Teaching statement

I have taught in a wide range of non-traditional formats: short courses at regional, national, and international conferences, and webinars for a geographically diverse audience. Students in these classes have a choice and will not tolerate a poorly taught class. I take it as validation of my teaching quality that I have been re-invited over and over again to give talks by the same organizations (American Society of Andrology, The Analysis Factor, International Research Conference on Complementary Medicine, Medical Library Association, Midwest Society of Pediatric Research).

I don't have (and don't believe in) an overarching philosophy of teaching. Good teaching comes from the little things, and I attribute my teaching success to three little things: finding compelling examples, using humor to make a point, and spending a large portion of my limited teaching time on small group exercises. I also want to mention some of the special challenges that I have faced with teaching in an online (webinar) format.

Compelling teaching examples

It takes a lot of time to find compelling teaching examples. They need to be vivid and memorable. They need to reflect the practice of statistics in the real world, but at the same time they need to avoid obscure details that only specialists in an area can follow.

In a book chapter that I wrote for Big Data Analysis for Bioinformatics and Biomedical Discoveries, I was faced with a challenge to find a compelling data set to illustrate the R programming language in action. Most data sets used in Bioinformatics, however, are narrowly focused and require a fairly specialized knowledge to fully comprehend. I chose a data set that had broader appeal and which was easily followed by anyone with a reasonable medical background, Son et al. Database of mRNA gene expression profiles of multiple human organs, Genome Res 2005. 15:443-450. This study took tissue samples from 19 different organs of 30 people (158 samples total) and fed them to a DNA microarray. This provided expression levels of almost 19 thousand genes. This made the data set large enough to qualify for a big data analysis. More importantly, the comparison was concrete and easy to discuss. How does gene expression differ in the heart versus the liver, or in the pancreas versus the spleen? Also important to me was that the data used in Son et al was freely available for download at the journal's website.

Another compelling data set is mortality on the Titanic, a large ocean liner that in 1912 struck an iceberg and sunk. One of the first things you might do with this data set is to calculate a two by two table of gender versus survival. The Titanic sunk during an era where society really did believe in the mantra "women and children first" though perhaps more so among first and second class passengers. The crosstabulation of gender and survival would look something like this.

```
##         No Yes
## Female 154 308
## Male   709 142
```

You can bring these numbers to life by pointing out that Kate Winslet was in the upper right corner of the 308 women who survived and that Leonardo DiCaprio, sadly, was in the lower left corner of the 709 men who died. The data set has an interesting feature: the relative risk of death is 2.5 times higher for males than females, but the odds ratio is much higher, almost 10. It also allows you to study a rather complex interaction of gender and passenger class. I've used the Titanic data set in a tutorial article about measures of risk (Simon SD. Understanding the odds ratio and relative risk. J Androl. 2001. 22(4):533-6), in a short course on logistic regression, and for some of the homework assignments in the Introduction to R, Introduction to SAS, and Introduction to SPSS classes. I take as validation of this approach the fact that other groups (most notably Kaggle) have also adopted the Titanic as an instructional data set.

Compelling examples are not limited to data sets. In my book, Statistical Evidence in Medical Trials, I talk about blinding with specific attention to blinding in surgical trials. Surgery is easily understood: you cut

someone open, take something out, and sew them back up again. But it requires special challenges to ensure blinding, such as the use of extra large bandages to cover up the size of the incision. I make special reference to a study of Parkinson's Disease where fetal cells were injected directly into the brain. The study had a control group, and in order to maintain the blind, the control patients also had their heads shaved, were put under an anesthetic, and the surgeons actually drilled into their skulls. The only difference was that nothing was injected after drilling if you were in the control group. Needless to say, this was a highly controversial study with one ethical expert writing a critical article with the title "I Need a Placebo Like I Need a Hole in the Head." The gruesome thought of skull drilling makes this example memorable.

There is no more compelling example relating to research methodology than the efforts to find a treatment for AIDS. Controversies surrounding AIDS research has changed the way we approach research today. When I lecture about surrogate outcomes, it is easy enough to come up with examples where reliance on surrogate outcomes has led us astray. The classic example is the CAST trial which showed that the use of anti-arrythmic drugs in patients with heart rhythm problems actually led to an increase in mortality versus placebo. It is harder to find examples where reliance on surrogate outcomes has helped us. AIDS trials, however, do clearly illustrate the value of surrogate outcomes. In the first studies of anti-retroviral treatments for AIDS patients, scientists originally advocated the use of "hard" endpoints like mortality and opportunistic infections. But AIDS advocates pushed for surrogate outcomes like changes in CD4 cell counts because hard endpoints took too long and required waiting until you had accumulated a sufficient number of bad events in the untreated group. It is clear that reliance on surrogate outcomes reduced the number of deaths in the clinical trial itself and allowed much earlier FDA approval of these treatments.

Using humor to make a point

My audiences are often apprehensive. Will this guy speak a lot of Greek and formulas to me? A bit of humor very early in the talk will often allay some of those fears. I try hard, however, to use humor as well to make a point. Humor comes from an exaggeration of a basic idea to levels of absurdity, which you can use profitably to emphasize your basic idea later in your talk.

In a lecture on sample size justification for a short course on grant writing, I started with a (fictional) story of a researcher who gets a six year, ten million dollar NIH grant and writes up a report summarizing the research saying "This is a new and innovative surgical approach and we are 95% confident that the cure rate is somewhere between 3% and 98%." This becomes a repeated touchstone for the rest of the talk. The agency that you are seeking to get grant money from wants some assurance that the results will be informative when you finish your work, and not a confidence interval that goes from 3% to 98%.

The previous joke is an original of mine, but I'm not above stealing other people's jokes. There is a classic about two statisticians travelling on an airplane and one engine after another explodes. After each explosion, the pilot announces that everything is okay, but the flight is delayed further and further after each explosion. After the third explosion, one statistician turns to the other and say "Boy I hope that last engine doesn't explode" [dramatic pause] "or we'll be up here forever!". I use this joke when I teach linear regression, because it illustrates a dangerous extrapolation beyond the range of observed data. Later, I introduce the intercept term and offer an interpretation (the estimated average value of Y when X equals zero). Then I point out that such an interpretation is a dangerous extrapolation when you have no data near the value X=0. In fact,the estimated travel time of a jet with X=0 engines is also an intercept term requiring the exact type of dangerous extrapolation.

I also use humor to assess my audience as well. At the very start, I'll tell a corny joke about degrees of freedom (a joke so bad that I won't repeat it here). I look at who laughs and who doesn't. When most of my audience laughs, I compliment them by telling them that if you understood that joke, you won't have any problems with the rest of my lecture. When most of my audience is quiet, I tell them that they are going to learn a lot today (and I teach things a bit more slowly).

Humor can be overdone, and students are not listening to you for entertainment. I try to keep my jokes short and get them out of the way early. But a little bit of humor does seem to help a lot.

Spending time on small group exercises

I hate to do small group exercises. I really hate them. When you are giving a short course at a research conference, you have a limited time frame, usually three to four hours. Small group exercises can easily eat up a third to a half of that time. I'd much rather be talking because there's so much to teach and so little time. Even so, I include small group exercises in almost all my short courses. The feedback I have gotten from students has been that the small group exercises are the best part of the class.

Constructing a small group exercise is not easy. You have to find a problem that students can tackle, so it can't be too hard, but it has to be challenging enough to force them to use some of the things they have just learned. It has to be something that everyone in the group feels that they can contribute. And it has to be something that each small group can summarize to the entire class in five minutes or less.

The reason that small group exercises work is that students have a variety of different experiences and can learn from each other. The more experienced students benefit because they have to understand the concepts at a higher level in order to articulate these concepts to the rest of the group. The less experienced students benefit because they get a chance to hear about the same concepts a second time and from a different perspective.

In the short course on grant writing, we gave each group a different research paper (actually, just the abstract from the paper) and asked them to suggest a new study with a different research design that builds on the paper's findings and that an agency might want to fund. Showing just the abstract is a big no-no in Evidence Based Medicine, but we apologized and explained that if we handed them a full paper they would run out of time before they even finished the research paper. Each group then appointed a spokesperson to summarize the original paper (just the PICO: Patient group, Intervention, Comparison group, and Outcome measure) and then propose their new research design. Once the spokesperson was done, we asked if anyone else in the small group wanted to add anything and opened it up for comments and questions by the other students. Getting our students to visualize a new research study was one of the big successes of our short course.

In a short course on setting up an independent statistical consulting practice, I was actually able to get two small group exercises squeezed into a four hour format. The first exercise was pairing up students and asking them to share with their partner where they hoped to be five years from now. This served as an ice breaker and got students to think about what a career as a consultant might mean for them. The second small group exercise took some fictional accounts (loosely based on reality) of bad client interactions. The groups had to decide on the best course of action, and this quite honestly might involve just walking away from the project completely, an option that is always available to an independent consultant. The short time frame did not allow each group to summarize their findings to the rest of the class, but the students still found the small group exercises to be valuable.

In a short course, Statistics for Medical Librarians, that I have taught in an online format and at multiple regional and national meetings of the Medical Library Association, I used small group exercises to dissect statistics found in actual peer-reviewed publications. I teach concepts like confidence intervals, provide a non-technical interpretation, and then ask students to do the same in small groups. I show them actual papers (actually abstracts again to save time) that show how a confidence interval might look "in the wild." Then each group has to summarize the abstract using a PICO format and then interpret the highlighted confidence interval in that abstract. All of the abstracts that I choose are from Open Source journals so the librarians can track down the full articles after the class ends, if they are so inclined.

Online teaching

I wanted to mention a bit about the special challenges associated with online teaching, because I see a transition to online teaching almost everywhere I look. I have done webinars, a form of online training, for several several organizations. I've learned a lot from these webinars, though they are not the same as teaching a semester long class in an online format.

One lesson I have learned is that you have to work much much harder at establishing a rapport with your students. In every webinar I have taught, I do not have the option of requiring the students to make themselves visible on a webcam, and only in a few did I have the option of having students ask questions orally rather than through a chat box. This makes the webinars less fun, quite frankly, than a short course taught to a live audience. But I have embraced the webinar format because it allows the participation of a large number of students who are otherwise geographically isolated.

To make up for not seeing and often not hearing the students, I try to make myself seen–using my own webcam when possible. I also take extra time to more directly encourage student participation. It starts with a joke. I introduce the joke with an exhortation. It is difficult, I point out, to say something funny and then hear total silence on the other end, so I after I tell this joke, I want you to type something in the chat box. A "haha" if you liked the joke or a "groan" if you hated it. Then I read the chorus of responses after the joke. It reinforces the connection between me and my audience and it lowers the barrier for students to use the chat box later for more serious comments.

When you ask for questions during a webinar, you need to wait long enough for people to type their questions. And you need to follow up your answer with another exhortation "Did that make sense" because you don't get the feedback from the knowing nods or the glazed eye confusion.

A webinar format demands a good Powerpoint presentation. I do not always use Powerpoint for live talks and short courses and subscribe to the admonition of many that "Powerpoint is Evil." For a webinar, however, if you don't give students a Powerpoint slide to look at, it makes it that much harder to keep a student's attention.

I've taught two traditional courses (Introduction to R and Introduction to SPSS) in an online format. These are in an asynchronous format. Students listen to mp4 files where you lecture and show Powerpoint slides and live screen shots of R and SPSS as those programs grind through their computations. The one issue I've noticed with the asynchronous format is that if one student asks a question, the other students would not normally get to benefit from hearing that question and hearing my response. They also lose out on the opportunity to add something to my answer if they can. So it is very important to share questions and answers that otherwise would only come to you privately via email.

Neither Introduction to R nor Introduction to SPSS lends itself well to small group exercises, but I do recognize by watching others at my current job that small group exercises take a much different form in an online format. In particular, they require much more written communication than oral communication, and the effort, especially for an asynchronous format, is spread out over a longer time frame. This can actually be an advantage because you need to explain yourself more clearly in a written format and the slower pace encourages more thought as well.

No doubt that I will encounter other issues as I teach more classes in an online format. I learned a lot about online teaching at various talks at the Joint Statistical Meetings, and plan to keep my eyes and ears open for other people's experiences.