COVID-19: Predictions and Prevention

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Introduction

Covid-19, more commonly known as Coronavirus, is a newly discovered infectious disease. The virus spreads primarily through bodily fluids, such as coughing or sneezing. Covid-19 is particularly hard to trace because it has a five to seven-day incubation period, yet the host can be contagious during this time while being asymptomatic. Although most people infected will experience moderate flu like symptoms, other groups will be more vulnerable to complications. These vulnerable groups of people include the following categories; over the age of sixty, smokers, diabetes, chronic respiratory disease and cardiovascular disease etc.

Origin

Chinese officials alerted the World Health Organization of an outbreak of some kind of virus on December 31st. By January 7th, Chinese scientists figured out that the virus was the Coronavirus. They discovered the Coronavirus was from the same family as Severe Acute

Respiratory Syndrome (SARS), which emerged in China in 2002 and Middle East Respiratory Syndrome (MERS), which infected people in the Middle East in 2012. As of April 15th, there are 82,692 confirmed Coronavirus cases with 4,632 related deaths in China alone. Luckily China has passed the peak of cases in early February and is on its way to recovery.

Source: Google Statistics

*Source: Google Statistics/trends*

A screenshot of a cell phone

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Impact on The United States

Ever since the initial incident in China, other countries around the world have shut down to prevent the spread of Coronavirus. The United States currently leads the world in both cases and deaths, as represented by the chart below.

*Source: Google Statistics/trends*

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*Source: worldometers.info*

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As of March 10th, Michigan started to record and report Covid-19 statistics. The following graph represents the metrics of the virus from 3/10 to 4/12.

*Author: Alexis Castellanos*

*Source of Data: michigan.gov*

*Key: Dates Points Recorded (3/10 – 4/12) = points*

*Confirmed Cases = cases*

*Confirmed Deaths = deaths*

*New Cases per day = c\_increase*

*New Deaths per day = d\_increase*

Michigan’s Cases and Deaths of Covid-19

A close up of a map

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As shown above both total cases and deaths are clearly growing rapidly in the state of Michigan. One could model these cases through exponential growth, as more data is available a possible prediction

Exponential Growth

*The following is an interactive graph displaying the exponential growth of the virus’s confirmed cases, deaths, new cases and new deaths, for the first 34 recorded dates in Michigan. The graph can be accessed by the source code.*

Exponential Growth of Covid-19 in MichiganA picture containing water, white, colorful, table

Description automatically generated

Starting from the first Michigan COVID-19 recorded date, March 10th, to the next date involves multiplying by some constant in our data. The number of cases tends to be a multiple of 1.18 to 1.25 (outside the outliers) of the cases reported in the previous day. Therefore, we can represent this epidemic as an example of exponential growth. To further understand our graph, we label the following variables.

= Change per day

= Quantity of cases on current day

= Average number of people in contact with an infected person on current day

= Probability of becoming infected

When the number of new cases each day is proportional to the number of existing cases it you must multiply by some constant:

While

Theoretically this can go on to infinity, yet we are bound by E and p, that will eventually decrease. Limited amount of population would result in our probability being the following:

Due to our limited population size, our exponential curve can become a Logistic Equation as the following:

To correctly analyze our data, we must account for the rate of growth. The rate of growth can be represented by the following:

As our variable G approaches, the numeric value of one can be a great sign of our exponential growth becoming a logistic equation. The point of G is equal to one is known as the inflection point. When the inflection point is reached, we can estimate the maximum number of cases to be the value of this instant’s cases multiplied by a factor of two (considering all factors to stay constant).Fortunately, reaching the capacity of population is not the only factor to end this pandemic. Other efforts can be made to reach this inflection point such as social distancing and precautionary measures (gloves, mask, etc.). Governor Whitmer ordering social distancing on March 25th reveals the following information shown below.

*Author: Alexis Castellanos*

*(March 25th is depicted as the 15th point in the following graph)*

Social Distancing Efforts

A close up of a map

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​The illustrations above could be misinterpreted as social distancing being ineffective. However, this is not the case; the extreme rise of confirmed cases was a result of increased testing throughout the state. Many hospitals and clinics started offering Coronavirus testing soon after the social distancing policy was enforced in Michigan. Towards the end of recorded dates (data points) we start to see a slight decrease in the rate of confirmed cases per day. Starting from April 6th (point 28) we can see our rate of growth ‘’ start approaching one. Shown below is our rate of growth for the last week of this report.

|  |  |
| --- | --- |
| Date |  |
| 4/6/2020 | 1.46 |
| 4/7/2020 | 1.06 |
| 4/8/2020 | 0.97 |
| 4/9/2020 | 1.02 |
| 4/10/2020 | 1.74 |
| 4/11/2020 | 0.54 |
| 4/12/2020 | 0.87 |

Unfortunately, social distancing alone will not be sufficient enough to halt the rapid spread and fatality of the Coronavirus. Current data cannot justify our last week’s average as a definite inflection point. The following graphs provide a forecast of the next five day’s new confirmed cases and deaths.

Predictions for Michigan

​Using linear regression at a 95% confidence interval we can make a good prediction of confirmed Covid-19 cases and deaths for the following five days.

Covid-19 Confirmed Cases Forecast

A close up of a map

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*Update: 4/15 Actual Cases: 27893*

*Update: 4/16 Actual Cases: 29119*

Covid-19 Fatality Forecast

A close up of a map

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*Update: 4/15 Actual Deaths: 1919*

*4/16 Actual Deaths 2091*

Successful Recovery

South Korea was on the rise reporting some of the highest numbers of confirmed cases in the world. However, South Korea was able to quickly reduce the spread of the virus.

*Source: Google Statistics/trends*

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South Korea managed to contain the spread of the virus early on due to techniques developed previously when they faced a similar viral outbreak, MERS in 2015. Apart from enforcing social distancing they also performed contact tracing which proved very successful. Contact tracing is when authorities trace whom the infected persons came in contact with. Once located they test and monitor them regardless if they show symptoms, if found positive they are quarantined and treated. Apart from human to human transmission, the infected can transmit disease by leaving traces of the virus in public places. This inspired South Korea to change the law, permitting the government to collect an infected persons data and security footage during an outbreak. Additionally, authorities publicly share the recent activity of newly found cases via smartphones. These locations display places and times in radar format. This information allows people to know if they cross paths with an infected person, so that they may be monitored and tested for the virus. South Korea was able to test hundreds of thousands of people more than any other country at the time, making it easier for authorities to see the spread of the virus. Tracing people's every move may seem controversial, but in South Korea they prioritized public health over privacy and saw notably great outcomes from this practice.

In regard to COVID-19, countries like Germany and the UK are starting to implement preemptive testing. On the other hand, the US is scrambling to provide adequate testing displayed by the rising cases in the US. The US can learn from the testing strategies South Korea implemented. Despite the US having a larger population these practices may prove successful.

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