

TJHSST Computer Systems Lab Senior  
Research Project  
Modeling the Effects of Disasters on a Human  
Population and Resources  
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**Abstract**

Recently over the past decades, numerous disasters such as the earthquakes and tsunamis have struck all over the world, and this project is an attempt to not only model the effects of these disasters on a human population accurately, but also to extrapolate the effects of future disasters on a nearby human population using a System Dynamics approach.

**Keywords:** Disasters, System Dynamics, Human Population, Recovery Curve

## **1 Introduction - Elaboration on the problem statement, purpose, and project scope**

### **1.1 Scope of Study**

The subject of the project is to model the effects of a disaster on a human population using system dynamics. The main goals of the project is to accurately model the behaviors of a human population and to make the

effects of the disasters accurate in the sense that the data created during the simulation is similar to data collected from real disasters. The project is worthwhile, because if this simulation works accurately, the effects of future disasters may be extrapolated from the test runs. The program, is not a Java-based program, but rather it is written using the NetLogo language. More specifically, I am using the System Dynamics portion of the NetLogo language, and the System Dynamics approach looks into the relationships between different local variables, as opposed to agent-based modeling, where the interactions between the individuals in the populations are pretty much random. This program might interest a meteorologist or someone who tracks earthquakes, because they might want to see how another future disaster will affect a nearby human population. So they can extrapolate data from the program for an earthquake or a hurricane and prepare necessary safeguards to minimize the number of human casualties. At the moment, I only have implemented three factors, which are human population, resources, and disasters. I want to complete the project so that the human population behaves as a normal human population in a wealthy country would, when there are no disasters. Then I want the population to recover as a normal population would after a disaster has struck. If I finish my main project early, I want to add another factor, which is the disaster-preventative measures that a population would take after a disaster has struck. Adding this factor would make the simulation more realistic and the extrapolated data would account for future disaster preventative measures.

## **1.2 Expected results**

I expect the program to correctly model a human population and the population and resources will exhibit a recovery-curve, after the population is struck by a disaster. In the end, all of the results will be shown by graphs, which are made inside of the NetLogo program. Even though I have created a simple simulation, the simulation is stilling missing many possible variables and this program may be used as a shell or foundation for future researchers.

## **1.3 Type of research**

This is Use-inspired basic research, because I am looking at the effects of disasters on populations to pursue fundamental understanding and to later extrapolate data from these models.

## **2 Background and review of current literature and research**

After reading many articles on other System Dynamics programs, Ive discovered all of the projects had one thing in common. The relationships and the interconnection of all the variables are very complex, and to have an accurate simulation, almost all, if not all, of the factors of a system need to be accounted for and worked into numerous relationships. I also realized that drawing a diagram of all the relationships and factors would help me visualize the problem better, because many of the authors of the article had drawn up their designs on paper first, before actually beginning to model their idea using a computer program. Many of the authors, also used a pre-existing System Dynamics program called Stella. My simulation will be like every other System Dynamics simulation, in the sense that Im simulating something based on the relationships between the factors in a system, and more specifically in my case, disasters on human population and resources.

## **3 Procedures and Methodology**

For this project, I plan to first model the behavior of a human population with respects to the resources that are available for population growth accurately. To test if I have created an accurate model, I will look at other human population models and compare my test runs, which are made by running and plotting the program on a graph inside of NetLogo, to the models and check if the curves are similar. After I create an accurate behavior, I will then start implementing different types of disasters that will not only affect the population, but also the resources in different ways. Once I have created the necessary variables and relationships, I will then test the effects of the disaster on a human population. The results of the test runs will be compared with that of real data, and then changes will be made to best fit the data from the test runs to the data found from real situations. If everything is finished, then a disaster-preventative variable will be taken into account and tested in similar ways (ie with data from real situations).

## 4 Expected Results

When I am finished with the project, I expect the program to correctly model a human population and the population and resources will exhibit a recovery-curve, after the population is struck by a disaster. In the end, all of the results will be shown by graphs, which are made inside of the NetLogo program. Even though I have created a simple simulation, the simulation is still missing many possible variables and this program may be used as a shell or foundation for future researchers.