
TEACHING STATISTICAL CONSULTING BEFORE STATISTICAL METHODOLOGY

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Course structure
Week 1: Introduction, overview and discussion of videotaped consulting sessions
Week 2: Problem solving and problem formulation
Week 3: ‘Panel of experts’ problem formulation
Week 4: The good consulting session and five-minute student roleplays
Week 5: 10-minute student roleplays and personality types
Week 6: What can go wrong — I (personalities)
Week 7: Consultation 1
Week 8: What can go wrong — II
Week 9: Session management and wants and needs
Week 10: Report writing
Week 11: Consultation 2
Week 12: Discussion of consultation 2, summary and feedback.

(also, Principles and Ethics)
A Systematic Study of the Consulting Literature as an Integral Part of Applied Training in Statistics

J.C. BASKERVILLE*
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.

The Practice of Statistics: The Real World Is an Idea Whose Time Has Come

WILLIAM G. HUNTER

2. THREE ROLES PLAYED BY CONSULTANTS

![Diagram showing the roles of a statistical consultant]

STATISTICIAN AS HELPER

STATISTICIAN AS COLLEAGUE

STATISTICIAN AS LEADER

PASSIVE

ACTIVE

CLIENT

PASSIVE

ACTIVE

STATISTICIAN

Figure 1. Three Roles of a Statistical Consultant: Helper, Leader, and Colleague
2.1. Statistician As Helper

In this situation, an active client seeks statistical assistance from a passive statistician. Without becoming involved to any important degree in the subject matter itself, the statistician attempts to do what the client requests. In this helper role, the statistician typically asks few questions and tries to get on with the job, as defined by the client, as quickly as possible. (In the extreme, the client may even prescribe the statistical technique to be used, but then the statistician is a technician rather than a consultant.)

Sometimes consultants willingly accept this role, which is appropriate in certain circumstances. More often, however, because of lack of time, they reluctantly acquiesce. In any event, I believe that statistical consultants should generally try to move to the right in Figure 1.

2.2. Statistician As Leader

In the leader role the statistician is active, the client passive. This role is sometimes inappropriately thrust upon the statistician when the client, offering up a complex set of data, asks the statistician to figure out what it all means. In abdicating any responsibility for the analysis, however, the client is misguided because analyzing a body of data means trying to extract all the useful information from it. Since the client will typically know much more about the data than the statistician, a better, more insightful, analysis will be possible if the client is actively involved.
2.3. Statistician As Colleague

In terms of Figure 1, nonroutine projects are most successful when both the client and the statistician contribute actively and, in particular, when the statistician is a fully functioning colleague. Hooke (1980), for example, describes the statistician’s consummate role as that of giving advice about scientific method itself, rather than assisting with mundane technical chores such as checking calculations for an analysis of variance (see also Marquardt 1979 and Mosteller 1979).

The two roles of helper and leader are characterized by one-way communication—the helper receives, the leader transmits. The role of the colleague, on the other hand, necessarily involves two-way communication, and hence makes possible what, for me, is the joy of being a statistician: working on and learning about many different problems, and sharing with clients the excitement of solving these problems.

3. THE CONSULTING PROCESS

Often the problem as initially posed by the client is not the real one; for example, crucial elements of the problem may not be volunteered. Therefore, it is of utmost importance that in each new situation the consultant try to discover what the real problem is. To
avoid the mistake of solving the wrong problem, thorough probing is essential (see Kimball 1957 for a discussion of errors of the third kind). Be curious. Ask lots of questions. If the client indicates, verbally or otherwise, that you are treading on sensitive ground, proceed with due regard for the client's feelings.

At the outset the most important question for the statistician to ask is: What is the objective of this investigation? I remember asking that question of two investigators who had been working together for some time on a particular project. After realizing that they disagreed on the answer, they started to thrash the whole thing out. A lively 45-minute discussion ensued. I listened to this discussion, but did not participate in it. When it ended, they agreed on what it was they were about. They thereupon said that I had been most helpful, and we said goodbye. Frequently the objectives of an investigation gradually change over time. Therefore, this aspect of a project always needs to be monitored.

Other useful questions to ask are: How were these data collected? In what order? On what days? By whom? How? How does the equipment work? What does it look like? May I see it work? Do any other relevant data exist? How much theory is known about the phenomenon being studied? To ensure that the consultant understands the problem—whether it be one of design or analysis—it is useful for the statistician to explain how she or he perceives the problem, asking the client to correct any misconceptions (Box, Hunter,
and Hunter 1978, p. 14). The essential purpose of asking such questions was succinctly stated by Fisher (1934–1935, p. 13) as follows:

It is a statistical commonplace that the interpretation of a body of data requires a knowledge of how it is obtained. Equally, it is usually understood that the conclusions drawn from experimental results must rest on a detailed knowledge of the experimental procedure actually employed.

Successful statistical consultants help their clients create useful models (hypotheses, theories) and isolate pivotal issues, the resolution of which will lead to further advances. They ask questions such as these: What mechanism is operating here? Can you think of a plausible reason why the results came out as they did? Can you think of alternative plausible (or semi-plausible) reasons? Such questions help clarify the thinking of both the client and the statistician. Statisticians should be continually learning, especially in fields in which they regularly consult, and failing to ask questions about the theory underlying the data is to miss an opportunity to learn.