Electronic Journal of General Medicine
2022, 19(6), em410
e-ISSN: 2516-3507
https://www.ejgm.co.uk/

MODESTUM

Original Article

OPEN ACCESS

Analyses of polynomial neural networks for prediction of the prevalence of monkeypox infections in Asia and around the world

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Citation: Majumder P. Analyses of polynomial neural networks for prediction of the prevalence of monkeypox infections in Asia and around the world. Electron J Gen Med. 2022;19(6):em410. https://doi.org/10.29333/ejgm/12400

ARTICLE INFO

Received: 02 Aug. 2022

Accepted: 24 Aug. 2022

ABSTRACT

Monkeypox is a zoonosis disease that can spread from animals to people. Squirrels, rats taken from Gambian slums, dormice, various monkey species, and other animals have all shown signs of monkeypox virus infection. Contact with bodily fluids, sores on the skin or on internal mucosal surfaces, like those in the mouth or throat, respiratory droplets, and infected objects can all result in the spread of the disease. As the World Health Organization has warned the entire world against this disease, it is necessary to predict its prevalence in the entire world. This study uses a polynomial neural network model to predict monkeypox prevalence. Data on confirmed monkeypox cases collected from 6 May 2022 to 28 July 2022 are presented here. Based on the data, the prediction will be done using the group method of data handling model. The intensity of the spreading of this disease in the 100 days to come will be predicted in this study. The prediction will be done around the world, especially around the countries of the Asian continent which have been tremendously affected by the said disease.

Keywords: PNN, GMDH model, prediction, monkeypox, prevalence

INTRODUCTION

It is monkeypox virus, which causes a zoonosis and human monkeypox is the latter. Monkeypox is an orthopox virus and close relative of smallpox. In 1970, it had become reported in central Africa [1] and some poorest and extremely marginalized communities have significantly been adversely affected [2,3]. Lymphadenopathy, rash, and fever are the clinical symptoms which indicate one's journey towards being attacked by monkeypox. Secondary bacterial infections, encephalitis, sight-threatening keratitis, and pneumonitis can be said to be complications rendered by monkeypox. It is not that the mortality rates which have been published are immune to varying substantially and being vulnerable to the bias ascertained by case [3-5]. In the Congo Basin outbreaks in which case fatality rates which have ranged from 1% to 10% have gotten reported have manifested, and it is higher virulence which what is lying behind the said pandemonium is found to be associated with [5, 6]. It is mostly young children and people affected by HIV who have died [6-8]. Transmission of monkeypox from one human to another has been described well [6,8,9]. It includes nosocomial and household transmission. Historically, the chains of transmission from one human to another are yet to be recognized well [3, 8]. It has been suggested by a systematic review that a secondary attack which ranges from 0% to 11% embraced the contacts by those who had not been vaccinated against smallpox [6]. Infectivity as well as in-vivo viral kinetics could not well be understood [3,7,10], and the clinical importance of what are known as skin shedding and prolonged viraemia is yet to be certain. The continent from which monkeypox has not been frequently exported is the African continent. A zoonotic outbreak took place in the USA in 2003 which had caused 47 cases, which were either confirmed or suspected [4,11-13]. Gambian giant dormice, rats, and squirrels were imported and said outbreak was the consequence of it owing to the virus' having been transmitted by these animals to prairie dogs which as pets had then been sold. Hospitalized not more than 14 patients had to be. Also, cases of transmission from one person to another had hardly been confirmed. It is the UK [14], the USA [11], Singapore [16], and Israel [15], which human beings after having travelled had been infected by the monkeypox which had been imported in. At present no certified treatments which can cure human monkeypox exist, although the USA has approved only two bio-available drugs which can orally be taken, tecovirimat, and brin cidofovir [17-19]. Tecovirimat has, as reported, been made use of in order to treat complicated vaccinia [20,21] and cowpox [22], though if or not this using is safe is yet to be identified. **Figure 1** and **Figure 2** represent the countries infected by monkeypox in the world and the Asian continent, respectively.

The number of patients infected by monkeypox appears to be rising, albeit slowly. England has confirmed 20 cases [23], while Spain has not confirmed but reported 23 suspected cases. Five cases have been confirmed by Portugal [24], while the USA has confirmed one case [25]. Muscleache, swollen lymph nodes, headache, fever, and chills, and exhaustion are its symptoms. Basically, what will develop is a rash that often begins its journey from the face to reach other parts of the body including the reproductory organs. Via different stages, a scab to finally fall off will be formed by the rash.

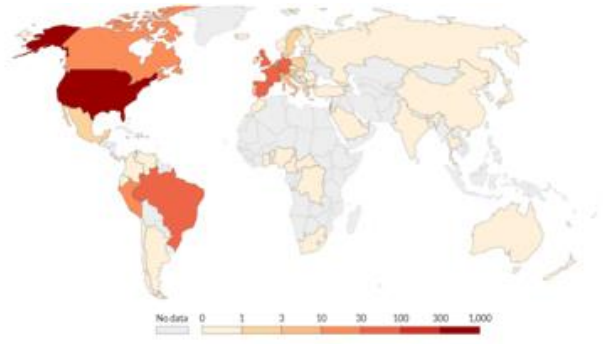

Figure 1. Monkeypox infected countries of world

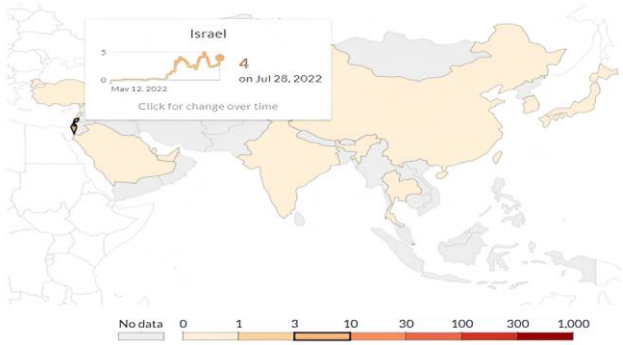

Figure 2. Monkeypox infected countries of Asian continent

The foresighted scientists issued a warning that these rare epidemics will expand in size and territory over time. According to infectious disease specialist Boghuma Titanji of Emory University, “in every monkeypox study on prior epidemics, there is always a warning about how we need to prepare for such outbreaks in the future.” It turns out that forecast was accurate.

Hence, it can safely be stated that predicting the prevalence of infections in the world owing to the monkeypox appears to be a necessity in order to contain the adverse effects by the said disease as much as possible. It may here be clarified that as the monkeypox has already attacked the Asian continent, having firstly attached the USA, the researcher deems it fit to conduct a study as regards the pervasiveness of the same disease.

The silhouette of the study undertaken is seen via the following objectives:

1. To predict the prevalence of the monkeypox in the world based on the collected data.
2. To forecast the pervasiveness of the monkeypox in the Asian continent based on the gathered data.
3. To predict the prevalence of the monkeypox in the most affected countries of the Asian continent based on the collected data.

DATA COLLECTION

The World Health Organization website and the website [26] of the affected confirmed case by monkeypox were used to gather the data. Data for the confirmed 6 May 2019 to 28 July 2020 period are shown in **Table 1**. Data on confirmed cases of monkeypox across the world and on the Asian continent are shown in **Table 1**.

Table 1. Table on top of a column (font size: 9)

Date	World	Asia	Date	World	Asia
06-05-2022	1	0	17-06-2022	194	0
07-05-2022	0	0	18-06-2022	5	0
08-05-2022	10	0	19-06-2022	7	0
09-05-2022	0	0	20-06-2022	294	0
10-05-2022	0	0	21-06-2022	282	6
11-05-2022	0	0	22-06-2022	174	2
12-05-2022	1	0	23-06-2022	441	0
13-05-2022	1	0	24-06-2022	321	6
14-05-2022	0	0	25-06-2022	12	0
15-05-2022	4	0	26-06-2022	196	0
16-05-2022	0	0	27-06-2022	387	13
17-05-2022	3	0	28-06-2022	348	4
18-05-2022	21	0	29-06-2022	153	5
19-05-2022	19	0	30-06-2022	807	5
20-05-2022	45	0	01-07-2022	269	0
21-05-2022	16	1	02-07-2022	44	0
22-05-2022	0	1	03-07-2022	40	0
23-05-2022	73	0	04-07-2022	495	10
24-05-2022	36	1	05-07-2022	447	3
25-05-2022	44	0	06-07-2022	232	0
26-05-2022	88	0	07-07-2022	686	4
27-05-2022	52	0	08-07-2022	1,060	0
28-05-2022	17	1	09-07-2022	122	0
29-05-2022	20	3	10-07-2022	27	2
30-05-2022	123	0	11-07-2022	591	5
31-05-2022	65	0	12-07-2022	874	9
01-06-2022	84	4	13-07-2022	418	7
02-06-2022	125	0	14-07-2022	490	10
03-06-2022	94	0	15-07-2022	1,009	0
04-06-2022	8	0	16-07-2022	16	0
05-06-2022	107	0	17-07-2022	22	8
06-06-2022	115	0	18-07-2022	536	1
07-06-2022	150	6	19-07-2022	1,475	6
08-06-2022	97	0	20-07-2022	574	3
09-06-2022	146	1	21-07-2022	642	1
10-06-2022	43	0	22-07-2022	720	0
11-06-2022	9	0	23-07-2022	2	0
12-06-2022	114	0	24-07-2022	19	9
13-06-2022	60	0	25-07-2022	1,221	5
14-06-2022	244	0	26-07-2022	1,417	7
15-06-2022	147	2	27-07-2022	1,256	0

POLYNOMIAL NEURAL NETWORK

One of the learning machine approaches built on the polynomial theory of complex systems is the group method of data handling (GMDH) model. The most important input parameters, number of layers, number of middle layer neurons, and ideal topological design of the network are automatically defined from this network. As a result, the GMDH network is a model of active neurons that self-organizes. The polynomial model used to configure the GMDH network’s topology during the training phase delivers the smallest error between the predicted value and the output that is actually seen.

Because of its flexibility, the neuro fuzzy GMDH network can readily be hybridized with other iterative and evolutionary algorithms [27]. The self-organizing, unidirectional GMDH neural network has numerous layers, each of which is made up of a number of neurons with a similar topology. The selection of model criterion in line with the objective of modelling and information division, GMDH will confirm the model automatically. This modelling process will result in several

models depending on the sorts of input units employed. Building Mamdani-style fuzzy models and Bayesian networks both used this automatic modelling technique successfully [28,29].

The basic objective of the GMDH network is to build a function in a feed-forward network using a second-degree transfer function as a foundation. This algorithm automatically determines the ideal model structure, the effective input variables, and the number of layers and neurons within the hidden layers. The Volterra series, which takes the form of an equation, is a nonlinear function that maps the input and output variables in a GMDH neural network (Eq. 1). Equation is used to analyze the Volterra series as a two-variable second-degree polynomial (Eq. 2).

$$\hat{y} = c_0 + \sum_{i=1}^{m} c_i x_i + \sum_{i=1}^{m}\sum_{j=1}^{m} c_{ij} x_{ij} + \sum_{i=1}^{m}\sum_{j=1}^{m}\sum_{k=1}^{m} c_{ijk} x_{ijk} + \cdots \quad (1)$$

$$G(x_i, x_j) = c_0 + c_1 x_i + c_2 x_j + c_3 x_i^2 + c_4 x_j^2 + c_5 x_i x_j + \cdots \quad (2)$$

The GMDH algorithm seeks to identify the Volterra series' c unknown coefficients. Regression techniques are used to solve the coefficients for each pair of input variables [30]. On this premise, the G function is defined, as follows in equation (3) while considering the principle of least squares error [31]:

$$E = \frac{\sum_{i=1}^{M}(y_i - G_i O)^2}{M}, \quad (3)$$

where $y_i = f(x_{i1}, x_{i2}, \cdots, x_{im}), i = 1(1)m$.

To create a trustworthy model for prediction, three parameters of the artificial neural network (ANN) based model must be accurately assessed. The network's topology, the weights assigned to links, and the kind of activation function are the parameters. Finding the ideal value of the parameters for which accurate prediction is achievable typically involves trial and error or the use of cognitive search algorithms like GA and PSO.

The issue with this approach is that it takes an excessive number of iterations and the use of numerous different algorithms to determine the ideal setting for the parameters. Thus, the complexity and amount of storage required to run such algorithms discourages their continued use and lowers their acceptability as a substitute for traditional models for the estimate of highly non-linear variables.

The PNN architecture, which implements the GMDH algorithms, is self-adaptive and can choose the topology for which the best model can be created using the training data already provided and a preselected fitness function, which measures the precision of the model predictions. To calculate the weights of the connections, the method employs more than 100 other algorithms. The performance of the algorithms is evaluated here as well using a fitness function, and the expected connection weights with the best algorithm are forecasted.

Because of this, constructing a model using a PNN as opposed to an ANN needed less storage and processing infrastructure. The correlation between the input and output index was therefore determined using this architecture in the current study so that an automated framework could be created to estimate location selection potential whenever and whenever a new option is identified.

GMDH has certain disadvantages. First, even for relatively simple systems, it tends to produce highly complex polynomials. Second, when it comes to highly nonlinear systems, GMDH also tends to build an excessively complicated network (model) because of its constrained generic structure (i.e., quadratic two-variable polynomials). Third, the GMDH method does not provide a structure that is very adaptable if there are fewer than three input variables.

A computational model known as an ANN is made up of numerous processing components coupled by a variable weight. The networks are made up of layers of parallel neurons. When neurophysiologist Warren McCulloch and a young mathematician named Walter Pitts modelled a basic neural network with electrical circuits for a paper on how neurons may function in 1943, they first presented the idea of an ANN. An increasing number of fields, including control, data compression, forecasting, optimization, pattern recognition, classification, speech, and vision, have turned to using ANNs in recent years [32, 33].

Equations (4) and (5) provide a description of the ANN model's objective function.

$$h_m = f(w_n x_n + b_j) \quad (4)$$

$$y = g(\varepsilon_n x_n + b_k) \quad (5)$$

The input is x_n, while the weight is w_n. The biases for input-to-hidden layer and hidden-to-output layer are b_j and b_k, respectively, the weight of the concealed layer is h_m and ε_n is the hidden layer. The activation functions between the input and hidden layers and between the hidden and output layers, respectively, are *f* and *g*.

Three parameters affect the ANN model's accuracy. the size of the weights, the number of hidden layers, and the kind of activation function used in the input-hidden and hidden-output layers. These parameters are often estimated using the trial-and-error method. But in recent years, search methods like GA, PSO [34], etc., have been used to pinpoint the parameter values that will result in the best accuracy from an ANN model.

RESULTS AND DISCUSSION

The prediction will be conducted around the world, particularly in countries of the Asian continent that have been greatly affected by the disease. Based on the data in **Table 1** and GMDH to predict monkeypox prevalence.

Result of Prediction of Prevalence of Pox in the World

The prevalence of monkeypox in the world can be predicted using GMDH. GMDH creates a forecast using the data in **Table 1**. **Figure 3** and **Appendix A** show the prevalence of monkeypox around the world. The author of this study makes a 100-day prediction after 28 July 2022. From the results, it is clear that the said desis increased up to 20 October 2022 but that the trend is decreasing. Eq. 6 of the model by which the prevalence of monkeypox is predicted is given by GMDH.

Model I: Y1=-420.784+"|id, day of week, fsin(7, 1)"*876.371+"|id, day of week, fsin(7, 2)"*85.6309+cycle*(-2.07772)+"|id, day of week, fcos(7, 2)"*241.471+"|id, day of week_4"*527.81 (6)

Result of Prediction of Prevalence of Pox in Asian Continent

The prevalence of monkeypox on the Asian continent can be predicted using GMDH. Based on the data in **Table 1**, GMDH creates a forecast.

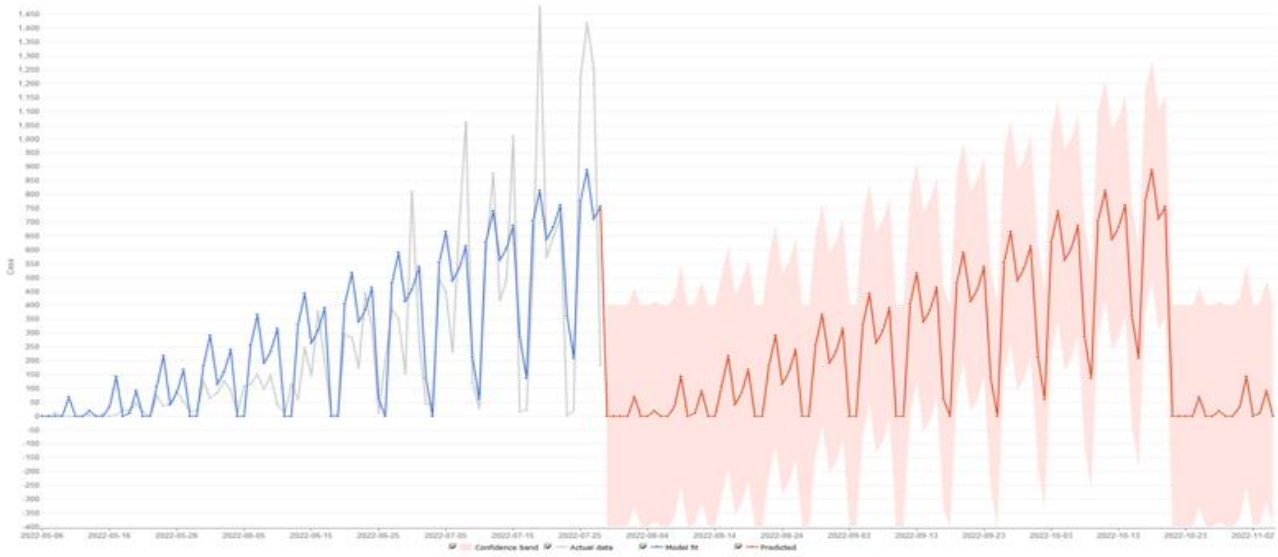

Figure 3. Observed and predicted outputs of the model in world

Figure 4. Observed and predicted outputs of the model in Asian continent

The prevalence of monkeypox around the Asian continent is shown in **Figure 4** and **Appendix B**. Based on this study, the author predicts 100 days after 28 July 2022. It is evident from the results that the trend of said demography increased until 18 October 2022, but that it then decreased. GMDH provides Eq. 7 of the model for predicting monkeypox prevalence.

Model II: Y1=-0.468927+cycle*0.234026+"|id, day of week_5"*(-3.57217) (7)

Result of Prediction of Prevalence of Pox in Israel

According to the data available, Israel is the worst victim of monkeypox. Hence, the author deems it fit to especially consider the said country for the present study. GMDH can predict monkeypox prevalence on the Asian continent in Israel. **Figure 5** and **Appendix C** illustrate the prevalence of monkeypox in Israel. The author predicts 100 days after 28 July 2022 based on this study. The results indicate that the demography trended upward until 20 October 2022, and then declined. A model for predicting monkeypox prevalence is provided by GMDH in Eq. 8.

Model III: Y1=-0.456423+cycle*0.259691+"|id, day of week_5"*(-2.92653) (8)

CONCLUSION

A prediction of monkeypox prevalence was made in the present study for the world, the Asian continent, and Israel. A PNN is used to make this prediction after collecting the data. This study has the advantage of being able to predict monkeypox prevalence for the world, the Asian continent, and Israel by using Model-I, Model-II, and Model-III. When the prevalence of monkeypox will be stopped has not been studied in this study, which is a drawback of the study. This study bears the expectation of eliminating these drawbacks in future using create a new model.

Funding: No funding source is reported for this study.

Declaration of interest: No conflict of interest is declared by the author.

Data sharing statement: Data supporting the findings and conclusions are available upon request from the author.

Figure 5. Observed and predicted outputs of the model in Is

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APPENDIX A

Table A. Predicted outputs of the model in the World

D	P	O	FF	L	U	D	P	O	FF	L	U
2022-07-29	836	0	0	-398.396	398.3964	2022-09-17	957	63	63	-335.396	461.3964
2022-07-30	435	0	0	-398.396	398.3964	2022-09-18	807	0	0	-398.396	398.3964
2022-07-31	285	0	0	-398.396	398.3964	2022-09-19	1,374	479	479	80.60357	877.3964
2022-08-01	852	0	0	-398.396	398.3964	2022-09-20	1,484	590	590	191.6036	988.3964
2022-08-02	963	68	68	-330.396	466.3964	2022-09-21	1,307	413	413	14.60357	811.3964
2022-08-03	786	0	0	-398.396	398.3964	2022-09-22	1,351	457	457	58.60357	855.3964
2022-08-04	830	0	0	-398.396	398.3964	2022-09-23	1,433	538	538	139.6036	936.3964
2022-08-05	911	17	17	-381.396	415.3964	2022-09-24	1,032	137	137	-261.396	535.3964
2022-08-06	510	0	0	-398.396	398.3964	2022-09-25	881	0	0	-398.396	398.3964
2022-08-07	360	0	0	-398.396	398.3964	2022-09-26	1,448	554	554	155.6036	952.3964
2022-08-08	927	32	32	-366.396	430.3964	2022-09-27	1,559	665	665	266.6036	1,063.396
2022-08-09	1,037	143	143	-255.396	541.3964	2022-09-28	1,382	488	488	89.60357	886.3964
2022-08-10	860	0	0	-398.396	398.3964	2022-09-29	1,426	532	532	133.6036	930.3964
2022-08-11	904	10	10	-388.396	408.3964	2022-09-30	1,507	613	613	214.6036	1,011.396
2022-08-12	985	91	91	-307.396	489.3964	2022-10-01	1,106	212	212	-186.396	610.3964
2022-08-13	584	0	0	-398.396	398.3964	2022-10-02	956	61	61	-337.396	459.3964
2022-08-14	434	0	0	-398.396	398.3964	2022-10-03	1,523	628	628	229.6036	1,026.396
2022-08-15	1,001	107	107	-291.396	505.3964	2022-10-04	1,633	739	739	340.6036	1,137.396
2022-08-16	1,112	217	217	-181.396	615.3964	2022-10-05	1,456	562	562	163.6036	960.3964
2022-08-17	935	41	41	-357.396	439.3964	2022-10-06	1,500	606	606	207.6036	1,004.396
2022-08-18	979	85	85	-313.396	483.3964	2022-10-07	1,582	687	687	288.6036	1,085.396
2022-08-19	1,060	166	166	-232.396	564.3964	2022-10-08	1,181	286	286	-112.396	684.3964
2022-08-20	659	0	0	-398.396	398.3964	2022-10-09	1,030	136	136	-262.396	534.3964
2022-08-21	509	0	0	-398.396	398.3964	2022-10-10	1,597	703	703	304.6036	1,101.396
2022-08-22	1,076	181	181	-217.396	579.3964	2022-10-11	1,708	814	814	415.6036	1,212.396
2022-08-23	1,186	292	292	-106.396	690.3964	2022-10-12	1,531	637	637	238.6036	1,035.396
2022-08-24	1,009	115	115	-283.396	513.3964	2022-10-13	1,575	681	681	282.6036	1,079.396
2022-08-25	1,053	159	159	-239.396	557.3964	2022-10-14	1,656	762	762	363.6036	1,160.396
2022-08-26	1,134	240	240	-158.396	638.3964	2022-10-15	1,255	361	361	-37.3964	759.3964
2022-08-27	733	0	0	-398.396	398.3964	2022-10-16	1,105	210	210	-188.396	608.3964
2022-08-28	583	0	0	-398.396	398.3964	2022-10-17	1,672	777	777	378.6036	1,175.396
2022-08-29	1,150	256	256	-142.396	654.3964	2022-10-18	1,782	888	888	489.6036	1,286.396
2022-08-30	1,261	366	366	-32.3964	764.3964	2022-10-19	1,605	711	711	312.6036	1,109.396
2022-08-31	1,084	190	190	-208.396	588.3964	2022-10-20	1,650	755	755	356.6036	1,153.396
2022-09-01	1,128	234	234	-164.396	632.3964	2022-10-21	1,731	0	0	-398.396	398.3964
2022-09-02	1,209	315	315	-83.3964	713.3964	2022-10-22	1,330	0	0	-398.396	398.3964
2022-09-03	808	0	0	-398.396	398.3964	2022-10-23	1,179	0	0	-398.396	398.3964
2022-09-04	658	0	0	-398.396	398.3964	2022-10-24	1,746	0	0	-398.396	398.3964
2022-09-05	1,225	330	330	-68.3964	728.3964	2022-10-25	1,857	68	68	-330.396	466.3964
2022-09-06	1,335	441	441	42.60357	839.3964	2022-10-26	1,680	0	0	-398.396	398.3964
2022-09-07	1,158	264	264	-134.396	662.3964	2022-10-27	1,724	0	0	-398.396	398.3964
2022-09-08	1,202	308	308	-90.3964	706.3964	2022-10-28	1,805	17	17	-381.396	415.3964
2022-09-09	1,284	389	389	-9.39643	787.3964	2022-10-29	1,404	0	0	-398.396	398.3964
2022-09-10	883	0	0	-398.396	398.3964	2022-10-30	1,254	0	0	-398.396	398.3964
2022-09-11	732	0	0	-398.396	398.3964	2022-10-31	1,821	32	32	-366.396	430.3964
2022-09-12	1,299	405	405	6.603571	803.3964	2022-11-01	1,931	143	143	-255.396	541.3964
2022-09-13	1,410	516	516	117.6036	914.3964	2022-11-02	1,754	0	0	-398.396	398.3964
2022-09-14	1,233	339	339	-59.3964	737.3964	2022-11-03	1,799	10	10	-388.396	408.3964
2022-09-15	1,277	383	383	-15.3964	781.3964	2022-11-04	1,880	91	91	-307.396	489.3964
2022-09-16	1,358	464	464	65.60357	862.3964	2022-11-05	1,479	0	0	-398.396	398.3964

Note. D: Date; P: Predictions; O: Override; FF: Final forecast; L: Lower; & U: Upper

APPENDIX B

Table B. Predicted outputs of the model in Asian continent

D	P	O	FF	L	U	D	P	O	FF	L	U
2022-07-29	6	-				2022-09-17	7	0	0	-5.84832	5.848324
2022-07-30	2	-				2022-09-18	10	3	3	-2.84832	8.848324
2022-07-31	6	-				2022-09-19	11	3	3	-2.84832	8.848324
2022-08-01	6	-				2022-09-20	11	3	3	-2.84832	8.848324
2022-08-02	7	-				2022-09-21	10	3	3	-2.84832	8.848324
2022-08-03	6	-				2022-09-22	10	3	3	-2.84832	8.848324
2022-08-04	6	-				2022-09-23	11	3	3	-2.84832	8.848324
2022-08-05	6	-				2022-09-24	7	0	0	-5.84832	5.848324
2022-08-06	3	-				2022-09-25	11	4	4	-1.84832	9.848324
2022-08-07	7	-				2022-09-26	11	4	4	-1.84832	9.848324
2022-08-08	7	-				2022-09-27	11	4	4	-1.84832	9.848324
2022-08-09	7	-				2022-09-28	11	3	3	-2.84832	8.848324
2022-08-10	6	-				2022-09-29	11	4	4	-1.84832	9.848324
2022-08-11	7	-				2022-09-30	11	4	4	-1.84832	9.848324
2022-08-12	7	-				2022-10-01	8	0	0	-5.84832	5.848324
2022-08-13	4	0	0	-5.84832	5.848324	2022-10-02	12	4	4	-1.84832	9.848324
2022-08-14	7	0	0	-5.84832	5.848324	2022-10-03	12	4	4	-1.84832	9.848324
2022-08-15	8	0	0	-5.84832	5.848324	2022-10-04	12	5	5	-0.84832	10.84832
2022-08-16	8	0	0	-5.84832	5.848324	2022-10-05	11	4	4	-1.84832	9.848324
2022-08-17	7	0	0	-5.84832	5.848324	2022-10-06	12	4	4	-1.84832	9.848324
2022-08-18	7	0	0	-5.84832	5.848324	2022-10-07	12	4	4	-1.84832	9.848324
2022-08-19	7	0	0	-5.84832	5.848324	2022-10-08	8	1	1	-4.84832	6.848324
2022-08-20	4	0	0	-5.84832	5.848324	2022-10-09	12	5	5	-0.84832	10.84832
2022-08-21	8	1	1	-4.84832	6.848324	2022-10-10	12	5	5	-0.84832	10.84832
2022-08-22	8	1	1	-4.84832	6.848324	2022-10-11	13	5	5	-0.84832	10.84832
2022-08-23	8	1	1	-4.84832	6.848324	2022-10-12	12	5	5	-0.84832	10.84832
2022-08-24	8	0	0	-5.84832	5.848324	2022-10-13	12	5	5	-0.84832	10.84832
2022-08-25	8	1	1	-4.84832	6.848324	2022-10-14	12	5	5	-0.84832	10.84832
2022-08-26	8	1	1	-4.84832	6.848324	2022-10-15	9	2	2	-3.84832	7.848324
2022-08-27	5	0	0	-5.84832	5.848324	2022-10-16	13	5	5	-0.84832	10.84832
2022-08-28	9	1	1	-4.84832	6.848324	2022-10-17	13	6	6	0.151676	11.84832
2022-08-29	9	1	1	-4.84832	6.848324	2022-10-18	13	6	6	0.151676	11.84832
2022-08-30	9	2	2	-3.84832	7.848324	2022-10-19	13	5	5	-0.84832	10.84832
2022-08-31	8	1	1	-4.84832	6.848324	2022-10-20	13	5	5	-0.84832	10.84832
2022-09-01	9	1	1	-4.84832	6.848324	2022-10-21	13	-			
2022-09-02	9	1	1	-4.84832	6.848324	2022-10-22	10	-			
2022-09-03	5	0	0	-5.84832	5.848324	2022-10-23	13	-			
2022-09-04	9	2	2	-3.84832	7.848324	2022-10-24	14	-			
2022-09-05	9	2	2	-3.84832	7.848324	2022-10-25	14	-			
2022-09-06	10	2	2	-3.84832	7.848324	2022-10-26	13	-			
2022-09-07	9	2	2	-3.84832	7.848324	2022-10-27	13	-			
2022-09-08	9	2	2	-3.84832	7.848324	2022-10-28	14	-			
2022-09-09	9	2	2	-3.84832	7.848324	2022-10-29	10	-			
2022-09-10	6	0	0	-5.84832	5.848324	2022-10-30	14	-			
2022-09-11	10	2	2	-3.84832	7.848324	2022-10-31	14	-			
2022-09-12	10	3	3	-2.84832	8.848324	2022-11-01	14	-			
2022-09-13	10	3	3	-2.84832	8.848324	2022-11-02	14	-			
2022-09-14	10	2	2	-3.84832	7.848324	2022-11-03	14	-			
2022-09-15	10	2	2	-3.84832	7.848324	2022-11-04	14	-			
2022-09-16	10	3	3	-2.84832	8.848324	2022-11-05	11	0	0	-5.84832	5.848324

Note. D: Date; P: Predictions; O: Override; FF: Final forecast; L: Lower; & U: Upper

APPENDIX C

Table C. Predicted outputs of the model in Israel

D	P	O	FF	L	U	D	P	O	FF	L	U
2022-07-29	6	-				2022-09-17	7	0	0	-5.84832	5.848324
2022-07-30	2	-				2022-09-18	10	3	3	-2.84832	8.848324
2022-07-31	6	-				2022-09-19	11	3	3	-2.84832	8.848324
2022-08-01	6	-				2022-09-20	11	3	3	-2.84832	8.848324
2022-08-02	7	-				2022-09-21	10	3	3	-2.84832	8.848324
2022-08-03	6	-				2022-09-22	10	3	3	-2.84832	8.848324
2022-08-04	6	-				2022-09-23	11	3	3	-2.84832	8.848324
2022-08-05	6	-				2022-09-24	7	0	0	-5.84832	5.848324
2022-08-06	3	-				2022-09-25	11	4	4	-1.84832	9.848324
2022-08-07	7	-				2022-09-26	11	4	4	-1.84832	9.848324
2022-08-08	7	-				2022-09-27	11	4	4	-1.84832	9.848324
2022-08-09	7	-				2022-09-28	11	3	3	-2.84832	8.848324
2022-08-10	6	-				2022-09-29	11	4	4	-1.84832	9.848324
2022-08-11	7	-				2022-09-30	11	4	4	-1.84832	9.848324
2022-08-12	7	-				2022-10-01	8	0	0	-5.84832	5.848324
2022-08-13	4	0	0	-5.84832	5.848324	2022-10-02	12	4	4	-1.84832	9.848324
2022-08-14	7	0	0	-5.84832	5.848324	2022-10-03	12	4	4	-1.84832	9.848324
2022-08-15	8	0	0	-5.84832	5.848324	2022-10-04	12	5	5	-0.84832	10.84832
2022-08-16	8	0	0	-5.84832	5.848324	2022-10-05	11	4	4	-1.84832	9.848324
2022-08-17	7	0	0	-5.84832	5.848324	2022-10-06	12	4	4	-1.84832	9.848324
2022-08-18	7	0	0	-5.84832	5.848324	2022-10-07	12	4	4	-1.84832	9.848324
2022-08-19	7	0	0	-5.84832	5.848324	2022-10-08	8	1	1	-4.84832	6.848324
2022-08-20	4	0	0	-5.84832	5.848324	2022-10-09	12	5	5	-0.84832	10.84832
2022-08-21	8	1	1	-4.84832	6.848324	2022-10-10	12	5	5	-0.84832	10.84832
2022-08-22	8	1	1	-4.84832	6.848324	2022-10-11	13	5	5	-0.84832	10.84832
2022-08-23	8	1	1	-4.84832	6.848324	2022-10-12	12	5	5	-0.84832	10.84832
2022-08-24	8	0	0	-5.84832	5.848324	2022-10-13	12	5	5	-0.84832	10.84832
2022-08-25	8	1	1	-4.84832	6.848324	2022-10-14	12	5	5	-0.84832	10.84832
2022-08-26	8	1	1	-4.84832	6.848324	2022-10-15	9	2	2	-3.84832	7.848324
2022-08-27	5	0	0	-5.84832	5.848324	2022-10-16	13	5	5	-0.84832	10.84832
2022-08-28	9	1	1	-4.84832	6.848324	2022-10-17	13	6	6	0.151676	11.84832
2022-08-29	9	1	1	-4.84832	6.848324	2022-10-18	13	6	6	0.151676	11.84832
2022-08-30	9	2	2	-3.84832	7.848324	2022-10-19	13	5	5	-0.84832	10.84832
2022-08-31	8	1	1	-4.84832	6.848324	2022-10-20	13	5	5	-0.84832	10.84832
2022-09-01	9	1	1	-4.84832	6.848324	2022-10-21	13	-			
2022-09-02	9	1	1	-4.84832	6.848324	2022-10-22	10	-			
2022-09-03	5	0	0	-5.84832	5.848324	2022-10-23	13	-			
2022-09-04	9	2	2	-3.84832	7.848324	2022-10-24	14	-			
2022-09-05	9	2	2	-3.84832	7.848324	2022-10-25	14	-			
2022-09-06	10	2	2	-3.84832	7.848324	2022-10-26	13	-			
2022-09-07	9	2	2	-3.84832	7.848324	2022-10-27	13	-			
2022-09-08	9	2	2	-3.84832	7.848324	2022-10-28	14	-			
2022-09-09	9	2	2	-3.84832	7.848324	2022-10-29	10	-			
2022-09-10	6	0	0	-5.84832	5.848324	2022-10-30	14	-			
2022-09-11	10	2	2	-3.84832	7.848324	2022-10-31	14	-			
2022-09-12	10	3	3	-2.84832	8.848324	2022-11-01	14	-			
2022-09-13	10	3	3	-2.84832	8.848324	2022-11-02	14	-			
2022-09-14	10	2	2	-3.84832	7.848324	2022-11-03	14	-			
2022-09-15	10	2	2	-3.84832	7.848324	2022-11-04	14	-			
2022-09-16	10	3	3	-2.84832	8.848324	2022-11-05	11	0	0	-5.84832	5.848324

Note. D: Date; P: Predictions; O: Override; FF: Final forecast; L: Lower; & U: Upper