A Combined Forecast Method Integrating Contextual Knowledge

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ABSTRACT

In the framework of TEI@I methodology, this paper proposes a combined forecast method integrating contextual knowledge (CFMIK). With the help of contextual knowledge, this method considers the effects of those factors that cannot be explicitly included in the forecast model, and thus it can efficiently decrease the forecast error resulted from the irregular events. Through a container throughput forecast case, this paper compares the performance of CFMIK, AFTER (a combined forecast method) and 3 types of single models (ARIMA, BP-ANN, exponential smoothing). The results show that the performance of CFMIK is better than that of the others.

Keywords: Combined Forecast, Container Throughput Forecast, Contextual Knowledge, Integrating Contextual Knowledge, TEI@I

INTRODUCTION

With the development of the economic globalization, the enterprises are facing more furious competition in increasingly more open and volatile markets. It is a key factor of success for the executives to obtain market information swiftly and make decisions scientifically. Economic forecast can predict the future by the rules extracted from historical information and thus bring the information advantage to decision makers. Consequently, economic forecast has always been an attention-holding issue.

In recent years, many forecast methods have been proposed, including regression models (Lam & Veall, 2002; Zhang & Thomas, 2010), intelligent algorithms (Chen et al., 2010; Rubio et al., 2011), exponential smoothing models (Chatfield et al., 2001; Hyndman et al., 2005), wavelet models (Jensen, 1999; Rua, 2010), state space models (Hyndman, 2002; Durbin, 2001), time series analysis models (Box et al., 1994; Gray & Thomson, 2002; Findley, 2004; Man & Tiao, 2009; Lahiani & Scaillet, 2009) and so forth. Given that every single forecast model has its advantages and disadvantages, Bates and Granger (1969) proposed a combined forecast method and presented its exciting performance.

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coming from the combination of the advantages of different single models. However, all the above models are based on the same assumption: History will repeat itself.

Nevertheless, everything comes with the specific context. Once the context changes, the development law will change correspondingly. For instance, the law of the stock market volatility before financial crisis may not be suited to that after the financial crisis, which will lead to a big forecast error despite of the above forecast methods used. Therefore, it is urgent to develop a new and reliable forecast framework integrating contextual knowledge to solve this problem.

Wang et al. (2004) proposed the TEI@I methodology integrating qualitative and quantitative analysis, which has been successfully applied in an increasingly number of areas owing to its high effectiveness of analyzing complex systems (Tian et al., 2009; Yan et al., 2007; Yu et al., 2007; Zhang et al., 2010). Based on the TEI@I methodology, this paper develops a combined forecast method integrating contextual knowledge (CFMIK), which employs different single models and integrates their outputs into a synthetic result with the help of contextual knowledge. This paper concentrates on 4 questions: (a) How to choose single models? (b) Which is better, direct forecast or iterated multistep forecast? (c) How to generate the combination candidate set of the single model outcomes? (d) How many single models should be integrated?

The remainder of this paper is organized as follows. It discusses the related work on contextual knowledge, introduces the contextual knowledge in economic forecast, and then interprets the detailed theoretical model and implementation procedure of CFMIK. Next, after a brief introduction of 3 single models used in the following empirical analysis, a case study of Tianjin Port’s container throughput forecast using CFMIK is presented. The conclusions and future research directions are contained in the last section.

LITERATURE REVIEW

Contextual knowledge can be defined as a possibly unlimited, personal and situated set of relevant knowledge involved in problem solving (Brezillion & Pomerol, 1999), including both objective factors, such as environment and background, and subjective factors, such as expertise. The significance of contextual knowledge has been thoroughly discussed in knowledge management area. For instance, Dieng (1999) argued for the importance of the situation/context in knowledge management. The context plays a key role in understanding the knowledge completely (Brezillion & Pomerol, 1999). Without the suitable context information, the knowledge will be separated from other relevant knowledge, which will lead to incomplete even wrong understanding of the knowledge (Klemke, 2000; Goldkuhl, 2001). Consequently, all the knowledge divorced from its context will be meaningless (Despres, 2000).

In recent years, contextual knowledge (also called domain knowledge) has gotten more and more attention in data mining area. For example, Fayyad (1996) argued that the significance of domain knowledge should be highly valued in every step of data mining. Pohle (2003) criticized the lack of effective technique for integrating human domain knowledge into the data mining process. Pazzani et al. (1994) found that if there were enough training data, the FOCL algorithm integrating domain knowledge could significantly reduce misclassification costs compared with the one without domain knowledge. Hirsh and Noordewier (1994) used contextual knowledge of molecular biology to preprocess data. Then, they applied C4.5 decision tree and back-propagate neural network to DNA sequences learning tasks with preprocessed and non-preprocessed data respectively, and the results showed that the preprocessing significantly improved the performance. Ambrosino and Buchanan (1999) presented that their augmented model integrating domain knowledge performed significantly better in
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