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Computer Simulation in Logistics

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The authors point out in the introduction that the study of logistics may defy mathematical precision. For example, the authors suggest that the school of hard knocks is the basic training ground for logistics. That is, because of the pressures of the real world and the complexity of a logistics problem, it may be impossible to quantify all aspects of a logistics decision. There are, however, a number of options available for the effective teaching of logistics. One is the case method, which can be rather artful in that it combines both quantitative and qualitative facts about a problem and attempts to solve it. Another way to teach logistics is to use simulation, which provides a more quantitative response to typical problems faced by logistics managers. This book is about simulation. The general caution for the reader is that, while simulation can be very flexible and applied to a variety of situations, each simulation needs to be tailor-made for each firm. Thus, there are risks with applying simulations as generic solutions to all firms.

This is a cross between a textbook and a how-to manual. It is organized with each chapter devoted to a particular simulation designed to solve logistics problems. No rationale is given for the selection of simulations which are contained in the book and not all of them seem to have direct relevance to the field, e.g., the selection of aircraft and siting an ambulance station. The major questions, according to the authors, were whether to include the simulations in each chapter, as opposed to placing them in the appendix, and what programming language to use. For the former question, discussion of each simulation is incorporated into each chapter while the specific code is in an appendix which accompanies each chapter. In regard to the second issue, basic is the language of choice. Actually the authors present each simulation in both Gwbasic and visual basic (VB). The rationale is that basic has been around since the 1960's and "is well known by a wide range of people in the field of simulation." Visual basic is a more modern version of that language and has an advantage in that it can be easily integrated with Excel spreadsheets. While it is true that basic has been around for approximately 40 years, it is not the case that it is necessarily the language of logistics managers. Nor is it necessarily taught in colleges and universities in favor of other programming languages. From that standpoint, the choice of language may pose difficulties in using this as a text. That is, it may require learning yet another language for both faculty and students. This may be less of a problem for practitioners who may use the book primarily as a how-to manual.

The book is organized by different simulations as individual chapters. Each simulation is discussed in terms of the methodology, the nature of the problem, the logic of the model (normally presented in Gwbasic), how to evaluate the results, how firms may make similar decisions in the real world, and any enhancements which may be made to the simulation by using visual basic. The authors have attempted to keep the simulations simple to encourage users to modify them for their own application. The discussion in each chapter is rather detailed both in terms of the basic code as well as the application to either Lotus or Excel spreadsheets. The result is that the reading can be quite tedious and the reader needs to be careful in following the literal instructions.

My primary criticisms of the book are the choice of simulation language and the selection of simulations which are supposed to be related to logistics. While most are rather logical, some appear odd. For example, the chapter headings are as follows:

The Normality of Things
When to Reorder and How Much?
Determining Warehouse Capacity
How Many Warehouse Docks?
How Many Trucks Should be Owned?
Tankers Serving a Pipeline
Selecting Aircraft
Just-In-Case Inventory for Delivery
Push Manufacturing
Pull Manufacturing
Combining Warehouses
Factory Inventory
The Economic Run Length
Siting an Ambulance Station

Chapter 1 discusses the normal distribution and its importance in simulation exercises. This chapter sets the tone of the book in presenting a detailed discussion of how to simulate the normal distribution as well as instructions on how to enter simulation code into spreadsheets. This chapter represents a building block for many of the subsequent chapters.

"When to Reorder and How Much" is very useful. The traditional way of dealing with this problem is by calculating the Economic Order Quantity (EOQ) which balances ordering and holding

costs. The difficulty is that the model makes assumptions which may not hold true in actual practice, e.g., the variability of lead times. The solution for the authors is a trial and error simulation which specifies reorder points while minimizing stock-out costs and related holding and ordering costs.

"Determining Warehouse Capacity" is also useful in that it can have wide application. The simulation assumes multiple products and dedicated warehouse space for each product. For example, each product has its own storage bin and products cannot be mixed in the same bin. However, if a bin is empty it can be used by any product. The question is, given some level of demand and its variability, how many storage bins does the warehouse needs? The next chapter, "How Many Warehouse Docks?", is normally solved with queuing theory. However, when assumptions regarding arrival patterns are not valid, such problems need to be simulated. My concern here is that this is not particularly new and would it be the province of the logistics manager or the industrial engineers to make such decisions?

"How Many Trucks Should be Owned" and "Tankers Serving a Pipeline" address similar problems. The authors differentiate the problems by suggesting that the tanker decision is driven more by operating efficiency while decisions as to how many trucks may also be driven by policy issues such as customer service. Both problems deal with the scheduling of different vehicles of various capacity to maximize capacity.

"Selecting Aircraft" takes the perspective of an airline, with a variety of planes, and asks how they should be routed given a fixed network, variation in demand and different vehicle capacities. Conceptually this chapter is similar to the questions of trucks and tankers above. While somewhat interesting, these may not be mainline decisions for a logistics manager. As in the case of determining the number of warehouse docks, these problems can be solved by alternative methods, e.g., linear programming and various routing algorithms.

There are a series of chapters dealing with "Just in Case Inventory for Delivery," as well as "Push Manufacturing," "Pull Manufacturing," and "Factory Inventory." When taken together, the value of these chapters is twofold. First, they suggest a hierarchy of inventory positions, e.g., a factory dealing with a distributor who in turn deals with a retailer, etc. Thus, there is an implied supply chain context to this discussion. In addition, there is value in the demonstration that inventory costs can be reduced by being reactive to actual movement of the product rather than anticipating product sales based on forecasts. Such a change in philosophy is at the core of current supply chain management strategies. The drawback to these chapters is that they assume the reduction of transit times, in order to minimize inventory, but don't consider increased transport costs.

"Combining Warehouses" deals with the question of warehouse consolidation. This topic is receiving substantial focus in the logistics literature through the application of the so-called "square root rule." Simulation offers a solution to some of the assumptions made by the square root rule including what happens to demand characteristics at the consolidated facility as well as transit time and transit time variability. Simulations are developed which cover a variety of situations ranging from a proactive and reactive ordering systems.

"Economic Run Length" deals with the classic problem of balancing production line set up costs and variable production costs. The authors enrich the problem by including various quality tolerances and variable demand for a variety of products. The simulation also allows orders to be filled directly from the production line as well as from inventory.

"Siting and Ambulance Station" is actually a poor choice of how to frame this type of location problem. This is actually a simulation of a center of gravity methodology which is helpful in siting plants and warehouses. It is a relatively straightforward method which finds the location by minimizing total ton-miles. Simulation allows the manager to make the analysis with greater precision rather than relying on restrictive assumptions.

In general the authors have taken great care to present this material in a useable format. Its value is clearly a function of the nature of the problems the reader wishes to solve and the reader's skill in basic. The volume would be enhanced further with a more extensive bibliography relating not so much to logistics but toward basic or other programming languages.

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