Assessing Mortality and Significant Morbidity Following Hurricane María in Puerto Rico

Rafael A Irizarry

Dana-Farber Cancer Institute and Harvard

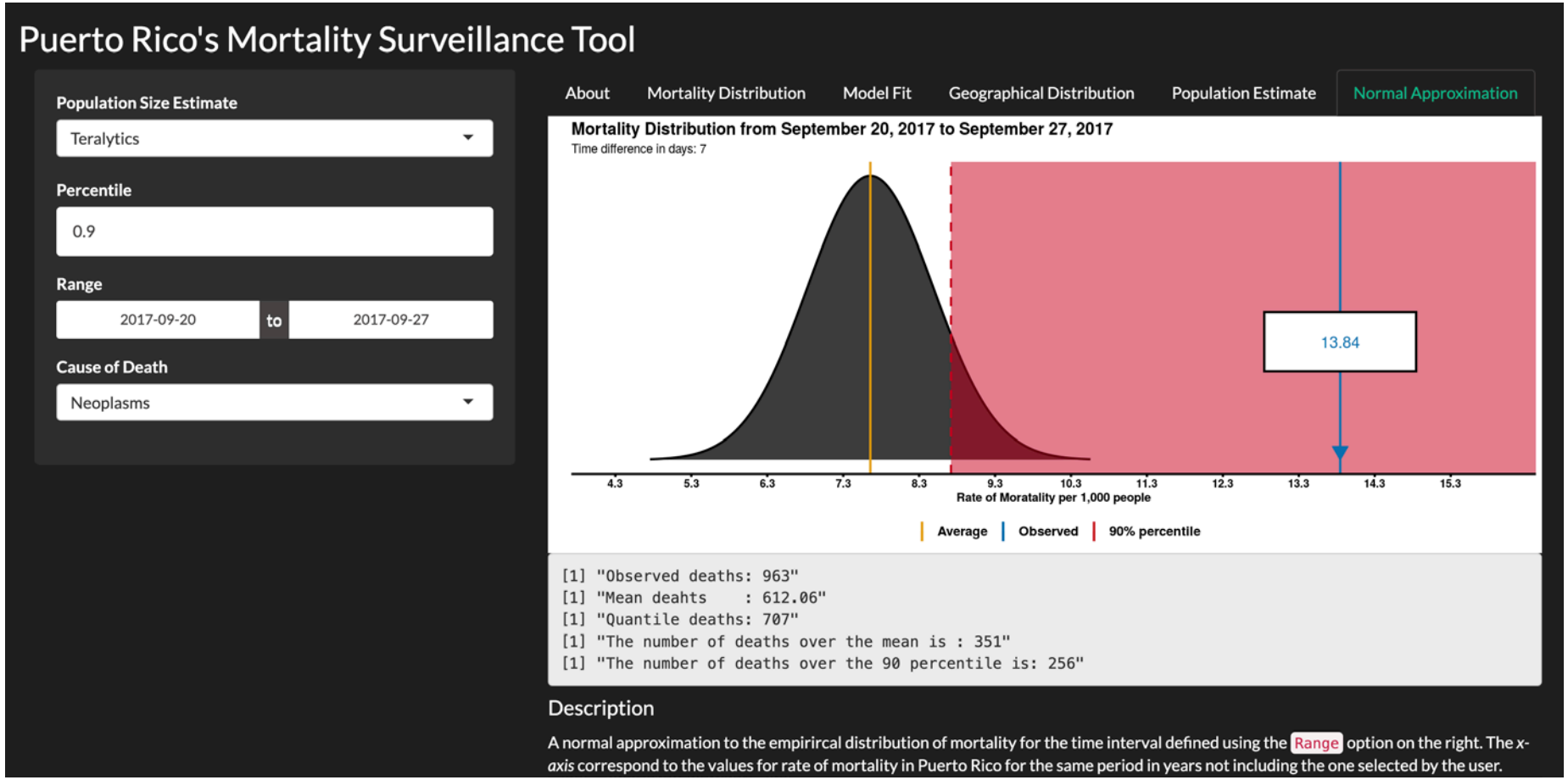
@rafalab

Surveillance app based on death rates

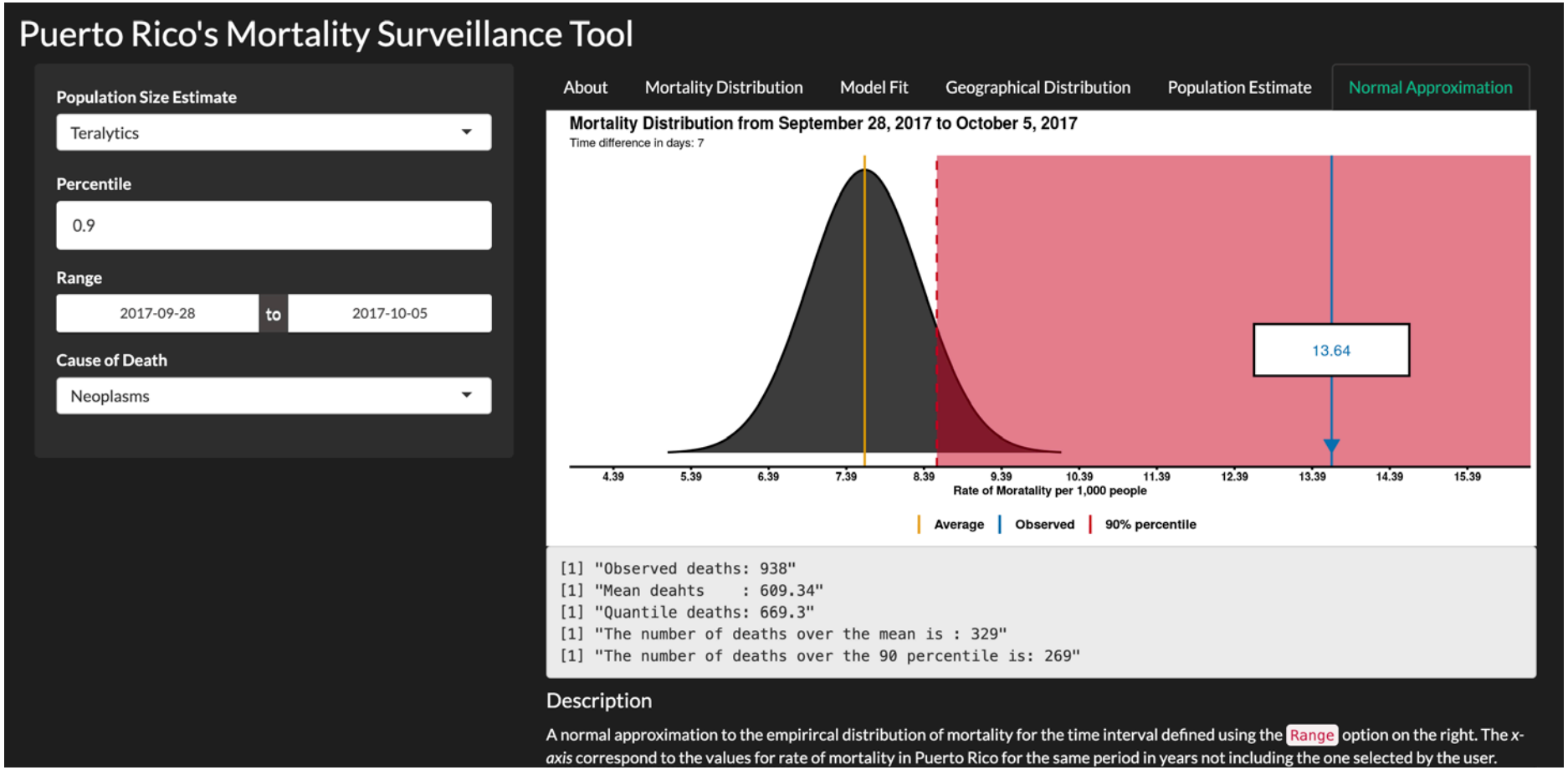
- Compares death rate in a give period to historical data
- Work by Rolando Acosta

https://rjnunez.shinyapps.io/prmst/

First week after María



Second week


Puerto Rico's Mortality Surveillance Tool
Population Size Estimate
Teralytics
Percentile
0.9
Range
2017-09-28
to
2017-10-05
Cause of Death
Neoplasms
About
Mortality Distribution
Model Fit
Geographical Distribution
Population Estimate
Normal Approximation
Mortality Distribution from September 28, 2017 to October 5, 2017
Time difference in days: 7
13.64
4.39
5.39
6.39
7.39
8.39
9.39
10.39
11.39
12.39
13.39
14.39
15.39
Rate of Moratality per 1,000 people
Average
Observed
90% percentile
[1] "Observed deaths: 938"
[1] "Mean deahts : 609.34"
[1] "Quantile deaths: 669.3"
[1] "The number of deaths over the mean is : 329"
[1] "The number of deaths over the 90 percentile is: 269"
Description
A normal approximation to the empirircal distribution of mortality for the time interval defined using the Range option on the right. The x-axis correspond to the values for rate of mortality in Puerto Rico for the same period in years not including the one selected by the user.

"Every death is a horror," Trump said, "but if you look at a real catastrophe like Katrina and you look at the tremendous -- hundreds and hundreds of people that died -- and you look at what happened here with, really, a storm that was just totally overpowering ... no one has ever seen anything like this."

"What is your death count?" he asked as he turned to Puerto Rico Gov. Ricardo Rosselló. "17?"

"16," Rosselló answered.

"16 people certified," Trump said. "Sixteen people versus in the thousands**. You can be very proud** of all of your people and all of our people working together.

Source: CNN

SOC ARXIV SocArXiv Papers Add a paper Search Donate Sign Up Sign In

Estimates of excess deaths in Puerto Rico following Hurricane Maria

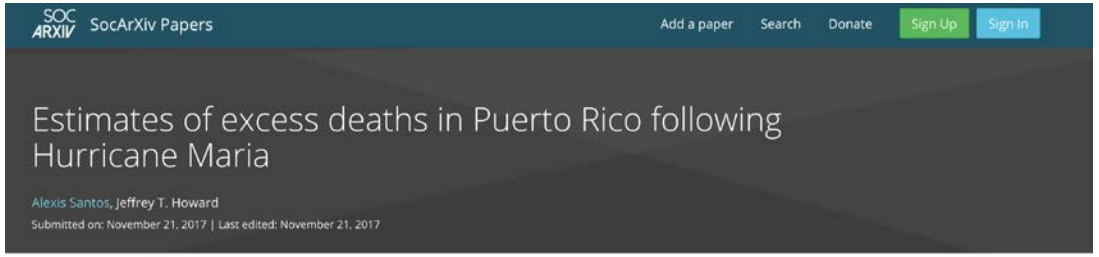
Alexis Santos, Jeffrey T. Howard

Submitted on: November 21, 2017 | Last edited: November 21, 2017

Results:

Expected deaths for September and October were 2,383 (95% C.I. 2,296-2,469) and 2,428 (95% C.I. 2,380 - 2,476), respectively. Estimates for total deaths, for September and October 2017 were 2,987 (95% CI 2,900-3,074) and 3,043 (95% C.I. 2995-3,091), respectively. **The difference between our estimates and the upper 95% CI for the average deaths is 518 deaths for September and 567 deaths for October.**

Different results for groups with access to death registry data

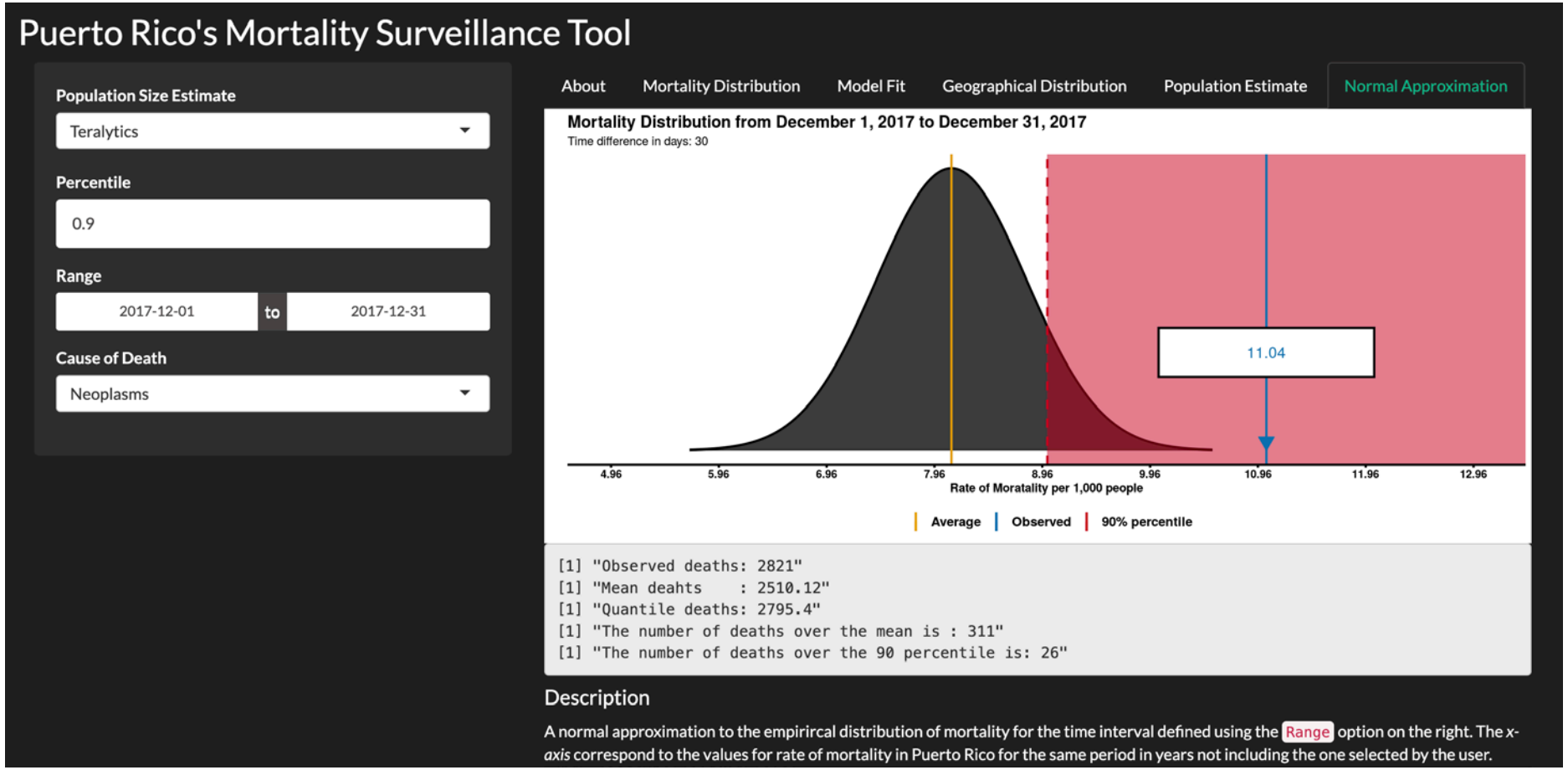


Expected deaths for September and October were 2,383 (95% C.I. 2,296-2,469) and 2,428 (95% C.I. 2,380 - 2,476), respectively. Estimates for total deaths, for September and October 2017 were 2,987 (95% CI 2,900-3,074) and 3,043 (95% C.I. 2995-3,091), respectively. **The difference between our estimates and the upper 95% CI for the average deaths is 518 deaths for September and 567 deaths for October.**

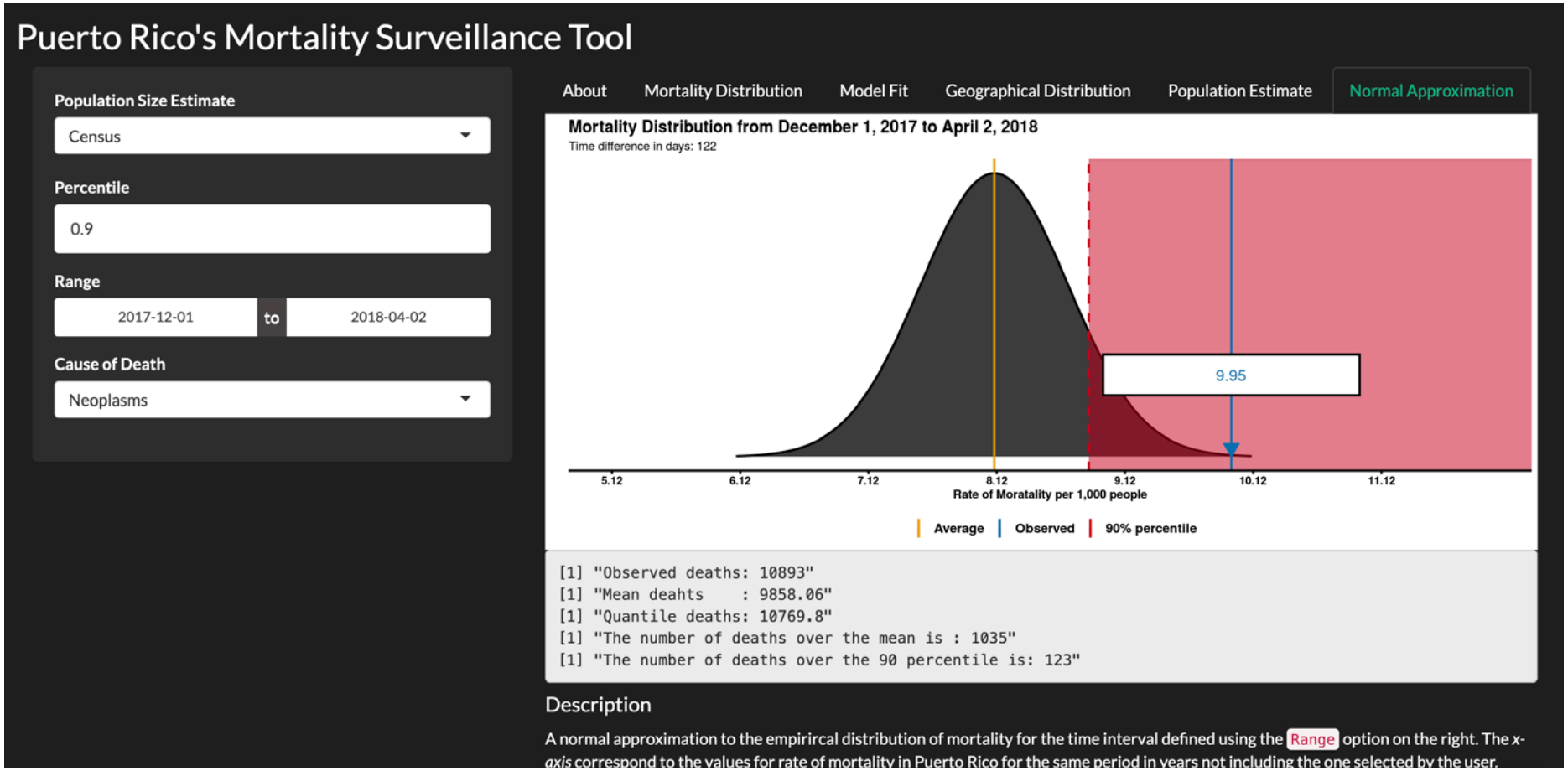
December 13 statement from Puerto Rico's Secretary of the Department Of Public Safety

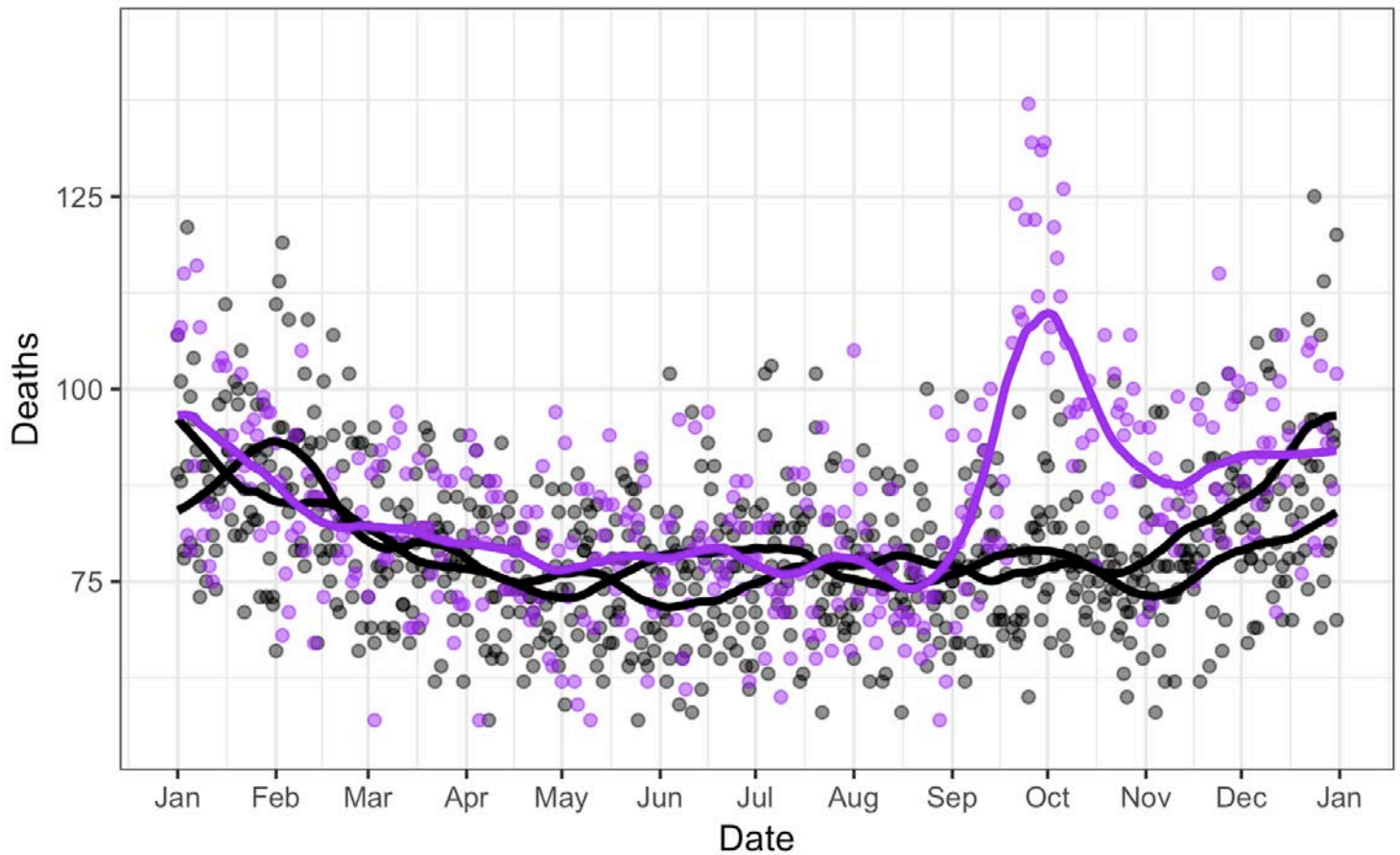
"According to the data, the total deaths registered in September were: 2,890 in 2017, 2,367 in 2016, and 2,258 in 2015. For October, the total of deaths registered were: 2,974 in 2017, 2,357 in 2016, and 2,393 in 2015. **It should be noted that similar numbers are seen in December and January of previous years when no atmospheric phenomenon took place**. For December, the total deaths were: 2,854 in 2016 and 2,516 in 2015. Meanwhile, in January the total deaths were: 2,894 in 2017, 2,742 in 2016, and 2,744 in 2015. With this, I suggest that the number of total deaths in Puerto Rico is not a fixed one. As for the deaths directly and indirectly related to hurricane Maria today, December 13, 2017, there are 64."

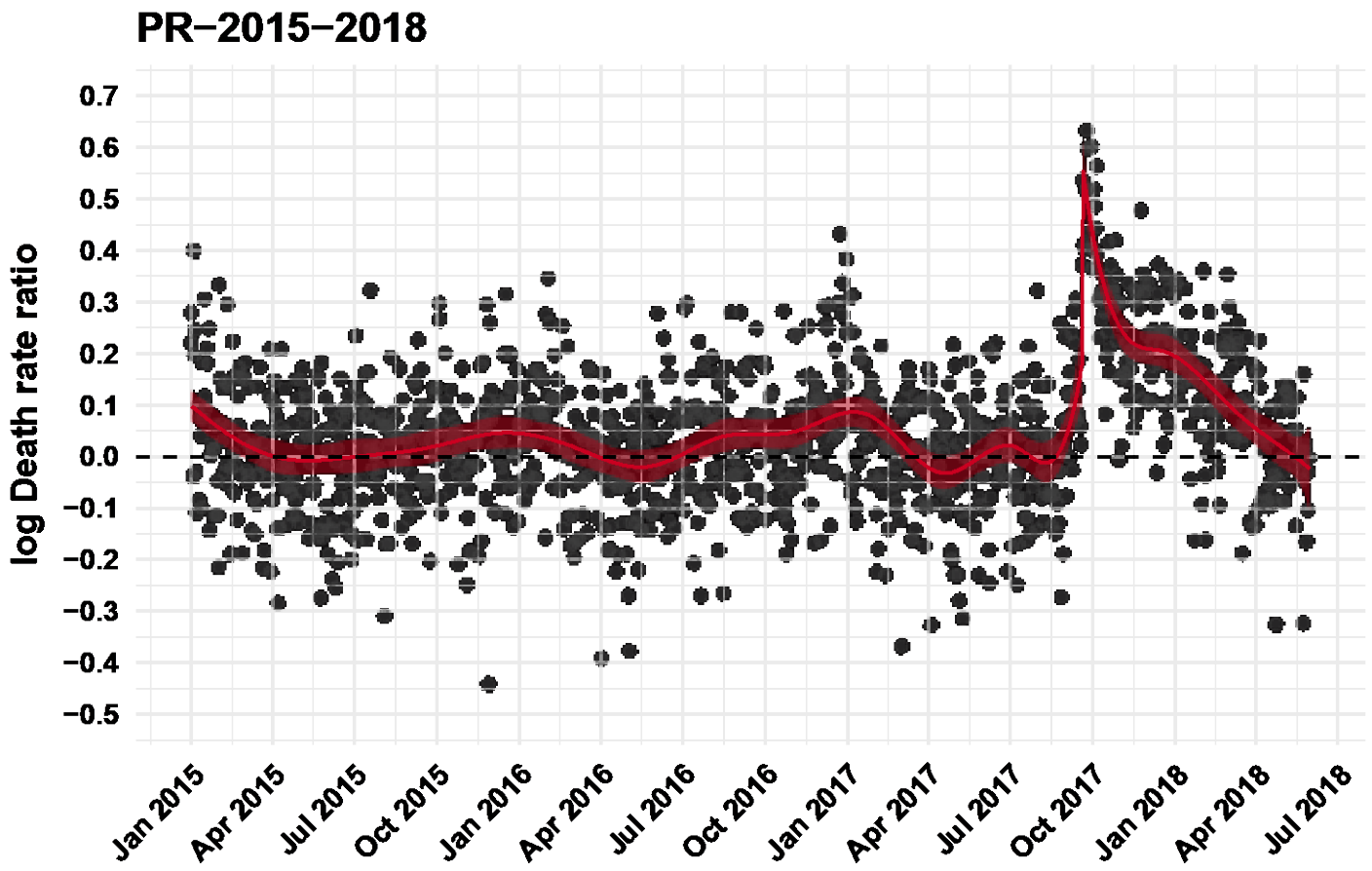
December

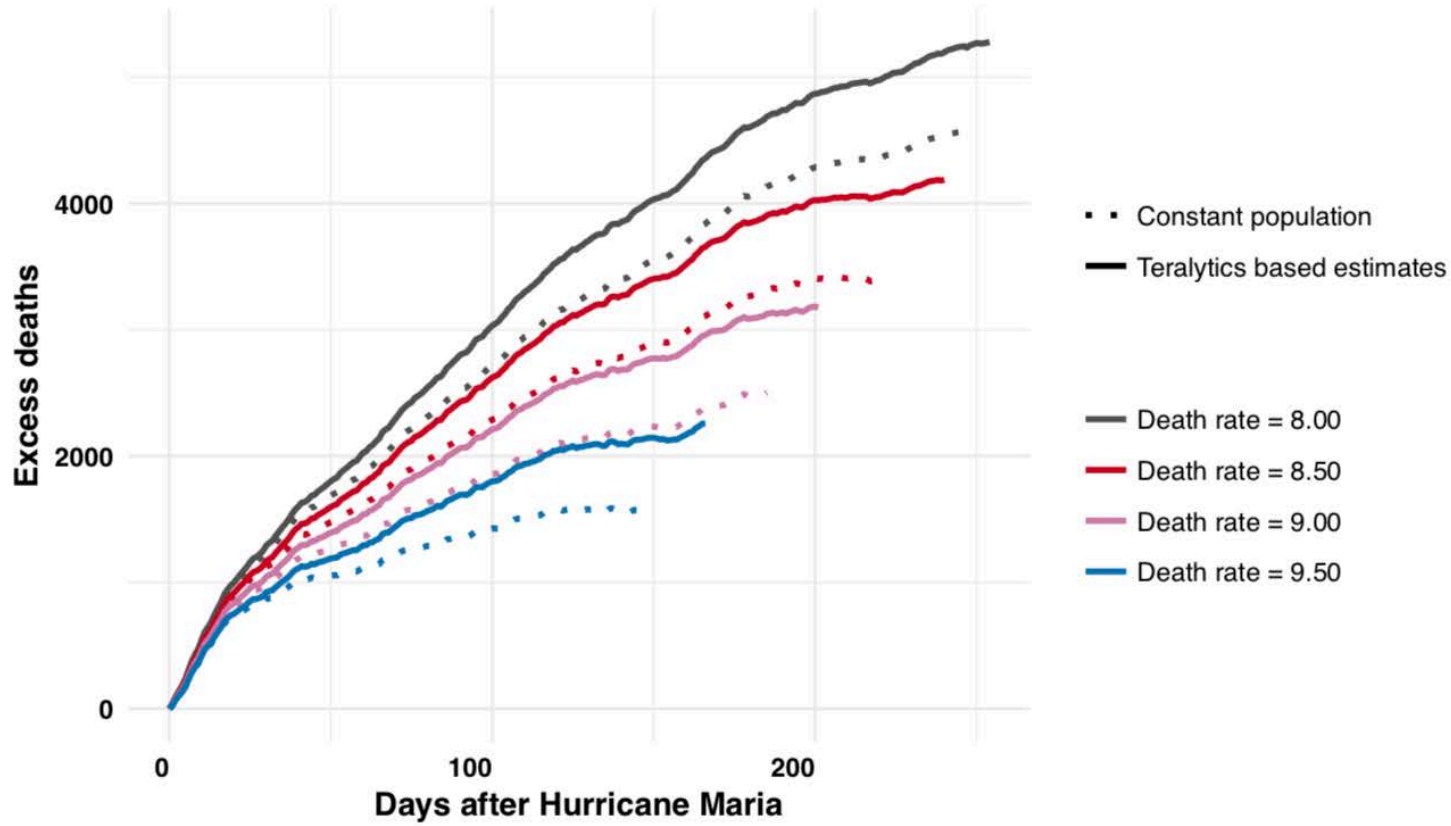

Puerto Rico's Mortality Surveillance Tool
Population Size Estimate
Teralytics
Percentile
0.9
Range
2017-12-01
to
2017-12-31
Cause of Death
Neoplasms
About
Mortality Distribution
Model Fit
Geographical Distribution
Population Estimate
Normal Approximation
Mortality Distribution from December 1, 2017 to December 31, 2017
Time difference in days: 30
11.04
4.96
5.96
6.96
7.96
8.96
9.96
10.96
11.96
12.96
Rate of Moratality per 1,000 people
Average
Observed
90% percentile
[1] "Observed deaths: 2821"
[1] "Mean deahts : 2510.12"
[1] "Quantile deaths: 2795.4"
[1] "The number of deaths over the mean is : 311"
[1] "The number of deaths over the 90 percentile is: 26"
Description
A normal approximation to the empirircal distribution of mortality for the time interval defined using the Range option on the right. The x-axis correspond to the values for rate of mortality in Puerto Rico for the same period in years not including the one selected by the user.

December using Census population estimate

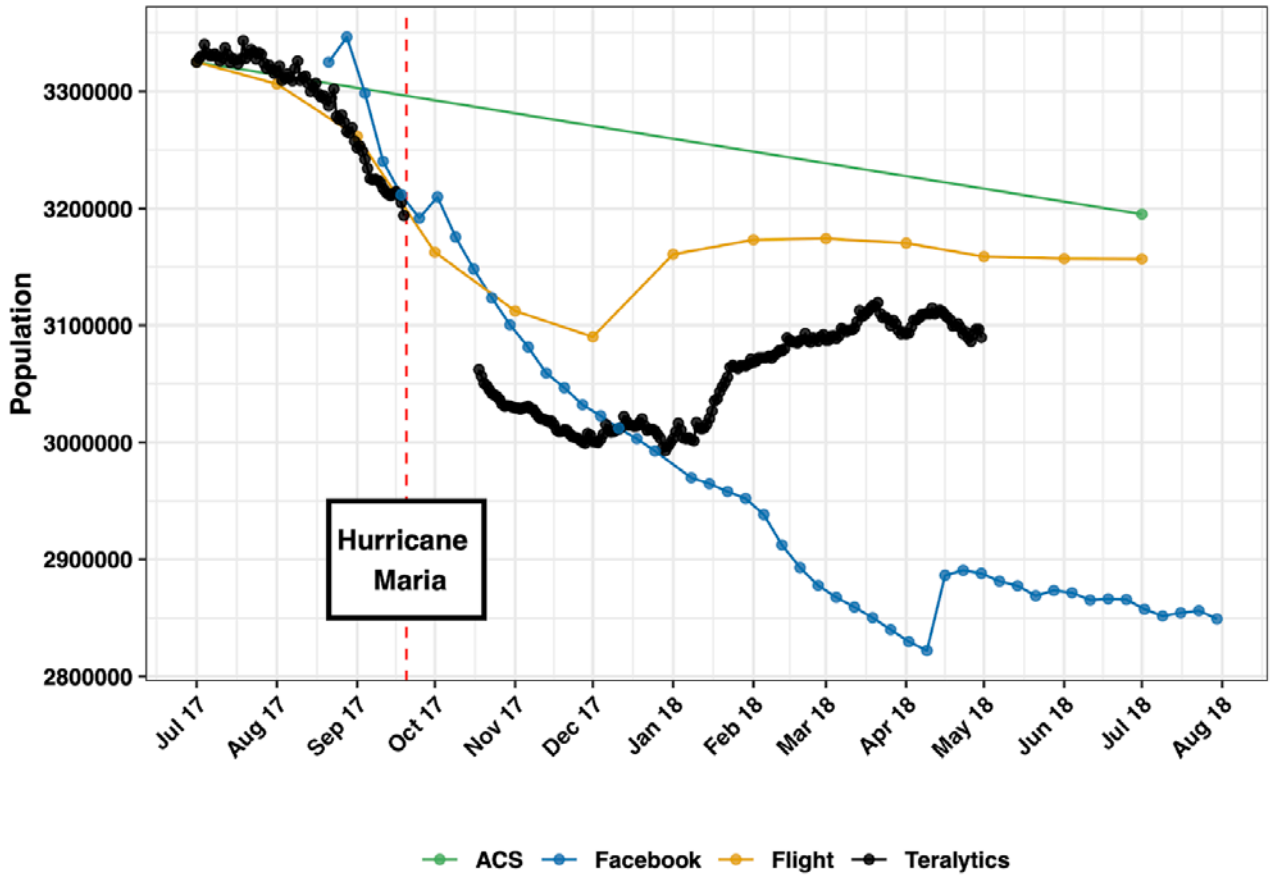



125
100
75
Deaths
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Date


PR−2015−2018
log Death rate ratio
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
−0.5
Jan 2015
Apr 2015
Jul 2015
Oct 2015
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Oct 2017
Jan 2018
Apr 2018
Jul 2018


Excess deaths
4000
2000
0
0
100
200
Days after Hurricane Maria
Constant population
Teralytics based estimates
Death rate = 8.00
Death rate = 8.50
Death rate = 9.00
Death rate = 9.50

Population estimates



Thanks

Puerto Rico's Mortality Surveillance Tool

Population Size Estimate

Census

Percentile

0.9

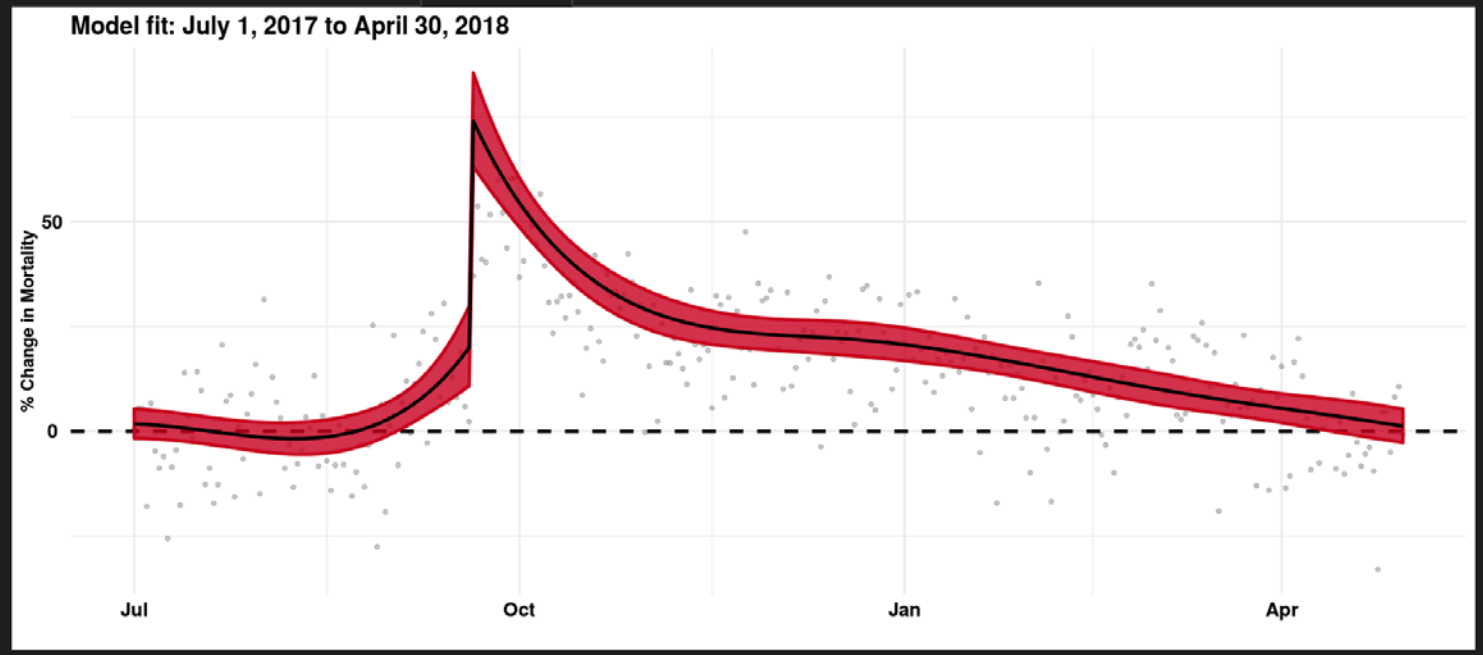
Range

2017-07-01 to 2018-04-30

Cause of Death

Neoplasms

About | Mortality Distribution | Model Fit | Geographical Distribution | Population Estimate | Normal Approximation



Description

Percent change in mortality from the average rate of mortality based on Acosta and Irizarry. The *y-axis* correspond to the percent change in mortality from the expected rate of mortality and the *x-axis* correspond to the period of time specified by the user. The solid-black line correspond to the estimated percent change in mortality and the red shaded region around the line shows the 95% confidence interval based on inverting the Wald statistic. Here is the following paragraph from Acosta and Irizarry to provide some intuition:

"A virus epidemic will make the solid-black line go up slowly, eradication of this epidemic will make the solid-black line go down slowly, and a catastrophe will make the the solid-black line jump up sharply"

Puerto Rico's Mortality Surveillance Tool

Population Size Estimate

Census

Percentile

0.9

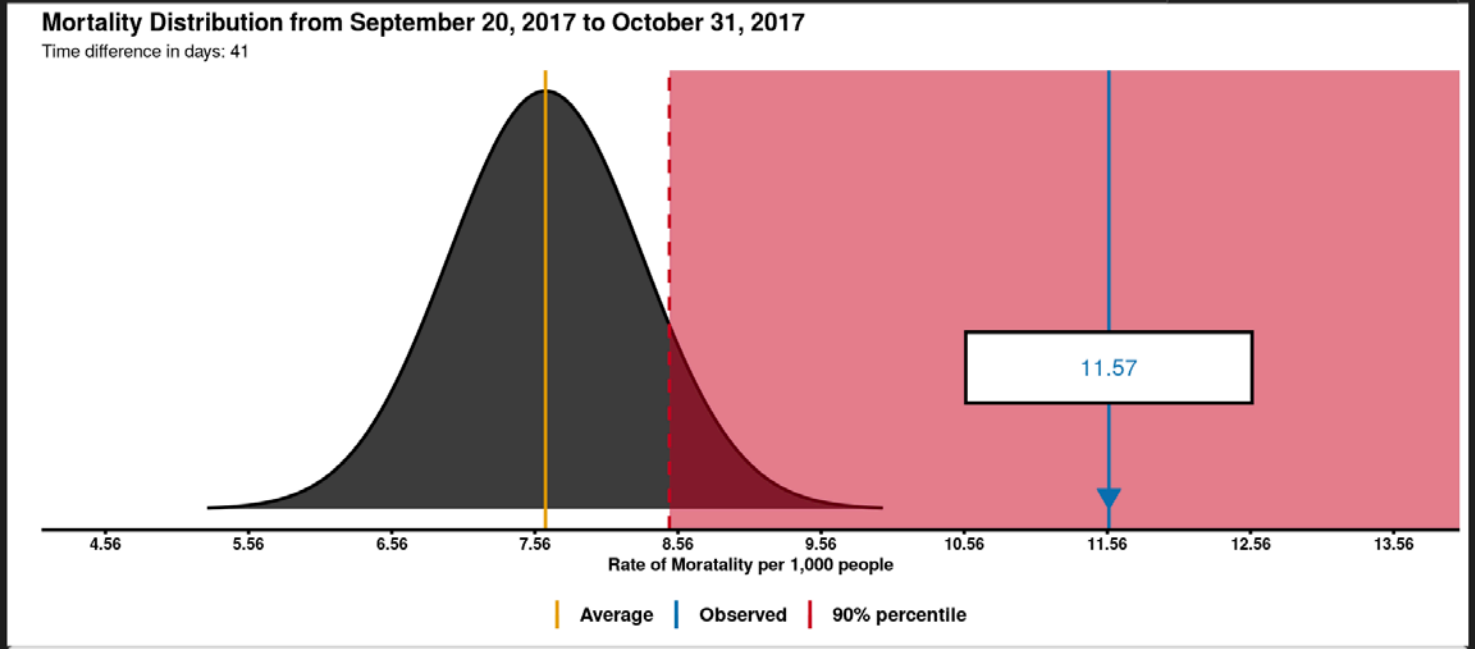
Range

2017-09-20 to 2017-10-31

Cause of Death

Neoplasms

About | Mortality Distribution | Model Fit | Geographical Distribution | Population Estimate | Normal Approximation




```
[1] "Observed deaths: 4379"
[1] "Mean deahts    : 3201.09"
[1] "Quantile deaths: 3484.3"
[1] "The number of deaths over the mean is : 1178"
[1] "The number of deaths over the 90 percentile is: 895"
```

Description

A normal approximation to the empirircal distribution of mortality for the time interval defined using the Range option on the right. The *x-axis* correspond to the values for rate of mortality in Puerto Rico for the same period in years not including the one selected by the user.