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Predicting Consumer Behaviour Using Artificial Neural Network

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Abstract: **A***rtificial Neural Networks (ANNs), a computational model inspired by the architecture of the human brain, exhibit certain features such as the ability to learn complex patterns of information and generalize the learned information. They are used for a number of data analysis tasks such as prediction, classification and clustering. They can operate even with partial and noisy information. In this paper, an application of ANN for predicting consumer behaviour has been discussed. It helps marketers to understand how consumers behave from alternatives (like products, brands and the like) and how consumers are influenced by their environment (reference groups, their family, salespersons and so on). Consumers' buying behavior is influenced by their cultural, social, personal and psychological factors. Most of them are uncontrollable and beyond the hands of marketers, but they have to be considered while trying to understand the complex behaviour of consumers. This paper is focused to understand the behaviour of consumers towards the purchase of two-wheelers by using an artificial neural network.*

Keywords: Artificial neural networks, consumer behaviour, prediction.

I. INTRODUCTION

Neural Networks are massive parallel distributed processes that have a natural propensity for storing experiential knowledge and making it available for use. Neural Networks are powerful data mining and modeling techniques that are capable of capturing and identifying complex relationships by input/output mechanism. The greatest advantage of Neural Networks is its ability of learning both linear and non-linear relationships in the modeling dataset. Since the development of ANNs is inspired from the human brain, it resembles the brain in two respects:

- Knowledge is acquired by the network from its environment through a learning process, i.e. learn from examples.
- Inter - neuron connection strengths, known as synaptic weights, are used to store the acquired knowledge. The accuracy of the acquired knowledge increases as the number of examples increases.

Based on connection methods among the neurons and the information flow directions in the network, neural network models can be divided into two kinds. Firstly, the feed forward neural network that has only forward information transfer but no feedback information. Second, the feedback neural network that has not only forward transfer of information but also reverse transfer (feedback) information. In this paper, a feed forward and back propagation neural network is used.

II. PREDICTING CONSUMER BEHAVIOUR USING NEURAL NETWORK

For predicting purchase behaviour of the consumers of two-wheeler companies, a survey was conducted which involved 400 consumers from different areas of Jodhpur city. The questionnaire used for the survey consists of 26 questions for collecting detailed information about consumers and five leading two-wheeler companies. For the survey data, a neural network has been developed which takes the 26 variables as input and predict the choice of the consumer. The variables considered for predicting the consumer behaviour are monthly income, profession, source of purchase, decision maker for purchase, purchase by cash or loan, availability of service provider, after sales service, before sales service, infrastructure, price satisfaction, less maintenance requirement, style, durability, mileage, easy driving, brand reputation, colour, special offer, exchange offer, special gift, cash discount, mileage after purchase, availability of service provider after purchase, price satisfaction after purchase, after service satisfaction, on road pickup and maintenance service.

The descriptions of the variables including their role, type and code are shown in Table 1.

Table 1: Description of Variables

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S. No	Variable Name	Role	Variable type	Description
1.	Name of the Company	Target	Binary	1. Bajaj 2. Yamaha 3. Royal Enfield 4. Hero Honda 5. TVS
2.	Monthly Income	Input	Categorical	1. Below 10,000 2. 10,000-20,000 3. 20,000-30,000 4. 30,000-40,000 5. 40,000 above
3.	Profession	Input	Categorical	1. Businessman 2. Others 3. Service 4. Student
4.	Source of purchase	Input	Categorical	1. Others 2. Newspaper 3. Friends 4. Parents 5. T.V
5.	Decision maker	Input	Categorical	1. Self 2. Parents 3. Brother/Sister 4. Others
6.	Cash/Loan	Input	Categorical	1. Cash 2. Loan
7.	Availability of service provider	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
8.	Before sales service	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
9.	After sales service	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
10.	Infrastructure	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
11.	Price	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
12.	Less Maintenance	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good

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				5. Excellent
13.	Style	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
14.	Durability	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
15.	Mileage	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
16.	Easy driving	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
17.	Brand reputation	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
18.	Color	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
19.	Special Offer	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
20.	Exchange offer	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
21.	Special gift	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
22.	Cash discount	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
23.	Mileage (After purchase)	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good

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				5. Excellent
24.	Price satisfaction (After purchase)	Input	Categorical	1. Poor. 2. Average 3. Good 4. Very good 5. Excellent
25.	Availability of service provider (After purchase)	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
26.	After service satisfaction (After purchase)	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent
27.	On road pickup maintenance (After purchase)	Input	Categorical	1. Poor 2. Average 3. Good 4. Very good 5. Excellent

III. IMPLEMENTATION AND RESULTS

- The neural network model for the prediction of consumer behaviour based on the survey data is created in Matlab software, as shown in Figure 1. For the training and validation of the neural network, the sample data is first partitioned into a training sample (70%), test sample (15%) and validation sample (15%). The training sample data is used to build and train the model. The test sample data is used for the testing of the model and the validation sample data is used for the validation of the model. Different results obtained from the network have been shown in the given figures 1-5. Figure 1 describes the type of a neural network and its working developed in Matlab software for predicting consumer buying behaviour based on the survey data. The network model shows that 26 input variables have been taken from detailed questionnaire with 52 hidden layers to predict consumer buying behaviour about five leading two-wheeler companies. The working of neural network has also been shown in the figure.

- Figure 2 shows the performance of the neural network model obtained after 6 iterations and it can be seen from the figure that best performance is obtained at epoch 3.

- Figure 3 shows results of regression analysis obtained from the neural network and results shows the trend line with R = 0.75908 which are quiet satisfactory as obtained from training, validation and testing of the survey data. It shows close agreement with the actual consumer buying behaviour obtained from the survey data.

Figures 4, figure 5 and figure 6 shows error histogram with 20 bins and errors and sorted errors respectively and it can be seen that errors obtained are quiet less which shows that performance of the network is quiet good enough to predict the consumer buying behaviour at the time of two-wheeler purchase.

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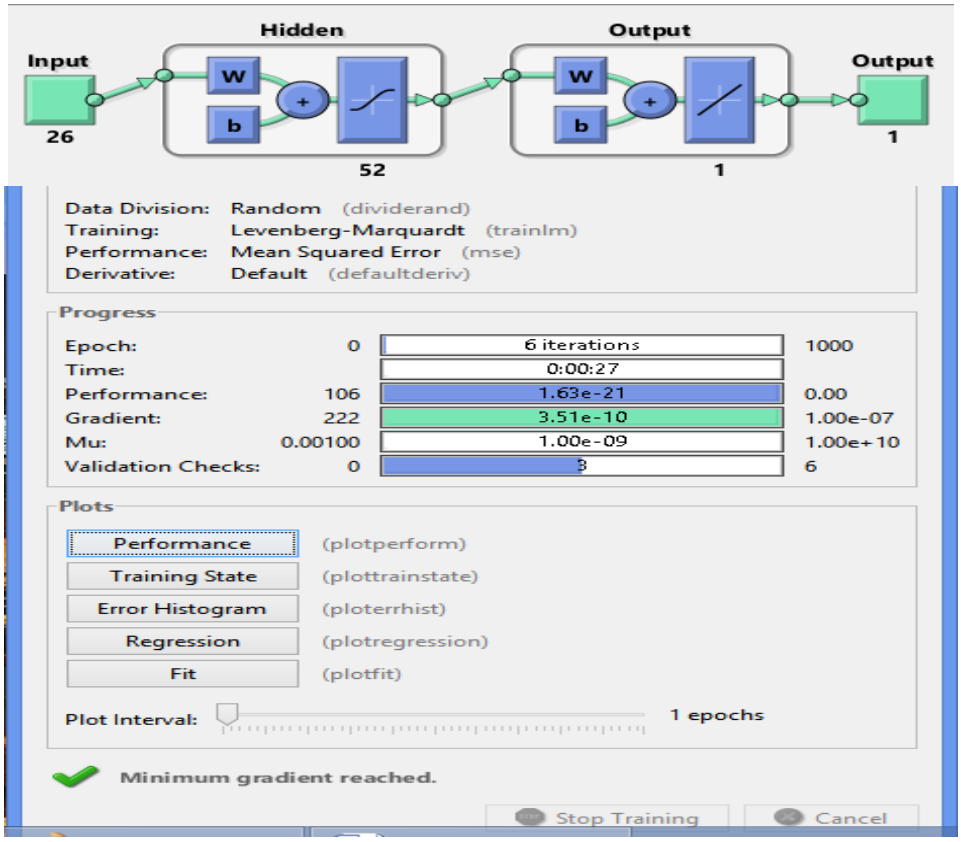

Figure 1: The neural network used and its training

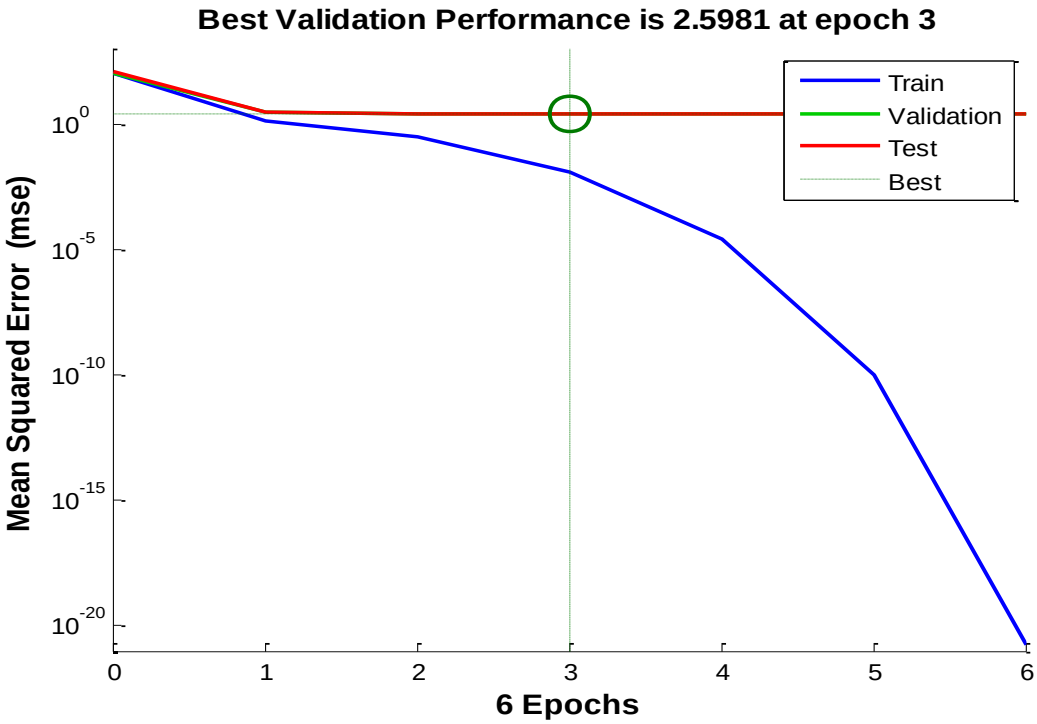

Figure 2: Performance of the network

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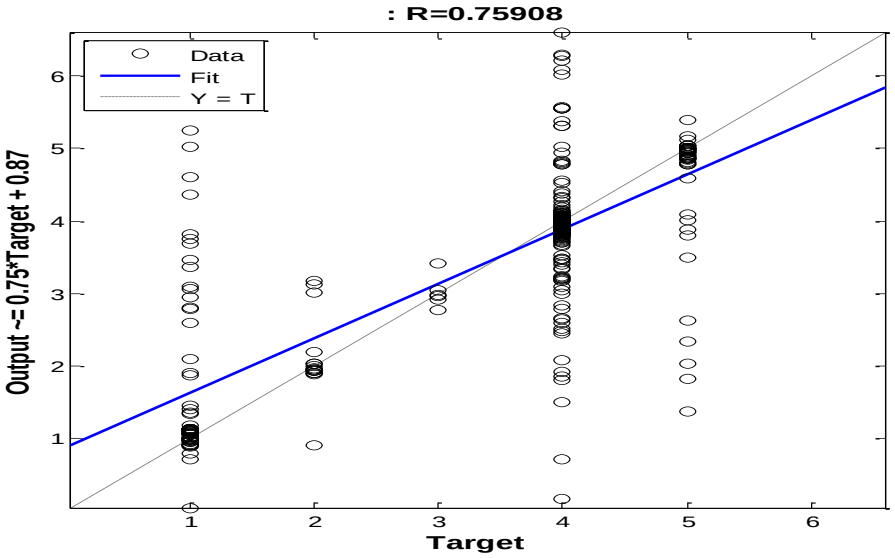

Figure 3: Regression analysis

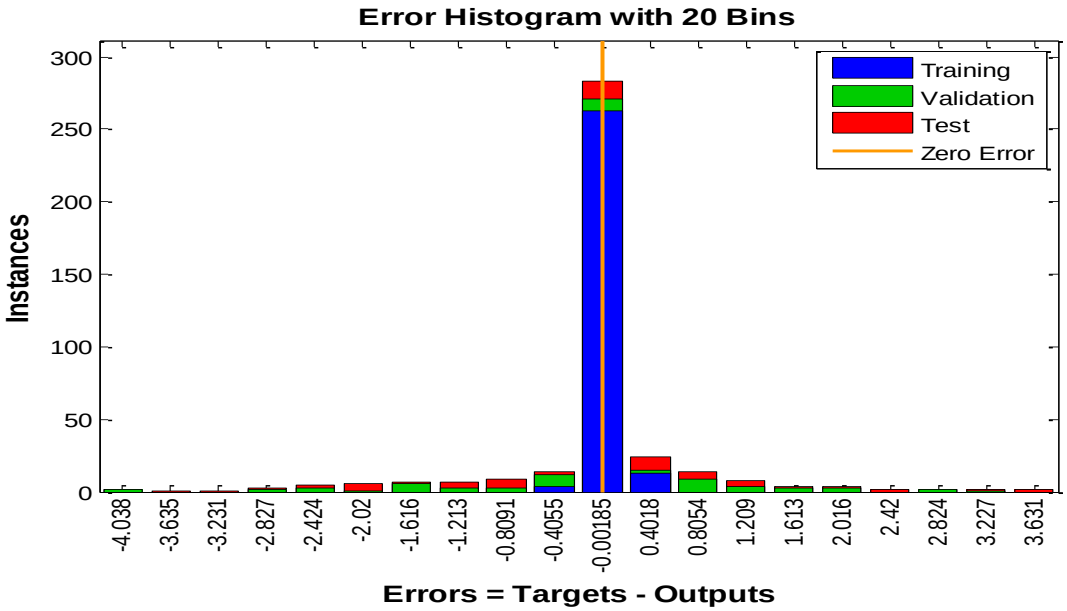

Figure 4: Error histogram with 20 bins

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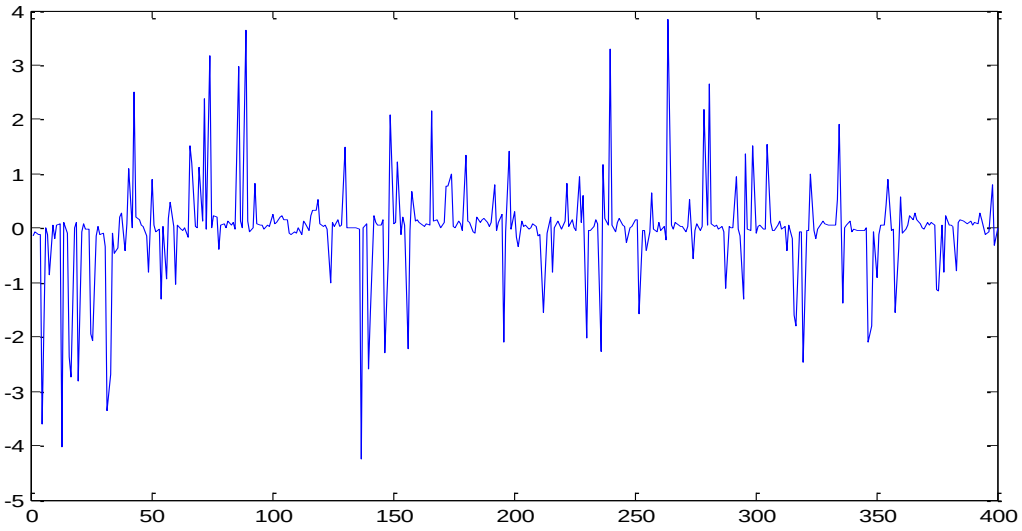

Figure 5: Occurrence of errors

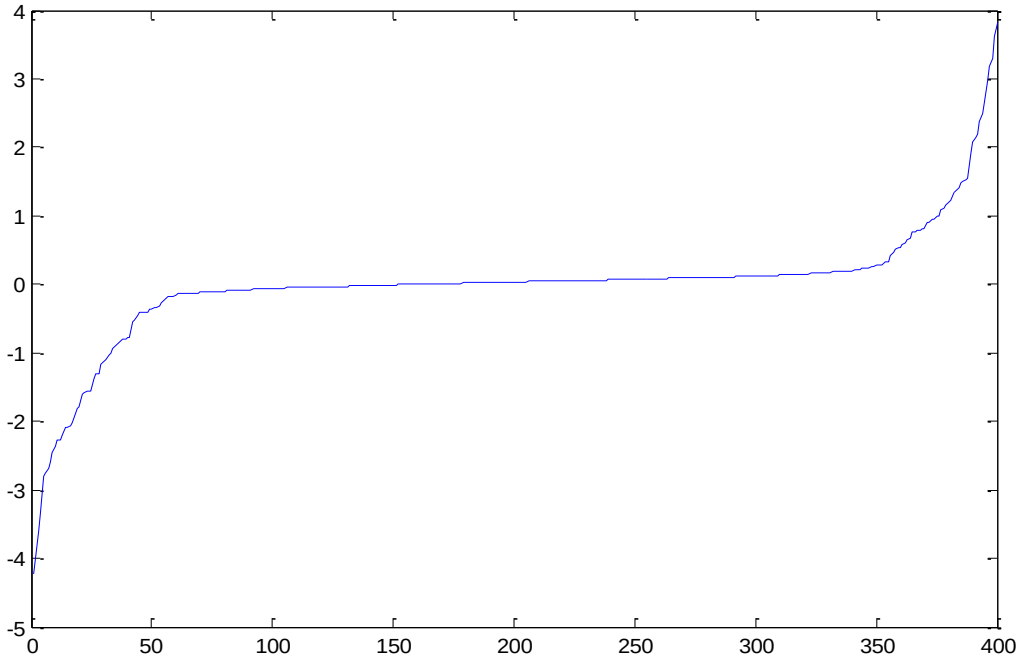

Figure 6: Sorted errors

IV. CONCLUSION

The knowledge of consumers buying behaviours can be utilised to plan marketing strategies by the companies. The results presented in this paper show that neural networks can be effectively used for predicting and determining consumer buying behaviours. The present work can be extended to larger demographic areas for more accurate predictions.

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