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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Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

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

We decided to normalize the raw nursing home data by two different parameters in order to narrow the scope of focus and neutralize non-essential information from the data. We nor-

*A thank you or further information

malized the data sets belonging to the nursing home population in the United States by a vaccination parameter characteristic to the nursing home demographic (an internal pressure), and by an external pressure, which was either cases per un-vaccinated individual in the United States, or fatalities per un-vaccinated individual in the United States. The purpose in these normalization parameters is to refine the analysis to reflect the nursing home environment and gauge how the un-vaccinated population outside of the nursing homes have affected the nursing home case and fatality rates. This is comparison is essential for us to be able to draw an inference as to whether or not the medical professionals (aka nurses) who are employed at these respective nursing homes, play a role in the propagation of the virus within the homes, and if so, to what deadly degree?

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.

- 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.1 National-Level Data Analysis Results

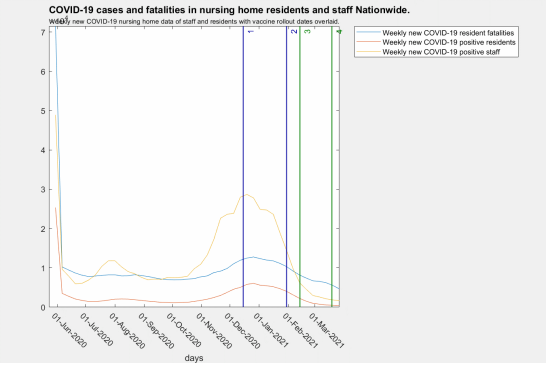

Figure 1: *The distribution of the first COVID-19 vaccine immediately reduced new COVID-19 cases in nursing home staff Nationwide, followed by a similar reduction in nursing home residents approximately 2 weeks later.*

II.2 State-Level Data Analysis Results

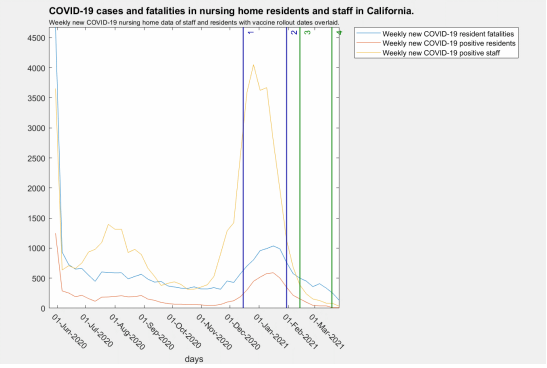

Figure 2: *Roughly 2 weeks after release of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in California begins to decline, followed by a reduction in COVID-19 cases and fatalities in residents approximately 2 weeks later.*

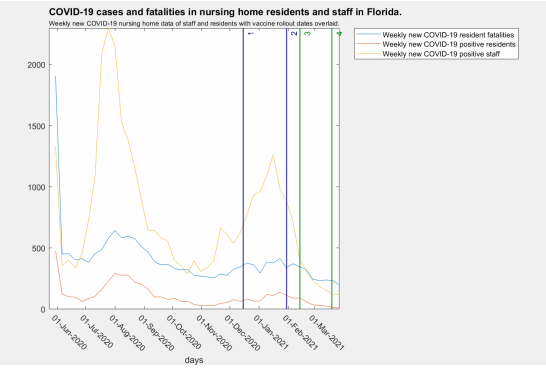

Figure 3: *Approximately 4 weeks after the distribution of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in Florida begin to decline, and COVID-19 cases and fatalities in nursing home residents remained constant for nearly 3 months after the first wave of vaccine distributions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

II.3 County-Level Data Analysis Results

Figure 5

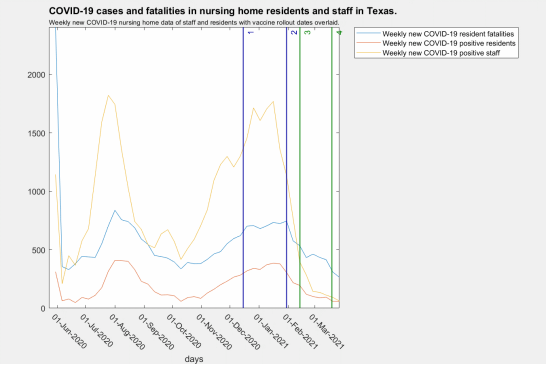

Figure 4: *Approximately 4 weeks after the release of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in Texas began to decline, followed by a decline in COVID-19 cases and fatalities in nursing home residents approximately 1 week later.*

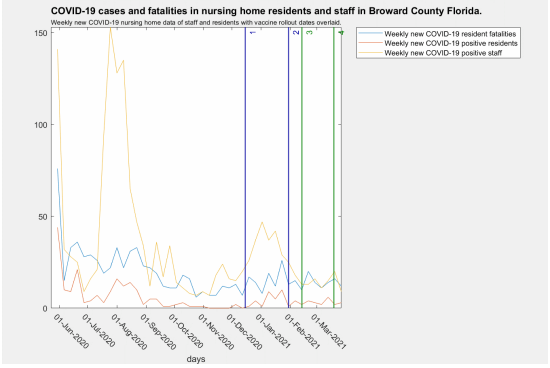

Figure 6: *Approximately 2 weeks after COVID-19 vaccine distribution begins, new COVID-19 cases in nursing home staff begin to decline in Broward County Florida,while COVID-19 cases and fatalities in nursing home residents remain constant, displaying no change.*

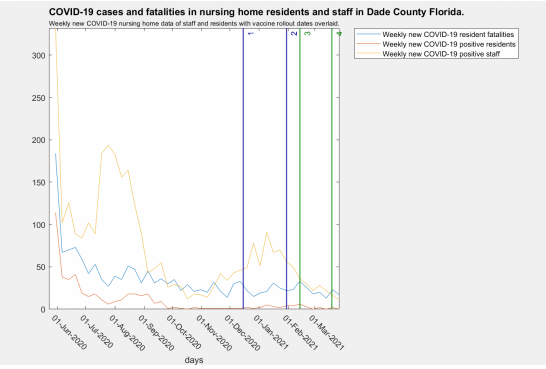

Figure 7: *Nearly 4 weeks after COVID-19 vaccine distribution begins, new COVID-19 cases in nursing home staff begin to decline in Dade County Florida, while COVID-19 cases and fatalities in nursing home residents remain constant with a slight display in decline approximately 1 month after staff decline.*

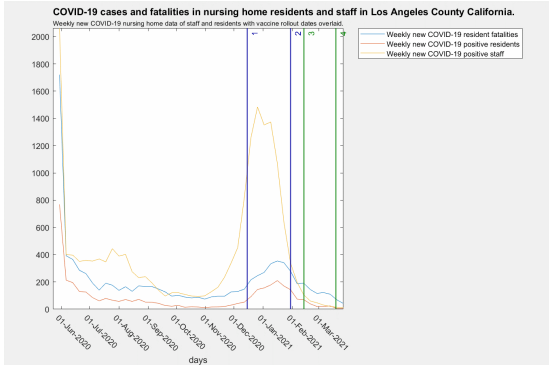

Figure 9: *The release of the first COVID-19 vaccine is followed by a reduction in new COVID-19 cases in nursing home staff in Los Angeles County, California approximately 3 weeks after distribution; succeeded by a reduction in COVID-19 cases and fatalities in nursing home residents approximately 1 week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

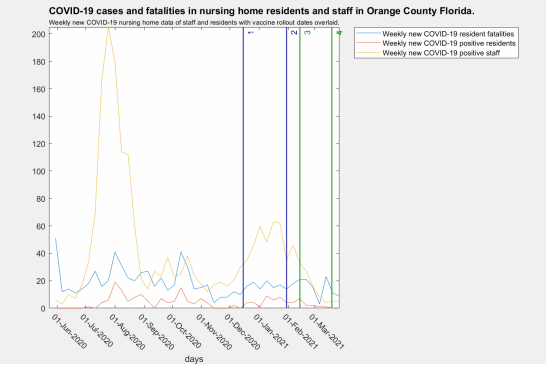

Figure 8: *Approximately 5 weeks after the start of COVID-19 vaccine distribution, new COVID-19 cases in nursing home staff begin to decline in Orange County, Florida, while COVID-19 cases and fatalities in nursing home residents decline approximately 1 month after staff decline.*

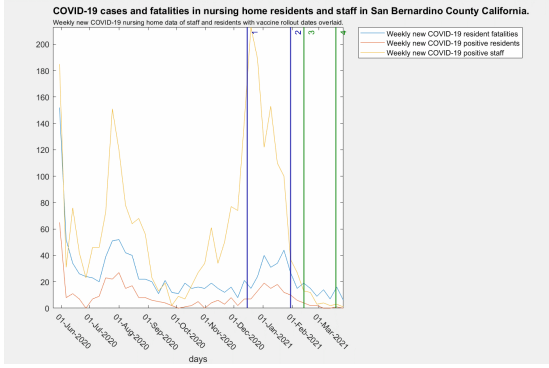

Figure 10: *The release of the first COVID-19 vaccine is followed by a reduction in new COVID-19 cases in nursing home staff in San Bernardino County, California within 3 weeks, followed by a decline in COVID-19 cases and fatalities in nursing home staff approximately 1 week later.*

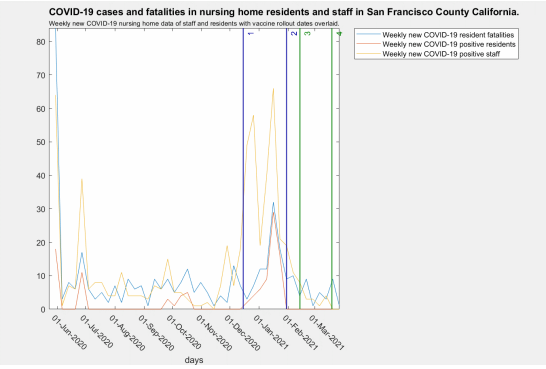

Figure 11: *Approximately 4 weeks after the distribution of the first COVID-19 vaccine, new COVID-19 cases in nursing home staff in San Francisco County, California begin to decline, followed by a decline in COVID-19 cases and fatalities in nursing home residents less than one week later.*

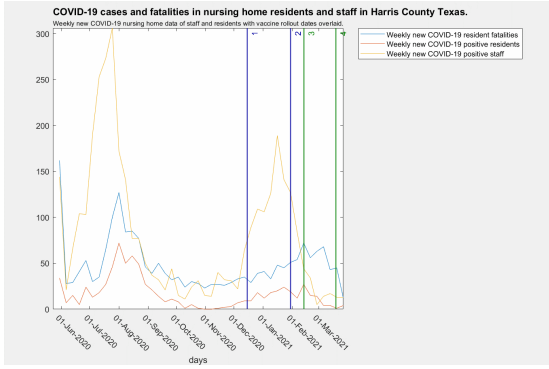

Figure 13: *New COVID-19 cases in nursing home staff in Harris County, Texas begin to decline approximately 5 weeks after the distribution of the first COVID-19 vaccine, followed by the decline in COVID-19 cases and fatalities in nursing home residents approximately 2 weeks later.*

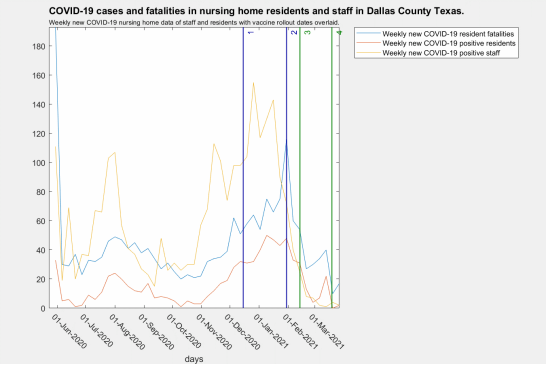

Figure 12: *New COVID-19 cases in nursing home staff in Dallas County, Texas begin to decline approximately 4 weeks after the distribution of the first COVID-19 vaccine, followed by the decline in COVID-19 cases and fatalities in nursing home residents approximately 2 weeks later.*

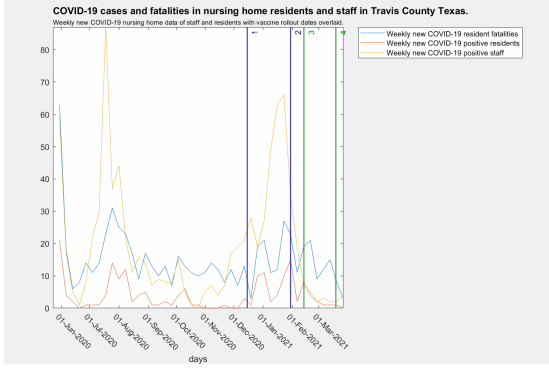

Figure 14: *New COVID-19 cases in nursing home staff in Travis County, Texas begin to decline approximately 5 weeks after the distribution of the first COVID-19 vaccine, followed by the decline in COVID-19 cases and fatalities in nursing home residents approximately 2 weeks later.*

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

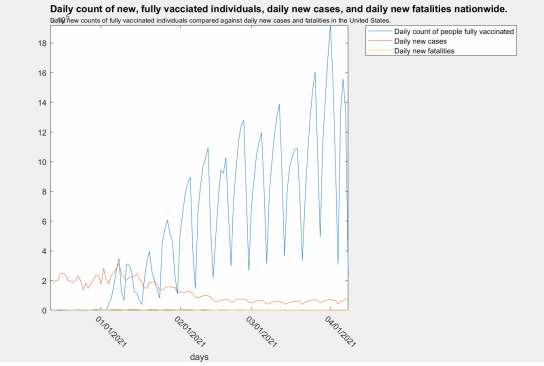

Figure 15: *A national timeline of daily new cases and fatalities due to COVID-19, plotted with daily new vaccines. According to the figure, as the rate of daily, new vaccinated individuals increases, daily new COVID-19 cases and fatalities decreases.*

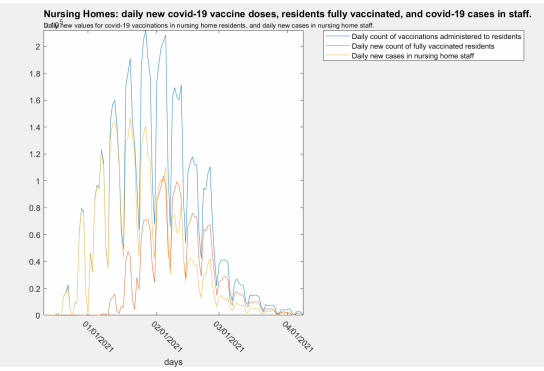

Figure 16: *A timeline of daily new COVID-19 vaccinations in long term care residents, daily count of new, fully vaccinated residents, and new COVID-19 cases in long term care staff.*

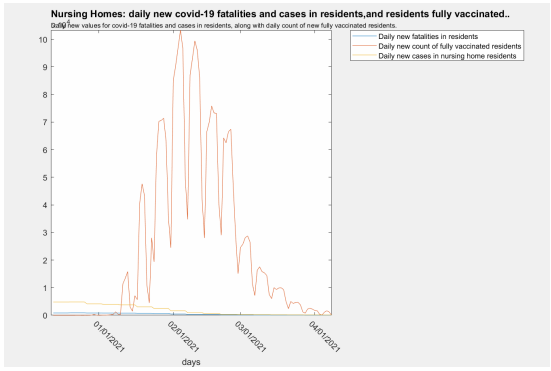

Figure 17: *A timeline of daily new COVID-19 cases and fatalities in long term care residents with daily new residents fully vaccinated.*

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.

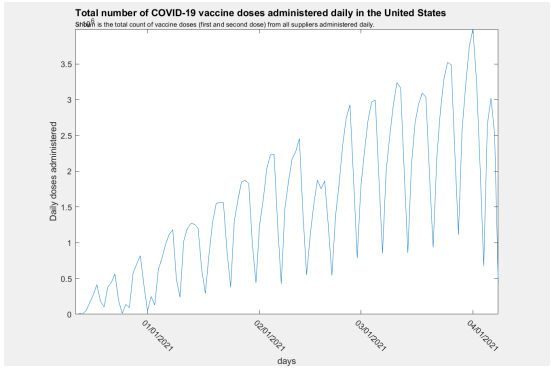

Figure 18: *Shown above is the daily count of COVID-19 vaccines administered daily in the United States. The count includes a first dose injection, a second dose injection, and a single-dose injection.*

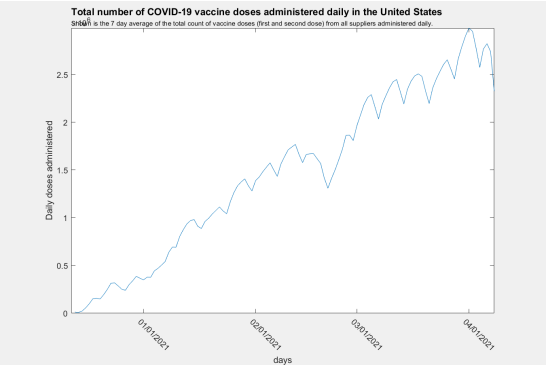

Figure 19: *Shown above is the rolling 7 day average of the count of COVID-19 vaccines administered daily in the United States. The count includes a first dose injection, a second dose injection, and a single-dose injection.*

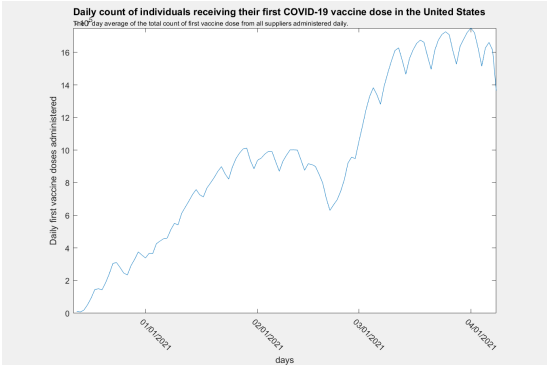

Figure 21: *Shown is the rolling 7 day average of individuals receiving their first COVID-19 vaccine dose in the United States.*

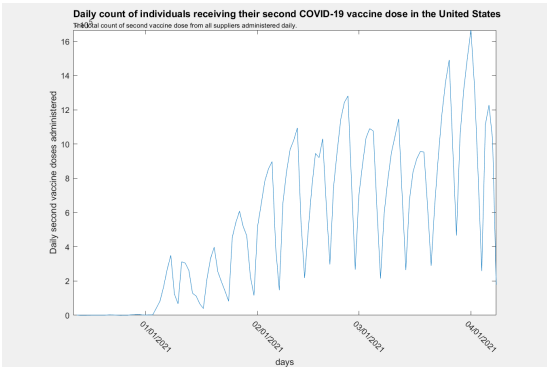

Figure 22: *Shown is the daily count of individuals receiving their second COVID-19 vaccine dose in the United States.*

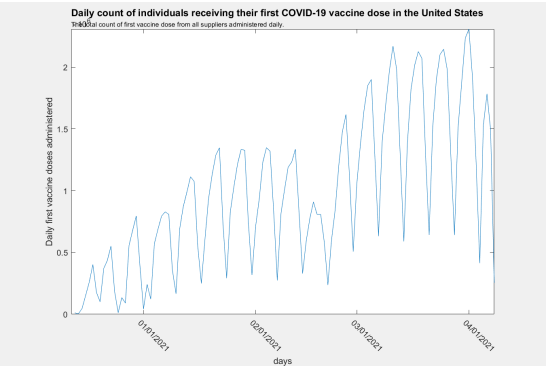

Figure 20: *Shown is the daily count of individuals receiving their first COVID-19 vaccine dose in the United States.*

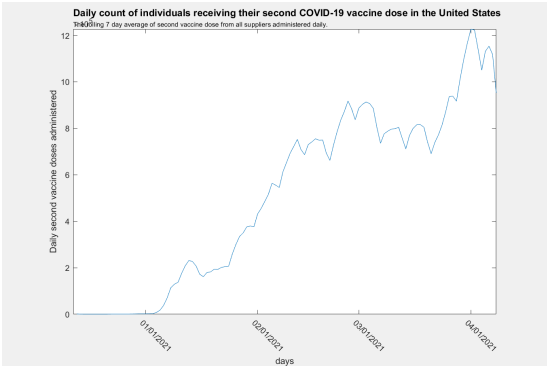

Figure 23: *Shown is the rolling 7 day average of individuals receiving their second COVID-19 vaccine dose in the United States.*

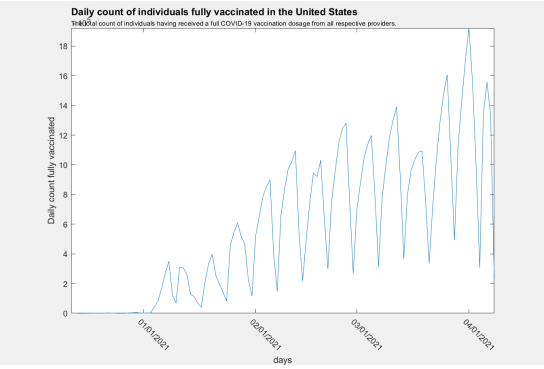

Figure 24: *Shown is the daily count of new individuas fully vaccinated in the United States.*

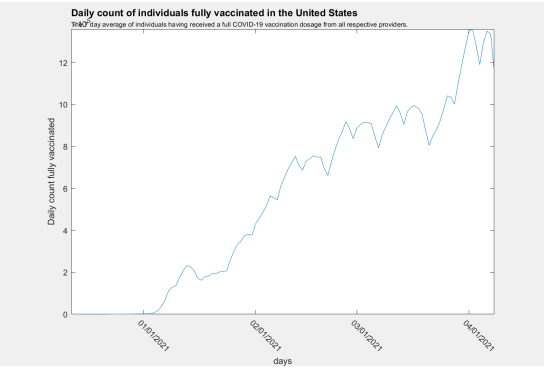

Figure 25: *Shown is the rolling 7 day average of new individuas fully vaccinated in the United States.*

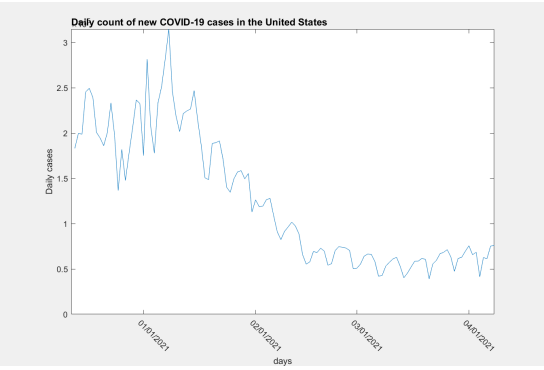

Figure 26: *Shown is the daily new count of individuals in the United States who have contracted COVID-19.*

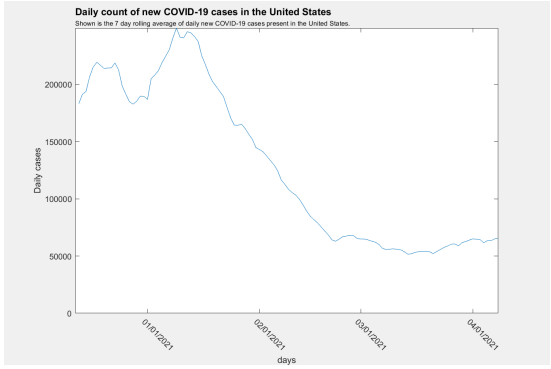

Figure 27: *Shown is the rolling 7 day average of individuals in the United States who have contracted COVID-19.*

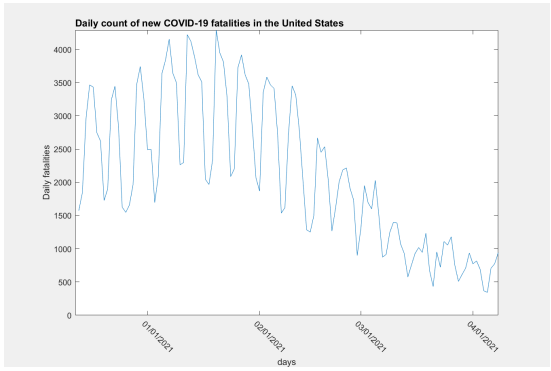

Figure 28: *Shown is the daily new count of deceased individuals in the United States who have died due to COVID-19.*

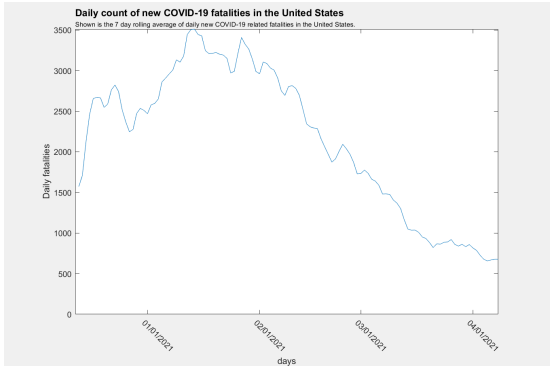

Figure 29: *Shown is the daily new count of deceased individuals in the United States who have died due to COVID-19.*

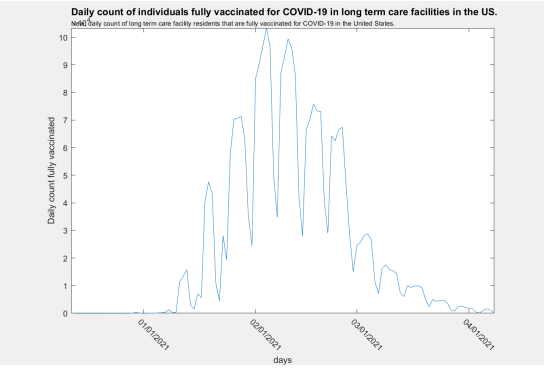

Figure 30: *Shown is the daily count for long term care residents who are fully vaccinated.*

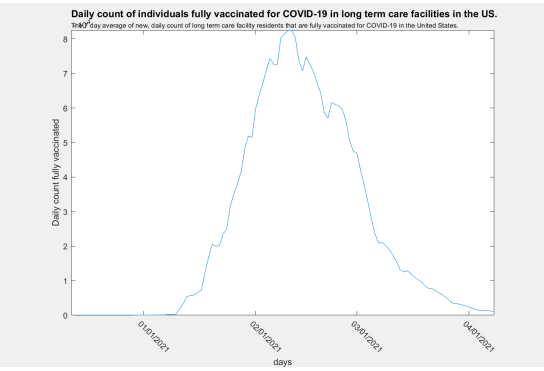

Figure 31: *Shown is the rolling 7 day average for long term care residents who are fully vaccinated.*

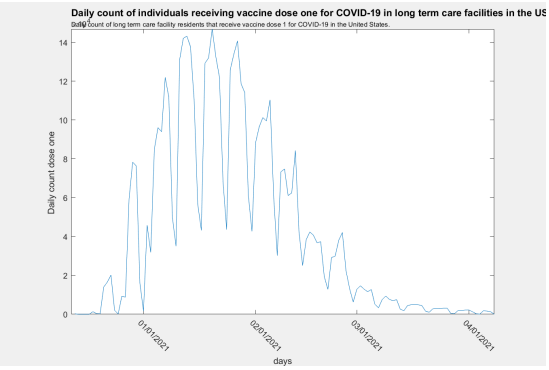

Figure 32: *Daily new count of nursing home residents who have received a first dose injection for COVID-19 vaccination.*

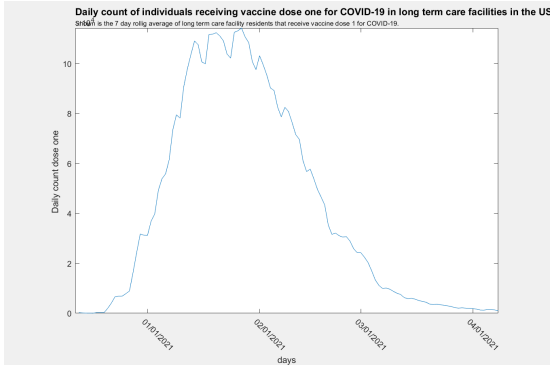

Figure 33: *Rolling 7 day average of nursing home residents who have received a first dose injection for COVID-19 vaccination*

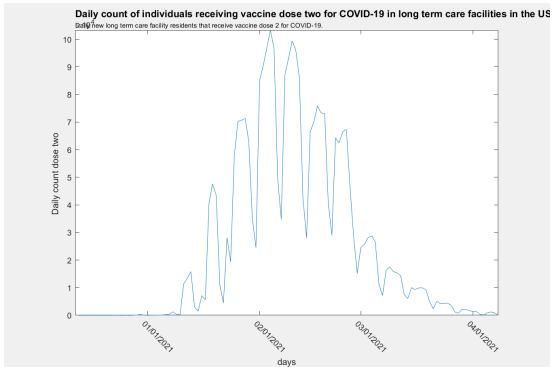

Figure 34: *Daily new count of nursing home residents who have received a second dose injection for COVID-19 vaccination.*

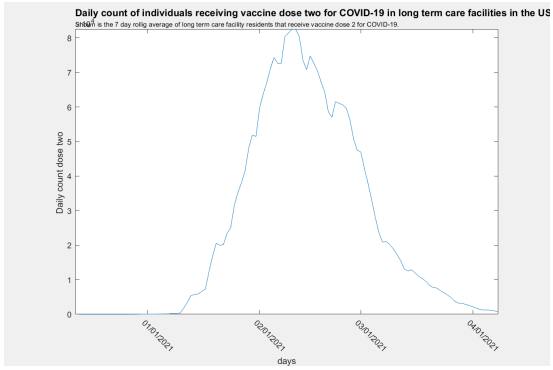

Figure 35: *Rolling 7 day average of nursing home residents who have received a second dose injection for COVID-19 vaccination.*

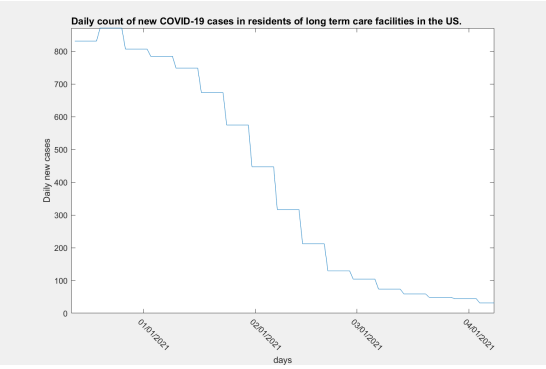

Figure 36: *Daily new COVID-19 cases in nursing home residents. *The data set has been modified from weekly to daily.*

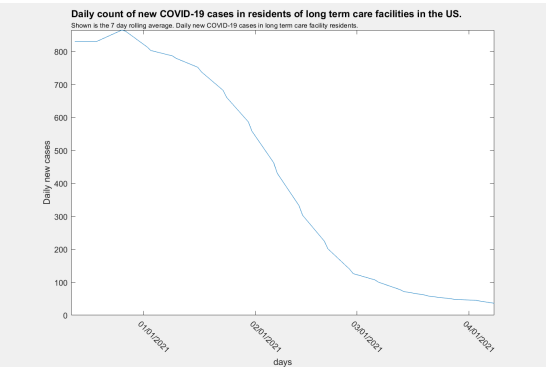

Figure 37: *Rolling 7 day average of COVID-19 cases in nursing home residents. *The data set has been modified from weekly to daily.*

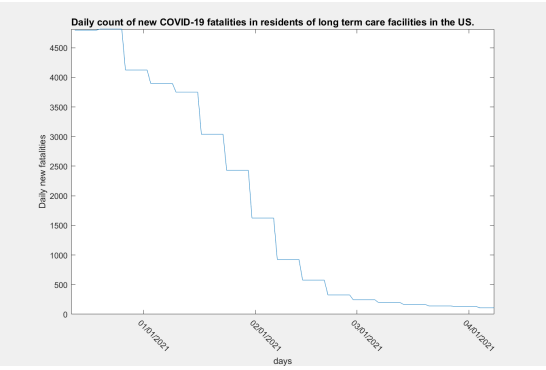

Figure 38: *Daily new COVID-19 related fatalities in nursing home residents. *The data set has been modified from weekly to daily.*

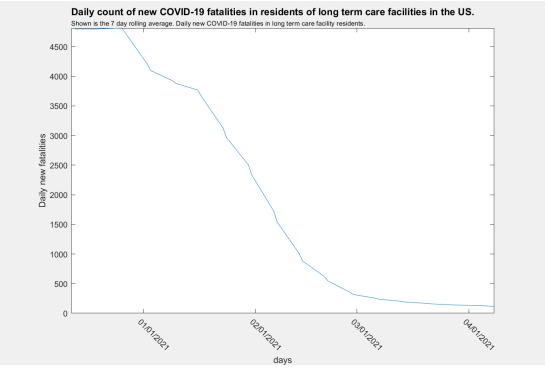

Figure 39: *Rolling 7 day average of COVID-19 related fatalities in nursing home residents. *The data set has been modified from weekly to daily.*

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

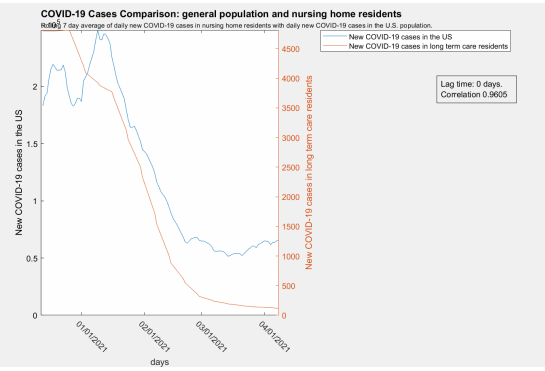

Figure 40: *Daily new COVID-19 cases in the general U.S. population and daily new COVID-19 cases in the nursing home population over time.*

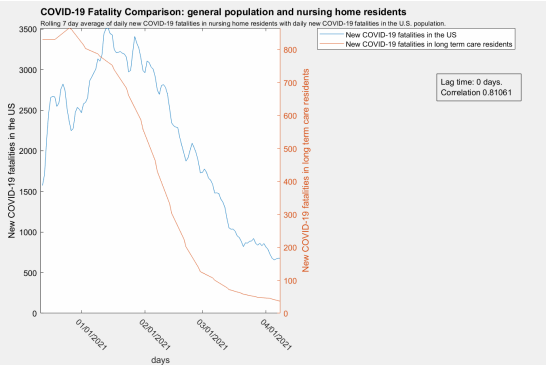

Figure 41: *Daily new COVID-19 fatalities in the general U.S. population and daily new COVID-19 fatalities in the nursing home population over time.*

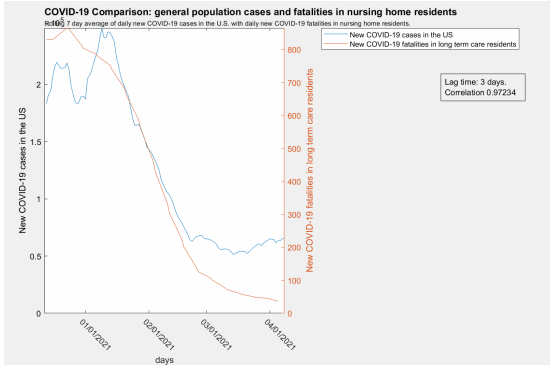

Figure 43: *Daily new COVID-19 cases in the general U.S. population and daily new COVID-19 fatalities in the nursing home population over time.*

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

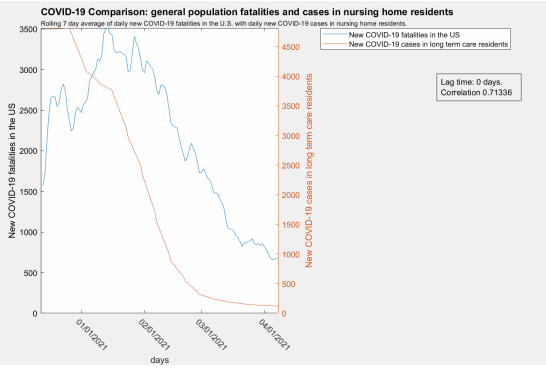

Figure 42: *Daily new COVID-19 fatalities in the general U.S. population and daily new COVID-19 cases in the nursing home population over time.*

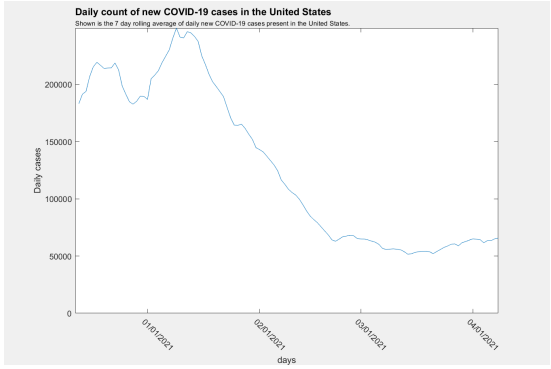

Figure 44: *Shown is the total number of daily, new COVID-19 cases in the US, with a 7 day moving average applied. This will be used as one of the normalization parameters.*

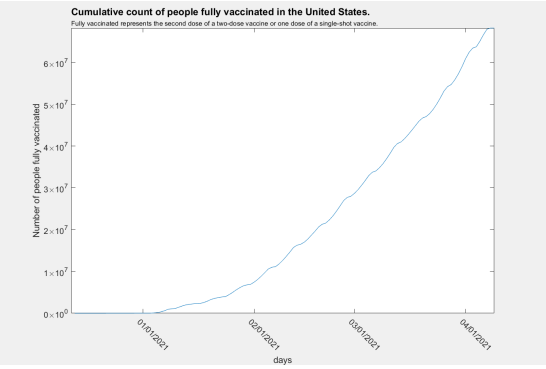

Figure 45: *Shown is the cumulative count of fully vaccinated individuals in the US over time. Fully vaccinated individuals refers to the individuals who have received the second dose of a two-dose vaccine or the shot of a single-dose vaccine.*

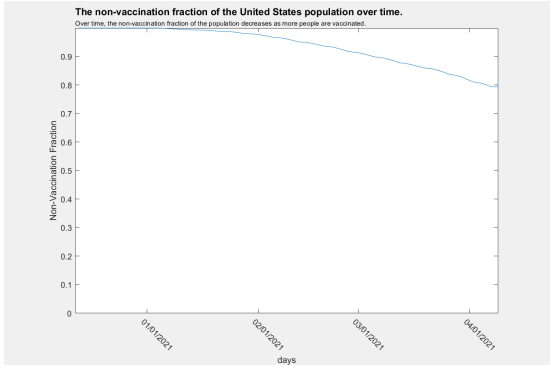

Figure 47: *Shown is the non-vaccination fraction of individuals in the US. The non-vaccination fraction is represented as the remainder of (1 - vacccination fraction). The non-vaccination fraction represents the proportion of individuals in the US who are not vaccinated for COVID-19.*

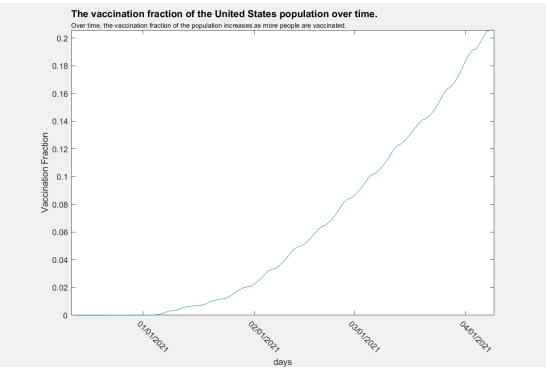

Figure 46: *Shown is the vaccination fraction of individuals in the US. The vaccination fraction is an iterative calculation that takes the ratio of individuals fully vaccinated to the total US population. The total US population used is: 331,449,281 per US.Census.gov.*

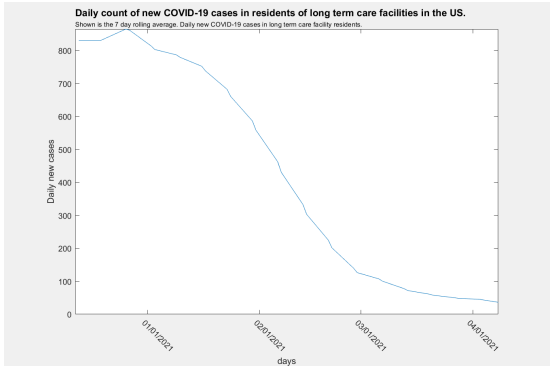

Figure 48: *Shown is the total number of daily, new COVID-19 cases in the long term care population, with a 7 day moving average applied. This will be used as one of the normalization parameters.*

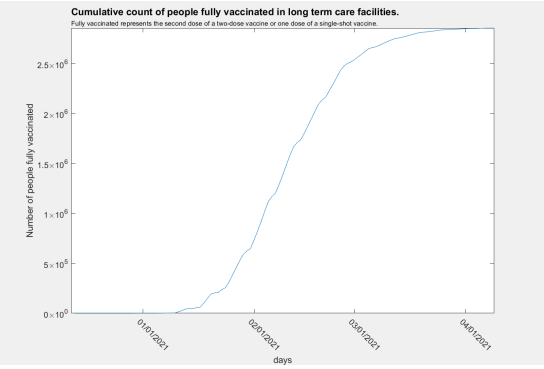

Figure 49: *Shown is the cumulative count of fully vaccinated individuals in long term care facilities over time. Fully vaccinated individuals refers to the individuals who have received the second dose of a two-dose vaccine or the shot of a single-dose vaccine.*

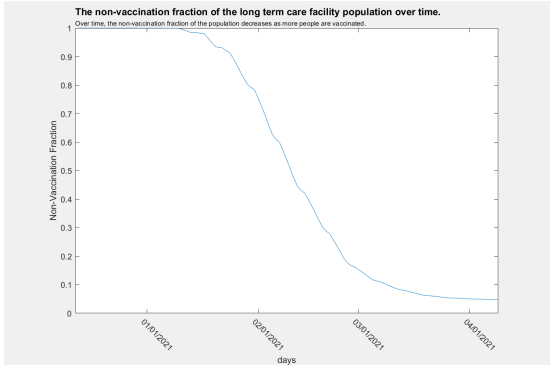

Figure 51: *Shown is the non-vaccination fraction of individuals in long term care facilities. The non-vaccination fraction is represented as the remainder of (1 - vaccination fraction). The non-vaccination fraction represents the proportion of individuals in the US who are not vaccinated for COVID-19.*

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

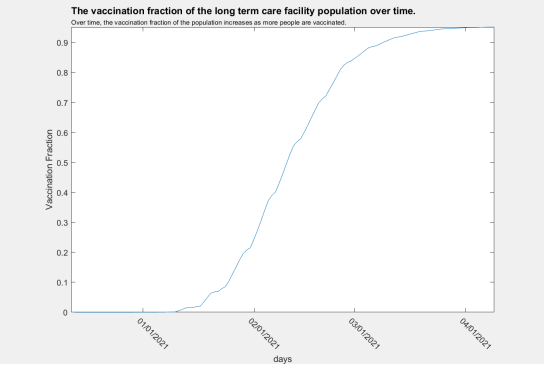

Figure 50: *Shown is the vaccination fraction of individuals in long term care facilities. The vaccination fraction is an iterative calculation that takes the ratio of individuals fully vaccinated to the total long term care population. The total LTC population used is: 3,000,000 per nih.gov publishing.*

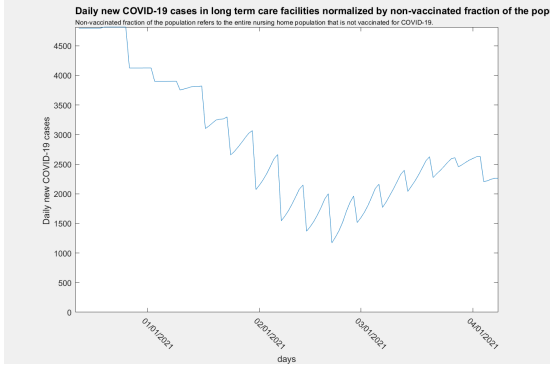

Figure 52: *Shown are the daily new COVID-19 cases in long term care facilities normalized by the percent of the LTC population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a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

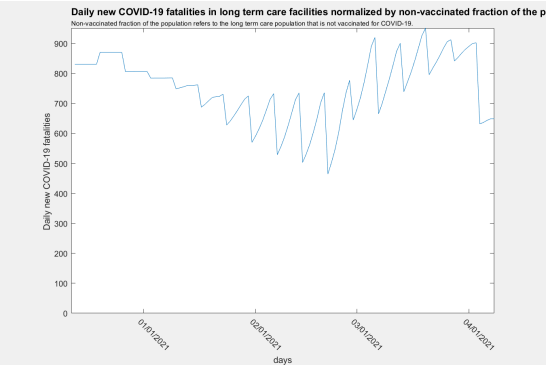

Figure 53: *Shown are the daily new COVID-19 fatalities in long term care facilities normalized by the percent of the LTC population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot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

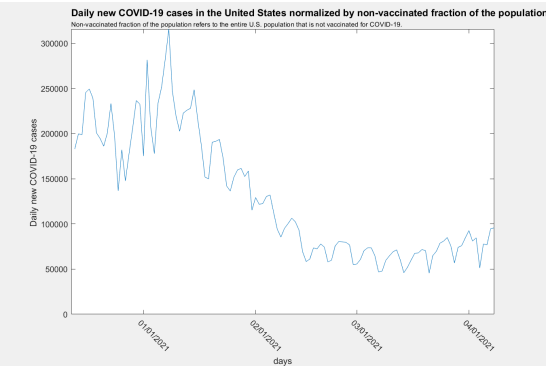

Figure 54: *Shown are the daily new COVID-19 cases in the United States normalized by the percent of the U.S. population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a single-dose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

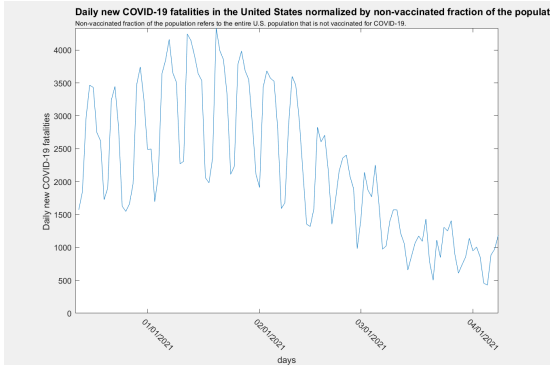

Figure 55: *Shown are the daily new COVID-19 fatalities in the United States normalized by the percent of the U.S. population that is not yet fully vaccinated for COVID-19 (meaning the percent of the population that has not yet received a second shot of a two-dose vaccination or a single shot for a single-dose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