

## NITRO STATS: Reflections from JSM Vancouver

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September 2010

Published in *Liaison*

Statisticians understand better than most what can happen with a small alteration to a single data value. The same is true with letters and words. Switch the order of the first two letters of "Intro" and get "Nitro". The title of this article is not a typo. It is a provocation about the need to "blow up" conventional introductory statistics courses.

There is considerable discussion and much writing about the need to change the teaching of statistics to the world. The recent JSM in Vancouver devoted considerable time and many sessions to this topic. In a data-centric world, the need for all of society to have a basic grasp of statistical ideas has never been greater. One need look no further than the federal government's ill-advised action to make the mandatory long-form Canada census voluntary instead. Or consider government economic stimulus packages (in Canada and in the United States), where the politicians take credit for positive change, without any awareness of what is natural variation or effects of regression to the mean.

I spent my time at the JSM in as many statistical education sessions as I could schedule. Based on the presentations, discussions and the debates they sparked, I have attempted here to articulate some of the challenges we face.

### **1. It matters WHERE you teach**

Teaching introductory statistics courses in a statistics department is very different from teaching in another department, school, or faculty. For example, statistics courses taught in a business school must provide skills and techniques required for following courses in finance, marketing, supply chain management and human resources, among others. And there is some pressure to tailor examples to those applications, despite the abundance of excellent illustrations from biostatistics and epidemiology, psychology, sports, etc. Teaching in a statistics department makes you your own boss. Teaching elsewhere makes you much more accountable to others. This distinction was made very clear in sessions about changing curricula in introductory statistics courses. Attempts to make radical revisions to topics and order of topics, such as those offered by Beth Chance and Allan Rossman (1) have not been embraced either inside or outside of statistics departments. Successful textbook author Dick De Veaux (2) told me, in a post-session conversation about this problem, that he and his textbook co-writers went as far as they dared in their books with respect to curriculum revision, but also recognized what the market would bear.

### **2. It matters HOW MANY you teach at one time**

Large classes pose unique and significant (in the practical sense) challenges. However, most of the innovations in teaching large classes seem to involve incorporating new technologies, the primary one being "clickers". While many agreed that they are helpful in assessment aspects of teaching, and in encouraging some basic level of feedback, the question remains whether they truly foster student participation and engagement.

Clicker experiences reported at the JSM were from a teacher's perspective, not a student's perspective. According to a small, non-representative survey I carried out (I asked my sons and their friends), clickers



are not needed if the teacher is capable of engaging students through stories, illustrations, anecdotes, and humour.

Most other advice from presenters and discussants concerned assessment and grading methods, training tutors, and experimentation with group projects. Teaching large classes and, in particular, multi-section courses with large classes, remains a major challenge for our field.

### **3. It matters WHO you teach**

Introductory statistics courses are not necessarily meant to produce entire classes of new statisticians. In my teaching career I have distinguished between users, practitioners, and statisticians. Intro courses are, for the most part, aimed at users of statistics, and to a lesser degree at future practitioners. Larry Weldon (9) offers a similar trichotomy, describing levels of a statistics course as being aimed at appreciation, practitioners, and experts, with experts needing more content rather than different content. I often use the analogy that, just as it is possible to learn to drive a car without first understanding the working of an internal combustion engine, it is also possible to learn user-level statistics without understanding the mathematical foundations.

We statisticians ask each other what to teach and how to teach. Perhaps we should be asking students what they hope to learn and how they would prefer to learn. In business, the old saw is that “the customer is always right.” In the classroom the student is not always right, but sometimes they are! Knowing the background and preparation of the students, and knowing their future educational plans should have an impact on course development.

### **4. It matters WHICH resources you teach with**

According to focus groups and other non-random samples of students I have surveyed, the trouble with most textbooks is that they have too much text. It is both instructive and alarming to watch today’s students studying. They sit in front of a computer with multiple windows open, including chat and messaging applications. They have an iPod or MP3 player plugged into their ears. They use their cell phone to send frequent text messages. All this while a textbook is open on their lap. They claim to be multi-tasking, which might best be defined as doing a number of things all at the same time, all equally poorly. Textbooks, study guides, course notes and other reference materials need to recognize the new, but not necessarily improved, learning styles.

Efforts to revamp the course curricula for intro stats courses are hindered by the textbook publishing business. A review of titles at the exhibitor’s hall at the JSM found countless offerings that have essentially the same content as textbooks 20 or more years ago, but with updated software instructions, illustrations, and examples. Truly revolutionary new titles (akin to Freedman, Pisani and Purves in 1978) have made little headway in the market.

### **5. It matters HOW you teach**

Presenters at the JSM reported on a tremendous amount of research and experimentation into different delivery systems, from traditional lecture format to small group learning, discussion groups, tutorials, on-line teaching, applied projects, use of software, and other high-tech resources. And there are wonderful on-line resources to assist with all of these approaches.

Statistical education is a growth area. In Canada we have the CSEN (Canadian Statistics Educator Network) (3). Other great resources are CAUSEweb (Consortium for the Advancement of Undergraduate Statistics Education) (4), Statway (The Carnegie Foundation for the Advancement of Teaching) (5), and



the Chance website (6). I also suggest checking out Jessica Utts' website (7) and Andrew Gelman's blog (8). And, not just in homage to our *Liaison* Editor, I encourage you to visit Larry Weldon's website (9)!

### **6. Most importantly, it matters WHAT you teach**

How many of us are familiar with the acronym GAISE, or Guidelines for Assessment and Instruction in Statistics Education? Reading the reports on the Pre-K-12 curriculum framework and for college courses should be mandatory for anyone teaching intro stats. GAISE's ultimate goal is "statistical literacy". Quoting from the report, "Statistics education as proposed in this Framework can promote the 'must have' competencies for graduates to 'thrive in the modern world'."

The contrarian in me asks the two-part question, "How is statistical literacy different from quantitative literacy, and how is it different from numeracy?" Statistical literacy requires basic fluency with quantitative concepts. In an intro stat class, is it safe to assume that students are comfortable with the size of large numbers (e.g. billions of dollars) or small numbers (e.g. one part per billion risk), or estimating instead of calculating, etc.? Can we teach the largely counter-intuitive concepts of uncertainty, probability, randomness and variation without basic mathematical skills? To paraphrase Douglas Hofstadter, our society would be unimaginably different if the average person truly understood basic mathematics. So a key challenge in deciding what to teach is where to start.

However, the major challenge of redesigning course content, is not figuring out which topics are worth adding – for example, techniques of measurement, graphical communication, risk assessment, permutation testing, statistical modelling, understanding randomness – but which topics we should drop. At the JSM, in a session entitled, "Letting Go to Grow," Jessica Utts (7), and Allan Rossman and Beth Chance (10), each presented their dream content in an intro stat course. It is well worth checking out their websites to learn more.

### **Conclusion:**

I encourage you, as statistical educators and statisticians concerned about preparing society for our data-centric world (the buzzword of this year's JSM), to help revise, redevelop, re-imagine, and rehabilitate the teaching of intro stats. Join the CSEN (Canadian Statistics Educator Network); share your teaching successes with others; be innovative and experimental. Our challenge is to figure out how to drop the "r" from "Intro Stats" and produce students who leave a first course in statistics being really "into stats".

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