Response to: "Mere Renovation Is Too Little Too Late: We Need To Rethink Our Undergraduate Curriculum From The Ground Up"

Roxy PECK, Beth CHANCE, and Allan ROSSMAN

First, we thank and congratulate George for a thought-provoking article. We whole-heartedly agree that implementation of the new guidelines will require considerable holistic thinking about the undergraduate curriculum for statistics majors. Rather than tweaking existing courses, departments should embrace the challenge to rethink everything from the first course, to progression and scaffolding through the curriculum, to assessment of learning objectives. For example, rather than continuing to compartmentalize computing, theory, and applications, courses should address the junction of all three areas. Algorithmic thinking needs to be explicitly taught, though not at the complete expense of mathematical underpinnings. We believe that Breiman's two cultures can complement and reinforce each other.

The tricky trade-off is of course in practice. What is feasible for departments to do in the near term? Continuing George's "tear-down" metaphor, which requires an expensive and time-consuming process, a key question is where to live in the meantime? Statistics departments cannot simply suspend their programs for a few years and then admit students once their new programs are established, so is it realistic to pursue drastic innovations such as attempting to break down departmental barriers and abandon teaching "subjects" entirely?

Other questions abound, such as: How will we know our new structure is feasible? Do we test and evaluate before we tear down and build, or do we just tear down, build, and hope for the best? Do we need to reach consensus within and among our departments first? How do we prepare current faculty, the vast majority of whom were taught in the probabilistic culture, to develop courses that teach skills from both cultures?

Perhaps we should begin with more modest renovations. For example, at Cal Poly, we have introduced a 4-unit "orientation" course for entering first-quarter students that begins our majors' discussions of historical roots of the discipline, ethics, future directions, "big data," computing in R, communication skills, and collaboration strategies.. This is followed by an applied introductory two-course sequence that focuses on the statistical investigation process as a whole, working with messy data and using simulation to motivate mathematical theory of statistical inference. We want our statistics majors to immediately apply their knowledge to genuine research studies, rather than waiting to finish courses in calculus and probability first. This sequence is followed by an applied regression course, where we are currently adding more topics on predictive modeling, but in a manner that complements the modelling culture while focusing on overarching principles of statistical thinking. We are still collectively revising and hope to go further (especially as more course materials and texts become available), but what topics can/should now be omitted and just how far and should we go?

We hope the ASA will continue to provide resources and support for such changes. We are encouraged by the special issue's focus on rethinking the undergraduate curriculum in a collaborative manner, sharing resources and lessons learned, and learning from how individual institutions uniquely balance between cultures. Only by changing how undergraduate statistics majors are taught now will we be able to positively impact the discipline in the future.

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, DOI: 10.1080/00031305.2015.10930. Roxy Peck is Professor Emerita, California Polytechnic State University–Statistics P.O. Box 7088, Los Osos, CA 93412. Beth Chance is Professor, Cal Poly, 1 Grand Ave, Department of Statistics, San Luis Obispo, CA 93047. Allan J. Rossman is Professor and Chair, Department of Statistics, Cal Poly San Luis Obispo, CA 93407.

