Road Map

01 The Data + Research

02 Exploratory Data Analysis

03 Numerical Analysis

04 Conclusion

THE DATA: Measles Vaccination Rates

- US Only
- Data collected in 2018-19 School Year
- Variables:
  - Type of school (public v private)
  - State, City, County, Year
  - Vaccination Rates
  - Enrollment numbers

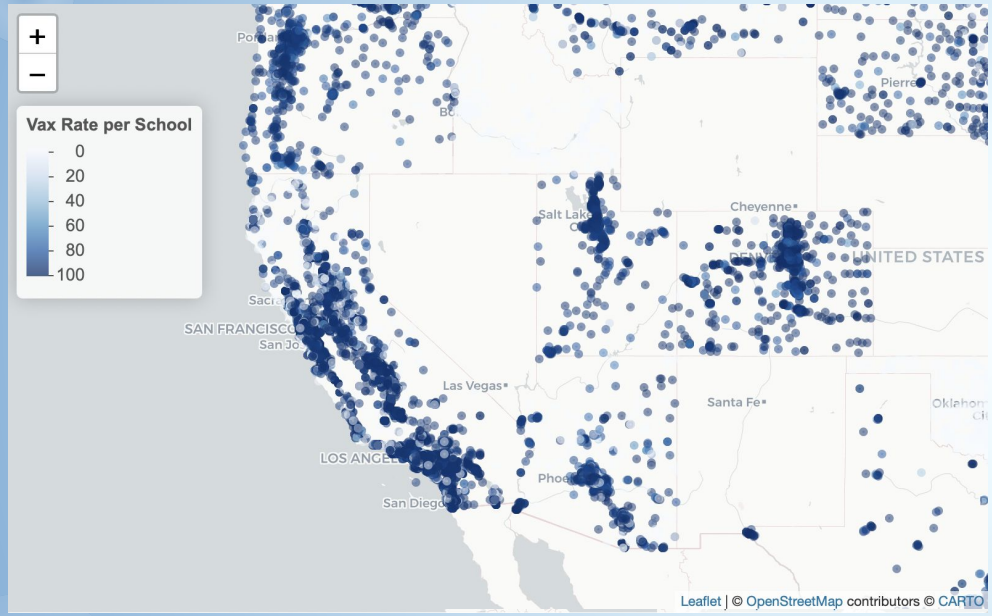
Motivation

- Many schools have dangerously low MMR Vaccination rates → increasing risk of measles outbreak.
- Measles cases have been on the rise.

Research Question

- Are schools' vaccination rates influenced by the type of school, state it's located in, and it's enrollment numbers?
- If so, can valid predictions on vaccination rates be made from these variables?

MMR Vaccination Map

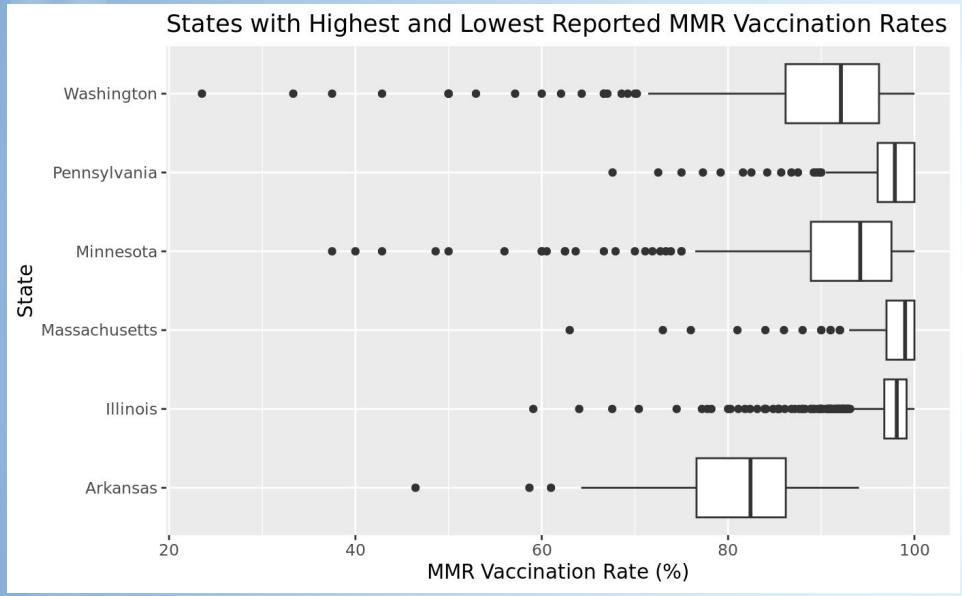


What does it display?

- General map of how mmr vaccination rates differ across different regions in the US.
- High/low percentage of mmr vaccination rates across different schools

Each data point represents a school, and the color represents the mmr vaccination rate at that school (reported) - where a light blue would represent low vaccination rates (if any) and dark blue would represent almost 100% (if not 100%) vaccination rates.

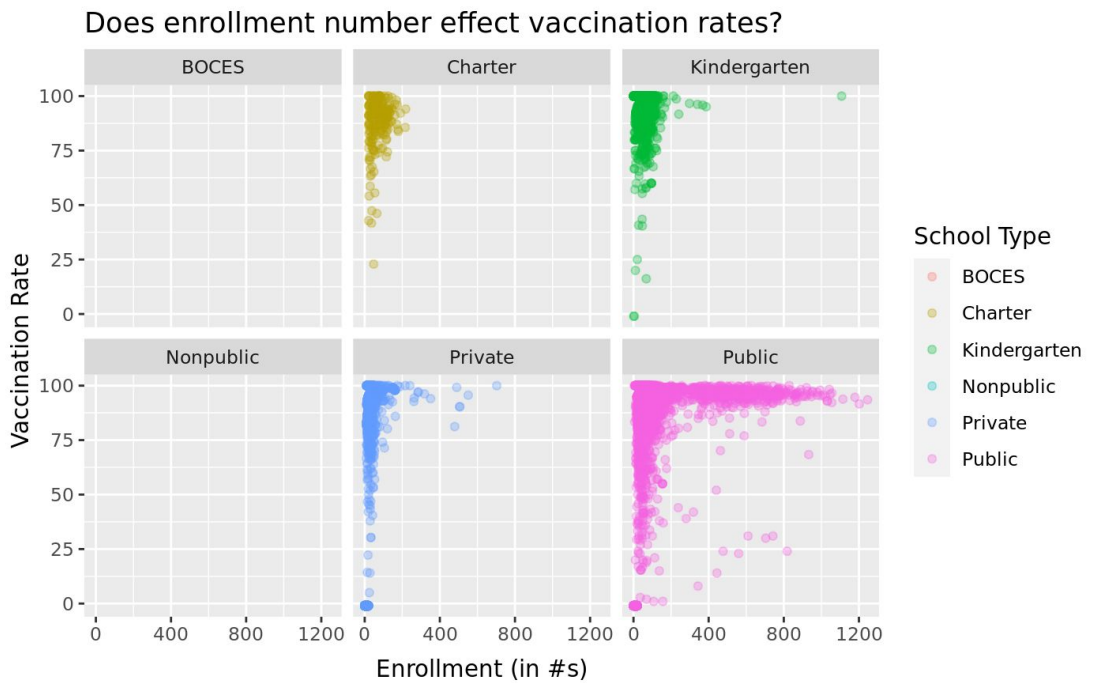
Rural vs. Urban Vaccination Rates



States with the highest (Massachusetts, Illinois, & Pennsylvania) and lowest (Arkansas, Washington, & Minnesota) mean MMR vaccination rates plotted

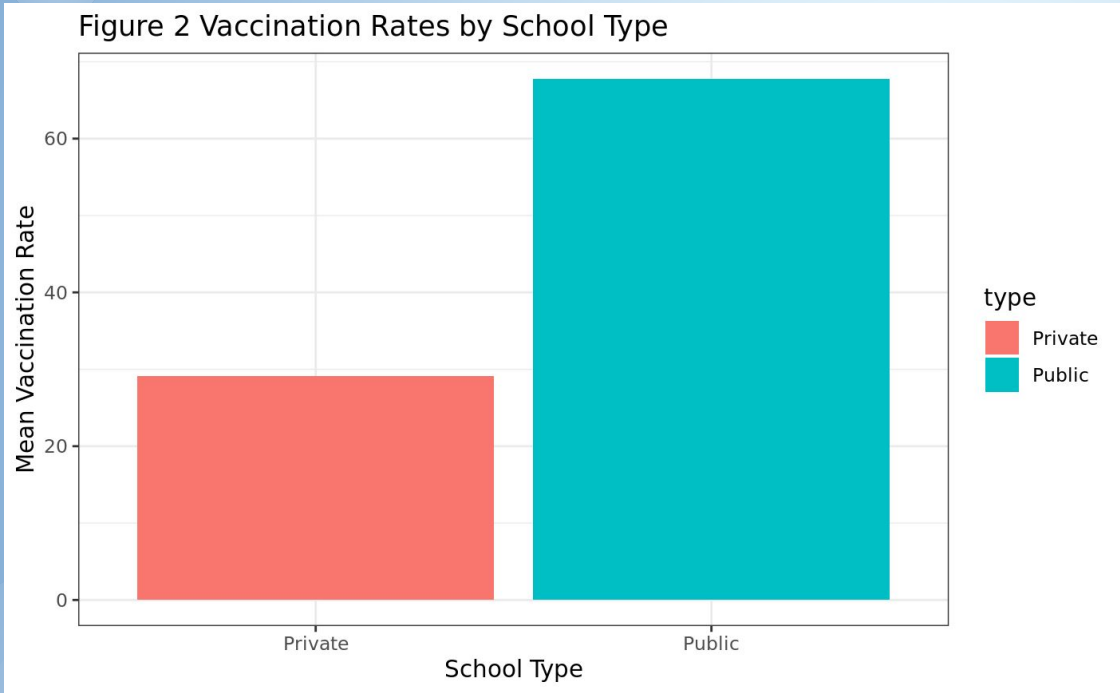
- % of the total population in urban areas per each state was found:
  - Massachusetts (92%)
  - Illinois (88.5%)
  - Pennsylvania (78.7%)
  - Arkansas (56.2%)
  - Washington (84.1%)
  - Minnesota (73.3%)
- Moderate relationship between urban/rural status of each state and MMR vaccination rate, but to a slight degree there is a trend.

Enrollment Number Effect on Vaccination Rate



- Refutes the idea that enrollment numbers influence reported MMR vaccination rates
- Gives reason for just analyzing between public vs private schools

Vaccination Rates by School Type



- Show a higher average vaccination rate for public schools
- Connections
  - Public schools: local government rules and control vaccination mandates
  - Private schools: potentially up to choice and out of government control

Inference Testing

Additive:
Adjusted r-squared: 0.24

Interactive:
Adjusted r-squared: 0.47

```
# A tibble: 9 × 5
  term              estimate std.error statistic   p.value
  <chr>                <dbl>     <dbl>     <dbl>     <dbl>
1 (Intercept)         81.2      1.57       51.9  0
2 typeKindergarten   -13.1      5.34       -2.45 1.42e-  2
3 typePrivate        -18.8      1.77      -10.6  2.37e- 26
4 typePublic           7.86     1.72        4.57 4.93e-  6
5 enroll               0.0923   0.00274    33.7  1.62e-242
6 stateCalifornia     -5.87     0.764      -7.68 1.69e- 14
7 stateColorado       21.0      5.07        4.14 3.43e-  5
8 stateOhio            4.45     0.858       5.18 2.21e-  7
9 stateUtah          -37.6      1.65      -22.8  6.82e-114
```

```
# A tibble: 40 × 5
   term                      estimate std.error statistic   p.value
   <chr>                        <dbl>     <dbl>     <dbl>     <dbl>
 1 (Intercept)                 83.6       2.64      31.7   3.16e-215
 2 typeKindergarten             4.05      7.03       0.576 5.65e-  1
 3 typePrivate                  4.42      4.84       0.913 3.61e-  1
 4 typePublic                   8.87      3.25       2.73  6.37e-  3
 5 enroll                       0.0597    0.0313     1.91  5.67e-  2
 6 stateCalifornia            -14.1       1.93      -7.27  3.74e- 13
 7 stateColorado                7.06      6.47       1.09  2.75e-  1
 8 stateOhio                   -3.96      2.06      -1.92  5.51e-  2
 9 stateUtah                    1.28      2.71       0.471 6.38e-  1
10 typeKindergarten:enroll     -0.0426    0.0942    -0.452 6.51e-  1
# … with 30 more rows
```

Variables: Enroll, Type, State

Hypothesis Testing

$H_0 : \bar{x}_{public} - \bar{x}_{private} = 0$ difference in mean vaccination rate is 0, there is no significant difference

$H_A : \bar{x}_{public} - \bar{x}_{private} \neq 0$ difference in mean vaccination rate is not 0, there is a significant difference

type <chr>	m <dbl>
Private	62.43583
Public	91.78767

- P-value = 0
- Evidence to reject the null hypothesis
  - (p-value < .05)
- Strong evidence for the alternative hypothesis:
  - Vaccination rate in public schools is significantly higher than in private schools.

Conclusion & Future Directions

- Vaccination rate is influenced by school type
- Our model has average power as a predictive measure

- Expanding the range of the the study
- Looking into better variables for creating a predictive model

THANK YOU!