Forecasting Covid-19 New Cases in Andorra

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Abstract - **Since December 2019, the whole world has been incrementally invaded and tormented by the COVID-19 pandemic. In this research article, the ANN technique was applied to analyze COVID-19 daily cases in Andorra. This study is based on daily new cases of COVID-19 in Andorra 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 apparently tell us that the model is stable in forecasting COVID-19 cases in the country. The results of the study indicate that daily COVID-19 cases in Andorra are likely to decline to zero around mid April 2021. Just like the rest of the world; Andorra ought to resort to prevention and control measures such as social distancing, wearing of masks, travel restrictions, quarantine, isolation, testing and tracing and so on, alongside vaccination.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The novel coronavirus disease 2019 (COVID-19) is a new beta coronavirus caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Sohrabi *et al*., 2020). The first infected case was discovered in Hubei, a province in the city of Wuhan in China, on December 31 2019 (Guan *et al*., 2020). While critical cases of COVID-19 might end up dying, infected people usually experience mild to severe respiratory illness (Sohrabi *et al*., 2020). Compared to other coronavirus families, COVID-19 is quite dangerous because of its asymptomatic and high human-to-human transmission (Shereen *et al*., 2020). Andorra's first case of COVID-19 was reported on February 25 2020, after an Italian national tested positive in the Southern part of the country (Ouargla). Artificial Neural Network (ANN) forecasting might play a pivotal role in understanding epidemic features of an outbreak. The primary objective of this paper is to analyze the pattern of COVID-19 new daily cases for all age groups in Andorra. This piece of work is envisioned to go a long way in helping policy makers understand the possible spreading pattern of COVID-19 in Andorra.

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 Andorra.

Data Issues

This study is based on daily new cases of COVID-19 in Andorra 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	A

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	0.105823
MSE	308.997659
MAE	11.210246

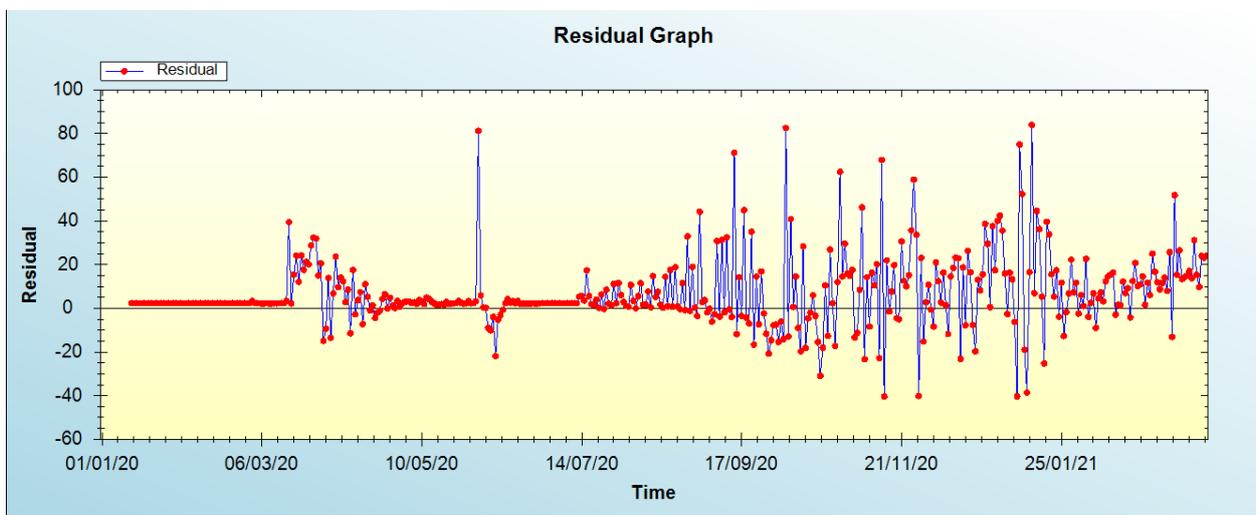*Residual Analysis for the Applied Model*

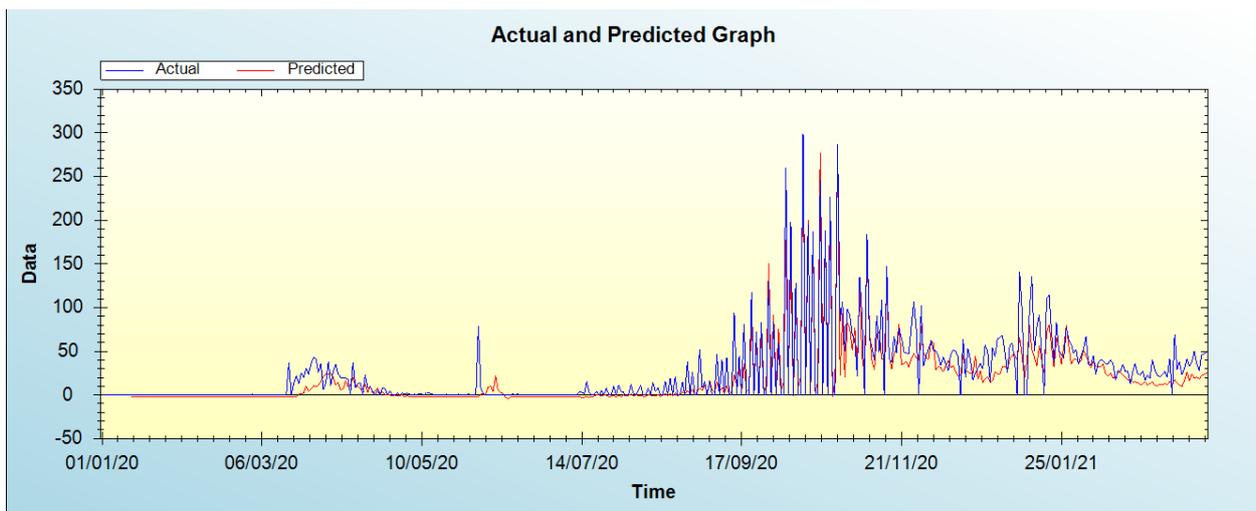**Figure 1: Residual analysis**

In-sample Forecast for A

Figure 2: In-sample forecast for the A series

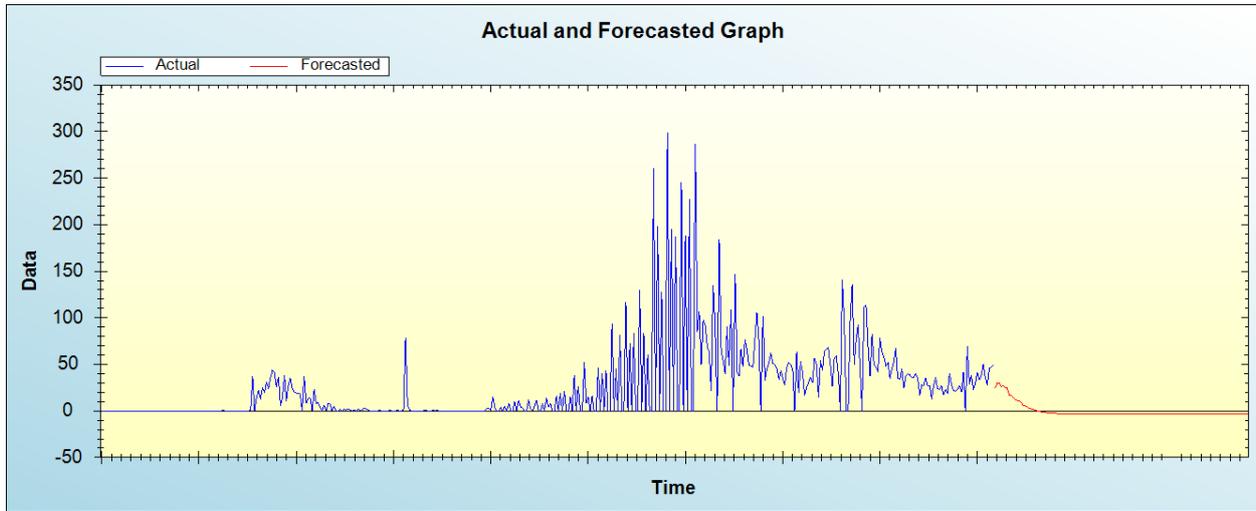*Out-of-Sample Forecast for A: Actual and Forecasted Graph*

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

Out-of-Sample Forecast for A: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecast
26/03/21	24.4013
27/03/21	29.9729
28/03/21	30.0552
29/03/21	26.1215
30/03/21	27.1563
31/03/21	25.1929
01/04/21	24.5597
02/04/21	17.1179
03/04/21	16.6580
04/04/21	15.0262
05/04/21	12.0569
06/04/21	11.3880
07/04/21	10.6540
08/04/21	9.1079
09/04/21	6.2399
10/04/21	5.3827
11/04/21	4.3125
12/04/21	2.9784
13/04/21	2.1649
14/04/21	1.6670
15/04/21	0.9520
16/04/21	0.0669
17/04/21	-0.3997
18/04/21	-0.8806
19/04/21	-1.3430
20/04/21	-1.6745
21/04/21	-1.8853
22/04/21	-2.1357
23/04/21	-2.3837
24/04/21	-2.5472
25/04/21	-2.6992
26/04/21	-2.8388
27/04/21	-2.9445
28/04/21	-3.0161
29/04/21	-3.0898
30/04/21	-3.1558
01/05/21	-3.2050

02/05/21	-3.2483
03/05/21	-3.2874
04/05/21	-3.3176
05/05/21	-3.3395
06/05/21	-3.3602
07/05/21	-3.3778
08/05/21	-3.3917
09/05/21	-3.4035
10/05/21	-3.4142
11/05/21	-3.4225
12/05/21	-3.4289
13/05/21	-3.4346
14/05/21	-3.4394
15/05/21	-3.4432
16/05/21	-3.4464
17/05/21	-3.4493
18/05/21	-3.4516
19/05/21	-3.4534
20/05/21	-3.4550
21/05/21	-3.4563
22/05/21	-3.4573
23/05/21	-3.4582
24/05/21	-3.4590
25/05/21	-3.4596
26/05/21	-3.4601
27/05/21	-3.4605
28/05/21	-3.4609
29/05/21	-3.4612
30/05/21	-3.4614
31/05/21	-3.4616
01/06/21	-3.4618
02/06/21	-3.4619
03/06/21	-3.4620
04/06/21	-3.4621
05/06/21	-3.4622
06/06/21	-3.4623
07/06/21	-3.4623
08/06/21	-3.4624
09/06/21	-3.4624
10/06/21	-3.4624
11/06/21	-3.4625
12/06/21	-3.4625
13/06/21	-3.4625
14/06/21	-3.4625
15/06/21	-3.4625
16/06/21	-3.4626
17/06/21	-3.4626
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30/06/21	-3.4626
01/07/21	-3.4626
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24/07/21	-3.4626
25/07/21	-3.4626
26/07/21	-3.4626
27/07/21	-3.4626
28/07/21	-3.4626
29/07/21	-3.4626
30/07/21	-3.4626
31/07/21	-3.4626

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 Andorra are likely to decline to zero around mid April 2021.

IV. CONCLUSION AND POLICY RECOMMENDATIONS

The untimely emergency of COVID-19 has spread all over the world and Andorra has not been spared. In this piece of work, we applied a basic ANN (12, 12, 1) univariate forecasting model. The results of the model indicate that daily COVID-19 cases in Andorra are likely to decline to zero around mid April 2021. The preventive and control strategies that have been in Andorra seem to have been effective and apparently resulted in avoiding a possibility of thousands of infections and deaths. However, there is still need for health authorities in the country to tighten-up preventive and control measures, especially travel restrictions, wearing of masks, social distancing and so on in order to completely win the war against this pandemic. Our study also serves as an empirical confirmation that the COVID-19 pandemic in Andorra is now under reasonable control.

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