

Chapter 9

Short-Term Time Series Prediction for a Logistics Outsourcing Company

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ABSTRACT

In this chapter, tools from univariate time series analysis and forecasting are presented and applied. Time series components, such as trend and seasonality are introduced and discussed, while time series methods are analyzed based on the type of the time series components. In the literature, linear methods are the most commonly used. However, real time series data often include nonlinear components, so linear time series forecasting may not be the optimal choice. Therefore, also a basic nonlinear forecasting method is presented. The necessity of these methods to logistics service providers and 3PL companies is presented by case studies that present how the operational and management costs can be cut down in order to ensure a service level. Short term forecasts are useful in all the units of activation of 3PL companies, i.e. supplies, production, distribution, storage, transportation, and service of customers.

INTRODUCTION

Time series is a set of evenly spaced, continuous, numerical data. It assumes the factors influencing the past will continue to influence the future and mainly uses statistical models as forecasting tools. Currently, logistics specialists estimate the demand for services using on their own experiences. This approach to everyday logistics is inconsistent at best. Moreover, before using a time series one

must understand which components are present in these data and choose the right forecasting method. Therefore, one should know how to choose the proper forecasting technique and method depending on the type of the data.

The forecasting methods can be divided in two main categories; the time series methods and the econometric methods. Time series or extrapolation methods are quantitative methods that only use past data of the time series to forecast future ones. These methods search for patterns in the time series and extrapolate these patterns into

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the future. Econometric methods use regression to forecast a time series variable by using other explanatory variables. We will only discuss the basic time series methods here.

In time series, we consider to be two sources of predictability; the existence of linear correlations in time and the nonlinear determinism. Currently, the time series forecasting methods exploit either the linear correlations of the signals or the nonlinear determinism. The basic linear time series methods are the moving average and the exponential smoothing. Nonlinear methods are more suitable for time series under the consideration that are produced by a nonlinear dynamic system that potentially contains also noise. These methods usually require larger time series than linear ones and small noise levels. We will present here a nonlinear method based on a local linear prediction models, the local average prediction, which exploits the neighborhood relations of the data.

Forecasting of time series is a very difficult task as it is hard to recognize the underlying patterns and relationships due to noise, random behaviors and unexpected 'changes', e.g. changes in the market due to the introduction of a new product. However, forecasts are constantly required and help companies and logistic service providers be more effective, reduce their costs and satisfy their customers. The forecasting of the future customers arrival rate in a bank or post office, the forecasting of the customer's demand as a function of time at shops, banks and restaurants for the good service of the customers, and the computation of the stock quantities needed, are only some of the incredibly lots of applications of forecasting, necessary for 3PL companies.

BACKGROUND

Logistics is becoming an important part of every economy and every business entity. The globalization has led many companies outsourcing their logistic functions to 3PL companies, which face

many challenges, e.g. find the optimal number of warehouses and distribution centres, the location of these warehouses, the optimal routings of the products, the scheduling of transportation to pick up the products from the manufacturers and deliver the products to the customers, and monitoring the inventory levels. Forecasting is an essential tool that helps 3PL companies overcome all these challenges. Of course, many forecasting methods have been developed and can be applied to different types of data, for different types of forecasting time horizons, have different estimation complexity and demand in computer efficiency and of course different reliability and precision of forecast. Time series methods are used mainly for short-term forecasts, and concern all units of activation of 3PL companies, e.g. the prediction of supply demands, control of reserves and requirements in personnel, materials, instruments, etc.

Forecasting the number of each type of products that clients are likely to use is the only way to ensure that a company orders the right amount of each. Ordering too few products may result in stock-outs and dissatisfied clients, while ordering too many products wastes resources and overburdens the supply system. Therefore, forecasting the supplies of a product is an important task. For example, each country should know the supplies of natural gas needed in order to satisfy its demand for energy (Al-Fattah, 2006; Dimitropoulos et al, 2005). Forecasts play a key role in the planning process of a 3PL company. Accurate forecasts are essential for risk reduction. Various attempts have been made to forecast industrial production, e.g. see (Thury and Witt, 1998; Bodo and Signorini, 1987). The scheduling of the transportation is also an important task for 3PL companies, i.e. organize to pick up the products from the manufacturers and deliver the products to the customers. Having constantly updated demand information and forecast, a company will be able to handle the inventory and transportation planning and scheduling more efficiently. Freight transportation demand (Zlatoper and Austrian, 1989) and forecasts of

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