MEDICAL CHANNEL

Original Article

FORECASTING OF ROAD TRAFFIC ACCIDENT INJURIES IN BAHAWAL VICTORIA HOSPITAL OF BAHAWALPUR

** Jamal Abdul Nasir, ** Muhammad Imran ***Syed Arif Ahmed Zaidi*

* Department of Statistics, MS Scholar, Director Sub Campus Rahim Yar Khan (RYK) & Assistant Professor of Statistics, The Islamia University of Bahawalpur, Pakistan, **Department of Statistics, MS Scholar, *** Department of community medicine, Quaid-e-Azam Medical College Bahawalpur,

ABSTRACT

Objectives: To forecast the monthly road traffic accident injuries (RTAIs) cases in BahawalVictoria Hospital (BVH) of Bahawalpur.
Design: The reported data for the present study with total time series entity 51 taken from BVH.
Period: March 2011 to May 2015.
Setting: BVH.
Methods: Artificial neural network (ANN) analysis has been carried out to forecast the RTAIs.
Results: Descriptive analysis revealed that from March 2011 to May 2015, total 189176 RTAIs cases are admitted in BVH, the average per month RTAIs cases are(3709 ± 577). Under the ANN algorithm, the efficient model has six input nodes, eleven hidden nodes and one output node with back propagation learning rate 0.05 and preferred activation function as hyperbolic tangent function. The established ANN model revealed that the increment for RTAIs cases is 4% expected in next six month.
Conclusions: RTAIsare expected to rise in BVH. These statistical outcomes about RTAIs and forecasting their incidence is an emerging for adequate planning and policies so that general public health related morbidity and mortality can be declined.

Keywords: Artificial neural network;Bahawalpur; forecasting model; road traffic accident injuries

Correspondence:
JAMAL ABDUL NASIR
MS Scholar
Department of Statistics,
Imranshakoor84@yahoo.com,
Director Sub Campus Rahim Yar Khan (RYK) & Assistant Professor of Statistics,
The Islamia University of Bahawalpur, Pakistan:
njamal76@hotmail.com

INTRODUCTION

Road traffic injuries has become a major public health concern, but preventable.Every year more than a million people lost their lives on the world's roads while the non-fatality injuries between 20 to 50 million.[1] The burden of RTAs is higher in developing countries, the RTAs fatalities and disabilities in low- and middle income countries are more than 85% and 90% respectively.[2]Africa has the higher rate (24.1/100000) and the European region has the lower rate(10.3/

100000), while south Asia placed on fourth (18.5/100000).[1] The globally annual road traffic fatality rate for overall, middle-income, low-income and high-income countries are 18/100000, 20.1/100000, 18.3/100000 and 8.7/100000 respectively.[1] Globally the death rate is much higher in Pedestrians, motorcyclists, cyclists and the passenger use public transport including Asia.[3-6] RTAs have become a fifth leading cause of death in 2030.[3] The poor road condition, traffic infrastructure, rapid motorization and the behaviour of road users caused an increment in RTAs fatalities and injuries in developing countries and continue to rise.[7] The major and the mutual causes of traffic road accident in throughout the globe are vehicle related factors, human related factors and environmental related factor.[8] The major factors that caused for RTAs in developing countries that contributes to the high rate of crashes are , lack of safety belt and helmet use, a large number of old vehicles on roads that often carry more people than their capacity and design, poor road design and maintenance and the traffic mix on roads.[9]

RTAs in Pakistan:

Pakistan is a developing country and ranked as a 6th most populous country in the globe. In Pakistan, the pedestrians and the rider of motorized (2 or 3 wheelers) at on greater risk and the leading cause of RTAs fatalities 41% and 39% respectively.[1] The main reason of traffic road accident is lack of awareness about traffic sense codes and orders, driver related factor, overloading over speed use of cell phone during driving and vehicle related factor.[10] In a survey based analysis in Islamabad the capital of Pakistan, was found the overall deficient about road safety awareness, while the data taken from the hospital showed that 87% RTAs cases due to negligence of traffic law.[11] The poor enforcement of traffic laws on seat-build and helmet wearing in Pakistan.[12] The enforcement of the new road laws plays a vital role in the reduction of RTAs and mortality.[13] The impact of traffic road accident is significantly associated with the victim and their families and the national economy particularly for developing .[3, 14] The roughly estimated cost related to traffic crashes is 1%, 1.5% and 2% of Gross national product in lower middle and high income countries respectively.[3] For Pakistan that cost is estimated to be 2% of the Pakistan's GDP.[15]

Prediction of RTAs using ANN:

Effective implementations of mathematical and statistical models that allow better understanding the level, trend and predicting its development. ANN used extensively to predict the RTAs occurrences in recent years.[16-20]

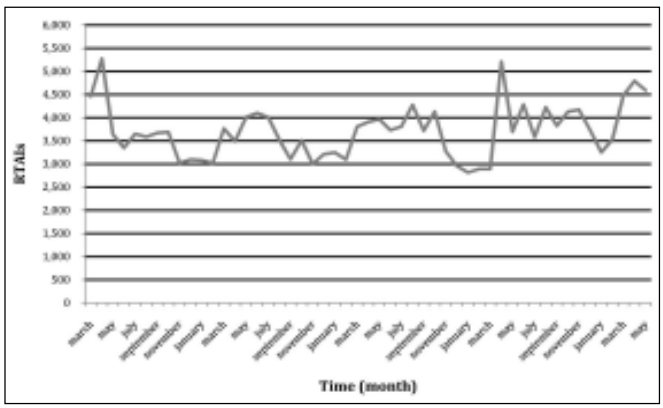
METHOD AND MATERIAL

The reported per month data for the present study with total time series entity 51 taken from BVH from March 2011 to May 2015.Artificial neural network approach has been achieved much popularity in last few years and applied in many different areas, especially for forecasting and classification purposes.[21-23]The basic objective of ANNs was to construct a model for mimicking the intelligence of human brain into machine. Similar to the work of a human brain, ANNs try to recognize regularities and patterns in the input data learn from experience and then provide generalized results based on their known previous knowledge. The formulation of ANNS depends upon a set of layers namely input layer, hidden layers, and output layer. These layers further comprise interconnections between the nodes of successive layers through the weights. The internal weights of the network are adjusted by an iterative process called training and the algorithm used for this purpose called training algorithm.An appropriate ANN model can be selected by taking into account the various sets of nodes with least accuracy measures. Among various activation functions like logistic sigmoid function, linear, hyperbolic tangent, Gaussian, etc. can also be used.[24]

TABLE 1
DESCRIPTIVE STATISTICS

Minimum	Maximum	Range	Sum	Mean	Std	Skewness	Kurtosis
2814	5273	2459	189176	3709	577	0.12	3.08

FIGURE 1
TIME PLOT OF RTAIS IN VICTORIA HOSPITAL BAHAWALPUR



RESULTS AND DISCUSSION

Descriptive analysis: The average per month record of RTAIs cases at Victoria Hospital Bahawalpur along with absolute measure of dispersion are reported in Table 1.

TABLE 2
ANN MODEL SELECTION USING VARIOUS COMBINATIONS OF INPUT AND HIDDEN LAYERS AND RMSE

Hidden Layer Neurons	**Input Layer Neurons**					
	1	2	3	4	5	6
1	505.31	477.97	457.87	461.31	462.79	467.75
2	487.45	478.30	427.85	361.40	362.89	355.08
3	484.85	478.54	423.83	329.09	292.39	271.34
4	484.58	479.11	379.27	313.06	296.36	248.53
5	483.11	478.91	377.74	316.18	235.45	140.52
6	493.30	479.37	367.42	255.74	224.81	93.86
7	473.32	480.92	374.65	305.72	124.35	170.74
8	482.99	481.06	373.59	272.79	137.67	88.75
9	482.69	481.33	388.60	222.53	127.65	108.81
10	465.66	480.50	334.13	207.78	160.70	91.58
11	469.51	481.37	355.20	227.90	91.50	65.22*
12	471.40	479.74	368.52	215.08	85.19	100.31

***lowest value of RMSE**

TABLE 3:
EXPECTED PER CENT CHANGE UNDER SELECTED ANN MODEL

Actual (Dec 2014 to May2015)	**Forecast (Nov 2014 to Apr 2015)**	**% change**
24367	25291	4

APPENDIX: A

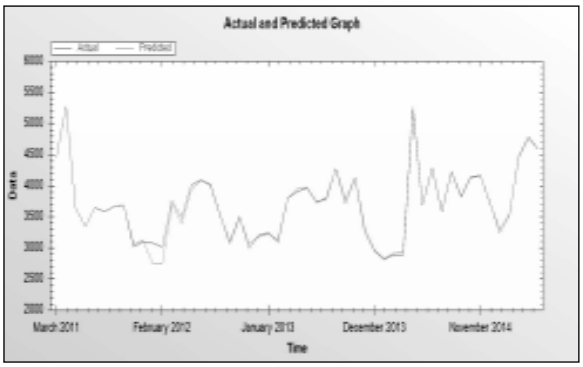


FIGURE 2: A PLOT OF ACTUAL AND PREDICTED

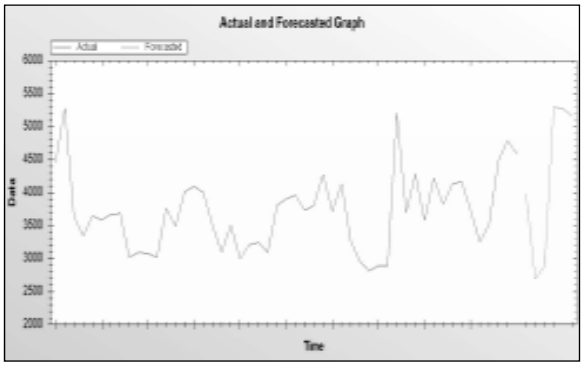


FIGURE 3: A PLOT OF ACTUAL AND FORECASTED

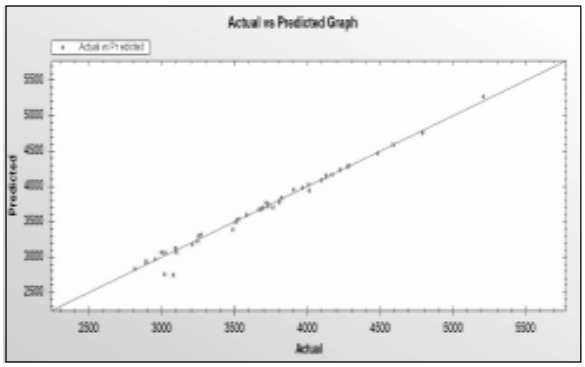


FIGURE 4: A PLOT OF ACTUAL VS PREDICTED

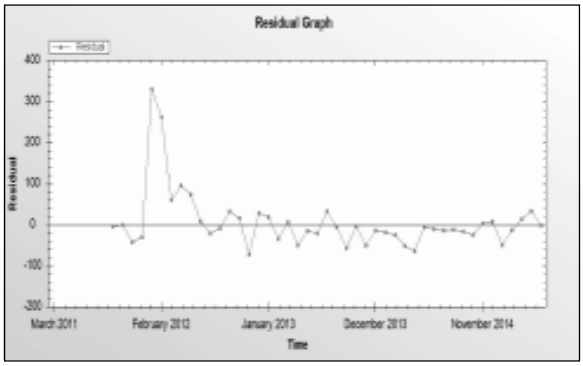


FIGURE 5: A PLOT OF RESIDUAL

From March 2011 to May 2015, total 189176 RTAIs cases are admitted in Victoria Hospital Bahawalpur. The average per month RTAIs cases admitted in hospital are (3709 ± 577).

Temporal analysis: A time plot of 51 month's (from March 2011 to May 2015) of RTAIs cases are depicted in Figure. The maximum (5273) and the minimum (2814) RTAIs cases arrived in April 2011 and January 2014. (Figure1).

ANN Analysis: To achieve an efficient ANN model for forecasting the monthly RTAIs cases different set of parameters .i.e. input and hidden layers (weights) are executed by using the learning rate 0.05 and hyperbolic tangent function as an activation function while the maximum number of iteration used 3000. The detail description of various set of nodes and root mean square error are illustrated in Table 2. The established efficient ANN model has 11 hidden layers, 6 input layers and 1 output layer with least root mean square error 65.22.

The graphical illustration of the final selected model is shown form Figure 2 through figure 5 (appendix A). The predicted values agree well the actual values are shown in Figure 2 by taking the monthly RTAIs along y-axis and time (month) along x-axis. Half year forecast made successfully under the selected ANN model (Figure 3) the expected increment 4% in next six month (Table 3). The plot of residual showing the pattern of randomness (Figure 5) and the plot of actual versus fitted is illustrated in Figure 4.

CONCLUSION

After the implementation of artificial neural network algorithm, the efficient model has six input nodes, eleven hidden nodes and one output node with back propagation learning rate 0.05 and preferred activation function as hyperbolic tangent function is an optimum forecasting model for the monthly RTAIs cases in BVH of Bahawalpur. The availability of these statistical outcomes will serve as a guide to formulate adequate policies regarding hospital emergencies serveries so that the morbidity and mortality due to RTAIs can be declined.

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