Forecasting Covid-19 New Cases in Poland

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Abstract - **COVID-19 has caused serious devastations to human populations across the world and Poland, just like any other country; has been affected too. In this article, the ANN model was applied to forecast COVID-19 cases in Poland. This study is based on daily new cases of COVID-19 in Poland 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 COVID-19 cases in the country. It is projected that daily COVID-19 cases in Poland are likely to remain very high over the out-of-sample period. We encourage the government of Poland to continue applying all World Health Organization (WHO) recommended control and preventive measures such as social distancing, sanitizing hands, washing of hands, face-mask wearing as well as vaccinations.**

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

Coronaviruses are a group of viruses that cause infection ranging from a usual cold to Severe Acute Respiratory Syndrome (SARS). The current coronavirus disease (COVID-19) was first reported in Wuhan, China, on 31 December 2019. Its common symptoms are cold, fever, breathings problems and shortness of breath. In more critical cases, pneumonia, kidney failure, severe acute respiratory syndrome and even loss of life have also been reported (WHO, 2020). The virus may spread from bats to humans through another intermediate host and cause severe respiratory syndrome (Li et al., 2020), characterized by strong human-to-human transmission trough the air (Guan et al., 2020). What makes COVID-19 so strange and frightening is the intensity of the virus and yet unknown mechanism (Kavadi et al., 2020). The infectivity of COVID-19 is far much greater than of influenza, with an estimated basic reproduction number of 2.28 (Zhang et al., 2020). The number of infections worldwide is still increasing (Wang et al., 2020). Studies on forecasting COVID-19 daily cases in Poland are very important for strategizing in the fight against the pandemic and yet the government has not yet presented any official COVID-19 predictive model in the country. This paper will contribute differently to the existing body of literature in the sense that we employ the Artificial Neural Networks (ANN) model, a deep learning technique suitable for forecasting complex data sets such as COVID-19 data sets. Our results are envisioned to compliment government efforts in the fight against COVID-19 in Poland.

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 Poland.

Data Issues

This study is based on daily new cases of COVID-19 in Poland 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	P
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	0.069080
MSE	1717672.468151
MAE	842.549316

Residual Analysis for the Applied Model
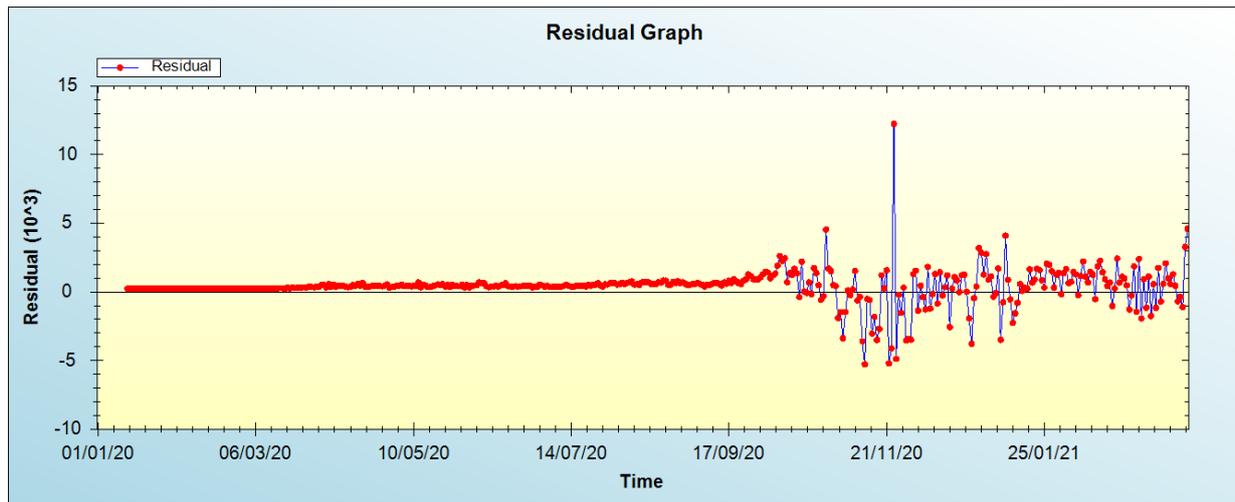
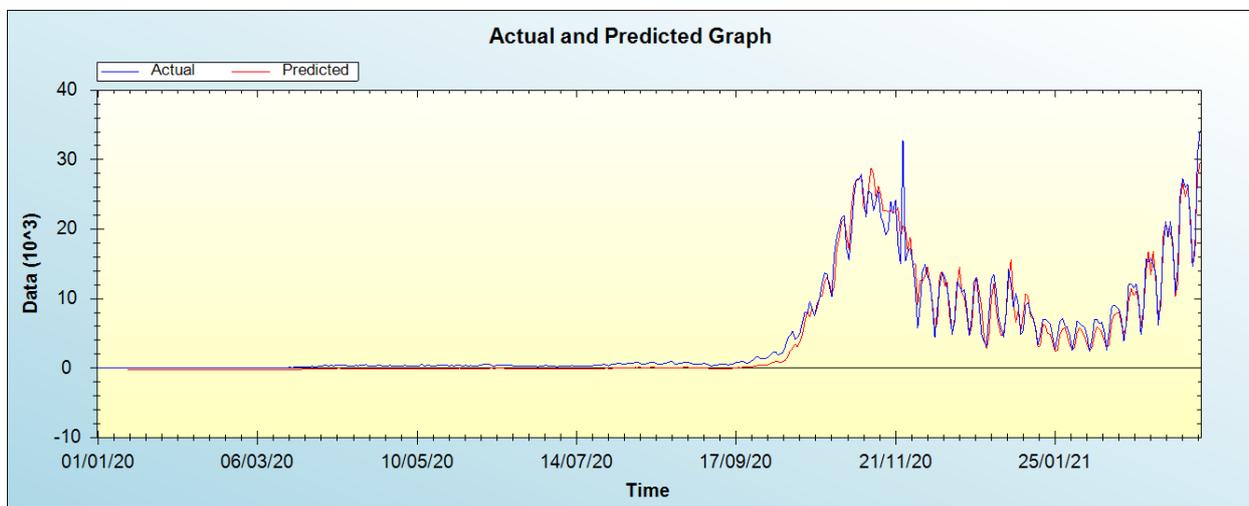**Figure 1: Residual analysis**

In-sample Forecast for P

Figure 2: In-sample forecast for the P series

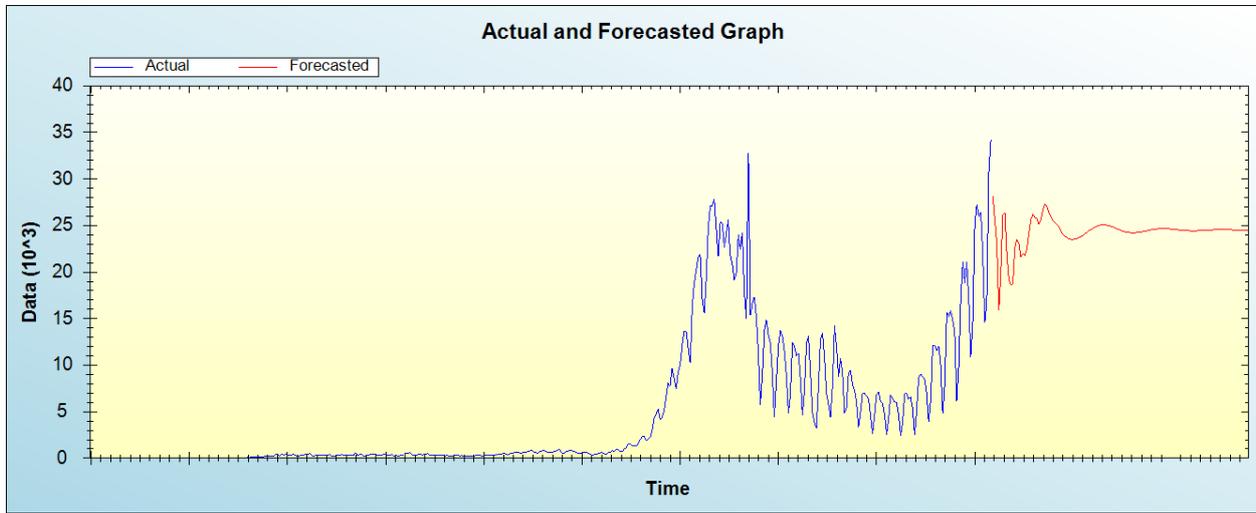*Out-of-Sample Forecast for P: Actual and Forecasted Graph*

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

Out-of-Sample Forecast for P: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	28096.1488
27/03/21	25620.8246
28/03/21	23019.0646
29/03/21	15906.0295
30/03/21	19939.4166
31/03/21	26152.5644
01/04/21	26343.4475
02/04/21	21920.8506
03/04/21	19286.8375
04/04/21	18602.8840
05/04/21	18727.9307
06/04/21	22632.1069
07/04/21	23521.0168
08/04/21	23076.1739
09/04/21	21593.0842
10/04/21	21986.3173
11/04/21	21755.3273
12/04/21	22468.3469
13/04/21	24115.1534
14/04/21	25662.3821
15/04/21	26199.3692
16/04/21	25854.5725
17/04/21	25705.1692
18/04/21	25148.7017
19/04/21	25617.4945
20/04/21	26659.2120
21/04/21	27324.9783
22/04/21	27020.3684
23/04/21	26416.1515
24/04/21	25930.4564
25/04/21	25527.2490
26/04/21	25285.6683
27/04/21	25084.0400
28/04/21	24854.4436
29/04/21	24400.4131

30/04/21	24049.2160
01/05/21	23875.6407
02/05/21	23722.3431
03/05/21	23588.3895
04/05/21	23516.4009
05/05/21	23516.8185
06/05/21	23561.5319
07/05/21	23615.9316
08/05/21	23700.4583
09/05/21	23813.2129
10/05/21	23923.0797
11/05/21	24093.8494
12/05/21	24281.6302
13/05/21	24429.8230
14/05/21	24573.2026
15/05/21	24708.6178
16/05/21	24829.4099
17/05/21	24930.7505
18/05/21	25002.2608
19/05/21	25055.3674
20/05/21	25077.7165
21/05/21	25063.7411
22/05/21	25036.0366
23/05/21	24981.3674
24/05/21	24903.4945
25/05/21	24823.3550
26/05/21	24734.0487
27/05/21	24641.4896
28/05/21	24550.7243
29/05/21	24462.5774
30/05/21	24389.1354
31/05/21	24326.2810
01/06/21	24275.0316
02/06/21	24243.0913
03/06/21	24221.8927
04/06/21	24214.3888
05/06/21	24223.1449
06/06/21	24240.6127
07/06/21	24269.3417
08/06/21	24306.2612
09/06/21	24347.7079
10/06/21	24395.0646
11/06/21	24442.0491
12/06/21	24488.0529
13/06/21	24533.1445
14/06/21	24571.9101
15/06/21	24605.8309
16/06/21	24633.5999
17/06/21	24652.3689
18/06/21	24664.3968
19/06/21	24668.2034
20/06/21	24664.2240
21/06/21	24654.5610
22/06/21	24638.2189
23/06/21	24617.7299
24/06/21	24594.5031
25/06/21	24568.4467
26/06/21	24542.5047
27/06/21	24517.1059
28/06/21	24492.9346
29/06/21	24472.0730
30/06/21	24454.1129
01/07/21	24440.0130
02/07/21	24430.4132

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03/07/21	24424.4945
04/07/21	24423.0346
05/07/21	24425.4469
06/07/21	24430.9247
07/07/21	24439.7217
08/07/21	24450.6003
09/07/21	24463.0308
10/07/21	24476.7213
11/07/21	24490.4216
12/07/21	24503.9344
13/07/21	24516.6525
14/07/21	24527.7745
15/07/21	24537.3708
16/07/21	24544.8495
17/07/21	24550.0279
18/07/21	24553.1351
19/07/21	24553.8595
20/07/21	24552.5412
21/07/21	24549.4561
22/07/21	24544.6498
23/07/21	24538.7196
24/07/21	24531.9010
25/07/21	24524.5017
26/07/21	24517.0847
27/07/21	24509.7925
28/07/21	24503.0088
29/07/21	24497.0635
30/07/21	24491.9936
31/07/21	24488.0861

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 Poland are likely to remain very high over the out-of-sample period.

IV. CONCLUSION & RECOMMENDATIONS

Predicting the trend of COVID-19 is an extremely vital challenge. The paper employed an ANN technique based on the hyperbolic tangent function as the activation function. It is projected that daily COVID-19 cases in Poland are likely to remain very high over the out-of-sample period. We encourage the government of Poland to continue applying all World Health Organization (WHO) recommended control and preventive measures such as social distancing, sanitizing hands, washing of hands, face-mask wearing as well as vaccinations.

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