

Forecasting Covid-19 New Cases in Monaco

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Abstract - In this study, the ANN approach was applied to analyze COVID-19 new cases in Monaco. The employed data covers the period 1 January 2020 – 25 March 2021 and the out-of-sample period ranges over the period 26 March – 31 July 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 cases in Monaco are likely to remain between 10 and 30 cases per day over the out-of-sample period. Amongst other suggested policy directions, there is need for the government of Monaco to ensure adherence to safety guidelines while continuing to create awareness about the COVID-19 pandemic.

Keywords: ANN, COVID-19, Forecasting.

I. INTRODUCTION

The COVID-19 pandemic originated in Wuhan City, China in late December 2019 and the outbreak caused great pandemonium in several countries as people fell sick and thousands died from the highly fatal disease (CDC, 2020; Wang et al, 2020; Tang et al, 2020). Even this year (2021) the disease is causing wide spread morbidity and mortality globally (WHO, 2020; Coelho et al, 2020). By August 2020, 17 million people had been infected by COVID-19 worldwide (Dong et al, 2020). Most of the countries in the world have managed to mitigate the impact of the pandemic by imposing lockdowns and enforcing the implementation of COVID-19 public health measures (Coelho et al, 2020; Ferguson et al, 2020). The development of COVID-19 vaccines in countries such as the USA, UK, Russia, China and India has brought relief to many people across the divide namely students, business people, health professionals and the research community. However the main concern is the emergence of new coronavirus variants which are highly transmissible and might be associated with severe clinical disease in other parts of the world. Some of the developed countries have experienced 3 waves of the pandemic and it seems this trend is likely to continue if effective vaccines are not rolled out quickly to all the affected regions. This will have serious consequences such as increased vulnerability of poor nations, the elderly people, people with chronic medical conditions, migrant workers and people working in the informal sector. The purpose of this study is to predict daily COVID-19 cases in Monaco using the artificial neural network approach. The findings of this study is expected to reveal the future evolution of the COVID-19 epidemic in Monaco and facilitate planning and allocation of resources towards prevention and control of COVID-19.

II. LITERATURE REVIEW

Černikovaitė & Karazijienė(2020) investigated the social-economic effects of COVID-19 pandemic in Lithuania. Scientific literature analysis, statistical analysis of secondary data and comparative analysis was done. The study concluded that Lithuania has a mild social-economic effects of COVID-19. Evaluation of the impact of curfews and other measures on SARS-CoV-2 transmission in French Guiana was carried out by Andronico et al (2020). The study reported and evaluated the control strategy implemented during a large SARS-CoV-2 epidemic in June-July 2020 in French Guiana that relied on curfews, targeted lockdowns and other measures. The authors found out that the combination of these interventions reduced the basic reproduction number of SARS-CoV-2 from 1.7 to 1.1, which was sufficient to avoid saturation of hospitals. Basing on the different short term forecasting models such as Autoregression, exponential smoothing and SIR models, Khanday et al (2020), SIR model was used and predicted 64% of the population could be infected by the virus considering the whole population is susceptible to be infectious. Autoregression, and exponential smoothing methods indicated there would be more than a 60% increase in the cases in the coming 20 days. The doubling of the number of total cases is found to around 16 days using an effective reproduction number.

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 new COVID-19 cases in Monaco.

Data Issues

This study is based on daily new cases of COVID-19 in Monaco 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).

IV. FINDINGS OF THE STUDY

ANN Model Summary

Table 1: ANN model summary

Variable	M
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	0.143150
MSE	20.548913
MAE	3.614314

Residual Analysis for the Applied Model

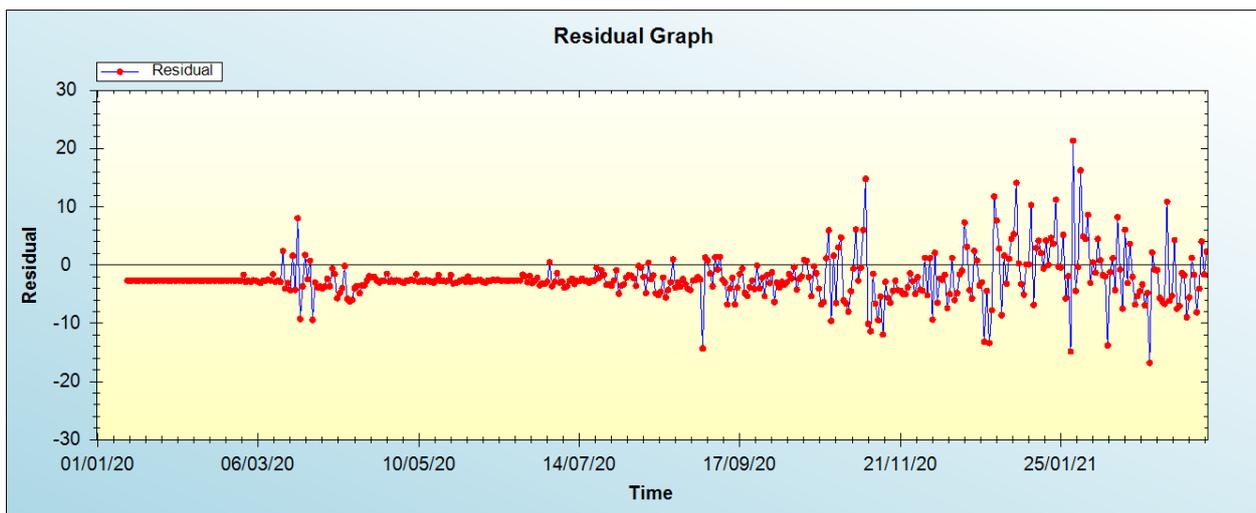


Figure 1: Residual analysis

In-sample Forecast for M

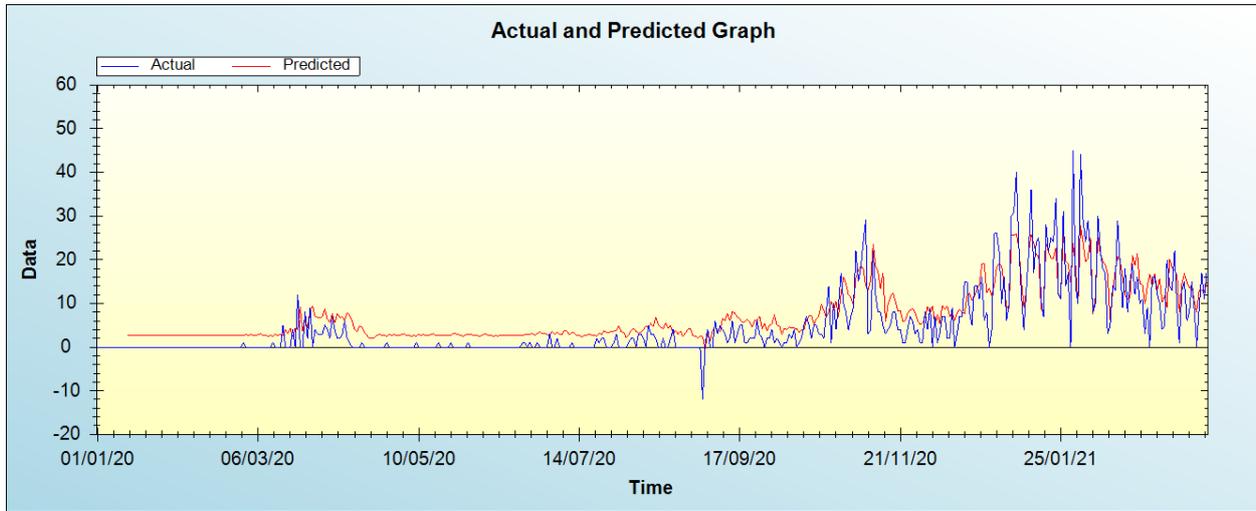


Figure 2: In-sample forecast for the M series

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

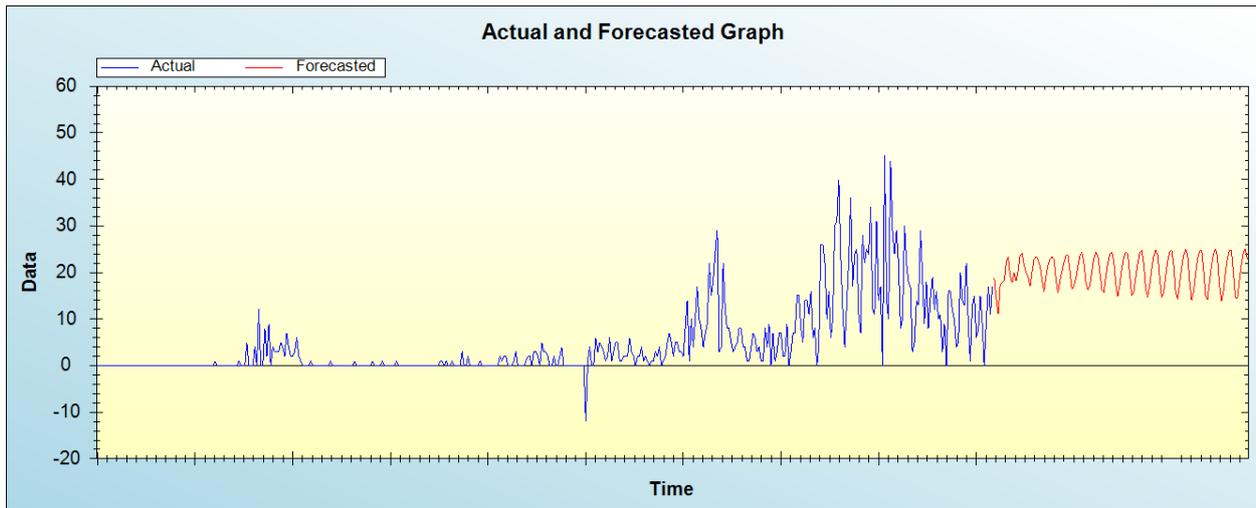


Figure 3: Out-of-sample forecast for M: actual and forecasted graph

Out-of-Sample Forecast for M: Forecasts only

Table 2: Tabulated out-of-sample forecasts

Day/Month/Year	Forecasts
26/03/21	18.7263
27/03/21	14.3570
28/03/21	11.1671
29/03/21	17.3082
30/03/21	17.9014
31/03/21	18.2409
01/04/21	22.3282
02/04/21	23.3604
03/04/21	19.1723
04/04/21	17.7558
05/04/21	19.9608
06/04/21	18.2478
07/04/21	20.5034
08/04/21	23.6619
09/04/21	24.1253

10/04/21	21.4959
11/04/21	20.0300
12/04/21	19.1724
13/04/21	16.9427
14/04/21	20.0776
15/04/21	22.8627
16/04/21	23.4768
17/04/21	22.6748
18/04/21	21.3650
19/04/21	18.3765
20/04/21	15.8282
21/04/21	19.1135
22/04/21	21.6159
23/04/21	22.7648
24/04/21	23.4024
25/04/21	22.7276
26/04/21	18.7647
27/04/21	15.6123
28/04/21	18.0808
29/04/21	20.2010
30/04/21	21.9902
01/05/21	23.6141
02/05/21	23.7888
03/05/21	20.1812
04/05/21	16.3441
05/05/21	17.0305
06/05/21	18.6896
07/05/21	21.0656
08/05/21	23.4112
09/05/21	24.3168
10/05/21	22.0596
11/05/21	17.9498
12/05/21	16.3059
13/05/21	17.1321
14/05/21	19.9972
15/05/21	22.8407
16/05/21	24.3114
17/05/21	23.6487
18/05/21	20.1414
19/05/21	16.3746
20/05/21	15.6907
21/05/21	18.7382
22/05/21	21.8367
23/05/21	23.8610
24/05/21	24.4326
25/05/21	22.3531
26/05/21	17.4987
27/05/21	14.8197
28/05/21	17.2407
29/05/21	20.4862
30/05/21	23.0324
31/05/21	24.4713
01/06/21	23.9779
02/06/21	19.5261
03/06/21	15.0097
04/06/21	15.7099
05/06/21	18.9505
06/06/21	21.8723
07/06/21	24.0806
08/06/21	24.7368
09/06/21	21.9095
10/06/21	16.4231
11/06/21	14.6663
12/06/21	17.2660

13/06/21	20.5264
14/06/21	23.3836
15/06/21	24.7764
16/06/21	23.8614
17/06/21	18.7892
18/06/21	14.6409
19/06/21	15.5530
20/06/21	19.0751
21/06/21	22.3005
22/06/21	24.3800
23/06/21	24.8382
24/06/21	21.4719
25/06/21	15.8618
26/06/21	14.2917
27/06/21	17.4325
28/06/21	20.9175
29/06/21	23.6754
30/06/21	24.9410
01/07/21	23.6682
02/07/21	18.1342
03/07/21	14.0673
04/07/21	15.6651
05/07/21	19.4136
06/07/21	22.5907
07/07/21	24.5626
08/07/21	24.8296
09/07/21	20.8867
10/07/21	15.1455
11/07/21	14.2482
12/07/21	17.7592
13/07/21	21.1987
14/07/21	23.9140
15/07/21	25.0425
16/07/21	23.3140
17/07/21	17.3671
18/07/21	13.8009
19/07/21	15.9524
20/07/21	19.7090
21/07/21	22.9127
22/07/21	24.7200
23/07/21	24.7365
24/07/21	20.1928
25/07/21	14.6440
26/07/21	14.3752
27/07/21	18.0977
28/07/21	21.5525
29/07/21	24.1267
30/07/21	25.1120
31/07/21	22.8346

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 Monaco are likely to remain between 10 and 30 cases per day over the out-of-sample period.

V. CONCLUSION AND POLICY RECOMMENDATIONS

The SARS-COV2 virus started in Wuhan, China; in a mysterious way and later detected by scientists as the causative agent of COVID-19 disease. The high transmissibility and emergence of new strains is making it difficult to predict its evolution. Several models have been used to forecast the spread and its incidence of the virus and some of the models have proved to have high predictive accuracy and others have performed dismally. Artificial intelligence techniques are among the best performing predictive models hence we proposed to apply the ANN (12, 12, 1) model in forecasting daily COVID-19 cases in Monaco. There is need for continued adherence to COVID-19 regulations.

REFERENCES

- [1] World Health Organization (2020). “Coronavirus disease 2019 (COVID-19)” Situation Rep. 67.
- [2] M. T. P. Coelho et al., Exponential phase of covid19 expansion is not driven by climate at global scale. medRxiv:10.1101/2020.04.02.20050773 (6 May 2020).
- [3] E. Dong, H. Du, L. Gardner, An interactive web-based dashboard to track COVID-19 in real time. *Lancet Infect. Dis.* 20, 533–534 (2020)
- [4] N. Ferguson et al., “Impact of non-pharmaceutical interventions (NPIs) to reduce COVID19 mortality and healthcare demand” (Rep. 9, Imperial College London, 2020)
- [5] Tang. B et al (2020). An updated estimation of the risk of transmission of the novel coronavirus (2019-nCoV). *Infectious Disease Modelling* 5, 248–255.
- [6] Tang. B et al (2020). Estimation of the transmission risk of the 2019-nCoV and its implication for public health interventions. *J. Clinical Med.* 9, 462.
- [7] Wang D et al (2020). Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *JAMA* 323, 1061–1069.
- [8] Wang H et al (2020). Phase-adjusted estimation of the number of coronavirus disease 2019 cases in Wuhan, China. *Cell Discovery* 6, 76.
- [9] Wang. W et al (2020). Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. *J. Med. Virology* 92, 441–447
- [10] CDC (2020). The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team, The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. *China CDC Weekly* 2, 113–122.

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