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COVI9-19 Pandemic

Business Analytics Practicum II

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Introduction

In the city of Wuhan, Hubei province, China, a series of cases of pneumonia occurred. On January 9, 2020, the Chinese health authorities announced that it is a new corona strain (2019-nCoV). This disease is now called COVID-19. 'CO' stands for corona, 'VI' for virus, and 'D' for disease. Formerly, this disease was referred to as '2019 novel coronavirus' or '2019-nCoV. Coronaviruses are a group of viruses that usually cause respiratory infections of varying severity in humans and animals. As of now, researchers know that the new coronavirus is spread through droplets released into the air when an infected person coughs or sneezes. The droplets generally do not travel more than a few feet, and they fall to the ground (or onto surfaces) in a few seconds. The coronavirus COVID-19 is affecting 213 countries and territories around the world and 2 international conveyances. Greece is one of the infected countries and in this assignment, we are going to show what is happening in Greece and compare Greece with other countries.

COVID-19 Dataset

The data source used for this analysis is the COVID19 package in R (https://covid19datahub.io/index.html) developed by Emanuele Guidotti, merged with exogenous variables helpful for a better understanding of COVID-19.

COVID-19 variables

Variable	Description
id	Unique identifier.
date	Observation date.

COVID-19 variables

Variable	Description
deaths	Cumulative number of deaths.
confirmed	Cumulative number of confirmed cases.
tests	Cumulative number of tests.
recovered	Cumulative number of patients released from hospitals or reported recovered.
hosp	Number of hospitalized patients on date.
icu	Number of hospitalized patients in ICUs on date.
vent	Number of patients requiring invasive ventilation on date.
population	Total population.

Policy measures

Variable	Description
school_closing	0: No measures - 1: Recommend closing - 2: Require closing (only some levels or categories, eg just high school, or just public schools - 3: Require closing all levels.
workplace_closing	0: No measures - 1: Recommend closing (or work from home) - 2: require closing for some sectors or categories of workers - 3: require closing (or work from home) all-but-essential workplaces (eg grocery stores, doctors).
cancel_events	0: No measures - 1: Recommend cancelling - 2: Require cancelling.
gatherings_restrictions	0: No restrictions - 1: Restrictions on very large gatherings (the limit is above 1000 people) - 2: Restrictions on gatherings between 100-1000 people - 3: Restrictions on gatherings between 10-100 people - 4: Restrictions on gatherings of less than 10 people.
transport_closing	0: No measures - 1: Recommend closing (or significantly reduce volume/route/means of transport available) - 2: Require closing (or prohibit most citizens from using it).
stay_home_restrictions	0: No measures - 1: recommend not leaving house - 2: require not leaving house with exceptions for daily exercise, grocery shopping, and "essential" trips - 3: Require not leaving house with minimal exceptions (e.g. allowed to leave only once every few days, or only one person can leave at a time, etc.).
internal_movement_restrictions	0: No measures - 1: Recommend closing (or significantly reduce volume/route/means of transport) - 2: Require closing (or prohibit most people from using it).
international_movement_restrictions	0: No measures - 1: Screening - 2: Quarantine arrivals from high-risk regions - 3: Ban on high-risk regions - 4: Total border closure.
information_campaigns	0: No COVID-19 public information campaign - 1: public officials urging caution about COVID-19 - 2: coordinated public information campaign (e.g. across traditional and social media).
testing_policy	0: No testing policy - 1: Only those who both (a) have symptoms AND (b) meet specific criteria (eg key workers, admitted to hospital, came into contact with a known case, returned from overseas) - 2: testing of anyone showing COVID-19 symptoms - 3: open public testing (eg "drive through" testing available to asymptomatic people).

Variable	Description
contact_tracing	0: No contact tracing - 1: Limited contact tracing, not done for all cases - 2: Comprehensive contact tracing, done for all cases.
stringency_index	Stringency of governmental responses.

Geographic information

Variable	Description
administrative_area_level	Administrative area level.
administrative_area_level_1	Administrative area of top level.
administrative_area_level_2	Administrative area of a lower level, usually states, regions or cantons.
administrative_area_level_3	Administrative are of a lower level, usually cities or municipalities.
latitude	Latitude.
longitude	Longitude.

COVID-19 Worldwide

The outbreak of COVID19 was first identified in Wuhan, China, in December 2019.The World Health Organization declared the outbreak a Public Health Emergency of International Concern on 30 January, and a pandemic on 11 March. As of 17 May 2020, more than 4.71 million cases of COVID-19 have been reported in more than 188 countries and territories, resulting in more than 315,000 deaths. More than 1.73 million people have recovered from the virus. Cases refer to the number of people who have been tested for COVID-19, and whose test has been confirmed positive according to official protocols.

Using the dataset provided by R package, the situation on 17/05/2020 regarding the confirmed cases worldwide is depicted on the picture below. The color and the size of the bubble represents the spred of COVID19 wordwide with regard to the population of each country.
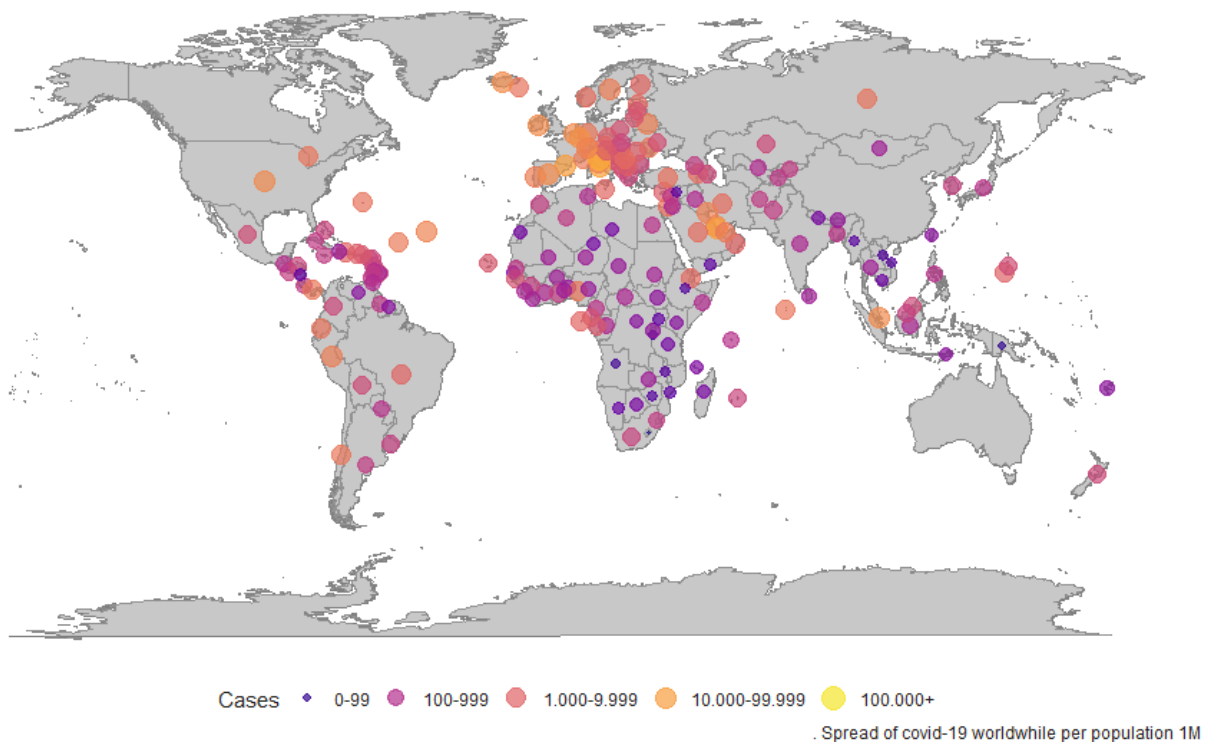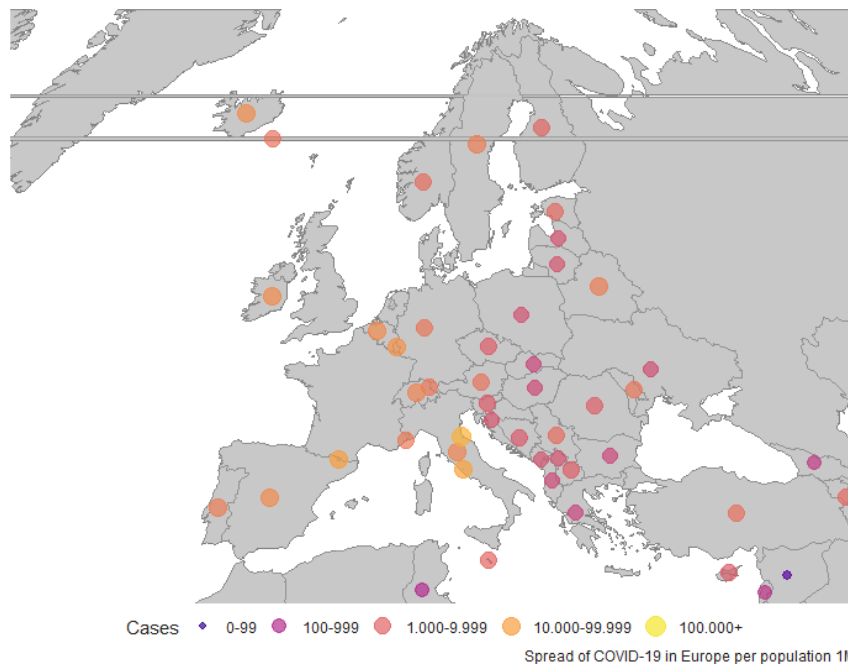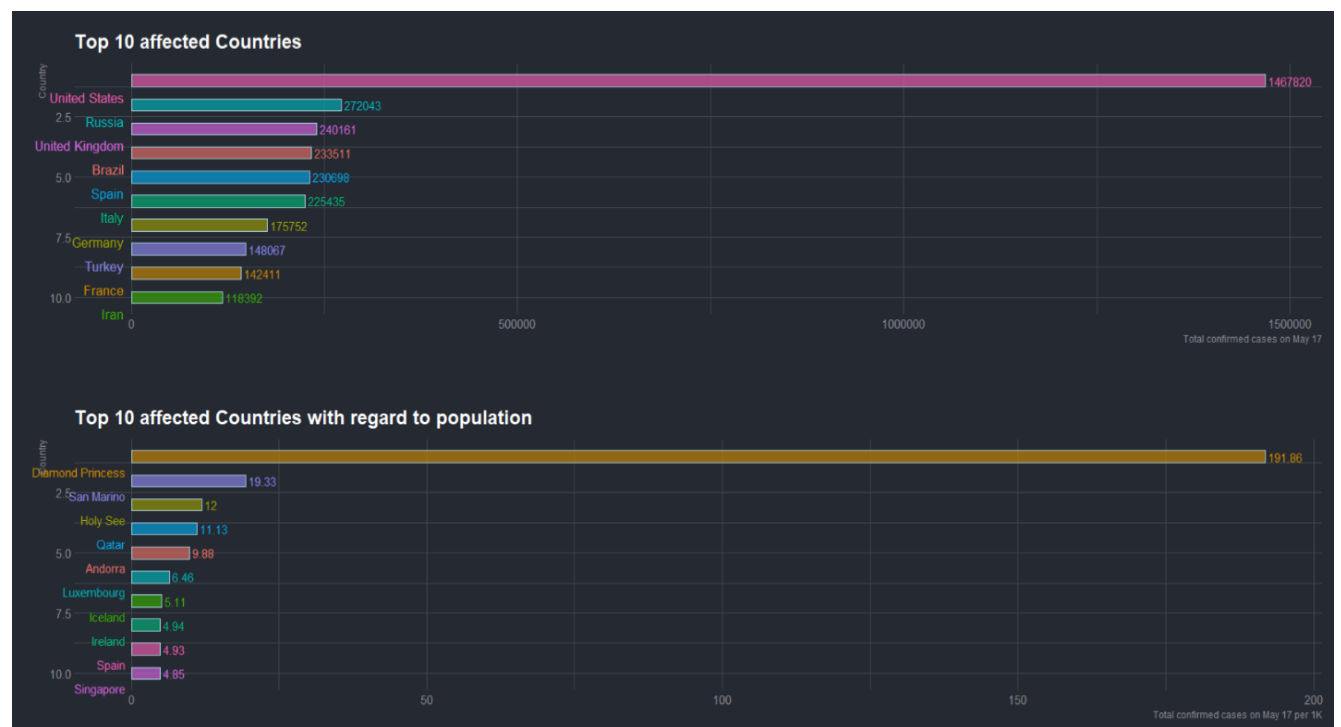

Cases ◆ 0-99 ● 100-999 ● 1.000-9.999 ● 10.000-99.999 ● 100.000+

. Spread of covid-19 worldwhile per population 1M

Figure 1

If we zoom in at Europe, me can see more details about the spread of the virus in European countries. (figure 2)

Cases   ◆ 0-99   ● 100-999   ● 1.000-9.999   ● 10.000-99.999   ● 100.000+

Spread of COVID-19 in Europe per population 1M

Most affected countries- TOP 10

Covid-19 has spread around the planet, sending billions of people into lockdown as health services struggle to cope. Below is a list of the countries most affected by the coronavirus, in terms of the number of registered cases on May 17, 2020. The 10 top countries affected are depicted regarding the absolute number of cases and regarding the population of each country. It come as no surprise that even if USA is the top country with the most cases (1.467.820), taking into consideration the population of each country, in the first place of top affected is the cruise ship Diamond Princess.


Top 10 affected Countries

Country	Total confirmed cases on May 17
United States	1467820
Russia	272043
United Kingdom	240161
Brazil	233511
Spain	230698
Italy	225435
Germany	175752
Turkey	148067
France	142411
Iran	118392

Top 10 affected Countries with regard to population

Country	Total confirmed cases on May 17 per 1K
Diamond Princess	191.86
San Marino	19.33
Holy See	12
Qatar	11.13
Andorra	9.88
Luxembourg	6.46
Iceland	5.11
Ireland	4.94
Spain	4.93
Singapore	4.85

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COVID19 in Greece

The COVID-19 pandemic first appeared in Greece on 26 February 2020 when the first COVID-19 case, a 38-year-old woman from Thessaloniki who had recently visited Northern Italy, was confirmed. Subsequent cases in late February and early March related to people who had travelled to Italy and a group of pilgrims who had travelled to Israel and Egypt, as well as their contacts. The first death from COVID-19 in Greece was a 66-year-old man, who died on 12 March. As of 17 May 2020, there have been 2,834 confirmed cases and 163 deaths, according to National Public Health Organization. However, the package of R that we used is not fully updated.

In the below plots we are going to investigate how COVID19 was spread and compare Greece with other countries, taking into account various metrics to be compared.

The dataset that we us, provided the cumulative cases per day for each country regarding confirmed, deaths and recovered cases for each country. We created a new column with the active cases, that is confirmed -deaths-recovered.

The trend line for the number of daily cases of active, confirmed, deaths and recovered people in Greece with the mean cases of rest of the world we can observe that Greece on average has less daily cases than the other countries and is below the benckmark.
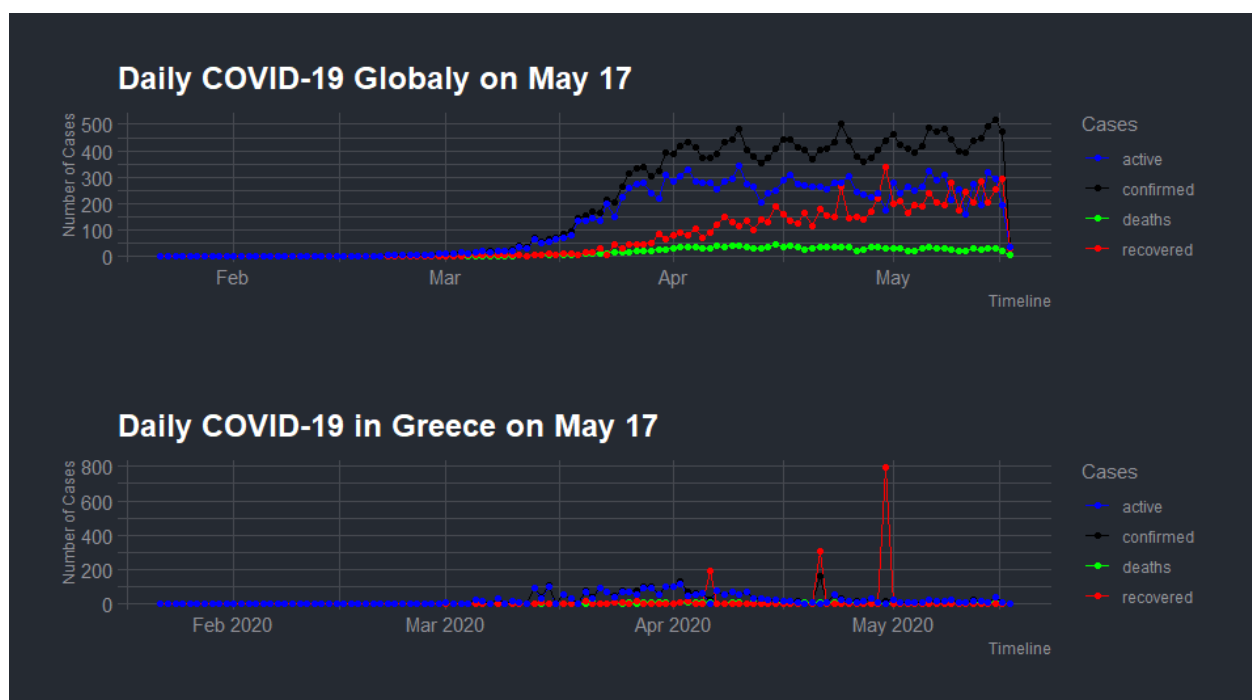
The same pattern is observed in the cumulative cases of the abovementioned categories. From March 2020, when the first case appeared in Greece the daily cases are below 100, with few exceptions.

Cumulative COVID-19 Globaly on May 17

Cumulative COVID-19 in Greece on May 17
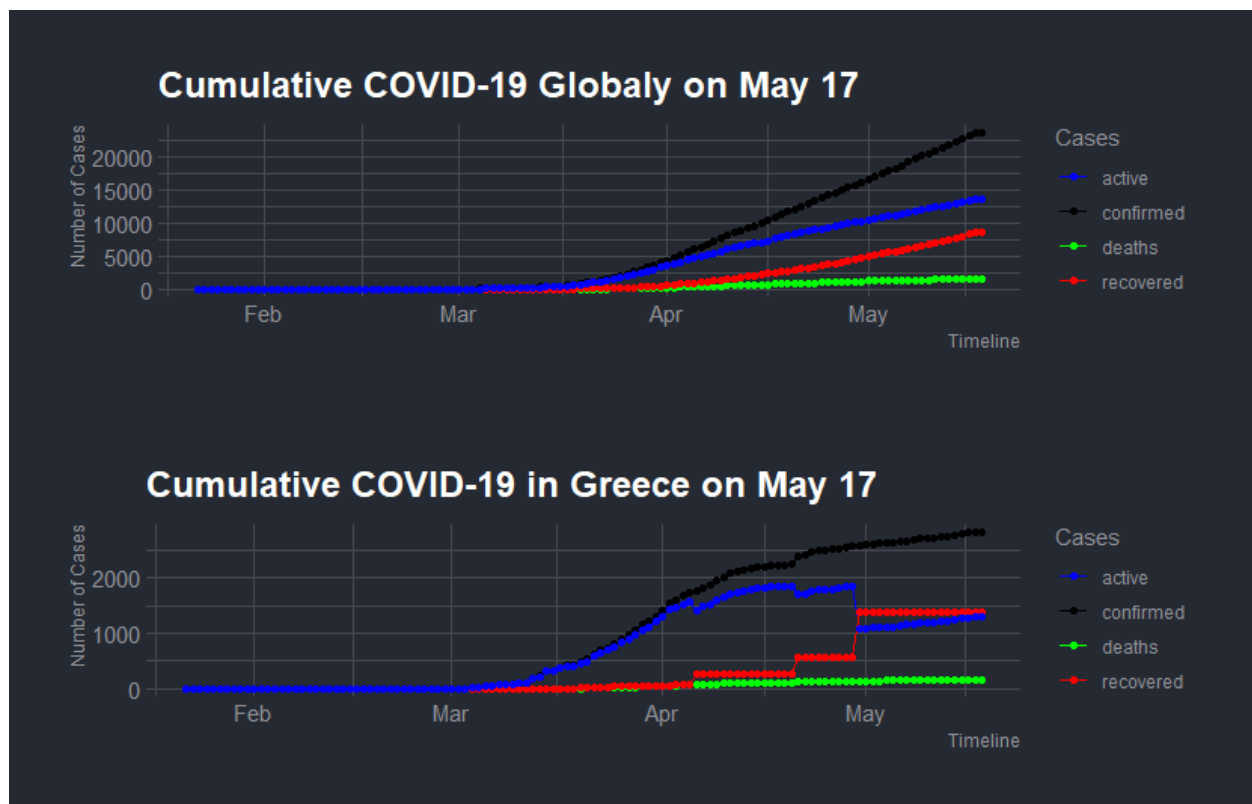
To better understand the data and what is going in Greece, we plotted in a boxplot the active, confirmed and recovered cases. Boxplots are a measure of how well distributed is the data in a data set. It divides the data set into three quartiles. This graph represents the minimum, maximum, median, first quartile and third quartile in the data set. The red dot represents Greece and we can see the median is more dispersed for all variables. We can also notice outliers at the higher extreme, and there are more since the y axis limit is settled from 100 to 100000.

Greece VS Balkans

Since Greece is part of Balkans countries, we thought that it would be a good idea to compare Greece with the other countries in Balkan Peninsula, considering that countries in the same geographical area belong in the same group regarding the spread of the virus. Calculating Infection Rate, that is the number of infected (confirmed) people divided by the population of the country, a new metric is created. The below plot depicts how the infection rate evolved through time in Balkan. We can observe that for the time being Greece scores the best, since on 17-05-2020 has the lowest infection rate among the countries.
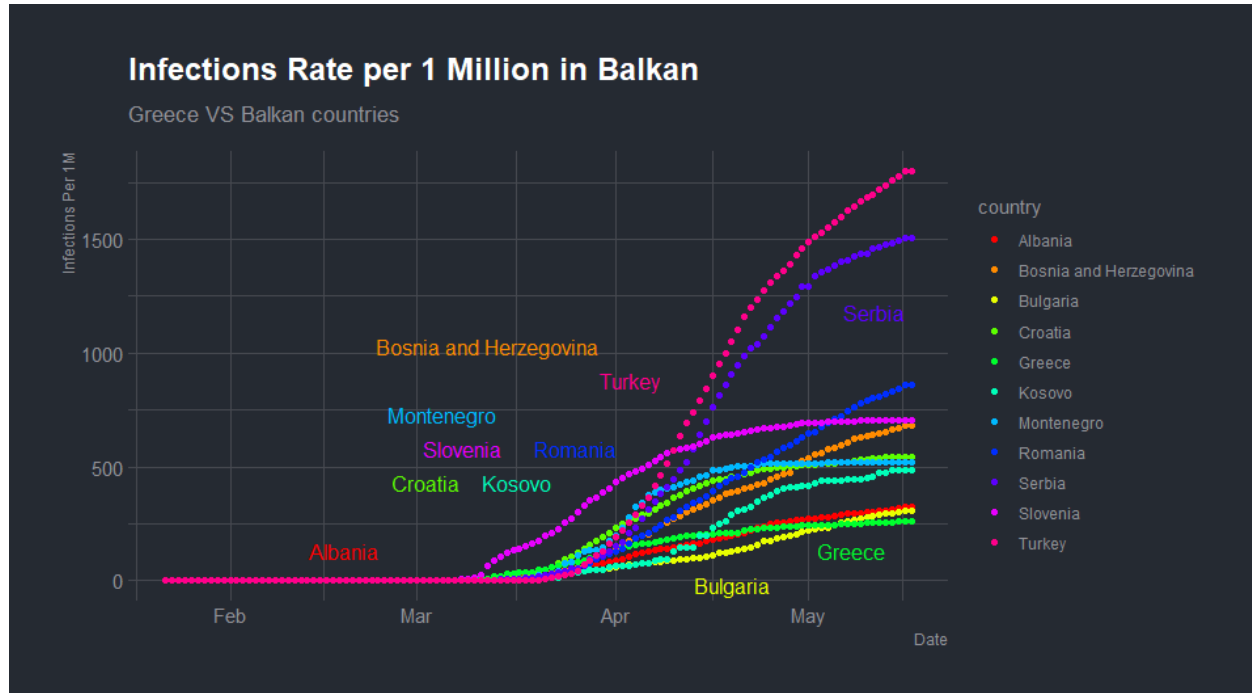

But how did Greece score regarding the recovered cases? An appropriate metric to capture the recovered group of people is to calculate the recovered cases per population. In the below treemap, is observed that Turkey has the most recovered cases per 1 million population and counts for the 28% of the map, with 1314 recovered cases per 1 million people. However, we should take into consideration that Turkey is one of top 10 the countries with the most cases (3rd plot) and that may affect this metric. Greece has 128 recovered cases per 1 million people and occupies 3% of the treemap.
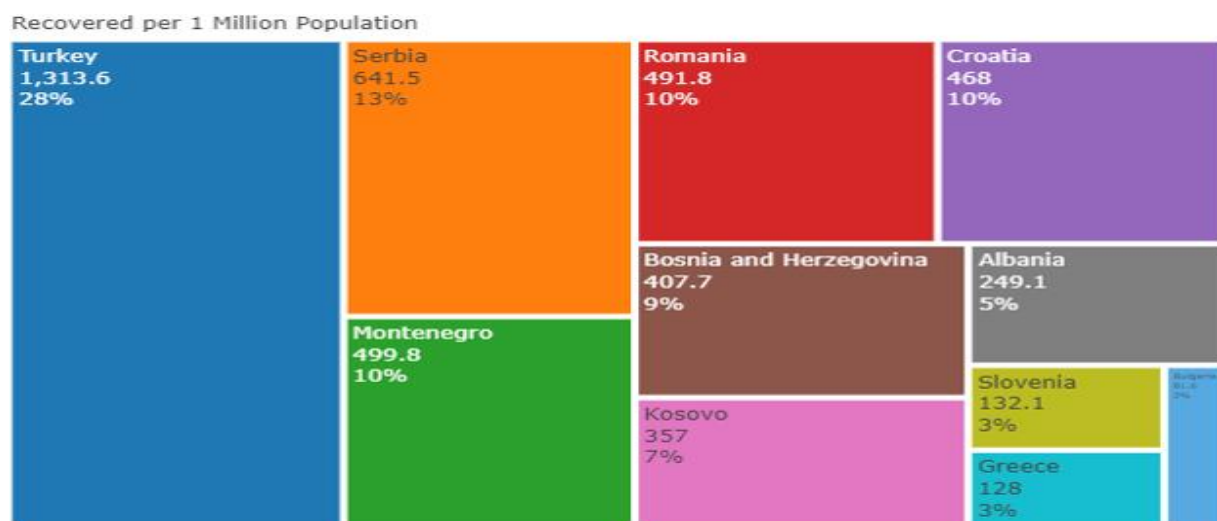
In the above plots we have seen the confirmed and the recovered cases in Balkan and how Greece scored among the countries. In the below chart we are going to investigate how Greece scored regarding deaths and active cases. Dumbbell plot is great for displaying changes between two points in time. We chose deaths and recovered to depict the gap between these two variables, in a descending order. Turkey again has the biggest gap due to the large number of infected people and Greece comes fifth in Balkans. Turkey, Serbia and Romania have gaps that overcome a difference of 3500 cases.
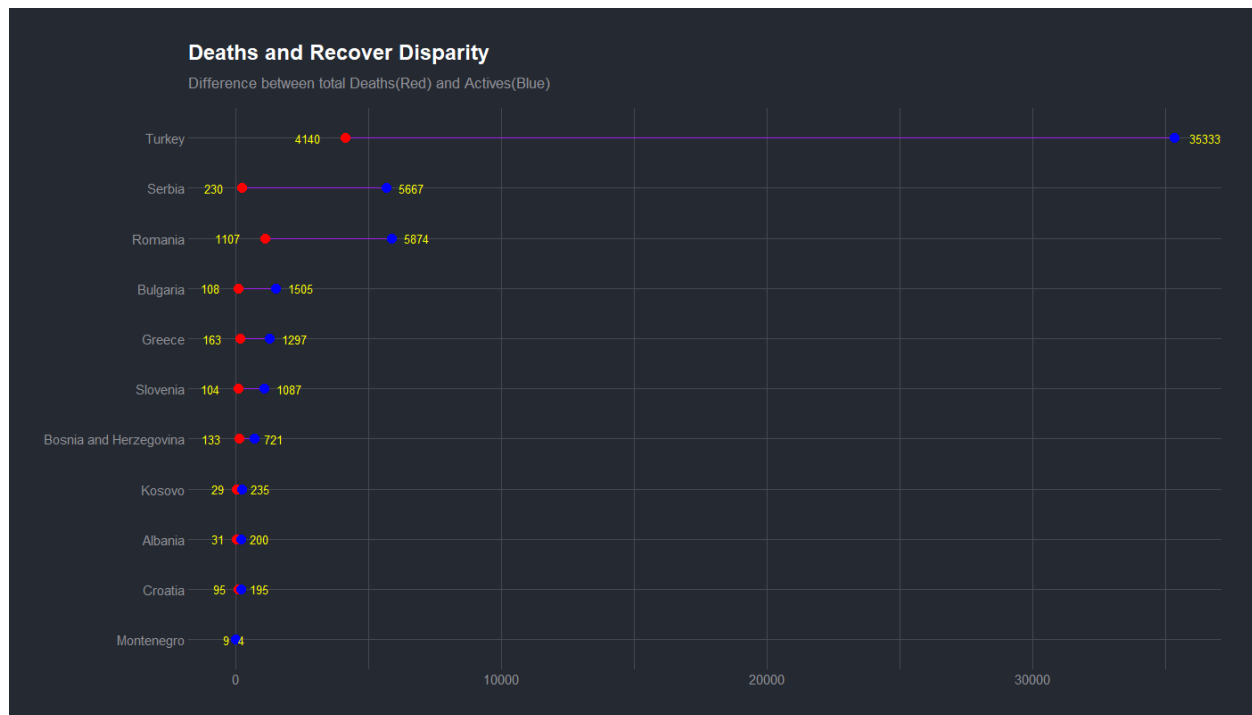

 Finally, an interesting plot regarding Balkan countries would be a scatter plot with Deaths and Confirmed cases on 17-05-2020. We can observe that Albania, Greece and Bulgaria have the lowest ratio of total deaths per confirmed cases per 100K population. That is really interesting since these three countries are neighbors and located in Southern Europe. On the other hand, Turkey again shows the highest ratio of deaths among confirmed cases. In order to better understand how the death rate (deaths divided with the population) is changing over the Balkan countries as the time goes by, we created an animated gif which represent who the logarithm of the death rate changes over time in Balkan.

**Total deaths and confirmed cases per 100k, by Country**
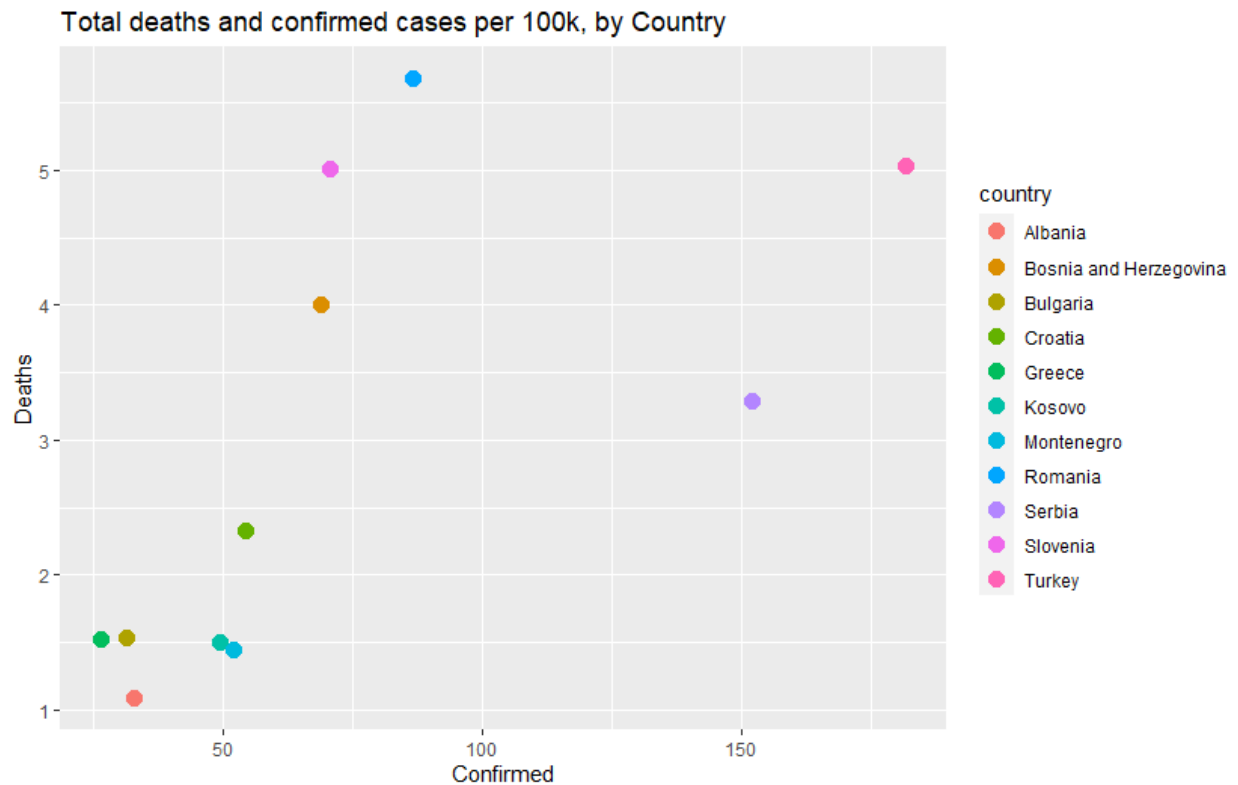
COVID-19 in countries with similar population with Greece

Greece a country located in Southeast Europe. Its population is approximately 10.7 million as of 2018. If we select countries with the same population with Greece, we can investigate how the whole spread of the virus went, regarding the lockdown measures for staying home taken in these countries. The below trellis like plot for different 5 countries with the same population with Greece.
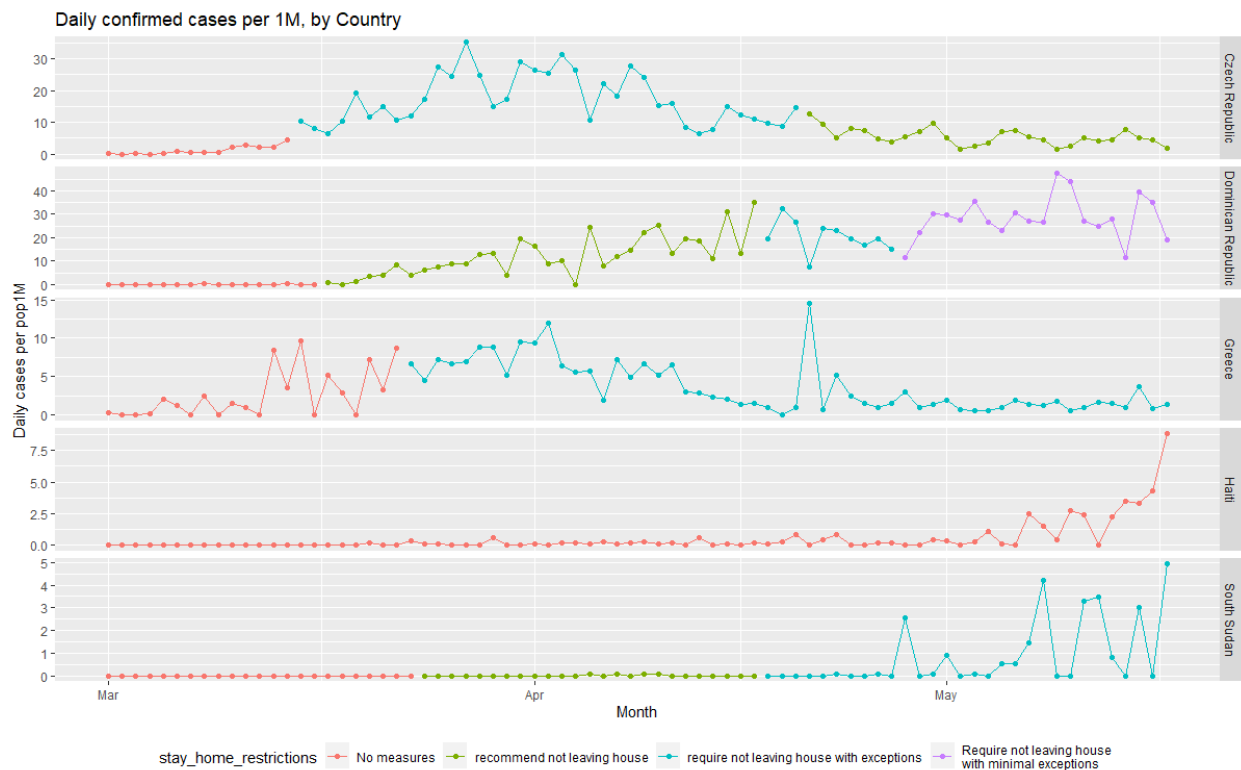
Haiti did not take any measure during the pandemic and that's why the daily cases are increasing the last days. In South Sudan there were not cases of confirmed until end of April and from then on, the country started to impose staying home restrictions. In Czech Republic, after the first confirmed cases, the government took restriction measures and from the mid of April the daily confirmed cases of infected people are decreasing. In Dominican Republic the daily confirmed cases are constantly increasing and that's why the government is imposing more strict measures as the time goes by. In Greece the confirmed cases started a bit earlier in comparison with the other cases. We can observe that after the first increases on the infected people the government took the appropriate measures requiring people to stay home with a few exceptions. From the end of May daily cases are gradually decreasing.

In the below trellis plot, we calculated the percentage change of confirmed cases on daily basis just to capture the rate of change over the months. The lower the rate, the better since we wish to see a decreasing percentage change on the number of confirmed cases each day.
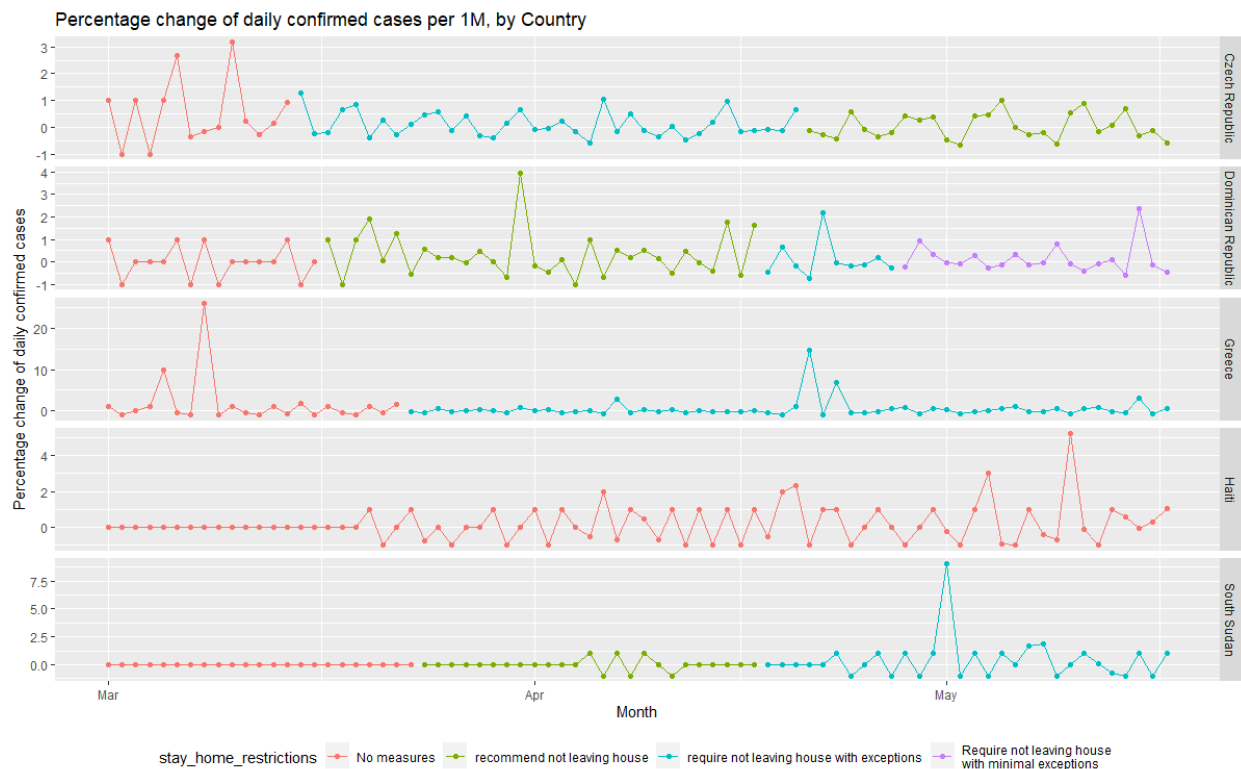
Conclusion

The coronavirus outbreak in Greece should have been a disaster. As a popular tourist destination, Greece received 27.2 million visitors in 2017 alone—presenting a potentially significant risk of COVID-19 from international travelers. And yet, Greece has avoided the worst of the global pandemic so far, with only 2.834 confirmed cases and 163 deaths as of May 18, one of the lowest counts in the European Union. The key to Greece's success, analysts say, was the government's early steps to contain the virus ahead of most of Europe. In late February, before a single death from the disease had been recorded, carnivals were canceled. Schools and universities nationwide were closed on March 10, when there were just 89 confirmed cases in the country. Cafes, restaurants and tourist spots were closed three days later, ledding the country to lockdown.