Today's statistical consultants are computer consultants as well, since almost all real data analyses are being done on the computer. Consultants exist because no researcher can understand his or her own field and in addition know all the statistical-computer tools that are available. The problem of resource management vis-a-vis research is becoming more acute, and the division of labor and expertise are essential components of the solution.

If you are a statistical-computer consultant you will have specialists from other fields that are your clients. These clients often perceive needs that are well beyond their level of knowledge. Over a period of time you will realize that there are many species of clients; species that have evolved different approaches to closing the knowledge gap.

The first category, thankfully, consists of well-motivated, hard working users of statistics programs who want to master their analyses, and come to you only as a last resort. They are sensitive to your work load and take up no more of your time than is absolutely necessary. They learn fast and never have to bring you the same type of problem twice. But you may not see that much of these users because their problem solving ability is so efficient.

On the other hand there are some aberrant species of client that you may see more frequently, despite the fact that their numbers are few. They range from those who expect you to do all of the work to those who think they have already done all the work, and just need a bit of advice. I have begun a taxonomy to help us identify these mutant species, and will describe them in order of descending expectations.

The first type is called "The Prince." He has not only read the book by that name, he believes in winning through intimidation. He has come to expect service because he belongs to the upper executive ranks. He looks something like the young Duke of Windsor. He naturally expects complete projects to be done for him.

A second species, with high hopes, if not expectations, is called "Betty Boop" or "Clyde Clod", as appropriate. The female version is not a modern woman; she calls herself: "little ol' me". She uses it in such sentences as "You mean you want little ol' me to do the computer work?" The male version has a self-descriptor too; he says he's "just a good ol' country boy". It's his way of telling you that he is as ignorant as a smallmile and would like to stay that way. Both Betty and Clyde hope that by convincing you of their inexperience, you will take pity and do their analyses for them.

A third category is called "The Conversationalist". He's informal and personable, and already has a start on his research. He will drop by your office or meet you for lunch. For five minutes he asks about your family and tells you about his coming trip. But then he says, "Oh, by the way, I've got a little problem with my computer analysis. I wonder if you could clear up a small point for me". He thinks that if you're a real pal, you'll spend the rest of the day working out his little problem.

The species called "The Nibbler" will catch you anywhere: the hallways, the elevator, the bus stop, the cafeteria line, or even your office. At first he seems easy to satisfy. After all, he wants "just 5 minutes of your time" to ask "just one quick question" about his latest computer run. It's his imploiring look that gets you. But if you are sympathetic and respond you'll find that with each nibble he takes bigger and bigger bites of your time.

The "Weight-Lifter" species is a hard working species. Each member has done many computer analyses, and to feel secure carries around at least 30 pounds of computer printout. Knapsacks are popular containers among the young, though some prefer boxes and others prefer special purpose carriers. Since they can demonstrate how hard they have worked they feel sure you won't mind helping with the interpretation.

These aberrant species share a number of traits in common. They are all somewhat in awe of the computer. They are slightly baffled by statistics. But more importantly, they do have some legitimate needs and aspirations that should be served, just as all the other researcher-clients have. Let me repeat: they all have needs that should be served.

Since the species represent such a diversity of species, each has different demands for help with statistics programs could easily lead to consulting chaos. You cannot sustain a real consulting process until you have a clearly stated consulting policy that defines the limits of the consultant's role. A consulting policy is what is used to sort out the work to be done by the client and the work to be done by the consultant. That policy must be a function of the level of financial support your organization has established for in-house consulting. Financially, clearly limit the level of support you can offer your clients. Figure 1 illustrates the range of services that can be offered.

The cost of statistical-computer consulting rises as you go up the scale seen in Figure 1. Error debugging is relatively inexpensive but is often unsatisfactory in terms of meeting client needs, and it contributes very little to the quality of research. On the other hand, providing ideas for analytic approaches requires a level of expertise that gets very costly. It is essential that your organization be aware of both the costs and benefits of each level of support, because only then can a reasonably clear consulting policy be established. And good cost-accounting practices should accompany the consulting process.

Whatever your consulting policy, all consulting jobs should have a common first stage, representing an effort that you should make in behalf of each and every client. Stage I has two elements: empathy and problem definition.

The first element requires simply that you and your client see each other as human beings.
LEVEL OF SUPPORT REQUIRED

- 100%
- Give Ideas/Programs
- Set Up Programs
- Suggest Programs
- Error Debugging
- 0%

FIGURE 1

You need to establish a basis for communication, as experienced consultants will testify. So, as shown in Figure 2, let your clients tell you a bit about themselves and their interests. You can respond by sharing some of your related interests. Empathy will be much appreciated. None of this will solve the communication problem, but may keep it from being insurmountable.

STAGE I, 1st ELEMENT:
EMPATHIZE/SOCIALIZE

FIGURE 2

The second element consists of defining the problem. This is as obvious as it is difficult. As can be seen in Figure 3, the recommended procedure is simple. First, let the client state the problem, then you re-state what you understand to be the problem. Try to avoid technical jargon if possible. You will be surprised to find that you may have to cycle through this process a number of times before you both agree on exactly what is the problem.

If you have taken your time you will have learned a great deal in Stage I, as shown in Figure 4. Not only will you have a clear restatement of the problem, you will also have a sense of your client's knowledge about statistics and computer programs, as well as his/her capacity for work of this type. This knowledge will be useful when you implement your consulting policy. In addition you will know where this problem is located in the research framework, be it the design, the experiment or the analytical stage. You can use this information later on when you are promoting the concept of good design.

STAGE I, 2nd ELEMENT:
STATE/RESTATE PROBLEM

FIGURE 3

RESULTS OF STAGE I

STAGE I GIVES:
- Clear Restatement of the Research Problem
- Client's Level of Knowledge
- Client's Capacity for Work
- Problem's Location in the Research Framework

FIGURE 4

Now it is time to divide up the work load. Stage II is where you implement your consulting policy. Figure 5 presents a typical situation, wherein your consulting work will not cover the gap between your client's levels of knowledge and need. This puts the consultant's dilemma in stark relief. To help at the client's level of knowledge is usually unproductive; it won't re-
result in effective research. To help at the client's perceived level of need may lead you into conflict with your own policy. The only way to effectively bridge the knowledge gap is to recognize that research needs are usually on a sliding scale. That is, there is more than one way to perform an analysis, and some are easier than others. For example, the mechanics of non-parametric tests are sometimes more easily understood than their parametric counterparts. Here is where your client's motivation and energy come into play. With the proper guidance, highly motivated and knowledgeable clients can tackle the most difficult methodologies. Less knowledgeable and/or motivated people should be steered to the simplest analysis that will meet their needs.

**TABLE 1**

**EXAMPLES OF OPTIONS**

<table>
<thead>
<tr>
<th>ORIGINAL</th>
<th>ALTERNATIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>All possible cross-tabs</td>
<td>Education - α, prior selection</td>
</tr>
<tr>
<td>Hotelling's $T^2$</td>
<td>Many $t$-tests, $w$/Bonferroni</td>
</tr>
<tr>
<td>Cluster analysis</td>
<td>Plot of principal components</td>
</tr>
<tr>
<td>Cross validation</td>
<td>Tukey's Jackknife</td>
</tr>
<tr>
<td>ANOVA $w/\text{covar } \tau_i = 0$</td>
<td>ANOVA</td>
</tr>
</tbody>
</table>

First, there was the client who wanted to do all possible cross-tabulations (and chi-square tests) using a 100 item questionnaire. A quick calculation of 100 things taken 2 at a time showed that this would have meant 4950 analyses on the same data set. The alternative was a review of the meaning of the family-$α$ level, and a-priori selection of the more important cross-classifications.

A second individual had heard that Hotellings-$T^2$ was appropriate for his data but he knew nothing about multivariate statistics. He was introduced to the concept of Bonferroni bounds, which allowed him to stick with the multiple $t$-tests which he understood. (In general, the uninitiated should avoid multivariate techniques; univariate techniques with Bonferroni bounds are much more useful to these clients.)

Still another person wanted to classify his sample into groups (a-posteriori), based on 6 predictor variables. He knew cluster analysis was a possible tool but had no time to learn about it. It turned out that the first three principal components accounted for practically all the variance in his variables. A 3-dimensional plot of the principal component scores gave a clear visualization of the clustering patterns.

One client who had done a discriminant analysis on a small sample was told he needed some cross-validation of the results. The sample was too small to split, and he had neither the resources nor the inclination to get a second sample. The answer was to use Tukey's JACKKNIFE technique (available in BMDP7M), which classifies holdout samples of size one, and where each observation is held out in turn.

Finally, there was the research worker who was told to do an analysis of covariance, but didn't know how to perform the analysis, although he had the data. He was lucky. The within-group correlation of the criterion with the covariate was essentially zero, which meant that the methodology reduced to an analysis of variance, which he was fully equipped to handle.

These examples serve to illustrate how to reduce the client's work load. Of course, this may or may not be necessary. Figure 6 shows some of the options available to the client for bridging his or her knowledge gap.

It can be seen that, once again, knowledge of each client's motivation and energy level becomes a catalyst for the consultant's response. Those with low drive can be given easy reading references and encouraged to attend short courses that are in keeping with the lowered research objectives that have been agreed upon. Researchers with more ambition can be directed toward more technical reading or possibly even formal courses of study, when these are in keeping with the more difficult research methodologies that have been chosen.

Once the work load has been divided, it usually gets accomplished, and results will come. These results should be reviewed by both client and consultant together for completeness and accuracy. Then the consultant's job is almost over. However the last task is to point out how such an analysis could be improved in
the future. Since the objective is to have well-planned research leading to clear-cut inferences, a fundamental improvement is possible when the consultant is brought in on the research project at the design stage. This is the consultant's opportunity to educate the client on the advantages of good design. The point should be made, but not belabored. If you've done a good job the client will be quick to seek you out at the start of the next project.

All of this can be summarized very briefly, as shown in Figure 7.

SUMMARY OF THE CONSULTING PROCESS

POLICY
EMPATHIZE/SOCIALIZE
RESTATE
PROBLEM
IMPLEMENT POLICY
RESULTS/REVIEW
EDUCATE & END

FIGURE 7

The acronym for the consulting process is PERSPIRE. It's easy to remember because that's what you'll do on the job. The first letter stands for policy. The consulting process exists because you have a clearly stated policy on the limits of the consultant's role. Under that policy umbrella you empathize and socialize with your client, get a clear restatement of the problem, implement the policy for division of labor, get the results, review them, extoll the virtues of good design, then bring the process to a close.

All of this can be fun. It is certainly an important role. If you enjoy all kinds of people and have a wide range of research interests, then maybe you were meant to be a statistical consultant.