CSE443 – Object Oriented Analysis and Desing

FINAL PROJECT - REPORT

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DESIGN PATTERNS:

In Epidemic Simulator Project, three design patterns were used.

Composite Design Pattern:

The first of these is the Composite Design Pattern.

This design pattern was used to create individual objects.

It allows the user to add individuals one by one and as bulk at once.

Composite is a structural design pattern that lets you compose objects into tree structures and then work with these structures as if they were individual objects.

There is an interface called IndividualInterface.

Individuals are kept in this type.

There are two classes, Individual and Individuals, which implement this interface.

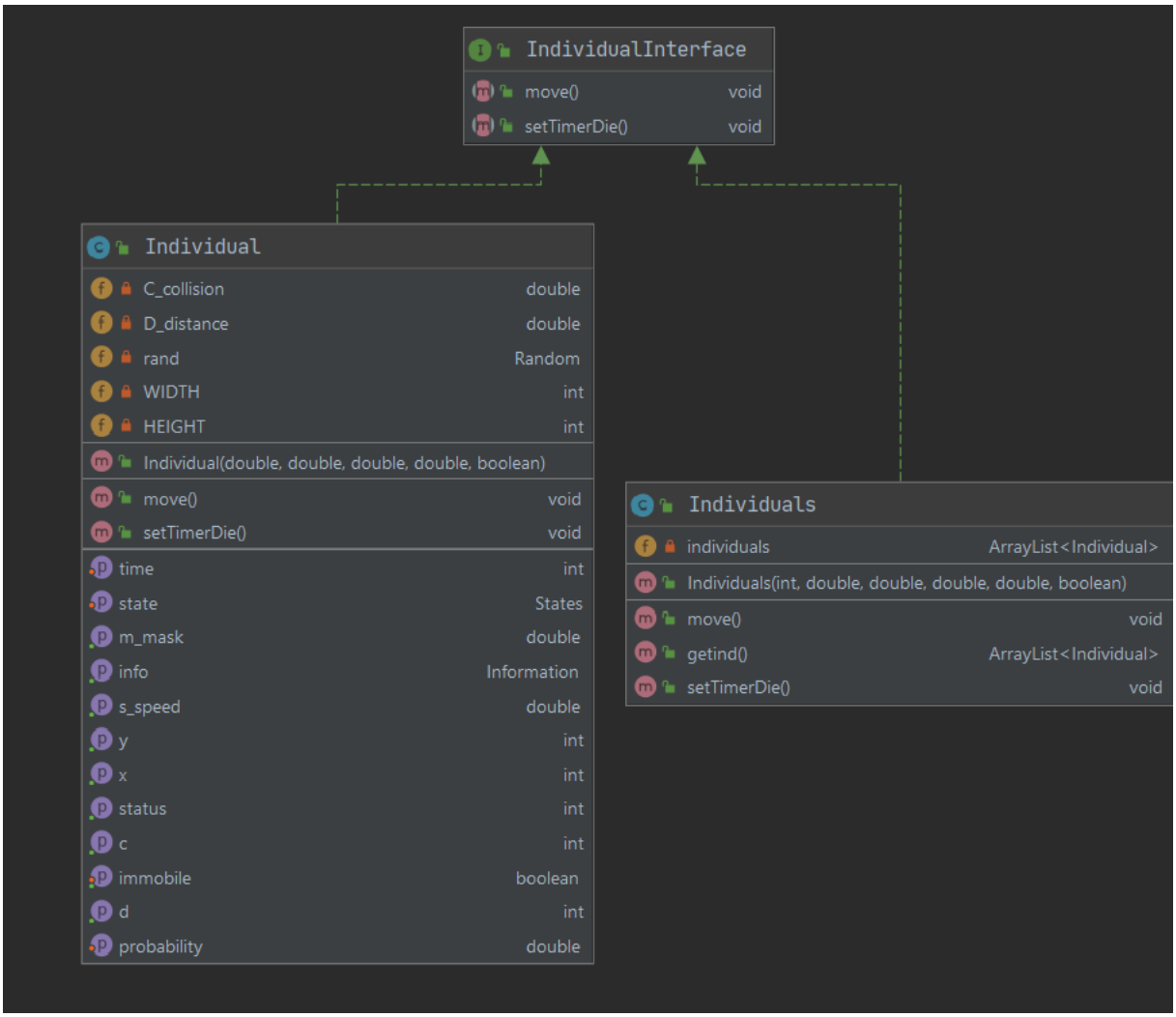
While the Individual class refers to a single individual, the Individuals class refers to individuals as a bulk.

You don’t need to know whether an object is a only one individual or a individuals bulk.

It can treat them all the same via the common interface.

When it called by a method, the objects themselves pass the request down the tree.

New Individual types into the app without breaking the existing code.



State Design Pattern:

There are 4 cases for individuals.

These cases actually indicate the instant situation (or state) of the individual.

These states are; healthy, infected, inhospital, dead.

Although every state has common aspects, each state has its own movement, controls and timers.

The individual class keeps the state as an object.

Individual uses the state class to perform the required movement, controls.

Thus, the state of the Individual object can be dynamically changed and a new behavior can be given.

State is a behavioral design pattern that lets an object alter its behavior when its internal state changes. It appears as if the object changed its class.

The main idea is that, at any given moment, there's a finite number of states which a program can be in.

However, depending on a current state, the program may or may not switch to certain other states.

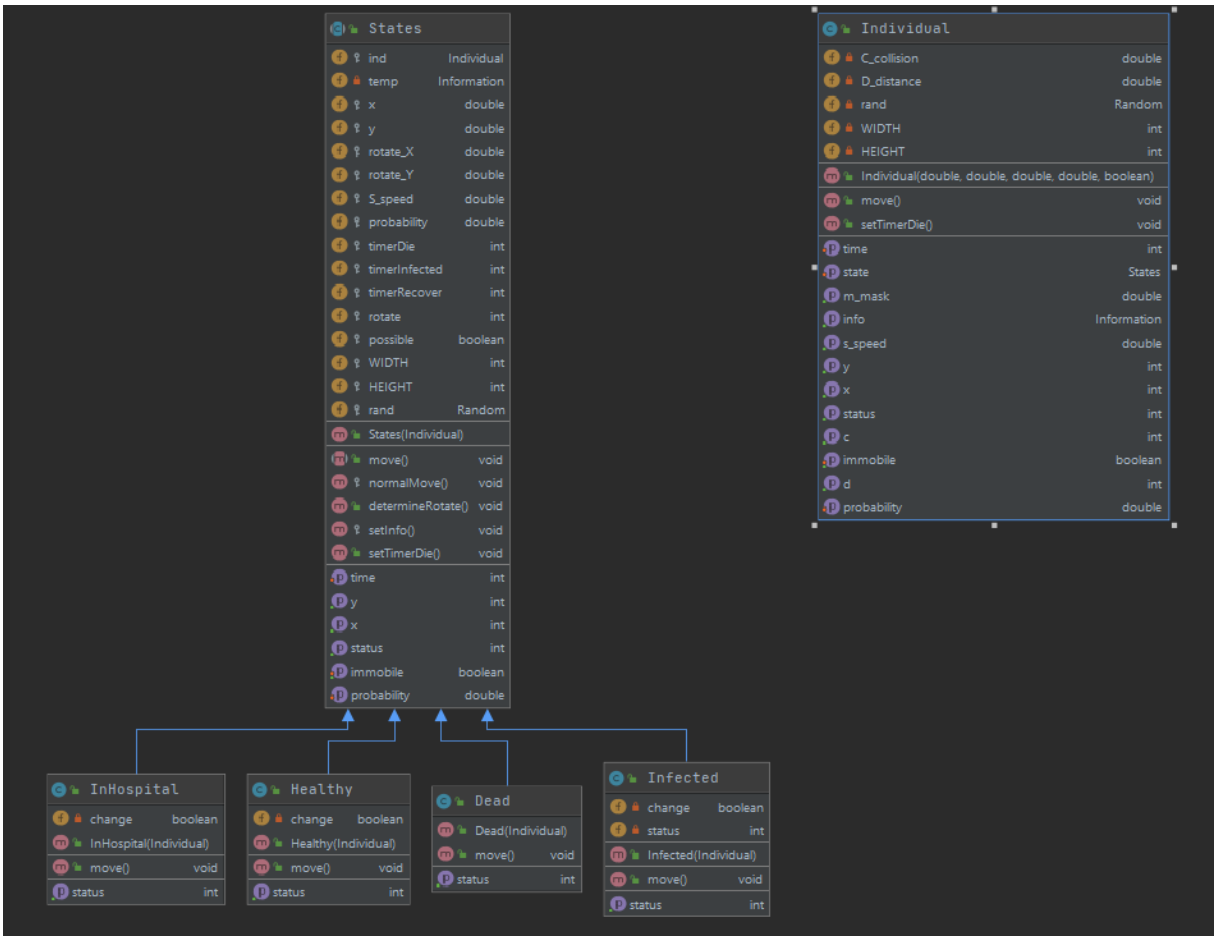
For example switch from healthy to infected.

The State pattern suggests that you create new classes for all possible states of an object and extract all state-specific behaviors into these classes.

It organize the code related to particular states into separate classes.

It allows introducing new states without changing the current state classes or context.

It simplifies the code of the context by eliminating bulky machine conditions.



Mediator Design Pattern:

The interaction between individuals was modeled and applied using the Mediator design model.

It acts as an intermediary between the interface class and the Individual class.

Using Mediator object in the interface class, it allows all individuals to move or perform functions such as pressing on the screen.

Mediator is a behavioral design pattern that lets you reduce chaotic dependencies between objects.

The pattern restricts direct communications between the objects and forces them to collaborate only via a mediator object. (between GUI and Individuals)

The Mediator pattern suggests that you should cease all direct communication between the components which you want to make independent of each other.

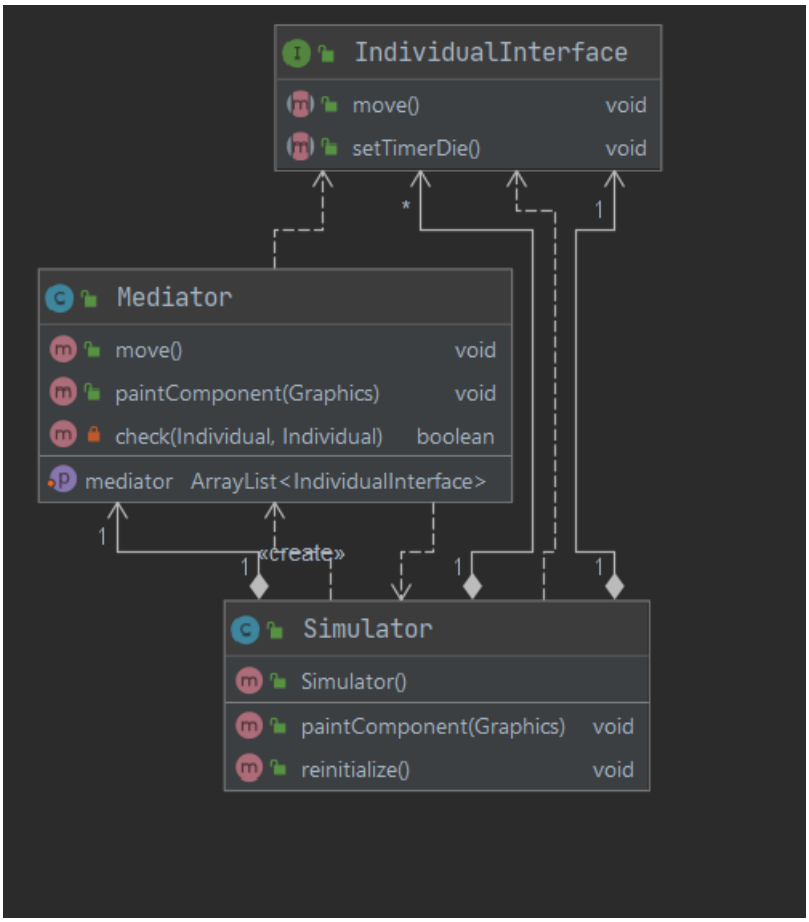
Instead, these components must collaborate indirectly, by calling a special mediator object that redirects the calls to appropriate components.

It can take the communication between the various components in one place, making it easier to understand and maintain.

New mediators can be introduced without having to change the actual components.

It reduces the coupling between the various components of a program. (GUI and Individuals)

Its individual components can be reused more easily.



MULTI-THREADED GUI:

The GUI is multithreaded and designed to be responsive at all times.

The user can pause, resume or restart the simulation.

Java's Timer Class was used to achieve this.

Timer is a utility class that can be used to schedule a thread to be executed at certain time in future.

Java Timer class can be used to schedule a task to be run one-time or to be run at regular intervals.

It create our own TimerTask that can be scheduled using java Timer class.

Java Timer class is thread safe and multiple threads can share a single Timer object without need for external synchronization.

```
timer = new Timer( delay: 1000, new epidemicListener());
timer.start();
```

Creates a Timer and initializes both the initial delay and between-event delay to delay milliseconds.

Starts the Timer, causing it to start sending action events to its listeners.

It will call epidemicListener every second.

epidemicListener is a listener that does what needs to be done every second.

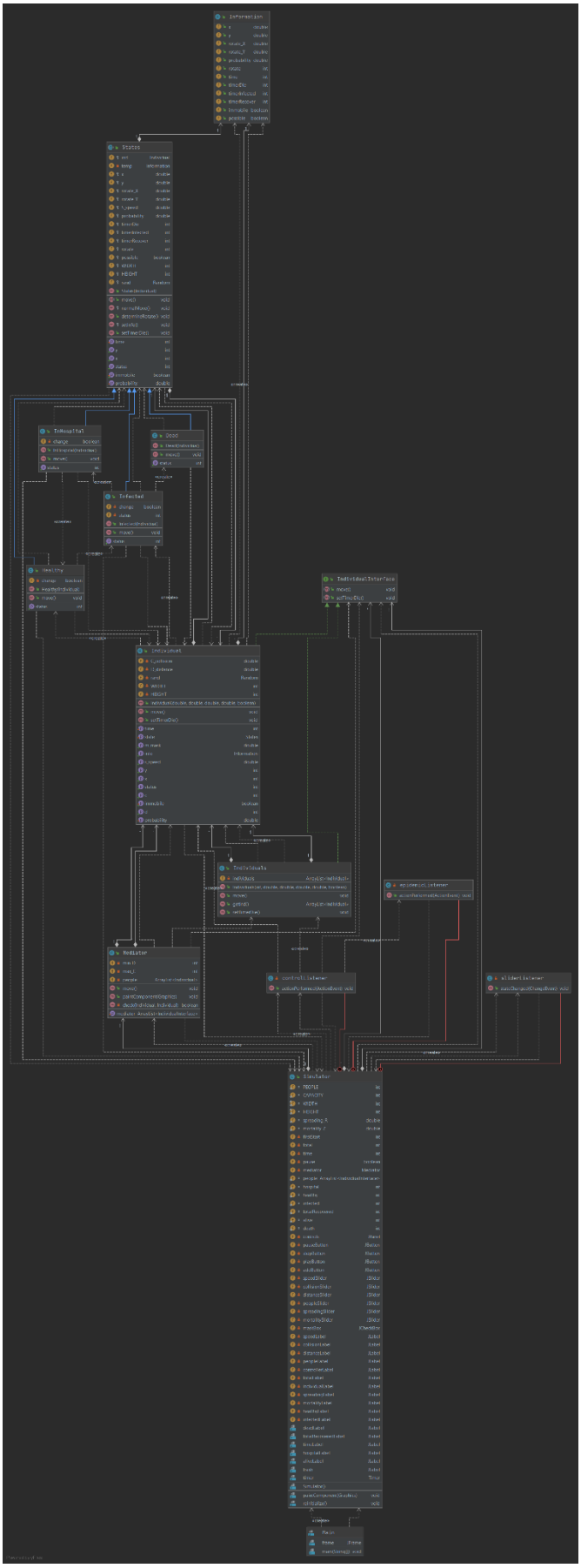
```
private class epidemicListener implements ActionListener{
    public void actionPerformed(ActionEvent e){
        mediator.move();
        if(pause == true){
            time = 0;
        }
        else {
            time += 1;
        }

        healthyLabel.setText("Healthy Amount: " + healthy);
        infectedLabel.setText("Infected Amount: " + infected);
        hospitalLabel.setText("In Hospital: " + hospital);
        aliveLabel.setText("Total Alive: " + alive);
        deadLabel.setText("Death Amount: " + death);
        totalRecoveredLabel.setText("Total Recovered Amount: " + totalRecovered);
        timeLabel.setText("TIMER: " + time);

        repaint();

        if(pause == true){
            timer.stop();
        }
    }
}
```

Class Diagram:



GRAPHICAL PLOTS:

R: Spreading Factor

Z: Mortality Rate

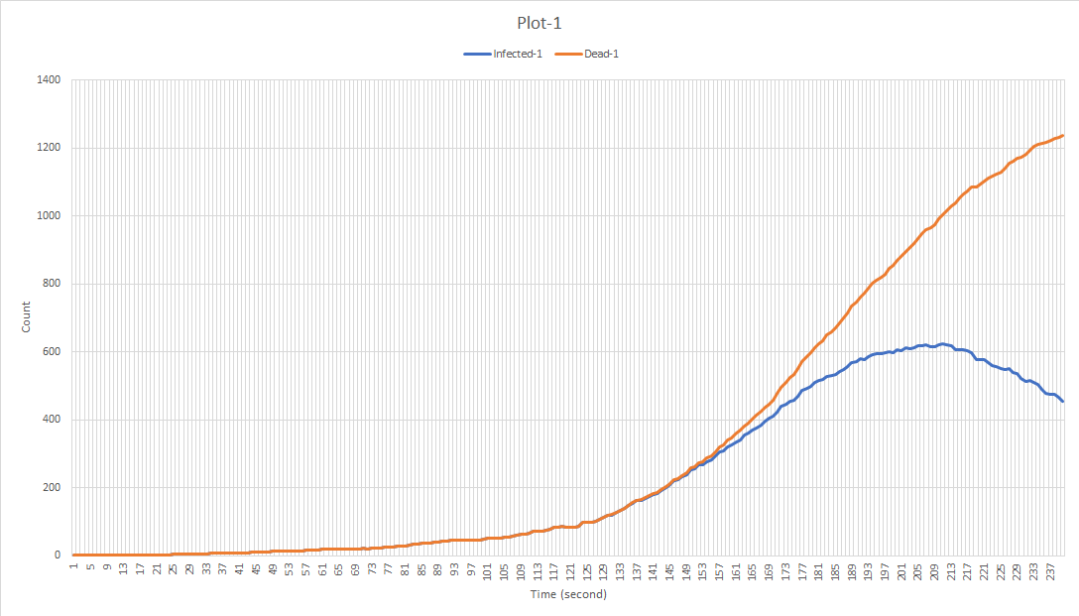
M: Percentage of mask use

D: Average social distance

1- Variable Spreading Factor R:

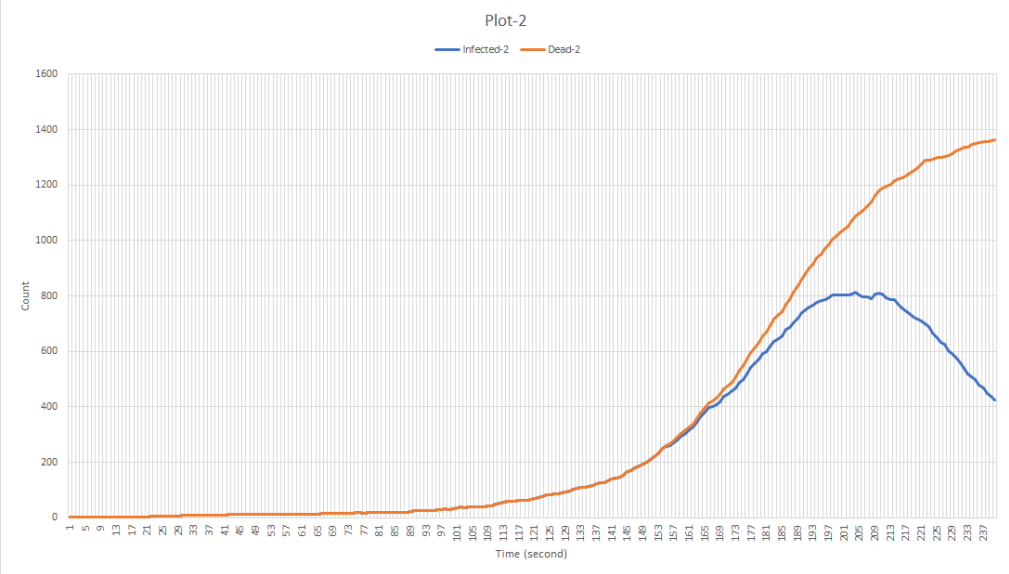
a- PLOT-1 (R: 0.6) :

R: 0.6, Z: 0.6 M: 0.25 D: 4.52



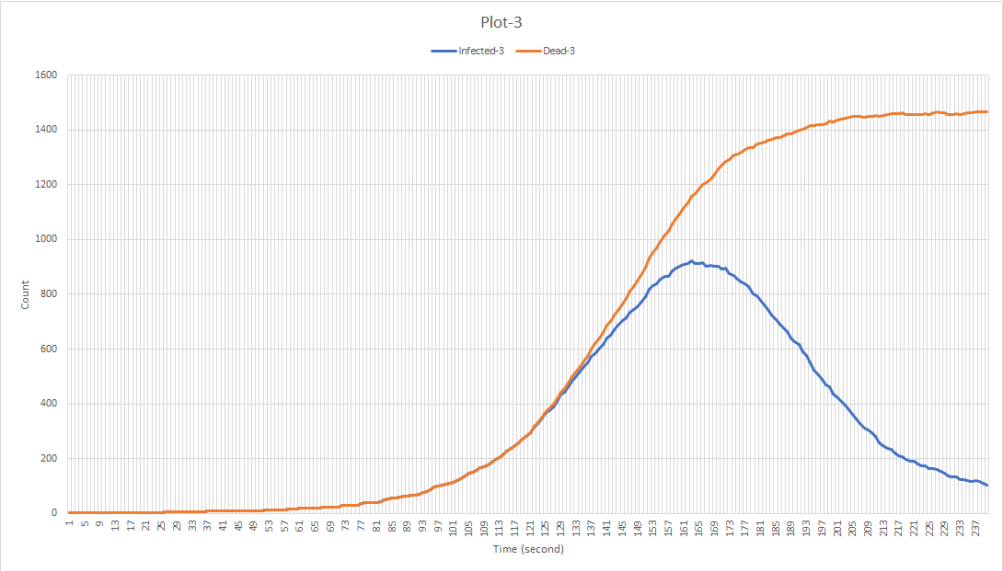
b- PLOT-2 (R: 0.8) :

R: 0.8, Z: 0.6 M: 0.25 D: 4.52



c- PLOT-3 (R: 1.0) :

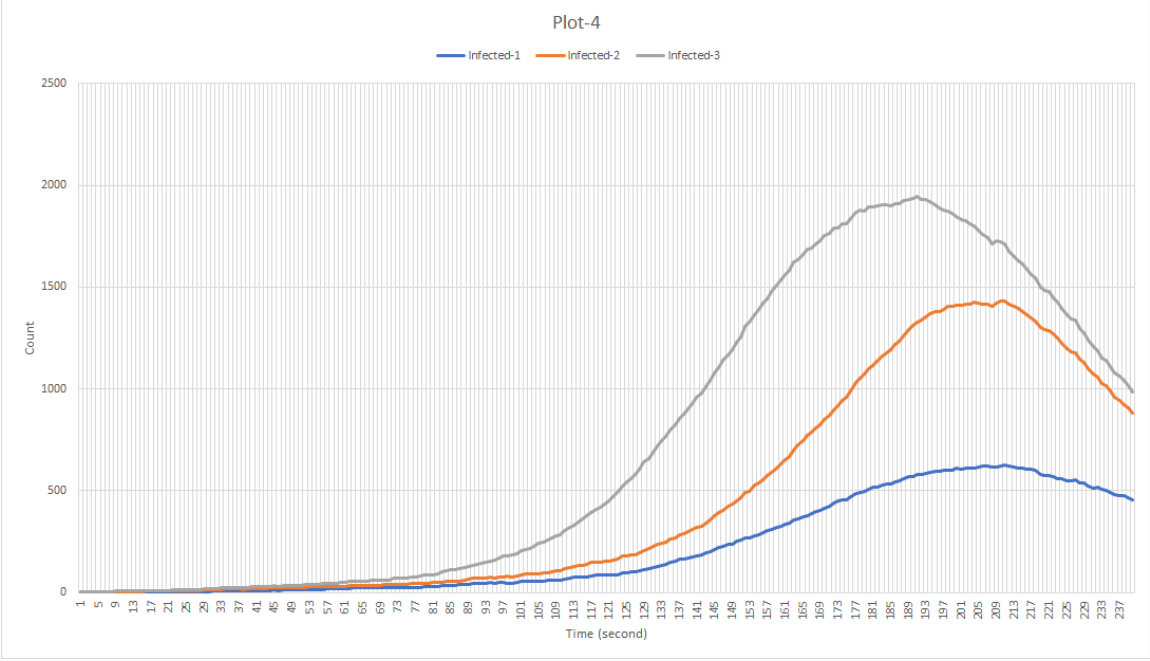
R: 1.0, **Z**: 0.6 **M**: 0.25 **D**: 4.52



d- PLOT-4 (Infecteds for R: 0.6, 0.8, 1.0) :

The change plot of the infected numbers of the simulation operated with 3 different values is given.

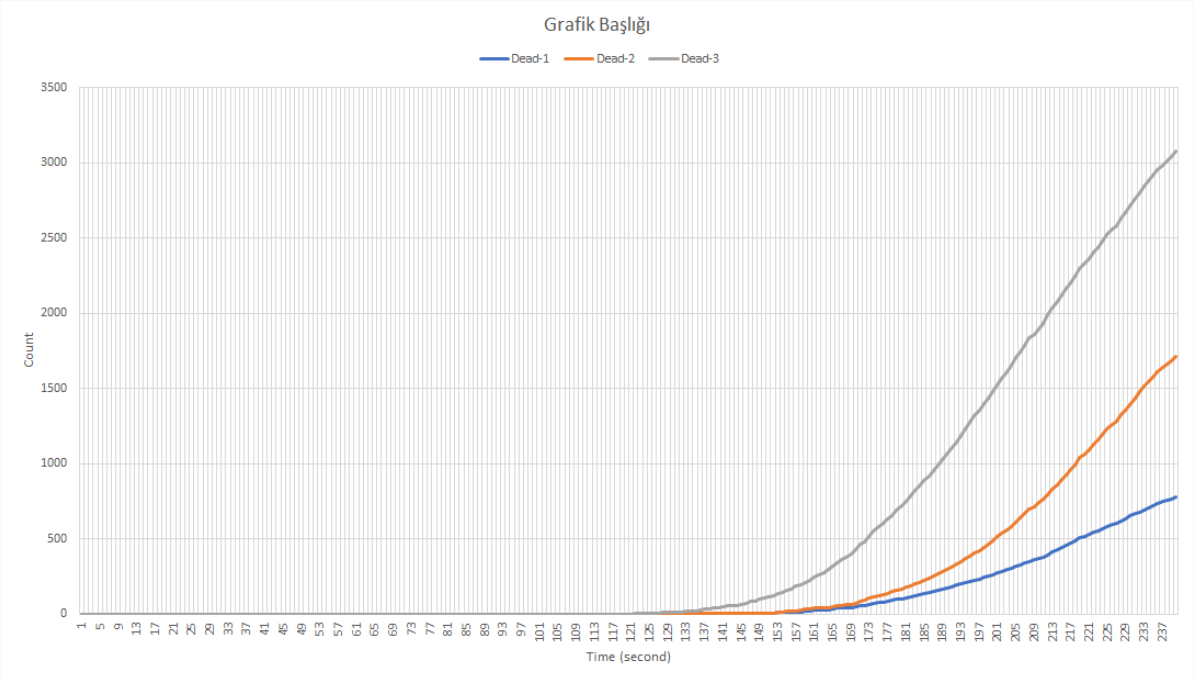
Infected1: R -> 0.6 Infected2: R -> 0.8 Infected3: R -> 1.0



e- PLOT-5 (Deads for R: 0.6, 0.8, 1.0) :

The change plot of the dead numbers of the simulation operated with 3 different values is given.

Dead1: R -> 0.6 Dead2: R -> 0.8 Dead3: R -> 1.0



As can be seen from the graphic, as the spreading factor increases, the number of infected and the number of dead can reach higher levels.

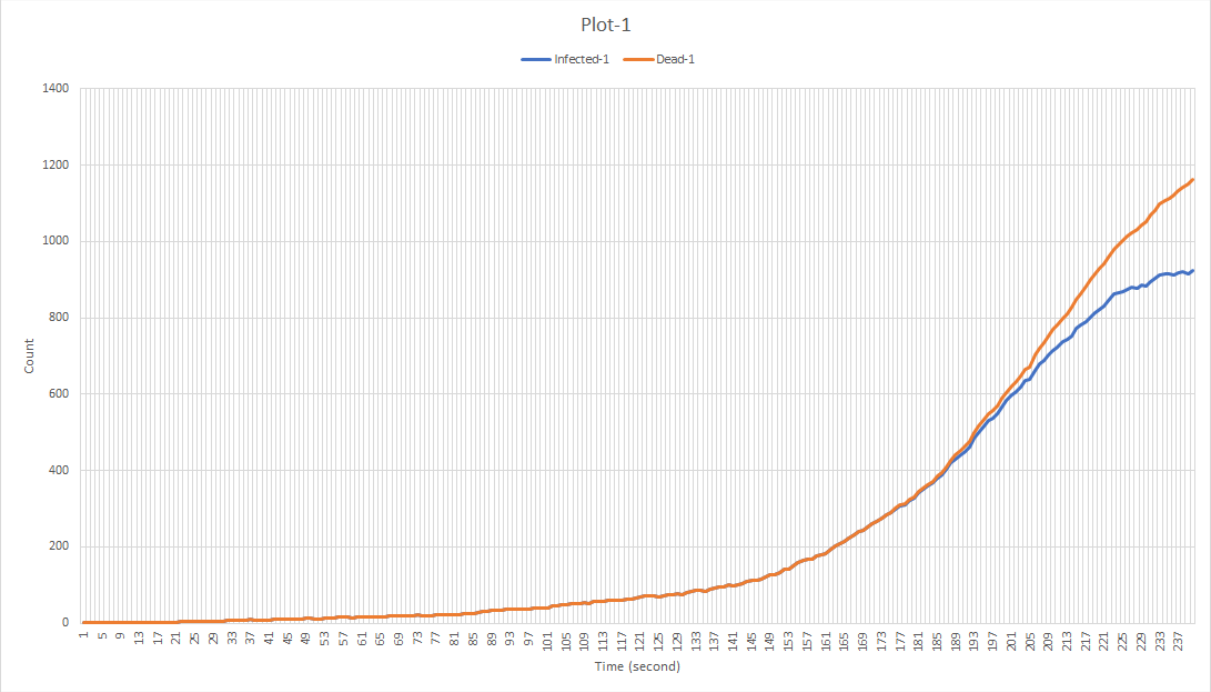
While the number of infected increases exponentially, the number of deaths increases exponentially.

As the population increases, more people will be infected, so an increase in the number of deaths will be observed.

2- Variable Mortality Rate Z:

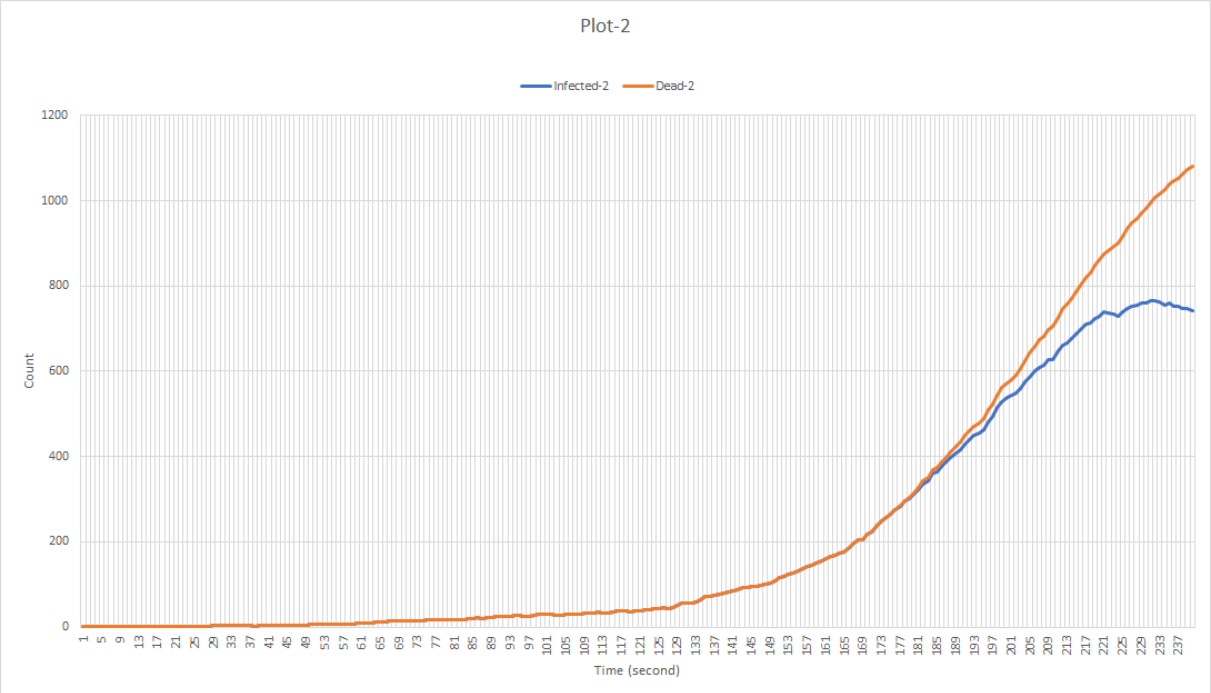
a- PLOT-1 (Z: 0.4) :

R: 0.6, **Z**: 0.4 **M**: 0.25 **D**: 4.52



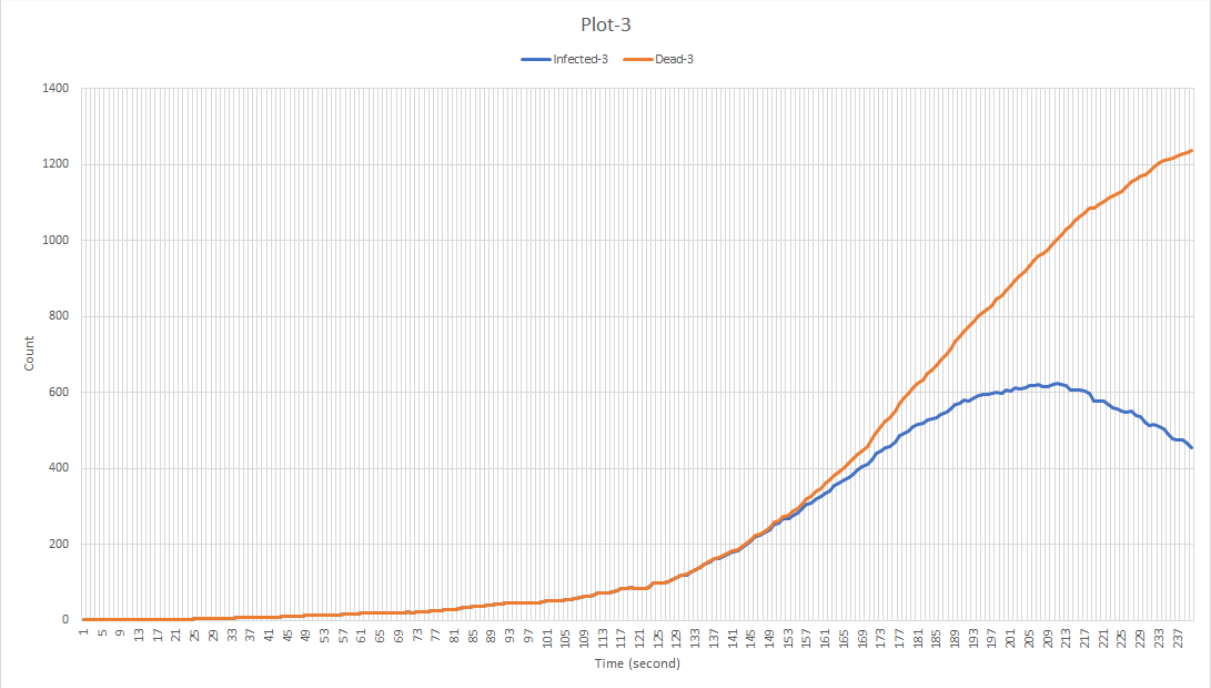
b- PLOT-2 (Z: 0.5) :

R: 0.6, **Z**: 0.5 **M**: 0.25 **D**: 4.52



c- PLOT-2 (Z: 0.6) :

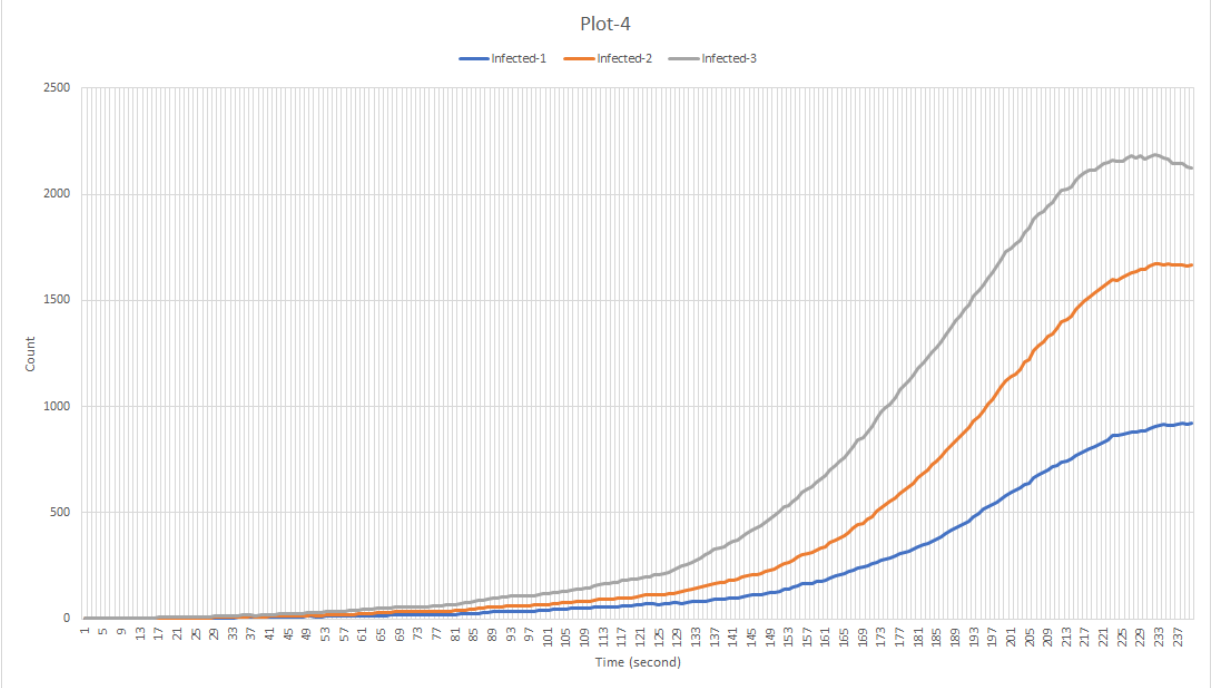
R: 0.6, **Z**: 0.6 **M**: 0.25 **D**: 4.52



d- PLOT-4 (Infecteds for Z: 0.4, 0.5, 0.6) :

The change plot of the infected numbers of the simulation operated with 3 different values is given.

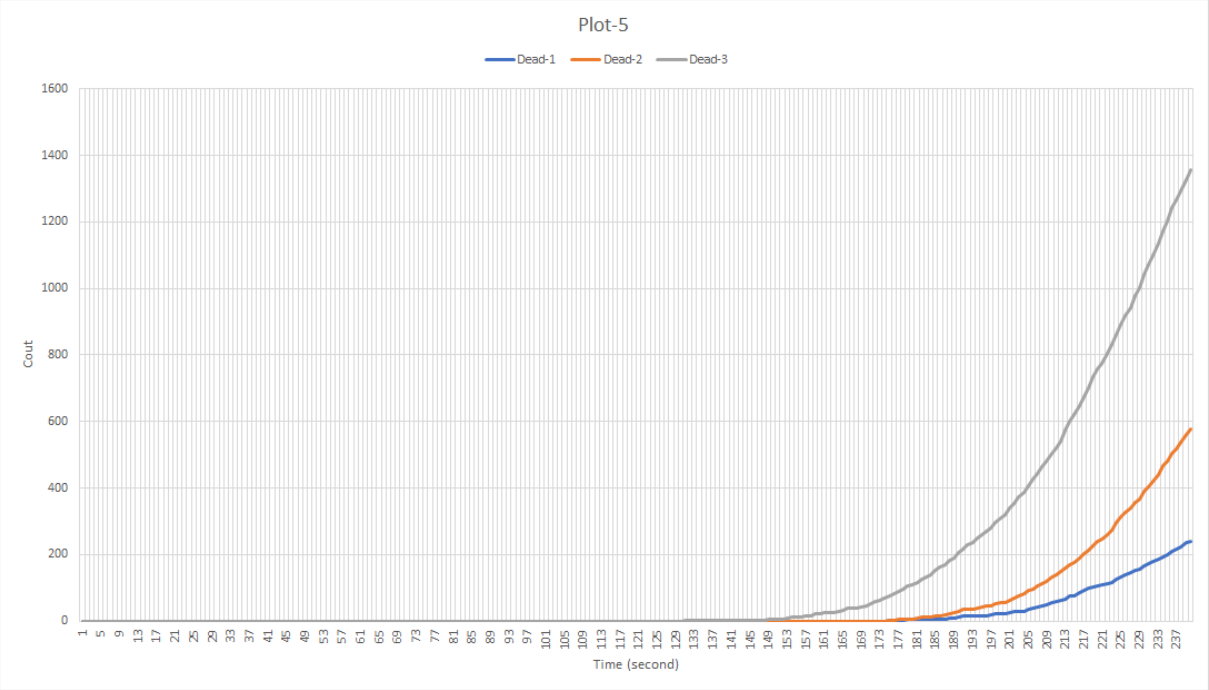
Infected1: Z -> 0.4 Infected2: Z -> 0.5 Infected3: Z -> 0.6



e- PLOT-5 (Deads for Z: 0.4, 0.5, 0.6):

The change plot of the dead numbers of the simulation operated with 3 different values is given.

Dead1: Z -> 0.4 Dead2: Z -> 0.5 Dead3: Z -> 0.6



As can be seen from the graphic, as the mortality rate increases, the number of infected and the number of dead can reach higher levels.

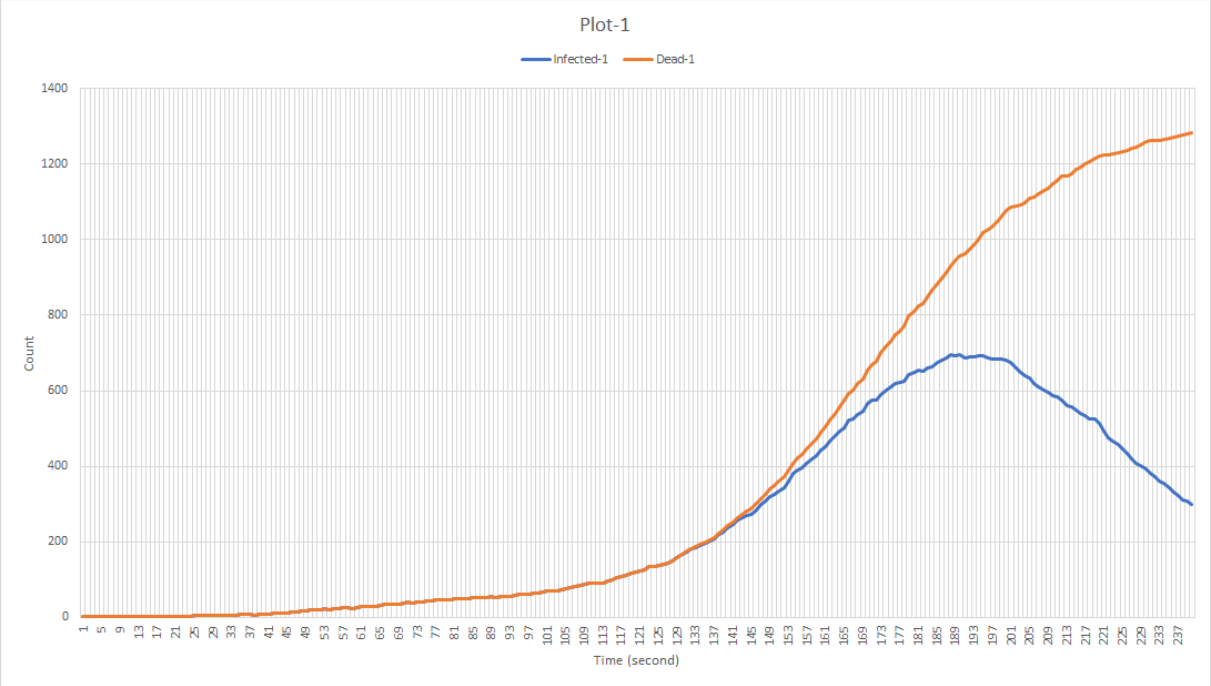
While the number of infected increases exponentially, the number of deaths increases exponentially.

As the population increases, more people will be infected, so an increase in the number of deaths will be observed.

3- Variable Percentage Mask M:

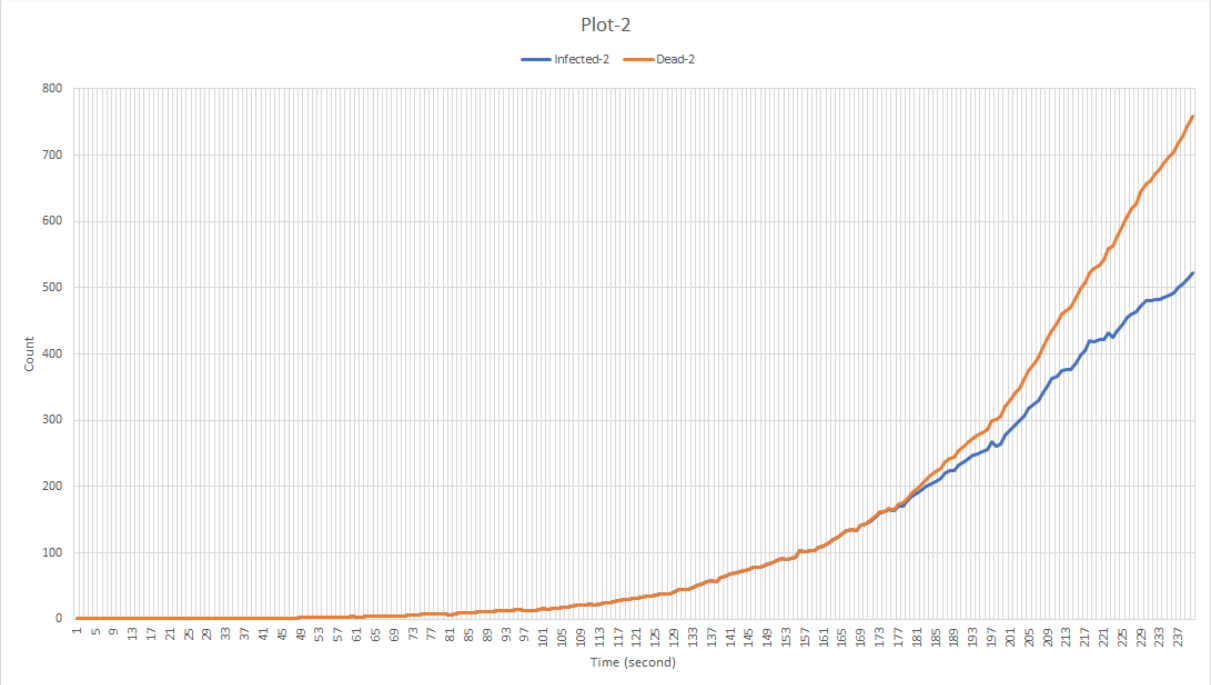
a- PLOT-1 (M: 0.25) :

R: 0.6, **Z**: 0.6 **M**: 0.25 **D**: 4.07



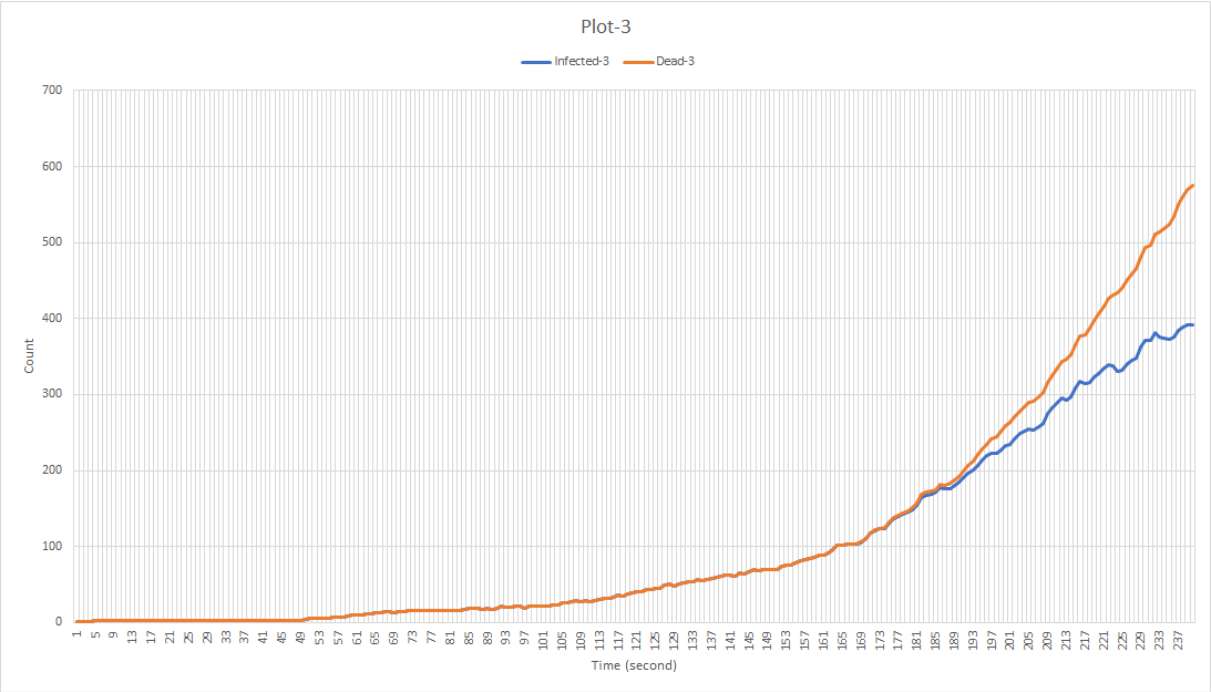
b- PLOT-2 (M: 0.34) :

R: 0.6, **Z**: 0.6 **M**: 0.34 **D**: 4.07



c- PLOT-3 (M: 0.43) :

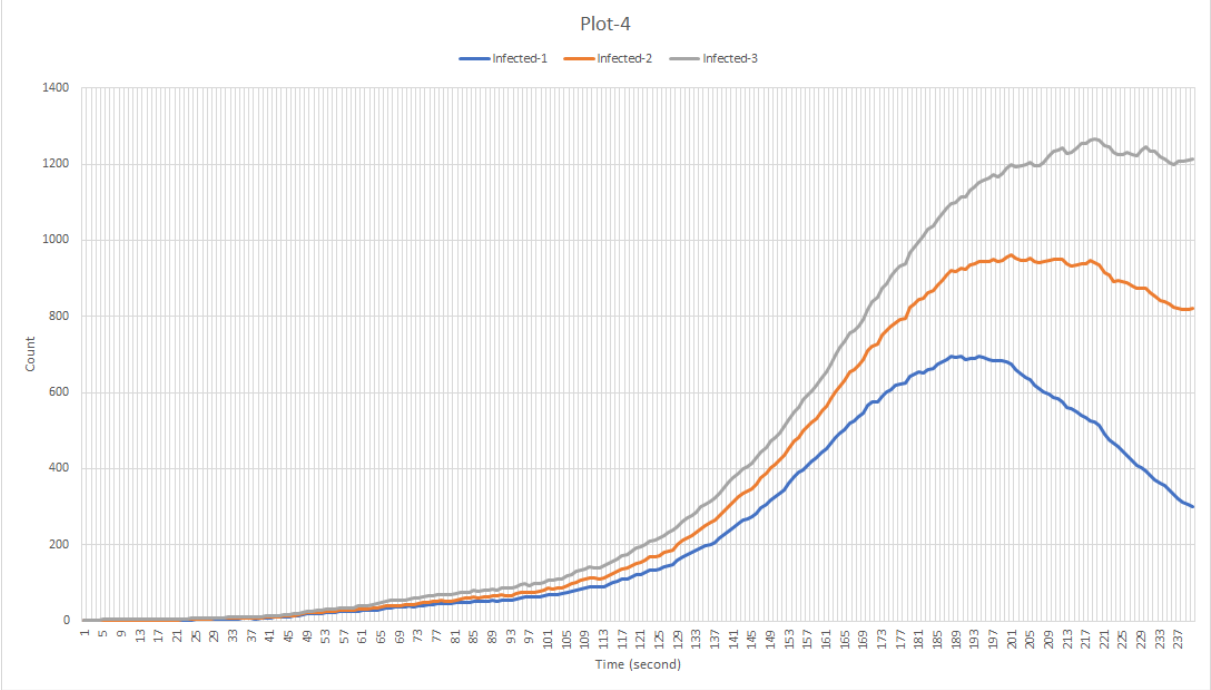
R: 0.6, **Z**: 0.6 **M**: 0.43 **D**: 4.07



d- PLOT-4 (Infecteds for M: 0.25, 0.34, 0.43) :

The change plot of the infected numbers of the simulation operated with 3 different values is given.

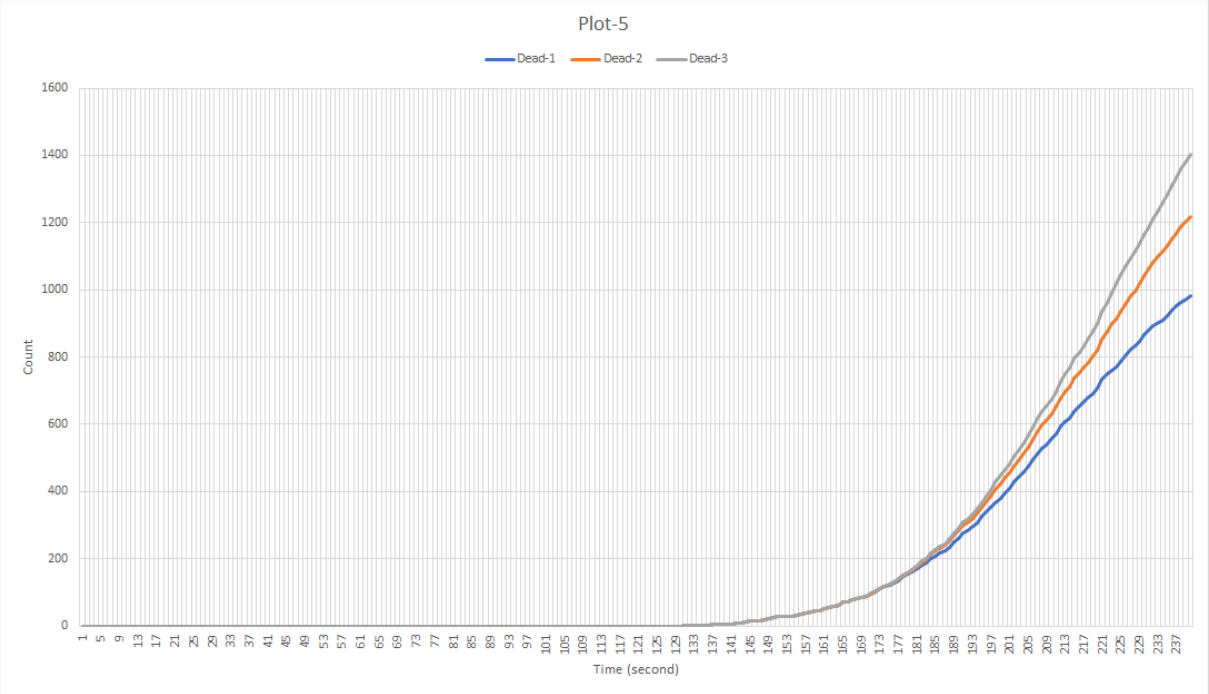
Infected1: M -> 0.43 Infected2: M -> 0.34 Infected3: M -> 0.25



e- PLOT-5 (Deads for M: 0.25, 0.34, 0.43) :

The change plot of the dead numbers of the simulation operated with 3 different values is given.

Infected1: M -> 0.43 Infected2: M -> 0.34 Infected3: M -> 0.25



As can be seen from the graphic, as the percentage mask decreases, the number of infected and the number of dead can reach higher levels.

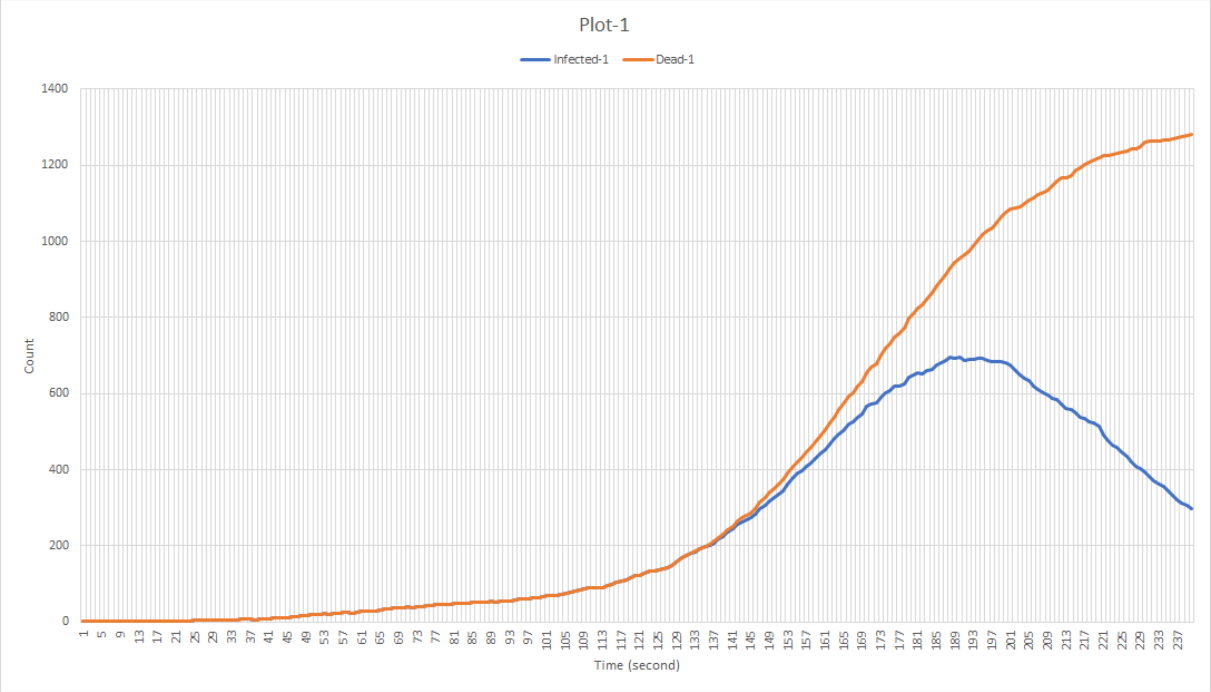
While the number of infected increases linearly, the number of deaths increases linearly.

As the population increases, more people will be infected, so an increase in the number of deaths will be observed.

4- Variable Average Distance D:

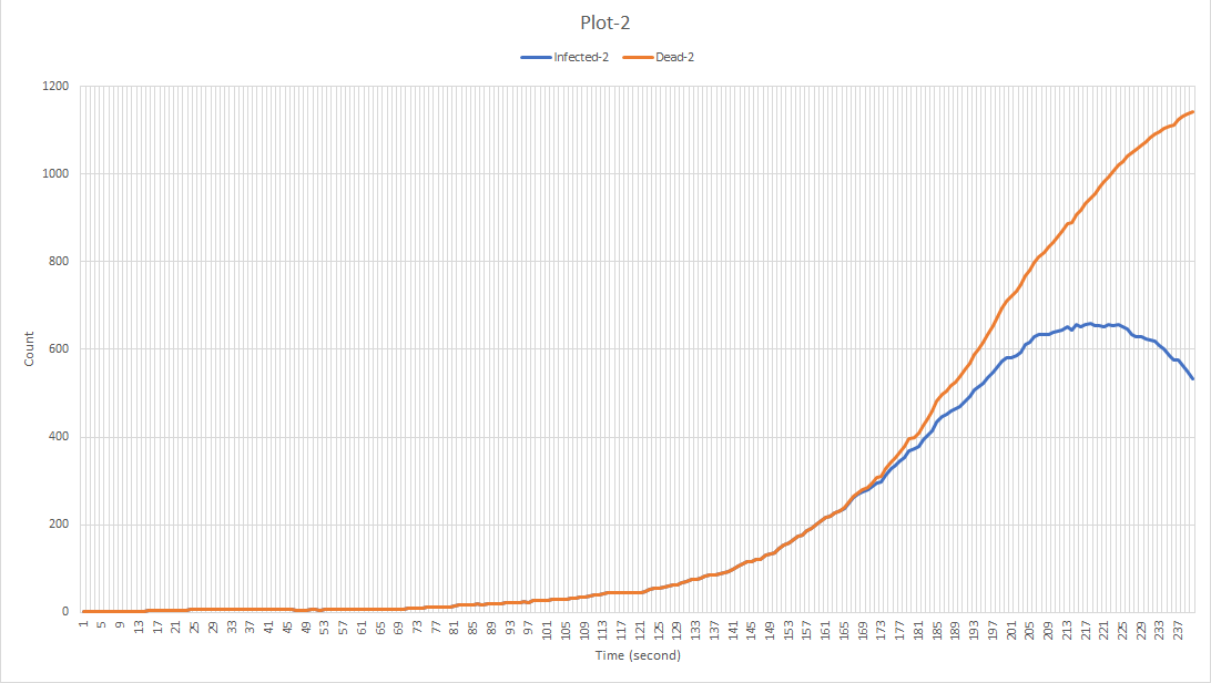
a- PLOT-1 (D: 4.07) :

R: 0.6, **Z**: 0.6 **M**: 0.25 **D**: 4.07



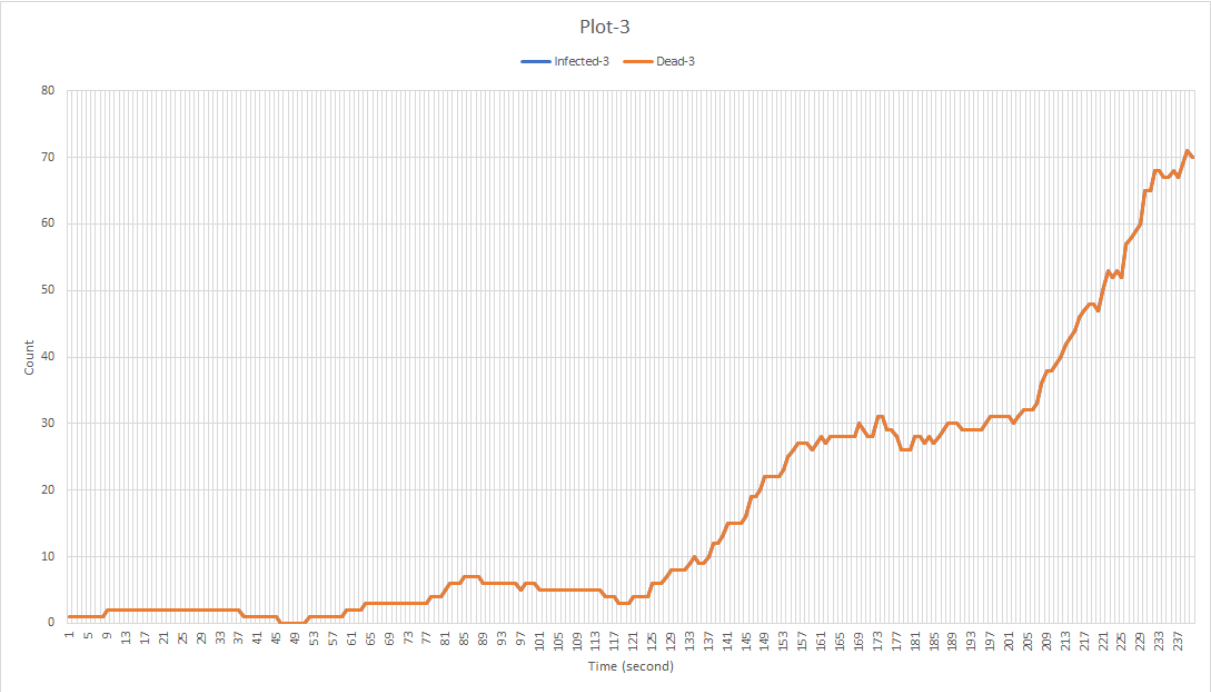
b- PLOT-2 (D: 5.07) :

R: 0.6, **Z**: 0.6 **M**: 0.25 **D**: 5.07



c- PLOT-2 (D: 6.22) :

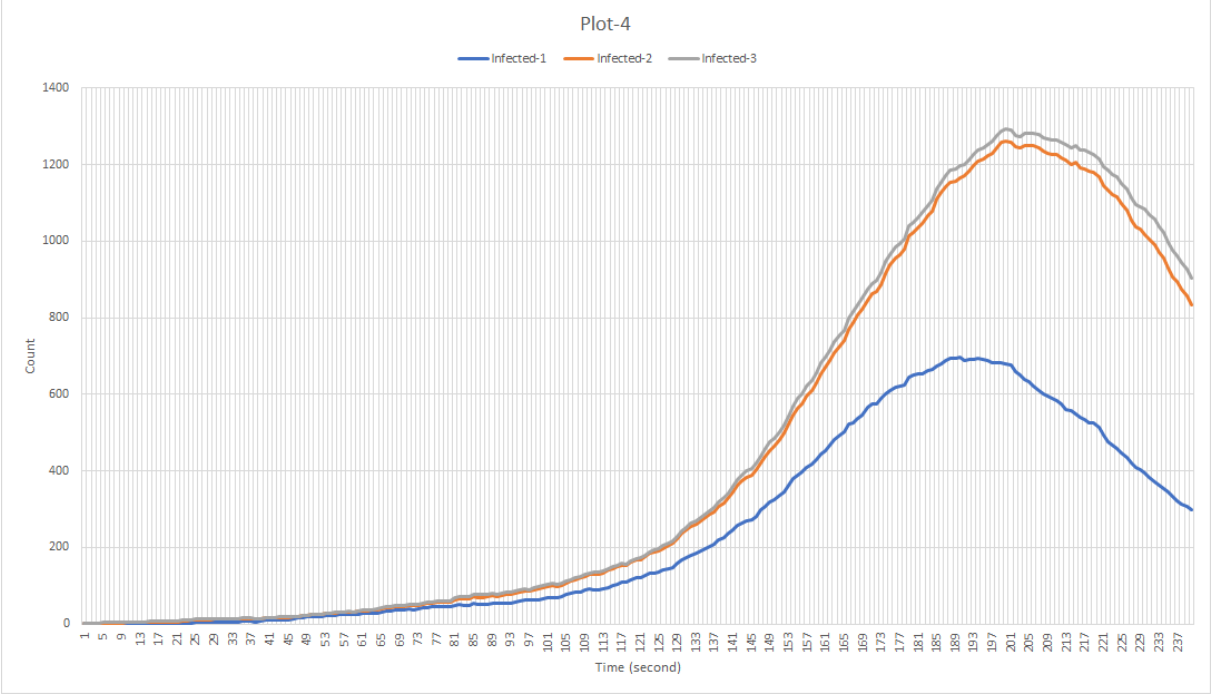
R: 0.6, **Z**: 0.6 **M**: 0.25 **D**: 6.22



d- PLOT-4 (Infecteds for D: 4.07, 5.07, 6.22) :

The change plot of the infected numbers of the simulation operated with 3 different values is given.

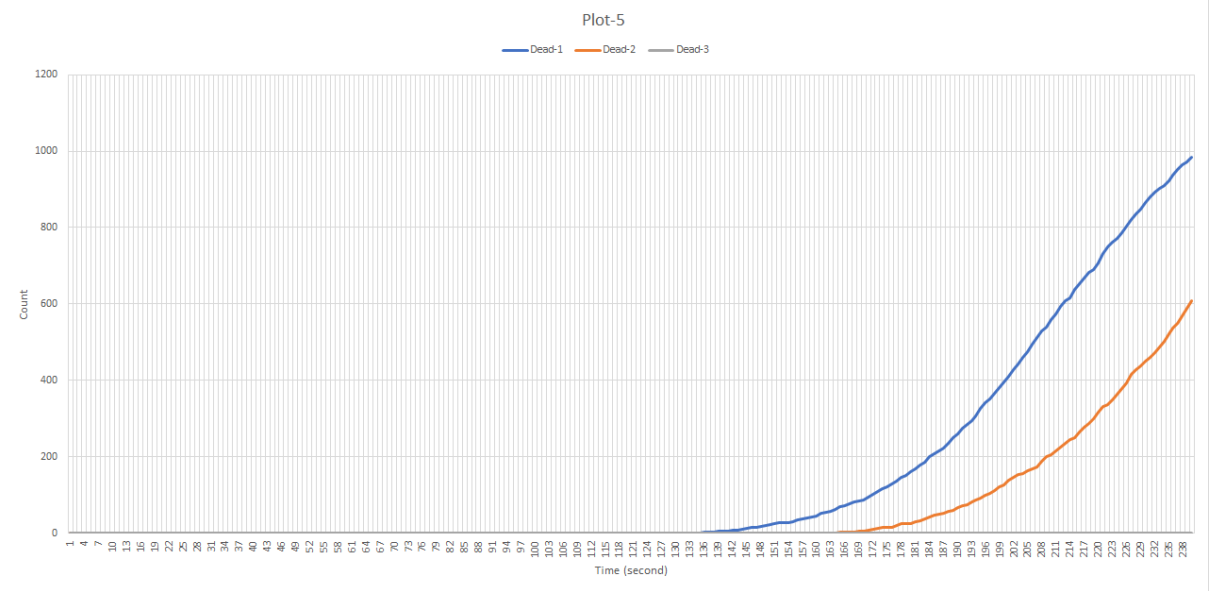
Infected1: D -> 6.22 Infected2: D -> 5.07 Infected3: D -> 4.07



e- PLOT-5 (Dead for D: 4.07, 5.07, 6.22) :

The change plot of the dead numbers of the simulation operated with 3 different values is given.

Dead1: D -> 4.07 Dead2: D -> 5.07 Dead3: D -> 6.22

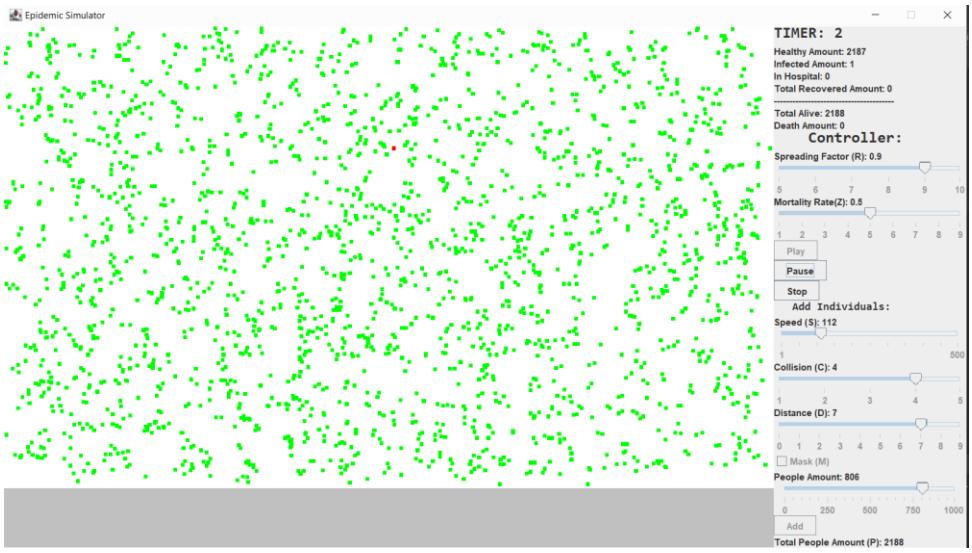


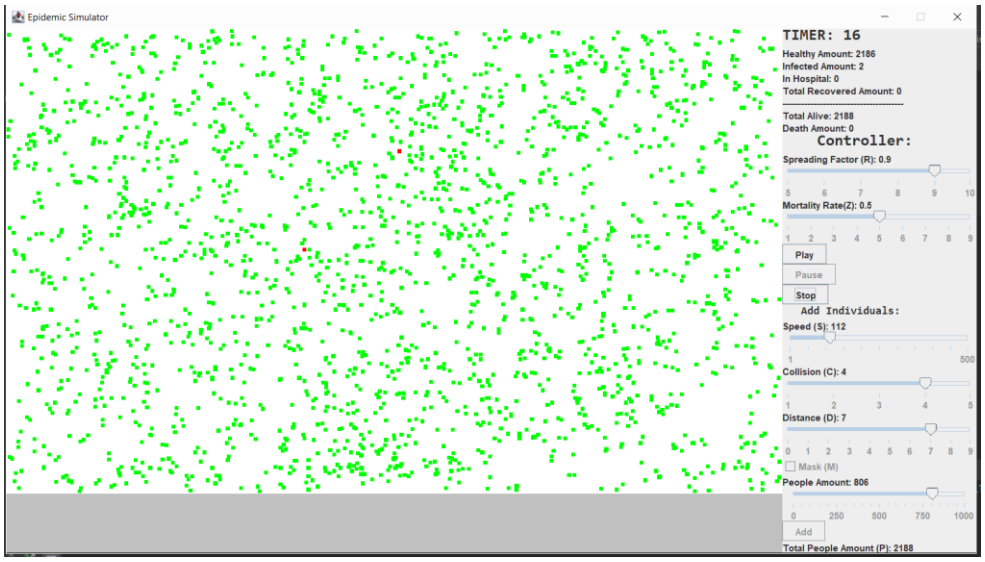
As can be seen from the graphic, as the average distance decreases, the number of infected and the number of dead can reach higher levels.

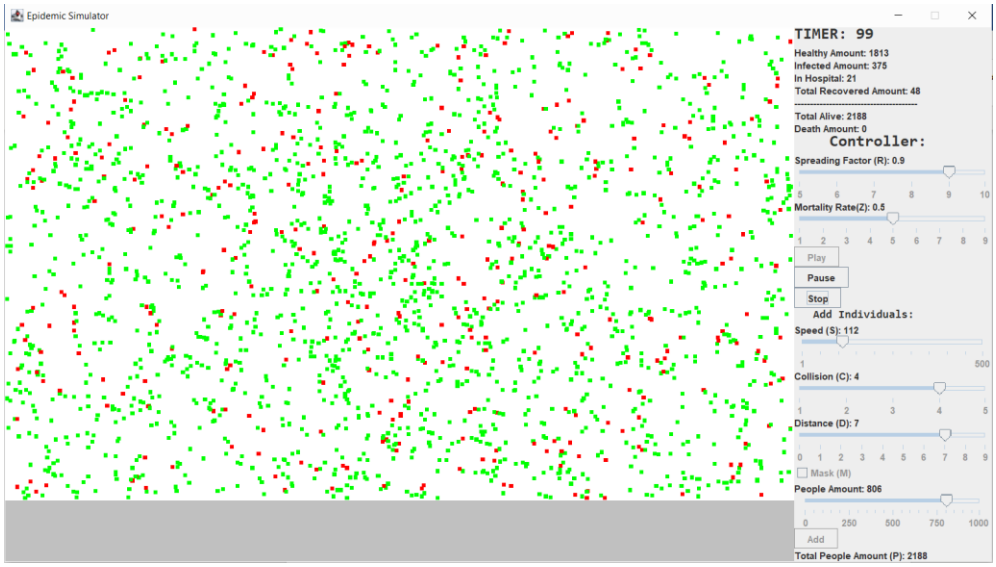
While the number of infected increases linearly, the number of deaths increases linearly.

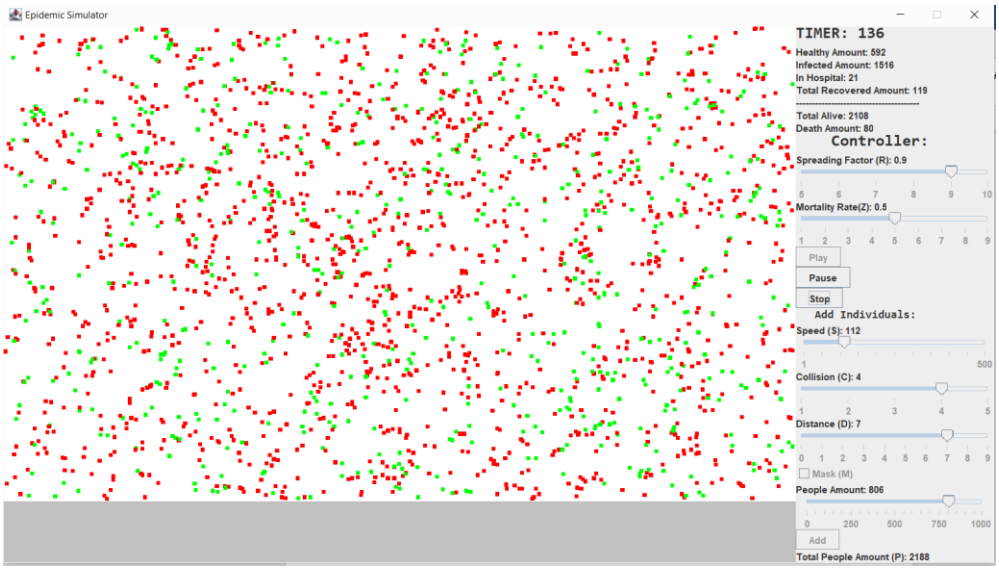
As the population increases, more people will be infected, so an increase in the number of deaths will be observed.

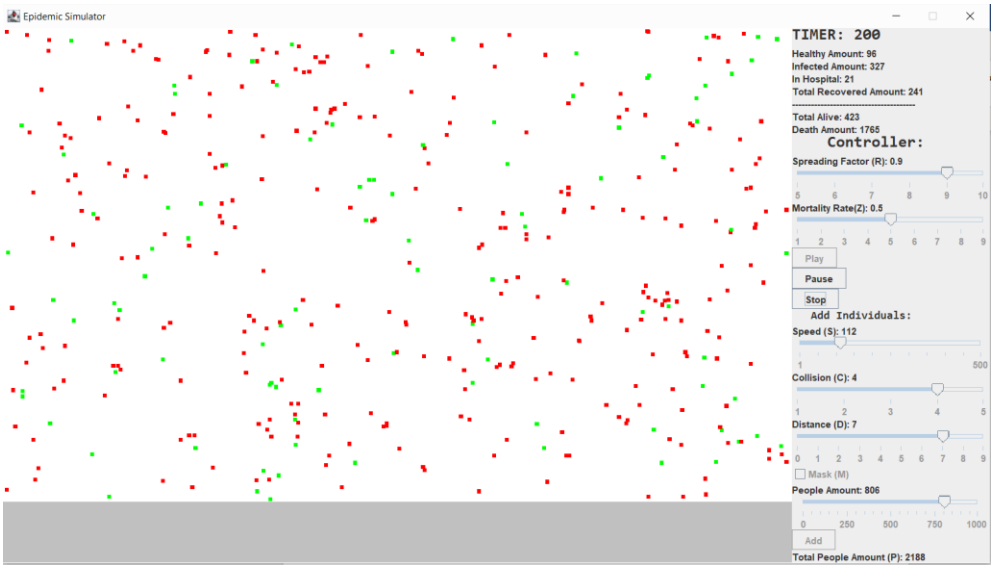
OUTPUTS:

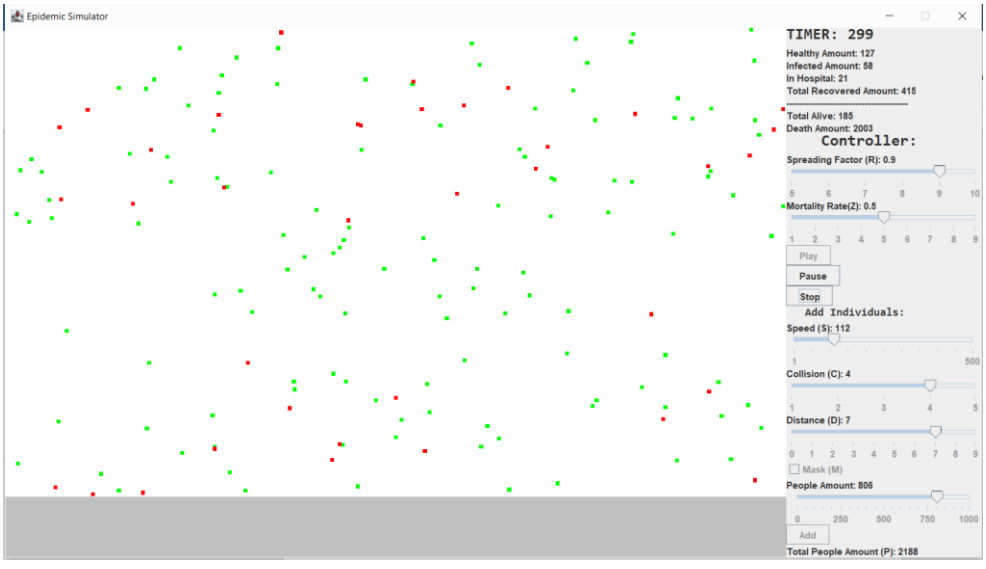

Epidemic Simulator
TIMER: 2
Healthy Amount: 2187
Infected Amount: 1
In Hospital: 0
Total Recovered Amount: 0
Total Alive: 2188
Death Amount: 0
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188

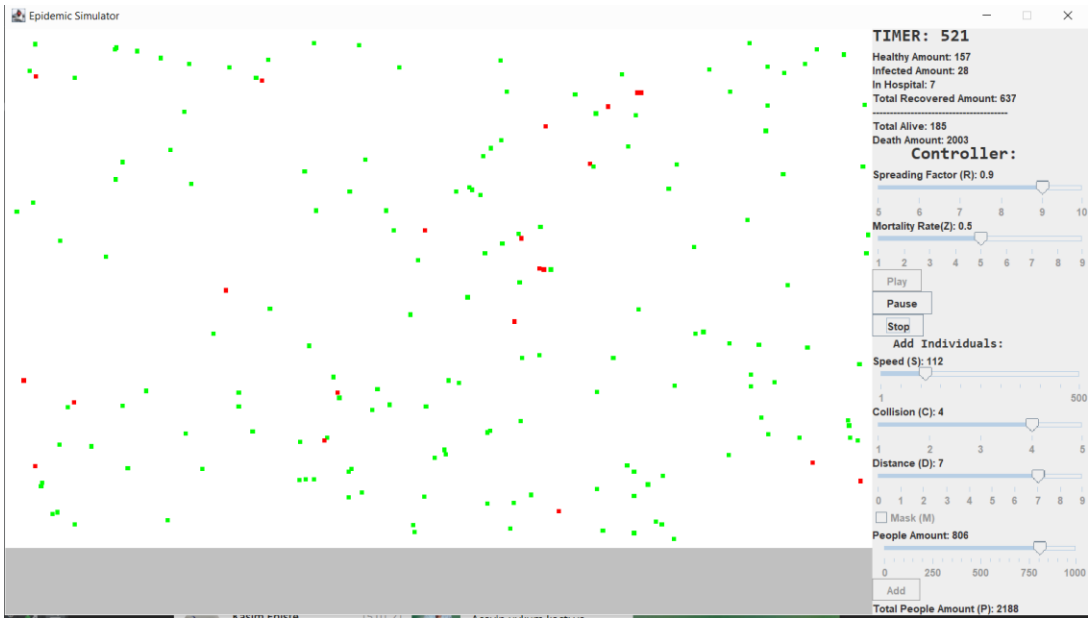

Epidemic Simulator
TIMER: 16
Healthy Amount: 2186
Infected Amount: 2
In Hospital: 0
Total Recovered Amount: 0
Total Alive: 2188
Death Amount: 0
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188

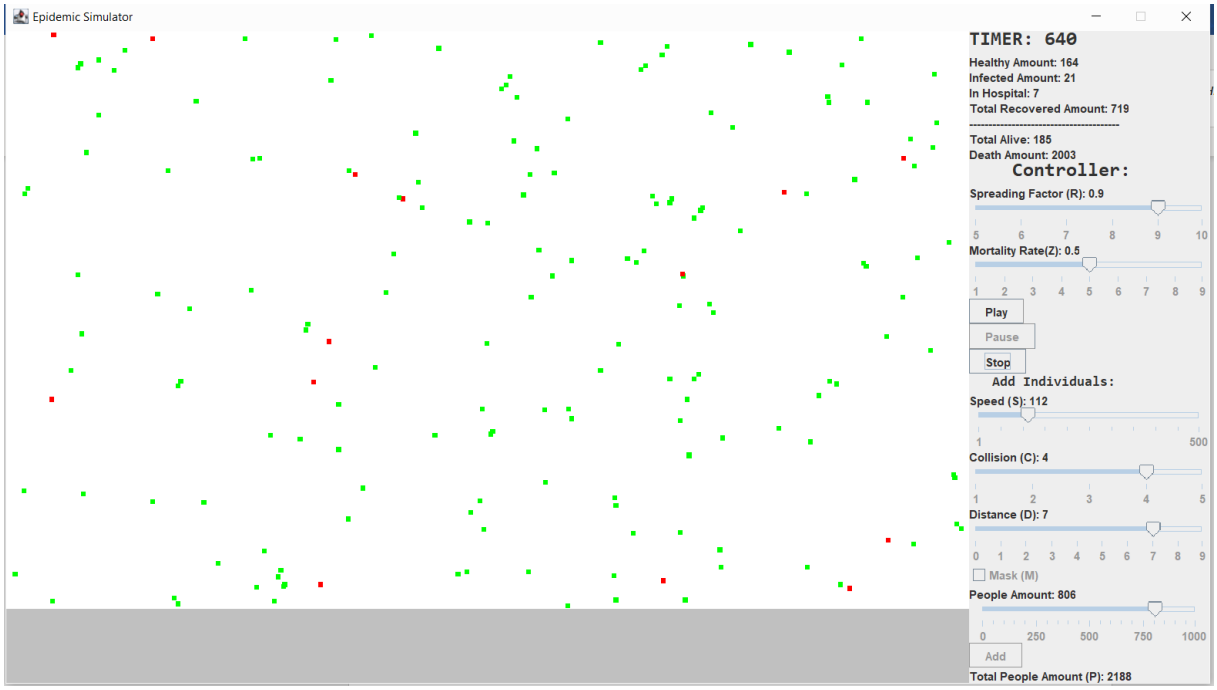

Epidemic Simulator
TIMER: 99
Healthy Amount: 1813
Infected Amount: 375
In Hospital: 21
Total Recovered Amount: 48
Total Alive: 2188
Death Amount: 0
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188


Epidemic Simulator
TIMER: 136
Healthy Amount: 592
Infected Amount: 1516
In Hospital: 21
Total Recovered Amount: 119
Total Alive: 2108
Death Amount: 80
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188


Epidemic Simulator
TIMER: 200
Healthy Amount: 96
Infected Amount: 327
In Hospital: 21
Total Recovered Amount: 241
Total Alive: 423
Death Amount: 1765
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188


Epidemic Simulator
TIMER: 299
Healthy Amount: 127
Infected Amount: 58
In Hospital: 21
Total Recovered Amount: 415
Total Alive: 185
Death Amount: 2003
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188


Epidemic Simulator
TIMER: 521
Healthy Amount: 157
Infected Amount: 28
In Hospital: 7
Total Recovered Amount: 637
Total Alive: 185
Death Amount: 2003
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188


Epidemic Simulator
TIMER: 640
Healthy Amount: 164
Infected Amount: 21
In Hospital: 7
Total Recovered Amount: 719
Total Alive: 185
Death Amount: 2003
Controller:
Spreading Factor (R): 0.9
Mortality Rate(Z): 0.5
Play
Pause
Stop
Add Individuals:
Speed (S): 112
Collision (C): 4
Distance (D): 7
Mask (M)
People Amount: 806
Add
Total People Amount (P): 2188