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Prediction of Soybean Price Trend via a Synthesis Method With Multistage Model

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ABSTRACT

Soybean is an important crop, so it is very important to forecast soybean price trend, which can stabilize the market. This paper presents a synthesis method with multistage model (SMwMM) in order to identify and forecast soybean price trend in China. In the previous work, Toeplitz inverse covariance-based clustering (TICC) has been applied to cluster the prices of four variables. The research has found that there are four patterns in soybean market price, which could be explained by economic theory. This paper considers four patterns as market risk levels. Based on the clustering results, the authors used long short-term memory (LSTM) to forecast the prices of these four variables. Multivariate long short-term memory (MLSTM) is then used to classify soybean price to determine level of risk. Experimental results show that (1) the LSTM model has achieved great fitting effect and high prediction accuracy and (2) the performance of MLSTM-FCN and MALSTM-FCN is better than that of LSTM-FCN and ALSTM-FCN. Furthermore, MALSTM-FCN had a higher accuracy than MLSTM-FCN, which reached 76.39%.

KEYWORDS

Forecast, Long Short-Term Memory, Multivariate Long Short-Term Memory, Soybean Price

INTRODUCTION

The soybean is an important source of high quality protein for human beings and an important raw material of edible oil. The soybean products are hard to be replaced as part of the human diet (He et al., 2017). In addition, the breeding industry needs a large amount of feed, which is mainly composed of corn and soybean. The corn provides sugar and the soybean provides protein. Therefore, soybean price directly affects soybean production, farmer income, animal husbandry cost and the stability of agricultural products market (Li, 2014).

From the economic angle, soybean plays such an important role in breeding industry that soybean price affects meat price. In addition, the instability of soybean price brings significant risks to other grains price (Xu & Ma, 2018). Therefore, the fluctuation of soybean price affects the development of agriculture, the quality of consumer life and the overall stability of market economy (Qian, 2017). Timely and accurate prediction for soybean price trend enables the government to make corresponding decisions in time and stabilize the market (Jiang, 2018). However, the drastic change of international

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soybean market leads to the continuous fluctuation of domestic soybean price in recent years. In this context, it is more important to predict soybean market price trend in China.

This paper aims at predicting soybean price trend in China. Predicting soybean price trend in China needs firstly determines different soybean price trend, that is, "Pattern of Soybean Price (PSP)" (Deng&Sun, 2019). Then forecast soybean price trend based on PSP classes and predicted soybean prices. Based on these analyses, the prediction of soybean price trend consists of three steps. Firstly, this paper cites the research results from Deng and Sun (2019), that is, there are four patterns in soybean price. Secondly, four variables related to soybean price are predicted respectively. The four variables are the soybean purchase price, corn market price, soybean futures price, and the soybean oil futures price. The second step is formalized as univariate time series prediction problem. Finally, the future soybean price trend is predicted according to the four kinds of predicted price. The third step is formalized as a multivariate time series classification problem, that is, the predicted prices are classified to determine which soybean price model they are in.

This paper proposes a Synthesis Method with Multistage Model (SMwMM), including clustering, prediction and classification, in order to predict soybean price trend. Firstly, this paper cites the research results from Deng and Sun (2019), that is, there are four patterns in soybean price. Deng and Sun (2019) used Toeplitz Inverse Covariance-based Clustering (TICC) (Hallac et al., 2017) to cluster the multivariate time series data set composed of four variables, including soybean purchase price, corn market price, soybean futures price and soybean-oil futures price. These four variables have a greater impact on soybean prices (Deng & Sun, 2019). Therefore, this paper also uses these four variables to conduct experiments in order to predict the soybean price trend more accurately. Then Long Short-Term Memory (LSTM) (Graves et al., 2012) is applied to forecast soybean purchase price, corn market price, soybean futures price and soybean oil futures price, respectively. Finally, this paper forecasts soybean price trend via Multivariate Attention Long Short-Term Memory Fully Convolutional Networks (MALSTM-FCN) (Karim et al., 2019), that is, classify price to determine which pattern the soybean price is in. In general, a new combination is proposed to predict soybean price trend by using the existing models. This combination is named SMwMM. Therefore, the contribution of this paper lies in the establishment of new soybean risk early-warning model. Compared with the traditional early-warning methods, this paper takes the discovered pattern as the early-warning alarm degree, which can avoid the subjectivity of artificial selection. This is helpful for more accurate prediction and early warning of soybean price. At the same time, it is also a new idea for agricultural monitoring and early warning, which provides methods and basis for the establishment of risk warning models for other agricultural products in China.

The remainder of this paper is organized as follows: Section 2 describes the literature review of soybean price prediction and classification algorithm. Section 3 briefly introduces structure of LSTM and the details of MALSTM, and explains the procedure of predicting soybean price trend via SMwMM. Experimental results are discussed in Section 4. Section 5 explains conclusions and major contributions.

RELATED WORKS

At present, there are a lot of researches about soybean price prediction at home and abroad. For example, Wang et al. (2016) derived the theoretical model of the optimal confidence interval to simulate the optimal interval forecast of soybean meal and non-GMO soybean futures price. David et al. (2017) applied the Auto Regressive Fractionally Integrated Moving Average (ARFIMA) model to predict soybean price. He et al. (2017) proposed an support vector regression based on adaptive particle swarm optimization (APSO_SVR) model to predict soybean price in China. Zhang et al. (2018) applied a quantile regression-radial basis function (QR-RBF) neural network model to predict of soybean price in China. Drachal (2019) proposed a new Bayesian model combination schemes for analysis of soybean price. These researches mentioned above are about to forecast univariate time

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