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Author

West, Webster

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Textbooks 2.0

1.0 INTRODUCTION

The textbook has served as the centerpiece of learning for almost every academic discipline for hundreds of years. In most cases, it has been the roadmap that an instructor uses to guide their students through the subject matter for their course, and students have relied on its content to master concepts introduced in the classroom environment. Traditionally, instructors have adopted textbooks based on how well they match the course material to be covered and their gauge of the clarity of the exposition. Students have then been forced to purchase the textbook based on the instructor's adoption. Thus, the textbook marketplace is unlike many consumer markets in that the end consumer does not make the product decision. This lack of input coupled with rising costs has left many disillusioned with the adoption process, but without another alternative, the printed textbook has cornered the educational market for decades.

The rise of the information age, however, has brought the role of the classic printed textbook into question. There are now a number of free sources of information available online covering virtually every subject. In statistics, for example, a Google search of the term "t test" leads one directly to a Wikipedia page on the subject, which contains a description of the hypothesis test along with examples of its uses. Similar links can be found to YouTube videos and individual instructor Web pages covering the subject. It seems now that students can access more information than they could possibly want or need on such subjects. The natural question then arises: "Do we still need textbooks?" My answer to this question is a simple "yes". With the wide variation in approach, jargon and notation in statistics education, I believe a single voice and narrative are essential to the learning process. Piecing together pedagogical material from various web sites may work well for the brightest of students but this approach may lead to a great deal of confusion for the average or below average learner. Most instructors in the field of statistics also rely heavily on the textbook for structuring their course and for assessing what their students know using the exercises therein. Textbooks also serve as the primary tool for updating the curriculum in a field such as statistics. When a new approach to the curriculum comes into play, the first question many instructors ask is "what textbook uses this approach?"

At the same time, I feel the format and contents of the standard textbook is ripe for significant change. This is, of course, strictly my perspective, but in this opinion piece, I will provide my thoughts on what the future form of a textbook in the field of statistics might be. My comments and vision will be focused herein on the introductory statistics textbook. In the interests of full disclosure, I must admit that I am currently under contract with Pearson Education to write a text such as the one I will describe below.

2.0 THE ARGUMENT FOR E-BOOKS

My current thinking on textbooks is framed largely by my experiences coordinating an introductory statistics course for engineers and scientists at Texas A&M University. A few years ago, I made the decision to adopt an electronic version of Miller and Freund's Probability and Statistics for Engineering and the Sciences by Richard Johnson (2010). This particular course already had a well-developed set of notes that outlined the material, and I was looking for a good reference that students could use outside of class as another source of information and examples. I had used this particular textbook for many years at the University of South Carolina, and I felt that its concise and accessible nature made it a natural choice for this purpose. The most important aspect of this adoption for me was the electronic format. The e-book offered a number of new features that were simply not possible with a traditional printed text at a price that was almost 50% less.

Perhaps the most important feature of this e-book was its search facility. The ability to search the entire text or selected chapters based on certain keywords greatly reduces the time it takes students to find reference material. This search even yields thumbnail previews of the relevant pages to help students more quickly digest what information is available. A history is also provided which allows students to conveniently access previous search results in the future. Once students find interesting relevant material, they can bookmark these pages and make annotations to them in a well-organized way. This greatly enhances the process of writing notes in the margins as students commonly do with printed textbooks. Indeed, even instructors can make annotations to the e-book that are available to all students using their version of the text.

While these usability features are certainly a big step forward from the print format, there is also a tremendous opportunity for integrating the e-book content with other course materials. For example, the assignments for my course are administered within a course management system. Within this system, I place direct links to the specific pages of the text that students may wish to review before completing the assignment. This sort of "just in time" approach to learning is one that is familiar to many college students as they consume information in this manner frequently. This linking can also work in the opposite direction, from the e-book to other course materials. As an example, StatCrunch (2012), the statistical software used in the course, can be linked to data sets from the electronic text so that students can easily open the data for analysis as they work through the examples.

These features and others like them, along with the cost incentives, made the initial adoption of an e-book an easy decision to make. Indeed, there is now little doubt in my mind that e-books represent the future of textbook publishing. While I consider my endeavors in this area thus far to be a step forward, there is much more that can be done to make the e-book even more enticing to instructors and students. The current edition of the e-book that I am using is basically a verbatim copy of the pages from the printed text with the features I describe above layered on top. If developed purely in electronic

format, there is no reason that an e-book should be restricted to such a static format. Indeed, there is room to embed much more interactive and visually interesting media content.

One item on my wish list is well-produced videos of course material and demonstrated examples. If done properly, this type of video content might significantly reduce some of the burden of lecturing from the instructor. As someone who has invested significant time in teacher training, I have found it troubling that so much effort is spent in an attempt to turn all faculty members into reasonable lecturers. There are already many talented lecturers, and with modern technology, it is possible to capture and accentuate their efforts so that others can benefit from them. Given these capabilities and the low level of student interaction in the typical lecture, it is quite odd that we continue to congregate in the classroom environment for the primary purpose of the instructor conveying material. In the field of statistics, instructors might better use class time to advocate student learning by answering questions and working out more detailed examples based on classroom discussion. Additionally, much time could be used to complete group activities that reinforce statistical concepts and methods. This flipped classroom experience will undoubtedly become a more viable concept when quality presentations become a significant part of the textbooks of the future.

Other items that can be embedded into an e-book to enhance the learning process include the commonly used interactive applets that are designed to help students with particular concepts and statistical software. In the case of applets, their use can be woven into the discussion within the text rather than being disconnected standalone items on individual Web pages. As an example, most introductory statistics textbooks feature a graphic showing multiple confidence intervals stacked one on another with a few of the intervals not covering a specific reference value. The role of confidence level and associated coverage probability, which is addressed with this graphic, might be replaced with an applet where students generate the confidence intervals interactively under different conditions and observe their properties. Statistical software may also be used to display data inline (not as external link) so that students may work through an example in the context of its discussion within the content. The Guidelines for Assessment and Instruction in Statistics Education (Aliaga, et. al 2010) suggest that large real data sets should be used in statistics courses for a variety of reasons. Integrating such data sets into the text using software with scrolling capabilities makes it possible to achieve this goal without cluttering the text with pages of data values.

It is also worth considering removing certain items that are standard in many printed texts to keep the discussion concise and focused in electronic format. Many textbooks contain instructions for performing specific statistical analyses in a variety of different software packages. This material may be linked to an external document so that it does not interrupt the flow of the material. Likewise, I also feel that exercises may also find a better home rather than within the text itself. While this may sound somewhat controversial, I strongly prefer the delivery of exercises in an external course management system. Many of these systems offer algorithmic exercise engines where elements within each exercise are randomly generated for each student. Examples of

such systems are MyStatLab (2012) and WebAssign (2012). In addition to pushing students to do their own work, these systems typically offer students multiple attempts at an exercise and provide immediate feedback to students about the correctness of their solution after each attempt. I have found such systems to be very effective for both conceptual exercises and for exercises involving the application of statistical methods. Removing these items should allow e-books to be more streamlined to focus purely on the pedagogical content.

The need for a close integration between an e-book and an underlying course management system is one reason that I think publishers will continue to play a significant role in the development and marketing of textbooks. Mission critical operation of a course management system requires a significant technology infrastructure, which most major publishers already have in place. In addition, publishers have resources to develop quality materials such as videos, applets and algorithmic exercises. While capturing video, for example, may seem to be within the grasp of most tech savvy instructors, the captured product will typically fall short in terms of student expectations of production quality. As the access to media increases, so do user expectations in terms of quality. There is also the need for resources to frequently update these materials in order to keep the content timely. For these and many more reasons, I think that open source online books will be unlikely to match those offered by publishers for the foreseeable future.

In addition to the infrastructure and financial resources that publishers provide, they also provide the all-important boots on the ground in terms of their campus representatives. As the StatCrunch developer, I have had the opportunity to visit many campuses with publishing representatives, and I have developed a newfound appreciation for the vital role that these individuals play in statistical education. Statistics is a strange academic discipline in that instructors from outside the discipline teach the overwhelming majority of statistics courses. They are typically reluctantly forced into teaching the subject due to a lack of qualified individuals at their institution. Many of these instructors have very little training in statistics, and they frequently struggle to stay abreast of statistical advancements and innovative ways to teach the subject. Publishing representatives play the key role of delivering innovative products to this somewhat inattentive and oft overworked group of instructors. This process has been in place for traditional textbooks for decades, and it is unlikely to change when e-books inevitably take over. There will still be a large need to demonstrate and train instructors to use these innovative products to their fullest potential. In fact, the need may be far greater than that which accompanies that of a traditional textbook. This is yet another reason why I don't see textbook publishers going away in the future. In fact, without these flag-wavers and technology training specialists, I am unsure whether any open access project will ever have a broad audience in statistics education.

3.0 TEXTBOOK DISSEMINATION

It is also worth considering what is the best bet for the future of e-book dissemination. As any time series expert will tell you, forecasting is a risky business. This is especially true in the field of technology where both hardware and software change at a rapid pace. A few short years ago, Flash technology from Adobe might have seemed a shoe-in for the future of e-book delivery. The e-book I have adopted is currently delivered in this format, but the underlying Flash software has already changed once since my original adoption. This rate of change might concern some instructors as they grapple with the ever-moving target of student computing. This concern is redoubled by the current shift towards more mobile computing platforms. As tablet computing and smart phones become more and more ubiquitous and affordable, it is hard to imagine that there will not be a strong demand for textbook material that is formatted for these devices. As an example, the latest Google Nexus 7 was recently released with a price tag of a mere \$229 which is little more than a student currently pays for a new textbook. Such a device could be used to house all of a student's e-books for an entire semester or perhaps for their entire academic career at a slightly higher price.

Mobile devices also represent an opportunity to create an even better textbook experience. One of the more impressive endeavors into the e-book world that I have seen recently has come with the release of iBooks 2 from Apple. This software provides a beautiful interactive display of textbook material on Apple's iPhone and iPad hardware. This release is accompanied by a staggeringly low target price of \$15 for a single textbook, a fraction of what students currently pay for even a used text. There is also a free companion software tool for authors to create texts in this format. This software allows for the somewhat straightforward integration of all the items from my wish list detailed above. Much of the standard fare for statistics textbooks, however, will need to be recreated using new technology compatible with these devices. Applets, for example, will need to be recreated in HTML5/JavaScript format rather than the now common Java and Flash formats. The amount of work involved in this technology move is not trivial, but over time there is no doubt that it can be accomplished. The development of content in these newer formats is another place where publisher resources can be brought to bear in order to speed up the process. What remains to be seen is how restrictive this format may be. There will undoubtedly be significant push back from instructors if the end result will only run on Apple hardware. Since a significant portion of the underlying technology is based on Web standards, these items should be easily portable to Android devices and other operating systems including the now standard student laptop. I am hopeful that any sort of exclusivity will not hinder the transition to the world of e-books.

4.0 DISCUSSION

With these technological advancements, I consider the e-book transition to be inevitable at this point. Frankly, I am surprised that more instructors have not already moved in this direction. There have been numerous projects targeted to the electronic format already. I was involved in developing the technology behind the now defunct CyberStats (Utts

1999) project published by Cybergnostics Inc. in the late 1990s. While outdated by today's technology standards, this project was somewhat ahead of its time. Still, this early work is very close in spirit to what I desire for my classroom today. The academic world and the statistics discipline in particular can sometimes move at a snail's pace in terms of technology adoption. As I discuss these ideas with many of my colleagues, they fondly describe the joy of holding a physical textbook in their hands and openly express doubt for how one might learn from material in any other format. I see this as instructors projecting their own learning styles onto their students who live in today's technology driven learning environment. Such statements from instructors are often made without strong consideration for their students who carry around heavy backpacks filled with many expensive textbooks. Other naysayers may also suggest that an e-book adoption requires students to have convenient access to technology, but I do not see this as a drawback. Almost every college student has a personal laptop, and Internet access is readily available for most students on campus, at home and in many other locations. In fact, in a recent class survey, all 69 of my students had a laptop that they carried with them regularly, most had a smartphone or tablet device and all but one desired an e-book over a traditional printed text. The time is now right for instructors to fully embrace the pedagogical, financial and physical benefits that e-book technology provides.

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