

Forecasting Covid-19 New Cases in Malta

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Malta. The employed data covers the period 1 January 2020 – 25 March 2021 and the out-of-sample period ranges over the period 26 March – 31 July 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is quite stable. The results of the study indicate that daily COVID-19 cases in Malta are likely to remain high over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Malta to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Malta is one of the smallest countries in Europe with an estimated population size close to half a million and a population density of 1562 persons/square kilometer (Malta statistics office, 2019). Malta proximity to Italy, one of the hardest hit European countries meant that Malta was at a high risk of being pounced by the COVID-19 pandemic (Micallef et al, 2020). The country has a high prevalence of chronic medical conditions like hypertension, obesity and Diabetes Mellitus (Guan et al, 2020; Cuschieri, 2020; Malta National statistics, 2019; Grech et al, 2015). Malta reported her first case of COVID-19 on the 7th of March 2020 and the country was successful in achieving low mortality rates when compared to other regional counterparts (European CDC, 2020). The government reacted to the COVID-19 pandemic by imposing restrictions on travel and implementing non-pharmacological interventions recommended by WHO to mitigate the spread of the SARS-COV2 virus. Modeling and forecasting COVID-19 has become very important in recent times in order to understand the evolution of the epidemic in the country, facilitate planning, decision making and allocation of adequate resources to curb the local transmissions. In this paper we apply the artificial neural network approach to predict daily COVID-19 cases in Malta. The results will trigger an appropriate public health response to the epidemic.

II. LITERATURE REVIEW

Nyoni et al (2020) predicted daily COVID-19 cases in Spain using artificial neural networks based on data covering the period February 1, 2020 to October 31, 2020. The out-of-sample period ranges over the period November 2020 to April 2021. The results of the study revealed that daily COVID-19 cases would follow a downwards trajectory characterized by “peaks” and “lows”. The evolution of the COVID-19 epidemic in Brazil was studied by Sousa et al (2020) using the SIR model. The study concluded that there is rapid COVID-19 spread and high mortality in Brazil. The epidemic peak was likely to be between late April and early May 2020. Bastos & Daniel (2020) assessed the impact of public health measures to control COVID-19 by utilizing the Modified SIR models. The study concluded that Short-term and long term forecasts indicate that social distancing measures are able to flatten the pattern of COVID-19. A dynamic hybrid model based on SEIRD and ascertainment rate with automatically selected parameters was developed by Ala'raj et al (2020). The proposed model consisted of two parts: the modified SEIRD dynamic model and ARIMA models. The study concluded that the model had a great ability to make accurate predictions of infected, recovered, and deceased patients.

III. METHODOLOGY

The Artificial Neural Network (ANN) approach, which is flexible and capable of nonlinear modeling; will be applied in this study. The ANN is a data processing system consisting of a large number of highly interconnected processing elements in architecture inspired by the way biological nervous systems of the brain appear like. Since no explicit guidelines exist for the determination of the ANN structure, the study applies the popular ANN (12, 12, 1) model based on the hyperbolic tangent activation function. This paper applies the Artificial Neural Network (ANN) approach in predicting new COVID-19 cases Malta.

Data Issues

This study is based on daily new cases of COVID-19 in Malta for the period 1 January 2020 – 25 March 2021. The out-of-sample forecast covers the period 26 March 2021 – 31 July 2021. All the data employed in this research paper was gathered from the Johns Hopkins University (USA).

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	M
Observations	438 (After Adjusting Endpoints)
Neural Network Architecture:	
Input Layer Neurons	12
Hidden Layer Neurons	12
Output Layer Neurons	1
Activation Function	Hyperbolic Tangent Function
Back Propagation Learning:	
Learning Rate	0.005
Momentum	0.05
Criteria:	
Error	0.091618
MSE	789.389227
MAE	19.437970

Residual Analysis for the Applied Model

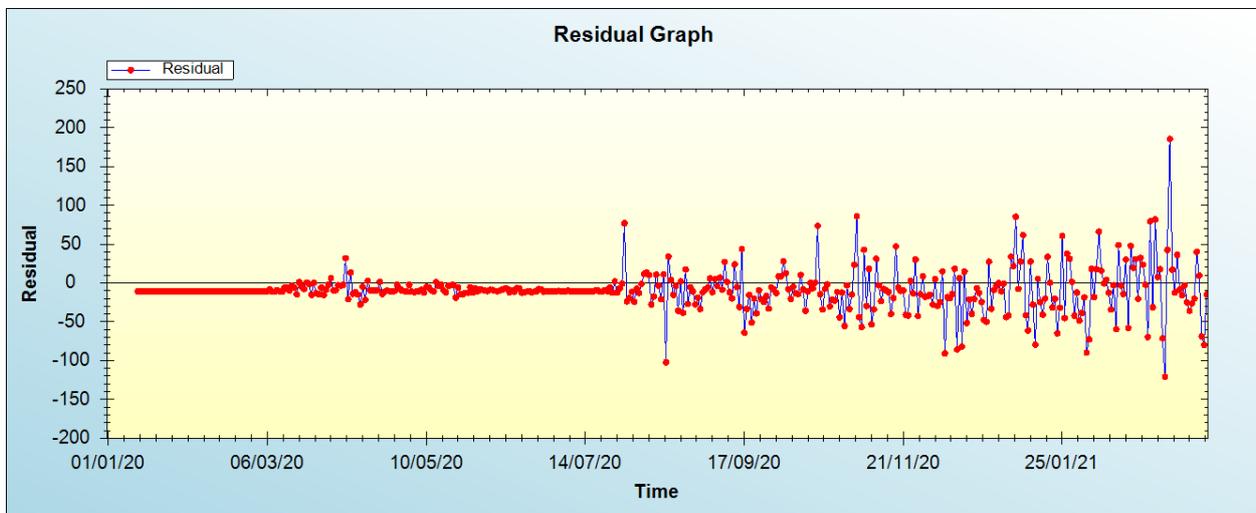


Figure 1: Residual analysis

In-sample Forecast for M

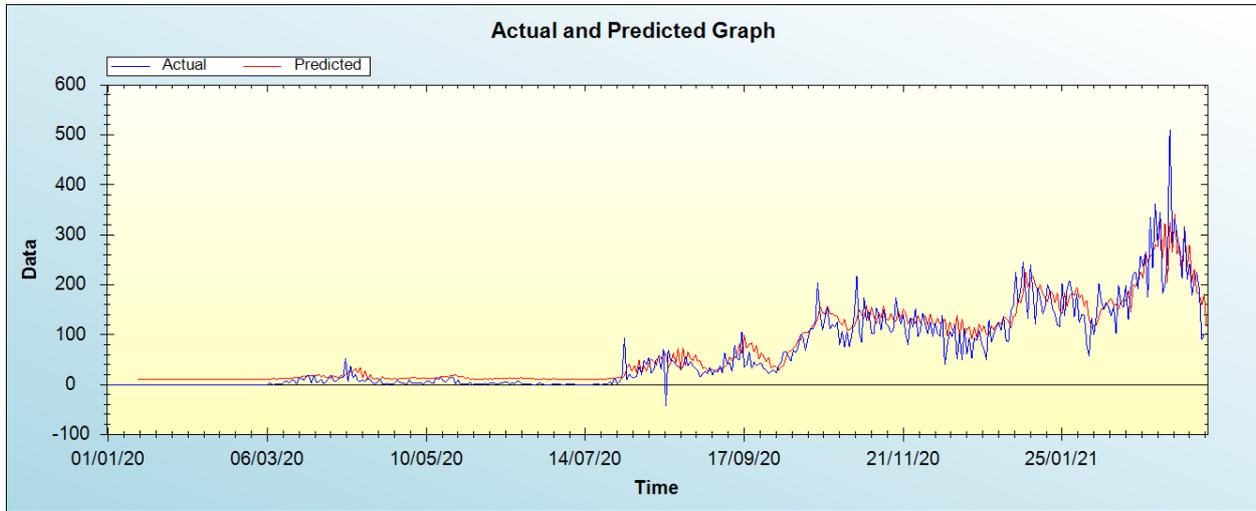


Figure 2: In-sample forecast for the M series

Out-of-Sample Forecast for M: Actual and Forecasted Graph

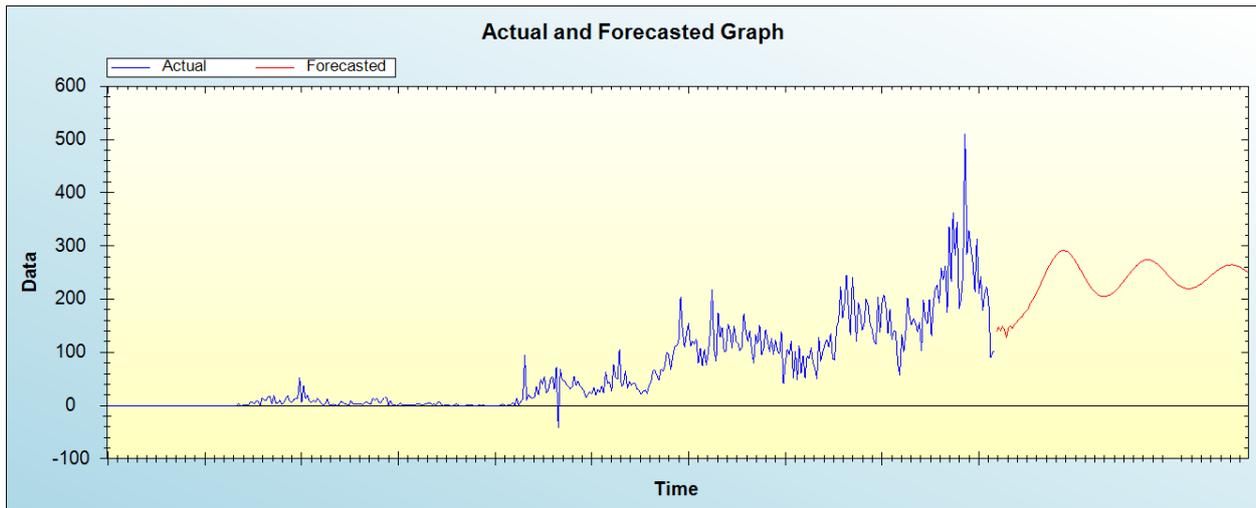


Figure 3: Out-of-sample forecast for M: actual and forecasted graph

Out-of-Sample Forecast for M: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasting
26/03/21	139.1176
27/03/21	146.8584
28/03/21	140.7265
29/03/21	148.5126
30/03/21	142.5019
31/03/21	127.7231
01/04/21	146.5383
02/04/21	149.9109
03/04/21	144.9087
04/04/21	151.6129
05/04/21	156.0383
06/04/21	160.1845
07/04/21	164.8021
08/04/21	166.7153
09/04/21	173.8895

10/04/21	178.2741
11/04/21	181.3921
12/04/21	190.7760
13/04/21	196.9257
14/04/21	202.0057
15/04/21	210.6500
16/04/21	217.9469
17/04/21	225.3697
18/04/21	233.9045
19/04/21	241.5577
20/04/21	249.9939
21/04/21	257.3794
22/04/21	264.4333
23/04/21	271.5656
24/04/21	276.9707
25/04/21	281.8253
26/04/21	286.2768
27/04/21	288.7456
28/04/21	290.6103
29/04/21	291.1788
30/04/21	290.3944
01/05/21	288.6514
02/05/21	285.7274
03/05/21	281.7991
04/05/21	277.1645
05/05/21	271.4122
06/05/21	265.4404
07/05/21	258.8679
08/05/21	252.0173
09/05/21	245.2669
10/05/21	238.6276
11/05/21	232.1713
12/05/21	226.3985
13/05/21	220.9670
14/05/21	216.3550
15/05/21	212.4334
16/05/21	209.2781
17/05/21	206.9645
18/05/21	205.4863
19/05/21	204.6932
20/05/21	204.8098
21/05/21	205.5229
22/05/21	206.9766
23/05/21	209.0572
24/05/21	211.7060
25/05/21	214.8678
26/05/21	218.5419
27/05/21	222.5407
28/05/21	226.9449
29/05/21	231.5452
30/05/21	236.3457
31/05/21	241.2160
01/06/21	246.0805
02/06/21	250.8073
03/06/21	255.3578
04/06/21	259.5445
05/06/21	263.3696
06/06/21	266.6658
07/06/21	269.4199
08/06/21	271.5274
09/06/21	272.9827
10/06/21	273.7095
11/06/21	273.7576
12/06/21	273.0628

13/06/21	271.7236
14/06/21	269.7150
15/06/21	267.1524
16/06/21	264.0595
17/06/21	260.5697
18/06/21	256.7262
19/06/21	252.6902
20/06/21	248.5056
21/06/21	244.3395
22/06/21	240.2385
23/06/21	236.3474
24/06/21	232.7074
25/06/21	229.4371
26/06/21	226.5523
27/06/21	224.1488
28/06/21	222.2142
29/06/21	220.8145
30/06/21	219.9196
01/07/21	219.5640
02/07/21	219.7035
03/07/21	220.3523
04/07/21	221.4501
05/07/21	222.9983
06/07/21	224.9260
07/07/21	227.2202
08/07/21	229.8046
09/07/21	232.6524
10/07/21	235.6809
11/07/21	238.8543
12/07/21	242.0827
13/07/21	245.3248
14/07/21	248.4881
15/07/21	251.5289
16/07/21	254.3592
17/07/21	256.9394
18/07/21	259.1915
19/07/21	261.0883
20/07/21	262.5673
21/07/21	263.6194
22/07/21	264.2029
23/07/21	264.3298
24/07/21	263.9820
25/07/21	263.1936
26/07/21	261.9696
27/07/21	260.3656
28/07/21	258.4063
29/07/21	256.1647
30/07/21	253.6807
31/07/21	251.0379

The main results of the study are shown in table 1. It is clear that the model is stable as confirmed by evaluation criterion as well as the residual plot of the model shown in figure 1. It is projected that daily COVID-19 cases in Malta are likely to remain high over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The COVID-19 outbreak which started in Wuhan, China caught several countries unprepared for a health crisis of that nature. Many countries have learnt a very important lesson that emergency preparedness is key in public health planning. It is also crucial to strengthen public health surveillance systems in order to detect outbreaks early in order implement mitigation measures early enough to minimize loss of lives. Furthermore the pandemic has taught us the lesson of having unity of purpose when faced with outbreaks like COVID-19. In this study we applied the artificial neural network approach to predict daily COVID-19 cases in Malta. The results indicate that daily COVID-19 cases in Malta are likely to remain high over the out-of-sample period. The

government must enforce adherence to COVID-19 prevention and control measures including vaccinating people against COVID-19.

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