Journal of Mountain Area Research Vol. 9, 2024
https://doi.org/10.53874/jmar.v9i0.203

Full length article

ANALYSIS OF COVID-19 DATA USING ARIMA-NEURAL ARTIFICIAL INTELLIGENCE

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ABSTRACT

An Auto Regressive Integrating Moving Average (ARIMA) - Neural Artificial Intelligence (Neural AI) are employed the nature and sustainability of the COVID-19 (2019-nCoV/SARS-CoV-2), pandemics, through the four different waves in the country Pakistan (from 26 Feb 2020 to 21 October 2020, first wave of epidemic, 22 October 2020 to 16 March 2021 second wave, 17 March 2021 to 10 July 2021 the third wave and 11 July 2021 to 30 September 2021respectively). the appropriate ARIMA (1, 1, 8) and (1,1,7) models for the 1st wave (26 Feb 2020 to 21 October 2020) to 4th wave (11 July 2021 to 30 September 2021) over to Pakistan are obtained on basis of small value of sum of square error (SSE), mean absolute Percentage Error (MAPE) and higher value of AIC/BIC. Afterwards, the Neural AI is also applied, which has one output neuron and many input neuron, inputs neurons for infectious cases reported in different regions of Pakistan (i.e., Punjab, Sindh, Khyber Pakhtunkhwa, Baluchistan, Gilgit Baltistan, Azad Jammu and Kashmir and capital city Islamabad). At this stage, the neural network is performed smoothly when which is delivered by only one predictor. Therefore, it is concluded that Neural AI results are more effective (with lower values of the sum of square error for both trained and testing data, along with related errors) compared to fitted ARIMA models. ARIMA models require a higher number of predictors and exhibit slightly higher error values. This conclusion is drawn to acquire univariate predictions for daily infected COVID-19 data series.

KEYWORDS: ARIMA, adequate model, COVID- 19 Pandemic, Artificial Intelligence

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1. INTRODUCTION

The Autoregressive Integrated Moving Average (ARIMA) and Artificial Neural Network (ANN) models are most significant and broadly applicable methodologies for analyzes of time series data. The eminence of the ARIMA models are obtained by statistical properties as the well-known Box –Jenkins procedure [1, 2]. In general, An ARIMA models are quite stretchy and represented various types of time series, such as pure autoregressive (AR), Moving Average (MA) and combined AR and MA(ARMA) series, that is a linear correlation erection is supposed amid the time series values and then, the nonlinear pattern of time series is computed by ARIMA model. It is interested point is that the guess of linear model to complex real world problem is not continually satisfactory. Artificial neural networks (ANNs) are broadly studied and used

in time series forecasting [2, 5, 6]. The major advantage of neural networks is their flexible nonlinear modeling capability. When authors are applied ANNs, there is no need to stipulate a specific model form. Slightly, the model is adaptively formed established on the structures accessible from of the data. This is suitable data driven approach for numerous empirical data sets which is available to propose a suitable data generating process. The AR (*p*, *d*, *q)* models have main four steps for checking stationary of data and suitable fitness of model, An ARIMA is forecasted the time series data with in the three ordered parameters (p, d, q), where "p" is stands for autoregressive model, "d" stands for differencing and "q" stands for moving average of the model, the procedure of Fitting in this model is raised as Box- Jenkins Method [1, 2, 3] the points p, d, q are the order of AR part, Difference and the MA part respectively, where AR is linear model whose variable of interest is reverted on its own lagged value is shown figure 1(a).

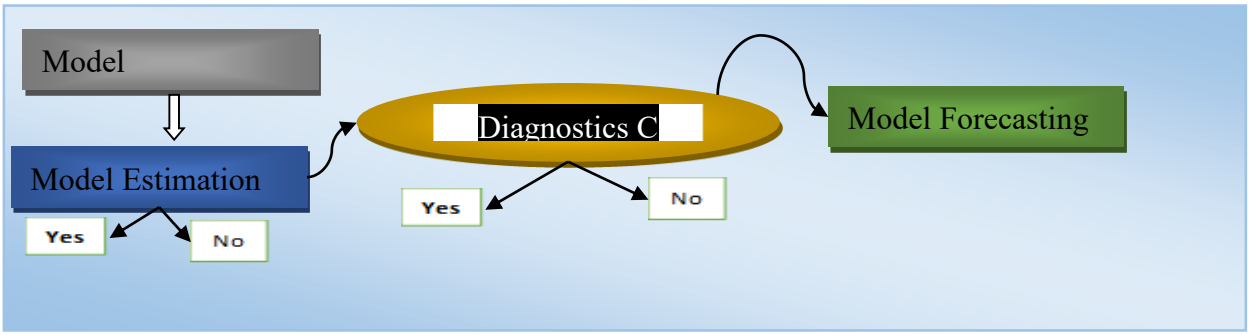

Figure 1(a). The Methodology of ARIMA Model (*p*, *d*, *q*).

In figure 1(a), is depicted an autoregressive (AR) model with the order, differencing is an approach, which is applied to make the time series stationary by subtracting the previous value particularly to remove trend or seasonality present in the data series, moving average operators is captured the connection among the current observation and the residual errors from previous forecasts.

In summary, the AR component models the relationship between the variable of interest and its past values, the differencing operation aims to make the time series stationary, and the MA component accounts for any remaining correlations in the time series after differencing. These three components together form an ARIMA (Auto Regressive Integrated Moving Average) model, which is a widely used model for time series analysis and forecasting.

Also, neural artificial NATs is called a simulated of the human brains, the brain has an ability to acquired new things, adjust to new and varying environment.it has been able to analyze the uncompleted and uncertain information and made its individual verdicts [1, 7, 8, 9]. The human brain is made up of neurons, there are above 1011 neurons in the human brain which connectively makes a network called neural network, through which they are connected which each other. Artificial Neural Networking ANN is an imitation of these neural networks where artificial neurons are linked in similar way as the brain network [3, 4, 6]. The model of AINN mostly composed of three layers known as, (a) Input Layer (b) Hidden Layer and (c) Output Layer. The model of the three layers, three input (x_1, x_2 and x_3), two bias terms and one output (y_1).

In this research authors are preferred the ARIMA model to predict the number of daily cases of Covid-19 in the year 2021 four time segments for prediction analyze. the epidemic peaks and estimating of the aspects of scopes and risk of the COVID-19 infectious disease via ARIMA and ANN models in the § 2.

2. DATA AND METHODOLOGY

To measure the precise forecasting of the pandemics of COVID-19 in Pakistan all over four waves of daily infected cases ranges from 26 February 2020 to 30 September 2021, daily infected data sets are divided in to four segments started from (26 Feb 2020 to 21 October 2020, 22 October 2020 to 16 March 2021,17 March 2021 to 10 July 2021 and 11 July 2021 to 30 September 2021 respectively).Data are attained from WHO, the regulations and coordination field epidemiology and disease surveillance division, National Institute of Health, Islamabad (government portal www.covid.gov.pk and www.emro.who.com).

2.1 Predictive Models

This study is applied and compared an autoregressive integrated moving average (ARIMA) and Artificial Neural Technology (NAT) , in order to make predictions for the daily number of COVID-19 infections in all four waves in the Pakistan An Auto-Regressive Integrated Moving Average (ARIMA) and Artificial Neural Network (ANN) techniques are applied to explore epidemiological phenomena, forecasting of epidemic peaks and estimating the aspects of scopes and risk of the infectious diseases , ARIMA is considered a model trends for forecasting of the infectious pandemics and known as powerful technique. The main characteristics of Neural Artificial Intelligence (Neural AI) is self-learning without earlier information of the nonlinear relationships that exist between the output and input variables and techniques have capacity to capture the small biases in the data and move them towards predictions of different models [1, 6, 9]. The ARIMA and Neural Artificial Intelligence (Neural AI) models structures are initially familiar, then the models with the preeminent error metrics are used to form the hybrid model, various researchers are advised, to evaluate the predictions of models suitability by the SSE, MASE (Mean Absolute Scaled Error), the MAPE (Mean Absolute Percentage Error) and the R^2 (Coefficient of Determination. The most appropriate ARIMA model for forecasting is also selected by value of HIC, BIC and AIC adequacy test. This study is determined the most accurate and precise model for the forecasting of Novel COVID-19 spreading trends in Pakistan region.

2.2 Development of ARIMA and Neural AI Models

Neural Artificial Intelligence (Neural AI) An ARIMA model is also applied to model the data [1,3,5,6]. An ARIMA order of the model is often used by expressive of ARIMA (p, d, q). The mathematically expression of the model is,

$$W_t = \frac{\mu + \theta(B)}{\emptyset(B)} a_t$$

Here,

W_t is designate the data time series of observed data (Y_t), at displays the independent random error , μ is the predictable value (that is called mean) in B is the back shift operator that is $BX_t = X_{t-1}$ $\emptyset\ (B)$ is the auto regressive operator which is obtainable as a mathematical expression in the back shift operator $\emptyset\ (B) = 1 - \emptyset_1 B - \cdots - \emptyset_p B^p$, $\theta(B)$ and $constant = \emptyset(B)\mu = \mu - \emptyset_1\mu - \emptyset_2\mu - \cdots - \emptyset_p\mu$ is the moving average operator denoted [1,3] as an expression in the back-

shift operator [Hussain, Abbas, & Ansari, 2012; Ljung & Box, 1978].

$$W_t = \mu + \sum_i \Psi_i B \quad X_{i,t} + n_t$$

Where $\Psi_i B$ is the transfer function time series, a proportion of ω and δ expression $\Psi_i(B) = (\omega_i(B)/\ \delta_i(B))B^{ki}$ is the noise series: $n_t = (\theta(B)/\ \phi(B))\ a_t$, this is the factor model.

$$W_t = \ \mu + \frac{\theta_1(\mathrm{B})\theta_2(\mathrm{B})}{\emptyset_1(B)\emptyset_2(B)} a_t$$

Where $\emptyset_1(B)\emptyset_2(B) = \phi(B)\theta_1(\mathrm{B})\theta_2(\mathrm{B}) = \theta(B), \phi$ and θ are to represent AR and MA orders of the ARIMA [1, 3, 5, 6].The Auto Regressive (AR) parts are limited the correlation amongst the existing values of the data series ,its previous values, AR (1) and AR(2) denotes that the existing values are correlated with instant previous values at time . The moving Average (MA) parts are representing the extent effect of random shocks, MA (1) and MA (2) which is indicated that the time t is correlated by the astonish at time t = 1 and t = 2.

ACF and PACF plots are constructed by differenced data to evaluate the autocorrelation and partial autocorrelation and partial autocorrelation of the stationary data series. These plots are applied to estimate the values of *p* and *q*. The ACF and PACF are constructed using actual, difference and transformed data. ARIMA modeling is ensured the accurate and robust time series forecasts.

An Neural Artificial Intelligence (NAI) Network is consisted the processing units known neurons, these artificial neurons is tried to imitate the behavior and structure of the natural neurons[5, 6, 9]. As alike ANN is inputs and one output. These neurons have a function which is determined the activation of the neurons. Inputs are writing as x_1, x_2, x_3 ..... X_n, the error also called the added with input and initialized its values as 1. The w_0, w_1, w_2, w_3.... W_n as weights, which are the connections to the signal. The product of these weights and inputs is given strength to the signal, analyzing the ensures the different neurons as an input from different sources there we have an output.

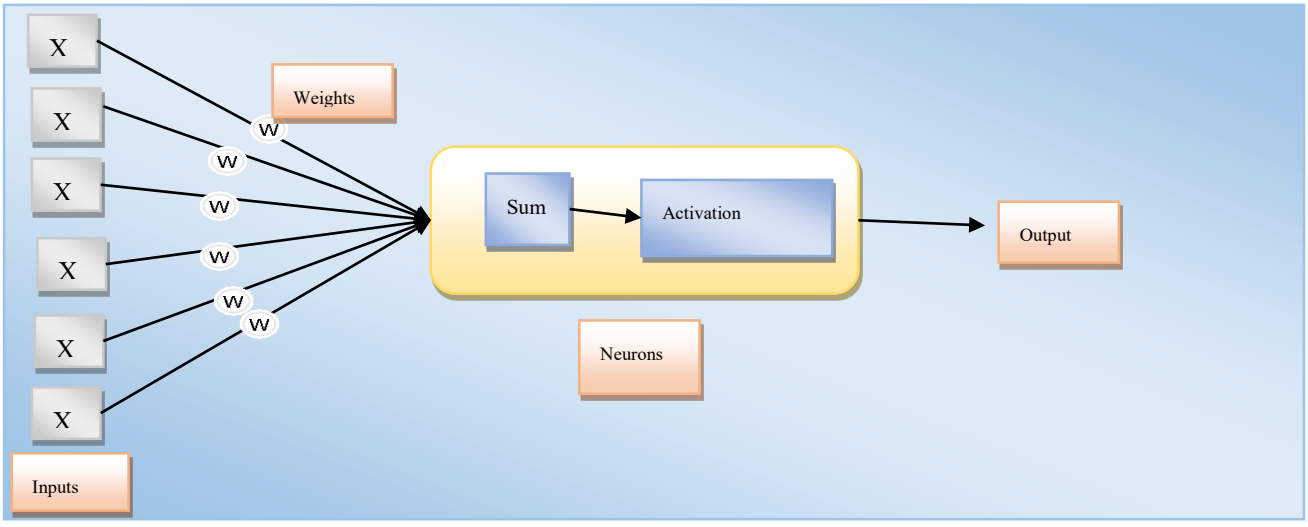

Figure 1(b). the model structure of Artificial Neural Network ANNs.

In the figure 1(b) is shown model of Neural Artificial Intelligence (Neural AI) model where X variables are inputs and W weights. The various functions are used for the activation of the model, but popular one is sigmoid function which is stated as

$$F(x) = \frac{1}{1 + e^{-x}}$$

Where,

$$Sum = \sum_{i=0}^{n} x_i w_i$$

The function other than Sigmoid are Linear, Step, ramp, and Hyperbolic Tangent function. Hyperbolic tangent function is same to the sigmoid but have limits from -1 to +1 while sigmoid have from 0 to 1. Sum is the weighted sum of the products of inputs and weights between the layers, sigmoid function used as an activation function which is an unceasing and differentiable calculations of the step functions, these interconnections between the neurons formed a neural network [6,8,9]. The model of ANNs generally serene of three layers is known as Input Layer, Hidden Layer and Output Layer. Input layers receives the input values while hidden layers are the set of neurons between output and input, it may be in single or multiple layers and the output layer have only one neuron are in figure 1(c) is indicated the model the three layers, three input (x_1, x_2 and x_3), two bias terms and one output (y_1). The weights are represented as W.

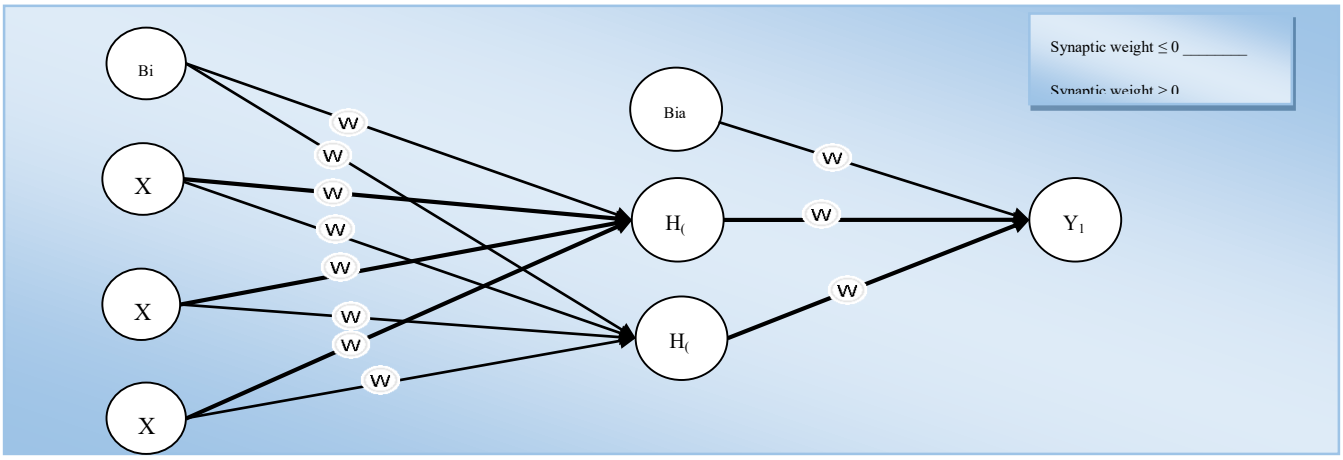

Figure 1(c). Artificial Neural Network model with Three inputs, two hidden and 1 output layers.

2.2 .1 Training- Testing Data Exploration

In Neural Artificial Intelligence (Neural AI), the training data are typically consisted of input-output pairs. The input data are used to predict the output, while the output data are the target values, the testing data are applied to assess how fit the trained model simplifies to new, unobserved examples. Which is empathetic the model's performance on real-world data.

In ARIMA, the training data are entailed a univariate time series. To determine the parameters of the ARIMA model, fitted to the training data to detention the patterns and dependencies in the time series, also. ARIMA model is training data is used to make forecasts on new unseen data and testing data is represented future time points outside the training period is used to calculate the accuracy of the fitted model predictions.

In certain, An ARIMA- Neural Artificial Intelligence (Neural AI) both methods are essential to divider the dataset into separate training and testing sets to certify an unbiased evaluation of the model's predictions. Basically, training data set is applied to optimize the parameters, Meanwhile the testing is obtained to assessing the generalization capabilities on unseen data.

2.3 Model Checking

2.3.1 Root Mean Square Error

The Root Mean Square Error is prediction values and true values alike the sum of error and variance based on difference between predicted values Yi and true value Xi, which is obtained by

$$RMSE = \sqrt{[\frac{1}{n}\sum_{i=1}^{n}(Y_i - X_i)]^2}$$

2.3.2 Synaptic Weight

The values of the weight are defined that the frequency / strength of the connections among the neurons, the weight has limits points which is lies between less than zero and above zero, which is calculated by the equation.

$$y_i = \sum_i w_{ij} x_i$$

2.3.3 Training -Testing Data

In ARIMA-NAINs is applied to types of data is as training data are those data which are feed to the model for their learning algorithms, up to 70 of the total data are preserved as a training data while the 30 percent data are considered as a testing data, which is provided an ultimate data values with simulate that the algorithm are trained effectively through making an accurate prediction.

3. RESULTS AND DISCUSSION

Auto-Regressive Integrated Moving Average (ARIMA) is chosen for trends and predicting modelling of the COVID-19 daily data segments in the case study of Pakistan from 26 February 2020 to 30 September 2021. Also, Neural Artificial Intelligence (Neural AI) techniques are used to more adequate forecasting and estimate the pandemic of COVID-19 peaks. which are main features being self-learning without earlier information of the nonlinear relationships that exist among the output and input variables to capture the small biases in the data and move them towards prediction of ARIMA-ANN models. In this research, authors are considered daily infected COVID-19 data for all of four pandemic waves (from 26 Feb 2020 to 21 October 2020, first wave of epidemic, 22 October 2020 to 16 March 2021 second wave, 17 March 2021 to 10 July 2021 the third wave and 11 July 2021 to 30 September 2021 forth waves respectively) over the country of Pakistan including Punjab, Sindh, Khyber Pakhtunkhwa, Baluchistan, Gilgit Baltistan, Azad Jammu and Kashmir and capital city Islamabad are depicted in figure 1.2 An ARIMA-ANNs modeling are performed.

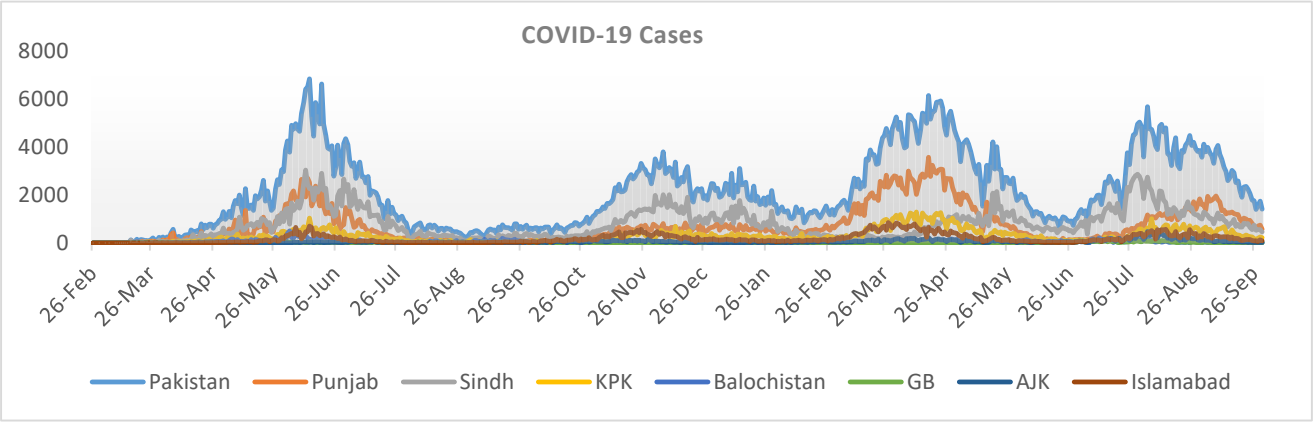

Figure 1.2: The COVID-19 infected data of Pakistan including Punjab, Sindh, Khyber Pakhtoon -Khuwa, Baluchistan, Gilgit Baltistan, Azad Jammu & Kashmir and capital City Islamabad (from 26 Feb 2020 to 30 September 2021)

By fitted ARIMA (1, 1, 8) model for first waves (from 26 Feb 2020 to 21 Oct 2020), fitted ARIMA (1, 1, 7) model for second to forth waves (from 22 October 2020 to 16 March 2021, 17 March 2021 to 10 July 2021 and 11 July 2021 to 30 September 2021) in total data sets of Pakistan is achieved excessive efficiency based on model parameter values selection in table 1.1(a-d) and figure 1.3(a-d) is depicted to predicted and residual values for fitted ARIMA model in all data series.

Table 1. 1(a). The parameter values of adequate ARIMA models for 1st wave in Pakistan

Variable	Coefficient	Standard error	T statics	Probability
C	3.1007	23.0745	0.1343	0.8932
AR (1)	-0.3034	0.0313	-9.6872	0.00
MA (8)	0.2181	0.0469	6.3558	0.00
SIGMASQ	118845.1	6144.405	19.342	0.00

Table 1.1 (b). The parameter values of adequate ARIMA models for 2nd wave in Pakistan.

Variable	Coefficient	Standard error	T statics	Probability
C	2.1007	18.0795	0.1043	0.2932
AR (1)	-1.3034	5.0313	-4.6472	0.00
MA (7)	0.2981	0.0649	7.3518	0.00
SIGMASQ	116750.1	3414.405	19.342	0.00

Table 1. 1(c). The parameter values of adequate ARIMA models for 3rd wave in Pakistan.

Variable	Coefficient	Standard error	T statics	Probability
C	4.1027	23.045	0.1343	0.3932
AR (1)	-0.3034	0.0513	-5.6522	0.00
MA (7)	0.1901	0.0342	5.586	0.00
SIGMASQ	118876.1	2144.405	13.342	0.00

Table 1.1 (d). The parameter values of adequate ARIMA models for 4th wave in Pakistan.

Variable	Coefficient	Standard error	T statics	Probability
C	3.1007	23.0745	0.1343	0.8932
AR (1)	-0.3034	0.0313	-3.6872	0.00
MA (7)	0.2081	0.0669	6.3558	0.00
SIGMASQ	113365.1	6144.405	10.342	0.00

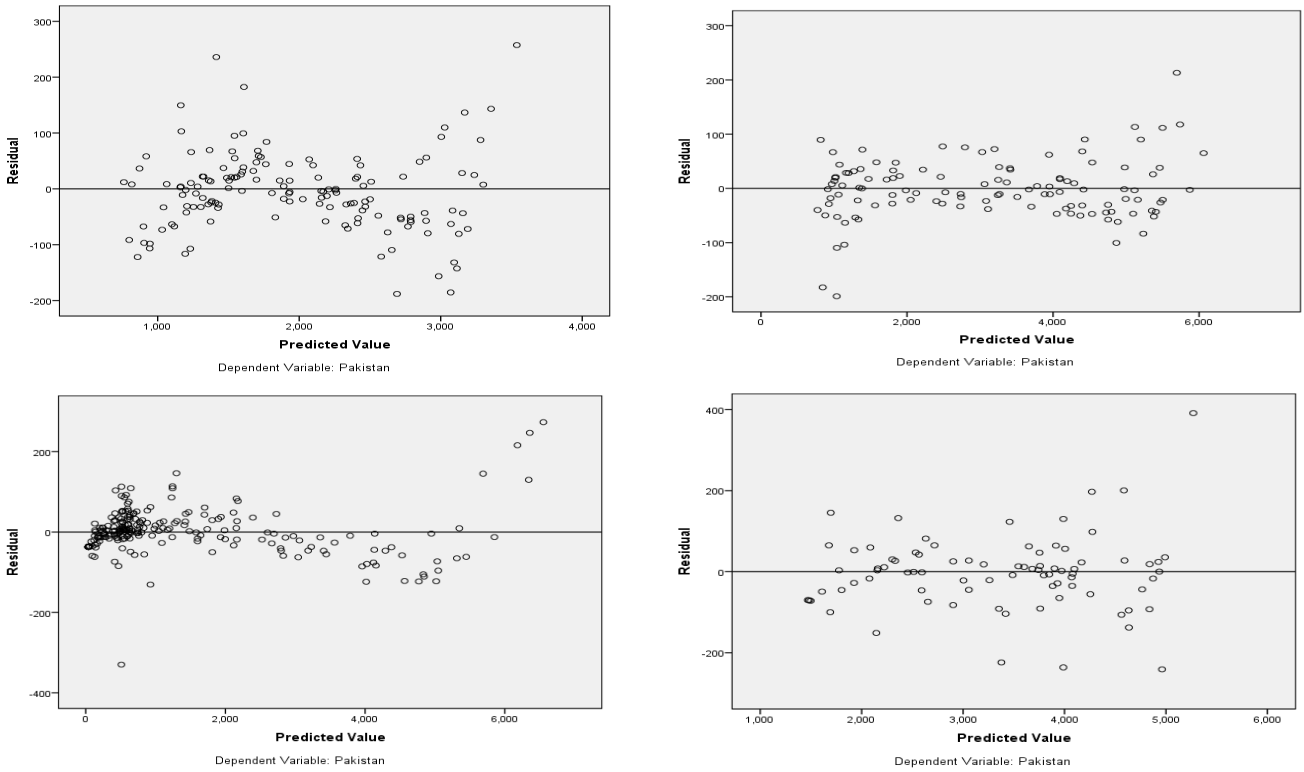

Figure 1.3(a-d) ARIMA model Predicted and Residual values in country Pakistan during 1st to 4th wave of COVID-19 pandemic.

Table 1.2. The Diagnostic test for adequate fitted ARIMA models on Novel COVID-19 1st to 4th waves from 26 Feb 2020 to 30 September 2021 in Pakistan.

Diagnostic Checking	1st wave	2nd wave	3rd wave	4th wave
Criterion	ARIMA (1,1,8)	ARIMA (1,1,7)	ARIMA (1,1,7)	ARIMA (1,1,7)
R-Square	0.1266	0.2549	0.1007	0.0782
SSE	28.2851	11667533	20887656	16756016
MSE	3.084	11.1379	-13.173	14.567
SER	347.673	287.660	433.793	466.487
F-Statistics	11.30722	16.080	4.144	2.178
Durbin-Watson	2.1289	2.0446	2.046	2.012
Log-likelihood	-1728.712	-1025.211	-859.67	-610.811
AIC	14.160	14.596	15.020	15.18
BIC	14.018	15.278	15.115	14.298
HIC	14.184	15.229	14.059	14.227
AIC/BIC	0.991032	0.994257	0.983715	0.982287
HIC/BIC	0.993674	0.996568	0.996295	0.995359

In table 1.2 suitable ARIMA models are analyzed by using model checking tests (SSE, R^2, symmetric error test, Durbin-Watson, Log-likelihood, Confidence, and prediction interval) and appropriate tests of selecting of best fitted models is based on (MAPE, HIC, BIC and AIC) for all waves of Pakistan. The smallest value of MAPE and little bit higher values of AIC/BIC is indicated the exponential increasing dynamic of 1st to 4th waves in data series over Pakistan.

An Neural AI model is used to detect the high generalization ability for prediction of COVID-19 pandemic over the all waves in Pakistan data series.an ANN model has considered input neuron layers are Punjab, Sindh, Khyber Pakhtunkhwa, Baluchistan, Gilgit Baltistan, Azad Jammu and Kashmir and capital city Islamabad with bias and hidden H(1:1) and H(1:2) and H(1:3) values are obtained and outputs layer is measured to total Pakistan data sets (see table 1.3(a-d).

Table 1.3 (a). The values of different hidden layers on the Artificial Neural Network ANN Model, design for the 1st wave of COVID-19 epidemic in country Pakistan.

Predictor	**Predicted**				**Output Layer**
	Hidden Layer				
Input Layer	**H (1:1)**	**H (1:2)**	**H (1:3)**	**H (1:4)**	
Bias	-.209	-.037	.201	-.559	
Punjab	7.288E-7	-.078	-.016	.321	
Sindh	-.048	-.194	-.056	.266	
KPK	.416	-.201	-.014	-.261	
Baluchistan	.221	.067	-.017	-.037	
GB	-.177	.019	-.146	-.001	
AJK	.157	-.020	.071	-.025	
Islamabad	-.177	.118	-.199	.143	
Output layer					
Bias					.776
H (1:1)					.558
H (1:2)					-.889
H (1:3)					-.811
H (1:4)					1.117

Table 1.3 (b). The values of different hidden layers on the Artificial Neural Network ANN Model, design for the 2nd wave of COVID-19 epidemic in country Pakistan.

Predictor	**Predicted**			**Output Layer**
	Hidden Layer			
Input Layer	H (1:1)	H (1:2)	H (1:3)	
Bias	-.249	.208	.107	
Punjab	.078	-.119	.167	
Sindh	.270	-.374	.291	
KPK	.090	.147	.065	
Baluchistan	.059	-.111	-.064	
GB	.107	.026	-.114	
AJK	.052	-.243	-.047	
Islamabad	.042	.143	.106	
Output layer				
Bias				.213
H (1:1)				1.366
H (1:2)				-.168
H (1:3)				1.218

Table 1.3 (c). The values of different hidden layers on the Artificial Neural Network ANN Model, design for the 3rd wave of Novel COVID-19 epidemic in country Pakistan.

Predictor	**Predicted**				**Output Layer**
	Hidden Layer				
Input Layer	**H (1:1)**	**H (1:2)**	**H (1:3)**	**H (1:4)**	
Bias	-.378	-.422	.265	.206	
Punjab	-.217	-.152	-.716	-.690	

Sindh	-.479	-.120	-.495	.334	
KPK	-.400	.077	-.351	-.171	
Baluchistan	-.227	-.045	.018	.152	
GB	.405	-.376	-.200	.396	
AJK	.315	-.131	-.103	-.159	
Islamabad	-.420	-.393	.211	.012	
Output layer					
Bias					.016
H (1:1)					-.395
H (1:2)					-.137
H (1:3)					-.660
H (1:4)					-.602

Table 1.3 (d). The values of different hidden layers on the Artificial Neural Network ANN Model, design for the 4th wave of Novel COVID-19 epidemic in country Pakistan.

Predictor	**Predicted**			**Output Layer**
	Hidden Layer			
Input Layer	**H (1:1)**	**H (1:2)**	**H (1:3)**	
Bias	.405	.013	-.095	
Punjab	.113	.097	.573	
Sindh	.065	.269	.191	
KPK	.382	-.018	-.085	
Baluchistan	.215	-.009	-.173	
GB	-.201	.103	-.074	
AJK	-.013	.012	.278	
Islamabad	.160	.117	-.279	
Output layer				
Bias				-.232
H (1:1)				.796
H (1:2)				1.819
H (1:3)				.483

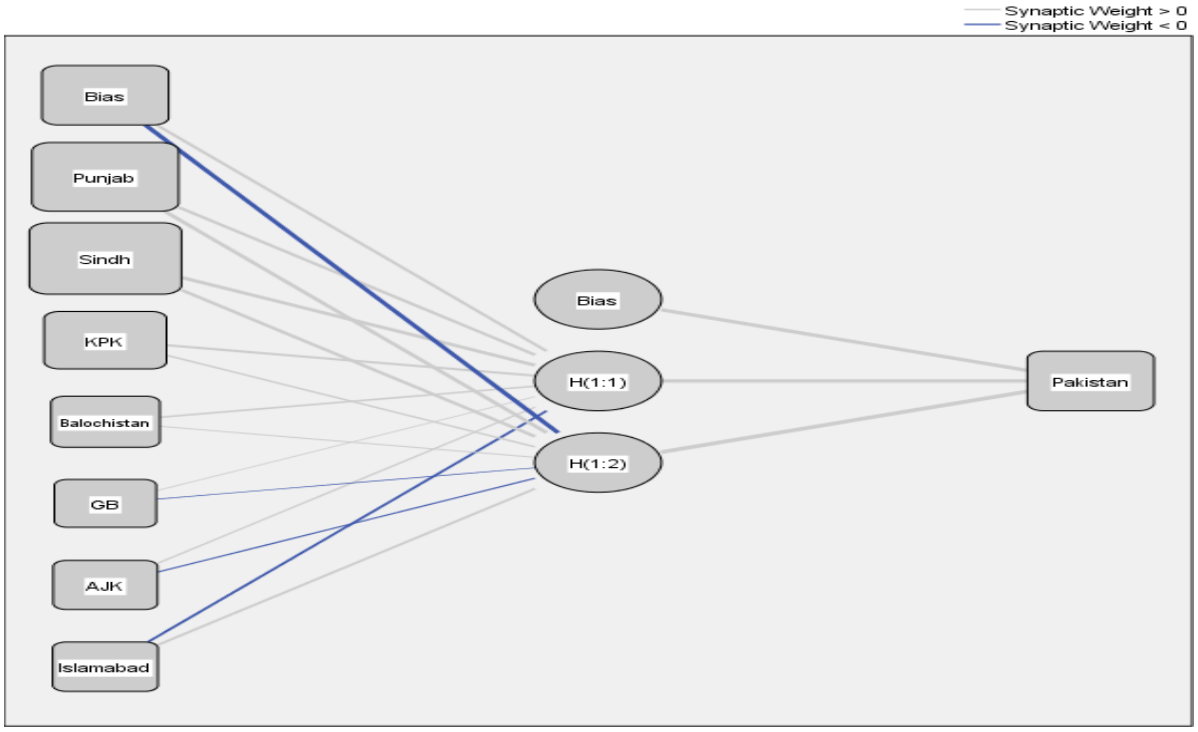

Figure 1.4 (a). Artificial Neutral Network ANN model of the first wave from (26th Feb 2020 to 21st Oct 2020) along the three layers, seven input (Punjab, Sindh, Khyber Pakhtoon Khuwa, Baluchistan, Gilgit Baltistan, Azad Jammu & Kashmir and capital City Islamabad), two bias terms and one output (Pakistan).

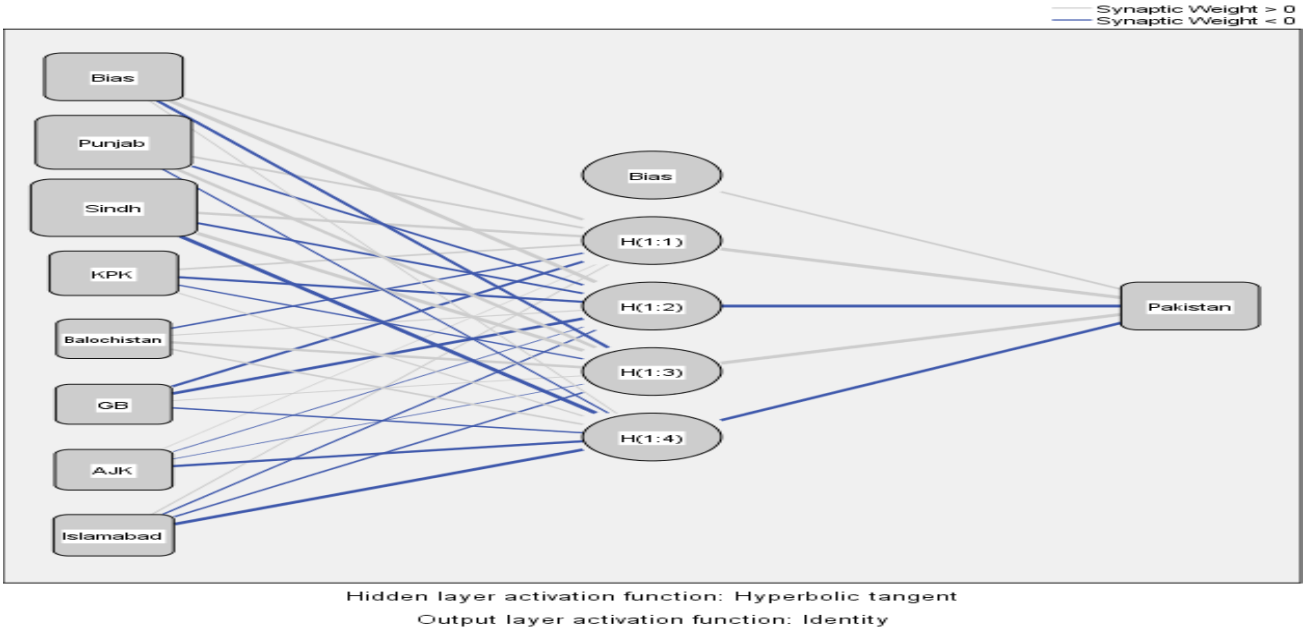

Figure 1.4 (b**)**. Artificial Neutral Network ANN model of the second wave from (22nd Oct 2020 to 16th March 2021) with the three layers, seven input (Punjab, Sindh, Khyber Pakhtoon Khuwa, Baluchistan, Gilgit Baltistan, Azad Jammu & Kashmir and capital City Islamabad), two bias terms and one output (Pakistan).

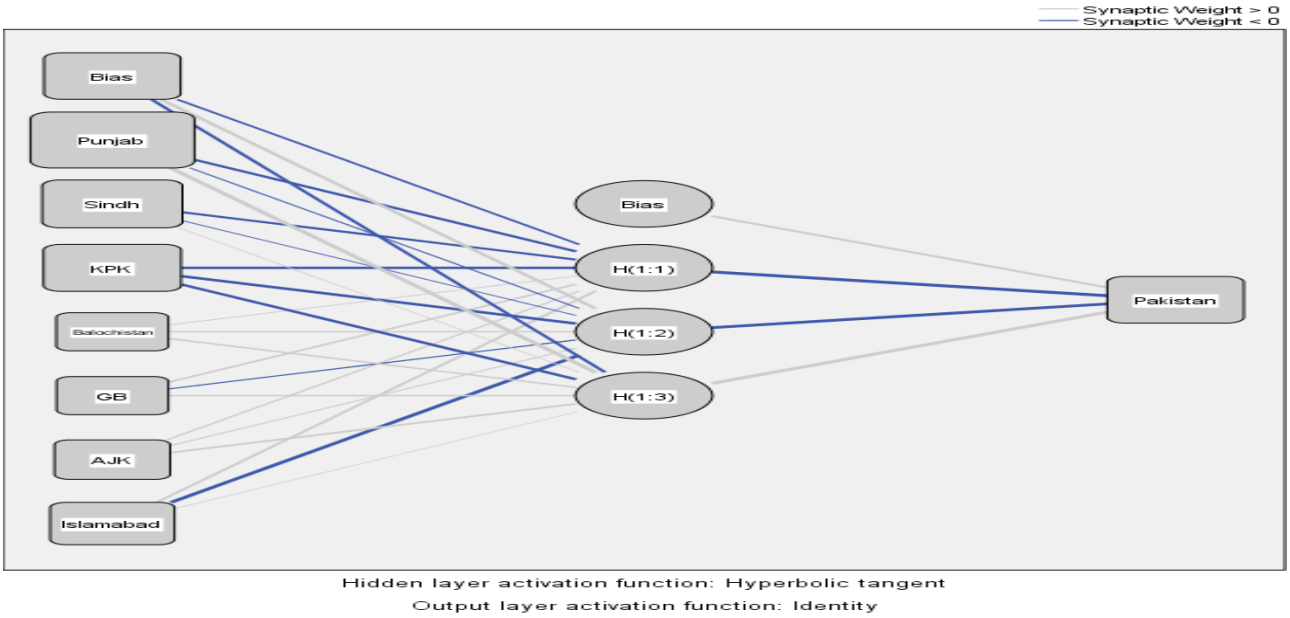

Figure 1.4 (c). Artificial Neutral Network ANN model of the third wave from (17th March 2021 to 10th July 2021) with the three layers, seven input (Punjab, Sindh, Khyber Pakhtoon Khuwa, Baluchistan, Gilgit Baltistan, Azad Jammu & Kashmir and capital City Islamabad), two bias terms and one output (Pakistan).

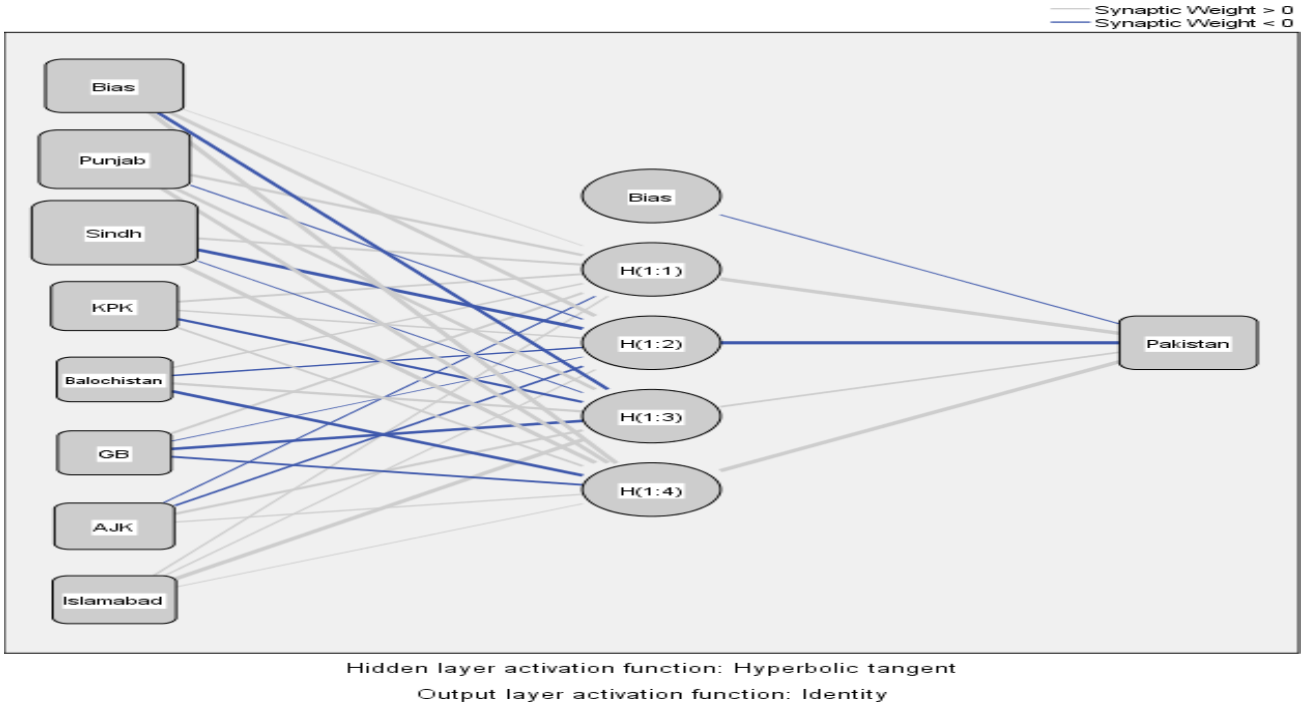

Figure 1.4 (d). Artificial Neutral Network ANN model of the forth wave from (11th July 2021 to 30th September 2021) with the three layers, seven input (Punjab, Sindh, Khyber Pakhtoon Khuwa, Baluchistan, Gilgit Baltistan, Azad Jammu & Kashmir and capital City Islamabad), two bias terms, four Hidden layers and one output (Pakistan).

In figure 1.4(a-d) is presented an ANN model of the first wave from (26 Feb 2020 to 21 October 2020, 22 October 2020 to 16 March 2021,17 March 2021 to 10 July 2021 and 11 July 2021 to 30 September 2021,) thru the three layers, seven input (Punjab, Sindh, Khyber Pakhtoon-Khuwa, Baluchistan, Gilgit Baltistan, Azad Jammu and Kashmir and capital City Islamabad), two bias terms and one output (Pakistan). Meanwhile the results of all of four waves are so diminutive along with ANN usage, which is possible to conclude that the purposed ANN models are explored adeptness for prediction as compare to selected ARIMA model , the sum of square and related error values for training and testing data sets of 1st wave is 0.128 and 1.002 and 0.051 and 0.001, 2nd to 4th waves are 0.372 and 0.008, 0.044 and 0.001, 0.194 and 0.007 where 0.317 and 0.007, 0.028 and 0.002, 0.098 and 0.011respectively (see table 1.

Table 1.4. Summary of the Artificial Neural Network ANN model of all four waves of Novel COVID-19 in country Pakistan.

Variables	Sum of Square Error		Relative Error	
	Training Data	Testing Data	Training Data	Testing Data
1st Wave	0.128	0.051	0.002	0.001
2nd Wave	0.372	0.317	0.008	0.014
3rd Wave	0.044	0.028	0.001	0.002
4th Wave	0.194	0.098	0.007	0.011

The results are detected to peaks of infectious COVID-19 2nd to 3rd segment (27 May to 30 June 2020) are confirmed speedily pandemic of COVID-19 disease, reason behand is overcrowding and breakage of social distancing. The result of the study is ensuring the applicability of ANN for the daily based prediction in the duration over all of four segments of pandemic. But ANNs model has less values of SSE for trained and testing data with related error as compared to ARIMA has high values of predictor error. Meanwhile, the ARIMA-ANN both models will be useful for assessing the effects of mediations, enhancing the strategies influence and for generating the long- and short-time predictions.

CONCLUSION

The present study is investigated the outbreak of COVID-19 pandemic in Pakistan. The results are showed the high generalization ability of the ANNs for short-term predictions of the pandemic outbreak of COVID-19. The Neural Artificial Intelligence (Neural AI) - ARIMA models are also confirmed the peak of pandemic. This research will be enhancing scientific aspects of health and information technology including socio economic and environmental planning. Which is facilitate a base for developing mathematical valuations procedure to rally the worsening administrative, health planning, faculties and researcher will be trained in solicitation of mathematics to real world problem.

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Received: 08 January 2024. Revised/Accepted: 08 May 2024.