Chapter 15

An Economic Order Quantity Model for New Products When Demand Follows Dynamic Innovation Process

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ABSTRACT

In this era of globalization and constant innovation, the life cycles of products are diminishing, which tends to cause dynamic behaviour in the system, and because of this, there is a constant introduction of new products in the market. Therefore, while developing inventory models for new products, it becomes necessary to consider dynamic parameters associated with the demand function and responsible for making the system dynamic, which are essential for economic ordering policies for such products. In this chapter, an economic order quantity model is developed in which the demand is time-dependent and innovation-driven. The parameters such as coefficient of innovation and potential market size associated with the demand function are considered dynamic over time to match the real feature of the system. The model is illustrated with a numerical example, and a comprehensive sensitivity analysis of the optimal solution with respect to different parameters is performed to know the utility of the model.

1. INTRODUCTION

The dynamic behaviour of the inventory system forces the inventory planner to manage and control the inventories in such a way that optimum inventory policy is maintained because the effective inventory management is the backbone of any business operations and it becomes more crucial when the parameters associated with the demand function are of dynamic nature. The dynamic behaviour of the system makes the people more cautious while taking decisions of economic ordering policies. The first and foremost task of any organization is to maintain optimum inventory

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level which is necessary to meet its requirement and avoid over or under inventory that can impact the financial figures. The dynamic behaviour of the system is generally observed when there is introduction of new products in the market. The management of such inventories becomes an important and critical function because these inventory resources besides being as assets of the organization and have economic value its contribution in the determination of financial health of the organization cannot be ignored. Now, the decision regarding optimum inventory level without developing mathematical models brings the decision maker in a confused state and does not support the fruitful decision for a complex system, which ultimately tends towards gambling. Because mathematical models are the primary tools for studying the behaviour of the system by incorporating all the components of the inventory system and gives a scientific way of solving decision making problems arising in a large and complex systems. The mathematical models have been proved useful for understanding the structure and functioning of the system, predicting future events and prescribing the best course of action. It also exhibits relationship between the parameters (quantitative variables) under a definite set of assumptions, which describe the system clearly and appropriately. Therefore, it is not advisable to take decisions based on established theories, intuition and experience always for a complex inventory system and a wise decision is to make analysis for economic ordering policies based on mathematical models.

This article uses mathematical model based on innovation diffusion criterion. The theory of innovation diffusion is highly desired for attentive management of the new products in order to minimize the total cost and maximize benefits. To make the business fascinating and demanding the importance of innovations in business and industry is highly significant. Rogers (1962) had observed that when a new product is introduced in the market consumers show variable buying behaviour and categorize them according to their time to purchase. Here, the demand function used to develop mathematical framework is based on the Fourt and Woodlock (1960). The coefficient of innovation and the potential market size incorporated in the demand model have been considered dynamic over time.

The approach of this paper is to focus on the effect of innovation factor on adoption behaviour of consumers under the condition that both potential market size as well as coefficient of innovation is dynamic dependent on time to minimize the total average cost. The article is divided into the following sections: literature survey to provide a theoretical background, model development, special cases and numerical examples with observations to know the behaviour of the model. Finally, the article concludes with a discussion on the application, extension and limitations of the model.

2. LITERATURE REVIEW

The innovation diffusion theory has been extensively used in the marketing literature, which is a well-known theory for the diffusion of new products. Therefore, while developing economic order quantity models for new products the incorporation of innovation diffusion theory is necessary. Innovation-Diffusion theory can be useful process to assist inventory manager for planning and making strategy to determine and control the stock levels within the physical distribution function to balance the need for product availability and at the same time minimizing the stock holding and handling costs.

Diffusion is defined as the process by which an innovation is communicated through certain channels over time among members of a social system (Rogers, 1983). “To use the theory of diffusion as an aid in planning new product introductions the marketing manager must have a model that represents the process of diffusion for
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