# Foundations Of Stochastic Inventory Theory

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interchangeability Stochastic Inventory Theory and the Demand for Money Inventory Models *Evan L. Porteus Evan Porteus Prashant Makwana Miao Song (Ph. D.) Nha-Nghi De la Cruz Robert F. Love Sandun C. Perera Robert Fairbairn Love Yu-Sheng Zheng Jaideep Jayaprakash Rao Robert F. Love Gregor White Smith Evan L. Porteus Baoding Liu Paul Herbert Zipkin Donald L. Iglehart Farrokh Nasri Gregor White Smith Éva Barancsi*

this book has a dual purpose serving as an advanced textbook designed to prepare doctoral students to do research on the mathematical foundations of inventory theory and as a reference work for those already engaged in such research all chapters conclude with exercises that either solidify or extend the concepts introduced

in 1958 stanford university press published studies in the mathematical theory of inventory and production edited by kenneth j arrow samuel karlin and herbert scarf which became the pioneering road map for the next forty years of research in this area one of the outgrowths of this research was development of the field of supply chain management which deals with the ways organizations can achieve competitive advantage by coordinating the activities involved in creating products including designing procuring transforming moving storing selling providing after sales service and recycling following in this tradition foundations of stochastic inventory theory has a dual purpose serving as an advanced textbook designed to prepare doctoral students to do research on the mathematical foundations of inventory theory and as a reference work for those already engaged in such research the author begins by presenting two basic inventory models the economic order quantity model which deals with cycle stocks and the newsvendor model which deals with safety stocks he then describes foundational concepts methods and tools that prepare the reader to analyze inventory problems in which uncertainty plays a key role dynamic optimization is an important part of this preparation which emphasizes insights gained from studying the role of uncertainty rather than focusing on the derivation of numerical solutions and algorithms with the exception of two chapters on computational issues in infinite horizon models all fourteen chapters in the book and four of the five appendixes conclude with exercises that either solidify or extend the concepts introduced some of these exercises have served as ph d qualifying examination questions in the operations information and technology area of the stanford graduate school of business

this dissertation extends the classical inventory control model to address stochastic inventory control problems raised in market making and robust supply chains in the financial market market makers assume the role of a counterpart so

that investors can trade any fixed amounts of assets at quoted bid or ask prices at any time market makers benefit from the spread between the bid and ask prices but they have to carry inventories of assets which expose them to potential losses when the market price moves in an undesirable direction one approach to reduce the risk associated with price uncertainty is to actively trade with other market makers at the price of losing potential spread gain we propose a dynamic programming model to determine the optimal active trading quantity which maximizes the market maker s expected utility for a single asset model we show that a threshold inventory control policy is optimal with respect to both an exponential utility criterion and a mean variance tradeoff objective special properties such as symmetry and monotonicity of the threshold levels are also investigated for a multiple asset model the mean variance analysis suggests that there exists a connected no trade region such that the market maker does not need to actively trade with other market makers if the inventory falls in the no trade region outside the no trade region the optimal way to adjust inventory levels can be obtained from the boundaries of the no trade region these properties of the optimal policy lead to practically efficient algorithms to solve the problem the dissertation also considers the stochastic inventory control model in robust supply chain systems traditional approaches in inventory control first estimate the demand distribution among a predefined family of distributions based on data fitting of historical demand observations and then optimize the inventory control policy using the estimated distributions which often leads to fragile solutions in case the preselected family of distributions was inadequate in this work we propose a minimax robust model that integrates data fitting and inventory optimization for the single item multi period periodic review stochastic lot sizing problem unlike the classical stochastic inventory models where demand distribution is known we assume that histograms are part of the input the robust model generalizes bayesian model and it can be interpreted as minimizing history dependent risk measures we prove that the optimal inventory control policies of the robust model share the same structure as the traditional stochastic dynamic programming counterpart in particular we analyze the robust models based on the chi square goodness of fit test if demand samples are obtained from a known distribution the robust model converges to the stochastic model with true distribution under general conditions

fixed costs of ordering items or setting up a process arise in many real life scenarios in their presence the most widely used ordering policy in the stochastic inventory literature is the s s policy optimality of s s policies and s s type policies have been investigated for various inventory models including those with discrete and continuous time reviews finite and infinite time horizons discounted and average cost objectives backlogging and lost sales settings standard and

generalized demand and cost structures deterministic and stochastic lead times single and multi product settings and coordinated pricing inventory decisions this survey provides a comprehensive review of this highly mature literature dating back to 1951 we discuss model specifications proof techniques specific results and limitations of the papers published on the topic we conclude the survey by providing suggestions for extensions and directions for future research

decision criteria and optimal inventory processes provides a theoretical and practical introduction to decision criteria and inventory processes inventory theory is presented by focusing on the analysis and processes underlying decision criteria included are many state of the art criterion models as background material these models are extended to the authors newly developed fuzzy criterion models which constitute a general framework for the study of stochastic inventory models with special focus on the real world inventory theoretic reservoir operations problems the applications of fuzzy criterion dynamic programming models are illustrated by reservoir operations including the integrated network of reservoir operation and the open inventory network problems an interesting feature of this book is the special attention it pays to the analysis of some theoretical and applied aspects of fuzzy criteria and dynamic fuzzy criterion models thus opening up a new way of injecting the much needed type of non cost intuitive and easy to use methods into multi stage inventory processes this is accomplished by constructing and optimizing the fuzzy criterion models developed for inventory processes practitioners in operations research management science and engineering will find numerous new ideas and strategies for modeling real world multi stage inventory problems and researchers and applied mathematicians will find this work a stimulating and useful reference

this text presents a complete treatment of inventory theory and models coverage is organized into an introductory section followed by a second which focuses on predictable supply and demand and the third section covering stochastic inventory models many developments related to inventory such as erp supply chain management jit and erp systems are integrated within the text

the paper surveys recent work in stochastic inventory theory areas emphasized include multi product models multi echelon models and stationary analysis of inventory models some concluding remarks are made about the future of the subject author

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