peers_activity

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Peer-reviewed Exercise: The SARS-CoV-2 (Covid-19) epidemic

The goal of this project is to produce plots similar to those in the South China Morning Post (SCMP), showing the cumulative number of infected people for different countries. To do that, we need to perform several data processing steps to filter and format the data as required.

The environment

Those are the required libraries.

```
library(tidyverse)
library(ggplot2)
library(lubridate)
library(reshape2)
library(dplyr)
```

Creating a Dataframe from the data

The dataset (time_series_covid19_confirmed_global.csv) can be obtained from this source. The data is compiled by the Johns Hopkins University Center for Systems Science and Engineering JHU CSSE.

We create a new dataframe from the data file.

```
df <- read.csv("data/time_series_covid19_confirmed_global.csv",header=T,stringsAsFactors=FALSE)
```

Exploring the data

Let's gain some insight of the data.

```
ncol(df)
```

```
## [1] 679
```

```
nrow(df)
```

```
## [1] 280
```

```r
colnames(df)[c(1:15)]
```

```
##  [1] "Province.State" "Country.Region" "Lat"            "Long"
##  [5] "X1.22.20"       "X1.23.20"       "X1.24.20"      "X1.25.20"
##  [9] "X1.26.20"       "X1.27.20"       "X1.28.20"      "X1.29.20"
## [13] "X1.30.20"       "X1.31.20"       "X2.1.20"
```

```r
colnames(df)[c(ncol(df))]
```

```
## [1] "X11.26.21"
```

It seems we have 280 rows and 679 columns, most of the colulmns correspond to daily dates which range from 22/01/2020 to 26/11/2021.

We remove the `Lat` and `Long` columns as we are not interested on this information. Lets take a look to the first columns of the dataset.

```r
df <- df[,c(1:2,5:ncol(df))]
df[c(1:10), c(1:5)]
```

```
##                   Province.State      Country.Region X1.22.20 X1.23.20 X1.24.20
## 1                                        Afghanistan        0        0        0
## 2                                            Albania        0        0        0
## 3                                            Algeria        0        0        0
## 4                                            Andorra        0        0        0
## 5                                             Angola        0        0        0
## 6                                  Antigua and Barbuda        0        0        0
## 7                                          Argentina        0        0        0
## 8                                            Armenia        0        0        0
## 9  Australian Capital Territory           Australia        0        0        0
## 10              New South Wales           Australia        0        0        0
```

Data Transformation

We will focus on the following countries: Belgium, China, France, Germany, Italy, Japan, Korea South, Netherlands, Portugal, Spain, United Kingdom and US.

```r
df <- df %>% filter(Country.Region %in% c("Belgium","China","France","Germany","Iran","Italy","Japan","
```

Lets take a look to what we got. We temporary omit the dates.

```r
df[,c(1:2)]
```

```
##                                 Province.State Country.Region
## 1                                                     Belgium
## 2                                        Anhui          China
## 3                                      Beijing          China
## 4                                    Chongqing          China
## 5                                       Fujian          China
## 6                                        Gansu          China
```

```
## 7                                  Guangdong          China
## 8                                    Guangxi          China
## 9                                    Guizhou          China
## 10                                    Hainan          China
## 11                                     Hebei          China
## 12                                Heilongjiang          China
## 13                                     Henan          China
## 14                                Hong Kong           China
## 15                                     Hubei          China
## 16                                     Hunan          China
## 17                               Inner Mongolia          China
## 18                                    Jiangsu          China
## 19                                    Jiangxi          China
## 20                                      Jilin          China
## 21                                   Liaoning          China
## 22                                      Macau          China
## 23                                    Ningxia          China
## 24                                    Qinghai          China
## 25                                    Shaanxi          China
## 26                                   Shandong          China
## 27                                   Shanghai          China
## 28                                     Shanxi          China
## 29                                    Sichuan          China
## 30                                    Tianjin          China
## 31                                      Tibet          China
## 32                                    Unknown          China
## 33                                    Xinjiang         China
## 34                                      Yunnan         China
## 35                                    Zhejiang         China
## 36                               French Guiana        France
## 37                             French Polynesia       France
## 38                                  Guadeloupe        France
## 39                                  Martinique        France
## 40                                    Mayotte         France
## 41                               New Caledonia        France
## 42                                    Reunion         France
## 43                             Saint Barthelemy       France
## 44                     Saint Pierre and Miquelon      France
## 45                                   St Martin        France
## 46                           Wallis and Futuna        France
## 47                                                    France
## 48                                                   Germany
## 49                                                      Iran
## 50                                                     Italy
## 51                                                     Japan
## 52                                                Korea, South
## 53                                      Aruba     Netherlands
## 54          Bonaire, Sint Eustatius and Saba      Netherlands
## 55                                    Curacao     Netherlands
## 56                                Sint Maarten    Netherlands
## 57                                                Netherlands
## 58                                                   Portugal
## 59                                                     Spain
## 60                                                        US
```

```
## 61                                     Anguilla United Kingdom
## 62                                      Bermuda United Kingdom
## 63                         British Virgin Islands United Kingdom
## 64                                 Cayman Islands United Kingdom
## 65                               Channel Islands United Kingdom
## 66                     Falkland Islands (Malvinas) United Kingdom
## 67                                    Gibraltar United Kingdom
## 68                                  Isle of Man United Kingdom
## 69                                   Montserrat United Kingdom
## 70 Saint Helena, Ascension and Tristan da Cunha United Kingdom
## 71                       Turks and Caicos Islands United Kingdom
## 72                                               United Kingdom
```

Some countries (e.g. France, United Kingdom, etc) have several colony states that will not be considered in this study, so we filter out the rows containing some entry in `Province.State`. China is a special case, as it is listed by its provinces.

```
df <- df %>% filter(Province.State == "" | Country.Region == "China")
df[,c(1:2)]
```

```
##    Province.State Country.Region
## 1                        Belgium
## 2           Anhui          China
## 3         Beijing          China
## 4       Chongqing          China
## 5          Fujian          China
## 6           Gansu          China
## 7       Guangdong          China
## 8         Guangxi          China
## 9         Guizhou          China
## 10         Hainan          China
## 11          Hebei          China
## 12   Heilongjiang          China
## 13          Henan          China
## 14      Hong Kong          China
## 15          Hubei          China
## 16          Hunan          China
## 17 Inner Mongolia          China
## 18        Jiangsu          China
## 19        Jiangxi          China
## 20          Jilin          China
## 21       Liaoning          China
## 22          Macau          China
## 23        Ningxia          China
## 24        Qinghai          China
## 25        Shaanxi          China
## 26       Shandong          China
## 27       Shanghai          China
## 28         Shanxi          China
## 29        Sichuan          China
## 30        Tianjin          China
## 31          Tibet          China
## 32        Unknown          China
```

```
## 33       Xinjiang          China
## 34         Yunnan          China
## 35       Zhejiang          China
## 36                         France
## 37                        Germany
## 38                           Iran
## 39                          Italy
## 40                          Japan
## 41                 Korea, South
## 42                  Netherlands
## 43                     Portugal
## 44                        Spain
## 45                           US
## 46                United Kingdom
```

The province of *HongKong* has to be considered as an independent country as it was treated this way by the SCMP. Thus, we modify the corresponding row.

```
df[df["Province.State"] == "Hong Kong", 2] <- "Hong Kong"
```

We get rid of the `Province.State` column as we do not need it anymore.

```
df <- df[,c(2:ncol(df))]
```

Let's check our dataset.

```
df[,c(1:5)]
```

```
##    Country.Region X1.22.20 X1.23.20 X1.24.20 X1.25.20
## 1         Belgium        0        0        0        0
## 2           China        1        9       15       39
## 3           China       14       22       36       41
## 4           China        6        9       27       57
## 5           China        1        5       10       18
## 6           China        0        2        2        4
## 7           China       26       32       53       78
## 8           China        2        5       23       23
## 9           China        1        3        3        4
## 10          China        4        5        8       19
## 11          China        1        1        2        8
## 12          China        0        2        4        9
## 13          China        5        5        9       32
## 14      Hong Kong        0        2        2        5
## 15          China      444      444      549      761
## 16          China        4        9       24       43
## 17          China        0        0        1        7
## 18          China        1        5        9       18
## 19          China        2        7       18       18
## 20          China        0        1        3        4
## 21          China        2        3        4       17
## 22          China        1        2        2        2
## 23          China        1        1        2        3
```

```
## 24          China        0        0        0        1
## 25          China        0        3        5       15
## 26          China        2        6       15       27
## 27          China        9       16       20       33
## 28          China        1        1        1        6
## 29          China        5        8       15       28
## 30          China        4        4        8       10
## 31          China        0        0        0        0
## 32          China        0        0        0        0
## 33          China        0        2        2        3
## 34          China        1        2        5       11
## 35          China       10       27       43       62
## 36         France        0        0        2        3
## 37        Germany        0        0        0        0
## 38           Iran        0        0        0        0
## 39          Italy        0        0        0        0
## 40          Japan        2        2        2        2
## 41   Korea, South        1        1        2        2
## 42    Netherlands        0        0        0        0
## 43       Portugal        0        0        0        0
## 44          Spain        0        0        0        0
## 45             US        1        1        2        2
## 46 United Kingdom        0        0        0        0
```

Next step is to group all the rows corresponding to *China* and add them up.

```
df <- df %>%
  group_by(Country.Region) %>%
  summarise(across(everything(), sum))

df[,c(1:5)]
```

```
## # A tibble: 14 x 5
##    Country.Region X1.22.20 X1.23.20 X1.24.20 X1.25.20
##    <chr>             <int>    <int>    <int>    <int>
##  1 Belgium               0        0        0        0
##  2 China               548      641      918     1401
##  3 France                0        0        2        3
##  4 Germany               0        0        0        0
##  5 Hong Kong             0        2        2        5
##  6 Iran                  0        0        0        0
##  7 Italy                 0        0        0        0
##  8 Japan                 2        2        2        2
##  9 Korea, South          1        1        2        2
## 10 Netherlands           0        0        0        0
## 11 Portugal              0        0        0        0
## 12 Spain                 0        0        0        0
## 13 United Kingdom        0        0        0        0
## 14 US                    1        1        2        2
```

Now, we flatten the date columns to proceed with the plotting. We check with a subset.

```r
melted_df <- melt(df, id.vars="Country.Region")
melted_df[c(1:20),]
```

```
##    Country.Region variable value
## 1         Belgium X1.22.20     0
## 2           China X1.22.20   548
## 3          France X1.22.20     0
## 4         Germany X1.22.20     0
## 5       Hong Kong X1.22.20     0
## 6            Iran X1.22.20     0
## 7           Italy X1.22.20     0
## 8           Japan X1.22.20     2
## 9    Korea, South X1.22.20     1
## 10    Netherlands X1.22.20     0
## 11       Portugal X1.22.20     0
## 12          Spain X1.22.20     0
## 13 United Kingdom X1.22.20     0
## 14             US X1.22.20     1
## 15        Belgium X1.23.20     0
## 16          China X1.23.20   641
## 17         France X1.23.20     0
## 18        Germany X1.23.20     0
## 19      Hong Kong X1.23.20     2
## 20           Iran X1.23.20     0
```

We need to format the dates correctly. We extract the useful information from the date names and an amount of years (2000) to each of them to get the real date.

```r
melted_df$variable = as.Date(melted_df$variable, "X%m.%d.%Y") %m+% years(2000)

melted_df[c(1:10),]
```

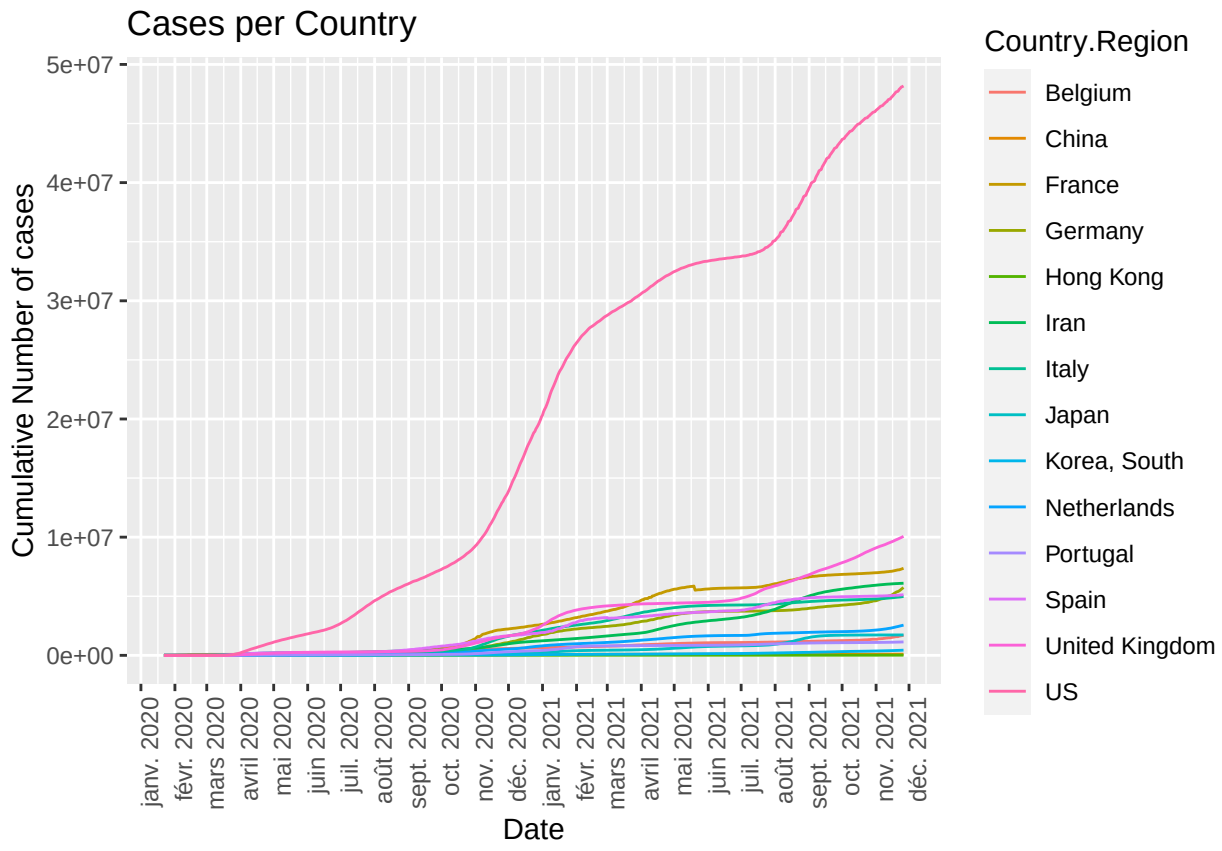
```
##    Country.Region   variable value
## 1         Belgium 2020-01-22     0
## 2           China 2020-01-22   548
## 3          France 2020-01-22     0
## 4         Germany 2020-01-22     0
## 5       Hong Kong 2020-01-22     0
## 6            Iran 2020-01-22     0
## 7           Italy 2020-01-22     0
## 8           Japan 2020-01-22     2
## 9    Korea, South 2020-01-22     1
## 10    Netherlands 2020-01-22     0
```

Ploting

Linear Scale

Using the `melted_df` dataframe, we create a plot with the dates (`variable`) on the x axis and the cumulative number of cases (`value`) in the y axis. The dates are expressed per month and for the number of cases we used a linear scale.

```
ggplot(melted_df, aes(x = variable, y = value)) + geom_line(aes(color = Country.Region, group = Country
```

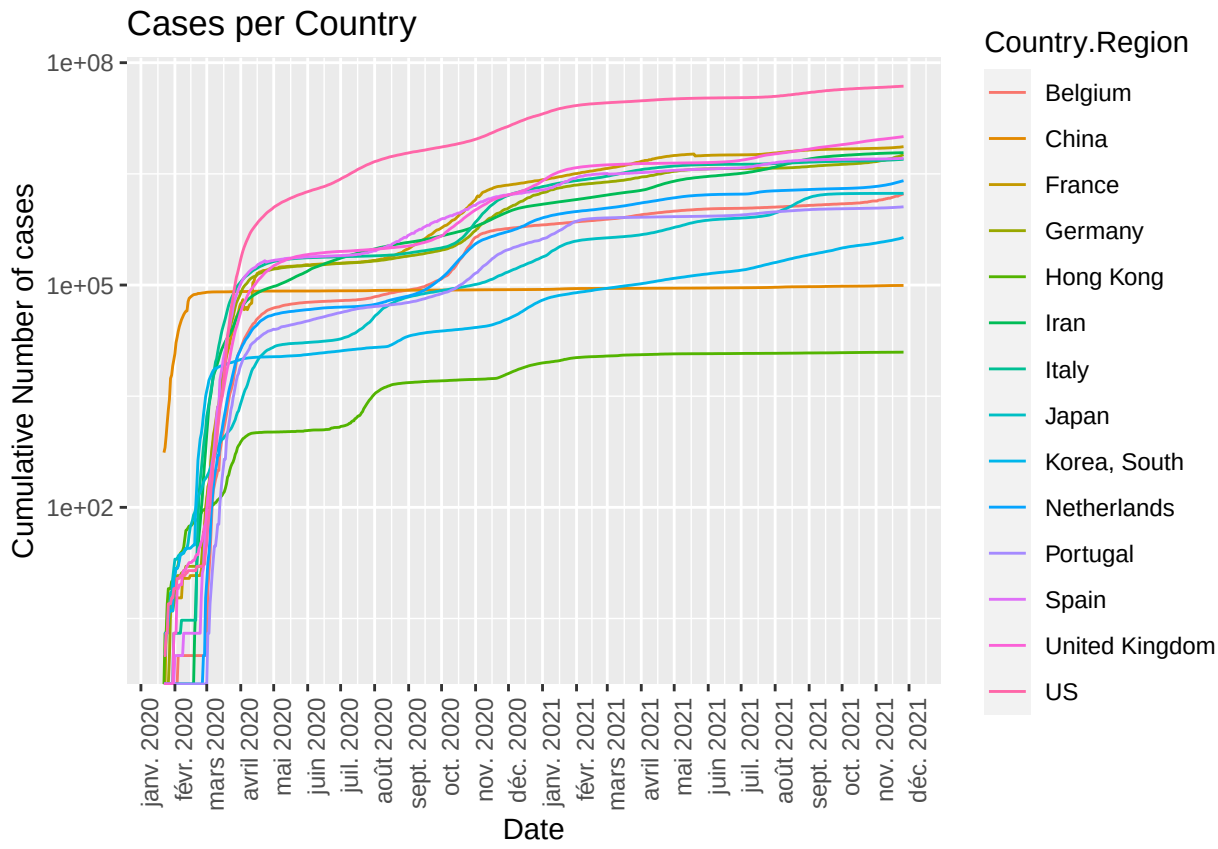


Logarithmic Scale

We recreate the same plot but using logarithmic scale this time.

```
ggplot(melted_df, aes(x = variable, y = value)) + geom_line(aes(color = Country.Region, group = Country
```

```
## Warning: Transformation introduced infinite values in continuous y-axis
```



Cumulative Number of deaths

We perform the same previously described steps over the table of number of deaths to get the corresponding graphs. This table has the exact same structure as the previous one.

```
df2 <- read.csv("data/time_series_covid19_deaths_global.csv",header=T,stringsAsFactors=FALSE)
```

Filter the countries of interes.

```
df2 <- df2 %>% filter(Country.Region %in% c("Belgium","China","France","Germany","Iran","Italy","Japan"
```

Filter out the countries' colonies.

```
df2 <- df2 %>% filter(Province.State == "" | Country.Region == "China")
```

We treat the province of Hong-Kong as a country.

```
df2[df2["Province.State"] == "Hong Kong", 2] <- "Hong Kong"
df2 <- df2[,c(2:ncol(df2))]
```

Group all the rows corresponding to *China* and add them up.

```
df2 <- df2 %>%
  group_by(Country.Region) %>%
  summarise(across(everything(), sum))
```

Flatten the columns to plot.

```
melted_df2 <- melt(df2, id.vars="Country.Region")
```

Formatting the dates.

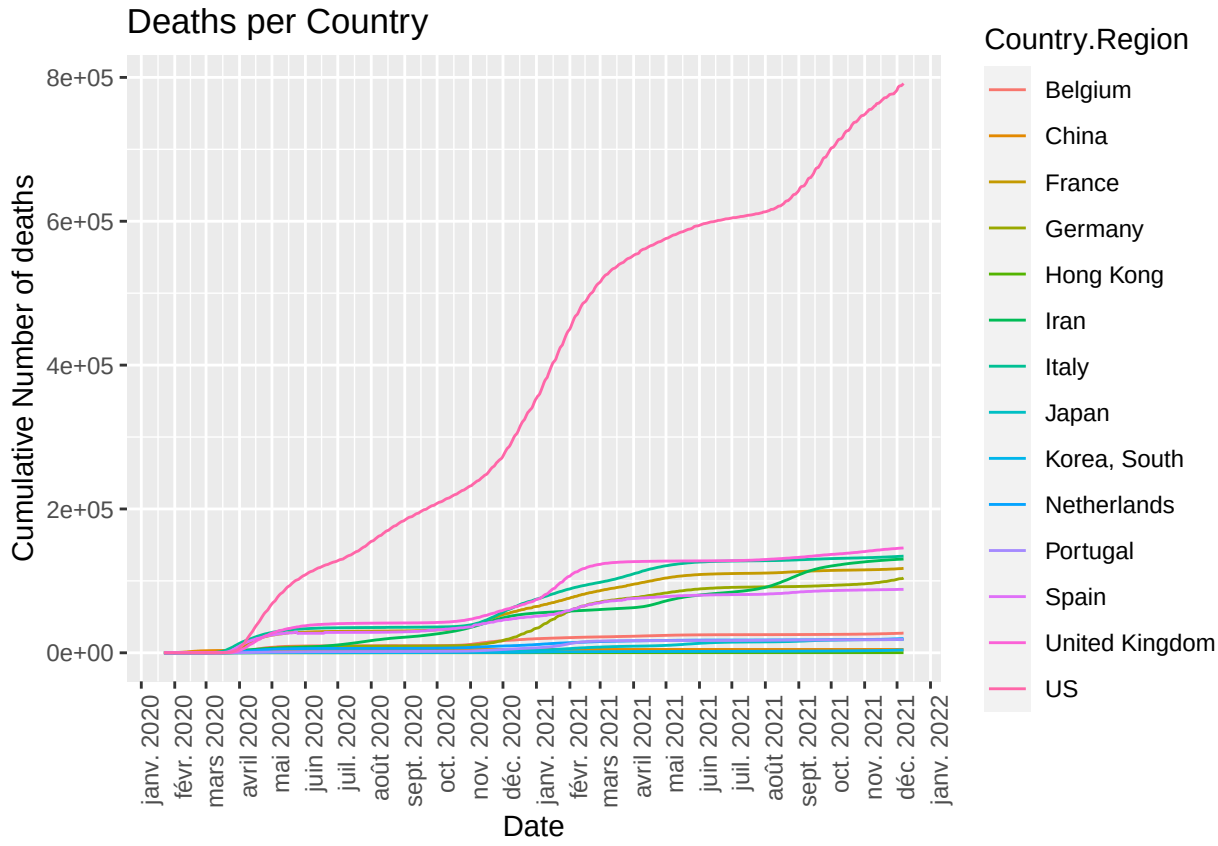
```
melted_df2$variable = as.Date(melted_df2$variable, "X%m.%d.%Y") %m+% years(2000)
```

Ploting

Linear Scale

```
ggplot(melted_df2, aes(x = variable, y = value)) + geom_line(aes(color = Country.Region, group = Country
```

```
## Warning: Removed 28 row(s) containing missing values (geom_path).
```



Logarithmic Scale

```
ggplot(melted_df2, aes(x = variable, y = value)) + geom_line(aes(color = Country.Region, group = Country
```

```
## Warning in self$trans$transform(x): NaNs produced
```

```
## Warning: Transformation introduced infinite values in continuous y-axis
```

```
## Warning: Removed 28 row(s) containing missing values (geom_path).
```