Predicting College Success
The Relative Value of Test Scores

Serge Herzog, PhD
Director, Institutional Analysis
Consultant, CRDA StatLab
University of Nevada, Reno
Reno, NV 89557, serge@unr.edu

Purpose of Study

• Follow-on analysis to previous study on predictive validity of ACT to gauge freshmen academic success, retention

• Measure contribution of ACT Composite score to predict freshmen success and retention, controlling for
  – Student socio-demographic background
  – Financial aid profile (aid type, unmet need)
  – Academic motivation (college choice/goal)
  – Academic preparation (HS rank/grades)
  – First-year campus experience (housing, LLC, acad/social support, math/English coursework, undeclared)
  – Employment/job plans while in college

http://www.unr.edu/ia/research

ACT State Conference
Reno, NV, February 6, 2015
Source and Data

• New full-time freshmen at the U. of Nevada, Reno

• Data elements:
  – Student demographics (age, gender, ethnicity/race, father/mother education, residency)
  – Academic preparation (HS GPA core-weighted, ACT scores/test date, HS rank, advanced standing/AP)
  – Motivation (delayed entry, test date, degree goal, college choice)
  – First-year acad experience (English/math, earned credits, GPA, online course, LLC member, tutoring support, undeclared)
  – First-year non-acad experiences (financial aid, housing, on-campus work, employment plans, diversity center)

• Predicted Outcomes:
  – Academic momentum (100pt-scale GPA x credits), spring/fall retention

Data Sample and Statistics

• Fall semester 2011 and 2012 cohorts

• Excluding:
  – Students with no ACT (SAT) record on file
  – Students with less than 12 attempted credits (PT)
  – Students with no fall semester credits completed
  – Students who did not complete entry survey
  – Statistical outliers (Cook’s, std residual +/- 3)

• Effective sample: ~ 4,600 students (83%)

• Analysis:
  – Multiple/logistic regression
  – Low-income, first-generation, minority subsets
Predicting College Success

- Prior to start of first semester at admission:
  - Student demographics, high school preparation
- At start/middle of first semester:
  - Major declared, financial aid profile, registered courses, degree goal, LLC member
- At end of first semester:
  - Credits earned, GPA
- What is the predictive value of the ACT test score at each stage compared to other student attributes

Predicting First-Semester College GPA/Credits Earned
At Time of Admission
Available Predictors

Ranked by Beta weight (standardized coefficient)

\(^\text{Alpha} <= 0.01; \text{Negative; Adj R-square=}.26; \text{VIF} < 1.8\)
Predicting First-Semester College GPA/Credits Earned At Time of Admission
Available Predictors

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.27; VIF < 2.1

Predicting First-Semester College GPA/Credits Earned At Time of Admission
Available Predictors

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.21; VIF < 1.3
Predicting First-Semester College GPA/Credits Earned
At Mid-Semester

Significant Predictors^$

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.32; VIF < 2.3
Predicting First-Semester College GPA/Credits Earned At Mid-Semester

Significant Predictors

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square = .22; VIF < 2.1; excl HS rank

Predicting First-Semester College GPA/Credits Earned At Mid-Semester

Non-Significant Predictors (with HSGPA/test Index)

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square = .32; VIF < 2.3
Predicting First-Semester College GPA/Credits Earned At Mid-Semester, First-Generation Students

Significant Predictors^*

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.30; VIF < 2.3; N=2,078

Predicting First-Semester College GPA/Credits Earned At Mid-Semester, First-Generation Students

Significant Predictors^*

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.26; VIF < 2.1; N=2,081
Predicting First-Semester College GPA/Credits Earned
At Mid-Semester, First-Generation Students

Significant Predictors

Ranked by Beta weight (standardized coefficient)

\[ \text{Adj R-square} = 0.30; \text{VIF} < 2.1; N = 2,081 \]

Predicting First-Semester College GPA/Credits Earned
At Mid-Semester, Low-Income (Pell) Students

Significant Predictors

Ranked by Beta weight (standardized coefficient)

\[ \text{Adj R-square} = 0.30; \text{VIF} < 2.2; N = 1,278 \]
Predicting First-Semester College GPA/Credits Earned At Mid-Semester, Low-Income (Pell) Students

Significant Predictors

- HS GPA
- Undeclared
- Merit aid
- Lives on campus
- Ethnic/racial/min*
- Test date
- No English course*
- Loan aid*
- Math-based major*

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.30; VIF < 2.3; N=1,278
Predicting First-Semester College GPA/Credits Earned
At Mid-Semester, Minority** Students

Significant Predictors^\

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.21; VIF < 2.5; N=998; **excl. Asians
Predicting First-Semester College GPA/Credits Earned
At Mid-Semester, Minority** Students

Significant Predictors^:

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01, ~= 0.02; *Negative; Adj R-square=.25; VIF < 2.5; N=998; **excl. Asians

Predicting First-Semester College GPA/Credits Earned
At Mid-Semester; Students from 'High SES' HS

Significant Predictors^ with ACT

Ranked by Beta weight (standardized coefficient)

^Alpha <= 0.01; *Negative; Adj R-square=.34; VIF < 2.5; N=535
Predicting First-Semester College GPA/Credits Earned At Mid-Semester; Students from 'High SES' HS

Significant Predictors\(^\wedge\) with HS GPA

Predicting First-Semester College GPA/Credits Earned At Mid-Semester; Students from 'High SES' HS

Significant Predictors\(^\wedge\) with HS Prep Index

\(^\wedge\)Alpha <= 0.01 ~ 0.03; *Negative; Adj R-square=.36; VIF < 1.8; N=535; excl. HS Rank

\(^\wedge\)Alpha <= 0.01 ~ 0.03; *Negative; Adj R-square=.32; VIF < 1.9; N=535; excl. HS Rank
Predicting First-Semester College GPA/Credits Earned
At Mid-Semester; Students from ‘Low SES’ HS

Significant Predictors\(^\dagger\) with HS Prep Index

\[\text{HS Prep Index, Undeclared}^*, \text{Merit aid, No English course}^*, \text{Tutoring support}^*, \text{Delayed college}^*\]

Ranked by Beta weight (standardized coefficient)

\(^\dagger\)Alpha <= 0.01 \(\approx 0.05\); *Negative; Adj R-square=.29; VIF < 1.6; N=369; excl. HS Rank

Predicting First-Semester College GPA/Credits Earned
At Mid-Semester; Students from ‘Low SES’ HS

Significant Predictors\(^\dagger\) with HS GPA

\[\text{HS GPA, Merit aid, HS Rank, Undeclared}^*, \text{Advanced standing}^*\]

Ranked by Beta weight (standardized coefficient)

\(^\dagger\)Alpha <= 0.01 \(\approx 0.03\); *Negative; Adj R-square=.30; VIF < 2.4; N=369
Predicting First-Semester College GPA/Credits Earned At Mid-Semester; Students from ‘Low SES’ HS

Significant Predictors\(^\wedge\) with ACT

Ranked by Beta weight (standardized coefficient)

\(^\wedge\)Alpha <= 0.01 ~= 0.03; *Negative; Adj R-square=.28; VIF < 2.3; N=369

Predicting College GPA Earned Credits

- \textit{Significant} at time of admission: HS GPA, test score, HS rank, WUE, gender/race
- \textit{Significant} at start/mid semester: HS GPA, test score, tutoring support, math rigor of major, LLC, undeclared, work/employment
- \textit{Non-significant}: parent education, Pell, college choice, age, test date, education goal, working on campus, financial need
- Combination of HSGPA and test score is more predictive for low-income students than first-generation students
- HSGPA most predictive, test score sig by itself without GPA, for all groups of students
- Test score is predictive for students from low-SES schools, but not for those from high-SES schools
Effect Size Formulas

- Academic momentum on persistence (Peterson)
  \[ \Delta p = p_1 - p_0 \]
  where
  \[ p_i = \frac{\exp(L_i)}{1 + \exp(L_i)} \]
  \[ L_i = L_0 + B_i X (1 - x) \]

- All other covariates (Cruce)
  \[ \Delta p = p_1 - p_0 \]
  where
  \[ p_i = \frac{\exp(L_i)}{1 + \exp(L_i)} \]
  \[ L_0 = \ln\left(\frac{p_0}{1 - p_0}\right) \]
  \[ L_1 = \ln\left(\frac{y}{1 - y}\right) \]

Predicting Second-Semester Persistence
At End of First Semester

Significant Predictors\(^\wedge\) with HS GPA/ACT Index (VIF<2.5)

<table>
<thead>
<tr>
<th>%pt Δ</th>
<th>2.4**</th>
<th>4.8</th>
<th>-9.1</th>
<th>4.6</th>
<th>-5.8</th>
<th>4.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall GPA/credits</td>
<td>Educational goal</td>
<td>Out of state*</td>
<td>Ethnic/ racial minor*</td>
<td>Clark CI/EL res*</td>
<td>UNR first choice*</td>
<td></td>
</tr>
</tbody>
</table>

\(^\wedge\)Alpha <= 0.01 ~ < 0.03; *Negative; **1 std dev; NK R-square=.17; HL =0.88; N=4,575
Predicting Fall-to-Fall Persistence
At Start of Second Semester

Significant Predictors\(^{a}\) with HS GPA/ACT Index (VIF<2.5)

\[\chi^2\]

\[\%pt \Delta: 5.6^{**} - 4.8 \quad 3.5 \quad 3.4 \quad -3.1 \quad -2.8 \quad 2.5\]

Ranked by Wald

\[^{a}\text{Alpha} \leq 0.01 \sim < 0.03; \text{Negative}; **1 \text{ std. dev.; NK} R\text{-square}=.14; HL =0.11; N=4,358\]

Predicting Fall-to-Fall Persistence
At End of Second Semester

Significant Predictors\(^{a}\) with HS GPA/ACT Index (VIF<2.5)

\[\chi^2\]

\[\%pt \Delta: 6.3^{**} - 6.2 \quad -5.5 \quad 3.6 \quad 3.5 \quad 3.0 \quad 2.6\]

Ranked by Wald

\[^{a}\text{Alpha} \leq 0.01 \sim < 0.03; \text{Negative}; **1 \text{ std. dev.; NK} R\text{-square}=.21; HL =0.87; N=4,332\]
Predicting Student Persistence

- Effect of HS GPA and test scores is largely mediated through college academic momentum (grades, earned credits)
- Academic momentum is far more predictive than other student attributes, and its significance magnifies with each semester during the freshman year
- Negative effects of residency (non-local) are outweighed by the combined effect of academic momentum and focus (tutoring support, education goal)
- Non-significant factors at end of first year: gender, age, Pell aid (first year), unmet financial need, working on campus, undeclared major, father's education

Fall-to-Spring Persistence

<table>
<thead>
<tr>
<th>Decile</th>
<th>GPA</th>
<th>CRS</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>0.5</td>
<td>3.6</td>
</tr>
<tr>
<td>10%</td>
<td>0.9</td>
<td>6.0</td>
</tr>
<tr>
<td>20%</td>
<td>1.3</td>
<td>8.1</td>
</tr>
<tr>
<td>30%</td>
<td>1.7</td>
<td>10.2</td>
</tr>
<tr>
<td>40%</td>
<td>2.2</td>
<td>11.8</td>
</tr>
<tr>
<td>50%</td>
<td>2.7</td>
<td>13.2</td>
</tr>
<tr>
<td>60%</td>
<td>3.2</td>
<td>14.4</td>
</tr>
<tr>
<td>70%</td>
<td>3.6</td>
<td>15.8</td>
</tr>
<tr>
<td>80%</td>
<td>3.9</td>
<td>18.0</td>
</tr>
<tr>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

First-Semester GPA/Credits Index Range Deciles
Spring-to-Fall Persistence

Second-Semester GPA/Credits Index Range Deciles

GPA:  0.7  1.1  1.4  1.7  2.0  2.4  3.0  3.4  3.7  3.8
CRS:  0.1  1.9  4.7  7.3  9.9 12.2 13.8 15.4 17.7 21.4
N:   7   15  72  116  216 350 922 1612 1154 111

Relative First-Semester Success by High School Origin

Note: Excluding schools with < 100 students enrolled.
Relative First-Semester Success by High School Origin

Note: Excluding schools with < 100 students enrolled.
### Predicting College GPA and Credits Completed

<table>
<thead>
<tr>
<th>White (N=7388)</th>
<th>Beta Coefficient</th>
<th>Adj R Square</th>
<th>Difference^</th>
<th>Predicted GPA</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HSGPA</td>
<td>ACTC</td>
<td>Total Change</td>
<td>Pred - Actual GPA</td>
<td></td>
</tr>
<tr>
<td>Fall GPA</td>
<td>0.46</td>
<td>0.15</td>
<td>0.28</td>
<td>0.02</td>
<td>0.0065</td>
</tr>
<tr>
<td>Fall Momentum</td>
<td>0.45</td>
<td>0.14</td>
<td>0.27</td>
<td>0.02</td>
<td>0.0096</td>
</tr>
</tbody>
</table>

**Asian (N=914)**

| Fall GPA       | 0.54              | 0.06         | 0.33         | 0.00          | -0.0468   | Under     |
| Fall Momentum  | 0.53              | 0.10         | 0.24         | 0.01          | -0.0562   | Under     |

**Hispanic (N=1079)**

| Fall GPA       | 0.40              | 0.18         | 0.24         | 0.03          | 0.0241    | Over      |
| Fall Momentum  | 0.40              | 0.16         | 0.22         | 0.03          | 0.0357    | Over      |

**Black (N=413)**

| Fall GPA       | 0.36              | 0.23         | 0.23         | 0.05          | 0.0249    | Over      |
| Fall Momentum  | 0.38              | 0.22         | 0.24         | 0.05          | 0.0081    | ~         |

Coefficients are all significant at the 0.01 level (1-tailed).
^ Balanced model (N=1000 random whites); Momentum diff in SE

*AP credits added no improvement in prediction for Asian and Blacks*

### Validity and Fairness

“Anything less than a strong correlation between test results and grades is usually taken to be evidence of invalidity and unfairness (in test scores, seldom in grades). That interpretation is inconsistent with the results reported here. Taking into account reasonable sources of difference, we found grades and test scores to be strongly related—for individuals as well as groups. [D]iscrepancies between the two have less to do with sources of invalidity or defects in tests than with errors in grades and incomplete information about students and their behavior in school.” (p. 27)


http://www.unr.edu/ia/research