**Problem 8: Covid-19 Simulation Report By Alexander Xu**

**Task 1: Introduction**

During 2020, Covid-19 was becoming an increasing concern regarding public health. As it has a high infection rate (R₀ value), it spreads very quickly if no prevention strategies are implemented. This R₀ value is used by epidemiologists to represent how contagious a disease is and can be used to find the value “α” used in this simulation (R₀/time).

The total number of cases after each day (if nothing is done) can be estimated by adding the number of old cases to the product of the number of old cases and the constant “α”.

The total number of cases after each day (if people start isolating) can be estimated by adding the number of old cases to the product of the number of old cases and the constant “α”, then subtracting the product of the number of old cases and a changing variable “isolation”.

This simulation approximates how many people will be infected with the Covid-19 by the end of 2020 both if nothing is done and if people start isolating themselves from others, lowering the spread of the virus. A simulation like this could be extremely useful, as it shows how different takes on the virus would affect the number of cases.

**Task 2: Results**

By finding the number of cases on two different dates, the “α” value was determined to be approximately 0.01782170171. This was done by finding the difference between the two dates, which in this case was 28 days (8/6/20 - 6/7/20) and then running a program with the equation newCases = oldCases + a \* oldCases, where the number of cases started at 7,769,783 and ended at 12,741,386. Through experimentation, this value was found to be 0.01782170171, which gave a result of 12,741,386.0000 cases after the 28 days.

Using this “α” value, the same simulation was run 206 times, going to the end of 2020. It was estimated that the number of Covid-19 cases would reach approximately 295651738 by 31/12/2020. Below is a table and scatter plot of the estimated number of Covid-19 cases (if nothing is done) after 8/6/2020 in increments of 10 days.

**Figure 1: Estimated Number of Covid Cases – No Prevention (8/6/2020-31/12/2020)**

|  |  |
| --- | --- |
| Days After 8/6/2020 | Number of Cases |
| 0 | 7769783 |
| 10 | 9270986 |
| 20 | 11062238 |
| 30 | 13199579 |
| 40 | 15749876 |
| 50 | 18792917 |
| 60 | 22423906 |
| 70 | 26756441 |
| 80 | 31926066 |
| 90 | 38094517 |
| 100 | 45454778 |
| 110 | 54237118 |
| 120 | 64716299 |
| 130 | 77220167 |
| 140 | 92139914 |
| 150 | 109942313 |
| 160 | 131184322 |
| 170 | 156530510 |
| 180 | 186773848 |
| 190 | 222860516 |
| 200 | 265919507 |
| 206 | 295651738 |

**Task 3: Discussion and Conclusion**

**From Figure 2, it can be seen that the number of cases over time follows an exponential trendline.**

**In the real world, this exponentially growing number of cases is a result of an average of more than 1 person infected by every infected person, hence causing the number of infected people to increase with time. With a virus as infectious as Covid-19, the only way the disease will die out is either if its hosts gain natural immunity against it, if it wipes out the population of its hosts or if methods such as isolation are implemented to prevent spread.**

**From the data, it is safe to conclude that if no prevention methods are implemented, then the number of cases will continue to grow exponentially until a large majority of the population have been infected, after which most infected people will recover and gain immunity and some will die.**

**Task 4: Extension**

**Using an isolation rate, which increases by 0.02% every day, the number of cases is decreased. (newCases = oldCases + a \* oldCases – isolation \* oldCases, where isolation = isolation + 0.0002 every day, starting at 0)**

**This is similar to the real world as the more serious the pandemic gets, the more people follow prevention strategies such as isolation. This decreases the amount of people that get infected, and, if an average of less than 1 person is infected by each infected person, then the disease will die off.**

**Figure 3: Estimated Number of Covid Cases – Prevention (8/6/2020-31/12/2020)**

|  |  |
| --- | --- |
| Days After 8/6/2020 | Number of Cases |
| 0 | 7769783 |
| 10 | 9189319 |
| 20 | 10656339 |
| 30 | 12116190 |
| 40 | 13506430 |
| 50 | 14760957 |
| 60 | 15815059 |
| 70 | 16610870 |
| 80 | 17102592 |
| 90 | 17260854 |
| 100 | 17075603 |
| 110 | 16557159 |
| 120 | 15735268 |
| 130 | 14656270 |
| 140 | 13378768 |
| 150 | 11968355 |
| 160 | 10492059 |
| 170 | 9013159 |
| 180 | 7586920 |
| 190 | 6257606 |
| 200 | 5056931 |
| 206 | 4406686 |

**From Figures 3 and 4, it is evident that the number of cases reaches its peak at around 90 days after 8/6/2020 and follows a polynomial trendline. After this turning point, the isolation rate becomes higher than the infection rate and the number of cases begin to decrease.**

**At the end of the year (31/12/2020), the model estimates there will still be approximately 4406686 cases of Covid-19, 291245052 less cases than if no prevention strategies were implemented. It also predicts that the number of infected people will reach 0 around 2580 days after 8/6/2020.**

**Task 5: Reflection**

**I started by making a base code for the simulation, where I experimented to find the approximate value of** “α”. From here, I made the simulation run for 206 days (to 31/12/2020) and exported the results per day to a spreadsheet. I then filtered these results to make the increments 10 days and created a scatter plot and table of results. For the extension, I altered my code so that there would be an isolation rate and again exported these results to excel, where I created another scatter plot and table of results. **Something I found difficult was deciding on a realistic rate to increase isolation, but through some experimenting, I found a suitable rate that seemed to match the simulation very well. Knowing what to write in the introduction was also quite difficult since I was not really sure whether I was supposed to write about Covid-19 or the simulation problem. I really enjoyed the simulations unit, although I think it would have been easier me if this assessment task was assigned earlier so as to leave more time to study for exams. Something I learned that was extremely useful was how to export results from python into an excel spreadsheet.**