A GASP SIMULATION STUDY OF A MULTI-PRODUCT INVENTORY SYSTEM

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1. INTRODUCTION

This study is concerned with the use of GASP simulation language to simulate a multi-product inventory system, and to compare two alternative inventory management systems, the (s,S) system and the one based on adaptive forecasting using exponential smoothing. The objectives of this study are to: (1) simulate a multi-product inventory system, the products having different demand rates, (2) determine the most effective parameter values for use in exponential smoothing formula, (3) make available a version of GASP II usable on the IBM 360, the original version being written for GE 225 and (4) quantify in economic terms the expected savings derived from the application of adaptive forecasting technique to the inventory system. This inventory problem is taken from Starr and Miller (20).

It is assumed that customers follow an exponential arrival pattern with a normally distributed demand quantity. A delay has been incorporated between the warehouse and the posting department. The posting delay is assumed to follow a normal distribution. The lead time, the period from the time the order point is reached until the ordered material is available in inventory, is also assumed to follow a normal distribution. The process generating demands does not change with time. In particular, this implies that the mean rate of demand remains constant over time. In particular, this implies that the mean rate of demand remains constant over time. The inventory considered is a typical case of a stock of products replenished by purchases. The products are assumed to possess different usage rates and that the demand for each of these items is independent of the demand for

other items. Customer demand continuously depletes the available stock of each item, and at the time that the inventory reaches a specified reorder level, an order is placed for the item.

GASP II was evolved at the Arizona State University by Pritsker and Kiviat (19). The original language and program were developed at the Applied Research Laboratory of the United States Steel Corporation by Kiviat (12). GASP is a computer program expressly designed for use in simulation studies of industrial systems to meet the growing demands for an efficient and easily understandable simulation language. The primary objectives were to promote the correct use of the simulation methodology by providing a workable tool to the prospective users and to reduce the long time usually required for the system studies by improving the communications between the engineer and the computer programmer. The language was based on a flowcharting description that used a small set of special symbols and conventions which were later related to particular GASP language statements. The applications of GASP to simulation projects include areas in steel manufacturing and transportation. GASP was written before the advent of SIMSCRIPT and probably owes much of its existence to this fact (12).

Packer (18) used IBM's IMPACT system (Inventory Management Planning and Control Technique) to simulate an inventory system to estimate cost savings resulting from adaptive forecasting as compared to optimal lot-size or economic order quantity. Batra (1) simulated a single-item inventory model using FORTRAN to investigate the effects of changes in the variances of demand and order lead time distribution on the actual

demand during review period distribution and demand during lead time distribution.

2. INVENTORY MANAGEMENT

Inventory theory is defined as finding input (replenishment) and output (demand) functions for an inventory (defined as an ideal resource of any kind) that maximize a given measure of effectiveness subject to certain restrictions (20).

The inventory control system is a day-to-day operating system. The inventory control system maintains a record of stock status on hand and on order. It processes transactions about receipts, disbursements and adjustments. It can check the stock status against one or more control numbers. If the comparison passes a logical test, the inventory control system will generate a replenishment order. The inventory control system can be analyzed as a set of formal procedures. The implementation of these procedures would involve a computer, or manually posted records, or even the physical stock itself. The role of an order point in the inventory control system is to trigger the release of another requisition for more stock. A customer demand is subtracted from the quantity on hand for the item. If the quantity on hand is less than the demand, the latter is a stockout and a stockout is recorded. But such a demand is added to the accumulative demand so that we have a record from which to forecast what the future demand would be. Whenever an order is placed to replenish the stock, the quantity is added to the system stock (stock recorded in book and the stock on order). When the resulting stock is received at the warehouse, the quantity received is added to the physical balance on hand. The quantity received would be the same as ordered.

The inventory management system exists to set numerical values on