Pedagogical considerations for simulation-based inference in a large-enrollment introductory biostatistics course.

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`https://mdbeckman.github.io/JSM2017-Baltimore/`

Outline:

- Brief Course Description
- Pedagogical opportunities
  - Simulation-based inference (SBI)
  - Large enrollment
  - Intersection of SBI & large enrollment
- Compare/contrast approaches (i.e. informal discussant)

Brief Course Description

- STAT 250: Introduction to Biostatistics
- 225 students enroll each semester
- Lecture Mon & Fri (50 min; all students)
- Lab Wed (50 min; 3 sections x 75 students)
- Design
  - Question of the day (life science; sometimes PSU rsh)
  - StatKey + Minitab
  - In-class exams
  - Group projects (using Michael Bulmer's *The Islands*)

Pedagogical opportunities: SBI

- Mathematical exposure
  - Fewer appeals to unseen mathematics (i.e. "hand waiving")
  - Natural scaffolding
    - Tangible/tactile introduction (Ernst 2004; Rossman, 2008)
    - Permutation distribution as possible segue (Ernst, 2004)
    - Transfer tedious yet simple process to computer (Cobb, 2007)
  - Intuition built on frequencies (Gigerenzer & Hoffrage, 1995)
- Flexibility of application (Efron, 2000, p. 1294)
- Facilitates some useful conversations
  - Thinking under the null (Wild et al. 2011)
  - p-values and the nature of randomness (Rossman, 2008)
  - Why OK to sample with replacement?

Pedagogical opportunities: SBI

- Introduce key concepts using SBI; revisit with non-SBI
  - Lock et al. (2013)
  - Tintle et al. (2016)
  - Zieffler et al. (2015); Garfield et al. (2012)
- SBI students seem to perform as well or better than peers in non-SBI courses
  - Maurer & Lock (2016)
  - Beckman, delMas, & Garfield (in press)
  - Tintle et al. (2012)

Pedagogical opportunities: Large enrollment

- Large sample size for student generated data (GAISE, 2016)
  - reliable demonstrations of asymptotic properties (e.g. CLT) using data generated in-class
  - unusual observations often generated in-class
    - outliers (e.g. wrong units & typos)
    - legitimate extreme obs. (the tails are real)
    - sensitivity analysis discussions
- (Anonymous) Engagement
  - Crowd-sourced Q&A
  - Live SMS inbox
  - Clickers
    - instant feedback
    - instant run-off
- Google Sheets, Forms, & other tools facilitate live capture of data for immediate use
- GAISE (2016) includes much more support for large classes

Pedagogical opportunities: Intersection of SBI & large enrollment

- Example: m&m activity in lecture
  - Live capture in Google Sheet
  - class approximates a sampling distribution
  - student builds bootstrap distribution
  - tangible comparison of sampling dist & bootstrap dist
- Example: StatKey on smart phones (during lecture)
  - accessible & scalable technology integration
  - partner work (one run the app; one take notes)

Concluding thoughts

- Pedagogical opportunities
  - Simulation-based inference (SBI)
  - Large enrollment
  - Intersection of SBI & large enrollment
- Translating small class pedagogy effectively to the large class environment is worth our effort & attention

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