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Model Base Analysis of COVID-19 Daily Infected Cases in Argentina

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ABSTRACT

The COVID-19 first appeared in 2019. According to the World Health Organization (WHO) reports there were 184,222,453 infected cases and 3,987,180 death total reported globally after one year. Argentina had been the second Latin American country severely hit by the COVID-19. The rate of daily infected cases in Argentina was 10%, approximately. Hence, the study is designed to forecast the daily infected cases of COVID -19 in Argentina. The daily infected cases of Argentina for the period of 22nd January 2020 to 6th July 2021 were obtained from the WHO database. The behavior of the daily infected cases examined by time series plots and Auto Correlation Function (ACF). The Sama Circular Model (SCM), Seasonal Auto-Regressive Integrated Moving Average (SARIMA), and Holt's Winters three-parameter additive and multiplicative models were tested to forecast the daily infected cases. The models were validated by applying the ACF, Anderson Darling test, and Ljung-Box Q (LBQ)-test. Both relative and absolute measurements of errors were used to assess the forecasting ability of the fitted models. The results of the study revealed that the SCM is a suitable model in forecasting daily infected cases of COVID -19 in Argentina, but not SARIMA and Holt's Winters models. It is recommended to conduct similar studies for other countries to capture similar behaviors and find the causes behind the seasonal behaviors of the rise and fall of daily infected cases.

Keywords: COVID -19, SCM, SARIMA, Holt's Winters Model

1. INTRODUCTION

1.1 Background of the Study

The COVID-19 is the worst pandemic reported, more than 3,939,936 death total after Swine Flu (2009; 2010). The COVID-19 first appeared in 2019. According to the World Health Organization (WHO) reports there were 184,222,453 infected cases and 3,987,180 death total reported globally after one year. The term COVID means Corona (CO), Virus (VI), Disease (D), and year 2019 (19) (Sugiyanto & Muchammad, 2020). Argentina had been the second Latin American country severely hit by the COVID-19. The first infected case was reported from Argentina on 3rd March 2020. WHO statistics, confirmed that the total infected cases in Argentina exceeded 4,526,473 and more than 4,136,824 of them recovered. The total number of death reported more than 95,594. The rate of daily infected cases in Argentina was 10% approximately. At present daily infected cases shows a declining trend but the future would be doubtful.

1.2 Research Problem

The rate of daily infected cases in Argentina is high. The daily infected cases in Argentina shows a wave-like pattern and declining trend at present. Konarasinghe, K.M.U.B., (2021-a): (2021-b): (2021-c) found that there were many seasonal behaviors within the daily infected cases in the Philippines, Italy, and Iran. There could be similar behaviors within the daily infected cases in Argentina. Identifying such behaviors of the daily cases would be a guide to examine the speed of the outbreak and reduce the rate of daily infected cases in the country. Hence, forecasting daily infected cases and find out the behavior of the outbreak would be more important.

1.3 Objective of the Study

The objective of the study is to forecast the daily infected cases of COVID-19 in Argentina.

1.4 Significance of the Study

The results of this study could be a guide that paves a path to develop various health and medical care strategies to control the outbreak and reduce the daily infected cases in Argentina. Forecasting daily infected cases would be another guide to work out the logistic requirements of medical and healthcare and produce with minimum waste (Konarasinghe, K.M.U.B., 2020). The results of the study can be used as a guide for lockdown schedules, effective supply delivery systems, online activities, control movements of the public, etc. Besides, the results would be another guide for future business developments. E-Commerce, virtual business, and other home business are suitable business developments to satisfy the requirements of the consumers in the present and post-pandemic situations. The authorities should take an initiative to provide substantial assistance for such business developments. The present business process should be re-engineered by observing the results of this study to minimize both systematic and unsystematic risk in business.

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2. LITERATURE REVIEW

The review of the study was focused on forecasting daily infected cases of COVID-19 in Argentina.

2.1 Studies Based on Modeling Outbreak in Argentina

Santos et al (2020) have applied the Susceptible, Exposed, Infected, Removed (SEIR) model to predict the outbreak of the disease in Buenos Aires and neighboring cities in Argentina. The same model has applied by Mayorga et al (2020) to predict asymptomatic and symptomatic patients in Argentina, and Vassallo et al (2020) to study the spread of the COVID-19 in Mar del Plata (MDP) in Argentina. Besides, Borracci & Giglio (2020) have applied the same model SEIR to forecast the autumn, winter outbreak in the metropolitan area of Buenos Aires, Argentina. Bergonzi et al (2020) have applied Susceptible, Exposed, Infectious, and Removed, Dead (SEIRD) and Susceptible, Exposed, Infectious, Removed (SEIR) models to predict the spread and compare the performance of these two models. Barreiro et al (2021) have applied Susceptible(S), Exposed(E), Infectious(I), Isolated in quarantine (Q), and Recovered (R) SEIQR model to assess the outbreak of the pandemic in Argentina. Pazos & Felicioni (2020) have applied Susceptible(S), Exposed (E), Infected (I), Hospitalized (H), Recovered (R), and (Dead) SEIHRD model COVID-19 outbreak in Argentina. Silveira & Pereira (2020) have applied Susceptible (S), Infected (I), Removed (R), and SIR to predict the outbreak in Argentina, Belgium, Brazil, Germany, Italy, New Zealand, Spain, and the United States.

The SEIR was the most commonly applied model to predict the pandemic in Argentina. Besides, SEIRD, SEIQR, SEIHRD, and SIR were other mathematical models applied for the purpose. The applications of time series and soft computing approaches were very few. The measurements of the forecasting ability were doubtful in few models and the attention on the verification process was less too. The consideration of the seasonal patterns of the outbreak was tiny. There would be more attention on forecasting daily cases, recoveries in Argentina.

3. METHODOLOGY

The daily cases of COVID-19 in Argentina for the period of 22nd January 2020 to 17th June 2021 were obtained from the WHO database. The behavior of the daily cases paves the path for the model selection to forecast daily infected cases in Argentina (Konarasinghe, K.M.U.B. 2016-a; 2016-b) and (Konarasinghe, W.G.S., & Abeynayake, 2014). There could be various patterns of trends, seasonal, cyclical, heavy, and minor volatility within the period of the data set (Konarasinghe, W.G.S. & Abeynayake, 2014). The time series plot and Auto Correlation Function (ACF) were used to recognize the patterns, as done by Konarasinghe, W.G.S., & Abeynayake (2014). As per the pattern of the data series, Sama Circular Model (SCM), Holt's Winters three-parameter additive and multiplicative models and Seasonal Auto-Regressive Integrated Moving Average (SARIMA) models were selected to test on forecasting the daily infected cases in Argentina.

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The model assumptions were tested by the Anderson Darling test, ACF, and Ljung-Box Q (LBQ) test (Konarasinghe, W.G.S., et al, 2015). There were three measurements of errors used to assess the forecasting ability, as per Konarasinghe, K.M.U.B. (2016-c; 2015-a; 2015-b). They are; Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE), and Mean Absolute Deviation (MAD). Log transformed data were used for the data analysis.

3.1 Circular Model (CM) and Sama Circular Model (SCM)

The development of the CM was based on; Fourier Transformation, the theory of Uniform Circular motion and Multiple Regression Analysis (Konarasinghe, W.G.S., 2016). The SCM is the improved version of the CM (Konarasinghe, W.G.S., 2018-b).

3.1.1 Circular Model (CM)

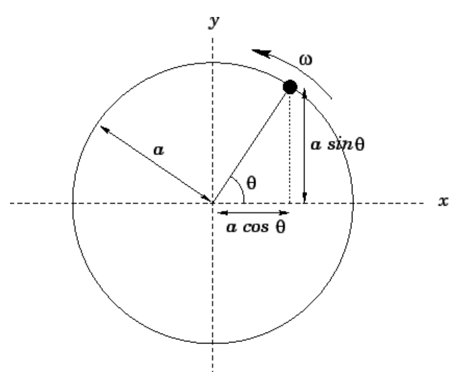
As explained in Konarasinghe (2016), a discrete version of the Fourier transformation for a function *f(x)* is written as:

$$f_x = \sum_{k=1}^{n} a_k \cos k\theta + b_k \sin k\theta \qquad (1)$$

Where a_k and b_k are amplitudes, k is the harmonic of oscillation.

The Fourier transformation is incorporated into a uniform circular motion of a particle in a horizontal circle and basic trigonometric ratios (Konarasinghe, W.G.S., 2016). A particle *P*, which is moving in a horizontal circle of center O and radius *a is* given in Figure 1. The ω is the angular speed of the particle;

Figure 1: Motion of a particle in a horizontal circle



Angular speed is defined as the rate of change of the angle with respect to time. Then;

$$\omega = \frac{d\theta}{dt}$$

$$\int_0^\theta d\theta = \int_0^t \omega \, \mathrm{dt}$$

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Hence, $\theta = \omega t$ (2)

Substitute (4) in (3); $f_x = \sum_{k=1}^{n} a_k \cos k\omega t + b_k \sin k\omega t$ (3)

At one complete circle θ=2π radians. Therefore, the time taken for one complete circle (T) is given by: $T = 2\pi / \omega$

Figure 2 and Figure 3 clearly show how to incorporate a particle in a horizontal circular motion to trigonometric functions;

Figure 2: sine function and reference circle

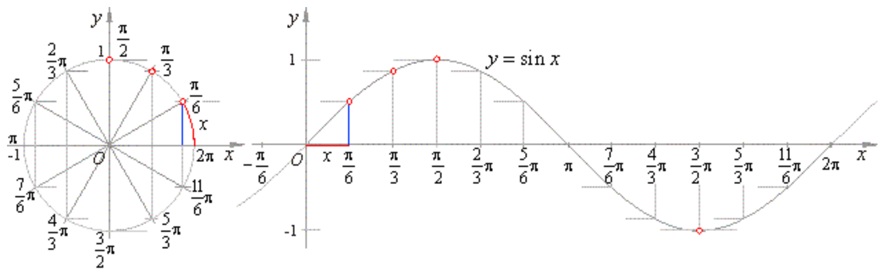
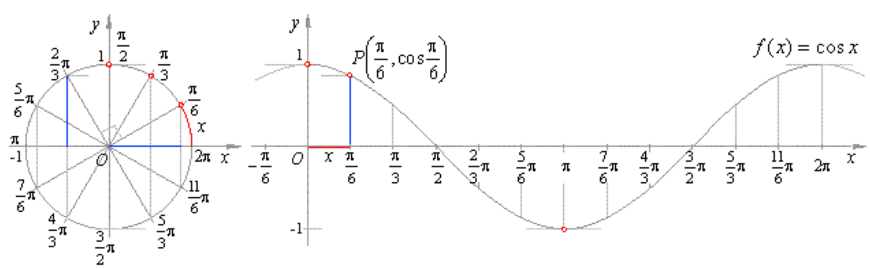


Figure 3: cosine function and reference circle



Reference to Figure (1) ; $\overrightarrow{op} = a(\cos\theta\,\mathbf{i} + \sin\theta\,\mathbf{j})$, where, a is the amplitude or wave height. A wave with constant amplitude is defined as a regular wave and a wave with variable amplitude is known as an irregular wave. In a circular motion, the time taken for one complete circle is known as the period of oscillation.

In other words, the period of oscillation is equal to the time between two peaks or troughs of sine or cosine function. If a time series follows a wave with f peaks in N observations, its period of oscillation can be given as;

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$$T = \frac{total \text{ number of periods}}{\text{total number of peaks}} = \frac{N}{f} \quad (4)$$

Hence, $\omega = 2\pi \frac{f}{N}$ (5)

Therefore, a variable Y_t, with an irregular wave pattern was modeled as;

$$Y_t = \sum_{k=1}^{n} (a_k \sin k\omega t + b_k \cos k\omega t) + \varepsilon_t \quad (6)$$

The model (8) was named as "Circular Model".

Model assumptions of the CM are; the series Y_t is trend-free, k is a positive real number, $\sin k\omega t$ and $\cos k\omega t$ are independent; residuals are Normally distributed and independent.

3.1.2 Sama Circular Model (SCM)

A limitation of the CM is that it is not applicable for a series with a trend. Konarasinghe, W.G.S. (2018-a; 2018-b) suggests the method of differencing to mitigate the limitation of the CM. In usual notation, differencing series of Y_t are as follows;

First differenced series: $Y_t^{'} = Y_t - Y_{t-1} = (1-B)Y_t$ (7)

Second differenced series:

$$Y_t^{''} = Y_t^{'} - Y_{t-1}^{'} = (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) = Y_t - 2Y_{t-1} + Y_{t-2} = (1-B)^2 Y_t \quad (8)$$

Similarly, d th order difference is, $Y_t^d = (1-B)^d Y_t$ (9)

Where, B is the Back Shift operator; $BY_t = Y_{t-1}$.

Assume Y_t^d is trend-free. Let, $Y_t^d = X_t$ then X_t could be modeled as;

$$X_t = \sum_{k=1}^{n} (a_k \sin k\omega t + b_k \cos k\omega t) + \varepsilon_t \quad (10)$$

Hence; $(1-B)^d Y_t = \sum_{k=1}^{n} (a_k \sin k\omega t + b_k \cos k\omega t) + \varepsilon_t$ (11)

the model (13); improved Circular Model, is named as "Sama Circular Model (SCM)".

3.2 Holt's Winters Three Parameter Models

Winters' Method smoothers data by Holt-Winters exponential smoothing and provides short to medium-range forecasting (Konarasinghe , K.M.U.B. 2016-d; 2018). This model can be applied when both trend and seasonality are present, with these two components being either additive or multiplicative (Holt, 1957). Winters' Method calculates dynamic

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estimates for three components; level, trend and seasonal which denotes α, β, and γ (with values between 0 and 1) (Holt, 1957). Formulae of Winter's multiplicative model is;

$$L_t = \alpha\,(Y_t / S_{t-p}) + (1-\alpha)\,[L_{t-1} + T_{t-1}] \quad (12\text{-}1)$$

$$T_t = \beta\,[L_t - L_{t-1}] + (1-\beta)T_{t-1} \quad (12\text{-}2)$$

$$S_t = \gamma\,(Y_t / L_t) + (1-\gamma)\,S_{t-p} \quad (12\text{-}3)$$

$$\hat{Y}_t = (L_{t-1} + T_{t-1})\,S_{t-p} \quad (12\text{-}4)$$

Where,

L_t = is the level at time t, α is the weight for the level, T_t = is the trend at time t, β is the weight for the trend, S_t = is the seasonal component at time t, γ is the weight for the seasonal component, p = is the seasonal period, Y_t = is the data value at time t, $\hat{Y}_t$ = is the fitted value, or one-period-ahead forecast, at time t.

Formulae of Winter's additive model is;

$$L_t = \alpha\,(Y_t - S_{t-p}) + (1-\alpha)\,[L_{t-1} + T_{t-1}] \quad (13\text{-}1)$$

$$T_t = \beta[L_t - L_{t-1}] + (1-\beta)T_{t-1} \quad (13\text{-}2)$$

$$S_t = \gamma\,(Y_t - L_t) + (1-\gamma)\,S_{t-p} \quad (13\text{-}3)$$

$$\hat{Y}_t = L_{t-1} + T_{t-1} + S_{t-p} \quad (13\text{-}4)$$

Where,

L_t = is the level at time t, α is the weight for the level, T_t is the trend at time t, β is the weight for the trend, S_t = is the seasonal component at time t, γ is the weight for the seasonal component, p = is the seasonal period, Y_t = is the data value at time t, $\hat{Y}_t$ = is the fitted value, or one-period-ahead forecast, at time t.

3.3 Seasonal Auto Regressive Integrated Moving Average (SARIMA)

ARIMA modeling can be used to model many different time series, with or without trend or seasonal components, and to provide forecasts (Box & Jenkins, 1970). The model as follows;

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An ARIMA model is given by:

$$\phi(B)(1-B)^d y_t = \theta(B)\varepsilon_t$$

Where; $\phi(B) = 1 - \phi_1 B - \phi_2 B^2 .... \phi_p B^p$

$\theta(B) - 1 - \theta_1 B - \theta_2 B^2 ...... \theta_P B^q$ (14)

$\varepsilon_t =$ Error term

D = Differencing term

B = Backshift operator ($B^a Y_t = Y_{t-a}$)

Analogous to the simple SARIMA parameters, these are:
Seasonal autoregressive - (Ps)
Seasonal differencing - (Ds)
Seasonal moving average parameters - (Qs)
Seasonal models are summarized as ARIMA (p, d, q) (P, D, Q)$_s$
Number of periods per season - S

$$(1-\phi_1 B)(1-\varphi_1 B^s)(1-B)(1-B^s)Y_t = (1-\theta_1 B)(1-\theta_1 B^s)\varepsilon_t \qquad (15)$$

4. RESULTS

The analysis contains two main parts:

4.1 Pattern recognition of daily infected cases in Argentina.
4.2 Forecasting daily infected cases in Argentina.

4.1 Pattern Recognition of Daily Infected Cases in Argentina

Figure 4 is the time series plot of daily infected cases of Argentina for the period of 22nd January 2020 to 6th July 2021. The first confirmed case was reported from Argentina on 1st March 2020. There have been many growths of daily cases within the precise period. The first growth for the period of 22nd January 2020 to 21st October 2020 has observed in Figure 4. The second growth for the period of 17th December 2020 to 12th January 2021. There were two exponential growths for the periods of 13th March to 16th April 2021 and 11th May to 27th May 2021 consecutively. There was a declining trend of daily infected cases in Argentina after 27th May 2021 up to now.

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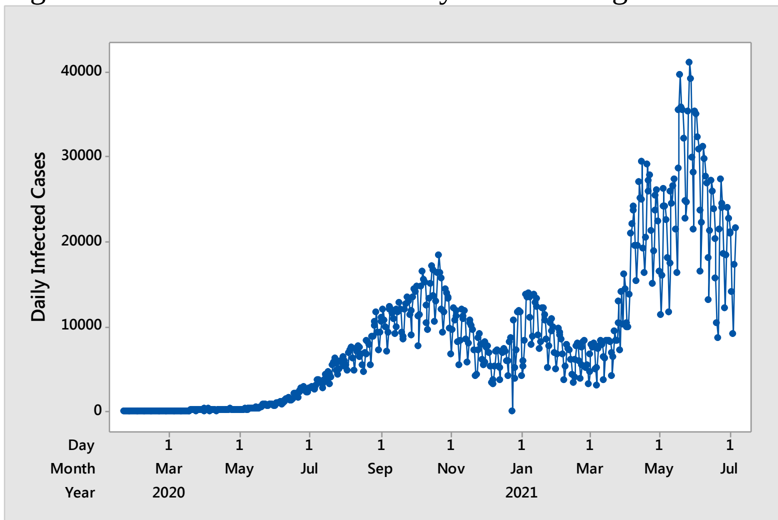
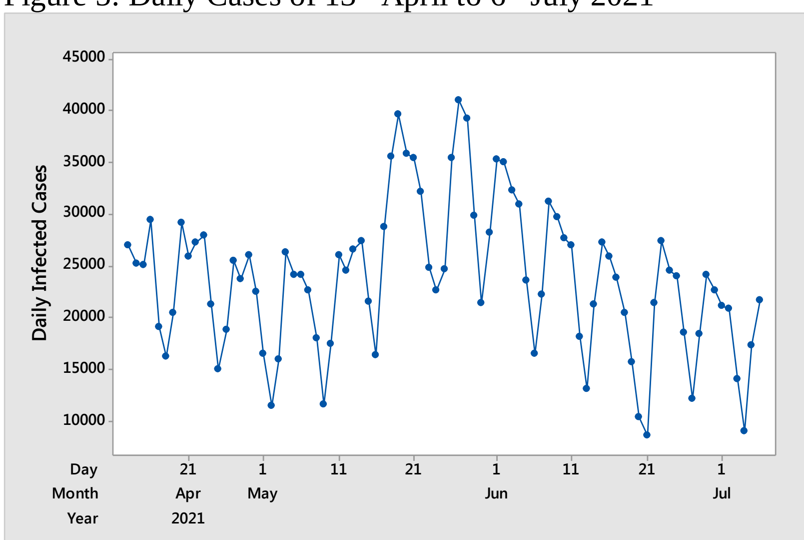
Figure 4: Time Series Plot of Daily Cases in Argentina



Hence, the data set for the period of 13th April 2021 to 6th July 2021 was used to forecast daily infected cases in Argentina and therefore the pattern of the period was examined furthermore. Figure 5 is the time series plot of daily cases for the period of 13th April 2021 to 6th July 2021. According to Figure 5, there is high volatility with a minor decline of daily infected cases in Argentina.

Figure 5: Daily Cases of 13th April to 6th July 2021



The ACF of the daily infected cases is shown in Figure 6. It shows several seasonal behaviors. There have been few significant lags. Supported the behavior of daily cases in ACF, it had been assumed that many seasonality behaviors were visible, but the lengths would be doubtful. The series is not stationary.

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Figure 6: ACF of Daily Cases (DC)

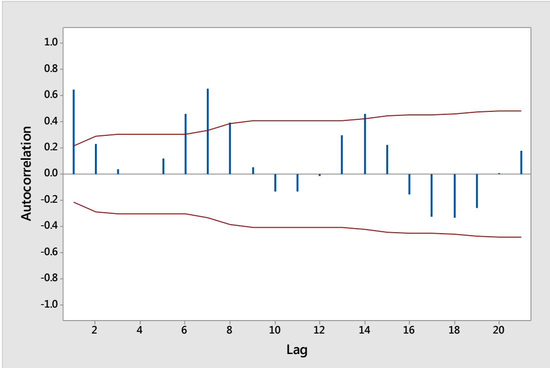


Figure 7: Plot of 1st Difference of DC

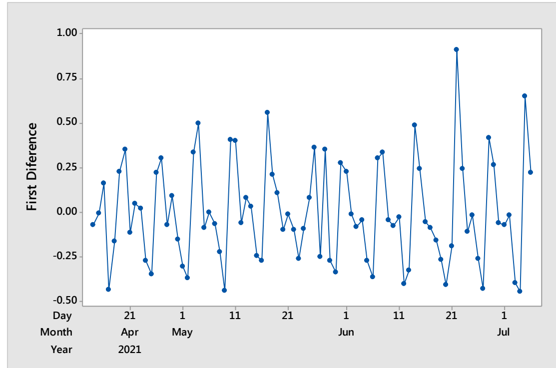


Figure 7 is that the plot of the first difference series of the daily infected cases in Argentina. The first difference series should obtain to look at the wave pattern of the series to apply SCM (Konarasinghe, W.G.S., 2019; 2020). The series shows a wave-like pattern with high volatility from the beginning to the end. The behavior of the series in Figure 7 is another evidence to pick the SCM to forecast daily infected cases in Argentina. Further, apply ACF with the 1st and 2nd difference of the series to check the stationary. Figures 8 and 9 are the ACF's of the 1st and 2nd difference of the series. The behaviors of both figures confirmed the non-stationary of the daily infected cases in Argentina. Because the non-stationary of the series, Seasonal Auto-Regressive Integrated Moving Average (SARIMA) cannot be applied for forecasting daily infected cases.

Figure 8: ACF of 1st Difference of DC

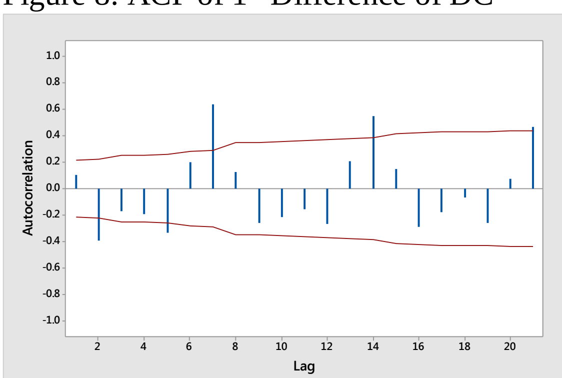
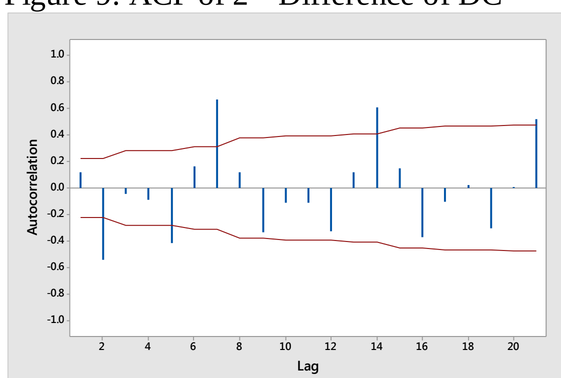


Figure 9: ACF of 2nd Difference of DC



Hence, SCM and Holt's Winters Three Parameter Models were tested to capture the seasonal behavior and forecast daily infected cases in Argentina.

4.2 Forecasting Daily Infected Cases in Argentina

Initially the SCM was run on 56 trigonometric series. The results of the Table 1 is the model summary of SCM.

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Table 1: Model Summary of SCM

Model	Model Fitting		Model Verification	
$Y_t = Y_{t-1} - 0.0972\sin 1.5\omega t - 0.0982\sin 6.5\omega t + 0.1278\cos 1.5\omega t + 0.0686\cos 2.75\omega t + 0.2326\cos 3.5\omega t + 0.2092\cos 4.25\omega t$	MAPE	1.1507	MAPE	4.8969
	MSE	0.0225	MSE	0.2996
	MAD	0.1165	MAD	0.4800
	Normality	P= 0.262		
	Independence of Residuals	Yes		

The results of the Table 1 revealed that there were 6 significant trigonometric series out of 56. They are; $\sin 1.5\omega t, \sin 6.5\omega t, \cos 1.5\omega t, \cos 2.75\omega t, \cos 3.5\omega t$ and $\cos 4.25\omega t$ .The model has shown the normality and independence of the residuals in the fitting. The measurements of errors are very low under the fitting. However, it is a little greater within side the verification process. Figure 10 is the actual vs. fits of SCM. The patterns of actual daily cases and fits are similar, deviations among them had been very few. Figure 11 is the actual vs. forecast of SCM. The deviation among actual daily cases and forecast became less. The behavior of the SCM forecast follows quite similar to actual behavior.

Figure 10: Actual vs. Fits of SCM

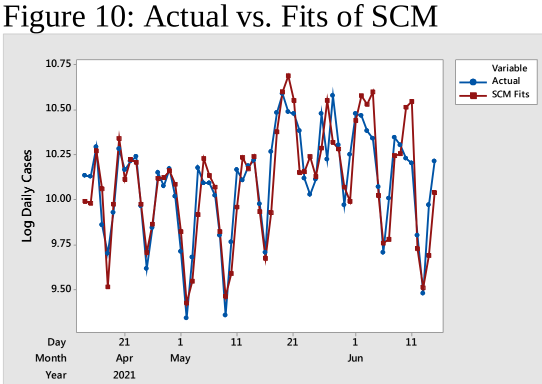
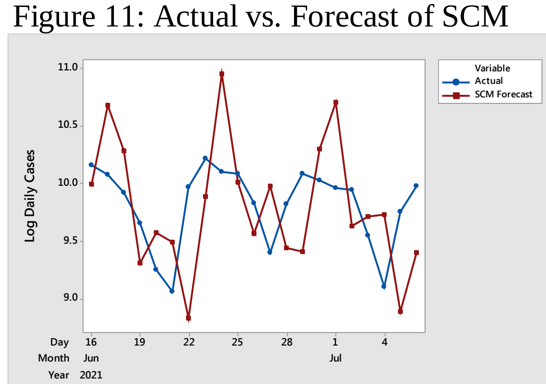


Figure 11: Actual vs. Forecast of SCM



Satisfying the model assumptions, the measurements of errors, and following the similar patterns of the actual, fits, and the forecast showed that, the SCM is an appropriate model to forecast daily infected cases of COVID -19 in Argentina. Further, SCM presents extra information of many seasonal lengths inside one significant trigonometric series. There were 6 significant trigonometric series within side the best fitting SCM (16). They are; $\sin 1.5\omega t, \sin 6.5\omega t, \cos 1.5\omega t, \cos 2.75\omega t, \cos 3.5\omega t$ and $\cos 4.25\omega t$ shown in, Figures 12, 13, 14, 15, 16, and 17. The fitted SCM is;

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$$Y_t = Y_{t-1} - 0.0972\sin 1.5\omega t - 0.0982\sin 6.5\omega t + 0.1278\cos 1.5\omega t + 0.0686\cos 2.75\omega t + 0.2326\cos 3.5\omega t + 0.2092\cos 4.25\omega t \quad (16)$$

This is another evidence to prove that the SCM is capable to follow a wave – like patterns (Konarasinghe, W.G.S. 2020). Figure 12 indicates that there have been wavelengths of 4 and 5 days. That means daily infected cases in Argentina rise and fall in 4 and 5 days intervals.

Figure 12: Plot of $\sin 1.5\omega t$

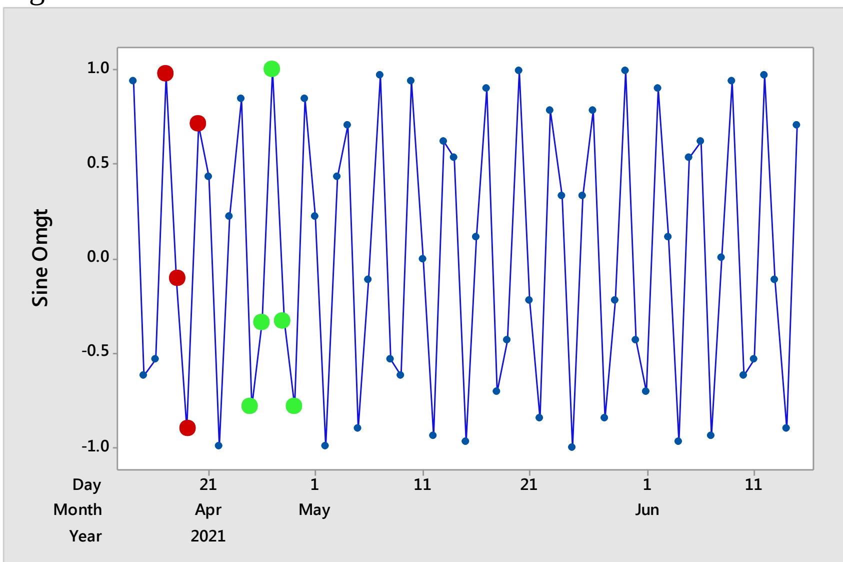

Figure 13 is the significant plot of $\sin 6.5\omega t$. The plot indicates that there have been wavelengths of 4 and 5 days. That means daily infected cases in Argentina rise and fall in 4 and 5 days periods.

Figure 13: Plot of $\sin 6.5\omega t$

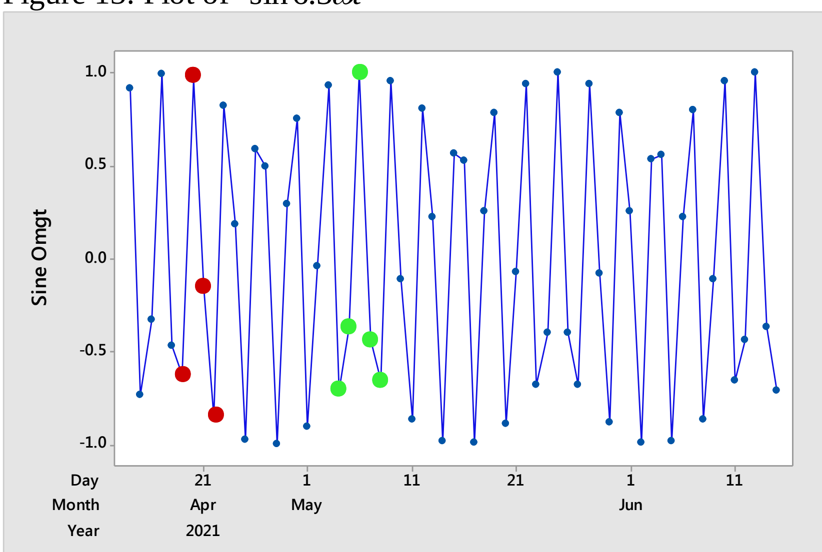

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Figure 14 is the significant plot of $\cos 1.5\omega t$. The plot indicates that there have been wavelengths of 4 and 5 days. That means daily infected cases in Argentina rise and fall in 4 and 5 days periods.

Figure 14: Plot of $\cos 1.5\omega t$

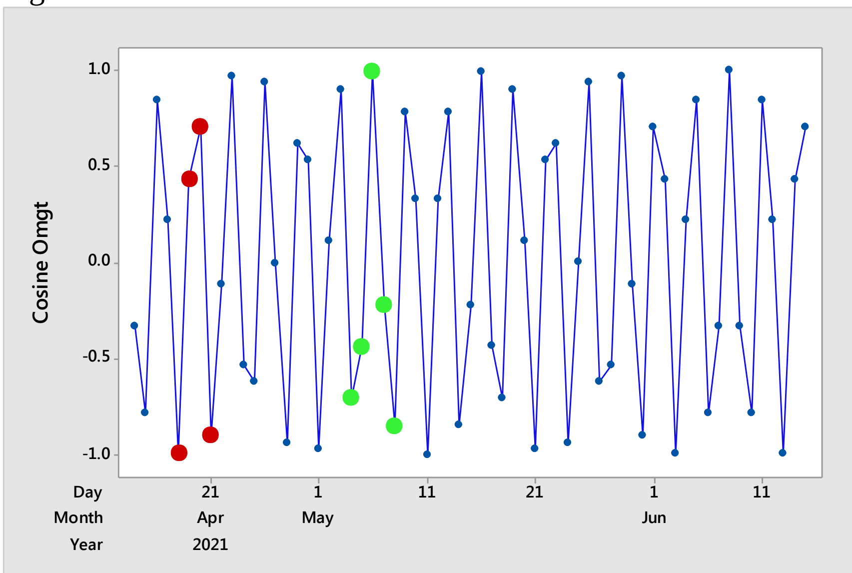

Figure 15 is the significant plot of $\cos 2.75\omega t$. The plot indicates that there have been wavelengths of 3 and 4 days. That means daily infected cases in Argentina rise and fall in 3 and 4 days periods.

Figure 15: Plot of $\cos 2.75\omega t$

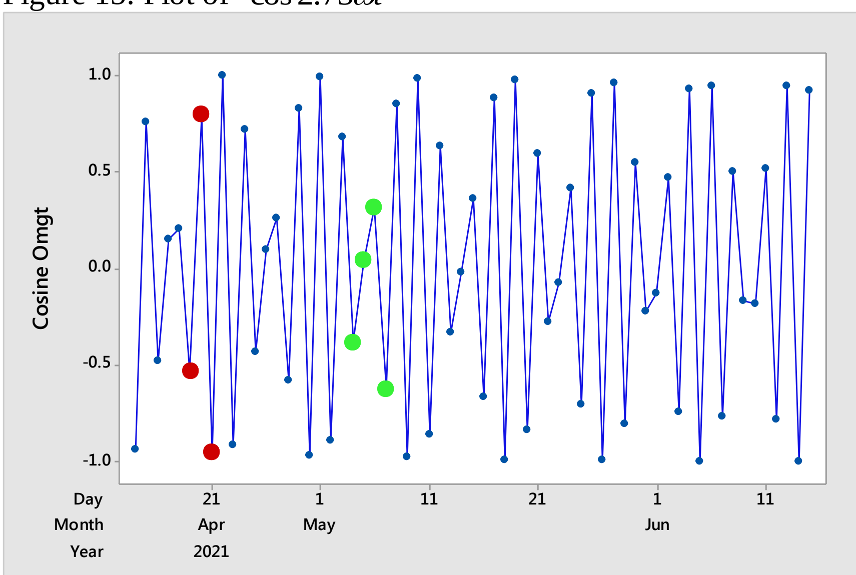

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Figure 16 is the significant plot of $\cos 3.5\omega t$. The plot shows that there have been wavelengths of 4 and 5 days. That means daily infected cases in Argentina rise and fall in 4 and 5 days periods.

Figure 16: Plot of $\cos 3.5\omega t$

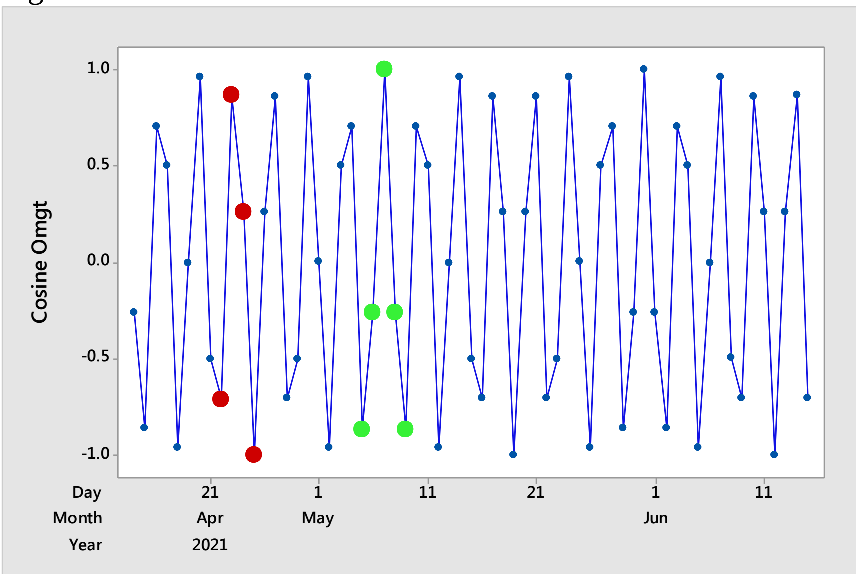
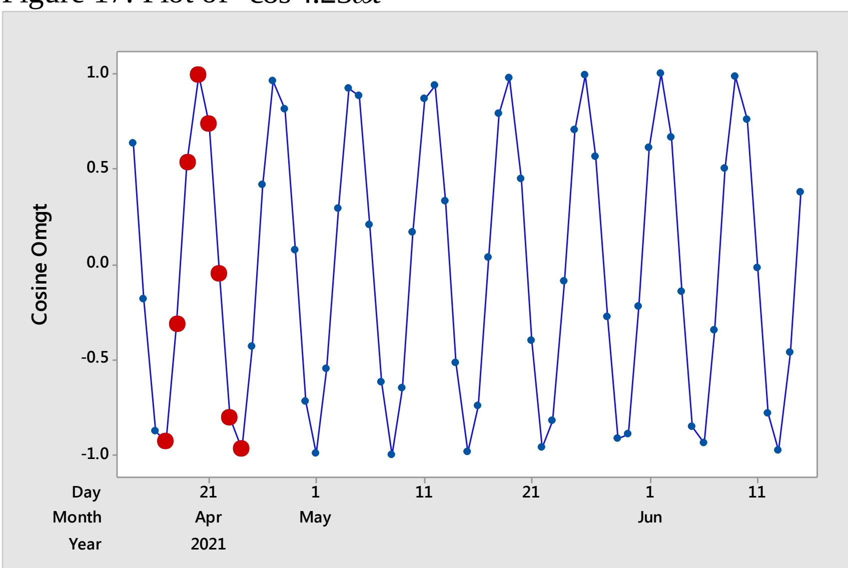


Figure 17 is the significant plot of $\cos 4.25\omega t$. The plot indicates that there is only one wavelength contain 8 days. That means daily infected cases in Argentina rise and fall in 8 days intervals

Figure 17: Plot of $\cos 4.25\omega t$



The significant trigonometric series of $\sin 1.5\omega t$, $\sin 6.5\omega t$, $\cos 1.5\omega t$ and $\cos 3.5\omega t$ of Figures 12, 13, 14, and 16 indicated the seasonal behaviors with the lengths of 4 and 5, days.

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In different words, daily infected cases in Argentina rise and fall in 4 and 5 days periods shown through 4 significant trigonometric series. Besides, the significant trigonometric series $\cos 2.75\omega t$ indicates that there have been wavelengths of 3 and 4 days in Figure 15. There is only one wavelength of 8 days accommodates within side the trigonometric series of $\cos 4.25\omega t$ in Figure 17.

Considering the results indicated by six significant trigonometric series of SCM, the rise and fall of daily infected cases accommodated in of 3, 4, and 5 days. It can would be taken as days on average. The remaining trigonometric series indicated the rise and fall of daily cases in 8 days. Due to the non – stationary of the series, SARIMA model couldn't be applied to model the daily infected cases. It was confirmed through ACF's of Figures 6, 8, and 9. Finally, the Holt's Winters additive and multiplicative models were tested for different α, γ, and δ values and 3, 4, 5, and 8 seasonal lengths. Models confirmed the normality, but not the independence of the residuals. Holt's Winters additive and multiplicative models does not confirm the model validation criterion. Hence, the Holt's Winters models is not recommended to forecasting daily infected cases in Argentina.

5. CONCLUSION AND RECOMMANDATIONS

It is concluded that the SCM is the best-suited model for forecasting daily infected cases of COVID -19 in Argentina due to the least measurement of errors, satisfying the model validation criterion, and capturing the wave – pattern of the actual daily cases. Holt's Winters additive and multiplicative models and SARIMA models were not suitable for the purpose due to the non-randomness of the residuals and non-stationary of the data series.

This is the third study of applying SCM in COVID -19 data. The performance of the SCM was extremely high, and it provided valuable information related to the behaviors of daily infected cases in Argentina. In different words, one wave packet contains many waves in a data series. The output of SCM in this study has identified 4 seasonal lengths of 3, 4, 5, and 8 days within the daily infected cases in Argentina with minimum effort. On average, it could be considered the rise and fall of daily infected cases exist in 4 and 8 days. This behavior would be one of the perfect guidelines to control the outbreak of the pandemic and reduce the rate of daily infected cases in Argentina. This guideline would be facilitated to control the movements of the public, making an effective lockdown schedule, preparing transportation schedules for the essential services, preparing an effective working schedule for the employees in both the public and private sector, etc.

A vaccine is a part of medical care. Medical care constitutes only 10% to 20% of health outcomes, approximately (AIM, 2019). That is not sufficient to prevent COVID -19.The remaining 80% to 90% incorporates several social factors, including other healthcare practices (AIM, 2019). Healthy lifestyles, working styles, food habits, and other non-pharmaceutical activities are few factors associate with healthcare practices (AIM, 2019).

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Non-pharmaceutical interventions are the primary mitigation strategy to control and minimize the outbreak of the COVID-19 pandemic (Kantor & Kantor, 2020). Avoiding handshakes, Tissue/ elbow sneeze, avoiding face touching, Wearing masks, Wearing eye Protection, Hand washing, Hand sanitizer, Social distancing, avoiding travel, required to stay at home/ quarantine are few non-pharmaceutical practices.

The lengths of rising and fall of the daily cases indicated by this study would be a guide to work out logistic requirements. Especially, effective and efficient logistic requirements need to enhance non-pharmaceutical practices controlling the outbreak of the pandemic. The results of this study provide another guide for planning the production capacities of health and medical care products with minimum waste.

The rate of daily infected cases in Argentina is very high. Hence, the quarantine procedures should be followed strictly and monitored by the medical and healthcare authorities from time to time. The government should provide facilities to the producers to produce healthy food and beverages to improve the immunity of the human body and restrict unhealthy food and beverages for the long run and to ensure a healthy society and economy in Argentina. Further, authorities should take initiatives to improve the self-discipline of the public to control the outbreak. The results of the study would be a lighthouse to develop and implement proactive measures to avoid the outbreak and combat the pandemic in Argentina.

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