No Change in Influenza Vaccination Rates Following the Peak of COVID-19

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DS 4002
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Project Motivation

COVID-19 onset led to...

- Increase in **health-consciousness**
  - masks, social distancing, hand sanitizer, cleaning surfaces and objects, sharing drinks and food
- Social media
  - **Anti-vaccination activism** became more visible in the US
- How does this influence perspectives towards other vaccinations?

Project Details

Research Question:

Will there be a significant **increase** in influenza vaccine coverage across Virginia following the onset of the COVID-19 Pandemic?

Modeling Approach:

ARIMA modeling for time series analysis, and significance testing using paired t-testing

Data Acquisition

Variable	Description	Variable Type
date	The date of when estimates are calculated or received by the CDC	yearmon
estimate	The estimated vaccination coverage or percent of persons vaccinated	numeric
cases	Number of reported COVID-19 cases	numeric

- Datasets acquired from **CDC**
  - Population: ages 18-64, not at high risk, Virginia residents
  - No licensing concerns
- Data Cleaning
  - Analysis file created from 2 datasets, removing unnecessary columns
    - Influenza vaccination coverage
    - COVID-19 surveillance
  - Converting date to yearmon for time series analysis
  - Replacing “NR” with 0

Analysis Plan and Justification

Phase 1

Dataset Establishment

- Merge two datasets
- Vaccination estimates are missing from June and July
- Need to replace with 0s so as not to affect time series analysis model

Phase 2

ARIMA Modeling

- Forecasting for 2024 and 2025
- Projected influenza vaccination ratings for
- Projected COVID-19 cases
- How do predictions compare to actual vaccination rates in 2022?

Phase 3

Paired T-Testing

- Conduct testing between the mean influenza vaccination coverage in 2018 and 2021
- Use the testing to find if there is significant difference between the two times

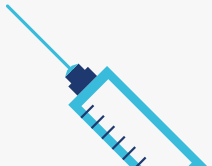
Phase 4

Compile Key Findings

- Create numerous visuals to better illustrate findings
- Answer research question using the graphs and results

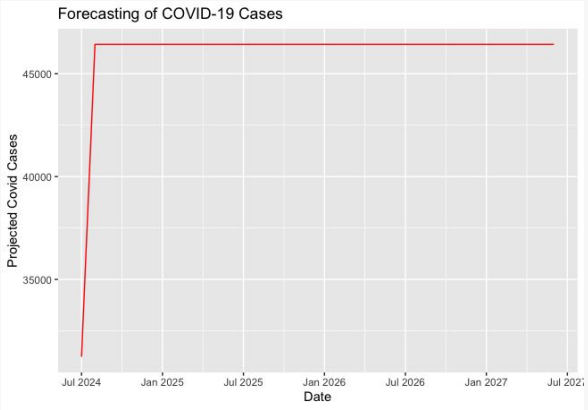
Tricky Analysis Decision

- The Influenza Vaccination Coverage dataset is grouped by sociodemographic group
- We had to focus on one specific group and chose 18-64 year olds not at high risk
- This decision resulted in excluding data from other groups like >65 and 18-64 year olds **at** high risk

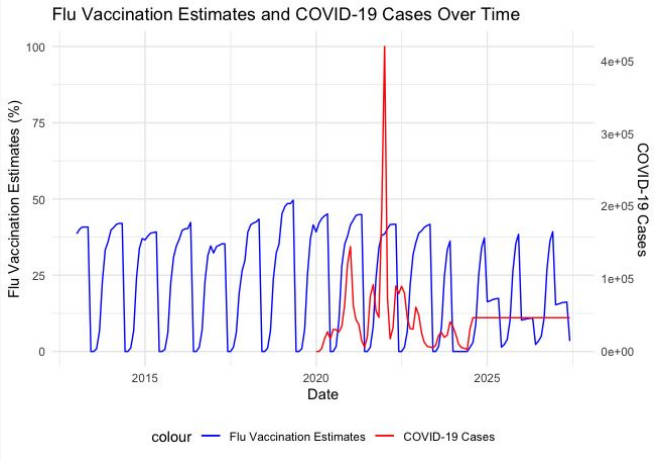


Bias and Uncertainty Validation

- Influenza Vaccination Coverage dataset includes non-random sampling, which can cause bias in the paired t-testing
- The vaccination coverage estimates are estimates with many percentages not having a high 95% confidence interval
- Vaccination rates show seasonality, which ARIMA does not consider



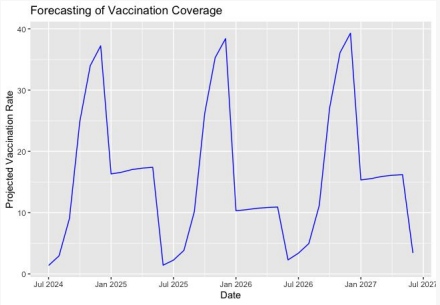
Results

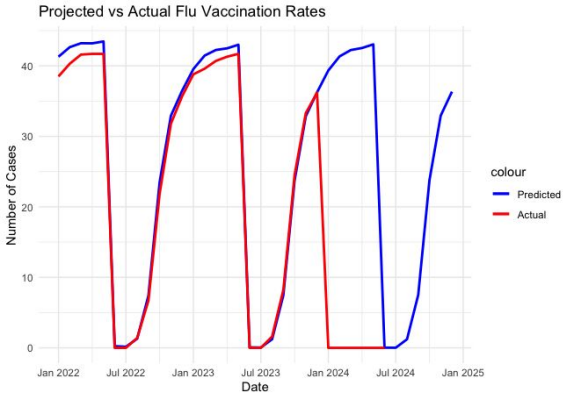


Significant change in vaccination rates after 2019?

Comparing the vaccination rates before and after COVID-19 onset (2018 and 2022)

- **Paired T-test**
- T-stat: -6.1308
- P-value: < 0.001





Does ARIMA predict vaccination rates prior to COVID-19 peak?

- Removing data prior to peak of COVID-19 cases
- No change in pattern, resembles data

Forecasting

- Little change in vaccination pattern
- Flat prediction of COVID-19 cases

Next Steps

1

Exploration

- Explore different vaccines
- Consider COVID-19 vaccination rates along with case counts
- Explore regional effects of more minor epidemics

2

Improvements

- Using additional forecasting methods
- Model with seasonality taken into account

3

Questions

- Do vaccination rates vary more in different states?
- How do incentives in each state effect vaccination

References

DC. (2024, October 2). *Preliminary Estimated Flu Disease Burden 2021-2022 Flu Season*. Flu Burden. https://www.cdc.gov/flu-burden/php/data-vis/2021-2022.html

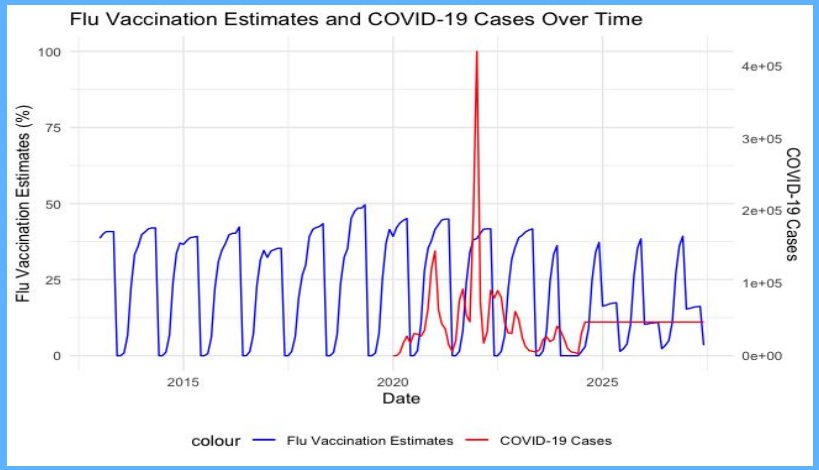
COVID-19 Case Surveillance Public Use Data with Geography | Data | Centers for Disease Control and Prevention. (n.d.). Retrieved October 10, 2024, from https://data.cdc.gov/Case-Surveillance/COVID-19-Case-Surveillance-Public-Use-Data-with-Ge/n8mc-b4w4/about_data

Influenza Vaccination Coverage for All Ages (6+ Months) | Data | Centers for Disease Control and Prevention. (n.d.). Retrieved October 10, 2024, from https://data.cdc.gov/Flu-Vaccinations/Influenza-Vaccination-Coverage-for-All-Ages-6-Mont/vh55-3he6/about_data

Richard M. Carpiano et al. "Confronting the Evolution and Expansion of anti-vaccine activism in the USA in the COVID-19 era." *The Lancet*, 2023. The Lancet, doi:10.1016/S0140-6736(23)00136-8.

Github: https://github.com/michellehkim280/DS4002_Project2/tree/main

Thank you!


Flu Vaccination Estimates and COVID-19 Cases Over Time
Flu Vaccination Estimates (%)
100
75
50
25
0
4e+05
3e+05
2e+05
1e+05
0e+00
COVID-19 Cases
2015
2020
2025
Date
colour
Flu Vaccination Estimates
COVID-19 Cases