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Life Time Milk Amount Prediction in Dairy Cows using Artificial Neural Networks

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***Abstract*:-** This research paper has the use of artificial neural networks for life time milk amount prediction in dairy cows. The study is based on back propagation neural network which has trained and tested based on dataset provided. In modelling the artificial neural networks based predictive model, two-hidden layer network has been constructed. Suitable milk amount predictions can provide farmers and producers with valuable information. For this research Different artificial neural networks had been trained and the best performing number of hidden layers and neurons and training algorithms recorded. The output performance of the artificial neural networks model in simulating cow's performance was compared with actual data as recorded by experimental work. Generally more nearer prediction values can be obtained by a neural network approach. This approach suggests that a non-linear relationship exists among the dependent and independent variables in the data. Thus prediction results show that the artificial neural networks models used in this study have the potential of predicting future performance of cows on the basis of early expression traits.

***Keywords*:** artificial neural networks, dairy cows, prediction, total milk amount, feed forward back propagation neural network, network training, nntool etc.

I. INTRODUCTION

Dairy industry has economically useful importance in India. The country is the world's largest milk producer [1], in India there are more than 13% of all other country's total milk production. India is the world's largest consumer of dairy products, which consumes almost 100% of its own milk production. In spite of having largest milk production, India has a very minor role in the world market. So Indian dairy sector should pay attention to increase the productivity of milk amount, Our research will be useful in this field by predicting life time milk of cow's in dairy industry we will choose the best performing cow in the dairy herd. The research topic "Prediction of milk amount in Dairy cow's using artificial neural networks" on which we worked predicts the values of 'Total milk amount' of dairy cows. Total milk amount is the amount of life time milk in liters that a particular cow gives in its life. This topic has the use of artificial neural networks to predict the values as the tool of data mining. The available data of no.

of cows already recorded are complex and non linear in nature. These data need to be collected in an organized form. This collected data can be then integrated and managed to form a dairy information system.

The main objective of this research work is to create and study the uses of the neural networks for the prediction of total milk amount in dairy cows. Creating an effective Indian dairy industry's research and development (R&D) program is both a predictive problem and an optimization problem..An artificial neural network (ANN), also called a neural network (NN), is a mathematical model or computational model based on biological neural network system, artificial neural network [2] are used for the evaluation of different parameters. ANN is a powerful data mining [3] tool that is able to capture and represent complex input/output relationships. The idea and motivation for the development of neural network technology raised from the desire to create and implement an artificial system that could perform intelligent tasks similar to those that are performed by the human brain. Neural network works like the human brain, a neural network obtains knowledge through learning by experience. A neural network's knowledge is stored within interneuron connection strengths known as weights. The main power and advantages of neural networks lies in the ability to represent both linear and non linear relationships directly from the data being modelled. Traditional linear models are simply not useful when it comes for true modelling data that contains non linear characteristics and non linear data representation. A neural network model is an architecture model that can be adjusted to produce a mapping from a given set of data to features of relationship among the data. The NN model is adjusted, or trained, using a collection of data from a given source as input, which can be referred to as the training set. After applying successful training algorithms, the neural network will be capable to perform classification, estimation, prediction, or simulation on new data from the same or similar sources. ANN is an information processing model that is inspired by the way biological nervous systems [4], such as the brain processing information system. The key element of this model is the new structure of the information processing system. These neural networks are modelled by a large number of highly interconnected processing elements (neurons) working in proper way to solve specific problems. ANNs, like people, learn by example as well as learn by experience. ANN architecture is modelled for a particular application, such as pattern recognition or data classification, through a learning process. Learning in biological systems [5] adds adjustments are called weights to the synaptic connections that exist between the neurons. A back propagation network [6] consists of at least three layers (multi layer perception) first is an input layer, second one is intermediate hidden layer, and last is an output layer. According to the Interactive Activation and Competition (IAC) neural networks and Hopfield networks, connection weights in a back propagation network are one way. In ANN usually, input units are connected in a feed-forward [7] fashion with input units fully connected to units in the hidden layer and hidden units fully connected to units in the output layer. An input pattern is propagated forward to the output units all the way through the intervening input-to-hidden and hidden-to-output weights when a Back Propagation network is created.

II. MATERIALS AND METHODS

For this research work we have used MATLAB R2009B software with 64 bit version and license no 161051. MATLAB software was installed in windows 2007 operating environment, while data of cows as recorded in national dairy research Institute was used as a data base.

Description of Database:

The present investigation was carried out on Karan Fries cows maintained at National Dairy Research Institute, Karnal Haryana (India). The data used in the present investigation were collected from pedigree sheets, calving

reports, health registers and auction sheets. A total of 2972 lactation records of 977 cows sired by 104 sires were utilized. Cows that have completed at least one lactation were considered in this study. Out of these data to predict the total life time amount of milk we had used no. of different cows' data, we created artificial neural network and data of cows were trained, verified and tested. The different data values we have used for life time milk amount prediction are as: Age on first calving (AFC), Calving interval, Total milk amount in first lactation, Productive life, Total Life time milk amount. It is the total amount of milk that any cow will give in its life time, We have to predict this value.

Research method:

One way of predicting the Total amount of milk of dairy cows is by using ANN. This process uses (nntool) case in MATLAB software to train, verify, and test the neural network. EXCEL software was used for input data processing.

Milk Amount Prediction Using Artificial Neural Networks:

In this research we have used graphical user interface to create ANN. A graphical user interface is used for the neural networks toolbox (nntool). This interface allows us for the following phases:

- First we have to load the Excel data files into the MATLAB workspace.
- Open the GUI to create networks for the input and target data using nntool.
- Enter input data and target data into the GUI by importing from workspace.
- Initialize the weights, train the network, and simulate networks output result.
- After simulating, export the training results from the GUI to the command line workspace.
- Save the created variables to the command line workspace from the GUI.

Training algorithms:

The back propagation was used for network training. Back-propagation neural networks (BPNN) are the common network architecture [8]. BPNNs are training algorithms in a supervised style. The input-output pairs are used to train a network until the network can approximate a function (Haykin, 1999) [9].

The best function: Different functions with different no. of architecture were investigated, using the Tansig function in the first hidden layer and Purelin function at second hidden layer we obtained the best results.

The best network architecture: The best architecture was calculated by testing a different number of neurons in the hidden layer. Normally, one or two hidden layers within random large number of neurons may be sufficient to estimate any function. The minimum number of neurons in current study is 5. In this order MSREG methods were used to determine minimum error. The LEARNGDM learning function was selected for learning purpose of neural network (4-2-1: 4 input, 2 hidden layers, and 1 output).

Training: In this part, 60% of input data comprising four kinds of information, Age at first calving, Calving interval, First lactation milk amount and Productive life were applied to train the network.

Verifying: In this programme, the time stop of calculation was applied with 20% data to determine the network structure work that was not used in training. Verifying data have checked in a different sequence of training and continued when the number of error reduced in the verifying.

Testing: Out of total data 20% data were applied for the testing process after training and verifying.

III. RESULTS AND DISCUSSIONS

Creating an ANN based on recorded experimental results helps in predicting the Life time milk amount without the need for any practical operation. The output of the created network is compared with the recorded data to check the created network performance. In this case, saven networks with different structures as shown in table1 were constructed to identify the optimal result. The other parameters shown in Table 1 such as training function, adaption learning function, performance function, number of hidden layer, transfer function in hidden layer, and transfer function in output layer, were considered to find the best network. The best network was selected based on the minimum error in training and the high correlation coefficient of data. The minimum error was extracted using the MSREG learning method for network7, as shown in Figure 1, which shows the mean square error. The correlation coefficient is also shown in different data sets in figure2 for Network7, with 5 neurons in the hidden layer, is considered to have the best performance with minimum error as shown in Figure1 and maximum correlation coefficient, close to 1 in figure 2. For this network, figure3 shows the network output data graph. Network output graph is the important parameter in comparing with the networks output data and input data. In figure3 network output data are similar to input data with minimum errors. However, the created network N7 is more knowledgeable than other network.

TABLE 1 Trained Networks Table

Layer1 = TANSIG, Layer2 = PURELIN, Network Type = FFBP

Network no.	Training function	Learning function	Performance Function	No. Of neurons
Network1	Trainbr	Learngdm	Mse	12
Network2	Trainbr	Learngdm	Msreg	15
Network3	Traingd	Learngdm	Mse	8
Network4	Trainbr	Learngdm	Mse	10
Network5	Traingd	Learngd	Msreg	10
Network6	Traingd	Learngd	Msreg	8
Network7	Trainbr	Learngdm	Msreg	5

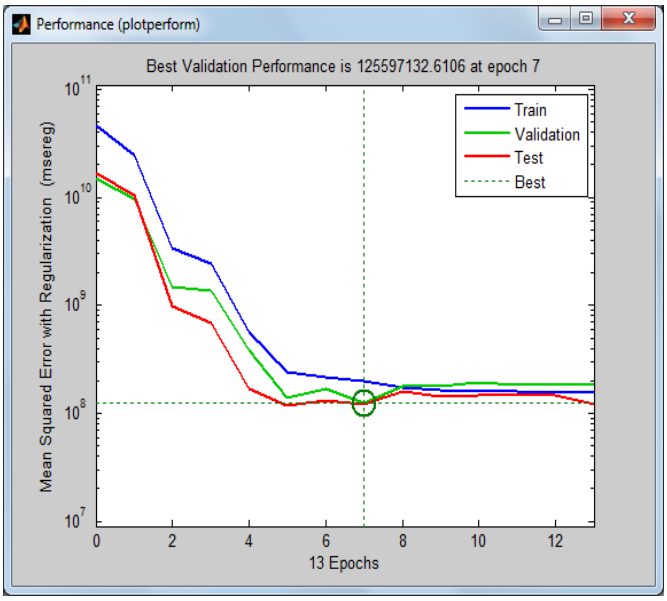

Figure1: Performance Graph

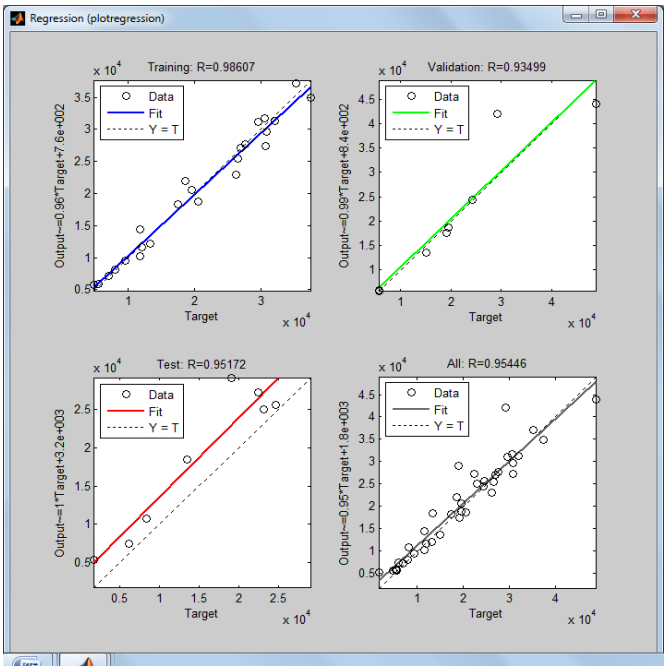

Figure2: Regression Graph showing Correlation Coefficient

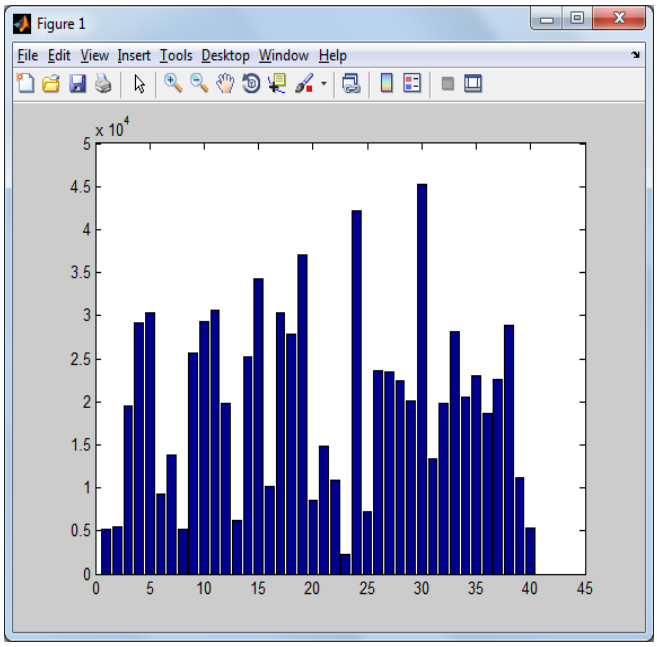

Figure3: Network output Graph showing Milk amount

IV. CONCLUSION

In the current study, the experimental results of cows data samples were applied to generate an artificial neural network to predict the Life tome milk amount of dairy cows. The outcome of the created ANN was compared with the results of the experimental work which shows the nearest values to the recorded data. The selected network and its parameters were:

1. The architecture of the selected network having minimum error was four input, two hidden layer and one output(4-2-1).
2. Out of total applied data 60% data were used for training and 20% and 20% data were used for verifying and testing, respectively.
3. The ultimate network to predict the total milk amount was feed-forward back propagation in which the training and learning functions were TRAINBR and LEARNGDM, respectively. While TANSIG and PURELIN were the transfer function on layer1 and layer2 respectively.
4. The output results of the created network are close to the results of the recorded data of experimental effort.
5. The selected ANN can be used to predict the total milk amount with minimum error, and a maximum correlation coefficient close to 1.

V. REFERENCES

[1] Dr K.G. Karmakar and Dr G.D. Banerjee, “Opportunities And Challenges in The Indian Dairy Industry”, Technical digest ISSUE 9, 2006.

[2] Dr. Yashpal Singh, and Alok Singh Chauhan, “Neural Networks in Data Mining”, Journal of Theoretical and Applied Information Technology 2005 - 2009 JATIT.

[3] Bharati M. Ramageri, “Data Mining Techniques and Applications”,Indian Journal of Computer Science and Engineering, Vol. 1 No. 4 301-305, 2006.

[4] Mohsen Hayati, and Zahra Mohebi, “Application of Artificial Neural Networks for Temperature Forecasting”, World Academy of Science, Engineering and Technology 28 2007.

[5] Anders Krogh, “Nature Biotechnology”, Volume 26, 2 Februry 2008.

[6] Parag.P.Kadu, Prof.Kishor P.Wagh, Dr.Prashant N. Chatur, “Temperature Prediction System Using Back propagation Neural Network”, ISSN:2249-5789,2010.

[7] Razavi S. V., Jumaat M. Z. and Ahmed H. EI-Shafie ,“Using feed-forward back propagation (FFBP) neural networks for compressive strength prediction of lightweight concrete made with different percentage of scoria instead of sand”, International Journal of the Physical Sciences Vol. 6(6), pp. 1325-1331, 18 March, 2011.

[8] Rumelhart DE, Hinton GE, Williams RJ (1986). Learning Internal Representations by Error Propagation. In Parallel Distributed Processing Foundations. Rumelhart DE, and McClelland J L. The MIT Press. . Vol. 1.

[9] Haykin S (1999). Neural networks: a comprehensive foundation. Prentice Hall Inc. Englewood Cliffs. N.J.

[10] U.S. Food and drug administration, “Hazards & Controls Guide For Dairy Foods HACCP”, CFSAN/Office of Compliance October 2007.

[11] Marie-Helene Hubert and Michel Moreaux, “The challenge of meeting the future food needs”, july 2007.

[12] Lampinen J, Vehtari, “A Bayesian approach for neural networks review and case studies”, Neural Networks 2001.

[13] Wade K M and Lacroix R,“ The role of artificial neural networks in animal breeding”, The fifth world congress on Genetics Applied to Livestock Production.