Forecasting Covid-19 New Cases in San Marino

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Abstract - **In this research article, the ANN approach was applied to analyze daily new cases of COVID-19 in San Marino. This study is based on daily new cases of COVID-19 in San Marino for the period 1 January 2020 – 25 March 2021. The out-of-sample forecast covers the period 26 March 2021 – 31 July 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is stable in forecasting daily new cases of COVID-19 in the country. The results of the study indicate that daily COVID-19 cases in San Marino are likely to significantly decline over the out-of-sample period. We, however; still recommend that the government of San Mario should ensure adherence to lock-down measures while creating massive awareness about the COVID-19 pandemic as well as scaling up vaccinations.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Since the first emergence of the Coronavirus Disease 2019 (COVID-19) in Wuhan, Hubei Province, China, in December 2019 (Wu *et al*., 2020), the scourge has proliferated globally and has affected literally all nations till date (Worldometers, 2020). The global outbreak and severity of this contagious disease (Li *et al*., 2020) prompted the World Health Organization (WHO) to declare it as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020, and then subsequently, to classify it as a pandemic on March 11, 2020 (WHO, 2020). As of August 2020, COVID-19 has infected approximately 20 million people across the globe with 90 countries in community transmission stage (WHO, 2020), leading to significant efforts towards control (Rawaf *et al*., 2020) and search for a cure (Le *et al*., 2020) for COVID-19 across the world. Definitely, the spread of this virus outbreak has seriously disrupted life, economy and health of citizens and this has become a great concern for everyone, as to how long will this scenario last and when the disease could be controlled (Sardar *et al*., 2020). Modeling and forecasting of the COVID-19 pandemic in San Marino, just like in any other affected country; remains important.

II. 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 in San Marino.

Data Issues

This study is based on daily new cases of COVID-19 in San Marino 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).

III. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	SM
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	0.210381
MSE	123.286674
MAE	8.889191

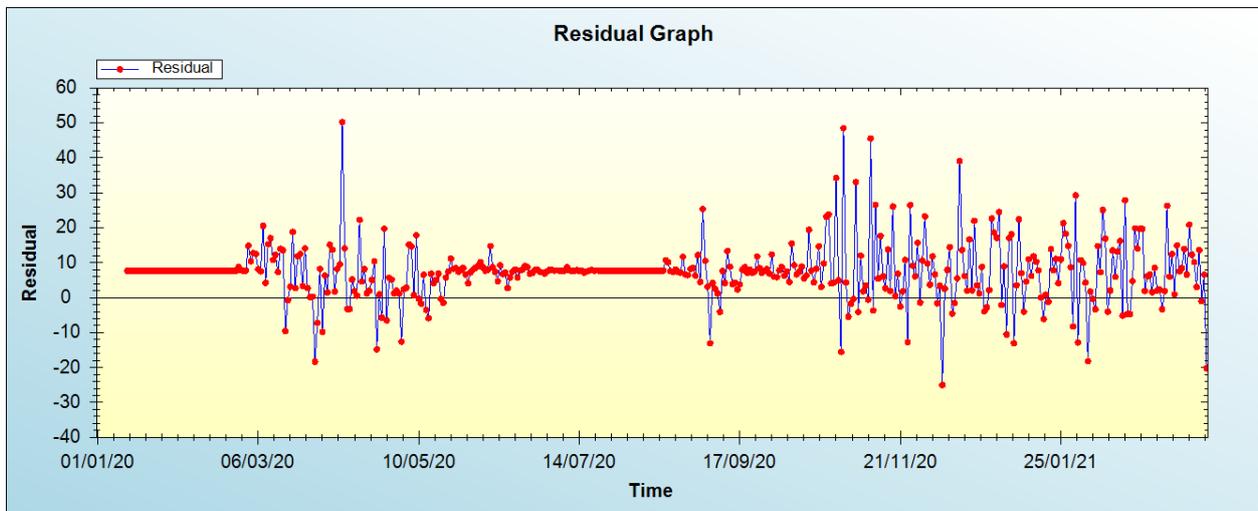*Residual Analysis for the Applied Model*

Figure 1: Residual analysis
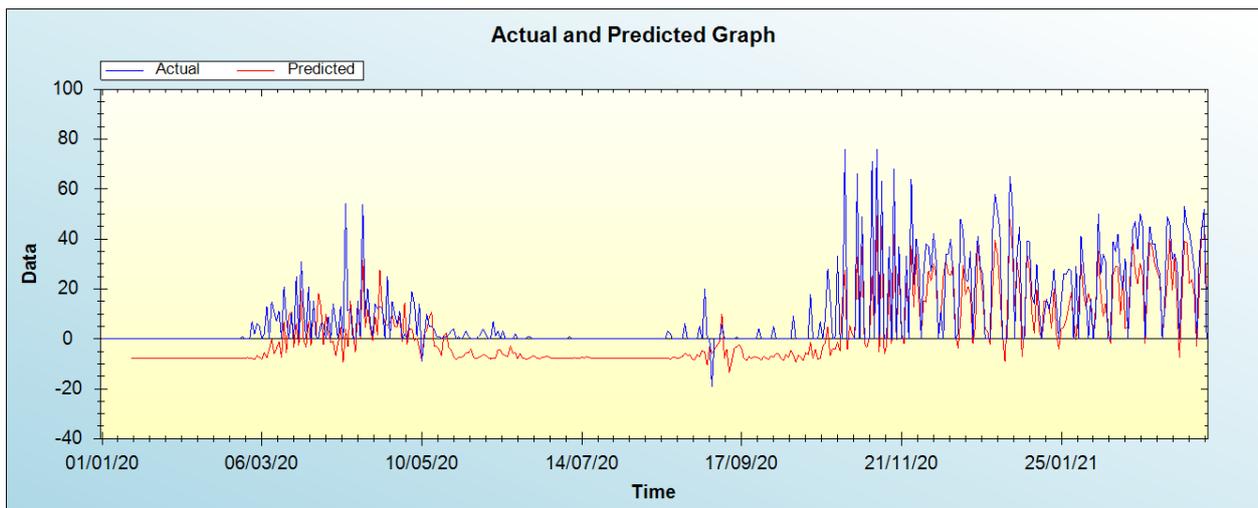
In-sample Forecast for SM

Figure 2: In-sample forecast for the SM series

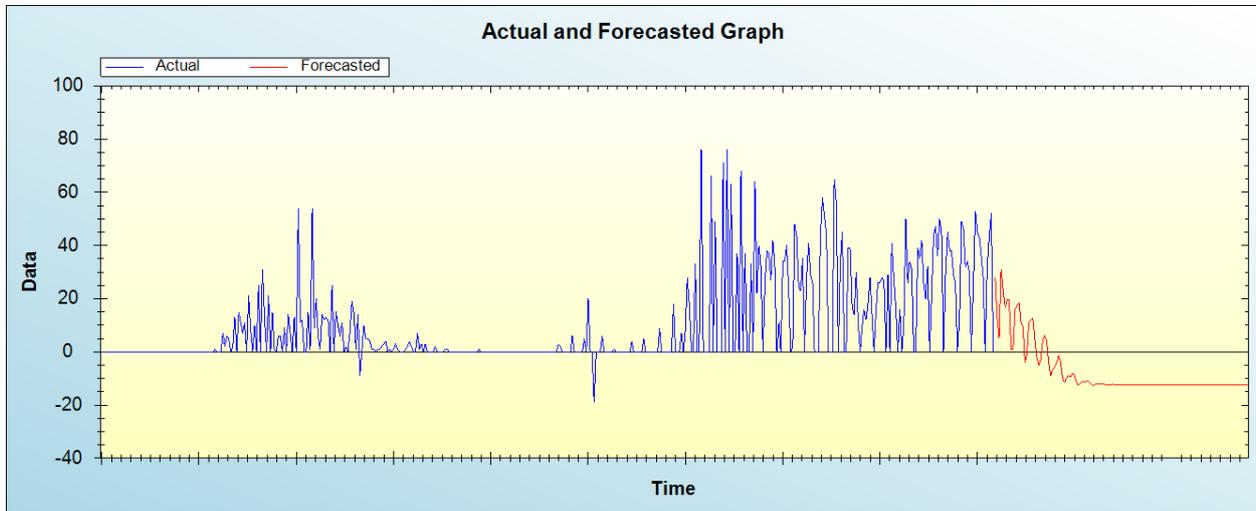*Out-of-Sample Forecast for SM: Actual and Forecasted Graph*

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

Out-of-Sample Forecast for SM: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	27.8688
27/03/21	12.9906
28/03/21	5.0508
29/03/21	31.1026
30/03/21	22.9791
31/03/21	16.9112
01/04/21	19.5495
02/04/21	19.4762
03/04/21	1.1021
04/04/21	0.7960
05/04/21	15.6744
06/04/21	17.2906
07/04/21	18.5332
08/04/21	10.8458
09/04/21	9.5832
10/04/21	-3.9444
11/04/21	-0.8212
12/04/21	11.1018
13/04/21	12.0717
14/04/21	12.5066
15/04/21	4.7934
16/04/21	-2.0400
17/04/21	-5.0376
18/04/21	-2.9528
19/04/21	4.4043
20/04/21	6.1859
21/04/21	3.9986
22/04/21	-4.1467
23/04/21	-8.9069
24/04/21	-6.5453
25/04/21	-5.6939
26/04/21	-3.9865
27/04/21	-1.4944
28/04/21	-3.6922
29/04/21	-10.0590

30/04/21	-11.4406
01/05/21	-9.7504
02/05/21	-8.9052
03/05/21	-9.4257
04/05/21	-8.0633
05/05/21	-8.6428
06/05/21	-11.5331
07/05/21	-12.6441
08/05/21	-11.6427
09/05/21	-10.9849
10/05/21	-11.4035
11/05/21	-11.1276
12/05/21	-11.1236
13/05/21	-11.8342
14/05/21	-12.7063
15/05/21	-12.4768
16/05/21	-11.9274
17/05/21	-11.9837
18/05/21	-12.0559
19/05/21	-12.0329
20/05/21	-12.1275
21/05/21	-12.4876
22/05/21	-12.5566
23/05/21	-12.3391
24/05/21	-12.1923
25/05/21	-12.2592
26/05/21	-12.3064
27/05/21	-12.2920
28/05/21	-12.3934
29/05/21	-12.4676
30/05/21	-12.4242
31/05/21	-12.3214
01/06/21	-12.3133
02/06/21	-12.3541
03/06/21	-12.3660
04/06/21	-12.3755
05/06/21	-12.4073
06/06/21	-12.4148
07/06/21	-12.3719
08/06/21	-12.3498
09/06/21	-12.3615
10/06/21	-12.3794
11/06/21	-12.3815
12/06/21	-12.3863
13/06/21	-12.3941
14/06/21	-12.3850
15/06/21	-12.3698
16/06/21	-12.3684
17/06/21	-12.3787
18/06/21	-12.3826
19/06/21	-12.3828
20/06/21	-12.3841
21/06/21	-12.3838
22/06/21	-12.3784
23/06/21	-12.3746
24/06/21	-12.3778
25/06/21	-12.3815
26/06/21	-12.3820
27/06/21	-12.3814
28/06/21	-12.3816
29/06/21	-12.3803
30/06/21	-12.3784
01/07/21	-12.3785
02/07/21	-12.3803

03/07/21	-12.3813
04/07/21	-12.3809
05/07/21	-12.3806
06/07/21	-12.3804
07/07/21	-12.3798
08/07/21	-12.3794
09/07/21	-12.3800
10/07/21	-12.3807
11/07/21	-12.3807
12/07/21	-12.3804
13/07/21	-12.3802
14/07/21	-12.3801
15/07/21	-12.3800
16/07/21	-12.3800
17/07/21	-12.3803
18/07/21	-12.3805
19/07/21	-12.3803
20/07/21	-12.3802
21/07/21	-12.3802
22/07/21	-12.3802
23/07/21	-12.3801
24/07/21	-12.3802
25/07/21	-12.3803
26/07/21	-12.3803
27/07/21	-12.3802
28/07/21	-12.3802
29/07/21	-12.3802
30/07/21	-12.3802
31/07/21	-12.3802

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 San Marino are likely to significantly decline over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

COVID-19, declared as a pandemic by WHO, is currently the most aggressive disease in the entire world, affecting everyone in this world, in one way or the other. It has become inevitable to forecast the daily new COVID-19 cases in San Marino as this information is important for policy makers to be in a position to control the pandemic. It is projected that daily COVID-19 cases in San Marino are likely to significantly decline over the out-of-sample period. We, however; still recommend that the government of San Mario should ensure adherence to lock-down measures while creating massive awareness about the COVID-19 pandemic. We also encourage the government to scale up COVID-19 vaccinations throughout the country.

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