Using Overall U.S. Mortality to help us understand the impact of COVID-19 & Death Data

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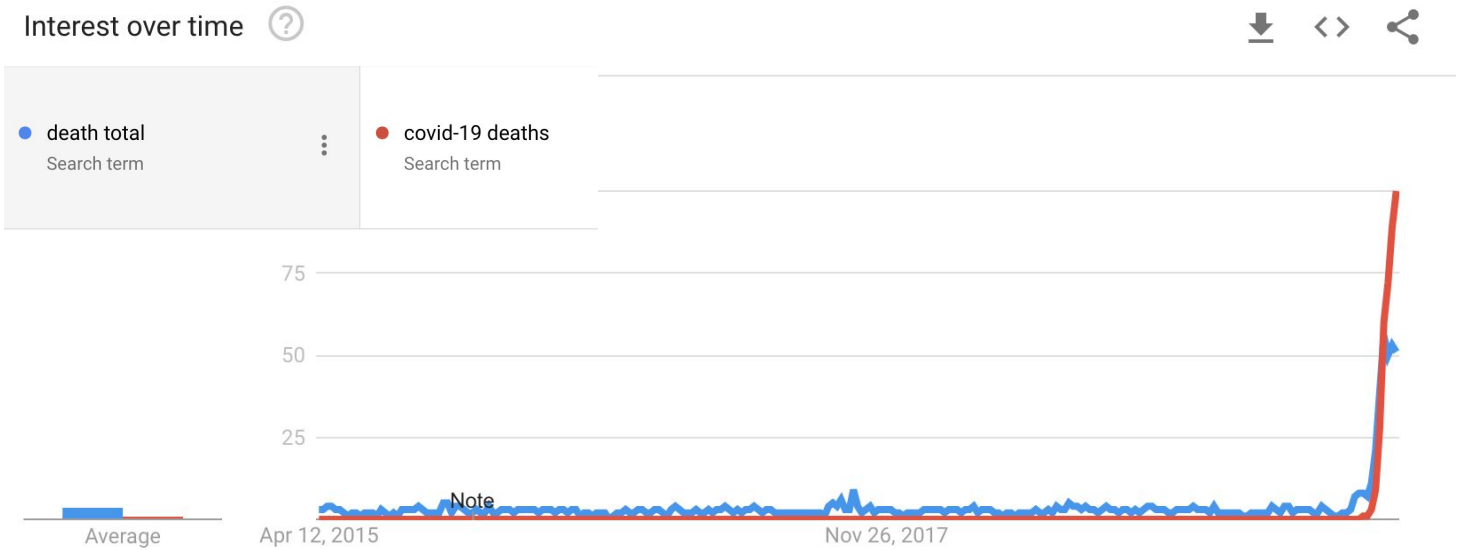
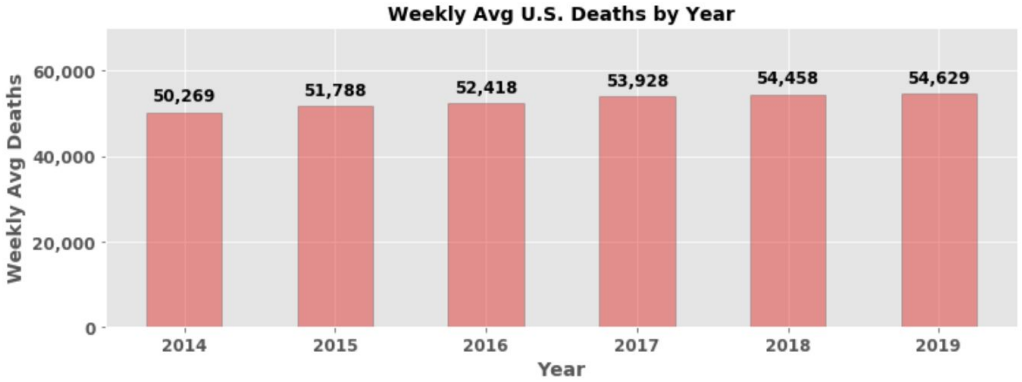
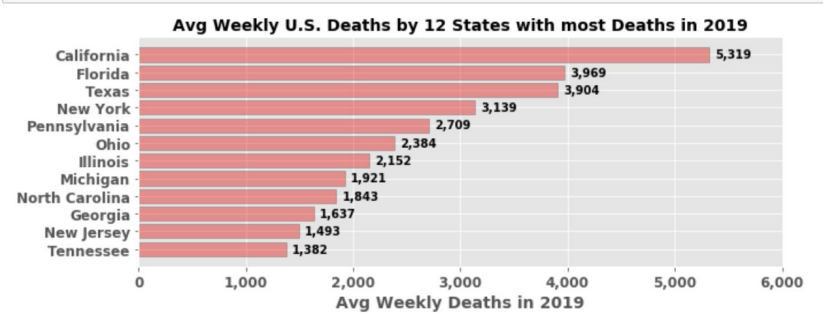
COVID-19 has coincided with an Increase in how often we encounter Death Figures



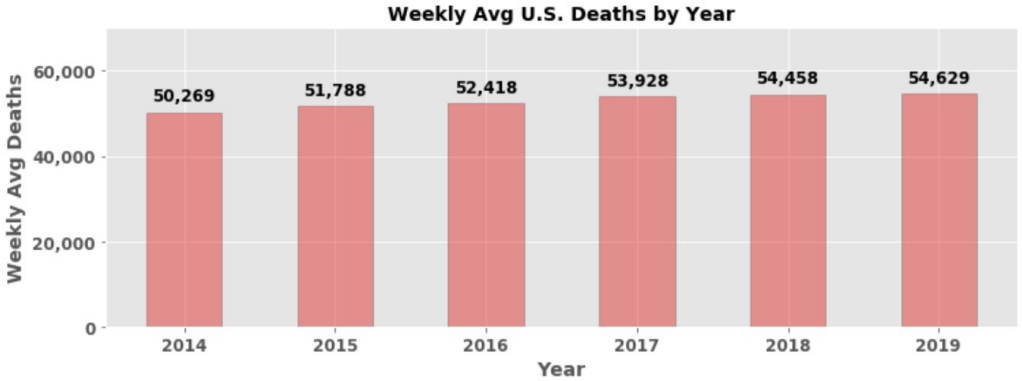
Daily reports on the totals of COVID-19 cases and deaths have become part of the everyday newscycle.

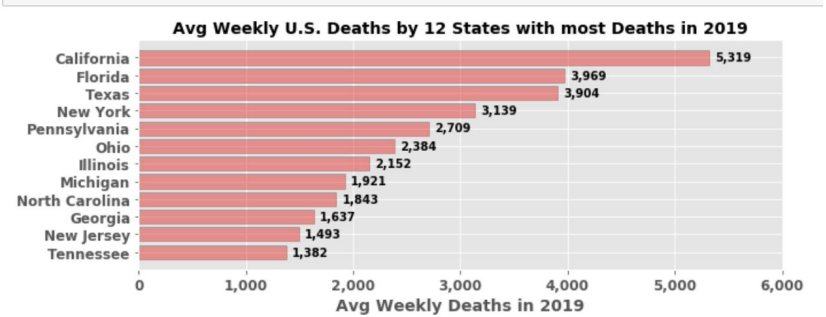
Putting it in Perspective: U.S. Weekly Mortality Trends





Putting it in Perspective: U.S. Weekly Mortality Trends

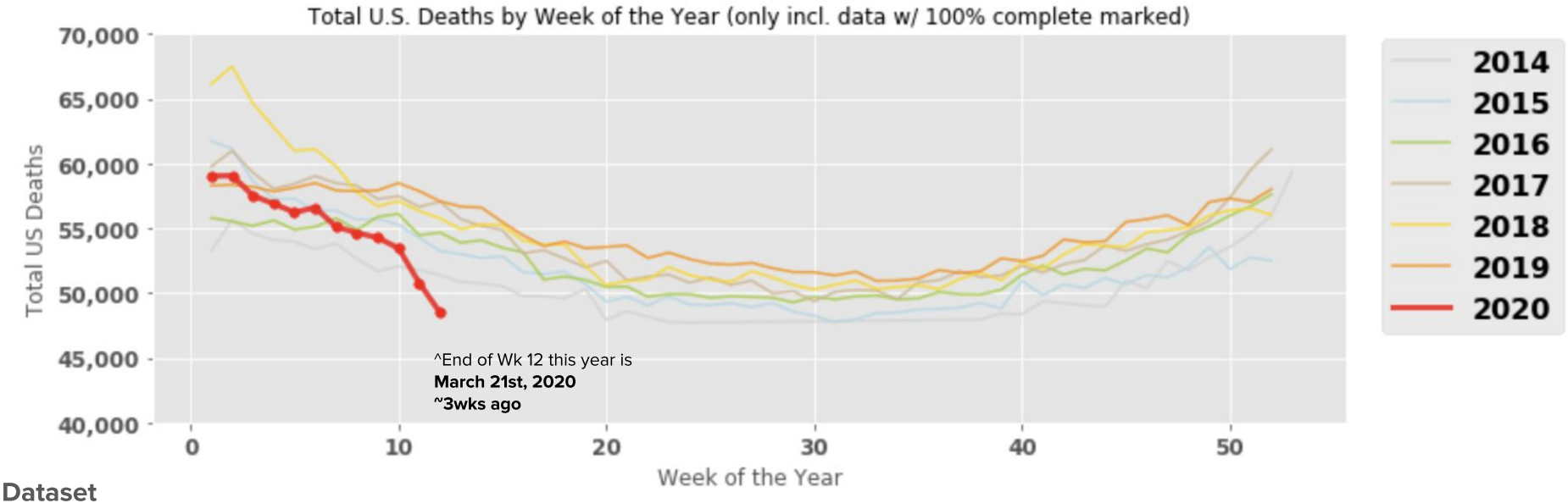




- Last week:
  - U.S. had 6,300+ deaths classified as COVID-19*. **~12%+ of Weekly Avg Deaths in 2019.**
  - New York had 2,800+ COVID-19 deaths last week. NY averaged just over 3k deaths per week last yr.

- This week:
  - U.S. is trending towards 11,000 deaths due to COVID-19*. **~20%+ of Weekly Avg Deaths in 2019.**
  - New York is trending towards 4,700 COVID-19 deaths this week.

U.S. Mortality Rates raise some interesting questions despite not having reliable data for past 3 wks



Dataset

1. **Influenza Division of the CDC (CSV File):**
   - Weekly Total Deaths and % from Influenza & Pneumonia at the National & State Levels.
   - Death certificates from state offices and leverages death codes.
   - Only use weeks containing 100% Complete marker, thus the added delay.

2. **2010 Census (CSV File):** Population estimates through 2019.
   - Extrapolate to 2020 using recent trends in net pop changes.

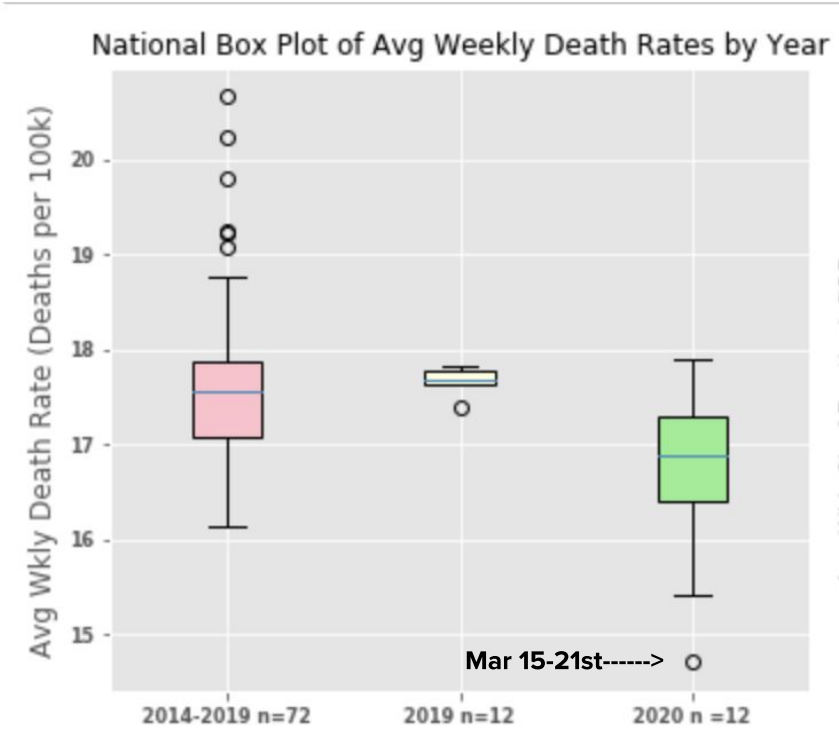
3. **The COVID-19 Tracking Project (API)**: Daily COVID cases and deaths used to isolate 12 States w/ highest COVID deaths.

Two Questions for U.S. & 12 States w/ highest COVID-19 Deaths

1. Is **Weekly Death Rate (Weely Deaths per 100k)** in 2020 lower compared to that in 2019 and in 2014-19?
    - Data allows me to compare through Week 12 (March 21st).

2. Since I also have Flu & Pneumonia data, is the **% of Deaths due to Influenza & Pneumonia** in 2020 higher than that seen in 2019 and 2014-19?
    - Data allows me to compare through Week 13 (March 28th) for certain states.

Question 1: Changes in Death Rates in 2020?



Sample Statistic

- Avg Weekly Death Rate (Deaths/100k)
- Sample size = 12 in 2020. CLT cannot be used.

One-Tailed Mann-Whitney Signed Rank Test to compare across yrs

- Null Hypothesis
  - *P*(Die in a wk in 2019 > Die in a wk in 2020) = 0.50
- Alternative Hypothesis
  - *P*(Die in a wk in 2019 > Die in a wk in 2020) ≠ 0.50

Results when comparing 2020 to 2019 & 2020 to 2014-19

- **Reject Null Hypothesis at alpha of 0.01 for the U.S. Weekly Death Rate.**
- **But Fail to Reject Null Hypothesis at the State Level for the 12 States with highest amount of COVID deaths**

Question 1: Changes in Death Rates in 2020?

What does this result mean:

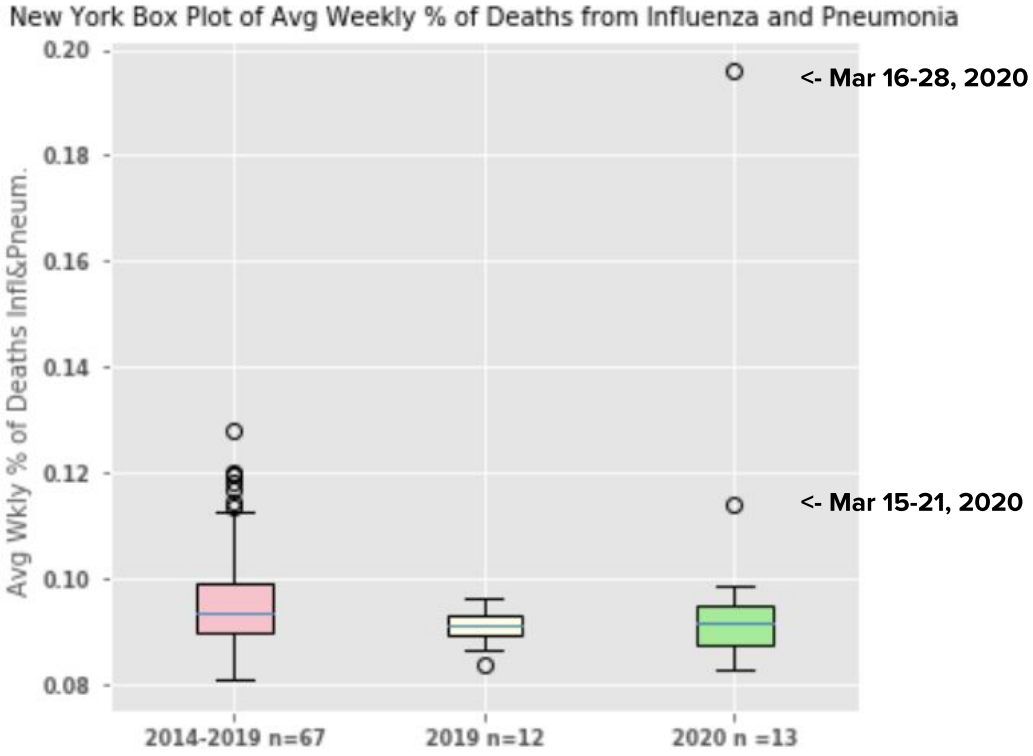
- Through Weeks 1-12 (through Mar 21 this year), 2014-19 and 2019 had higher death rates than 2020 in the U.S. (α = 0.01), but this does not hold in the 12 States w/ the highest amount of COVID-19 deaths.

Possible Explanations:

- **Speculative:** Change in behaviors starting in March.
  - Decline in Heart Attacks & Strokes seen in hospitals (source).
  - Seeing 10x deaths at home (source).

- **Data Quality Issues:** Despite CDC's 100% complete label, data changes. Small Sample too.
  - If I exclude the most recent data marked at 100% complete, Weeks 11-12, I would fail to reject both Null Hypotheses at an alpha of 0.2.

Question 2: Changes in % of deaths w/ Influenza & Pneumonia code?



Sample Statistic

- Avg Weekly % Deaths due to Influenza+Pneumonia
- Comprised of sample size = 13 in 2020.

Two-Tailed Mann-Whitney Signed Rank Test to compare across yrs

- Null Hypothesis
  - *P*(Death due to Influenza & Pneumonia in 2020 > Death due to I&P in 2019) = 0.50
- Alternative Hypothesis
  - *P*(Death due to Influenza & Pneumonia in 2020 > Death due to I&P in 2019) ≠ 0.50

Results when comparing 2020 to 2019 & 2020 to 2014-19

- Fail to reject Null Hypothesis at alpha of 0.10 for all States aside from Florida (NY is close).

Conclusion

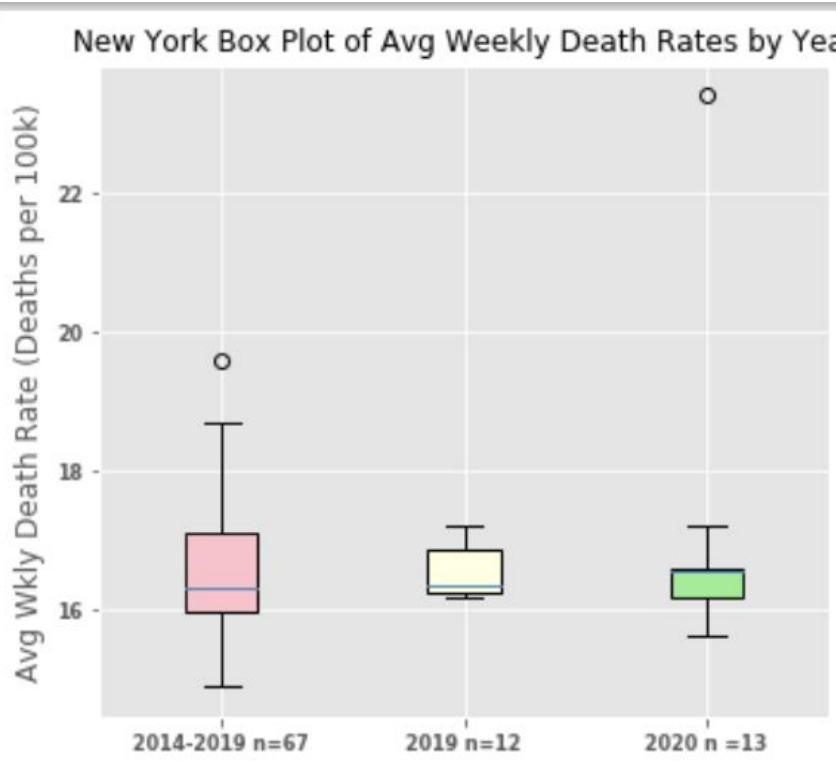
- Issues with daily mortality data explain common headlines popping up.
  - Daily Death #s & Cause are regularly report on.
    - CDC goes back and publishes Deaths due to Influenza in 2 year lookback.
    - CDC marks data as 100% complete but it can still change.
    - Issues between discerning b/w Pneumonia, Influenza, & COVID-19
      - (Russia is classifying all Pneumonia deaths as COVID)

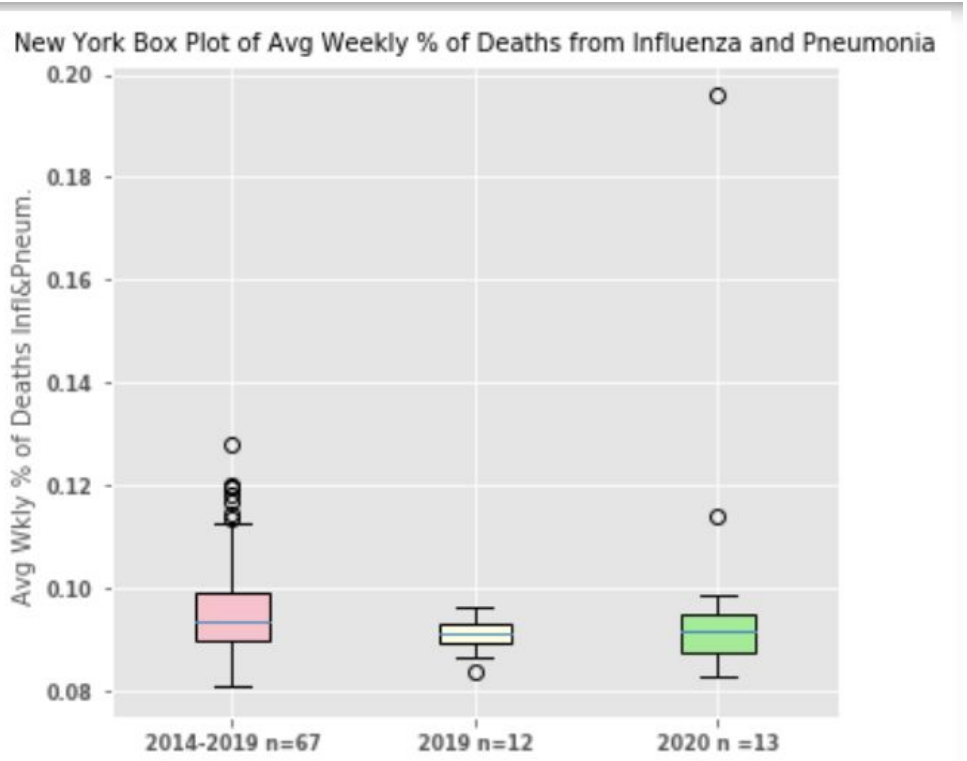
- Will re-run analysis to keep watchful eye on how 2020's overall mortality & pneumonia deaths continue to evolve relative to prior years when thinking about COVID-19 totals.

- Directory of States & National Box Plot Images of Weekly Death Rate and Weekly % of Deaths due to P&I
- P-Value Summary Table Link

Appendix

- More plots like this available here





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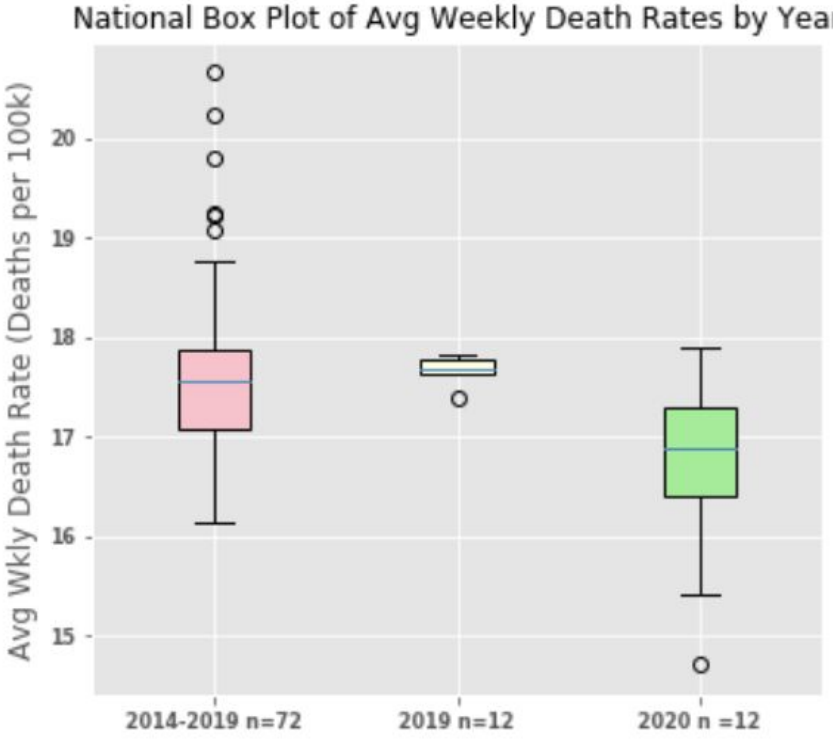
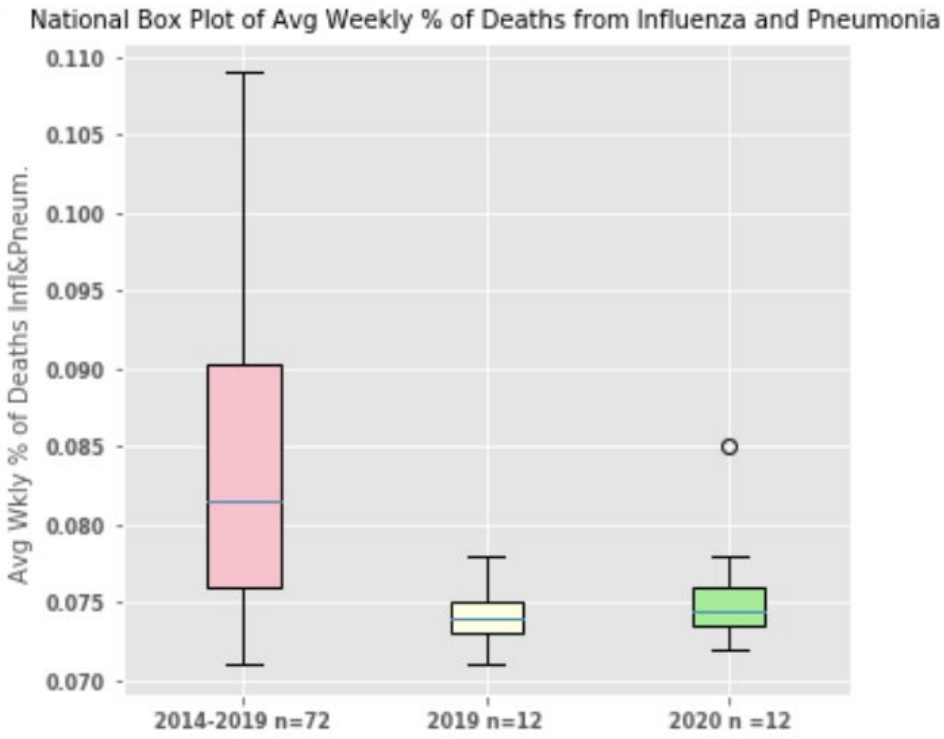




Appendix

- P-Value Summary available here

	state	samp_size_curr_yr	pval_dr_MW_yr
0	New York	13	0.435
1	New Jersey	13	0.221
2	Michigan	13	0.304
3	Massachusetts	12	0.284
4	Louisiana	8	0.164
5	California	12	0.760
6	Illinois	13	0.992
7	Florida	13	0.955
8	Georgia	10	0.414
9	Texas	11	0.243
10	National	12	0.004

This shows p-value for the weekly death rate comparing 2020 to 2019 using a 1-tailed Mann Whitney U Test.

P-Values below 0.01 mean that I would reject the Null Hypothesis that and in fact, 2019's death rate is higher to an $\alpha = 0.01$.

> $P(\text{Die in a week in 2019} > \text{Die in a week in 2020}) = 0.50$

Appendix

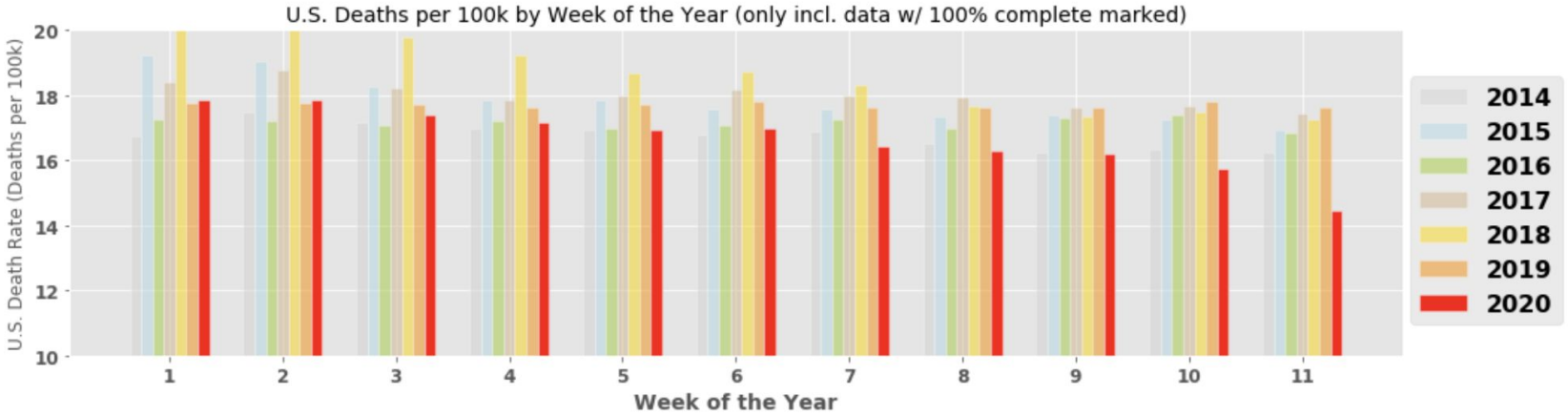
- P-Value Summary available here

	state	samp_size_curr_yr	pval_pi_MW_yr
0	New York	13	0.892
1	New Jersey	13	0.278
2	Michigan	13	0.269
3	Massachusetts	12	0.892
4	Louisiana	8	0.638
5	California	12	0.219
6	Illinois	13	0.150
7	Florida	13	0.002
8	Georgia	10	0.350
9	Texas	11	0.542
10	National	12	0.539

This shows p-value for the % of deaths due to Pneumonia and Influenza comparing 2020 to 2019 using a 2-tailed Mann Whitney U Test.

P-Values below 0.10 mean that I would reject the Null Hypothesis and suggest, 2019 and 2020's % of deaths due to Pneumonia and Influenza is not the same to an $\alpha = 0.10$.

Appendix: Alternative look at Death Rate



^End of Wk 11 this year is **March 14th, 2020**