Precalculus Skills

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Overview

- Focus on pre- and post-diagnostic in a two-term differential calculus course, Math 110.
- A study on how different types of questions correlate with student performance (2010).
- Preliminary analysis on how much remedial exercises can improve students’ precalculus skills (2011).
Precalculus Diagnostic Test – Reasons and Purposes

- The reason
  - Students with weak precalculus skills tend to struggle in the first calculus course.

- For students
  - Make them aware of their weaknesses in precalculus skills
  - If necessary, remedial exercises will be provided to strengthen their skills

- For us
  - To identify what precalculus skills are the most important for success in calculus
  - The analysis of common errors give us some insight in students’ misconceptions.
16 multiple-choice questions, 50 minutes
- 8 questions on algebra
- 4 word problems
- 4 other questions related to graphs, functions and geometry

Given in September as a pre-diagnostic.
The same diagnostic was given again in March as a post-diagnostic.
Pre-/post-diagnostic results

- Pre-diagnostic: DT1; Post-diagnostic: DT2
  - Top third: N = 66, DT1 > 50%
  - Middle third: N = 90, 31.25% ≤ DT1 ≤ 50%
  - Lower third: N = 51 DT1 < 31.25%
- Those with high scores in DT1 did not improve in DT2
Pre-/post-diagnostic results

For those in the lower third in DT1, the largest improvement was on algebra questions.
Correlation with course grades

- Correlation between DT1 and course grades decreases as the course proceeds.
- DT2 written in March correlates better with the final exam in April and the final grades.
- The correlation between DT1 and DT2 is $r = 0.52$.

<table>
<thead>
<tr>
<th>$r$</th>
<th>Oct MT</th>
<th>Dec Exam</th>
<th>Feb MT</th>
<th>Apr Exam</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>DT1</td>
<td>0.52</td>
<td>0.42</td>
<td>0.32</td>
<td>0.28</td>
<td>0.35</td>
</tr>
<tr>
<td>DT2</td>
<td></td>
<td></td>
<td>0.42</td>
<td>0.50</td>
<td></td>
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For those who did not take math for a long time…

- Those who did not take math for more than 1 year before Math 110 did substantially worse than their peers in DT1.
- However, they were able to catch up in DT2.

![Bar chart showing diagnostic scores for DT1 and DT2, comparing < 1 yr gap (N=76) and > 1 yr gap (N=60).](chart.png)
Remedial exercises

- Introduced in 2011
- Consist of two parts
  - Algebra
  - Non-algebra (functions, graphs, geometry, word problems)
- Assigned online “weekly”, from Week 6 in Term 1 to Week 10 in Term 2, a total of 14 sets.
- The algebra exercises are mandatory if students fail the algebra part of DT1.
- The non-algebra exercises are mandatory if students fail the non-algebra part of DT1.
Remedial exercises

- A: remedial exercises required and completed
- B: remedial exercises required but not completed
- C: remedial exercises not required

![Bar chart showing performance in Algebra and Non-algebra with sample sizes (A N=39), B (N=30), C (N=37) for DT1 and DT2 groups, and A (N=33), B (N=21), C (N=52) for another group.](chart.png)
Summary

- Low-performing students in DT1 improved their skills through the course, but still not reaching the level of high-performing students.

- The gap in skills level between students who did not take math for more than 1 year and their peers closed after the course.

- Weekly remedial work improved algebra skills, but did not show an effect with non-algebra skills.
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