

AD VALOREM REVENUE AND SCHOOL QUALITY:

PREDICTING SCHOOL PERFORMANCE IN OKLAHOMA PUBLIC
SCHOOLS USING NEURAL NETWORKS, PCA AND REGRESSION

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MACSS Project Proposal

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RESEARCH QUESTION:

- Is a school district's ad valorem revenue the primary driver of school quality in Oklahoma?
- Oklahoma school quality is measured in through a statewide evaluation tool called the A – F Report card
- Schools are issued a letter grade at the end of each academic year to judge their academic performance on end of year state subject tests
- A-F Letter grade is based entirely on test performance and does not account for socio-economic factors

A-F Report Card

2015 - 2016

Grades 07 - 08

District: OKLAHOMA CITY

55 1089 523

School: ROOSEVELT MS

2016 Student Achievement (50%)¹

Subject	# of Students	Performance Index	Letter Grade
Reading	653	42	F
Mathematics/Algebra I	660	42	F
Science	313	23	F
Social Studies/Geography/US History	655	30	F
Writing	***	***	***
	2281	36	F

Overall Student Growth (Progress Towards Proficiency) (25%)²

Subject	# of Students	Performance Index	Letter Grade
Reading	627	57	F
Mathematics/Algebra I	636	60	D
	1263	58	F

Bottom Quartile Student Growth (Progress Toward Proficiency)(25%)³

Subject	# of Students	Performance Index	Letter Grade
Reading	156	46	F
Mathematics/Algebra I	158	44	F
Overall Bottom Quartile Growth Grade	314	45	F

Bonus Points (Maximum 10 Points)⁴

Category	Points Earned
Attendance Rate	0 (91%)
Dropout Rate	2 (<5%)
Advanced Coursework	2 (Participation 55%)
Total	4

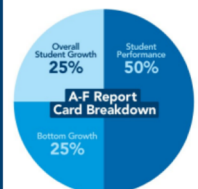
FINAL GRADE

48 F

F
48

School Performance Grading Scale

Grade Range	Letter Grade
90-100	A
80-89	B
70-79	C
60-69	D
Below 60	F



RESEARCH SUPPORTS CONVENTIONAL WISDOM

- **More money means more and better teachers:**
 - “Students of less effective teachers experienced reading achievement gains of one third of a standard deviation less than that of students with effective teachers. In mathematics the differences was slightly less than one half a standard deviation.” (Stronge et al 2008)
- **More money means smaller class sizes, even when quality teachers are not available**
 - *Class Size Reduction and Student Achievement: The Potential Tradeoff between Teacher Quality and Class Size* (Jepsen et al 2007)

RESEARCH ALSO DISPROVES CONVENTIONAL WISDOM:

- **School quality and outcomes of students is not related to student teacher ratio or spending:**
 - “...studies find that, on balance, improving school resources such as the pupil-teacher ratio or per pupil spending do not improve students performance on standardized achievement tests” (Eide et al 1997)
 - *The Effects of Class Size on Student Achievement: New Evidence from Population Variation* (Hoxby 2008)
- **A students performance is not related to school quality but more reliant on parents and family:**
 - “Most previous research on effects of school has concluded that the effect of school or teacher quality on academic achievement is less than that of family background or other characteristics” (Heyneman et al 1983)
- **School quality doesn't matter at all:**
 - *Does School Quality Matter? Evidence From The National Longitudinal Survey of Youth* ([Betts 1995](#))

GOALS & CONTRIBUTION OF RESEARCH:

- **Goals:**

- Understand how different economic and sociological factors interact with each other to influence school quality
- Create predictive model for school quality using Oklahoma's existing A-F Framework
- Employ model to create and enhance existing policy levers

- **Research Contribution:**

- Very little school quality program evaluation literature employs neural networks
- Using neural networks and other theoretical approaches means model is not constrained to a subject domain
- Captures the complex interactions of variables that eludes other predictive or explanatory models
- Brings together diverse but related data sets to develop a more robust models

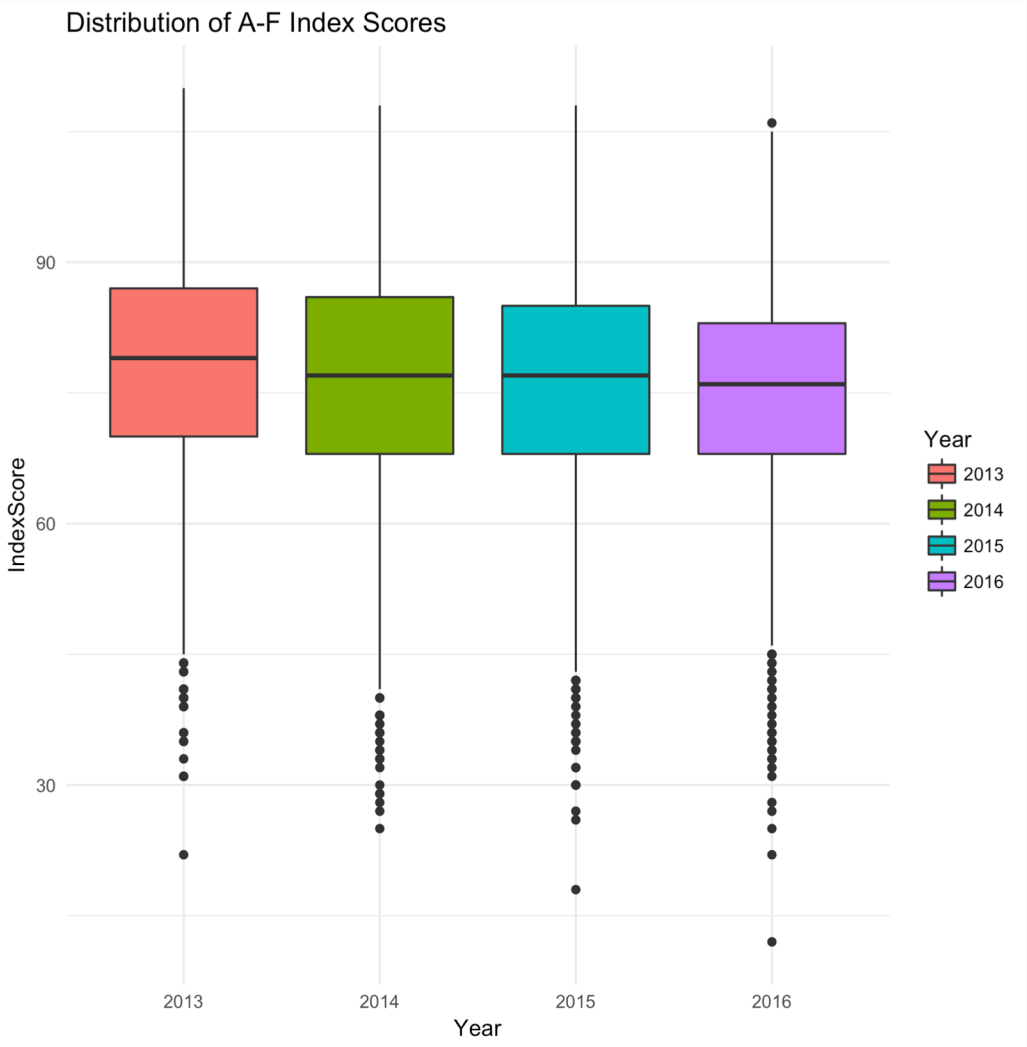
WHY THIS PROJECT IS INTERESTING

- Oklahoma is ranked [#39](#) in education
- [What's the Matter with Oklahoma](#) – Economist Article from January 30th 2018
- [Budget Crisis forces 4 day school week](#)
- As of April 2, 2018 Teachers in Oklahoma are on strike – similar to West Virginia
- Ad Valorem Taxes make up a large percentage of school district's revenue
- Lots of economic activity in Oklahoma
 - Scott Pruitt, former AG of Oklahoma, opened Oklahoma to fracking for oil and gas causing a surge in revenues for Oklahoma counties and added land valuation
 - Google building server farms in Oklahoma (Minco County)

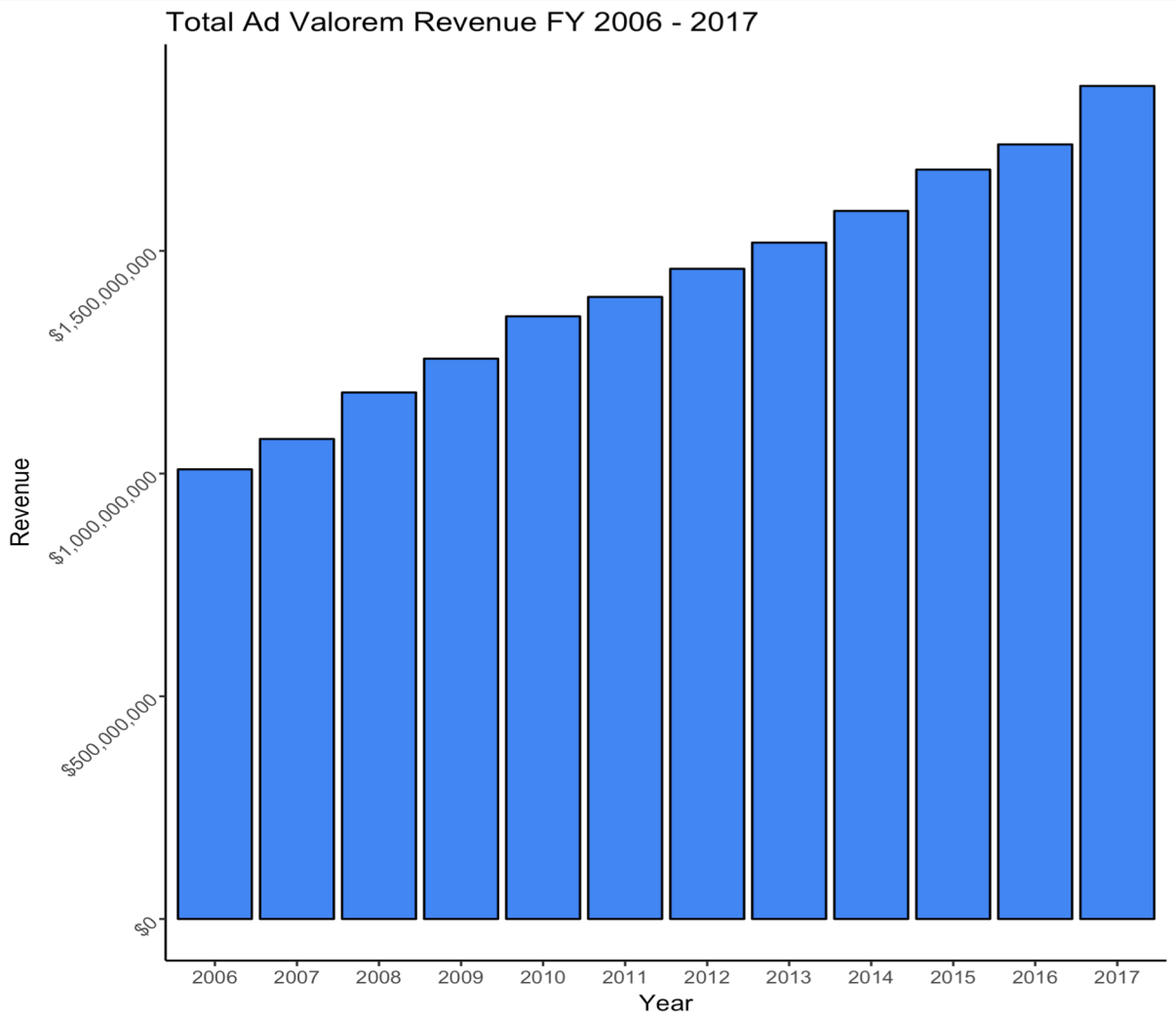
DATA AND SOURCES

- Oklahoma has a robust reporting index that offers rich variety of data source:
 - **Office of Educational Quality and Accountability District and School Profile Reports**
 - Reports will provide basis for non financial dimensions to analysis
 - Included Data:
 - ADM, ADA, % Attending College, Average ACT Score, Suspension Rates, Average Income, Average Property Value, % of parents attending Parent Teacher Conference, juvenile arrests, Free and Reduced Lunch
 - **Oklahoma Cost Accounting System District Revenue Summary Reports:**
 - Detailed break down of state and federal incomes for school budgets
 - Will act as the main source of calculating ad valorem revenue as well as any other revenue source
 - Data available from 2006 to 2017
 - **Oklahoma A-F Reporting Index:**
 - Contains A-F Index Scores and inputs into A-F Score for 2013 - 2016

SOURCE: OKSDE A-F REPORT INDEX



SOURCE: OCAS DISTRICT REVENUE SUMMARY REPORT



THEORY & METHODS:

- Use three different methods to test model:
 - **Linear Regression**
 - Predict A-F Index Score using linear model
 - **Principal Component Analysis (PCA)**
 - Dimensionality Reduction combined with Regression methods
 - **Artificial Neural Network**
 - Capture hidden layers, non-linear relationships and interaction effects that illustrates the complexity that goes into measuring school quality.
- Using these theories and methods I will evaluate the performance to see which one provides the most accurate prediction of school quality

COMPUTATIONAL TOOLS:

- **MySQL**
 - Use database hosted by the Oklahoma Public School Resource Center to aggregate and manage necessary data
- **Python**
 - Data Cleaning and Management – SQLAlchemy, Pandas, Numpy
 - Multinomial Logistic Regression – Scikit learn LogisticRegression()
 - Principal Component Analysis – Scikit Learn Decomposition()
 - Artificial Neural Network – Tensor Flow, PyTorch