Preface

The importance of managing inventories properly in global supply chains cannot be denied. Each component of these numerous supply chains must function appropriately so that inventories are managed efficiently. To manage efficiently requires the leaders and staffs in each organization to comprehend certain basic principles and laws. The purpose of this book is to discuss these principles.

The contents of this text represent a collection of lecture notes that have been created over the past 33 years at Cornell University. As such, the topics discussed, the sequence in which they are presented, and the level of mathematical sophistication required to understand the contents of this text are based on my interests and the backgrounds of my students. Clearly, not all topics found in the vast literature on quantitative methods used to model and solve inventory management problems can be covered in a one-semester course. Consequently, this book is limited in scope and depth.

The contents of the book are organized in a manner that I have found to be effective in teaching the subject matter. After an introductory chapter in which the fundamental issues pertaining to the management of inventories are discussed, we introduce a variety of models and algorithms. Each such model is developed on the basis of a set of assumptions about the manner in which an operating environment functions.

In Chapter 2 we study the classic economic order quantity problem. This type of problem is based on the assumption that demands occur at a constant, continuous, and known rate over an infinite planning horizon. Furthermore, the cost structure remains constant over this infinite horizon as well. The focus is on managing inventories at a single location.

The material in Chapter 3 extends the topic covered in Chapter 2. Several multi-location or multi-item models are analyzed. These analyses are based on what are called power-of-two policies. Again, the underlying operating environments are assured to be deterministic and unchanging over an infinite horizon.

The assumptions made about the operating environment are altered in Chapter 4. Here the planning horizon is finite in length and divided into periods. Demands and costs are assumed to be known in each period, although they may change from period to period.

In all subsequent chapters, uncertainty is present in the operating environment. In Chapter 5 we study single-period problems in which customer demand is assumed to be described by a random variable. In Chapter 6, the analysis is extended to multiple periods. The discussion largely focuses on establishing properties of optimal policies in finite-horizon settings when demand is described by a non-stationary process through time. Serial systems are also discussed. The objective is to minimize the expected costs of holding inventories and stocking out. Thus, the cost structure in this chapter is limited to the case where there are no fixed ordering costs.

In Chapter 7, we study environments in which demands can occur at any point in time over an infinite planning horizon. Whereas we assumed in Chapter 6 that inventory procurement decisions were made periodically, in this chapter we assume such decisions are made continuously in time. The underlying stochastic processes governing the demand processes are stationary over the infinite planning horizon, as are the costs. As in Chapter 6, we assume there are no fixed ordering costs.

The analysis in Chapter 7 is confined to managing items in a single location. In Chapter 8 we extend the analysis to multi-echelon systems. Thus the underlying system is one in which inventory decisions are made continuously through time, but now in multiple locations. The importance of understanding the interactions of inventory policies between echelons is the main topic of this chapter.

Chapters 9 and 10 contain extensions of the materials in Chapters 7 and 6, respectively. In both chapters, we introduce the impact that fixed ordering costs have on the form of optimal operating policies as well as on the methods used to model and solve the resulting optimization problems. Both exact and approximate models are presented along with appropriate algorithms and heuristics. A proof of the optimality of so-called (s,S) policies is given, too.

As mentioned, the materials contained in this text are ones that have been taught to Cornell students. These students are seniors and first year graduate students. As such, they have studied optimization methods, probability theory (non-measure-theoretic) and stochastic processes in undergraduate level courses prior to taking the inventory management course. In addition to presenting fundamental principles to them, the intent of the course is also to demonstrate the application of the topics they have studied previously.

The text is written so that sections can be read mostly independently. To make this possible, notation is presented in each major section of each chapter. The text could be used in different ways. For example, a half semester course could consist of material in Chapter 2, Section 4.1, Sections 5.1–5.2, Sections 6.2–6.3, most of Sections 9.1–

9.2, Sections 10.1–10.2, and Section 10.5. While we have chosen to examine stochastic lot sizing problems at the end of the text, these materials could easily be studied in a different sequence. For example, Chapter 9 could be studied after Chapter 3, and Chapter 10 could be studied after Chapter 6. Rearranging the sequence in which the text can be read is possible because of the way it has been written.

I have mentioned that the scope of this text is limited. I encourage readers to study other texts to complete their understanding of the basic principles underlying the topic of inventory management. These texts include those authored by Sven Axsäter; Ed Silver and Rein Peterson; Steve Nahmias; Craig Sherbrooke; Paul Zipkin; and Evan Porteus. Each of these authors has made exceptional contributions to the science and practice of inventory management.

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