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A Systematic Study of the Consulting Literature as an Integral Part of Applied Training in Statistics

J.C. BASKERVILLE*

Seven important topics in statistical consulting are suggested as focal points for a study of the consulting literature. We have found that reading and discussing a few papers relevant to each topic, and considering how these topics are related, can be meaningfully integrated into training applied statisticians.

KEY WORDS: Statistical consulting; Training of statisticians; Training of consultants; Statistics and science; Report preparation; Ethics.

1. INTRODUCTION

A graduate course called "Statistical Consulting, Computing, and Data Analysis" has evolved at the University of Western Ontario during the last three years. This is a professionally (as opposed to academically) oriented course that combines these three aspects of statistical practice. A case study approach is used, along with detailed discussion of a number of current projects. Thus the course has a minimal amount of fixed subject matter. During the year (two terms), each student gradually becomes involved in consulting and with a project requiring substantial data analysis, or statistical computing, or both. A systematic study of the consulting literature can be successfully integrated into such a course; students begin to see how such considerations as ethical issues and client-consultant interaction relate to statistical practice. All students are asked to read each paper and one student is responsible for presenting a summary and leading a discussion.

To approach the literature in a systematic fashion, seven topics have been grouped under the four major headings of Sections 2 through 5. Section 2, on training strategies, can serve as a useful advance organizer. Since a major course objective is the development of consulting skills, Section 3 serves as the focal point, and within this section the consulting skills are presented in the order in which they are needed in a consultation. The topics in Section 4 on personal atti-

tudes represent important issues that could be interspersed with or discussed after the topics of Section 3. Organizational and administrative issues are discussed in Section 5.

These topics are not isolated aspects, but inter-related components of professional statistical practice in general. For example, statisticians' attitudes toward empirical work (Sec. 4.1) will have an effect on their interaction with clients (Sec. 3.1) whose research is of an empirical nature. Increased familiarity with such work through model finding and problem solving (Sec. 3.2) may modify these attitudes and improve methods of empirical investigation.

The papers and texts listed within each topic represent suggested initial readings rather than an exhaustive list. (Such a list can be found, for example, in Woodward and Schucany 1977.)

2. THE TRAINING OF STATISTICAL CONSULTANTS

Expert opinions on different strategies of training are of immediate interest. Such information provides students with some standards to which their own training can be compared and may help guide them through the maze of graduate school courses.

In addition to material on consultant training in statistics, the other helping professions, particularly psychology, have substantial literature on the training of counselors. Although the objectives of various types of helping relationships differ, there are many analogies in the interpersonal domain. The papers by Boen (1972) and Boen and Fryd (1978) provide examples of such analogies. Thus many of the models for counselor training and interpersonal behavior are directly related to statistical consulting. A few appropriate texts from other disciplines are referenced here and in the next section under the client-consultant interaction. These serve as an entrée to the available literature.

Suggested Reading: Cox (1968), Gilmore (1973), Tarter and Berger (1972), and Watts (1970).

3. CONSULTING SKILLS

3.1 The Client-Consultant Interaction

The psychosocial dynamics of the client-consultant relationship are an important factor in the degree of satisfaction derived by all parties in a joint venture. Such dynamics particularly dominate a first session, which often sets the tone for subsequent meetings.

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Beginning statisticians have often had to neglect their social skills in favor of long hours of toil in the mathematical vineyards and may be at a severe disadvantage here. In fact, certain maladaptive types of consultant behavior described by Hyams (1971) and Boen and Fryd (1978) might be seen as an attempt to regain some advantage in this situation. At any rate, for many students, the first "Hello, have a seat. Would you like a . . . ?" is an event fraught with apprehension. Discussion of the papers and texts listed below can provide a useful perspective on what one might expect or want to follow the initial contact.

Suggested Reading: Blocher (1974), Boen (1972), Boen and Fryd (1978), Combs (1978), Egan (1975), Hansen (1978), and Hyams (1971).

3.2 Model Finding and Problem Solving

Certainly one of the most exciting aspects of consultative or collaborative work is the opportunity for creativity in the solution of real problems. This often takes the form of choosing from a range of available methods or models the one that best fits the problem and the client. An analysis that is too far beyond the accepted procedures of inference in a particular discipline may be viewed skeptically by clients and their colleagues who are journal editors or potential referees. However, if the client is willing to learn and the statistician is willing to do some teaching and selling, the statistician can introduce improved methodology into the client's discipline.

A primary implication of these considerations for the student is that often the "usual" optimality criteria for selecting a model or procedure must be augmented by considerations of feasibility (i.e., cost, availability) and marketability (what can be understood without too much cost). To be successful here the consulting statistician must have a thorough knowledge of the relevant methodology and a thorough understanding of the problem and its scientific context. In summary, the statistician must be willing to learn and appreciate the significance of the client's project and the state of the art of the analyses being planned.

Although there are few papers in the consulting literature devoted entirely to the problem-solving and model-finding aspect, a number make considerable comments on this topic.

Suggested Reading: Daniel (1969), Polya (1957), Schucany (1972), and Sprent (1970).

3.3 Report Preparation

The ultimate record of the statistician's contribution to a project is the written report to the client or collaborative team. The failure to provide such a report, even when not explicitly required, is at once an avoidance of professional accountability on the part of the statistician, and an invitation to less than full recognition by the other parties involved of the statis-

tician's contribution. A well-organized and skillfully written final report is far more useful to the client and the statistician than a series of preliminary results produced on many occasions and reported informally to the client. Many of the results appearing in final reports, no matter how good, will never appear in print elsewhere. Thus such reports are an important testimonial to the statistician's effectiveness and commitment to applied work.

In our course we require students to write proposals or interim reports as well as final reports on all their consulting projects. Periodic oral progress reports, as well as final oral presentations, are also required. Notice of these presentations is sent to professionals.

The statistical literature does not have much to offer in the area of written or oral report preparation and presentation. Some notable exceptions are given below as well as some references on scientific and technical writing and good writing in general. Peterson (1961) and Deming (1965) are of particular interest and also relate to Sections 4.1 and 4.2, respectively.

Suggested Reading: Bickel and Houpp (1966), Deming (1965), Peterson (1961), Strunk and White (1979), *A Manual of Style* (1969), and Woodford (1967).

4. PERSONAL ATTITUDES

4.1 The Role of the Statistician in Scientific Inference

Although many of the early contributors to statistical theory and methodology, such as Fisher and Youden, were active participants in the process of scientific inference, the more commonplace route to statistics today is through mathematics. Anyone who has taught science knows that for students a concrete example provides a much clearer "proof" than does a string of abstract symbols. This is simply a reflection of the fact that experimental verification is the scientist's route to truth. Thus the science student is not disturbed by the fact that only one case of an infinite number has been settled, because that is precisely how science moves. The mathematician, however, has no patience for the slow unfolding of imperfect knowledge and soon, through deductive logic, leaves the realm of scientific method.

Although the dichotomy presented here is no doubt an oversimplification, it illustrates a source of much missed communication between scientists and statisticians. If students of statistics were reminded of the role of statistics in science, they might profitably pay more attention to scientific inference and regard themselves as statistical scientists rather than applied mathematicians.

Suggested Reading: Bliss (1969), Box (1976), Fisher (1955), and Snedecor (1950).

4.2 Principles and Ethics

Questions of division of responsibility and recognition arise in any joint effort. Such questions may

involve a simple division of labor, complex issues of authorship, or ethical responsibility to the client or the statistical profession. Until statistics has a formal professional code of ethics, each statistician must develop a personal code and professional policy. The Ad Hoc Committee on Code of Conduct of the American Statistical Association has proposed an interim code that establishes general guidelines and calls for the creation of a continuing committee on ethics. In addition, a number of papers that will give the student a start in this direction are available.

Suggested Reading: Bross (1974), Committee on Code of Conduct (1980), Deming (1965, 1966, and 1972), and Gibbons (1973).

5. ORGANIZATIONAL AND ADMINISTRATIVE CONSIDERATIONS

Statisticians find employment in a wide range of circumstances. The type of institution and its administrative organization and policies will have an effect on all the areas discussed here. An awareness of these effects can be of great assistance to students in choosing the type of situation best suited to their abilities and interests.

Suggested Reading: Bancroft (1971), Cameron (1969), Gehan (1980), Hammond (1980), Healy (1973), Marquardt (1979), Mead (1976), and Workshop on Statistical Consulting (1979).

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