

Inventory control in presence of advance demand information and heterogenous demand – Thesis proposal at 1 Sep. 2009

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Thesis proposal committee

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Papers involved

1. Bisheng Du, Christian Larsen. 2008. Base stock policies with degraded service to larger orders. Download: http://www.hha.dk/bs/wp/log/L_2008_07.pdf
2. Bisheng Du, Christian Larsen. 2009. Investigating comparative advantages of advance demand information in presence of heterogeneous demand. (General version)
3. Bisheng Du, Christian Larsen. 2009. Comparing reservation policies of advance orders in presence of heterogeneous demand. (specific version)

1 Introduction

Due to the quest for efficiency accelerated by the so called financial crisis, inventory management is a vital function in almost all kinds of industries. The literature on inventory management is growing fast. Not only there are numerous publications in inventory management practices, but

also, There are many newest publications in the inventory theory as well. ([Zipkin, 2000](#)) and the references therein provide a thorough review of recent advances in inventory control theory and its relation to supply chain. there are also some other popular inventory theory books for instance ([Silver et al., 1998](#)), [Axsäter \(2006\)](#) and [Porteus \(2002\)](#).

Much of the literature on inventory models ignore advance demand information. Advance demand information means that if a request for an order occurs, say at time point τ , the customer also specifies a time point, say time point $y + \tau$, where he wants to receive his order. Thus, y can be interpreted as the demand lead-time of the customer.

Therefore, One of the critical factors playing a role on the inventory theory is its advance demand information. Many suppliers have recognized that advance demand information may yield significant positive impact. It enables them to better optimize their inventory levels as well as service levels.

As a result, the advance demand information in inventory control and supply chain management has become very active research topic that has received increasing attention in the academic literature in Operations Management, and Supply Chain Management. For instance, [Hariharan and Zipkin \(1995\)](#) is the first paper concerned about advance demand information. Later, [Özer \(2000\)](#) finished his doctoral dissertation with title "Supply Chain Management under Advance Demand Information", [Chen \(2001\)](#) studied the topic with inventory and marketing interface, [van Donselaar et al. \(2001\)](#), [Gallego and Özer \(2001\)](#), [Gallego and Özer \(2002\)](#), [Gallego and Özer \(2003\)](#), [Hu \(2003\)](#), [Lu et al. \(2003\)](#), [Özer and Wei \(2004\)](#), [Marklund \(2006\)](#), as well as some recent literatures extend the previous works. [Wang and Toktay \(2008\)](#) consider the inventory management with advance demand information and flexible delivery. Under the imperfect advance demand information case, [Benjaafar et al. \(2007\)](#) use it to investigate production-inventory systems with updating. [Tan et al. \(2007\)](#) consider it in the environments of Vendor Managed Inventory (VMI) applications and Collaborative Planning, Forecasting, and Replenishment (CPFR). [Tan \(2008\)](#) use the imperfect advance demand information in forecasting.

In realistic situation, inventory systems often face many different customer demands classification. Most of the existing literatures on inventory models are just assumed that all demands of a single

item is equally important. However, in practice, the demand for an item can often be categorized into classes with different priorities. Considering multiple demand classes in inventory control is an interesting extension of existing theory which has many practical applications. See [Topkis, 1968](#); [Evans, 1968](#); [Kaplan, 1969](#); [Frank et al., 2003](#); [Tempelmeier, 2006](#) for periodic review models and [Nahmias and Demmy, 1981](#); [Dekker et al., 1998, 2002](#); [Melchiors et al., 2000](#); [Melchiors, 2003](#); [Deshpande et al., 2003](#) for continuous review models.

2 Brief Literature Review on inventory rationing

In this section, we introduce some typical papers involved in the topics with different subcategories, lost sales and backorders, as well as Periodic review and Continuous review. This section just is a brief classification, in next section we will review with this topic to my research for more detail.

2.1 Periodic review

2.1.1 Lost Sales

With Periodic review and lost sales, there are few papers involved in inventory rationing, such as: Two demand classes: [Evans \(1968\)](#); N demand classes: [Veinott \(1965\)](#).

2.1.2 Backorders

With Periodic review and Backorders, there are few papers involved in inventory rationing, such as: Two demand classes: [Kaplan \(1969\)](#), [Frank et al. \(2003\)](#); N demand classes: [Katircioglu and Atkins \(1996\)](#).

2.2 Continuous review

2.2.1 Lost Sales

With Continuous review and lost sales, there are few papers involved in inventory rationing, such as: Two demand classes: [Melchiors et al. \(2000\)](#); N demand classes: [Melchiors \(2001\)](#), [Dekker et al. \(2002\)](#), [Ha \(1997a\)](#).

2.2.2 Backorders

With Continuous review and Backorders, there are few papers involved in inventory rationing, such as: Two demand classes: [Nahmias and Demmy \(1981\)](#), [Moon and Kang \(1998\)](#), [Deshpande et al. \(2003\)](#), [Dekker et al. \(1998\)](#); N demand classes: [Ha \(1997b\)](#), [Ha \(2000\)](#), [de Vericourt et al. \(2002\)](#).

3 Research Contributions

3.1 Base stock policies with degraded service to larger orders

We study an inventory system controlled by a base stock policy assuming a compound renewal demand process. We extend the base stock policy by incorporating rules for degrading the service of larger orders. Two specific rules are considered, denoted $Postpone(q, t)$ and $Split(q)$, respectively. The aim of using these rules is to achieve a given order fill rate of the regular orders (those of size less than or equal to the parameter q) having less inventory. We develop mathematical expressions for the performance measures order fill rate (of the regular orders) and average on-hand inventory level. Based on numerical experiments, our conclusion is that $Split(q)$ seems to perform best.

3.2 Investigating comparative advantages of advance demand information in presence of heterogeneous demand

The paper studies aspects of advance demand information and heterogeneous demand in a mathematical model of an inventory system. The concept advance demand information is that cus-

tomers ahead in time of actual demand place their orders. The concept heterogeneous demand refers to that there are different customer classes with distinct demand behaviour. It is assumed that the inventory system is operated by a base stock policy and there two customer classes that must be served from the inventory. One customer class, Class 1, do not provide any advance demand information at all, while the other, Class 2 does. There are given mathematical expressions of the service measure order fill rate offered to each class. The aim is to do an investigation of the magnitude of discrepancy in service between these two customer classes.

3.3 Comparing reservation policies of advance orders in presence of heterogeneous demand

It is a more specific version of the contribution mentioned in section [3.2](#).

In order to motivate customers to provide advance order information it is advantageous to make a reservation of the order at the inventory, thereby preventing later arriving orders to get access to the inventory before this particular order. However, a complete reservation policy, that is, reserving the order immediately will maybe give to bad service performance to the Class 1 customers. Therefore a strategy where the reservation is made somewhere in between the request date and the need date can be advantageous. We will formulate two specific policies for such a partial reservation strategy. We will for each policy derive mathematical expressions of the order fill rate service measure, offered to each class. The aim is to do an investigation of the magnitude of discrepancy in service between these two customer classes and to explore which of the two reservation policies that performs best.

3.4 Advance demand information with different Pricing options

Under construction.

3.5 Optimal Price and channel advantage with heterogeneous demand

Under construction.

4 Proposed structure of the thesis

The thesis consists of the following papers. Materials 1, 2 and 3 can be found in the three papers attached.

1. Base stock policies with degraded service to larger orders
(Submitted to *IJPE*)
2. Investigating comparative advantages of advanced demand information in presence of heterogeneous demand
(Semi-completed, the general case, want to do more deep investigation)
3. Comparing reservation policies of advance orders in presence of heterogeneous demand
(Semi-completed, the specific case)
4. Advance demand information with different Pricing options
(To be done, initial crude plan)
5. Optimal Price and channel advantage with heterogeneous demand
(To be done, initial crude plan)

5 Remarks and Future Works

In this thesis proposal,

1. I am planning on improving some technical aspects of the solution algorithm and simulation processes for the basic problem.
2. I am also planning to formally prove the results in the paper, and provide some more additional numerical investigations.

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