

# Forecasting Covid-19 New Cases in Uruguay

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**Abstract -** The outbreak of COVID-19 is a public health emergency of international concern. Governments, researchers and healthcare professionals of various disciplines are addressing the problem of controlling the spread of the virus while reducing the negative effect on the economy and society. In this research article, the ANN approach was applied to analyze COVID-19 cases in Uruguay. This study is based on daily new cases of COVID-19 in Uruguay 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 basic ANN model indicate that the model is stable. Our results show that daily COVID-19 cases will remain significantly high in the out-of-sample period. We encourage the government of Uruguay to continue enforcing control and preventive measures suggested by WHO, for example, face-mask wearing, social distancing, isolations, and quarantine as well as vaccinations.

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

## I. INTRODUCTION

COVID-19, known to have originated from Wuhan city in Hubei Province in China, is caused by a novel coronavirus, widely recognized as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Ng *et al.*, 2020). Being declared by WHO as a pandemic, the novel coronavirus is now a major emergency worldwide (Haghanifar *et al.*, 2020). The virus is transmitted from one person to another by respiratory droplets or close contact with a contaminated surface (WHO, 2020). The most common symptoms are fever, cough, and dyspnea, which may appear 2 – 14 days after exposure to virus (Kanne *et al.*, 2020). Optimal decision making in the context of COVID-19 pandemic is a complex process (Alamo *et al.*, 2020) that requires the use of reliable predictive models such as Artificial Neural Network (ANN) models. In fact, in a state of pandemic, the ability to accurately forecast caseload is extremely important to help inform policy makers on how to allocate limited healthcare resources, rapidly control the outbreak and ensure the safety of the general public (Kapoor *et al.*, 2020; Li *et al.*, 2020). For decision makers in Uruguay, one of the biggest challenges posed by the virus is how the pandemic will behave in the coming months. This study seeks to model and forecast COVID-19 cases in Uruguay using a basic ANN model.

## 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 Uruguay.

### Data Issues

This study is based on daily new cases of COVID-19 in Uruguay 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	U
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	0.061047
MSE	8472.422809
MAE	42.736399

*Residual Analysis for the Applied Model*

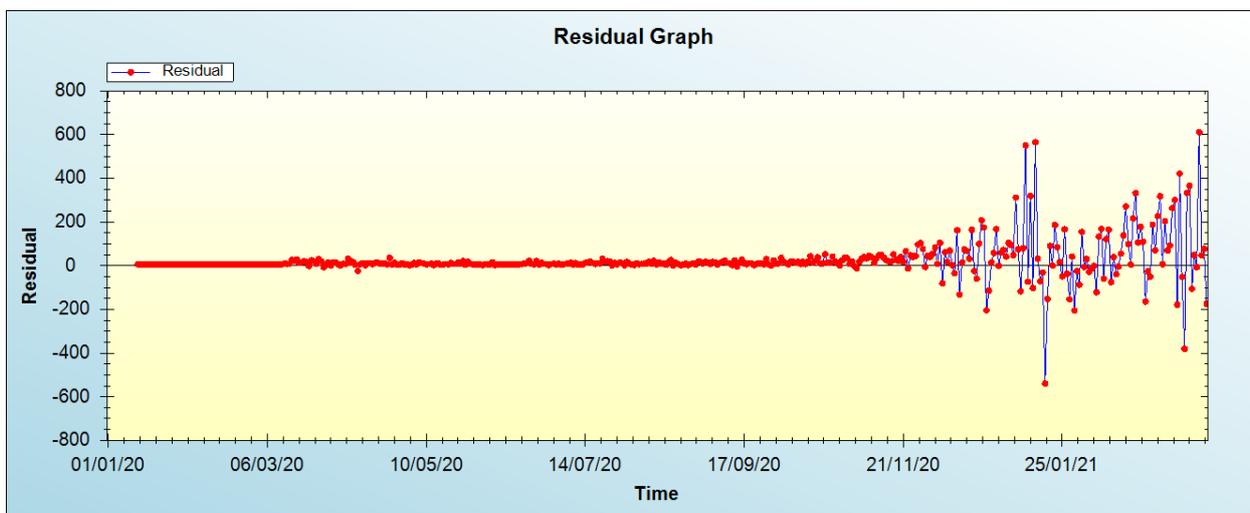


Figure 1: Residual analysis

*In-sample Forecast for U*

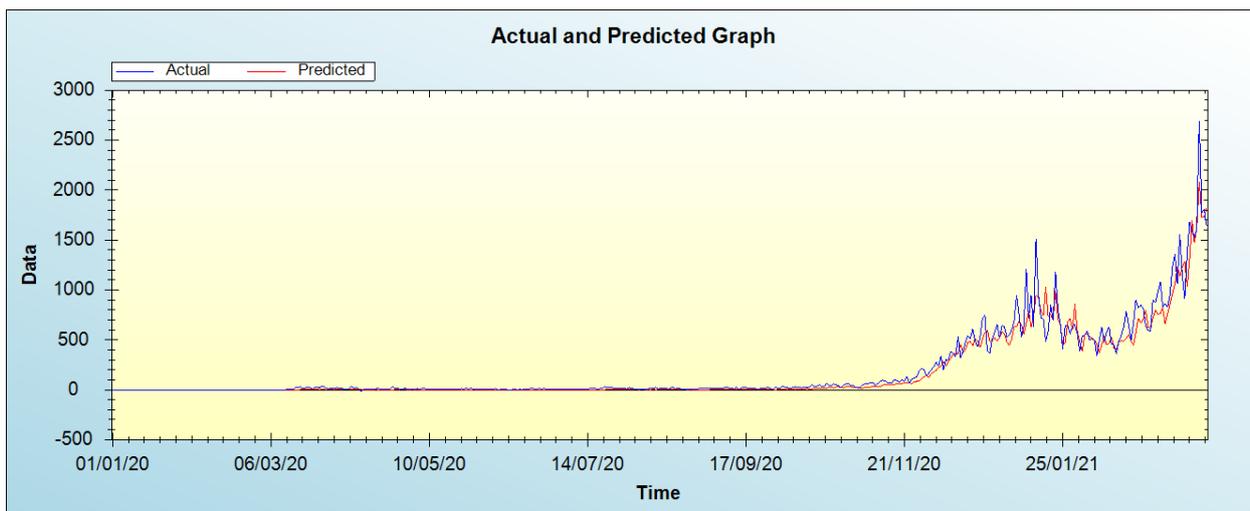


Figure 2: In-sample forecast for the U series

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

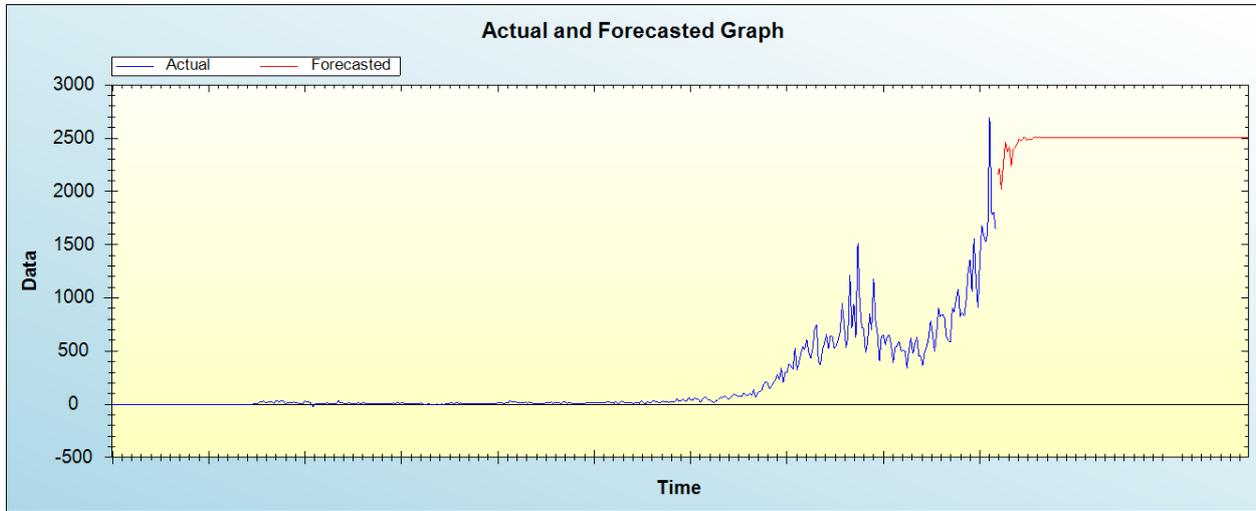


Figure 3: Out-of-sample forecast for U: actual and forecasted graph

Out-of-Sample Forecast for U: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
26/03/21	2158.2498
27/03/21	2217.4690
28/03/21	2020.4331
29/03/21	2259.3545
30/03/21	2462.0795
31/03/21	2367.9725
01/04/21	2419.4250
02/04/21	2236.5139
03/04/21	2395.4459
04/04/21	2417.2314
05/04/21	2445.7267
06/04/21	2494.0668
07/04/21	2472.9820
08/04/21	2499.9566
09/04/21	2507.6670
10/04/21	2477.9678
11/04/21	2490.7894
12/04/21	2482.8536
13/04/21	2502.1572
14/04/21	2511.2589
15/04/21	2504.7769
16/04/21	2510.3237
17/04/21	2506.9018
18/04/21	2505.8690
19/04/21	2506.6268
20/04/21	2503.2358
21/04/21	2506.5436
22/04/21	2507.4461
23/04/21	2507.9672
24/04/21	2508.8902
25/04/21	2507.2677
26/04/21	2507.4733
27/04/21	2507.2848
28/04/21	2506.8716
29/04/21	2507.3335
30/04/21	2507.2019
01/05/21	2507.5696

02/05/21	2507.7201
03/05/21	2507.4810
04/05/21	2507.5197
05/05/21	2507.3460
06/05/21	2507.3398
07/05/21	2507.4068
08/05/21	2507.3694
09/05/21	2507.4545
10/05/21	2507.4575
11/05/21	2507.4524
12/05/21	2507.4587
13/05/21	2507.4104
14/05/21	2507.4143
15/05/21	2507.4141
16/05/21	2507.4146
17/05/21	2507.4323
18/05/21	2507.4286
19/05/21	2507.4334
20/05/21	2507.4326
21/05/21	2507.4251
22/05/21	2507.4258
23/05/21	2507.4224
24/05/21	2507.4239
25/05/21	2507.4269
26/05/21	2507.4266
27/05/21	2507.4282
28/05/21	2507.4274
29/05/21	2507.4266
30/05/21	2507.4265
31/05/21	2507.4256
01/06/21	2507.4260
02/06/21	2507.4262
03/06/21	2507.4264
04/06/21	2507.4268
05/06/21	2507.4266
06/06/21	2507.4266
07/06/21	2507.4265
08/06/21	2507.4263
09/06/21	2507.4264
10/06/21	2507.4263
11/06/21	2507.4264
12/06/21	2507.4265
13/06/21	2507.4265
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15/06/21	2507.4264
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26/07/21	2507.4264
27/07/21	2507.4264
28/07/21	2507.4264
29/07/21	2507.4264
30/07/21	2507.4264
31/07/21	2507.4264

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

#### IV. CONCLUSION & RECOMMENDATIONS

Access to accurate outbreak prediction models is important to obtain insights into the likely spread and consequences of infectious diseases. Governments and other legislative bodies rely on insights from prediction models to suggest new policies and to assess the effectiveness of the enforced policies (Remuzzi & Remuzzi, 2020). Therefore, in order to prepare, understand and control the spread of the disease, researchers globally have come together in a collaborative effort to model and forecast COVID-19 (Kapoor *et al.*, 2020). Consistently, in this work, we use a generalized ANN (12, 12, 1) model to analyze daily COVID-19 cases in Uruguay. Our results show that daily COVID-19 cases will remain significantly high in the out-of-sample period. We encourage the government of Uruguay to continue enforcing control and preventive measures suggested by WHO, for example, face-mask wearing, social distancing, isolations, and quarantine as well as vaccinations.

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