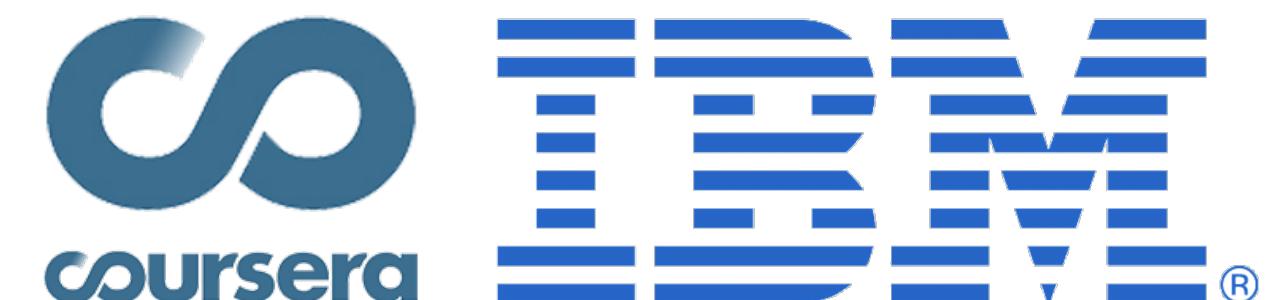


A close-up, semi-transparent rendering of several COVID-19 virus particles against a dark gray background. The particles are spherical with a distinct 'crown' or spike-like structure on their surface, colored in shades of red, orange, yellow, and white.

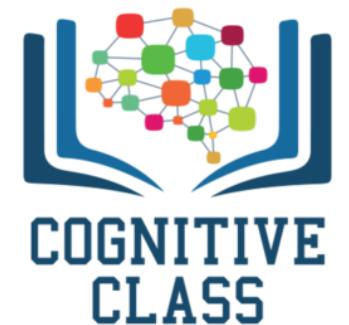
by E. KARENTZOS

# COVID-19: THE GREEK OUTBREAK

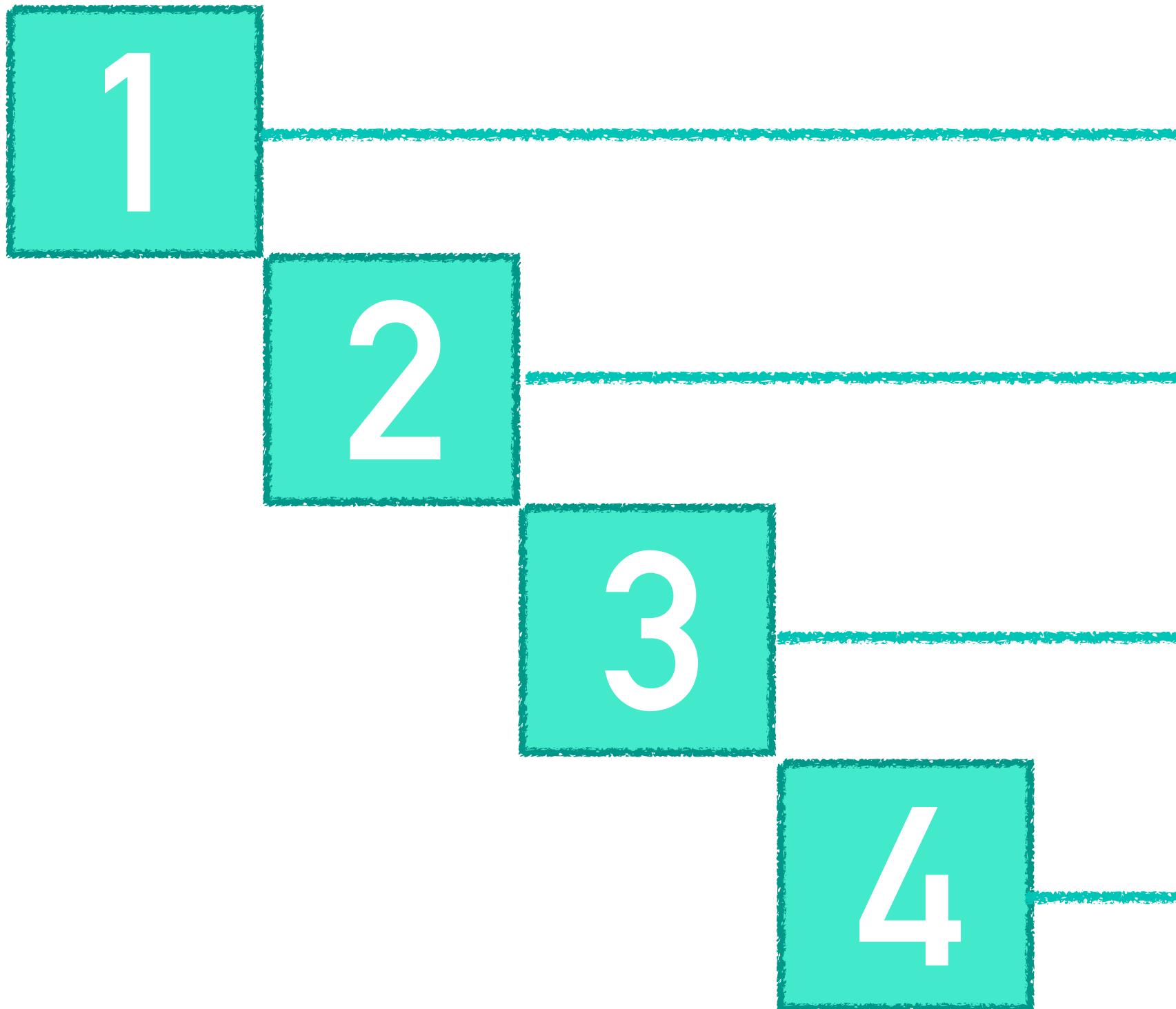


IBM Final Capstone Project

14.07.2020



# OUTLINES



**The Coronavirus (Covid-19)**

**The Global Outbreak**

**The Covid-19 in GREECE**

**Remarks**

# THE CORONAVIRUS = COVID-19

The Corona-virus disease 2019 (COVID-19) is a pandemic first originated in Wuhan the capital of Hubei province, China in December 2019 and then spread globally. It is caused by a severe acute respiratory syndrome corona-virus-2 (SARS-CoV-2).

## 5 January 2020

WHO published our first Disease Outbreak News (Pneumonia of unknown cause in China) on the new virus.

## 12 January 2020

China publicly shared the genetic sequence of COVID-19.

## 30 January 2020

WHO's situation report for 30 January reported **7818** total confirmed cases worldwide, with the majority of these in China, and **82** cases reported in 18 countries outside China.

## 16-24 February 2020

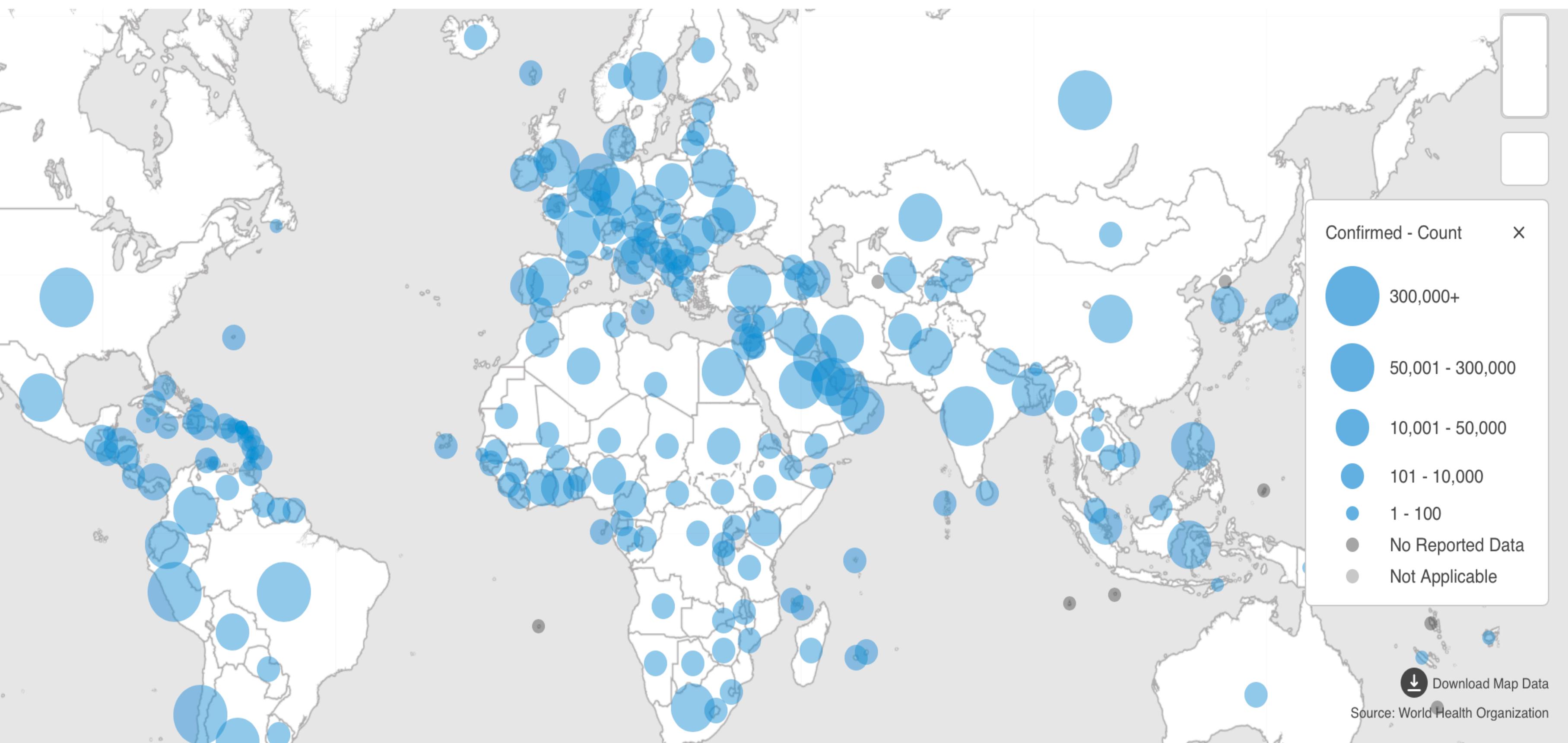
The WHO-China Joint mission.

## 11 March 2020

The alarming levels of spread, severity, and the inaction, made WHO to declare that COVID-19 can be characterised as a **PANDEMIC**.



# THE GLOBAL OUTBREAK



**12,750,275**  
Confirmed Cases

**197,510**  
New Cases

**566,355**  
Deaths

# THE GLOBAL OUTBREAK

## 200000

confirmed cases of Covid-19 in a day have been counted globally since the 22th of January, 2020.

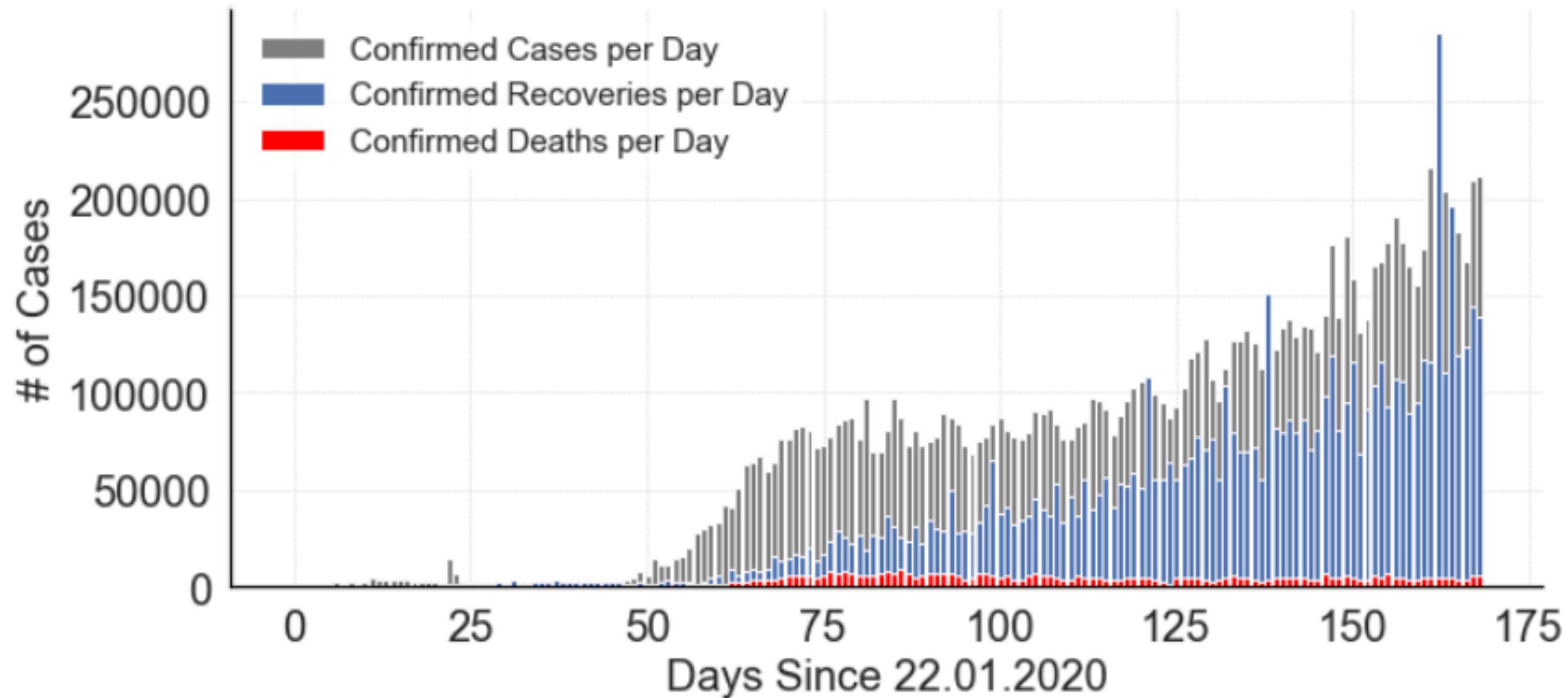
## Day 50

After that day the cases have been increased rapidly, indicating the severeness and the fast spread of the disease among the country's population.

WHO declares a PANDEMIC.

## 150000

recovery cases of Covid-19 in a day have been counted globally since the 22th of January, 2020.



Province/State	Country/Region	Lat	Long	1/22/20	1/23/20	1/24/20	1/25/20	1/26/20	1/27/20	...	6/29/20	6/30/20	7/1/20	7/2/20	7/3/20	7/4/20
0	NaN	Afghanistan	33.0000	65.0000	0	0	0	0	0	0	31238	31517	31836	32022	32324	32671
1	NaN	Albania	41.1533	20.1683	0	0	0	0	0	0	2466	2535	2580	2662	2752	2819
2	NaN	Algeria	28.0339	1.6596	0	0	0	0	0	0	13571	13907	14272	14657	15070	15500
3	NaN	Andorra	42.5063	1.5218	0	0	0	0	0	0	855	855	855	855	855	855
4	NaN	Angola	-11.2027	17.8739	0	0	0	0	0	0	276	284	291	315	328	340

5 rows x 173 columns

# THE GLOBAL OUTBREAK

**1** At 11th of March 2020 the WHO declared the Covid-19 PANDEMIC.

Table shows the confirmed Covid-19 cases in

**CHINA**

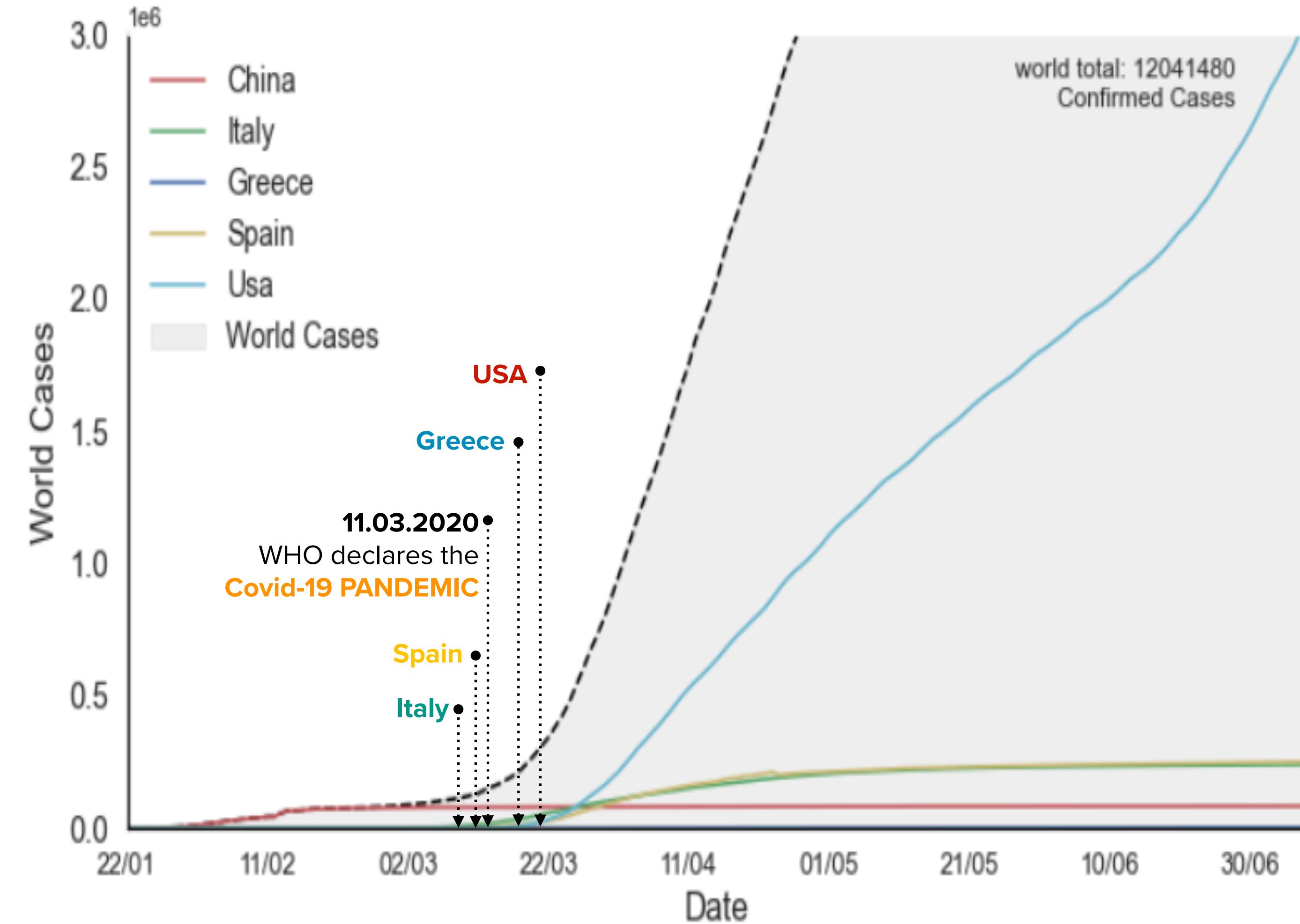
the first 5 days from the counting day.

Date	World Cases
22/01	555
23/01	654
24/01	941
25/01	1434
26/01	2118

**2** The virus has been spread in **ITALY** after a big commercial conference in Milan. The health system of Italy saturated rapidly, while the measures never been applied properly.

**3** Similarly to Italy, other **European** countries and **USA** have been infected severely. Once again the measures applied either locally or not at all.

**4** **GREECE** acted seriously and directly by applied tight measures nationally. This kept the number of cases too low in comparison with the rest of the countries worldwide.



# THE COVID-19 IN GREECE

26 February 2020

The **first case** in Greece was confirmed when a 38-year-old woman from Thessaloniki who had recently visited **Northern Italy**, was confirmed to be infected.

3826

Confirmed Cases

1442

Recovered

12 March 2020

The **first death** from COVID-19 in Greece was a 66-year-old man.

193

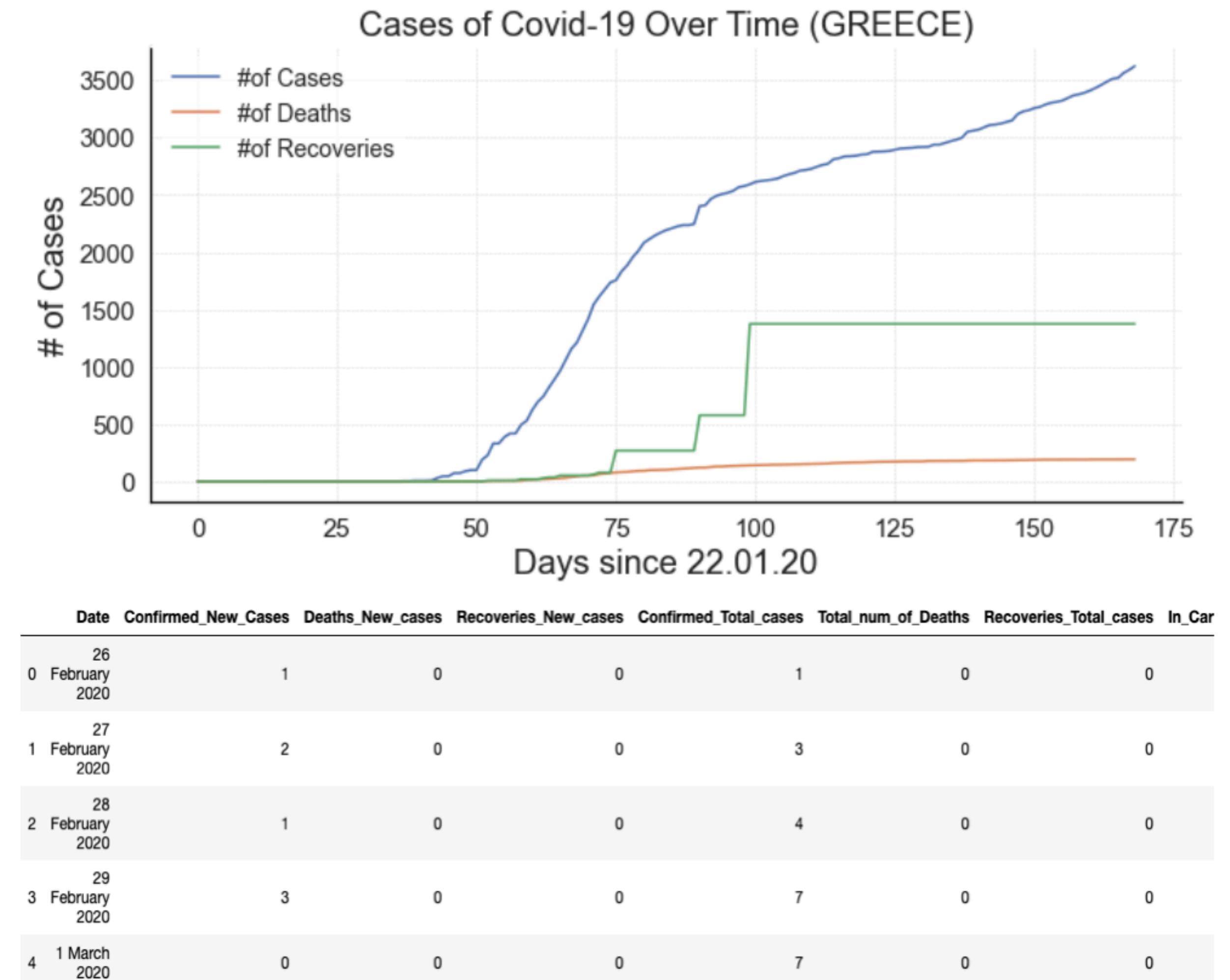
Deaths

13 July 2020

**27** new cases of covid-19, mainly coming from abroad.

12

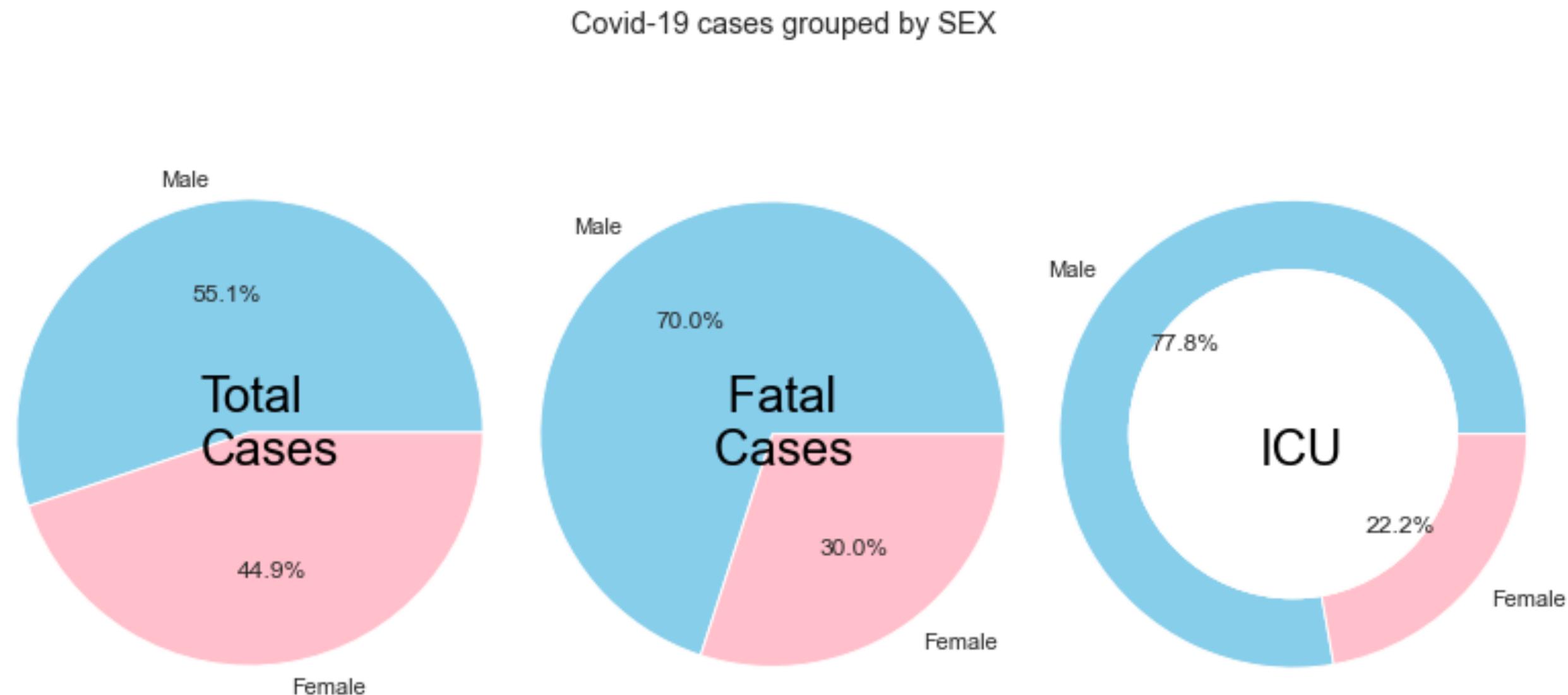
ICU Treatment



# THE COVID-19 IN GREECE: AGE AND SEX

## Data grouped by SEX

As can be deduced from the pie charts, **MEN** are more **susceptible** to the virus, and they are having more intense symptoms as they hospitalised much more in ICUs than **WOMEN**, with a **mortality rate** of **8.3%**.

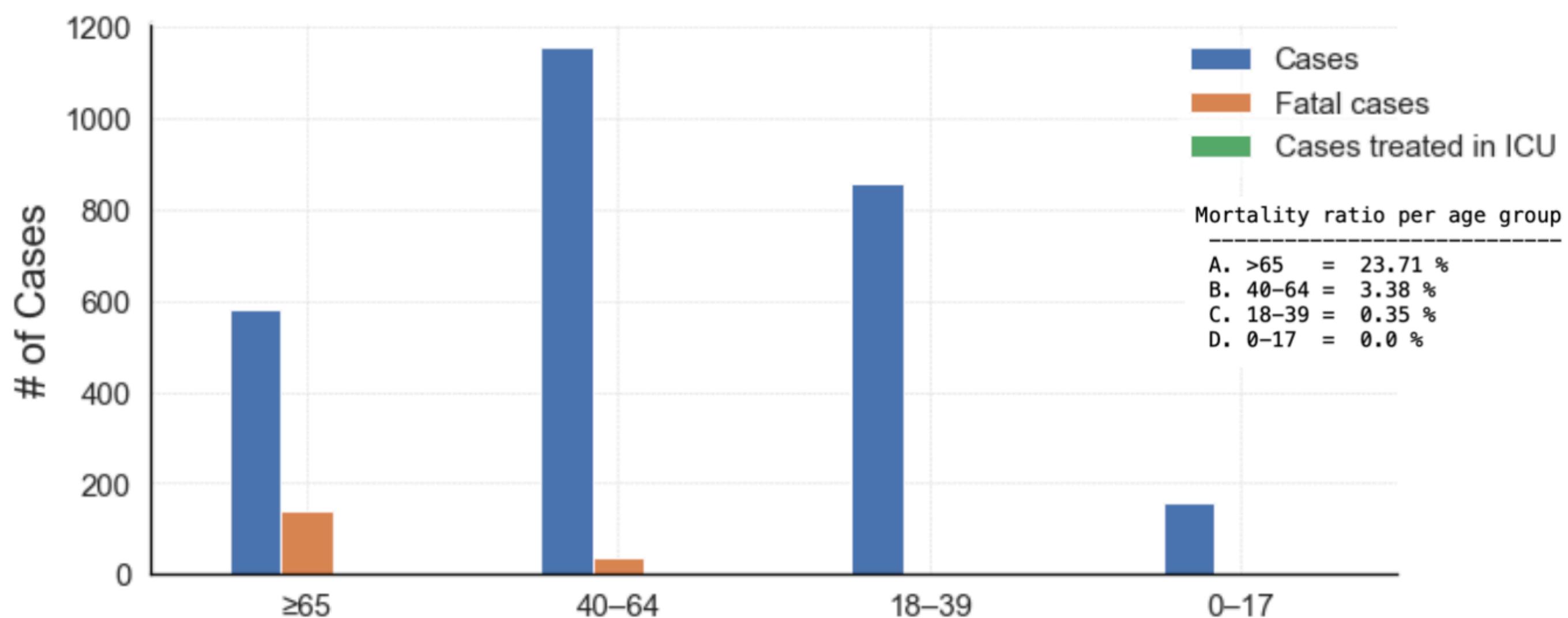


## Data grouped by AGE

The majority of people infected with coronavirus (COVID-19) in Greece were between the age of **40 to 64** years over the period under consideration.

The **younger ages** are more **tolerant** against the virus and its symptoms, nonetheless, can be affected. On the most of the cases their symptoms are less intense or even absent.

The mortality ratio is also presented, where the mortality rate in case of contamination for the **ELDERS** reaches the **23.7%**.

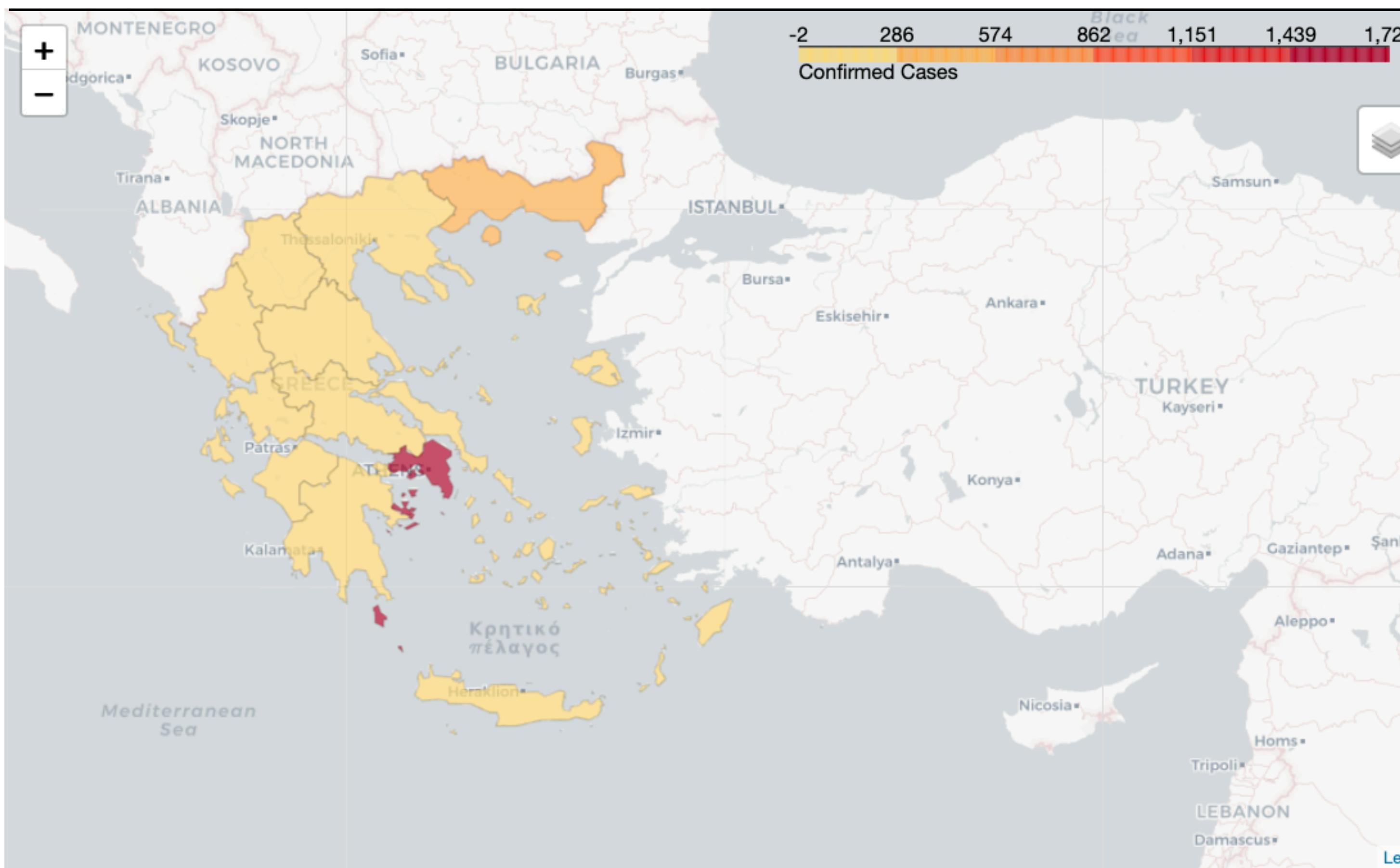


# THE COVID-19 IN GREECE: CHOROPLETH

DATA : Grouped by **REGION**.

MODULE : **Folium/Choropleth**

FILE : greece-regions.geojson

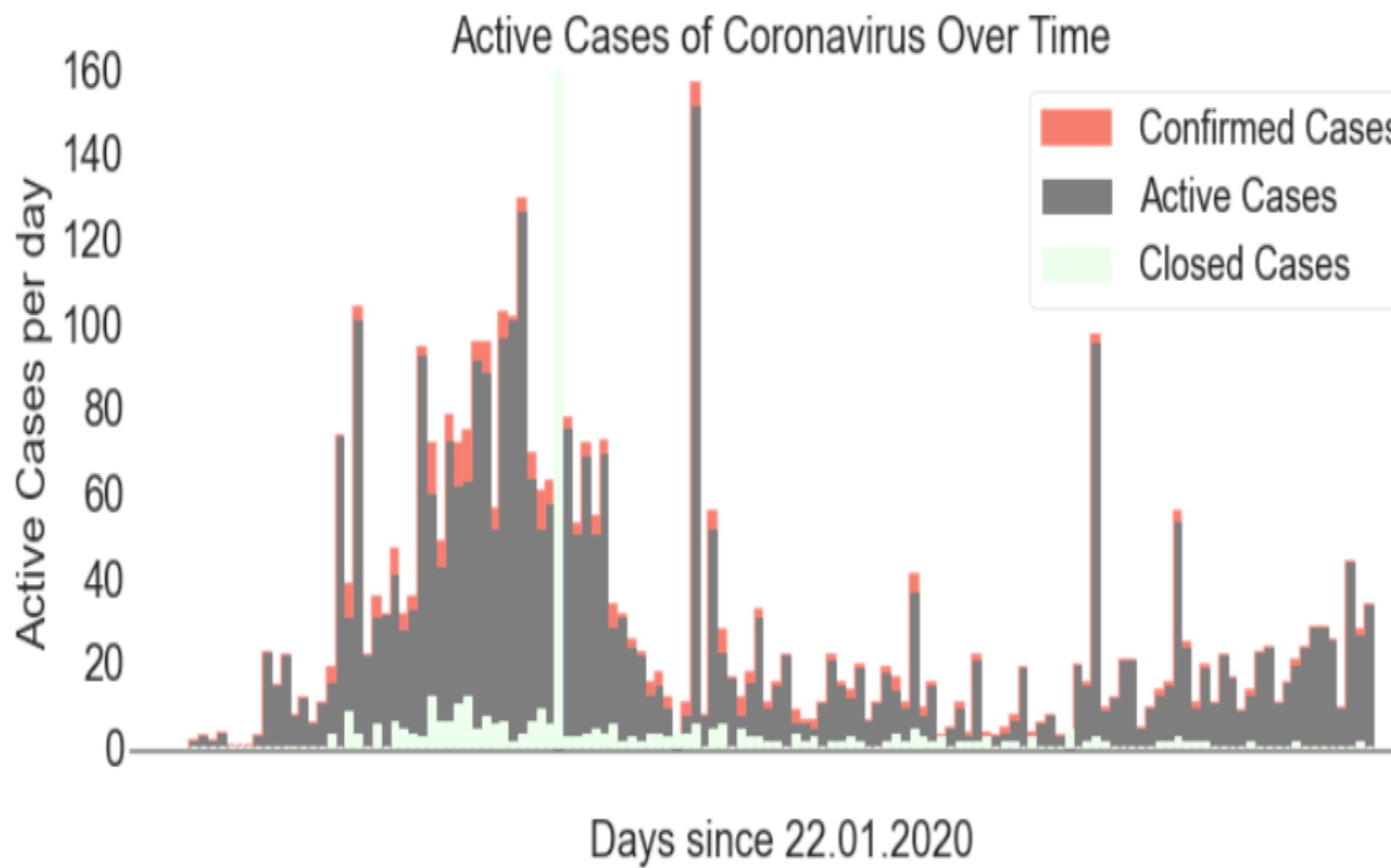


	Region	Cases	Deaths
0	Attica	1710	81
1	Central Macedonia	213	18
2	Peloponnese	200	1
3	Thessaly	188	2
4	Western Macedonia	180	29
5	Eastern Macedonia and Thrace	357	22
6	Western Greece	86	5
7	Central Greece	85	0
8	Crete	22	1
9	Ionian Islands	15	2
10	Epirus	31	0
11	South Aegean	21	0
12	North Aegean	19	1
13	Mount Athos	4	0

# THE COVID-19 IN GREECE

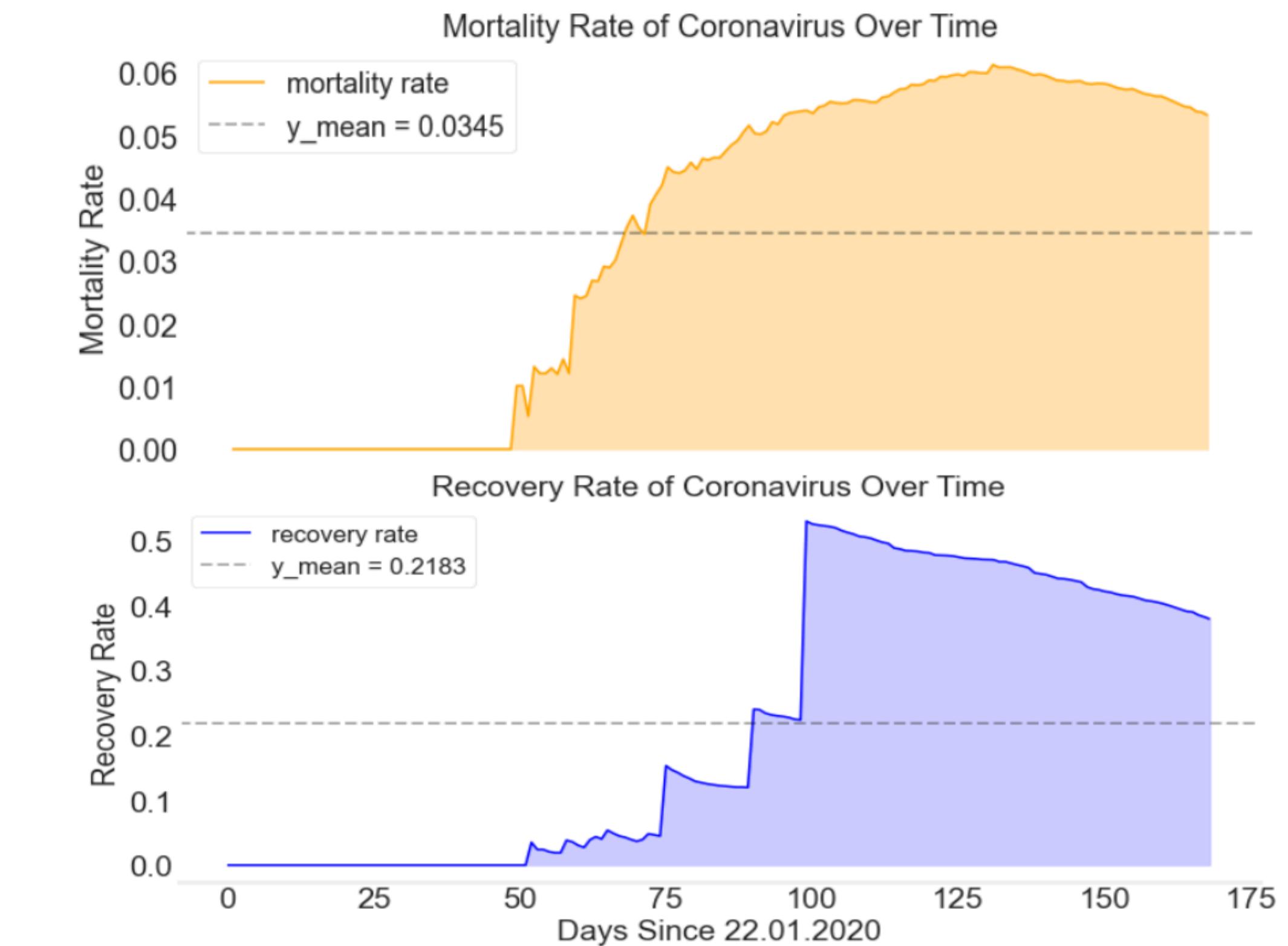
Most people who fall sick with COVID-19 will experience mild to moderate symptoms and recover without special treatment. **Active cases** are those that are confirmed without taking under consideration the closed cases, i.e. the fatal and the recovered ones.

## ACTIVE CASES



## MORTALITY & RECOVERY RATES

The **MORTALITY** statistics survey the number of deaths, while the **RECOVERY** rate survey the number of recoveries accordingly. As has been calculated the average increase in number of Confirmed Cases every day is **28**, from where there is an average increase in number of **2 recovered cases and 1 death cases every day respectively**.



## GROWTH FACTOR

Growth factor is the factor by which a quantity multiplies itself over time.

$$GF = \frac{\text{everyday's new (Confirmed,Recovered,Deaths)}}{\text{Previous day (Confirmed,Recovered,Deaths)}}$$

A. **GF > 1** : indicates an increase corresponding cases.

**GF > 1 but trending downward** : It is a positive sign

**GF > 1 but growing constantly** : It is a sign of exponential growth.

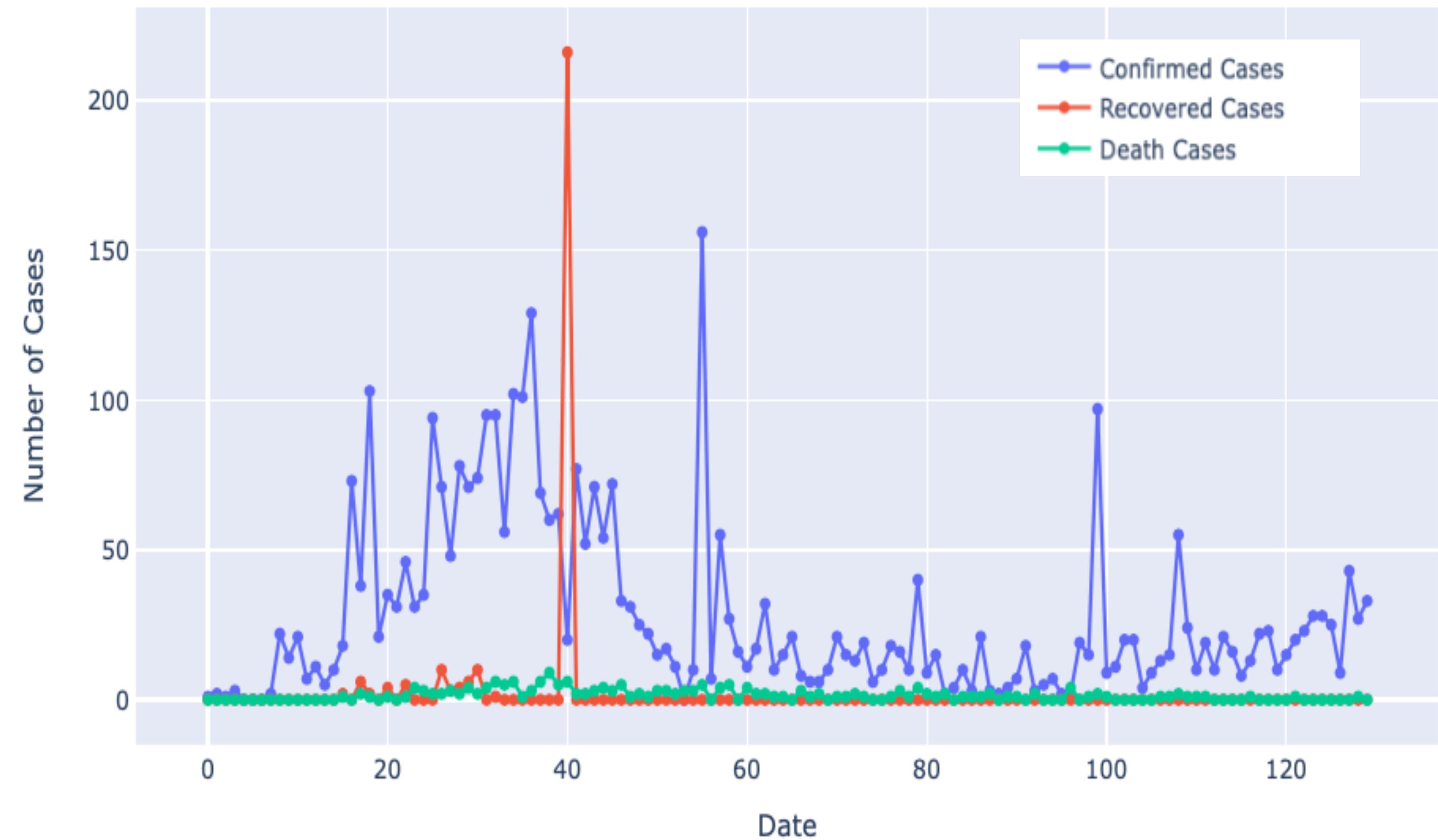
B. **GF = 1 and constant at 1** : It indicates there is no change in any kind of cases.

Median growth factor of number of Confirmed Cases : 1.0422535211267605

Median growth factor of number of Recovered Cases : 1.3333333333333333

Median growth factor of number of Death Cases : 1.0

Daily increase in different types of cases in Greece

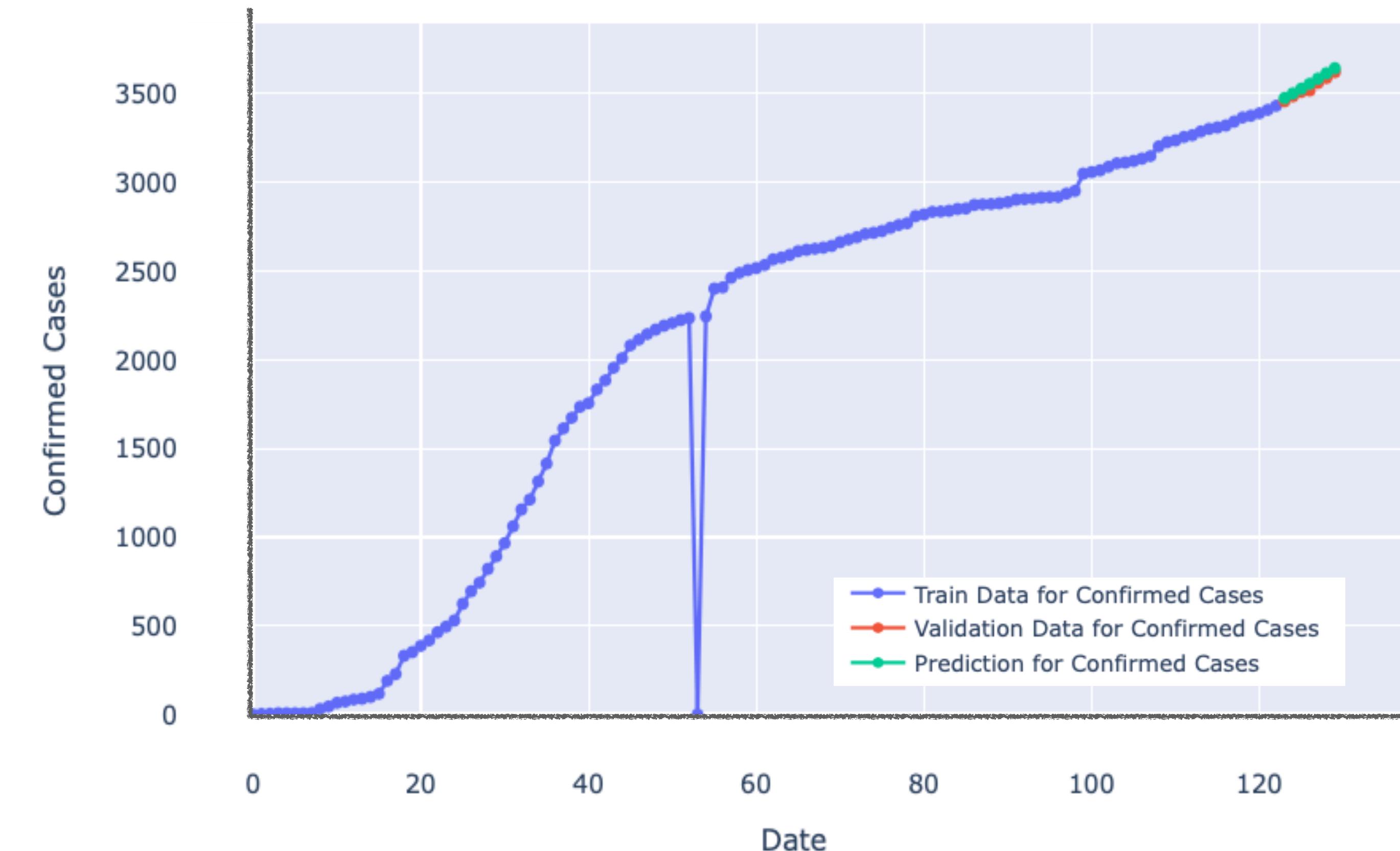


# PREDICTION USING MACHINE LEARNING MODELS: THE AR MODEL

The modelling of the data can be a straight-forward procedure when the dataframe is prepared! **Split** the dataframe to **TRAIN** and **TEST** datasets in an analogy of **80-20%**, using the Train Test Split functionality. Because this is a time series forecast, we will “chop off” a portion of our latest data and use that as the test set. Then we will **TRAIN** on the **REST** of the data and **forecast into the future**. Afterwards we can **COMPARE** our **FORECAST** with the section of data we chopped off. Now that the model has been fitted to the training data, we can forecast into the future.

The **Auto-Regression** is a time series model that uses observations from previous time steps as input to a regression equation to predict the value at the next time step. It is a very simple idea that can result in accurate forecasts on a range of time series problems. Time Series have several key features such as trend, seasonality, and noise. Forecasting is the process of making predictions of the future, based on past and present data. One of the most common methods for this is the **ARIMA** model, which stands for **AutoRegressive Integrated Moving Average**.

Model Name	Root Mean Squared Error
4 Auto Regressive Model (AR)	23.73
3 Holt's Linear	30.89
5 Moving Average Model (MA)	34.96
6 SARIMA Model	34.96
1 Polynomial Regression	280.22
0 Linear Regression	475.25
2 Support Vector Machine Regressor	875.35



# THE COVID-19 IN GREECE: CLUSTERIZATION

- A. Use **Foursquare** location data for the iconic place of Acropolis Athens, GR.
- B. Conduct **K-means clustering** to group the venues of the selected borough, namely Acropolis.
- C. Nearby venues, several touristic attractions are located in Acropolis

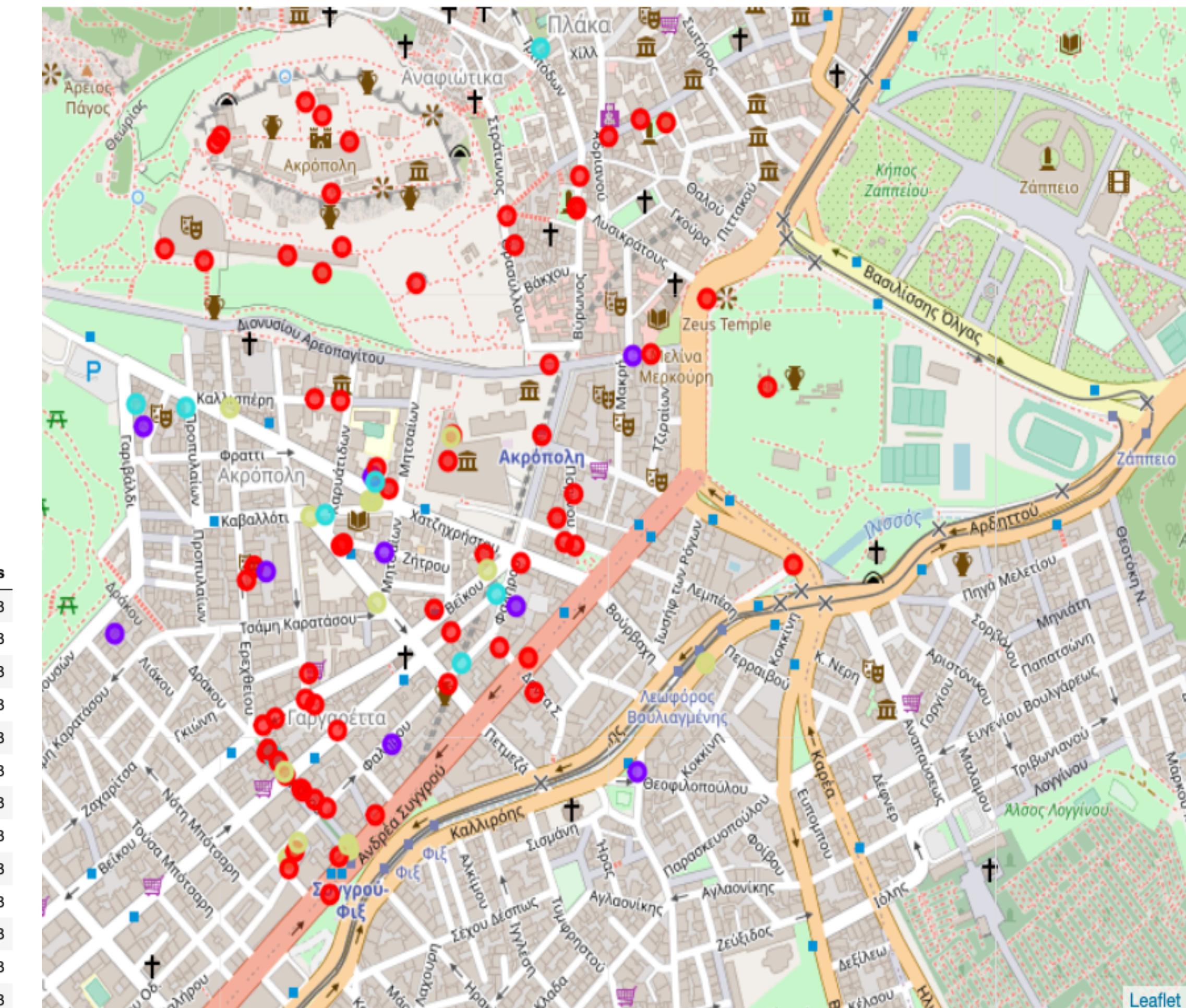
There are plenty of places in this iconic neighbourhood of Athens, that can either boost the economy by welcoming more clients especially the Spring and Summer periods or deteriorate the health system by strengthening the spread of the virus, creating new hot spots.

Measures!

	name	cluster labels
0	Dionysiou Areopagitou (Διονυσίου Αρεοπαγίτου)	0
1	Acropolis Museum (Μουσείο Ακρόπολης)	0
2	Drupes & Drips	0
5	Terra Carpo	0
6	Wine O'Clock	0
...	...	...
90	My market	0
91	Mikel Coffee Company	0
93	Lovie Cosmetics	0
95	South Slope of Acropolis (Νότια Κλιτύς Ακροπόλ...	0
96	Στάση σχολικού	0

Clusters

	name	cluster labels
9	ManiMani (ΜάνηΜάνη)	2
11	Balcony Restaurant & Bar	2
37	Plato El Greco	2
57	Strofi (Στροφή)	2
60	ΑΤΤΙΚΟΣ Greek House	2
64	Kafeneio (Καφενείο)	2
66	Ψητοπωλείον	2
89	Atrium Greek Bistrot	2
	name	cluster labels
3	Little Tree Books & Coffee	3
4	Lotte	3
16	Coffee Dive Acropolis	3
27	Gargarettta	3
34	'Opos Palia (Οπώς Παλιά)	3
35	Cafe & Restaurant at Acropolis Museum (Καφέ & ...)	3
40	FLAT WHITE artisan café	3
69	KINONÓ	3
83	Ο Μπαμπάς	3
85	Roua Cafe	3
88	zaKaza	3
92	Fourteen 14	3
94	Metro Cafe	3
12	Herodion Hotel	1
20	AthensWas Hotel	1
25	Coco-Mat Hotel	1
39	Philippos Hotel	1
50	B4B Athens Signature Hotel	1
71	Acropolis Select Hotel	1
74	Acropolis Hill Hotel	1
79	Acropolis View Hotel	1
80	Divani Palace Acropolis	1



# REMARKS

From this **capstone** we have learned that:

**1.** a preliminary data exploration must be done before building a predictor, **2.** the predictor should be built by taking into account also the real life (in our case, the restriction laws introduced by the Greek government and their effects after a week); **3.** once the predictor is built, also errors should be considered. Thus the range of errors must be calculated in order to have a more accurate prediction; and **4.** a comparison between real (new) data and the predictor is always welcome, because it allows you to verify whether the model is correct or not.

However, at first glance it is either the economy or the health system of a country that will be affected by the pandemic. In some cases unfortunately this happened simultaneously... Before the pandemic an iconic place like Acropolis used to be described as a history in motion, the center of intellect, entertainment and gastronomy... while during the pandemic can be referred as potentially dangerous for the public health due to its variety. Health versus economy all day long... Without a balance economy might and will be unfortunately translated to health...

Nonetheless, Greece still stands strong against the Covid-19 pandemic, and should be proud amongst bigger and stronger countries as a successful candidate to lift its measures in order to see its way back to reality, restarting its economy by welcoming tourists all around the world.

Country Name	Number of Confirmed Cases	Number of Deaths	Number of Recoveries	Number of Active Cases	Mortality Rate
90 Bosnia and Herzegovina	3935	178	2338	1419	0.0452351
91 Central African Republic	3429	45	699	2685	0.0131234
92 Greece	3376	191	1374	1811	0.0565758
93 Thailand	3162	58	3053	51	0.0183428
94 Costa Rica	3130	15	1366	1749	0.00479233
95 Somalia	2894	90	887	1917	0.0310988
96 Croatia	2691	107	2152	432	0.0397622
97 Albania	2402	55	1384	963	0.0228976
98 Cuba	2332	86	2201	45	0.0368782
99 Maldives	2324	8	1911	405	0.00344234
100 Nicaragua	2170	74	1238	858	0.0341014

# REFERENCES

1. **WHO Archive** : <https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19>
2. **Greek Government** : <https://covid19.gov.gr/covid19-live-analytics/>
3. **Wikipedia** : [https://en.wikipedia.org/wiki/COVID-19\\_pandemic\\_in\\_Greece](https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Greece)
4. **govgr-pdf** : <https://eody.gov.gr/wp-content/uploads/2020/06/covid-gr-daily-report-20200624.pdf>
5. **WHO** : <https://covid19.who.int>
6. **Generic** : <https://www.google.com/search?client=safari&rls=en&q=covid-19+greece&ie=UTF-8&oe=UTF-8>