

Confessing Our Sins: How Research Informs Teaching

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Abstract

The purpose of this talk is to make a persuasive argument that teaching and research are complementary activities, each improving and informing the other. The consulting statistician is in an enviable position: he or she has a wealth of resources for adding wonderful illustrations – and cautionary tales – to lectures. Moreover, apt references to real-world research enable the lecturer to speak vividly and with authority, to inspire, to identify common pitfalls, and to establish the importance of statistics to every component of the research process. Teaching provides opportunities to improve research, both by extending the instructor’s knowledge base, and by training the next generation of collaborators – thus improving the quality of research and closing the circle. When working with young investigators, the consulting process naturally involves a great deal of teaching – and many educational opportunities to present our profession and shape future interactions.

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1. Introduction

In considering the interplay between teaching and research, I believe that it is helpful to couch this consideration in a broader context of “teaching” than formal classroom instruction – and to extend it also to the teaching that we as statisticians provide when we consult with our fellow researchers, including students and faculty, as well as when we participate in critically important roles as facilitators of faculty development, which often are the most prominent when research proposals are being developed. The interaction between teaching and research was brought home to me many years ago by one of my favorite undergraduate professors, an anthropologist, whose lectures were often punctuated with his pet aphorism: “Research is to Teaching as Sin is to Confession” - and who exhorted his students “to go out and sin, and then tell everybody about it!” An interesting perspective, I think, on the activities of those who both teach and do research.

2. How Research Informs Teaching

2.1 The Consulting Statistician is in An Enviably Position

The teacher-researcher can draw upon a wealth of resources for adding wonderful, apt illustrations to lectures. Examples from real-world research enable the lecturer to speak vividly – and everyone loves a good story! Such illustrations can be extremely helpful

with setting the tone of the lecture and accomplishing desired pacing. Appropriate anecdotes can certainly lighten the mood, and lift barriers to learning – sometimes just be relieving tension with a bit of humor or giving students time to catch their breaths after a demanding stretch of technical presentation or Socratic method. Illustrations from our experiences provide cautionary tales – and help them to stick. One of the most helpful types of anecdote, from both the statistician’s and collaborator’s point of view, may be those that illustrate that design and analysis should go hand in hand – and when they don’t, it usually shows, to the detriment of the research. It is crucial that we impress upon students (aka prospective collaborators) the importance of involving the statistician early in the planning process, lest we – and they – are left in this position:

“To call in the statistician after the experiment is done may be no more than asking him to perform a post-mortem examination: he may be able to say what the experiment died of.”

- Sir Ronald Aylmer Fisher (1938)

2.2 Other Contributions to Teaching

The use of illustrations grounded in real-life research makes yet another contribution to teaching – it lends the voice of authority and experience. The use of vignettes is yet another means of accommodating different learning styles, and provides motivation for the practically-minded non-statistician. Finally, a suitable cautionary tale may add that final bit of persuasion needed by the recalcitrant listener who has been unwilling to change, but may now be willing to consider a wider repertoire of statistical approaches. The following case study, for example, may be used to motivate a consideration of nonparametric procedures:

Figure 1 illustrates data similar to those of an actual study with modest sample sizes, so modest that the data are provided in the submitted manuscript. The authors claim to have found a statistically significant difference in mean antibody titers via a two-sample Student’s t-test. In contrast, the statistician-reviewer finds

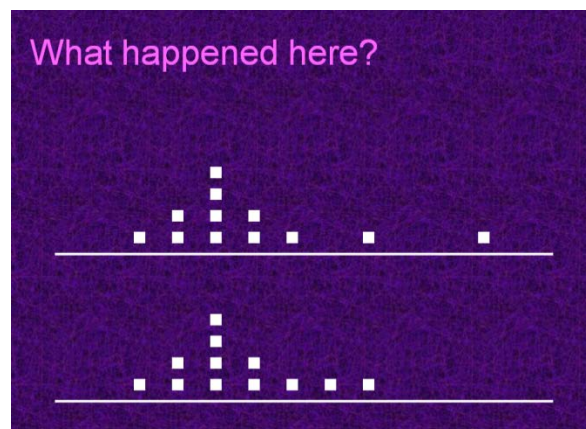


Figure 1: Diagrammatic representation of the distribution of antibody titers in two groups in a small research study

no evidence of a difference in the distribution of antibody titles between the two groups based on the Mann-Whitney procedures, and further notes the identical medians. The ensuing class discussion brings out the relevant issues of the skewed nature of the data, normality assumptions of the parametric procedure, the difficulty of evaluating conformance to assumptions with small sample sizes, the sensitivity of the mean to extreme observations, and the potential utility of nonparametric approaches.

3. How Teaching Informs Research

Teaching provides opportunities to improve research, both by extending the instructor's knowledge base, and by training the next generation of collaborators, thus improving the quality of research and closing the circle. This process works in both directions – when collaborating with young investigators, including residents, graduate students and junior faculty, the consulting process naturally involves a great deal of teaching. It also presents many educational opportunities for the statistician.

3.1 Teaching Furthers the Goals of Good Research Practice

Further, teaching provides us with opportunities to inculcate principles of good research practice, and to inspire and motivate. The teaching of statistics also provides us with an opportunity for creating in our collaborators an appreciation for what we do – and for what we can do for them as research collaborators. It enables us to establish the importance of statistics to every component of the research process, and to encourage collaborators to consult with us “early and often”. And it is worth mentioning that the statistician is in an enviable position to contribute to faculty development on an institutional level, both via individual interactions with faculty, and through formal workshops and presentations to junior and not-so-junior faculty, notably in study design and grant proposal development.

The interface between teaching and research is perhaps nowhere more apparent than in the training of consulting statisticians, both formally and informally. Such interfaces provide opportunities for illustrating common pitfalls for the consulting statistician. They assist trainees in appreciating the key steps and considerations in grant proposal development, and in formulating effective responses to reviews of both manuscripts and grant proposal submissions. A few cautionary tales are not amiss when educating your statisticians on the various aspects of consulting. When “passing the baton” to trainees, one of my favored bits of advice is to “run not walk” when a collaborator responds to a query with “You don't need to know that.”

3.2 What about the “Sins” of Others?

Properly chosen, cautionary tales provide a means of delivering strong caveats that are likely to linger in memory. They are in this sense generally an improvement on “never do this” sermonizing. And it is perhaps easier to acknowledge the importance and implications of an error when it is not one's own. However, the spirit and tone of the discourse is also important, as are

discretion and maintenance of confidentiality when using examples drawn from experience. One illustration I like to use illuminates an investigator's honest misunderstanding of the implications of adjustment for multiple comparisons. The salient features are two: one, that there was no attempt to dissemble or to subvert good statistical practice on the part of the collaborator; second, that the open communication between statistician and investigator brought the problem to light. Such anecdotes bear messages for both the statistician-in-training and the student who will come day be consulting with a statistician in research endeavors. These include the importance of communication, the mutual respect inherent in a good consulting relationship, the helpfulness of continued questioning on the part of the statistician, and the importance of forbearance on the part of the researcher faced with the statistician's many questions.

3.3 What about Our Own "Falls from Grace"?

In the course of my work at two institutions, I have given a number of workshops related to grant proposal development, and the most popular by far is on response to review. I believe this is because this workshop is full of stories of circumstances gone wrong, sometimes very wrong... which, after some effort, righted themselves. Again, there is no substitute for the authenticity of personal experience, perhaps delivered with some of the intensity provided by the lingering angst – and subsequent relief – of a challenging experience.

However, relating our own professional challenges in other quarters may also be of considerable benefit to those we mentor. I can think of several occasions where a teacher or superior whom I respected shared with me a personal setback, a professional failure, or a grueling experience from the years of graduate training. In each case, the message was a powerful and reassuring one – even highly successful and admired individuals of high achievement encounter setbacks, but these can be weathered and overcome. By sharing our own stories with our students, we can provide encouragement as well as constructive advice.

4. Discussion

The statistician's research experiences provide a wealth of opportunities to enrich our teaching. In closing, I would like to add the observation that this is true of all of our teaching, and that classroom teaching, the mutual education of the consulting experience, and the contributions of the statistician to faculty development all represent opportunities to present our profession and shape future interactions.

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Reference

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