Leveraging simulation to address the statistical investigation process and improve the accessibility of the introductory statistics course

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Abstract:

The past two decades has seen much discussion about "Stat101," the algebra-based introductory statistics course for non-statistics majors. As a result, Stat101 has seen much change in terms of content, pedagogy, and technology use. In that sense, the present-day Stat101 is much more "modern" than it was twenty years ago. One aspect, though, that remains quite "traditional" in most Stat101 courses is the sequencing of topics which compartmentalizes concepts (data collection, descriptive statistics, sampling distributions and probability, inferential statistics), instead of integrating them into the statistical investigation process. Additionally, the traditional sequencing relegates inference to the end of the term, allowing little time for students to develop a strong understanding of this core concept.

In this talk, I will describe the implementation of our novel approach to Stat101, where we apply the entire statistical investigation process – ask a research question, collect data, analyze the data, formulate conclusions and next steps – from day one. We begin by applying the statistical investigation process to investigate questions about a single-proportion, allowing students to build on intuition about whether "the observed result is likely to have happened by random chance alone?", and then spiral back throughout the course for increasingly complex data scenarios. This holistic focus on the statistical investigation process relies on introducing the concept of statistical inference early, using a simulation-based approach that utilizes modern computing power and puts the logic of inference at the center of the curriculum (e.g., Cobb (2007)). Using simulated instead of theoretical distributions not only facilitates early exposure to inference, providing students with repeated opportunities to practice their learning, but also expands the accessibility of inferential thinking to students of varied mathematics backgrounds. I will also demonstrate our fully-integrated applets used for simulations and to develop students' multivariable thinking via data visualization, and share assessment findings.

Keywords:
Randomization and permutation tests; web applets; data visualization; education; multivariable thinking