THE DEVELOPMENT OF AN EXPERT SYSTEM FOR INVENTORY MANAGEMENT

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Abstract

Techniques used in the development of EXSIM (EXpert System for Inventory Management) are described. The system converts the overall objectives of inventory managers into recommendations as to how to achieve those objectives. It also compares the costs of alternatives in relation to supply. The modelling is carried out using data contained in the user's computerised inventory system combined with feedback from the user. The system makes use of the user's intuition after first testing the validity thereof.

INTRODUCTION

Almost all inventory systems which determine reordering criteria do so poorly. Consequently, inventory managers find it necessary to review the computer's recommended orders before the orders are placed. The time taken to do this forms part of the effective lead time and, consequently, it increases the required investment in stock. Any need for an inventory manager to take the above-mentioned action indicates that there is a need for the setting of reordering criteria to be improved.

EXSIM (EXpert System for Inventory Management) was developed for the purposes of

1. determining reordering criteria and
2. strategic analysis in relation to inventory management.

TECHNIQUES

Most of the techniques described by Johnston [1988] are used to assist with the modelling or strategic analysis.

The system is used in conjunction with the user's existing inventory system. It determines reordering criteria for each of
a large number of items subject to the user's objectives in relation to overall investment in stock and purchasing staff work load. It does so in such a manner as to come close to maximising the overall service level subject to the above-mentioned objectives. EXSIM achieves this by iterative adjustment of the shortage and ordering cost parameters to satisfy the user's objectives. It uses samples of items for this purpose, the samples being selected by the computer using the method described by Johnston [1988].

The system informs the user of the effects of his objectives.

It provides a very high service level for items for which it is economic to do so. This is rarely done in computer systems. Doing this provides two important benefits, viz.

1. it results in a high overall service level in relation to the overall investment in stock and

2. it enables the inventory manager to devote little attention to the majority of items and concentrate his efforts on the items for which it is costly to provide good service.

The forecasting of demands is currently carried out by the technique developed by Lahiri [1979].

The method by which the reordering criteria are calculated is based on that which was developed by Vignaux and Jain [1988]. That technique has been modified to deal with uncertainty about the long term future. Inventory systems which fail to take this into account tend not to be trusted by users. It is something which is usually very difficult to model. However, a useful guide to the modelling of it can be obtained by examining what experienced and capable inventory managers do in practice in a variety of situations. EXSIM tests the validity of the user's intuition by only allowing him to change reordering criteria after informing him of the costs involved. When he makes such changes, appropriate adjustments are made to parameters of the algorithm which is used to determine the reordering criteria. This approach has the advantage of simplicity. Its main disadvantage is that when the costs associated with uncertainty about the long term future are required, those costs must be inferred from the user's alterations to reordering criteria.

The system obtains its data from the user's inventory system. It carries out most of the modelling of the inventory by using

1. the data from the inventory system and

2. the changes which the user makes to the computer's recommendations in spite of being told of the costs involved.

The manner in which the system is intended to be used for reviewing reordering criteria is as follows:

1. Data is transferred from the inventory system to EXSIM.
2. The user enters his overall objectives.

3. EXSIM adjusts its parameters to achieve those objectives.

4. EXSIM prints information concerning the items for which it is not possible to achieve a high service level at little cost.

5. The user makes any desired changes to the reordering criteria for those items. EXSIM accepts those changes only after informing the user of the costs involved.

6. The recommended reordering criteria together with the changes made by the user are transferred to the inventory system to control subsequent reordering.

On the first occasion on which EXSIM is used, the user teaches it about the uncertainty concerning the long term future as described above.

If EXSIM is used correctly, there should normally be little, if any, need for the user to examine his inventory system's reordering recommendations before placing orders.

For any item, the user can compare alternatives in relation to supply by altering or controlling one or more of the following:

1. lead time
2. unit cost
3. reorder point
4. mean order quantity
5. order-up-to level
6. service level
7. average investment in stock
8. safety stock in days supply
9. order cycle

He can also consider a combination of a normal method of supply (e.g. by sea) and an emergency method of supply (e.g. by air). This is achieved by an iterative process.

When alternatives are being compared for an item, EXSIM determines near optimal reordering criteria subject to the constraints imposed by the user. This is done by "reversing" relevant algorithms when it is reasonable to do so. In other cases, iterative methods are used. The user is informed of the costs involved so that he can make an informed decision as to whether or not he should make the changes which he is contemplating.
All of the iterative processes used by the system involve, in the second or third and subsequent iterations, making an estimate of the optimal solution based on the results of earlier iterations.

References

