European Union COVID-19 Report

Sriram Nyshadham

2/20/2022

EU COVID-19 report

I wanted work on the COVID-19 data for specific countries that have data with the European Center for Disease Control on their responses. I will clean up the data, analyze it in relation to the stay at home orders, and model it and find correlation.

Read in data

I used data provided by professor during the course, and I have input a dataset that gave the precaution responses during the pandemic by a few countries within the EU.

```
url_in <- "https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/csse_covi
global_conf <- read_csv(str_c(url_in, "time_series_covid19_confirmed_global.csv"))
global_deaths <- read_csv(str_c(url_in,"time_series_covid19_deaths_global.csv"))
global_recovered <- read_csv(str_c(url_in, "time_series_covid19_recovered_global.csv"))

eu_url <- "https://www.ecdc.europa.eu/sites/default/files/documents/response_graphs_data_2021-05-26.csv
eu_resp <- read_csv(eu_url)

uid_lookup_url <- "https://raw.githubusercontent.com/CSSEGISandData/COVID-19/master/csse_covid_19_data/U
uid <- read_csv(uid_lookup_url)
```

```
global_conf <- global_conf %>% pivot_longer(cols=-c(`Province/State`, `Country/Region`, Lat, Long), name

global_deaths <- global_deaths %>% pivot_longer(cols=-c(`Province/State`, `Country/Region`, Lat, Long),

global <- global_conf %>% full_join(global_deaths) %>% rename(Country_Region = `Country/Region`, Provinc
```

```
## Joining, by = c("Province/State", "Country/Region", "date")
```

```
global <- global %>% filter(cases > 0)

global_recovered <- global_recovered %>% pivot_longer(cols=-c(`Province/State`, `Country/Region`, Lat, L
global_recovered <- global_recovered %>% rename(Country_Region = `Country/Region`,Province_State = `Prov
global <- global %>% full_join(global_recovered)
```

```
## Joining, by = c("Province_State", "Country_Region", "date")
```

```
global <- global %>% filter(cases > 0)
global
```

```
## # A tibble: 197,185 x 6
##    Province_State Country_Region date       cases deaths recovered
##    <chr>          <chr>          <date>     <dbl>  <dbl>     <dbl>
##  1 <NA>           Afghanistan    2020-02-24     5      0         0
```

```
##  2 <NA>           Afghanistan    2020-02-25     5      0         0
##  3 <NA>           Afghanistan    2020-02-26     5      0         0
##  4 <NA>           Afghanistan    2020-02-27     5      0         0
##  5 <NA>           Afghanistan    2020-02-28     5      0         0
##  6 <NA>           Afghanistan    2020-02-29     5      0         0
##  7 <NA>           Afghanistan    2020-03-01     5      0         0
##  8 <NA>           Afghanistan    2020-03-02     5      0         0
##  9 <NA>           Afghanistan    2020-03-03     5      0         0
## 10 <NA>           Afghanistan    2020-03-04     5      0         0
## # ... with 197,175 more rows
```

Global data tidying

Tidying up the data and use the UID to extract the population of each country. There is no continous data on population amount, just a maximum.

```
global <- global %>% unite("Combined_Key", c("Province_State", "Country_Region"), sep = ", ", na.rm = TR


global <- global %>%
  left_join(uid, by=c("Province_State", "Country_Region", "Combined_Key")) %>%
  select(-c(UID,FIPS))
```

EU Tidying up data and joining

I wanted to have only the countries that have data on their stay at home orders, so I chose only that response from the EU dataset. I then joined the global dataset

```
eu <- eu_resp %>% filter(Response_measure=="StayHomeOrder")
```

I then removed all the NA values from the end of the precaution dates, and set them to todays date. I also took all the rows that correspond to countries within the precautions dataset from the global continous data provided from John Hopkins database.

```
eu[is.na(eu$date_end), "date_end"] = as.Date(today())
                                                        #%>% merge(x=global, y=eu_resp, by.x="Country_
eu_covid <- global[global$Country_Region %in% eu$Country,]

eu_covid <- eu_covid %>% select(-c(iso2, iso3, code3, Admin2))
```

All of Europe

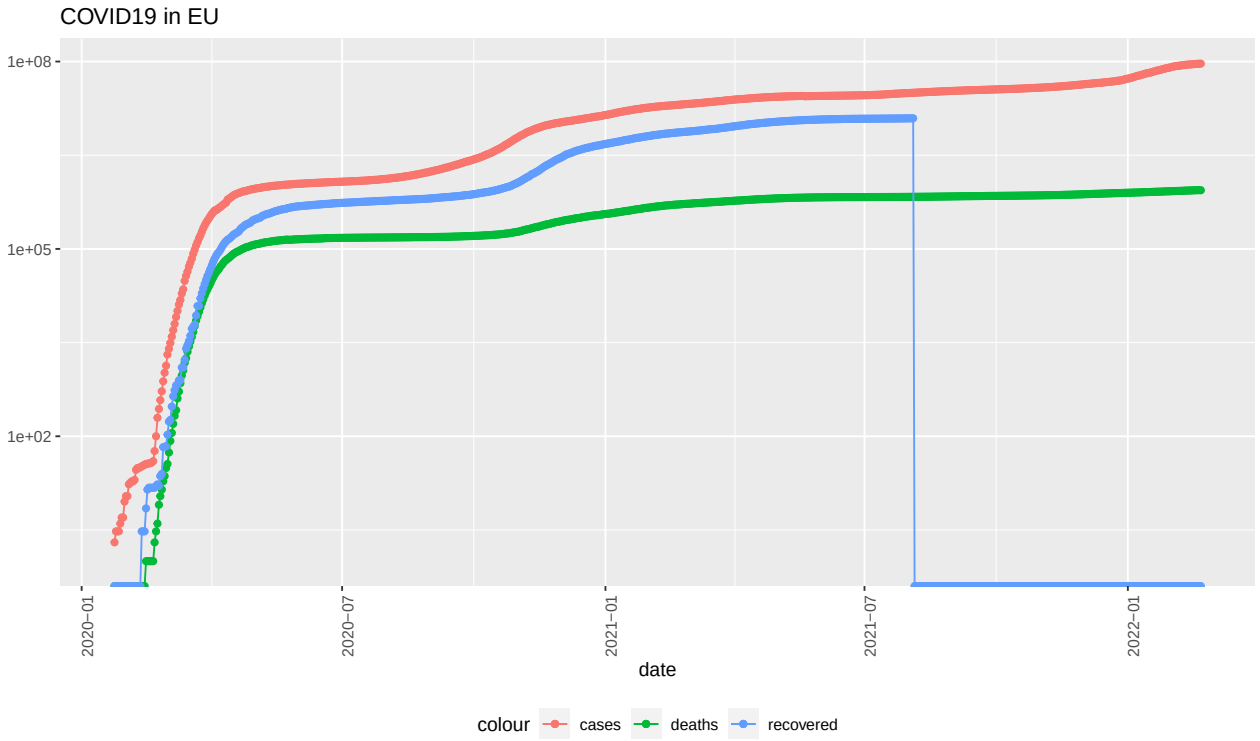
I first started by analyzing and visualizing the data for all the countries. This is a graph with the cumulative of: cases, deaths and recoveries.

```
EU_cntries_ttl <- eu_covid %>% group_by(date) %>% summarize(recovered = sum(recovered), cases=sum(cases)
EU_cntries_ttl
```

```
## # A tibble: 760 x 5
##    date       cases deaths recovered Population
##    <date>     <dbl>  <dbl>     <dbl>      <dbl>
##  1 2020-01-24     2      0         0   65249843
##  2 2020-01-25     3      0         0   65249843
##  3 2020-01-26     3      0         0   65249843
##  4 2020-01-27     3      0         0   65249843
##  5 2020-01-28     4      0         0   65249843
##  6 2020-01-29     5      0         0   65249843
```

```
##  7 2020-01-30     5      0         0   65249843
##  8 2020-01-31     9      0         0  193597675
##  9 2020-02-01    11      0         0  240352458
## 10 2020-02-02    11      0         0  240352458
## # ... with 750 more rows
```

```
EU_cntries_ttl %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in EU"), y=NULL)
```



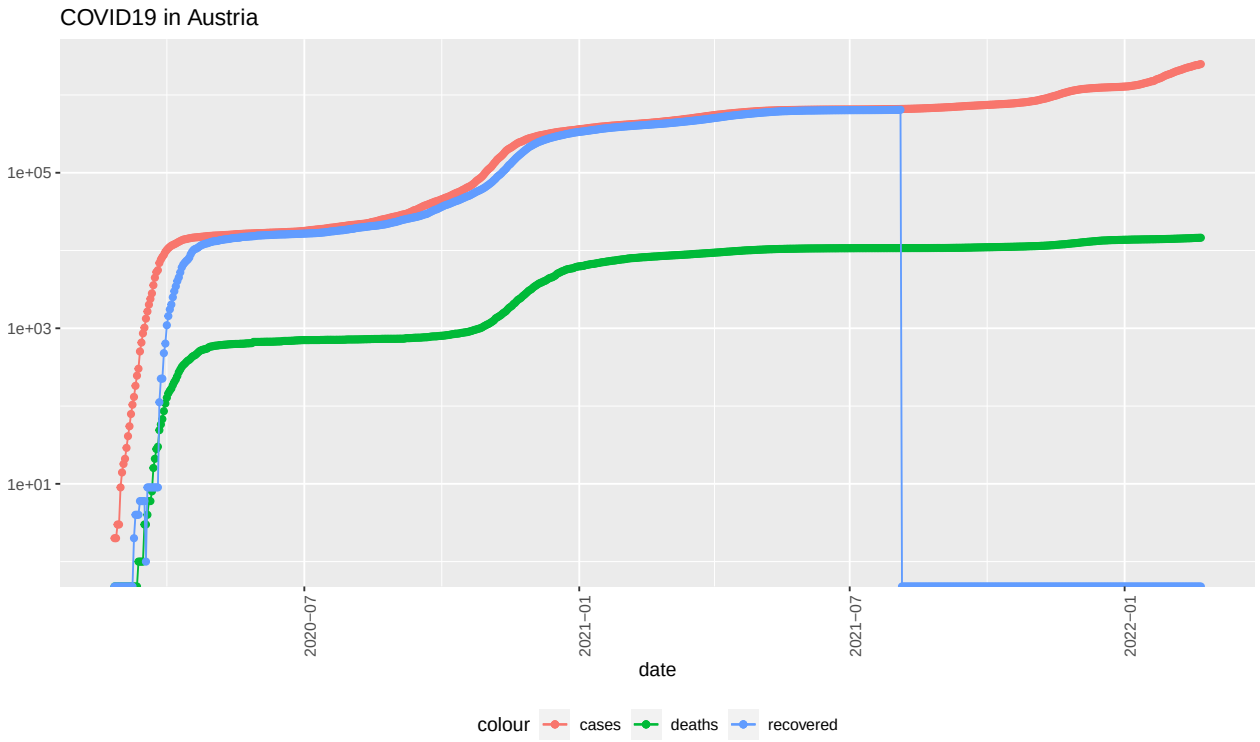
Per Country Visualizations

Here we can see the curves of deaths and cases for a few countries in EU that are registered with the ECDC.

Austria

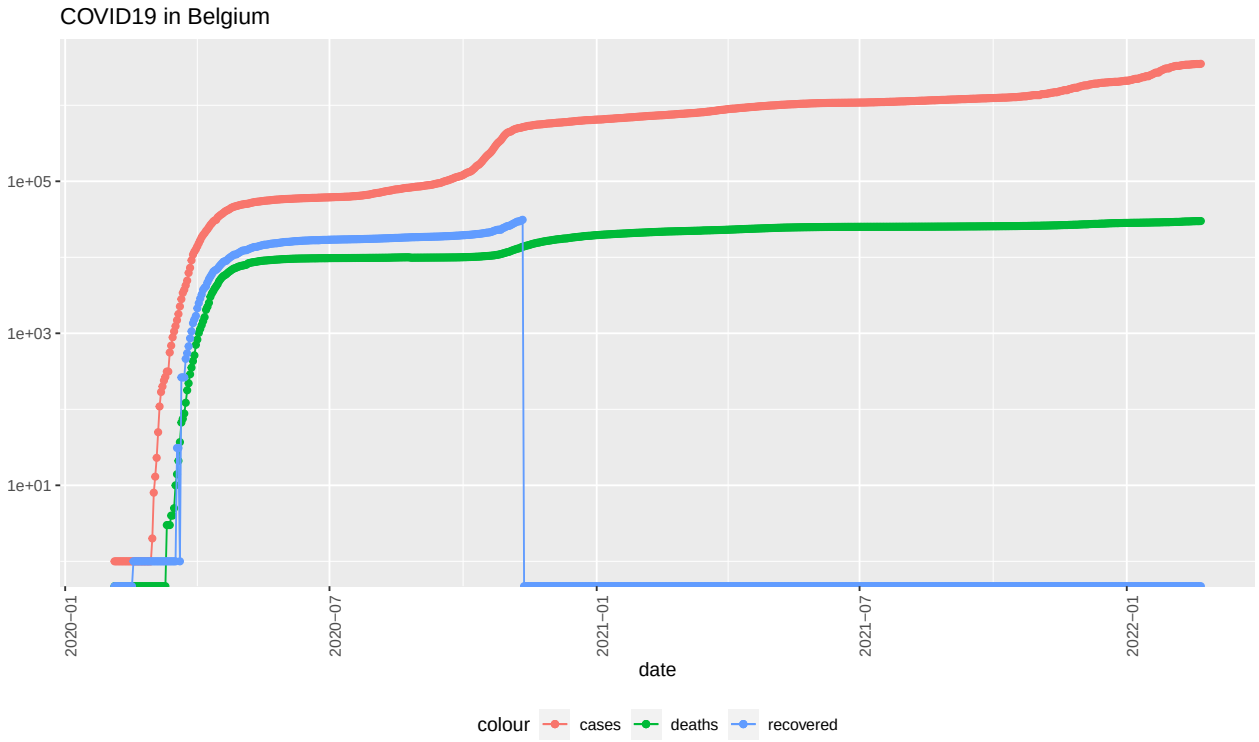
```
cntry <- "Austria"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
```

```
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



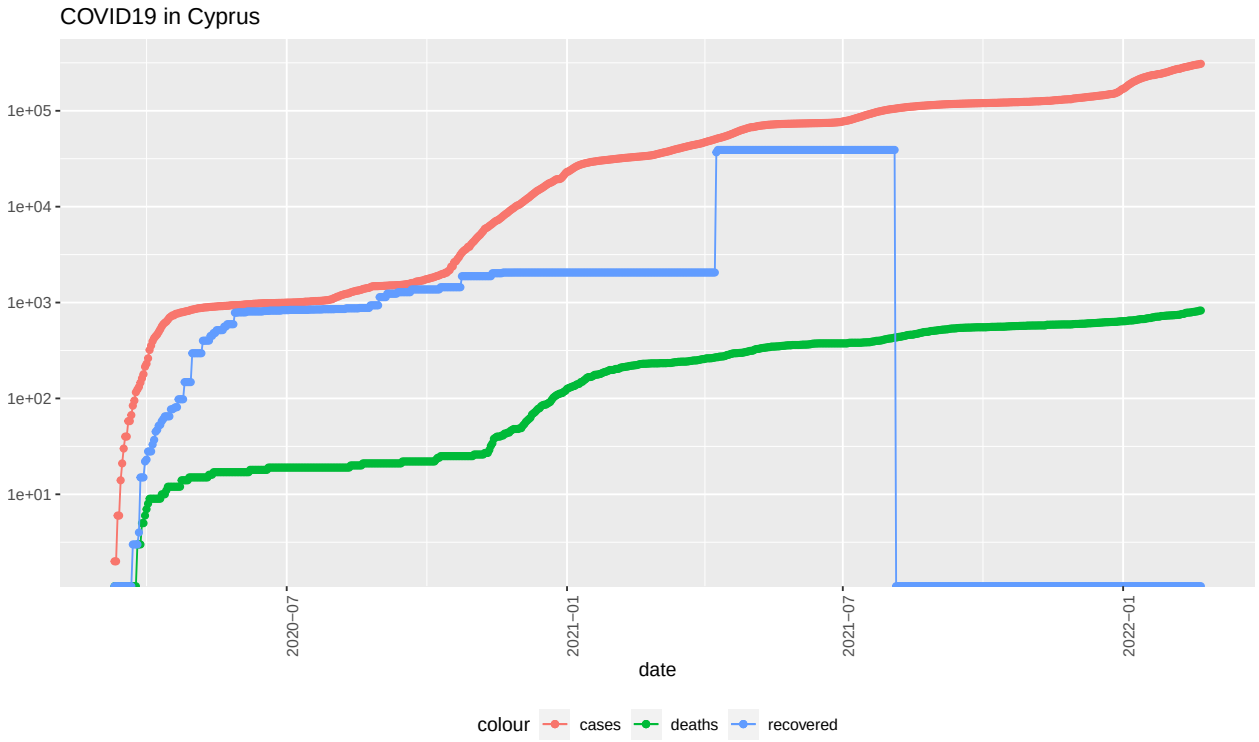
Belgium

```
cntry <- "Belgium"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



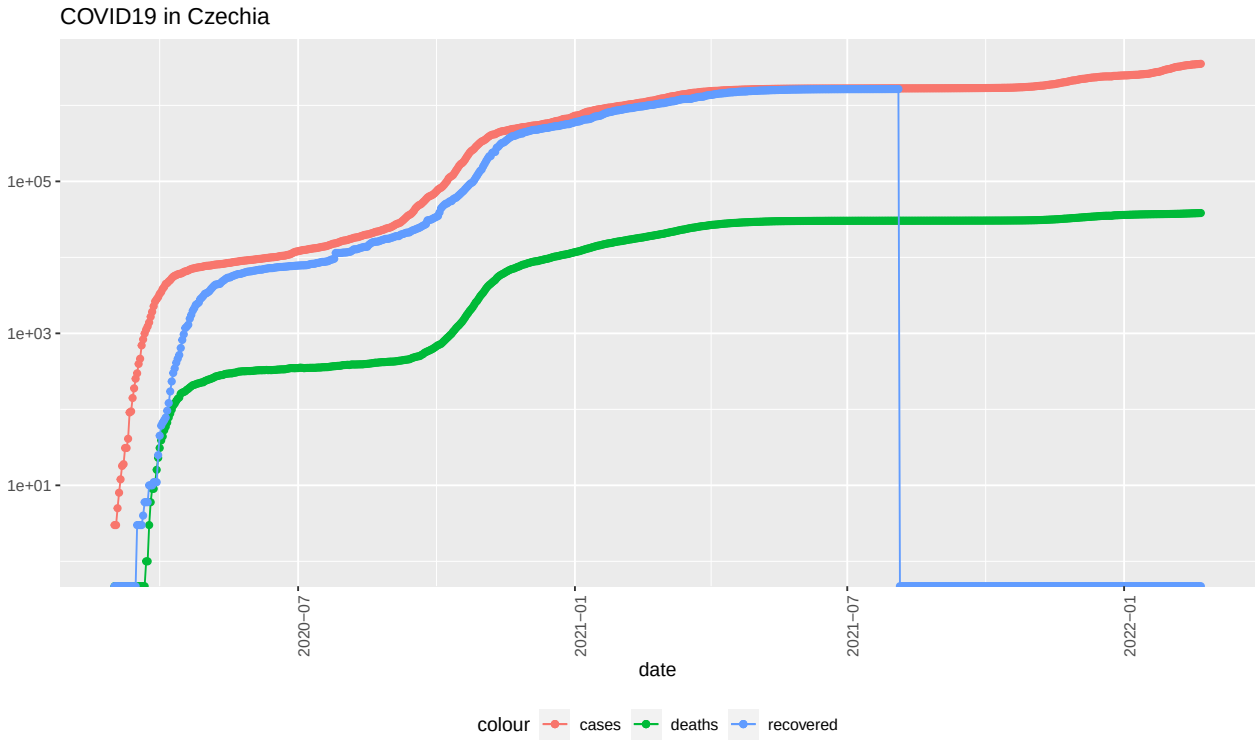
Cyprus

```
cntry <- "Cyprus"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



Czechia

```
cntry <- "Czechia"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```

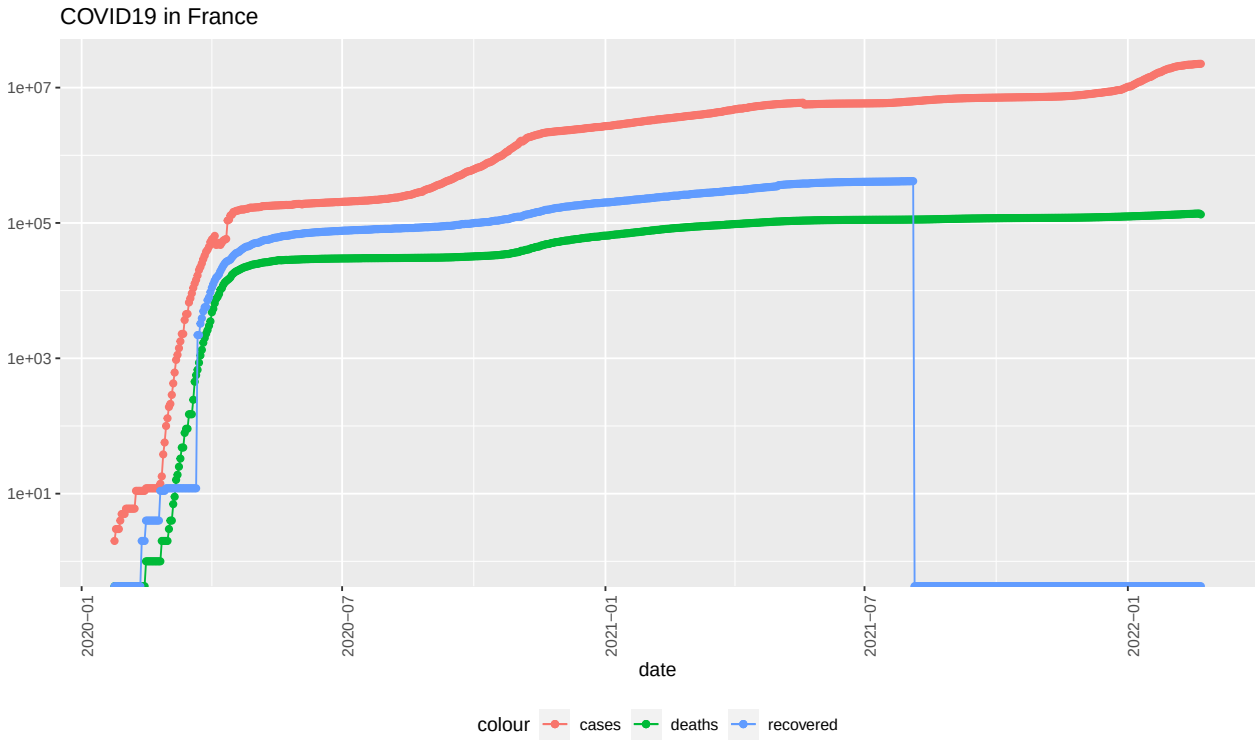


France

I included territories such as French Guiana within this data, but it would be better to put them in their own graph.

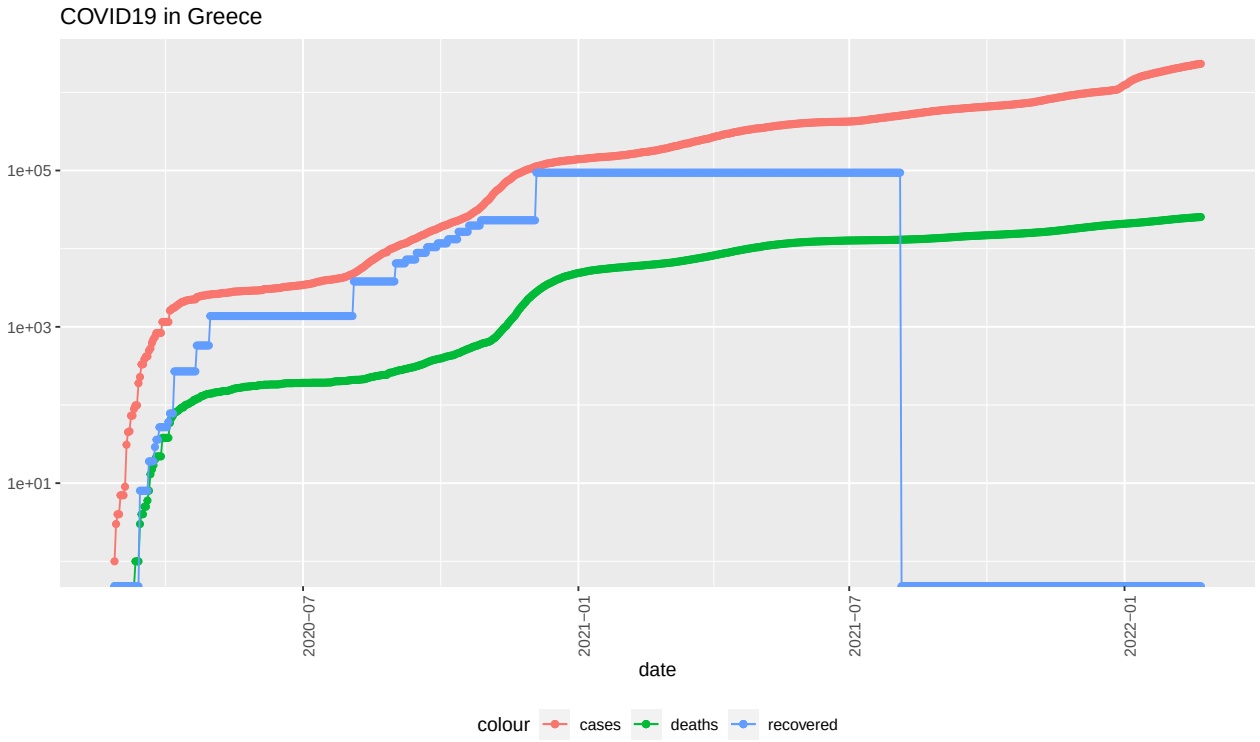
```
cntry <- "France"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>% group_by("Country_Region", date) %
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```

```
## `summarise()` has grouped output by '"Country_Region"'. You can override using
## the `.groups` argument.
```



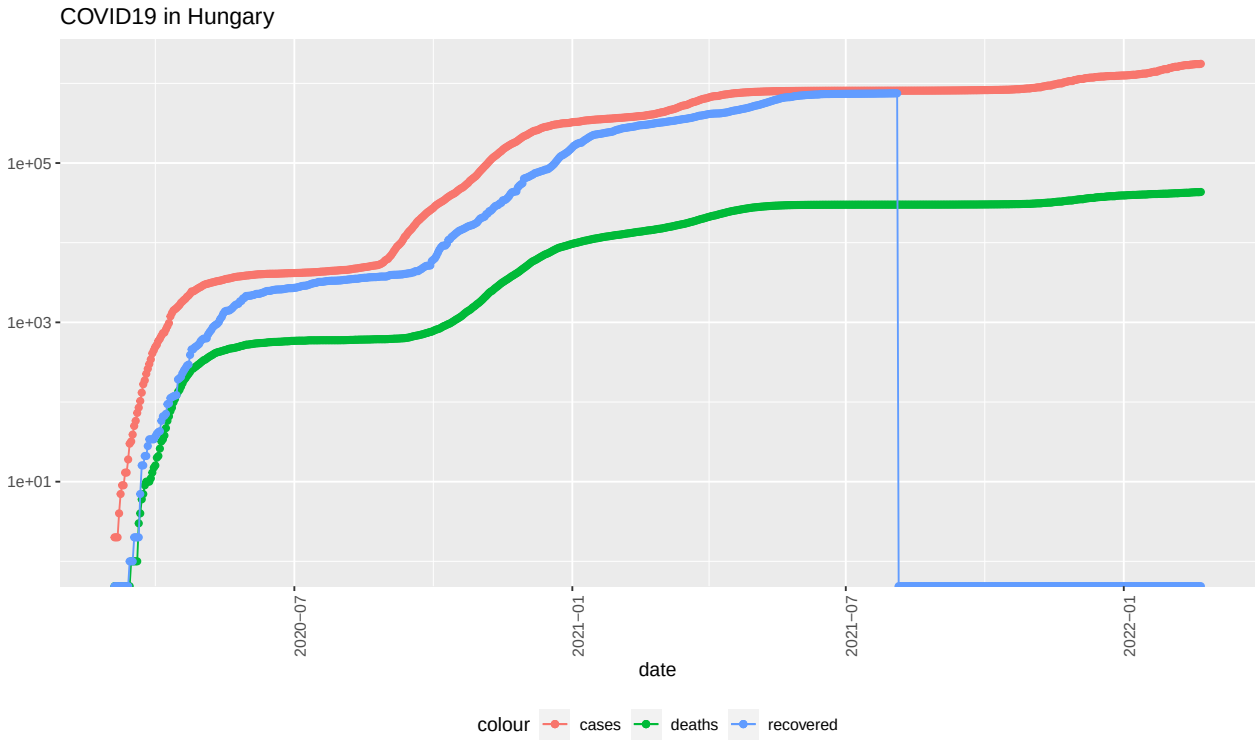
Greece

```
cntry <- "Greece"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



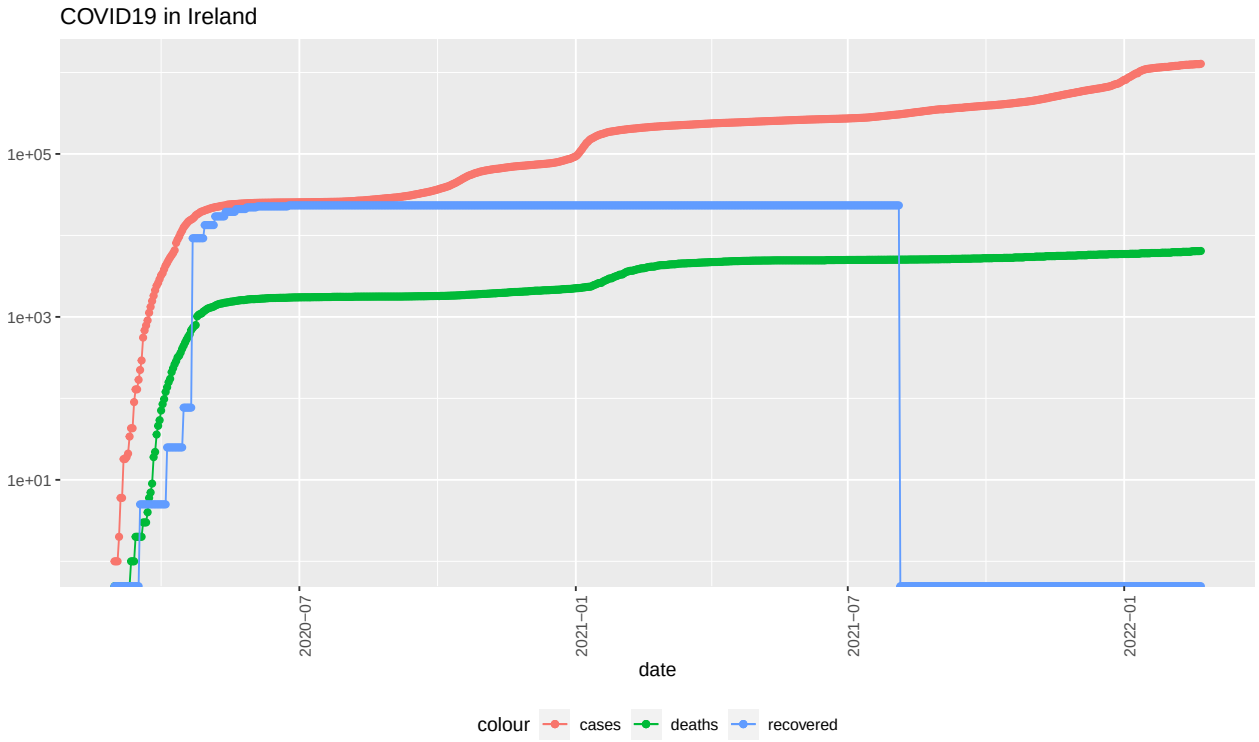
Hungary

```
cntry <- "Hungary"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



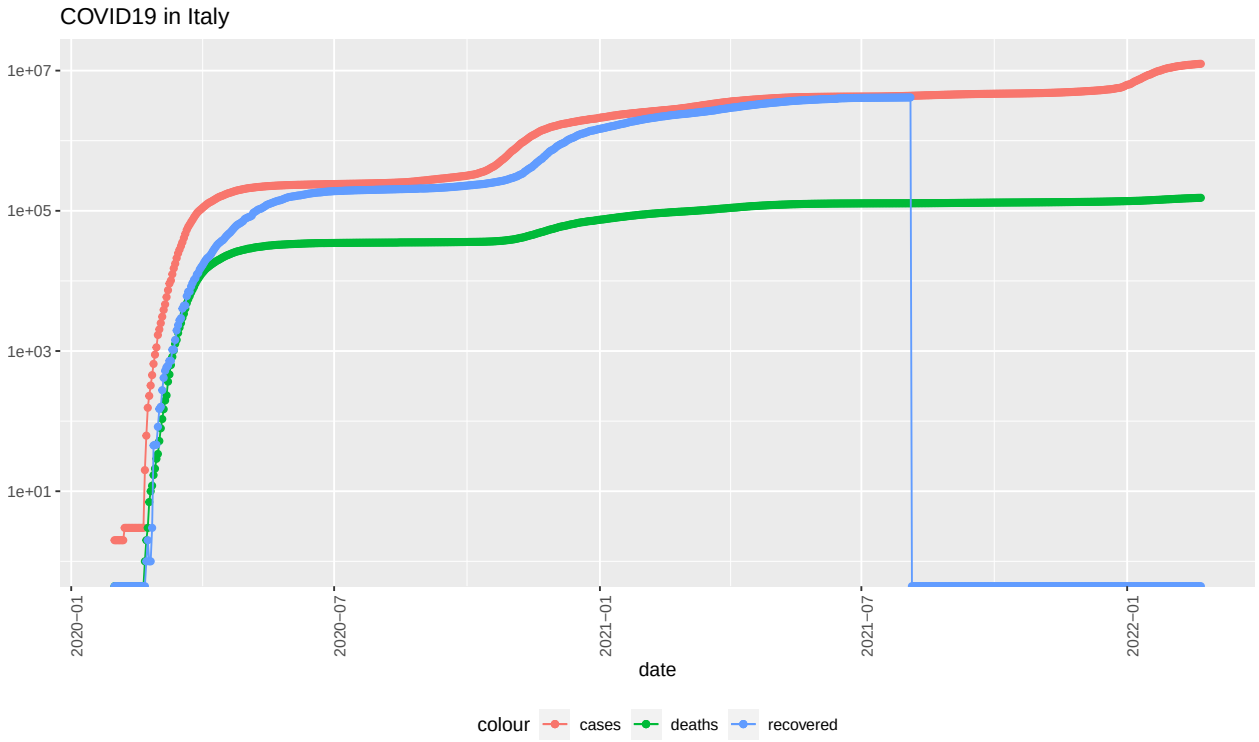
Ireland

```
cntry <- "Ireland"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



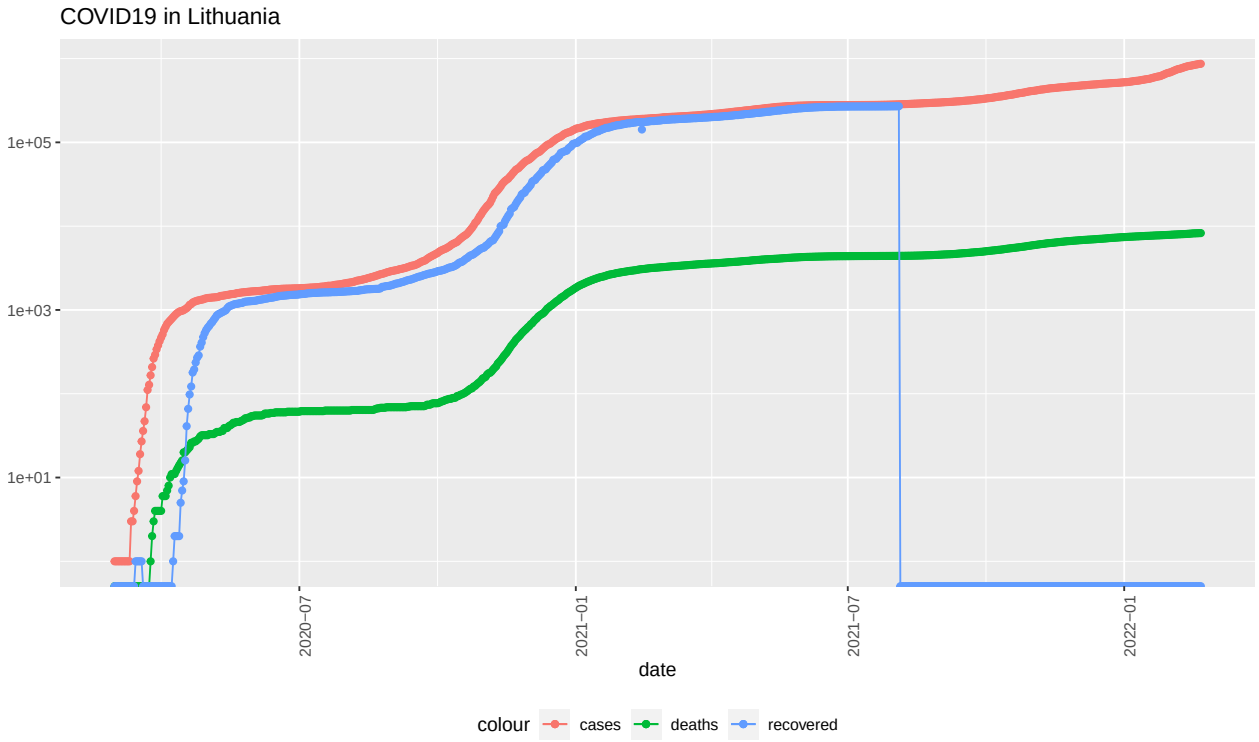
Italy

```
cntry <- "Italy"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



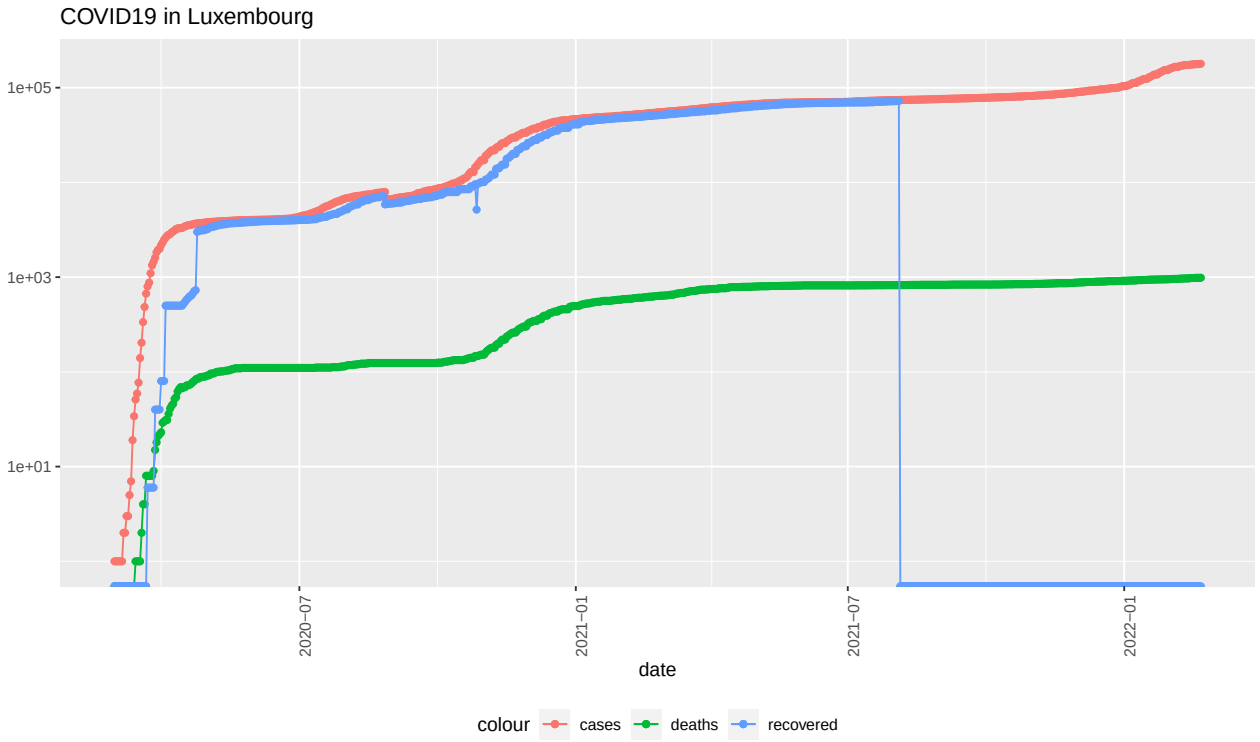
Lithuania

```
cntry <- "Lithuania"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



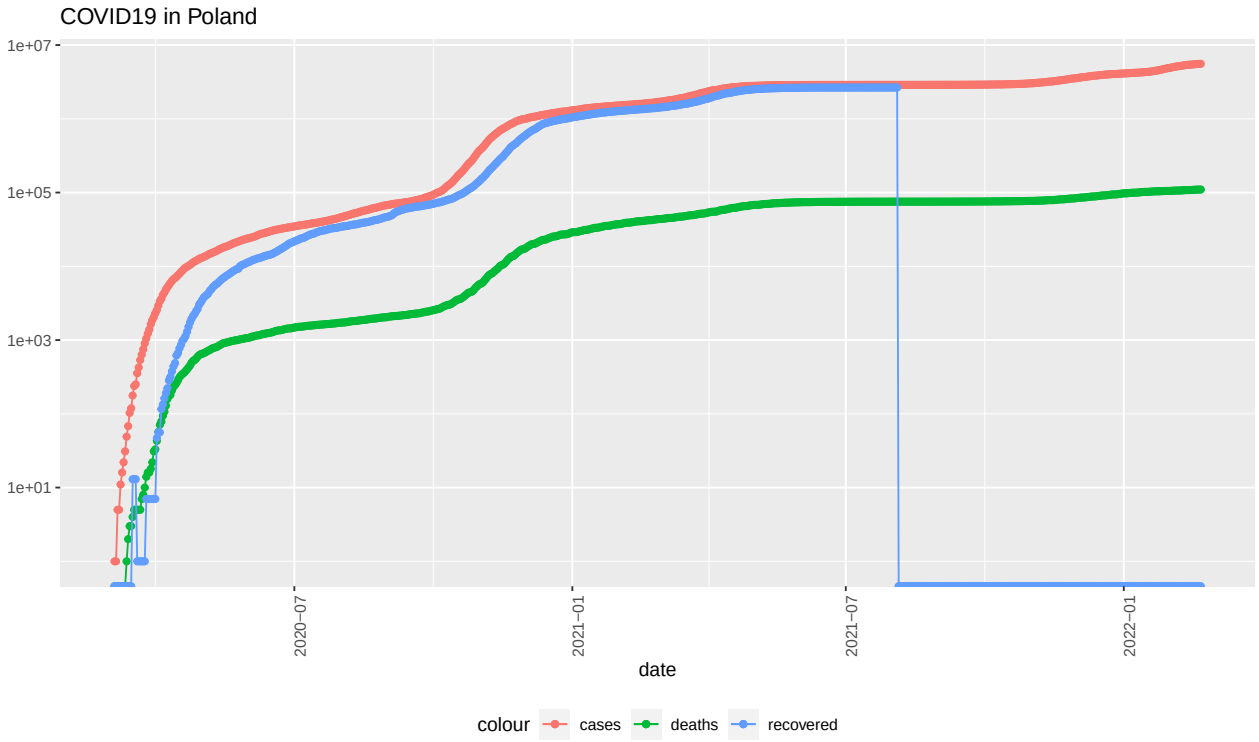
Luxembourg

```
cntry <- "Luxembourg"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



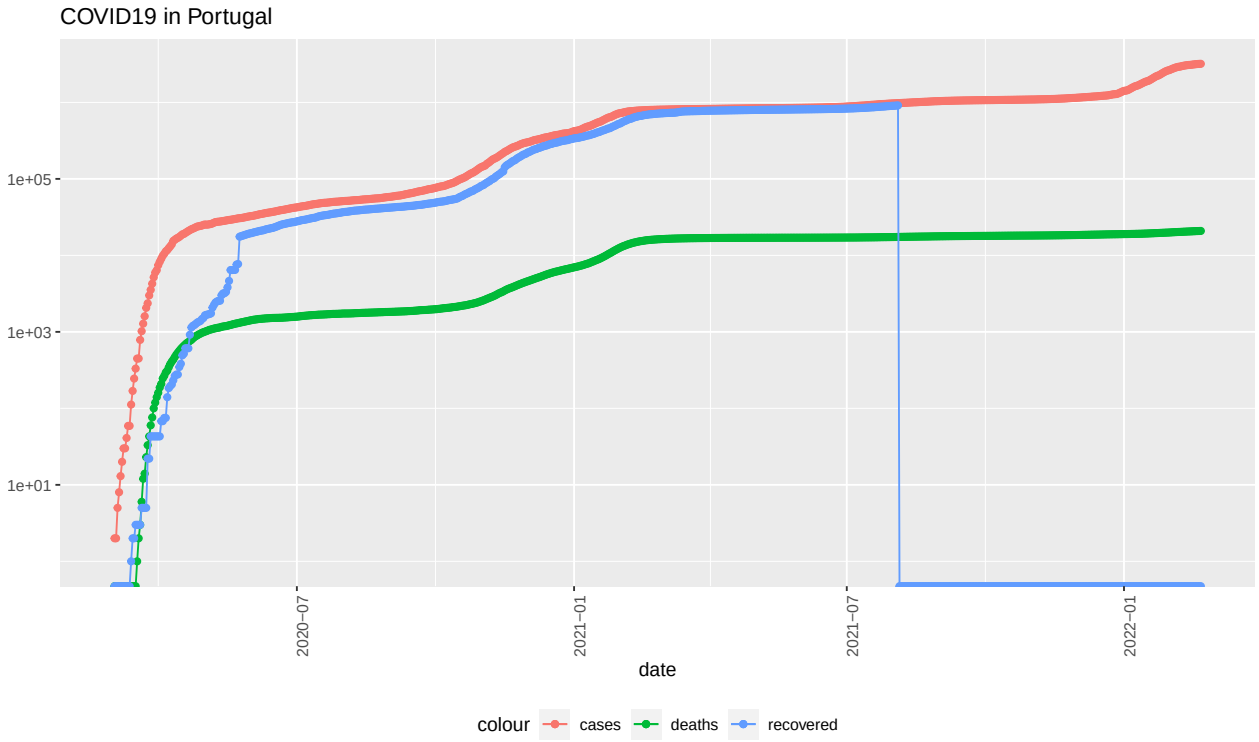
Poland

```
cntry <- "Poland"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



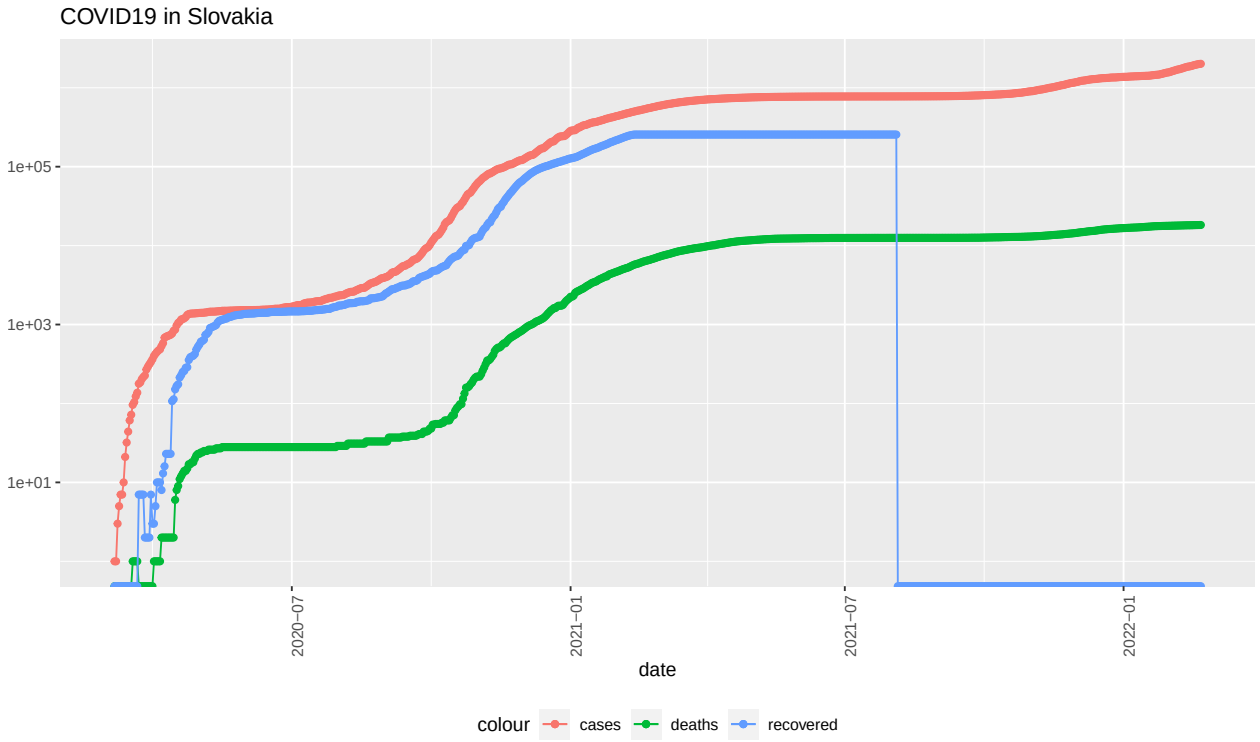
Portugal

```
cntry <- "Portugal"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



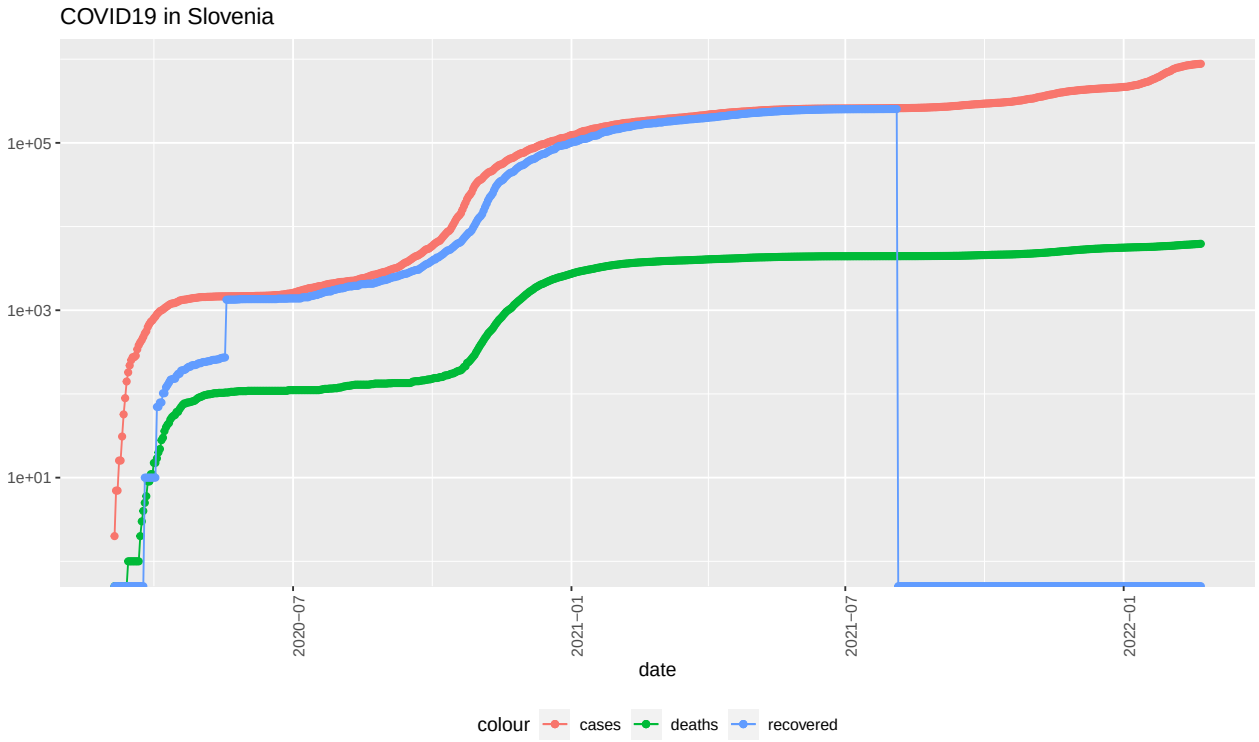
Slovakia

```
cntry <- "Slovakia"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



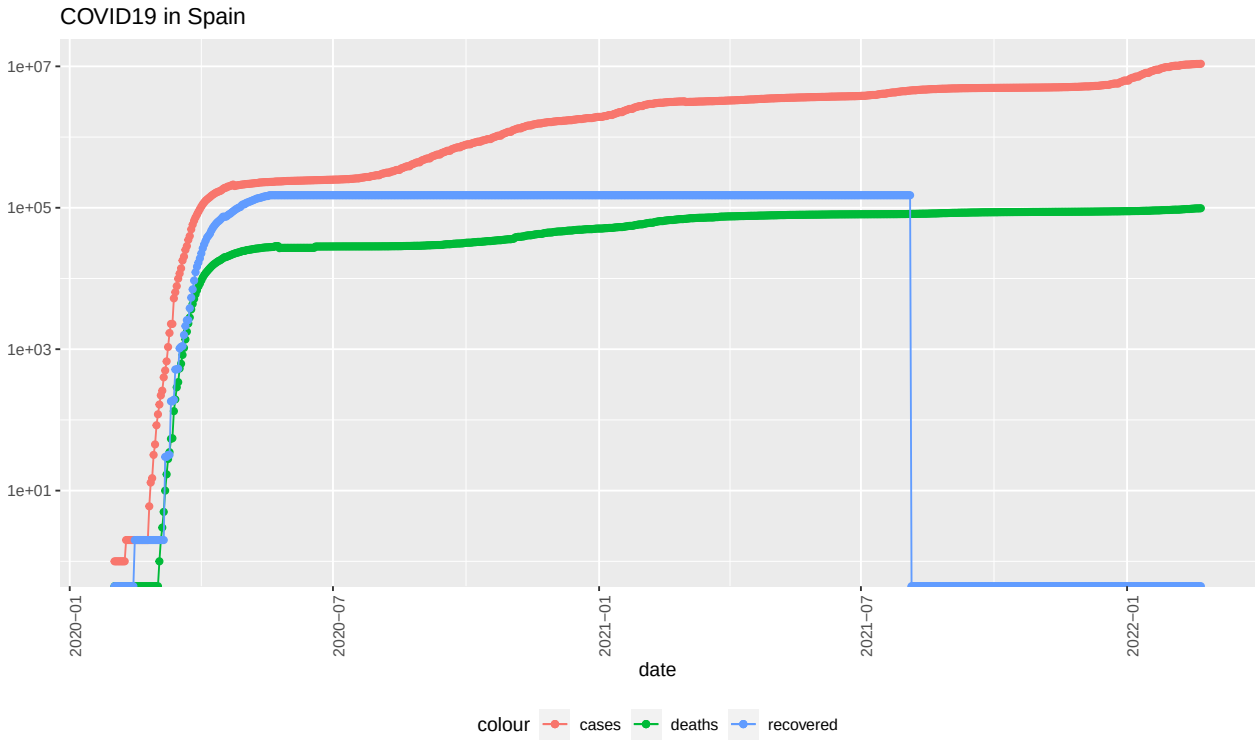
Slovenia

```
cntry <- "Slovenia"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



Spain

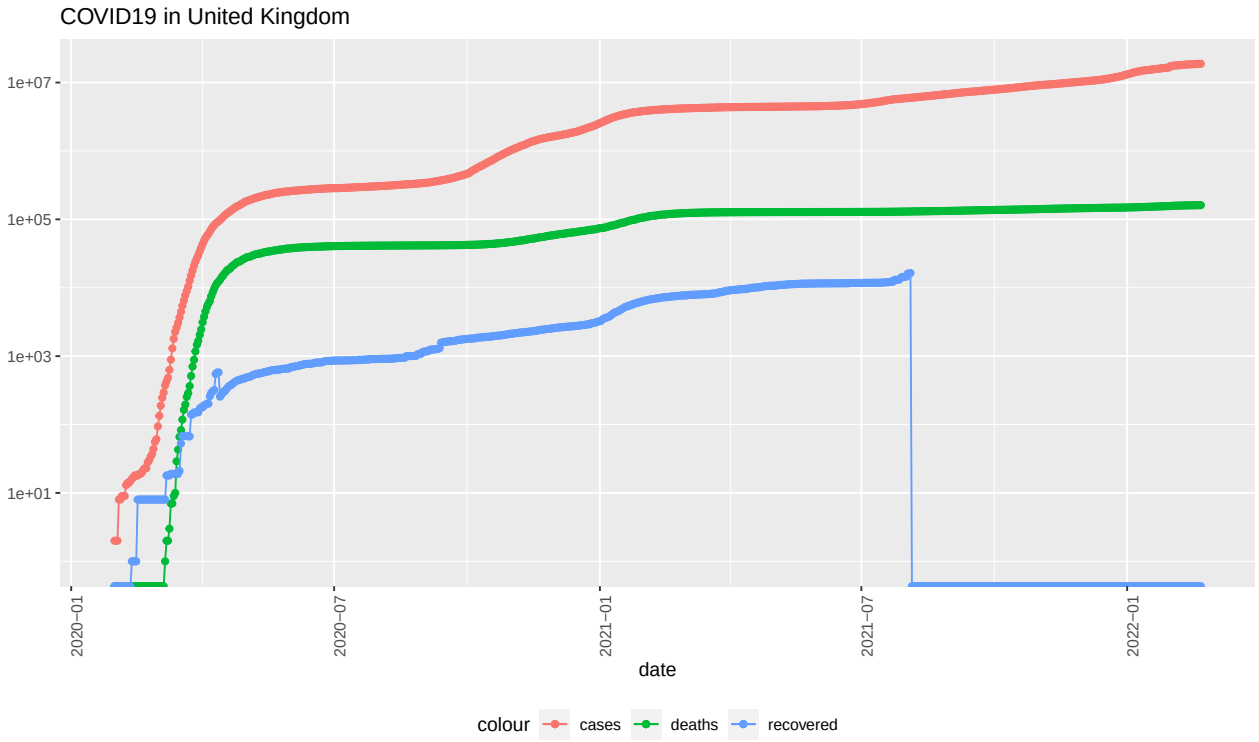
```
cntry <- "Spain"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```



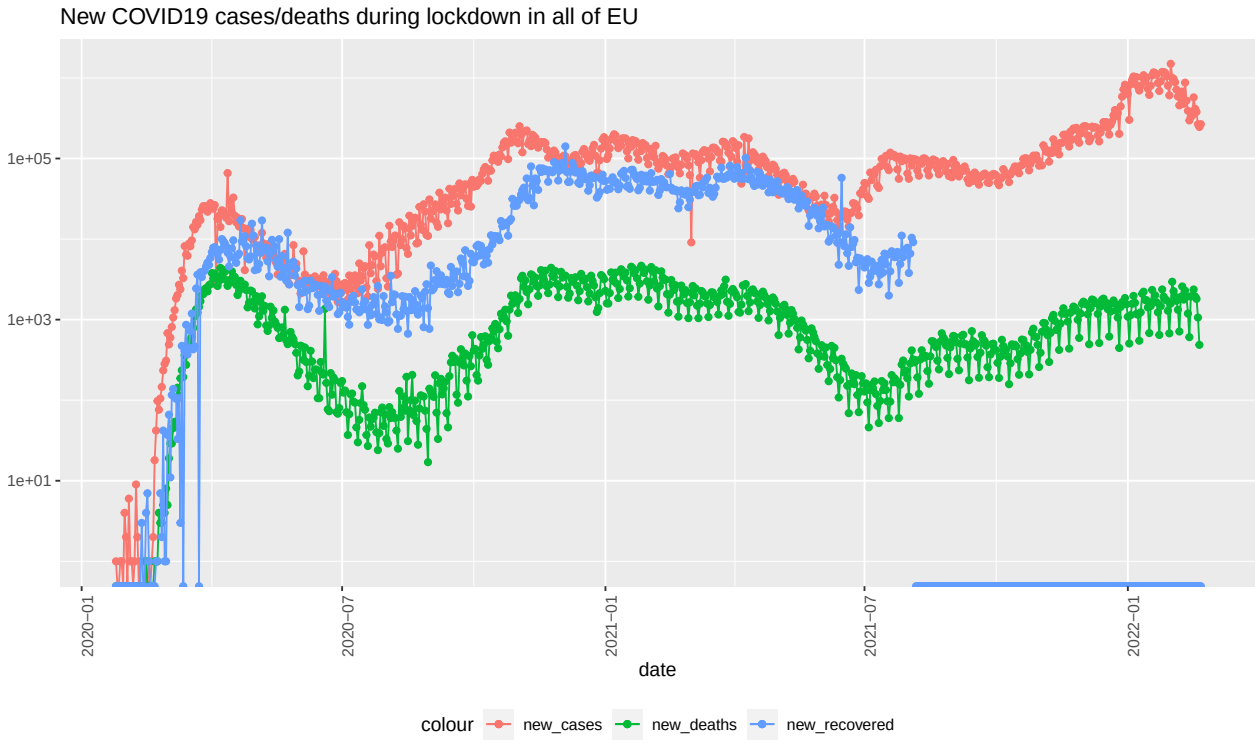
United Kingdom

```
cntry <- "United Kingdom"
eu_covid %>% filter(Country_Region == cntry) %>% filter(cases>0) %>% group_by(Country_Region, date) %>%
  ggplot(aes(x=date, y=cases)) +
  geom_line(aes(color="cases"))+
  geom_point(aes(color="cases"))+
  geom_line(aes(y=deaths, color="deaths"))+
  geom_point(aes(y=deaths, color="deaths"))+
  geom_line(aes(y=recovered, color="recovered"))+
  geom_point(aes(y=recovered, color="recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("COVID19 in ", cntry), y=NULL)
```

```
## `summarise()` has grouped output by 'Country_Region'. You can override using
## the `.groups` argument.
```




```
EU_cntries_ttl<- EU_cntries_ttl  %>% mutate(new_recovered = recovered - lag(recovered), new_cases=cases
EU_cntries_ttl %>%
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in all of EU"), y=NULL)
```



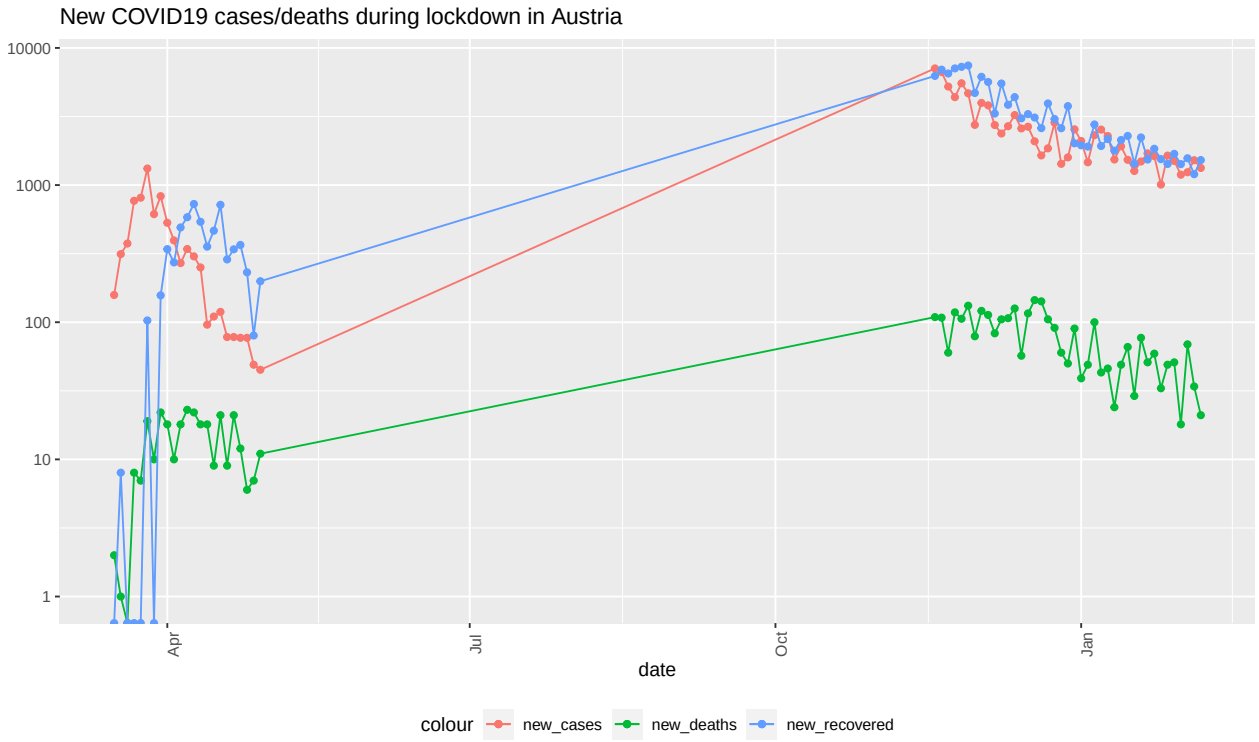
Lockdown Visualizations with new cases/deaths

Here we can see the curves the daily change of the cases, deaths and recoveries within individual countries. The graph will only show the data of cases, deaths and recoveries during that countries lockdown. The aim of these lockdowns is to slow down the spread of the virus as to not overwhelm the healthcare system. I will talk about the conclusions of this later in this document.

Austria

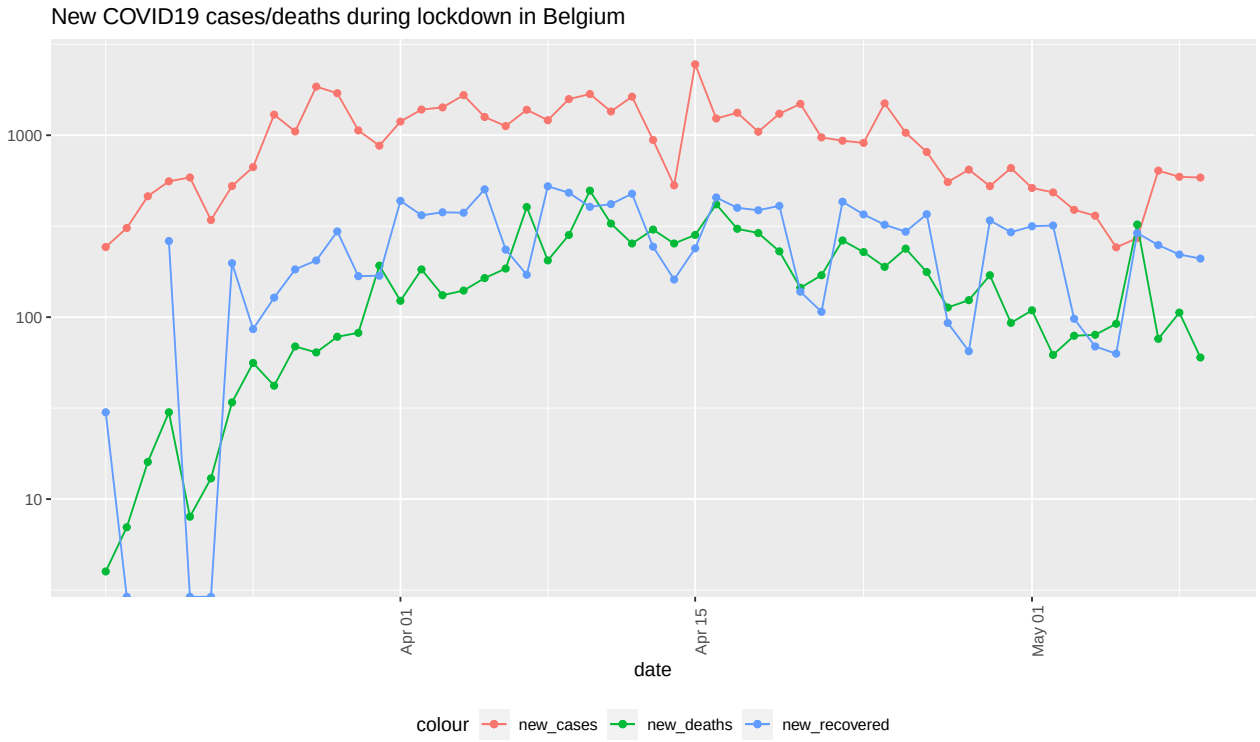
Austria is a clear example of a country that had to go through multiple stay at home orders due to the clear increase of cases and deaths between the two precautionary decisions. But, it shows a fall in cases, deaths, and recoveries.

```
cntry <- "Austria"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered), new
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



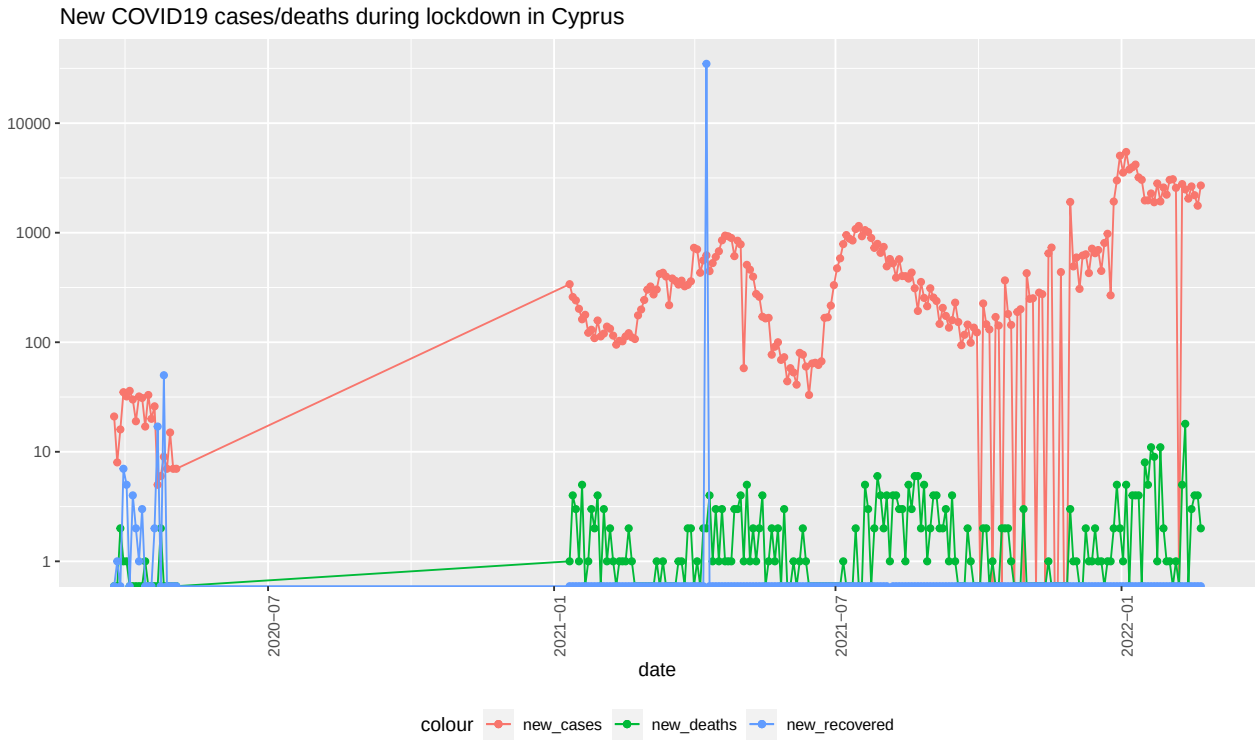
Belgium

```
cntry <- "Belgium"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



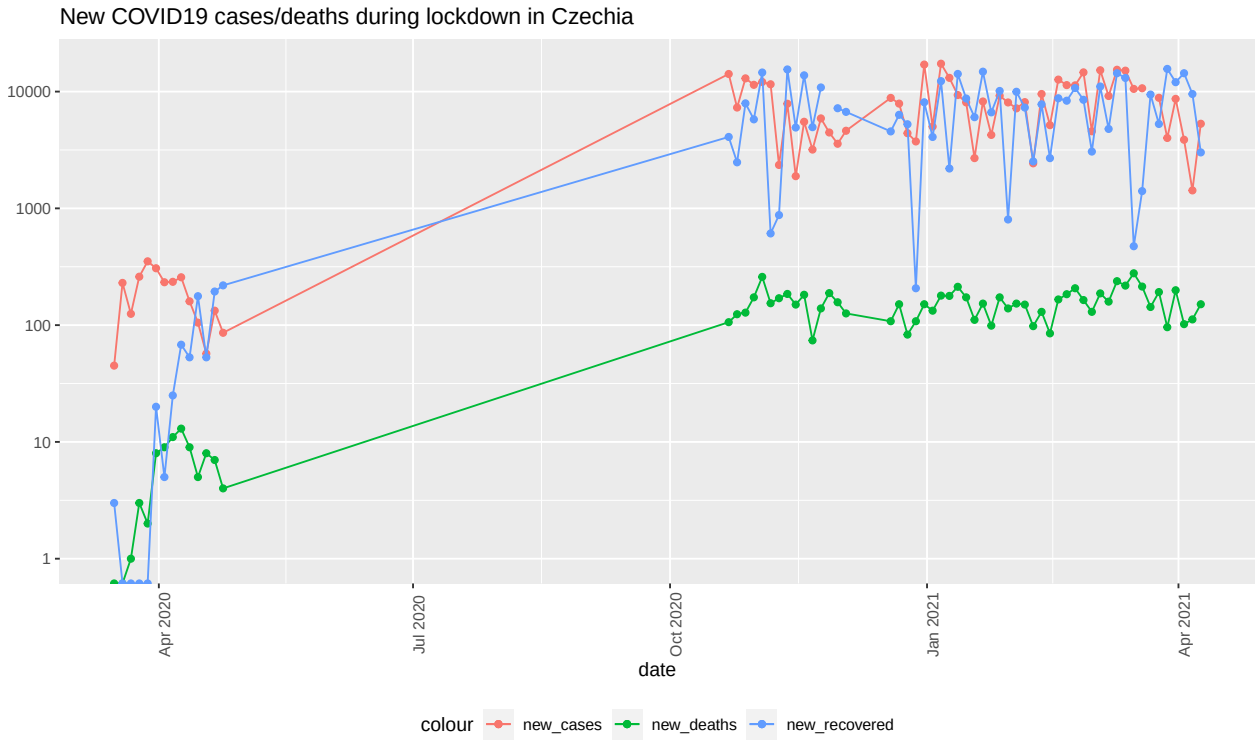
Cyprus

```
cntry <- "Cyprus"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



Czechia

```
cntry <- "Czechia"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```

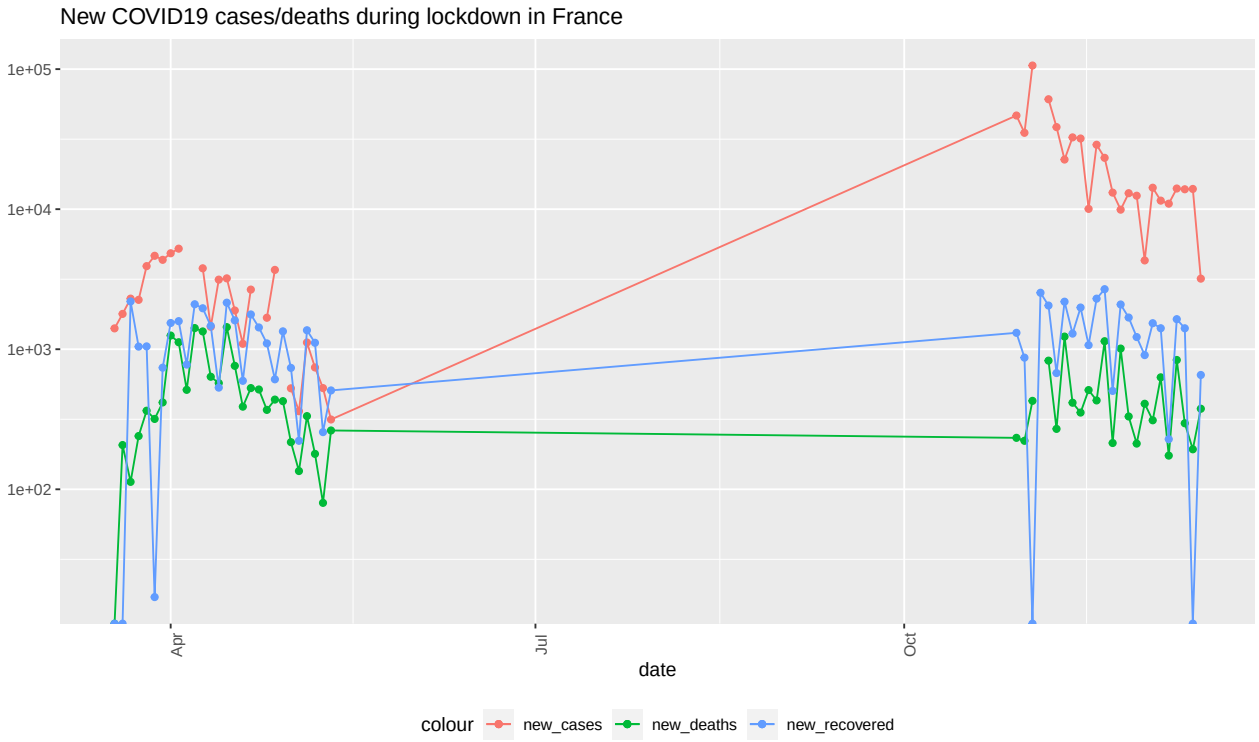


France

I included territories such as French Guiana within this data, but it would be better to put them in their own graph.

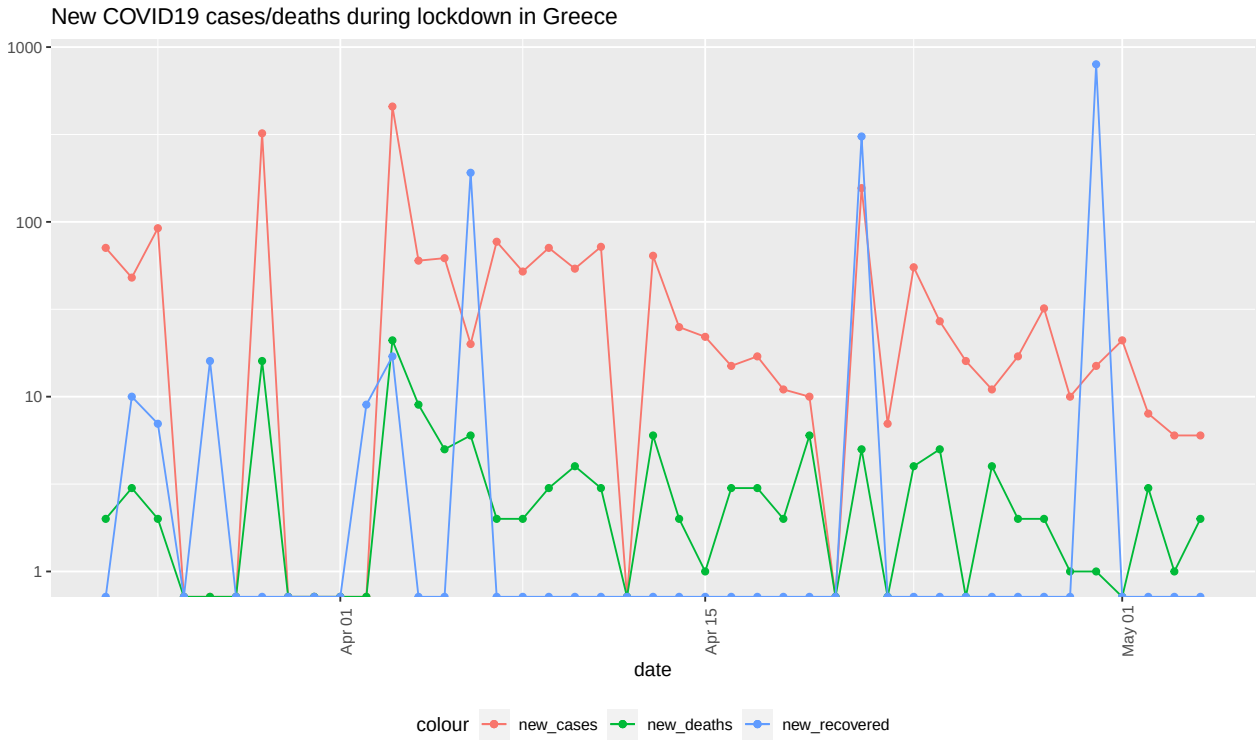
```
cntry <- "France"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered), new
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```

```
## `summarise()` has grouped output by '"Country_Region"'. You can override using
## the `.groups` argument.
```



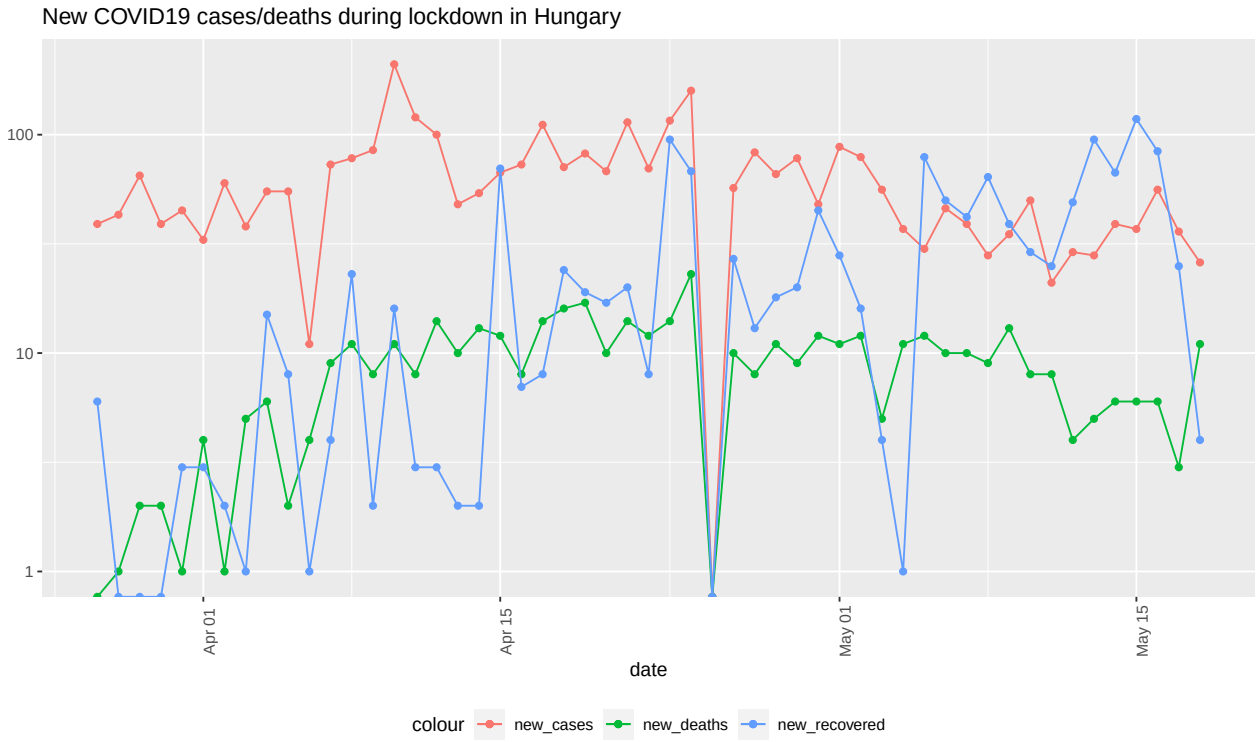
Greece

```
cntry <- "Greece"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



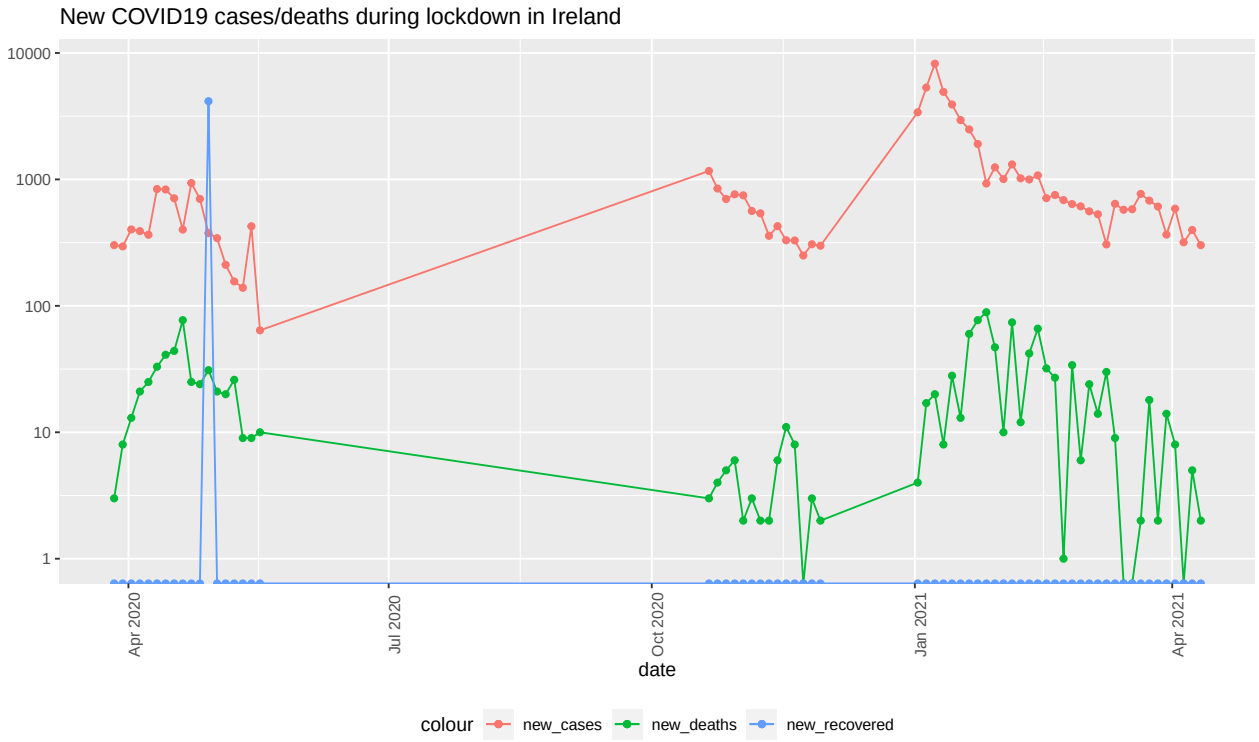
Hungary

```
cntry <- "Hungary"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



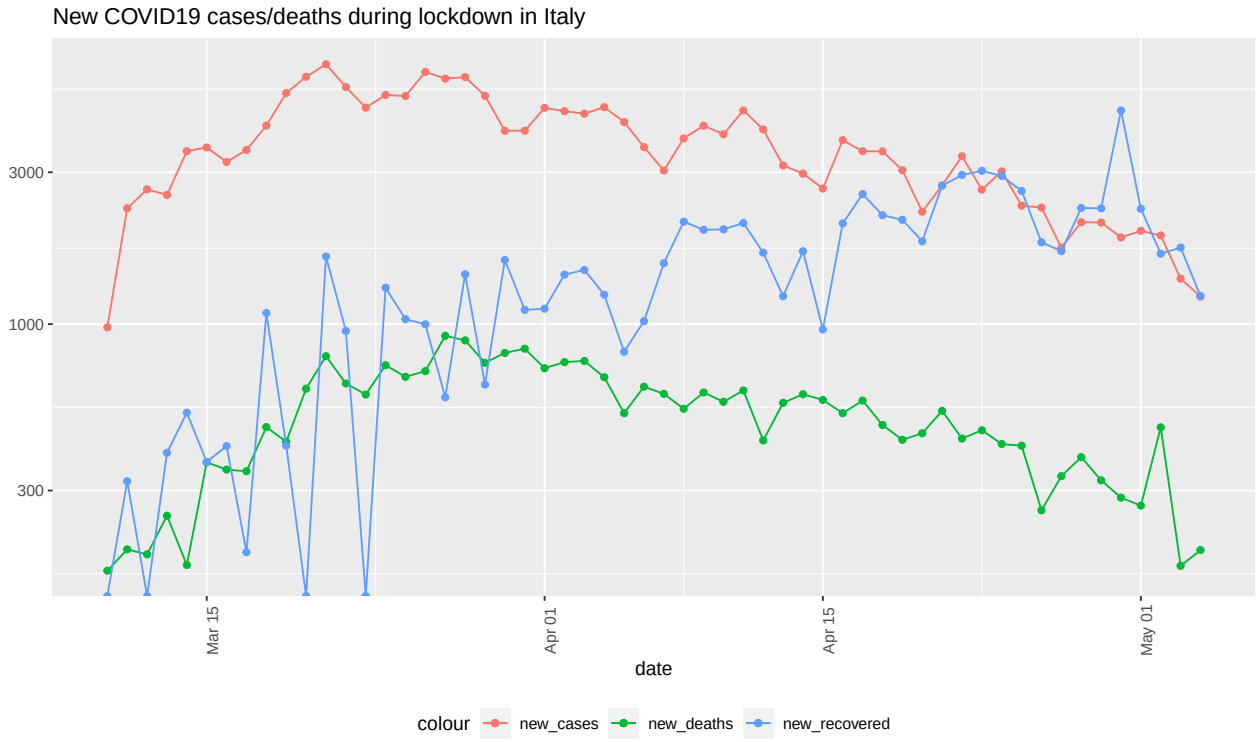
Ireland

```
cntry <- "Ireland"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



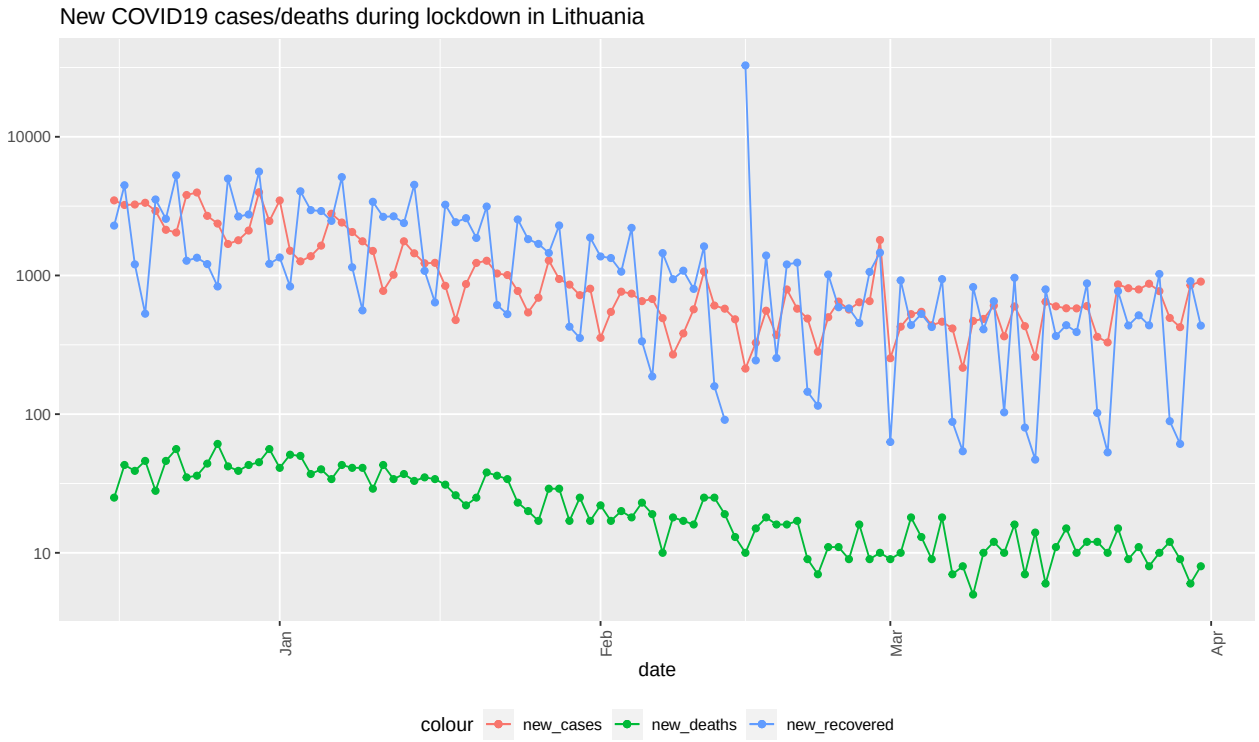
Italy

```
cntry <- "Italy"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



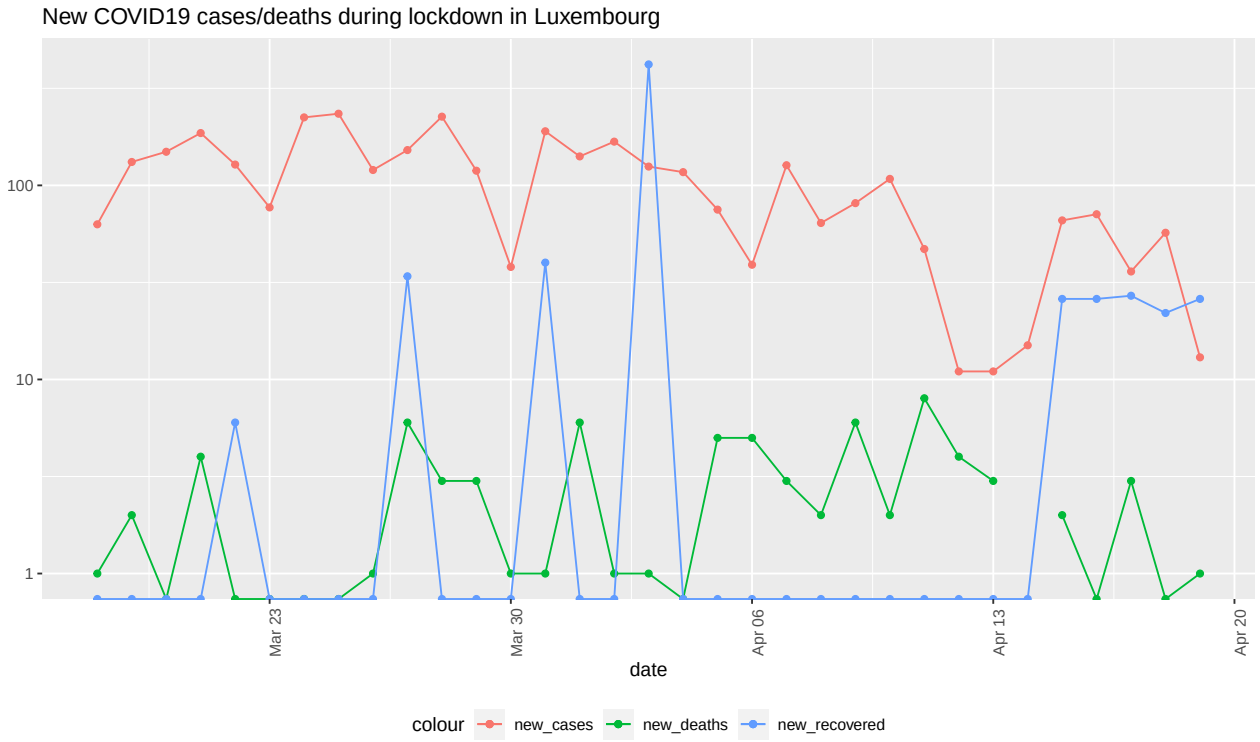
Lithuania

```
cntry <- "Lithuania"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



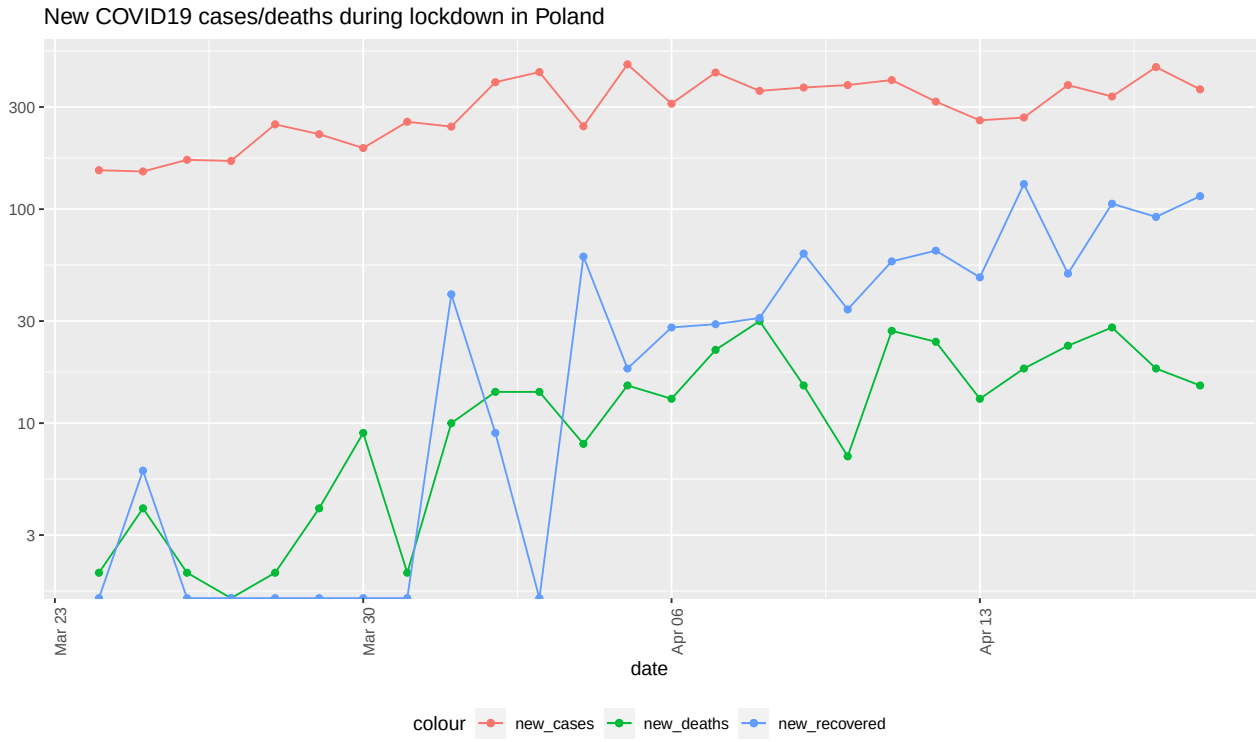
Luxembourg

```
cntry <- "Luxembourg"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



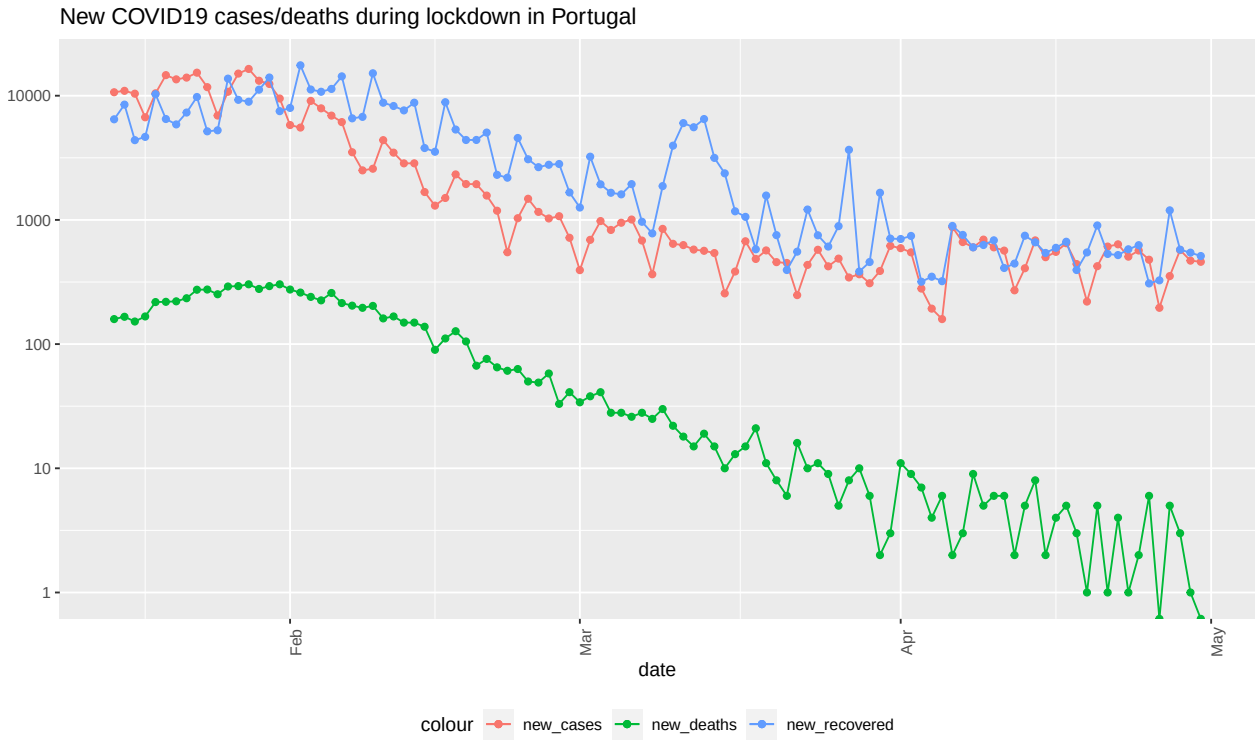
Poland

```
cntry <- "Poland"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



Portugal

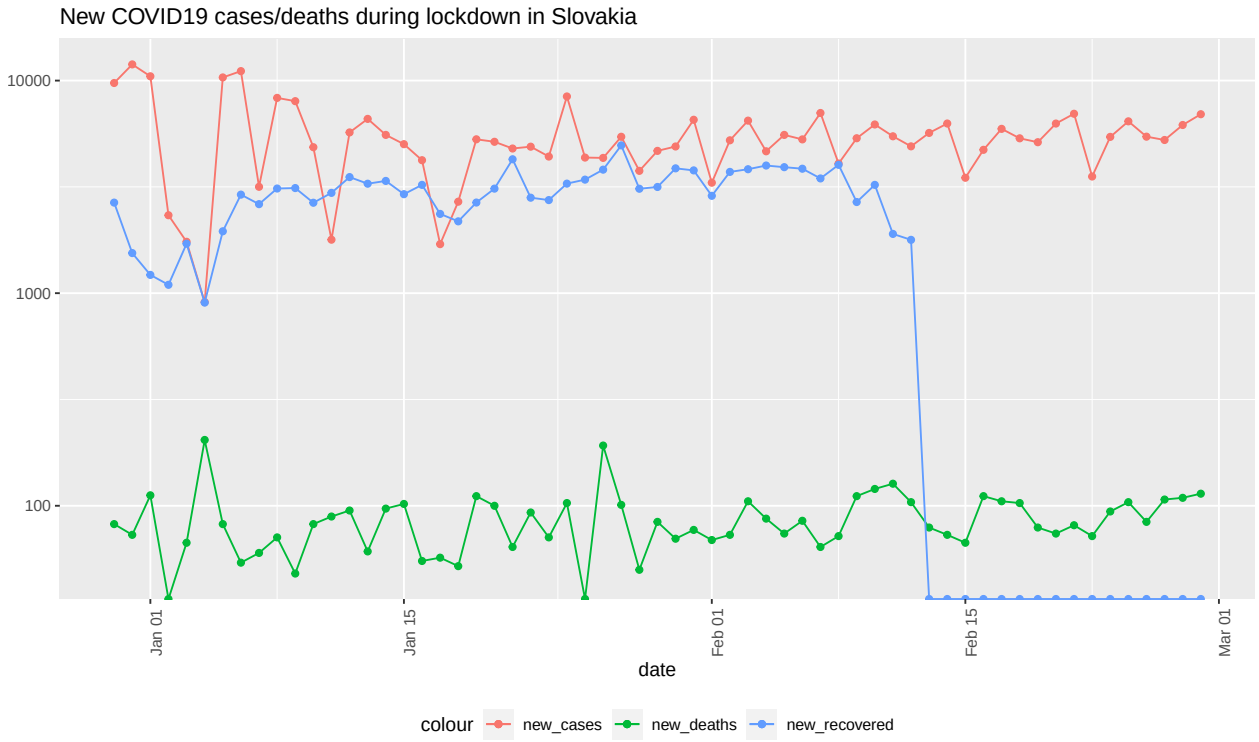
```
cntry <- "Portugal"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



Slovakia

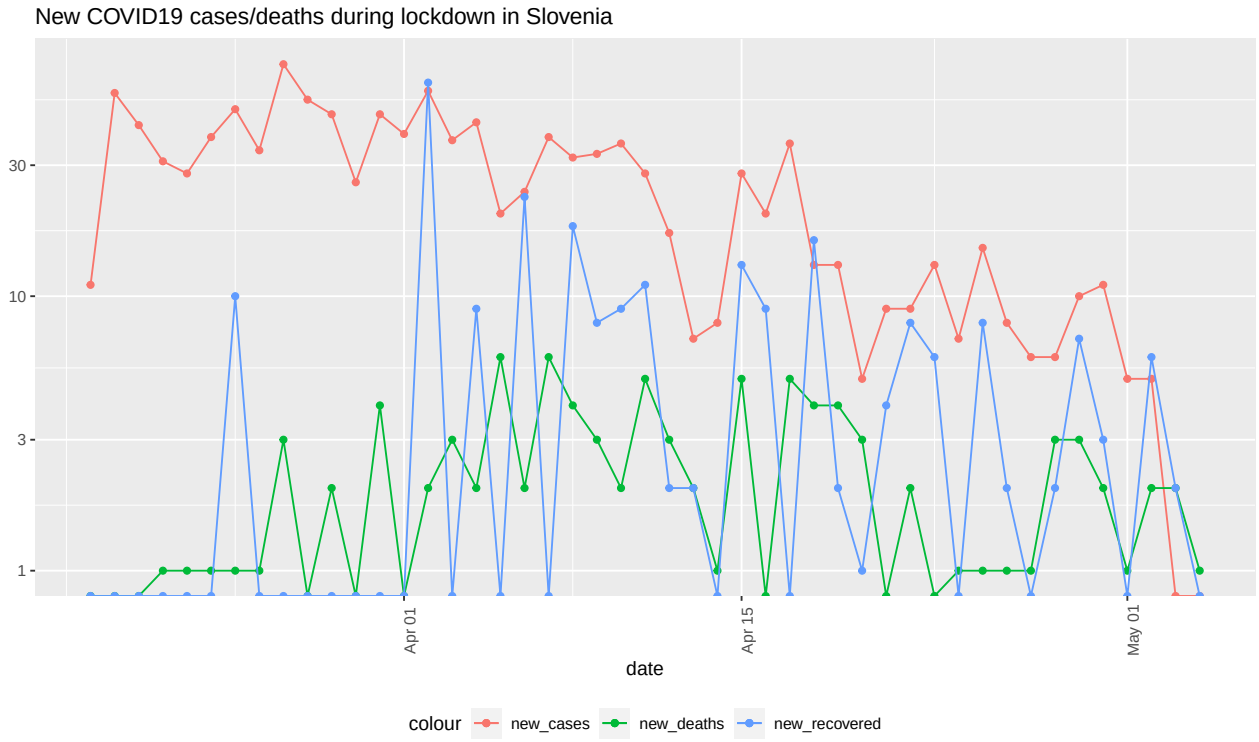
Slovakia stopped reporting new recoveries to the ECDC around Feb 12th of 2021.

```
cntry <- "Slovakia"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



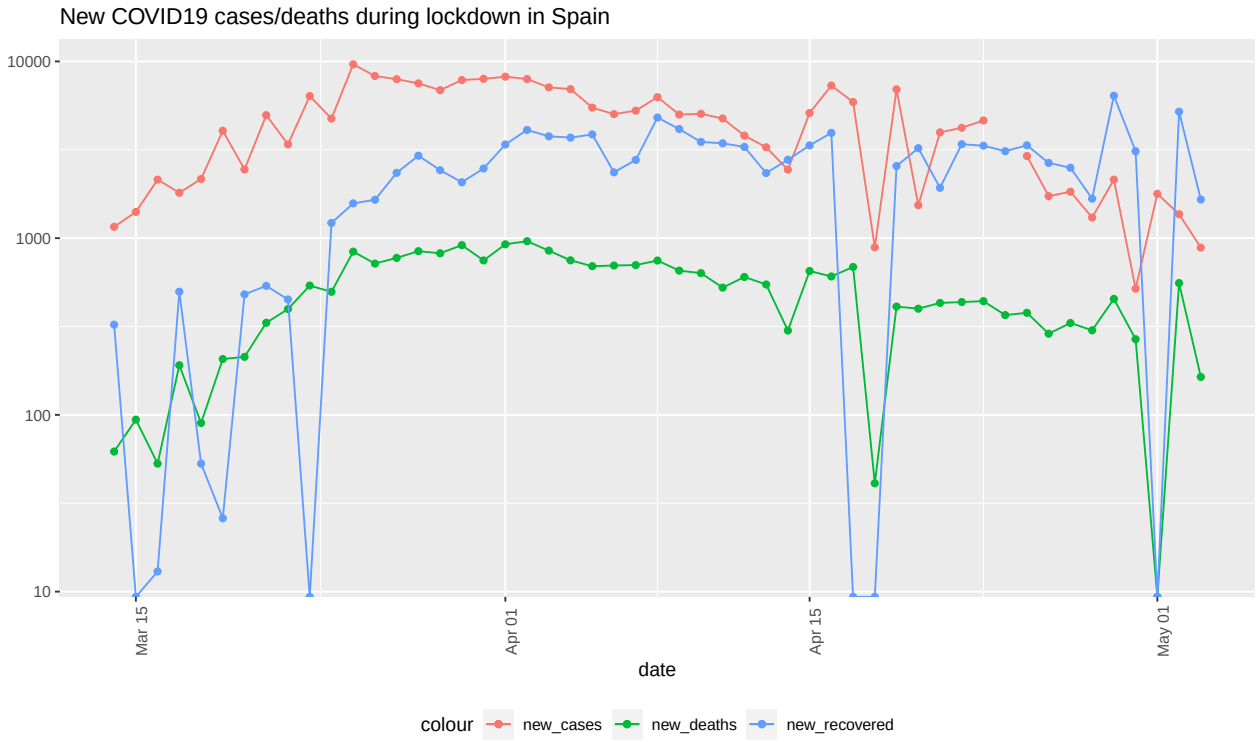
Slovenia

```
cntry <- "Slovenia"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



Spain

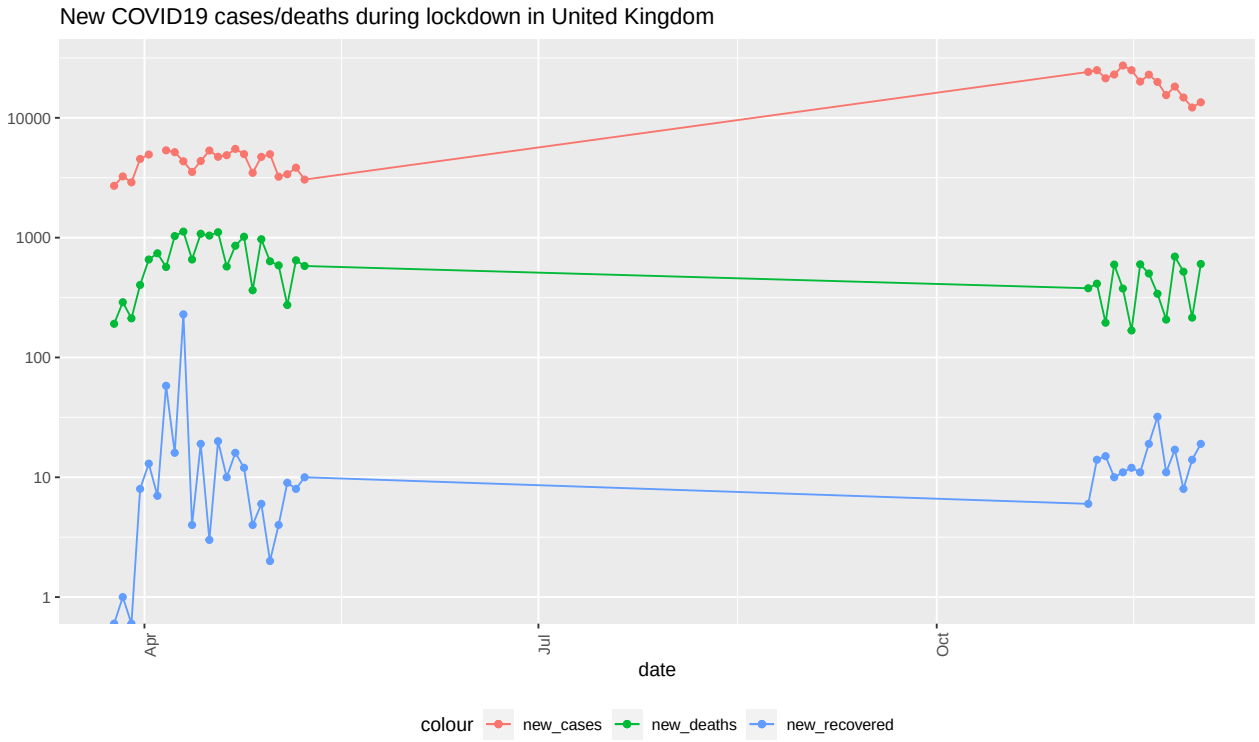
```
cntry <- "Spain"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered),new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```



United Kingdom

```
cntry <- "United Kingdom"
lockdown <- eu %>% filter(Country == cntry)
eu_covid %>% filter(Country_Region == cntry) %>% mutate(new_recovered = recovered - lag(recovered), new_
  ggplot(aes(x=date, y=new_cases)) +
  geom_line(aes(color="new_cases"))+
  geom_point(aes(color="new_cases"))+
  geom_line(aes(y=new_deaths, color="new_deaths"))+
  geom_point(aes(y=new_deaths, color="new_deaths"))+
  geom_line(aes(y=new_recovered, color="new_recovered"))+
  geom_point(aes(y=new_recovered, color="new_recovered"))+
  scale_y_log10()+theme(legend.position="bottom", axis.text.x=element_text(angle=90))+
  labs(title=str_c("New COVID19 cases/deaths during lockdown in ", cntry), y=NULL)
```

```
## `summarise()` has grouped output by 'Country_Region'. You can override using
## the `.groups` argument.
```



Some countries fail to report their daily newly recovered, this might be the fault of many systems that need to be connected or a failure by my code to see that change.

Modelling

I decided to run the same model we did in class, as I am a beginner within modelling of data. First, we need to calculate the cases/thousand, and deaths/thousand

```
EUTotal <- eu_covid %>% group_by(Country_Region) %>%
  summarize(deaths = max(deaths),
            cases = max(cases),
            population = max(Population),
            cases_per_thou = 1000*cases/population,
            deaths_per_thou = 1000*deaths/population)
EUTotal
```

```
## # A tibble: 17 x 6
##    Country_Region deaths    cases population cases_per_thou deaths_per_thou
##    <chr>           <dbl>    <dbl>      <dbl>          <dbl>           <dbl>
##  1 Austria         14594  2494535    9006400           277.           1.62
##  2 Belgium         30015  3512212   11492641           306.           2.61
##  3 Cyprus            825   308917    1207361           256.           0.683
##  4 Czechia         38335  3523869   10708982           329.           3.58
##  5 France         133671 21717576   65249843           333.           2.05
##  6 Greece          25417  2317014   10423056           222.           2.44
##  7 Hungary         43299  1759685    9660350           182.           4.48
##  8 Ireland          6443  1276778    4937796           259.           1.30
##  9 Italy          153190 12494459   60461828           207.           2.53
## 10 Lithuania        8267   865559    2722291           318.           3.04
```

```
## 11 Luxembourg        985   178507     625976           285.           1.57
## 12 Poland          109833  5563446   37846605           147.           2.90
## 13 Portugal         20866  3193178   10196707           313.           2.05
## 14 Slovakia         18252  2010065    5459643           368.           3.34
## 15 Slovenia          6222   880073    2078932           423.           2.99
## 16 Spain            98462 10858000   46754783           232.           2.11
## 17 United Kingdom 160610 18654572   67886004           275.           2.37
```

Next, we run the linear model on the data to find the correlation between the cases and deaths

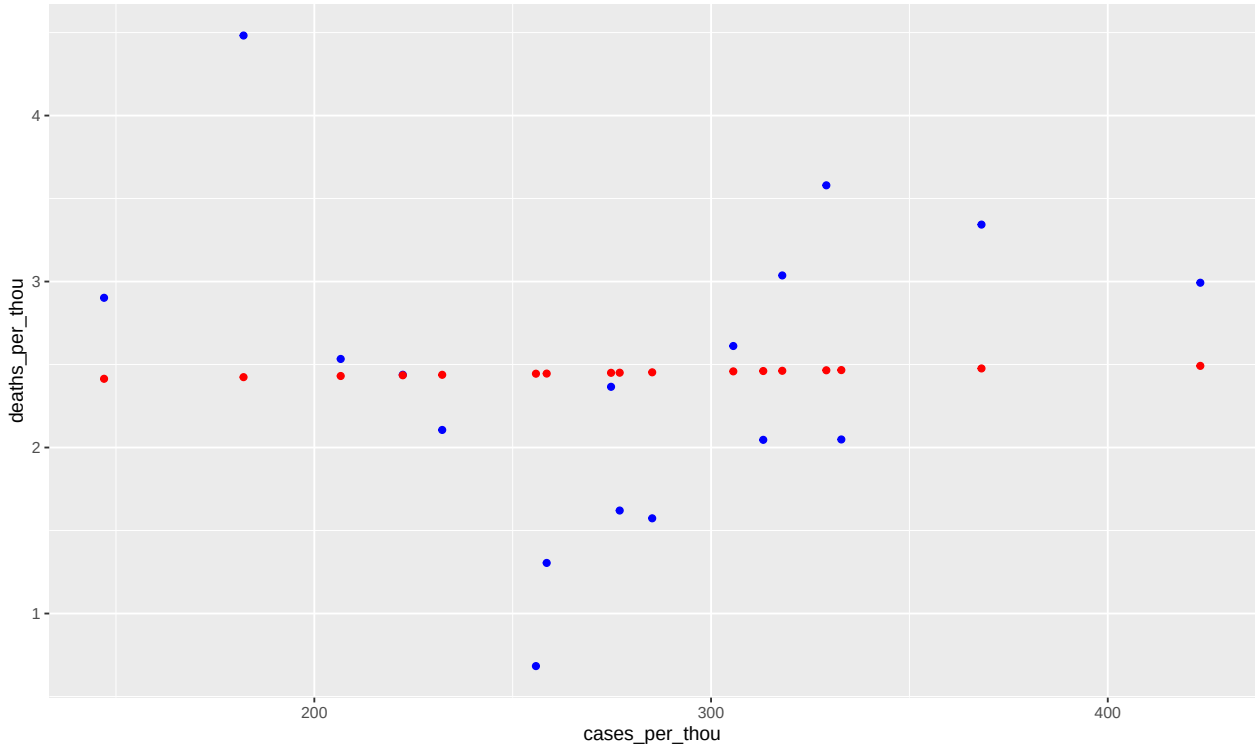
```
mod <- lm(deaths_per_thou ~ cases_per_thou, data=EUTotal)
summary(mod)
```

```
##
## Call:
## lm(formula = deaths_per_thou ~ cases_per_thou, data = EUTotal)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -1.7615 -0.4179  0.0032  0.5009  2.0581
##
## Coefficients:
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)    2.3726827  0.9817513   2.417   0.0289 *
## cases_per_thou 0.0002819  0.0034296   0.082   0.9356
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9456 on 15 degrees of freedom
## Multiple R-squared:  0.0004501,  Adjusted R-squared:  -0.06619
## F-statistic: 0.006755 on 1 and 15 DF,  p-value: 0.9356
```

```
EUTotal %>% mutate(pred=predict(mod))
```

```
## # A tibble: 17 x 7
##    Country_Region deaths   cases population cases_per_thou deaths_per_thou  pred
##    <chr>           <dbl>   <dbl>      <dbl>          <dbl>           <dbl> <dbl>
##  1 Austria         14594  2.49e6    9006400           277.            1.62   2.45
##  2 Belgium         30015  3.51e6   11492641           306.            2.61   2.46
##  3 Cyprus            825  3.09e5    1207361           256.            0.683  2.44
##  4 Czechia         38335  3.52e6   10708982           329.            3.58   2.47
##  5 France         133671  2.17e7   65249843           333.            2.05   2.47
##  6 Greece          25417  2.32e6   10423056           222.            2.44   2.44
##  7 Hungary         43299  1.76e6    9660350           182.            4.48   2.42
##  8 Ireland          6443  1.28e6    4937796           259.            1.30   2.45
##  9 Italy          153190  1.25e7   60461828           207.            2.53   2.43
## 10 Lithuania        8267  8.66e5    2722291           318.            3.04   2.46
## 11 Luxembourg        985  1.79e5     625976           285.            1.57   2.45
## 12 Poland         109833  5.56e6   37846605           147.            2.90   2.41
## 13 Portugal        20866  3.19e6   10196707           313.            2.05   2.46
## 14 Slovakia        18252  2.01e6    5459643           368.            3.34   2.48
## 15 Slovenia         6222  8.80e5    2078932           423.            2.99   2.49
## 16 Spain           98462  1.09e7   46754783           232.            2.11   2.44
## 17 United Kingdom 160610  1.87e7   67886004           275.            2.37   2.45
```

```
EUTotal_w_pred <- EUTotal %>% mutate(pred=predict(mod))
EUTotal_w_pred %>% ggplot() +
  geom_point(aes(x=cases_per_thou, y = deaths_per_thou), color="blue") +
  geom_point(aes(x=cases_per_thou, y = pred), color="red")
```



Bias

I believe that the bias comes from the underlying infrastructure of the healthcare systems of each country. This depends highly on reporting of the cases, deaths and recoveries, but not all recoveries are reported, not all cases are reported, and we can have false reporting when it comes to deaths. My personal bias comes when evaluating the countries and removing rows to make my graphs seem more clean.This data does not take into consideration the immunization levels of each country, as that could be releveant to the steady decline of the infection rate. There are many countries that are not on the list that took precautions, and this is may be a bias by the ECDC. But, it removes the study of the effects of Stay at home orders within those countries.

Conclusion

In conclusion, COVID-19 has ravaged many countries but as a society the effects of us staying at home and flattening curve can obviously be seen in my graphs above. Countries such as Italy had the deaths in the country dip during the lockdown process, but this can also be attributed to learning how to deal with the virus as they were hit harder than any country early on in the pandemic. Many countries fail to provide data for newly recovered people, for example: Greece seems to fail to report any new recoveries from Jan 2021 - Apr 2021, and this is the failure of the connection between federal government systems and EU systems.

I believe that for this assignment (and course in general) there was a clear lack in teaching of modeling the data to find correlation between data. This would have helped me in further investigating the data. My model failed to find any correlation between the two variables, and needs more information to find a clear indication of the rise in cases/deaths.