Teaching Probability: From coin to classroom flipping

Lessons from Active Learning

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Active Learning

- Any instructional method that engages students in the learning process in the classroom
 - Describes in-class activities such as group problem-solving
 - Contrast with traditional lecture, where students (passively?) receive information
- Why Probability?
 - Active Learning has been applied successfully* to STEM fields
 - Long tradition in introductory Statistics courses
 - Probability offers lots of good opportunities for Active Learning
- * (Freeman et al., PNAS, 2014)

Flipping the Class

- What portion is devoted to active learning?
 - From intermittent instruction to totally flipped classroom (no lecturing)
- More "flipping" = more *preparation*, for students & instructor
 - Assigned readings/videos, pre-class quizzes
- Classroom configuration
 - TEAL* might be ideal, but auditoriums also work
- (* Technology Enhanced Active Learning)

Activities

- What do you want students to do?
 - Problem-solving, discussions, experiments
 - Should be geared towards higher-order thinking
- Collaboration
 - Great for engagement, muddles assessment
- Support & Feedback
 - More is better
- Technology
 - Response systems, chats/forums, internet, programing

My Setup

• Introductory, calculus-based probability course (STAB52)

- Large classes: 100+ students/section
- Diverse audience: Math, Stats, CS
- Broad content: from axioms to limit results

Active learning implementation

- Semi-flipped classroom: assigned readings/videos → 1hr lecture → → 1hr problem-solving, facilitated by instructor & 2/3 TA's
- Formative assessment:

Fall '16:	Fall '17:
Weekly short quizzes	Graded Worksheets
(best 9/11 worth 15%)	(best 18/24 worth 15%)
 No collaboration 	Collaboration allowed

Student Engagement

• **Drop rate** (# enrolled students, start \rightarrow end)

F '16: 31.6% (307→201) F '17: 17.3% (445→368)

• Participation (quiz/worksheet attendance)



Student Acceptance

Course Evaluations

Q: Course provided me w/ deeper understanding of the subject matter.
 [scale: 1 (not at all), to 5 (a great deal)]

	Historic	F'16	F'17
Avg:	3.34	3.12	3.80

• F'17 Online Survey

Q: Which format do you think is best for this course?



Student Learning

Course marks

	F'16	F'17
Mean	62.9	64.2
St.Dev.	16.1	15.5
Fail rate	10%	10%



- F'17 slightly better, but not significant
- Confounded by: curving, drop rates (selection bias), collaboration (mark boost)
- Need test on concept inventory

Summary

- Active Learning results
 - Engagement (
 - Student buy-in (I)
 - Learning (?)
- Other advantages: feedback, interaction
- Active Learning is worth it!
 - Matter of teaching style, takes some time to develop
 - Collaboration and incentives are important