

COVID-19 Data Analysis with R - Worldwide*

Yanchang Zhao
yanchang@RDataMining.com
<http://RDataMining.com>

14 August 2020

Contents

1	Introduction	1
1.1	Data Source	1
1.2	R Packages	1
2	Loading Data	1
3	Data Preparation	3
3.1	Data Cleaning	3
3.2	Worldwide Cases	3
3.3	Daily Increases and Death Rates	4
4	Worldwide Cases	5
4.1	World Map	5
4.2	Number of Cases	6
4.3	Active Confirmed Cases	7
4.4	Deaths and Recovered Cases	8
4.5	Death Rates	9
5	Top Twenty Countries	10
5.1	Confirmed vs Deaths	14
5.2	Comparison across Countries	16
5.3	Death Rates	24
5.4	Countries with Highest Death Rates	26
6	Conclusions	26
	Appendix A. Processed Data	26
	Appendix A.1 COVID-19 Cases Worldwide	26
	Appendix A.2 Latest Cases by Country	29
	Appendix B. How to Cite This Work	32
	Appendix C. Contact	33

*©2020 Yanchang Zhao, RDataMining.com.

1 Introduction

This is an analysis report of the Novel Coronavirus (COVID-19) around the world, to demonstrate data processing and visualisation with R, *tidyverse* and *ggplot2*. This report will be updated from time to time, with new data and more analysis. Please find its latest version at <http://www.rdatamining.com/docs/Coronavirus-data-analysis-world.pdf>.

A similar COVID-19 analysis report for China is available at <http://www.rdatamining.com/docs/Coronavirus-data-analysis-china.pdf>, if you are particularly interested what has happened in China.

1.1 Data Source

The data source used for this analysis is *the 2019 Novel Coronavirus COVID-19 (2019-nCoV) Data Repository*¹ built by the Center for Systems Science and Engineering, Johns Hopkins University.

1.2 R Packages

Below is a list of R packages used for this analysis. Package *magrittr* is for pipe operations like `%>%` and `%<>%` and *lubridate* for date operations. Package *tidyverse* is a collection of R packages for data science, including *dplyr* and *tidyr* for data processing and *ggplot2* for graphics. Package *gridExtra* is for arranging multiple grid-based plots on a page and *kableExtra* works together with `kable()` from *knitr* to build complex HTML or LaTeX tables.

```
library(magrittr) # pipe operations
library(lubridate) # date operations
library(tidyverse) # ggplot2, tidyr, dplyr...
library(gridExtra) # multiple grid-based plots on a page
library(ggforce) # accelerating ggplot2
library(kableExtra) # complex tables
library(leaflet) # map
```

2 Loading Data

At first, the datasets, which are three CSV files, are downloaded and saved as local files and then are loaded into R.

```
## source data files
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
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
raw.data.confirmed <- read.csv('./data/time_series_covid19_confirmed_global.csv')
raw.data.deaths <- read.csv('./data/time_series_covid19_deaths_global.csv')
```

¹<https://github.com/CSSEGISandData/COVID-19>

```
raw.data.recovered <- read.csv('./data/time_series_covid19_recovered_global.csv')

dim(raw.data.confirmed)
```

```
## [1] 266 209
```

Each dataset has 266 rows, corresponding to country/region/province/state. It has 209 columns. Starting from column 5, each column corresponds to a single day. Here we have a look at the first 10 rows and the first 10 columns.

```
raw.data.confirmed[1:10, 1:10] %>%
  kable('latex', booktabs=T, caption='Raw Data (Confirmed, First 10 Columns only)') %>%
  kable_styling(font_size=5, latex_options = c('striped', 'hold_position', 'repeat_header'))
```

Table 1: Raw Data (Confirmed, First 10 Columns only)

Province.State	Country.Region	Lat	Long	X1.22.20	X1.23.20	X1.24.20	X1.25.20	X1.26.20	X1.27.20
	Afghanistan	33.93911	67.70995	0	0	0	0	0	0
	Albania	41.15330	20.16830	0	0	0	0	0	0
	Algeria	28.03390	1.65960	0	0	0	0	0	0
	Andorra	42.50630	1.52180	0	0	0	0	0	0
	Angola	-11.20270	17.87390	0	0	0	0	0	0
	Antigua and Barbuda	17.06080	-61.79640	0	0	0	0	0	0
	Argentina	-38.41610	-63.61670	0	0	0	0	0	0
	Armenia	40.06910	45.03820	0	0	0	0	0	0
Australian Capital Territory	Australia	-35.47350	149.01240	0	0	0	0	0	0
New South Wales	Australia	-33.86880	151.20930	0	0	0	0	3	4

Below we check the time frame of the data.

```
n.col <- ncol(raw.data.confirmed)
## get dates from column names
dates <- names(raw.data.confirmed)[5:n.col] %>% substr(2,8) %>% mdy()
range(dates)
```

```
## [1] "2020-01-22" "2020-08-13"
```

```
min.date <- min(dates)
max.date <- max(dates)
min.date.txt <- min.date %>% format('%d %b %Y')
max.date.txt <- max.date %>% format('%d %b %Y') %>% paste('UTC')
```

It shows that the data was last updated on 13 Aug 2020 UTC and all the stats and charts in this report are based on that data.

3 Data Preparation

3.1 Data Cleaning

The three datasets are converted from wide to long format and then are aggregated by country. After that, they are merged into one single dataset.

```
## data 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, na.rm=T)) %>% as.data.frame()
return(data)
}

## clean the three datasets
data.confirmed <- raw.data.confirmed %>% cleanData() %>% rename(confirmed=count)
data.deaths <- raw.data.deaths %>% cleanData() %>% rename(deaths=count)
data.recovered <- raw.data.recovered %>% 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)
# data %<>% mutate(recovered = ifelse(is.na(recovered), lag(recovered, 1), recovered))

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

## latest 10 records in US
data %>% filter(country=='US') %>% tail(10) %>%
  kable('latex', row.names=F, booktabs=T,
        caption='Raw Data (with first 10 Columns Only)',
        format.args=list(big.mark=',')) %>%
  kable_styling(latex_options = c('striped', 'hold_position', 'repeat_header'))

```

Table 2: Raw Data (with first 10 Columns Only)

country	date	confirmed	deaths	recovered
US	2020-08-04	4,771,080	157,482	1,528,979
US	2020-08-05	4,823,890	158,854	1,577,851
US	2020-08-06	4,883,582	160,104	1,598,624
US	2020-08-07	4,941,755	161,347	1,623,870
US	2020-08-08	4,997,929	162,423	1,643,118
US	2020-08-09	5,044,864	162,938	1,656,864
US	2020-08-10	5,094,400	163,463	1,670,755
US	2020-08-11	5,141,208	164,527	1,714,960
US	2020-08-12	5,197,411	166,034	1,753,760
US	2020-08-13	5,248,854	167,110	1,774,648

There are 188 countries with confirmed COVID-19 cases, as of 13 Aug 2020 UTC.

3.2 Worldwide Cases

The raw data provide the daily number of cases in every country. They are aggregated below to derive the daily stats of the whole world.

```

## counts for the whole world
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)
```

```
## active confirmed cases
```

```
data %<>% mutate(active.confirmed = confirmed - deaths - recovered)
```

3.3 Daily Increases and Death Rates

After that, the daily increases of death and recovered cases and the death rates are calculated.

`rate.upper` is calculated with the total dead and recovered cases. It is the upper bound of death rate and the reasons are

- 1) there were much more deaths than recovered cases when the coronavirus broke out and when it was not contained, and
- 2) the daily number of death will decrease and that of recovered will increase as it becomes contained and more effective measures and treatments are used.

`rate.lower` is calculated with total dead and confirmed cases. It is a lower bound of death rate, because there are and will be new deaths from the active confirmed cases. The final death rate is expected to be in between of the above two rates.

`rate.daily` is calculated with the daily dead and recovered cases and therefore is more volatile than the above two. However, it can give us a clue of the current situation: whether it is very serious or is getting better.

```
## sort by country and date
```

```
data %<>% arrange(country, date)
```

```
## daily increases of deaths and recovered cases
```

```
## set NA to the increases on day1
```

```
n <- nrow(data)
```

```
day1 <- min(data$date)
```

```
data %<>% mutate(new.confirmed = ifelse(date == day1, NA, confirmed - lag(confirmed, n=1)),  
               new.deaths = ifelse(date == day1, NA, deaths - lag(deaths, n=1)),  
               new.recovered = ifelse(date == day1, NA, recovered - lag(recovered, n=1)))
```

```
## change negative number of new cases to zero
```

```
data %<>% mutate(new.confirmed = ifelse(new.confirmed < 0, 0, new.confirmed),  
               new.deaths = ifelse(new.deaths < 0, 0, new.deaths),  
               new.recovered = ifelse(new.recovered < 0, 0, new.recovered))
```

```
## death rate based on total deaths and recovered cases
```

```
data %<>% mutate(rate.upper = (100 * deaths / (deaths + recovered)) %>% round(1))
```

```
## lower bound: death rate based on total confirmed cases
```

```
data %<>% mutate(rate.lower = (100 * deaths / confirmed) %>% round(1))
```

```
## death rate based on the number of death/recovered on every single day
```

```
data %<>% mutate(rate.daily = (100 * new.deaths / (new.deaths + new.recovered)) %>% round(1))
```

```
## convert from wide to long format, for drawing area plots
```

```
data.long <- data %>%
```

```
  select(c(country, date, confirmed, active.confirmed, recovered, deaths)) %>%
```

```
  gather(key=type, value=count, -c(country, date))
```

```
## set factor levels to show them in a desirable order
```

```
data.long %<>% mutate(type=recode_factor(type, confirmed='Total Confirmed',  
                                       active.confirmed='Active Confirmed',
```

```

recovered='Recovered',
deaths='Deaths'))

## convert from wide to long format, for drawing area plots
rates.long <- data %>%
  # filter(country %in% top.countries) %>%
  select(c(country, date, rate.upper, rate.lower, rate.daily)) %>%
  # mutate(country=factor(country, levels=top.countries)) %>%
  gather(key=type, value=count, -c(country, date))
# set factor levels to show them in a desirable order
rates.long %<>% mutate(type=recode_factor(type, rate.daily='Daily',
                                          rate.lower='Lower bound',
                                          rate.upper='Upper bound'))

```

4 Worldwide Cases

After tidying up the data, we visualise it with various charts.

4.1 World Map

Below is a world map of vconfirmed cases. An interactive map can be created if running the code in R or RStudio, or knitting it into a HTML file.

```

## select last column, which is the number of latest confirmed cases
x <- raw.data.confirmed
x$confirmed <- x[, ncol(x)]
x %<>% select(c(Country.Region, Province.State, Lat, Long, confirmed)) %>%
  mutate(txt=paste0(Country.Region, ' - ', Province.State, ': ', confirmed))

m <- leaflet(width=1200, height=800) %>% addTiles()
# circle marker (units in pixels)
m %<>% addCircleMarkers(x$Long, x$Lat,
  # radius=2+log2(x$confirmed),
  radius=0.03*sqrt(x$confirmed),
  stroke=F,
  color='red', fillOpacity=0.3,
  popup=x$txt)

# world
m

```

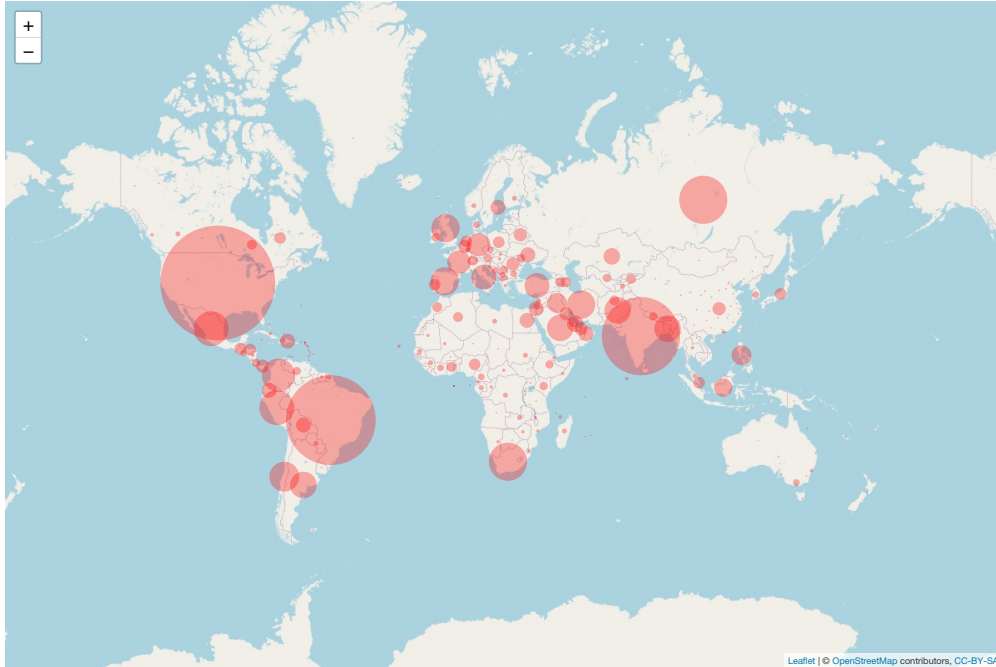


Figure 1: World Map

Views of some specific countries or regions can be produced with the script below.

```
## China
m %>% setView(95, 35, zoom=4)
## Australia and New Zealand
m %>% setView(135, -27, zoom=4)
## US and Canada
m %>% setView(-105, 40, zoom=4)
## Europe
m %>% setView(10, 50, zoom=4)
```

4.2 Number of Cases

In the rest of this section, we will focus on the cases worldwide. Similar analysis for a single country can be done by filter the data with the corresponding country name.

```
# data %<>% filter(country=='China')
# data %<>% filter(country=='Australia')
world.long <- data.long %>% filter(country == 'World')

## cases - 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('Numbers of 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=7),
        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('Numbers of 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=7),
        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')
## show two plots side by side
grid.arrange(plot1, plot2, ncol=2)

```

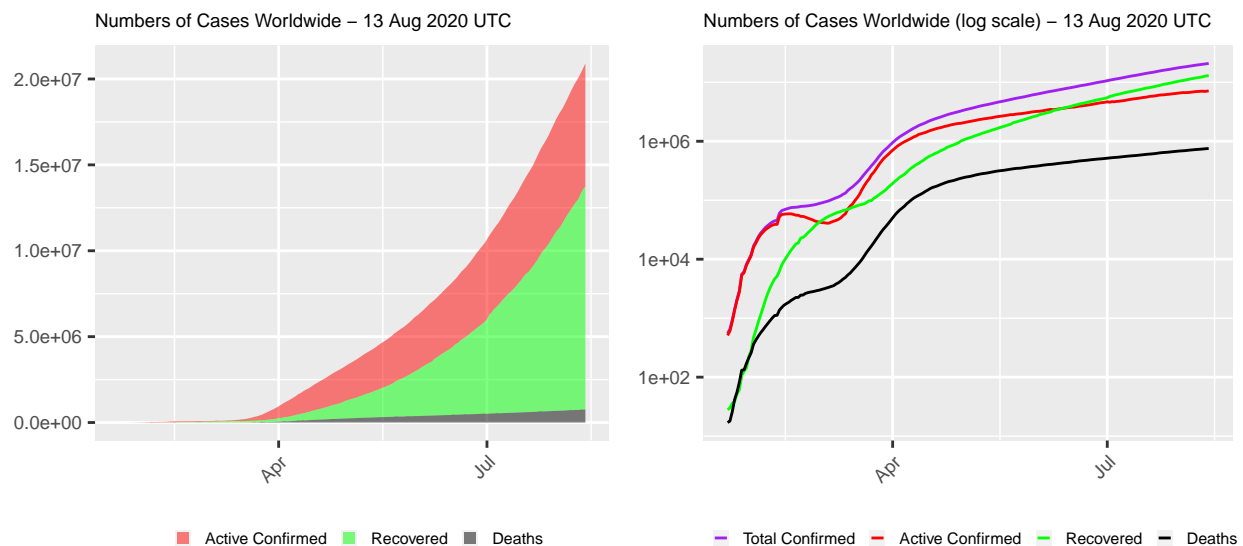


Figure 2: COVID-19 Cases Worldwide

4.3 Active Confirmed Cases

```

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

## active confirmed and daily new confirmed
plot1 <- ggplot(data.world, aes(x=date, y=active.confirmed)) +
  geom_point() + geom_smooth() +
  xlab('') + ylab('Count') + labs(title='Active Confirmed Cases') +
  theme(axis.text.x=element_text(angle=45, hjust=1))
plot2 <- ggplot(data.world, aes(x=date, y=new.confirmed)) +

```



```
geom_point() + geom_smooth() +
xlab('') + ylab('Count') + labs(title='Daily New Confirmed Cases') +
theme(axis.text.x=element_text(angle=45, hjust=1))
## show two plots side by side
grid.arrange(plot1, plot2, ncol=2)
```

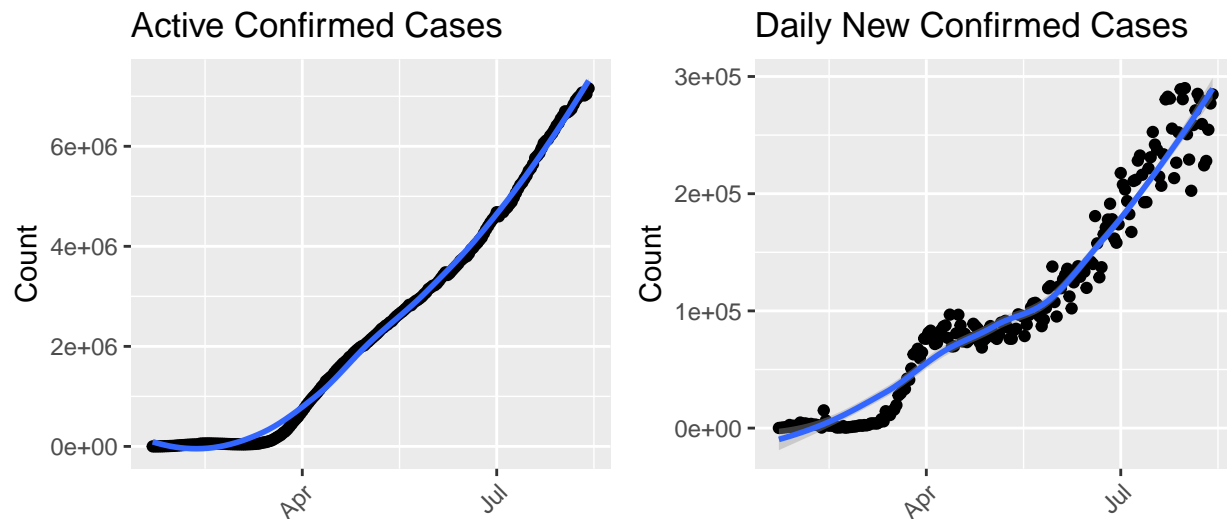


Figure 3: Active Confirmed Cases

Figure 3 shows the numbers of active (see left chart) and new (see right chart) confirmed cases. The blue lines are smoothed conditional means and the grey band around them show the 95% confidence interval.

4.4 Deaths and Recovered Cases

```
## a scatter plot with a smoothed line and vertical x-axis labels
plot1 <- ggplot(data.world, aes(x=date, y=deaths)) +
  geom_point() + geom_smooth() +
  xlab('') + ylab('Count') + labs(title='Accumulative Deaths') +
  theme(axis.text.x=element_text(angle=45, hjust=1))
plot2 <- ggplot(data.world, aes(x=date, y=recovered)) +
  geom_point() + geom_smooth() +
  xlab('') + ylab('Count') + labs(title='Accumulative Recovered Cases') +
  theme(axis.text.x=element_text(angle=45, hjust=1))
plot3 <- ggplot(data.world, aes(x=date, y=new.deaths)) +
  geom_point() + geom_smooth() +
  xlab('') + ylab('Count') + labs(title='New Deaths') +
  theme(axis.text.x=element_text(angle=45, hjust=1))
plot4 <- ggplot(data.world, aes(x=date, y=new.recovered)) +
  geom_point() + geom_smooth() +
  xlab('') + ylab('Count') + labs(title='New Recovered Cases') +
  theme(axis.text.x=element_text(angle=45, hjust=1))
## show four plots together, with 2 plots in each row
grid.arrange(plot1, plot2, plot3, plot4, nrow=2)
```

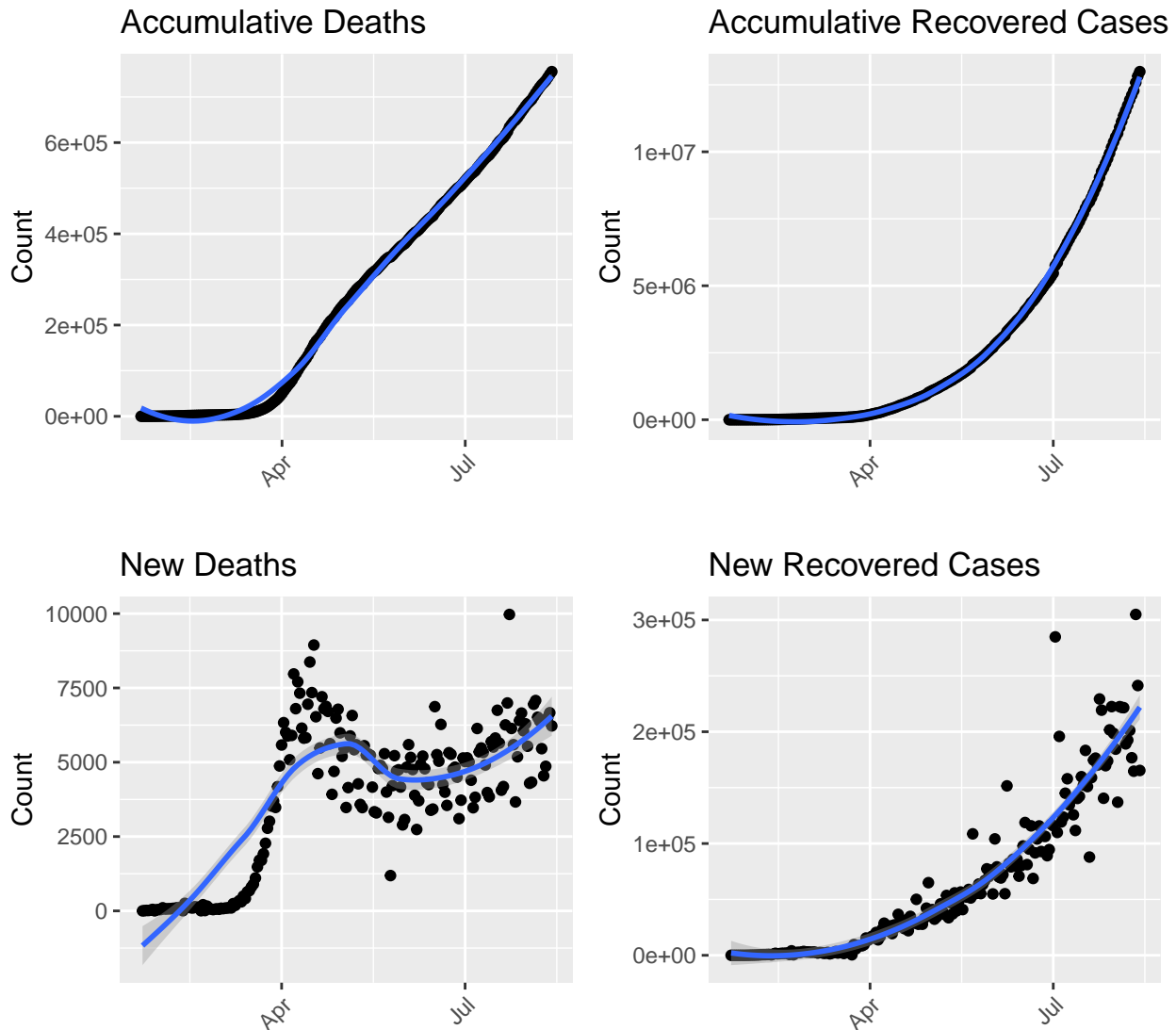


Figure 4: Deaths and Recovered Cases

4.5 Death Rates

Figure 5 shows death rates calculated in three different ways (see Section 3.3 for details). The left chart shows the death rates from 22 Jan 2020 to 13 Aug 2020 UTC and the right one is a zoom-in view of the rates in last two weeks.

In the right chart, the upper bound (in blue) is decreasing, as there will be more recovered cases and fewer dead ones daily as time goes on. However, the lower bound (in green) keeps going up, as there are and will be new deaths from the active confirmed cases. Therefore, the final death rate is expected to be in-between of those two rates, and based on the latest data retrieved as of 13 Aug 2020 UTC, it will be between 3.6% and 5.5%.

A surge in the daily death rate (in red) in late March suggests that the situation is changing dramatically (actually, getting worse) and that above lower/upper bounds are likely to increase shortly. A likely reason of that surge is the outbreak of coronavirus in Iran, Europe and US.

```
## three death rates
plot1 <- ggplot(data.world, aes(x=date)) +
```

```

geom_line(aes(y=rate.upper, colour='Upper bound')) +
geom_line(aes(y=rate.lower, colour='Lower bound')) +
geom_line(aes(y=rate.daily, colour='Daily')) +
xlab('') + ylab('Death Rate (%)') + labs(title='Overall') +
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, 99))
## focusing on last 2 weeks
# y.max <- data.world[n-(14:0), ] %>% select(rate.upper, rate.lower, rate.daily) %>% max()
plot2 <- ggplot(data.world[n-(14:0),], aes(x=date)) +
geom_line(aes(y=rate.upper, colour='Upper bound')) +
geom_line(aes(y=rate.lower, colour='Lower bound')) +
geom_line(aes(y=rate.daily, colour='Daily')) +
xlab('') + ylab('Death Rate (%)') + labs(title='Last two weeks') +
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, 20))
grid.arrange(plot1, plot2, ncol=2)

```

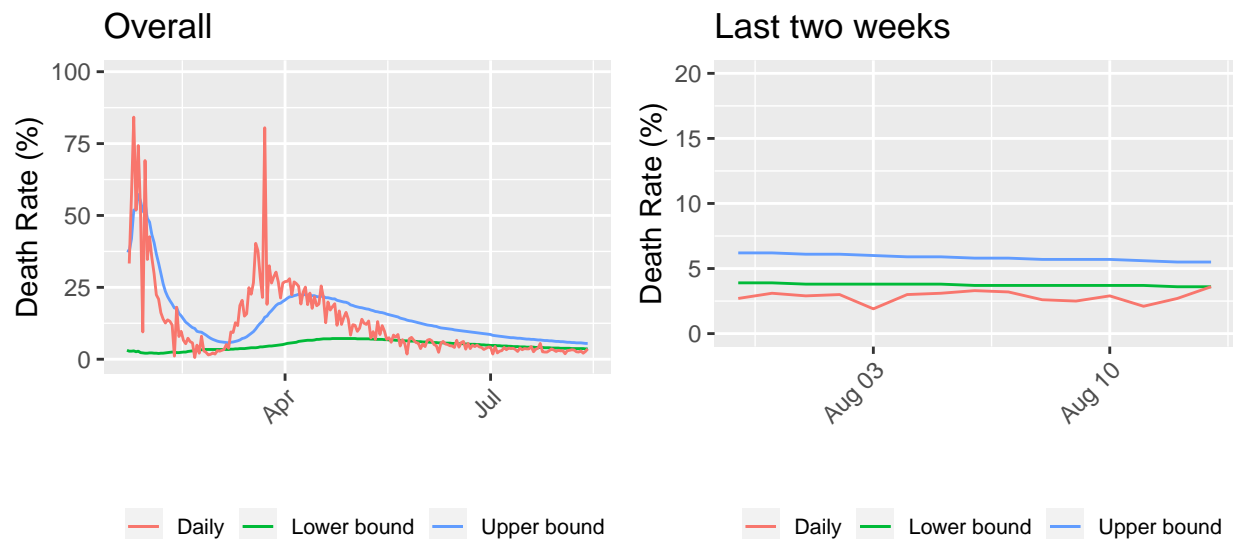


Figure 5: Death Rate

5 Top Twenty Countries

Next, we will have a look at the top 20 countries in total confirmed cases.

```

## ranking by confirmed cases
data.latest.all <- data %>% filter(date == max(date)) %>%
  select(country, date,
         confirmed, new.confirmed, active.confirmed,
         recovered, deaths, new.deaths, death.rate=rate.lower) %>%
  mutate(ranking = dense_rank(desc(confirmed)))

```

```

k <- 20
## top 20 countries: 21 incl. 'World'
top.countries <- data.latest.all %>% filter(ranking <= k + 1) %>%
  arrange(ranking) %>% pull(country) %>% as.character()
top.countries %>% setdiff('World') %>% print()

## [1] "US"           "Brazil"       "India"        "Russia"
## [5] "South Africa" "Mexico"       "Peru"         "Colombia"
## [9] "Chile"        "Spain"        "Iran"         "United Kingdom"
## [13] "Saudi Arabia" "Pakistan"     "Argentina"    "Bangladesh"
## [17] "Italy"        "Turkey"      "France"       "Germany"

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

data.latest %>% mutate(death.rate=death.rate %>% format(nsmall=1) %>% paste0('%')) %>%
  kable('latex', booktabs=T, row.names=T, align=c('l', rep('r', 6)),
    caption=paste0('Cases in Top 20 Countries - ', max.date.txt,
    '. See a complete list of all infected countries at the end of this report.'),
    format.args=list(big.mark=',')) %>%
  kable_styling(font_size=7, latex_options=c('striped', 'hold_position', 'repeat_header'))

## convert from wide to long format, for drawing area plots
data.latest.long <- data.latest %>% filter(country!='World') %>%
  gather(key=type, value=count, -country)
## set factor levels to show them with proper text and in a desirable order
data.latest.long %<>% mutate(type=recode_factor(type,
  confirmed='Total Confirmed',
  deaths='Total Deaths',
  death.rate='Death Rate (%)',
  new.confirmed='New Confirmed (compared with one day before)',
  new.deaths='New Deaths (compared with one day before)',
  active.confirmed='Active Confirmed'))

## 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_fill_discrete(name='Country', labels=aes(count)) +
  theme(legend.title=element_blank(),
    legend.position='none',
    plot.title=element_text(size=11),

```

Table 3: Cases in Top 20 Countries - 13 Aug 2020 UTC. See a complete list of all infected countries at the end of this report.

	country	confirmed	deaths	death.rate	new.confirmed	new.deaths	active.confirmed
1	World	20,905,891	755,589	3.6%	284,751	6,223	7,158,126
2	US	5,248,854	167,110	3.2%	51,443	1,076	3,307,096
3	Brazil	3,224,876	105,463	3.3%	60,091	1,262	598,313
4	India	2,461,190	48,040	2.0%	64,553	1,007	661,595
5	Russia	905,762	15,353	1.7%	5,017	122	175,475
6	South Africa	572,865	11,270	2.0%	3,946	260	123,978
7	Mexico	505,751	55,293	10.9%	7,371	627	43,875
8	Peru	498,555	21,713	4.4%	8,875	212	134,904
9	Colombia	433,805	14,145	3.3%	11,286	308	169,166
10	Chile	380,034	10,299	2.7%	1,866	94	16,604
11	Spain	337,334	28,605	8.5%	7,550	26	158,353
12	Iran	336,324	19,162	5.7%	2,625	174	25,104
13	United Kingdom	315,600	46,791	14.8%	19	0	267,330
14	Saudi Arabia	294,519	3,303	1.1%	1,482	34	30,823
15	Pakistan	286,674	6,139	2.1%	753	10	16,475
16	Argentina	276,072	5,362	1.9%	7,498	149	78,276
17	Bangladesh	269,115	3,557	1.3%	2,617	44	110,687
18	Italy	252,235	35,231	14.0%	522	6	14,081
19	Turkey	245,635	5,912	2.4%	1,243	21	11,666
20	France	244,096	30,392	12.5%	8	17	130,092
21	Germany	222,281	9,217	4.1%	1,422	4	13,410
22	Others	3,594,314	113,232	3.2%	44,580	770	1,070,823

```
axis.text=element_text(size=7),
axis.text.x=element_text(angle=45, hjust=1)) +
facet_wrap(~type, ncol=1, scales='free_y')
```

Top 20 Countries with Most Confirmed Cases – 13 Aug 2020 UTC

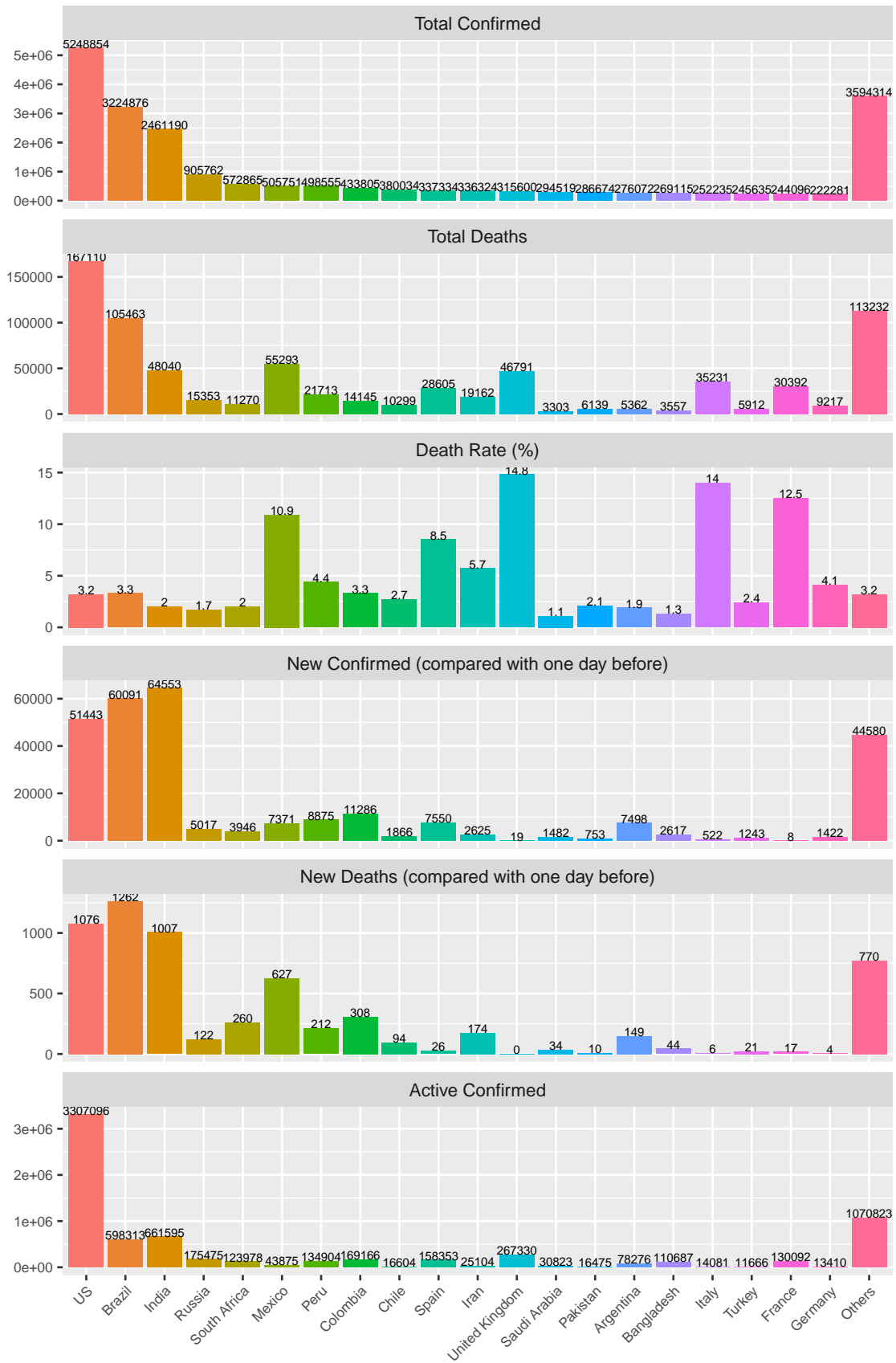
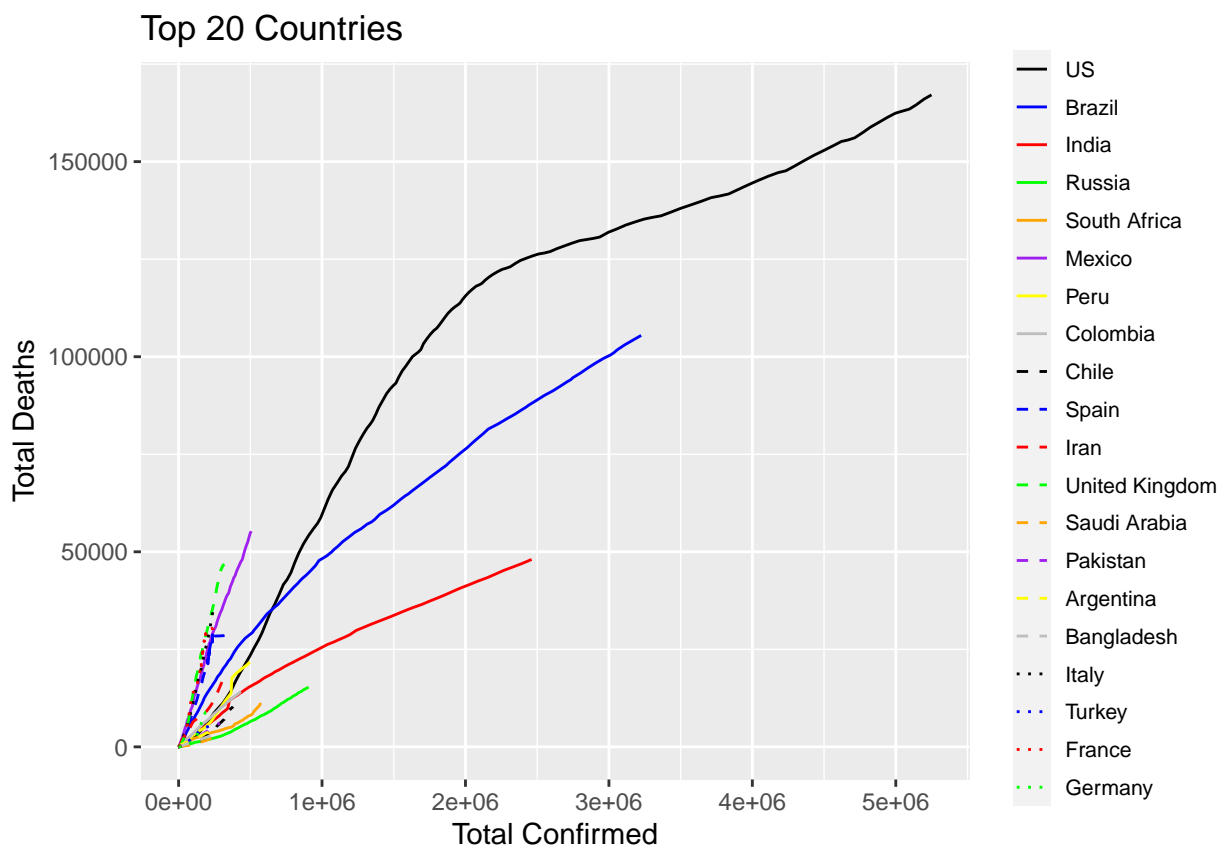


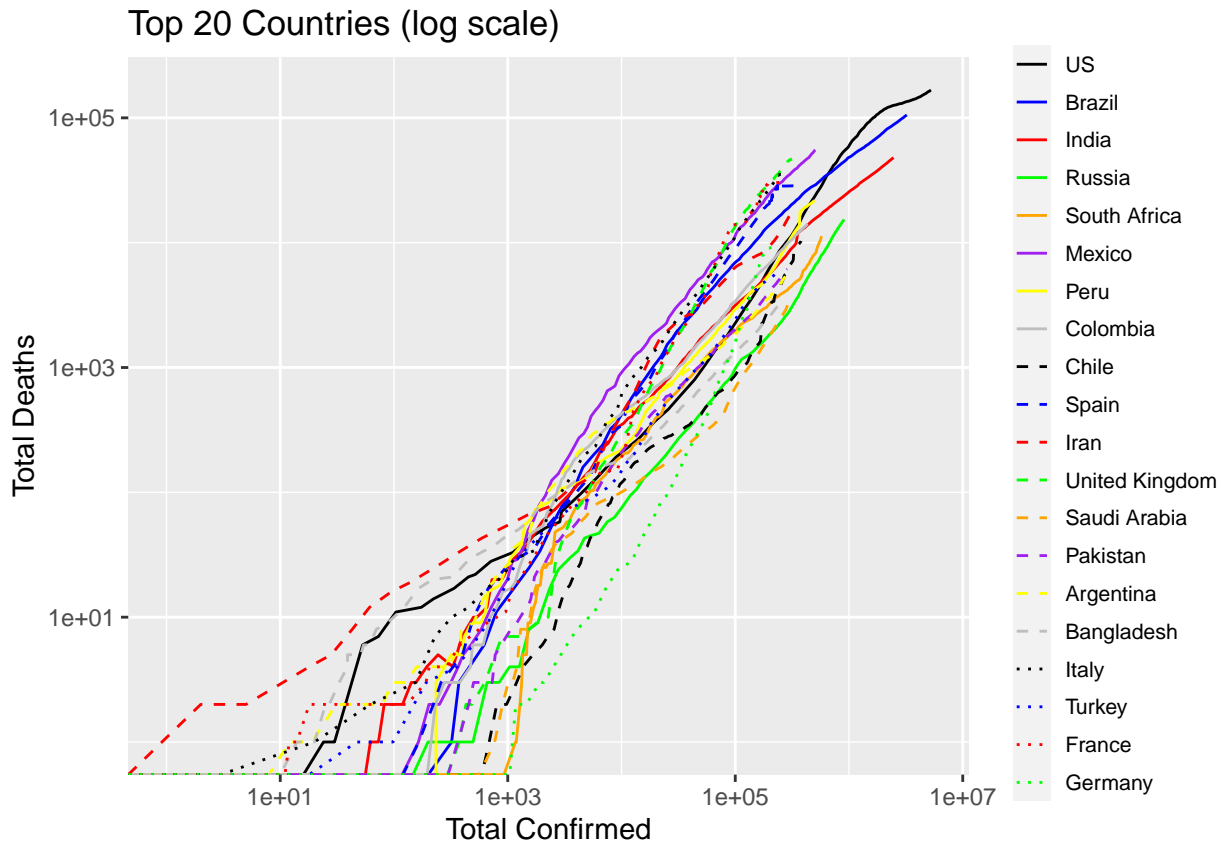
Figure 6: Top 20 Countries with Most Confirmed Cases

5.1 Confirmed vs Deaths

```
# linetypes <- rep(c("dotted", "dashed", "solid"), each=8)
# colors <- rep(c('grey', 'yellow', 'purple', 'orange', 'green', 'red', 'blue', 'black'), 3)
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')) %>%
  mutate(country=country %>% factor(levels=c(top.countries)))
p <- 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'))
p + labs(title=paste0('Top 20 Countries'))
```



```
p + scale_x_log10() + scale_y_log10() +
  labs(title=paste0('Top 20 Countries (log scale)'))
```



The two figures below show the numbers of confirmed cases and deaths of top 20 countries, as well as the death rates up to 13 Aug 2020 UTC.

```
df <- data.latest %>% filter(country %in% setdiff(top.countries, 'World'))
## breaks for circle size in legend; needs to be adjusted accordingly when the number of total confirmed
breaks.confirmed <- c(5e3, 1e4, 2e4, 5e4, 1e5, 2e5, 5e5, 1e6, 2e6, 5e6, 1e7)
```

```
plot1 <- df %>% ggplot(aes(x=confirmed, y=deaths, col=death.rate, size=active.confirmed)) +
  scale_size(name='Active Confirmed', trans='log2', breaks=breaks.confirmed) +
  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='#56B1F7', high='#132B43') +
  scale_x_log10() + scale_y_log10() +
  labs(title=paste0('Top 20 Countries - Confirmed vs Deaths (log scale)'))
```

```
plot2 <- df %>% ggplot(aes(x=new.confirmed, y=new.deaths, col=death.rate, size=active.confirmed)) +
  scale_size(name='Active Confirmed', trans='log2', breaks=breaks.confirmed) +
  geom_text(aes(label=country), size=2.5, check_overlap=T, vjust=-1.6) +
  geom_point() +
  xlab('New Confirmed') + ylab('New Deaths') +
  labs(col="Death Rate (%)") +
  scale_color_gradient(low='#56B1F7', high='#132B43') +
  scale_x_log10() + scale_y_log10() +
  labs(title=paste0('Top 20 Countries - New Confirmed vs New Deaths (log scale)'))
```



```
grid.arrange(plot1, plot2, ncol=1)
```

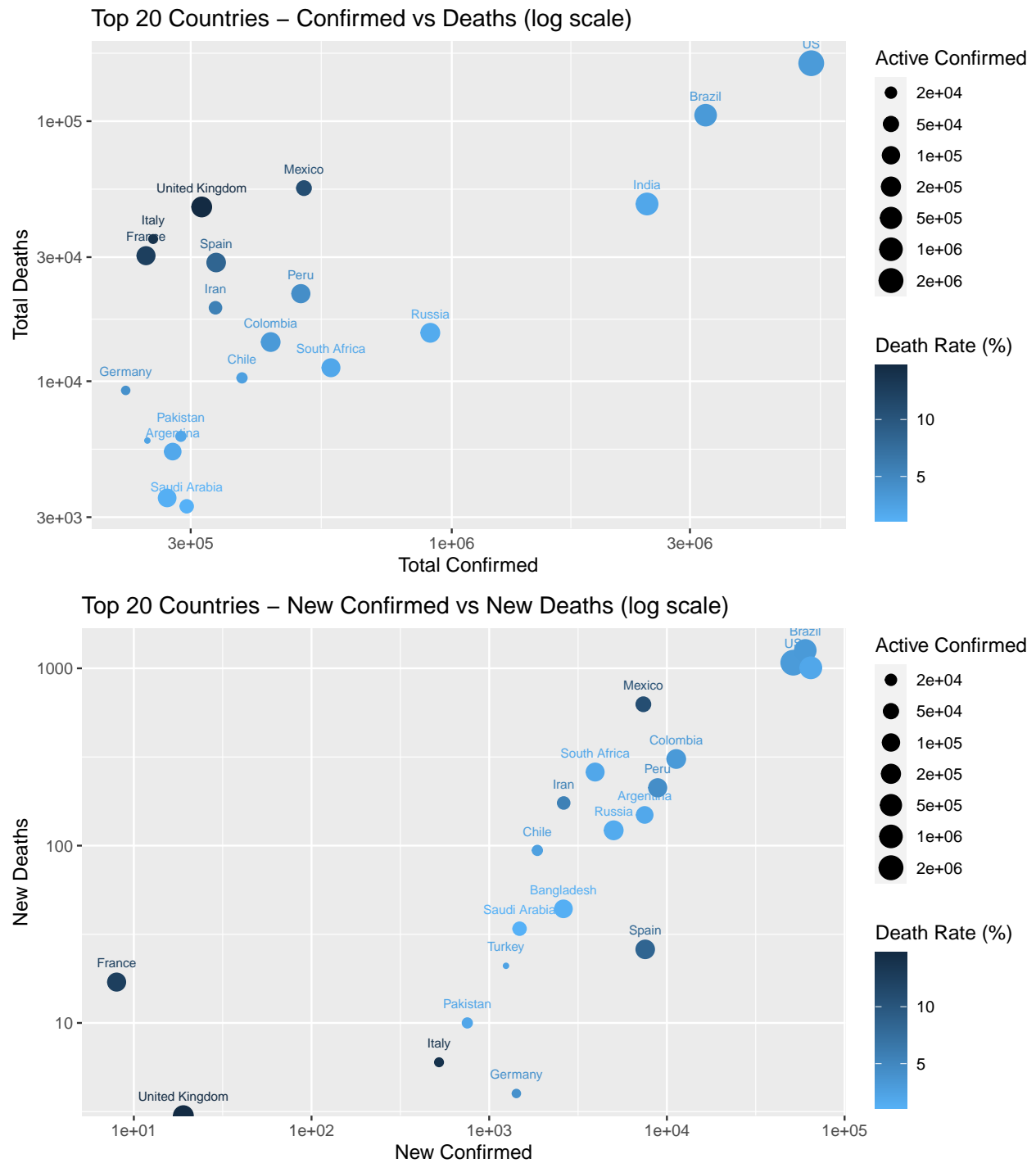


Figure 7: Top 20 Countries

5.2 Comparison across Countries

The area plots blow show the numbers of dead, recovered, total and active confirmed cases. Note that, in the area plot, the total number of total confirmed cases is represented by the total areas of active confirmed,

recovered and dead.

```
## plot: cases by type
df <- data.long %>% filter(country %in% top.countries) %<>%
  mutate(country=country %>% factor(levels=c(top.countries)))

p <- df %>% filter(country != 'World') %>%
  ggplot(aes(x=date, y=count)) + xlab('') + ylab('Count') +
  theme(legend.title=element_blank(),
        legend.text=element_text(size=8),
        legend.key.size=unit(0.5, 'cm'),
        plot.title=element_text(size=11),
        axis.text.x=element_text(angle=45, hjust=1)) +
  facet_wrap(~type, ncol=2, scales='free_y')

## area plot
plot1 <- p + geom_area(aes(fill=country)) +
  labs(title=paste0('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)
```

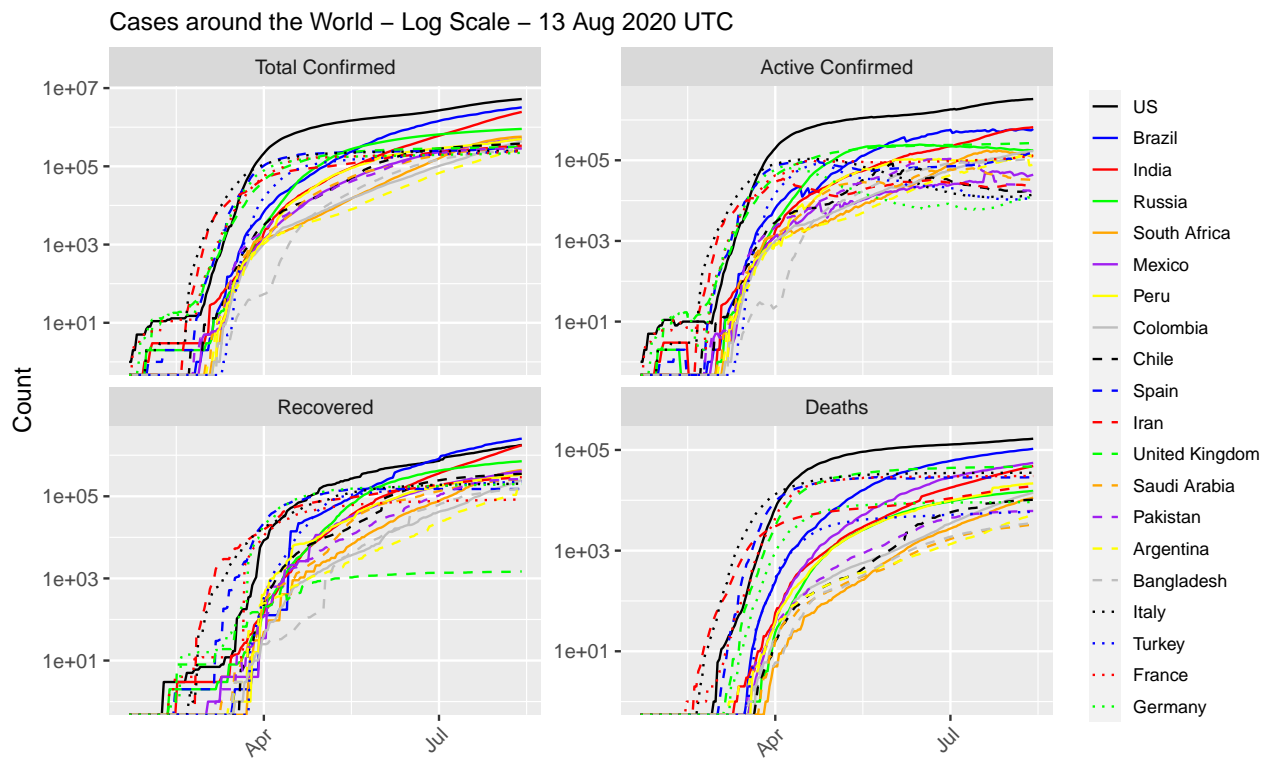
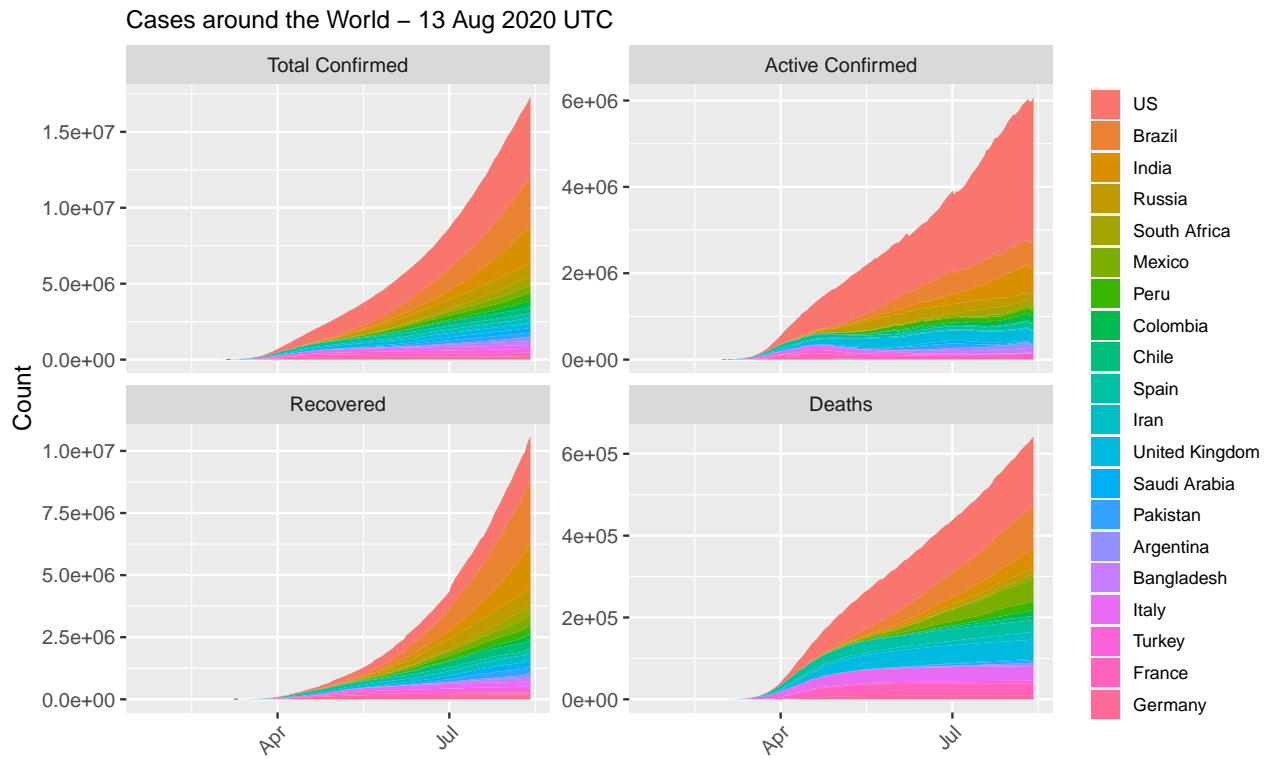


Figure 8: Cases around the World

```
## 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=8),
        legend.key.size=unit(0.5, 'cm'),
        plot.title=element_text(size=11),
        axis.text.x=element_text(angle=45, hjust=1)) +
  facet_wrap(~type, ncol=2, scales='free_y')
p + geom_area(aes(fill=country)) +
  labs(title=paste0('Cases around the World (excl. China) - ', max.date.txt))

```

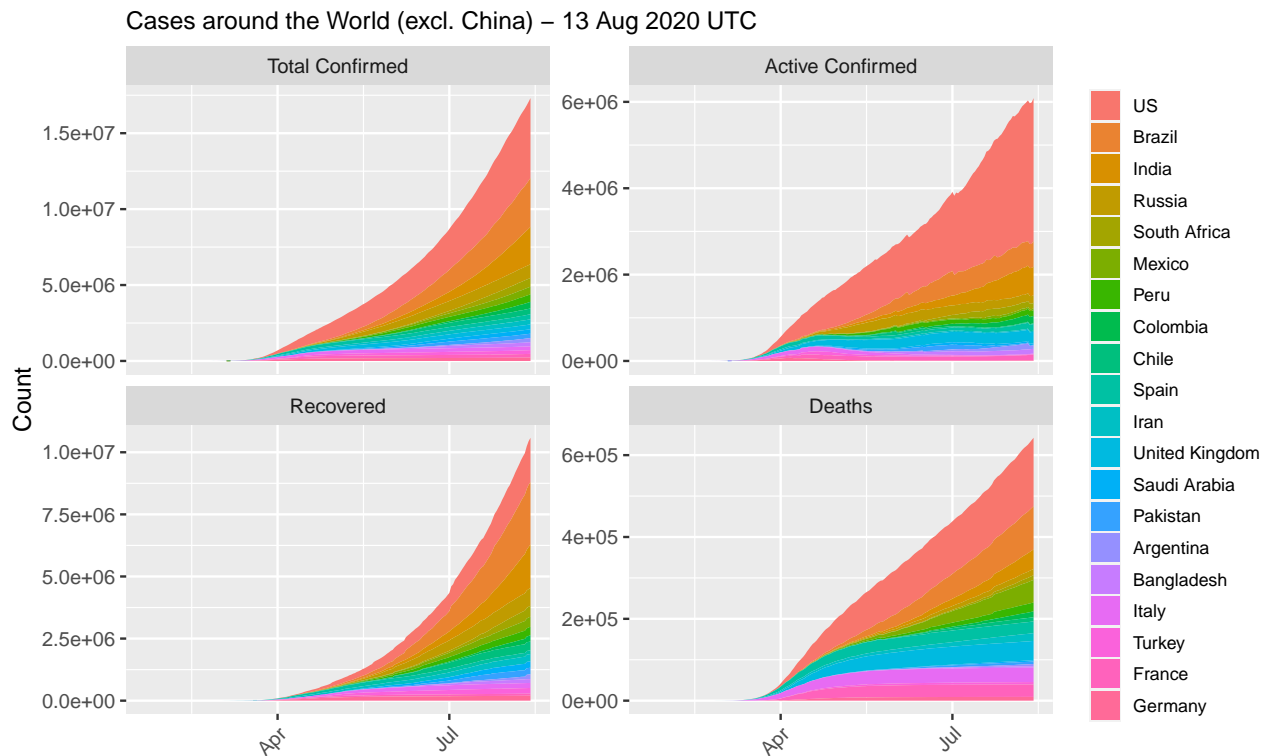


Figure 9: Cases around the World (excl. China)

```

## remove 'Others'
top.countries %<>% setdiff('Others')
## if China or Australia not in top 20, add them in
if(!('China' %in% top.countries)) {
  top.countries %<>% c('China')
}
if(!('Australia' %in% top.countries)) {
  top.countries %<>% c('Australia')
}
df <- data.long %>% filter(country %in% top.countries) %<>%
  mutate(country=country %>% factor(levels=c(top.countries)))

## cases by country - area plot
df %>% filter(country != 'World' & type != 'Total Confirmed') %>%
  ggplot(aes(x=date, y=count, fill=type)) +
  geom_area(alpha=0.5) +

```

```

# xlab('') + ylab('') +
labs(title=paste0('Numbers of COVID-19 Cases in Top 20 Countries - ',
                  max.date.txt)) +
scale_fill_manual(values=c('red', 'green', 'black')) +
theme(legend.title=element_blank(), legend.position='bottom',
      plot.title = element_text(size=12),
      axis.title.x=element_blank(),
      axis.title.y=element_blank(),
      legend.key.size=unit(0.4, 'cm'),
      # legend.text=element_text(size=7),
      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, scales='free_y')

```

Numbers of COVID-19 Cases in Top 20 Countries – 13 Aug 2020 UTC

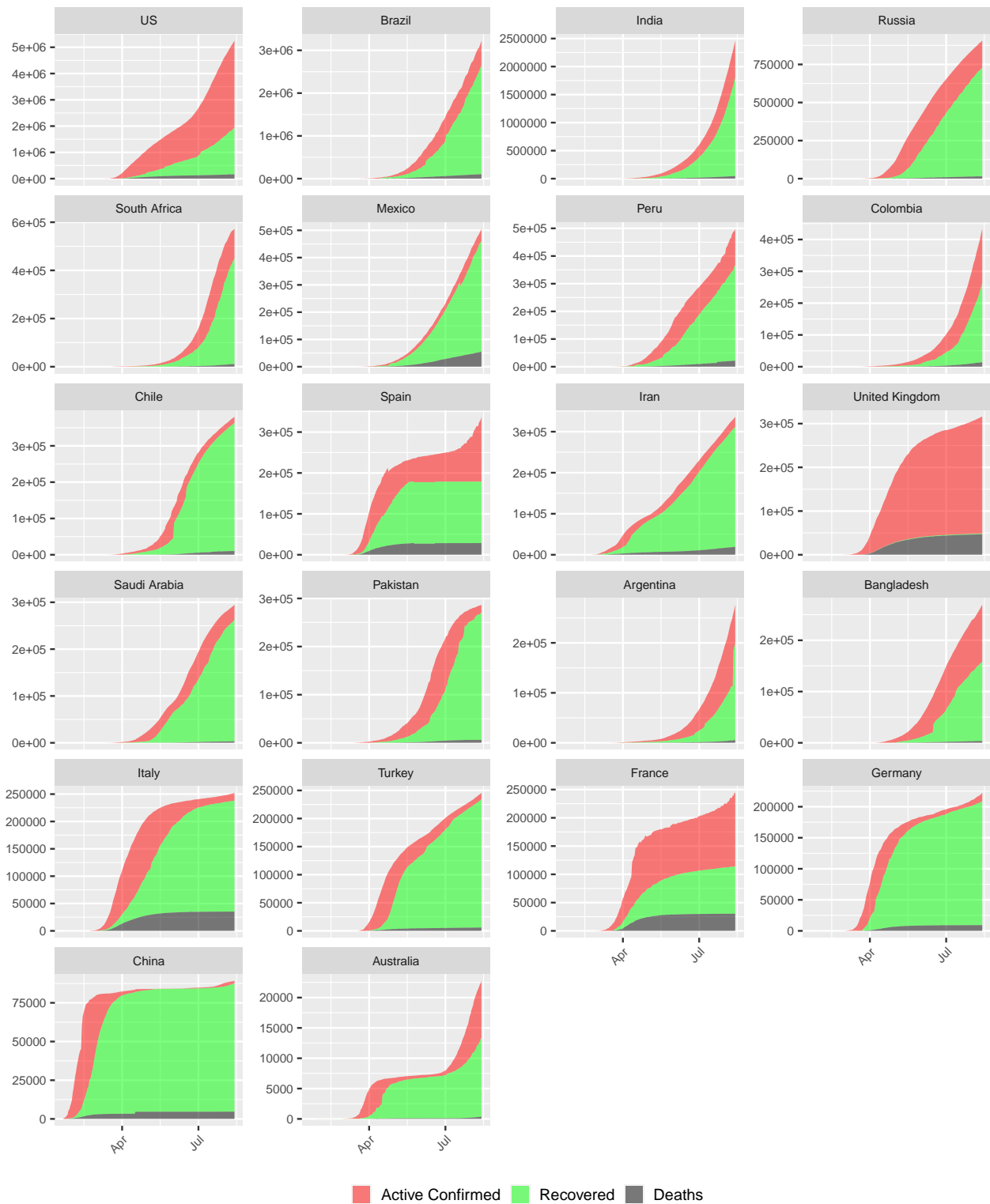


Figure 10: COVID-19 Cases in Top 20 Countries. Ordered descendingly by number of confirmed cases.

```

## cases by country - line plot - log scale
p <- df %>% filter(country != 'World') %>%
  ggplot(aes(x=date, y=count, color=type)) +
  geom_line() +
  labs(title=paste0('Numbers of COVID-19 Cases in Top 20 Countries (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=12),
        axis.title.x=element_blank(),
        axis.title.y=element_blank(),
        legend.key.size=unit(0.4, 'cm'),
        # legend.text=element_text(size=7),
        strip.text.x=element_text(size=7),
        axis.text=element_text(size=7),
        axis.text.x=element_text(angle=45, hjust=1)) +
  scale_y_continuous(trans='log10')
p + facet_wrap(~country, ncol=4, scales='free_y')

```

Numbers of COVID-19 Cases in Top 20 Countries (log scale) – 13 Aug 2020 UTC

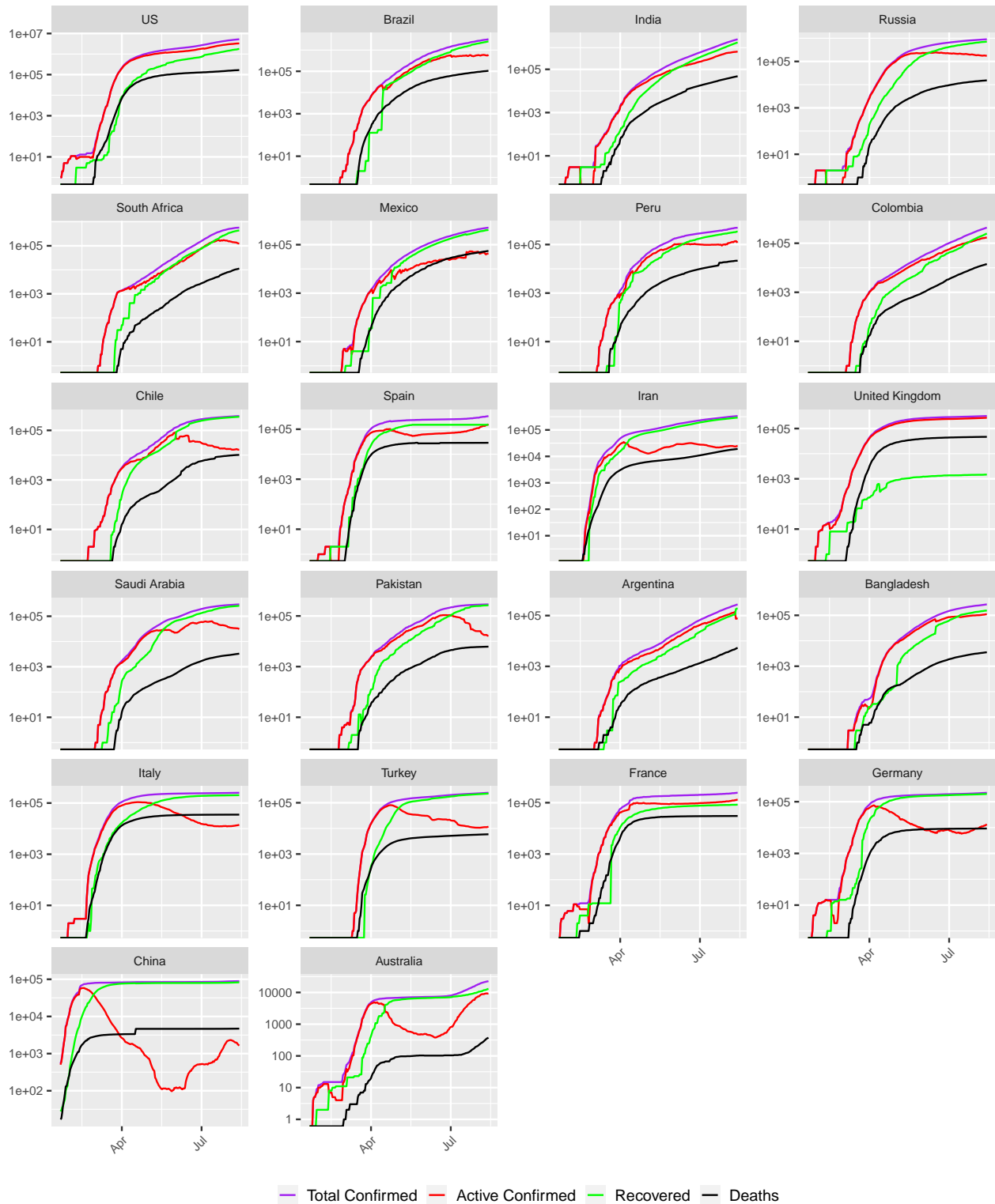


Figure 11: COVID-19 Cases Top 20 Countries (log scale). Ordered descendingly by number of confirmed cases.


```
## plot over multiple pages
# p + facet_wrap_paginate(~country, nrow=4, ncol=3, page=1, scales='free_y')
# p + facet_wrap_paginate(~country, nrow=4, ncol=3, page=2, scales='free_y')
```

Figures 10 and 11 show that China has entered a post-epidemic phase, followed by Australia and Germany, with an increase of recovered cases (in green) every day and a shrinking of the active confirmed cases (in red). In contrast, there are sharp surges in Russia, South America (incl. Brazil, Peru, Chile and Mexico) and West/South Asia (incl. Saudi Arabia, India and Pakistan), which suggests that the virus spread is accelerating there.

5.3 Death Rates

```
## three death rates
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, 99)) +
  facet_wrap(~country, ncol=4)
```

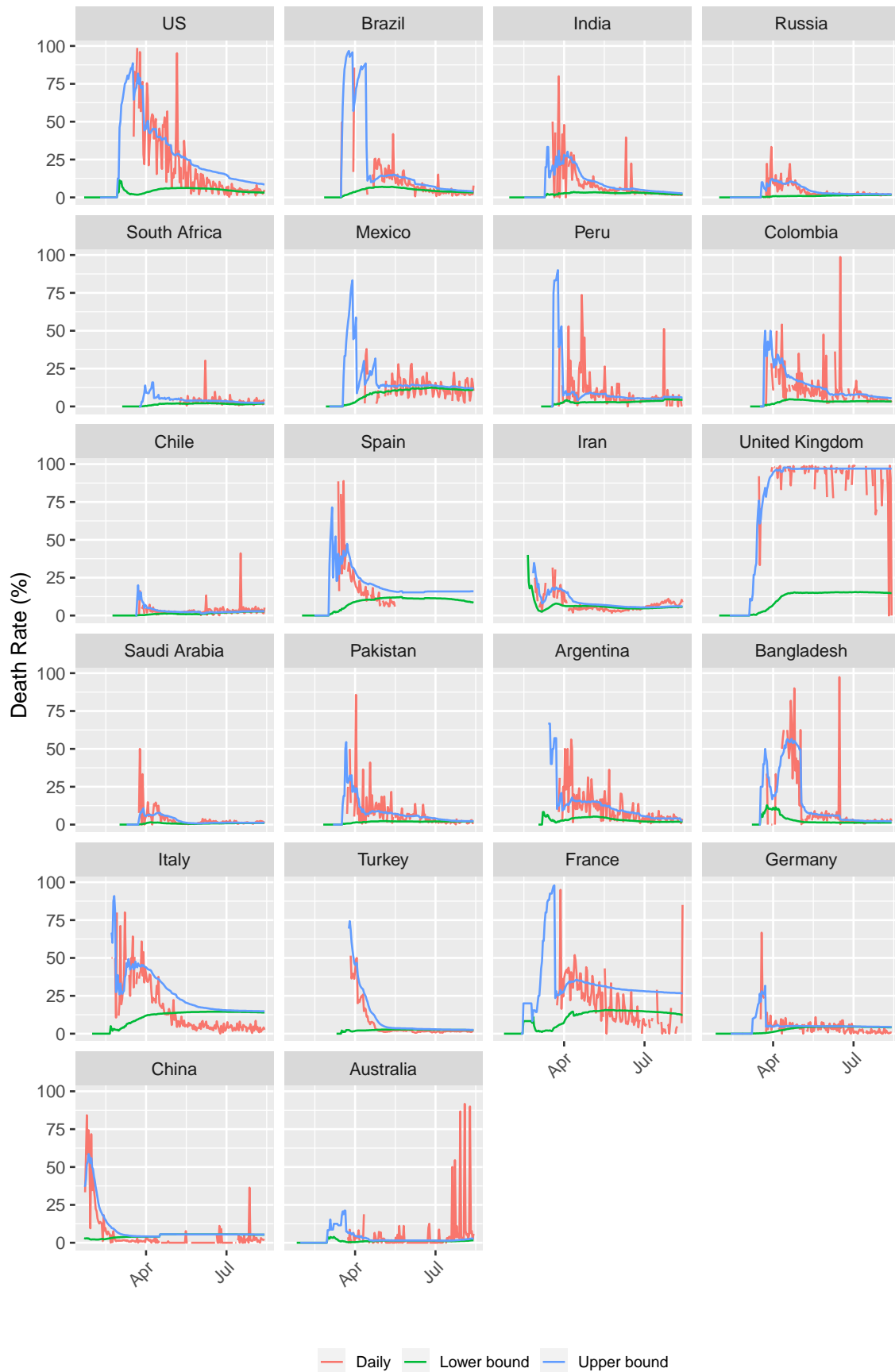


Figure 12: Death Rates

5.4 Countries with Highest Death Rates

Below are a list of top 20 countries with the highest death rates out of countries having 2000+ confirmed cases.

```
## sort the latest data by death rate, and if tie, by confirmed
df <- data %>% filter(date == max(date) & country != 'World' & confirmed >= 2000) %>%
  select(country, confirmed, new.confirmed, active.confirmed,
         recovered, deaths, new.deaths, 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.args=list(big.mark=',')) %>%
  kable_styling(font_size=7, latex_options=c('striped', 'hold_position', 'repeat_header'))
```

Table 4: Top 20 Countries with Highest Death Rates - 13 Aug 2020 UTC

	country	confirmed	new.confirmed	active.confirmed	recovered	deaths	new.deaths	death.rate
1	United Kingdom	315,600	19	267,330	1,479	46,791	0	14.8%
2	Italy	252,235	522	14,081	202,923	35,231	6	14.0%
3	Belgium	76,191	544	48,362	17,913	9,916	16	13.0%
4	Hungary	4,813	45	645	3,561	607	2	12.6%
5	France	244,096	8	130,092	83,612	30,392	17	12.5%
6	Mexico	505,751	7,371	43,875	406,583	55,293	627	10.9%
7	Netherlands	62,406	688	55,966	253	6,187	5	9.9%
8	Spain	337,334	7,550	158,353	150,376	28,605	26	8.5%
9	Canada	123,180	477	4,857	109,260	9,063	11	7.4%
10	Sweden	83,852	397	78,076	0	5,776	2	6.9%
11	Ireland	26,929	91	1,791	23,364	1,774	0	6.6%
12	Sudan	12,115	82	5,018	6,305	792	6	6.5%
13	Ecuador	98,343	1,233	13,376	78,957	6,010	26	6.1%
14	Iran	336,324	2,625	25,104	292,058	19,162	174	5.7%
15	Slovenia	2,332	29	243	1,960	129	0	5.5%
16	China	89,144	99	1,640	82,804	4,700	3	5.3%
17	Egypt	96,108	145	34,111	56,890	5,107	22	5.3%
18	Switzerland	37,403	234	2,712	32,700	1,991	0	5.3%
19	Mali	2,597	15	493	1,979	125	0	4.8%
20	Indonesia	132,816	2,098	39,290	87,558	5,968	65	4.5%

6 Conclusions

As of 13 Aug 2020 UTC, there are 188 countries with confirmed COVID-19 cases. It seems to be contained in China, but starts to break out in rest of the world. The current death rate is in between 3.6% and 5.5%, but it is likely to change dramatically with the breakout in many countries, such as European countries.

Appendix A. Processed Data

Blow is the processed data for this analysis.

Appendix A.1 COVID-19 Cases Worldwide

```
## sort by date descendingly and re-order columns
data.world %<>% arrange(desc(date)) %>%
```

```

select(c(date, confirmed, deaths, recovered, active.confirmed,
        new.confirmed, new.deaths, new.recovered, rate.lower, rate.upper, rate.daily))
## output as a table
data.world %>%
  mutate(rate.upper = rate.upper %>% format(nsmall=1) %>% paste0('\\%'),
         rate.lower = rate.lower %>% format(nsmall=1) %>% paste0('\\%'),
         rate.daily = rate.daily %>% format(nsmall=1) %>% paste0('\\%')) %>%
  kable('latex', escape=F, booktabs=T, longtable=T,
        caption='Cases in the Whole World',
        format.args=list(big.mark=','),
        align=c('l', rep('r', 10))) %>%
  kable_styling(font_size=4, latex_options=c('striped', 'hold_position', 'repeat_header'))

```

Table 5: Cases in the Whole World

date	confirmed	deaths	recovered	active.confirmed	new.confirmed	new.deaths	new.recovered	rate.lower	rate.upper	rate.daily
2020-08-13	20,905,891	755,589	12,992,176	7,158,126	284,751	6,223	165,361	3.6%	5.5%	3.6%
2020-08-12	20,621,140	749,366	12,826,815	7,044,959	276,952	6,666	241,342	3.6%	5.5%	2.7%
2020-08-11	20,344,188	742,700	12,585,473	7,016,015	254,564	6,509	304,953	3.7%	5.6%	2.1%
2020-08-10	20,089,624	736,191	12,280,520	7,072,913	227,941	4,865	164,695	3.7%	5.7%	2.9%
2020-08-09	19,861,683	731,326	12,115,825	7,014,532	224,177	4,545	176,716	3.7%	5.7%	2.5%
2020-08-08	19,637,506	726,781	11,939,109	6,971,616	259,470	5,457	201,182	3.7%	5.7%	2.6%
2020-08-07	19,378,036	721,324	11,737,927	6,918,785	280,887	6,384	192,526	3.7%	5.8%	3.2%
2020-08-06	19,097,149	714,940	11,545,401	6,836,808	285,196	6,516	189,126	3.7%	5.8%	3.3%
2020-08-05	18,811,953	708,424	11,356,275	6,747,254	271,164	7,077	221,540	3.8%	5.9%	3.1%
2020-08-04	18,540,789	701,347	11,134,735	6,704,707	258,581	6,951	221,735	3.8%	5.9%	3.0%
2020-08-03	18,282,208	694,396	10,913,000	6,674,812	202,485	4,331	222,445	3.8%	6.0%	1.9%
2020-08-02	18,079,723	690,065	10,690,555	6,699,103	229,106	4,292	136,970	3.8%	6.1%	3.0%
2020-08-01	17,850,617	685,773	10,553,585	6,611,259	250,712	5,539	184,445	3.8%	6.1%	2.9%
2020-07-31	17,599,905	680,234	10,369,140	6,550,531	290,100	6,293	198,490	3.9%	6.2%	3.1%
2020-07-30	17,309,805	673,941	10,170,650	6,465,214	167,369	6,057	222,487	3.9%	6.2%	2.7%
2020-07-29	17,029,155	667,884	9,948,163	6,413,108	289,149	6,654	201,690	3.9%	6.3%	3.2%
2020-07-28	16,740,006	661,230	9,746,473	6,332,303	252,337	6,405	173,854	3.9%	6.4%	3.6%
2020-07-27	16,487,669	654,825	9,572,619	6,260,225	220,454	5,183	169,623	4.0%	6.4%	3.0%
2020-07-26	16,261,215	649,642	9,402,996	6,208,577	213,280	3,665	140,476	4.0%	6.5%	2.5%
2020-07-25	16,047,935	645,977	9,262,520	6,139,438	255,545	5,592	219,317	4.0%	6.5%	2.5%
2020-07-24	15,792,390	640,385	9,043,203	6,108,802	281,165	6,137	229,317	4.1%	6.6%	2.6%
2020-07-23	15,511,225	634,248	8,813,886	6,063,091	282,756	9,973	170,164	4.1%	6.7%	5.5%
2020-07-22	15,228,469	624,275	8,643,722	5,960,472	280,479	6,994	176,387	4.1%	6.7%	3.8%
2020-07-21	14,947,990	617,281	8,467,335	5,863,374	233,623	6,256	174,647	4.1%	6.8%	3.5%
2020-07-20	14,714,367	611,025	8,292,688	5,810,654	206,778	4,183	158,996	4.2%	6.9%	2.6%
2020-07-19	14,507,589	606,842	8,133,692	5,767,055	214,647	4,059	87,877	4.2%	6.9%	4.4%
2020-07-18	14,292,942	602,783	8,045,815	5,644,344	237,635	5,644	150,957	4.2%	7.0%	3.6%
2020-07-17	14,055,307	597,139	7,894,858	5,563,310	241,907	6,749	183,310	4.2%	7.0%	3.6%
2020-07-16	13,813,400	590,390	7,711,548	5,511,462	252,673	5,815	152,370	4.3%	7.1%	3.7%
2020-07-15	13,560,727	584,575	7,559,178	5,416,974	231,119	5,512	159,781	4.3%	7.2%	3.3%
2020-07-14	13,329,608	579,063	7,399,397	5,351,148	221,639	5,694	142,200	4.3%	7.3%	3.9%
2020-07-13	13,107,969	573,369	7,257,197	5,277,403	192,808	3,838	140,344	4.4%	7.3%	2.7%
2020-07-12	12,915,161	569,531	7,116,853	5,228,777	192,655	3,980	111,679	4.4%	7.4%	3.4%
2020-07-11	12,722,506	565,551	7,005,174	5,151,781	216,125	4,908	125,709	4.4%	7.5%	3.8%
2020-07-10	12,506,381	560,643	6,879,465	5,066,273	232,577	5,330	139,392	4.5%	7.5%	3.7%
2020-07-09	12,273,804	555,313	6,740,073	4,978,418	228,227	5,480	134,514	4.5%	7.6%	3.9%
2020-07-08	12,045,577	549,833	6,605,559	4,890,185	211,802	5,349	157,949	4.6%	7.7%	3.3%
2020-07-07	11,833,775	544,484	6,447,610	4,841,681	210,844	6,136	145,025	4.6%	7.8%	4.1%
2020-07-06	11,622,931	538,348	6,302,585	4,781,998	167,343	3,823	123,612	4.6%	7.9%	3.0%
2020-07-05	11,455,588	534,525	6,178,973	4,742,090	182,581	3,470	119,322	4.7%	8.0%	2.8%
2020-07-04	11,273,007	531,055	6,059,651	4,682,301	193,681	4,396	195,833	4.7%	8.1%	2.2%
2020-07-03	11,079,326	526,659	5,863,818	4,688,849	203,567	5,010	109,900	4.8%	8.2%	4.4%
2020-07-02	10,875,759	521,649	5,753,918	4,600,192	207,745	5,148	284,877	4.8%	8.3%	1.8%
2020-07-01	10,668,014	516,501	5,469,041	4,682,472	217,655	5,024	115,926	4.8%	8.6%	4.2%
2020-06-30	10,450,359	511,477	5,353,115	4,585,767	173,819	5,144	117,322	4.9%	8.7%	4.2%
2020-06-29	10,276,540	506,333	5,235,793	4,534,414	158,151	3,724	94,566	4.9%	8.8%	3.8%
2020-06-28	10,118,389	502,609	5,141,227	4,474,553	161,726	3,103	89,120	5.0%	8.9%	3.4%
2020-06-27	9,956,663	499,506	5,052,107	4,405,050	178,172	4,499	106,365	5.0%	9.0%	4.1%
2020-06-26	9,778,491	495,007	4,945,742	4,337,742	191,415	4,836	106,714	5.1%	9.1%	4.3%
2020-06-25	9,587,076	490,171	4,839,028	4,257,877	177,982	4,766	92,856	5.1%	9.2%	4.9%
2020-06-24	9,409,094	485,405	4,746,172	4,177,517	171,235	5,269	115,760	5.2%	9.3%	4.4%
2020-06-23	9,237,859	480,136	4,630,412	4,127,311	165,385	5,322	104,075	5.2%	9.4%	4.9%
2020-06-22	9,072,474	474,814	4,526,337	4,071,323	137,271	3,549	91,626	5.2%	9.5%	3.7%
2020-06-21	8,935,203	471,265	4,434,711	4,029,227	128,614	3,993	68,737	5.3%	9.6%	5.5%
2020-06-20	8,806,589	467,272	4,365,974	3,973,343	157,634	4,252	115,825	5.3%	9.7%	3.5%
2020-06-19	8,648,955	463,020	4,250,149	3,935,786	180,889	6,273	95,015	5.4%	9.8%	6.2%
2020-06-18	8,468,066	456,747	4,155,134	3,856,185	140,005	5,035	81,142	5.4%	9.9%	5.8%
2020-06-17	8,328,061	451,712	4,073,992	3,802,357	141,994	5,257	118,787	5.4%	10.0%	4.2%
2020-06-16	8,186,067	446,455	3,955,205	3,784,407	141,532	6,871	97,840	5.5%	10.1%	6.6%
2020-06-15	8,044,535	439,584	3,857,365	3,747,586	119,638	3,425	80,208	5.5%	10.2%	4.1%
2020-06-14	7,924,897	436,159	3,777,157	3,711,581	133,474	3,385	70,785	5.5%	10.4%	4.6%
2020-06-13	7,791,423	432,774	3,706,372	3,652,277	135,957	4,250	85,934	5.6%	10.5%	4.7%
2020-06-12	7,655,466	428,524	3,620,438	3,606,504	129,122	4,307	79,724	5.6%	10.6%	5.1%
2020-06-11	7,526,344	424,217	3,540,714	3,561,413	138,115	4,781	85,882	5.6%	10.7%	5.3%
2020-06-10	7,388,229	419,436	3,454,832	3,513,961	133,996	5,206	79,138	5.7%	10.8%	6.2%
2020-06-09	7,254,233	414,230	3,375,694	3,464,309	124,371	4,927	82,282	5.7%	10.9%	5.6%

Table 5: Cases in the Whole World (continued)

date	confirmed	deaths	recovered	active.confirmed	new.confirmed	new.deaths	new.recovered	rate.lower	rate.upper	rate.daily
2020-06-08	7,129,862	409,303	3,293,412	3,427,147	102,144	3,705	151,563	5.7%	11.1%	2.4%
2020-06-07	7,027,718	405,598	3,141,849	3,480,271	112,295	2,738	55,101	5.8%	11.4%	4.7%
2020-06-06	6,915,423	402,860	3,086,748	3,425,815	135,953	3,888	72,204	5.8%	11.5%	5.1%
2020-06-05	6,779,470	398,972	3,014,544	3,365,954	130,868	4,755	69,159	5.9%	11.7%	6.4%
2020-06-04	6,648,602	394,217	2,945,385	3,309,000	126,956	5,163	70,053	5.9%	11.8%	6.9%
2020-06-03	6,521,646	389,054	2,875,332	3,257,260	119,323	5,593	79,104	6.0%	11.9%	6.6%
2020-06-02	6,402,323	383,461	2,796,228	3,222,634	120,837	4,833	104,123	6.0%	12.1%	4.4%
2020-06-01	6,281,486	378,628	2,692,105	3,210,753	95,209	3,073	54,897	6.0%	12.3%	5.3%
2020-05-31	6,186,277	375,555	2,637,208	3,173,514	107,558	2,893	76,320	6.1%	12.5%	3.7%
2020-05-30	6,078,719	372,662	2,560,888	3,145,169	137,829	4,166	70,453	6.1%	12.7%	5.6%
2020-05-29	5,940,890	368,496	2,490,435	3,081,959	121,171	4,747	77,346	6.2%	12.9%	5.8%
2020-05-28	5,819,719	363,749	2,413,089	3,042,881	119,314	4,711	66,857	6.3%	13.1%	6.6%
2020-05-27	5,700,405	359,038	2,346,232	2,995,135	102,600	5,222	63,393	6.3%	13.3%	7.6%
2020-05-26	5,597,805	353,816	2,282,839	2,961,150	92,522	4,213	55,214	6.3%	13.4%	7.1%
2020-05-25	5,505,283	349,603	2,227,625	2,928,055	86,963	1,188	63,723	6.4%	13.6%	1.8%
2020-05-24	5,418,320	348,415	2,163,902	2,906,003	95,326	3,146	55,440	6.4%	13.9%	5.4%
2020-05-23	5,322,994	345,269	2,108,462	2,869,263	105,289	3,998	54,971	6.5%	14.1%	6.8%
2020-05-22	5,217,705	341,271	2,053,491	2,822,943	106,900	5,288	108,651	6.5%	14.3%	4.6%
2020-05-21	5,110,805	335,983	1,944,840	2,829,982	106,334	4,797	51,265	6.6%	14.7%	8.6%
2020-05-20	5,004,471	331,186	1,893,575	2,779,710	103,029	4,896	58,928	6.6%	14.9%	7.7%
2020-05-19	4,901,442	326,290	1,834,647	2,740,505	96,393	4,788	52,105	6.7%	15.1%	8.4%
2020-05-18	4,805,409	321,502	1,782,542	2,701,005	88,291	3,297	52,921	6.7%	15.3%	5.9%
2020-05-17	4,716,758	318,205	1,729,621	2,668,932	78,521	3,335	40,907	6.7%	15.5%	7.5%
2020-05-16	4,638,237	314,870	1,688,714	2,634,653	95,422	4,164	56,592	6.8%	15.7%	6.9%
2020-05-15	4,542,815	310,706	1,632,122	2,599,987	96,367	5,235	48,008	6.8%	16.0%	9.8%
2020-05-14	4,446,448	305,471	1,584,114	2,556,863	97,088	5,277	39,716	6.9%	16.2%	11.7%
2020-05-13	4,349,360	300,194	1,544,398	2,504,768	84,776	5,241	55,856	6.9%	16.3%	8.6%
2020-05-12	4,264,584	294,953	1,488,542	2,481,089	83,575	5,557	37,021	6.9%	16.5%	13.1%
2020-05-11	4,181,009	289,396	1,451,521	2,440,092	76,241	3,475	46,994	6.9%	16.6%	6.9%
2020-05-10	4,104,768	285,921	1,404,527	2,414,320	76,246	3,581	33,594	7.0%	16.9%	9.6%
2020-05-09	4,028,522	282,340	1,370,933	2,375,249	85,846	4,274	53,550	7.0%	17.1%	7.4%
2020-05-08	3,942,676	278,066	1,317,383	2,347,227	91,518	5,589	36,550	7.1%	17.4%	13.3%
2020-05-07	3,851,158	272,477	1,280,833	2,297,848	89,085	5,425	39,468	7.1%	17.5%	12.1%
2020-05-06	3,762,073	267,052	1,241,365	2,253,656	90,023	6,574	46,006	7.1%	17.7%	12.5%
2020-05-05	3,672,050	260,478	1,195,359	2,216,213	79,992	5,886	36,540	7.1%	17.9%	13.9%
2020-05-04	3,592,058	254,592	1,158,819	2,178,647	76,101	4,148	34,087	7.1%	18.0%	10.8%
2020-05-03	3,515,957	250,444	1,124,732	2,140,781	77,618	3,478	32,316	7.1%	18.2%	9.7%
2020-05-02	3,438,339	246,966	1,092,416	2,098,957	81,676	5,461	40,879	7.2%	18.4%	11.8%
2020-05-01	3,356,663	241,505	1,051,537	2,063,621	87,055	5,199	38,253	7.2%	18.7%	12.0%
2020-04-30	3,269,608	236,306	1,013,284	2,020,018	83,683	5,990	64,966	7.2%	18.9%	8.4%
2020-04-29	3,185,925	230,316	948,318	2,007,291	77,047	6,783	42,182	7.2%	19.5%	13.9%
2020-04-28	3,108,878	223,533	906,136	1,979,209	75,306	6,486	33,271	7.2%	19.8%	16.3%
2020-04-27	3,033,572	217,047	872,865	1,943,660	68,719	4,691	27,769	7.2%	19.9%	14.5%
2020-04-26	2,964,853	212,356	845,096	1,907,401	72,943	3,920	28,605	7.2%	20.1%	12.1%
2020-04-25	2,891,910	208,436	816,491	1,866,983	84,938	5,624	27,779	7.2%	20.3%	16.8%
2020-04-24	2,806,972	202,812	788,712	1,815,448	86,945	6,711	50,051	7.2%	20.5%	11.8%
2020-04-23	2,720,027	196,101	738,661	1,785,265	89,000	6,881	28,780	7.2%	21.0%	19.3%
2020-04-22	2,631,027	189,220	709,881	1,731,926	76,786	6,800	30,425	7.2%	21.0%	18.3%
2020-04-21	2,554,241	182,420	679,456	1,692,365	75,281	7,204	34,843	7.1%	21.2%	17.1%
2020-04-20	2,478,960	175,216	644,613	1,659,131	73,353	5,479	21,990	7.1%	21.4%	19.9%
2020-04-19	2,405,607	169,737	622,623	1,613,247	80,504	4,617	31,655	7.1%	21.4%	12.7%
2020-04-18	2,325,103	165,120	590,968	1,569,015	73,958	6,531	23,919	7.1%	21.8%	21.4%
2020-04-17	2,251,145	158,589	567,049	1,525,507	87,719	8,944	26,123	7.0%	21.9%	25.5%
2020-04-16	2,163,426	149,645	540,926	1,472,855	96,686	7,343	30,820	6.9%	21.7%	19.2%
2020-04-15	2,066,740	142,302	510,106	1,414,332	80,839	8,372	36,670	6.9%	21.8%	18.6%
2020-04-14	1,985,901	133,930	473,436	1,378,535	69,838	6,952	25,089	6.7%	22.1%	21.7%
2020-04-13	1,916,063	126,978	448,347	1,340,738	69,673	5,825	27,167	6.6%	22.1%	17.7%
2020-04-12	1,846,390	121,153	421,180	1,304,057	96,815	5,810	19,414	6.6%	22.3%	23.0%
2020-04-11	1,749,575	115,343	401,766	1,232,466	76,955	6,147	26,257	6.6%	22.3%	19.0%
2020-04-10	1,672,620	109,196	375,509	1,187,915	87,595	7,324	21,802	6.5%	22.5%	25.1%
2020-04-09	1,585,025	101,872	353,707	1,129,446	86,665	7,706	25,348	6.4%	22.4%	23.3%
2020-04-08	1,498,360	94,166	328,359	1,075,835	83,780	6,802	28,716	6.3%	22.3%	19.2%
2020-04-07	1,414,580	87,364	299,643	1,027,573	76,868	7,971	23,391	6.2%	22.6%	25.4%
2020-04-06	1,337,712	79,393	276,252	982,067	72,677	5,903	16,580	5.9%	22.3%	26.3%
2020-04-05	1,265,035	73,490	259,672	931,873	71,713	5,084	13,840	5.8%	22.1%	26.9%
2020-04-04	1,193,322	68,406	245,832	879,084	80,463	5,884	20,417	5.7%	21.8%	22.4%
2020-04-03	1,112,859	62,522	225,415	824,922	83,155	6,007	15,448	5.6%	21.7%	28.0%
2020-04-02	1,029,704	56,515	209,967	763,222	81,414	6,332	17,049	5.5%	21.2%	27.1%
2020-04-01	948,290	50,183	192,918	705,189	76,214	5,581	15,093	5.3%	20.6%	27.0%
2020-03-31	872,076	44,602	177,825	649,649	76,410	4,875	13,488	5.1%	20.1%	26.5%
2020-03-30	795,666	39,727	164,337	591,602	64,642	4,178	15,446	5.0%	19.5%	21.3%
2020-03-29	731,024	35,549	148,891	546,584	59,577	3,480	9,467	4.9%	19.3%	26.9%
2020-03-28	671,447	32,069	139,424	499,954	67,656	3,699	8,503	4.8%	18.7%	30.3%
2020-03-27	603,791	28,370	130,921	444,500	64,400	3,527	8,776	4.7%	17.8%	28.7%
2020-03-26	539,391	24,843	122,145	392,403	62,897	3,015	8,370	4.6%	16.9%	26.5%
2020-03-25	476,494	21,828	113,775	340,891	50,819	2,781	5,783	4.6%	16.1%	32.5%
2020-03-24	425,675	19,047	107,992	298,636	41,167	2,275	9,641	4.5%	15.0%	19.1%
2020-03-23	384,508	16,772	98,351	269,385	42,167	1,922	466	4.4%	14.6%	80.5%
2020-03-22	342,341	14,850	97,885	229,606	33,420	1,701	6,215	4.3%	13.2%	21.5%
2020-03-21	308,921	13,149	91,670	204,102	32,309	1,707	4,267	4.3%	12.5%	28.6%
2020-03-20	276,612	11,442	87,403	177,767	29,610	1,480	2,445	4.1%	11.6%	37.7%
2020-03-19	247,002	9,962	84,958	152,082	27,919	1,107	1,637	4.0%	10.5%	40.3%
2020-03-18	219,083	8,855	83,321	126,907	19,596	899	2,483	4.0%	9.6%	26.6%
2020-03-17	199,487	7,956	80,838	110,693	15,847	805	2,752	4.0%	9.0%	22.6%
2020-03-16	183,640	7,151	78,086	98,403	14,667	680	2,054	3.9%	8.4%	24.9%
2020-03-15	168,973	6,471	76,032	86,470	11,149	641	3,410	3.8%	7.8%	15.8%
2020-03-14	157,824	5,830	72,622	79,372	11,108	417	2,371	3.7%	7.4%	15.0%
2020-03-13	146,716	5,413	70,251	71,052	14,407	497	1,927	3.7%	7.2%	20.5%
2020-03-12	132,309	4,916	68,324	59,069	5,750	305	1,322	3.7%	6.7%	18.7%

Table 5: Cases in the Whole World (continued)

date	confirmed	deaths	recovered	active.confirmed	new.confirmed	new.deaths	new.recovered	rate.lower	rate.upper	rate.daily
2020-03-11	126,559	4,611	67,002	54,946	7,663	345	2,598	3.6%	6.4%	11.7%
2020-03-10	118,896	4,266	64,404	50,226	5,024	279	1,911	3.6%	6.2%	12.7%
2020-03-09	113,872	3,987	62,493	47,392	3,900	184	1,799	3.5%	6.0%	9.3%
2020-03-08	109,972	3,803	60,694	45,475	3,954	244	2,335	3.5%	5.9%	9.5%
2020-03-07	106,018	3,559	58,359	44,100	4,038	99	2,494	3.4%	5.7%	3.8%
2020-03-06	101,980	3,460	55,865	42,655	3,943	112	2,069	3.4%	5.8%	5.1%
2020-03-05	98,037	3,348	53,796	40,893	2,791	93	2,626	3.4%	5.9%	3.4%
2020-03-04	95,246	3,255	51,170	40,821	2,299	95	2,942	3.4%	6.0%	3.1%
2020-03-03	92,947	3,160	48,228	41,559	2,578	75	2,626	3.4%	6.1%	2.8%
2020-03-02	90,369	3,085	45,602	41,682	1,974	89	2,886	3.4%	6.3%	3.0%
2020-03-01	88,395	2,996	42,716	42,683	2,384	54	2,934	3.4%	6.6%	1.8%
2020-02-29	86,011	2,942	39,782	43,287	1,895	69	3,071	3.4%	6.9%	2.2%
2020-02-28	84,116	2,873	36,711	44,532	1,377	59	3,434	3.4%	7.3%	1.7%
2020-02-27	82,739	2,814	33,277	46,648	1,364	43	2,893	3.4%	7.8%	1.5%
2020-02-26	81,375	2,771	30,384	48,220	977	61	2,479	3.4%	8.4%	2.4%
2020-02-25	80,398	2,710	27,905	49,783	853	80	2,678	3.4%	8.9%	2.9%
2020-02-24	79,545	2,630	25,227	51,688	564	160	1,833	3.3%	9.4%	8.0%
2020-02-23	78,981	2,470	23,394	53,117	380	11	508	3.1%	9.9%	2.1%
2020-02-22	78,601	2,459	22,886	53,256	1,761	207	3,996	3.1%	9.7%	4.9%
2020-02-21	76,840	2,252	18,890	55,698	629	4	713	2.9%	10.7%	0.6%
2020-02-20	76,211	2,248	18,177	55,786	560	125	2,056	2.9%	11.0%	5.7%
2020-02-19	75,651	2,123	16,121	57,407	500	115	1,769	2.8%	11.6%	6.1%
2020-02-18	75,151	2,008	14,352	58,791	1,882	140	1,769	2.7%	12.3%	7.3%
2020-02-17	73,269	1,868	12,583	58,818	2,035	98	1,718	2.5%	12.9%	5.4%
2020-02-16	71,234	1,770	10,865	58,599	2,184	104	1,470	2.5%	14.0%	6.6%
2020-02-15	69,050	1,666	9,395	57,989	2,142	143	1,337	2.4%	15.1%	9.7%
2020-02-14	66,908	1,523	8,058	57,327	6,527	152	1,763	2.3%	15.9%	7.9%
2020-02-13	60,381	1,371	6,295	52,715	15,153	253	1,145	2.3%	17.9%	18.1%
2020-02-12	45,228	1,118	5,150	38,960	418	5	467	2.5%	17.8%	1.1%
2020-02-11	44,810	1,113	4,683	39,014	2,042	100	737	2.5%	19.2%	11.9%
2020-02-10	42,768	1,013	3,946	37,809	2,609	107	702	2.4%	20.4%	13.2%
2020-02-09	40,159	906	3,244	36,009	3,030	100	628	2.3%	21.8%	13.7%
2020-02-08	37,129	806	2,616	33,707	2,734	87	605	2.2%	23.6%	12.6%
2020-02-07	34,395	719	2,011	31,665	3,593	85	524	2.1%	26.3%	14.0%
2020-02-06	30,802	634	1,487	28,681	3,159	70	363	2.1%	29.9%	16.2%
2020-02-05	27,643	564	1,124	25,955	3,745	72	272	2.0%	33.4%	20.9%
2020-02-04	23,898	492	852	22,554	4,011	66	229	2.1%	36.6%	22.4%
2020-02-03	19,887	426	623	18,838	3,100	64	151	2.1%	40.6%	29.8%
2020-02-02	16,787	362	472	15,953	4,749	103	188	2.2%	43.4%	35.4%
2020-02-01	12,038	259	284	11,495	2,111	46	62	2.2%	47.7%	42.6%
2020-01-31	9,927	213	222	9,492	1,693	42	79	2.1%	49.0%	34.7%
2020-01-30	8,234	171	143	7,920	2,068	38	17	2.1%	54.5%	69.1%
2020-01-29	6,166	133	126	5,907	588	2	19	2.2%	51.4%	9.5%
2020-01-28	5,578	131	107	5,340	2,651	49	46	2.3%	55.0%	51.6%
2020-01-27	2,927	82	61	2,784	809	26	9	2.8%	57.3%	74.3%
2020-01-26	2,118	56	52	2,010	684	14	13	2.6%	51.9%	51.9%
2020-01-25	1,434	42	39	1,353	493	16	3	2.9%	51.9%	84.2%
2020-01-24	941	26	36	879	287	8	6	2.8%	41.9%	57.1%
2020-01-23	654	18	30	606	99	1	2	2.8%	37.5%	33.3%
2020-01-22	555	17	28	510				3.1%	37.8%	NA%

Appendix A.2 Latest Cases by Country

```
## highlight high death rates (if >= 5%) for those countries with 2000+ confirmed cases
data.latest.all %>% arrange(desc(confirmed)) %>% select(-c(date, ranking)) %>%
  mutate(death.rate=ifelse(confirmed >= 2000 & death.rate >= 5,
    cell_spec(format(death.rate, big.mark=',') %>% paste0('%'),
      "latex", color="red", bold=T),
    cell_spec(format(death.rate, big.mark=',') %>% paste0('%'),
      "latex", color="black", bold=F))) %>%
  kable(format='latex', escape=F, booktabs=T, longtable=T, row.names=T,
    caption=paste0('Cases by Country (', max.date.txt, ')'),
    format.args=list(big.mark=','),
    align=c('l', rep('r', 7))) %>%
  kable_styling(font_size=6, latex_options=c('striped', 'hold_position', 'repeat_header'))
```

Table 6: Cases by Country (13 Aug 2020 UTC)

	country	confirmed	new.confirmed	active.confirmed	recovered	deaths	new.deaths	death.rate
1	World	20,905,891	284,751	7,158,126	12,992,176	755,589	6,223	3.6%
2	US	5,248,854	51,443	3,307,096	1,774,648	167,110	1,076	3.2%
3	Brazil	3,224,876	60,091	598,313	2,521,100	105,463	1,262	3.3%
4	India	2,461,190	64,553	661,595	1,751,555	48,040	1,007	2.0%

Table 6: Cases by Country (13 Aug 2020 UTC) (continued)

	country	confirmed	new.confirmed	active.confirmed	recovered	deaths	new.deaths	death.rate
5	Russia	905,762	5,017	175,475	714,934	15,353	122	1.7%
6	South Africa	572,865	3,946	123,978	437,617	11,270	260	2.0%
7	Mexico	505,751	7,371	43,875	406,583	55,293	627	10.9%
8	Peru	498,555	8,875	134,904	341,938	21,713	212	4.4%
9	Colombia	433,805	11,286	169,166	250,494	14,145	308	3.3%
10	Chile	380,034	1,866	16,604	353,131	10,299	94	2.7%
11	Spain	337,334	7,550	158,353	150,376	28,605	26	8.5%
12	Iran	336,324	2,625	25,104	292,058	19,162	174	5.7%
13	United Kingdom	315,600	19	267,330	1,479	46,791	0	14.8%
14	Saudi Arabia	294,519	1,482	30,823	260,393	3,303	34	1.1%
15	Pakistan	286,674	753	16,475	264,060	6,139	10	2.1%
16	Argentina	276,072	7,498	78,276	192,434	5,362	149	1.9%
17	Bangladesh	269,115	2,617	110,687	154,871	3,557	44	1.3%
18	Italy	252,235	522	14,081	202,923	35,231	6	14.0%
19	Turkey	245,635	1,243	11,666	228,057	5,912	21	2.4%
20	France	244,096	8	130,092	83,612	30,392	17	12.5%
21	Germany	222,281	1,422	13,410	199,654	9,217	4	4.1%
22	Iraq	164,277	3,841	41,428	117,208	5,641	53	3.4%
23	Philippines	147,526	3,777	74,713	70,387	2,426	22	1.6%
24	Indonesia	132,816	2,098	39,290	87,558	5,968	65	4.5%
25	Canada	123,180	477	4,857	109,260	9,063	11	7.4%
26	Qatar	114,281	343	3,134	110,957	190	0	0.2%
27	Kazakhstan	101,848	476	23,823	76,756	1,269	0	1.2%
28	Ecuador	98,343	1,233	13,376	78,957	6,010	26	6.1%
29	Bolivia	96,459	1,388	58,855	33,720	3,884	57	4.0%
30	Egypt	96,108	145	34,111	56,890	5,107	22	5.3%
31	Israel	89,822	1,671	24,425	64,746	651	12	0.7%
32	China	89,144	99	1,640	82,804	4,700	3	5.3%
33	Ukraine	88,136	1,632	38,435	47,678	2,023	24	2.3%
34	Sweden	83,852	397	78,076	0	5,776	2	6.9%
35	Dominican Republic	83,134	910	33,795	47,946	1,393	22	1.7%
36	Oman	82,531	232	4,702	77,278	551	12	0.7%
37	Panama	78,446	1,069	24,514	52,210	1,722	19	2.2%
38	Belgium	76,191	544	48,362	17,913	9,916	16	13.0%
39	Kuwait	74,486	701	7,898	66,099	489	0	0.7%
40	Belarus	69,203	101	2,426	66,178	599	4	0.9%
41	Romania	66,631	1,454	32,224	31,547	2,860	53	4.3%
42	United Arab Emirates	63,489	277	5,759	57,372	358	0	0.6%
43	Netherlands	62,406	688	55,966	253	6,187	5	9.9%
44	Guatemala	60,284	1,195	9,683	48,305	2,296	29	3.8%
45	Singapore	55,497	102	4,734	50,736	27	0	0.0%
46	Poland	54,487	811	14,682	37,961	1,844	14	3.4%
47	Portugal	53,548	325	12,601	39,177	1,770	6	3.3%
48	Japan	52,471	1,183	15,207	36,191	1,073	7	2.0%
49	Honduras	49,042	385	40,468	7,032	1,542	9	3.1%
50	Nigeria	48,116	373	12,841	34,309	966	10	2.0%
51	Bahrain	45,726	462	3,379	42,180	167	1	0.4%
52	Ghana	41,725	153	2,007	39,495	223	0	0.5%
53	Kyrgyzstan	41,069	310	6,294	33,288	1,487	3	3.6%
54	Armenia	41,023	229	6,317	33,897	809	3	2.0%
55	Morocco	37,935	1,241	10,664	26,687	584	28	1.5%
56	Afghanistan	37,424	79	9,347	26,714	1,363	9	3.6%
57	Switzerland	37,403	234	2,712	32,700	1,991	0	5.3%
58	Algeria	37,187	488	9,842	26,004	1,341	8	3.6%
59	Azerbaijan	33,915	91	2,146	31,269	500	3	1.5%
60	Uzbekistan	33,323	669	5,894	27,213	216	5	0.6%
61	Venezuela	30,369	1,281	8,725	21,385	259	12	0.9%
62	Moldova	29,087	390	7,933	20,276	878	15	3.0%
63	Serbia	28,998	247	28,337	0	661	3	2.3%
64	Kenya	28,754	650	13,194	15,100	460	4	1.6%
65	Ireland	26,929	91	1,791	23,364	1,774	0	6.6%
66	Ethiopia	26,204	1,086	14,297	11,428	479	16	1.8%
67	Costa Rica	26,129	1,072	17,445	8,412	272	9	1.0%
68	Nepal	24,957	525	8,025	16,837	95	4	0.4%
69	Australia	22,742	384	9,366	13,001	375	14	1.6%
70	Austria	22,594	155	1,523	20,346	725	1	3.2%
71	El Salvador	21,993	349	11,155	10,254	584	7	2.7%
72	Czechia	19,401	326	5,436	13,574	391	0	2.0%

Table 6: Cases by Country (13 Aug 2020 UTC) (continued)

	country	confirmed	new.confirmed	active.confirmed	recovered	deaths	new.deaths	death.rate
73	Cameroon	18,308	45	2,587	15,320	401	0	2.2%
74	Cote d'Ivoire	16,889	42	3,260	13,522	107	2	0.6%
75	Denmark	15,590	167	1,599	13,370	621	0	4.0%
76	West Bank and Gaza	15,491	307	6,199	9,186	106	1	0.7%
77	Bosnia and Herzegovina	15,184	223	5,570	9,156	458	5	3.0%
78	Korea, South	14,873	103	705	13,863	305	0	2.1%
79	Bulgaria	13,893	0	4,932	8,479	482	0	3.5%
80	Madagascar	13,522	125	1,580	11,780	162	6	1.2%
81	North Macedonia	12,357	140	3,163	8,662	532	2	4.3%
82	Sudan	12,115	82	5,018	6,305	792	6	6.5%
83	Senegal	11,740	153	3,924	7,572	244	2	2.1%
84	Kosovo	10,795	376	4,019	6,411	365	24	3.4%
85	Norway	9,851	68	737	8,857	257	1	2.6%
86	Congo (Kinshasa)	9,589	51	875	8,480	234	9	2.4%
87	Malaysia	9,129	15	183	8,821	125	0	1.4%
88	Zambia	8,663	162	1,016	7,401	246	0	2.8%
89	Paraguay	8,389	371	2,776	5,516	97	4	1.2%
90	Guinea	8,198	82	1,028	7,120	50	0	0.6%
91	Gabon	8,077	0	2,106	5,920	51	0	0.6%
92	Tajikistan	7,950	38	1,146	6,741	63	0	0.8%
93	Haiti	7,781	38	2,466	5,123	192	5	2.5%
94	Lebanon	7,711	298	5,123	2,496	92	3	1.2%
95	Finland	7,683	41	300	7,050	333	0	4.3%
96	Luxembourg	7,368	68	832	6,414	122	0	1.7%
97	Libya	7,050	439	6,099	816	135	3	1.9%
98	Albania	6,971	154	3,142	3,616	213	5	3.1%
99	Mauritania	6,653	31	653	5,843	157	0	2.4%
100	Greece	6,381	204	4,813	1,347	221	5	3.5%
101	Croatia	6,050	180	811	5,078	161	1	2.7%
102	Maldives	5,494	128	2,553	2,920	21	0	0.4%
103	Djibouti	5,358	0	132	5,167	59	0	1.1%
104	Zimbabwe	4,990	97	2,935	1,927	128	6	2.6%
105	Malawi	4,912	160	2,209	2,550	153	1	3.1%
106	Equatorial Guinea	4,821	0	2,556	2,182	83	0	1.7%
107	Hungary	4,813	45	645	3,561	607	2	12.6%
108	Central African Republic	4,652	0	2,863	1,728	61	0	1.3%
109	Nicaragua	4,115	0	1,074	2,913	128	0	3.1%
110	Montenegro	3,857	44	1,104	2,680	73	0	1.9%
111	Congo (Brazzaville)	3,745	0	2,060	1,625	60	0	1.6%
112	Eswatini	3,599	74	1,543	1,991	65	2	1.8%
113	Namibia	3,544	138	2,669	848	27	5	0.8%
114	Thailand	3,359	3	132	3,169	58	0	1.7%
115	Somalia	3,227	0	1,406	1,728	93	0	2.9%
116	Cuba	3,174	46	560	2,525	89	1	2.8%
117	Cabo Verde	3,073	73	808	2,232	33	0	1.1%
118	Sri Lanka	2,882	1	225	2,646	11	0	0.4%
119	Suriname	2,761	108	891	1,830	40	1	1.4%
120	Slovakia	2,739	49	769	1,939	31	0	1.1%
121	Mozambique	2,638	79	1,604	1,015	19	0	0.7%
122	Mali	2,597	15	493	1,979	125	0	4.8%
123	South Sudan	2,478	1	1,256	1,175	47	0	1.9%
124	Slovenia	2,332	29	243	1,960	129	0	5.5%
125	Lithuania	2,330	21	560	1,689	81	0	3.5%
126	Rwanda	2,200	11	634	1,558	8	0	0.4%
127	Estonia	2,174	0	136	1,975	63	0	2.9%
128	Guinea-Bissau	2,088	0	1,044	1,015	29	0	1.4%
129	Benin	2,014	0	295	1,681	38	0	1.9%
130	Iceland	1,976	4	114	1,852	10	0	0.5%
131	Sierra Leone	1,940	3	375	1,496	69	0	3.6%
132	Tunisia	1,847	67	492	1,302	53	1	2.9%
133	Yemen	1,847	6	370	949	528	0	28.6%
134	Angola	1,815	53	1,158	577	80	0	4.4%
135	New Zealand	1,602	13	49	1,531	22	0	1.4%
136	Gambia	1,556	79	1,246	267	43	10	2.8%
137	Syria	1,432	105	982	395	55	2	3.8%
138	Uruguay	1,409	16	192	1,180	37	0	2.6%
139	Uganda	1,353	21	201	1,141	11	2	0.8%
140	Jordan	1,320	17	87	1,222	11	0	0.8%

Table 6: Cases by Country (13 Aug 2020 UTC) (continued)

	country	confirmed	new.confirmed	active.confirmed	recovered	deaths	new.deaths	death.rate
141	Latvia	1,307	4	197	1,078	32	0	2.4%
142	Cyprus	1,305	14	415	870	20	0	1.5%
143	Georgia	1,283	5	198	1,068	17	0	1.3%
144	Liberia	1,252	0	432	738	82	0	6.5%
145	Malta	1,245	55	528	708	9	0	0.7%
146	Burkina Faso	1,228	15	177	997	54	0	4.4%
147	Botswana	1,214	148	1,091	120	3	1	0.2%
148	Niger	1,161	0	17	1,075	69	0	5.9%
149	Togo	1,104	12	287	791	26	0	2.4%
150	Bahamas	1,089	53	936	138	15	0	1.4%
151	Jamaica	1,071	6	303	754	14	0	1.3%
152	Andorra	981	4	70	858	53	0	5.4%
153	Chad	949	0	13	860	76	0	8.0%
154	Vietnam	911	28	465	425	21	3	2.3%
155	Lesotho	884	86	588	271	25	1	2.8%
156	Sao Tome and Principe	883	1	60	808	15	0	1.7%
157	Diamond Princess	712	0	48	651	13	0	1.8%
158	San Marino	699	0	0	657	42	0	6.0%
159	Guyana	631	8	407	202	22	0	3.5%
160	Tanzania	509	0	305	183	21	0	4.1%
161	Taiwan*	481	0	24	450	7	0	1.5%
162	Burundi	410	1	94	315	1	0	0.2%
163	Trinidad and Tobago	404	78	257	139	8	0	2.0%
164	Comoros	399	0	13	379	7	0	1.8%
165	Burma	369	8	42	321	6	0	1.6%
166	Mauritius	344	0	0	334	10	0	2.9%
167	Mongolia	297	0	28	269	0	0	0.0%
168	Belize	296	86	262	32	2	0	0.7%
169	Eritrea	285	0	37	248	0	0	0.0%
170	Cambodia	273	1	48	225	0	0	0.0%
171	Papua New Guinea	271	0	190	78	3	0	1.1%
172	Barbados	144	0	19	118	7	0	4.9%
173	Monaco	144	3	26	114	4	0	2.8%
174	Brunei	142	0	1	138	3	0	2.1%
175	Bhutan	128	15	28	100	0	0	0.0%
176	Seychelles	127	0	1	126	0	0	0.0%
177	Antigua and Barbuda	92	0	13	76	3	0	3.3%
178	Liechtenstein	90	0	2	87	1	0	1.1%
179	Saint Vincent and the Grenadines	57	0	2	55	0	0	0.0%
180	Fiji	28	1	7	20	1	0	3.6%
181	Saint Lucia	25	0	0	25	0	0	0.0%
182	Timor-Leste	25	0	1	24	0	0	0.0%
183	Grenada	24	0	1	23	0	0	0.0%
184	Laos	20	0	1	19	0	0	0.0%
185	Dominica	18	0	0	18	0	0	0.0%
186	Saint Kitts and Nevis	17	0	0	17	0	0	0.0%
187	Holy See	12	0	0	12	0	0	0.0%
188	Western Sahara	10	0	1	8	1	0	10.0%
189	MS Zaandam	9	0	7	0	2	0	22.2%

Appendix B. How to Cite This Work

Citation

Yanchang Zhao, COVID-19 Data Analysis with R – Worldwide. RDataMining.com, 2020. URL: <http://www.rdatamining.com/docs/Coronavirus-data-analysis-world.pdf>.

BibTex

```
@techreport{Zhao2020Covid19world,
  Author = {Yanchang Zhao},
  Institution = {RDataMining.com},
  Title = {COVID-19 Data Analysis with R – Worldwide},
```

Url = {<http://www.rdatamining.com/docs/Coronavirus-data-analysis-world.pdf>},
Year = {2020}}

Appendix C. Contact

Contact:

Dr. Yanchang Zhao

Email: yanchang@RDataMining.com

Twitter: @RDataMining

LinkedIn: <http://group.rdatamining.com>

Comments and suggestions and welcome. Thanks!