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Short Communication

Pandemic Simulation and Analysis

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Abstract

Since the last month of 2019, mankind has been making great efforts to eradicate the corona virus. The trend has generally been positive in trying to cope with a situation where, on the one hand, scientists develop vaccines and other means to combat the virus, but the virus, on the other hand, develops variant mutations. Currently, the COVID-19 plague has been considerably reduced in most countries through vaccines and other means. The struggle with COVID-19 has motivated the development of a model to treat any pandemic situation, such as COVID-19. Some of the means developed in this challenge are technological, on the one hand, and change the behavioral habits of society, on the other hand. We will present here a model that illustrates this paradigm.

Keywords: Zoom; Social network; Target function; Multiplication coefficient; Discretization

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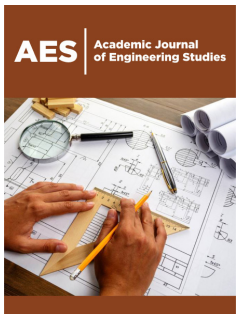

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Introduction

First, we will separate the entities, their attributes, and the mutual relationships that take part in such a life changing experience.

The main relevant entities are humans, the virus, the disease, economic issues, the weapons, and the government. The attributes of each entity are as follows:

A. Humans: vulnerability, age (older, mid age, and children), profession (e.g., physicians, teachers, and high-tech home workers);

B. Virus: the life length, infection time, the probability to infect, the frequency of replication, the sensitivity to antibodies, the potential for developing mutations, and its time;

C. Disease: the period of time, side effects (probability), severity (using extra equipment-such as ECMO), and mortality;

D. Economic issues: The distribution of the economic benefits between the following branches: the automation level, working online-using social media, shipping goods, e.g., foods to clients, or requiring clients to come to the shopping center themselves.

E. Weapons: There are several types:

1. Vaccines (immunization time, price, and side effects);
2. Medications (validation time and price);
3. Masks: wearing a mask provides some kind of protection;
4. **Isolation:** Separating population groups according to their vulnerability to the pandemic. These aspects should be considered regarding this topic:

Social media, such as ZOOM, enables the community to keep a healthy distance each from other.

Controlling: selecting the entrance to public locations, according to the person's

immunity level generated artificially using a series of vaccines or by being infected in the past and recovering afterwards.

The effectiveness of vaccines and other control measures can be measured using the following tests:

a. A PCR test: it checks the number of viruses in a unit volume of the blood with an accuracy close to 100%.

b. An antigen test: it checks the antigens in the oral and nose cavity; it is quicker but less reliable than the PCR test.

F. Government: The government is a regulator that controls to some extent the breaking of the pandemic. Some of the above-mentioned weapons against the disease are publically available tools used by the government. In order to use them, the target function should be defined to indicate the priorities and the limits-red lines should be avoided at almost any cost. The main relevant parameters are as follows:

1. The number of seriously ill persons-dangerously approaching the maximum hospitalization capacity.

2. The mortality levels.

3. The decrease in production and the increase in expenses at the national level, which are measured in terms of money; this also includes human lives and their health level. Red lines should be defined to avoid an economic disaster.

The above entities' notations can be summarized in a simplified and discretized equations system, which is represented here by the formula below:

t - the time in days;

$N_{\inf ected}$ (t)- the number of infected humans on the t-th day.

q-the multiplication coefficient, indicating the increase (q>1) or decrease (q<1) of the ill population in one day.

$$N_{\inf ected}(t) = q\ N_{\inf ected}(t-1) = q^t N_{\inf ected}(0)$$

The aim of implementing the equations via a simulation is to enable, using the gathered data, to predict more precisely, the pandemic parameters.