**Assessment of Coronavirus (COVID-19) in the United states of America, specifically Kentucky.**

**Purpose:** The purpose of this study is to explore how the United states of America (USA is affected by current epidemic COVID-19 (as of 04/04/2020 a demonstrated how the state of Kentucky can be affected in the near future.

**Methodology:** The data use in this research is the cumulative counts of coronavirus cases in the United States, at the state level. According to the New York Times (NYT), This data set is the product of dozens of journalists working across several time zones to monitor, analyze data releases and seek clarification from public officials on how they categorize cases. The data was compiled by NYT.

**Limitations:** “Because of the patchwork of reporting methods for this data across more than 50 state and territorial governments and hundreds of local health departments, our journalists sometimes had to make difficult interpretations about how to count and record cases” (NYT). For this reason, the data presented in this research will, in some cases, not match exactly with the information reported by states and counties.

**Findings:** The findings of this study suggest that Kentucky and the majority of the Untied State of America will continue to have an increase in reported cases and deaths of COVID-19, if the population does not adherer to social distancing guidelines created by Centers of Disease Control and Prevention (CDC).

**Introduction**

In today’s modern world, it is becoming clear that because of globalization, an infection disease can transmit globally very quickly, never in the history of humanity all the continents can be susceptible to be infected with the same type of disease at very fast rate. Examples like the Bubonic plague (also now as the Black Death) spread widely by limited means of transportation which, according to History, it was likely [spread by trading ships](https://www.history.com/this-day-in-history/black-death-is-created-allegedly) (History.com Editors, 2010). But not at the same degree of COVIC-19, How are civilizations today prepare to deal with this scenario? Can a country stop at some degree the rate of transmission of an infection disease inside its borders?

The Coronavirus also known as (CODVI-19) it is good subject to study, recently classified as a pandemic (March 11, 2020) by World Health Organization (WHO). A pandemic is the worldwide spread of a new disease (WHO). At this point, it is not a question if we can stop (CODVI-19) from spreading but if we control the spread of it, Dr. Anthony S. Fauci director of the National Institute of Allergy and infectious diseases (NIAID), has stated multiple times not only to news media networks but also in the USA White House Press Room .

This research paper focus on (COVID-19), examining the impact that COVID-19 can have in the population by analysis data, using it can predict a pattern of infection across the USA targeting specifically the state of Kentucky. By knowing which parts of the USA are more likely to have a greater degree of infection rate than others, the government at state and federal levels can create an effective guidelines to try and slow rate of infections in the areas that are consider critical, rather than focusing in the entire country as whole, targeting a specific areas based on analysis can give an edge combating the disease. This problem is important because not only it is affecting the whole world but also the United State of America, specifically the state of Kentucky which is where I reside.

**Literate review**

According to an article of Business insiders, as of March 26, 2020 The united states of America is the country with most confirm cases of coronavirus “83,507” (Berke 2020). Surpassing that of China “81,782” which according to WHO is where COVID-19 outbreak begun. How is possible that Country that has more 1.4 billion people has less confirmed cases that the USA which has only about a fourth that amount of that of China as its population “330,633,707”. Do the methods applied in both countries to slow down the rate of infection has something to do with this relation? The first person to test positive from COVID-19 reside in Whuhan, China, Dec. 8, 2019 (Department of Defense). The 45th president of the united states on March 13, 2020 declared COVID-19 outbreak a national emergency (Department of Defense). It took about 4 months since the virus had its first confirm case for the USA to start implanting slow down measures to try to put the breaks to the spread of the virus, on March 16, 2020 social distancing guidelines at all level of society where starting to be implemented (Department of Defense). Was this measures impose by the federal government of the USA where to little or late to prevent the spread of COVID-19 in a meaningful way in the short term?

To answer this questions is important to understand better the virus how it is transmitted, according to the CDC, COVID-19 is thought to spread mainly from person to person, mainly through respiratory droplets produced when an infected person coughs or sneezes. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. Spread is more likely when people are in close contact with one another (within about 6 feet). According to a study conducted by Los Alamos National Laboratory, Los Alamos, New Mexico, USA. States that the R0 is between 2.2–2.7 (R0 is the number of cases, on average, an infected person will cause during their infectious period). In ***Figure 1*** will show a graphical representation of what this means.

**Data Analysis and Results**

**Overall USA**

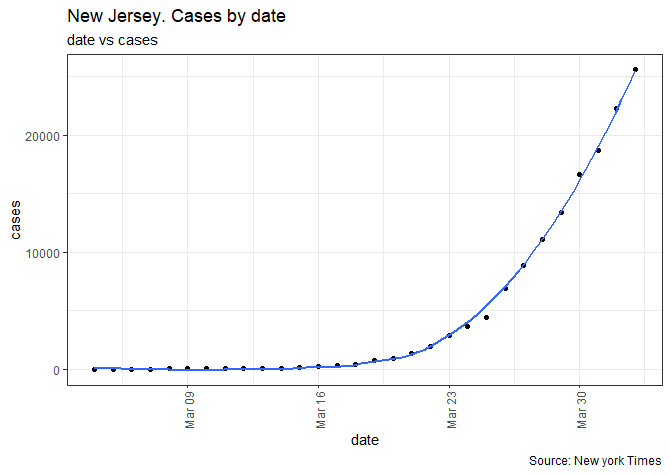
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Description automatically generated As of March 16, 2020, there were 4,337 confirm cases of COVID-19 in the USA when social Distancing guidelines were enacted, as of April 4th, 2020. There are closely to 250,000 cases of COVID-19, that is an increase of 5,764.35% from March 16 to April 4th. This sudden increase in cases in a short period of time (19 days) suggested that COVID-19 grows exponentially. The mathematical definition of exponential growth can be defined as follows; “a quantity that increases with a rate proportional to its current size will grow exponentially” (Yates 2020). In other words, as the quantity increases so does that rate at which it grows. By analyzing ***figure 1,*** simply by looking at it, we can see a visual representation of exponential growth curve. It is important to note that exponential grow does not necessarily mean a fast rate of grow. I all depend of one the factors associated with it. For example, if someone were to invest $100 at 1% per year it would take that individual over 900 years to become a millionaire. So, the rate of spread of COVID-19 will depend on the number of individuals that are infected at the begging of the outbreak, the more people are infected at the begging, the more people they will infect and the more the cases will rise. As it stands today April 4th, considering ***figure 1***, there are 250,000 confirm cases in the USA, this is not a good sign for the future to come, because the outbreak COVID-19 is still in its infancy in the USA, which stands to reason, if all the factors remain the same, that is if the United States Citizen do not adherer to the guidelines state by the CDC it would be a catastrophe, the number of new cases would sky rocket.

**Figure 2: Coronavirus Cases in the USA**

**Figure 1: Coronavirus Cases in the USA**

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Description automatically generatedThe first case of Corona Virus in the USA was confirmed on January 21, 2020 in the state Washington, according to the data retrieve from the NYT. As of April 4th, 2020. ***Figure 2*** shows the distribution of cases across the different states in the USA. New York is the critical area in the USA with more than 98,770 confirm cases. Follow it by New Jersey with 25,590 confirm cases. All of the other states show in the graph have less than 11,000 confirm cases. So, it stands to reason, that more emphasis needs to be focus in in these two states more so than any of the other states. Locking at ***figure 3 and 4*** fallow a similar exponential Growth pattern in this critical states which can be assign that the number of confirm cases in these two states is growing rapidly per day. According to U.S. Census Bureau, New York state has one the most densely populated cities in the USA, “New York City” Population Density is 28,211, in other words, for each square mile there are 28,211 individual living in that mile. This creates optimal condition for COVID-19 to spread rapidly, as mention before COVID-19 R0 is set to be on average between 2.2-2.7. We can determine base on this information given and the data provided by ***Figures 2, 3*** that New York State, will become the epicenter of COVID-19 in the USA if is not already.

**Figure 4: Coronavirus Cases in the New Jersey**

**Figure 3: Coronavirus Cases in the New York**

It is important to consider that social distancing guidelines were implemented on March 16, 2020, because of it the effect that this measure may have are still not reflected in the ***Figure 3****,* **4** due to the time that has passed since 16 of march is not enough for the guidelines to have a tangible impact to slow down the spread of the virus. According to article written by Stephen A. Lauer, MS, PhD, the incubation period of COVID-19, the time it can take for the disease to show any symptoms in an individual can take up 14 days.

**Analyzes of Kentucky**

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Description automatically generatedAccording to Census Bureau, Kentucky has a size population of 4,467,673 people as of June 1, 2019, it is the 26th largest division in United States in terms of population, Its biggest cites are the following; The most populous is Lexigton-Fayette (population of 295,803), Ironville (population of 288,649) and Meads (population of 285,649). ***Figure 2*** suggests that Kentucky has 755 confirm cases of COVID-19 as of April 4th, 2020. That amount of confirm cases only represents a 0.0000169% of its total population, distributing the cases by county it is possible to appreciate what areas are more affected by COVID-19 than other in Kentucky.

**Figure 5: Coronavirus Cases in Kentucky by County**

The Counties that are most affected in Kentucky by COVID-19 are according to ***figure 2,*** the following; Jefferson 249 cases, Fayette 124 cases and Daviess 44 cases. All other counties have less than 31 cases respectively. Considering Jefferson county deaths and cases of COVID-19, it is possible to extract valuable information than can be used to create a predicted model that can give an estimate on how Jefferson county would be affected by virus as the cases grow. ***Figure 6*** shows if a model of Jefferson county is reliable or not. ***R2*** value allow us to A close up of a map

Description automatically generatedknow how much variation is explained by the model, in this case ***R2= 96%,*** in other words, the model can explain 96% of the variation of the data. As for the “***Pvalue”*** it can be understood to be how significant is the model, usually a **p**Value <= 0.05 is consider statistically significant. Jefferson county model shows a A close up of text on a white background

Description automatically generatedPvalue that is less than 0.05. In conclusion, the Jefferson county model is reliable enough that it can be used to estimate how increases of cases affects the number of deaths in Jefferson county. For example, what would happen in Jefferson county sees an increase of confirm cases to 750, using the equation of line (y = slope(cases) + intercept) it is possible to conclude that y=0. 042477(750) + (-0.087627) is equal to 32 new deaths, ***figure 7*** shows Jefferson model.

**Figure 6: statistics of Jefferson model**

**Figure 7: Jefferson County model**

It is also possible to apply this same methodology to the entire state of Kentucky, if taking into account all things discuss above, for example COVID-19 grows exponentially, if we assume a R0 = 2.2-2.7. It is probable to express a formula for exponential growth that can be apply in Kentucky. Rhett Allain is an associate professor of physics at Southeastern Louisiana University, in his article he uses a formula derived from to calculate exponential grow . As***N*** increases, the number of *new* infections (𝚫**N**) each day constantly increases, the infection rate is **a** and 𝚫**t** is the change in time (measured in days). Rhett Allain suggested that is possible to A screenshot of a cell phone

Description automatically generatedmodify the formula stated above to **N** as function of time using differential equation to get ,  the number of infected people (**N**) depends on the starting number (**N0**) and***e*** (the natural number) raised to the product of **a** and **t**. So, if assume that N=1(first case of Corona Virus in Kentucky March 6th 2020 ), a = 2 (infection rate, since a person cannot infect 2.4-2.7 for purpose of simplicity the value will be rounded down 2), and 𝚫t will have starting time of 0 with time A close up of a map

Description automatically generatedsteps of 0.1 We can arrive at the conclusion that after 60 days, according the equation stated above there will be 150,000 confirm cases of COVID-19 in Kentucky assuming the other variables do not change over time ***figure 8*** shows the results *(1.5e5 = 150,000).*

**Figure 8: Kentucky Growth model**

**Figure 9: Statistics Kentucky Growth model**

Using the models shown in ***figure 10 is*** possible to estimate the number of deaths if the confirm cases reach 150,000. By using the equation of line (y = slope(cases) + intercept), we can conclude that y=0. 032633(150,000) + (-0.07065) is equal to 4,894.88 or 4,895 deaths. ***Figure 9*** shows us if a A close up of text on a white background

Description automatically generatedmodel of Kentucky is reliable or not. ***R2*** value allow us to know how much variation is explained by the model, in this case ***R2= 89%,*** in other words, the model can explain 89% of the variation of the data. As for the “***Pvalue”*** it can be understood to be how significant is the model, usually a **p**Value = 0.05 is consider statistically significant. Kentucky model shows a Pvalue that is less than 0.05. In other words, the Kentucky model is reliable enough that it can be used to estimate how increases of cases affects the number of deaths.

**Figure 10: Statistics Kentucky Growth model**

**Conclusion**

It is the utmost importance to control the spread coronavirus in the USA, millions of people can be affected by It if the disease is left untouched. Some places are more affected than others, for example, New York State and New Jersey. The spread of the virus in these states is growing exponentially. If this pattern is not changed, the ability of the states to control the outbreak can become very limited. New York State can become the epicenter of the virus if the state keeps adding new cases to an already alarming number of cases in the state. Kentucky, on the other hand, does not have nearly as big a problem as the other two states mention, with only 755 reported cases. But the utmost attention must be put by its government to ensure the spread of COVID-19 becomes very limited, as models show, if the state does not take the necessary precaution, it will become a tough situation to manage adequately. COVID-19 has proven without a thought that our current civilization is not prepared for dealing with this kind of scenario, especially the USA. There is still much to learn and revised to ensure the risk of another pandemic like COVID-19 will be less in the future.

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