

## FUZZY SEASONAL DEMAND AND FUZZY TOTAL DEMAND PRODUCTION QUANTITIES BASED ON INTERVAL-VALUED FUZZY SETS

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**ABSTRACT.** Both seasonal demand  $r$  and total demand  $R$  in the production inventory model are difficult to estimate precisely to actual  $r_0$  and  $R_0$  values, respectively. Hence, we will set the membership grade at  $r_0$  and  $R_0$  in an interval  $[\lambda, 1]$ ,  $0 < \lambda < 1$ , and then, obtain the interval-valued fuzzy sets  $\tilde{r}$  and  $\tilde{R}$ , respectively. For each production quantity period  $q$ , we can obtain the fuzzy total cost  $G_q(\tilde{r}, \tilde{R})$  and determine the defuzzification of  $G_q(\tilde{r}, \tilde{R})$  as the estimate of the total cost. This paper presents production inventory model uncertain problems that would be helpful in the real world.

**Keywords:** Production inventory model, Fuzzy demand, Interval-valued fuzzy set, Estimate of total cost

1. **Introduction.** A series of inventory article issued by Yao et al. [1,5,6,10,11] discusses fuzzy inventory and production fuzzy inventory with or without backorders. We may fuzzify the order quantity  $q$  as  $\tilde{Q}$ . Therefore, we can determine the centroid of the fuzzy total cost as the estimate of the total cost. The above fuzzy inventory concept without backorder was discussed in [5,11]. There are two fuzzy inventories with backorder cases to discuss.

Fuzzify the quantity of order  $q$  as  $\tilde{Q}$  and the insufficient stock quantity  $s$  was treated as a crisp variable [10,11]. Fuzzify the insufficient stock quantity  $s$  as  $\tilde{S}$  and the  $q$  order quantity is treated as a crisp variable [1]. In each case, we can obtain the fuzzy total cost and determine its centroid as the total cost estimate. In [6], we may fuzzify the demand quantity  $r$  and production quantity  $d$  to obtain the fuzzy total cost and its centroid as the estimate of the total cost in the fuzzy sense. Because the crisp variables  $q$ ,  $s$ ,  $d$  which we want to fuzzify, are all in the denominator of the crisp total cost function, it is difficult to solve the problem using the interval-valued fuzzy set  $\tilde{Q}$ ,  $\tilde{S}$  and  $\tilde{d}$ . So  $\tilde{Q}$ ,  $\tilde{S}$  and  $\tilde{d}$  are measured by the usually triangular fuzzy number or usually trapezoid fuzzy number.

Chen et al. [2] fuzzified the order cost, inventory cost and backorder cost into trapezoidal fuzzy numbers and used the functional principle and the estimate of the total cost in the fuzzy sense. Ishii and Konno [4] fuzzified the shortage cost into a fuzzy number in a classical newsboy problem aimed to find the optimal ordering quantity in the fuzzy ordering sense. Petrovic and Sweeney [7] fuzzified the demand, lead time and inventory level into triangular fuzzy numbers in an inventory control model; then decided the order quantity using the fuzzy proposition method. Roy and Maiti [8] rewrote the classic economic order quantity problem into a nonlinear programming problem form and introduced fuzziness