Self-driven mastery in MOOCs

9 July 2013
Elements of mastery learning

1. Predefined standards for mastery
2. Individualized, corrective feedback
3. Repeated formative assessments
4. *Gated progression
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self-driven mastery
Goal of this talk

What can we say about **self-driven mastery** in massive open online courses (MOOCs)?
Course selection criteria

- formative assessments (e.g., quizzes and homework assignments)
- multiple allowed re-submission attempts
- summative assessment (e.g., final exam)

28 Coursera MOOCs
1 million students
3/4 STEM, 1/4 humanities
Multiple submissions encourage grade improvement

![Graph showing first and last submission scores]

- First submission scores
- Last submission scores

Normalized cumulative scores over all assessments
Grade improvement provides incentive to resubmit
In some sense, this is all obvious.

- Who wouldn't want better grades?
- The law of diminishing returns

But is real learning taking place?
Measuring self-driven mastery

**formative assessments**

summed differences between first and last submission scores

**summative assessment**

performance on final exam
Self-driven mastery

![Graph showing relationship between formative score improvement and final exam performance.](image)

Algorithms: Design and Analysis, Part I
(Tim Roughgarden, Stanford)
Self-driven mastery
Covariate adjustment

Include covariates to remove confounding by general ability

- summed initial scores for each assignment
- total number of submissions for each assignment
Stratified analysis
Stratified analysis

![Graph showing the relationship between formative score improvement and final exam performance. The x-axis represents formative score improvement, ranging from 0 to 40, and the y-axis represents final exam performance, ranging from 0 to 30. The dots are color-coded, indicating different categories or groups. A trend line is also shown, indicating a positive correlation.](image-url)
Stratified analysis
QED
QED...or not.
Why we're being too optimistic

**Correlation vs. causation**

- Students who work the hardest to improve their grades are more motivated in general.
Why we're being too optimistic

Correlation vs. causation

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Correlation vs. causation

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Why we're being too pessimistic

Ignoring cumulative effects

- By adjusting for initial score on each assignment, we won't detect cumulative benefits of self-driven mastery.
Why we're being too pessimistic

Ignoring cumulative effects

- By adjusting for initial score on each assignment, we won't detect cumulative benefits of self-driven mastery.

What if material from assignments build on each other?

- skills-based classes
- programming classes
Fundamental limitation

- students who **do** make use of self-driven mastery
- students who **don't** make use of self-driven mastery
Why not just implement mastery learning directly?

- Works in the classroom.
- Works in 1-on-1 tutoring.
- But does it work in the MOOC setting?
  - How do you know when mastery achieved?
  - How to set the threshold of mastery?
  - What if students get frustrated and quit?
  - What about students who don't want to play?
Summary

- Self-driven mastery
  - When adjusting for student ability, formative score improvements are associated with increased summative performance.
  - But beware the caveats!

- Mastery in the MOOC setting
Questions?

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