ORIGINAL ARTICLE

Effectiveness of Population Density as Natural Social Distancing in COVID19 Spreading

AKRAM JASSIM JAWAD
Department of Polymer and Petrochemical Industrials Engineering, College of Materials Engineering, University of Babylon, Iraq.
Correspondence to Akram Jassim Jawad Email: akrammaterials4@gmail.com Cell: +447734423517, +9647804652125

ABSTRACT

Recently, many countries have decided to reopen gradually and some of them have thought that social distance has not that significant affections. in our study, new view of importance the social distancing to prevent spreading coronavirus have presented in the term of the relationship between peak day and period times with population density of nine countries. Data for nine different countries in different coronavirus situation have been analyzed. The analysis process were applied by using three programs namely; WebPlotDigitizer, WSxM and Origin programs. The results provide evidence of the effectiveness of social distance by calculation the effect of population density on coronavirus infection. That was applied by two stages, the first one by determination two different groups of countries depending of the rate and range of coronavirus spreading. These two groups namely developed and developing COVID19 infection which lead to calculate the peak day and the period times of developed groups. Then, analysis of that data with population density was evaluated to indicate there are significant affections of population density on peak day and pear period times which explain the importance of social distance between people to manage and control that. The results showed that increasing in peak day and peak period times with increasing the population density.

Keywords: COVID19, Coronavirus, Population Density, Social Distancing, Peak Day, Period Times.

INTRODUCTION

The previous recording of influenza pandemics prove that stockpiles of antiviral drugs will be limited amounts which can be used mostly for treating the critical cases of influenza. On the other hand, social distancing is one of the most important non pharmaceutical interventions (NPIs)[1] will be widely applied by health services to minimize influenza spreading in the society which has three obvious benefits. The first positive point would be to delay the date of the infections peak to prepare more longer time for the healthcare teams, the second point to minimize the volume of the epidemic peak profile, and the last one to make the infections distributions over a longer period of time which is enabling more significant management of these issues and the more effect potential for drugs to be applied[2]. Infections by virus, such as COVID 19, are believed to spread more through close distance contact in the society like homes, workplaces, schools and public places, and more affected in crowded and busy cities and countries[3]. Predictive, mathematical and statistical models for epidemics like COVID19[4] are important and fundamental parts in the term of understanding the epidemic and to make the plan in effective way to control that. There are many models have been developed to use in the case of the COVID-19 pandemic, Lin and his colleagues extended a SEIR (susceptible, exposed, infectious, removed) model by considering the risk perception and the cumulative value of cases[5], Anastassopoulou and his colleagues suggested a discrete-time SIR model which cover the dead individuals[6], Casella proposed a control-oriented SIR mathematical model which includes the delay effecting and compares that between different containment strategies[7] and Wu and his colleagues applied transmission dynamics concept to calculate the clinical activity of COVID-19[8].

In fact, lock-down and social distancing restrictions could lead to poverty and in some cases to under nutrition, educational weakness and undo enhancements in access to health services which are achieved in the last years[9]. In our work, we try to analysis the relationship between population density and sizes on COVID19 spreading in the terms of peak day and pea period times in nine different countries.

METHODOLOGY

Figure 1 shows the steps of methodology of the chose and the analysis for nine different countries in deep details. Choose ten different countries roughly and analyzed them data as shown in figure 1. It can be seen that the first stage is going to the website of university[10] to choose the countries randomly in the form of picture by utilizing of snipping tool. Then, this picture will convert to data by using WebPlotDigitizer program and save it in the excel form for the next step. After that, the data will change to a smooth curve by using WSxM program and save it in the form of picture again. Depending on the form of the curve, these curves will divided into two types of behaviors; with peak which is namely as developed country and without peak which is namely as developing country. The first group will convert again to data in the form of excel file which will plot as a curve by using Origin program. Analysis and fitting of data will have been applied by that program to calculate the peak point data analysis which will use next in the model analysis. Otherwise, the second group of curves will pass directly to the general model to predict and calculate the peak point.

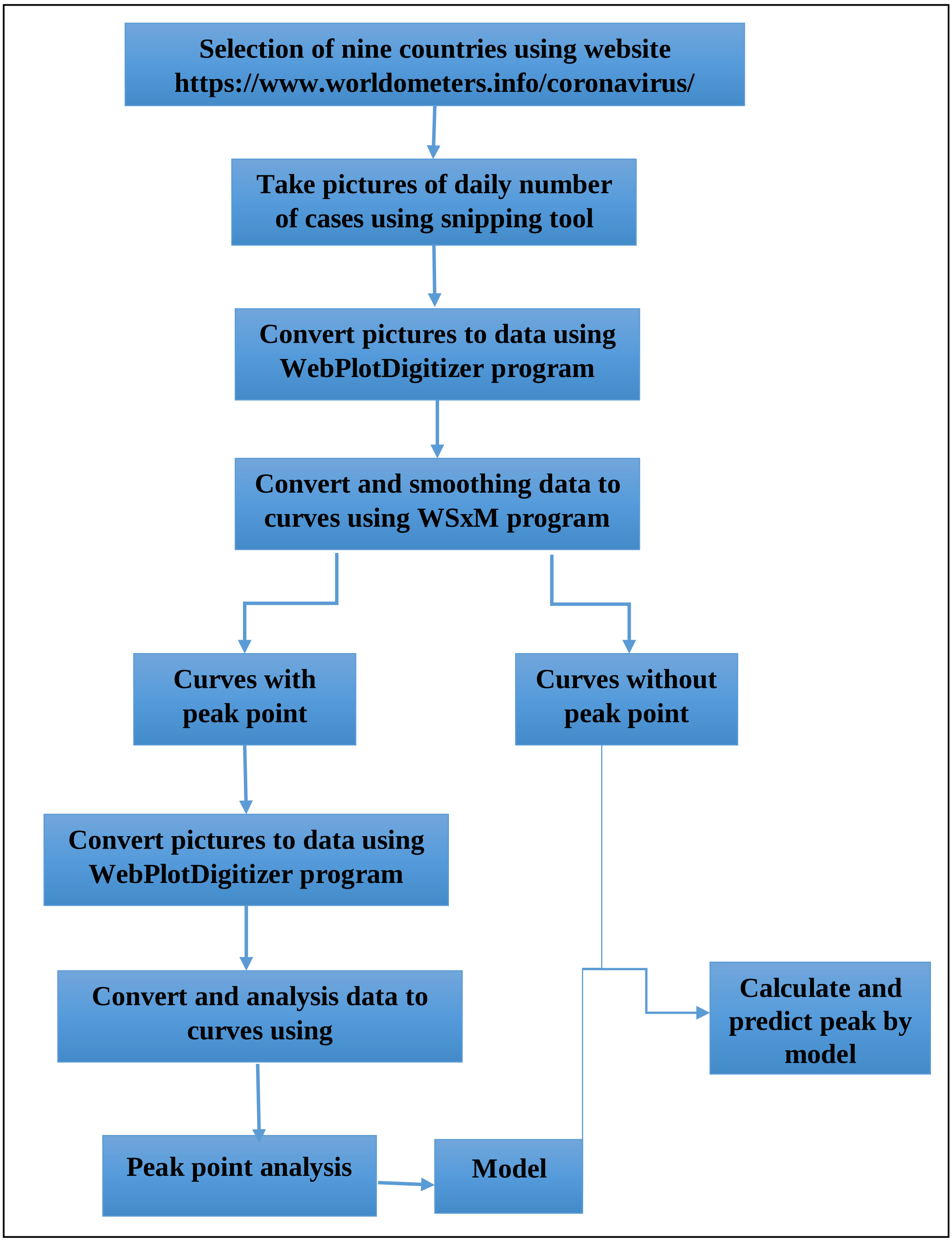


Figure 1. Methodology of choose and analysis the data of different countries.

RESULTS AND DISCUSSIONS

The most important five steps in the analysis of data have reported in the first in figure 2. The figure shows the first analysis stage is taking the picture by using snipping tool. Then, this picture converts to data in the form of excel file using WebPlotDigitizer program in stage two. After that, that data have to change and to smother curve by utilizing of WSxM program in stage three. Depending on the last stage, these curves will divided into groups as we mentioned in figure 1, the first one that have peak point, while the other does not have. If the curve have peak point, it will be saved. Then, this curve will convert into data by using again WebPlotDigitizer program in stage four and finally it will changed to curve and analysis it to produce the model by Origin program in the stage five. On the other hand, curves that do not have peak point, it will be calculated and predicted by the determined model.

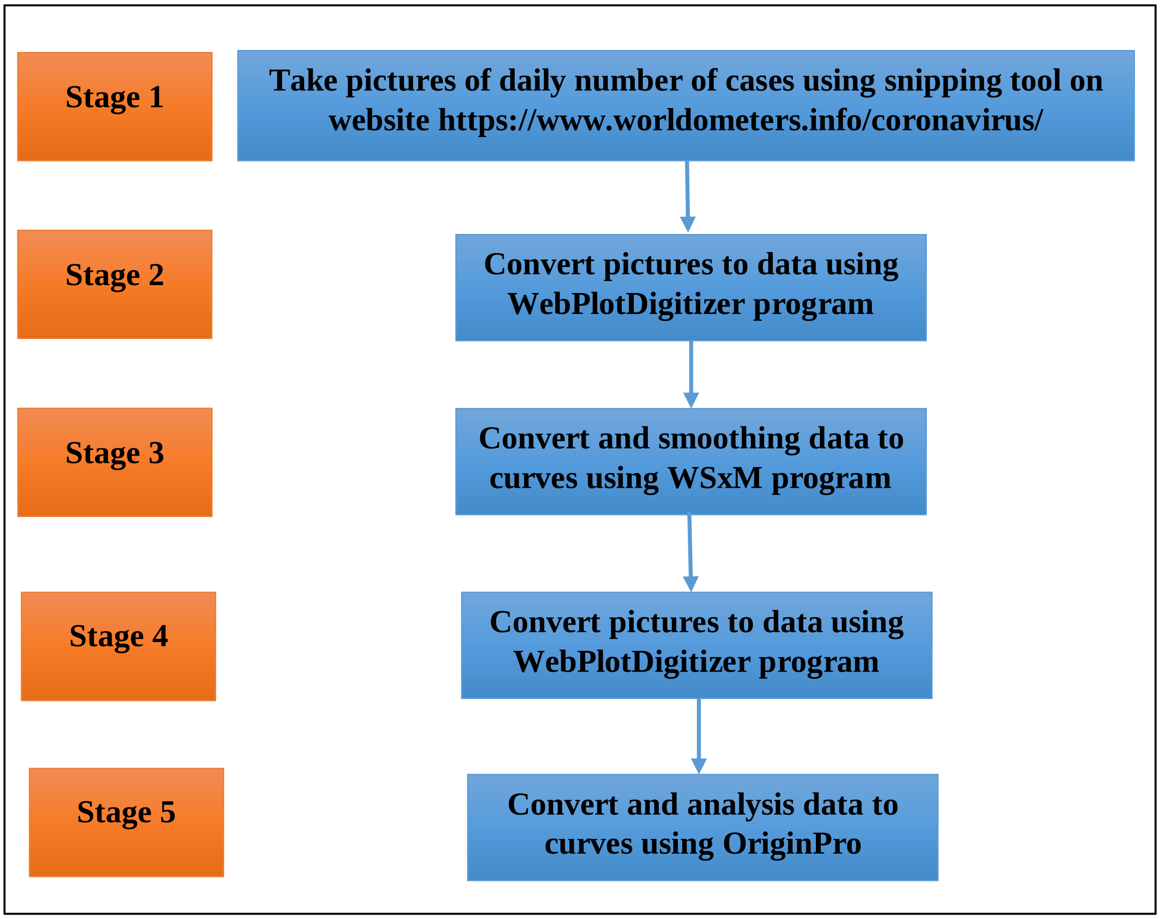
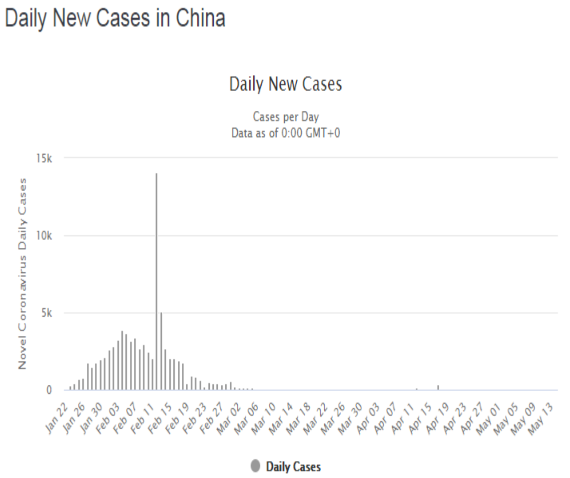
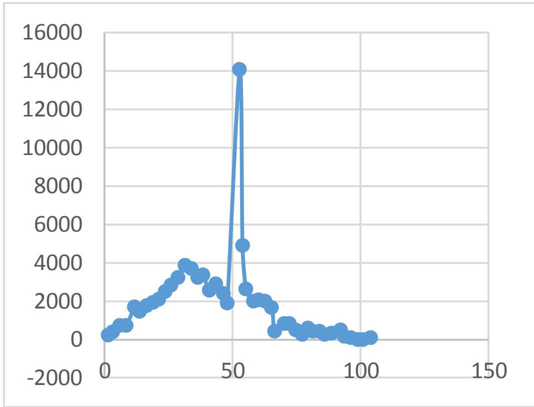
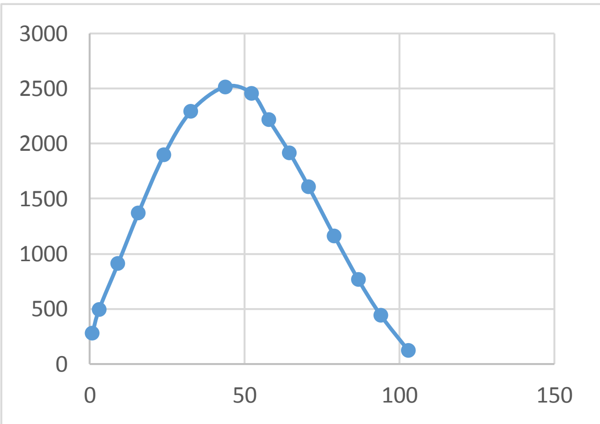


Figure 2. The important five steps of results data analysis.

The main five steps of each country in our work have presented in figure 3, 4, 5, 6, 7, 8, 9, 10 and 11, which are represent China, France, Germany, Iran, Iraq, Italy, Spain, the United Kingdom and the United States, respectively. In each figure, there are five curves which act the mentioned five steps in figure 2, which calculate until 14/May/2020. The main goal of this five steps is calculation of period and date of peak to analysis that with the population size of these countries in the next stage. Generally, it is clear that Chain, France, Germany, Italy and Spain are belong to the developed coronavirus group because there are peak point, while Iran, Iraq, the United Kingdom and the United States are belong to the developing group.For developed coronavirus countries group, figure 3 shows the peak point was after 43 days for China and the period time of peak was 100 days. While, figure 4 and 5 illustrate the peak points were after 30 and 28 days for France and Germany, and the period times of peak were 60 and 70 days, respectively. In figure 8 and 9, the peak points of Italy and Spain were after 33 and 30 days, respectively, while the period times of peak was 80 days for them. On the other hand, figures 6, 7, 10 and 11 show that Iran, Iraq, the United Kingdom and the United State do not have the peak point and the period time of peak.







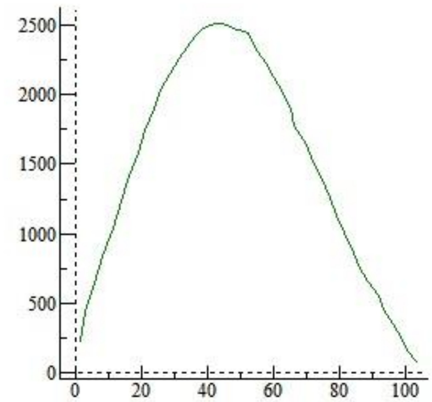


Figure 3. The main five steps in the data analysis

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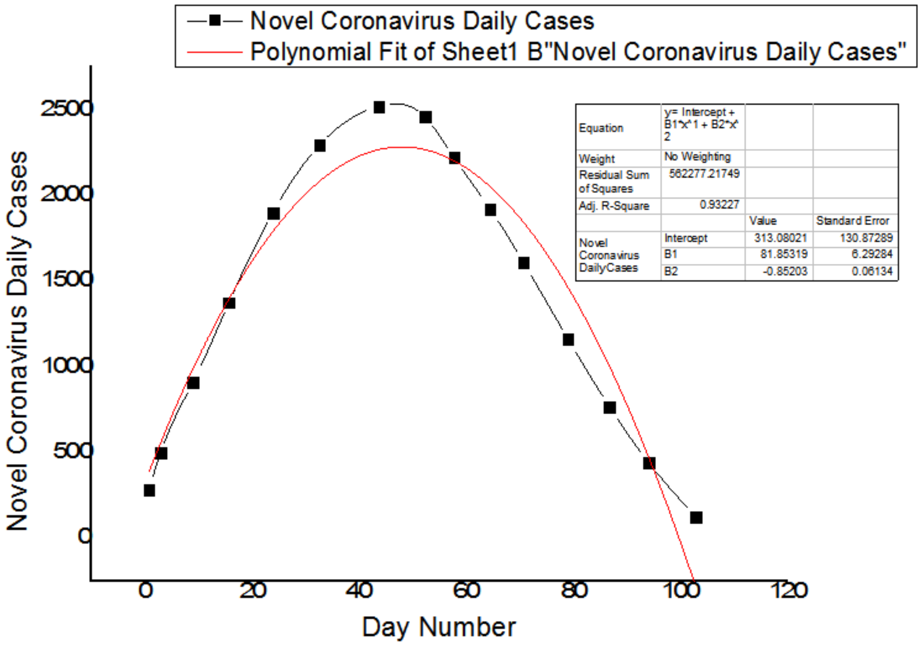


novel COVID19 daily cases in China.

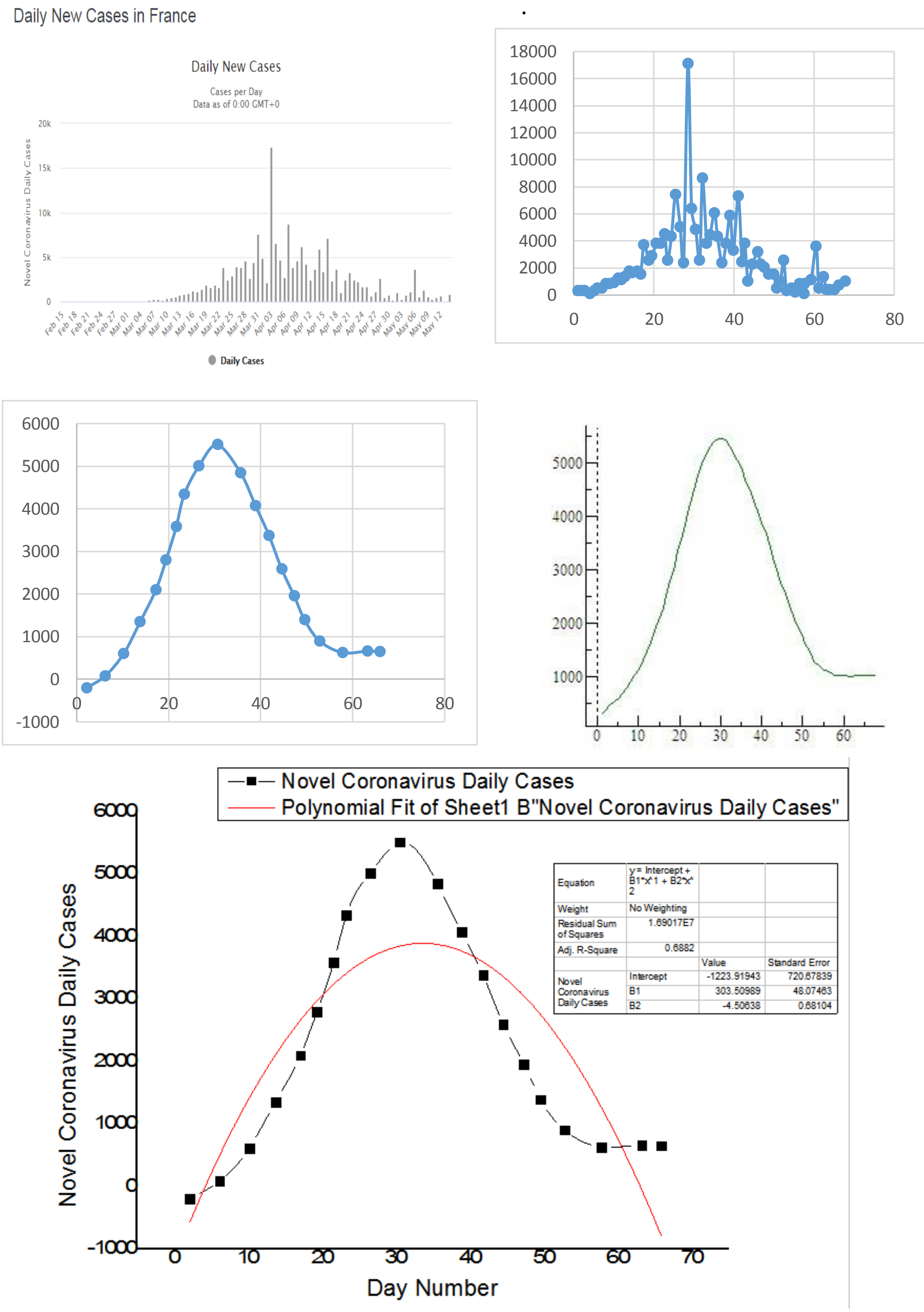


Figure 4. The main five steps in the data analysis of novel COVID19 daily cases in France.

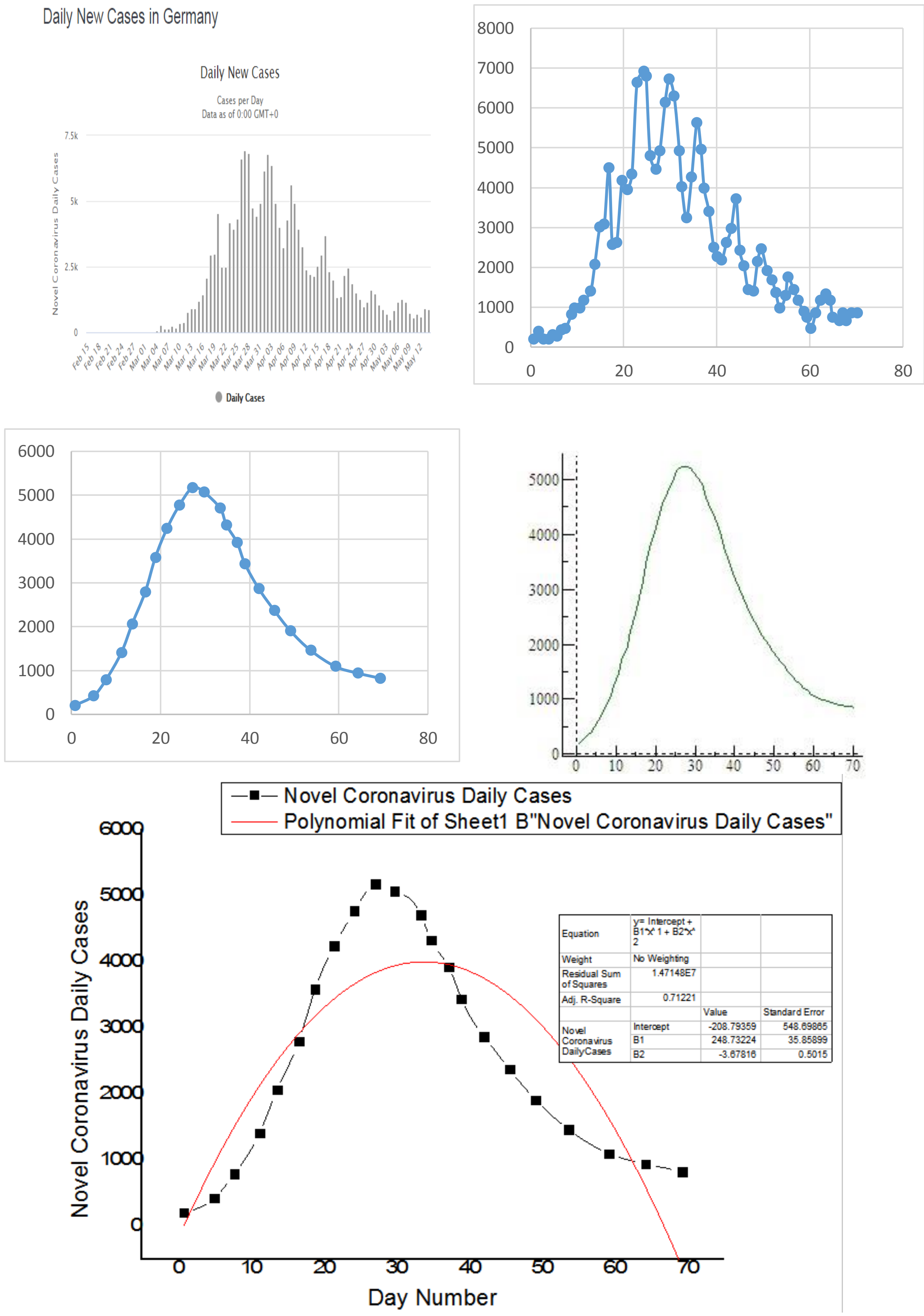


Figure 6. The main five steps in the data analysis of novel COVID19 daily cases in Germany.

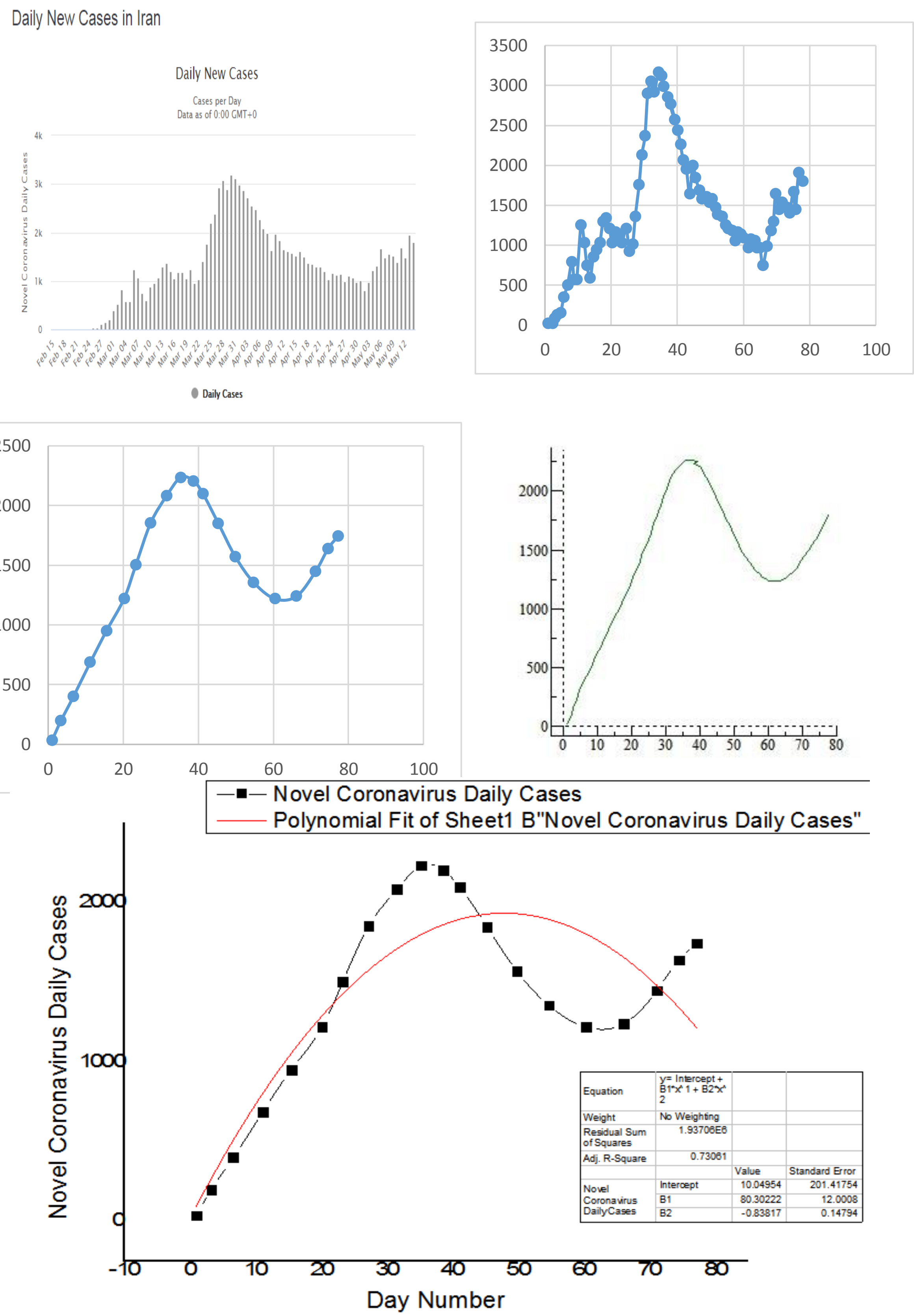


Figure 6. The main five steps in the data analysis of novel COVID19 daily cases in Iran.

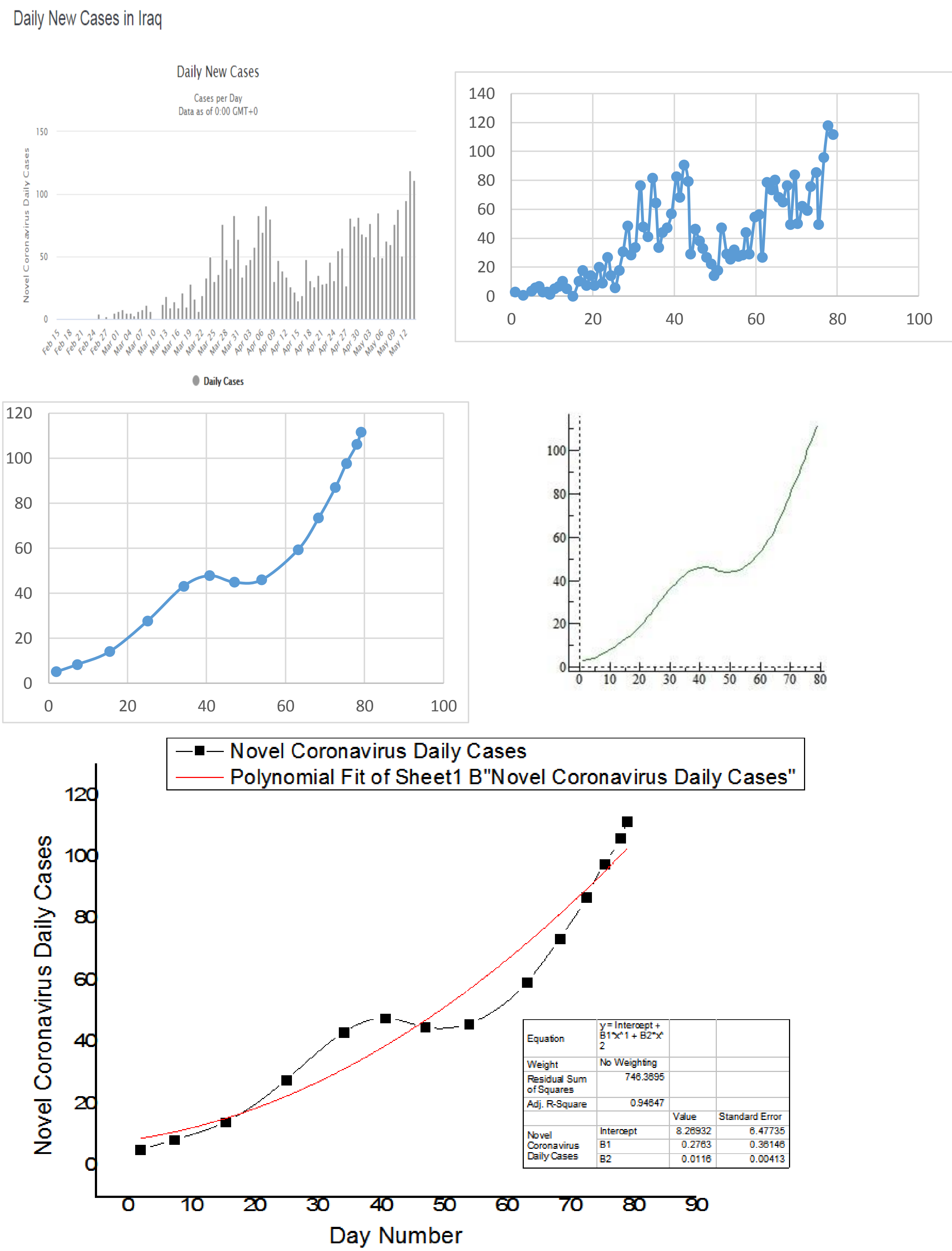
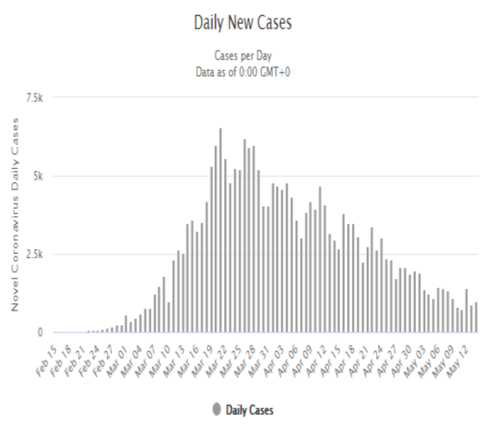
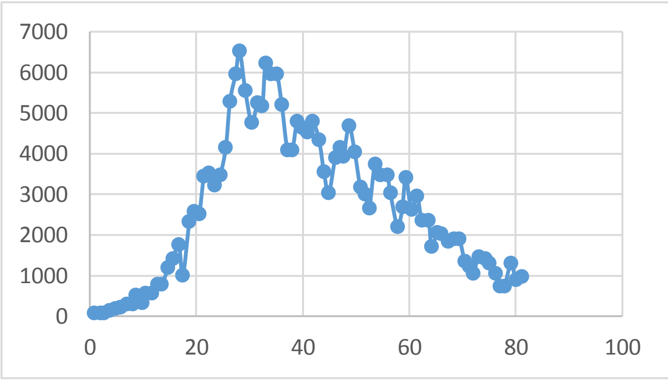
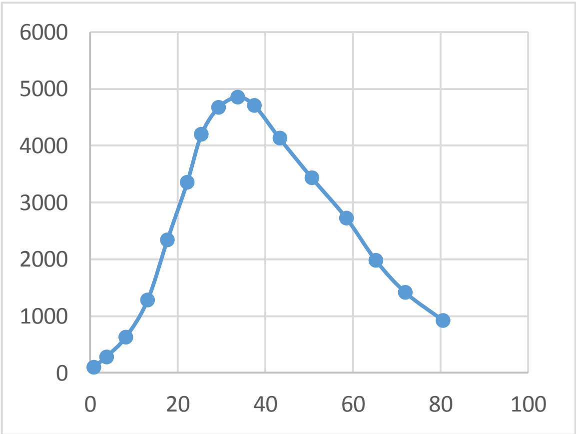


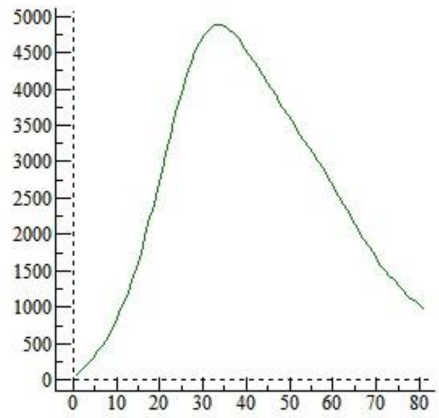
Figure 7. The main five steps in the data analysis of novel COVID19 daily cases in Iraq.

Daily New Cases in Italy









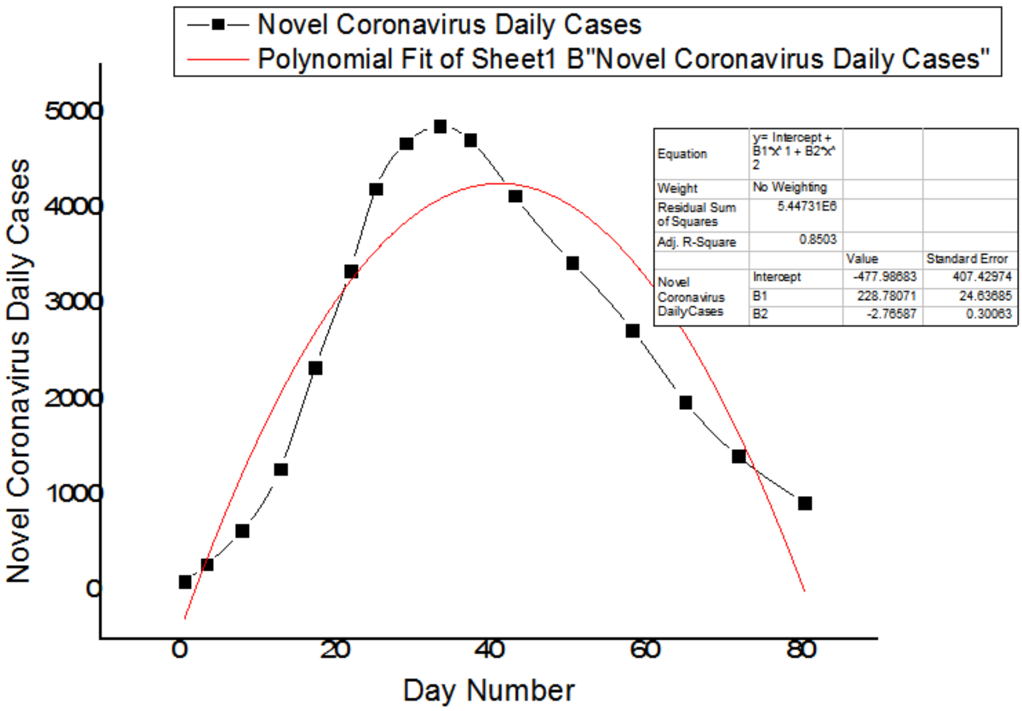
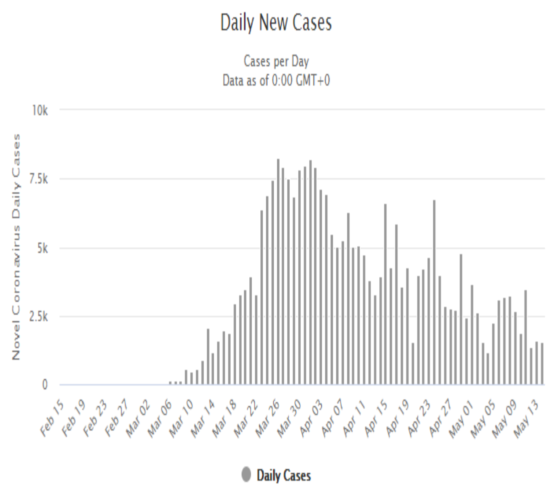
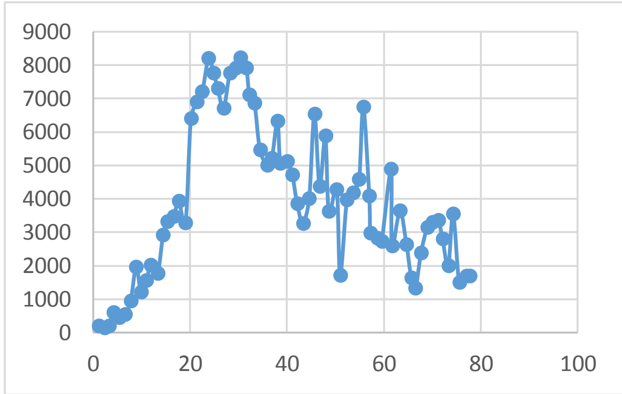


Figure 8. The main five steps in the data analysis of novel COVID19 daily cases in Italy.

Daily New Cases in Spain





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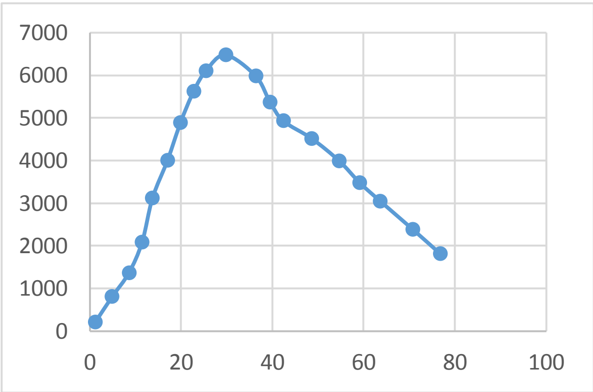
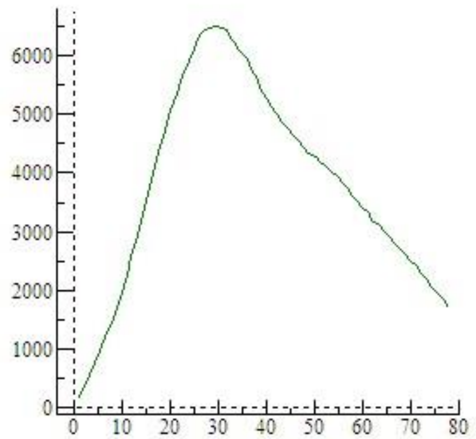
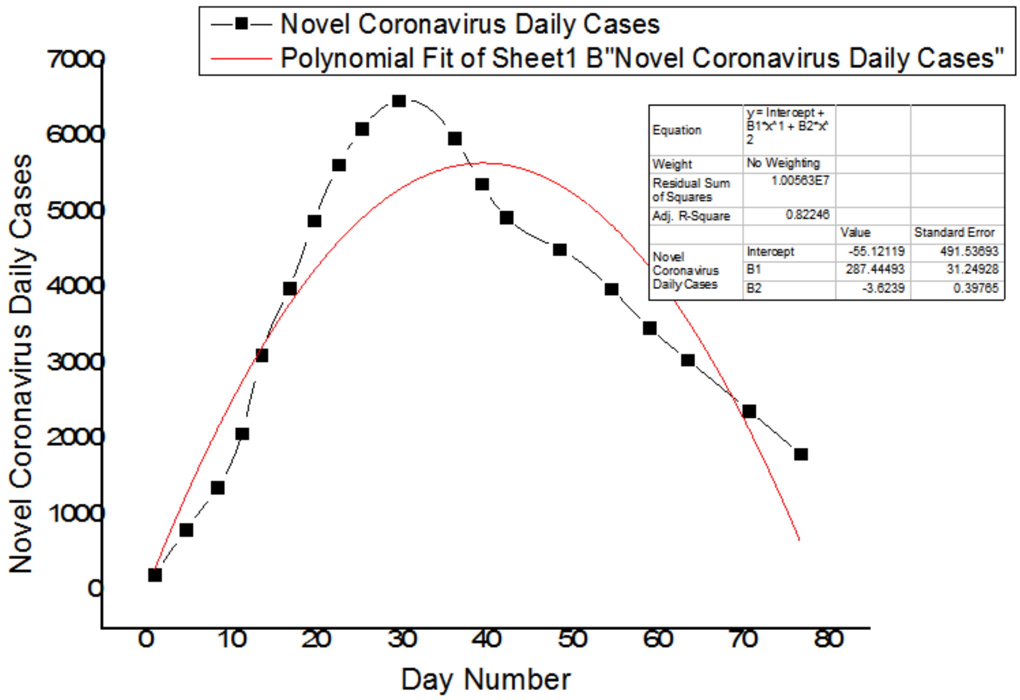
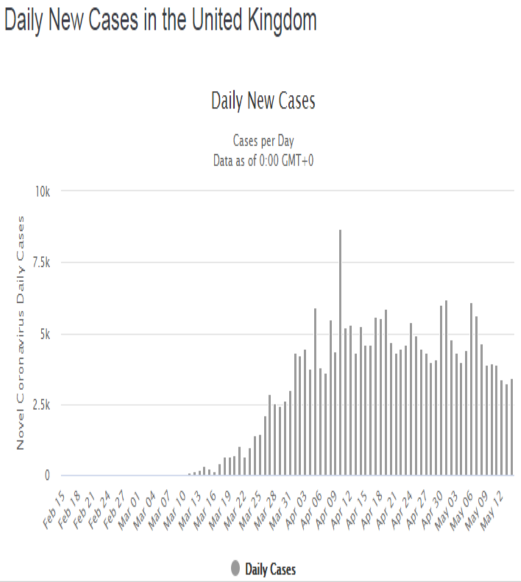


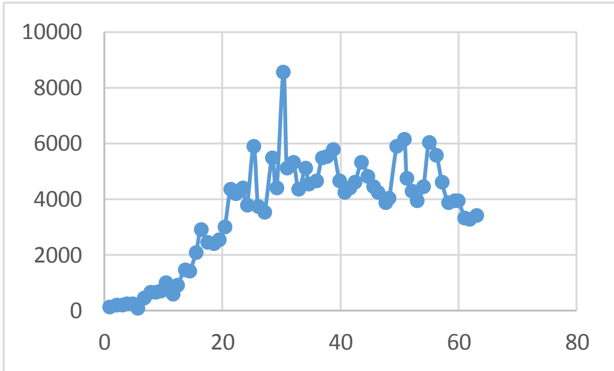
Figure 9. The main five steps the data

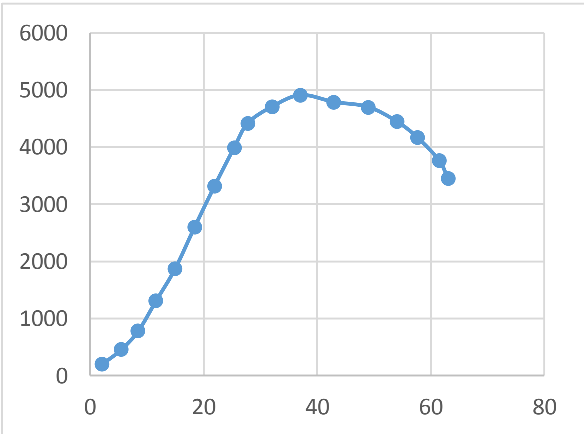


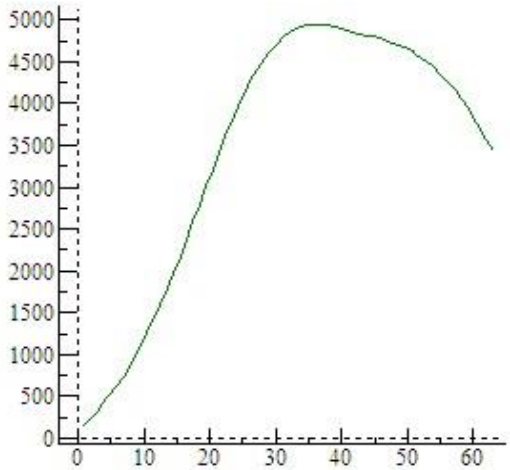


analysis of novel COVID19 daily cases in Spain.









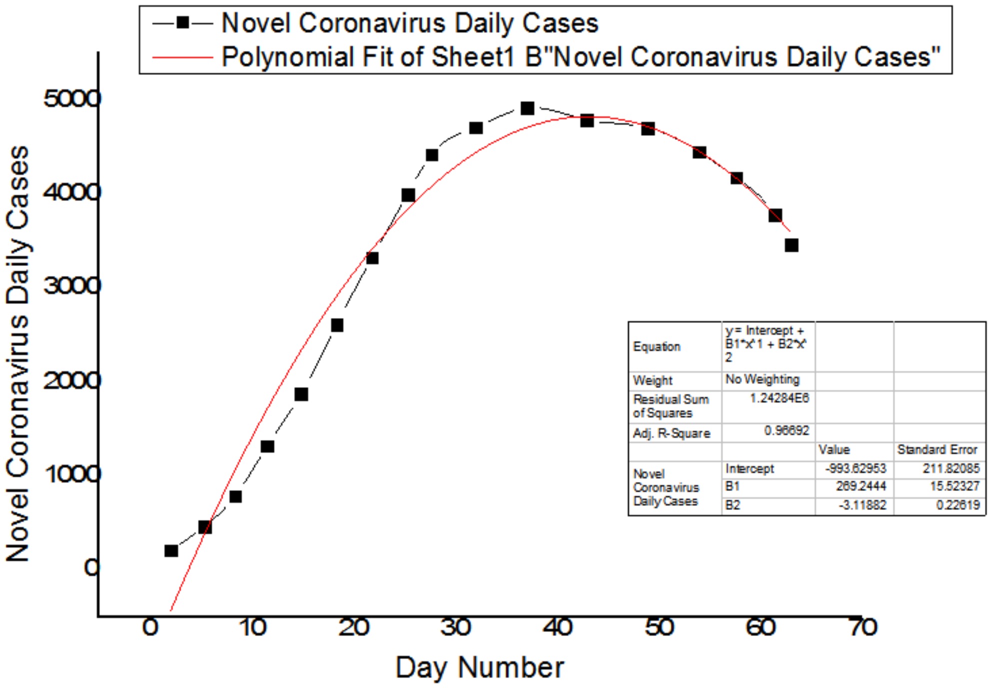


Figure 10. The main five steps in the data analysis of novel COVID19 daily cases in the United Kingdom.

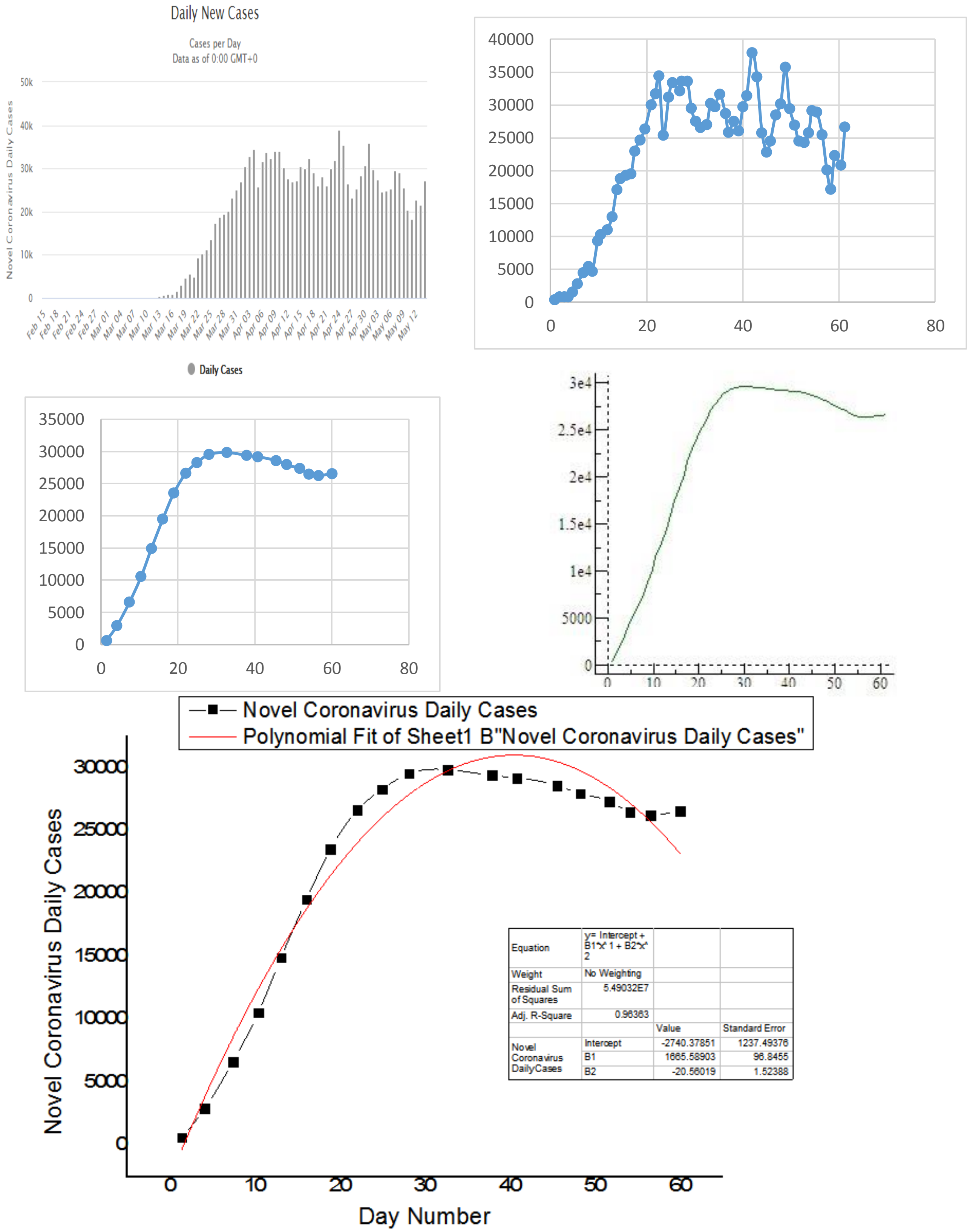


Figure 11. The main five steps in the data analysis of novel COVID19 daily cases in the United States.

The relationship between the dates of peak day, novel coronavirus daily cases, peak period times, the ratio of peak period times and the dates of peak with the density of population per square mile are shown in figure 12, 13, 14 and 15, respectively, for five different countries which are regarded as developed coronavirus countries. The countries are France, China, Italy, Spain and Germany which have the density of population per square mile about 100, 142, 197, 210 and 235, respectively[11]. It is clear that the peak day decreases with increasing the density of population. However, there are rising in the peak day in the range of density of population between 99-140 milion per mile square. That is may be due to the random distribution of population and the high age level of Italy, as an example.

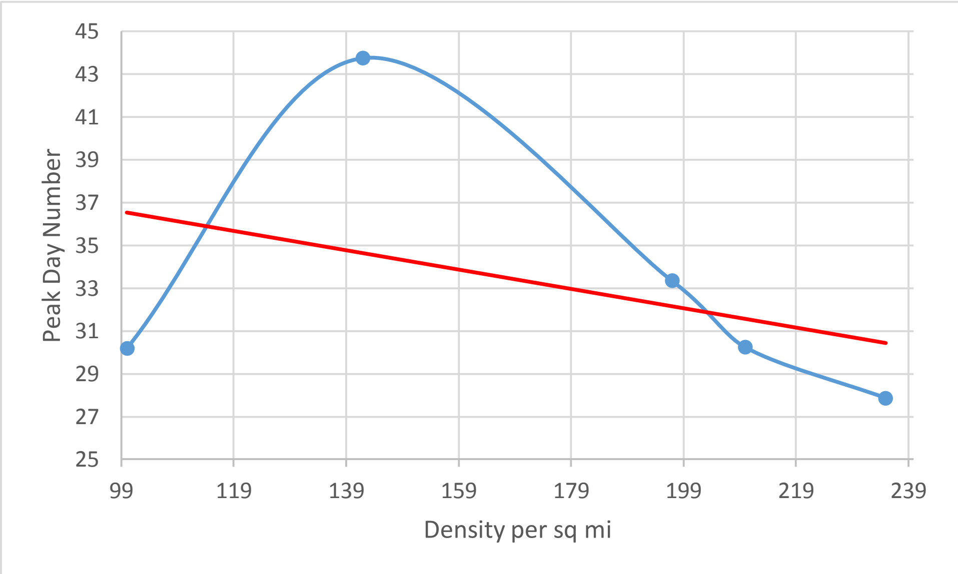


Figure 12. The relationship between density of population per square mile and the date of peak day.

Novel coronavirus daily cases increases with increasing the density of population because the social contact will be more likely and the infection rate will be higher. It seems that Italy has lower point with regard other four countries. That is may be belong to high restricted procedure that applied by the government which also explain why it has higher peak point in figure 12.

Figure 14 provide evidence about the increasing of peak period times as the population density increasing. This behavior happened as we have mentioned and discussed that early in last figure, because the high density of population leads to high ability of contact between people and makes the social distance less and lower.

The relationship between the ratios of peak period times to peak day with population density shows significant effecting of these parameters. Where, there are increasing in that ratio with increasing population density because the number of people during specific area will be higher. That number encourages higher level of infection as a result to minimize the social distance between people.

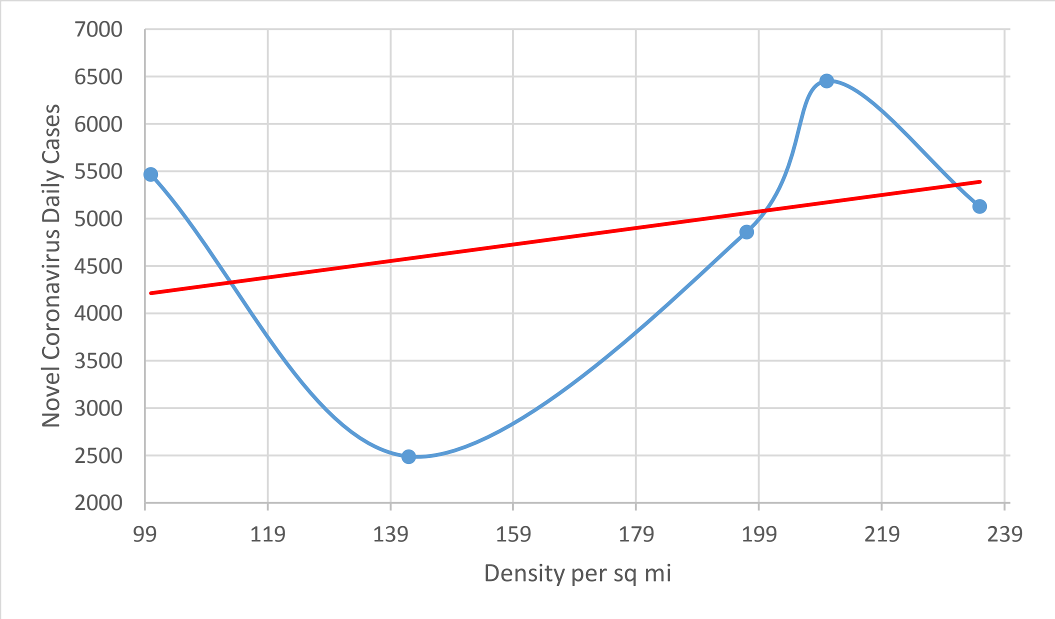


Figure 13. Novel coronavirus daily cases

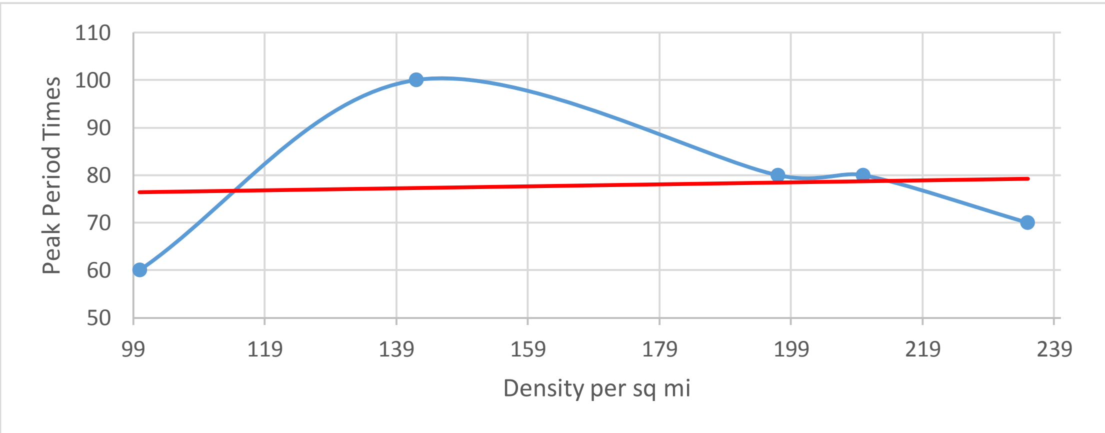


Figure 14. Peak period times

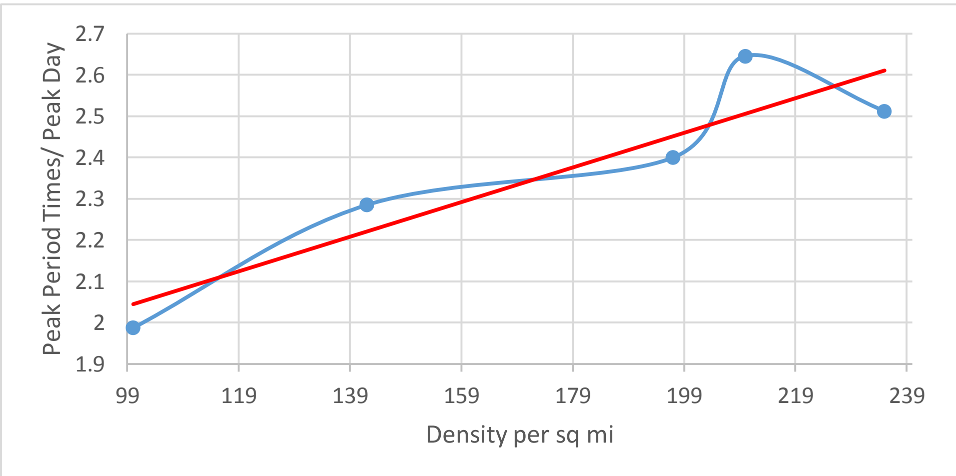


Figure 15. The relationship between the ratio of peak period times and peak day with population density per square mile.

CONCLUSIONS

This work provide evidence of the effectiveness of social distance by calculation the effect of population density on coronavirus infection. That was applied by two stages, the first one by determination two different groups of countries depending of the rate and range of coronavirus spreading. These two groups namely developed and developing COVID19 infection which lead to calculate the peak day and the period times of developed groups. Then, analysis of that data with population density was evaluated to indicate there are significant affections of population density on peak day and peak period times which explain the importance of social distance between people to manage and control that situation. Generally speaking, the results showed that increasing in peak day and peak period times with increasing the population density.

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