Mathematics Letters, eISSN: 2948-3735, 1 (2): 329-340, 2022

FORECASTING THE COVID-19 OCCURRENCE TREND IN MALAYSIA BY USING GROWTH RATE MODEL

Mohamad Azim Azfar Kamarudin[1], Nurul Hanis Che Omar[2] and Ainon Mardhiyah Shahidan[3*]

Department of Mathematics, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor

[1]2020899194@student.uitm.edu.my, [2]2020810126@student.uitm.edu.my, [3*]ainon@fskm.uitm.edu.my

(indicates the corresponding author)*

ABSTRACT

In late 2019 the virus know as SARS-CoV-2 was first discovered in Wuhan, China, and has spread throughout the world which it is thought to have originated in bats according to World Health Organization (2019). Cough, fever, congestion nose, chest pain, and possibly diarrhea are signs of COVID-19. Ministry of Health Malaysia (2020) stated that the on January 25, 2020, the first coronavirus disease 2019 (COVID-19) case was identified in Malaysia. At present, Malaysia is one of the countries where the deadly coronavirus is still spreading. Thus, it is crucial to control the spreading of virus COVID-19 as well as the prediction of new COVID-19 infection during the current pandemic. The main objective of this study is to obtain the daily growth rate of COVID-19 in Malaysia by using the Growth Rate model. This model is chosen because it is simple and reliable way to depict how quickly the number of infections is fluctuating daily. The results of the study shows the forecasting trendline of growth rates for COVID-19 in Malaysia based on the 700 daily data obtained between 1/2/2020 until 31/12/2021.

Keywords*: COVID-19, Growth Rate model, SARS-CoV-2 .*

Received for review: 08-09-2022; Accepted: 22-09-2022; Published: 01-11-2022

1. Introduction

1.1 Background of The Study

In late 2019 the virus known asSARS-CoV-2 was first discovered in Wuhan, China and has spread throughout the world which it is thought to have originated in bats according to World Health Organization (2019). Coronaviruses are a diverse group of viruses that can cause people to catch a cold and it also may infected animals such as bats, cattles and camels (WHO,2019). Due to this, SARS-CoV-2 is the virus that causes COVID-19 which includes viruses that cause everything from head or chest colds to more serious but less common disorders including severe acute respiratory syndrome (SARS) and Middle East respiratory syndrome (MERS) (WHO,2019). Ministry of Health (2020) stated that cough, fever, congestion nose, chest pain, and possibly diarrhea are signs of COVID-19. According to WebMD (2020), SARS-CoV-2 infected humans in one of Wuhan's wet market when buyers purchased fresh meat and seafood including the animals that have been killed on the spot. Cobras, wild boars, and raccoon dogs are among the wild or prohibited species sold at some wet markets in China that lead to viruses from these animals can swap genes in crowded area. When a virus undergoes significant alterations, it can begin to infect among human in China that has killed at least 100,000 people.Ministry of Health Malaysia (2020) stated that the on January 25, 2020, the first coronavirus disease 2019 (COVID-19) case was identified in Malaysia. This marked the beginning of an infection wave that lasted for nearly 3 weeks. Three tourists from China who had close contact with an infected person in Singapore arrived in Johor, Malaysia on the 24th of January 2020. The first three cases of COVID-19 in Malaysia were verified to be imported cases which is defined as infections acquired outside of Malaysia, based on the individual case's travel history. In addition, on February 27, a second wave began to spread after 11 days with no new cases. The largest increase in local cases and imported cases to neighbouring country, Brunei was caused by a Tablighi Jamaat religious gathering in Sri Petaling, Kuala Lumpur was attended by roughly 14,500 people (Independent, 2020). The Sabah state election in September 2020 and multiple outbreaks at Top Glove facilities in late 2020 contributed to the occurrence of a third wave of COVID-19 infections in the country (South China Morning Post,2020). Since then, Malaysia's Ministry of Health (MOH) has started documenting and reporting the cases through its Crisis Preparedness Response Centre (CPRC). The COVID-19 statistics are updated every day using data obtained from the MOH website on the overall number of active cases, recoveries, and casualties.

1.2 Problem Statement

Malaysia is one of the countries where the deadly coronavirus is still spreading. It is crucial to control the spreading of virus COVID-19 as well as the prediction of new COVID-19 infection during the current pandemic. Thus, this study proposed to observe the COVID-19 occurrence in Malaysia by using Growth Rate model. This model is chosen because it is simple and reliable way to depict how quickly the number of infections is fluctuating daily.

1.3 Research Objective

The objective of this study is:

a) To obtain the daily growth rate of COVID-19 in Malaysia.
b) To obtain the best fit line to represent the growth rate of new cases for COVID-19.
c) To obtain mean squared error by using growth rate of the COVID-19 new cases.

1.4 Significance of Study

From the observations made on the occurrence trend of COVID-19 would be able to help individuals to understand the steps implemented in order to control the spread of Covid-19.

1.5 Scope of Study

The study focuses on the number of COVID-19 cases in Malaysia. Data collected for 700 days which is from 1/2/2020 to 31/12/2021 is which within 2 years. The limitations of this study is the results obtained based on the data recorded in website covidnow for the year 2020 until 2021.

1.6 Literature Review

Previous study has applied Susceptible, Exposed, Infectious and Removed (SEIR) model in forecasting the COVID-19 trend in Malaysia. Among them are Aidlina and Ying Lim (2020) which use this deterministic model based on illness development, individual epidemiological status, and intervention methods has been presented. The applicability of the SSA-RF model in predicting COVID-19 cases in Malaysia was investigated in this study by Shazlyn et al. (2021). Sarat et al. (2021) in their study implement the modified SEIR model in investigating the effect of the Sri Petaling gathering and the MCO on the propagation of COVID-19 in Malaysia. The nonstandard finite difference (NSFD) scheme and Runge-Kutta fourth order approach are used to numerically solve the proposed framework. A mathematical model that incorporates isolation class to show the dynamical behaviour of COVID-19 infection was implemented by Anwar et al. (2020). Moreover, a study done by Olumuyiwa et al. (2021) proposed a new mathematical model to look into the most recent coronavirus disease outbreak (COVID-19) in Pakistan. The fundamental reproductive number that serves as an epidemic indicator is derived from the greatest eigenvalue of the next-generation matrix and is analysed qualitatively using the stability theory of differential equations. According to Wan Ahmad et al. (2021) in their study, they evaluate the trend line pattern, obtain the appropriate statistical equation model, and predict individual numbers infected by COVID-19. In their study, they also want to obtain a predictive equation model and forecast death rate for Malaysia and Italy. In Tang et al. (2021) article, they explain the prolonged nature of the pandemic in the 26 Brazilian states and their capitals as well as in the Federative Unit by using a mathematical model to forecast the COVID-19 trajectory and evaluate the impact of governmental choices on this evolution.

2. Methodology

Flowchart

Figure 1 shows the summarize of the research methodology for this study.

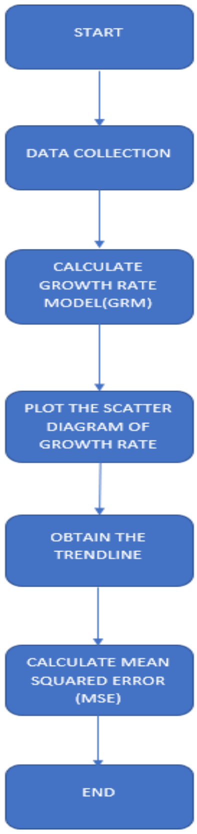

Figure 1: Flowchart of research methodolgy

Step 1: Data collection

Data cases of COVID-19 are obtained from website covidnow where it is updated daily by the Malaysian government. The data understudy consists of the number of new cases from 1/2/2020 until 31/12/2021 which is 700 days.

Step 2: Calculate the growth rate (Tang et al., 2021)

The daily growth rate (m_t) is calculated using equation (1).

$$m_t = \frac{N_t - N_{t-1}}{N_{t-1}} \qquad (1)$$

where

m_t = Growth rate

N_t = Present number of cases

N_{t-1} = Previous number of cases

Step 3: Plot the scatter diagram of growth rate using Microsoft Excel.

The growth rate observations are divided into three periods based on the scenario related to occurrence of COVID-19 as shown in Table 1.

Table 1: The divisions of observations based on scenario related to occurrence of COVID-19.

Periods	**Date**	**Scenario**
P1	1/2/2020 – 17/3/2020	Early stage of COVID-19.
P2	18/3/2020 – 23/2/2021	Implementation of Movement Control Order (MCO), mandatory usage of face mask in public places.
P3	24/2/2021 – 31/12/2021	Implementation of vaccinations and boosters.

The scatter diagrams for the growth rate of COVID-19 will be plotted for each periods P1, P2, P3 and the overall of growth rate using Microsoft Excel.

Step 4: Obtain the trendline of the growth rate of COVID-19 new cases.

The trendline for the growth rate of COVID-19 will be plotted for each periods P1,P2,P3 and the overall of growth rate using Microsoft Excel.

Step 5: Calculate the mean squared error of growth rate (MSE).

The value of mean squared error will be calculated using Microsoft Excel.

3. Results and Discussion

In this section, the results and findings of this study being discuss. The scatter diagram of the growth rate of COVID-19 daily cases and the trendline for each periods P1, P2, P3 and overall of growth rate will be interpret.

3.1 Early stage of COVID-19. (P1)

Table 4: Trendline data of growth rate for P1 (1/2/2020-17/3/2020).

Type of trendline	Equation of trendline	SSE	MSE
Linear	m_t = 0.0268t - 0.3299	=71.3218	=1.5505
Quadratic	m_t = 0.0006t^2 - 0.003t - 0.0914	=63.6760	=1.3843
Polynomial of degree 3	m_t = -4E-05t^3 + 0.0037t^2 - 0.0606t + 0.1462	=63.4798	=1.3800

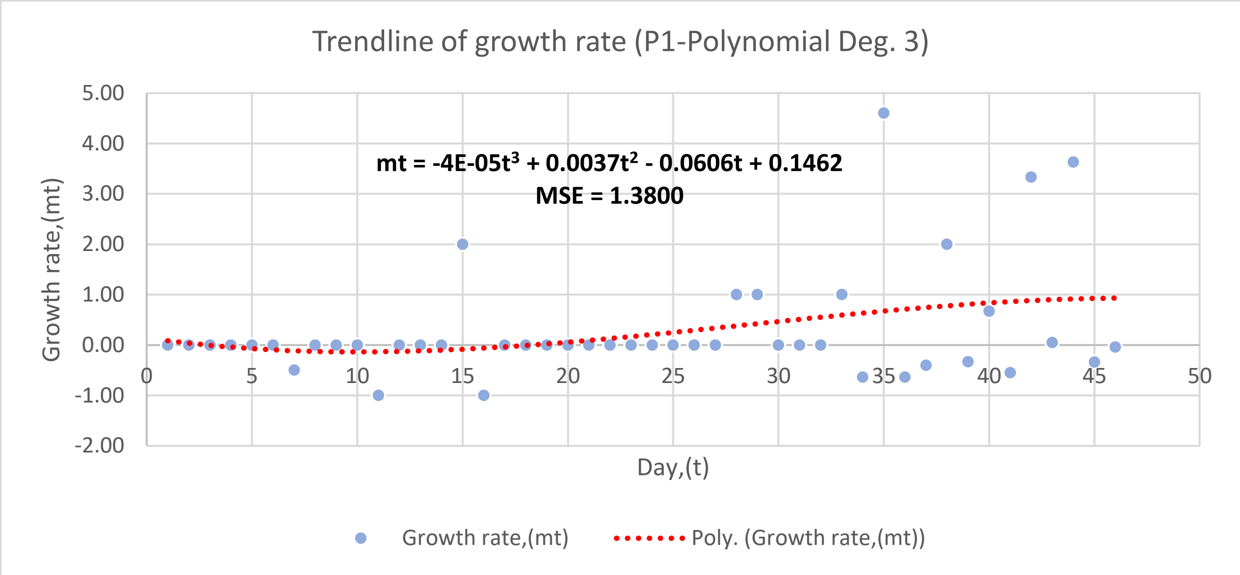

Figure 2: Polynomial of degree 3 trendline for P1.

Table 4 shows trendline data of growth rate for P1 which is the early stage of COVID-19 in Malaysia. At this stage, people still unaware, ignorant and disbelieving of the COVID-19 virus that contribute in spreading the virus widely (Malaysiakini,2020). In addition, some individuals also do not know the symptom of COVID-19 as well as not wearing a mask when they are in the crowded places. The trendline with the smallest value of mean squared error will be chosen as the best fit line for the data. From the table above, polynomial of degree 3 trendline give the smallest mean squared error which is 1.3800. So, this trendline type is the best fit line that fit the data. Figure 2 shows the polynomial of degree 3 trendline for P1. For the first 10 days, the trendline shows decreasing trend and continue to increase at 15 days.

3.2 Implementation of Movement Control Order. (P2)

Table 5: Trendline data of growth rate for P2 (18/3/2/2020-23/2/2021).

Type of trendline	Equation of trendline	SSE	MSE
Linear	m_t = -0.0001t + 0.1035	=93.5700	=0.2810
Quadratic	m_t = -3E-06t^2 + 0.001t + 0.0402	=93.6661	=0.2813
Polynomial of degree 3	m_t = -5E-09t^3 - 7E-07t^2 + 0.0006t + 0.0503	=93.5142	=0.2808

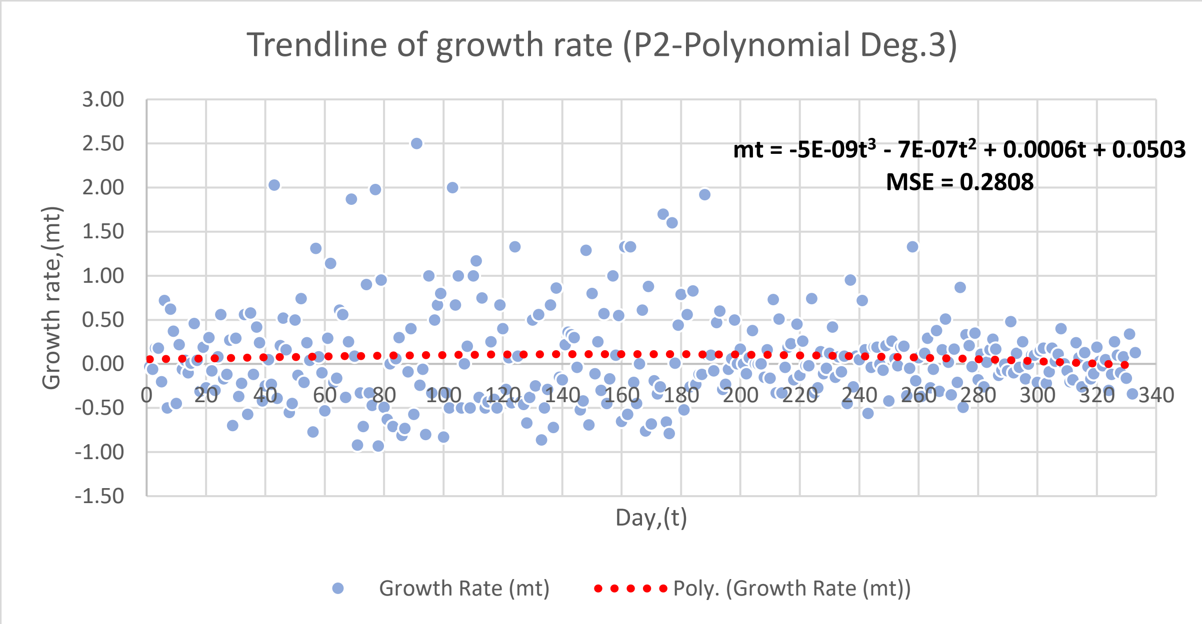

Figure 3: Polynomial of degree 3 trendline for P2.

Table 5 shows trendline data of growth rate for P2 which is the implementation of Movement Control Order (MCO). The trendline with the smallest value of mean squared error will be chosen as the best fit line for the data. From the table above, polynomial of degree 3 trendline give the smallest mean squared error which is 0.2808. So, this trendline type is the best fit line that fit the data. Figure 3 shows the polynomial of degree 3 trendline for P2. For the 140 days, the trendline showing a slight increasing trend and began to decrease at 200 days.

3.3 Implementation of vaccinations and booster (P3).

Table 6: Trendline data of growth rate for P2 (24/2/2021-31/12/2021).

Type of trendline	Equation of trendline	SSE	MSE
Linear	m_t = -0.0001t + 0.0282	=5.3427	=0.0172
Quadratic	m_t = -6E-08t^2 - 9E-05t + 0.0272	=5.3327	=0.0171
Polynomial of degree 3	m_t = 2E-08t^3 - 1E-05t^2 + 0.0012t - 0.0059	=5.3424	=0.0172

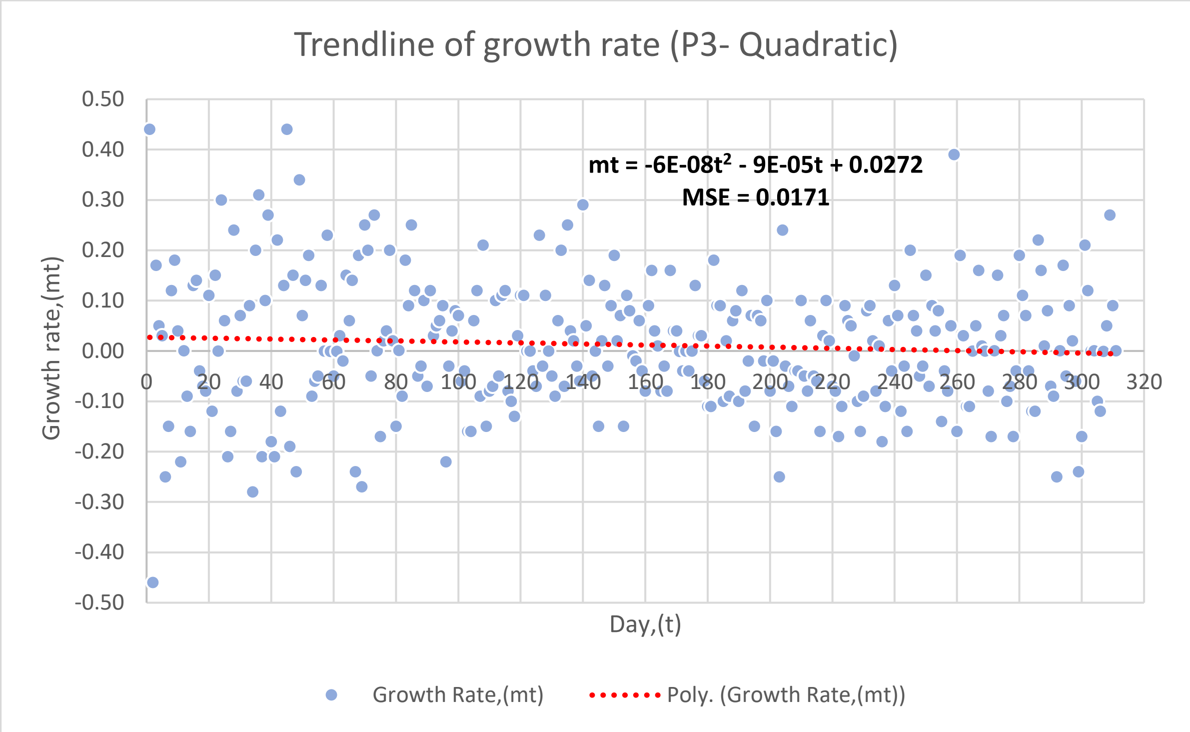

Figure 4: Quadratic trendline for P3.

Table 6 shows trendline data of growth rate for P3 which is the implementation of vaccinations and booster in Malaysia. The trendline with the smallest value of mean squared error will be chosen as the best fit line for the data. From the table above, quadratic trendline give the smallest mean squared error which is 0.0171. So, this trendline type is the best fit line that fit the data. Figure 4 shows that quadratic trendline for P3. The trendline is decreasing from the first day of P3 until the last day. This is due to a lot of people getting their vaccinations dose and booster.

4.4 Overall growth rate from 1st February 2020 until 31st December 2021. (P4)

Table 7: Trendline data of growth rate for overall (1/2/2020-31/12/2021).

Type of trendline	Equation of trendline	SSE	MSE
Linear	m_t = -0.0002t+ 0.1011	=116.4858	=0.1696
Quadratic	m_t = -3E-07t^2 + 3E-05t + 0.0792	=115.1344	=0.1676
Polynomial of degree 3	m_t = 3E-09t^3 - 4E-06t^2 + 0.0009t + 0.0265	=114.5085	=0.1667

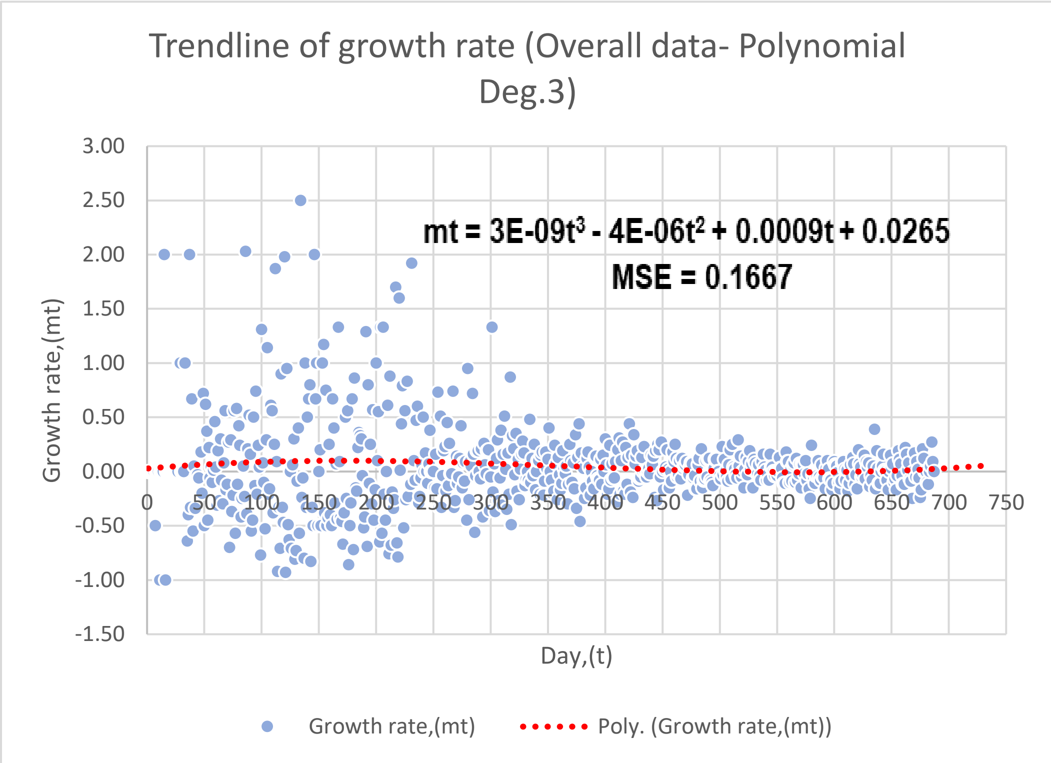

Figure 5: Polynomial of degree 3 trendline for overall of growth rate.

Table 7 shows trendline data of growth rate for overall of growth rate which is 700 days. The trendline with the smallest value of mean squared error will be chosen as the best fit line for the data. From the table above, polynomial of degree 3 trendline give the smallest mean squared error which is 0.1667. So, this trendline type is the best fit line that fit the data. Figure 5 shows that polynomial of degree 3 trendline for overall growth rate. The trendline shows the increasing trend from first day until 200 days. After 200 days, the trendline shows decreasing trend until 650 days. The forecasting trendline at 700 days until 750 days which is 50 days were observed and showing increasing line.

4. Conclusion and Recommendations

The Growth Rate Method (GRM) is a straightforward mathematical model approach applied in this study to comprehensively explore the whole COVID-19 pandemic scenario in Malaysia. The results of the study shows the growth rates, the trendline of growth rates and mean squared error where there are 3 periods which are P1, P2, P3 and also overall growth rate. For each periods, the trendline observed will be linear, quadratic, and polynomial of degree 3. The trendline with the smallest value of mean squared error will be chosen as the best fit line for the data.

P1 shows the result where the polynomial of degree 3 trendline give the smallest mean squared error which is 1.3800 and the trendline shows decreasing trend and continue to increase at 15 days. Meanwhile part 2 shows the polynomial of degree 3 trendline give the smallest mean squared error which is 0.2808 and the trendline showing a slight increasing trend and began to decrease at 200 days. Part 3 shows the quadratic trendline give the smallest mean squared error which is 0.0171 and the trendline is decreasing from the first day of P3 until the last day. Overall growth rate shows the result that polynomial of degree 3 trendline give the smallest mean squared error which is 0.1667 and the trendline shows decreasing trend until 650 days. Lastly, the forecasting trendline shows that the trendline at 700 days until 750 days which is 50 days were observed and showing increasing line.

For further recommendation, it is recommended that other researchers use different mathematical model to solve the forecasting of COVID-19 such as SEIR model or SSA-RS model. In addition, there are also other forecasting model such as Euler's model, cubic spline interpolation model and ARIMA model.

Acknowledgement

The authors would like to thank to Department of Mathematics, Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA for supporting this project.

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