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Detecting change and forecasting in a viral post epidemic using break for time series components (BFTSC)

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Abstract

The main objective of this study is to examine the phenomenon of COVID-19 pandemic in Malaysia and presenting recommendations. COVID-19 data was obtained from the data stream of Universiti Utara Malaysia library. In the methodology, BFAST (Break for additive, Season and trend) and BFTSC (Break for time series components) was used to examine the mode of movement in the COVID-19 pandemic using R and Python software. BFTSC was created to capture the trend, seasonal, cyclical and irregular components as a combined image and to present them in a single plot. The result obtained from the components (pattern) extracted using BFTSC was suggest to be used for post Covid balancing and for future COVID-19 pandemic. Result was based on careful examination of COVID-19 pandemic and it was reveals that the pandemic may not reoccur again but gradually sliding to disappearance. Hence COVID-19 would total disappear before 2025 and by 2026 the world would have forgotten about COVID-19. Reoccurrence by 2021 can only slightly and can also be controlled by the ten recommendation listed in this study.

Keywords: COVID-19, pandemic, break for time series components, forecast, control, trend change

1. Introduction

Historical findings reveals that COVID-19 is not a spirit but has existed in animals for decades as SARS-CoV-2 ^[10, 15]. Phylogenetic investigation suggests that SARS-CoV-2 originated in animals, probably bats, and was transmitted to other animals before crossing into humans. Huanan wet market in Wuhan City was known to be one of the major abode of COVID-19 ^[11, 13]. In November 2002 in China two non-endemic coronaviruses have caused serious disease. SARS-CoV was first to be noticed, though not known well at the initially time and coming to the attention of World Health Organization (WHO) in 2003 ^[16, 12]. The outburst quickly disappear by July 2003 ^[9, 17]. Another case was reported in China at April 2004 ^[14, 19]. The disease caused Severe Acute Respiratory Syndrome (SARS), a flu-like illness. Total of 8098 cases and 774 deaths were recorded. SARS-CoV appears to have originated in horseshoe bats and possibly transmitted to humans (18, 20). MERS-CoV was initially identified as the reason for fatal infection in Saudi Arabia in 2012 ^[3, 4, 9]. The pandemic affected up to 30 countries unlike SARS, MERS is still prevalent in its region ^[1, 2]. As at November 2019, 2494 confirmed cases has been notified, of which 858 was critical ^[5, 8]. SARS-CoV-2 is more closely related to SARS-CoV or MERS-CoV, strongly suggesting that it is an innovative coronavirus in humans ^[10, 12]. Person-to-person spread seems to depend on close contact, such as providing care to an infected person or within a hospital setting. SARS-CoV is transferred through droplets from respiratory track, contact with surfaces and possibly through face and contact ^[11, 15]. In just a month, 3300 cases was recorded in Hong Kong, Hanoi and Singapore and this was labeled as devastating ^[17, 19]. For comparison, one month after 59 cases of COVID-19 were identified with 24, 554 cases globally. These figures were reduced by the restrictions on travel ban and lockdown measures recommended by WHO ^[18, 20]. According to WHO data, recurrent flu is responsible for three to five million reported cases of severe illness and 290, 000-650, 000 deaths each year in that period.

On 30th December 2019, World Health Organization (WHO) was officially informed about the increasing cases of tract infectious diseases that affects breathing process in humans in Wuhan City ^[1, 4]. Wuhan is a home to 11 million people and the cultural and economic hub of central China ^[2, 5]. At 5th January 2020, 59 related issues as being reported but none had been fatal ^[3, 8]. 10th of January 2020, up to 282 cases was confirmed to WHO, four of them were in Japan origin, South Korea origin and Thailand origin ^[6, 10]. Six deaths was recorded in Wuhan of which 51 confirmed people were seriously ill and 12 are in life-threatening condition ^[7, 9]. This virus was responsible for the isolation of those who test positive to it ^[4]. This was the cause of the severe critical breathing and lungs track syndrome that became well known as COVID-19 ^[21, 23]. This was a novel coronavirus from SARS-CoV-2 ^[22]. As of May 2020, the increase rate has being recorded as 82,591 COVID-19 worldwide this were being confirmed as daily and the death rate was over 4200 per day ^[3, 21].

COVID-19 in Malaysia. COVID-19 was reported in Malaysia at 15th January 2020, some carrier were suspected to have brought it from China through capital of Singapore on 25 January (15). Initially, the confirmed cases were relatively low, at January 20th Malaysian citizens began to notice it in the Malaysian capital Kuala Lumpur ^[17]. At March 10th 2020 large numbers of Malaysia was reported to have contacted COVID-19 which was traced to spread through Tablighi Jamaat religious gathering held in Sri Petaling, Kuala Lumpur, this resulted to an explosion on the local Malaysian the contacted COVID-19 virus ^[22]. In less than two weeks in March 2020, Malaysian had recorded 2000 active cases of COVID-19 pandemic ^[21]. This trend begins with 30 active case at early March 2020 and suddenly increase to large numbers of active cases towards the end of March ^[14]. At March 16th 2020, the virus was reported to have reached every state and some villages ^[4]. The Director General of Health immediately respond and start to stockpile equipment, detect and monitor cases, and treat COVID-19 patients that were reported to have been initiated as early as 6th January 2020 ^[10]. Strict measures were put in place to control the outbreak of COVID-19 in Malaysia on 13th March, at 16th March 2020 Movement Control Order (MCO) was introduce Nationwide ^[19]. The movement control (MCO) is to finally stop the spread of COVID-19 in Malaysia ^[19]. During the period of MCO, traveling, large gathering and every form of social activities were prohibited. 10th July Recovery Movement Control Order (RMCO) was introduced due low case of COVID-19 recorded. At 15th July schools and other ministry start to gradually resume but still stick to safety rules and social distance ^[7]. Virus outbreak occurs in three forms such as endemic, epidemic and pandemic. Endemic is an outbreak that is associated with a specific group of people or tribe. Epidemic is an outbreak that is associated with a large numbers of people in a given community irrespective of tribe, age, height and colour of skin. Pandemic is an epidemic outbreak that spread from one country to another within a

short interval of time and claiming a lot of life and there economy.

2. Literature, analysis, material and methods

COVID-19 data was obtained from University Utara Library data stream from February 2020 to June 2020. BFTSC was used to identify the time series components present in the disease pandemic using R, Python and excel software. As of 30TH June 2020 Malaysia recorded an estimated 121 deaths while confirm cases 8626 and discharge case of 8318. The data is a daily data with weekly frequency of 7. 151 data points is examined using BFTSC, the trends is further cross examined using excel plot. Time series statistics would be used in examining this COVID-19 data. The four component of time series always occur together in the same series, it is difficult to differentiate them because some of them looks alike. Knowing the pattern of each component of time series statistics and the relative related theories associated with them, it will help us in understanding each and every component better.

Trend which is one of the first and most common component of time series statistics, this was examined. The trend component describe the direction of movements and also represent the general activities of a given system, the trend also represent long run growth or decline over a given period ^[24, 25]. Seasonal component also known as seasonal variation was also observe in time series data, it appear in mixture form with other component of time series, seasonal variation as an identical pattern in time series which flow over a period of time in a regular and steady manner, Seasonal variation are forms of fluctuations that occurs on a regular bases which are recurring from season to season with about the same and equal period of time and stage of intensity ^[24]. Cyclical components was views as a periodic and irregular fluctuation about a fixed position ^[24]. Cyclic disturbance are common up swing and down swing of a given sequence in an unpredictable fashion, it is the unbalanced and irregular changes observed in a sequence of data which is due to changes that occurs in a given data. Irregular variation is considered as the sporadic movement of sequence of data in a random fashion ^[24]. It was also observe that irregular pattern (I) are any form of fluctuations not classify as one of trend, seasonal and cyclical. Irregular component of the time series statistics is not easy to explain, for that reason it is not easy to predict, assessment of irregular component is expected to occur only when variance of the data is not very large, or else decomposition of the series may not be possible, given a data with large magnitude of deviation, the extrapolation for the future data will not be accurate. The only possible alternative that would result to a probabilistic space for the future value provided if and only if the probability of irregular is known ^[25]. Irregular variation or accidental or erratic fluctuations e.g. rise in prices of disease, pandemic, steel due to strike in the factory, COVID-19, air accident, train accident, flood, earth quick, war etc.

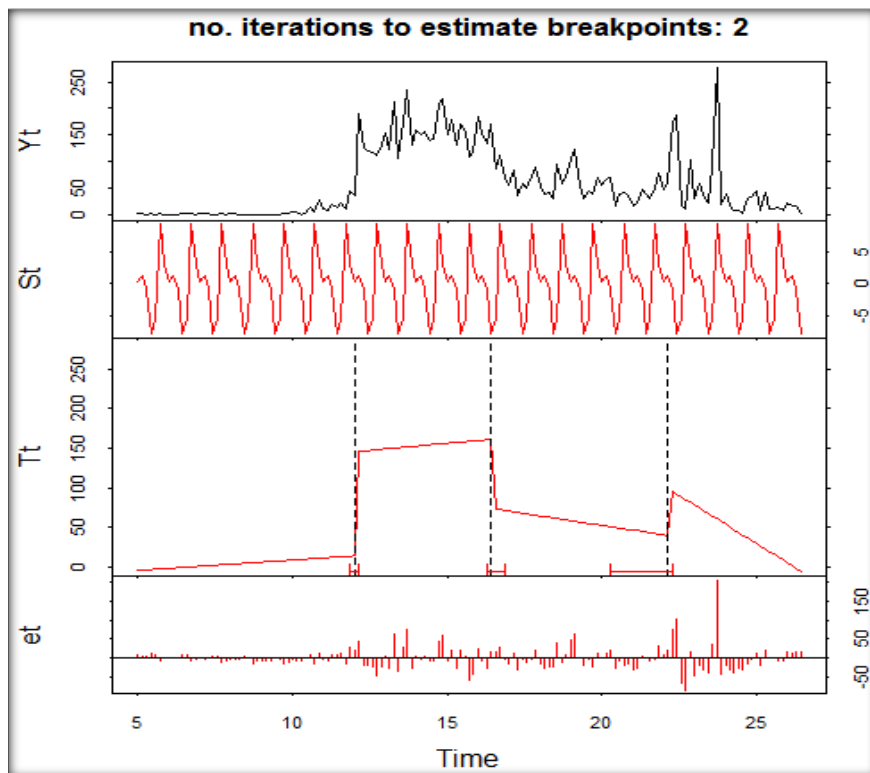


Fig 1: BFAST time plot of Confirmed cases of COVID-19 in Malaysia

The COVID-19 confirmed case was plot in figure 1, the data shows the presence of more irregular components directly from the data section in the first section of the plot (Yt). COVID-19 is a pandemic which is more of irregular time series variation. Irregular variation is considered as the sporadic movement of sequence of data in a random fashion [25]. BFAST also show the presence of seasonal variations (St) which may not be considered in this study because an epidemic is not expected to have season fluctuations due to the large damage that always resulted from its occurrence. The plot on BFAST also show trend with 3break points, this indicated that the COVID-19 data from February 2020 to June 2020 does not support a linear trend and is more of irregular movement. To summarize the COVID-19 data with a technique that would produce only the time series variations

that is present in the data, we use BFTSC. BFTSC is considered better alternative than the BFAST technique based on findings in the previous study in term of precision, time period of data incubation and flexible methods. Only the variations which are present in a time series data would be automatically plotted by BFTSC, BFTSC gives proper separations of all the time series components and plot only the most dominant one unlike BFAST that would just plot without proper separations. BFTSC is designed to capture all the time series components on a different individual point time plot [25]. BFTSC is created to include cyclical and irregular components if they actually existed in the data. Figure 2 is the BFTSC of COVID-19 from February to June in Malaysia.

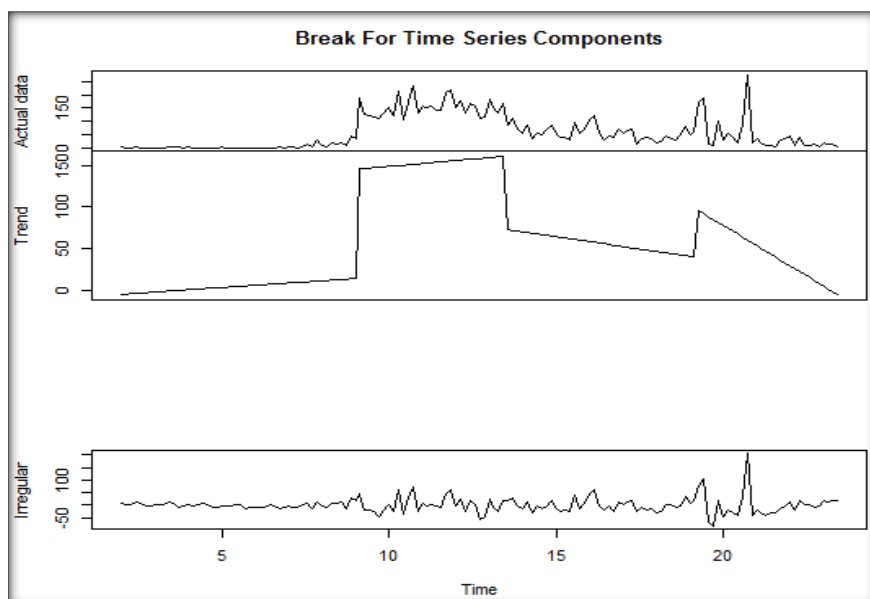


Fig 2: BFTSC time plot of Confirmed cases of COVID-19 in Malaysia

The actual variations present in Malaysia COVID-19 data is plotted using BFTSC in Figure 2. BFTSC did not mix all the time series variations together but extracted only the variations that are present. The COVID-19 data in Malaysia only spanned for 5 months and did not cross from season to season, so seasonal variation is not expected to be presented. The actual data show dominance of irregular variations which is also detailed out in the irregular variation section. The trend show 3breaks which indicated as explained earlier as not being a linear trend data but more of irregular pattern data. The irregular variation shows its peak as the highest recorded confirmed case at May 2020 and did not repeat itself again.

This indicated that COVID-19 in Malaysia begins to die down from June 2020. To further examine the COVID-19 data each of the confirmed case and death case is plotted in figure 3 and 4. The confirmed COVID-19 case plotted by BFTSC in the actual data show no difference from the one plotted by excel, this added more weight to the reliability of BFTSC. From figure 3, the pandemic only occur and spread in a period of time and was very high around March to May after which it begins to drop. This shows that the measure that was put in place to curb the spread of COVID-19 in Malaysia was actually very effective. Figure 4 examine the death due to COVID-19 and respect to the confirmed case.

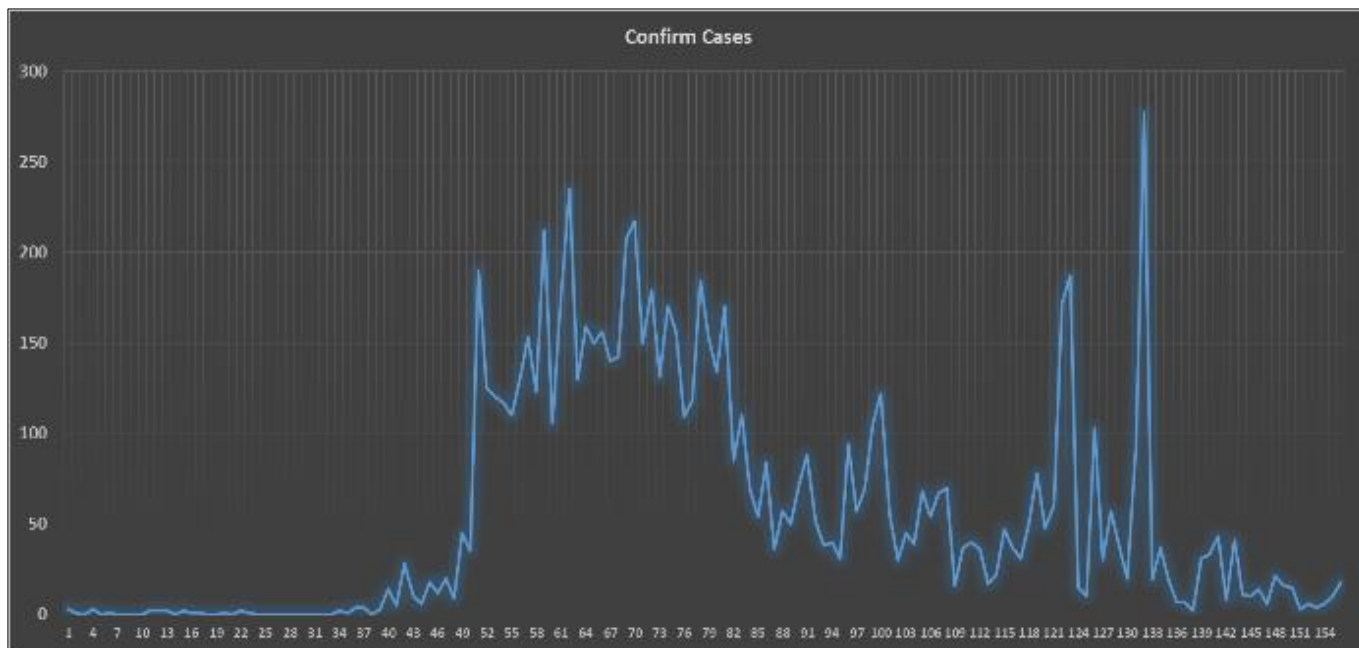


Fig 3: Time plot of Confirmed cases of COVID-19 in Malaysia

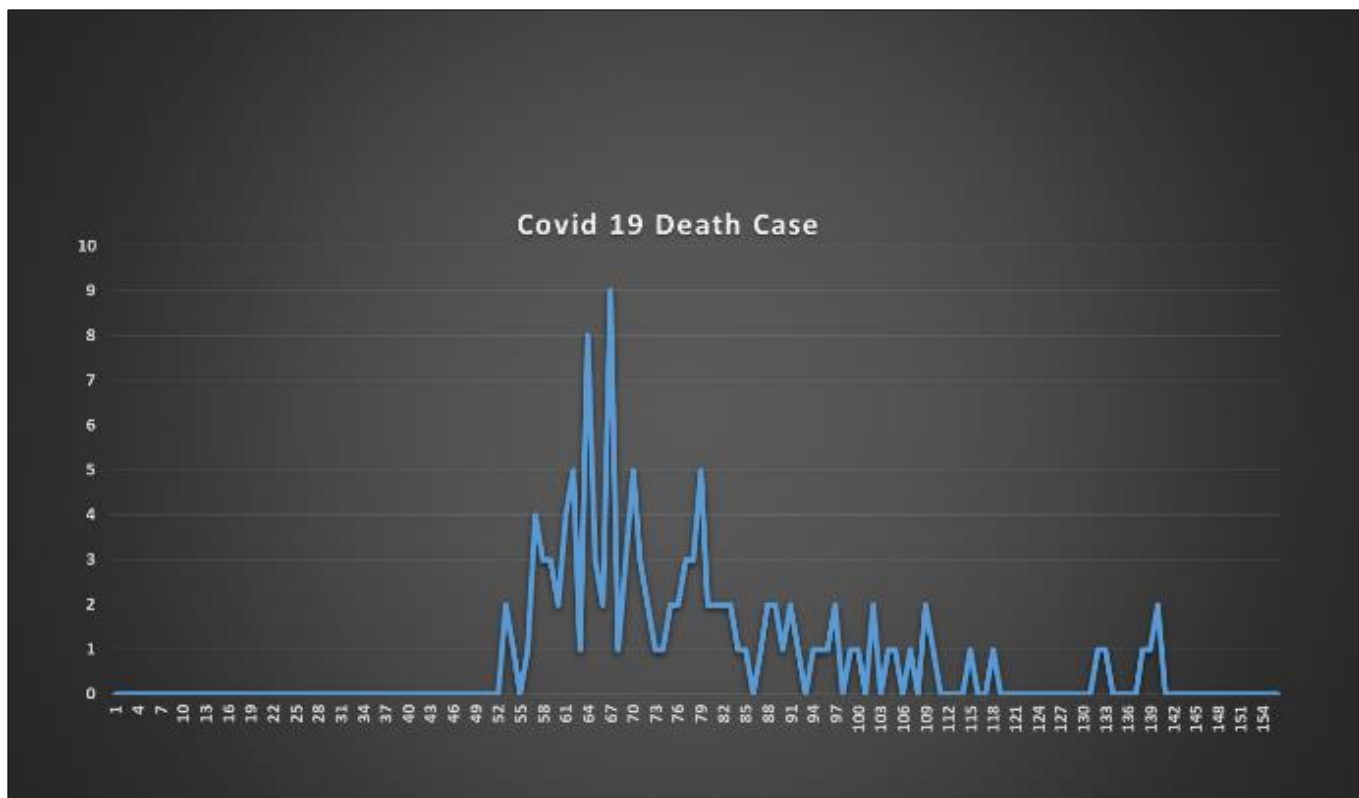


Fig 4: Time plot of Death cases of COVID-19 in Malaysia

The death case due to COVID-19 is plotted by manual time plot. The death due to COVID-19 also stream line with the confirmed case in figure 3, the pandemic only occur and spread in a period of time and was very high around March to May after which it begins to drop, the death was also very high at the same period (March to May). If the spread can

only be controlled, the confirm cases would stop and eventually the death rate would also stop. The drop in COVID-19 death rate at June shows that the measure that was put in place to curb the spread of COVID-19 in Malaysia was very effective. Figure 5. Time plot of Confirmed cases and Death case of COVID-19 in Malaysia.

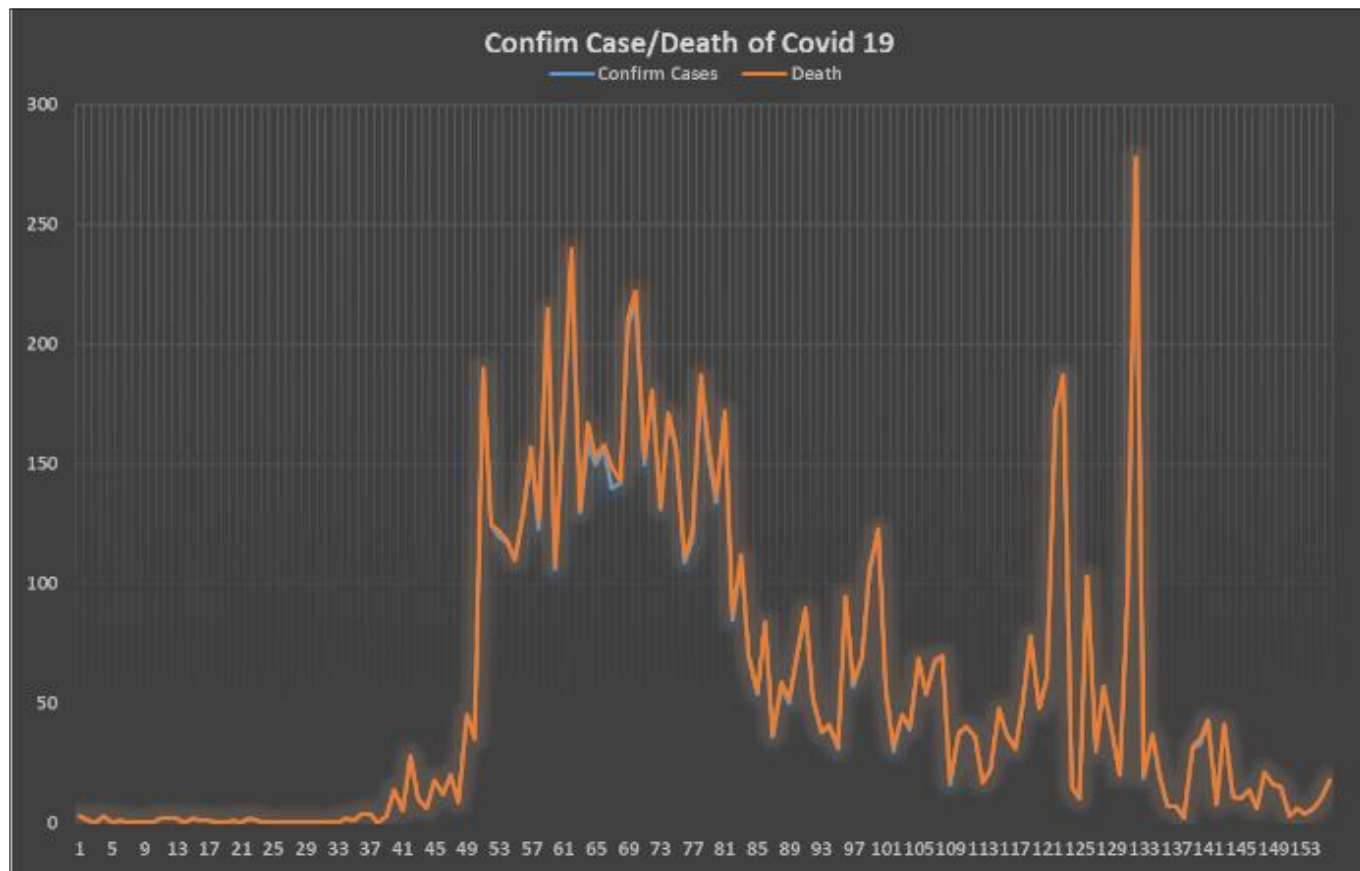


Fig 5: Time plot of Confirmed cases and Death case of COVID-19 in Malaysia

The seasonal index to confirm if the COVID-19 data cannot be predicted using seasonal index. R^2 shows a value of 0.014149 and the adjusted R^2 was 0.007533, standard error was very high to be 693.5818. The R^2 shows that very low depended (COVID-19 confirmed case Y_t) variable can be explained by the independent variable (T_t -time), hence the COVID-19 data is not actually dependent on time (time of COVID-19 occurrence). COVID-19 data in Malaysia has little or nothing to do with time, it is just an irregular components of time series panel data. To achieve accurate prediction, the R^2 is expected not to be less than 1 (24). The R^2 was too low to justify further prediction any further occurrence of COVID-19, this indicated that there is no repetition and occurrences of COVID-19 pandemic in the next near months. The essence of prediction is to know if COVID-19 would return again in a near days/ months but with the low R^2 COVID-19 would not return in any near time. Hence, recommendation can be presented to prevent future occurrences of any form of pandemic, epidemic and endemic.

3. Result

The observations from figure 1, 2, 3, 4, and table 1 and 2 reveals that the COVID-19 data in Malaysia is more of irregular data. The purpose of any prediction is to know if there would be any occurrence of such events in the future. COVID-19 is a pandemic in form of irregular time series variation and is not expected to reappear in a short time interval. Unlike like seasonal variation and cyclical variations

that has a time intervals of repetitions. Low R^2 indicated that there will not be a perfect prediction of COVID-19 in Malaysia hence there is no feasible reoccurrence of COVID-19 as pandemic in Malaysia in the near months. There is no feasible repetition of such pandemic in the next near futures, COVID-19 would gradually die down and disappear, on or before 2028 the world would have forgotten about the pandemic. But a recommendation would be put forward to prevent any other possible forms of disaster.

4. Discussion

COVID-19 in Malaysia. COVID-19 was reported in Malaysia at 15th January 2020, some carrier were suspected to have brought it from China through capital of Singapore on 25 January (15) just as stated in the introduction of this study. In less than two weeks in March 2020, Malaysian had recorded 2000 active cases of COVID-19 pandemic (2). COVID-19 is spread through a (air-lifting airlines) aeroplane, it move from airport of one country to another airport of another country. Human bodies serve as incubator for 2 week and during this period the COVID-19 keep spreading. This is why the spread was very fast in short intervals of time. The data is a daily data with weekly frequency of 7. 151 data points was examined using BFTSC. The trends was further cross examined using python and excel plot. Figure 1,2,3,4 with careful examination reveals that the COVID-19 data in Malaysia is more of irregular data, hence seasonal and cyclical components are not important in this case. The R^2

was too low to predict any further occurrence of COVID-19. The essence of prediction is to know if COVID-19 would return again in a near days/ months but with the low R^2 COVID-19 would not return in any near time. Hence COVID-19 would total disappear before 2025 and by 2026 the world would have forgotten COVID-19, recommendation can be presented to prevent future occurrences of such pandemic, epidemic and endemic.

5. Conclusion

Irregular components is a pandemic that as reveal by BFTSC in figure 2. Irregular components of time series only occur once in a long interval of time and not repeating itself in a regular interval of time (2). COVID-19 is an irregular components of time series, it is a disaster just like war, earthquake, Cholera, Typhoid, Ebola, Influenza, Lesser fever, Meningitis, MERS-COV, Pleaque, SARS, Small Pox, Tularaemia, Yellow fever, Zika virus and many more. Though COVID-19 spread through Air-lifting as a medium of spread but never the less land travel, water travel and all other forms of transportations needs to be properly checked and monitored.

7. Recommendation

COVID-19 is believe to be spread through air-lift from one passenger to another in an aeroplane. To prevent any form of disaster, the following recommendation is put forward. (1) One more total lockdown by December 2020 after which not allowing anyone with a symptoms of related issues like COVID-19 into Malaysia. (2) Fast tracking research that can produce cure/vaccine against COVID-19 is a further innovation in science and is highly recommended. (3) Proper and accurate check, test and checking before any one is permitted to enter into the aeroplane and proper and accurate test immediately after alighting from the flight.(4) Pandemic can also spread through water (water travel like ships). Every passenger in any ship coming into Malaysia should be accurate check, test and checking before any one is permitted to enter into the ship and also immediately after alighting from the ship. This recommendation is for both local and international ships to prevent transmission of local diseases like water born diseases. (5) Diseases can also spread through land (land travel like cars, large buses, large lorries etc.). Every passenger coming into Malaysia by land should be accurate check, test and rechecking before any one is permitted to enter into the bus and proper and accurate test immediately after alighting from the bus. This recommendation is for both local and international bus and Lorries.

This would also prevent transmission of local diseases like water born diseases and food related infection. (6) Inter country and interstate marriage should also be proper checked to prevent regenerating inheritance sickness and endemic. (7) Model that can predict epidemic like flood, fire outbreak, earthquake etc. should be encouraged. (8) Any food items coming to Malaysia from China or any other countries should also be proper checked and rechecked to prevent regenerating inheritance sickness and endemic diseases. (9) Luggage and curriers items coming to Malaysia from any other countries should also be proper checked and rechecked to prevent regenerating inheritance sickness and endemic. (10) By taking and implementing precaution 1 to 5. Pandemic like COVID-19, influenza, MERS-COV, SARS, Tularaemia, Zika virus, HIV, Epatitis, Gonoria etc.

7. Weakness and future research

The issue of how large is large and maximum sample size for COVID-19 accepted by BFAST and BFTSC is yet to be addressed [28]. Likewise the issue of maximum sample size for Manual method of time series identification COVID-19 data. BFTSC and BFAST are not being fully utilized addressed because it's a new automated time series identification technique and depends on the nature of individual research and interest. More automated and innovated time series components identifications is a welcome development. Model that can predict epidemic like flood, fire outbreak, earthquake etc. should be encouraged. A special technique that can forecast irregular time series component automatically is a good and welcome innovation in forecasting field.

8. Authors contributions

Dr. Ajare Emmanuel Oloruntoba: Analyzing, producing the results and writing the paper. Dr. Adefabi Adekunle: works on the contents and structuring, flow of the paper. Dr Olorunpomi Temitope Olubunmi and Job Eunice Ohunene worked on type setting and Proof reading.

9. Ethics

This is the original manuscript prepared by three authors; there will be no expectation of any ethical problems after the publication. The three authors have read and approved the manuscript.

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