COVID_economic_analysis

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Let's first load our packages

```
library(tidyverse)
```

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

## v ggplot2 3.3.5     v purrr   0.3.4
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.1
## v readr   2.1.1     v forcats 0.5.1

## Warning: package 'stringr' was built under R version 4.1.3

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

```
library(readxl)
```

Then, using the "readx1" package we'll load our data

```
covid_2022 <- read.csv("covid_data_04_09_2022.csv")
covid_2020 <- read.csv("covid_data_20_01_2020.csv")
gdp_rate <- read.csv("GDP Growth Rate by Country.csv")
gdp_per_capita <- read.csv("GDP Per Capita by Country.csv")
infation <- read.csv("Inflation Rate by Country.csv")
```

#Procesing data

We want to analyze if there is a correlation between COVID and some economic metrics. In order to get it, we have to merge our 4 data frames in just one.

```
covid_2020 <- covid_2020 %>% rename(Country.Name=Country.Region)
covid_2022 <- covid_2022 %>% rename(Country.Name=Country..Other)
#We start by renaming one column to use the merge function
```

Before we merge our data, we have to make the rows names be the same, in order to get it we'll change some abbreviate names

```
covid_2020[covid_2020=="USA"] <- "United States"
covid_2020[covid_2020=="S. Korea"] <- "South Korea"
covid_2020[covid_2020=="UK"] <- "United Kingdom"
covid_2022[covid_2022=="USA"] <- "United States"
covid_2022[covid_2022=="S. Korea"] <- "South Korea"
covid_2022[covid_2022=="UK"] <- "United Kingdom"
```

```
all_togheter_2020 <- merge(x = covid_2020,
                           y = gdp_rate, by="Country.Name",
                           all=T)
all_togheter_2020 <- merge(x=all_togheter_2020,
                      y=gdp_per_capita, by ="Country.Name",
                      all=T)
all_togheter_2020 <- merge(x=all_togheter_2020,
                      y=infation, by="Country.Name",
                      all=T)

#we do the same with data from 2022
all_togheter_2022 <- merge(x = covid_2022,
                           y = gdp_rate, by="Country.Name",
                           all=T)
all_togheter_2022 <- merge(x=all_togheter_2022,
                      y=gdp_per_capita, by ="Country.Name",
                      all=T)
all_togheter_2022 <- merge(x=all_togheter_2022,
                      y=infation, by="Country.Name",
                      all=T)
```

#Cleaning data

We have merged our data, but now the column names are not readables, we don't know what is the gdp_rate, gdp_per capita and the inflation rate. So, let's change the column labels

```
colnames(all_togheter_2022) #first we visualize the colum names
```

```
##  [1] "Country.Name"      "X."                "Total.Cases"
##  [4] "New.Cases"         "Total.Deaths"      "New.Deaths"
##  [7] "Total.Recovered"   "New.Recovered"     "Active.Cases"
## [10] "Serious..Critical" "Tot.Cases..1M.pop" "Deaths..1M.pop"
## [13] "Total.Tests"       "Tests...1M.pop"    "Population"
## [16] "X2021.x"           "X2020.x"           "X2019.x"
## [19] "X2018.x"           "X2017.x"           "X2021.y"
## [22] "X2020.y"           "X2019.y"           "X2018.y"
## [25] "X2017.y"           "X2021"             "X2020"
## [28] "X2019"             "X2018"             "X2017"
```

```
head(all_togheter_2022) #display the first rows
```

```
##     Country.Name  X. Total.Cases New.Cases Total.Deaths New.Deaths
## 1                 NA         721        NA           15         NA
## 2    Afghanistan 117      194163        NA         7782         NA
## 3         Africa  NA    12616085        NA       257418         NA
```

```
## 4        Albania 101      330193        NA         3582         NA
## 5        Algeria 105      270443        NA         6879         NA
## 6 American Samoa  NA          NA        NA           NA         NA
##   Total.Recovered New.Recovered Active.Cases Serious..Critical
## 1             706                         0                 0
## 2         172,168                    14,213              1124
## 3      11,943,257                   415,410              1026
## 4         322,849                     3,762                NA
## 5         182,067                    81,497                 6
## 6            <NA>          <NA>         <NA>                NA
##   Tot.Cases..1M.pop Deaths..1M.pop Total.Tests Tests...1M.pop Population
## 1                NA             NA          NA             NA         NA
## 2              4755            191     1073129          26282   40831974
## 3                NA             NA          NA             NA         NA
## 4            115011           1248     1941032         676087    2870979
## 5              5935            151      230861           5066   45570311
## 6                NA             NA          NA             NA         NA
##   X2021.x X2020.x X2019.x X2018.x X2017.x X2021.y X2020.y X2019.y X2018.y
## 1      NA      NA      NA      NA      NA      NA      NA      NA      NA
## 2  0.0000 -0.0235  0.0391  0.0119  0.0265       0     517     494     486
## 3      NA      NA      NA      NA      NA      NA      NA      NA      NA
## 4  0.0854 -0.0348  0.0209  0.0402  0.0380    6494    5332    5396    5288
## 5  0.0385 -0.0510  0.0100  0.0110  0.0130    3765    3307    3990    4142
## 6  0.0000  0.0392 -0.0049  0.0267 -0.0699       0   12845   11715   11522
##   X2017.y  X2021  X2020  X2019  X2018  X2017
## 1      NA     NA     NA     NA     NA     NA
## 2     517 0.0000 0.0000 0.0230 0.0063 0.0498
## 3      NA     NA     NA     NA     NA     NA
## 4    4531 0.0204 0.0162 0.0141 0.0203 0.0206
## 5    4110 0.0723 0.0242 0.0195 0.0427 0.0559
## 6   11004     NA     NA     NA     NA     NA
```

```
filter(gdp_per_capita,Country.Name=="Afghanistan")
```

```
##   Country.Name X2021 X2020 X2019 X2018 X2017
## 1  Afghanistan     0   517   494   486   517
```

```
filter(gdp_rate, Country.Name=="Afghanistan")
```

```
##   Country.Name X2021   X2020  X2019  X2018  X2017
## 1  Afghanistan     0 -0.0235 0.0391 0.0119 0.0265
```

```
filter(infation, Country.Name=="Afghanistan")
```

```
##   Country.Name X2021 X2020 X2019  X2018  X2017
## 1  Afghanistan     0     0 0.023 0.0063 0.0498
```

```
#filter the Afghanistan row to match the columns with their real name
all_togheter_2020 <- rename(all_togheter_2020,
                           "gdp_per_capita_2021"="X2021.y",
       "gdp_per_capita_2020"="X2020.y",
```

```
       "gdp_per_capita_2019"="X2019.y",
       "gdp_per_capita_2018"="X2018.y",
       "gdp_per_capita_2017"="X2017.y",
       "gdp_rate_2021"="X2021.x",
       "gdp_rate_2020"="X2020.x",
       "gdp_rate_2019"="X2019.x",
       "gdp_rate_2018"="X2018.x",
       "gdp_rate_2017"="X2017.x",
       "inflation_rate_2021"="X2021",
       "inflation_rate_2020"="X2020",
       "inflation_rate_2019"="X2019",
       "inflation_rate_2018"="X2018",
       "inflation_rate_2017"="X2017")
#renaming columns from 2020 data

all_togheter_2022 <- rename(all_togheter_2022,
                           "gdp_per_capita_2021"="X2021.y",
       "gdp_per_capita_2020"="X2020.y",
       "gdp_per_capita_2019"="X2019.y",
       "gdp_per_capita_2018"="X2018.y",
       "gdp_per_capita_2017"="X2017.y",
       "gdp_rate_2021"="X2021.x",
       "gdp_rate_2020"="X2020.x",
       "gdp_rate_2019"="X2019.x",
       "gdp_rate_2018"="X2018.x",
       "gdp_rate_2017"="X2017.x",
       "inflation_rate_2021"="X2021",
       "inflation_rate_2020"="X2020",
       "inflation_rate_2019"="X2019",
       "inflation_rate_2018"="X2018",
       "inflation_rate_2017"="X2017")
#renaming columns from 2022 data

all_togheter_2022 %>%
  filter(Country.Name %in% c("Europe", "Africa", "South America",
                             "Oceania", "Asia", "North America",
                             "Total:", "World")) #analizing what rows we will delete
```

```
##     Country.Name X. Total.Cases New.Cases Total.Deaths New.Deaths
## 1         Africa NA    12616085        NA       257418         NA
## 2           Asia NA   184743469     39257      1469343         78
## 3         Europe NA   222253960        NA      1904758         NA
## 4  North America NA   114689858       990      1526246          5
## 5        Oceania NA    12191895      5539        19637         10
## 6  South America NA    63731409        NA      1326129         NA
## 7         Total: NA    12616085        NA       257418         NA
## 8         Total: NA    12191895      5539        19637         10
## 9         Total: NA   222253960        NA      1904758         NA
## 10        Total: NA   184743469     39257      1469343         78
## 11        Total: NA   610227397     45786      6503546         93
## 12        Total: NA   114689858       990      1526246          5
## 13        Total: NA    63731409        NA      1326129         NA
## 14        Total: NA         721        NA           15         NA
```

```
## 15         World NA   610227397     45786      6503546         93
##    Total.Recovered New.Recovered Active.Cases Serious..Critical
## 1       11,943,257                   415,410              1026
## 2      176,662,607      +181,088    6,611,519             12443
## 3      216,173,591       +29,100    4,175,611              9106
## 4      108,543,243        +7,154    4,620,369              9090
## 5       11,973,879        +1,693      198,379               144
## 6       61,754,756        +5,400      650,524             10505
## 7       11,943,257                   415,410              1026
## 8       11,973,879        +1,693      198,379               144
## 9      216,173,591                 4,175,611              9106
## 10     176,662,607      +181,088    6,611,519             12443
## 11     587,052,039      +224,435   16,671,812             42314
## 12     108,543,243        +7,154    4,620,369              9090
## 13      61,754,756                   650,524             10505
## 14             706                         0                 0
## 15     587,052,039      +224,435   16,671,812             42314
##    Tot.Cases..1M.pop Deaths..1M.pop Total.Tests Tests...1M.pop Population
## 1                 NA             NA          NA              NA         NA
## 2                 NA             NA          NA              NA         NA
## 3                 NA             NA          NA              NA         NA
## 4                 NA             NA          NA              NA         NA
## 5                 NA             NA          NA              NA         NA
## 6                 NA             NA          NA              NA         NA
## 7                 NA             NA          NA              NA         NA
## 8                 NA             NA          NA              NA         NA
## 9                 NA             NA          NA              NA         NA
## 10                NA             NA          NA              NA         NA
## 11             78286          834.3          NA              NA         NA
## 12                NA             NA          NA              NA         NA
## 13                NA             NA          NA              NA         NA
## 14                NA             NA          NA              NA         NA
## 15             78286          834.3          NA              NA         NA
##    gdp_rate_2021 gdp_rate_2020 gdp_rate_2019 gdp_rate_2018 gdp_rate_2017
## 1             NA            NA            NA            NA            NA
## 2             NA            NA            NA            NA            NA
## 3             NA            NA            NA            NA            NA
## 4             NA            NA            NA            NA            NA
## 5             NA            NA            NA            NA            NA
## 6             NA            NA            NA            NA            NA
## 7             NA            NA            NA            NA            NA
## 8             NA            NA            NA            NA            NA
## 9             NA            NA            NA            NA            NA
## 10            NA            NA            NA            NA            NA
## 11            NA            NA            NA            NA            NA
## 12            NA            NA            NA            NA            NA
## 13            NA            NA            NA            NA            NA
## 14            NA            NA            NA            NA            NA
## 15            NA            NA            NA            NA            NA
##    gdp_per_capita_2021 gdp_per_capita_2020 gdp_per_capita_2019
## 1                   NA                  NA                  NA
## 2                   NA                  NA                  NA
## 3                   NA                  NA                  NA
## 4                   NA                  NA                  NA
```

```
## 5                   NA                   NA                   NA
## 6                   NA                   NA                   NA
## 7                   NA                   NA                   NA
## 8                   NA                   NA                   NA
## 9                   NA                   NA                   NA
## 10                  NA                   NA                   NA
## 11                  NA                   NA                   NA
## 12                  NA                   NA                   NA
## 13                  NA                   NA                   NA
## 14                  NA                   NA                   NA
## 15                  NA                   NA                   NA
##    gdp_per_capita_2018 gdp_per_capita_2017 inflation_rate_2021
## 1                   NA                   NA                   NA
## 2                   NA                   NA                   NA
## 3                   NA                   NA                   NA
## 4                   NA                   NA                   NA
## 5                   NA                   NA                   NA
## 6                   NA                   NA                   NA
## 7                   NA                   NA                   NA
## 8                   NA                   NA                   NA
## 9                   NA                   NA                   NA
## 10                  NA                   NA                   NA
## 11                  NA                   NA                   NA
## 12                  NA                   NA                   NA
## 13                  NA                   NA                   NA
## 14                  NA                   NA                   NA
## 15                  NA                   NA                   NA
##    inflation_rate_2020 inflation_rate_2019 inflation_rate_2018
## 1                   NA                   NA                   NA
## 2                   NA                   NA                   NA
## 3                   NA                   NA                   NA
## 4                   NA                   NA                   NA
## 5                   NA                   NA                   NA
## 6                   NA                   NA                   NA
## 7                   NA                   NA                   NA
## 8                   NA                   NA                   NA
## 9                   NA                   NA                   NA
## 10                  NA                   NA                   NA
## 11                  NA                   NA                   NA
## 12                  NA                   NA                   NA
## 13                  NA                   NA                   NA
## 14                  NA                   NA                   NA
## 15                  NA                   NA                   NA
##    inflation_rate_2017
## 1                   NA
## 2                   NA
## 3                   NA
## 4                   NA
## 5                   NA
## 6                   NA
## 7                   NA
## 8                   NA
## 9                   NA
## 10                  NA
```

```
## 11                   NA
## 12                   NA
## 13                   NA
## 14                   NA
## 15                   NA
```

```
all_togheter_2022 <-all_togheter_2022 %>%
  filter(!Country.Name %in% c("Europe", "Africa", "South America",
                              "Oceania", "Asia", "North America",
                              "Total:", "World"))
#finally, let's remove some columns that have general metric by region
```

Now that we have our data, it's time to make our analysis

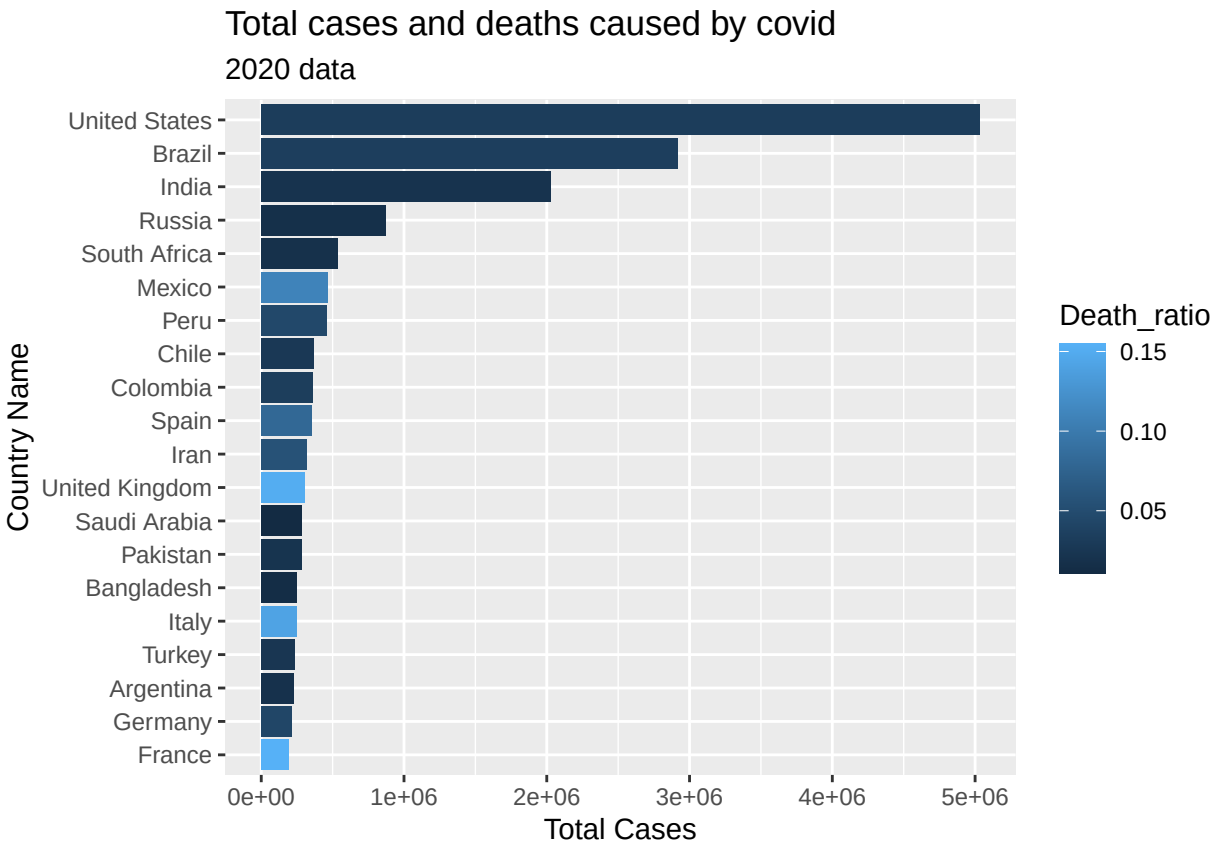
#Analysis

```
data_2020 <- all_togheter_2020 %>%
  arrange(desc(TotalCases)) %>%
  slice(1:20) # Top 20 highest TotalCases by country 2020


data_2022 <- all_togheter_2022 %>%
  arrange(desc(Total.Cases)) %>%
  slice(1:20) # Top 20 highest TotalCases by country 2022
```

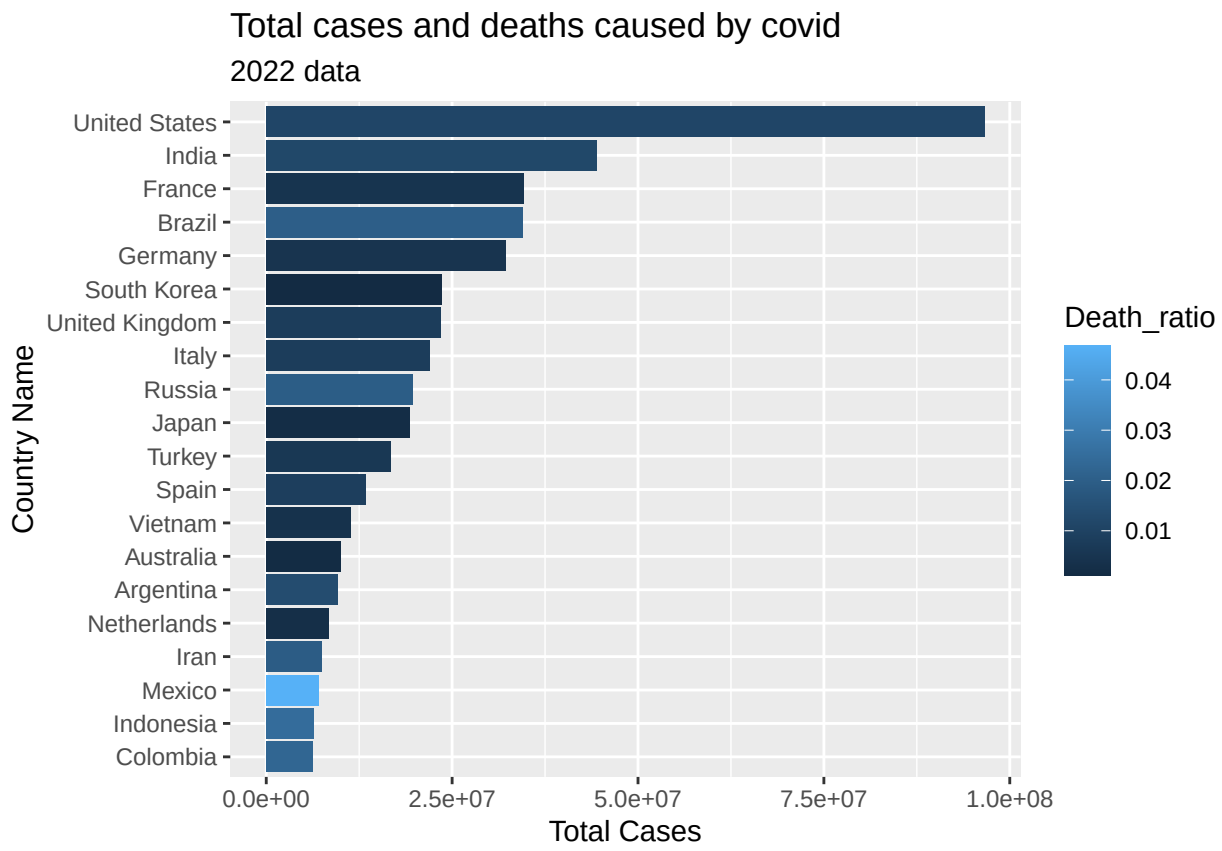
#Analizing Now it's time to analize our data. First we will compare the population's countries with their Death_ratio, which is just a division, Population/Total Death.

```
data_2020 <- mutate(data_2020, Death_ratio=TotalDeaths/TotalCases)
#we created in a first step our new Death_ratio column
data_2020 %>% ggplot(aes(x=reorder(Country.Name, +TotalCases), TotalCases, fill=Death_ratio)) +
  geom_bar(stat="identity", position="stack")+
  labs(x="Country Name", y="Total Cases",
       title="Total cases and deaths caused by covid",
       subtitle="2020 data") + coord_flip()
```



Now we analize the same but with data from 2022

```
data_2022 <- mutate(data_2022, Death_ratio=Total.Deaths/Total.Cases)
#we created in a first step our new Death_ratio column
data_2022 %>% ggplot(aes(x=reorder(Country.Name, +Total.Cases), Total.Cases, fill=Death_ratio)) +
  geom_bar(stat="identity", position="stack")+
  labs(x="Country Name", y="Total Cases",
       title="Total cases and deaths caused by covid",
       subtitle="2022 data") + coord_flip()
```



Comparing data from 2020 and 2022 Changing the colnames to make data_2022 and data_2020 can match. And merge their rows

```
colnames(data_2020)
```

```
##  [1] "Country.Name"         "Continent"            "Population"
##  [4] "TotalCases"           "NewCases"             "TotalDeaths"
##  [7] "NewDeaths"            "TotalRecovered"       "NewRecovered"
## [10] "ActiveCases"          "Serious.Critical"     "Tot.Cases.1M.pop"
## [13] "Deaths.1M.pop"        "TotalTests"           "Tests.1M.pop"
## [16] "WHO.Region"           "gdp_rate_2021"        "gdp_rate_2020"
## [19] "gdp_rate_2019"        "gdp_rate_2018"        "gdp_rate_2017"
## [22] "gdp_per_capita_2021" "gdp_per_capita_2020" "gdp_per_capita_2019"
## [25] "gdp_per_capita_2018" "gdp_per_capita_2017" "inflation_rate_2021"
## [28] "inflation_rate_2020" "inflation_rate_2019" "inflation_rate_2018"
## [31] "inflation_rate_2017" "Death_ratio"
```

```
colnames(data_2022)
```

```
##  [1] "Country.Name"         "X."                   "Total.Cases"
##  [4] "New.Cases"            "Total.Deaths"         "New.Deaths"
##  [7] "Total.Recovered"      "New.Recovered"        "Active.Cases"
## [10] "Serious..Critical"    "Tot.Cases..1M.pop"    "Deaths..1M.pop"
## [13] "Total.Tests"          "Tests...1M.pop"       "Population"
## [16] "gdp_rate_2021"        "gdp_rate_2020"        "gdp_rate_2019"
```

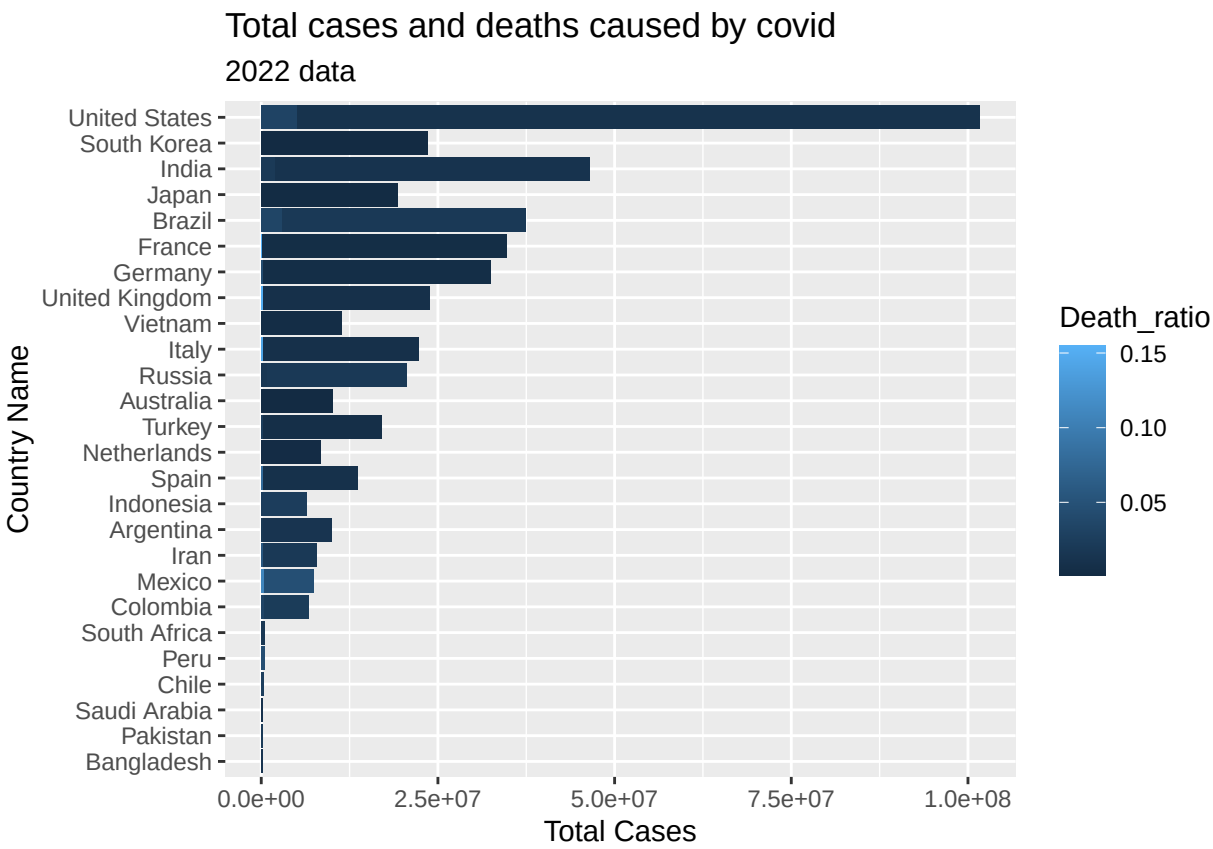
```
## [19] "gdp_rate_2018"       "gdp_rate_2017"       "gdp_per_capita_2021"
## [22] "gdp_per_capita_2020" "gdp_per_capita_2019" "gdp_per_capita_2018"
## [25] "gdp_per_capita_2017" "inflation_rate_2021" "inflation_rate_2020"
## [28] "inflation_rate_2019" "inflation_rate_2018" "inflation_rate_2017"
## [31] "Death_ratio"
```

```
data_2020 <- select(data_2020, -Continent, WHO.Region,-NewRecovered, -NewDeaths, -TotalRecovered,
                    NewCases, -ActiveCases, -ActiveCases)
data_2022 <- select(data_2022, -New.Recovered, -New.Deaths, -Total.Recovered,
                    New.Cases, -Active.Cases, -Active.Cases)
data_2022 <- data_2022[,-2]

data_2020 <-data_2020 %>% rename(Total.Cases=TotalCases,
                     Total.Deaths=TotalDeaths,
                     Serious..Critical=Serious.Critical,
                     Tot.Cases..1M.pop=Tot.Cases.1M.pop,
                     Deaths..1M.pop=Deaths.1M.pop,
                     Total.Tests=TotalTests,
                     Tests...1M.pop=Tests.1M.pop,
                     Deaths..1M.pop=Deaths.1M.pop
                     )

all_data <- bind_rows(data_2020, data_2022)
```

```
all_data %>% ggplot(aes(x=reorder(Country.Name, +Total.Cases), Total.Cases, fill=Death_ratio)) +
  geom_bar(stat="identity", position="stack")+
  labs(x="Country Name", y="Total Cases",
       title="Total cases and deaths caused by covid",
       subtitle="2022 data") + coord_flip()
```



But, there's a relationship between COVID and the gdp per capita in 2020? Let's make a linear regression analysis to have an answer.

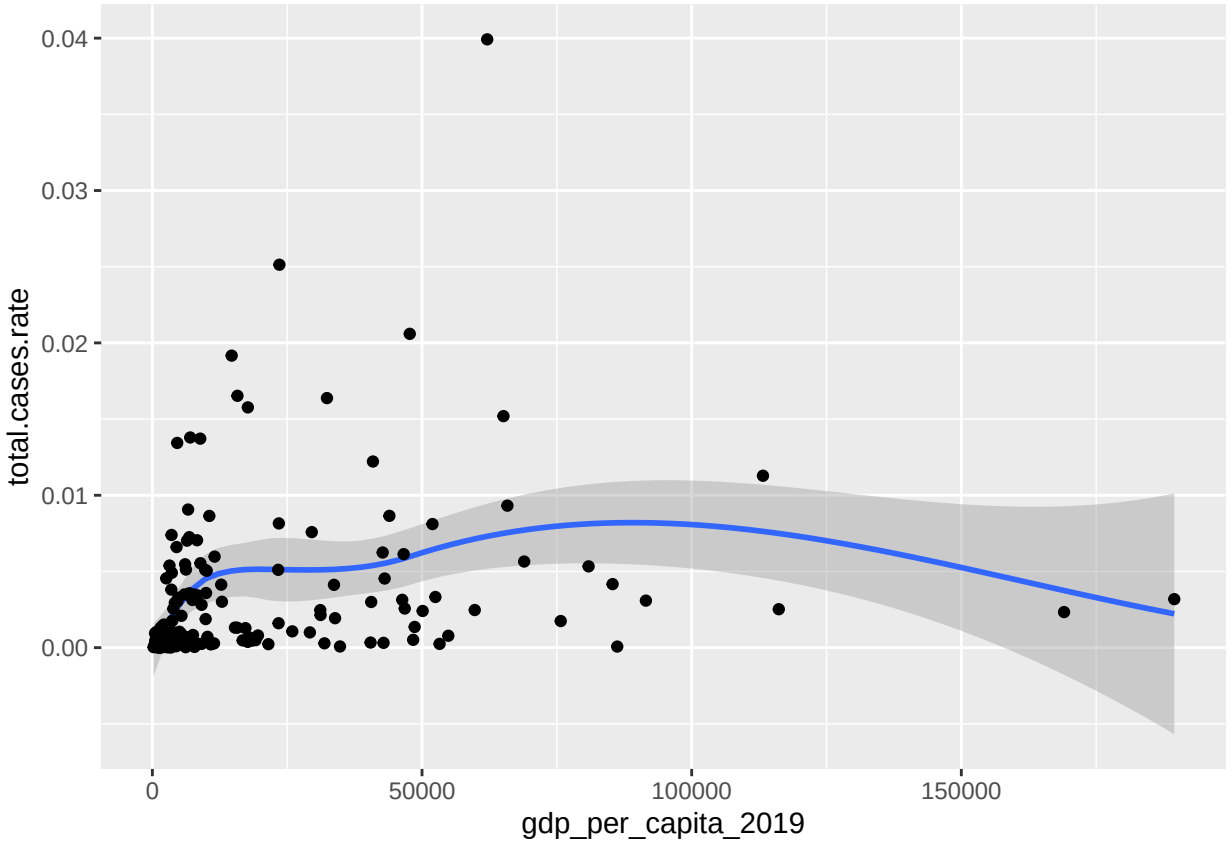
```
all_togheter_2020 <- mutate(all_togheter_2020,                total.cases.rate=TotalCases/Population)
#first we standarize our variable, having a relation between total cases and population by country, in

all_togheter_2020 %>% ggplot() +
  geom_smooth(aes(gdp_per_capita_2019, total.cases.rate))+
  geom_point(aes(gdp_per_capita_2019, total.cases.rate))
```

```
## `geom_smooth()` using method = 'loess' and formula 'y ~ x'

## Warning: Removed 81 rows containing non-finite values (stat_smooth).

## Warning: Removed 81 rows containing missing values (geom_point).
```




```
all_togheter_2020 %>% lm(formula=total.cases.rate ~gdp_per_capita_2019) %>%
  summary()
```

```
##
## Call:
## lm(formula = total.cases.rate ~ gdp_per_capita_2019, data = .)
##
## Residuals:
##       Min        1Q    Median        3Q       Max
## -0.007329 -0.002458 -0.001863  0.000711  0.034830
##
## Coefficients:
##                      Estimate Std. Error t value Pr(>|t|)
## (Intercept)         2.450e-03  4.746e-04   5.161 6.95e-07 ***
## gdp_per_capita_2019 4.255e-08  1.355e-08   3.139  0.00201 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.005111 on 166 degrees of freedom
##   (81 observations deleted due to missingness)
## Multiple R-squared:  0.05603,    Adjusted R-squared:  0.05034
## F-statistic: 9.853 on 1 and 166 DF,  p-value: 0.002007
```

```
all_togheter_2020 %>% lm(formula=gdp_per_capita_2019~total.cases.rate) %>%
  summary()
```

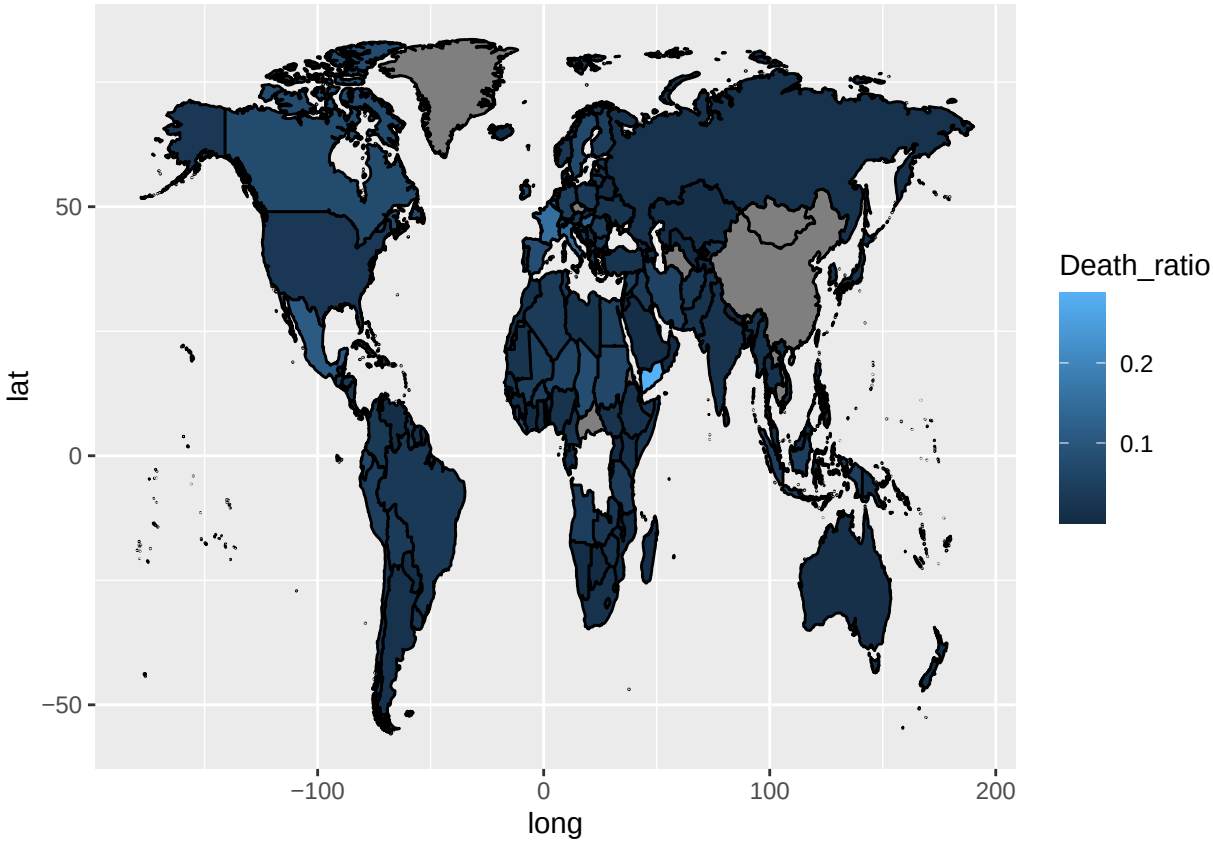
```
##
## Call:
## lm(formula = gdp_per_capita_2019 ~ total.cases.rate, data = .)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -28259 -14655 -11770   3614 170124
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)          15172       2589   5.859 2.44e-08 ***
## total.cases.rate   1316858     419524   3.139  0.00201 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 28440 on 166 degrees of freedom
##   (81 observations deleted due to missingness)
## Multiple R-squared:  0.05603,    Adjusted R-squared:  0.05034
## F-statistic: 9.853 on 1 and 166 DF,  p-value: 0.002007
```

To interpret this model, we will not focus on the r-squared, we will just focus on the significance of the variables in the model. In this case we have two statistical significant variables in both models. The first one is the GDP per capita, which is significant, explains that the GDP per capita of a country determine the covid cases in a country.

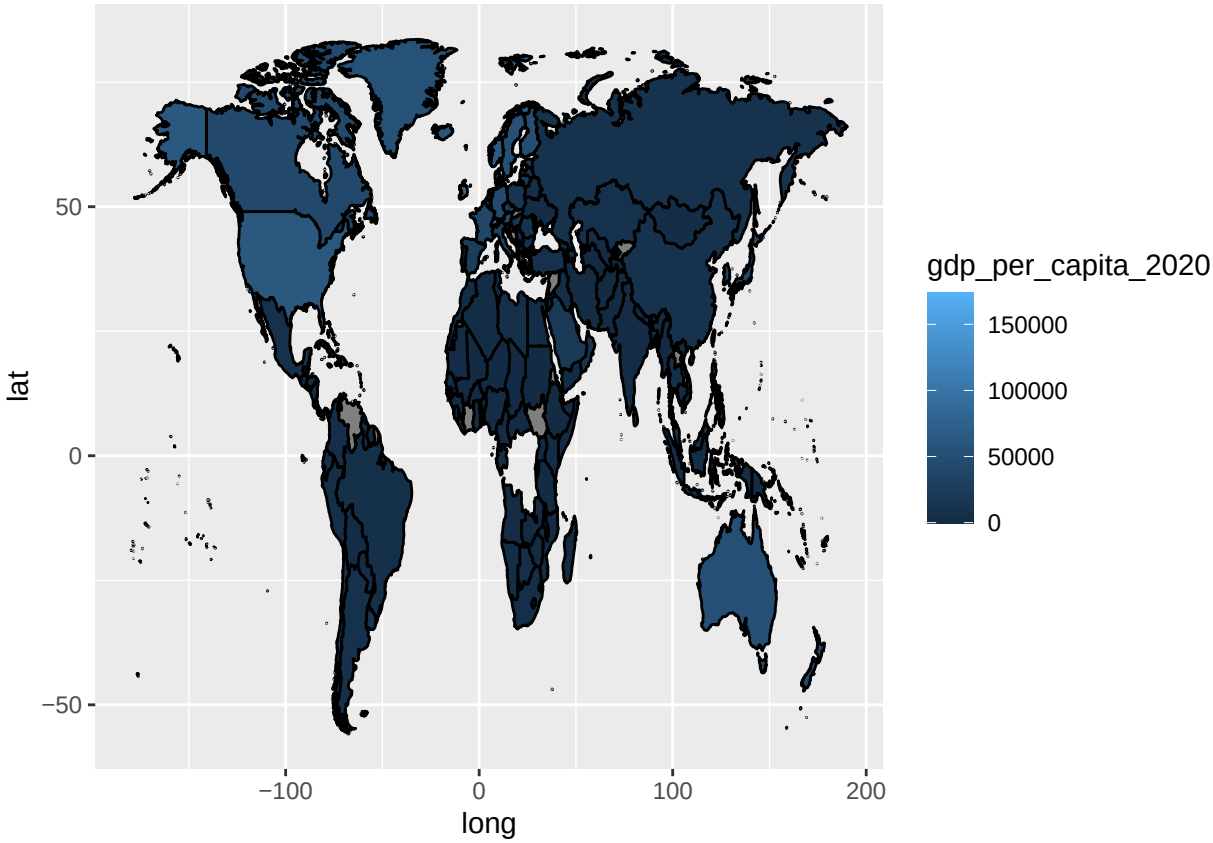
```
mapdata <- map_data("world")
mapdata <- mapdata %>% rename("Country.Name" = "region")
mapdata[mapdata=="USA"] <- "United States"
all_togheter_2020 <- mutate(all_togheter_2020,
                  Death_ratio=TotalDeaths/TotalCases)

map_data <- right_join(mapdata, all_togheter_2020, by="Country.Name")

ggplot(map_data, aes(long, lat, group=group))+
  geom_polygon(aes(fill=Death_ratio), color="black")
```




```
ggplot(map_data, aes(long, lat, group=group))+
  geom_polygon(aes(fill=gdp_per_capita_2020), color="black")
```


50
0
−50
lat
−100
0
100
200
long
gdp_per_capita_2020
150000
100000
50000
0