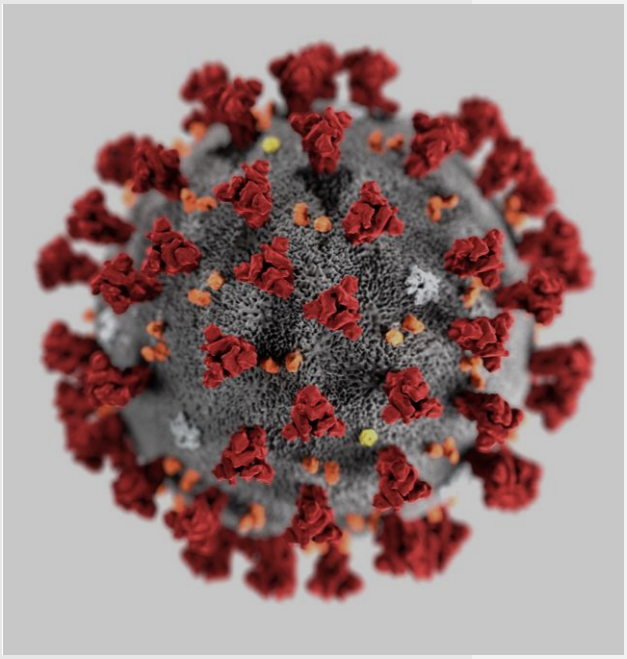

Project Report

Stay at Home

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Introduction

Coronavirus disease 2019 (COVID-19) is the third coronavirus infection in two decades that was originally described in Asia, after severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS). As the COVID-19 pandemic spreads worldwide, intensive care unit (ICU) practitioners, hospital administrators, governments, policy makers, and researchers must prepare for a surge in critically ill patients. We aim to provide an estimation about the effects of spreading COVID cases by evaluating in light of the usage and capacity of intensive care units (ICU) in Turkey.

Timeline of the Project

01 Data Collection

We collected reliable data about COVID spread, cases, deaths and the usages of ICUs from the world.

02 Estimation

We made estimates about the future of COVID-19 in Turkey with the help of machine learning algorithms.

03 Modeling & Simulation

We created a model that explain the ICU system. Then we simulated this model.

04 Analyzing

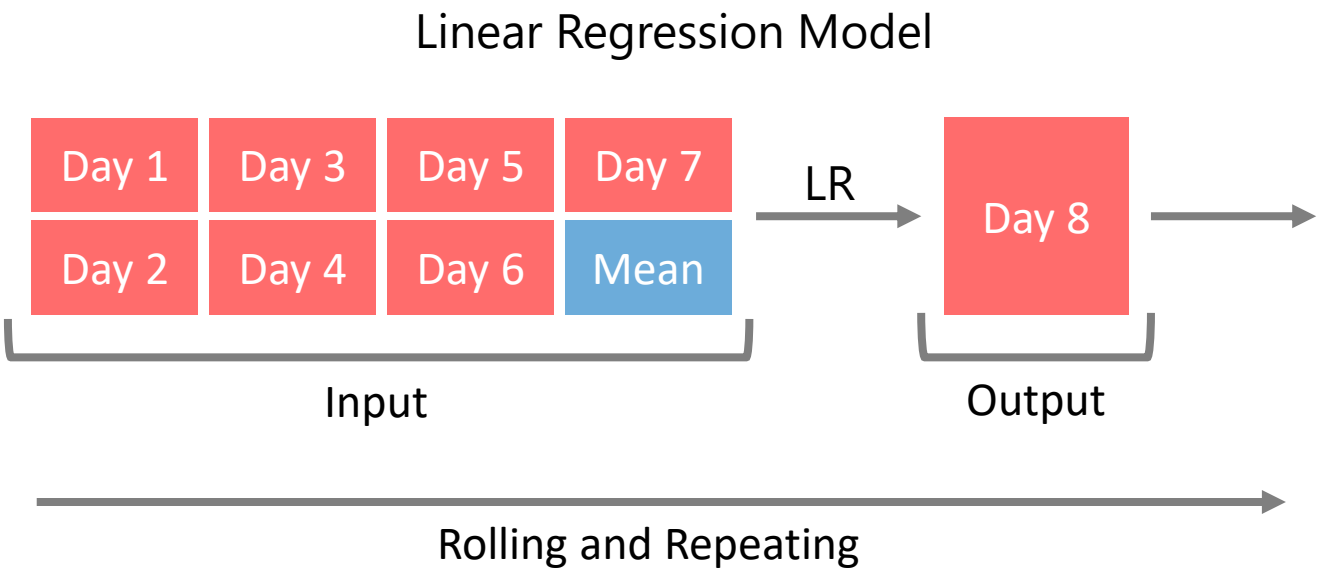
We analyzed the result of simulation.

Estimation

The first step of the project is estimation of number of COVID-19 cases in Turkey. We found that linear regression is the most suitable estimation method among all estimation methods according to R2 test, MSE,MAE metrics.

After the selection of estimation method, we made two linear regression(LR). Both LR perceives last 7 days case data and their average as inputs. The reason of using last 7 days data is that the symptoms of disease appear. In additon, to make model more stable, we made feature extraction by adding last 7 day's mean value. After the estimation 8. day data, LR was made sequentially by rolling of days. As a result, we acquire the estimation of next 50 day's case data for Turkey.

The difference between first and second LRs is whether Turkey is a succesful country in manner of battle of COVID or not. While second LR used data from countries that have high case increase rate, first LR perceives Turkey as an average country and includes data from all around the world. In second LR, we used clustering algorithms to determine the worst countries.



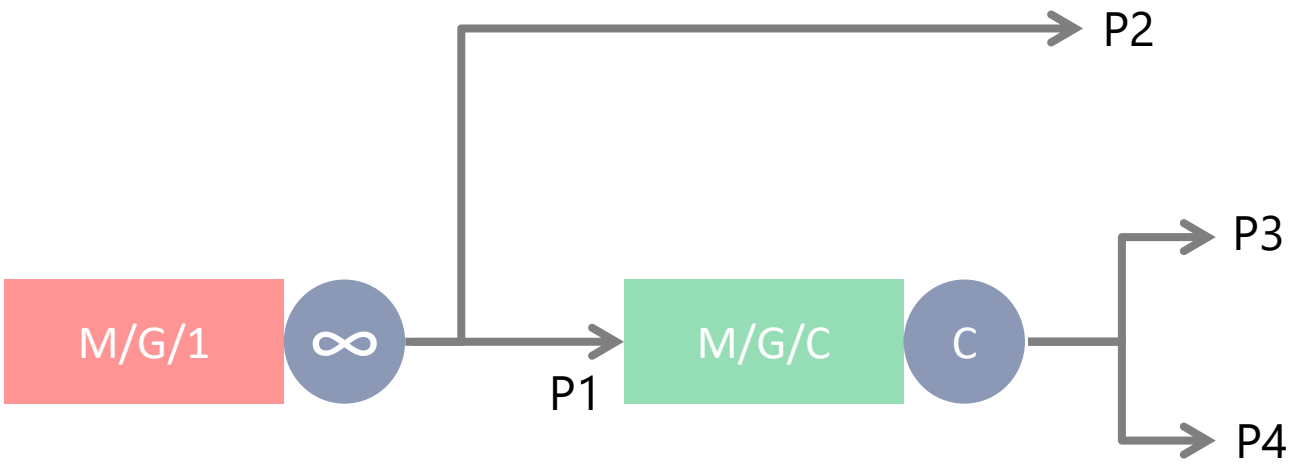
After two linear regression, we create the average and worst case data for Turkey to using simulation. The reason of making 2 linear regression is the measure of Turkey's ICU performance in different scenerios.

Modeling

To explain the ICU system in Turkey, we created a queue model. The queue contains two server. The first queue in the system represents the COVID positive patients in Turkey. People who are infected wait at home until they shows symptom. While some people pull through the ilness without going to hospital (P2), ingravescent people are hospitalized and are taken to intensive care (P1). The second queue represents the infected people that treat in ICU system. Some of people in ICU unfornutanely die (P3) and remaining people can survive (P4).

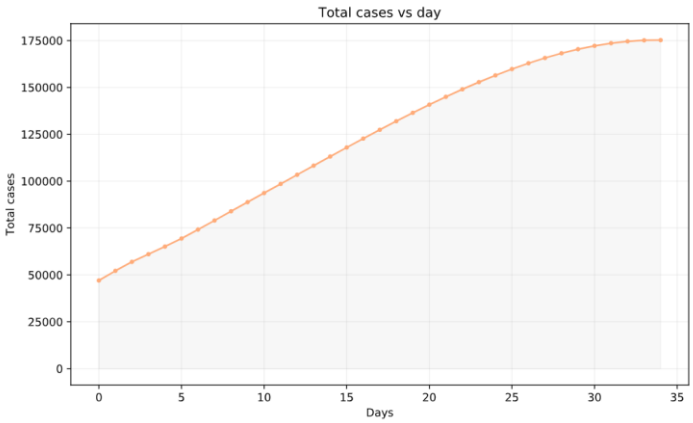
In this simulation we assume that the arrival process of the patients to the hospital is a Poisson process. Because in the estimation we make, we take into account the effects between 2 patients. So in the simulation, probability of a new COVID positive patient is independent from other patients. Because the time between 2 poisson processes is an exponential distribution random variable, we use exponential distribution.

There is no restriction in the number of people who are infected(∞). However, the capacity of intensive care unit in Turkey is finite.(C)

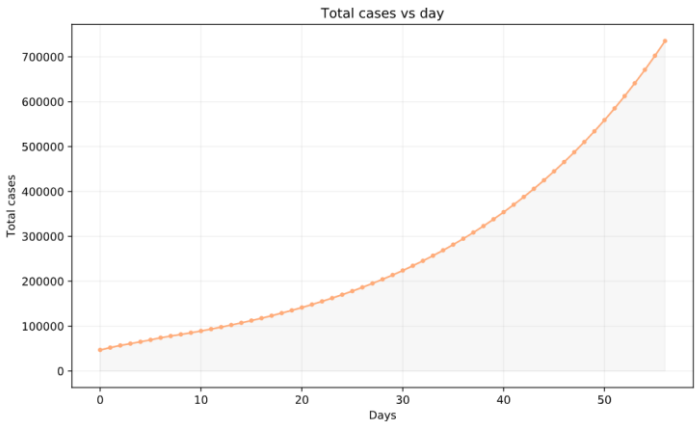


Total Cases

Average Scenerio

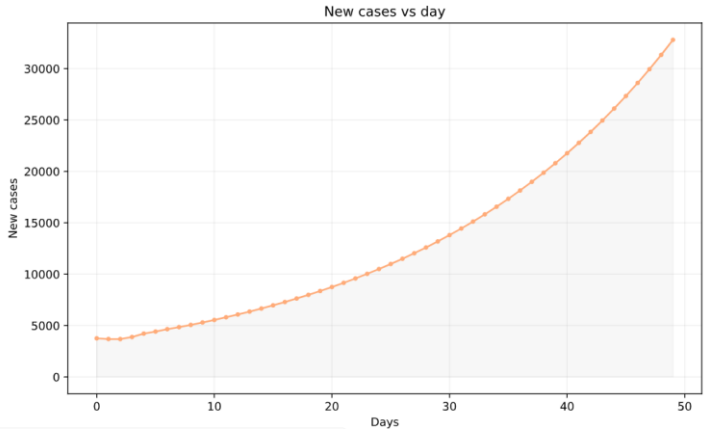


Worst Scenerio

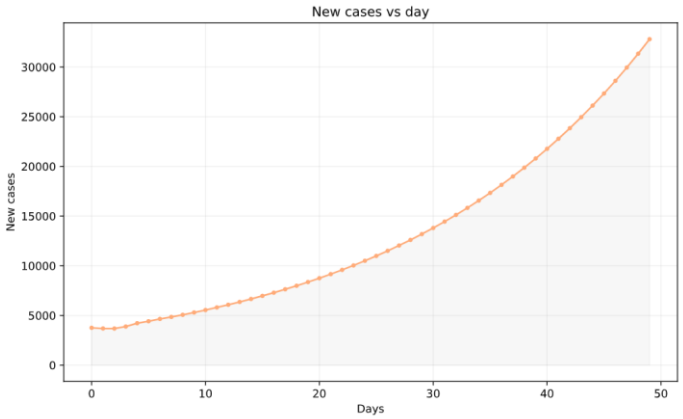


New Cases

Average Scenerio

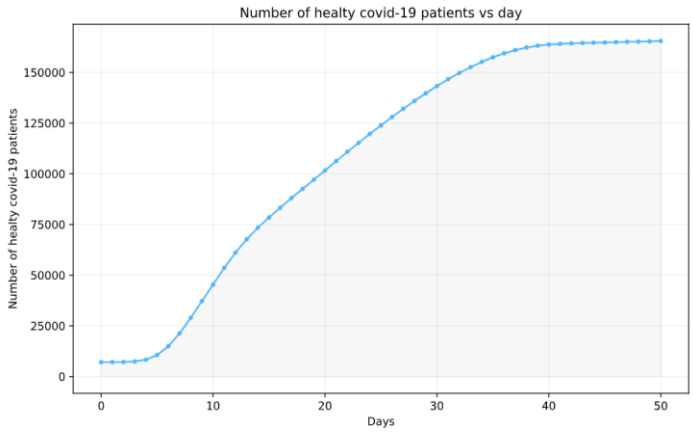


Worst Scenerio



Number of Healthy Patients

Average Scenerio



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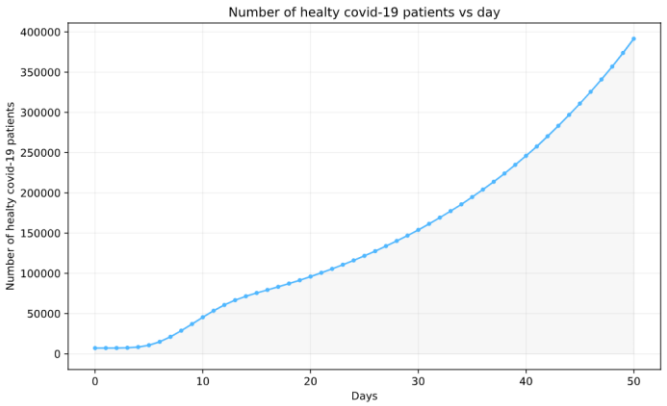
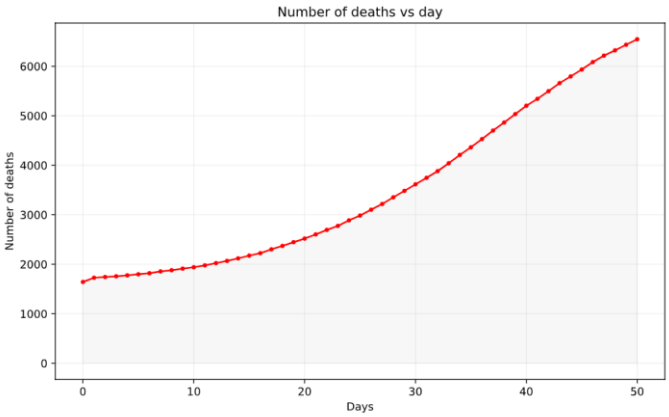
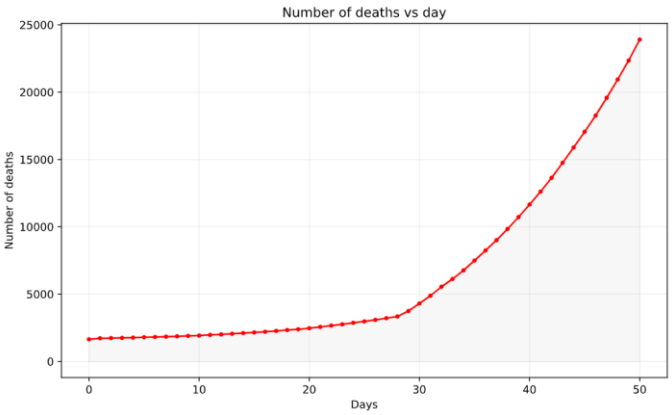


Number of Deaths

Average Scenerio

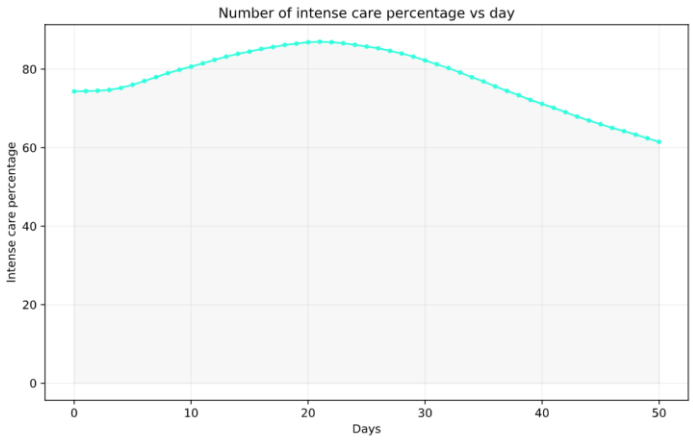


Worst Scenerio



Intensive Care Unit Usage

Average Scenerio



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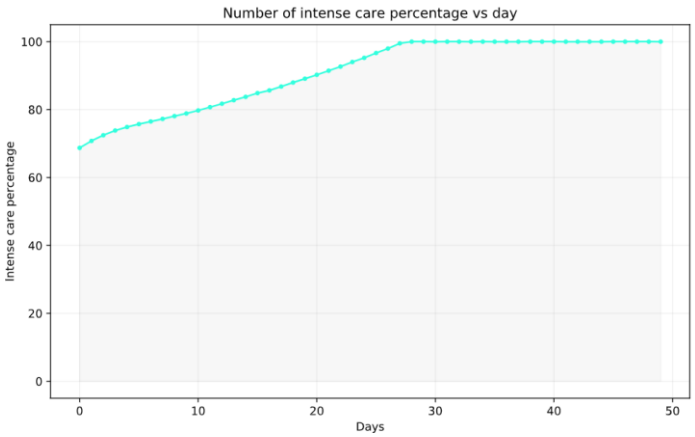
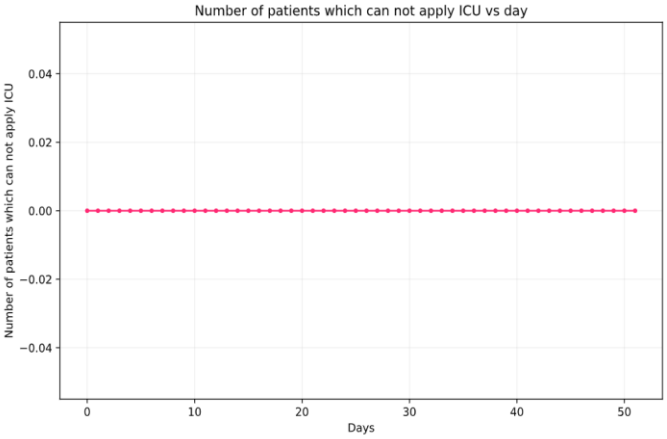


Number of Patients who can’t apply ICU

Average Scenerio



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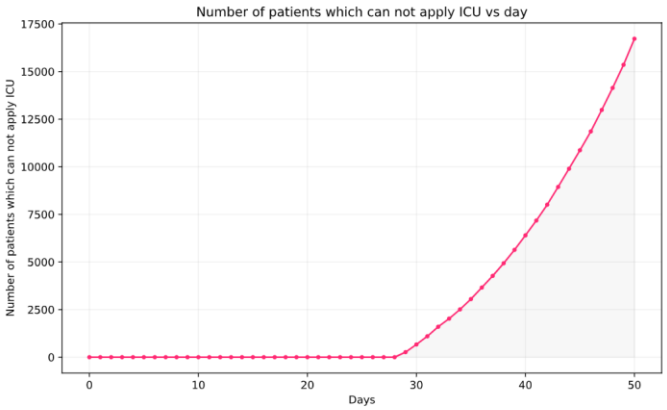

Conclusion

COVID is one of the biggest pandemics in the history of the world that cause death, disrupt supply chains and cause bankruptcy, and also radically change people's lives. Although COVID has a lot of detrimental effects on economies and peoples social life, its most destructive effect is on human life. It is very important that the intensive care capacity of the countries is sufficient for the infected people to recover. We tried to answer whether there is sufficient capacity Turkey's intensive care according to various spread scenarios in this study.

According to the analysis results, in case of a rate of increase in world average spread rate, intensive care capacity usage of Turkey does not exceed 80%. However, this analysis was based upon all of the country. There might be some deficiencies from city to city. A spreading rate above the world average prevents many people from being treated in intensive care.