State Unemployment vs COVID

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Unemployment Data by State, January 2020 - March 2021

Importing and cleaning data on state unemployment rates during the coronavirus pandemic:

```
bls_unemployment_data <- read.csv("rawdata/Unemployment by state 2020-2021.csv")[,c(1,2,3,4,11)]

# List of state names:
state_names <- bls_unemployment_data$State[1:53]

# Initialize empty matrix
unemployment_data <- data.frame(matrix(ncol=55,nrow=15))

# Label matrix with state names
colnames(unemployment_data) <- c("Year", "Month", state_names)

# Initialize dates
unemployment_data$Year <- c(rep(2020,12),rep(2021,3))
unemployment_data$Month <- c(1:12, 1:3)


# Fill in matrix with data from the BLS file
for (m in 1:15) {
  for (s in 1:53) {
    unemployment_data[m,s+2]<-bls_unemployment_data[s+53*(m-1),5]
  }
}

# Save the cleaned data
write.csv(unemployment_data,"output/unemployment data.csv")
```

COVID Cases by State

Importing and cleaning data on state COVID case and death counts:

```
# Define helper functions to extract the year, month, and day of a COVID report:
year_num <- function(x) {
  as.numeric(substr(x,1,4))
}
month_num <- function(x) {
  as.numeric(substr(x,6,7))
}
day_num <- function(x) {
  as.numeric(substr(x,9,10))
}
```

```r
# Read dataset of daily COVID cases and deaths for each state
covid_by_state <- read.csv("rawdata/COVID cases by state.csv")[,c(1,2,3,6,8,11)]

# Parse date strings from the file
covid_by_state$submission_date <- as.Date(covid_by_state$submission_date, format = "%m/%d/%Y")

# Get the year, month, and day using the helper functions:
covid_by_state$year <- year_num(covid_by_state$submission_date)
covid_by_state$month <- month_num(covid_by_state$submission_date)
covid_by_state$day <- day_num(covid_by_state$submission_date)

# Sort dataframe by location and date
attach(covid_by_state)
covid_by_state <- covid_by_state[order(year, month, day, state),]
detach(covid_by_state)
```

Now we need to group and sum the daily cases in each state by month:

```r
covid_data <- covid_by_state %>%
  group_by(state, year, month) %>%
  summarize(cases=sum(new_case),deaths=sum(new_death))
```

```
## `summarise()` has grouped output by 'state', 'year'. You can override using the `.groups` argument.
```

We now have COVID data by state and month, but need to organize it.

```r
# Copy the monthly unemployment data table:
cases_data <- unemployment_data[,1:2]
cases_data[16,] <- c(2021,4)
deaths_data <- unemployment_data[,1:2]
deaths_data[16,] <- c(2021,4)

# Fill in the monthly COVID case and deaths dataframes:
for (s in 1:60) {
  cases_data[s+2] <- rep(0,16)
  colnames(cases_data)[s+2] <- covid_data$state[1+16*(s-1)]
  deaths_data[s+2] <- rep(0,16)
  colnames(deaths_data)[s+2] <- covid_data$state[1+16*(s-1)]
  for (m in 1:16) {
    cases_data[m,s+2] <- covid_data[1+16*(s-1)+m,4]
    deaths_data[m,s+2] <- covid_data[1+16*(s-1)+m,5]
  }
}
```

Remove American Samoa, Federated States of Micronesia, Guam, MP, PW, RMI, Virgin Islands, and Los Angeles County. (I'm retaining New York City because it is present in both the unemployment and COVID cases/deaths datasets.)

```r
cases_data <- cases_data[c(-16),c(-6,-14,-16,-31,-47,-48,-50,-57)]
deaths_data <- deaths_data[c(-16),c(-6,-14,-16,-31,-47,-48,-50,-57)]
unemployment_data <- unemployment_data[,c(-8)]
```

Sorting the unemployment data by abbreviation to match the case data:

```r
colnames(unemployment_data) <- c(
  "Year","Month","AL","AK","AZ","AR","CA","CO","CT","DE","DC","FL","GA","HI",
  "ID","IL","IN","IA","KS","KY","LA","ME","MD","MA","MI","MN","MS","MO","MT",
```

```
  "NE","NV","NH","NJ","NM","NY","NYC","NC","ND","OH","OK","OR","PA","RI","SC",
  "SD","TN","TX","UT","VT","VA","WA","WV","WI","WY"
)
unemployment_data <- unemployment_data[,
                                       c(1,2,4,3,6,5,7:9,11,10,12:14,18,15:17,
                                         19:21,24,23,22,25:26,28,27,29,37:38,
                                         30,32,33:34,31,35,36,39:48,
                                         50,49,51,53,52,54)
                                       ]
```

We can subtract the previous month's unemployment rate from the next month's unemployment rate to find the monthly change in unemployment:

```
unemployment_changes <- unemployment_data
unemployment_changes[1:14,3:54] <- unemployment_changes[2:15,3:54] - unemployment_changes[1:14,3:54]
unemployment_changes <- unemployment_changes[c(-15),]
```

Now let's find the correlation between COVID cases and deaths, and unemployment in each state.

This is commented out because it produces 104 scatterplots with ablines, but you can run this code to view the relationship within each state.

```
# for (i in 1:52) {
#   cases <- cases_data[1:14,i+2]
#   deaths <- deaths_data[1:14,i+2]
#   unemp_chg <- unemployment_changes[,i+2]
#   cases_vs_unemp <- lm(unemp_chg ~ cases)
#   deaths_vs_unemp <- lm(unemp_chg ~ deaths)
#   plot(cases,unemp_chg, main=paste(colnames(unemployment_changes)[i+2],"unemployment change vs cases"
#   abline(cases_vs_unemp$coefficients[[1]],cases_vs_unemp$coefficients[[2]])
#   plot(deaths, unemp_chg, main=paste(colnames(unemployment_changes)[i+2],"unemployment change vs deat
#   abline(deaths_vs_unemp$coefficients[[1]],deaths_vs_unemp$coefficients[[2]])
# }
```

This time, concatenate all states to find the overall correlations for cases and deaths to unemployment:

```
cases <- numeric(14*52)
deaths <- numeric(14*52)
unemp <- numeric(14*52)
for (m in 1:14) {
  for (s in 1:52) {
    cases[s+52*(m-1)] <- cases_data[m,s+2]
    deaths[s+52*(m-1)] <- deaths_data[m,s+2]
    unemp[s+52*(m-1)] <- unemployment_changes[m,s+2]
  }
}
# cases_vs_unemp <- lm(unemp ~ cases)
# summary(cases_vs_unemp)
# deaths_vs_unemp <- lm(unemp ~ deaths)
# summary(deaths_vs_unemp)

both_vs_unemp <- lm(unemp ~ cases + deaths)
summary(both_vs_unemp)
```

```
##
## Call:
## lm(formula = unemp ~ cases + deaths)
```

```
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.1004 -0.9036 -0.2363  0.0553 22.9232
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.469e-02  1.302e-01   0.343    0.732
## cases       -1.146e-05  2.241e-06  -5.112 4.08e-07 ***
## deaths       7.821e-04  1.339e-04   5.842 7.80e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.061 on 725 degrees of freedom
## Multiple R-squared:  0.04597,    Adjusted R-squared:  0.04333
## F-statistic: 17.47 on 2 and 725 DF,  p-value: 3.907e-08
```

Adjusting case and death counts by state population to obtain per capita figures:

```r
state_pops <- read.csv("output/State populations 2020.csv")[,-1]
# Delete New York City because it's not in the state population list
cases_per_capita <- cases_data[,-38]
deaths_per_capita <- deaths_data[,-38]

for (m in 1:15) {
  for (s in 1:51) {
    # divide cases_data and deaths_data columns by the pop of that state
    cases_per_capita[m,s+2] <- cases_per_capita[m,s+2]/as.numeric(state_pops[2,s])
    deaths_per_capita[m,s+2] <- deaths_per_capita[m,s+2]/as.numeric(state_pops[2,s])
  }
}
```

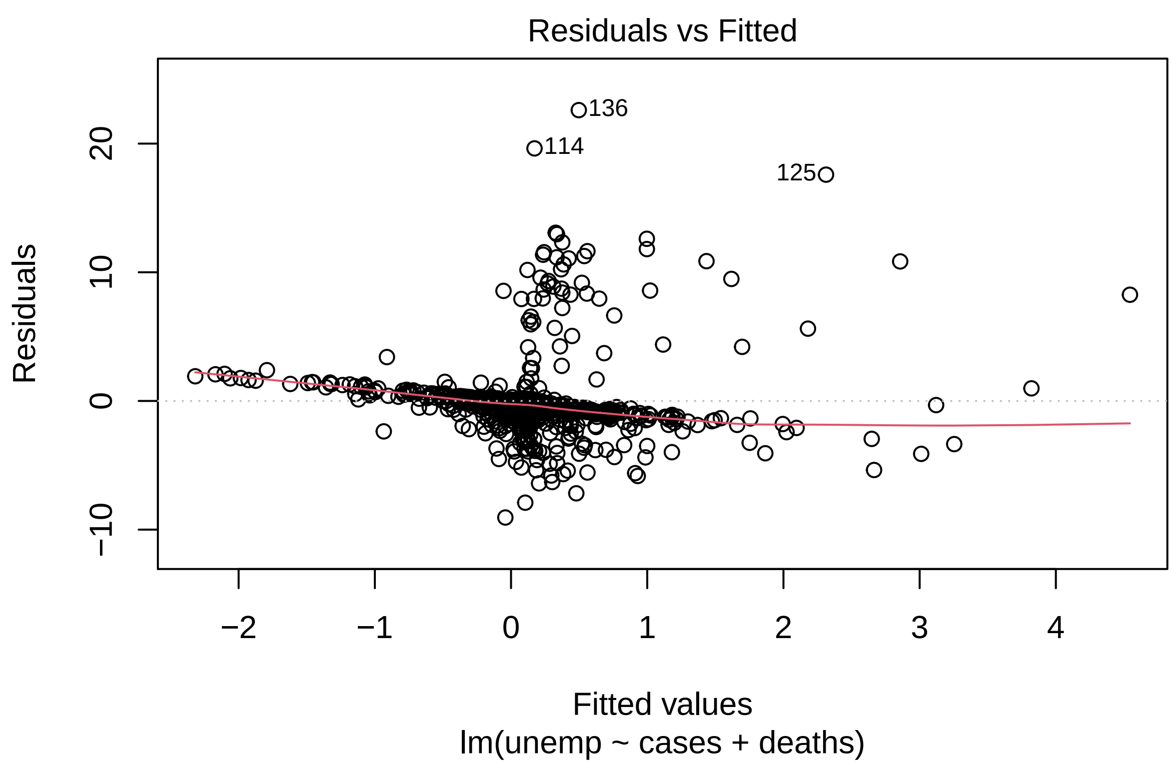
Repeating the above analysis using the per capita rates instead of gross figures:

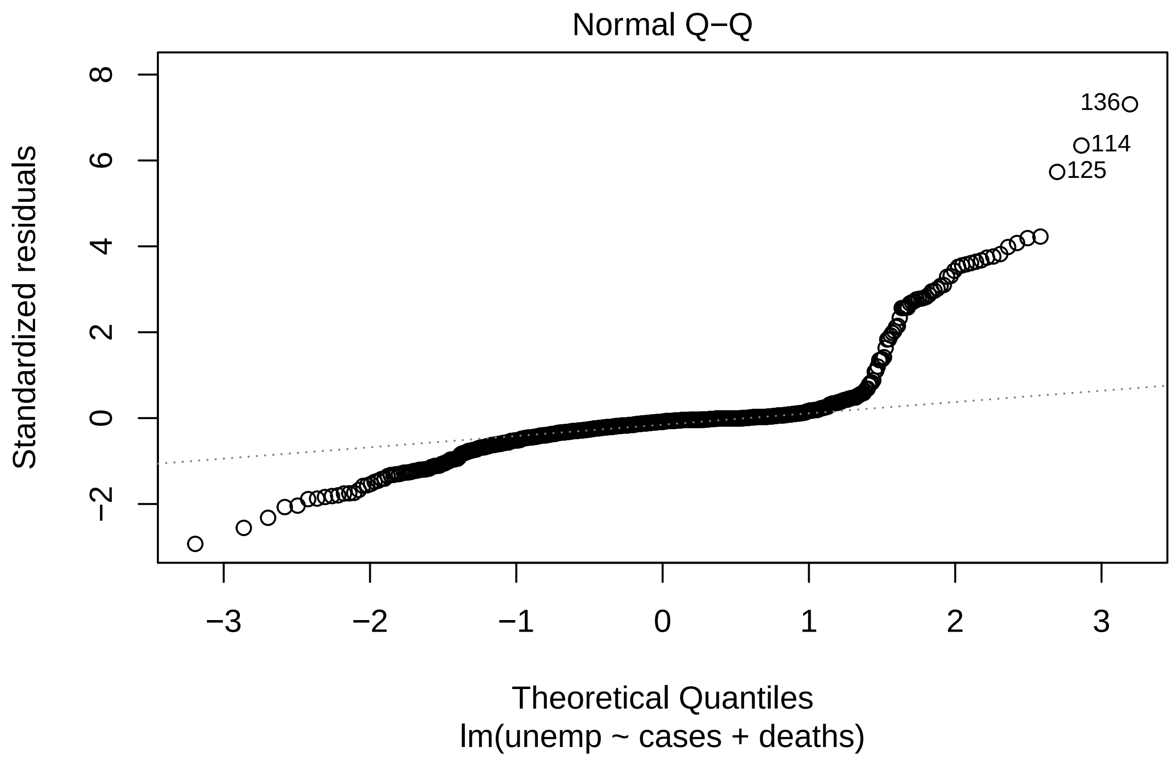
```r
cases <- numeric(14*51)
deaths <- numeric(14*51)
unemp <- numeric(14*51)
for (m in 1:14) {
  for (s in 1:51) {
    cases[s+51*(m-1)] <- cases_per_capita[m,s+2]
    deaths[s+51*(m-1)] <- deaths_per_capita[m,s+2]
    unemp[s+51*(m-1)] <- unemployment_changes[m,s+2]
  }
}
# cases_vs_unemp <- lm(unemp ~ cases)
# summary(cases_vs_unemp)
# deaths_vs_unemp <- lm(unemp ~ deaths)
# summary(deaths_vs_unemp)

both_vs_unemp <- lm(unemp ~ cases + deaths)
summary(both_vs_unemp)
```

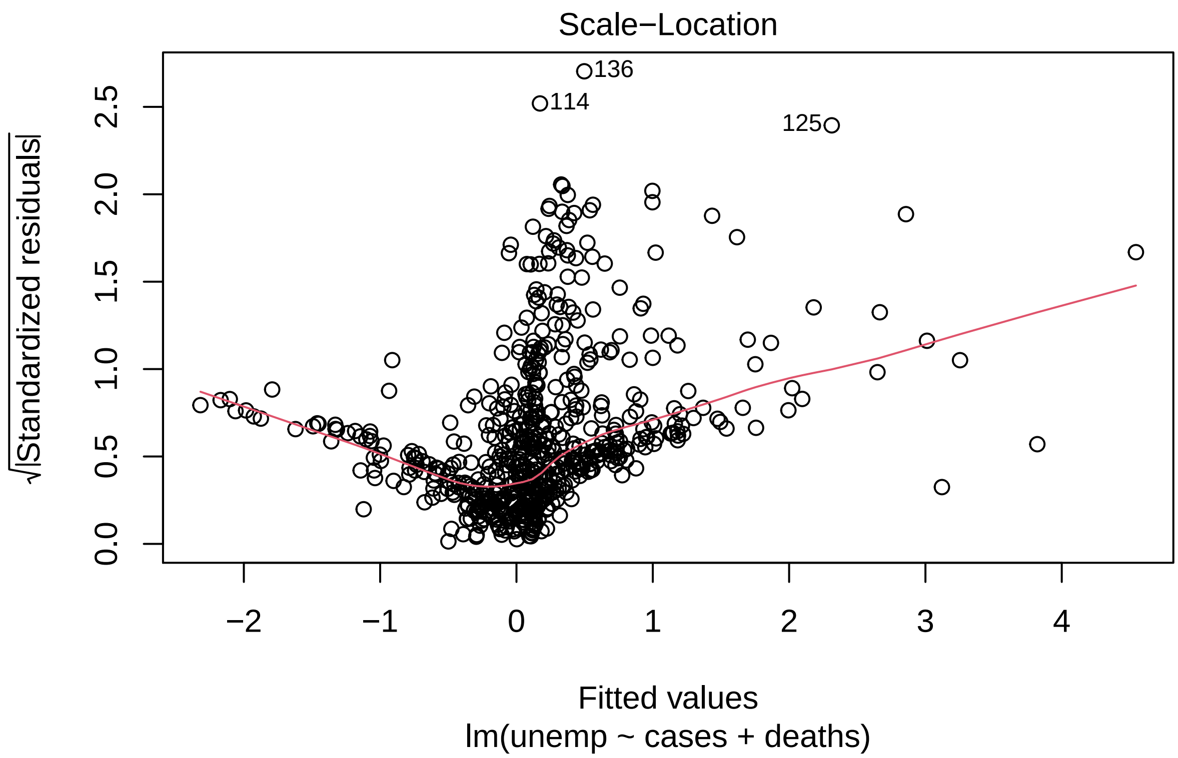
```
##
## Call:
## lm(formula = unemp ~ cases + deaths)
##
```

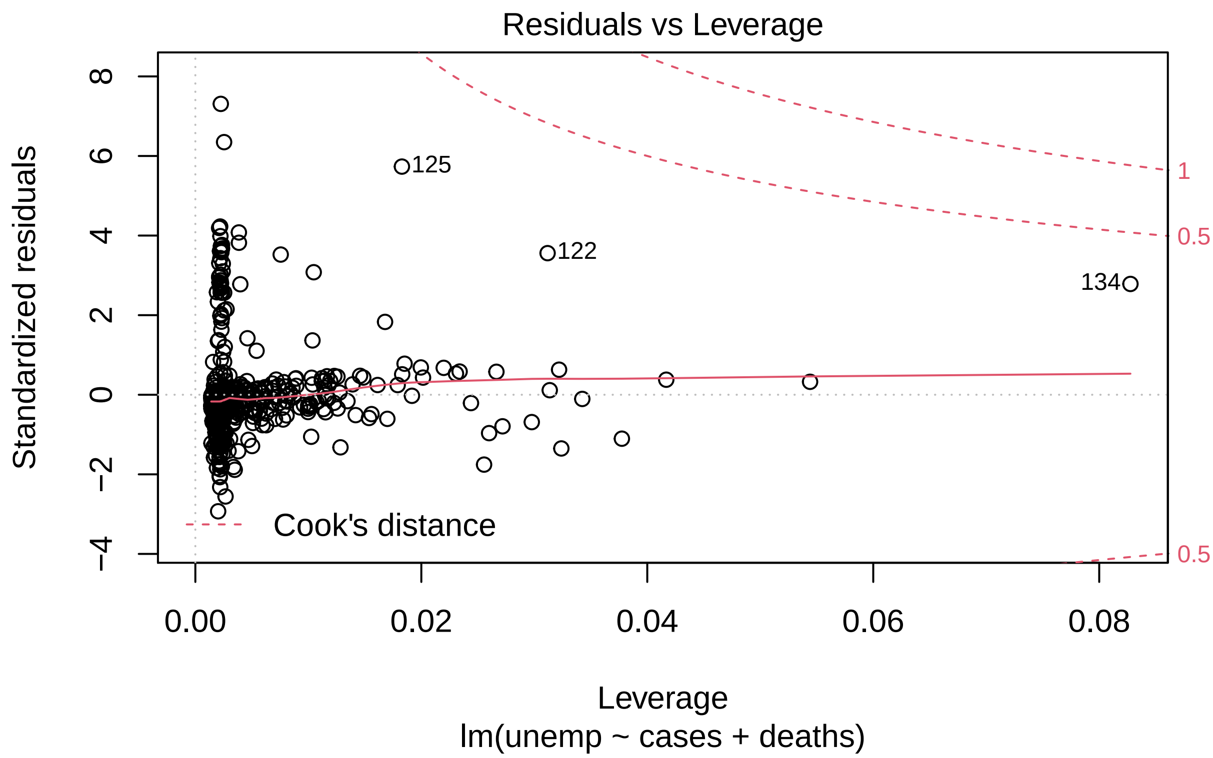
```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -9.0583 -1.0211 -0.2608  0.0787 22.6027
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)    0.1213     0.1614   0.752    0.452
## cases       -117.7508    23.0686  -5.104 4.26e-07 ***
## deaths      7329.4915  1415.9616   5.176 2.95e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 3.096 on 711 degrees of freedom
## Multiple R-squared:  0.04153,    Adjusted R-squared:  0.03884
## F-statistic:  15.4 on 2 and 711 DF,  p-value: 2.822e-07
```

```r
plot(both_vs_unemp)
```




Normal Q−Q
Standardized residuals
Theoretical Quantiles
lm(unemp ~ cases + deaths)
136
114
125
−3
−2
−1
0
1
2
3
8
6
4
2
0
−2


Scale−Location
√|Standardized residuals|
0.0
0.5
1.0
1.5
2.0
2.5
136
114
125
−2
−1
0
1
2
3
4
Fitted values
lm(unemp ~ cases + deaths)



So we see that cases and deaths are both highly significant predictors of monthly unemployment change, with a negative coefficient on cases and a positive coefficient for deaths.