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Sensitivity Analysis for Newsvendor Model with General Advertisement-Sensitive Demand

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Abstract

Advertising is a very important measure to induce consumer demand and make more profit for a firm. The newsvendor problem with advertising decision provides an important means to examine how operational problems interacts with marketing issues to influence decision-making at the firm level. In this paper, we explore the changes of optimal decisions about the system parameters for newsvendor model under general additive-multiplicative advertising-dependent demand distribution through comparative statics method.

Keywords: Marketing and operations interface; newsvendor model with advertise-setting; comparative statics

1. Introduction

The integration of marketing and operations management has become a main research area in operation and supply chain. Advertising is often the most effective method of promotion; hence, advertising investment plays a key role in a firm's marketing decisions. Therefore, incorporating the advertising effect in to the classic newsvendor problem is important. We call these models as newsvendor model with adverting (NPA) model. Wang [1, 2, and 3] investigated the NPA model under general additive demand, general multiplicative demand and general multiplicative demand with emergency

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ordering. Recently, Wang and Zhou [4] discussed the supply chain coordination with NPA and proposed an improved revenue-sharing contract to achieve the supply chain coordination; Wang and Hu [5] established that the supply chain can with NPA not be coordinated with the buy back, revenue sharing, target rebate and quantity flexibility contract and showed quantity discount contract can coordinate the supply chain and give a special quantity discount contract and presented a new contract called revenue and loss sharing contract to coordinates the decentralized supply chain. Wang, Zhou and Wang [6, 7] investigated the supply chain coordination with a specific NPPA model using improved revenue sharing contract and combined return and sales rebate/penalty contract. Wang [8] recently presents the newsvendor model with general additive-multiplicative advertisement-sensitive demand models. In this paper, we will answer what are the change trends of optimal advertising decision relative to system parameters deterministic model and our mode. We will need the following nomenclature in this paper such as in [8]

Nomenclature

p	retail price
q	order quantity
a	advertising premium
v,s,c	per unit salvage value, shortage penalty and purchase cost respectively
$\mathrm{D}(a,\xi)=\alpha(a)\xi+\beta(a)$	
ξ	nonnegative random variable with mean 1
$\Pi(a,q)$	expected demand
a^*,q^*	optimal decisions

2. The Model

According to [8], the expected profit for any advertising premium and order quantity is:.

$$\Pi(a,q)=(p+s-c)q-(p+s-v)\int_0^{\frac{q-\beta(a)}{\alpha(a)}}(q-\alpha(a)x-\beta(a))f(x)dx-a\text{-}s[\alpha(a)+\beta(a)]$$

The optimal order quantity q^* for any fixed a is

$$q^*=\alpha(a)\mathrm{F}^{-1}(\rho)+\beta(a)$$

Where, $\rho=\dfrac{\mathrm{p}+\mathrm{s}-\mathrm{c}}{\mathrm{p}+\mathrm{s}-\mathrm{v}}$.

The expected profit for any optimal ordering quatity is

$$\Pi(a)=\Pi(a,q^*)=\alpha(a)[(p+s-v)\int_0^{\mathrm{F}^{-1}(\rho)}xf(x)dx-s]+(p-c)\beta(a)-a$$