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Comment: The future of the textbook (Utts)

Commentary on the Papers

The thought-provoking papers by Çetinkaya-Rundel et al, Zieffler et al and West provide an excellent opportunity for rethinking the traditional textbook-based model of delivering statistics education. The common theme among the papers is that electronic publishing allows instructors the freedom to customize materials to fit the needs of individual courses, instructors and institutions, often at a fraction of the cost of traditional textbooks.

The paper by Çetinkaya-Rundel et al describes *OpenIntro Statistics*, a free on-line textbook written by the authors of the paper, and accompanied by some other teaching materials. I applaud their effort to provide free teaching materials, and am impressed by the amount of work they have done to create a full textbook complete with interesting data sets and exercises. The paper reads almost exclusively as an advertisement for their textbook, which would probably be seen as self-serving and offensive if it were written to promote a for-profit textbook. But because it promotes a free resource, it is in fact an interesting introduction not only to their textbook, but to the benefits and drawbacks of free educational resources.

One issue not mentioned in their paper or on their accompanying website is what has allowed them to have the time to create these materials. Traditionally, universities do not provide incentives for creating teaching materials, and do not provide release time for working on such projects unless they are grant-funded. Most textbooks authors I have spoken with work nights and weekends on their books, with the work adding to their regular university workload rather than substituting for part of it. I believe that this culture has created a vacuum in the development of free educational materials that would be filled if universities were more accommodating of these efforts in their reward systems.

Zieffler et al begin with an overview of the traditional textbook in comparison with electronic books. They then describe their randomization-based CATALST (Change Agents for Teaching and Learning Statistics) course, and the textbook they have created to accompany it. Unlike the *OpenIntro* project, the CATALST course and textbook development were funded by a grant from the National Science Foundation. The project provides an excellent example of how innovation follows funding. The course has been a multi-year effort and has resulted in an innovative course and materials that can be exported to other universities. Further, the materials were developed using knowledge of research in education and cognitive science, and additional educational research was included as part of the project.

West was an early innovator and proponent of electronic materials for teaching statistics, and his paper illustrates how these materials can be incorporated into the introductory course, with or without a traditional textbook. His paper has many ideas for blending the traditional with the new, and provides guidelines that teachers could follow if they are ready to incorporate some new methods, but not completely abandon the traditional modes of instruction.

In the remainder of this commentary I was planning to discuss the benefits and drawbacks of electronic materials used in place of print textbooks, but in trying to do so, recognized that the distinction is actually different from that. The proper distinction, as illustrated in the accompanying papers, is between materials produced and marketed by textbook publishers and materials produced without their support (and accompanying expenses).

My Experience and Disclaimer

First, a disclaimer: I'm the author of three statistics textbooks (*Seeing Through Statistics*, *Mind On Statistics* and *Statistical Ideas and Methods*, the last two with co-author Robert Heckard) for which I receive royalties. I was also the editor-in-chief of *CyberStats*, a complete online statistics course, for which I did not receive royalties (although the individual authors did). *CyberStats* was divided into several dozen units written by different authors and included numerous online activities, online quizzes with immediate feedback, exercises, links to a glossary and to related materials in other units, a rudimentary course management system, and other resources unique to online materials. Introduced in the late 1990's, it was almost surely ahead of its time. It's hard to imagine now, but at that time many students did not have reliable internet access, and some did not have computer access at all. Most instructors who used *CyberStats* used a textbook as well.

I also have experience developing a hybrid introductory statistics course, which is still taught at the University of California, Davis, where I was on the faculty at the time. I taught the course for three years, and did a formal study comparing it with a traditional course (Utts et al, 2003). I used both a textbook and *CyberStats*, and met with the class weekly. From that experience I concluded that the instructor is most useful for explaining material that is not easily grasped from print and online materials alone. When I finally settled on the most successful model for the hybrid course it included a one-page weekly guide for the students, and the use of in-class time for answering questions, followed by a short quiz. I did no traditional lecturing at all, except for short spontaneous lectures prompted by student questions. The weekly guide summarized the big ideas for the week, provided advice on what to read in the book and online, and suggested activities to try for the week.

In my comparison of the hybrid and traditional course I found that students performed about equally well, but that the hybrid students relied more heavily on the textbook and online materials for learning than did the students in the traditional course. When I asked students in the two types of course to identify their primary source of learning, the hybrid students were about equally split between the textbook and *CyberStats*. Perhaps surprisingly, about half of the students in the traditional class identified the textbook as their primary source of learning, with the remaining half split about equally between the lectures and the homework (Utts et al, 2003).

The Roles of Authors and Publishers

As mentioned in some of the papers, under the traditional textbook model publishers play multiple roles. They serve as gatekeepers in finding authors or in accepting textbook proposals. They solicit reviews of submitted materials, then they shepherd the book through the publication process, often hiring editors, artists and other professionals to add features that may or may not actually improve the learning experience for students using the book. They hire others to provide

ancillary materials such as test banks, and then play a role in marketing the book. If the book is successful, they solicit reviews for suggested revisions for new editions, and then start the process again to produce those new editions. All of these services add a very substantial amount to the cost of the book.

How necessary are these features, and is there a replacement for them in the creation of electronic materials? In this discussion it is important to distinguish between two types of electronic textbooks. One type is the equivalent of a traditional textbook that is available online, but with some advantages online publishing can offer, such as customized sets of chapters and the facility for editing by individual instructors. This model is the one used for *OpenIntro Statistics*. The other model is an interactive set of materials without a linear path through them; this was the model for *CyberStats*. It contained 36 separate units, each of which followed the same basic structure, and each of which contained self-assessment tools, exercises, applets, and other features. The units were designed to be covered in whatever order the instructor chose. And because they were online instead of in print, there was complete flexibility in terms of how many units to access and in what order. Students were charged a small fee to use *CyberStats*.

Certainly most of the publishers' roles would translate to materials produced electronically under both models. When creating *CyberStats*, Alex Kugushev, who conceived of the idea and oversaw the whole process, single-handedly accomplished many of the tasks done by publishers. He had founded Duxbury Press and spent his career publishing statistics textbooks, and so he had the relevant expertise and numerous contacts for marketing the materials. Some of the tasks, such as creating test bank questions, were handled by the authors of the units. Others, such as creating applets, were accomplished by hiring a few of the unit authors to write materials for other units as well as their own.

As editor-in-chief of *CyberStats* my intention was to edit all of the pages for content and consistency, but that task soon became overwhelming. At one point, I found that there were over 7000 pages as part of the package! These included instructional pages, quizzes, exercises, examples, applets, a glossary, and other supporting materials. I provided a structure for authors to use when creating units, including mandatory sections such as *Think First*, *Basics*, *Uses*, and *Warnings*, but there was substantial variability in the quality, terminology, and so on used throughout the units. Unlike an online textbook like *OpenIntro Statistics*, which is more like a traditional textbook, the complete *CyberStats* package would have been almost impossible for one or a small group of authors to create without devoting full-time attention to it for an extended period.

From this experience I concluded that creating a comprehensive electronic course that takes full advantage of available media would have to be a trade-off between content and quality control unless it were to be a full-time project accomplished by a team with various areas of expertise. It could not be accomplished by one or a few individuals working extra nights and weekends, like the writing of a textbook can.

The journal publication process is currently facing the same quality-control dilemma as electronic educational materials. The quality control that accompanies the traditional refereeing process is sometimes sacrificed in favor of timely electronic publication, especially in disciplines

for which days or weeks matter when trying to be the first to report a research finding. And of course the internet in general is fraught with the problem of quality control of information. I do not think the solution to this dilemma will come easily, and it places more of a burden on consumers of information to serve as their own gate-keepers, something students and some instructors are not qualified to do.

Advantages and Disadvantages of Traditional Textbooks

As mentioned earlier, I was intending to discuss the advantages and disadvantages of traditional versus electronic textbooks, but it soon became clear that the appropriate distinction is between publisher-backed textbooks (print or electronic) and individual or community-based electronic textbooks.

In an ideal world, there would be free, high-quality electronic and print materials that students could use interactively, with materials and feedback geared to the individual student's learning style, ability, prior knowledge and experience. However, unless the method of delivery changes to individualized online instruction, it makes sense to consider the less ideal, but more realistic, model in which the instructor chooses a textbook or other source of material and uses it uniformly for the entire class. What are the advantages and disadvantages of the two models in that situation?

First, I suspect that Statistics is unlike most other disciplines in one very important respect: Many instructors who teach introductory statistics were not trained in statistics, and may have little knowledge of the material or about what makes a good introductory course. For those instructors, the textbook is often their major source for learning the material they are teaching. Therefore, it is important for them to have a high-quality, unified and authoritative source of information, exercises, and supplementary materials. Of course the materials could be provided electronically, but the important point is that there should be a clear path through them, and they should include detailed explanations, examples and supporting materials. This kind of package is something traditional textbook publishers are experts at providing.

Probably the most important advantage of materials that are not created and backed by traditional publishers is that they can be provided at low or no cost to students. However, someone needs to create these materials, and there is a cost involved in developing them. Ironically, my experience is that writing a textbook, while time-consuming, was much less so than creating a comprehensive set of online course materials. Yet, unlike textbooks, there is an expectation that if material is on the web, it should be free. Universities would do a great service in this regard if they rewarded faculty for developing these materials in lieu of traditional publications. Although there would be no refereeing process in advance, it should not be difficult to design a system for evaluating these kinds of materials when faculty members are reviewed. And community feedback would soon dictate which materials were most valued by instructors and students.

Another advantage of materials that are not controlled by publishers is that they can be created, expanded, and edited by a community or by individual instructors to suit their needs. One problem with community creation and editing, as illustrated by sites such as Wikipedia, is that the process results in varying degrees of accuracy and quality. However, experienced instructors

who are willing to spend a small amount of effort should be able to modify the materials and serve as gate-keepers for their own students. In fact many instructors may prefer to do so, and this is something they cannot do with publisher-based materials, even if they are in electronic form.

In summary, electronic materials have the advantage that they are cheap to deliver and can be customized to suit individual instructors' needs. However, the intellectual cost of creating these materials is as high as or higher than the intellectual cost of creating traditional textbooks. Universities, publishers and authors have not yet created a uniformly viable model for meeting those costs, while ensuring that the materials are high-quality and low-cost to students.

In any case, I think the next decade is likely to be one of extensive change in the delivery of education, prompted not only by changes in textbook options but also by budget constraints that have required universities to look for more efficient models for delivering education. Research universities in particular are likely to go through major structural changes; see for example the June 2012 report from the National Academies Press, *Research Universities and the Future of America: Ten Breakthrough Actions Vital to Our Nation's Prosperity and Security*. Let's hope that the expansion of low-cost, high quality educational materials is part of that change.

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