Academic Success Factors in K-12 Education (A Quantitative Analysis)

Brianna Chew, UC Riverside
Prior Research

- As the gap between rich and poor grows, so does the gap between high and low performing students
- Family structures, such as single parent households, influence how students perform
- Encouraging students to read outside of school and participate in the arts effect reading and math test scores

Problem

- The academic achievement gap continues to grow each year
- Lower performing students are less likely to attend college
- Adults with no college degree tend to not make as much income to support their family

What demographic and socioeconomic factors affect student success?
Measuring Academic Success

Literature Review

• Students’ academic success can be measured by SAT results

• 3-hour long, standardized exam is divided into three subjects - math, reading, and writing.

• SAT predicts college readiness and academic achievement equally amongst all ethnicities
Hypothesis

- Demographic factors may be correlated to SAT scores

Sample & Methods

- Sample size, $n=1,070$
- Hotspot Analysis
- Logistic Regression
- Data Visualization
Tapestry Segmentation
Top 3 Schools

Monta Vista High School
Santa Clara County
Average SAT Score: 2043
Percent of Students Scored Above 1500: 75.1%

Mission San Jose High School
Alameda County
Average SAT Score: 2039
Percent of Students Scored Above 1500: 79.8%

Saratoga High School
Santa Clara County
Average SAT Score: 2009
Percent of Students Scored Above 1500: 76.8%
Centennial High School
Los Angeles County
Average SAT Score: 1079
Percent of Students Scored Above 1500: 1.9%

Fremont High School
Alameda County
Average SAT Score 1080
Percent of Students Scored Above 1500: 0.75%

Roosevelt High School
Fresno County
Average SAT Score: 1115
Percent of Students Scored Above 1500: 2.7%
Logistic Regression
Sample Division

n = 1,070

<table>
<thead>
<tr>
<th>Training Set</th>
<th>Validation Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>749 Schools</td>
<td>321 Schools</td>
</tr>
</tbody>
</table>
Demographic and Socioeconomic Variables

Household Spending Potential Indexes
- Education Annually
- Test Prep & Tutoring Services
- Health Insurance
- Alcoholic Beverages
- Online Entertainment/Games
- Books
- Cable and Satellite TV Services
- Pets
- Musical Instruments & Accessories
- Elementary/HS School Books/Supplies
- School Meals
- Social/Recreation/Civic Clubs Member Fee

Demographic Variables
- Household Size
- Husband-wife Families
- Multigenerational Households
- Population aged 5-17 who speak Spanish/No English
- Diversity Index
- Single Father Households with Kids
- Single Mother Household with Kids

Socioeconomic Variables
- Household Income
- Households with Income Below Poverty Level
- Education Attainment: Bachelor’s Degree

Businesses
- Number of Educational Services (NAICS)
- Number of Occupations: Education/Library
Classification Model

\[ y = 4.49 - 0.82x_1 + 0.05x_2 - 0.06x_3 - 0.003x_4 - 0.0005x_5 + 0.05x_6 + 0.002x_7 + 0.03x_8 - 0.02x_9 - 0.08x_{10} \]

<table>
<thead>
<tr>
<th>Term</th>
<th>Estimate</th>
<th>Std Error</th>
<th>ChiSquare</th>
<th>Prob&gt;ChiSq</th>
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<td>Intercept</td>
<td>4.48566838</td>
<td>0.9880703</td>
<td>20.61</td>
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<td>(x_1) 2017 Average Household Size</td>
<td>-0.8208772</td>
<td>0.3628465</td>
<td>5.12</td>
<td>0.0237*</td>
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<td>(x_2) Online Entertainment/Games:Ind</td>
<td>0.04542688</td>
<td>0.0202414</td>
<td>5.04</td>
<td>0.0248*</td>
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<td>(x_3) Musical Instruments &amp; Acc:Ind</td>
<td>-0.0645742</td>
<td>0.032116</td>
<td>4.04</td>
<td>0.0444*</td>
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<td>(x_4) 2010 Multigenerational HHs</td>
<td>-0.0026234</td>
<td>0.0008054</td>
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<td>(x_5) 2017 Education: Bachelor's Degree</td>
<td>-0.0005044</td>
<td>7.8779e-5</td>
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<td>(x_6) Social/Recreation/Civic Clubs Member Fee:Ind</td>
<td>0.04725331</td>
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<td>(x_7) 2010 Husband-wife Fam: Own Kids &lt;18</td>
<td>0.00177097</td>
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<td>(x_8) Educational Services - Businesses (NAICS)</td>
<td>0.03179732</td>
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<td>(x_9) ACS Pop 5-17 speak Span/No English</td>
<td>-0.0178355</td>
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<td>(x_{10}) 2017 Diversity Index</td>
<td>-0.0817789</td>
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<td>46.56</td>
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Confusion Matrix

**Training Data**
\( n = 749 \)

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<tr>
<th>Actual</th>
<th>Predicted Count</th>
<th>BINARY RESULT</th>
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<tbody>
<tr>
<td>1</td>
<td>237/286 = 0.83</td>
<td>70/463 = 0.15</td>
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<tr>
<td>0</td>
<td>49/286 = 0.17</td>
<td>393/463 = 0.85</td>
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Accuracy Rate: 84%
Misclassification Rate: 16%

**Validation Data**
\( n = 321 \)

<table>
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<tr>
<th>Actual</th>
<th>Predicted Count</th>
<th>BINARY RESULT</th>
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<tr>
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<td>31/190 = 0.16</td>
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<td>0</td>
<td>34/131 = 0.26</td>
<td>159/190 = 0.84</td>
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ROC Curve

Receiver Operating Characteristics
Training Set

Receiver Operating Characteristics
Validation Set

<table>
<thead>
<tr>
<th>BINARY RESULT</th>
<th>Area</th>
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<tr>
<td>1</td>
<td>0.9129</td>
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<tr>
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</table>

<table>
<thead>
<tr>
<th>BINARY RESULT</th>
<th>Area</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>0.8907</td>
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<tr>
<td>0</td>
<td>0.8907</td>
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</table>
SAT Scores vs. Income
SAT Scores vs. Bachelor’s Degrees
SAT Scores vs. Educational Businesses
SAT Scores vs. Multigenerational Households
Conclusion

Variables that affect SAT scores are:

- Multigenerational Households
- Husband-Wife Households
- Parental Education
- Diversity Index
- Language Barriers
- Income
- Online Entertainment Games
- Social/Rec./Club Membership Fees
- Educational Businesses and Services
- Musical Instruments
My Interpretation

What can we do now?

• Be more proactive about helping students earlier in their academic careers

• Create and fund programs to help students perform better on exams and academics in general, specifically in the lower socioeconomic areas

• Build a stronger connection between college campuses and high schools
Acknowledgements

Thank you to both my faculty mentors,  
*Professor Asish Satpathy*  
and  
*Associate Dean Elaine Wong*,  
from the UCR School of Business for advising me throughout this project.
To access the maps, please refer to this Story Map

https://arcg.is/0rirC0


