Optimal price, warranty length and production rate for the dynamic sales market

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Abstract

A decision model is presented for producers to determine the optimal price, warranty length and production rate of a product in the dynamic sales market to maximize profits based on the pre-determined life cycle. The free renewal warranty policy is considered under which failed items are renewed before the end of the warranty length at no cost to consumers. The expected number of renewals based on the warranty length is derived for a Weibull lifetime distributed product. The cost function involves production cost, warranty cost and inventory cost. A solution approach using the maximum principle is described and is applied to two specific types of markets. The first type of market considers a multiplicative

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effect of dynamic sale rates function on diffusion, and the second type of market considers market potential of dynamic sale rates function. Effects of the inventory volume, unit cost of the product and market effects on the optimal solution are investigated, and finally some conclusions are drawn based on the analysis.

**Keywords:** Free renewal, Weibull distribution, price, warranty length, production rate.

1. **Introduction**

Consumers make their purchasing decisions in the market on the basis of perceptual product attributes that can be influenced by various factors under the producer’s control, such as product quality and marketing mix of the product. Promoting sales volume is always an effective course of increasing profits, which is the major goal for most of the producers. To stimulate consumer’s purchase willingness, producers must determine the reasonable selling prices for their products. For the same class of products in the market, lower price usually tends to enhance the sales volume, but leads to a decrease in the unit profit. Pricing must be based on the cost to create profits; meanwhile, the price of a product should not be too high to dissuade consumers from purchasing. Therefore, producers have to treat product pricing as a competitive tool in their marketing strategy. In addition to the selling price, consumers may predict the quality of a product based on its warranty, which is considered as the assurance that the producer provides after evaluating the strength of the product (Boulding and Kirmani, 1993). Warranty is an important factor of marketing products as better warranty signals higher product quality and provides greater assurance to customers. Warranty can also be considered as a marketing tool to differentiate from competitors, since a satisfactory warranty policy will certainly enhance consumers’ purchase willingness (Menezes and Currim, 1992; Padmanabhan, 1993). If the producer promises to renew or repair products when failures occur, the commitment length of warranty, which may be related to the product’s lifetime distribution, generally plays a key role on deciding the total cost of the product. Wu et al. (2006) presented an approach for determining the price and warranty length of a normal lifetime distributed product.