Keeping the Statistician in Statistics Education

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Abstract
The addition of statistics to the Common Core State Standards (CCSS) has brought statistics education from an exclusively university level discipline into the more broad K-12 system. Statistics is no longer isolated in the university, rather it has been catapulted to the national education spotlight. There is a growing audience for statistics and it is imperative to define "statistics education" in a way that is consistent with the goals of the field without compromising the discipline of statistics.

Key Words: Statistics education

1. Introduction

We are at an impasse in statistics education. As programs are created, courses are revised, and the field evolves we must learn from the past, our current leaders and develop a cohesive plan to move statistics education into the future. This discussion focuses on two key messages:

1. Statistics educators are and must continue to be statisticians.
2. We must leverage the interdisciplinary nature of statistics, yet retain control over the discipline.

Statistics education cannot just be thought of as how students learn in an undergraduate introduction course, service course, or high school AP course. "To successfully develop students statistical thinking, teachers must have deep knowledge and understanding of statistics and the way that students learn statistics" (ASA and National Council of Teachers of Mathematics, 2013). The following is a brief discussion of the "New Face of Statistics Education" from a perspective of a new statistician and statistics educator. This session was intended to spark discussion of the future of statistics education, not provide a guideline.

2. Math vs. Statistics Education

When thinking of the history of statistics, one cannot avoid the parallel and comparison to mathematics. Statistics as a discipline stems from mathematics education and statistics (Ben-Zvi and Garfield, 2008). In fact, most statistics faculty belong to a department of mathematics and statistics.

In contrast with our mathematics colleagues, statistics courses are taught within psychology departments, business schools, biology departments, teachers' colleges, etc... Although the course should be adapted to meet the needs of a K-12 teacher, engineer, biologist, psychometrician, etc..., the underlying theory remains the same regardless of the application. This provides a unique challenge to the statistics educator that that is not as prevalent in mathematics education. This requires a unified approach -one subject in many places- to statistics education. In order to

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accomplish this unified approach, statistics education must have a solid foundation in statistics.

It is pointed out in Ben-Zvi and Garfield (2008) that "the preparation of teachers of statistics requires different experiences than those that prepare a person to teach mathematics" and a statistics educator must:

- Analyze real, and potentially messy data,
- Understand the role of assumptions,
- Have familiarity with statistical software.

This is a major departure from our mathematics counterparts. True understanding these concepts cannot be mastered in an introductory course and arguably at the undergraduate level. Mastery of those topics takes practice as a statistician. Thus, complete understanding of the introductory concepts goes well beyond the course itself. Advanced knowledge is required to answer those "what if" questions posed by students. To keep current with the statistics used in practice, the statistics educator is ideally a practicing, actively researching statistician. Additionally, a minimum of a Master's level suggested by the Guideline for Statistics Education Graduate Programs should be strictly adhered to (Garfield et al., 2009). It should be noted that currently there is extensive work being conducted on the new guidelines for undergraduate education. Although this is an extremely important issue, the details of a curriculum are not the topic of this discussion.

3. The Next Step

The article "Statistics Education: Perusing the Past, Embracing the Present, and Charting the Future" by Richard Scheaffer Scheaffer (2001) offers a clear history of statistics and an uncannily accurate prediction of the future. Similar to current ideals, the 2001 paper suggests emphasizing understanding and communication of statistical ideas, randomization methods in introductory statistics courses, more data and active learning to name a few (Scheaffer, 2001). Clearly these ideas are a large part of current statistics research and current curricular changes (ie. Lock, Gould).

Scheaffer (2001, pg. 6) continued with a suggestion for the future in 2001: "The next step is to enhance undergraduate offerings in statistics so that more college and university students have opportunities to major in the subject or to at least strengthen their backgrounds in the subject for whatever their field of choice might be."Hence, statistics education should not be so narrowly focused on the introductory course and the introduction topics. The future of statistics education is in our future statisticians and we must focus on cultivating the next generation.

4. Concluding Thoughts

There are so many pioneers, emerging leaders in the field that embody what a statistics educator should look like. These are statisticians with a portion of their research focus on statistics education; however, they maintain other focuses in their research. Here are few examples (there are MANY others):

- Dennis Pearl is a professor in the Department of Statistics at The Ohio State University, Director of the Consortium for the Advancement of Undergraduate

Statistics Education (CAUSE) and an associate director of the Mathematical Biosciences Institute (MBI). His research interests include the statistical analysis of nucleotide sequences and phylogenetic trees, simulation-based estimation, **statistical education**, modeling biological phenomena, and problems in clinical and translational research (See `http://www.stat.osu.edu/~dkp/`).

- Anna Emilia Bargagliotti, an Assistant Professor at Loyola Marymount University, states"[t]here are two strands to my research: nonparametric statistics and mathematics/statistics education"(See http://abargagliotti.com/3.html).
- Joan Garfield, Professor of Educational Psychology at University of Minnesota, has "combined [her] teaching and research interests into one focus: exploring how to improve student learning of statistics" `http://www.cehd.umn.edu/edpsych/people/Faculty/Garfield.html`.

Note that this definition of an ideal statistics educator is not limited to pure statisticians. Simply,researchers in statistics education need to: (1) talk the language of statisticians; (2) allow the discipline to develop; (3) not overstate their findings;(4) have patience; (5) persevere in doing quality research (Hilton, 2007). Above all keep the statistician in statistics education.

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