

## COMMUNICATION IN STATISTICAL CONSULTATION

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*Almost all statisticians get requests for help with data analysis from clients in other fields. In order to provide such help it is essential that the statistician understands the client's problem prior to solving it and is able to explain the answer to the problem to the client once it has been solved. From the client's point of view, the problem should be properly explained to the statistician and the statistician's solution should be understood so that it can be used. This need for understanding the problem and explaining the solution leads to a series of communications between the statistician and client. The purpose of this study is to explain how this communication unfolds and issues that might influence it.*

### INTRODUCTION

Statistical consulting can be defined as “the collaboration of a statistician with another professional for the purpose of devising solutions to research problems” (Kirk, 1991).

Virtually all statisticians get requests for help with problems that involve statistical data analysis and/or application of statistical methods. The person requesting the help (the client) is familiar with the problem description in terms of the material of the subject he/she is working in. The statistician needs to express the problem in a form where statistical methods can be applied to solve the problem. This is usually the starting point of the process of communication that takes place between the statistician and the client. Effective communication is obviously a crucial aspect of the successful collaboration of the statistician and client and having good communication skills is as important as having a good theoretical knowledge (Russell, 2001). According to Boen and Zahn (1982) the approach to statistical consulting can be one of the following:

- 1 The statistician and the researcher(s) work together in a team (collaborative consulting).
- 2 The statistician is called upon to fulfill a specialist consulting role in the research (straight consulting).

According to Cabrera and McDougall (2002) the statistician should have scientific, statistical, computation and communication (verbal and written) skills. The communication issues raised here apply more to the second type of collaboration, although some could be applied to collaborative consulting.

### INITIAL MEETING BETWEEN THE STATISTICIAN AND THE CLIENT

The client contacts the statistician (usually by e-mail or phone) for specialized help with some problem involving the application of a statistical technique and/or the statistical analysis of a data set. A time and a place for the meeting to take place are arranged. Prior to the first meeting the client is requested to bring along any information/data that had already been collected (computerized or in manual form).

At the beginning of the meeting the client is requested to explain the problem and the type of help needed. The statistician listens carefully to the explanation and guides the explanation towards the root of the problem by asking well directed questions in non-technical language. The skills required for a statistician doing consulting have been described by a number of authors (Barnett, 1986; Anderson & Loynes 1986; Cabrera & McDougall 2002). The questions should be asked so that the client supplies the following information:

- 1 Be precise about the objectives of the analysis, give a brief background to the problem and how the results obtained from the study are to be used.
- 2 Give a description of the variables and data that are being studied and possible relationships that might have to be investigated.

- 3 A list of questions to be answered/hypotheses to be tested and where in the data answers to such questions might be found.

At the end of this initial explanation of the problem, the client should feel satisfied that the nature of the help required has been clearly communicated to the statistician. The statistician should start forming an idea about possible techniques that could be used to solve the problem from a statistical point of view. To make a further selection among these possibilities, the statistician might ask questions to get a feel whether certain assumptions are met, e.g., are subjects allocated randomly to treatments or was there some blocking involved in the allocation?

If the statistician's understanding of the client's problem might require a basic knowledge of the client's field of study, the statistician should be prepared to do additional reading. Hand and Everitt (1987) suggest that mutual understanding by the client and statistician of each other's disciplines can be helpful in collaborations.

At this stage of the consultation no solution to the problem should be offered. Neither should any opinion be expressed about possible solutions suggestions made by the client. At the conclusion of the initial meeting some time schedule for providing a solution should be discussed.

#### CLARIFYING ISSUES THAT ARISE DURING PROBLEM SOLVING/DATA ANALYSIS

After the initial meeting the statistician should have a fairly good idea on how to go about solving the problem presented by the client. The first step in the analysis of the data would be to check the data and to check that the assumptions needed to apply the analysis technique are met. Chatfield (2007) gives an example where a thorough check of assumptions totally changed the conclusions reached when performing tests. During this part of the analysis, issues might arise that the statistician would have to clarify with the client prior to proceeding with the analysis.

Examples:

- 1 Unusually large/small values in the data set or values that look out of place in the context of the data.
- 2 Client domain knowledge that could be used in the data analysis e.g. when studying the movements of rhinos after release, the client could provide information on the different time phases to be studied.
- 3 Missing values in the data and assumptions to be made when imputing such missing values.
- 4 Follow up questions concerning hypotheses discussed at the initial meeting, e.g., if treatment A is found to be better than treatment B, would safety and side effect issues also have to be studied before a final recommendation concerning the treatments could be made? The various stages of statistical investigation are discussed by Chatfield (1988).

#### COMMUNICATING THE SOLUTION TO THE CLIENT

The most important part of the analysis (from a communication point of view) is writing a report that explains the method(s) used in the analysis and conveys the main results to the client. The report should be written in simple, non-technical language that the client could easily follow. Fenn Buderer (2000) explains the communication skills needed when writing a report on a statistical consultation. The following are suggestions for the structure of the report:

- 1 Title Page
- 2 Executive summary. This should give a brief account of the conclusions and main results of the study. It should be very short and to the point.
- 3 Introduction: A description of the problem and background information.
- 4 Results of the analysis: This should consist of a brief, non-technical discussion of the methods used to arrive at the solution and a discussion of the results in a practical way. This section usually contains tables, graphs, various summary statistics and interpretation of results. If hypotheses are to be tested, these results should prove or disprove them. If sizable computer output is generated, the output file should appear as an appendix.
- 5 Conclusion. Should be like the executive summary but longer and more detailed.

- 6 References: List of books or articles that are cited on the text.
- 7 Appendix with computer output, computer generated or other relevant material that would interrupt the flow of the discussion in the main part of the report.

At the meeting where the solution is communicated to the client, the main features of the report will be discussed and the practical applications explained. An in depth discussion of the techniques used to arrive at the solution will be omitted from the discussion, but the client should be assured that if any technical queries should arise they should be referred to the statistician. During the meeting the client will also be given the opportunity to ask questions on the practical meaning of the results of the analysis.

#### POST COMPLETION FOLLOW UP

After receiving the report from the statistician the client will take some time to study it in depth. In this study the main issues from the client's point of view would be whether the problem had been satisfactorily solved and whether the report is sufficiently understood in order for the solution to be useful. The client might contact the statistician on the following issues:

- 1 To make sure that the recommendations made as part of the solution to the problem are well understood and correctly interpreted.
- 2 To answer technical queries from other sources e.g. when a study leader or external examiner might question the reasons why a particular technique is being used. Such a query would be referred to the statistician.
- 3 Conclusions that are clearly at odds with results that could logically be expected from the experiment e.g. when a placebo effect is found to be significantly better than a treatment effect.
- 4 When the results from the analysis raise further issues that will have to be researched with the aid of data analysis e.g. if treatment A is better than treatment B but is a lot more expensive, should one still proceed with using treatment A in stead of treatment B?

#### PERIPHERAL COMMUNICATION ISSUES

The following are issues that might influence communication between the statistician and client at any of the stages described beforehand.

1. The expectations of clients regarding data analysis can vary considerably. The statistician should make an assessment about the type of client the analysis is being done for and what the client would expect from the analysis. The client's view of the role of the statistician might differ considerably from that of the statistician. Kirk (1991) mentions the following views a client might have of the roles of statistician in a consulting situation: helper, leader, data blesser, collaborator or teacher.

2. Patience for both the statistician and the client to fully understand each other's view of the problem. Neither the statistician nor the client should try to be an expert in the other's field of study, but should have at least a superficial understanding of the other's field of study to be able to communicate effectively about the nature of the problem and the solution to the problem. The client must have a sufficient understanding of the statistician's report to be able to implement the solution to the problem.

3. The statistician should assess the client's level of knowledge of measurement, research design, and statistics, and talk at an appropriate level. Adjustments should be made as more information about the client is gained.

4. The statistician should be aware that non-verbal aspects of communication also matter when communicating with the client. A number of authors make reference to these aspects e.g. Derr (2000)–body language, Kirk–eye contact, Boen and Zahn–the human side of consultation, Cabrera and McDougal (2002)–politeness towards the client. Stegman (1985) describes various client types. Browne (1996) provides some communications tips for beginning consultants. When

communicating with many of the clients, psychological and diplomatic skills are as important as statistical ones.

5. Client's perceived and real knowledge of statistical methods. Finch (1999) discusses client expectations in statistical consulting situations. The following types of clients have been observed during statistical consulting sessions.

5.1. Statistically ignorant clients who have never heard of statistical techniques until a few days before the first consulting meeting. When consulting with such a client the statistician should market statistics as a problem solving tool as well as asking probing questions in order to get the client to explain the problem correctly.

5.2. Clients who have vaguely heard of some statistical techniques (correlation, t-test, chi-square test) and suggest that these might be solutions to the problem. When consulting, the statistician should ignore these suggestions and still ask the usual questions to get to the root of the problem.

5.3. Clients who maintain that statistical techniques only play a minor role in the analysis of their data. At the initial consultation these clients produce a basic statistical analysis (totally inappropriate) done by somebody else in their domain of knowledge, e.g., a few pie charts and bar charts or an F-test performed on nominal data. They state that an analysis such as this is all they need to perform and that this forms a minor part of their data analysis effort. Other data analysis related questions will be answered by applying techniques from their own domain of knowledge. The results from such analyses should basically be ignored by the statistician and the usual procedure should be followed to get to the root of the problem.

5.4. The "black box" clients. These are clients who expect magic formulae and look for a simple formula into which values can be substituted which can provide accurate answers to complicated problems. For many types of problems, an expectation to find such a formula is totally unrealistic. If such a formula could be found even in a simple, specialized case of the problem, the statistician will have to communicate its limitations to the client. If no such formula could be found, the statistician should clearly explain why not and convince the client why an alternative solution will provide the answer the client is looking for.

5.5. Clients who profess to know what statistical methods to use but do not have time to do it themselves. The statistician is simply used as a technician (number cruncher) to carry out the client's requests. This is of course totally contrary to the statistician's view of the role he/she is supposed to fulfill. In such a situation the statistician's skills of marketing relevant statistical methods as a tool to obtain the correct solution to the problem could be put to the test.

5.6. Clients who are skilled researchers in other fields and try to impose their knowledge on a statistician. Chatfield (1988) give some examples of personal experiences with such clients. Perhaps the best approach for a statistician in such a situation would be to explain the difference between a hypothesis (which has not yet been tested) and conclusions arrived at via applying statistical techniques. Obviously the application of statistical data analysis techniques would be the only way of verifying whether a hypothesis could be reasonable.

6. The client should be informed if there are any problems or shortcomings concerning the data set e.g. working with a sample which is too small or working with data that are obviously biased. If these problems are of such a serious nature that results obtained from analyzing the data would be meaningless, an analysis of the data should not be performed. In such a case the statistician should investigate remedies for the problem e.g. discarding part of the data or start from scratch with collecting data.

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