John Hopkins COVID-19 Project

student

7/22/2021

John Hopkins COVID-19:

This is a breakdown of COVID-19 data from John Hopkins github.com site. (source: https://github.com/CSSEGISandData/COVID-19/tree/master/csse_covid_19_data/csse_covid_19_time_series)

Loading R Packages:

```
## Warning: package 'tidyverse' was built under R version 4.0.5

## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v ggplot2 3.3.3     v purrr   0.3.4
## v tibble  3.1.0     v dplyr   1.0.5
## v tidyr   1.1.3     v stringr 1.4.0
## v readr   1.4.0     v forcats 0.5.1

## Warning: package 'tibble' was built under R version 4.0.4

## Warning: package 'tidyr' was built under R version 4.0.4

## Warning: package 'readr' was built under R version 4.0.5

## Warning: package 'purrr' was built under R version 4.0.3

## Warning: package 'dplyr' was built under R version 4.0.4

## Warning: package 'stringr' was built under R version 4.0.3

## Warning: package 'forcats' was built under R version 4.0.5

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()

## Warning: package 'lubridate' was built under R version 4.0.5

##
## Attaching package: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

Reading-in: Data:

```
url_in <- "https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_cov

file_names <- c("time_series_covid19_confirmed_global.csv",
                "time_series_covid19_deaths_global.csv",
                "time_series_covid19_confirmed_US.csv",
                "time_series_covid19_deaths_US.csv")

urls <- str_c(url_in, file_names)

global_cases <- read_csv(urls[1])
global_deaths <- read_csv(urls[2])
US_cases <- read_csv(urls[3])
US_deaths <- read_csv(urls[4])
```

Summary of Data:

```
head(US_cases)
```

```
## # A tibble: 6 x 567
##        UID iso2  iso3  code3  FIPS Admin2  Province_State Country_Region   Lat
##      <dbl> <chr> <chr> <dbl> <dbl> <chr>   <chr>          <chr>          <dbl>
## 1 84001001 US    USA     840  1001 Autauga Alabama        US              32.5
## 2 84001003 US    USA     840  1003 Baldwin Alabama        US              30.7
## 3 84001005 US    USA     840  1005 Barbour Alabama        US              31.9
## 4 84001007 US    USA     840  1007 Bibb    Alabama        US              33.0
## 5 84001009 US    USA     840  1009 Blount  Alabama        US              34.0
## 6 84001011 US    USA     840  1011 Bullock Alabama        US              32.1
## # ... with 558 more variables: Long_ <dbl>, Combined_Key <chr>, 1/22/20 <dbl>,
## #   1/23/20 <dbl>, 1/24/20 <dbl>, 1/25/20 <dbl>, 1/26/20 <dbl>, 1/27/20 <dbl>,
## #   1/28/20 <dbl>, 1/29/20 <dbl>, 1/30/20 <dbl>, 1/31/20 <dbl>, 2/1/20 <dbl>,
## #   2/2/20 <dbl>, 2/3/20 <dbl>, 2/4/20 <dbl>, 2/5/20 <dbl>, 2/6/20 <dbl>,
## #   2/7/20 <dbl>, 2/8/20 <dbl>, 2/9/20 <dbl>, 2/10/20 <dbl>, 2/11/20 <dbl>,
## #   2/12/20 <dbl>, 2/13/20 <dbl>, 2/14/20 <dbl>, 2/15/20 <dbl>, 2/16/20 <dbl>,
## #   2/17/20 <dbl>, 2/18/20 <dbl>, 2/19/20 <dbl>, 2/20/20 <dbl>, 2/21/20 <dbl>,
## #   2/22/20 <dbl>, 2/23/20 <dbl>, 2/24/20 <dbl>, 2/25/20 <dbl>, 2/26/20 <dbl>,
## #   2/27/20 <dbl>, 2/28/20 <dbl>, 2/29/20 <dbl>, 3/1/20 <dbl>, 3/2/20 <dbl>,
## #   3/3/20 <dbl>, 3/4/20 <dbl>, 3/5/20 <dbl>, 3/6/20 <dbl>, 3/7/20 <dbl>,
## #   3/8/20 <dbl>, 3/9/20 <dbl>, 3/10/20 <dbl>, 3/11/20 <dbl>, 3/12/20 <dbl>,
## #   3/13/20 <dbl>, 3/14/20 <dbl>, 3/15/20 <dbl>, 3/16/20 <dbl>, 3/17/20 <dbl>,
## #   3/18/20 <dbl>, 3/19/20 <dbl>, 3/20/20 <dbl>, 3/21/20 <dbl>, 3/22/20 <dbl>,
## #   3/23/20 <dbl>, 3/24/20 <dbl>, 3/25/20 <dbl>, 3/26/20 <dbl>, 3/27/20 <dbl>,
## #   3/28/20 <dbl>, 3/29/20 <dbl>, 3/30/20 <dbl>, 3/31/20 <dbl>, 4/1/20 <dbl>,
## #   4/2/20 <dbl>, 4/3/20 <dbl>, 4/4/20 <dbl>, 4/5/20 <dbl>, 4/6/20 <dbl>,
## #   4/7/20 <dbl>, 4/8/20 <dbl>, 4/9/20 <dbl>, 4/10/20 <dbl>, 4/11/20 <dbl>,
## #   4/12/20 <dbl>, 4/13/20 <dbl>, 4/14/20 <dbl>, 4/15/20 <dbl>, 4/16/20 <dbl>,
## #   4/17/20 <dbl>, 4/18/20 <dbl>, 4/19/20 <dbl>, 4/20/20 <dbl>, 4/21/20 <dbl>,
## #   4/22/20 <dbl>, 4/23/20 <dbl>, 4/24/20 <dbl>, 4/25/20 <dbl>, 4/26/20 <dbl>,
## #   4/27/20 <dbl>, 4/28/20 <dbl>, ...
```

```r
head(US_deaths)
```

```
## # A tibble: 6 x 568
##        UID iso2  iso3  code3  FIPS Admin2  Province_State Country_Region   Lat
##      <dbl> <chr> <chr> <dbl> <dbl> <chr>   <chr>          <chr>          <dbl>
## 1 84001001 US    USA     840  1001 Autauga Alabama        US              32.5
## 2 84001003 US    USA     840  1003 Baldwin Alabama        US              30.7
## 3 84001005 US    USA     840  1005 Barbour Alabama        US              31.9
## 4 84001007 US    USA     840  1007 Bibb    Alabama        US              33.0
## 5 84001009 US    USA     840  1009 Blount  Alabama        US              34.0
## 6 84001011 US    USA     840  1011 Bullock Alabama        US              32.1
## # ... with 559 more variables: Long_ <dbl>, Combined_Key <chr>,
## #   Population <dbl>, 1/22/20 <dbl>, 1/23/20 <dbl>, 1/24/20 <dbl>,
## #   1/25/20 <dbl>, 1/26/20 <dbl>, 1/27/20 <dbl>, 1/28/20 <dbl>, 1/29/20 <dbl>,
## #   1/30/20 <dbl>, 1/31/20 <dbl>, 2/1/20 <dbl>, 2/2/20 <dbl>, 2/3/20 <dbl>,
## #   2/4/20 <dbl>, 2/5/20 <dbl>, 2/6/20 <dbl>, 2/7/20 <dbl>, 2/8/20 <dbl>,
## #   2/9/20 <dbl>, 2/10/20 <dbl>, 2/11/20 <dbl>, 2/12/20 <dbl>, 2/13/20 <dbl>,
## #   2/14/20 <dbl>, 2/15/20 <dbl>, 2/16/20 <dbl>, 2/17/20 <dbl>, 2/18/20 <dbl>,
## #   2/19/20 <dbl>, 2/20/20 <dbl>, 2/21/20 <dbl>, 2/22/20 <dbl>, 2/23/20 <dbl>,
## #   2/24/20 <dbl>, 2/25/20 <dbl>, 2/26/20 <dbl>, 2/27/20 <dbl>, 2/28/20 <dbl>,
## #   2/29/20 <dbl>, 3/1/20 <dbl>, 3/2/20 <dbl>, 3/3/20 <dbl>, 3/4/20 <dbl>,
## #   3/5/20 <dbl>, 3/6/20 <dbl>, 3/7/20 <dbl>, 3/8/20 <dbl>, 3/9/20 <dbl>,
## #   3/10/20 <dbl>, 3/11/20 <dbl>, 3/12/20 <dbl>, 3/13/20 <dbl>, 3/14/20 <dbl>,
## #   3/15/20 <dbl>, 3/16/20 <dbl>, 3/17/20 <dbl>, 3/18/20 <dbl>, 3/19/20 <dbl>,
## #   3/20/20 <dbl>, 3/21/20 <dbl>, 3/22/20 <dbl>, 3/23/20 <dbl>, 3/24/20 <dbl>,
## #   3/25/20 <dbl>, 3/26/20 <dbl>, 3/27/20 <dbl>, 3/28/20 <dbl>, 3/29/20 <dbl>,
## #   3/30/20 <dbl>, 3/31/20 <dbl>, 4/1/20 <dbl>, 4/2/20 <dbl>, 4/3/20 <dbl>,
## #   4/4/20 <dbl>, 4/5/20 <dbl>, 4/6/20 <dbl>, 4/7/20 <dbl>, 4/8/20 <dbl>,
## #   4/9/20 <dbl>, 4/10/20 <dbl>, 4/11/20 <dbl>, 4/12/20 <dbl>, 4/13/20 <dbl>,
## #   4/14/20 <dbl>, 4/15/20 <dbl>, 4/16/20 <dbl>, 4/17/20 <dbl>, 4/18/20 <dbl>,
## #   4/19/20 <dbl>, 4/20/20 <dbl>, 4/21/20 <dbl>, 4/22/20 <dbl>, 4/23/20 <dbl>,
## #   4/24/20 <dbl>, 4/25/20 <dbl>, 4/26/20 <dbl>, 4/27/20 <dbl>, ...
```

```r
# Top Fields (short list):
# * Province_State: US State
# * Country_Region: Country Part
# * Last_Update: Date of last update
# * Lat: Global Coordinates
# * Long: Global Coordinates
# * Confirmed: Number of Cases
# * Deaths: Number of deaths
# * Recovered: Number of recovered
# * Active: Number of active cases
# * Incident_Rate: Incidents of cases
# * Total_Test_Results: Number of tests (have been)
# * People_Hospitalized: Number of people need to be put in hospital
```

 # TIDY DATA (a wee bit):

```r
global_cases <- global_cases %>%
  pivot_longer(cols = -c('Province/State', 'Country/Region', Lat, Long), names_to = "date", values_to =
```

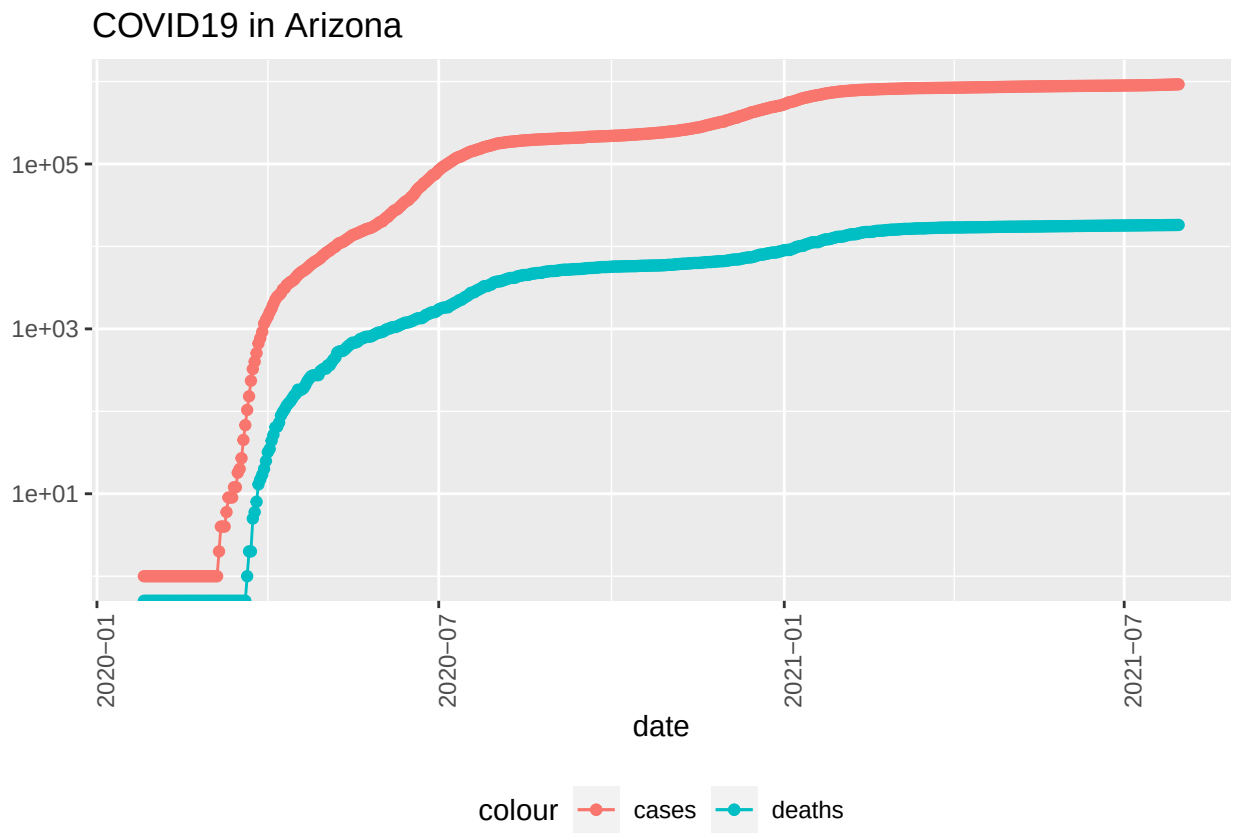
```
  select (-c(Lat, Long))

global_deaths <- global_deaths %>%
  pivot_longer(cols = -c('Province/State', 'Country/Region', Lat, Long), names_to = "date", values_to =
  select (-c(Lat, Long))

global <- global_cases %>%
  full_join(global_deaths) %>%
  rename(Country_Region = 'Country/Region', Province_State = 'Province/State') %>%
  mutate(date = mdy(date))

global <- global %>% filter(cases > 0)

US_cases <- US_cases %>%
  pivot_longer(cols = -(UID:Combined_Key),
               names_to = "date",
               values_to = "cases") %>%
  select(Admin2:cases) %>%
  mutate(date = mdy(date)) %>%
  select(-c(Lat, Long_))

US_deaths <- US_deaths %>%
  pivot_longer(cols = -(UID:Population),
               names_to = "date",
               values_to = "deaths") %>%
  select(Admin2:deaths) %>%
  mutate(date = mdy(date)) %>%
  select(-c(Lat, Long_))

US <- US_cases %>%
  full_join (US_deaths)

global <- global %>%
  unite("Combined_Key",
        c(Province_State, Country_Region),
        sep = ", ",
        na.rm = TRUE,
        remove = FALSE)

uid_lookup_url <- "https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/

uid <- read_csv(uid_lookup_url) %>%
  select(-c(Lat, Long_, Combined_Key, code3, iso2, iso3, Admin2))

global <- global %>%
  left_join(uid, by = c("Province_State", "Country_Region")) %>%
  select(-c(UID, FIPS))  %>%
  select(Province_State, Country_Region, date,
         cases, deaths, Population,
         Combined_Key)
```

Visualization Prep:

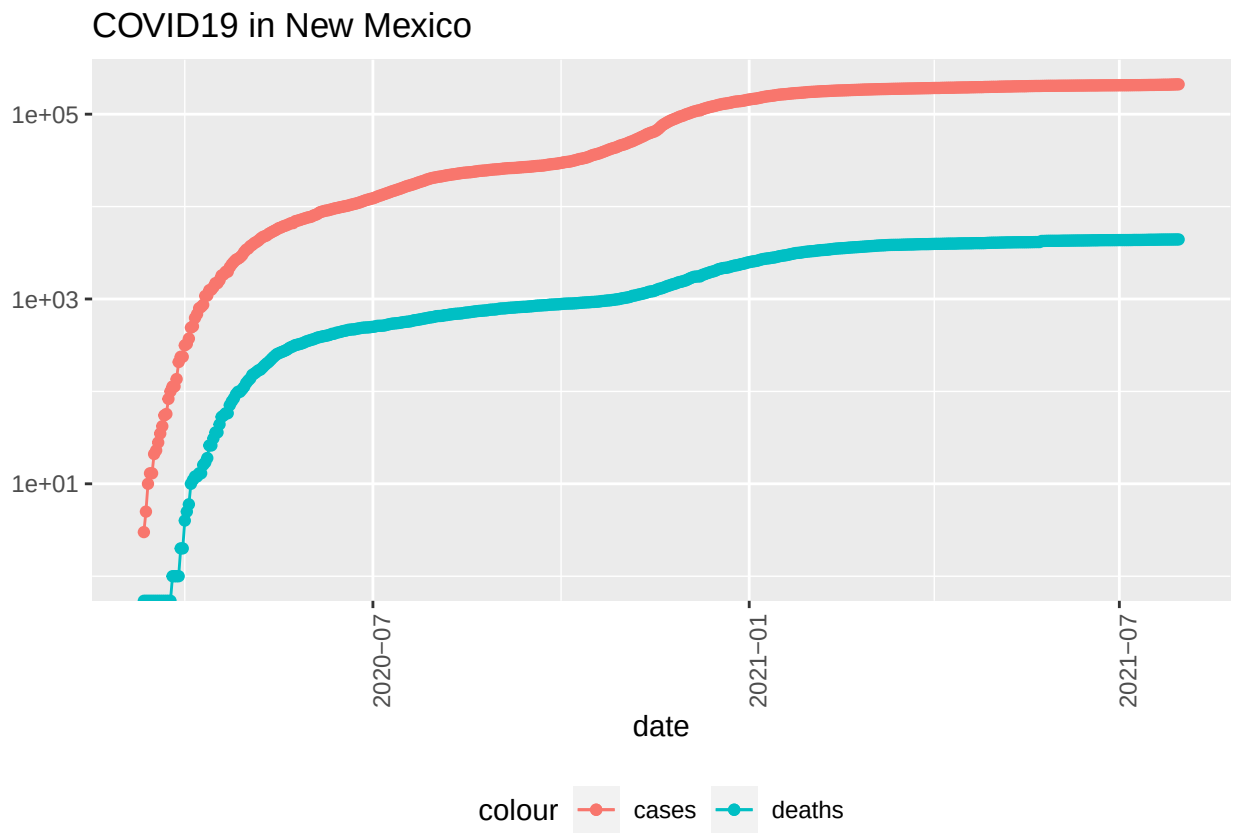
```
US_by_state <- US %>%
  group_by(Province_State, Country_Region, date) %>%
  summarize(cases = sum(cases), deaths = sum(deaths),
            Population = sum(Population)) %>%
  mutate(deaths_per_mill = deaths *1000000 / Population)  %>%
  select(Province_State, Country_Region, date,
         cases, deaths, deaths_per_mill, Population) %>%
  ungroup()

US_totals <- US_by_state  %>%
  group_by(Country_Region, date) %>%
  summarize(cases = sum(cases), deaths = sum(deaths),
            Population = sum(Population)) %>%
  mutate(deaths_per_mill = deaths * 1000000 / Population) %>%
  select(Country_Region, date,
         cases, deaths, deaths_per_mill, Population) %>%
  ungroup()
```

Three Visualizations:

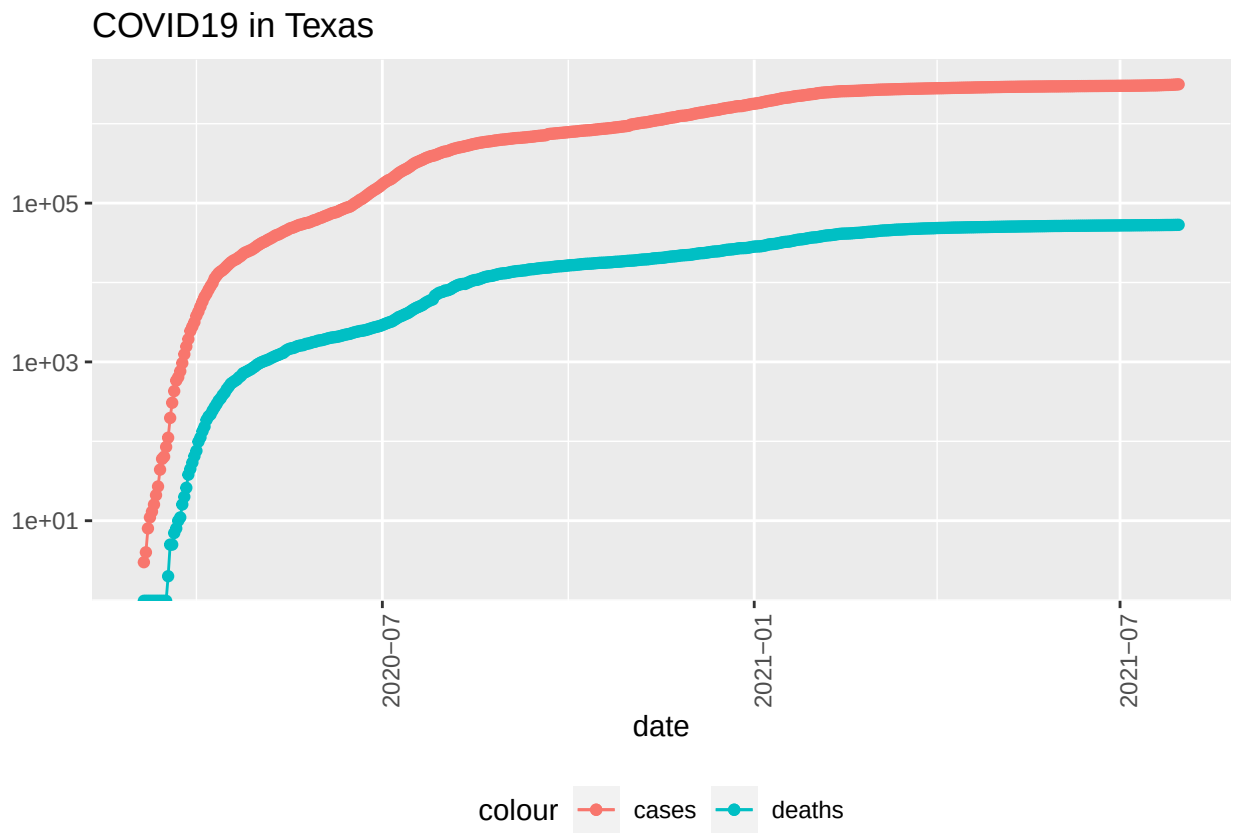
```
state <- "Arizona"
US_by_state %>%
  filter(Province_State == state) %>%
  filter(cases > 0) %>%
  ggplot(aes(x = date, y = cases)) +
  geom_line(aes(color = "cases")) +
  geom_point(aes(color = "cases")) +
  geom_line(aes(y = deaths, color = "deaths")) +
  geom_point(aes(y = deaths, color = "deaths")) +
  scale_y_log10() +
  theme(legend.position="bottom",
        axis.text.x = element_text(angle = 90)) +
  labs(title = str_c("COVID19 in " , state), y = NULL)
```



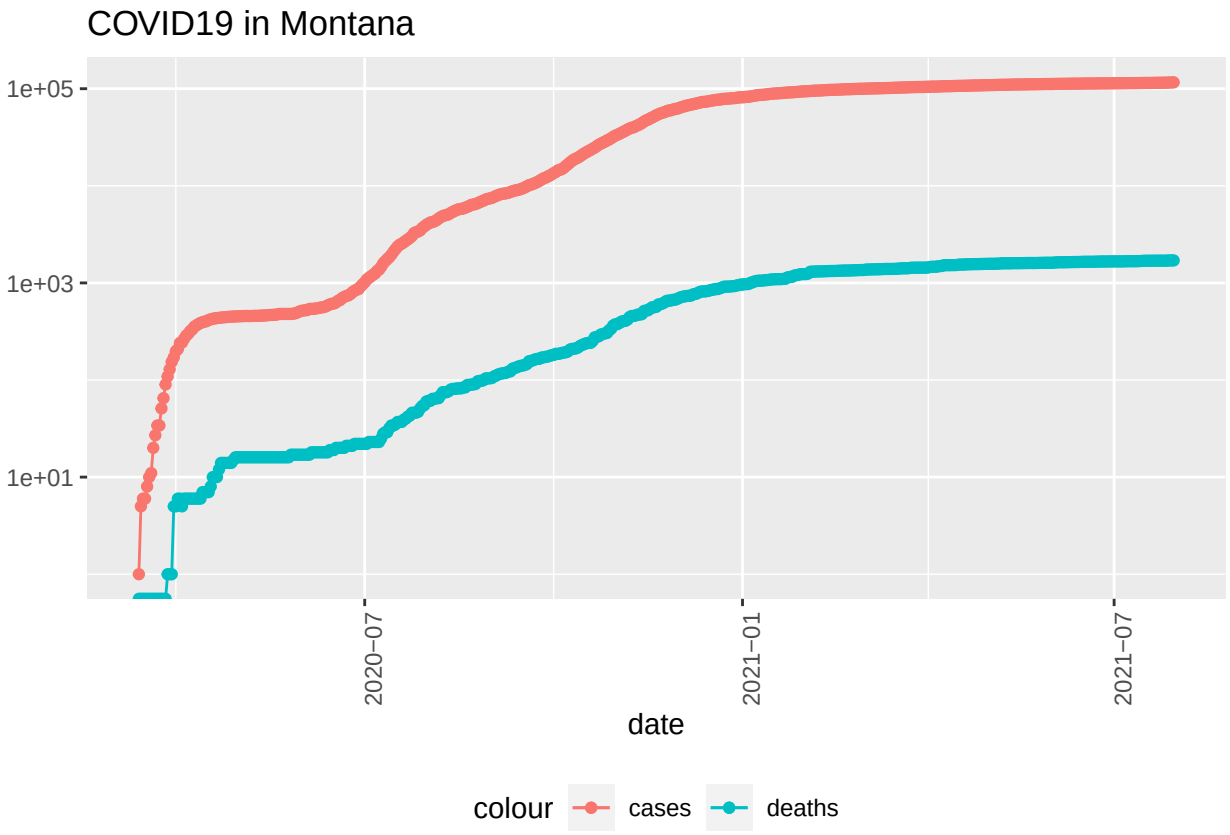

```
state <- "New Mexico"
US_by_state %>%
  filter(Province_State == state) %>%
  filter(cases > 0) %>%
  ggplot(aes(x = date, y = cases)) +
  geom_line(aes(color = "cases")) +
  geom_point(aes(color = "cases")) +
  geom_line(aes(y = deaths, color = "deaths")) +
  geom_point(aes(y = deaths, color = "deaths")) +
  scale_y_log10() +
  theme(legend.position="bottom",
        axis.text.x = element_text(angle = 90)) +
  labs(title = str_c("COVID19 in " , state), y = NULL)
```



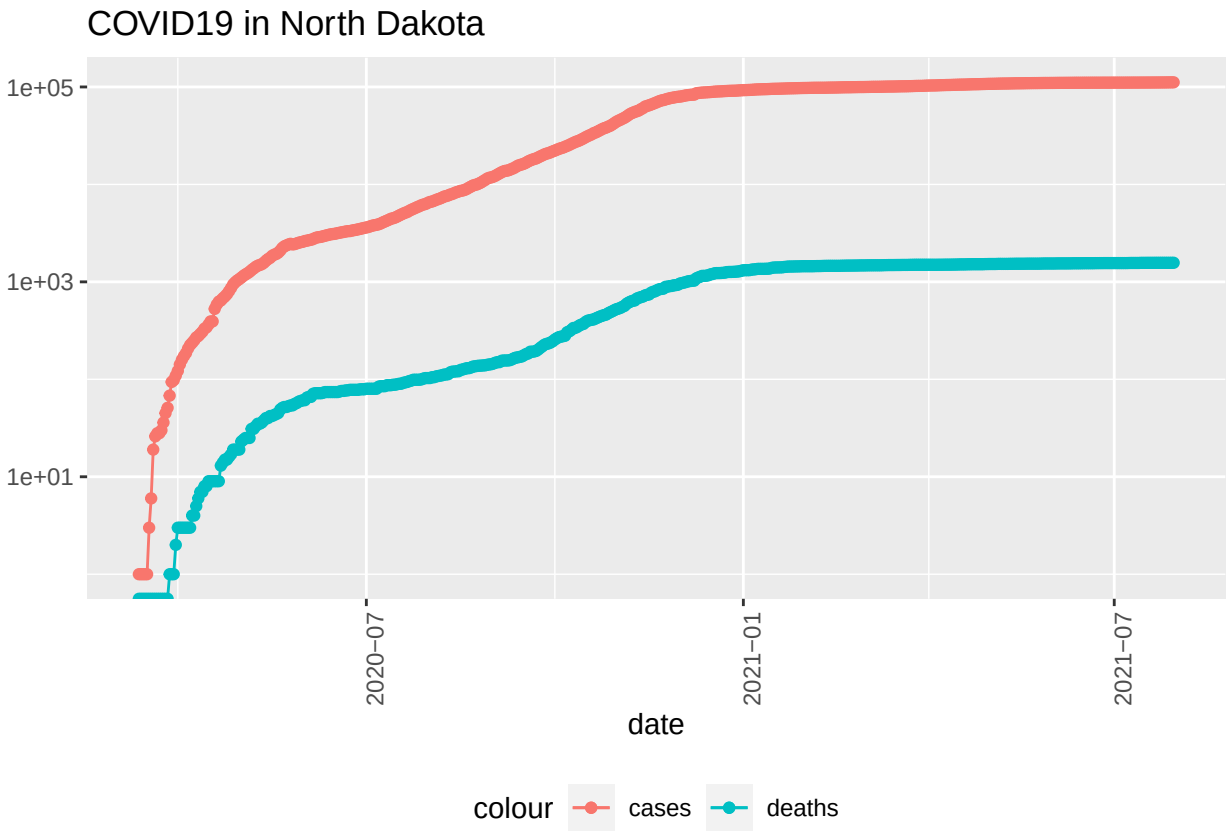

```
state <- "Texas"
US_by_state %>%
  filter(Province_State == state) %>%
  filter(cases > 0) %>%
  ggplot(aes(x = date, y = cases)) +
  geom_line(aes(color = "cases")) +
  geom_point(aes(color = "cases")) +
  geom_line(aes(y = deaths, color = "deaths")) +
  geom_point(aes(y = deaths, color = "deaths")) +
  scale_y_log10() +
  theme(legend.position="bottom",
        axis.text.x = element_text(angle = 90)) +
  labs(title = str_c("COVID19 in " , state), y = NULL)
```



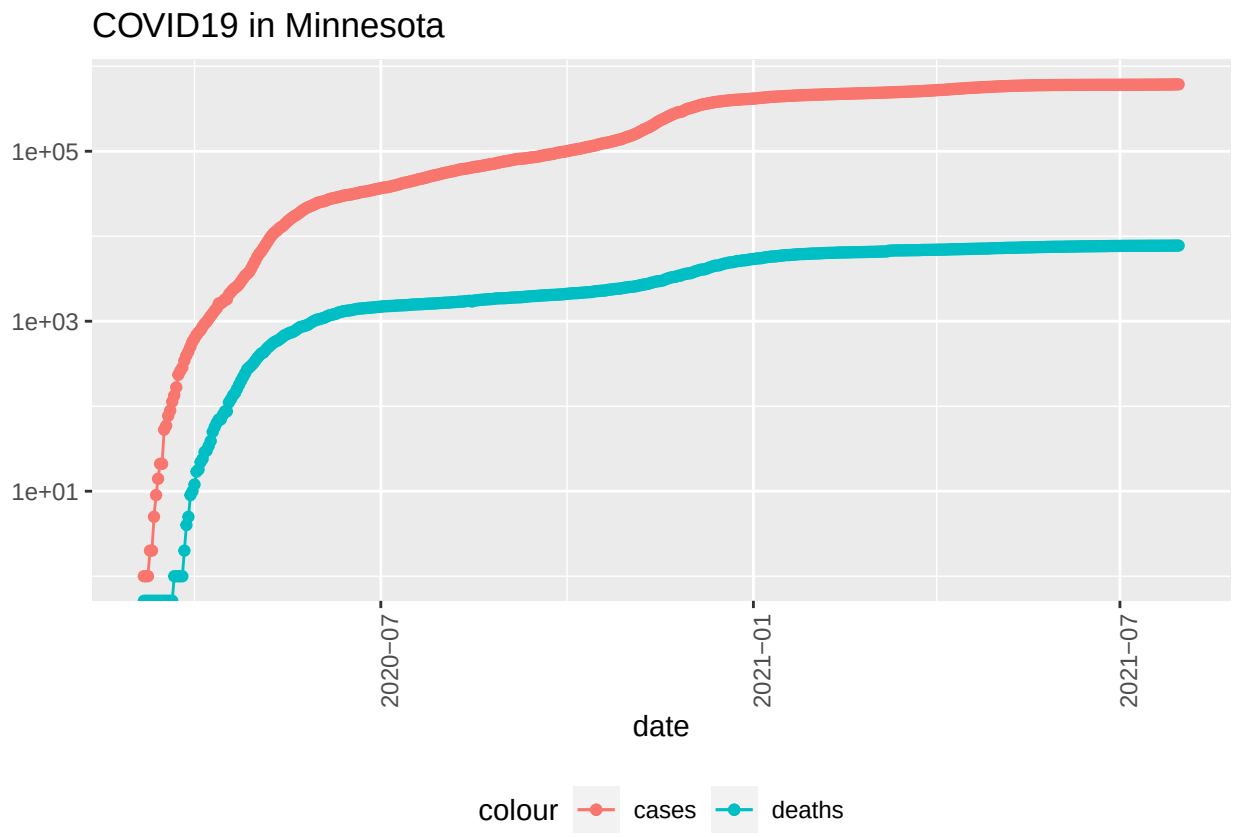

```
state <- "Montana"
US_by_state %>%
  filter(Province_State == state) %>%
  filter(cases > 0) %>%
  ggplot(aes(x = date, y = cases)) +
  geom_line(aes(color = "cases")) +
  geom_point(aes(color = "cases")) +
  geom_line(aes(y = deaths, color = "deaths")) +
  geom_point(aes(y = deaths, color = "deaths")) +
  scale_y_log10() +
  theme(legend.position="bottom",
        axis.text.x = element_text(angle = 90)) +
  labs(title = str_c("COVID19 in " , state), y = NULL)
```




```
#------------------------------------------------------------------------------
state <- "North Dakota"
US_by_state %>%
  filter(Province_State == state) %>%
  filter(cases > 0) %>%
  ggplot(aes(x = date, y = cases)) +
  geom_line(aes(color = "cases")) +
  geom_point(aes(color = "cases")) +
  geom_line(aes(y = deaths, color = "deaths")) +
  geom_point(aes(y = deaths, color = "deaths")) +
  scale_y_log10() +
  theme(legend.position="bottom",
        axis.text.x = element_text(angle = 90)) +
  labs(title = str_c("COVID19 in " , state), y = NULL)
```




```
#-------------------------------------------------------------------------------
state <- "Minnesota"
US_by_state %>%
  filter(Province_State == state) %>%
  filter(cases > 0) %>%
  ggplot(aes(x = date, y = cases)) +
  geom_line(aes(color = "cases")) +
  geom_point(aes(color = "cases")) +
  geom_line(aes(y = deaths, color = "deaths")) +
  geom_point(aes(y = deaths, color = "deaths")) +
  scale_y_log10() +
  theme(legend.position="bottom",
        axis.text.x = element_text(angle = 90)) +
  labs(title = str_c("COVID19 in " , state), y = NULL)
```



MODEL:

```
US_state_totals <- US_by_state %>%
  group_by(Province_State) %>%
  summarize(deaths = max(deaths), cases = max(cases),
            population = max(Population),
            cases_per_thou = 1000* cases / population,
            deaths_per_thou = 1000 * deaths / population) %>%
  filter(cases > 0, population > 0)


#-------------------------------------------------------------------------------
# Best states:
#-------------------------------------------------------------------------------
US_state_totals %>%
  slice_min(deaths_per_thou, n = 10) %>%
  select(deaths_per_thou, cases_per_thou, everything())
```

```
## # A tibble: 10 x 6
##    deaths_per_thou cases_per_thou Province_State        deaths  cases population
##              <dbl>          <dbl> <chr>                  <dbl>  <dbl>      <dbl>
##  1          0.0363           3.32 Northern Mariana Isl~      2    183      55144
##  2          0.345           42.9  Virgin Islands            37   4606     107268
##  3          0.379           29.6  Hawaii                   537  41925    1415872
##  4          0.417           39.9  Vermont                  260  24889     623989
##  5          0.525          102.   Alaska                   389  75486     740995
```

```
##  6          0.669           52.4  Maine                  899  70372    1344212
##  7          0.678           52.1  Oregon                2858 219755    4217737
##  8          0.687           38.7  Puerto Rico           2578 145487    3754939
##  9          0.765          135.   Utah                  2451 432467    3205958
## 10          0.804           62.1  Washington            6122 473076    7614893
```

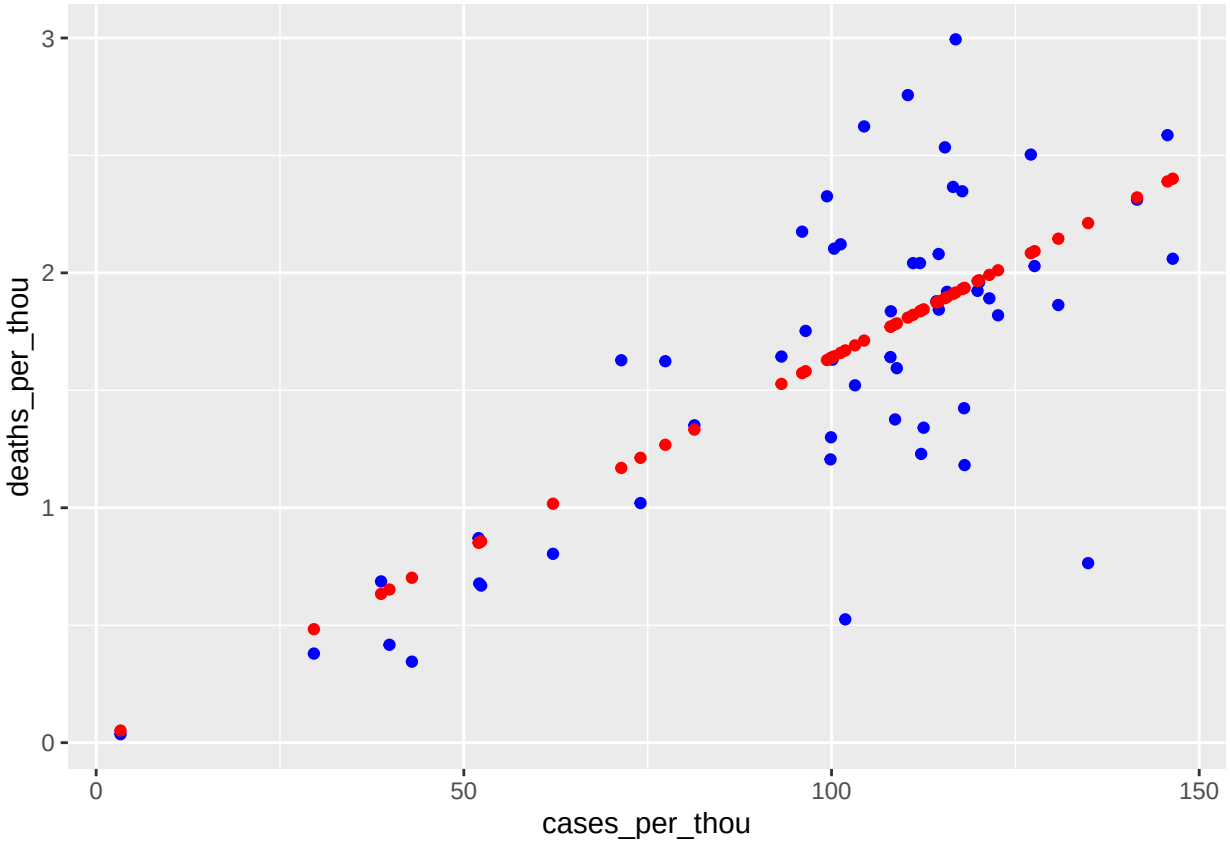
```
#-------------------------------------------------------------------------------
# Worst states:
#-------------------------------------------------------------------------------
US_state_totals %>%
  slice_max(deaths_per_thou, n = 10) %>%
  select(deaths_per_thou, cases_per_thou, everything())
```

```
## # A tibble: 10 x 6
##    deaths_per_thou cases_per_thou Province_State deaths   cases population
##              <dbl>          <dbl> <chr>           <dbl>   <dbl>      <dbl>
##  1            2.99           117.  New Jersey      26595 1038171    8882190
##  2            2.76           110.  New York        53632 2147318   19453561
##  3            2.62           104.  Massachusetts   18082  719780    6892503
##  4            2.59           146.  Rhode Island     2740  154339    1059361
##  5            2.53           115.  Mississippi      7543  343505    2976149
##  6            2.50           127.  Arizona         18224  925169    7278717
##  7            2.37           117.  Louisiana       10999  541679    4648794
##  8            2.35           118.  Alabama         11510  577463    4903185
##  9            2.33            99.4 Connecticut      8293  354335    3565287
## 10            2.31           142.  South Dakota     2045  125225     884659
```

```
mod <- lm(deaths_per_thou ~ cases_per_thou, data = US_state_totals)

x_grid <- seq(1, 151)
new_df <- tibble(cases_per_thou = x_grid)
US_state_totals %>% mutate(pred = predict(mod))
```

```
## # A tibble: 55 x 7
##    Province_State  deaths  cases population cases_per_thou deaths_per_thou  pred
##    <chr>            <dbl>  <dbl>      <dbl>          <dbl>           <dbl> <dbl>
##  1 Alabama          11510 5.77e5    4903185          118.            2.35   1.93
##  2 Alaska             389 7.55e4     740995          102.            0.525  1.67
##  3 Arizona          18224 9.25e5    7278717          127.            2.50   2.08
##  4 Arkansas          6123 3.85e5    3017804          128.            2.03   2.09
##  5 California       64423 3.96e6   39512223          100.            1.63   1.64
##  6 Colorado          6945 5.75e5    5758736           99.9           1.21   1.64
##  7 Connecticut       8293 3.54e5    3565287           99.4           2.33   1.63
##  8 Delaware          1830 1.11e5     973764          114.            1.88   1.87
##  9 District of Co~   1149 5.04e4     705749           71.4           1.63   1.17
## 10 Florida          39079 2.63e6   21477737          123.            1.82   2.01
## # ... with 45 more rows
```

```
#-------------------------------------------------------------------------------
US_tot_w_pred <- US_state_totals %>% mutate(pred = predict(mod))
US_tot_w_pred %>% ggplot() +
  geom_point(aes(x = cases_per_thou, y = deaths_per_thou), color = "blue") +
  geom_point(aes(x = cases_per_thou, y = pred), color = "red")
```



Plots: Snap Short of Three States Review:

I was interested in the three upper northern states and three lower states, partly because of the climate. As you can see from the three upper states, there seems to be a difference in the onset of the COVID19 between Minnesota compared with North Dakota and Montana, which both of these states were a little bit more gradual compared to Minnesota. Minnesota had very similar onset attributes to Texas and Arizona.

Model:

Earlier-on in the model, you can see that the predictions are quite accurate, however as time goes on the spread becomes more defined, also outliers are seen readily.

Conclusion:

Conclusion of the John Hopkins (JH) COVID19 data: As expected, the data has many facets that can be shown in various ways. Though, an impressive amount of data, one needs to question if all variables are accounted for some real understanding of what makes up the details of COVID19. Tracking and understanding the data is shown here but I found myself questioning what this was really telling me. Obviously, you can see that the start of COVID19 was very fast, and rather maintained a consistent pattern, which holds true throughout the period examined. In regards to properties that would be interesting in the future to study would be the correlation between: mask wearing, school interactions (of all grades and classification), public gatherings and such said items that would provide depth.

Bias:

This entire project is very much subject to all sorts of biasness. The data collection methods need to be examined to see if data was indeed collected correctly, personal bias from the collectors need to be accounted for as well. The nature of COVID19 leads itself also to people not reporting said issues, affects, interactions, as well as wrong doings.

Citation Note:

Code was reproduced from video of Professor, as suggested: "Feel free to repeat and reuse what I did if you want to". I have more than two unique visualization and model that I created, as suggested.