Data Science - COVID-19

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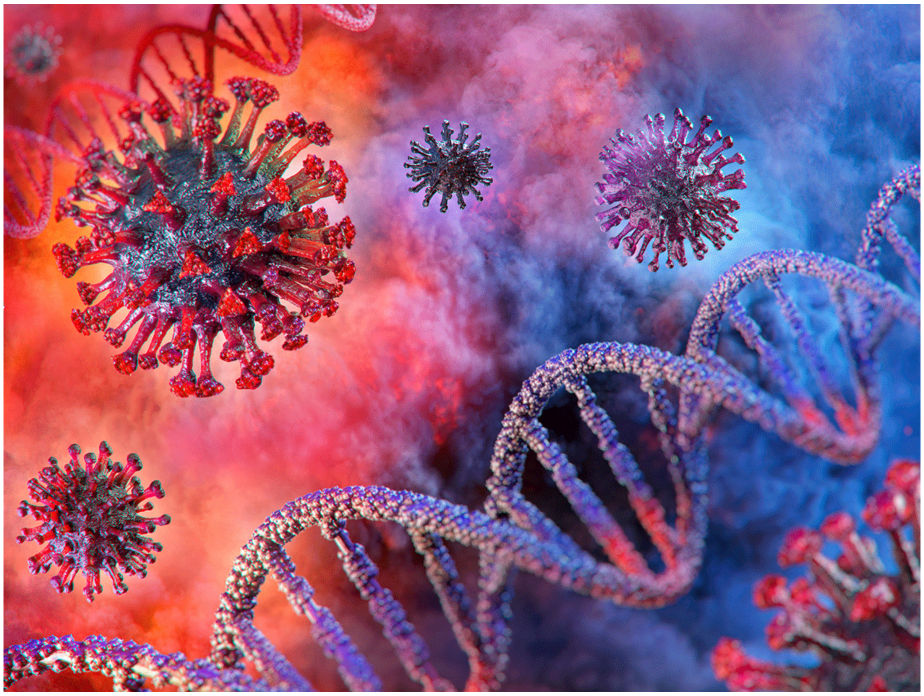


Analysis coronavirus disease (COVID-19).

This is an R Markdown document. It is intented to publicy illustrate how R statistics can help you out to output data science pipeline.

About this data

It changes rapidly

It doesn't include all cases

Confirmed cases aren't all cases. They only include people who tested positive. Testing rules and availability vary by country.

Data Repository: Johns Hopkins University.

```
# This is an analysis report of the Novel Coronavirus (COVID-19)
# Aim for data processing, visualisation and statstics
# Source code: http://yanchang.rdatamining.com/
# set directory
# Data Source: 2019 Data Repository https://github.com/CSSEGISandData/COVID-19
# R Packages:
library(magrittr) # pipline operations
library(lubridate) # date operation
```

```
##
## Attaching package: 'lubridate'

## The following object is masked from 'package:base':
##
##     date
```

```
library(tidyverse) # data science pips
```

```
## -- Attaching packages -----------------------------------------------------------------

## v ggplot2 3.3.0     v purrr   0.3.3
## v tibble  2.1.3     v dplyr   0.8.5
## v tidyr   1.0.2     v stringr 1.4.0
## v readr   1.3.1     v forcats 0.5.0

## -- Conflicts --------------------------------------------------------------------------
## x lubridate::as.difftime() masks base::as.difftime()
## x lubridate::date()        masks base::date()
## x tidyr::extract()         masks magrittr::extract()
## x dplyr::filter()          masks stats::filter()
## x lubridate::intersect()   masks base::intersect()
## x dplyr::lag()             masks stats::lag()
## x purrr::set_names()       masks magrittr::set_names()
## x lubridate::setdiff()     masks base::setdiff()
## x lubridate::union()       masks base::union()
```

```
library(gridExtra) # grid based plots
```

```
##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##     combine
```

```r
library(dplyr)
library(leaflet)
library(ggforce)
library(kableExtra)
```

```
##
## Attaching package: 'kableExtra'

## The following object is masked from 'package:dplyr':
##
##     group_rows
```

```r
# Loading data
# At first, three CSV files, are downloaded and saved as local files
# and then loaded into R
# source data files changes everytime
filenames <- c('time_series_covid19_confirmed_global.csv',
               'time_series_covid19_deaths_global.csv',
               'time_series_covid19_recovered_global.csv')
url.path <- paste0('https://raw.githubusercontent.com/CSSEGISandData/COVID-19/',
                   'master/csse_covid_19_data/csse_covid_19_time_series/')

#download files to local folder
download <- function(filename) {
  url <- file.path(url.path, filename)
  dest <- file.path('./data', filename)
  download.file(url, dest)
}
bin <- lapply(filenames, download)


# load data into R
data.confirmed.original <- read.csv('./data/time_series_covid19_confirmed_global.csv')
data.deaths.original <- read.csv('./data/time_series_covid19_deaths_global.csv')
data.recovered.original <- read.csv('./data/time_series_covid19_recovered_global.csv')
```

```r
# check dimension of data confirmed
dim(data.confirmed.original)
```

```
## [1] 256  75
```

Below we check the time frame of data set

```r
# check time frame of the data
n.col <- ncol(data.confirmed.original) # 58 variables
# get dates from column names
dates <- names(data.confirmed.original)[5:n.col] %>% substr(2,8) %>% mdy()
range(dates)
```

```
## [1] "2020-01-22" "2020-04-01"
```

```r
min.date <- min(dates)
max.date <- max(dates)
max.date.txt <- max.date %>% format('%d %b %Y')
min.date.txt <- min.date %>% format('%d %b Y')
# last update on 26 March 2020 max.date
```

```r
# Data Preparation steps:
# 1.From wide to long format
# 2.Aggregate by country
# 3. merge into a signe dataset
# cleaning and transformation
cleanData <- function(data) {
  ## remove some columns
  data %<>% select(-c(Province.State, Lat, Long)) %>% rename(country=Country.Region)
  ## convert from wide to long format
  data %<>% gather(key=date, value=count, -country)
  ## convert from character to date
  data %<>% mutate(date = date %>% substr(2,8) %>% mdy())
  ## aggregate by country
  data %<>% group_by(country, date) %>% summarise(count=sum(count)) %>% as.data.frame()
  return(data)
}
# clean the three datasets
data.confirmed <- data.confirmed.original %>% cleanData() %>% rename(confirmed=count)
data.deaths <- data.deaths.original %>% cleanData() %>% rename(deaths=count)
data.recovered <- data.recovered.original %>% cleanData() %>% rename(recovered=count)

# merge above 3 datasets into one, by country and date
```

```r
data <- data.confirmed %>% merge(data.deaths, all = T) %>% merge(data.recovered, all = T)

# countries/regions with confirmed cases (excl cruise ships)
countries <- data %>% pull(country) %>% setdiff('Cruise Ship')

# last 10 records when it first broke out in Spain
data %>% filter(country =='Spain')%>% tail(10)
```

```
##    country       date confirmed deaths recovered
## 62   Spain 2020-03-23     35136   2311      2575
## 63   Spain 2020-03-24     39885   2808      3794
## 64   Spain 2020-03-25     49515   3647      5367
## 65   Spain 2020-03-26     57786   4365      7015
## 66   Spain 2020-03-27     65719   5138      9357
## 67   Spain 2020-03-28     73235   5982     12285
## 68   Spain 2020-03-29     80110   6803     14709
## 69   Spain 2020-03-30     87956   7716     16780
## 70   Spain 2020-03-31     95923   8464     19259
## 71   Spain 2020-04-01    104118   9387     22647
```

```r
# counts for worldwide
data.world <- data %>% group_by(date) %>%
  summarise(country='World',
            confirmed=sum(confirmed, na.rm = T),
            deaths=sum(deaths, na.rm = T),
            recovered=sum(recovered, na.rm = T))

data %<>% rbind(data.world)

# current confirmed cases
data %<>% mutate(remaining.confirmed = confirmed - deaths - recovered)
```

```r
# Visualisation
# After preparing the data, we portrait it in various graphs

# TOP Ten Countries
# ranking by confirmed cases
data.latest.all <- data %>% filter(date == max(date)) %>%
  select(country, date,
         confirmed, confirmed.new, remaining.confirmed, recovered, deaths.new, deaths, death
# top 20 countries incl 11 World
k<- 20
top.countries <- data.latest.all %>% filter(ranking <= k+1) %>%
  arrange(ranking) %>% pull(country) %>% as.character()
top.countries %>% setdiff('World') %>% print()
```

```
##  [1] "US"             "Italy"          "Spain"          "China"
##  [5] "Germany"        "France"         "Iran"           "United Kingdom"
##  [9] "Switzerland"    "Turkey"         "Belgium"        "Netherlands"
## [13] "Austria"        "Korea, South"   "Canada"         "Portugal"
## [17] "Brazil"         "Israel"         "Sweden"         "Norway"
```

```
names(data.latest.all)
```

```
##  [1] "country"             "date"                "confirmed"
##  [4] "confirmed.new"       "remaining.confirmed" "recovered"
##  [7] "deaths.new"          "deaths"              "death.rate"
## [10] "ranking"
```

```
## add 'Others'
top.countries %<>% c('Others')
## put all others in a single group of 'Others'
data.latest <- data.latest.all %>% filter(!is.na(country)) %>%
mutate(country=ifelse(ranking <= k + 1, as.character(country), 'Others')) %>%
mutate(country=country %>% factor(levels=c(top.countries)))

data.latest %<>% group_by(country) %>%
  summarise(confirmed=sum(confirmed), confirmed.new=sum(confirmed.new), remaining.confirmed
            mutate(death.rate=(100*deaths/confirmed) %>% round(1))
data.latest %<>% select(c(country, confirmed, deaths,death.rate, confirmed.new, deaths.new,

data.latest %>% mutate(death.rate=death.rate %>% format(nsmall=1) %>% paste0('%')) %>% kable
```

Worldmap

```
x <- data.confirmed.original
x$confirmed <- x[, ncol(x)]
x %>% select(c(Country.Region, Province.State, Lat, Long, confirmed)) %>%
  mutate(txt=paste0(Country.Region, '-', Province.State, ':', confirmed))
```

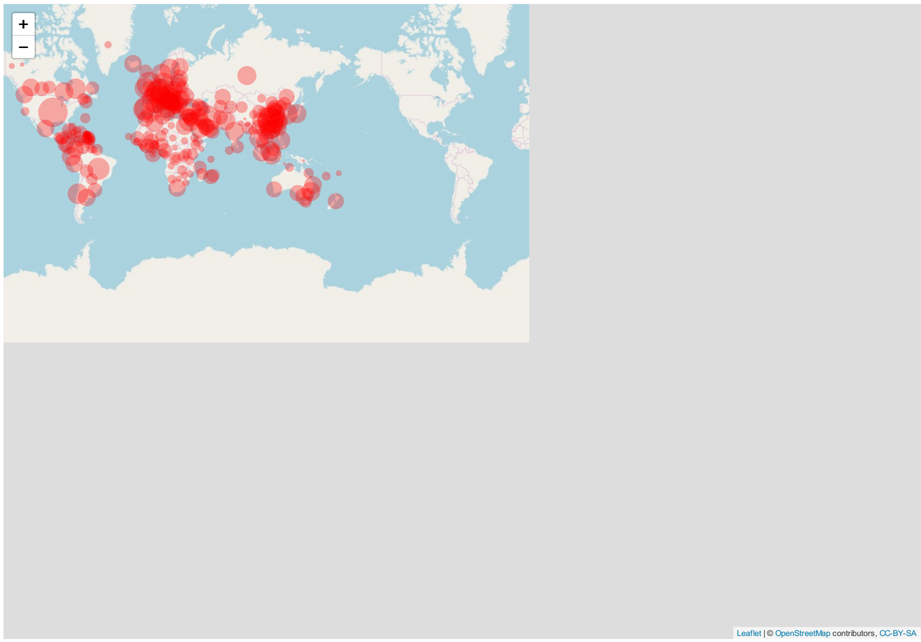
```
##                       Country.Region               Province.State        Lat
## 1                        Afghanistan                               33.000000
## 2                            Albania                               41.153300
## 3                            Algeria                               28.033900
## 4                            Andorra                               42.506300
## 5                             Angola                              -11.202700
## 6                Antigua and Barbuda                               17.060800
## 7                          Argentina                              -38.416100
## 8                            Armenia                               40.069100
## 9                          Australia Australian Capital Territory -35.473500
```

Table 1: Cases in Top 20 Countries - 01 Apr 2020.

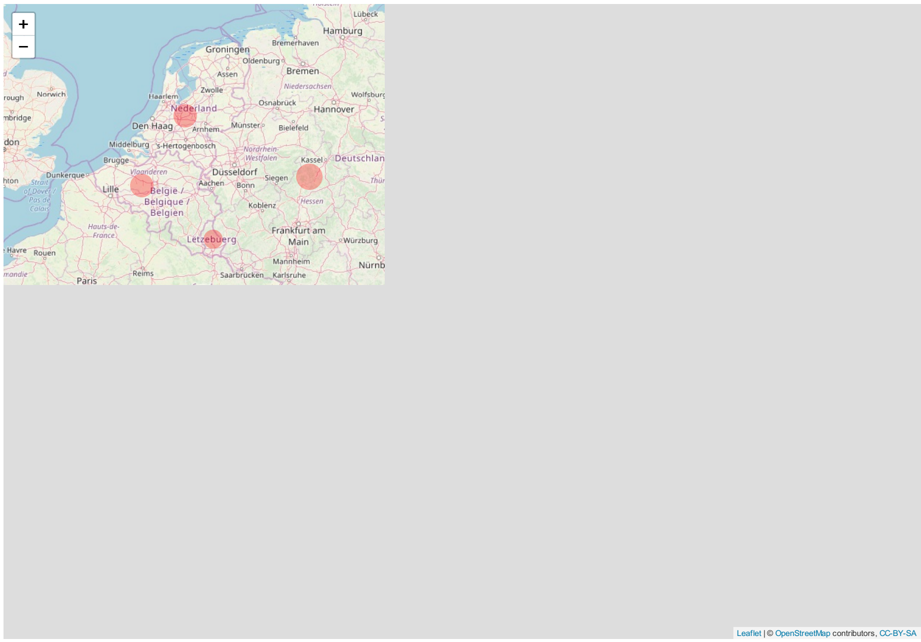
	country	confirmed	deaths	death.rate	confirmed.new	deaths.new	remaining.confirmed
1	World	932,605	46,809	5.0%	75,118	4,702	692,619
2	US	213,372	4,757	2.2%	25,200	884	200,141
3	Italy	110,574	13,155	11.9%	4,782	727	80,572
4	Spain	104,118	9,387	9.0%	8,195	923	72,084
5	China	82,361	3,316	4.0%	82	7	2,640
6	Germany	77,872	920	1.2%	6,064	145	58,252
7	France	57,749	4,043	7.0%	4,922	511	42,653
8	Iran	47,593	3,036	6.4%	2,988	138	29,084
9	United Kingdom	29,865	2,357	7.9%	4,384	564	27,329
10	Switzerland	17,768	488	2.7%	1,163	55	14,313
11	Turkey	15,679	277	1.8%	2,148	63	15,069
12	Belgium	13,964	828	5.9%	1,189	123	11,004
13	Netherlands	13,696	1,175	8.6%	1,029	135	12,261
14	Austria	10,711	146	1.4%	531	18	9,129
15	Korea, South	9,887	165	1.7%	101	3	4,155
16	Canada	9,560	109	1.1%	1,033	8	8,127
17	Portugal	8,251	187	2.3%	808	27	8,021
18	Brazil	6,836	240	3.5%	1,119	39	6,469
19	Israel	6,092	26	0.4%	734	6	5,825
20	Sweden	4,947	239	4.8%	512	59	4,605
21	Norway	4,863	44	0.9%	222	5	4,806
22	Others	86,847	1,914	2.2%	7,912	262	76,080

```
## 10                         Australia              New South Wales -33.868800
## 11                         Australia           Northern Territory -12.463400
## 12                         Australia                   Queensland -28.016700
## 13                         Australia              South Australia -34.928500
## 14                         Australia                     Tasmania -41.454500
## 15                         Australia                     Victoria -37.813600
## 16                         Australia            Western Australia -31.950500
## 17                           Austria                               47.516200
## 18                        Azerbaijan                               40.143100
## 19                           Bahamas                               25.034300
## 20                           Bahrain                               26.027500
## 21                        Bangladesh                               23.685000
## 22                          Barbados                               13.193900
## 23                           Belarus                               53.709800
## 24                           Belgium                               50.833300
## 25                             Benin                                9.307700
## 26                            Bhutan                               27.514200
## 27                           Bolivia                              -16.290200
## 28            Bosnia and Herzegovina                               43.915900
## 29                            Brazil                              -14.235000
## 30                            Brunei                                4.535300
## 31                          Bulgaria                               42.733900
## 32                      Burkina Faso                               12.238300
## 33                        Cabo Verde                               16.538800
## 34                          Cambodia                               11.550000
## 35                          Cameroon                                3.848000
## 36                            Canada                    Alberta  53.933300
## 37                            Canada           British Columbia  49.282700
## 38                            Canada             Grand Princess  37.648900
## 39                            Canada                   Manitoba  53.760900
## 40                            Canada              New Brunswick  46.565300
## 41                            Canada  Newfoundland and Labrador  53.135500
## 42                            Canada                Nova Scotia  44.682000
## 43                            Canada                    Ontario  51.253800
## 44                            Canada       Prince Edward Island  46.510700
## 45                            Canada                     Quebec  52.939900
## 46                            Canada               Saskatchewan  52.939900
## 47          Central African Republic                                6.611100
## 48                              Chad                               15.454200
## 49                             Chile                              -35.675100
## 50                             China                      Anhui  31.825700
## 51                             China                    Beijing  40.182400
## 52                             China                  Chongqing  30.057200
## 53                             China                     Fujian  26.078900
## 54                             China                      Gansu  37.809900
## 55                             China                  Guangdong  23.341700
## 56                             China                    Guangxi  23.829800
## 57                             China                    Guizhou  26.815400
## 58                             China                     Hainan  19.195900
## 59                             China                      Hebei  39.549000
## 60                             China               Heilongjiang  47.862000
## 61                             China                      Henan  33.882000
## 62                             China                  Hong Kong  22.300000
## 63                             China                      Hubei  30.975600
## 64                             China                      Hunan  27.610400
## 65                             China             Inner Mongolia  44.093500
## 66                             China                    Jiangsu  32.971100
## 67                             China                    Jiangxi  27.614000
## 68                             China                      Jilin  43.666100
## 69                             China                   Liaoning  41.295600
## 70                             China                      Macau  22.166700
## 71                             China                    Ningxia  37.269200
## 72                             China                    Qinghai  35.745200
## 73                             China                    Shaanxi  35.191700
## 74                             China                   Shandong  36.342700
## 75                             China                   Shanghai  31.202000
## 76                             China                     Shanxi  37.577700
## 77                             China                    Sichuan  30.617100
## 78                              China                      Tianjin  39.305400
## 79                              China                        Tibet  31.692700
## 80                              China                     Xinjiang  41.112900
## 81                              China                       Yunnan  24.974000
## 82                              China                     Zhejiang  29.183200
## 83                           Colombia                                4.570900
## 84               Congo (Brazzaville)                               -4.038300
## 85                  Congo (Kinshasa)                               -4.038300
## 86                         Costa Rica                                9.748900
## 87                      Cote d'Ivoire                                7.540000
## 88                            Croatia                               45.100000
## 89                   Diamond Princess                                0.000000
## 90                               Cuba                               22.000000
## 91                             Cyprus                               35.126400
## 92                            Czechia                               49.817500
## 93                            Denmark                Faroe Islands  61.892600
## 94                            Denmark                    Greenland  71.706900
## 95                            Denmark                               56.263900
## 96                           Djibouti                               11.825100
## 97                 Dominican Republic                               18.735700
## 98                            Ecuador                               -1.831200
## 99                              Egypt                               26.000000
## 100                       El Salvador                               13.794200
## 101                 Equatorial Guinea                                1.500000
## 102                           Eritrea                               15.179400
## 103                           Estonia                               58.595300
## 104                          Eswatini                              -26.522500
## 105                          Ethiopia                                9.145000
## 106                              Fiji                              -17.713400
## 107                           Finland                               64.000000
## 108                            France                French Guiana   3.933900
## 109                            France             French Polynesia -17.679700
## 110                            France                   Guadeloupe  16.250000
## 111                            France                      Mayotte -12.827500
## 112                            France                New Caledonia -20.904300
## 113                            France                      Reunion -21.135100
## 114                            France             Saint Barthelemy  17.900000
## 115                            France                    St Martin  18.070800
## 116                            France                   Martinique  14.641500
## 117                            France                               46.227600
## 118                             Gabon                               -0.803700
## 119                            Gambia                               13.443200
## 120                           Georgia                               42.315400
## 121                           Germany                               51.000000
## 122                             Ghana                                7.946500
## 123                            Greece                               39.074200
## 124                    Guatemala                          15.783500
## 125                       Guinea                           9.945600
## 126                       Guyana                           5.000000
## 127                        Haiti                          18.971200
## 128                     Holy See                          41.902900
## 129                     Honduras                          15.200000
## 130                      Hungary                          47.162500
## 131                      Iceland                          64.963100
## 132                        India                          21.000000
## 133                    Indonesia                          -0.789300
## 134                         Iran                          32.000000
## 135                         Iraq                          33.000000
## 136                      Ireland                          53.142400
## 137                       Israel                          31.000000
## 138                        Italy                          43.000000
## 139                      Jamaica                          18.109600
## 140                        Japan                          36.000000
## 141                       Jordan                          31.240000
## 142                   Kazakhstan                          48.019600
## 143                        Kenya                          -0.023600
## 144                 Korea, South                          36.000000
## 145                       Kuwait                          29.500000
## 146                   Kyrgyzstan                          41.204400
## 147                       Latvia                          56.879600
## 148                      Lebanon                          33.854700
## 149                      Liberia                           6.428100
## 150                Liechtenstein                          47.140000
## 151                    Lithuania                          55.169400
## 152                   Luxembourg                          49.815300
## 153                   Madagascar                         -18.766900
## 154                     Malaysia                           2.500000
## 155                     Maldives                           3.202800
## 156                        Malta                          35.937500
## 157                   Mauritania                          21.007900
## 158                    Mauritius                         -20.200000
## 159                       Mexico                          23.634500
## 160                      Moldova                          47.411600
## 161                       Monaco                          43.733300
## 162                     Mongolia                          46.862500
## 163                   Montenegro                          42.500000
## 164                      Morocco                          31.791700
## 165                      Namibia                         -22.957600
## 166                        Nepal                          28.166700
## 167                  Netherlands                 Aruba  12.518600
## 168                  Netherlands               Curacao  12.169600
## 169                  Netherlands          Sint Maarten  18.042500
## 170                      Netherlands                               52.132600
## 171                      New Zealand                              -40.900600
## 172                        Nicaragua                               12.865400
## 173                            Niger                               17.607800
## 174                          Nigeria                                9.082000
## 175                  North Macedonia                               41.608600
## 176                           Norway                               60.472000
## 177                             Oman                               21.000000
## 178                         Pakistan                               30.375300
## 179                           Panama                                8.538000
## 180                 Papua New Guinea                               -6.315000
## 181                         Paraguay                              -23.442500
## 182                             Peru                               -9.190000
## 183                      Philippines                               13.000000
## 184                           Poland                               51.919400
## 185                         Portugal                               39.399900
## 186                            Qatar                               25.354800
## 187                          Romania                               45.943200
## 188                           Russia                               60.000000
## 189                           Rwanda                               -1.940300
## 190                      Saint Lucia                               13.909400
## 191 Saint Vincent and the Grenadines                               12.984300
## 192                       San Marino                               43.942400
## 193                     Saudi Arabia                               24.000000
## 194                          Senegal                               14.497400
## 195                           Serbia                               44.016500
## 196                       Seychelles                               -4.679600
## 197                        Singapore                                1.283300
## 198                         Slovakia                               48.669000
## 199                         Slovenia                               46.151200
## 200                          Somalia                                5.152100
## 201                     South Africa                              -30.559500
## 202                            Spain                               40.000000
## 203                        Sri Lanka                                7.000000
## 204                            Sudan                               12.862800
## 205                         Suriname                                3.919300
## 206                           Sweden                               63.000000
## 207                      Switzerland                               46.818200
## 208                          Taiwan*                               23.700000
## 209                         Tanzania                               -6.369000
## 210                         Thailand                               15.000000
## 211                             Togo                                8.619500
## 212              Trinidad and Tobago                               10.691800
## 213                          Tunisia                               34.000000
## 214                           Turkey                               38.963700
## 215                           Uganda                                1.000000
## 216                          Ukraine                               48.379400
## 217             United Arab Emirates                               24.000000
## 218                   United Kingdom                      Bermuda  32.307800
## 219                   United Kingdom               Cayman Islands  19.313300
## 220                   United Kingdom              Channel Islands  49.372300
## 221                   United Kingdom                    Gibraltar  36.140800
## 222                   United Kingdom                  Isle of Man  54.236100
## 223                   United Kingdom                   Montserrat  16.742500
## 224                   United Kingdom                               55.378100
## 225                          Uruguay                              -32.522800
## 226                               US                               37.090200
## 227                       Uzbekistan                               41.377500
## 228                        Venezuela                                6.423800
## 229                          Vietnam                               16.000000
## 230                           Zambia                              -15.416700
## 231                         Zimbabwe                              -20.000000
## 232                           Canada             Diamond Princess   0.000000
## 233                         Dominica                               15.415000
## 234                          Grenada                               12.116500
## 235                       Mozambique                              -18.665695
## 236                            Syria                               34.802075
## 237                      Timor-Leste                               -8.874217
## 238                           Belize                               13.193900
## 239                           Canada                    Recovered   0.000000
## 240                             Laos                               19.856270
## 241                            Libya                               26.335100
## 242               West Bank and Gaza                               31.952200
## 243                    Guinea-Bissau                               11.803700
## 244                             Mali                               17.570692
## 245            Saint Kitts and Nevis                               17.357822
## 246                           Canada        Northwest Territories  64.825500
## 247                           Canada                        Yukon  64.282300
## 248                           Kosovo                               42.602636
## 249                            Burma                               21.916200
## 250                   United Kingdom                     Anguilla  18.220600
## 251                   United Kingdom       British Virgin Islands  18.420700
## 252                   United Kingdom     Turks and Caicos Islands  21.694000
## 253                       MS Zaandam                                0.000000
## 254                         Botswana                              -22.328500
## 255                          Burundi                               -3.373100
## 256                     Sierra Leone                                8.460555
##             Long confirmed                                      txt
## 1     65.000000       237                         Afghanistan-:237
## 2     20.168300       259                             Albania-:259
## 3      1.659600       847                             Algeria-:847
## 4      1.521800       390                             Andorra-:390
## 5     17.873900         8                                 Angola-:8
## 6    -61.796400         7                    Antigua and Barbuda-:7
## 7    -63.616700      1054                           Argentina-:1054
## 8     45.038200       571                              Armenia-:571
## 9    149.012400        84 Australia-Australian Capital Territory:84
## 10   151.209300      2182            Australia-New South Wales:2182
## 11   130.845600        19           Australia-Northern Territory:19
## 12   153.400000       781                  Australia-Queensland:781
## 13   138.600700       367             Australia-South Australia:367
## 14   145.970700        69                     Australia-Tasmania:69
## 15   144.963100       968                    Australia-Victoria:968
## 16   115.860500       392           Australia-Western Australia:392
## 17    14.550100     10711                            Austria-:10711
## 18    47.576900       359                           Azerbaijan-:359
## 19   -77.396300        21                               Bahamas-:21
## 20    50.550000       569                              Bahrain-:569
## 21    90.356300        54                            Bangladesh-:54
## 22   -59.543200        34                              Barbados-:34
## 23    27.953400       163                              Belarus-:163
## 24     4.000000     13964                            Belgium-:13964
## 25     2.315800        13                                 Benin-:13
## 26    90.433600         4                                 Bhutan-:4
## 27   -63.588700       115                              Bolivia-:115
## 28    17.679100       459               Bosnia and Herzegovina-:459
## 29   -51.925300      6836                              Brazil-:6836
## 30   114.727700       131                               Brunei-:131
## 31    25.485800       422                             Bulgaria-:422
## 32    -1.561600       282                         Burkina Faso-:282
## 33   -23.041800         6                             Cabo Verde-:6
## 34   104.916700       109                             Cambodia-:109
## 35    11.502100       233                             Cameroon-:233
## 36  -116.576500       754                        Canada-Alberta:754
## 37  -123.120700      1013              Canada-British Columbia:1013
## 38  -122.665500        13                  Canada-Grand Princess:13
## 39   -98.813900       127                       Canada-Manitoba:127
## 40   -66.461900        81                   Canada-New Brunswick:81
## 41   -57.660400       175      Canada-Newfoundland and Labrador:175
## 42   -63.744300       173                    Canada-Nova Scotia:173
## 43   -85.323200      2392                       Canada-Ontario:2392
## 44   -63.416800        21            Canada-Prince Edward Island:21
## 45   -73.549100      4611                        Canada-Quebec:4611
## 46  -106.450900       193                   Canada-Saskatchewan:193
## 47    20.939400         3               Central African Republic-:3
## 48    18.732200         7                                   Chad-:7
## 49   -71.543000      3031                               Chile-:3031
## 50   117.226400       990                           China-Anhui:990
## 51   116.414200       580                        China-Beijing:580
## 52   107.874000       579                      China-Chongqing:579
## 53   117.987400       345                         China-Fujian:345
## 54   101.058300       138                          China-Gansu:138
## 55   113.424400      1501                     China-Guangdong:1501
## 56   108.788100       254                        China-Guangxi:254
## 57   106.874800       146                        China-Guizhou:146
## 58   109.745300       168                         China-Hainan:168
## 59   116.130600       323                          China-Hebei:323
## 60   127.761500       484                   China-Heilongjiang:484
## 61   113.614000      1276                         China-Henan:1276
## 62   114.200000       765                      China-Hong Kong:765
## 63   112.270700     67802                        China-Hubei:67802
## 64   111.708800      1018                         China-Hunan:1018
## 65   113.944800       111                 China-Inner Mongolia:111
## 66   119.455000       646                        China-Jiangsu:646
## 67   115.722100       937                        China-Jiangxi:937
## 68   126.192300        98                           China-Jilin:98
## 69   122.608500       140                       China-Liaoning:140
## 70   113.550000        41                           China-Macau:41
## 71   106.165500        75                         China-Ningxia:75
## 72    95.995600        18                         China-Qinghai:18
## 73   108.870100       255                        China-Shaanxi:255
## 74   118.149800       774                       China-Shandong:774
## 75   121.449100       516                       China-Shanghai:516
## 76   112.292200       137                         China-Shanxi:137
## 77   102.710300       552                        China-Sichuan:552
## 78   117.323000       176                        China-Tianjin:176
## 79    88.092400         1                            China-Tibet:1
## 80    85.240100        76                        China-Xinjiang:76
## 81   101.487000       182                         China-Yunnan:182
## 82   120.093400      1257                     China-Zhejiang:1257
## 83   -74.297300      1065                           Colombia-:1065
## 84    21.758700        19                  Congo (Brazzaville)-:19
## 85    21.758700       109                    Congo (Kinshasa)-:109
## 86   -83.753400       375                          Costa Rica-:375
## 87    -5.547100       190                       Cote d'Ivoire-:190
## 88    15.200000       963                             Croatia-:963
## 89     0.000000       712                    Diamond Princess-:712
## 90   -80.000000       212                                Cuba-:212
## 91    33.429900       320                              Cyprus-:320
## 92    15.473000      3508                            Czechia-:3508
## 93    -6.911800       173                Denmark-Faroe Islands:173
## 94   -42.604300        10                     Denmark-Greenland:10
## 95     9.501800      3107                            Denmark-:3107
## 96    42.590300        33                             Djibouti-:33
## 97   -70.162700      1284                  Dominican Republic-:1284
## 98   -78.183400      2748                             Ecuador-:2748
## 99    30.000000       779                                Egypt-:779
## 100  -88.896500        32                           El Salvador-:32
## 101   10.000000        15                     Equatorial Guinea-:15
## 102   39.782300        15                               Eritrea-:15
## 103   25.013600       779                              Estonia-:779
## 104   31.465900         9                               Eswatini-:9
## 105   40.489700        29                              Ethiopia-:29
## 106  178.065000         5                                   Fiji-:5
## 107   26.000000      1446                             Finland-:1446
## 108  -53.125800        51                   France-French Guiana:51
## 109  149.406800        37                France-French Polynesia:37
## 110  -61.583300       125                     France-Guadeloupe:125
## 111   45.166200        94                         France-Mayotte:94
## 112  165.618000        16                   France-New Caledonia:16
## 113   55.247100       281                        France-Reunion:281
## 114  -62.833300         6                 France-Saint Barthelemy:6
## 115  -63.050100        15                       France-St Martin:15
## 116  -61.024200       135                     France-Martinique:135
## 117    2.213700     56989                             France-:56989
## 118   11.609400        18                                 Gabon-:18
## 119  -15.310100         4                                 Gambia-:4
## 120   43.356900       117                              Georgia-:117
## 121    9.000000     77872                            Germany-:77872
## 122   -1.023200       195                                Ghana-:195
## 123   21.824300      1415                              Greece-:1415
## 124  -90.230800        39                             Guatemala-:39
## 125   -9.696600        30                                Guinea-:30
## 126  -58.750000        19                                Guyana-:19
## 127  -72.285200        16                                 Haiti-:16
## 128   12.453400         6                               Holy See-:6
## 129  -86.241900       172                             Honduras-:172
## 130   19.503300       525                              Hungary-:525
## 131  -19.020800      1220                             Iceland-:1220
## 132   78.000000      1998                               India-:1998
## 133  113.921300      1677                           Indonesia-:1677
## 134   53.000000     47593                               Iran-:47593
## 135   44.000000       728                                 Iraq-:728
## 136   -7.692100      3447                             Ireland-:3447
## 137   35.000000      6092                              Israel-:6092
## 138   12.000000    110574                             Italy-:110574
## 139  -77.297500        44                               Jamaica-:44
## 140  138.000000      2178                               Japan-:2178
## 141   36.510000       278                               Jordan-:278
## 142   66.923700       380                           Kazakhstan-:380
## 143   37.906200        81                                 Kenya-:81
## 144  128.000000      9887                        Korea, South-:9887
## 145   47.750000       317                               Kuwait-:317
## 146   74.766100       111                           Kyrgyzstan-:111
## 147   24.603200       446                               Latvia-:446
## 148   35.862300       479                              Lebanon-:479
## 149   -9.429500         6                                Liberia-:6
## 150    9.550000        68                         Liechtenstein-:68
## 151   23.881300       581                            Lithuania-:581
## 152    6.129600      2319                          Luxembourg-:2319
## 153   46.869100        57                            Madagascar-:57
## 154  112.500000      2908                            Malaysia-:2908
## 155   73.220700        19                              Maldives-:19
## 156   14.375400       188                                Malta-:188
## 157   10.940800         6                             Mauritania-:6
## 158   57.500000       161                            Mauritius-:161
## 159 -102.552800      1215                              Mexico-:1215
## 160   28.369900       423                              Moldova-:423
## 161    7.416700        55                                Monaco-:55
## 162  103.846700        14                              Mongolia-:14
## 163   19.300000       123                           Montenegro-:123
## 164   -7.092600       654                              Morocco-:654
## 165   18.490400        14                               Namibia-:14
## 166   84.250000         5                                  Nepal-:5
## 167  -70.035800        55                      Netherlands-Aruba:55
## 168  -68.990000        11                    Netherlands-Curacao:11
## 169  -63.054800        16               Netherlands-Sint Maarten:16
## 170    5.291300     13614                        Netherlands-:13614
## 171  174.886000       708                          New Zealand-:708
## 172  -85.207200         5                              Nicaragua-:5
## 173    8.081700        74                                 Niger-:74
## 174    8.675300       174                              Nigeria-:174
## 175   21.745300       354                      North Macedonia-:354
## 176    8.468900      4863                              Norway-:4863
## 177   57.000000       210                                 Oman-:210
## 178   69.345100      2118                            Pakistan-:2118
## 179  -80.782100      1181                              Panama-:1181
## 180  143.955500         1                       Papua New Guinea-:1
## 181  -58.443800        69                              Paraguay-:69
## 182  -75.015200      1323                                Peru-:1323
## 183  122.000000      2311                         Philippines-:2311
## 184   19.145100      2554                              Poland-:2554
## 185   -8.224500      8251                            Portugal-:8251
## 186   51.183900       835                                Qatar-:835
## 187   24.966800      2460                             Romania-:2460
## 188   90.000000      2777                              Russia-:2777
## 189   29.873900        82                                Rwanda-:82
## 190  -60.978900        13                           Saint Lucia-:13
## 191  -61.287200         1       Saint Vincent and the Grenadines-:1
## 192   12.457800       236                           San Marino-:236
## 193   45.000000      1720                        Saudi Arabia-:1720
## 194  -14.452400       190                              Senegal-:190
## 195   21.005900      1060                              Serbia-:1060
## 196   55.492000        10                            Seychelles-:10
## 197  103.833300      1000                           Singapore-:1000
## 198   19.699000       400                             Slovakia-:400
## 199   14.995500       841                             Slovenia-:841
## 200   46.199600         5                                Somalia-:5
## 201   22.937500      1380                        South Africa-:1380
## 202   -4.000000    104118                             Spain-:104118
## 203   81.000000       146                            Sri Lanka-:146
## 204   30.217600         7                                  Sudan-:7
## 205  -56.027800        10                              Suriname-:10
## 206   16.000000      4947                              Sweden-:4947
## 207    8.227500     17768                        Switzerland-:17768
## 208  121.000000       329                              Taiwan*-:329
## 209   34.888800        20                              Tanzania-:20
## 210  101.000000      1771                            Thailand-:1771
## 211    0.824800        36                                  Togo-:36
## 212  -61.222500        90                   Trinidad and Tobago-:90
## 213    9.000000       423                              Tunisia-:423
## 214   35.243300     15679                             Turkey-:15679
## 215   32.000000        44                                Uganda-:44
## 216   31.165600       794                              Ukraine-:794
## 217   54.000000       814                 United Arab Emirates-:814
## 218  -64.750500        32                 United Kingdom-Bermuda:32
## 219  -81.254600        22          United Kingdom-Cayman Islands:22
## 220   -2.364400       172        United Kingdom-Channel Islands:172
## 221   -5.353600        81               United Kingdom-Gibraltar:81
## 222   -4.548100        68             United Kingdom-Isle of Man:68
## 223  -62.187400         5               United Kingdom-Montserrat:5
## 224   -3.436000     29474                     United Kingdom-:29474
## 225  -55.765800       338                              Uruguay-:338
## 226  -95.712900    213372                                US-:213372
## 227   64.585300       181                           Uzbekistan-:181
## 228  -66.589700       143                            Venezuela-:143
## 229  108.000000       218                              Vietnam-:218
## 230   28.283300        36                                 Zambia-:36
## 231   30.000000         8                               Zimbabwe-:8
## 232    0.000000         0                 Canada-Diamond Princess:0
## 233  -61.371000        12                               Dominica-:12
## 234  -61.679000         9                                 Grenada-:9
## 235   35.529562        10                               Mozambique-:10
## 236   38.996815        10                                    Syria-:10
## 237  125.727539         1                               Timor-Leste-:1
## 238  -59.543200         3                                    Belize-:3
## 239    0.000000         0                           Canada-Recovered:0
## 240  102.495496        10                                     Laos-:10
## 241   17.228331        10                                    Libya-:10
## 242   35.233200       134                      West Bank and Gaza-:134
## 243  -15.180400         9                             Guinea-Bissau-:9
## 244   -3.996166        31                                     Mali-:31
## 245  -62.782998         8                     Saint Kitts and Nevis-:8
## 246 -124.845700         2             Canada-Northwest Territories:2
## 247 -135.000000         5                               Canada-Yukon:5
## 248   20.902977       125                                 Kosovo-:125
## 249   95.956000        15                                    Burma-:15
## 250  -63.068600         2                 United Kingdom-Anguilla:2
## 251  -64.640000         3   United Kingdom-British Virgin Islands:3
## 252  -71.797900         6 United Kingdom-Turks and Caicos Islands:6
## 253    0.000000         9                               MS Zaandam-:9
## 254   24.684900         4                                 Botswana-:4
## 255   29.918900         2                                  Burundi-:2
## 256  -11.779889         2                             Sierra Leone-:2
```

```
map <- leaflet() %>% addTiles()
#marker
map %<>% addCircleMarkers(x$Long, x$Lat, radius = 2+log2(x$confirmed), stroke = F,
                          color = 'red', fillOpacity = 0.3, popup = x$txt)
map
```



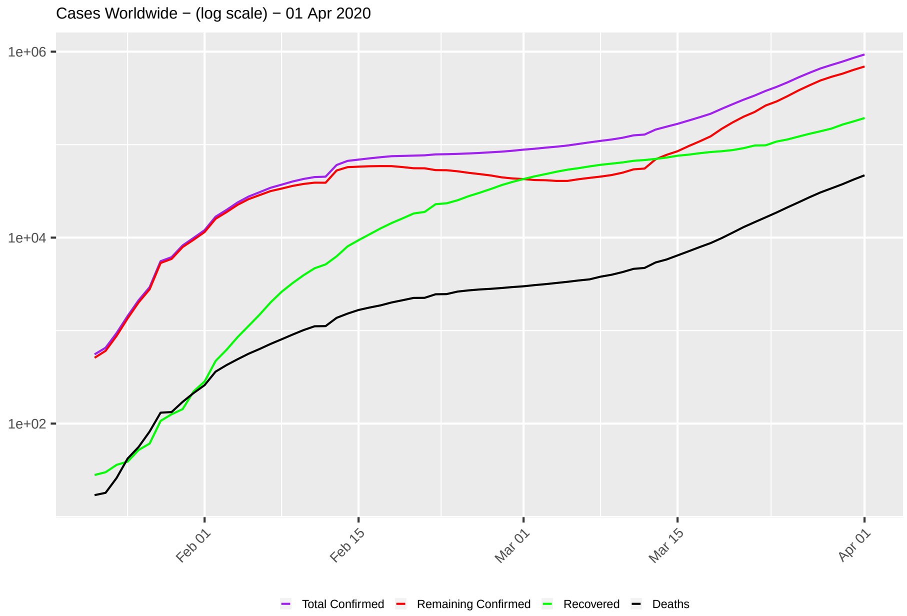
```
map %>% setView(5, 52,zoom = 6)
```



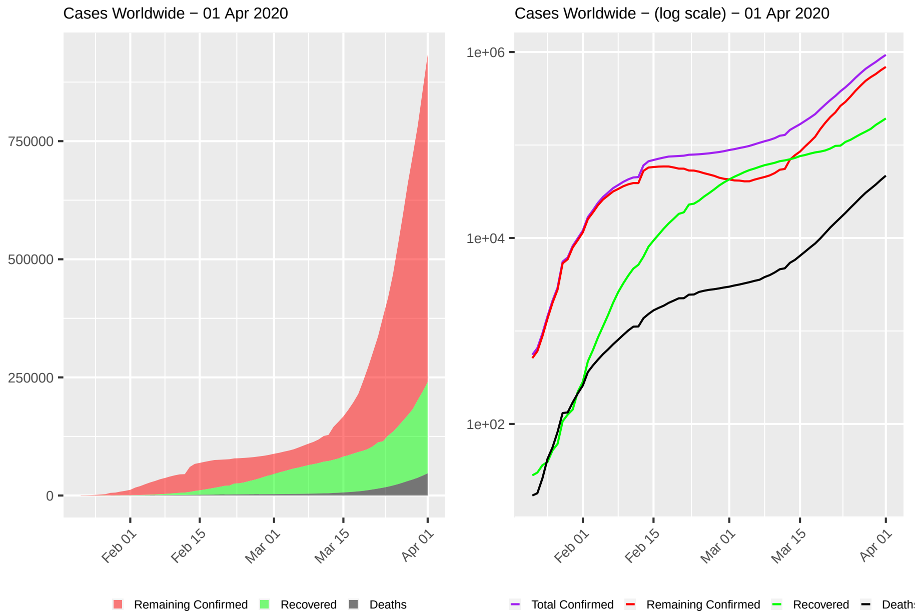
Number of cases:

```r
world.long <- data.long %>% filter(country =='World') # can be also filtered for different
```

```r
# area plot
plot1 <- world.long %>% filter(type != 'Total Confirmed') %>%
  ggplot(aes(x=date, y=count)) +
  geom_area(aes(fill=type), alpha=0.5) +
  labs(title=paste0('Cases Worldwide - ', max.date.txt)) +
  scale_fill_manual(values=c('red', 'green', 'black')) +
  theme(legend.title=element_blank(), legend.position='bottom',
        plot.title = element_text(size=8),
        axis.title.x=element_blank(),
        axis.title.y=element_blank(),
        legend.key.size=unit(0.2, 'cm'),
        legend.text=element_text(size=6),
        axis.text=element_text(size=7),
        axis.text.x=element_text(angle=45, hjust=1))


plot2 <- world.long %>%
  ggplot(aes(x=date,y=count)) +
  geom_line(aes(color=type)) +
  labs(title = paste0('Cases Worldwide - (log scale) - ', max.date.txt)) +
  scale_color_manual(values=c('purple', 'red', 'green', 'black')) +
  theme(legend.title=element_blank(), legend.position='bottom',
        plot.title = element_text(size =8),
        axis.title.x=element_blank(),
        axis.title.y = element_blank(),
        legend.key.size = unit(0.2, 'cm'),
        legend.text = element_text(size =6),
        axis.text = element_text(size = 7),
        axis.text.x =element_text(angle = 45, hjust = 1)) +
  scale_y_continuous(trans = 'log10')

plot2
```



```
grid.arrange(plot1, plot2, ncol=2)
```



Current confirmed Cases:

```r
data.world <- data %>% filter(country == 'World')
n <- nrow(data.world)

##current confirmed and daily new confirmed
plot1 <- ggplot(data.world, aes(x=date, y=remaining.confirmed)) +
  geom_point()+geom_smooth()+
  xlab('') + ylab('Count') + labs(title = 'Current Confirmed Cases') +
  theme(axis.text.x = element_text(angle = 45, hjust = 1))

plot2 <- ggplot(data.world, aes(x=date, y=confirmed.new))+ geom_point() + geom_smooth() + xl
  theme(axis.text.x = element_text(angle =45, hjust=1))
```

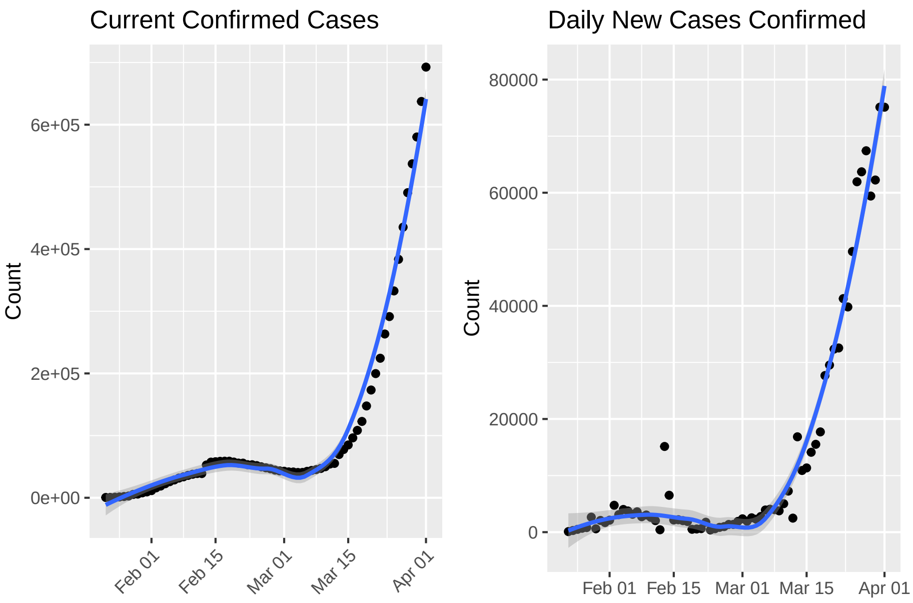
```
## List of 1
##  $ axis.text.x:List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 1
##   ..$ vjust        : NULL
##   ..$ angle        : num 45
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi FALSE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  - attr(*, "class")= chr [1:2] "theme" "gg"
##  - attr(*, "complete")= logi FALSE
##  - attr(*, "validate")= logi TRUE
```

```r
grid.arrange(plot1, plot2, ncol=2)
```

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

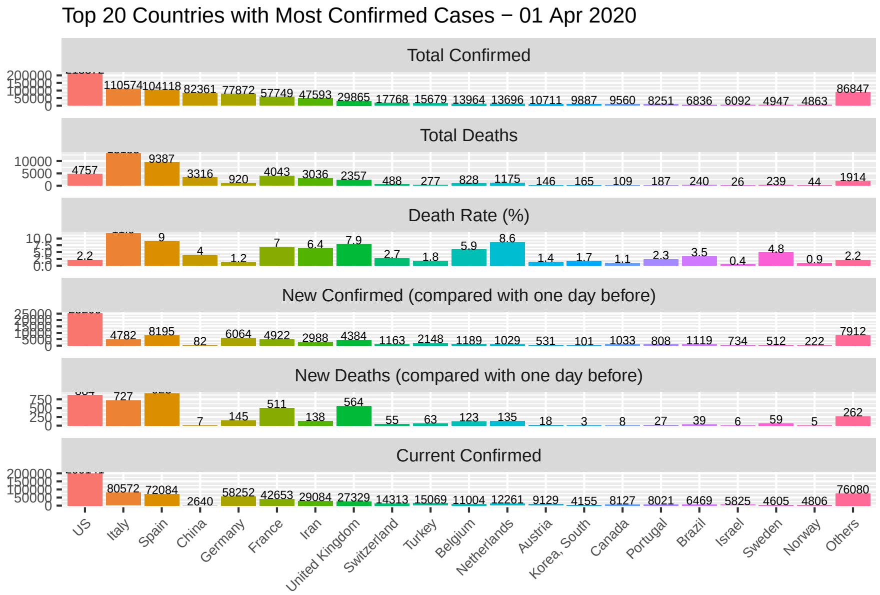
```
## Warning: Removed 1 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 1 rows containing missing values (geom_point).
```

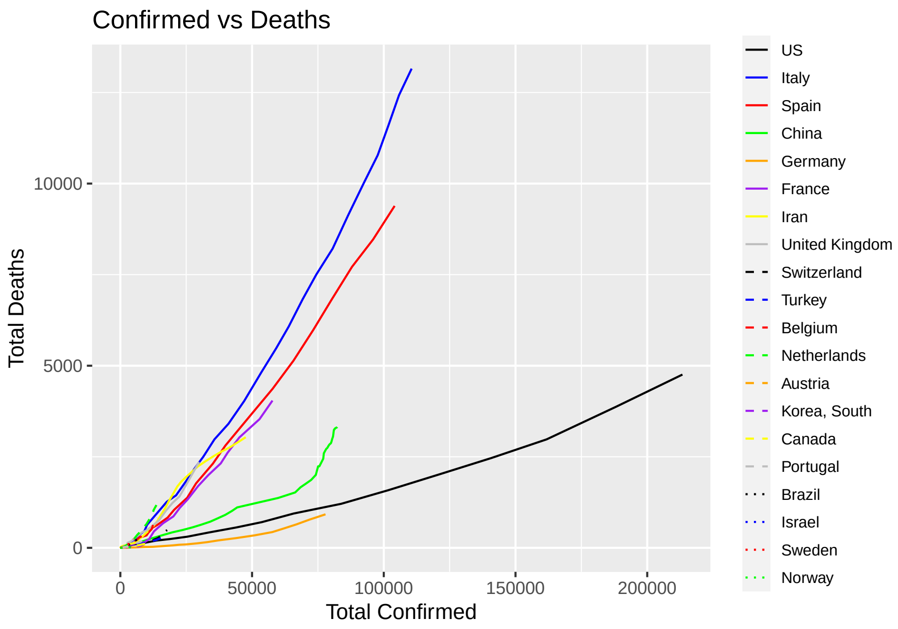


Bar Chart

```
data.latest.long <- data.latest %>% filter(country!='World') %>% gather(key=type, value=cour


data.latest.long %<>% mutate(type=recode_factor(type, confirmed='Total Confirmed', deaths='T

## bar chart
data.latest.long %>% ggplot(aes(x=country, y=count, fill=country, group=country)) +
  geom_bar(stat='identity') +
  geom_text(aes(label=count, y=count),size=2, vjust=0) +
  xlab('') + ylab('') +
  labs(title=paste0('Top 20 Countries with Most Confirmed Cases - ', max.date.txt))+ scale_f
  theme(legend.title=element_blank(),
        legend.position='none',
        plot.title=element_text(size=11),axis.text=element_text(size=7), axis.text.x=element
```



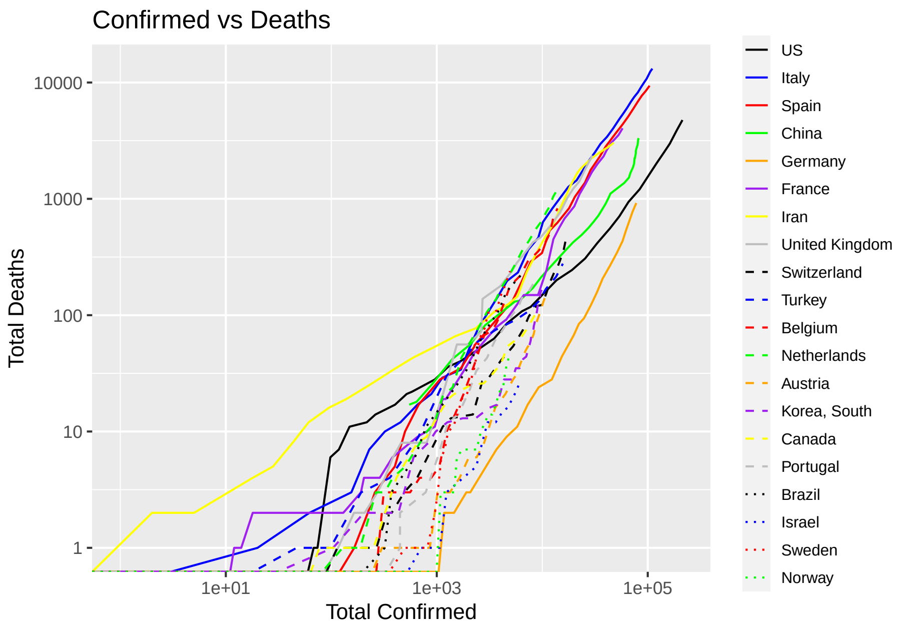
```r
# Confirmed versus Deaths
linetypes <- rep(c("solid", "dashed", "dotted"), each=8)
colors <- rep(c('black', 'blue', 'red', 'green', 'orange', 'purple', 'yellow', 'grey'), 3)
df <- data %>% filter(country %in% setdiff(top.countries, c('World', 'Others'))) %>%
mutate(country=country %>% factor(levels=c(top.countries)))
vs <- df %>% ggplot(aes(x=confirmed, y=deaths, group=country)) +
  geom_line(aes(color=country, linetype=country)) +
  xlab('Total Confirmed') + ylab('Total Deaths') +
  scale_linetype_manual(values=linetypes) +
  scale_color_manual(values=colors) +
  theme(legend.title=element_blank(),
        legend.text=element_text(size=8),
        legend.key.size=unit(0.5, 'cm')) + ggtitle('Confirmed vs Deaths')
vs
```



```
vs + scale_x_log10() + scale_y_log10()
```

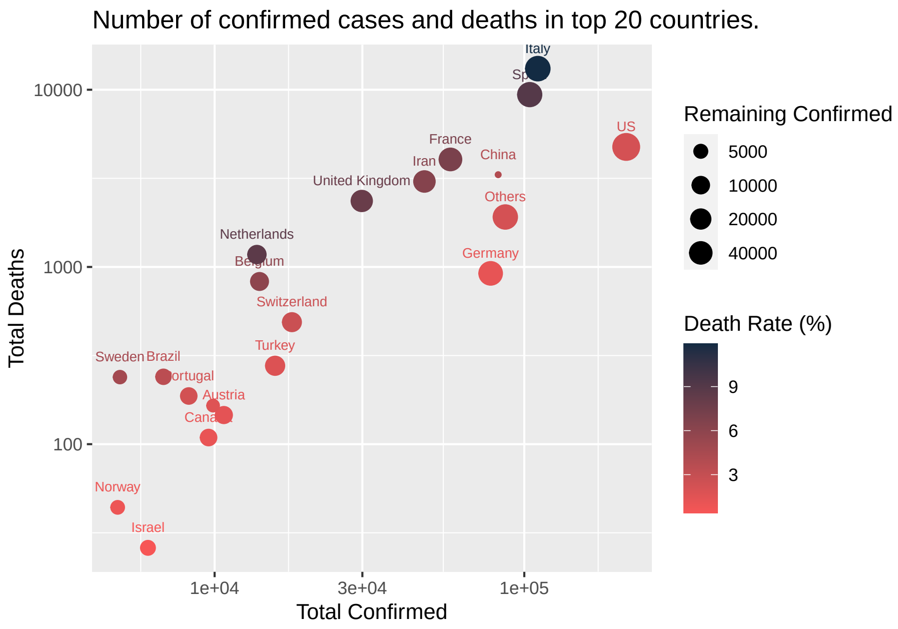
```
## Warning: Transformation introduced infinite values in continuous x-axis
```

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



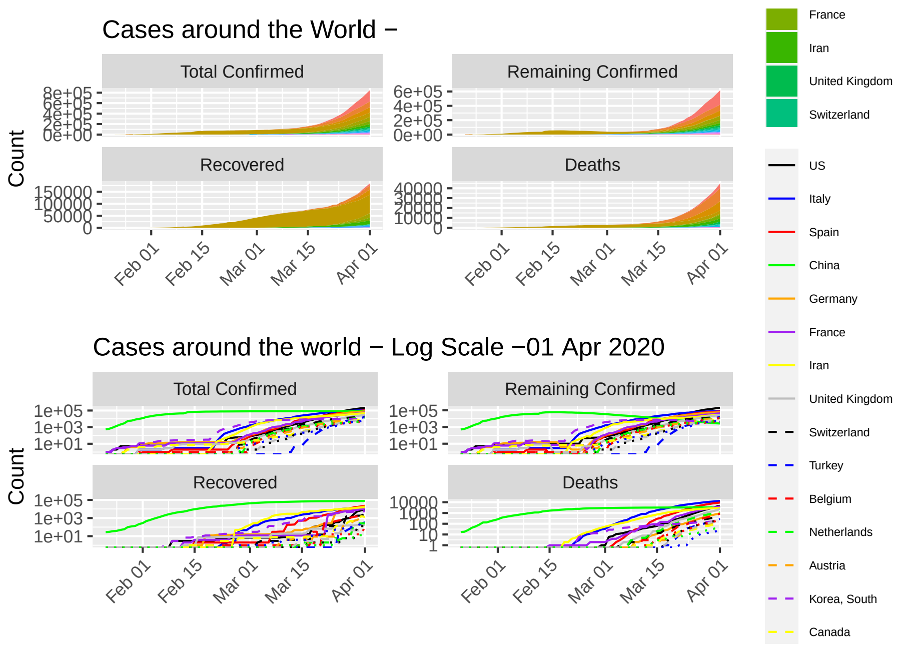
Number of confirmed cases and deaths in top 20 countries.

```
df <- data.latest %>% filter(country %in% setdiff(top.countries, 'World'))

plot1 <- df %>% ggplot(aes(x=confirmed, y=deaths, col=death.rate, size=remaining.confirmed))
scale_size(name='Remaining Confirmed', trans='log2', breaks=c(1e3, 2e3, 5e3, 1e4, 2e4, 4e4))
geom_text(aes(label=country), size=2.5, check_overlap=T, vjust=-1.6) +
geom_point() +
xlab('Total Confirmed') + ylab('Total Deaths') +
labs(col="Death Rate (%)") +
scale_color_gradient(low='#f75656', high='#132B43') +
scale_x_log10() + scale_y_log10()
plot1
```

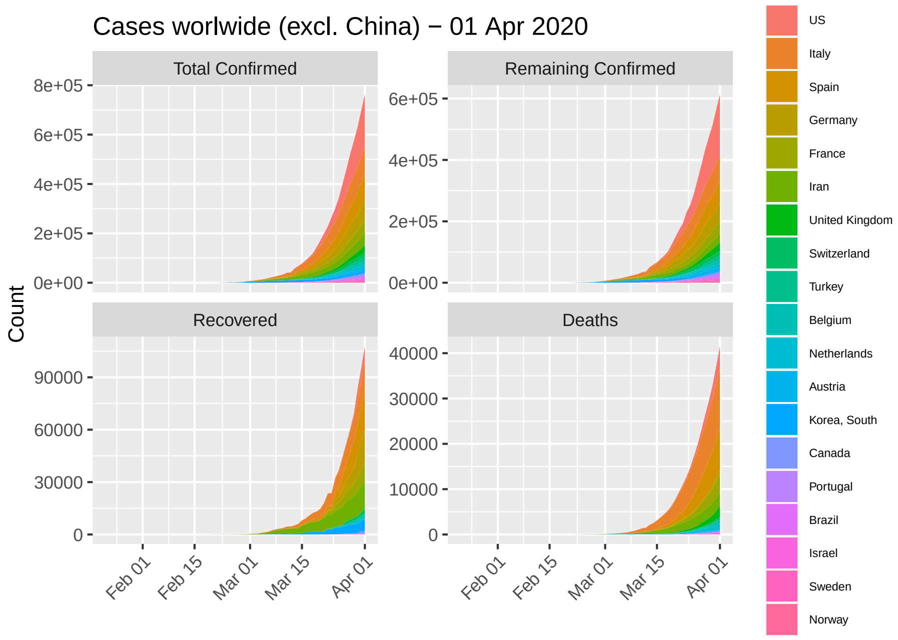


```
df <- data.long %>% filter(country %in% top.countries) %<>% mutate(country=country %>% facto

### CASES AROUND WORLD
p <- df%>% filter(country !='World') %>%
  ggplot(aes(x=date, y=count)) + xlab('') + ylab('Count') +
  theme(legend.title=element_blank(),
        legend.text = element_text(size=6),
        legend.key.size=unit(0.6, 'cm'),
        axis.text.x=element_text(angle = 45, hjust=1)) +
  facet_wrap(~type, ncol = 2, scale='free_y')
# area plot
plot1 <- p + geom_area(aes(fill=country)) +
  labs(title='Cases around the World - ', max.date.txt)

# line plot and in log scale
#linetypes <- rep(c('solid','dashed','dotted'), each=8)
#colors <- rep(c('black','blue','red','green','orange', 'purple', 'yellow', 'grey'), 3)
plot2 <- p + geom_line(aes(color=country, linetype=country)) +
  scale_linetype_manual(values = linetypes) +
  scale_color_manual(values = colors) +
  labs(title =paste0('Cases around the world - Log Scale -', max.date.txt)) +
  scale_y_continuous(trans = 'log10')
grid.arrange(plot1, plot2, ncol=1)
```

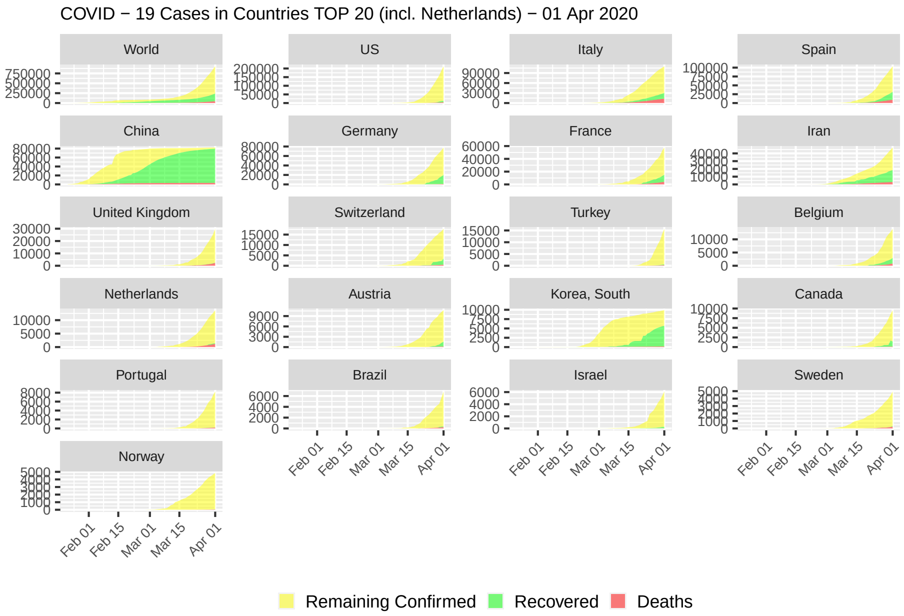
```
## Warning: Transformation introduced infinite values in continuous y-axis
```



```r
# Plot: excluding China
p <- df%>% filter(!(country %in% c('World', 'China'))) %>%
  ggplot(aes(x=date, y=count)) + xlab('') + ylab('Count') +
  theme(legend.title=element_blank(),
        legend.text = element_text(size=6),
        legend.key.size=unit(0.6, 'cm'),
        axis.text.x=element_text(angle = 45, hjust=1)) +
  facet_wrap(~type, ncol = 2, scale='free_y')
p + geom_area(aes(fill=country)) +
  labs(title=paste0('Cases worlwide (excl. China) - ', max.date.txt))
```



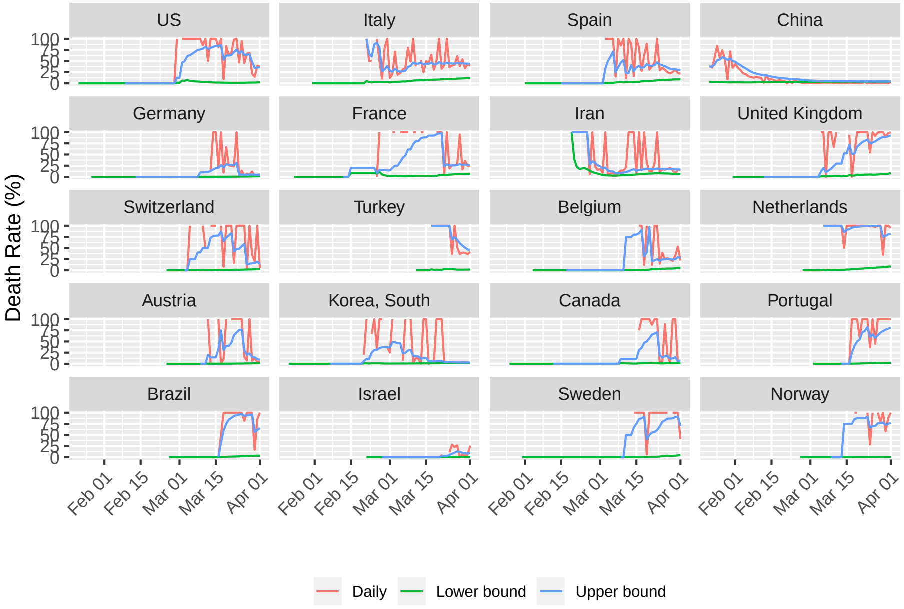
```
# # # list(countries) == 'Netherlands'

## If The Netherland is not top 20, add it in and remove 'Others'
if(!('Netherlands' %in% top.countries)) {
  top.countries %<>% setdiff('Others') %>% c('Netherlands')
  df <- data.long %>% filter(country %in% top.countries) %>%
    mutate(country=country %>% factor(levels = c(top.countries)))
}

# cases by country - area plot
df %>% filter(type != 'World' & type !='Total Confirmed') %>%
  ggplot(aes(x=date, y=count, fill=type)) +
  geom_area(alpha=0.5) +
  labs(title = paste0('COVID - 19 Cases in Countries TOP 20 (incl. Netherlands) - ', max.dat
  scale_fill_manual(values=c('yellow','green','red')) +
  theme(legend.title=element_blank(), legend.position='bottom',
        plot.title= element_text(size = 9),
        axis.title.x=element_blank(),
        axis.title.y = element_blank(),
        legend.key.size = unit(0.3, 'cm'),
        strip.text.x = element_text(size=7),
        axis.text=element_text(size = 7),
        axis.text.x = element_text(angle=45, hjust=1)) +
  facet_wrap(~country, ncol=4, scale='free_y') + facet_wrap(~country, ncol=4, scales = 'free
```



Deaths rate:

```r
rate.max <- rates.long$count %>% max(na.rm=T)

df <- rates.long %>% filter(country %in% setdiff(top.countries, 'World')) %>%
  mutate(country=factor(country, levels=top.countries))

df %>% ggplot(aes(x=date, y=count, color=type)) +
  geom_line() +
  xlab('') + ylab('Death Rate (%)') +
  theme(legend.position='bottom', legend.title=element_blank(),
        legend.text=element_text(size=8),
        legend.key.size=unit(0.5, 'cm'),
        axis.text.x=element_text(angle=45, hjust=1)) +
ylim(c(0, 100)) +
facet_wrap(~country, ncol=4)
```

```
## Warning: Removed 36 row(s) containing missing values (geom_path).
```



Countries with Highest Death Rates

```
## sort the latest data by death rate, and if tie, by confirmed
df <- data %>% filter(date == max(date) & country != 'World' & confirmed >= 100) %>%
  select(country, confirmed, confirmed.new, remaining.confirmed,
         recovered, deaths, deaths.new, death.rate=rate.lower) %>%
  arrange(desc(death.rate, confirmed))

df %>% head(20) %>%
mutate(death.rate=death.rate %>% format(nsmall=1) %>% paste0('%')) %>%
  kable('latex', booktabs=T, row.names=T, align=c('l', rep('r', 7)),
        caption=paste0('Top 20 Countries with Highest Death Rates - ', max.date.txt), format
kable_styling(font_size=7, latex_options=c('striped', 'hold_position', 'repeat_header'))
```

Note that this is an developing story. Check back for updates.

Table 2: Top 20 Countries with Highest Death Rates - 01 Apr 2020

	country	confirmed	confirmed.new	remaining.confirmed	recovered	deaths	deaths.new	death.rate
1	Italy	110,574	4,782	80,572	16,847	13,155	727	11.9%
2	San Marino	236	0	197	13	26	0	11.0%
3	Indonesia	1,677	149	1,417	103	157	21	9.4%
4	Spain	104,118	8,195	72,084	22,647	9,387	923	9.0%
5	Netherlands	13,696	1,029	12,261	260	1,175	135	8.6%
6	Congo (Kinshasa)	109	11	97	3	9	1	8.3%
7	United Kingdom	29,865	4,384	27,329	179	2,357	564	7.9%
8	Iraq	728	34	494	182	52	2	7.1%
9	France	57,749	4,922	42,653	11,053	4,043	511	7.0%
10	Algeria	847	131	728	61	58	14	6.8%
11	Egypt	779	69	548	179	52	6	6.7%
12	Iran	47,593	2,988	29,084	15,473	3,036	138	6.4%
13	Bolivia	115	8	107	1	7	1	6.1%
14	Morocco	654	37	586	29	39	3	6.0%
15	Belgium	13,964	1,189	11,004	2,132	828	123	5.9%
16	Albania	259	16	177	67	15	0	5.8%
17	Honduras	172	31	159	3	10	3	5.8%
18	Burkina Faso	282	21	220	46	16	2	5.7%
19	Sweden	4,947	512	4,605	103	239	59	4.8%
20	Dominican Republic	1,284	175	1,218	9	57	6	4.4%