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Application of time series modelling in price forecasting of agricultural commodities

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Abstract
Time series modelling is a dynamic research, which mostly aims to carefully collect and rigorously study the past observations of a time series to develop an appropriate model which describes the inherent structure of the series. This model is then used to generate future values for the series, i.e. to make forecasts. Time series forecasting thus can be termed as the act of predicting the future by understanding the past Forecasting the price of agriculture commodity such as vegetables, fruits (Horticultural crops) cereals, pulses, oilseeds (Agricultural crop) etc. is important related to economic concerned, farmer perspective, Agriculturist and Industrialist. Price forecasting help famers to take effective decision regarding market price (mandi price) or selling price of their crop, which crop to grow to earn profit, ultimately improve the condition and income of famer and also helps policy maker for agriculture decision. For forecasting area, production & productivity of agricultural crops, mostly ARIMA (Autoregressive integrated Moving average) Model is used but in case of price forecasting of agricultural crops ANN (Artificial Neural Network) is used. Neural Network approaches are applied in the field of agriculture for price forecasting in both short term and long terms Large amount of data related to commodity price, daily market price, arrival price is available. Neural approach with fuzzy can be used and also neuro fuzzy system may help in future for future price forecasting of commodity.

Keywords: time series modelling, price forecasting, agricultural commodity, arima, ANN, fuzzy

1. Introduction
Time series forecasting can be termed as the act of predicting the future by understanding the past. Due to the indispensable importance of time series forecasting in numerous practical fields such as business, economics, finance, science and engineering, etc. proper care should be taken to fit an adequate model to the underlying time series. It is obvious that a successful time series forecasting depends on an appropriate model fitting. A lot of efforts have been done by researchers over many years for the development of efficient models to improve the forecasting accuracy. As a result, various important time series forecasting models have been evolved in literature.

1.1 ARIMA Model
One of the most popular and frequently used stochastic time series models is the Autoregressive Integrated Moving Average (ARIMA). The basic assumption made to implement this model is that the considered time series is linear and follows a particular known statistical distribution, such as the normal distribution. ARIMA model has subclasses of other models, such as the Autoregressive (AR), Moving Average (MA) and Autoregressive Moving Average (ARMA) models.

1.2 SARIMA Model
For seasonal time series forecasting, Box and Jenkins had proposed a quite successful variation of ARIMA model, viz. the Seasonal ARIMA (SARIMA) The popularity of the ARIMA model is mainly due to its flexibility to represent several varieties of time series with simplicity as well as the associated Box-Jenkins methodology for optimal model building process. But the severe limitation of these models is the pre-assumed linear form of the associated time series which becomes inadequate in many practical situations. To overcome this drawback, various non-linear stochastic models have been proposed in literature however from implementation point of view these are not so straight-forward and simple as the ARIMA models.

1.3 ANNs Model
Recently, artificial neural networks (ANNs) have attracted increasing attentions in the domain of time series forecasting. Although initially biologically inspired, but later on ANNs have been successfully applied in many different areas, especially for forecasting and classification purposes. The excellent feature of ANNs, when applied to time series forecasting problems is their inherent capability of non-linear modelling, without any presumption about the statistical distribution followed by the observations. The appropriate model is adaptively formed based on the given data. Due to this reason, ANNs are data-driven and self-adaptive by nature. During the past few years a substantial amount of research works have been carried out towards the application of neural networks for time series modeling and forecasting. In 2008, C. Hamzacebi had presented a new ANN model, viz. the Seasonal Artificial Neural Network (SANN) model for seasonal time series forecasting. His proposed model is surprisingly simple and also has been experimentally verified to be quite successful and efficient in forecasting seasonal time series.

1.4 Agricultural commodity

In recent year, agriculture commodity price affects the economics of our country. Increasingly demand of crops mainly fruits & vegetables in India or outside the country affect the price of commodity. Private Agriculture Industry or Farmer growth not only depends on the production or yielding of crop but also on the price of commodity. Factors such as time horizon, temperature, season, policies, productivity, and transportation cost etc., affect the price. Agriculture commodity price changes drastically and fastly and affecting the life of farmer and human being. Future price forecasting of agriculture commodity is not an easy task. Price fluctuation, price analysis, trend analysis in price can be done so that early information regarding crop price help farmer in decision related activity for a crop to sowed in field or to sell product in market. Agriculture is one of the fields that contribute to Gross Domestic Product. New tools and techniques are developing that help famer providing early information related to crop, policies etc. So, for the risk related to crop price, or pricing information analysis, price forecasting, price fluctuation of a crop are the different concerned area where one can applied the Soft computing technique, fuzzy approach, data mining technique to identify the truth or hidden pattern from agriculture product market price.

1.5 Data Mining

Data Mining is the process by which one can identify the hidden pattern, correlation among the data and also helps in forecasting the future trends. Data mining techniques can be applied in the field of agriculture for forecasting the price of product by predictive model task. Data mining forecasting model task include regression analysis, classification, time series data analysis and prediction. Forecasting can be done by using historical day or past data about price and based on that future price can be forecast. Regression analysis helps in mapping the data value to real value prediction variable. Mapping done by function and require learning that is one can use the past value for fitting to the function and can predict the future value. Commodity price varies with time. Time points such as daily, weekly, yearly price value of commodity are obtained for forecasting future price based on time series data. One can also perform temporal analysis on agriculture price data of product varying with time. Association rule may involve temporal aspect and relationship. Based on time series future values can be predicted. Neural Network is an information processing system inspired by the way biological neurons work and process information. Neural Networks helps in deriving information or extracting patterns from complicated or imprecise data. Many researchers use neural network approach for forecasting either short term or long-term price forecasting of vegetable commodity. recurrent neural network can be used for forecasting. In this survey report, an idea of using soft computing approach or big data analytic approach for forecasting analytics of prices of agriculture commodities.

1.6 Price Forecasting

Price forecasting helps farmer and agriculturist to know about the growth or trend or price value of product before selling to mandi also help the policy maker for creation of different policy by generating rules according to price analysis. By analysing the price value, demand or supply as well as cultivated area related to crop helps farmer for decision making activity and ultimately helps in economic growth of our country.

Experimental Evidences & Literature Study

Shih *et al*. proposed a model for price prediction based on weighted case-based reasoning approach. Three cases such as equal wighted, unequal weigth and linear weighted CBR are investigated and compare. Most suitable weight for features are selected by genetic algorithm. For prediction model data related to imported chicken, economic index and production data from Taiwan agriculture is used. Result of proposed research shows that CBR approach performance is better than other predcition approach such as linear regression, regression tree, CART and neural net. Result also give information that colourful boiler and chiks price affect the price. Kohzadi *et al*. for price forecasting of commodity compare neural network model with time series model. They used price data of US live cattle and wheat of forty years taken from USDA. Multi-Layer Feed forward neural approach a supervised leraning technique is compared with ARIMA. Slinding window and walk forward approach is used. They suggested that NN perform better than ARIMA and Mean square error is about 27 and 56 percent lower than ARIMA. Also, other measure shows by a neural network such as absolute mean error and mean absolute percent error were also lower. Neural netwokr has the capabiltiy to show major turning points for both wheat and cattle. Zou *et al*. for forecasting china food grain price, explore and compare the neural network and time series model. Researcher gives a new concept to create a model by combining two model such as time series model ARIMA and neural network approach such as back propagation using Equal weigth method i.e using arithmetic average of individual forecast as it is an easy method. Two kinds of evaluation criteria such as quantitative evaluation such as MSE, MAPE, and MAE and turning point is evaluated by advance version of Mertons test used by researcher. The result shows that forecasting performance of combine model is better then individual in terms of error evaluation measurement. Network structure such as 2*4*1 is selected to model price series and ARIMA (1,1,0) is realtively best as per researcher findings. Also suggested that ANN is best suited model for capturing profit and turning points and better then traditional ARIMA and also accuracy achieve by combine model is better than individual one. In financial market, back propagation is used for discovering nonlinearity in financial data. But back propagation suffer from problem of low converges and is not robust method so the researchers Haofei *et al.* for price froecasting learning task in nerual nets bring in concept of multi stage optimization in back propagation. In their paper they state that problem of backpropagation can be overcome by MSOA and performance of forecasting in terms of error and directional evalution measurement is better achieved by MSOA. Average Training time of MSOA is 4.25s and of Back propagation is 7.83s respectively. Yu *et al*. uses neural network as a meta learning technique for designing a time series forecasting model to increase prediction accuracy while data consist of noise. Researchers do meta modelling by performing data partition and sampling for creation of different subset of training based on that base learning model is created and Fuzzy neural network is used in study for both as base learner and meta learner. They used PCA technique for model selection and pruning and then meta model is created from selected model. They concluded that prediction

performance of nonlinear metamodelling technique is better when compare to single time series forecasting models such as ARIMA, FNN and SVM and other linear metamodelling technique such as simple averaging, simple MSE, Stack d regression, variance weighting for financial time series data. netwrok perform well with pruning using PCA. Gan-Qiong Li *et al*., proposed a forecasting model where short term price forecasting of tomato has been done by three layer Feed forward neural network and result compared with time series ARIMA model and shows that neural network performs better for price prediction of one day with accuracy is about 90 % or week before price prediciton with accuracy about 80 %. Riberio *et al*. proposed a hybrid commodity price forecasting model for sugar price prediction using feed forward neural network such as multilayer perceptron model and Kalman filter. Data from brazilian and Indian market is taken for study. Kalman filter is used to consider price as stochastic process and also include future price in forecasting and also minimise the error measure. ANN is used for Exogenous variable analysis and also ANN applied to Kalman filter result to get improvement in result. Subhasree *et al.* predict the next day price of vegetable using time series data. Machine learning algorithm such as Radial basis fucntion, back propagation neural network and genetic based neural network is used for study and comparative result concluded that predictive accuracy achieved by genetic based neural network is about 89% and error rate is 0.11 which is better than both back propagation whose accuracy is about 79 % and error rate is 0.21 and radial basis function accuracy is 52 % and error rate of 0.48. Ahumada *et al.* discussed that the forecasting accuracy of individual food price model can be improved by considering their cross dependency. Food price of Soyabean, corn and wheat are strongly correlated. They estimated Equlibrium correction model for each food price and them studied the residual cross correlation for interdependency and thus perfom a joint modelling. Four different econometric model are studied such as EqCM, DEqCM, DVAR and randomwalk econometric model are tested for each food price with different time horizon and scheme such as recursive or fixed. And they concluded that EqCM(Single for wheat and joint for corn and soyabean) perfrom best for time horizon h=4. For forecasting price of agricultural product in brazil, researchers Pinheiro and senna perform multivariate analysis of price of products and also uses neural network application for forecasting price i.e, combine the ANN model with multivariate analysis. They study on time series of price for product. Product chooses based on the export volume growth of product. Daily time series data is converted into weekly data. In their study, Forecast for ANN-MSSA and ANN are compared with 12 week data to final week sample. In this study the difference between ANN-MSSA and the ANN model is given by the treatment to separate noise from the original time series. Empirical data states that performance of MSSA-ANN methodology is better than that of ANN model. Study combines MSSA to decompose the time series with ANN model and good alternative for forecasting price of different commodity. Result will be useful to formulate and implement policies directed to agriculture sector.

Conclusion

To maximize profit in agriculture marketing, there is need to forecast the future price of commodity among the farmers and other participant of market. In the aforementioned work a study of different forecasting methodologies is done in agricultural market environment. Multiple factor such as seasonality, trend, cycle, holidays, economic index etc., affects the price of commodity, for that reason price forecasting is not a simpler task. It can be concluded that Forecasting require filtering, smoothing of data due to missing and noisy data, storage and retrieval of historical data, model creation for processing past data and predicting future trend or value. Performance measure such as MSE, MAPE is used for evaluating the performance of forecasting model. There are several linear and nonlinear method individually or jointly used for forecasting such as ARIMA, Hybrid ARIMA-GARCH, and back propagation, Feed forward neural network, radial basis, genetic is used for optimization etc. are used by the researcher for forecasting. Accordingly, in future other Time series modelling, Evolutionary approach with fuzzy can be used for better forecasting and also one can employ deep learning with big data for agriculture commodity price forecasting.

References

1. Nowrouz Kohzadi, Milton S Boyd, Bahman Kermanshahi, Iebling Kaastra. "A comparison of artificial neural network and timeseries model for forecasting commodity prices," Neuro Computing, 1996, 169-181.
2. Rafik A Aliev, Bijan Fazlollahi, Rustam M Vahidov, "Genetic algorithm-based learning of fuzzy neural networks. Part 1:feed-forward fuzzy neural network," Fuzzy Sets and Systems, pp. 351-358, 1998-2001.
3. Shih ML, Huang BW, Nan-Hsing Chiu, Chiu C, Hu WY. "Farm price prediction using case-based reasoning approach-A case of broiler industry in Taiwan," Computer and Electronics in Agriculture, 2009, 70-75.
4. Zou HF, Xia GP, Wang HY, Yang FT. "An investingation and comparision of artificial neural network and time series model for chinese food grain price forecasting.," NEURO COMPUTING: Elsevier, 2007, pp. 2913-2923.
5. Zou Haofei, Xia Guoping, Yang Fangting, Yang Han. "A neural network model based on the multi stage optimization approach for short term price forecasting in china," Expert system with Application, 2007, pp. 347-356.
6. Lean Yu, Shouyang Wang, Kin Lai Keung. "A neural network based nonlinear metamodeling approach to financial time series forecasting.," Applied Soft Computing. 2009; 9:563-574.
7. Gan-qiong Li, Shi-wei Xu, Zhe-min Li. "Short-Term price forecasting for Agro-products using Artificial Neural Networks," in Elsevier, 2010, pp. 278-287.
8. Celma Q Ribeiro, Sydnei M Oliveria. "A hybrid commodity price forecasting model applie dto the sugar-alcohol sector," Autralian Journal of Agricultural and Resource Economics. 2011; 55(2):180-198.
9. Girish K Jha, Kanchan Sinha. "Agricultural Price Forecasting Using Neural Network Model: an Innovative Information Delivery System," Agricultural Economics Research Review. 2013; 26(2):229-239.