**The SIR model:**

The SIR model consists of three categories which classified the different classes of people within a viral outbreak. This model is widely used to predict the spread and progression of a viral outbreak. In simple terms the SIR outbreak model can be represented as follows:

Where the ‘Susceptibles’ is class of people that can contract the virus, this is everyone. The next step is the ‘Infected’ stage where its classed as people who contract the virus. The last stage being ‘Recovered’ which classes people as having moved from infected to the recovered stage. This equation is then equated to ‘N’ which represents the whole number of people from all of these classes.

When considering this equation the following initial conditions can be extrapolated: Where S(0) will be everyone that has the potential to be infected, I(0) will be a very small number of people, lastly there will be no infected people.

From these conditions by considering the rate of change for these three variables the mathematical connection between each class or stage is true: The system of differential equations is used to represent this model:

By examining this system of differential equations, it is shown that for is equal to representing the decrease of people from the susceptible stage as they become infected out of the whole populous. Secondly in is carried over representing the increase from susceptible to infected, secondly shows the amount of people leaving the infected stage to the recovered stage. Lastly represents the amount of people who have recovered by moving out of the infected stage to recovered. Towards the end of the model the amount of susceptible trends towards 0 as all the populous has become 0.

**Predictions & Conclusions:**

By looking at the infected class of people at time ‘t = 0’ this shows the initial number of susceptible and infected. From calculating this equation; mathematically this is showing the rate of change, the rate of change allows two conclusions to be drawn: If the rate of change is less than 0 shows us the rate of infected is slowing meaning the virus or infection is eventually going to die out. If it is greater than 0 the opposite is true meaning an epidemic will occur. The above equation can than be transformed to:

Specifically looking at this equation represents the transmission rate leading to the amount of people moving from susceptible to infected, this variable can be related to preventative measures that help lower this rate; examples being washing of hands, social distancing, travel restrictions, and other measures that have been implemented to help slow this infection rate and thus reduce , This model also takes into account the potential for a vaccine that is developed during the epidemic where represents this.

**Exponential Growth**

As shown in the differential equations above shows that is a potential solution to the differential equation being: . Given that the solution shows exponential growth. This is true as by assuming the amount of susceptible people initially is constant and doesn’t change, leads to the exponential growth of pandemics.