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Prediction of Future Market Price for Agricultural Commodities

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Abstract

The agricultural commodity prices have a volatile nature which may increase or decrease inconsistently causing an adverse effect on the economy. The work carried out here for predicting prices of agricultural commodities is useful for the farmers because of which they can sow appropriate crop depending on its future price. Agriculture products have seasonal rates; these rates are spread over the entire year. If these rates are known/alerted to the farmers in advance, then it will be promising on ROI (Return on Investments). It requires that the rates of the agricultural products updated into the dataset of each state and each crop; in this application five crops are considered. The predictions are done based on neural networks Neuroph framework in java platform and also the previous year's data. The results are produced on mobile application using android. Web based interface is also provided for displaying processed commodity rates in graphical interface. Agricultural experts can follow these graphs and predict market rateswhich can be informed to the farmers. The results will be provided based on the location of the users of this application.

Keywords: Commodity Price, Neural Network, Back Propagation, Prediction, Agriculture, Dataset

Introduction

Farmer (producer) deals with a challenge to satisfy the consumer demands by providing what is desired, and also he must get good price for his product, thus a framework for complex information analysis is to be built to help farmers make decisions for planning and sowing seeds. Changing agricultural prices prove to be significant in fight against poverty. The prediction of future crop price movements can be a valuable budgetary planning system for various government agencies and farmer aid programs. In this smart age as we can call, that is the age of smartphone's and Internet, everything is getting advanced and digital and there is a need for the advancement of agriculture as well as farmers which is done by this application which will help farmers in knowing the future prices of the crops. Farmers and also the agri-businessmen are in accordance with the advanced world through precision farming. With this they also need to know the future crops price so that farmers can plan on sowing of seed and agri-businessmen can plan about the market for these crops. The farmer can be made technically advanced by providing him this application by which he can be an active participant in this smart age. This will help in the growth of the economy of any country and especially India as its main occupation is farming.

Agriculture products have seasonal rates; these rates are spread over the entire year. If these rates are known/alerted to the farmers in advance, then it will be promising on ROI (Return on Investments). This project will alert the farmer about what crop he can sow so that by the time of harvesting, he gets better returns on investment. The

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prices of agricultural commodities have a basic impact on the lifestyle and economy. Many countries have price early warning systems to monitor and evaluate crop prices so that the price can be predicted in order to guarantee that the agricultural economy is stable and growing.

The change in price should be known by the farmers or agri-businessmen. From the time of crop sown to the time of harvest, they have a threat of price uncertainty, hence in the agricultural market the prediction of future price of agricultural products can help the production and the pricing of the crops correctly. This predicting of crop price would also help to make agricultural policies and improve configuration of agricultural resources, resulting in development of the whole economy of a country and a great boost for a developing country like India. Thus, the framework of price prediction is of great significance.

Related Work

There are many hybridisation models which are used to forecast commodity prices. The drawback was requirement of expert knowledge [Yethiraj, 2012]. The author studies many methods which were developed for knowing the yield of the soil and to know which crop can be best produced in the particular soil. The soil can be tested depending on water content, colour, and contents of the soil like the minerals in the soil. The author says these should be tested first in the soil to know the quality of soil and then to analyse which crop can be grown in it. To do this he states the data mining techniques. The author finally comments that the field of agriculture along with the technology will yield a great future for the people associated with it.

Raghuveer, Yogesh and Shwetha (2014) stated that the decision tree analysis was used to analyse the productivity of soya bean crop which is influenced by the rain and humidity and evaporation which reveals crops depend largely on weather conditions.

Dieng (2008) analysed different methods for prediction among which he felt that the methods which are non-parametric must also be studied as they are mostly neglected in most of the studies and also he states that the experts should help the producers and give correct knowledge and advice.

Naik and Jain (2002) stated in Indian Journal of Agricultural Economics that the agricultural commodity prices are not predicted correctly due to improper management of the markets such as transportation and infrastructure for these markets and also some third party interference.

Ahuja (2006) concluded in the International Research Journal of Finance and Economics that Indian market is growing with the new market policies and exchanges. There is also an increase in the trade due to the changes in the market policy and due to new government rules.

Kamal (2007) concluded that the commodity market is growing in terms of turnover. He also stated considering of various factors in the market for risk management and also the forecasting of price by considering the marketing, processing and interest in the commodity market for production.

The UNCTAD 2009 Report gives a good idea by which the trading in the market could return higher price but it makes some assumptions that don't have scientific reasoning.

Van Tilburg R and Van Der Stichele (2011) claim that financial investments have pushed up prices and added to volatility of prices. However, the evidence provided for this is selective and little analysis is done.

Wahl (2008), in his article, differentiates between the factors for price rise of agricultural commodities as long term and short term factors in which the demand for the crops, production are termed under long term factors and rise in fertilizer price, exchange rates, improper harvests, restrictions on exports, and speculations are considered under short term factors for price rise. Among these the author indicates speculation as the main factor for price rise.

As the price of vegetables have seasonal cyclical factors, some authors use signal processing methods to analyse the historic data and predict future prices. The limitation of this method is that it assumes that the period of price changes is fixed and will follow the same cycle in the future. As the price is impacted by many factors, it cannot have a fixed change cycle. Those methods cannot handle both linear and nonlinear patterns at the same time.

Kavitha, Udhayakumar and Nagarajan (2013) state that Markov models are the one which are independent of the past history if we want to predict the future depending on the present scenario. Here the authors used HMM to

find the behaviour of the stock market using the one day difference in the stock rates and if the calculated results are same in some part of a year then the steady state probability is obtained. This can be used as a base for the agricultural price prediction if we observe the same pattern in the price behaviour in a year.

Ticlavilca, Feuz and McKee (2010) illustrate the use of Multivariate Relevance Vector Machine for prediction of agricultural commodities price in advance that is before 2 to 3 months. The model works good for one or two months ahead prediction but the performance degrades a bit when it considers three months ahead. For three commodities the predictions are done based on confidence intervals and the sparse property of the Multivariate Relevance Vector Machine is not analysed.

Woodill and Udell (2012) propose that "farmers are adopting mobile phone technologies at a higher rate than the general public." and also state how farmers can get guidance from expert at remote places through mobile technologies and increase the produce in their farm.

Shawn, Cole and Fernando (2012) discuss about GPS and GIS to the management of farms. Predictions were done based on the seasonal rates of the commodities (French, 2010). Confidence intervals are built among the consumers and farmers (Li, Xu, Li, Sun & Dong, 2012).

Scope and Objective

The news releases from the government does not reach the farmers in time, therefore an alert system is being built for releases for future prices.

Scope: The application is to guide farmers, as to which product to sow, so that by the time harvesting there is good return. The attempt is to develop an application which completely uses the power of neural networks and predicts the prices and alerts the farmers.

Objective: The objective of the study isto help farmers by providing timely information about the crops to be grown. Agricultural products have seasonal rates; these rates are spread over the entire year. If these rates are known/alerted to the farmers in advance, they can sow and harvest the crop at the right time when the rates are likely to be high, then it will be promising on ROI (Return of Investment).

Network and Model

Artificial Intelligence (AI) is the field of Computer Science that attempts to give computers human like abilities of prediction and reorganisation. Computers are given human like abilities by the use of a neural network. The neural network is like a brain which has the capabilities like thinking and sensing. It is also built using neurons as the brain is built of neurons. Neurons are individual cells that can process small amounts of information and then activate other neurons to continue the process. The term neural network, as it is normally used, is actually different. Computers attempt to simulate an artificial neural network. However most publications use the term "neural network" rather than "artificial neural network."

Advantages of Neural Networks

The following are advantages of neural networks.

1. **Nonlinearity:** The nonlinearity of the neural networks is achieved because the neurons are spread over and none of the neurons are linear and hence they give the advantage of nonlinearity.
2. **Input-output mapping:** The input factors are used for training of the neural networks and are known as training data. These are useful in producing the output in the neural networks and hence these inputs should be mapped with the output.
3. **Adaptively:** Neural networks have a built-in capability of adapting to the changing input data or the training set automatically.This proves to be a good benefit for the applications which have volatile datasets.
4. **Contextual information:** The knowledge obtained from learning step is presented in a contextual manner in the processing state of the neural network.
5. **Fault tolerance:** The neural networks offer fault tolerance as they tend to ignore some faults and also they tend to keep the performance a bit low to accommodate fault tolerance without actually harming the overall task of the neural networks.
6. **VLSI implements ability:** The ability to implement the VLSI models makes the neural networks more beneficial for fast computation.
7. **Uniformity of analysis and design:** The neural networks provide uniformity as it uses the neurons and

these neurons are uniform by which the neural networks learning pattern and the analysis and design of the neural networks can be used for referring with different applications built using neural networks. This provides the uniformity in the neural networks design and analysis.

8. **Neurobiological analogy:** The neural networks are based on the structure and working of the human brain that is on the neurons concept of the human brain which will control and help in working of the networks. This makes the neural networks work and think as the human brain and do the tasks which may involve human like thinking and making decisions (http://www.cs.ukzn.ac.za).

These advantages of neural network make a way for the usage of it in this application along with the back propogation algorithm.

The step by step working of back propogation algorithm is as follows:

Step 1: The data with which the neural network is to be trained should be collected.

Step 2: The data needs to be processed and normalised so that it can be suited to the application.

Step 3: Now we need to select the network or build it on which we want to run our application.

Step 4: The optimisation methods must be selected and the network training will start.

Step 5: The network has to be tested and if the test gives error back propagate to the step 3 where the network is to be determined else give the result (Nasira and Hemageetha, 2012).

Fig. 2 shows the sample neural network with backpropogation capabilities.

1. The output of a neuron in a layer goes to all neurons in the following layer.
2. Each neuron has its own input weights.
3. The weights for the input layer are assumed to be 1 for each input. In other words, input values are not changed.
4. The output is obtained by applying inputs to the input layer and outputs are obtained in the output layer.

Fig. 1: Flowchart for Back Propogation Neural Network

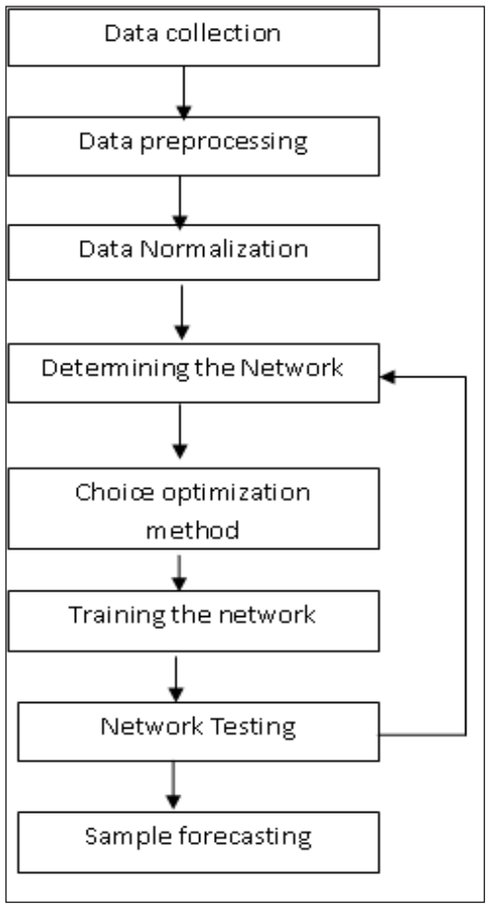
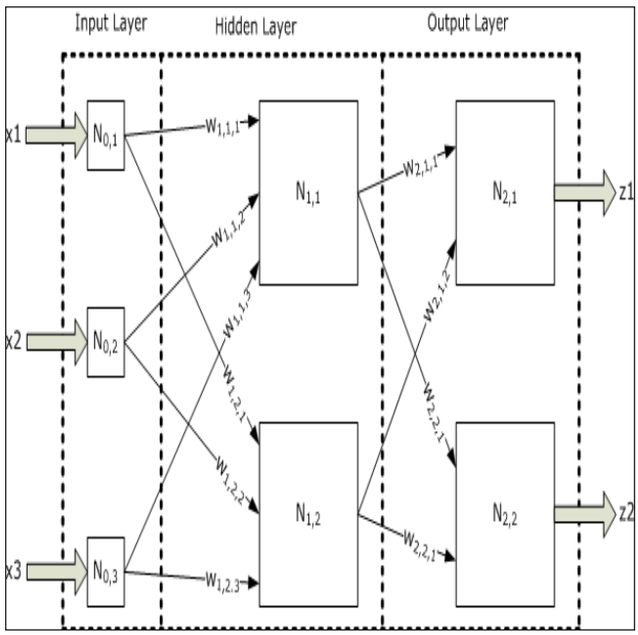


Fig. 2: Sample Neural Networkwith Backpropogation Capabilities



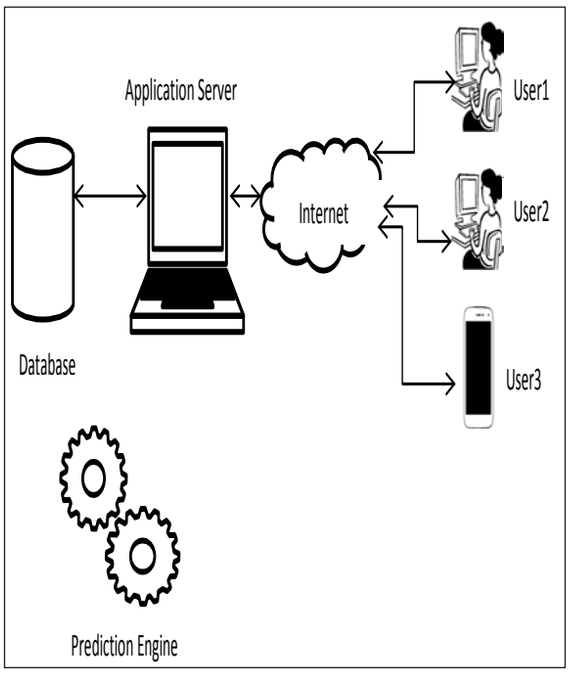
5. The back propagation NN must have at least an input layer and an output layer. It could have zero or more hidden layers.

The prediction of crops price is achieved by training the neural network with the training set that is maintained as a dataset for different crops in different states. This neural network based prediction model proves to be very useful as the large historical data about the crops price is maintained in the dataset and which can be fed into the network as input into the input layer by which the neural network will learn and predict the future crop prices. This result is given out by the output layer of the neural network. The software implementation of this is achieved through Neuroph and this will give the similar results as compared to theoretical result of the neural model. The dataset is fed into this Neuroph neural network and then the network learning starts after this the trained network predicts the future price and gives this result as an output.

Methodology

The system architecture for this project is as shown in Fig. 3.

Fig. 3: System Architecture



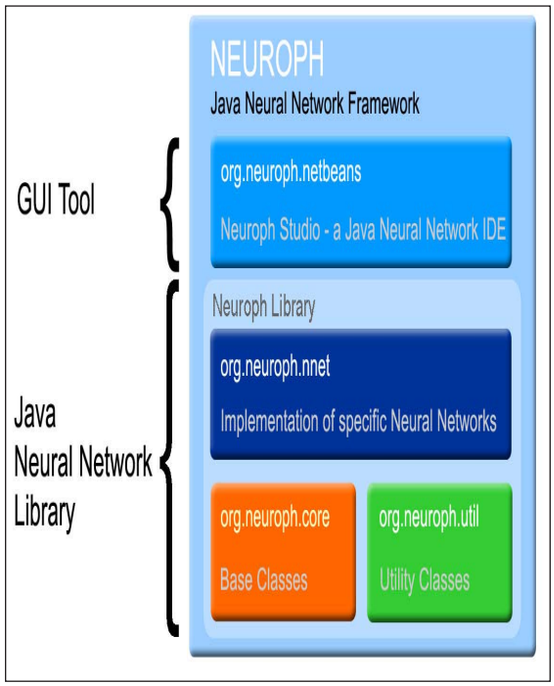
The application server used in this application is the Glass Fish server 3.1.2 which serves to connect the database and the prediction engine along with the users and also to process the requests from the users and give response about the predicted prices. The dataset contains prices of the agricultural commodities and the database for the registered users is maintained. The main part is the prediction engine which will predict the future prices. This part is built using Neuroph 2.5 and encog 2.5 in Java under NetBeans IDE. The server used is a Glass Fishserver. There is a web interface which shows the predicted prices of the 5 crops selected like wheat, bajra, rice, paddy, and jowar which are the used crops in day-to-day life so only these crops are considered in this application. Then there is also an android app which also helps in knowing the predicted price of these crops.

The dataset for the crops previous prices is collected from the online site of Ministry of Agriculture, India i.e. Agromarknet.nic. The prices for states for each month are collected from this site and formulated in the dataset according to different states so that the farmers and agribusiness personnel can view the predictions of the crops price according to the states.

The prediction engine is the heart of this application or the system thatis built using neural networks and back propogation technique. The NetBeans IDE is used for the development which uses Neuroph 2.5. This consists of the Java library and GUI neural network editor called easy Neurons. Then Java library is used to create the neural network for prediction of crop price in Java program. This is used along with Encog 2.5 which is an Artificial Intelligence (AI) framework for Java and .Net. Though Encog supports several areas of AI outside neural networks, the primary focus for the Encog 2.x versions is neural network programming. Using these two, the neural network is built and the prices are predicted after the specified months which the user specifies.

The graphs for the earlier price and the predicted price are generated which are line graphs with prices and time on its axis. By using this graph farmers or agribusiness personnel can easily understand the price trends and also visually predict whether the price is increased or not or if there is the same price. Using this web interface and graphs the agri-experts can inform farmers about what to sow so that he can get better ROI (Return on Investment). This can be achieved by building the agri-centres in every village.

Fig. 4: Neuroph 2.5 Framework (http://neuroph.sourceforge.net/documentation.html)



The android application is also build keeping in mind the smart age and people turning towards the android use in tablets or mobile phones. This app will also help to predict the crop prices and will be done depending on months after which the prediction is to be done. The app is interfaced with the web application. This app will help in forming the digital India as the farmers are getting more technology into their farming methods this app will prove to be a good aid in predicting the prices of crops on the go. This android app will show or give the alerts to the farmers and also the notifications on the mobile about the price rise of the crops.

Results

The graphical results for this application are obtained and are presented depending on the state for which the prediction is done. From these results in graphical form we can analyse the prices of the 5 crops selected in this application and also know about the past history of those crops for that state.

The graph here shows the names of the crops and line graphs for each crop with a different colour. Price is shown on y-axis and time on x-axis. The line for each crop shows its price fluctuations from the month the dataset is maintained and the last point shows the predicted crop price.

Fig. 5: Prediction Graph for Gujarat State

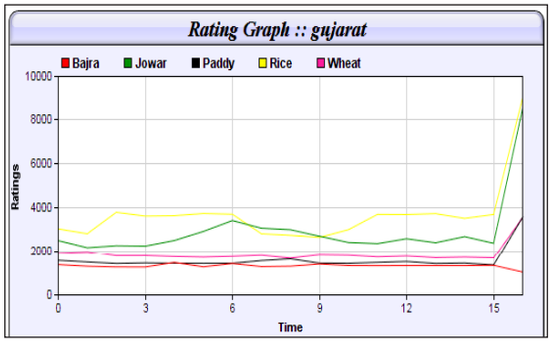
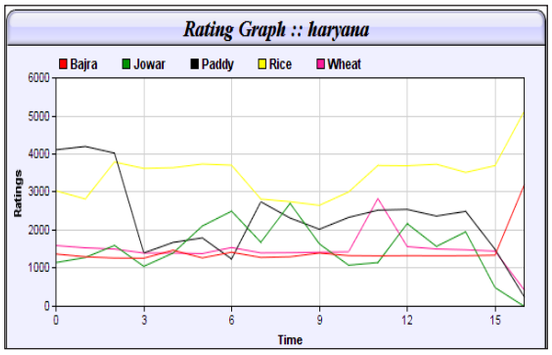


Fig.6: Prediction Graph for Haryana State



The last point in the line graph gives the predicted value for a particular crop after the time period entered in months by the user of this application. The rise or fall in the crop price can easily be seen in the graph by analysing the line for each crop.

Fig.7: Prediction Graph for Madhya Pradesh State

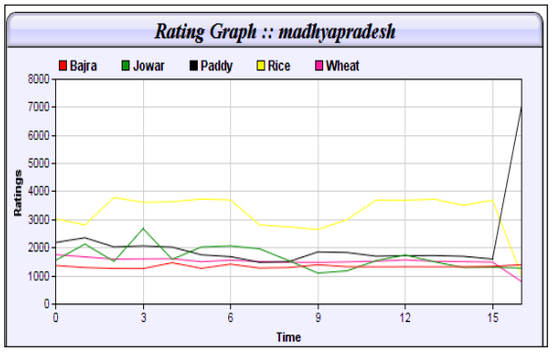


Fig. 8: Prediction Graph for Andhra Pradesh State

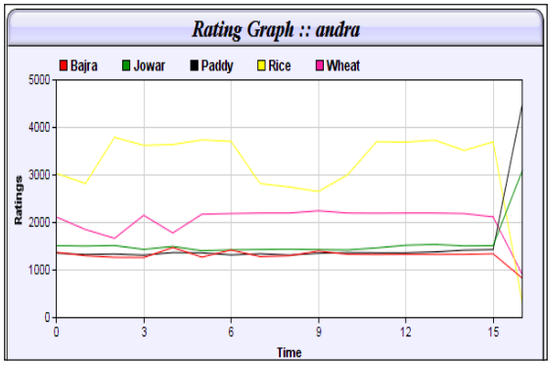
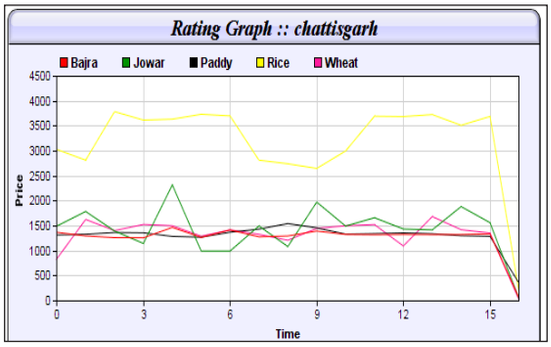


Fig. 9: Prediction Graph for Chhattisgarh State



Conclusion

Agricultural price prediction need for decision-making at all levels is increasing due to globalisation and market integration in this smart age. This necessitates an effort towards designing a market intelligence system by integrating traditional statistical methods with soft computing techniques like neural networks to provide accurate and timely price forecast by taking into account the local information from the farmers, traders and online site from Govt. of India which is Agmarknet.nic to make decisions well in advance. The predictions for the price are done and are shown in graphical format on web application and also an android mobile application. This application predicts the future prices accurately and precisely and makes the farmers alert about which crop to sow to get better ROI (Return on Investments) and to make timely decisions. It is also helpful for the agri policy makers to make policies which will be helpful to farmers as well as consumers. Thus this application is very useful for obtaining a better economy in a developing country like India.

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