

Challenges, Changes and Choices in the Undergraduate Statistics Curriculum

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George Cobb has (yet again) written a thought-provoking and entertaining article that should be required reading for anyone involved in the training of statisticians. My reactions when reading the article ranged from agreement with the main ideas to pessimism about the viability of implementing them. My pessimistic side predicts that the recommendations will meet the fate Cobb describes for Bayesian methods before computing made them tractable, namely “Statisticians read the arguments, followed the proofs, nodded in agreement, and continued in their pursuit of incoherence.”

What changed the landscape for Bayesian methods was not only that computers made them tractable, but that a few innovative leaders made it easy for others to implement and teach them by writing textbooks and computer programs that could be used in the classroom and the consulting room. We need those innovators if we are to implement the widespread changes recommended in Cobb’s article.

My optimistic side kicked in when I realized how much and how quickly things have changed during my academic career. It’s hard to remember that it wasn’t until at least 10 years after I started teaching that faculty members were given individual computers, rather than relying on single mainframe computers that served the whole campus! And in 1987 when I took a one year leave of absence to work at SRI International I became one of the first in my academic circle to have an email address. Commercial email providers didn’t become popular until the mid-1990s. We have come a very long way in a very short time. And the pace is quickening.

In the remainder of this commentary I address a variety of unrelated issues brought to mind when reading Cobb’s article. The first is a reminiscence of the workshop and article that led to my first published commentary (Utts, 1986), in Volume 1 of *Statistical Science*, in response to an article titled “Computers in Statistical Research” (Eddy, 1986). Next is an exploration of why undergraduate degrees in statistics should be offered at all. And third is a discussion of what happens after graduation, and indeed, to those who have graduated already.

The aforementioned *Statistical Science* paper was a commentary on an article (Eddy, 1986) about how academic statistics departments were beginning to acquire their own computers, and speculating on how this would affect the future of research in statistics. The article was the culmination of a workshop on the topic, and should be required reading for anyone who thinks the statistics profession has not changed in the past 30 years! The relevance of my 1986 commentary to the Cobb article is that I outlined a science fiction story then that I feared would be

upon us 30 to 40 years hence, in other words, just about now. The essence of the story was that statisticians were no longer needed because the “black box” was able to do everything automatically: spitting out p -values, confidence intervals and conclusions without any need for the thoughtful input of a human. But eventually someone realized that results were being generated that made no sense. When they tried to figure out what was in the black box it was impossible to do so, until they located some ancient statisticians who actually remembered the reasoning that used to be part of the decision-making that accompanied the algorithms. Let’s make sure we don’t go there!

Any discussion of what should be covered in the undergraduate curriculum needs to take into account the fact that the reason for having an undergraduate degree in statistics is changing rapidly. What will become of our undergraduates? A small percentage of them are likely to attend graduate school, but the rest are likely to get jobs that involve working with data. What do they need to know to be hired, what do we want them to know once they start working, and are those the same? We need information on what kinds of jobs our bachelors’ level graduates are getting, but anecdotal evidence indicates that the jobs they are getting require more computing skills than high-level statistical thinking. I agree with Cobb’s view that we need to train our students to combine algorithmic thinking with probabilistic thinking, even if it is not immediately obvious that they need the latter for these data-crunching jobs. Otherwise, it is too likely that my science fiction story will become reality.

The biggest challenge our graduates will face (eventually) is the same one that probably faces most professionals in this era, and that is keeping current with changing technology and methodology. As a profession, I think we need to vastly increase our continuing education offerings. I’ve restricted my comments to the undergraduate level because that’s the focus of Cobb’s article, but I think we need more continuing education at all levels. I agree with Brown and Kass (2009) that no one can be expected to know all areas of statistics anymore—there are simply too many specialties, and effective statisticians need to learn a good deal about the disciplines in which they collaborate in addition to keeping current with developments in statistics. As a profession we need to develop mechanisms for offering continuing education in addition to the ones currently available (such as short courses and webinars).

One final note is that I think the emergence of undergraduate programs in data science is a good step forward. It is easier to think about implementing change when it’s viewed as part of a new major than a revision of a current one. But even within existing statistics majors, I don’t think radical change is needed to implement the ideas put forth by Cobb. Changes to existing courses could easily be made that would accomplish much of what Cobb recommends. And it is only on this final point that

Online discussion of “Mere Renovation is Too Little Too Late: We Need to Rethink Our Undergraduate Curriculum From the Ground Up,” by George Cobb, *The American Statistician*, 69. Jessica Utts, University of California, Irvine (Email: jutts@uci.edu).

I disagree with Cobb. I think an appropriate amount of “mere” renovation would be sufficient to create the effect he wants. But we need innovators to make it happen.

References

Brown, E.N., and Kass, R. E. (2009), “What is Statistics?,” *The American Statistician*, 63, 2, 105–110.

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