STUDENTS' UNDERSTANDING OF RANDOMIZATION-BASED INFERENCE

Catherine Case, Melanie Battle, and Dr. Tim Jacobbe
School of Teaching and Learning
University of Florida, Gainesville, FL 32611
ccase@ufl.edu

INTRODUCTION

Before modern computing power allowed for rapid simulations, introductory statistics courses necessarily relied on methods like z tests and t tests to introduce the core logic of inference; today, a growing number of statistics educators (e.g., Cobb, 2007) are proposing that these traditional methods be replaced or supplemented with randomization-based tests. Because randomization tests more directly model the randomness inherent in the study design, some believe that these tests can help students develop a deeper conceptual understanding of statistical significance and p-values. In this study, we explored whether conceptual understanding of p-values could be improved by exposure to randomization-based inference, even in students familiar with more formal methods.

OVERVIEW OF THE STUDY

To explore students' understanding of randomization-based inference, we conducted two lessons in which students familiar with traditional inference methods used physical and computer simulations to estimate p-values. The lessons were informed in part by materials from the CATALST curriculum (Zieffler & Catalysts for Chance, 2013), and the computer simulations were carried out using Rossman/Chance applets.

To assess the impact of the lessons, we prompted students to write brief explanations of p-values without relying on statistical jargon, to apply these explanations in different contexts, and to self-evaluate their understanding before and after participation. Evaluating student responses in light of existing research (Holcomb, Chance, Rossman, & Cobb, 2010; Lane-Getaz, 2007), we investigated students' varying conceptions of p-values, with particular focus on commonly held misconceptions. We also examined the ways in which students demonstrated improvement after engaging in these simulation activities and considered modifications to address enduring misconceptions.

RESULTS

Even after more than a semester of instruction, students hold a wide range of conceptions of p-values and statistical inference. After implementing two lessons with randomization-based inference, some students demonstrated improvement in their conceptual understanding of p-values. Further, the students reacted positively to these activities with the majority reporting that their understanding had improved. We believe that incorporating randomization-based inference into traditional courses to improve conceptual understanding is a promising area for future research.

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