

# PREDICTION OF DAILY NEW COVID-19 CASES IN BANGLADESH USING ARTIFICIAL NEURAL NETWORKS

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## ABSTRACT

The corona virus disease (COVID-19) was first identified in Bangladesh on March 8, 2020. As of 15 May 2020 there were 20065 confirmed cases inclusive of 3882 recoveries and 298 COVID-19 associated deaths (Mukaddes et al, 2020). The purpose of this piece of work is to forecast COVID-19 infections using daily new cases of the coronavirus in Bangladesh by applying the ANN model. The employed data covers 8March 2020 to 31October 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 indicate that the model is stable in forecasting daily new Covid-19 infections. The results of the study indicate that daily new Corona virus cases in the out of sample period is projected to rise up until around 7 December 2020 where the daily figures will stagnate at around 3800 new infections throughout the rest of the forecast period. However, if an effective coronavirus vaccine is availed early we expect a drop in the daily new cases in the out-of sample period Therefore, the study recommends to the government of Bangladesh to tighten lockdown measures, intensify testing and contact tracing in the community and other control measures.

**Keywords:** - ANN, COVID-19, Forecasting

## INTRODUCTION

COVID-19 is the latest global health problem which has resulted in loss of lives and strained financial ,material and human resources .It is the third zoonotic human virus of the century in the world (Gralinski & Menachery, 2020).In late December 2019,the disease was first identified in Wuhan city, Hubei Province in China and thought to spread an outbreak of a viral pneumonia(WHO,2020).Since the disease was not previously identified in humans ,WHO delayed to declare COVID-19 as a public health Emergency on January 30 ,2020 and later as pandemic on 11March 2020.By 31 May 2020 there were 6.2 million and 0.37 million cases and deaths respectively(WHO, 2020a).As global cases of the virus exceeded 10million with confirmed death toll of greater 509,779(until 30June ,2020),scientists emphasize the critical need to escalate testing ,isolation, contact tracing, and to build awareness among communities in order to respond to the pandemic (Morales et al, 2020;Wang & Wang 2020; Velavan & Meyer, 2020). This study seeks to forecast the number of new COVID-19 infections using daily time series data with a view to inform public health policy so that effective and appropriate preventive and control measures are instituted by the government of Bangladesh in order to save lives.

**LITERATURE REVIEW**

Table 1: Literature Review

AUTHOR(S) (year)	STUDY PERIOD	METHOD	MAJOR FINDINGS
Fargana et al. 2020	8March to April 2020	Modified SIR Model	For the total population (100%), the model the peaks at 214875 infected cases and 7743(death cases). lock down and individual hygiene can slow down the outbreak but unable to eradicate the disease in the society
Hridoy et al,2020	8March 2020 to 13 June 2020	Logistic curve, Long Short term (LSTM) network,	The total number of confirmed cases will continue to grow exponentially. Thus, strict lockdown and maintaining social distancing is necessary to reduce COVID-19 transmission
Shimul et al. 2020	March to June 2020	SIR model, Gompertz method, Facebook Prophet, Quadratic Modeling	The prevalence of COVID-19 may be between 200,000 and 600,000 towards end of year and it may take 9months (270days) to flatten the epidemic curve.
Rahman et al ,2020	8March to 8August 2020	GIS, Analytical hierarchy process based weighted sum Method.	The covid-19 pandemic is still in exposure level with disease transmission rate of 20,37%, doubling time of cases is 11days, fatality rate 1.3%, recovery rate

			57.50 %. The disease propagates from the central parts and Dhaka was the most exposed district followed by Chattogram, Narayanganj, Cumilla and Bogra, the central, eastern and south eastern parts were recognized as highly vulnerable zones.
Hoque et al ,2020	March to July 2020	SIRD model	Herd immunity threshold can be reduced to 31% than that of 60% by considering age group cluster analysis resulting in a total of 53.0 million susceptible populations.
Mukaddes et al,2020	8March 2020 to May 15, 2020	SEIRD model	Lower transmission rates of 0.045, recovery rate of 0.03, death rate 0.01, cumulative number of active (infected) cases follows an exponential trend. Reproduction number is 2.85, Transmission trends indicate COVID-19 outbreak.

## METHOD

This paper applies the multi-layer perceptron neural network type of the ANN approach in order to predict daily new COVID-19 infections in Bangladesh. This research specifically applies the ANN (12, 12, 1) model and chooses the more efficient hyperbolic tangent function as the activation function.

## Data Issues

This study is based on daily new Covid-19 cases (referred to as V series in this study) for all age groups in Bangladesh. The data covers the period 8 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 2: Descriptive statistics

Mean	Median	Minimum	Maximum
1713.0	1603.0	0.00000	4019.0
Std. Dev.	C.V.	Skewness	Ex. kurtosis
1150.8	0.67182	0.048615	-1.0543
5% Perc.	95% Perc.	IQ range	Missing obs.
2.0000	3531.1	1997.0	0

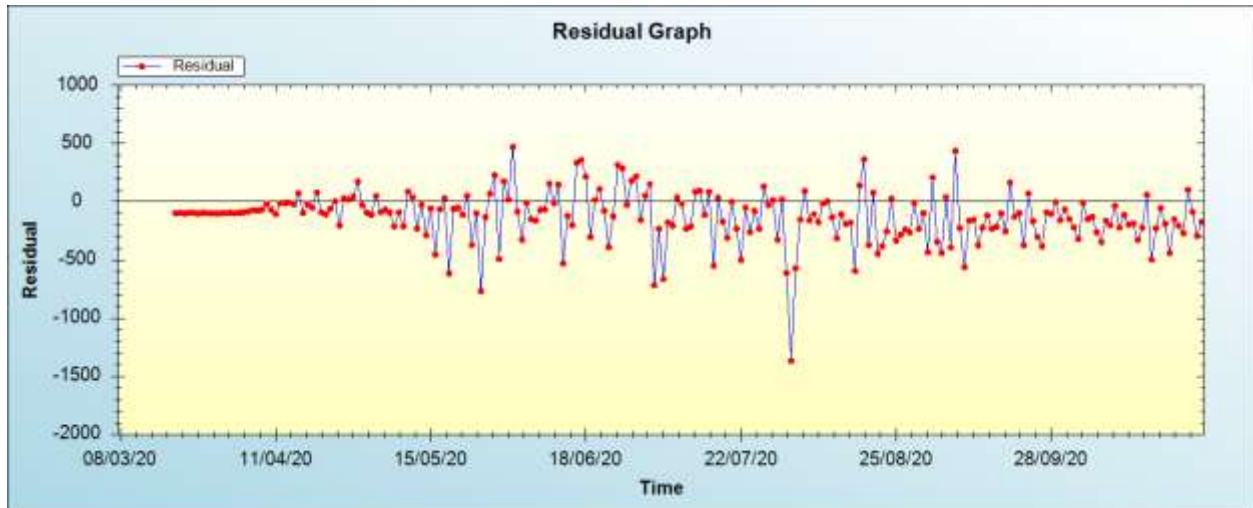
### ANN MODEL SUMMARY FOR COVID-19 DAILY CASES IN BANGLADESH

Table 3: ANN model summary

Variable	V
Observations	226 (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	0.112325
MSE	62899.446949
MAE	184.352004

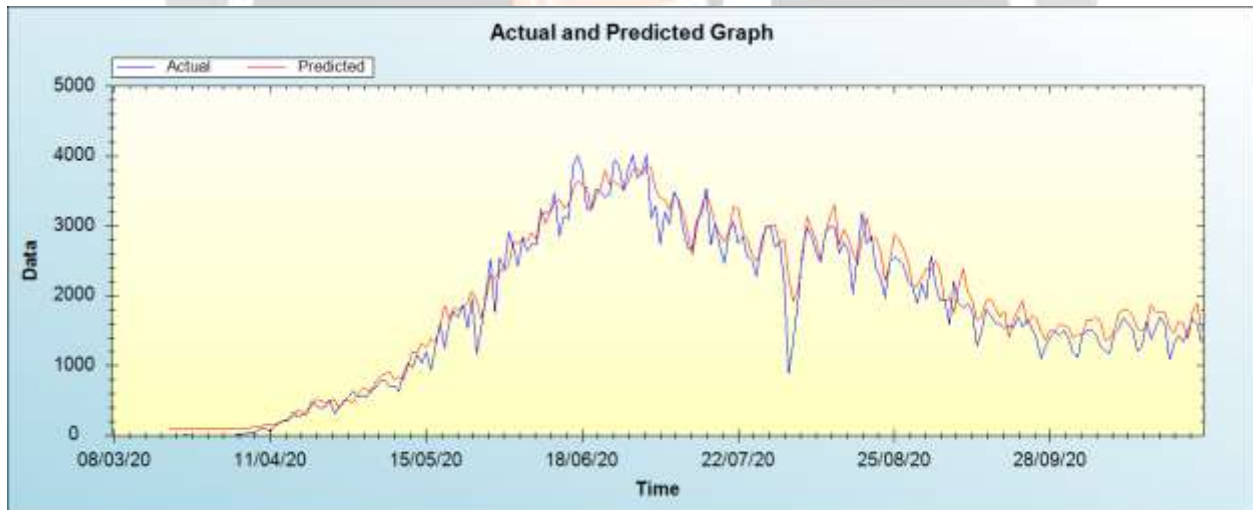
*Residual Analysis for the ANN model*

Figure 2: Residual analysis



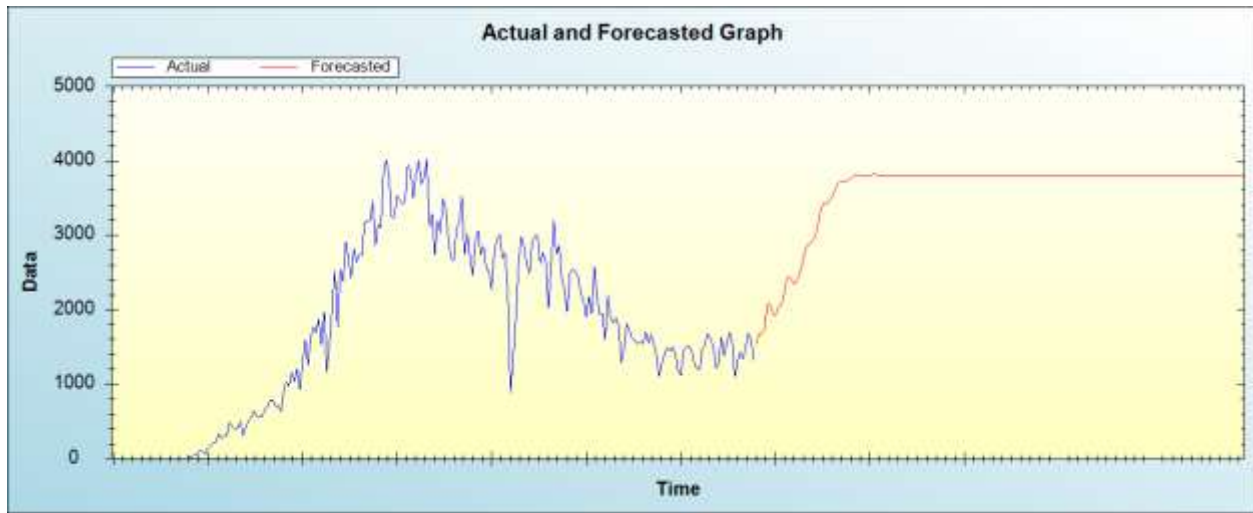
*In-sample Forecast for V*

Figure 3: In-sample forecast for the V series



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

Figure 4: Out-of-sample forecast for V: actual and forecasted graph



*Out-of-Sample Forecast for V: Forecasts only*

Table 4: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
01/11/20	1539.1558
02/11/20	1684.2510
03/11/20	1678.2711
04/11/20	1743.1913
05/11/20	2074.5215
06/11/20	2071.1714
07/11/20	1956.2699
08/11/20	1916.0877
09/11/20	2039.6620
10/11/20	2062.1156
11/11/20	2143.7271
12/11/20	2390.0362

13/11/20	2447.5395
14/11/20	2401.0890
15/11/20	2344.2798
16/11/20	2384.5244
17/11/20	2479.0776
18/11/20	2614.4524
19/11/20	2801.4417
20/11/20	2867.6679
21/11/20	2899.3497
22/11/20	2930.8137
23/11/20	3019.0645
24/11/20	3194.1683
25/11/20	3360.7071
26/11/20	3429.9044
27/11/20	3410.3127
28/11/20	3457.2801
29/11/20	3522.5466
30/11/20	3602.6060
01/12/20	3684.6670
02/12/20	3717.8203
03/12/20	3716.0831
04/12/20	3718.4710
05/12/20	3740.8382
06/12/20	3764.8737
07/12/20	3797.6906
08/12/20	3813.3046

09/12/20	3809.2144
10/12/20	3801.9485
11/12/20	3796.3974
12/12/20	3798.7539
13/12/20	3807.2363
14/12/20	3815.7128
15/12/20	3814.8045
16/12/20	3808.4234
17/12/20	3801.0270
18/12/20	3796.1964
19/12/20	3797.3326
20/12/20	3801.3769
21/12/20	3804.0671
22/12/20	3802.7147
23/12/20	3798.9266
24/12/20	3795.0482
25/12/20	3793.6835
26/12/20	3795.4301
27/12/20	3798.0956
28/12/20	3799.5446
29/12/20	3798.8114
30/12/20	3796.8689
31/12/20	3795.2875
01/01/21	3795.2883
02/01/21	3796.6846
03/01/21	3798.2246



04/01/21	3798.8317
05/01/21	3798.2411
06/01/21	3797.1602
07/01/21	3796.4932
08/01/21	3796.7229
09/01/21	3797.5601
10/01/21	3798.2975
11/01/21	3798.4245
12/01/21	3797.9518
13/01/21	3797.3419
14/01/21	3797.0673
15/01/21	3797.2847
16/01/21	3797.7496
17/01/21	3798.0715
18/01/21	3798.0322
19/01/21	3797.7153
20/01/21	3797.3997
21/01/21	3797.3151
22/01/21	3797.4861
23/01/21	3797.7403
24/01/21	3797.8724
25/01/21	3797.8024
26/01/21	3797.6139
27/01/21	3797.4657
28/01/21	3797.4607
29/01/21	3797.5797

30/01/21	3797.7131
31/01/21	3797.7593
01/02/21	3797.6982
02/02/21	3797.5928
03/02/21	3797.5291
04/02/21	3797.5480
05/02/21	3797.6223
06/02/21	3797.6878
07/02/21	3797.6973
08/02/21	3797.6530
09/02/21	3797.5968
10/02/21	3797.5726
11/02/21	3797.5933
12/02/21	3797.6363
13/02/21	3797.6659
14/02/21	3797.6623
15/02/21	3797.6336
16/02/21	3797.6052
17/02/21	3797.5983
18/02/21	3797.6145
19/02/21	3797.6380
20/02/21	3797.6500
21/02/21	3797.6435
22/02/21	3797.6263
23/02/21	3797.6129
24/02/21	3797.6127

25/02/21	3797.6237
26/02/21	3797.6359
27/02/21	3797.6399
28/02/21	3797.6342
01/03/21	3797.6245
02/03/21	3797.6187
03/03/21	3797.6205
04/03/21	3797.6274
05/03/21	3797.6333
06/03/21	3797.6341
07/03/21	3797.6299
08/03/21	3797.6248
09/03/21	3797.6226
10/03/21	3797.6246
11/03/21	3797.6285
12/03/21	3797.6312
13/03/21	3797.6308
14/03/21	3797.6281
15/03/21	3797.6256
16/03/21	3797.6250
17/03/21	3797.6265
18/03/21	3797.6286
19/03/21	3797.6297
20/03/21	3797.6291
21/03/21	3797.6275
22/03/21	3797.6263

23/03/21	3797.6263
24/03/21	3797.6273
25/03/21	3797.6284
26/03/21	3797.6288
27/03/21	3797.6282
28/03/21	3797.6274
29/03/21	3797.6268
30/03/21	3797.6270
31/03/21	3797.6276
01/04/21	3797.6282
02/04/21	3797.6282
03/04/21	3797.6279
04/04/21	3797.6274
05/04/21	3797.6272
06/04/21	3797.6274
07/04/21	3797.6277
08/04/21	3797.6280
09/04/21	3797.6279
10/04/21	3797.6277
11/04/21	3797.6275
12/04/21	3797.6274
13/04/21	3797.6276
14/04/21	3797.6278
15/04/21	3797.6278
16/04/21	3797.6278
17/04/21	3797.6276

18/04/21	3797.6275
19/04/21	3797.6275
20/04/21	3797.6276
21/04/21	3797.6277
22/04/21	3797.6278
23/04/21	3797.6277
24/04/21	3797.6276
25/04/21	3797.6276
26/04/21	3797.6276
27/04/21	3797.6277
28/04/21	3797.6277
29/04/21	3797.6277
30/04/21	3797.6277

Figure 1, shows that the average number of daily new covid-19 infections is 1713, the minimum is 0 and the maximum daily corona virus infection is 4019 cases. Figure 3 shows that the applied model simulates observed data very well. The residual graph and model evaluation criteria show that the ANN model is stable and suitable for forecasting daily new corona virus cases. The out of sample forecast graph shows that daily new coronavirus infections will increase until around 7 December 2020 where daily new cases are expected to stagnate around 3800 per day until end of April 2021 (flattening of the curve as shown in the out of sample forecast graph). These results are consistent with previous studies such as Shimul et al. (2020).

## CONCLUSION & RECOMMENDATIONS

Corona virus is a global health challenge and Bangladesh is not an exception. Results of the study show that the expected number of daily new covid-19 infections around 7 December 2020 will stagnate at around 3800 cases per day. This means that the government of Bangladesh needs to step up its lockdown and other preventive measures to try and bring down the number of new Covid-19 infections. The results also revealed that even if these control measures are in place it will not be possible to eradicate the disease unless an effective vaccine is made available.

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