Analysis of ALEKS Placement Test

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WASHTENAW COMMUNITY COLLEGE
OVERVIEW

1. Background

2. Goals of the study

3. Data/Method

4. Results

5. Discussion
1. Background

Recent research and debates about effectiveness of Developmental
Unnecessary delay causing dropout, cost in time and money
Efficacy of placement test as sole criterion
◦ Placed students lower than their potential
◦ High school GPA improved the accuracy of placement
Initiatives to use multiple measures for placement

*Belfied, C. R., & Crosta, P. M. (2012)*
*Hughes, K. L., & Scott-Clayton, J. (2011)*
*Scott-Clayton, J. (2012)*
*Bahr, P.R., Orians, E. L., & Schanker, J.B. (2016)*
Snapshot

What happens to WCC students who are initially placed in a developmental Math level:

Fall 2010 new students (n = 1960)
Tracked over 6 years of elapsed time
WCC: Percent of students who eventually took at least college level Math course (level 3) by initial Dev. Math placement

- Level 0: 43%
- Level 1: 47%
- Level 2: 65%
WCC: Percent of Dev. Math students who graduated and/or transferred to a university by initial Math placement

Math Level at Entry
- Level 0
  - After 2 years: 12%
  - After 4 years: 34%
  - After 6 years: 54%
- Level 1
  - After 2 years: 13%
  - After 4 years: 35%
  - After 6 years: 47%
- Level 2
  - After 2 years: 16%
  - After 4 years: 42%
  - After 6 years: 53%
- College level
  - After 2 years: 30%
  - After 4 years: 59%
  - After 6 years: 68%
- Above College Level
  - After 2 years: 40%
  - After 4 years: 69%
  - After 6 years: 77%

College Level: Level 3    Above College Level: above Level 3
2. Goals of the study

- Examine the validity of ALEKS as placement test using WCC data
  - How to quantify the evidence of effectiveness of ALEKS as a placement test?
  - Use the same method as national studies

- Explore other measures w.r.t. predictive capabilities to student performance
3. Method

- Estimate strength of correlation between initial ALEKS test score and final grade points of first math courses (Correlation of Determination, or R-Square)
  How well does ALEKS score predict grade in a student’s first math course?

- Estimate Placement Accuracy rates and Error rates (Decision model) as indexes of evaluating effectiveness of current cut scores
  Three reference courses: MTH 169, MTH 176, and MTH 180

- Estimate strength of correlation between ACT math, HSGPA, SAT math, ALEKS scores and measures of first term students performance (Correlation of Determination)
4. Data

Entering students Winter, Spring/Summer, and Fall of 2017 (2017 calendar year)

Samples vary by analyses

- Valid ALEKS scores: reported within one month semester begins.
- Full ALEKS sample: 1,290 students, 610 students took math courses in the first term
- Course samples: initial ALEKS score + math grade
- Samples of all other test score than ALEKS
5. Results

Data summary: ALEKS score distribution

65% of students in placement sample placed in Developmental courses, using current cut score (ALEKS = 30)
Data summary: average ALEKS score by subgroup
Correlation between ALEKS score and course grade:
Average ALEKS score of students receiving a grade of C or higher/grade below C, by course

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade of C-or-higher</th>
<th>Grade of Below C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 067</td>
<td>8.2</td>
<td>7.1</td>
</tr>
<tr>
<td>Math 094</td>
<td>18.4</td>
<td>20.3</td>
</tr>
<tr>
<td>Math 097</td>
<td>20.8</td>
<td>19.7</td>
</tr>
<tr>
<td>Math 160</td>
<td>37.6</td>
<td>42.8</td>
</tr>
<tr>
<td>Math 169</td>
<td>34.9</td>
<td>32.1</td>
</tr>
<tr>
<td>Math 176</td>
<td>51.5</td>
<td>45.1</td>
</tr>
<tr>
<td>Math 125</td>
<td>34.1</td>
<td>31.7</td>
</tr>
<tr>
<td>Math 180</td>
<td>42.8</td>
<td>58.4</td>
</tr>
</tbody>
</table>
Correlation between ALEKS score and course grade:
Average ALEKS score of students receiving a grade of B or higher/grade below B, by course

<table>
<thead>
<tr>
<th>Course</th>
<th>Grade of B or higher</th>
<th>Grade below B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 067</td>
<td>8.5</td>
<td>7.0</td>
</tr>
<tr>
<td>Math 094</td>
<td>18.3</td>
<td>19.8</td>
</tr>
<tr>
<td>Math 097</td>
<td>21.2</td>
<td>19.4</td>
</tr>
<tr>
<td>Math 125</td>
<td>33.4</td>
<td>33.6</td>
</tr>
<tr>
<td>Math 160</td>
<td>37.8</td>
<td>40.8</td>
</tr>
<tr>
<td>Math 169</td>
<td>34.9</td>
<td>33.1</td>
</tr>
<tr>
<td>Math 176</td>
<td>51.7</td>
<td>46.0</td>
</tr>
<tr>
<td>Math 180</td>
<td>62.7</td>
<td>41.9</td>
</tr>
</tbody>
</table>
Correlation between ALEKS score and course grade:
Low strength of relationship

Percentage of variation of course grade explained by ALEKS score
Placement Accuracy Rate and Error Rate

Placement accuracy rates (College Board, ACT, CCRC)
Decision model (Sawyer, 1989, 1996)
No placement rule can avoid making some mistakes
Accuracy rate -> correct decision
Error rate -> incorrect decision
underestimate/overestimate
A decision model: 4 possible outcomes

Placement group

- Predicted successful
  - A: True positive (accurately placed in college level)
  - D: False negative (under placed)
- Predicted unsuccessful
  - B: False Positive (Over placed)
  - C: True Negative (accurately placed in lower level)

Cut score $K$

Below cutoff

Above cutoff
<table>
<thead>
<tr>
<th>Step</th>
<th>Sample</th>
<th>Variable</th>
<th>Model</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Estimation sample</td>
<td>ALEKS scores</td>
<td>Logistic Regression</td>
<td>Prediction equation (intercepts ( \alpha ) and regression coefficients ( \beta ))</td>
</tr>
<tr>
<td></td>
<td>ALEKS students enrolled in a reference math course in first semester: MATH 169: Inter. Alg. (n = 75) MATH 176: College. Alg. (n = 52) MATH 180: Pre-Calculus (n = 33)</td>
<td>Final grades: (Earn B or higher Earn C or higher)</td>
<td>[ P(x) = P(Y=1 \mid X=x) = \left(1 + e^{-\alpha - \beta x}\right)^{-1} ] Where ( Y = 1 ) if student is successful, 0 if a student is unsuccessful ( X ) is the student’s Alek test score</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Placement sample: Entire ALEKS group: n = 1290</td>
<td>Only ALEKS scores</td>
<td>Extrapolation to score below cut score to get pred. probability of success for each of test score value.</td>
<td>Est. Proportions of 4 placement outcomes (Accuracy rate, Error rate)</td>
</tr>
</tbody>
</table>
MATH 169: Predicted proportion of students associated with 4 possible outcomes, using current WCC cut score

<table>
<thead>
<tr>
<th>Grade of B or higher</th>
<th>Grade of C or higher</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>D</strong> (underplaced)</td>
<td><strong>D</strong> (underplaced)</td>
</tr>
<tr>
<td>(0.43)</td>
<td>(0.48)</td>
</tr>
<tr>
<td>(0.33) Correctly placed</td>
<td>(0.28) Correctly placed</td>
</tr>
<tr>
<td><strong>A</strong></td>
<td><strong>A</strong></td>
</tr>
<tr>
<td>(0.18) Correctly placed</td>
<td>(0.20) Correctly placed</td>
</tr>
<tr>
<td><strong>B</strong> (overplaced)</td>
<td><strong>B</strong> (overplaced)</td>
</tr>
<tr>
<td>(0.065)</td>
<td>(0.043)</td>
</tr>
</tbody>
</table>

Accuracy rate = \(0.18 + 0.33 = 0.51\)
Accuracy rate = \(0.20 + 0.28 = 0.48\)

Error rate = \(0.065 + 0.43 = 0.49\)
Error rate = \(0.043 + 0.48 = 0.52\)
### Summary of Predicted proportion of students associated with 4 possible placement outcomes using current cut score, by course

<table>
<thead>
<tr>
<th>Criteria of Success</th>
<th>Correlation (r)</th>
<th>A</th>
<th>B Overplaced</th>
<th>C</th>
<th>D Underplaced</th>
<th>Correct classification</th>
<th>Incorrect classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 169</td>
<td>0.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B or higher</td>
<td>0.18</td>
<td>0.065</td>
<td>0.33</td>
<td>0.43</td>
<td>0.51</td>
<td>0.495</td>
<td></td>
</tr>
<tr>
<td>C or higher</td>
<td>0.2</td>
<td>0.043</td>
<td>0.28</td>
<td>0.48</td>
<td>0.48</td>
<td>0.523</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 176</td>
<td>0.29</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B or higher</td>
<td>0.022</td>
<td>0.053</td>
<td>0.6</td>
<td>0.37</td>
<td>0.622</td>
<td>0.423</td>
<td></td>
</tr>
<tr>
<td>C or higher</td>
<td>0.023</td>
<td>0.0038</td>
<td>0.56</td>
<td>0.41</td>
<td>0.583</td>
<td>0.4138</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MATH 180</td>
<td>0.58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B or higher</td>
<td>0.007</td>
<td>0</td>
<td>0.939</td>
<td>0.0528</td>
<td>0.946</td>
<td>0.0528</td>
<td></td>
</tr>
<tr>
<td>C or higher</td>
<td>0.0073</td>
<td>0</td>
<td>0.569</td>
<td>0.423</td>
<td>0.57625</td>
<td>0.423</td>
<td></td>
</tr>
</tbody>
</table>
Accuracy rate curves for MATH 169, MATH 176, MATH 180
Relationship to placement outcomes

• Accuracy rate positively associated with bivariate correlation coefficient between test score and course grade.

• Low proportion of students below cut score increases TRUE POSITIVE RATE (students who score above cut off and are predicted to be successful in the course)
Relationship to placement outcomes

- Success
- Not success

Placement
Cut score

Points:
- A
- B
- C
- D
Explore the association of other test scores with math/college performance

- Matched ACT math, SAT math, or HSGPA score with first semester outcome data (3 semesters)
- Bivariate linear regression models
- Estimated Coefficients of determination (Percent of variability of outcome variable explained by a test score)
- Limitation: Not have enough students with multiple test scores

First semester Outcomes:
- Level math grade
- Semester credits earned
- Semester GPA

HGPA n=215
ACT n=273
SAT n = 1074
ALEKS n = 1290
Percent of variance of math grades explained by each of test scores

<table>
<thead>
<tr>
<th>Predicted Success</th>
<th>Math Level 1</th>
<th>Math Level 2</th>
<th>Math Level 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aleks</td>
<td>4.4%</td>
<td>0.0%</td>
<td>5.8%</td>
</tr>
<tr>
<td>ACT math</td>
<td>9.0%</td>
<td>1.0%</td>
<td>0.2%</td>
</tr>
<tr>
<td>New SAT math</td>
<td>4.4%</td>
<td>6.8%</td>
<td>10.9%</td>
</tr>
<tr>
<td>HS GPA</td>
<td>36.0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Percent of variance of college performance (Semester Credits earned, GPA) explained by each of test scores

<table>
<thead>
<tr>
<th></th>
<th>SemCrEarn</th>
<th>SemGPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.7%</td>
<td>18.5%</td>
<td>18.5%</td>
</tr>
<tr>
<td>0.3%</td>
<td>4.4%</td>
<td>5.3%</td>
</tr>
<tr>
<td>0.0%</td>
<td>13.0%</td>
<td></td>
</tr>
<tr>
<td>ALS</td>
<td>ACT math</td>
<td>New SAT math</td>
</tr>
</tbody>
</table>

Aleks | ACT math | New SAT math | HS GPA
6. Conclusions

Results consistent with national studies
- Low predictive capability for math grade in developmental courses
- Accuracy rates for course placement are not high (except MTH180 w.r.t. B criteria)
- Accuracy rate for B criterion is better than C criterion
- Many students placed below their capabilities

High school GPA potentially a better predictor for math and college performance (need more data to confirm)

Results of analysis of COMPASS is similar to those of ALEKS
6. Discussion

Approaches to improve the accuracy for course placement
- Consider multiple measures (MM) for placement
- More information ---> better prediction
- Comm. Colleges have been using MM:
  - California
  - North Carolina
  - Virginia
  - Michigan: Mid Michigan Comm. College

Approaches to improve the effectiveness of developmental education
Discussion