the Asian Statistical Institute. That review makes it clear to me that many concerned statisticians have interpreted Petter Jakob Bjerve's recent words on communication gaps much in the same way another of our participants, Leslie Kish, did when he reflected on his understanding of Bjerve's Presidential Address to the ISI, in his own Presidential Address to the American Statistical Association. In Kish's address he stated his agreement with Bjerve -- particularly where Bjerve "worries about the wide gap existing between official statisticians and academic statisticians. Professionally, these two groups seem to be living in two different worlds without communication in between."

As a participant in the ISI conference in Warsaw, I also heard the remarks which triggered these important conferences and papers by concerned statisticians throughout the world. For those authors' papers I have had an opportunity to review, I found a strong tendency to address only that

part of Bjerve's message in which he focused on the problem of communication among statisticians by saying:

> "The problems of communication and cooperation are particularly serious between the two categories of statisticians to which most ISI members belong, viz., the statistical theorists and the statistical data specialists. ...To a considerable degree the employment structure entailing the specialization is responsible for this situation. ...As a consequence, within the ISI, the statistical theorists are largely academic statisticians and the statistical data specialists are largely official statisticians. I point at this because the organizational bodies employing most ISI members, the universities and the statistical agencies, are in the position to establish such communication lines and such cooperation schemes as seem fit to improve the situation and, in addition, to benefit individual statisticians. The ISI can also no doubt make important contributions to this effect."

Though I am sure most of us could certainly point to exceptions in this description, I am personally willing to accept it as a reasonable generalization of the current status of communication throughout our profession. I am not willing, however, to accept the notion that because academic and statistical agencies are the institutions within which statistical theorists and statistical data specialists primarily perform their work, that improvements in the current situation will necessarily be found within the confines of the two institutions. My concern is that we should not, because of an organizational convenience, limit our access to alternative solutions which may be found in other individuals, disciplines, or institutions.

Bjerve cautioned us to be aware of the multi-faceted nature of this communication problem by stating:

> "There is also a need to strengthen relations between subject-matter analysts and official statisticians, whereas the relations between subject-matter analysts and statistical theorists in general seem to be good."

In essence, then, Bjerve has said that of the three groups of statisticians (1) the statistical theorist (2) the statistical data specialist, and (3) the subject matter specialist, the first order communication gap is between the statistical theorist and the statistical data specialists. Though there existed a second order communications gap between the subject matter analysts and the statistical data specialists, Bjerve did not deal with that specific issue in his Presidential Address.

All of us, I am sure, have faced that difficult task of deciding what detail we should emphasize in any presentation having a limited time frame. And I am sure most of us would have allocated our emphasis much in the same way Bjerve did.

However, I am convinced that we should not limit the focus of the current world-wide discussion. Rather, I strongly feel we should also consider the communication gaps which exist among <u>all</u> statisticians, especially in the context of the environment in which all statisticians conduct their activities.

Let me get to what I think is the weakness in the manner in which we usually address problems by relating an incident that took place between an American Frontiersman and an American Indian during the early settlement of the United States.

As the story goes, the Frontiersman was explaining to the Indian how much more he knew about the world around them than did the Indian. To demonstrate the magnitude of his perceived superiority, the Frontiersman picked up a small stick and drew a small circle (with a diameter of about six inches) in the soft ground and said this is what the Indian knows. He then drew a much larger circle (with a diameter of about sixty inches) encompassing the smaller circle and said this is what I know. The Indian nodded, walked over to the woods, picked up a much larger stick and proceeded to draw a circle (about sixty feet in diameter) around the entire area where the two men stood. After completing the circle the Indian looked at the Frontiersman and said, this is how much both of us do not know!

One of the things I was beginning to understand toward the end of my tenure as the Census Bureau Director, was that the Bureau spent a great portion of its limited resources trying to more precisely measure what it had already measured before. In essence we were trying to do a better job of measuring what was in our small "circle." We did not spend enough time -- not because it wasn't of interest, but because of the way we were organized, experienced, funded, etc. -- thinking about that larger circle about which we knew relatively less. As I have become increasingly concerned about this myopic predisposition we were forced into, I've discussed the issue with a variety of individuals and have come to the conclusion that it is not a problem unique to large government agencies. Rather, it is a problem that exists throughout academic institutions, large corporations, and yes, even private research organizations.

What is this problem? Essentially it is this--we as professionals have not adequately performed our most fundamental function, that of clearly

and comprehensively formulating a problem. The importance of this function is found in the old saying that "a problem well put is half solved." Or stated another way, "A problem ill-put will never be solved."

The lesson to be gleaned from the story of the Frontiersman and the Indian is not whether we can identify with the academic theorist, the data collection specialist, the subject matter specialists, the American Indian or the Frontiersman. What is important is that we understand and admit there is a much larger "circle" and that we are not capable of describing either the outer circle or the two inner circles.

Most of us desire to be able to define our problems in fairly precise terms. Additionally, we generally like to focus our attentions on those issues with which we are most knowledgeable. However, if we as professionals are going to do something that is more meaningful to society, then we must work on our problems in the context of society. However, in dealing with societal problems the likelihood of clear and crisp problems and solutions is greatly diminished. But this trade-off of additional difficulty for more relevant activity is not without its rewards. I agree with Tukey and others who in essence have said:

> "Far better an approximate solution to the right problem, than an exact solution to the wrong problem."

Before we try to narrow the communication gap between theorists and practitioners within the broader context of society, we should first determine whether it is this communication gap which is causing the problem. I am not, of course, asking whether it is a problem -- that answer is obvious. The question is related to whether it is the root problem.

I am reminded of Merton's comments in the opening chapter of his book,

Social Theory and Social Structure:

> "This announced interest in consolidating the reciprocal relations between social theory and social research is suspiciously irreproachable.
>
> "Where will one find a social scientists disclaiming the desirability of the 'integration' of theory and empirical research? Unless it is given some special force, this position will possess the same measure of trivial truth as the position held by Calvin Coolidge's preacher who was unexceptionally 'against sin.'."

If this conference is to be more than just another meeting of statisticians, we must add "body" to the abstract notion of closing the gap between academic and governmental statisticians.

It is my contention that statisticians -- all statisticians -- have a basic problem. That problem is:

We are not providing sufficiently relevant empirical evidence to society.

I am aware that as a profession we do have other activities in place attempting to deal with this problem. Indeed, the participants of this conference are playing leading roles in such activities. I am also aware that the limited focus of this conference was predicated on the notion that the subject of "the communication gap between agencies that generate social and economic statistics and that sector of the academic community which is concerned with the development of statistical theory and methods, is not currently receiving sufficient attention."

Though it is difficult to disagree with the contention that insufficient

attention is being devoted to the subject, it is equally difficult to agree that we can deal with the communication gap issue without having satisfactorily addressed the broader issue of what is it that the users of statistics require of us.

My thesis is quite simple:

<u>It will be much easier for all statisticians to narrow the communication gap among themselves if they better understand the information needs of the societies they are committed to serve.</u>

Leslie Kish has reminded us of our unique role in very clear terms:

> 'Thus statistics differs fundamentally from other sciences. The data of other scientists come chiefly from their own disciplines -- though they may also take side trips into other fields. In stark contrast, statisticians have no fields of their own from which to harvest their data. Statisticians get all their data from other fields, and from <u>all</u> other fields, wherever data are gathered. Because we have no field of data of our own we cannot work without others, but they also cannot do without us -- or not very well, or for very long."

Gathering the human and financial resources to deal with the problem of developing a better understanding of what is required of us will not be easy -- but, we are not alone in understanding the importance of accomplishing this task.

The Presidential Address of Wassily Leontief to the American Economic Association where he pointed out to his colleagues that theory will never be improved without empirical test indicates to me a willingness to join with us in this endeavor.

"True advance can be achieved only through an iterative process in which improved theoretical formulation raises new empirical questions and the answers to these questions, in their turn, lead to new theoretical insights. The 'givens' of today become the 'unknowns' that will have to be explained tomorrow.

- - - - - - -

"The shift from causal empiricism that dominates much of today's econometric work to systematic large-scale factual analysis will not be easy. To start with, it will require a sharp increase in the annual appropriation for Federal Statistical Agencies. The quality of government statistics has, of course, been steadily improving. The coverage, however, does not keep up with the growing complexity of our social and economic system and our capability of handling larger and larger data flows."

In an effort to illustrate what can be accomplished, Leontief provides an example of a sector of the economy which has bridged one of the communication gaps. In his example, however, he has unwittingly identified an additional problem.

He goes on to point out that "official agricultural statistics" in the United States are more complete, reliable, and systematic than those pertaining to any other major sector of our economy.

Another of our participants, Jim Bonnen, has reviewed Leontief's comments and has made the observation that correctly drawing the big circle once does not insure that it will always maintain its correct shape.

Bonnen in his Presidential Address to the American Agricultural Economic Association dealt with the problem of constant review. He said:

"Leontief pays a high compliment to this profession by explicitly exempting agricultural economics from his indictment. He describes our discipline as 'an exceptional example of a healthy balance between theoretical and empirical analysis and of the readiness of professional economists to cooperate with experts in the neighboring diciplines...' However, the AAEA Economic Statistics Committee argues in 1972 that the honor Leontief accords us 'properly belongs to an earlier generation...' and that agricultural economists are now falling into the same errors which Leontief ascribes to the economics profession.

"The capacity and reputation of agricultural economics was built around a balanced investment in the theoretical and empirical. We have lost much of our early interest in the design and collection of data and now often fail to collect needed data or to respect those who do. There is evidence that we are failing also to update our conceptual base at a pace sufficient to keep up with major changes in agriculture. Conceptual failure directly undermines the deductive processes of knowing, while empirical failure directly undermines the inductive processes of knowing. Thus, these are two different kinds of failure. Either long pursued could be fatal. I am sure we will not let this happen."

Over the past fifteen years, my experience as a provider of information has led me to the conclusion that as providers of information we can

no longer complain that our information users do not know how to tell us what they need, and therefore, we cannot be held accountable for the fact that there is not sufficient information for society to better understand itself.

The problem is too important to point the finger of blame at anyone else. The decisions facing society have never been easy. They are more difficult and more important now because we are entering a period in which the tolerable "margin of error" that both the governmental and private sectors will be allowed in the conduct of everyday affairs is greatly narrowed. We can no longer tolerate the kinds of intuitive judgments which have led to the political, social and environmental disasters of the last several decades.

As a profession, we have made many significant improvements in the methods with which we conduct our activities. This has allowed us to become more efficient. The time has come when we need to develop procedures which insure that we will use the improved methodologies to provide sufficiently relevant information in a manner which will allow society to more effectively allocate our remaining limited resources.

In a paper titled The Next Steps in the Development of a National-State System of Vital and Health Statistics, Philip Hauser made the following comments regarding health statistics which in my judgment can be generalized to all statistics:

> "Permit me to call your attention to the brief descriptions of the seven components of the Cooperative Health Statistics System which leave me a little disappointed, as I shall indicate."

Having listed the seven components, Hauser then said:

"These are the seven components, but they leave out something which I hope some subsequent publications will emphasize. What I have in mind is contained in a bit of poetry....I quote from 'Huntsman, What Quarry?' by Edna St. Vincent Millay:

"Upon this gifted age, in its dark hour,
Rains from the sky a meteoric shower
Of Facts...they lie unquestioned, uncombined.
Wisdom enough to leech us of our ill
Is daily spun, but there exists no loom
To weave it into fabric;....."

Hauser went on to say:

"I do not know whether Edna St. Vincent Millay had this conference in mind, but she certainly could have not said anything more appropriate to the occasion. What I missed in this appropriate literature is reference to that loom to weave the mountain of uncoordinated, unsynthesized, unintegrated, and unanalyzed statistics into a meaningful fabric for purposes of health policy and program formulation."

Allowing one more liberty with Edna St. Vincent Millay's work, I must ask what should be the framework of the loom from which we will weave a more meaningful fabric describing our society.

Whatever framework we eventually choose for the loom to provide for the whole cloth of Statistics for national decision making, it will require a plan. The plan I will suggest this evening fulfills the same role as a blueprint. A blueprint does not build a new structure, but it provides the best available information to those who will put up the building. No

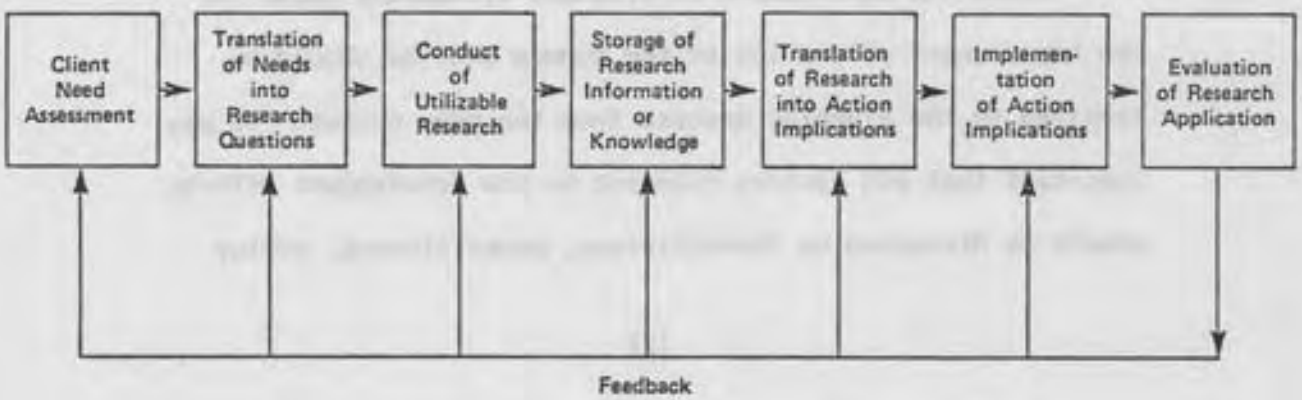
blueprint can replace human evaluation and judgment at the construction site; they are the factors that make the building possible. In the same way what I am about to suggest is not a solution to close the communications gap, it is simply a concept for enhancing statistical utilization and is a modification of a proposal developed by Gerald Zaltman of the University of Pittsburgh for the Research Application to National Needs (RANN) Task Force (A Division of the National Science Foundation).

The concept I'll mention this evening calls for the creation of a functional group which could serve anywhere from a "pool of talent" to a planning review staff to a centralized policy group, any of which could serve the entire statistical community. The general thrust of the group's actions is best understood by utilizing Zaltman's description of Knowledge Transfer as an outline for discussion.

> "Knowledge transfer is the broad process by which the needs of research users are determined and communicated to researchers, leading to research designed to meet these needs, and eventually to new knowledge based on research which is communicated to users who apply this knowledge to answer their needs."

Zaltman's description can be schematically represented by the following illustration.

THE MAIN ELEMENTS OF THE KNOWLEDGE TRANSFER OR RESEARCH UTILIZATION PROCESS



Each basic element in this scheme represents an explicit area which should be of major concern to producers (whether they be theorists or practitioners) and users of statistical information.

1. Client Need Assessment

Client need assessment is the process of determining users' needs. It is, in essence, identifying information gaps -- precisely. Some of the actions which are necessary to effectively monitor and understand the information needs of users are:

a. Identify who are the users of statistical information both today and in the future.

b. Establish a procedure which provides for an agreed upon priority list of user information needs on a continuous basis.

c. Identify resources for the support of developmental research on client need assessment.

d. Establish a center of competency which can provide expertise on client need assessment to other interested parties.

I believe that recommendation 3.1 of the panel that was convened by the Asian Statistical Institute provides us with the underlying assumption which supports the activities I've just outlined.

> "Since the development efforts are ultimately meant for the improvement of the lot of the common man, he should be involved in the planning process from the very outset. It was important that all factors relevent to the development efforts should be discussed by theoreticians, practitioners, policy

makers and representatives of the public to ensure involvement of a broad-base and subsequent wider acceptance."

2. Translation of Needs Into Research Questions

Once an information need has been identified among a user group, it is necessary to state this need in terms of a researchable question. To accomplish this task requires the identification of relevant disciplines or subdisciplines from which we can glean further insight into the problem. This branching out assists in:

a. Bringing all plausible sources of information to bear on the problem.

b. Bringing multiple-perspectives to the issue thus enhancing the chances of solving the problem properly.

c. Eliciting the attention and interest of researchers and persons who are not directly interested in applied research in general, or applied research in the specific field in question, but who are or can be contributors to the problem at hand.

The real difficulty in performing this activity, is in eliciting the attention and interest of researchers. Bill Kruskal has reminded me that perhaps one of the reasons that the theorist chooses not to deal with the issues related to application is that the imagination of the theorist has not been sufficiently whetted by the manner in which application problems have been formulated. He has hypothesized that perhaps if we could describe some of the practical problems faced in applications in mathematical terms, abstracted to mathematical formulae, this would more likely capture the theorist's imagination and lead to greater involvement. If this

hypothesis is correct, (and I was interested in Bjerve's comments of the Norwegian experience), I believe the function of translating needs into research questions is a function which is one of the most likely meeting grounds for the theorist and the practitioner.

3. Conduct of Utilizable Research

This segment requires the development of procedures which at least:

a. Ensure there is meaningful interaction between statisticians and the user community during all phases of the research process.

b. Ensure that the eventual user is consulted not only as to the content needs of the study, but that the user's requirements as to level of accuracy and format of presentation are also considered prior to the initiation of the study.

c. That the research proper is conducted within an agreed upon set of procedures and that the consequences and the costs of the procedures selected are clearly understood by the user.

4. Storage of Research Information or Knowledge

Research results should be cataloged and stored in an easy to use information system.

To enhance the chances that information stored will be easily accessible:

a. User needs should be one of the classifying criteria in the information storage system.

b. Both current and related past research studies should be stored.

To enhance the chances that the above two features can be accomplished we need to:

c. Identify resources for the support of developmental research on the storage of information.

d. Continually review for meaningful developments the research storage and dissemination activities of governmental and private statistical programs.

5. Translation of Research Into Action Implications

Perhaps the single most devastating comment that can be said of a completed research project is the phrase "so what." If the basis of that question is vested in the notion that the final product does not fit into an analytical decision process, I contend that the researcher must accept part of the blame. This does not mean that researchers must be accountable for the translation of research into action steps. It does mean that researchers must understand the translation process and insure that their product is compatible. Research textbooks generally do a good job in teaching the technical aspects of conducting research. There are, however, only rare instances where efforts are taking place to teach the process of translating research results into action.

This segment may require the identification and, if necessary, training of a cadre of individuals who are capable of dealing in both the world of data collection and the world of policy decision-making.

Indeed, one could envision a graduate curriculum being developed to complement (and perhaps eventually replace) the curriculum for training academic PHD's, the ever increasing need for which, Les Kish has reminded us,was the result of an era "which has just ended." Both Fellegi and Murthy in their papers provide an excellent beginning for a discussion on

developing such a new curriculum.

6. Implementation of Action Implications

Though the statistician is generally not held unaccountable for implementing the actions called for in research findings, the statistician can and should be held accountable for bringing the strengths of the statistical discipline to bear on the study of this segment.

I believe that the statistician should become more aggressive and ask that he be consulted by the users of statistics during the implementation process.

7. Evaluation of Research Applications

The evaluation of research applications is as difficult as it is important. In this segment we need to consider at the very minimum:

a. The time interval between the availability of relevant research and the time it was needed.

b. The elapsed time between first use and widespread use.

c. The intensity or degree of use by different users.

d. The costs of research development relative to the actual and potential uses to which it is applied.

The concept of knowledge transfer I have just described is not an action plan. It is simply my attempt to add substance to my generalization that we, as statisticians, must broaden our vision and our role if we are truly going to deal effectively with the communication gap about which we have convened this conference. Let me now suggest an action plan.

First, both the ISI and the ASA or other statistical societies should commit to a follow-on conference. The purpose of the conference should be to outline the design of a functional mechanism or entity, either temporary or permanent, to focus on insuring the more effective utilization of

statistical information.

Second, the participants and the conference's process should be selected and designed to insure that as many important perceptions of the mechanism or entity will be included in its design, and conversely, that important aspects will not be overlooked or excluded outright. Essentially the terms which best describe the planning process that is needed to design the proposed conference are:

1. Adversarial
2. Participative, and
3. Integrative

The conference's process should be adversarial (dialectical) in the sense that it should explicitly create and employ conflict and debate between different views for the prime purpose of challenging and testing any single definition of an important policy issue.

The process should be participative in that it should seek to incorporate as many different views of the issue by those who would be affected by the resultant statistical policies (e.g., those who will have to work with and within the statistical system, approve it, implement it, administer it, etc.)

This feature is critical because unless those who will utilize the mechanism are sincerely involved in its design from its very inception, the resultant end-product would not likely be utilized.

The process should be integrative in the sense that it should seek to synthesize into a whole, the different views of the various parties and interests to the issue.

Of all the papers I have reviewed relative to this subject, the one that comes closest to what I am suggesting is the paper at the Asian

Statistical Institute by Kinhide Mushakoji, of the United Nations University in Tokyo. In that paper Mushakoji warns us that:

> "A series of meetings may not be enough to find how the gap between theorists and practitioners can be bridged. This is why the United Nations University's Human and Social Development Programme proposed to build a network where theorists and practitioners would dialogue on goals, processes and indicators for development."

And I hope Mushakoji was considering the type of conference I have just described when he said:

> "....practitioners specialized in development planning at the grassroot, regional, national and international levels should be invited to compare notes among themselves and tell the theorists of the kind of theories and models they expect them to build and develop. It is only by inviting the practitioners to open dialogues with the theorists that the latter will be able to fully benefit from the former's experiences and develop theories and methods which are not only sophisticated but also operationally relevant."

The opportunity to prepare a paper for any audience is indeed a mixed blessing. On the one hand, there is that ever present gnawing anxiety that comes about when after you are finished with your final draft, you ask yourself, "Have I said anything that is really meaningful for the audience?" This anxiety is, of course, greatly magnified when the valuable time of the participants of this conference is factored into the equation. On the other hand, there is that feeling of exhilaration that comes when

you realize the opportunity to impact on an important issue.

Weighing these two conflicting emotions in the context of my personal concerns about our profession and our world society, my scale leans in the direction of exhilaration. And because of that I thank you for the opportunity to share with you my thoughts and feelings about the subject of this conference.

Now if you will grant me only one favor, you can sufficiently tip the scale away from any gnawing anxiety that might still be within me. My request is quite simple, particularly since many of you are not only aware, but are the embodiment, of what I am about to ask.

Promise me that you will remember the following statement that has stuck with me and to which I attribute whatever success I have had in my career as a provider of information.

"The providers of data give us our wherewithal.
But the users of information give us our purpose."

Vincent P. Barabba

SEMINAR ON STATISTICS
MARCH 8-10, 1978

March 7

7:00 p.m.	Dinner and Get Acquainted

March 8

9:45 - 10:30	Opening remarks: Duncan, Bjerve
10:30 - 10:45	Break
10:45 - 12:30	Statistical Standards for Government Service - Paper: Hansen Discussion Leader: Murthy Rapporteur: Kruskal
12:30 - 2:00	Lunch
2:00 - 3:30	Statistical Standards (cont'd.)
3:30 - 3:45	Break
3:45 - 5:15	Academic Training Required for Government Statistical Work - Paper: Fellegi Discussion Leader: Cansado Rapporteur: Durbin
5:30	Dinner Address - Building A Bridge to Effectiveness: Vincent P. Barabba

March 9

9:30 - 10:45	In-Service Training for Statisticians - Paper: Eldridge Discussion Leader: Parel Rapporteur: Sicron
10:45 - 11:00	Break
11:00 - 12:30	Exchange of Statisticians - Paper: Savage Discussion Leader: Bjerve Rapporteur: Martin
12:30 - 2:00	Lunch
2:00 - 3:30	Advisory Committees - Paper: Taeuber Discussion Leader: Moser Rapporteur: Duffett
3:30 - 3:45	Break
3:45 - 5:30	Cooperative Arrangements Between Governmental and Non-Governmental Organizations - Paper: Macura Discussion Leader: Bonnen Rapporteur: Parke

March 10

9:00 - 10:30	Reports by Rapporteurs - discussion
10:30 - 10:45	Break
10:45 - 12:30	Reports by Rapporteurs - discussion
12:45	Lunch - followed by concluding remarks
3:00	Adjournment

APPENDIX B

NAMES, ADDRESSES AND AFFILIATIONS OF CONFERENCE PARTICIPANTS

Dr. Murray Aborn
Program Director
Special Projects and Social Indicators
National Science Foundation
Washington, D.C. 20550

Mr. Vincent P. Barabba
Manager, Market Research
Xerox Corporation
Xerox Square 025
Rochester, N.Y. 14644

Dr. Petter Jakob Bjerve, Director
Central Bureau of Statistics
Droningensgate 16
Oslo, Norway

Dr. James T. Bonnen, Executive Director
Federal Statistical Systems Project
President's Reorganization Project
Executive Office of the President
Washington, D.C. 20503

Dr. Enrique Cansado, Director
CIENES
Casilla 10015
Santiago, Chile

Mr. Walter Duffett
506 Driveway
Ottawa, Ontario K1S 3N4
Canada

Dr. Joseph Duncan, Director
Office of Federal Statistical Policy and Standards
Department of Commerce
Washington, D.C. 20230

Prof. James Durbin
London School of Economics
Houghton Street
London WC2A 2AE
England

Ms. Marie Eldridge, Administrator
National Center for Education Statistics
U.S Office of Education
Washington, D.C. 20202

Dr. Ivan Fellegi
Assistant Chief Statistician
Statistics Canada
Ottawa, Ontario K1A 0T6
Canada

Prof. Leslie Kish
Institute for Social Research
University of Michigan
Ann Arbor, Michigan 48106

Prof. William H. Kruskal
University of Chicago
Chicago, Illinois 60637

Dr. Fred C. Leone, Executive Dir.
American Statistical Association
806 - 15th Street, N.W.
Washington, D.C. 20005

Mr. Milos Macura
Ekonomski Institut
Marsala Tita 16
11000 Beograd
Yugoslavia

Dr. Edmond Malinvaud*
Directeur General
Institut National de la Statistique et des Etudes Economiques
Paris, France

Dr. Margaret Martin, Executive Dir.
Committee on National Statistics
National Academy of Sciences
2101 Constitution Ave., N.W.
Washington, D.C. 20418

Sir Claus Moser, Director
Central Statistical Office
Cabinet Office
Great George Street
London SWIP 2AQ
England

*Submitted a paper, but was not present at the seminar

Prof. M. N. Murthy
Statistical Institute for Asia and the Pacific
Akasaka PO Box 13
Tokyo 107
Japan

Mr. Harold Nisselson
Associate Director for Statistical Standards and Methods
U.S. Bureau of the Census
Washington, D.C. 20233

Dr. Cristina P. Parel, Dean
University of the Philippines
Statistical Center
Padre Aaura
P.O. Box 479
Manila, Philippines

Mr. Robert Parke, Director
Center for Coordination of Research on Social Indicators
Social Science Research Council
1755 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Prof. I. Richard Savage
Department of Statistics
Yale University
New Haven, Connecticut 06520

Dr. Moshe Sicron
Government Statistician
Central Bureau of Statistics
Hakiyra-Romema P.O.B. 13015
Jerusalem 91130
Israel

Dr. Conrad Taeuber, Director
Center for Population Research
Kennedy Institute, Georgetown University
3520 Prospect Street, N.W.
Washington, D.C. 20057

Prof. S. Tulya-Muhika, Director
Institute of Statistics and Applied Economics
Makerere University
P.O. Box 7062
Kampala, Uganda

Mr. Allen H. Young, Deputy Dir.
Bureau of Economic Analysis
U.S. Department of Commerce
Washington, D.C. 20230

Mr. Joseph Waksberg
Statistician
WESTAT, Inc.
11600 Nebel Street
Rockville, Maryland 20852

Ms. Katherine Wallman
Office of Federal Statistical Policy and Standards
Department of Commerce
Washington, D.C. 20230

Prof. Graham N. Wilkinson
Visiting Professor
Mathematics Research Center
University of Wisconsin, Madison
610 Walnut Street
Madison, Wisconsin 53706