

## DEVELOPING STATISTICAL CONSULTANCY SKILLS IN POST-GRADUATE STUDENTS: A CASE STUDY

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*The training of postgraduate students in transferable skills is becoming increasingly important in the UK across disciplines. For postgraduate statisticians, a crucial ability is to be able to develop consultancy skills. These include the ability to interact with a client, to distil the nature of the problem, to choose a suitable methodological approach and to communicate results effectively. This paper describes a case study in developing such skills from the point of view of the students.*

### INTRODUCTION

The development of consultancy skills in statisticians has long been recognised by some as an essential element of statistical training. Van Belle (1982) identifies six challenges that students have to face. These include listening to the client, the integration and differentiation of the problem, tailoring a solution to the client's level, the need to take one's time, the need to determine whether the client has an active or passive role, and the negotiation of authorship and acknowledgement. How to encourage and develop such diverse skills, however, is less clear. Previous studies have focused on teaching such skills through formal courses (Baskerville, 1981) or role-play (Taplin, 2007). In this paper, we focus on an action learning approach (McGill and Brockbank, 2003) whereby students were confronted with a real life consultancy problem and encouraged to develop an approach, in collaboration with the support of two senior members of staff. A crucial component of action learning is the "authority to act", and the taking of ownership, but with facilitators and mentors providing support. While action learning has been used to teach statistics (Wingkvist, 1990), we are unaware of its use in teaching consultancy skills. We describe the project as a case study and discuss the successes and failures of this approach.

### METHODOLOGY

In a mini project conducted at Lancaster University, four postgraduate statistics students involved themselves in the activities of the university statistical consulting unit. Three different modes of consultancy training were utilized in the study. The first was the observational approach whereby a student shadowed a member of the academic staff during consultancy meetings. The second was the supervisory approach in which a student was required to discuss the problem with their supervisor and to take actions as guided by the supervisor. The third approach was the "hands on" approach in which two students took ownership of a problem to provide consultancy for a client. Guidance was given at the beginning of the project from mentors and then was sought by the students as and when needed.

In this paper we present the experiences of the students within the third approach. We describe how the students gained an understanding of the client's (JB) problem and how a practical solution to the problem was obtained. The Action Learning approach needed the formation of a team. The two postgraduate students (SS and EY) were supported by two mentors (BF and GR), who were experienced in consultancy and available throughout the duration of the project.

### AN OVERVIEW OF THE CLIENT AND HER PROJECT

The client was a final year Ph.D. student studying the subject of anger in the workplace. She had performed a literature review and had carried out qualitative work on the subject in the form of focus groups. From the information gained she had developed a theoretical model of the Causes, Influences and Experiences of anger within the workplace. She had also designed and administered 'Anger Diaries' to a sample of individuals working within 4 different sectors; Health, Education, Retail and Wholesale. These anger diaries collected information regarding personal details as well as the causes, influences and experience of anger within the participants' workplace over 1 month.

## UNDERSTANDING THE PROBLEM

An important first step in the consultancy procedure was to develop an understanding of the work the client had already undertaken. These initial meetings were attended by the client, one of the consultancy mentors and the two students. Since the client was a Ph.D. student in the final stages of her research, there was actually a lot of work that had already been put into her project. Prior to approaching the consultancy group, the client had undertaken a literature review and conducted a series of focus groups which had led to the development and proposal of her theoretical model. The statistical section, with which she wanted help, was to be among the final pieces of her work. This helped us to not only identify the contextual goals of her research, but also the role the statistics were to play within her work.

Key in providing support was to ascertain the point at which the client had decided she needed our help. The client had in fact already chosen her survey methodology, identified her sample and had administered the survey. The data had even been collected and entered into an Excel spreadsheet and SPSS data file. The part the client was seeking help about was the analysis. From this, we were interested to find out if she had any ideas as to how she would like to go about analysing the data. Although she had spoken to a statistician a few years ago, at the beginning of her study, she did not know what to do and so was very open to ideas, providing they helped her achieve her goal.

Ascertaining a clear aim for what the statistical analysis had to achieve was very important in order for us to be able to meet her requirements. However it was also important to discuss the feasibility of her expectations. In essence, the client wanted to use the data she had collected to assess the accuracy of her proposed theoretical model and, where appropriate, to suggest modifications. However, the model she had proposed was very complex and we therefore explained that we would like to approach this by breaking her model up into sections. By discussing her theoretical model with her, we found that the theoretical frame work she had utilized and developed could be partitioned up in a way that would make sense given the context of her work.

The time frame within which we had to work also had a large bearing on what could be achieved and so it was essential that we established our goals quickly. The client contacted the consultancy group in late October and was required to submit her draft Ph.D. at the beginning of January. However family commitments of the client and our own work commitments meant that this time was even further reduced. In addition, the client confessed that her ability in statistics would need to improve for her to be able to conduct the statistical analysis confidently and appropriately. It was therefore explained that it was unlikely that it would be possible to assess the whole of her theoretical model in the detail she would like, but that focus would have to be given to a particular part.

Following the initial series of meetings, the students were given ownership of the project but with strong support from the consultancy mentors.

## PROVIDING A PRACTICAL SOLUTION

One of the first considerations was where to hold sessions with the client. Fortunately, the Postgraduate Statistics Centre had available a small room containing a couple of computers and a white board which could be booked in advance for short periods of time. This provided us with a quiet and comfortable environment in which to work with the client. The computing facilities available meant we could show the client directly how to use SPSS to analyse her data and the booking facility meant we could be sure of being able to work without distractions.

Given the client's previous experience with statistical software, the decision was made to keep the analysis within SPSS. This was a package that both she and the consultancy team had access to and had experience with. This avoided having to familiarize the client with the software whilst teaching her the statistical skills she needed. It also meant that once she had left the sessions with us she was able to put into practice what she had learnt easily.

The initial step was to get the client performing some exploratory analysis that would allow her to check her data entry for mistakes. Further exploratory techniques were then explained to her so that she could summarise her sample population well and produce a basic preliminary analysis of the data which explored issues of interest to her. This was achieved by identifying

potential issues of interest and showing her how she could address them using simple tables and charts. She was then shown how to achieve these graphics in SPSS. In addition, a summary 'help sheet' was produced to act as a reminder of the possible techniques available to her.

The students requested that the client produce a draft of her exploratory analysis so that they could read through what she had done. This enabled them to gauge how effectively they had explained the various concepts to her, how quickly she had picked them up and where weaknesses lay. This allowed them to provide her with feedback on the appropriateness of her analysis and interpretations and address areas of difficulty to ensure a solid foundation before they moved on to more sophisticated statistical methods.

One area of difficulty related to the complexity of the client data. As the data consisted of a number of anger episodes for each individual, there was a multi-level structure, with explanatory variables at the anger incident level and also at the respondent level. The mentors and students met to discuss this problem, and an approach using SPSS (Generalised Estimating Equations) was decided upon. The method lay beyond the client's knowledge of statistical methods, but the students felt able to explain the method, and felt sure that the client would be able to approach the method and understand and interpret the output.

In order to effectively explain the chosen modelling procedure, a number of materials were prepared before the final sessions between the students and the client.

- Firstly, an example of the use of the model was produced showing typical SPSS output. The SPSS output was annotated with example interpretations.
- A 'help sheet' was then produced to explain the choice of statistical model and when it can be appropriately applied, along with the references for the methodology.
- In addition, a set of screen casts (video tutorials) were embedded within a web page, to provide a 'take away' explanation of how to perform the analysis within SPSS.

This enabled the client to take charge of the analysis herself, and to understand the output. In particular, the video tutorials were effective in explaining the user interface and the mechanics of model fitting. The students also made themselves available to the client via email for consultation.

## DISCUSSION

The outcome of the project was mostly positive for both client and students. The client was more than happy with the work achieved and the way in which the students worked with her. The students were also pleased with the outcome of the project. When experiencing consultancy for the first time, in order to build the student's confidence it is probably key to have a successful project. In part, this depends on the flexibility and openness of the client, and this is difficult to judge beforehand. In the students' evaluation they stated "Despite having such a positive experience we now understand how projects like these can fall apart due to differences in opinion and personality".

The students commented further on their experience, and identified key elements of the experience. These included the fact that there were two students working together, that real satisfaction was gained from the help given, that the workload balance between client and students was negotiated successfully and issues relating to support mentoring and reward.

*Being able to prepare the help materials in advance helped cement and also show the pitfalls in our knowledge. Though it did take longer than we would have expected to prepare these materials, working together meant it was possible. If this project had only involved one of us, we might not have obtained the success we did. In fact, even for the two of us we felt that the project was very time consuming, though we can put this down to our desire to not fail and inexperience of knowing when to stop.*

*In hindsight we think that one of the reasons for our enjoyment was that someone had directly benefited from our work and that they also acknowledged and appreciated this. We think this was a direct result from being able to initially convince the client that what she asked for was*

*unachievable, despite being incredible interesting and from that we then set our own goals. This is probably easier than it sounds and success rates will naturally vary.*

*Managing to get the client into a 'statistical' mindset is obviously important. We think that this was successfully done by having her carry out her own EDA and report the results back to us. From this we began to hear things such as "there's so much we could do" and "there are many questions we could ask" which we agreed and then from this she was able to tell us, in the context of the data what she was interested in. This made our job much easier as we were no longer having to 'translate' her ideas into statistical terms and she also knew what to expect.*

*At the beginning we found it difficult to delegate work effectively between each other, however by the end of the project this was not a problem and actually enjoyed working with each other as we felt that we had worked to our own strengths.*

*Since we were inexperienced, having a supportive department was vital to this project. Being able to discuss ideas with experienced statisticians obviously had its advantages. Unexpected by-products of this were that we built up working relations within the department as well as developed confidence in ourselves knowing that we cannot be expected to know everything. Traditional courses put an emphasis on the assessment which often requires you to know and recall a large quantity of information, however the consultancy experience has taught us that it is acceptable to not always know the answer and instead what you need to be able to do is go away and find out the answer.*

*An important aspect of consultancy is the reward. How will you be rewarded for your hard work? And maybe more importantly, how do you go about making sure you are rewarded? Being able to shadow members of staff at this stage allowed us to see how negotiations developed. After discussing this aspect between ourselves and with other members of staff, we developed our own understanding of what a reward is to us and how to go about achieving it.*

In conclusion, the method of consultancy training described here was very successful, but relied on enthusiasm from client, students and mentors. More work needs to be done with other clients and students to more generally assess its effectiveness across a wider range of scenarios.

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