

# Forecasting Covid-19 Mortality in Belgium

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**Abstract - In this study, the ANN approach was applied to analyze COVID-19 mortality in Belgium. The employed data covers the period 1 January 2020-20 April 2021 and the out-of-sample period ranges over the period 21 April-31 August 2021. The residuals and forecast evaluation criteria (Error, MSE and MAE) of the applied model indicate that the model is quite stable. The results of the study indicate that daily COVID-19 mortality cases in Belgium are likely to decline significantly over the out-of-sample period. There is need, however, for the government of Belgium to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic and scaling up COVID-19 vaccination.**

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

## I. INTRODUCTION

The artificial neural network model is an artificial intelligence technique based on the function and structure of the biological neuron. Its application in various fields has gained popularity (Niazkar, 2020; Niazkar et al, 2020; Niazkar, 2019). It is a very useful tool for analyzing the relationship between input and output data. The model has to be trained using a set of records consisting of input and output data (Niazkar & Niazkar, 2020). The multilayer perceptron is the most widely used artificial neural network framework (Zhang, 2003). It is made up of 3 layers of neurons which are connected by acyclic links. The layers are input, hidden and output layers. The back propagation algorithm is used in the training process (Kaushik & Sahi, 2018; Fojnica et al, 2016). In this study we apply the multilayer perceptron to predict daily COVID-19 deaths in Belgium. The findings are expected to reveal the future trends of COVID-19 mortality in Belgium and assist in evaluating the intervention activities to curb the spread of the SARS-COV2 virus.

## II. LITERATURE REVIEW

Molenberghs et al (2020) analyzed COVID-19 mortality in Belgium over the period 8 March – 9 May 2020 (Weeks 11-19), using number of deaths per million, infection fatality rates, and the relation between COVID-19 mortality and excess death rates. Publicly available COVID-19 mortality (2020); overall mortality (2009 – 2020) data in Belgium and demographic data on the Belgian population; data on the nursing home population; results of repeated sero-prevalence surveys in March-April 2020 were utilized. The study revealed that the total number of excess deaths makes April 2020 the deadliest month since WWII, with excess deaths far larger than in early 2017 or 2018. Sierra et al (2020) assessed the appropriateness of the country's COVID-19 mortality surveillance that includes long-term care facilities deaths and deaths in possible cases, the number of COVID-19 deaths was compared with the number of deaths from all-cause mortality. Mortality during the COVID-19 pandemic was also compared with historical mortality rates from the last century including those of the Spanish influenza pandemic. Excess mortality predictions and COVID-19 mortality data were analysed for the period March 10th to June 21st 2020. The study concluded that excess mortality, daily and monthly number of deaths in Belgium were historically high classifying undeniably the first wave of the COVID-19 epidemic as a fatal event. The artificial neural framework was applied by Niazkar & Niazkar (2020) to predict the COVID-19 outbreak. The authors proposed 14 ANN based models. The ANN-based models were utilized to estimate the confirmed cases of COVID-19 in China, Japan, Singapore, Iran, Italy, South Africa and United States of America. The results of the study indicated that considering incubation period of SARS-COV-2 in prediction models may generate more accurate estimations.

## III. 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 COVID-19 mortality cases Belgium.

**Data Issues**

This study is based on daily COVID-19 mortality cases in Belgium for the period 1 January 2020 – 20 April 2021. The out-of-sample forecast covers the period 21 April – 31 August 2021. All the data employed in this research paper was gathered from the Johns Hopkins University (USA).

**IV. FINDINGS OF THE STUDY**

**ANN Model Summary**

Table 1: ANN model summary

Variable	B
Observations	464 (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	0.089539
MSE	929.823136
MAE	21.267858

*Residual Analysis for the Applied Model*

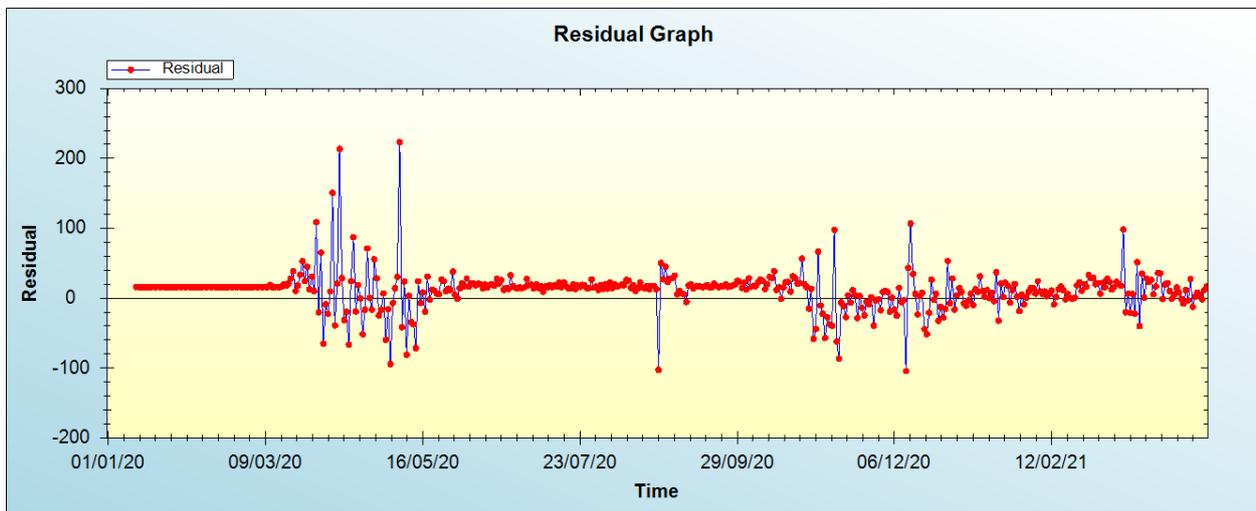


Figure 1: Residual analysis

*In-sample Forecast for B*

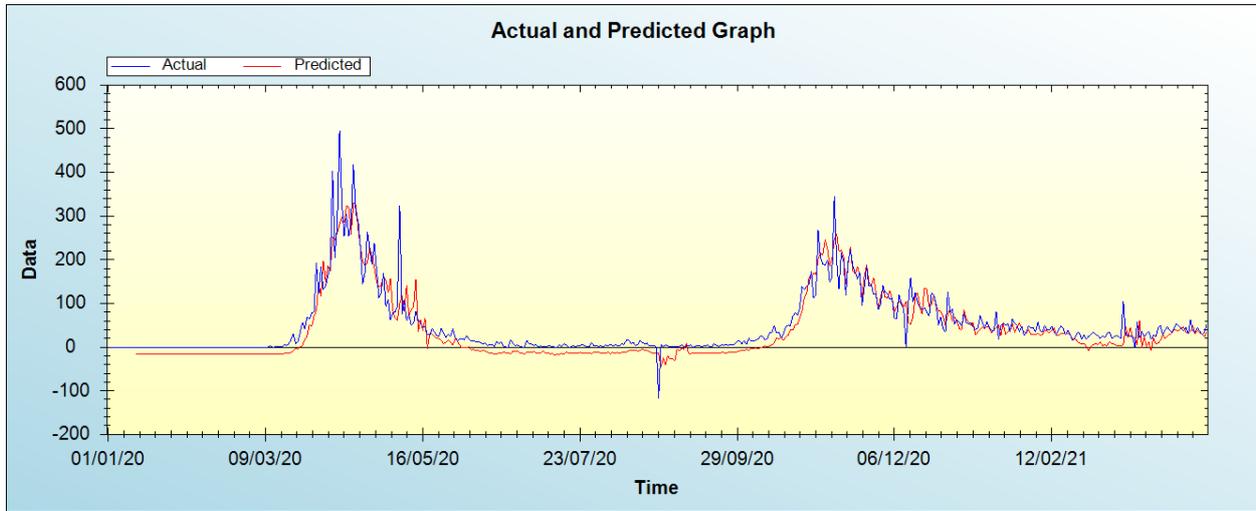


Figure 2: In-sample forecast for the B series

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

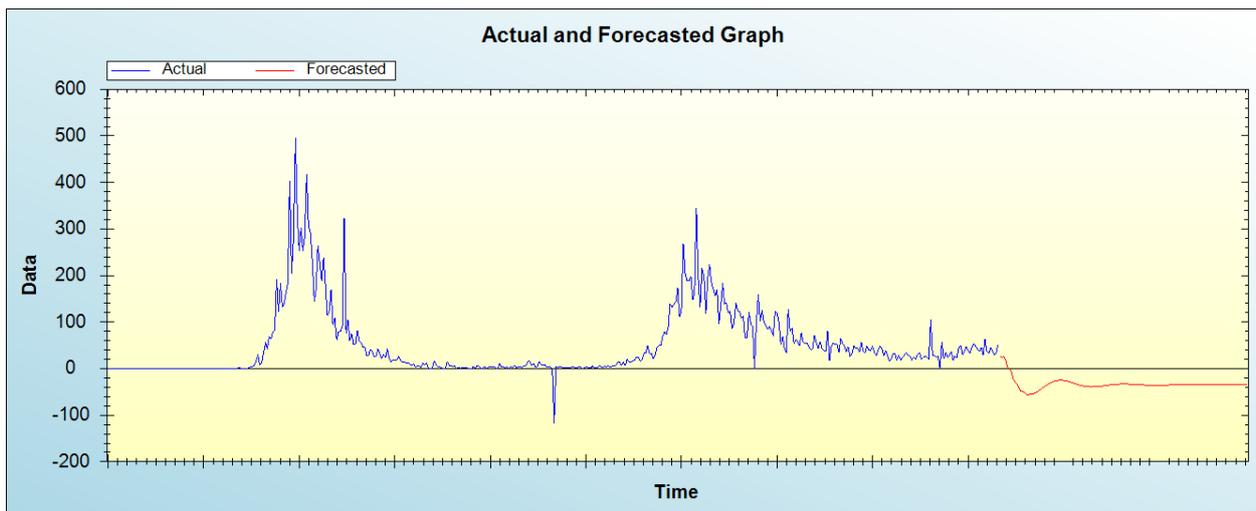


Figure 3: Out-of-sample forecast for B: actual and forecasted graph

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

Table 2: Tabulated out-of-sample forecasts

Date	Forecasts
21/04/21	27.9087
22/04/21	23.9395
23/04/21	26.2919
24/04/21	17.0942
25/04/21	2.4807

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 mortality cases in Belgium are likely to decline significantly over the out-of-sample period. We expect the pandemic to be under reasonable control in the country, by end of April 2021.

#### IV. CONCLUSION AND POLICY RECOMMENDATIONS

Artificial intelligence is a very useful tool for predicting the evolution of infectious diseases like COVID-19. Several studies which were done in the past have shown the high predictive accuracy of AI methods (Nyoni et al, 2020; Zhao et al, 2020; Niazkar, 2019). Artificial neural networks are one of the widely used AI techniques and these include the multilayer perceptron (MLP), recurrent neural network, radial basis function (RBF) and the generalized regression neural network (GRNN). In this paper we applied the MLP neural network to predict daily COVID-19 deaths in Belgium. The results of the study suggest that daily COVID-19 mortality cases in Belgium are likely to decline significantly over the out-of-sample period.. Therefore we encourage the authorities in Belgium to scale up COVID-19 vaccination and relentlessly enforce public adherence to WHO recommendations like wearing face mask, social distancing and hygiene practices.

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#### Citation of this Article:

Dr. Smartson. P. NYONI, Mr. Thabani NYONI, Mr. Tatenda. A. CHIHOHO, “Forecasting Covid-19 Mortality in Belgium” Published in *International Research Journal of Innovations in Engineering and Technology - IRJIET*, Volume 5, Issue 6, pp 710-713, June 2021. Article DOI <https://doi.org/10.47001/IRJIET/2021.506124>

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