<u>CSE 544 - Final Project</u>
<u>Analyzing Covid Dataset</u>

<u>Part 1 - Data Cleaning</u>

COVID cases and deaths dataset

- First we selected the data for the two states assigned to us: Connecticut (CT) and Florida (FL).
- Step 1: Removing missing (NAN) values
    - There were no rows with missing values for the columns of interest in either state's data, i.e. the columns corresponding to total cases, total deaths, new cases and new deaths.
- Step 2: Daily data from cumulative data
    - From the given total cases which are cumulative, we compute the daily values by subtracting the value of the previous rows. This comes out to be the same as the column corresponding to new cases in the dataset.
- Step 3: Sanitizing data
    - In both derived and given daily new cases, we observe that the values for some days are negative. We change them to 0. These negative cases could be attributed to the adjustment in cases that is done for the overall tally. Logically, we assume that there are no new cases on that day.
    - Note: There were negative values in the data for Connecticut.
        - 2 negative values in daily data for col tot_cases
        - 19 negative values in daily data for col tot_death
- Step 4: Outlier removal using Tukey's rule. Note: The entire date range is considered for outlier removal.
    - Connecticut:
        - <u>Cases:</u> Outlier count: 85, lower_threshold: -1259.5, upper_threshold: 2160.5, IQR: 855.0
        - <u>Deaths:</u> Outlier count: 100, lower_threshold: -22.5, upper_threshold: 37.5, IQR: 15.0
        - Total outlier rows removed: 150 (after taking union of the two above and removing those with 0 values)
    - Florida:
        - <u>Cases:</u> Outlier count: 68, lower_threshold: -8867.5, upper_threshold: 19176.5, IQR: 7011.0
        - <u>Deaths:</u> Outlier count: 38, lower_threshold: -106.0, upper_threshold: 262.0, IQR: 92.0
        - Total outlier rows removed: 89 (after taking union of the two above and removing those with 0 values)

COVID vaccinations dataset

- First we selected the data for the two states assigned to us: Connecticut (CT) and Florida (FL).
- Step 1: Removing missing (NAN) values
    - There were no rows with missing values for the columns of interest in either state's data, i.e. the columns corresponding to administered vaccines.
- Step 2: Daily data from cumulative data
    - From the given total cases which are cumulative, we compute the daily values by subtracting the value of the previous rows.
- Step 3: Sanitizing data
    - Unlike the COVID cases and deaths dataset for Connecticut, we do not observe any negative values after computing daily values.
- Step 4: Outlier removal using Tukey's rule. Note: The entire date range is considered for outlier removal.
    - Connecticut:
        - <u>Administered vaccines:</u> Outlier count: 19, lower_threshold: -17617.5, upper_threshold: 44930.5, IQR: 15637.0
        - Total outlier rows removed: 19
    - Florida:
        - <u>Administered vaccines:</u> 41, lower_threshold: -77903.5, upper_threshold: 195356.5, IQR: 68315.0
        - Total outlier rows removed: 41

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<u>Part 2 - Mandatory Analysis</u>

Subpart A - Mean Hypothesis Test

**** WALD'S ONE SAMPLE TEST ****
Testing null hypothesis that the mean of daily **new_cases** in Feb 2021 is same as March 2021 for state - **Florida**
True Mean = 6444.04, Sample Mean = 4940.74, Standard Error = 12.62
Rejected null hypothesis as the **Walds Statistic 119.08** is greater than the critical value 1.96 specified.

**** WALD'S ONE SAMPLE TEST ****
Testing null hypothesis that the mean of daily **new_deaths** in Feb 2021 is same as March 2021 for state - **Florida**
True Mean = 122.86, Sample Mean = 62.58, Standard Error = 1.42
Rejected null hypothesis as the **Walds Statistic 42.42** is greater than the critical value 1.96 specified.

**** WALD'S ONE SAMPLE TEST ****
Testing null hypothesis that the mean of daily **new_cases** in Feb 2021 is same as March 2021 for state - **Connecticut**
True Mean = 605.17, Sample Mean = 723.41, Standard Error = 5.18
Rejected null hypothesis as the **Walds Statistic 22.84** is greater than the critical value 1.96 specified.

**** WALD'S ONE SAMPLE TEST ****
Testing null hypothesis that the mean of daily **new_deaths** in Feb 2021 is same as March 2021 for state - **Connecticut**
True Mean = 13.74, Sample Mean = 6.85, Standard Error = 0.50
Rejected null hypothesis as the **Walds Statistic 13.67** is greater than the critical value 1.96 specified.

**** T TEST ****
Testing null hypothesis that the mean of daily **new_cases** in Feb 2021 is same as March 2021 for state - **Florida**
True Mean = 6444.04, Sample Mean = 4940.74, Standard Deviation = 988.98
Rejected null hypothesis as the **T Statistic 8.463** is greater than the critical value 2.04 specified.

**** T TEST ****
Testing null hypothesis that the mean of daily **new_deaths** in Feb 2021 is same as March 2021 for state - **Florida**
True Mean = 122.86, Sample Mean = 62.58, Standard Deviation = 13.48
Rejected null hypothesis as the **T Statistic 24.902** is greater than the critical value 2.04 specified.

**** T TEST ****
Testing null hypothesis that the mean of daily **new_cases** in Feb 2021 is same as March 2021 for state - **Connecticut**
True Mean = 605.17, Sample Mean = 723.41, Standard Deviation = 604.38
Accepted null hypothesis as the **T Statistic 1.017** is less than or equal to the critical value 2.06 specified.

**** T TEST ****
Testing null hypothesis that the mean of daily **new_deaths** in Feb 2021 is same as March 2021 for state - **Connecticut**
True Mean = 13.74, Sample Mean = 6.85, Standard Deviation = 6.36
Rejected null hypothesis as the T Statistic 5.626 is greater than the critical value 2.06 specified.

**** Z-TEST ****
Testing null hypothesis that the mean of daily **new_cases** in Feb 2021 is same as March 2021 for state - **Florida**
Mean X = 4940.74, Mean Y = 6444.04, Standard Deviation = 3982.87
Rejected null hypothesis as the **Z Statistic 2.1 i**s greater than the critical value 1.96 specified.

**** Z-TEST ****
Testing null hypothesis that the mean of daily **new_deaths** in Feb 2021 is same as March 2021 for state - **Florida**
Mean X = 62.58, Mean Y = 122.86, Standard Deviation = 59.90
Rejected null hypothesis as the **Z Statistic 5.6** is greater than the critical value 1.96 specified.

**** Z-TEST ****
Testing null hypothesis that the mean of daily **new_cases** in Feb 2021 is same as March 2021 for state - **Connecticut**
Mean X = 723.41, Mean Y = 605.17, Standard Deviation = 494.41
Accepted null hypothesis as the **Z Statistic 1.24** is less than or equal to the critical value 1.96 specified.

**** Z-TEST ****
Testing null hypothesis that the mean of daily **new_deaths** in Feb 2021 is same as March 2021 for state - **Connecticut**
Mean X = 6.85, Mean Y = 13.74, Standard Deviation = 7.98
Rejected null hypothesis as the **Z Statistic 4.49** is greater than the critical value 1.96 specified.

**** WALD'S TWO SAMPLE TEST ****
Testing null hypothesis that the difference in mean of daily **new_cases** in Feb 2021 and March 2021 is zero for state - **Florida**
Mean X = 6444.04, Mean Y = 4940.74, Standard Error = 19.74
Rejected null hypothesis as the **Wald's Statistic 76.17** is greater than the critical value 1.96 specified.

**** WALD'S TWO SAMPLE TEST ****
Testing null hypothesis that the difference in mean of daily **new_deaths** in Feb 2021 and March 2021 is zero for state - Florida
Mean X = 122.86, Mean Y = 62.58, Standard Error = 2.53
Rejected null hypothesis as the **Wald's Statistic 23.81** is greater than the critical value 1.96 specified.

**** WALD'S TWO SAMPLE TEST ****
Testing null hypothesis that the difference in mean of daily **new_cases** in Feb 2021 and March 2021 is zero for state - **Connecticut**
Mean X = 605.17, Mean Y = 723.41, Standard Error = 7.29
Rejected null hypothesis as the **Wald's Statistic 16.22** is greater than the critical value 1.96 specified.

**** WALD'S TWO SAMPLE TEST ****
Testing null hypothesis that the difference in mean of daily **new_deaths** in Feb 2021 and March 2021 is zero for state - **Connecticut**
Mean X = 13.74, Mean Y = 6.85, Standard Error = 0.92

Rejected null hypothesis as the **Wald's Statistic 7.47** is greater than the critical value 1.96 specified.

**** T TEST UNPAIRED ****
Testing null hypothesis that the difference in mean of daily **new_cases** in Feb 2021 and March 2021 is zero for state - **Florida**
Mean X = 6444.04, Mean Y = 4940.74, Standard Deviation = 375.54
Rejected null hypothesis as the **T Statistic 4.0** is greater than the critical value 2.0 specified.

**** T TEST UNPAIRED ****
Testing null hypothesis that the difference in mean of daily **new_deaths** in Feb 2021 and March 2021 is zero for state - **Florida**
Mean X = 122.86, Mean Y = 62.58, Standard Deviation = 6.14
Rejected null hypothesis as the **T Statistic 9.82** is greater than the critical value 2.0 specified.

**** T TEST UNPAIRED ****
Testing null hypothesis that the difference in mean of daily **new_cases** in Feb 2021 and March 2021 is zero for state - **Connecticut**
Mean X = 605.17, Mean Y = 723.41, Standard Deviation = 157.60
Accepted null hypothesis as the **T Statistic 0.75** is less than or equal to the critical value 2.01 specified.

**** T TEST UNPAIRED ****
Testing null hypothesis that the difference in mean of daily **new_deaths** in Feb 2021 and March 2021 is zero for state - **Connecticut**
Mean X = 13.74, Mean Y = 6.85, Standard Deviation = 2.78
Rejected null hypothesis as the **T Statistic 2.47** is greater than the critical value 2.01 specified.

Validity of Hypothesis Test on the given Dataset

- Wald's test
    - Wald's test requires that the estimator be asymptotically normal. According to the Central Limit Theorem asymptotic normality kicks in on data size >= 31
    - The dataset for Connecticut has only 27 rows in March so both the one sample and two sample Wald's test are not applicable
    - The dataset for Florida has 31 rows in March but only 28 in February. So, the one sample test is applicable here as AN kicks in but the two sample test is not applicable
- T-test
    - The main assumption while conducting the T-test is that the data is normally distributed. Since that is not the case for us both unpaired and single sample T-test are invalid
- Z-test
    - Z test is helpful when the standard deviation of the distribution is known and the distribution is normal or for larger datasets asymptotically normal

- Since we are calculating the standard deviation of each state and the exact deviation of the underlying distribution is not known, the Z test may not be applicable here.
- Moreover the distribution of the data is not Normal(given Poisson) and the dataset size is > 30 for only Florida. So the Z-test is not applicable due to these reasons

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Subpart B - Inference of equality of distributions

All applicable tests reject the null hypothesis, implying that the distribution of daily new cases and deaths for the two states is NOT the same for the given period from Oct to Dec 2021.

**** TWO SAMPLE KS TEST ****
Testing null hypothesis that the distribution of daily **new_cases** from Oct to Dec 2021 is same for the two states - Connecticut and Florida.
Rejected null hypothesis as the **d statistic value 0.8686** is greater than the given critical value 0.05.

**** TWO SAMPLE KS TEST ****
Testing null hypothesis that the distribution of daily **new_deaths** from Oct to Dec 2021 is same for the two states - Connecticut and Florida.
Rejected null hypothesis as the **d statistic value 0.9477** is greater than the given critical value 0.05.

**** PERMUTATION TEST ****
Testing null hypothesis that the distribution of daily **new_cases** from Oct to Dec 2021 is same for the two states - Connecticut and Florida.
T-obs value = 2293.4681
Rejected null hypothesis as the **p-value is 0.0**, which is lesser than the given critical value 0.05.

**** PERMUTATION TEST ****
Testing null hypothesis that the distribution of daily **new_deaths** from Oct to Dec 2021 is same for the two states - Connecticut and Florida.
T-obs value = 47.1481
Rejected null hypothesis as the **p-value is 0.0**, which is lesser than the given critical value 0.05.

**** ONE SAMPLE KS TEST - POISSON ****
Testing null hypothesis that the distribution of daily **new_cases** from Oct to Dec 2021 is same for the two states, by estimating the MME parameter of Poisson distribution from Connecticut data and testing for Florida.
MME value for lambda: 496.68 (on Connecticut data)

Rejected null hypothesis as the **d statistic value 1.0** is greater than the given critical value 0.05.

**** ONE SAMPLE KS TEST - POISSON ****
Testing null hypothesis that the distribution of daily **new_deaths** from Oct to Dec 2021 is same for the two states, by estimating the MME parameter of Poisson distribution from Connecticut data and testing for Florida.
MME value for lambda: 3.0 (on Connecticut data)
Rejected null hypothesis as the **d statistic value 1.0** is greater than the given critical value 0.05.

**** ONE SAMPLE KS TEST - GEOMETRIC ****
Testing null hypothesis that the distribution of daily **new_cases** from Oct to Dec 2021 is same for the two states, by estimating the MME parameter of Geometric distribution from Connecticut data and testing for Florida.
MME value for p: 0.0020 (on Connecticut data)
Rejected null hypothesis as the **d statistic value 0.8382** is greater than the given critical value 0.05.

**** ONE SAMPLE KS TEST - GEOMETRIC ****
Testing null hypothesis that the distribution of daily **new_deaths** from Oct to Dec 2021 is same for the two states, by estimating the MME parameter of Geometric distribution Connecticut data and testing for Florida.
MME value for p: 0.3333 (on Connecticut data)
Rejected null hypothesis as the **d statistic value 0.999** is greater than the given critical value 0.05.

**** ONE SAMPLE KS TEST - BINOMIAL ****
Testing null hypothesis that the distribution of daily **new_cases** from Oct to Dec 2021 is same for the two states, by estimating the MME parameter of Binomial distribution from Connecticut data and testing for Florida.
MME value for n: -0.9038 (on Connecticut data)
MME value for p: -549.5698 (on Connecticut data)
The assumption that this data is binomially distributed might be incorrect, so would not be useful for testing our inference.

**** ONE SAMPLE KS TEST - BINOMIAL ****
Testing null hypothesis that the distribution of daily **new_deaths** from Oct to Dec 2021 is same for the two states, by estimating the MME parameter of Binomial distribution Connecticut data and testing for Florida.
MME value for n: -0.2923 (on Connecticut data)
MME value for p: -10.2622 (on Connecticut data)
The assumption that this data is binomially distributed might be incorrect, so would not be useful for testing our inference.

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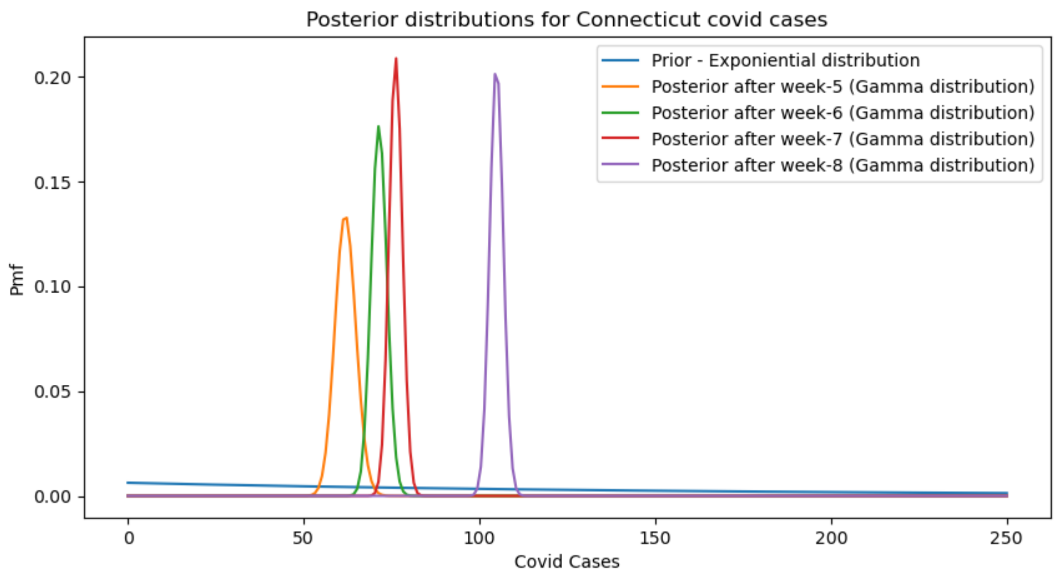
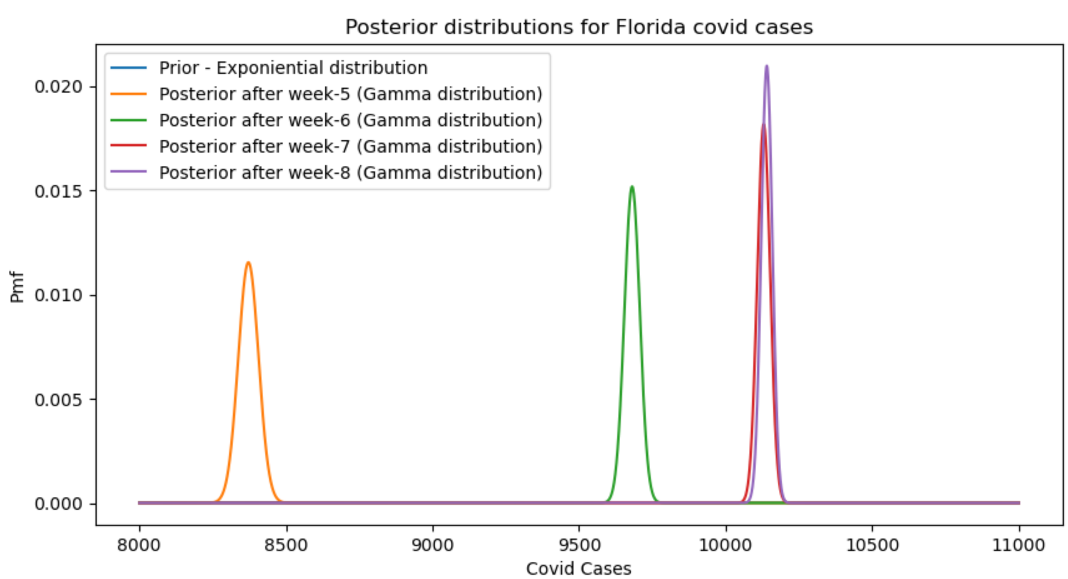
Subpart C - Bayesian Inference

----------- Connecticut stats --------------



MAP for posterior after week 5: 62
MAP for posterior after week 6: 71
MAP for posterior after week 7: 76
MAP for posterior after week 8: 104

----------- Florida stats --------------



MAP for posterior after week 5: 8372
MAP for posterior after week 6: 9680
MAP for posterior after week 7: 10129
MAP for posterior after week 8: 10140

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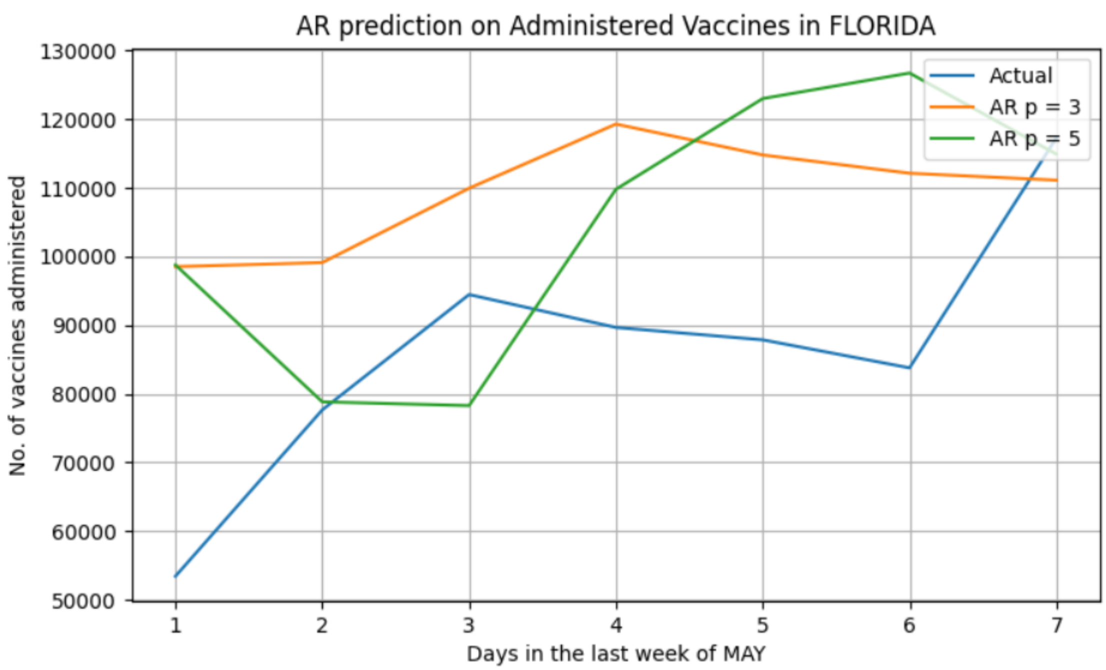
Subpart D - AR and EWMA
Datasets used : 1. clean_fl_vax.csv
2. clean_ct_vax.csv

Results for AR:

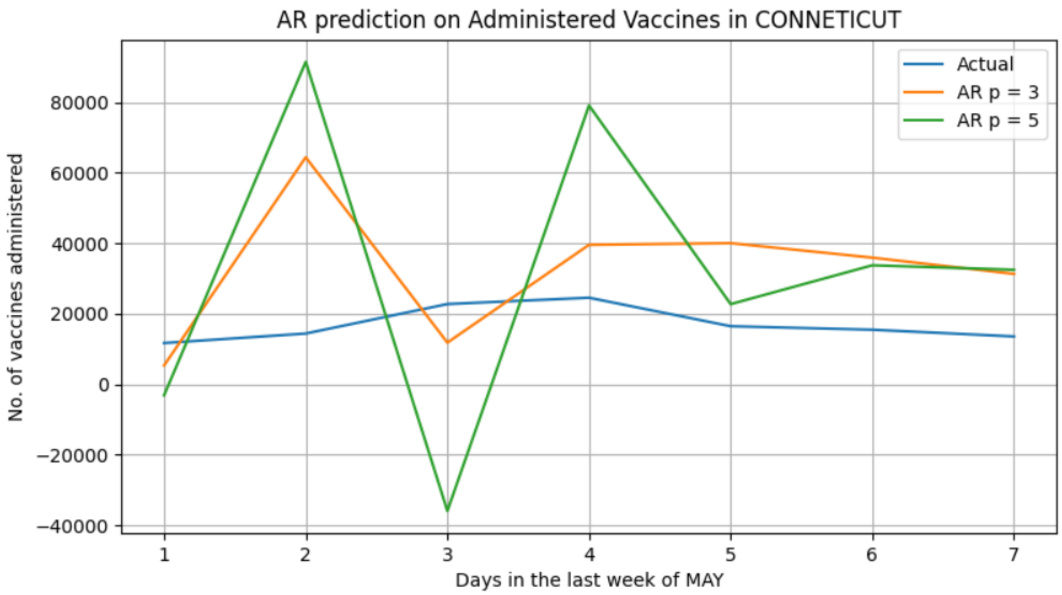
Florida state : MSE of AR with p = 5 is 829267172.6180378
Florida state : MAPE of AR with p = 5 is 31.307592050677094

Florida state : MSE of AR with p = 3 is 739274278.7641994
Florida state : MAPE of AR with p = 3 is 33.018925510119836



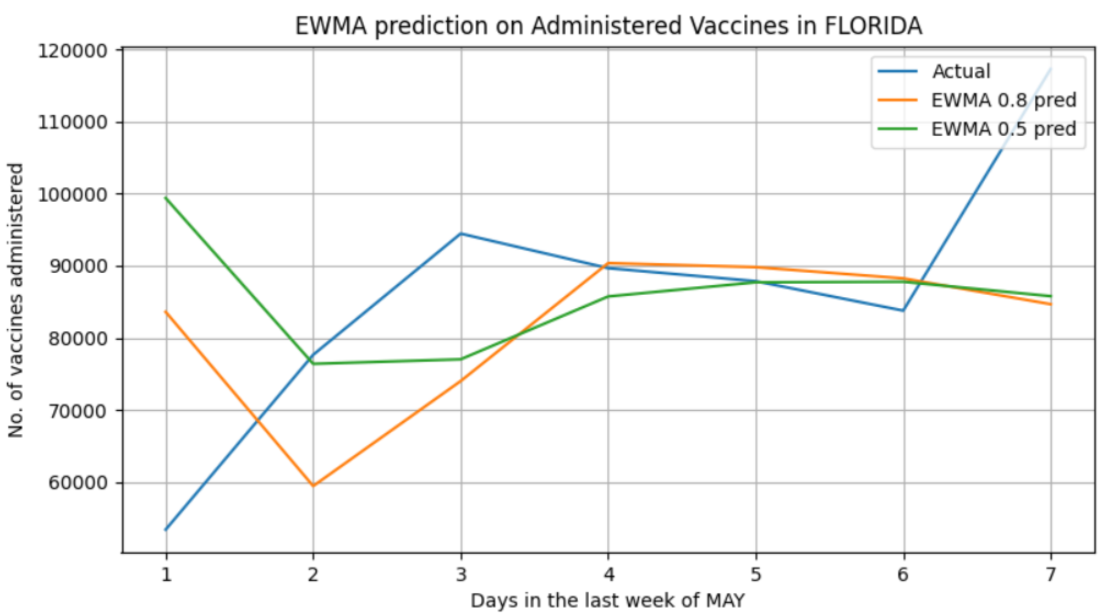
Connecticut state : MSE of AR with p = 5 is 1898593695.291856
Connecticut state : MAPE of AR with p = 5 is 205.0479699332696

Connecticut state : MSE of AR with p = 3 is 595637903.3929976
Connecticut state : MAPE of AR with p = 3 is 130.79599564489774



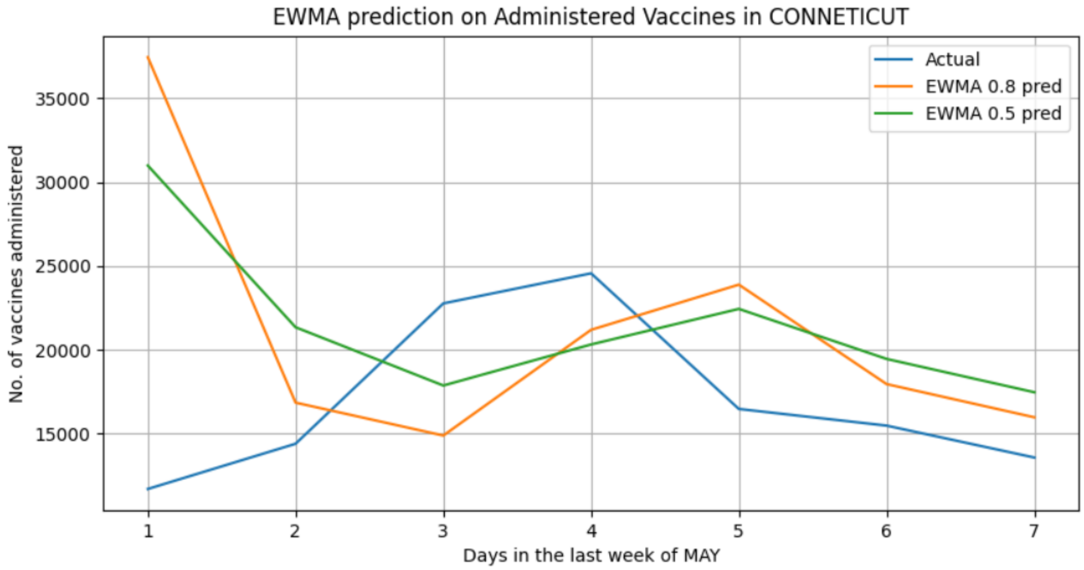
Results for EWMA:
Florida state : MSE of EWMA with alpha = 0.5 is 491210072.75293267
Florida state : MAPE of EWMA with alpha = 0.5 is 20.315775911433764

Florida state : MSE of EWMA with alpha = 0.8 is 392155199.0659545
Florida state : MAPE of EWMA with alpha = 0.8 is 19.662692116925534



Connecticut state : MSE of EWMA with alpha = 0.5 is 75390911.36785716
Connecticut state : MAPE of EWMA with alpha = 0.5 is 48.8319483281303

Connecticut state : MSE of EWMA with alpha = 0.8 is 115367230.24892072
Connecticut state : MAPE of EWMA with alpha = 0.8 is 51.91457208166833



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Subpart E - Paired T-test

Results for paired T-test:

(Null Hypothesis) **H0:**
Mean of vaccines administered for september 2021 in florida = mean of vaccines administered for september 2021 in connecticut.

T value for Paired T-test for means of number of vaccines administered between Florida state and Connecticut State for september 2021 :- 8.635195067497035
-> We are rejecting the null hypothesis since the absolute value of T is greater than T(30,0.025) = 2.042

(Null Hypothesis) **H0:**
Mean of vaccines administered for november 2021 in florida = mean of vaccines administered for november 2021 in connecticut.

T value for Paired T-test for means of number of vaccines administered between Florida state and Connecticut State for november 2021:- 10.217237395908846
-> We are rejecting the null hypothesis since the absolute value of T is greater than T(30,0.025) = 2.042

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Part 3 - Exploratory Analysis:

Preprocessing:

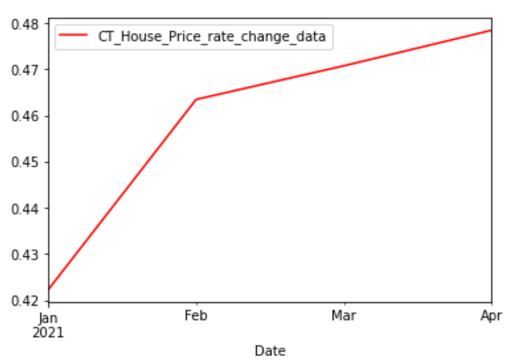
X dataset is of the house prices in Connecticut each month from 2020 to 2022. We have generated a new column which indicates the percentage change in the House price per month. In both the Cases and Vaccination datasets, mean of daily count per month has been used as monthly count data.
All the data available has been normalized using min-max normalization.

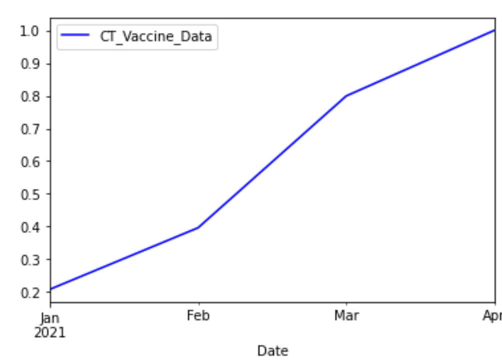
A. Pearson Correlation for case, vaccine and house rate data between Jan 2021 to May 2021 (Connecticut)

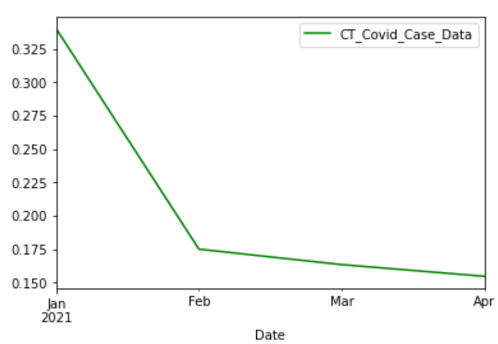
Below are a few events listed which have impacted the data in consideration

January 4: Healthcare workers began receiving scheduled second vaccination doses for those who had already received one dose.
February 1: The mandatory closing time for dine-in restaurants was moved from 10 PM to 11 PM. Mask guidelines, social distancing recommendations, and the 50% capacity limit on houses of worship were left unchanged, but the numerical cap on group size was lifted.
February 8: As of this date, more than 50% of the population 75 years old or older was partially vaccinated, leading to the announcement that vaccinations would be opened to those 65 or older.
May 3: Connecticut was the first state to fully vaccinate 50% of its adult population.

Graph for each dataset:







Calculation of Pearson Correlation between 3 possibilities:

Case 1: Mean Monthly Covid Case Count vs Mean Monthly Vaccination Count

H0: Mean Monthly Covid Case Count and Mean Monthly Vaccination Count are not linearly correlated
H1: Mean Monthly Covid Case Count and Mean Monthly Vaccination Count are linearly correlated

Calculated Value = -0.78351845
As |-0.78351845| > 0.5, We reject the null hypothesis
Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count have a **negative linear correlation**

Case 2: Mean Monthly House Price Change Rate vs Mean Monthly Covid Case Count

H0: Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count are not linearly correlated
H1: Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count are linearly correlated

Calculated Value = -0.98832128
As |-0.98832128| > 0.5, We reject the null hypothesis

Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count have a **negative linear correlation**

Case 3: Mean Monthly House Price Change Rate vs Mean Monthly Vaccination Count

H0: Mean Monthly House Price Change Rate and Mean Monthly Vaccination Count are not linearly correlated
H1: Mean Monthly House Price Change Rate and Mean Monthly Vaccination Count are linearly correlated

Calculated Value = 0.86542085
As |0.86542085| > 0.5, We reject the null hypothesis

Mean Monthly House Price Change Rate and Mean Monthly Vaccination Count have a **positive linear correlation**

Results:
House price rate change and Vaccination count have a positive linear correlation with each other and a negative linear correlation with Covid Case Count between January 2021 and May 2021. According to the timeline of COVID in Connecticut during this time range (mentioned earlier), it can be deduced that increase in vaccination has positively impacted the Connecticut

real estate industry and has led to reduction in the Covid cases. All 3 data sets are linearly correlated to one another.

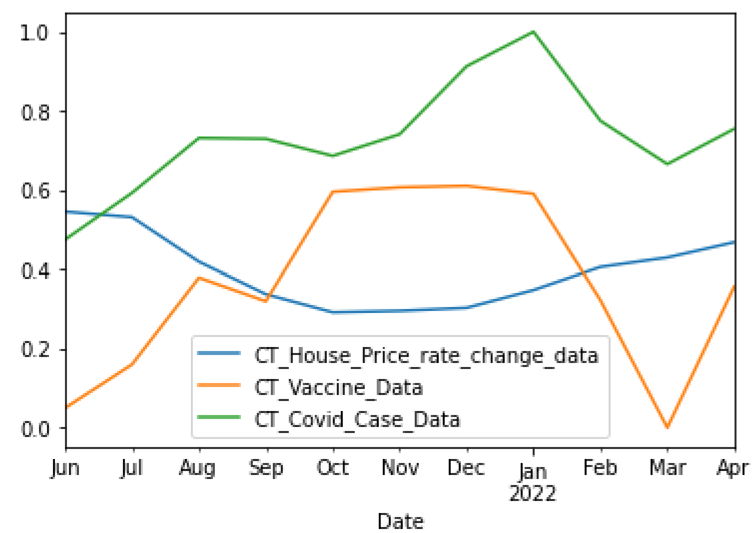
B. Pearson Correlation for case, vaccine and house rate data between June 2021 to May 2022 (Connecticut)

Below are a few events listed which have impacted the data in consideration

June 1, 2021: The Delta variant, first identified in India in late 2020, becomes the dominant variant in the U.S. The variant kicks off a third wave of infections during the summer of 2021. The present vaccination was about 90% effective against the delta variant and the cases kept increasing

November 26, 2021: World Health Organization classifies a new variant, Omicron, as a variant of concern after it was first reported by scientists in South Africa. The variant has several mutations in the spike protein that concern scientists around the world. The present vaccination was about not effective against the omicron variant and hence we see the spike in cases

Graph for each dataset:



Calculation of Pearson Correlation between 2 possibilities:

Case 1: Mean Monthly House Price Change Rate vs Mean Monthly Covid Case Count

H0: Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count are not linearly correlated
H1: Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count are linearly correlated

Calculated Value = -0.647678754
As |-0.647678754| > 0.5, We reject the null hypothesis
Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count have a **negative linear correlation**

Case 2: Mean Monthly House Price Rate Change vs Mean Monthly Vaccination Count

H0: Mean Monthly House Price Change Rate and Mean Monthly Vaccination Count are not linearly correlated
H1: Mean Monthly House Price Change Rate and Mean Monthly Vaccination Count are linearly correlated

Calculated Value = -0.8194726285
As |-0.8194726285| > 0.5, We reject the null hypothesis

Mean Monthly House Price Change Rate and Mean Monthly Vaccination Count have a **negative linear correlation**

Results:
House prices and vaccination counts have a negative linear correlation. This may be attributed to the advent of omicron and delta variants and hence this trend is different to the one seen in part a.

C. Chi-Square testing to check independence of data samples

1. **Check the independence between housing price change rate and administration of different vaccines in the state of Connecticut.**

H0: Housing price change rate (HPCR) is independent of vaccine administration in the state of Connecticut
H1: Housing price change rate (HPCR) is dependent on vaccine administration in the state of Connecticut

	Pfizer	Janssen	Moderna	Total
Max house price rate change	247857	16575	102437	366869
Min house price rate change	270293	6398	85013	361704
Total	518150	22973	187450	728573

Qscore = 7063.22
Degree of Freedom = (2-1) * (3-1)
p-value = 0.0 (nan) < 0.05

Hence , we reject the null hypothesis
HPCR is not independent of the vaccines administered in Connecticut.

2. **Check the independence between housing price change rate and deaths due to covid in the states of California, Texas, Florida and New York.**

California, Texas, Florida and New York have been the 4 states with the highest deaths during covid pandemic. The months selected for chi square are the ones which have the maximum and minimum
HPCR.

H0: Housing price change rate (HPCR) is independent of deaths due to coronavirus.
H1: Housing price change rate (HPCR) is dependent on deaths due to coronavirus.

	California Deaths	Texas Deaths	Florida Deaths	New York Deaths	Total
Max HPCR month	1013	535	903	151	2602
Min HPCR month	2850	6006	2665	793	12314
Total	3863	6541	3568	944	14916

Qscore = 751.21
Degree of Freedom = (2-1) * (4-1)
p-value = 0.0 < 0.05

Hence , we reject the null hypothesis
HPCR is not independent deaths due to coronavirus based on data from top death experiencing cities and months with minimum and maximum HPCR

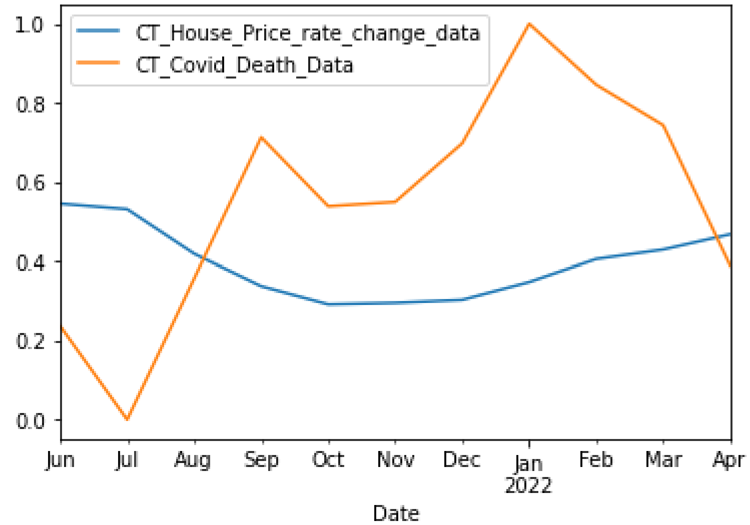
D. Pearson Correlation testing between deaths during covid and Housing Price Change Rate in Connecticut

Below are a few events listed which have impacted the data in consideration

June 1, 2021: The Delta variant, first identified in India in late 2020, becomes the dominant variant in the U.S. The variant kicks off a third wave of infections during the summer of 2021.
November 26, 2021: World Health Organization classifies a new variant, Omicron, as a variant of concern after it was first reported by scientists in South Africa. The variant has several mutations in the spike protein that concern scientists around the world. [LINK]

Deaths began to drop In January 2021. By April that year, the United States saw a decline in deaths corresponding to increases in vaccinations. And that June, death levels returned to near June 2019 levels. This decline was short-lived, though, as the Delta variant caused another spike in deaths in July and August. Deaths dropped slightly in the fall, but then the Omicron variant emerged just as holiday travel picked up in December 2021. [LINK]

Graph for each dataset:



Case: <u>HPCR vs Death Count</u>

H0: House Price Change Rate and Covid Death Count are not linearly correlated
H1: House Price Change Rate and Covid Death Count are linearly correlated

Calculated Value = 0.65040010
As |-0.65040010| > 0.5, We reject the null hypothesis
Mean Monthly House Price Change Rate and Mean Monthly Covid Case Count have a **negative linear correlation**

Results:
House prices and death counts have a negative linear correlation. This may be attributed to the advent of omicron and delta variants. Its potential justification is mentioned in the event description.