

PREDICTION OF COVID-19 CASES IN ARGENTINA USING ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

Due to the rapid spread of COVID-19 around the globe, governments continue to be compelled to swiftly find solutions to reduce infection rates and keep mortality as low as possible. In the current study, the ANN approach was applied to analyze daily COVID-19 cases in Argentina. The employed data covers the period March 3, 2020 – October 31, 2020 and the out-of-sample period ranges over the period November 2020 to April 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model show us that the model is stable and thus adequate. The forecasts suggest that COVID-19 cases will most likely range between 10000 and 16000 per day in Argentina, over the period November 2020 to April 2021. The Argentine government should ensure the continued compliance to control and preventive COVID-19 measures such as social distancing, quarantine, isolation, face-mask wearing and so on, in line with WHO stipulated guidelines.

Keywords: - ANN, COVID-19, Forecasting

INTRODUCTION

The first case of coronavirus disease (COVID-19) was discovered in November in China, in a person living in Wuhan, the capital city of the country's Hubei province (Bolano-Ortiz *et al.*, 2020; Wu *et al.*, 2020). Despite the fact that the origin of the virus is still questionable (Konarasinghe, 2020), early stages of COVID-19 have been linked to a live animal seafood market in Wuhan; pointing to a zoonotic origin of the pandemic (Chowell *et al.*, 2020). COVID-19 produces mild symptoms in most people (fever, cough, sore throat, and difficulty breathing) but can lead to severe respiratory illness and death (Dantas *et al.*, 2020). The disease is highly contagious, and it is contracted through respiratory droplets originating from an infected person (CDC, 2020). In Argentina, the first case was confirmed on March 3, 2020 by the Ministry of Health (MINSAs, 2020), and the Argentine national government established a full lockdown on March 20, 2020 (BOEAR, 2020). Forecasting daily confirmed COVID-19 cases is an important activity that will go a long way in assisting policy makers in anticipating the requirement of healthcare resources and to save human lives (Konarasinghe, 2020). Indeed, the forecasting of confirmed cases is a critical issue that helps in understanding the fast spread of COVID-19 (Alqaness *et al.*, 2020). The main of this paper is to forecast daily COVID-19 cases in Argentina.

METHODOLOGY

This paper applies the multi-layer perceptron neural network type of the ANN approach in order to predict daily new COVID-19 infections in Argentina. This study particularly applies the ANN (12, 12, 1) model and chooses the more efficient hyperbolic tangent function as the activation function. The research is based on daily new Covid19 cases (referred to as AG series in this study) for all age groups in Argentina. The data covers the period 3 March 2020 to 31 October 2020 while the out-of-sample forecast covers the period November 2020 to April 2021. All the data employed in this paper was gathered from the COVID-19 data repository prepared by the CSSE at JH University.

FINDINGS OF THE STUDY

DESCRIPTIVE STATISTICS

Table 1: Descriptive statistics

Mean	Median	Minimum	Maximum
4802.2	2648.0	0.00000	18326.
Std. Dev.	C.V.	Skewness	Ex. kurtosis
5132.8	1.0688	0.77312	-0.73080
5% Perc.	95% Perc.	IQ range	Missing obs.
3.2000	14628.	8884.0	0

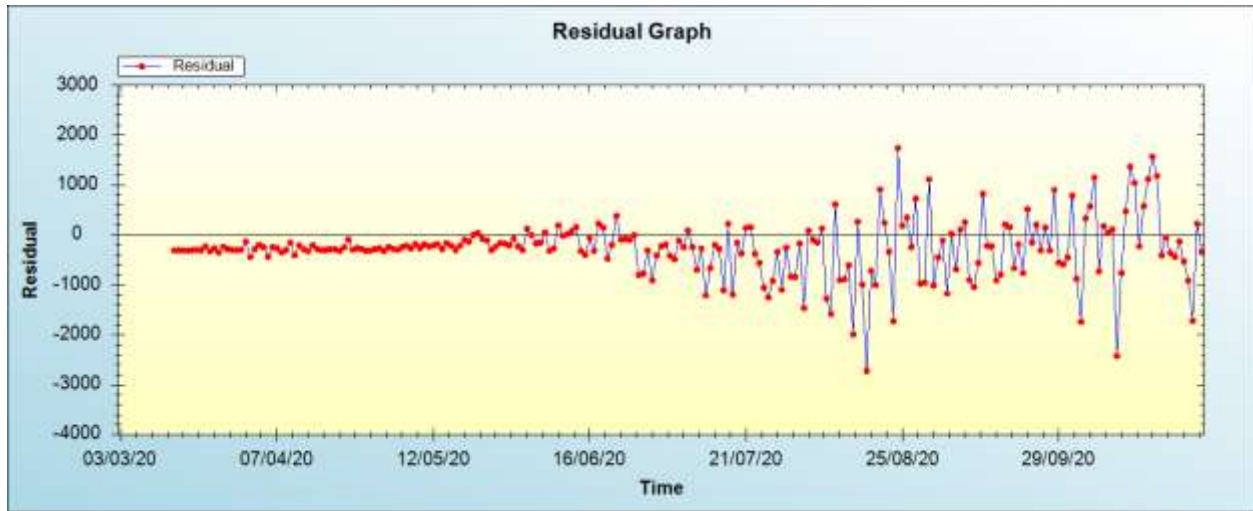
ANN MODEL SUMMARY FOR COVID-19 DAILY CASES IN ARGENTINA

Table 2: ANN model summary

Variable	AG
Observations	231(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	0.062336
MSE	402783.196973
MAE	460.988913

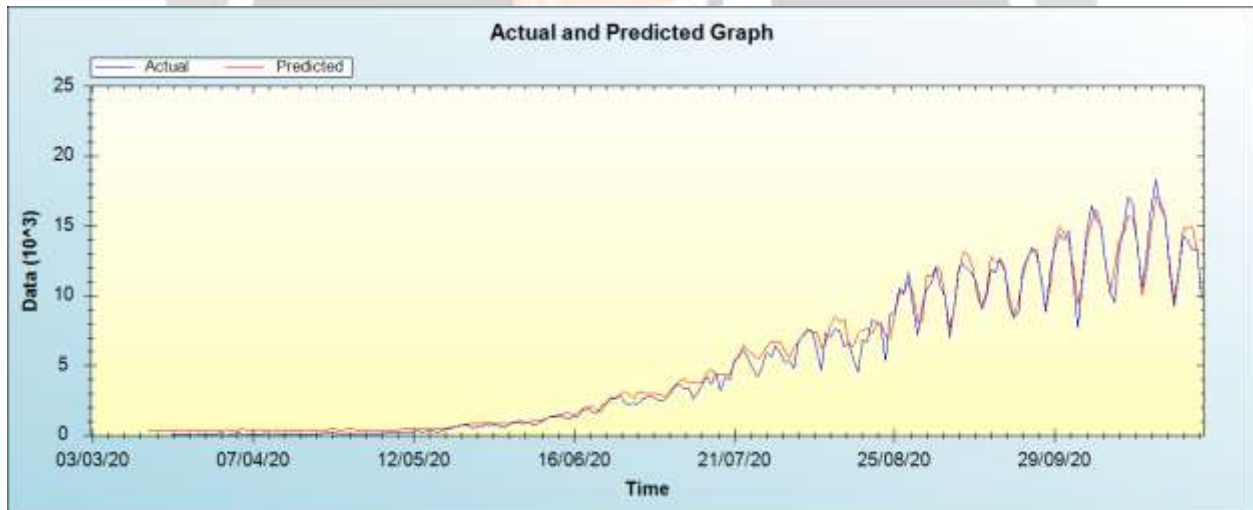
Residual Analysis for the ANN model

Figure 1: Residual analysis



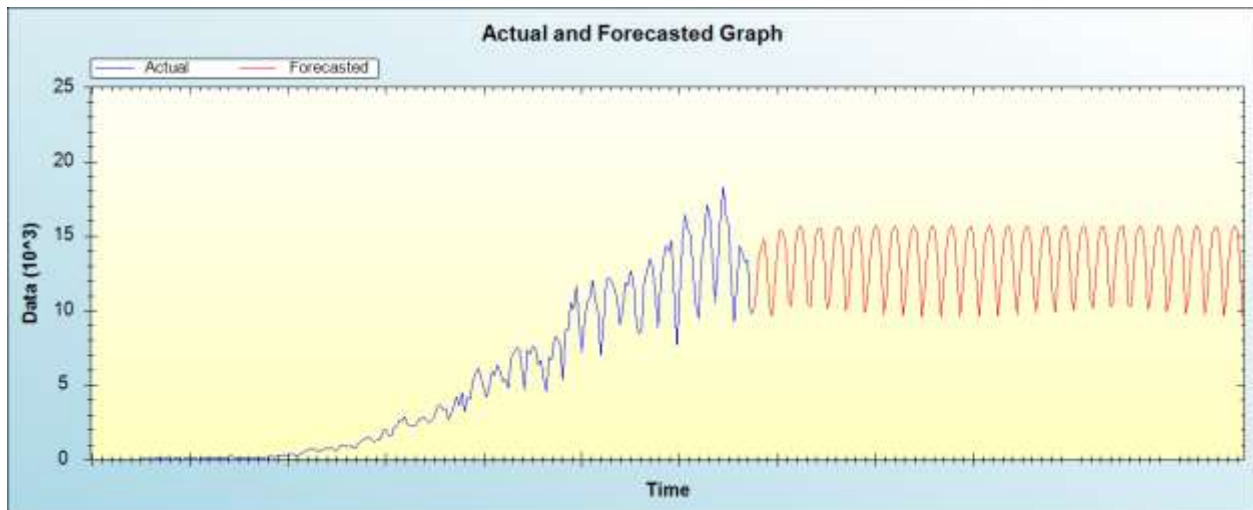
In-sample Forecast for AG

Figure 2: In-sample forecast for the AG series



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

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



Out-of-Sample Forecast for AG: Forecasts only

Table 3: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
01/11/20	9902.2269
02/11/20	10986.9344
03/11/20	13491.7032
04/11/20	14229.6123
05/11/20	14834.6703
06/11/20	13388.2626
07/11/20	10203.4163
08/11/20	9632.7568
09/11/20	12084.5203
10/11/20	14330.4848
11/11/20	15450.5380
12/11/20	15276.3280
13/11/20	14430.7390
14/11/20	10791.5811

15/11/20	10241.9244
16/11/20	12748.0053
17/11/20	15143.9854
18/11/20	15633.3058
19/11/20	15598.4905
20/11/20	14252.8155
21/11/20	10456.9298
22/11/20	10275.8654
23/11/20	12799.2984
24/11/20	15022.2912
25/11/20	15520.5925
26/11/20	15528.7169
27/11/20	14051.0435
28/11/20	10135.3356
29/11/20	10451.3957
30/11/20	12972.6428
01/12/20	15109.1458
02/12/20	15599.6107
03/12/20	15547.2976
04/12/20	13936.1315
05/12/20	9994.1837
06/12/20	10591.5311
07/12/20	13230.5952
08/12/20	15201.6846
09/12/20	15670.7219
10/12/20	15523.2389

11/12/20	13778.8198
12/12/20	9850.4112
13/12/20	10740.6132
14/12/20	13450.2206
15/12/20	15259.0751
16/12/20	15679.1704
17/12/20	15485.8172
18/12/20	13563.1634
19/12/20	9733.6063
20/12/20	10873.9825
21/12/20	13648.3364
22/12/20	15296.3724
23/12/20	15686.6958
24/12/20	15427.9773
25/12/20	13328.0516
26/12/20	9645.6190
27/12/20	11004.3657
28/12/20	13832.9647
29/12/20	15336.0094
30/12/20	15689.6030
31/12/20	15365.3827
01/01/21	13082.6978
02/01/21	9593.8189
03/01/21	11136.5019
04/01/21	14006.7484
05/01/21	15372.1158

06/01/21	15691.6164
07/01/21	15295.9039
08/01/21	12823.6735
09/01/21	9569.5333
10/01/21	11267.4645
11/01/21	14163.2807
12/01/21	15403.7754
13/01/21	15691.2628
14/01/21	15220.5532
15/01/21	12556.3534
16/01/21	9573.5905
17/01/21	11400.9256
18/01/21	14304.7273
19/01/21	15434.4157
20/01/21	15691.0484
21/01/21	15140.3078
22/01/21	12284.6268
23/01/21	9602.2892
24/01/21	11538.3492
25/01/21	14432.2541
26/01/21	15464.4782
27/01/21	15690.4352
28/01/21	15055.3758
29/01/21	12011.7640
30/01/21	9653.3414
31/01/21	11681.3914

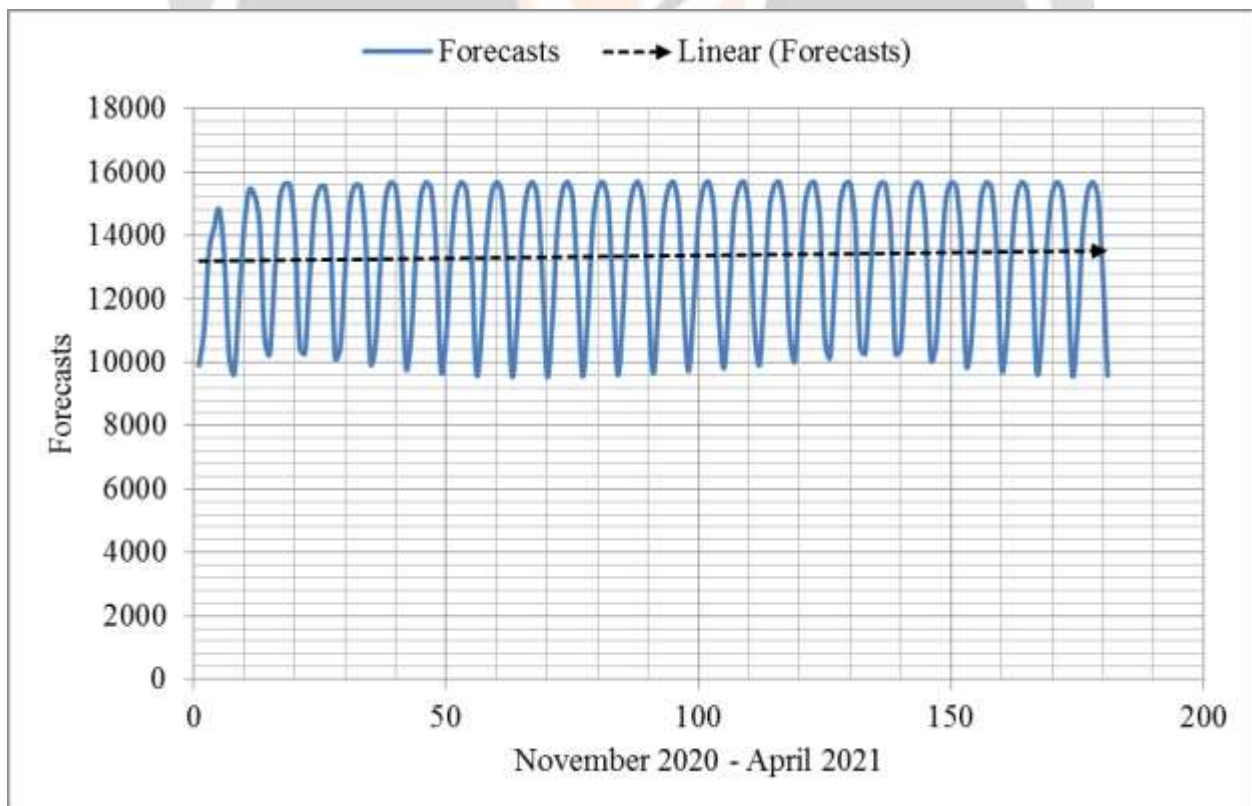
01/02/21	14547.4241
02/02/21	15494.0829
03/02/21	15689.2555
04/02/21	14965.1509
05/02/21	11740.0941
06/02/21	9723.7331
07/02/21	11831.3443
08/02/21	14651.6121
09/02/21	15523.0112
10/02/21	15686.7079
11/02/21	14868.7664
12/02/21	11472.0507
13/02/21	9810.8490
14/02/21	11989.6397
15/02/21	14746.4627
16/02/21	15550.9937
17/02/21	15681.9924
18/02/21	14764.9152
19/02/21	11209.8660
20/02/21	9912.0027
21/02/21	12157.4132
22/02/21	14833.3787
23/02/21	15577.4867
24/02/21	15674.1365
25/02/21	14651.9345
26/02/21	10955.8624

27/02/21	10024.6459
28/02/21	12335.4436
01/03/21	14913.5377
02/03/21	15601.9397
03/03/21	15662.1797
04/03/21	14527.8873
05/03/21	10712.7082
06/03/21	10146.2600
07/03/21	12523.8815
08/03/21	14987.7982
09/03/21	15623.8603
10/03/21	15645.1800
11/03/21	14390.6954
12/03/21	10483.6311
13/03/21	10274.3984
14/03/21	12721.9223
15/03/21	15056.6526
16/03/21	15642.8518
17/03/21	15622.2555
18/03/21	14238.2778
19/03/21	10272.4491
20/03/21	10406.6845
21/03/21	12927.4851
22/03/21	15120.2008
23/03/21	15658.6310
24/03/21	15592.6062

25/03/21	14068.7869
26/03/21	10083.3862
27/03/21	10540.9169
28/03/21	13137.0931
29/03/21	15178.2455
30/03/21	15671.0499
31/03/21	15555.5819
01/04/21	13880.9165
02/04/21	9920.5905
03/04/21	10675.2576
04/04/21	13346.1212
05/04/21	15230.5061
06/04/21	15680.1269
07/04/21	15510.7822
08/04/21	13674.2453
09/04/21	9787.4507
10/04/21	10808.4834
11/04/21	13549.4858
12/04/21	15276.9230
13/04/21	15686.1003
14/04/21	15458.1707
15/04/21	13449.5075
16/04/21	9685.9714
17/04/21	10940.1843
18/04/21	13742.5947
19/04/21	15317.9167

20/04/21	15689.4680
21/04/21	15398.1313
22/04/21	13208.6581
23/04/21	9616.5090
24/04/21	11070.7959
25/04/21	13922.1637
26/04/21	15354.4413
27/04/21	15690.9469
28/04/21	15331.3946
29/04/21	12954.6496
30/04/21	9577.9712

Figure 4: Graphical presentation of out-of-sample forecasts



The descriptive statistics, summary of the applied basic ANN model, residual analysis, in-sample forecasts as well as out-of-sample forecasts are presented in table 1, table 2, figure 1, figure 2 and well as figures 3 and 4 and table 3, respectively. The employed forecasting model is stable and acceptable as shown in the residual analysis. The forecasts show that COVID-19 cases will

most likely range between 10000 and 16000 per day in Argentina, over the period November 2020 to April 2021.

CONCLUSION & RECOMMENDATIONS

The outbreak of COVID-19 has adversely affected many countries around the world, including Argentina. Based on 243 daily observations of COVID-19 cases in Argentina, this research used the ANN (12, 12, 1) model to come up with forecasts ranging over the period November 2020 to April 2021. The results of the study suggest that daily COVID-19 cases will, generally; be at least 1000 cases per day, characterized by a maximum of 16000 cases per day; over the period November 2020 – April 2021. The Argentine government should ensure the continued compliance to control and preventive COVID-19 measures such as social distancing, quarantine, isolation, face-mask wearing and so on, as outlined by the WHO. This will help a lot in managing the pandemic in the country.

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