Data Science - COVID-19

Carlos Utrilla Guerrero

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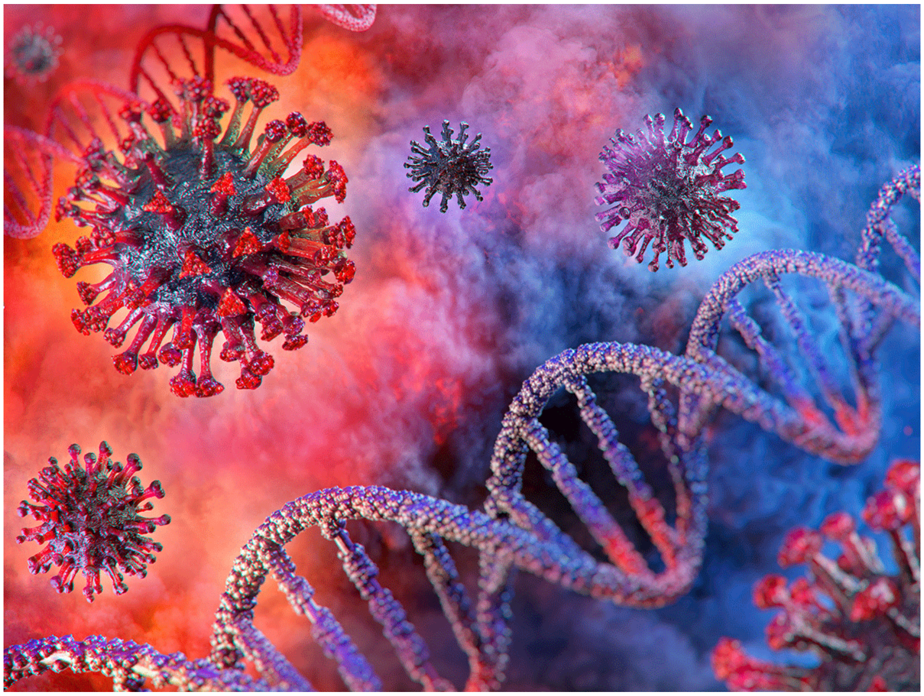


Analysis coronavirus disease (COVID-19).

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')
```

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

```
## [1] 253  71
```

Below we check the time frame of data set

```
# 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" "2020-03-28"
```

```
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
```

```
# 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
```

```
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
## 58   Spain 2020-03-19     17963    830      1107
## 59   Spain 2020-03-20     20410   1043      1588
## 60   Spain 2020-03-21     25374   1375      2125
## 61   Spain 2020-03-22     28768   1772      2575
## 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
```

```
# 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)
```

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

```
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,r

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))
```

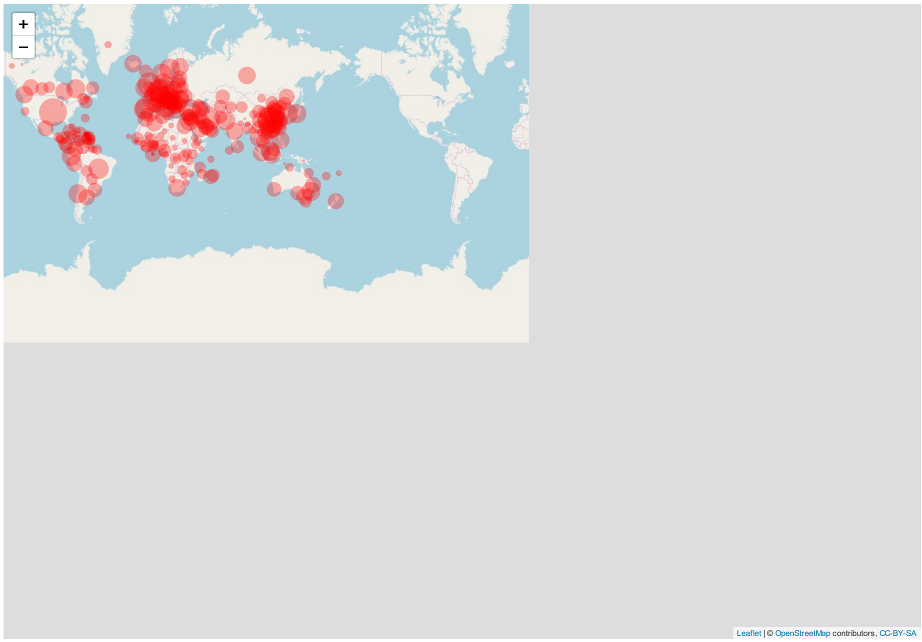
```
##                          Country.Region               Province.State        Lat
## 1                           Afghanistan                               33.000000
## 2                               Albania                               41.153300
## 3                               Algeria                               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 - 28 Mar 2020.

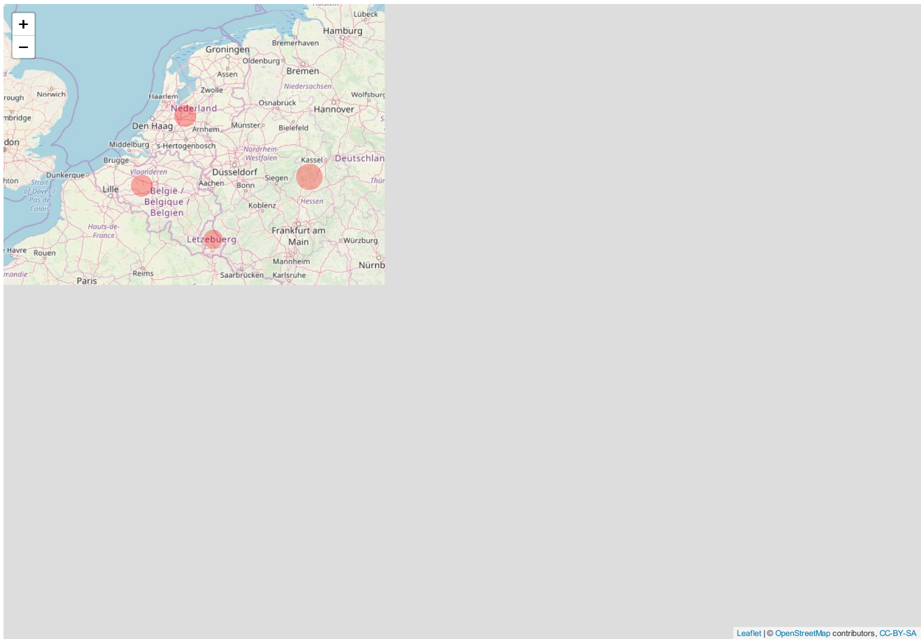
	country	confirmed	deaths	death.rate	confirmed.new	deaths.new	remaining.confirmed
1	World	660,706	30,652	4.6%	67,415	3,454	490,639
2	US	121,478	2,026	1.7%	19,821	445	118,380
3	Italy	92,472	10,023	10.8%	5,974	889	70,065
4	China	81,999	3,299	4.0%	102	3	3,600
5	Spain	73,235	5,982	8.2%	7,516	844	54,968
6	Germany	57,695	433	0.8%	6,824	91	48,781
7	France	38,105	2,317	6.1%	4,703	320	30,064
8	Iran	35,408	2,517	7.1%	3,076	139	21,212
9	United Kingdom	17,312	1,021	5.9%	2,567	260	16,140
10	Switzerland	14,076	264	1.9%	1,148	33	12,282
11	Netherlands	9,819	640	6.5%	1,172	93	9,173
12	Korea, South	9,478	144	1.5%	146	5	4,523
13	Belgium	9,134	353	3.9%	1,850	64	7,718
14	Austria	8,271	68	0.8%	614	10	7,978
15	Turkey	7,402	108	1.5%	1,704	16	7,224
16	Canada	5,576	61	1.1%	894	7	5,049
17	Portugal	5,170	100	1.9%	902	24	5,027
18	Norway	4,015	23	0.6%	260	4	3,985
19	Brazil	3,904	111	2.8%	487	19	3,787
20	Australia	3,640	14	0.4%	497	1	3,382
21	Israel	3,619	12	0.3%	584	0	3,518
22	Others	58,898	1,136	1.9%	6,574	187	53,783

```
## 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
##            Long confirmed                                       txt
## 1     65.000000       110                          Afghanistan-:110
## 2     20.168300       197                              Albania-:197
## 3      1.659600       454                              Algeria-:454
## 4      1.521800       308                              Andorra-:308
## 5     17.873900         5                                 Angola-:5
## 6    -61.796400         7                    Antigua and Barbuda-:7
## 7    -63.616700       690                            Argentina-:690
## 8      45.038200       407                              Armenia-:407
## 9     149.012400        71 Australia-Australian Capital Territory:71
## 10    151.209300      1617            Australia-New South Wales:1617
## 11    130.845600        15           Australia-Northern Territory:15
## 12    153.400000       625                  Australia-Queensland:625
## 13    138.600700       287             Australia-South Australia:287
## 14    145.970700        62                      Australia-Tasmania:62
## 15    144.963100       685                    Australia-Victoria:685
## 16    115.860500       278           Australia-Western Australia:278
## 17     14.550100      8271                             Austria-:8271
## 18     47.576900       182                           Azerbaijan-:182
## 19    -77.396300        10                               Bahamas-:10
## 20     50.550000       476                              Bahrain-:476
## 21     90.356300        48                            Bangladesh-:48
## 22    -59.543200        26                              Barbados-:26
## 23     27.953400        94                               Belarus-:94
## 24      4.000000      9134                             Belgium-:9134
## 25      2.315800         6                                  Benin-:6
## 26     90.433600         3                                 Bhutan-:3
## 27    -63.588700        74                               Bolivia-:74
## 28     17.679100       258               Bosnia and Herzegovina-:258
## 29    -51.925300      3904                              Brazil-:3904
## 30    114.727700       120                               Brunei-:120
## 31     25.485800       331                             Bulgaria-:331
## 32     -1.561600       207                         Burkina Faso-:207
## 33    -23.041800         5                             Cabo Verde-:5
## 34    104.916700        99                              Cambodia-:99
## 35     11.502100        91                              Cameroon-:91
## 36   -116.576500       542                        Canada-Alberta:542
## 37   -123.120700       884               Canada-British Columbia:884
## 38   -122.665500        13                  Canada-Grand Princess:13
## 39    -98.813900        64                        Canada-Manitoba:64
## 40    -66.461900        51                   Canada-New Brunswick:51
## 41    -57.660400       120      Canada-Newfoundland and Labrador:120
## 42    -63.744300       110                    Canada-Nova Scotia:110
## 43    -85.323200      1144                       Canada-Ontario:1144
## 44    -63.416800        11            Canada-Prince Edward Island:11
## 45    -73.549100      2498                        Canada-Quebec:2498
## 46   -106.450900       134                   Canada-Saskatchewan:134
## 47     20.939400         3               Central African Republic-:3
## 48     18.732200         3                                   Chad-:3
## 49    -71.543000      1909                               Chile-:1909
## 50    117.226400       990                           China-Anhui:990
## 51    116.414200       573                         China-Beijing:573
## 52    107.874000       578                       China-Chongqing:578
## 53    117.987400       337                          China-Fujian:337
## 54   101.058300       136                           China-Gansu:136
## 55   113.424400      1467                      China-Guangdong:1467
## 56   108.788100       254                         China-Guangxi:254
## 57   106.874800       146                         China-Guizhou:146
## 58   109.745300       168                          China-Hainan:168
## 59   116.130600       319                           China-Hebei:319
## 60   127.761500       484                    China-Heilongjiang:484
## 61   113.614000      1275                          China-Henan:1275
## 62   114.200000       561                       China-Hong Kong:561
## 63   112.270700     67801                         China-Hubei:67801
## 64   111.708800      1018                          China-Hunan:1018
## 65   113.944800        94                   China-Inner Mongolia:94
## 66   119.455000       641                         China-Jiangsu:641
## 67   115.722100       936                         China-Jiangxi:936
## 68   126.192300        97                            China-Jilin:97
## 69   122.608500       132                        China-Liaoning:132
## 70   113.550000        37                            China-Macau:37
## 71   106.165500        75                          China-Ningxia:75
## 72    95.995600        18                          China-Qinghai:18
## 73   108.870100       253                         China-Shaanxi:253
## 74   118.149800       772                        China-Shandong:772
## 75   121.449100       485                        China-Shanghai:485
## 76   112.292200       135                          China-Shanxi:135
## 77   102.710300       548                         China-Sichuan:548
## 78   117.323000       161                         China-Tianjin:161
## 79    88.092400         1                             China-Tibet:1
## 80    85.240100        76                         China-Xinjiang:76
## 81   101.487000       180                          China-Yunnan:180
## 82   120.093400      1251                       China-Zhejiang:1251
## 83   -74.297300       608                             Colombia-:608
## 84    21.758700         4                    Congo (Brazzaville)-:4
## 85    21.758700        65                      Congo (Kinshasa)-:65
## 86   -83.753400       295                           Costa Rica-:295
## 87    -5.547100       101                        Cote d'Ivoire-:101
## 88    15.200000       657                              Croatia-:657
## 89     0.000000       712                     Diamond Princess-:712
## 90   -80.000000       119                                 Cuba-:119
## 91    33.429900       179                               Cyprus-:179
## 92    15.473000      2631                             Czechia-:2631
## 93    -6.911800       155                 Denmark-Faroe Islands:155
## 94   -42.604300        10                      Denmark-Greenland:10
## 95     9.501800      2201                             Denmark-:2201
## 96    42.590300        14                              Djibouti-:14
## 97   -70.162700       719                   Dominican Republic-:719
## 98   -78.183400      1823                             Ecuador-:1823
## 99    30.000000       576                                Egypt-:576
## 100  -88.896500        19                           El Salvador-:19
## 101   10.000000        12                     Equatorial Guinea-:12
## 102   39.782300         6                                Eritrea-:6
## 103   25.013600       645                              Estonia-:645
## 104   31.465900         9                               Eswatini-:9
## 105   40.489700        16                              Ethiopia-:16
## 106  178.065000         5                                   Fiji-:5
## 107   26.000000      1167                             Finland-:1167
## 108  -53.125800        28                   France-French Guiana:28
## 109  149.406800        30                France-French Polynesia:30
## 110  -61.583300       102                     France-Guadeloupe:102
## 111   45.166200        63                         France-Mayotte:63
## 112  165.618000        15                   France-New Caledonia:15
## 113   55.247100       183                        France-Reunion:183
## 114  -62.833300         5                 France-Saint Barthelemy:5
## 115  -63.050100        11                       France-St Martin:11
## 116  -61.024200        93                      France-Martinique:93
## 117    2.213700     37575                             France-:37575
## 118   11.609400         7                                  Gabon-:7
## 119  -15.310100         3                                 Gambia-:3
## 120   43.356900        90                               Georgia-:90
## 121    9.000000     57695                            Germany-:57695
## 122   -1.023200       141                                Ghana-:141
## 123   21.824300      1061                              Greece-:1061
## 124  -90.230800        34                             Guatemala-:34
## 125   -9.696600         8                                 Guinea-:8
## 126  -58.750000         8                                 Guyana-:8
## 127  -72.285200         8                                  Haiti-:8
## 128   12.453400         6                               Holy See-:6
## 129  -86.241900        95                              Honduras-:95
## 130   19.503300       343                              Hungary-:343
## 131  -19.020800       963                              Iceland-:963
## 132   78.000000       987                                India-:987
## 133  113.921300      1155                           Indonesia-:1155
## 134   53.000000     35408                               Iran-:35408
## 135   44.000000       506                                 Iraq-:506
## 136   -7.692100      2415                             Ireland-:2415
## 137   35.000000      3619                              Israel-:3619
## 138   12.000000     92472                              Italy-:92472
## 139  -77.297500        30                               Jamaica-:30
## 140  138.000000      1693                               Japan-:1693
## 141   36.510000       246                               Jordan-:246
## 142   66.923700       228                           Kazakhstan-:228
## 143   37.906200        38                                 Kenya-:38
## 144  128.000000      9478                        Korea, South-:9478
## 145   47.750000       235                               Kuwait-:235
## 146   74.766100         58                             Kyrgyzstan-:58
## 147   24.603200        305                                Latvia-:305
## 148   35.862300        412                               Lebanon-:412
## 149   -9.429500          3                                 Liberia-:3
## 150    9.550000         56                          Liechtenstein-:56
## 151   23.881300        394                             Lithuania-:394
## 152    6.129600       1831                           Luxembourg-:1831
## 153   46.869100         26                             Madagascar-:26
## 154  112.500000       2320                             Malaysia-:2320
## 155   73.220700         16                               Maldives-:16
## 156   14.375400        149                                 Malta-:149
## 157   10.940800          5                              Mauritania-:5
## 158   57.500000        102                             Mauritius-:102
## 159 -102.552800        717                                Mexico-:717
## 160   28.369900        231                               Moldova-:231
## 161    7.416700         42                                 Monaco-:42
## 162  103.846700         12                               Mongolia-:12
## 163   19.300000         84                             Montenegro-:84
## 164   -7.092600        402                               Morocco-:402
## 165   18.490400          8                                 Namibia-:8
## 166   84.250000          5                                   Nepal-:5
## 167  -70.035800         46                       Netherlands-Aruba:46
## 168  -68.990000          8                      Netherlands-Curacao:8
## 169  -63.054800          3                 Netherlands-Sint Maarten:3
## 170    5.291300       9762                          Netherlands-:9762
## 171  174.886000        451                           New Zealand-:451
## 172  -85.207200          4                               Nicaragua-:4
## 173    8.081700         10                                  Niger-:10
## 174    8.675300         89                                Nigeria-:89
## 175   21.745300        241                       North Macedonia-:241
## 176    8.468900       4015                               Norway-:4015
## 177   57.000000        152                                  Oman-:152
## 178   69.345100       1495                             Pakistan-:1495
## 179  -80.782100        786                                Panama-:786
## 180  143.955500          1                        Papua New Guinea-:1
## 181  -58.443800         56                               Paraguay-:56
## 182  -75.015200        671                                  Peru-:671
## 183  122.000000       1075                          Philippines-:1075
## 184   19.145100       1638                               Poland-:1638
## 185   -8.224500       5170                             Portugal-:5170
## 186   51.183900        590                                 Qatar-:590
## 187   24.966800       1452                              Romania-:1452
## 188   90.000000       1264                               Russia-:1264
## 189   29.873900         60                                 Rwanda-:60
## 190  -60.978900          3                             Saint Lucia-:3
## 191  -61.287200          1        Saint Vincent and the Grenadines-:1
## 192   12.457800       224                           San Marino-:224
## 193   45.000000      1203                        Saudi Arabia-:1203
## 194  -14.452400       130                              Senegal-:130
## 195   21.005900       659                               Serbia-:659
## 196   55.492000         8                             Seychelles-:8
## 197  103.833300       802                            Singapore-:802
## 198   19.699000       292                             Slovakia-:292
## 199   14.995500       684                             Slovenia-:684
## 200   46.199600         3                                Somalia-:3
## 201   22.937500      1187                        South Africa-:1187
## 202   -4.000000     73235                              Spain-:73235
## 203   81.000000       113                            Sri Lanka-:113
## 204   30.217600         5                                  Sudan-:5
## 205  -56.027800         8                               Suriname-:8
## 206   16.000000      3447                              Sweden-:3447
## 207    8.227500     14076                        Switzerland-:14076
## 208  121.000000       283                              Taiwan*-:283
## 209   34.888800        14                              Tanzania-:14
## 210  101.000000      1245                            Thailand-:1245
## 211    0.824800        25                                  Togo-:25
## 212  -61.222500        74                   Trinidad and Tobago-:74
## 213    9.000000       278                              Tunisia-:278
## 214   35.243300      7402                              Turkey-:7402
## 215   32.000000        30                                Uganda-:30
## 216   31.165600       356                              Ukraine-:356
## 217   54.000000       468                 United Arab Emirates-:468
## 218  -64.750500        17                 United Kingdom-Bermuda:17
## 219  -81.254600         8           United Kingdom-Cayman Islands:8
## 220   -2.364400        97         United Kingdom-Channel Islands:97
## 221   -5.353600        56               United Kingdom-Gibraltar:56
## 222   -4.548100        32             United Kingdom-Isle of Man:32
## 223  -62.187400         5               United Kingdom-Montserrat:5
## 224   -3.436000     17089                     United Kingdom-:17089
## 225  -55.765800       274                              Uruguay-:274
## 226  -95.712900    121478                                US-:121478
## 227   64.585300       104                           Uzbekistan-:104
## 228  -66.589700       119                            Venezuela-:119
## 229  108.000000       174                              Vietnam-:174
## 230   28.283300        28                                Zambia-:28
## 231   30.000000         7                               Zimbabwe-:7
## 232    0.000000         0                 Canada-Diamond Princess:0
## 233  -61.371000        11                              Dominica-:11
## 234  -61.679000         7                                Grenada-:7
## 235   35.529562         8                             Mozambique-:8
## 236   38.996815         5                                  Syria-:5
## 237  125.727539         1                            Timor-Leste-:1
## 238  -59.543200         2                                 Belize-:2
## 239    0.000000         0                        Canada-Recovered:0
## 240  102.495496         8                                   Laos-:8
## 241   17.228331         3                                  Libya-:3
## 242   35.233200        98                    West Bank and Gaza-:98
## 243  -15.180400         2                          Guinea-Bissau-:2
## 244   -3.996166        18                                  Mali-:18
## 245  -62.782998         2                  Saint Kitts and Nevis-:2
## 246 -124.845700         1            Canada-Northwest Territories:1
## 247 -135.000000         4                            Canada-Yukon:4
## 248   20.902977        91                                Kosovo-:91
## 249   95.956000         8                                  Burma-:8
## 250  -63.068600         2                 United Kingdom-Anguilla:2
## 251  -64.640000         2   United Kingdom-British Virgin Islands:2
## 252  -71.797900         4 United Kingdom-Turks and Caicos Islands:4
## 253    0.000000         2                             MS Zaandam-:2
```

```r
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)
```



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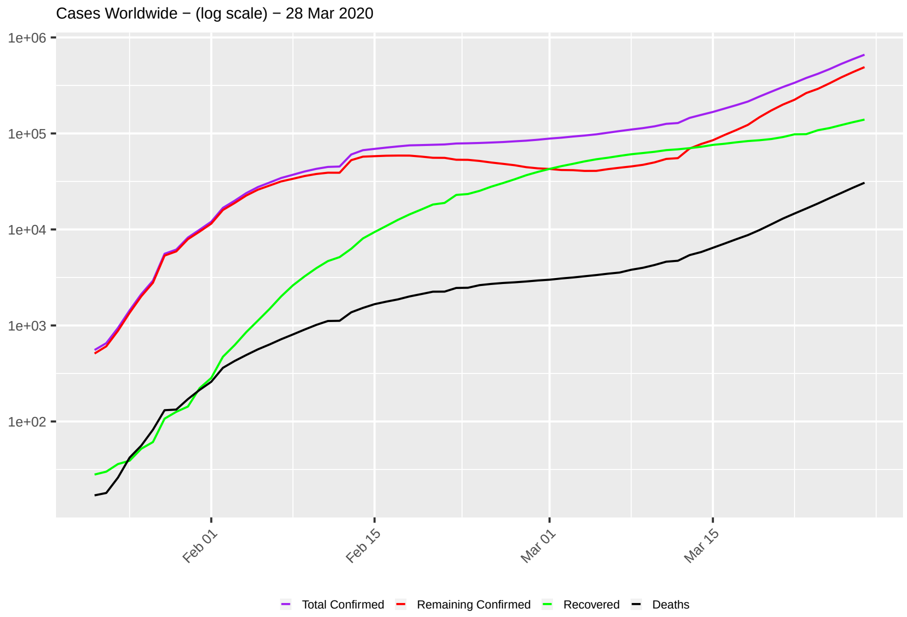
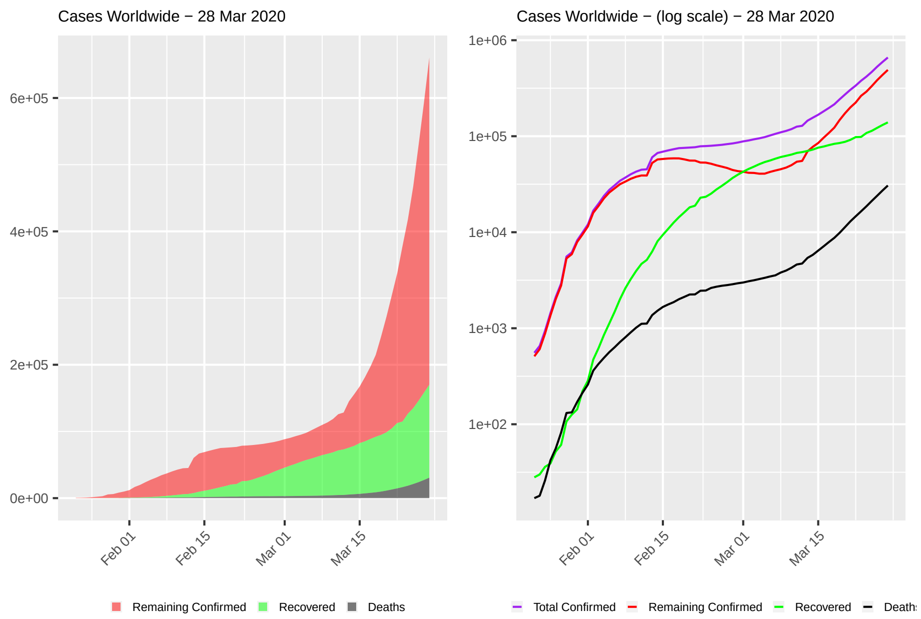
Number of cases:

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

```
# 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)
```



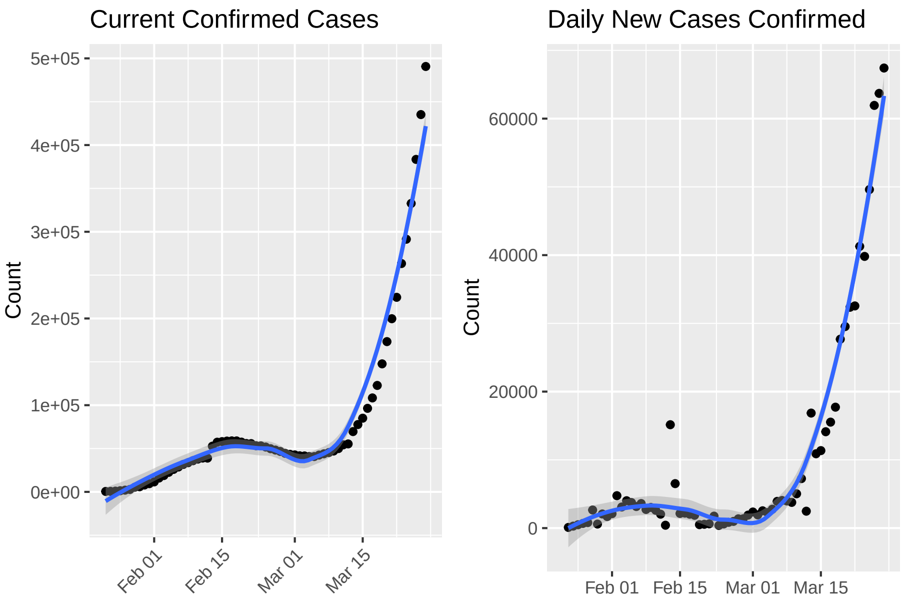
Current confirmed Cases:

```
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
```

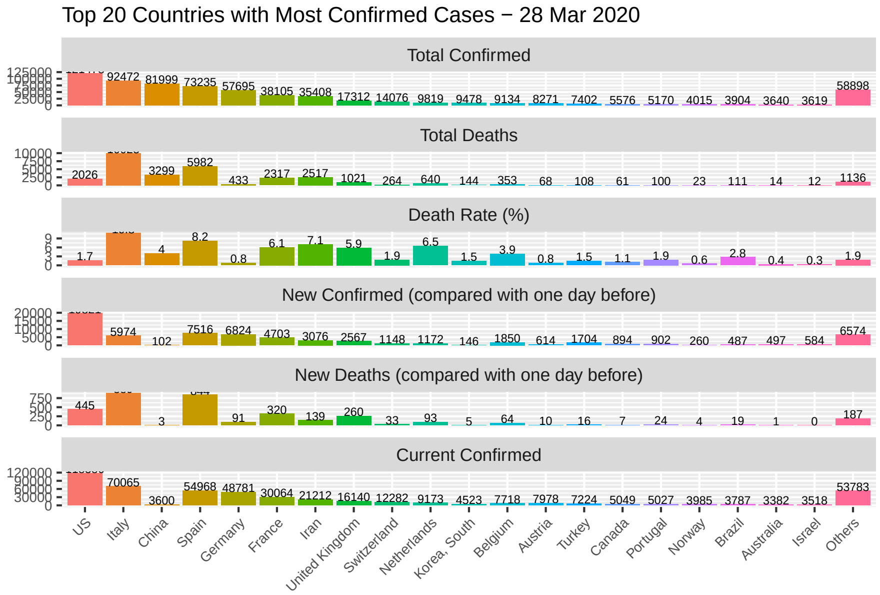
```
grid.arrange(plot1, plot2, ncol=2)
```

```
## `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).
```

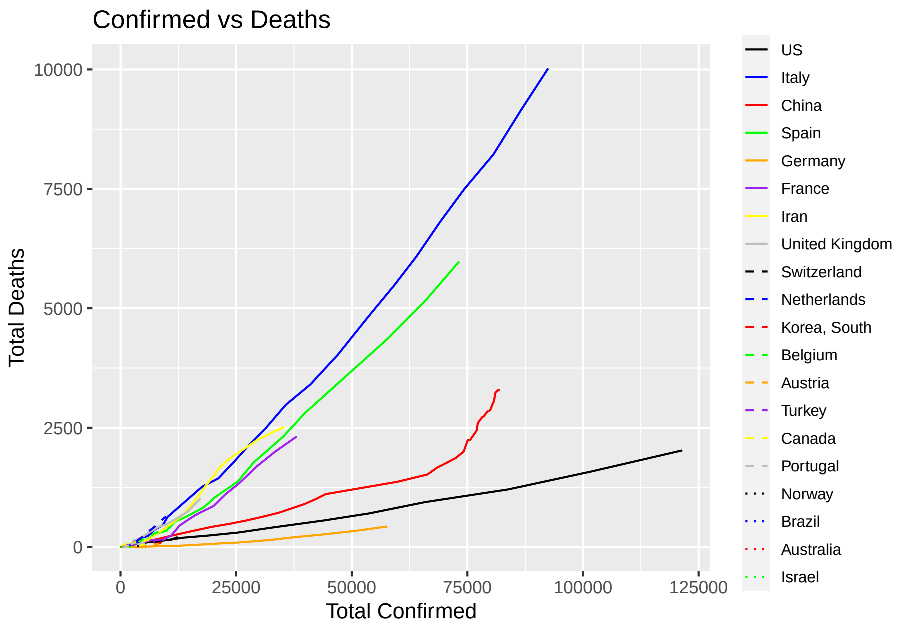


Bar Chart

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


data.latest.long %<>% mutate(type=recode_factor(type, confirmed='Total Confirmed', deaths='
## 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
```

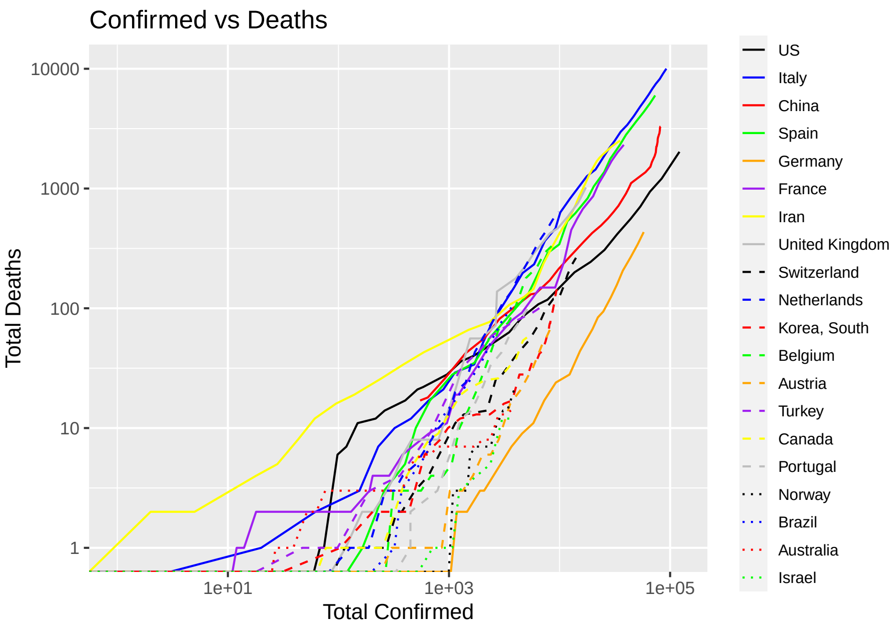


```
# Confirmed versus Deaths
linetypes <- rep(c("solid", "dashed", "dotted"), each=8)
colors <- rep(c('black', 'blue', 'red', 'green', 'orange', 'purple', 'yellow', 'grey'), 3)
df <- data %>% filter(country %in% setdiff(top.countries, c('World', 'Others'))) %>%
mutate(country=country %>% factor(levels=c(top.countries)))
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
```



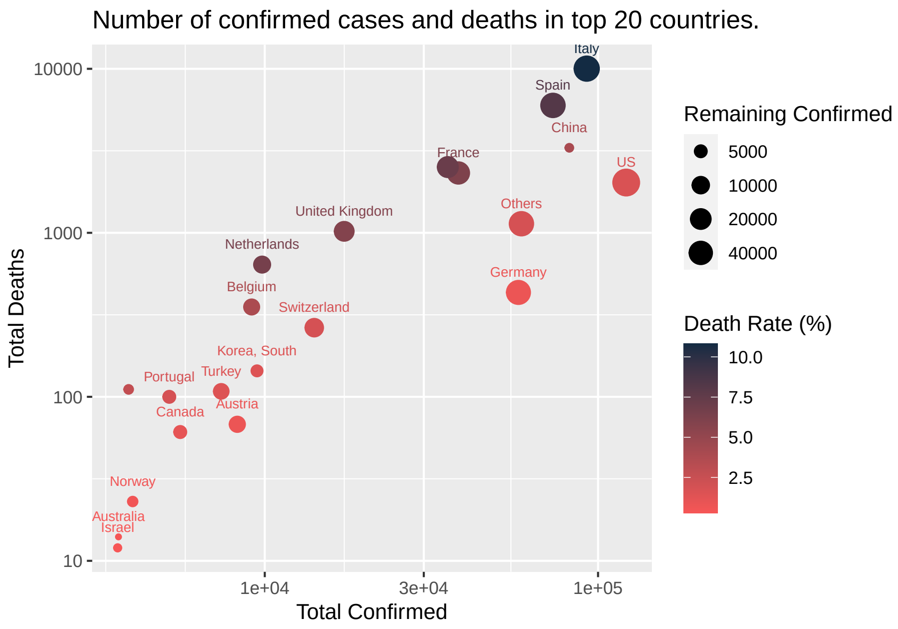
```
vs + scale_x_log10() + scale_y_log10()
```

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

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



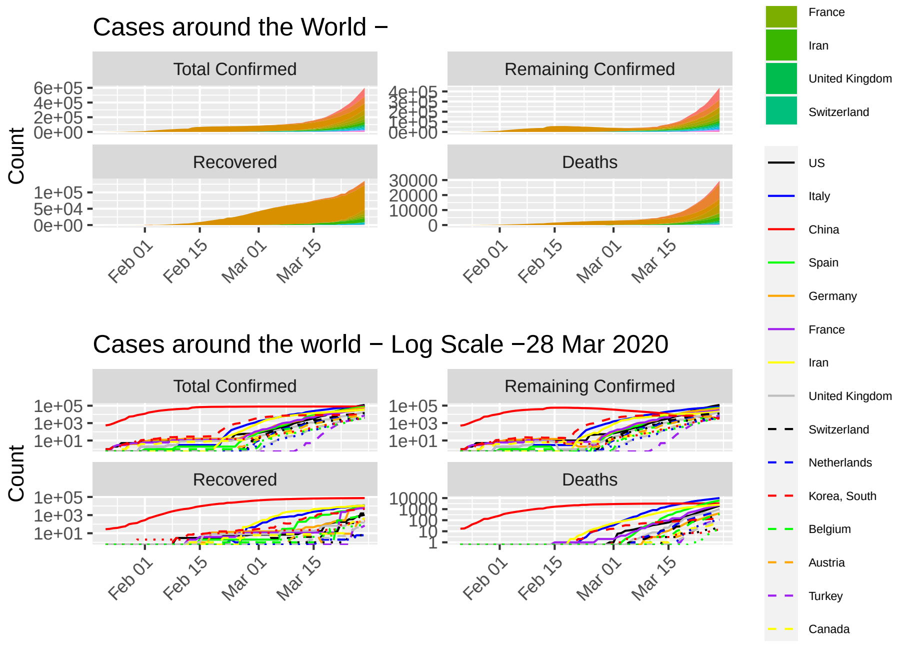
Number of confirmed cases and deaths in top 20 countries.

```
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
```

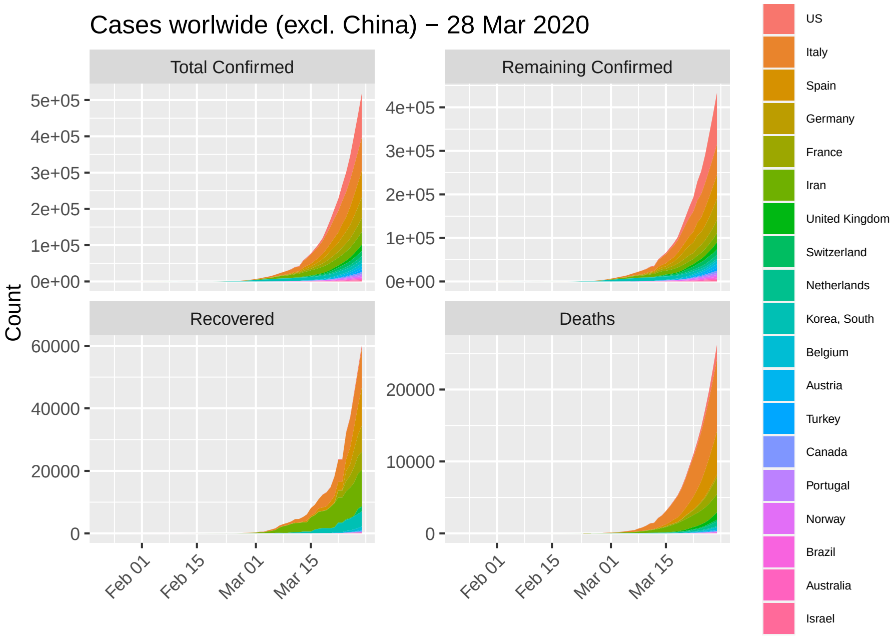


```
df <- data.long %>% filter(country %in% top.countries) %<>% mutate(country=country %>% facto

### 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)
```

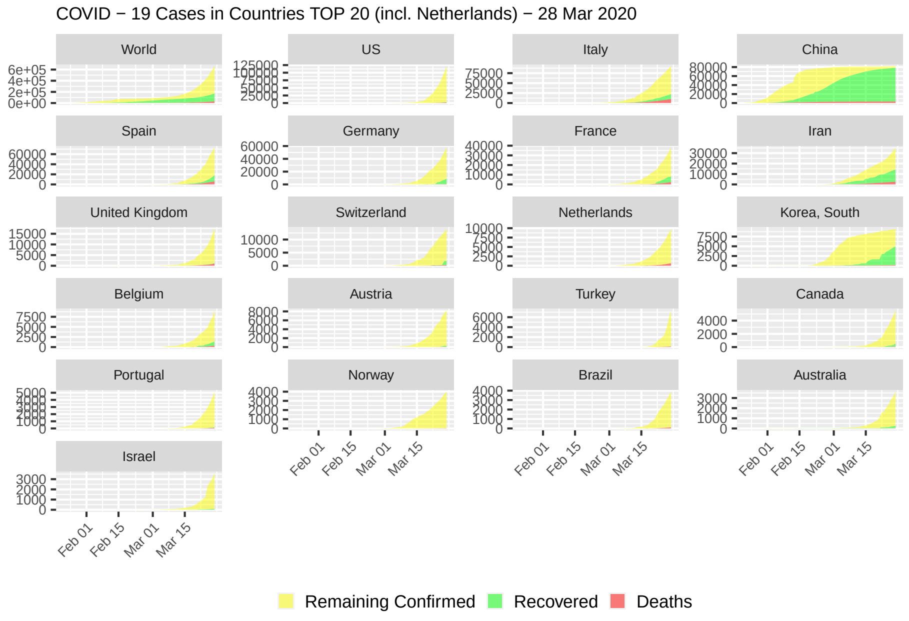
```
## Warning: Transformation introduced infinite values in continuous y-axis
```



```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))
```



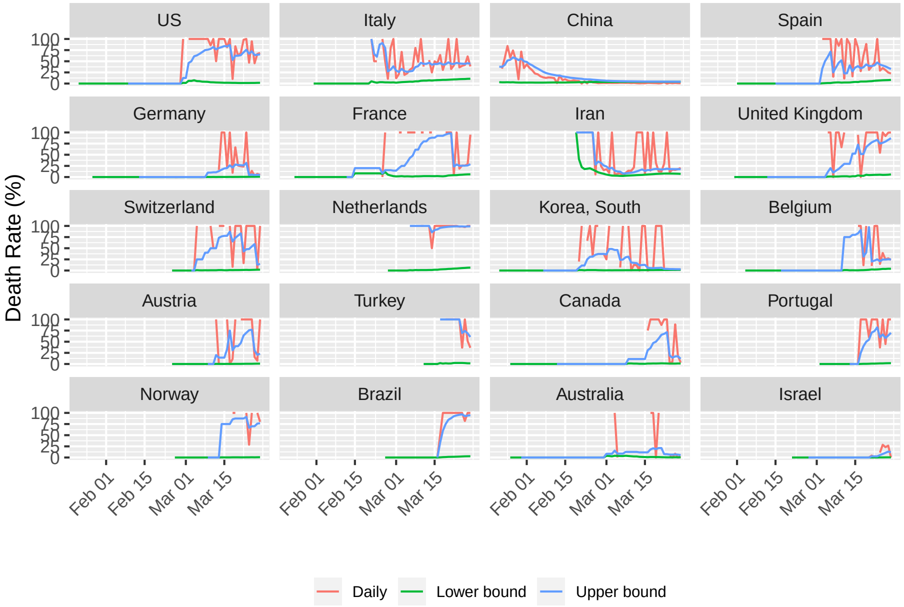
```
# # # list(countries) == 'Netherlands'

## 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:

```
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 - 28 Mar 2020

	country	confirmed	confirmed.new	remaining.confirmed	recovered	deaths	deaths.new	death.rate
1	Italy	92,472	5,974	70,065	12,384	10,023	889	10.8%
2	San Marino	224	1	196	6	22	1	9.8%
3	Indonesia	1,155	109	994	59	102	15	8.8%
4	Iraq	506	48	333	131	42	2	8.3%
5	Spain	73,235	7,516	54,968	12,285	5,982	844	8.2%
6	Iran	35,408	3,076	21,212	11,679	2,517	139	7.1%
7	Netherlands	9,819	1,172	9,173	6	640	93	6.5%
8	Algeria	454	45	394	31	29	3	6.4%
9	Philippines	1,075	272	972	35	68	14	6.3%
10	Egypt	576	40	419	121	36	6	6.2%
11	Morocco	402	57	366	11	25	2	6.2%
12	France	38,105	4,703	30,064	5,724	2,317	320	6.1%
13	United Kingdom	17,312	2,567	16,140	151	1,021	260	5.9%
14	Burkina Faso	207	27	175	21	11	2	5.3%
15	Albania	197	11	156	31	10	2	5.1%
16	China	81,999	102	3,600	75,100	3,299	3	4.0%
17	Belgium	9,134	1,850	7,718	1,063	353	64	3.9%
18	Dominican Republic	719	138	688	3	28	8	3.9%
19	Afghanistan	110	0	104	2	4	0	3.6%
20	Ghana	141	4	134	2	5	1	3.5%