

The Effect of COVID-19 Vaccinating Health Professionals Prior to Patients

JACOB H, LAUREN H, ETHAN R, DAVID W*

Abstract

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I. INTRODUCTION

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II. METHODS

I. Model Methods

General process of how the guys created the model. What they chose as parameters, why they chose specific set-up/ structure etc.

- software used
- Thought process, planning
- architecture of model chosen and why
- how/why parameters were chosen
- optimization methods
- 1-D model set up
- 2-D model set up

II. Data Analysis Methods

Process and methods used to gather and then analyze the data. How we ruled out factors, how we ruled in factors, process of elimination etc.

*A thank you or further information

- Where is data from
- How we got it
- Pipeline analysis set-up
- types of plots generated
- Analysis after plots– how we determined "significance" in event analysis
- What constitutes ruling in a parameter; ruling out a parameter
- What constitutes a likely conclusion

III. RESULTS

I. Model Results

I.1 Jake's Model Results

I.2 Ethan's Model Results

II. Data Analysis Results

II.2 State-Level Data Analysis Results

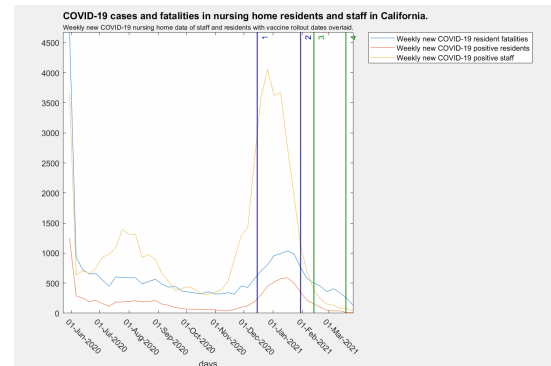


Figure 2: Roughly 2 weeks after release of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in California begins to decline, followed by a reduction in COVID-19 cases and fatalities in residents approximately 2 weeks later.

II.1 National-Level Data Analysis Results

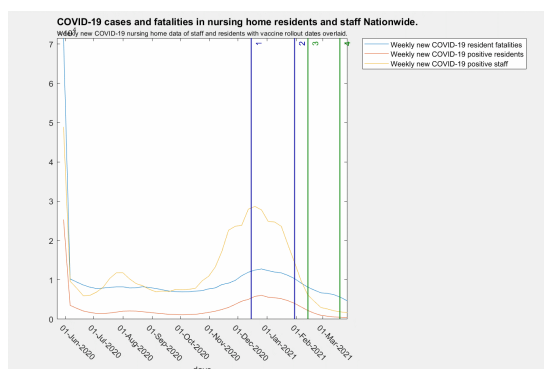


Figure 1: The distribution of the first COVID-19 vaccine immediately reduced new COVID-19 cases in nursing home staff Nationwide, followed by a similar reduction in nursing home residents approximately 2 weeks later.

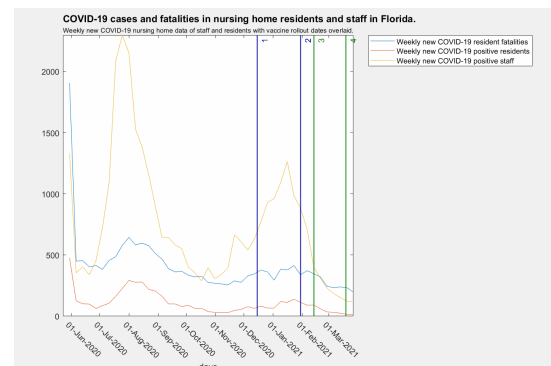


Figure 3: Approximately 4 weeks after the distribution of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in Florida begin to decline, and COVID-19 cases and fatalities in nursing home residents remained constant for nearly 3 months after the first wave of vaccine distributions before declining.

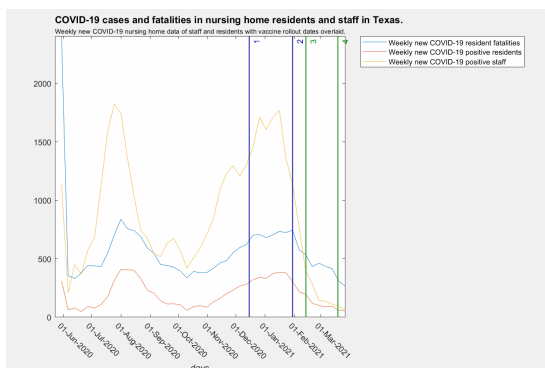


Figure 4: Approximately 4 weeks after the release of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in Texas began to decline, followed by a decline in COVID-19 cases and fatalities in nursing home residents approximately 1 week later.

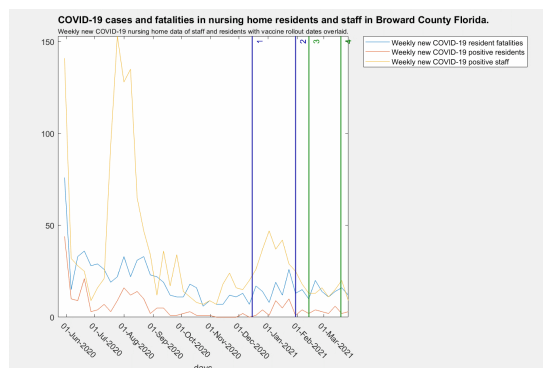


Figure 6: Approximately 2 weeks after COVID-19 vaccine distribution begins, new COVID-19 cases in nursing home staff begin to decline in Broward County Florida, while COVID-19 cases and fatalities in nursing home residents remain constant, displaying no change.

II.3 County-Level Data Analysis Results



Figure 5

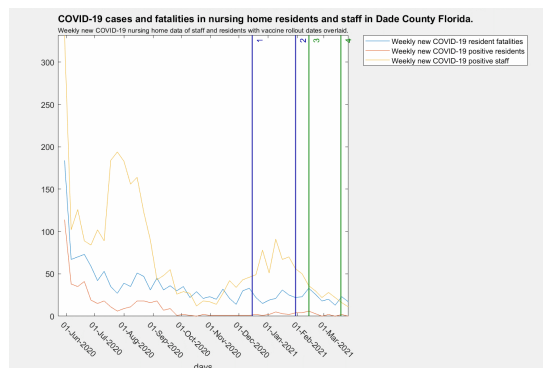


Figure 7: Nearly 4 weeks after COVID-19 vaccine distribution begins, new COVID-19 cases in nursing home staff begin to decline in Dade County Florida, while COVID-19 cases and fatalities in nursing home residents remain constant with a slight display in decline approximately 1 month after staff decline.

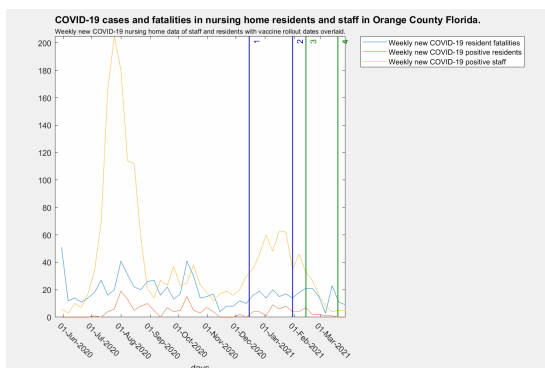


Figure 8: Approximately 5 weeks after the start of COVID-19 vaccine distribution, new COVID-19 cases in nursing home staff begin to decline in Orange County, Florida, while COVID-19 cases and fatalities in nursing home residents decline approximately 1 month after staff decline.

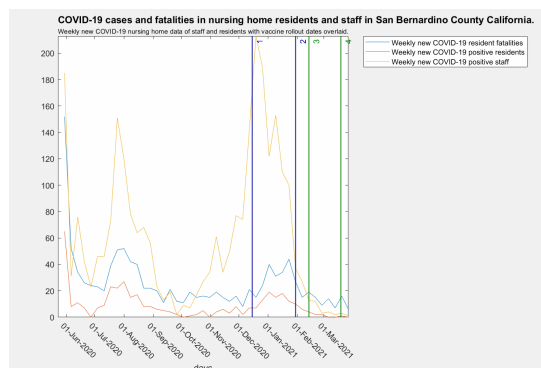


Figure 10: The release of the first COVID-19 vaccine is followed by a reduction in new COVID-19 cases in nursing home staff in San Bernardino County, California within 3 weeks, followed by a decline in COVID-19 cases and fatalities in nursing home staff approximately 1 week later.

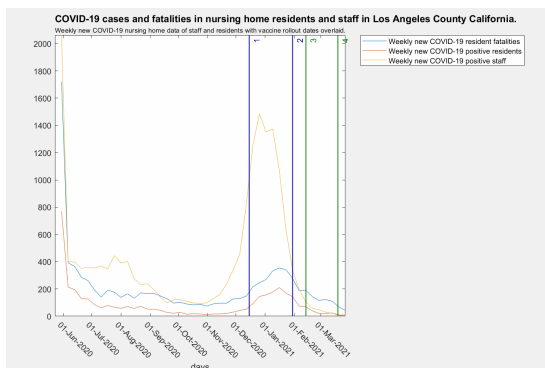


Figure 9: The release of the first COVID-19 vaccine is followed by a reduction in new COVID-19 cases in nursing home staff in Los Angeles County, California approximately 3 weeks after distribution; succeeded by a reduction in COVID-19 cases and fatalities in nursing home residents approximately 1 week later.

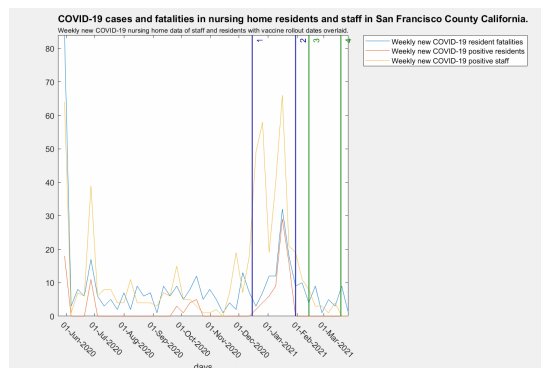


Figure 11: Approximately 4 weeks after the distribution of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in San Francisco County, California begin to decline, followed by a decline in COVID-19 cases and fatalities in nursing home residents less than one week later.

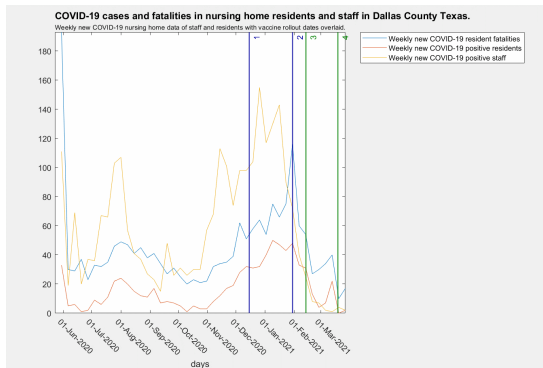


Figure 12: New COVID-19 cases in nursing home staff in Dallas County, Texas begin to decline approximately 4 weeks after the distribution of the first COVID-19 vaccine, followed by the decline in COVID-19 cases and fatalities in nursing home residents approximately 2 weeks later.

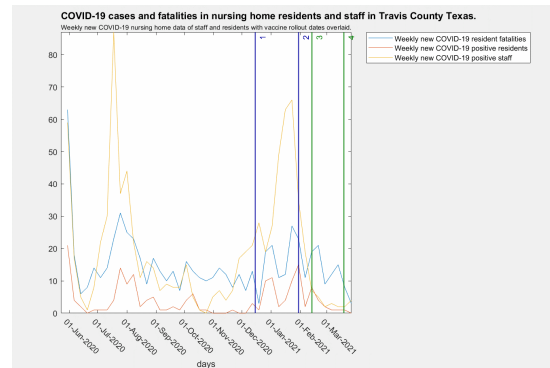


Figure 14: New COVID-19 cases in nursing home staff in Travis County, Texas begin to decline approximately 5 weeks after the distribution of the first COVID-19 vaccine, followed by the decline in COVID-19 cases and fatalities in nursing home residents approximately 2 weeks later.

III. Vaccinations in general public 65+ and in assisted living facility residents

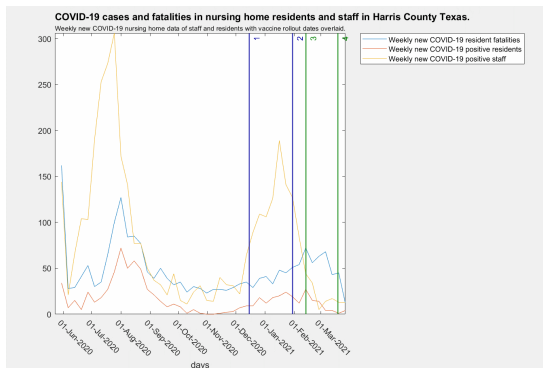


Figure 13: New COVID-19 cases in nursing home staff in Harris County, Texas begin to decline approximately 5 weeks after the distribution of the first COVID-19 vaccine, followed by the decline in COVID-19 cases and fatalities in nursing home residents approximately 2 weeks later.

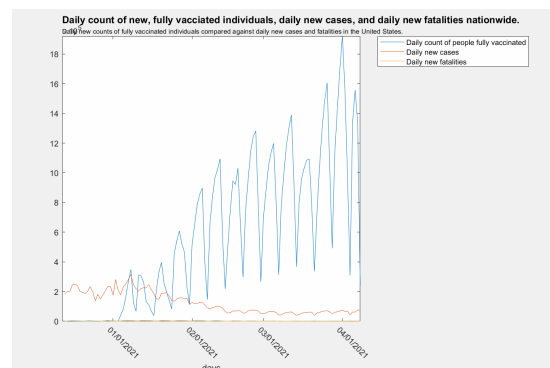


Figure 15: A national timeline of daily new cases and fatalities due to COVID-19, plotted with daily new vaccines. According to the figure, as the rate of daily, new vaccinated individuals increases, daily new COVID-19 cases and fatalities decreases.

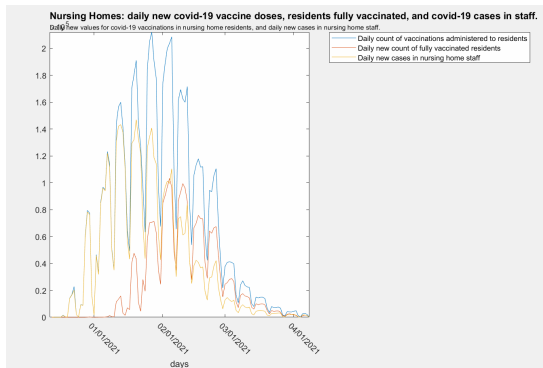


Figure 16: A timeline of daily new COVID-19 vaccinations in long term care residents, daily count of new, fully vaccinated residents, and new COVID-19 cases in long term care staff.

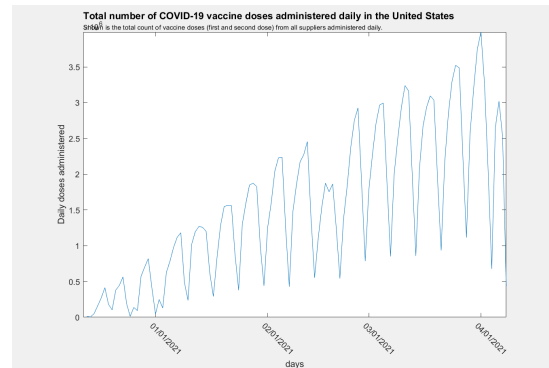


Figure 18: Shown above is the daily count of COVID-19 vaccines administered daily in the United States. The count includes a first dose injection, a second dose injection, and a single-dose injection.

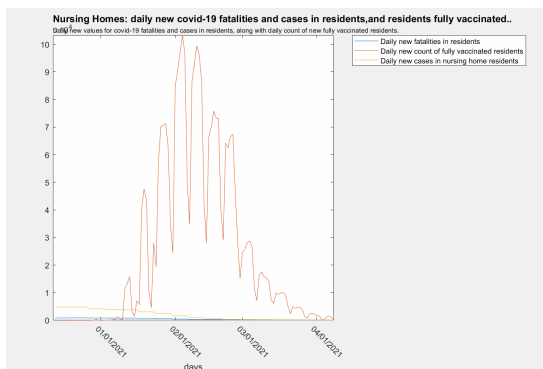


Figure 17: A timeline of daily new COVID-19 cases and fatalities in long term care residents with daily new residents fully vaccinated.

IV. National and Long Term Care Facility Data: Single Plots, Processed and Unprocessed

The data is presented with the unprocessed plot, followed by the same plot with a 7 day moving average applied to the data.

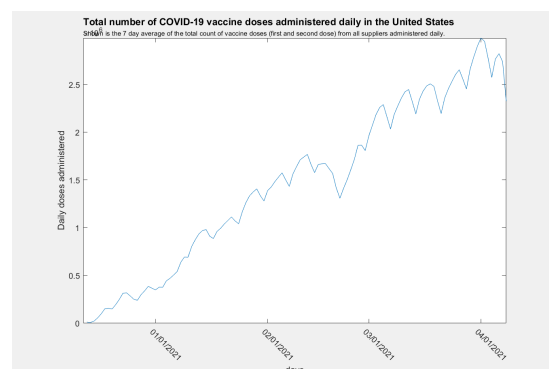


Figure 19: Shown above is the rolling 7 day average of the count of COVID-19 vaccines administered daily in the United States. The count includes a first dose injection, a second dose injection, and a single-dose injection.

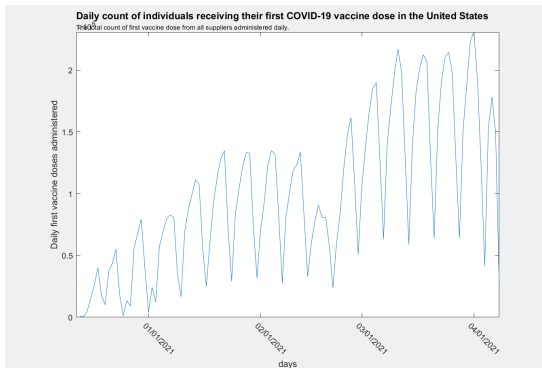


Figure 20: Shown is the daily count of individuals receiving their first COVID-19 vaccine dose in the United States.

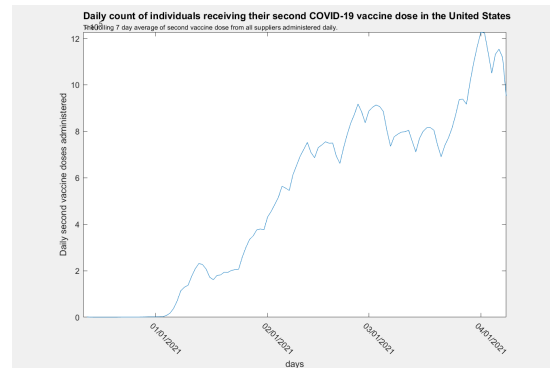


Figure 23: Shown is the rolling 7 day average of individuals receiving their second COVID-19 vaccine dose in the United States.

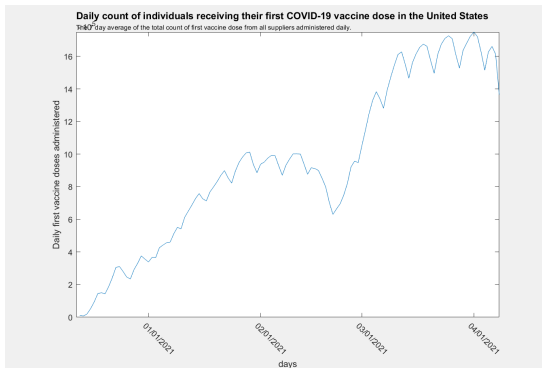


Figure 21: Shown is the rolling 7 day average of individuals receiving their first COVID-19 vaccine dose in the United States.

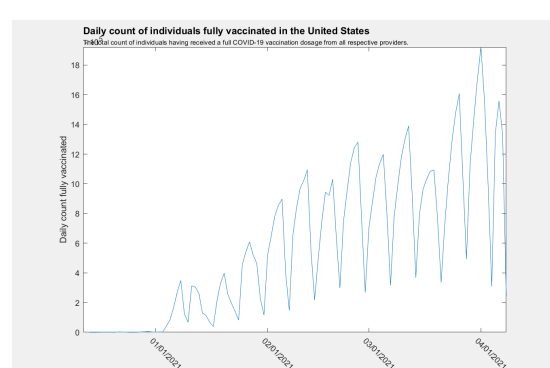


Figure 24: Shown is the daily count of new individuals fully vaccinated in the United States.

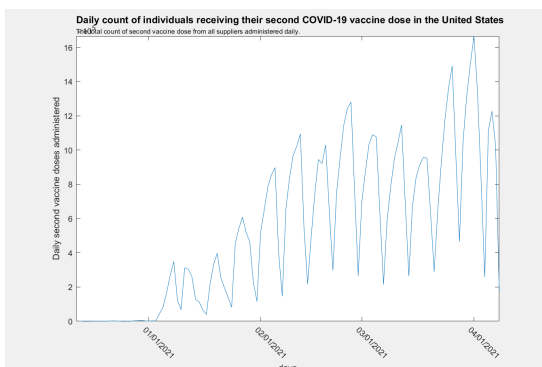


Figure 22: Shown is the daily count of individuals receiving their second COVID-19 vaccine dose in the United States.

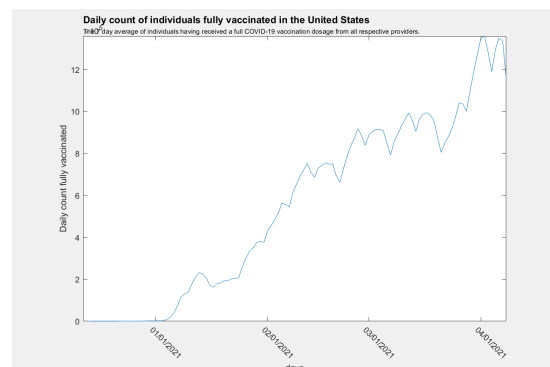


Figure 25: Shown is the rolling 7 day average of new individuals fully vaccinated in the United States.

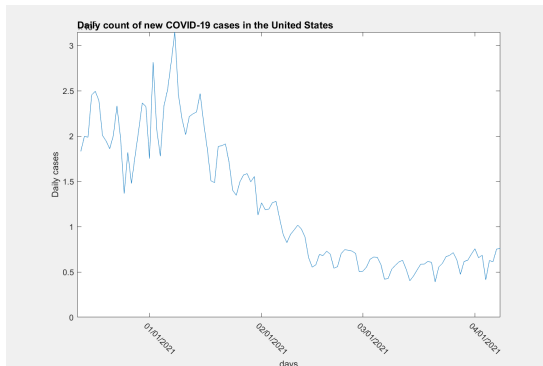


Figure 26: Shown is the daily new count of individuals in the United States who have contracted COVID-19.

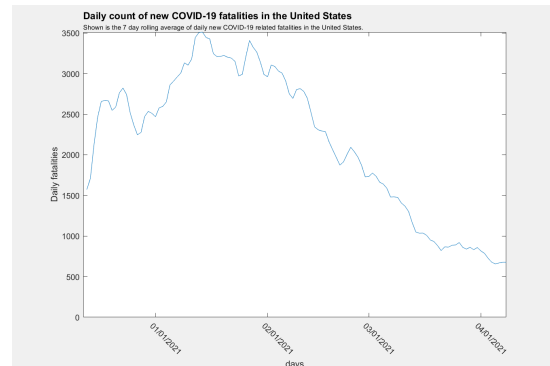


Figure 29: Shown is the daily new count of deceased individuals in the United States who have died due to COVID-19.

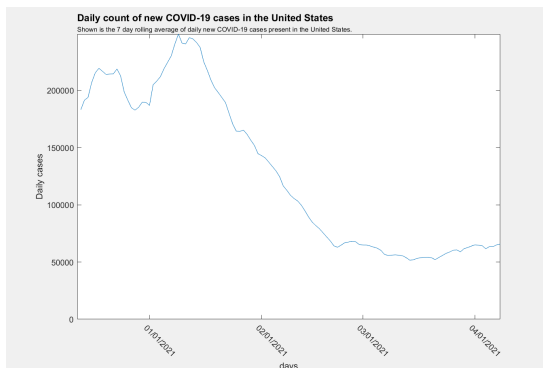


Figure 27: Shown is the rolling 7 day average of individuals in the United States who have contracted COVID-19.

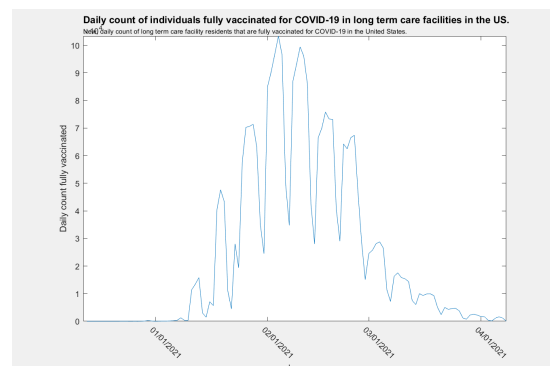


Figure 30: Shown is the daily count for long term care residents who are fully vaccinated.

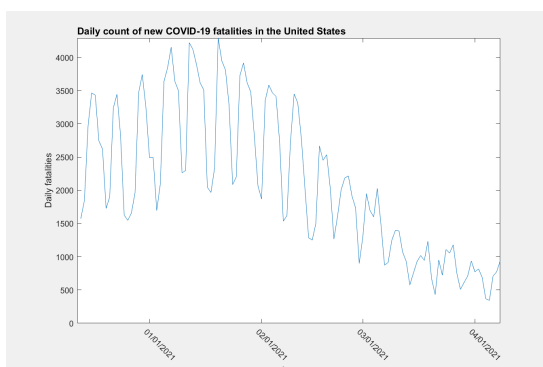


Figure 28: Shown is the daily new count of deceased individuals in the United States who have died due to COVID-19.

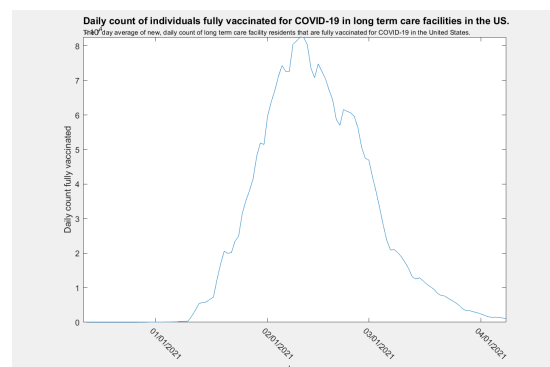


Figure 31: Shown is the rolling 7 day average for long term care residents who are fully vaccinated.

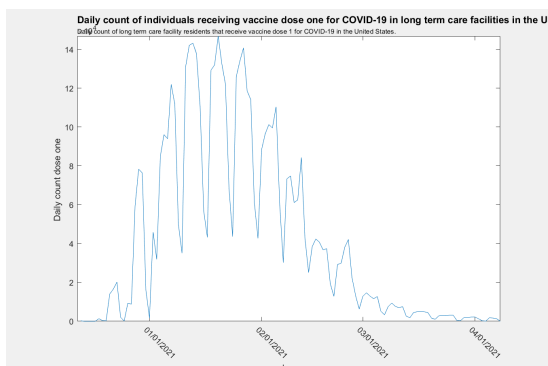


Figure 32: Daily new count of nursing home residents who have received a first dose injection for COVID-19 vaccination.

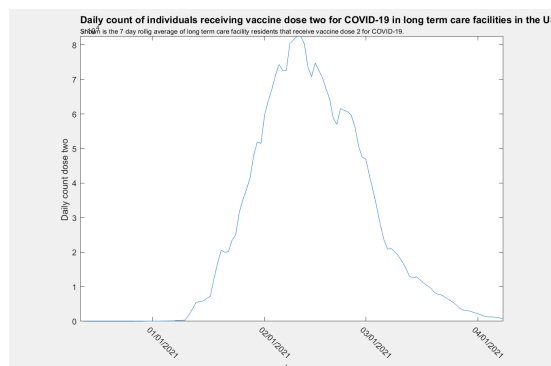


Figure 35: Rolling 7 day average of nursing home residents who have received a second dose injection for COVID-19 vaccination.

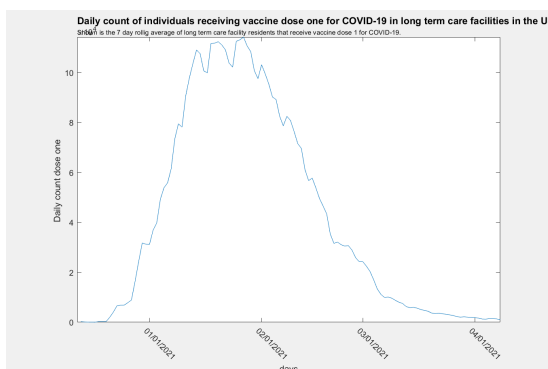


Figure 33: Rolling 7 day average of nursing home residents who have received a first dose injection for COVID-19 vaccination

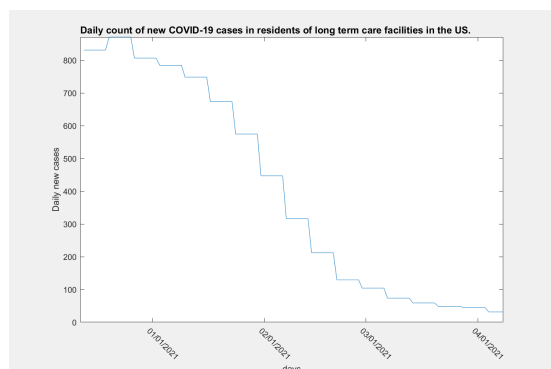


Figure 36: Daily new COVID-19 cases in nursing home residents. *The data set has been modified from weekly to daily.

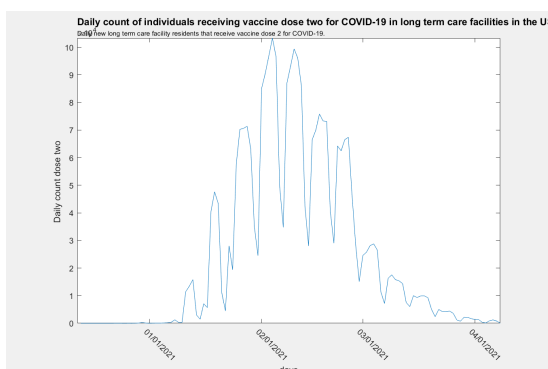


Figure 34: Daily new count of nursing home residents who have received a second dose injection for COVID-19 vaccination.

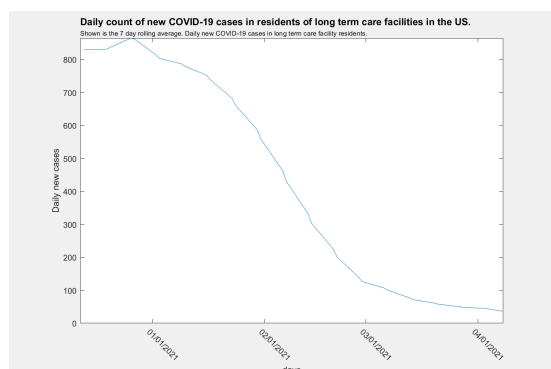


Figure 37: Rolling 7 day average of COVID-19 cases in nursing home residents. *The data set has been modified from weekly to daily.

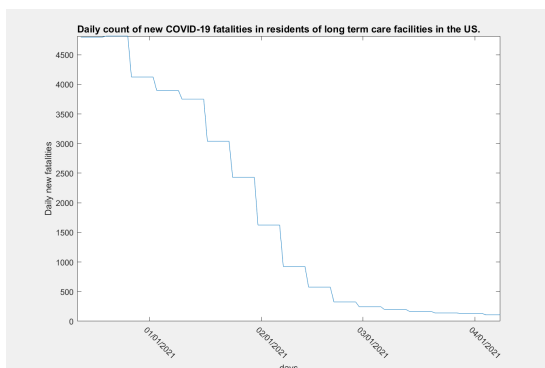


Figure 38: Daily new COVID-19 related fatalities in nursing home residents. *The data set has been modified from weekly to daily.

V. National and Long Term Care Facility Data: Joint Plots, with and without Normalization

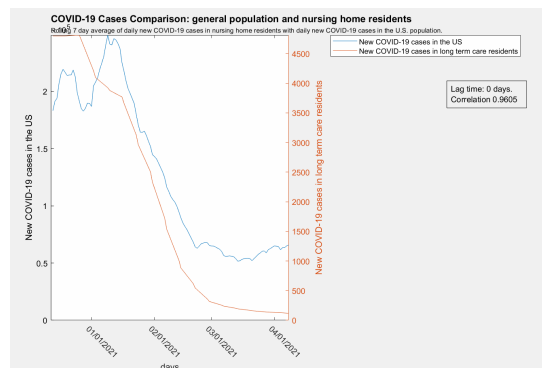


Figure 40: Daily new COVID-19 cases in the general U.S. population and daily new COVID-19 cases in the nursing home population over time.

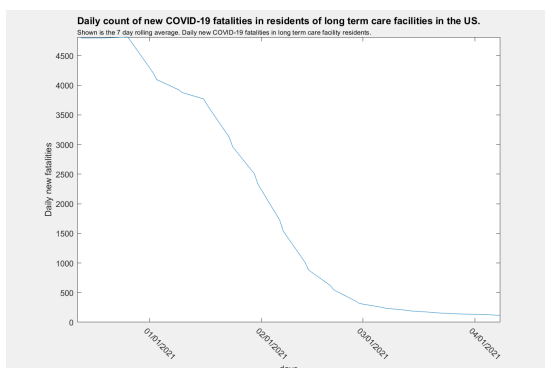


Figure 39: Rolling 7 day average of COVID-19 related fatalities in nursing home residents. *The data set has been modified from weekly to daily.

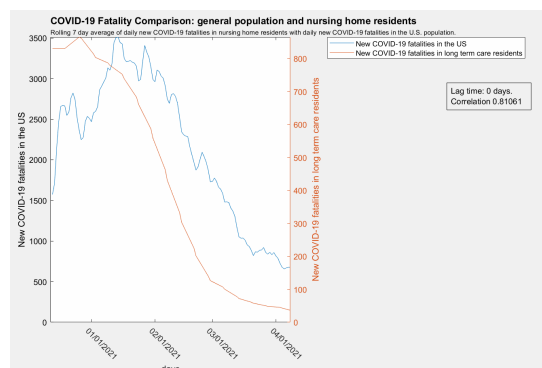


Figure 41: Daily new COVID-19 fatalities in the general U.S. population and daily new COVID-19 fatalities in the nursing home population over time.

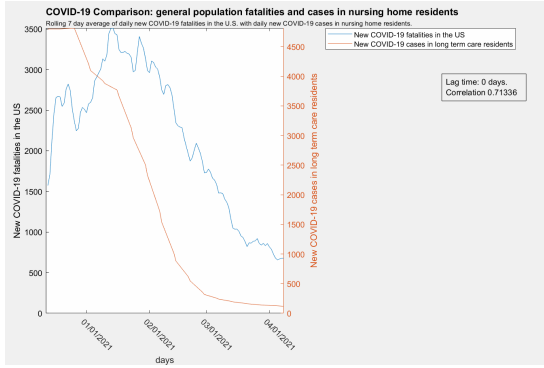


Figure 42: Daily new COVID-19 fatalities in the general U.S. population and daily new COVID-19 cases in the nursing home population over time.

VI. Vaccination Fraction, Non-Vaccination Fraction, Normalization Parameters

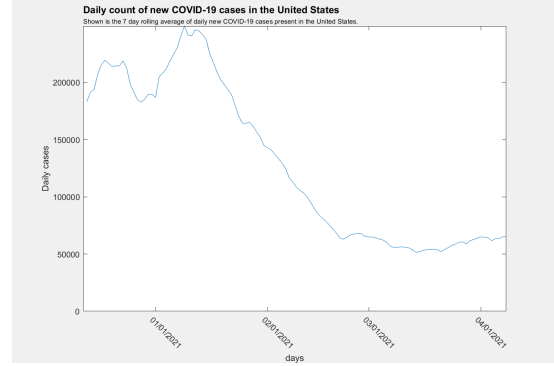


Figure 44: Shown is the total number of daily, new COVID-19 cases in the US, with a 7 day moving average applied. This will be used as one of the normalization parameters.

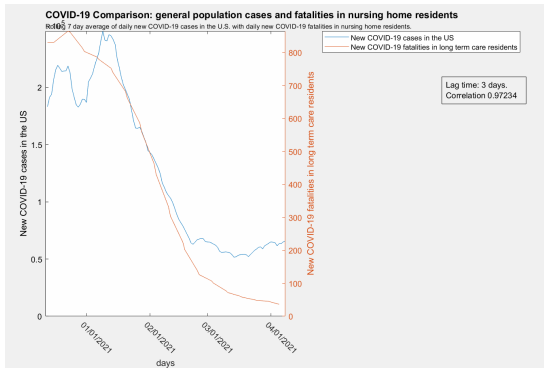


Figure 43: Daily new COVID-19 cases in the general U.S. population and daily new COVID-19 fatalities in the nursing home population over time.

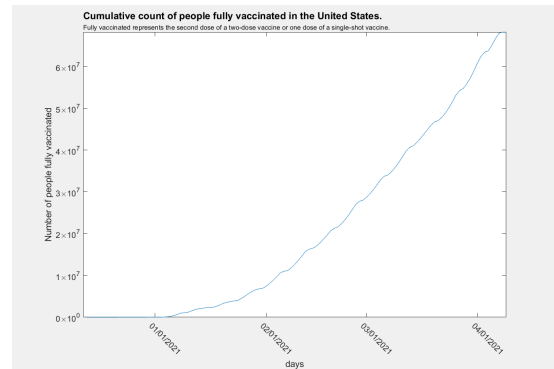


Figure 45: Shown is the cumulative count of fully vaccinated individuals in the US over time. Fully vaccinated individuals refers to the individuals who have received the second dose of a two-dose vaccine or the shot of a single-dose vaccine.

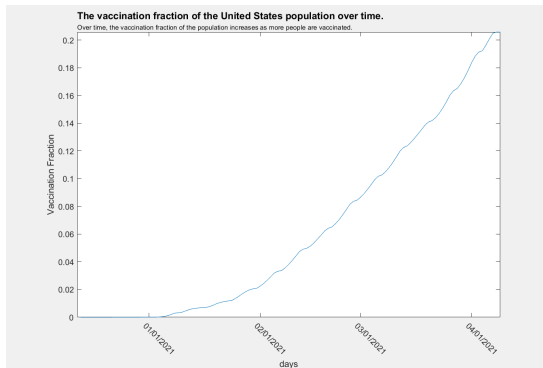


Figure 46: Shown is the vaccination fraction of individuals in the US. The vaccination fraction is an iterative calculation that takes the ratio of individuals fully vaccinated to the total US population. The total US population used is: 331,449,281 per US.Census.gov.

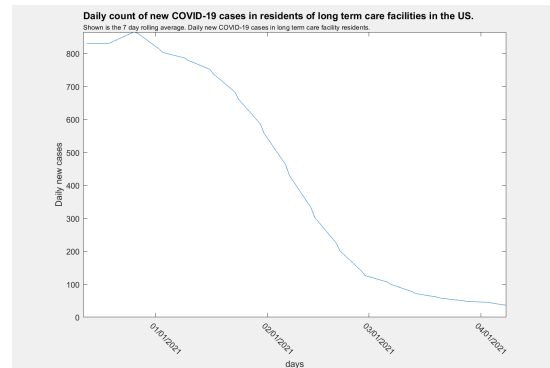


Figure 48: Shown is the total number of daily, new COVID-19 cases in the long term care population, with a 7 day moving average applied. This will be used as one of the normalization parameters.

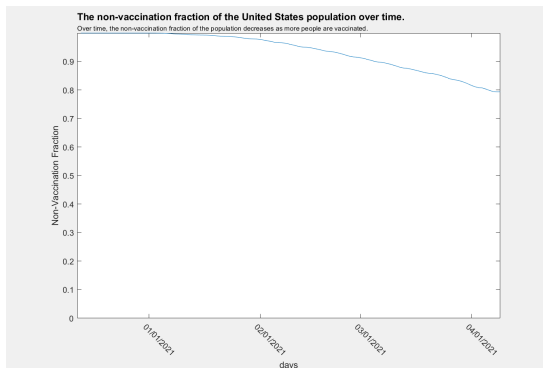


Figure 47: Shown is the non-vaccination fraction of individuals in the US. The non-vaccination fraction is represented as the remainder of $(1 - \text{vaccination fraction})$. The non-vaccination fraction represents the proportion of individuals in the US who are not vaccinated for COVID-19.

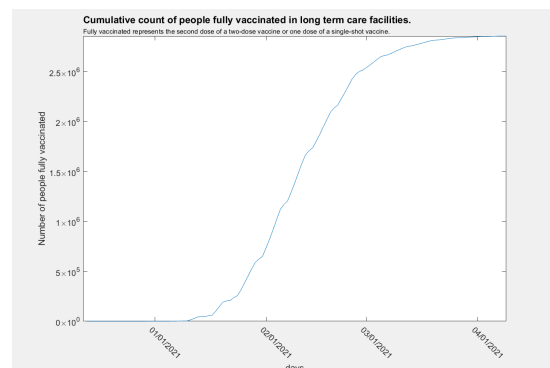


Figure 49: Shown is the cumulative count of fully vaccinated individuals in long term care facilities over time. Fully vaccinated individuals refers to the individuals who have received the second dose of a two-dose vaccine or the shot of a single-dose vaccine.

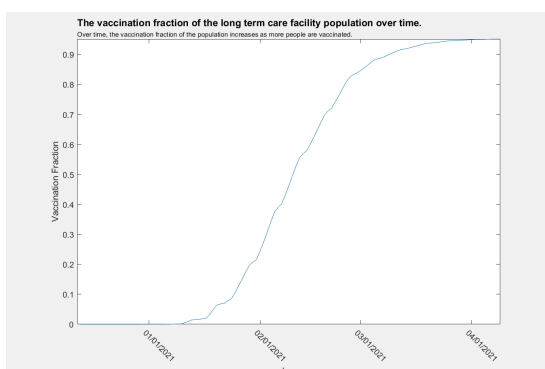


Figure 50: Shown is the vaccination fraction of individuals in long term care facilities. The vaccination fraction is an iterative calculation that takes the ratio of individuals fully vaccinated to the total long term care population. The total LTC population used is: 3,000,000 per nih.gov publishing.

VII. LTC: cases and fatalities, USA: cases and fatalities (normalized)

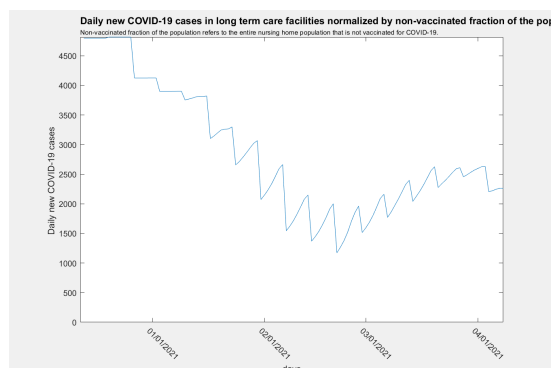


Figure 52: Shown are the daily new COVID-19 cases in long term care facilities normalized by the percent of the LTC population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a single-dose vaccination).

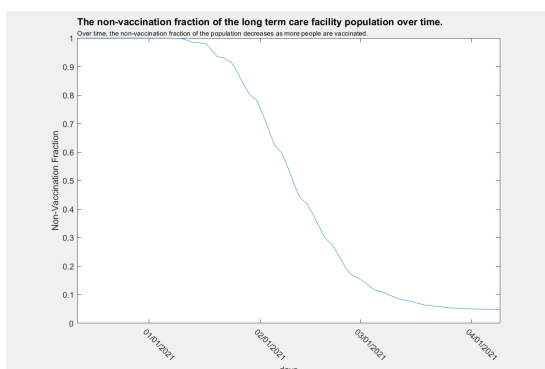


Figure 51: Shown is the non-vaccination fraction of individuals in long term care facilities. The non-vaccination fraction is represented as the remainder of $(1 - \text{vaccination fraction})$. The non-vaccination fraction represents the proportion of individuals in the US who are not vaccinated for COVID-19.

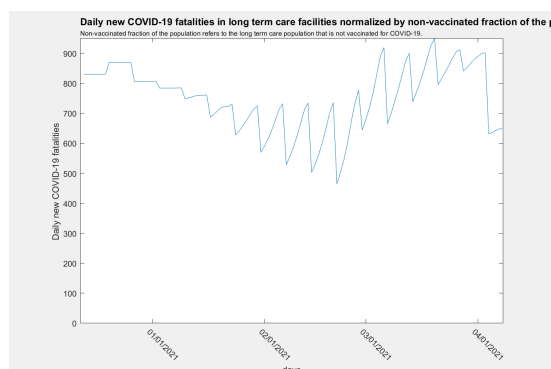


Figure 53: Shown are the daily new COVID-19 fatalities in long term care facilities normalized by the percent of the LTC population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a single-dose vaccination).

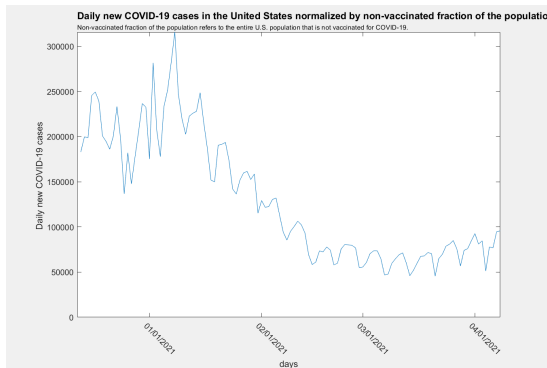


Figure 54: Shown are the daily new COVID-19 cases in the United States normalized by the percent of the U.S. population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a single-dose vaccination).

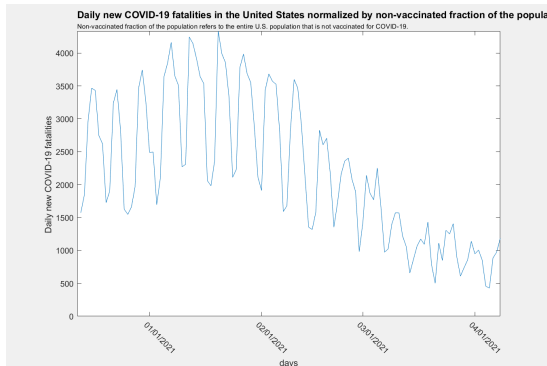


Figure 55: Shown are the daily new COVID-19 fatalities in the United States normalized by the percent of the U.S. population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a single-dose vaccination).

VIII. Nursing Home Statistics

1. Histogram w/ scatterplot
2. Pie Chart?
3. Graph chart for comparison?

IV. DISCUSSION

I. Model Discussion

1. Jake's model
2. Ethan's model

II. Event Analysis Discussion

The effectiveness of vaccinating the population against COVID-19 is undeniably positive, and is apparent through the decline in the presence of COVID-19 within the nursing home setting at the National, State, and County level.

1. Nationwide has declined
2. California & Texas have declined; Florida residents remain constant– weird.
3. by the time 80-90% of first dose has been delivered, everyone is at low levels for COVID-19 in nursing home
4. health professionals are vectors
5. vaccinating health professionals first, and earlier saves lives faster
- 6.

REFERENCES

- [Figueredo and Wolf, 2009] Figueredo, A. J. and Wolf, P. S. A. (2009). Assortative pairing and life history strategy - a cross-cultural study. *Human Nature*, 20:317–330.