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A COMPARISON OF EOQ WITH JIT

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Abstract— The literature on implementation of EOQ (Economic Order, Quantity) and JIT(Just in Time) are increasing from past few years. Both the systems have their own Advantages as well as disadvantages for implementations. The most important point is which one to be adopted. As the advantage of EOQ System is getting the benefits of discounts and reduce the risk of out of stock situations. Whereas JIT may be implemented for reduction of holding cost or EOQ may not be possible in all the cases. In some situations, only JIT can be used. In many situations both the systems may be implemented. In this paper, a comparative study has been carried to find out when which system is more cost effective. For this purpose, a probabilistic inventory model with a constraint on holding cost is studied and extended. In this paper, it is assumed that some amount of space is reduced by adopting JIT and cost price per unit item increased the difference between two costs has been calculated, and found a point where these two costs are equal (i.e. indifference point) and the same is demonstrated by taking a numerical example. Sensitive Analysis is also carried out.

Keywords: **EOQ, JIT, Indifference point**

I. INTRODUCTION

Till 1960 only EOQ (Economic Order Quantity) was in practice and the companies were trying to manage their inventory between over production and shortages. In 1960 Toyota, a Car manufacturing company in Japan was studied and implemented a new policy called as JIT(just-in-time). According to this policy the items are produced whenever an order is placed and immediately it delivers to the customer. This is also known as Push and Pull System.

In Push and Pull System, less inventory is stored. So it was observed that the carrying cost also reduced. Later on many companies started implementing JIT. As both the systems are more prominent the researchers started studying on comparison. Firstly, Fazel started study on the comparison of both the models and developed a series of innovative mathematical models to directly compare the cost differences between EOQ and JIT.

A new function Z as the difference of the cost was taken and found a indifference point (i.e.

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the point where both the costs are equal) and concluded that below this point EOQ is better and beyond this point JIT is better. Later on many researchers revised this model by incorporating the new parameters and tried to find the indifference points.

1.1. EOQ

If the products are ordered well in advance and to gain the benefit of discounts, a two warehouse is used in EOQ system. In EOQ models the holding cost involves rent, salaries for the staff to maintain the inventory preservation technologies to maintain the quality, interest on the principal amount i.e. the amount which is invested on the inventory / infrastructure of the warehouse, current bills and the expenditure involved in maintaining the inventory.

It minimizes the total of ordering cost, carrying cost. It is a short term model where the orders are placed for a fixed time and reordered after the stock is completed or after reaching a buffer stock.

1.2. JIT

JIT is a Japanese Management philosophy. In JIT system the products are ordered according to need and necessity. It is a long run model and involves more on supply chain management as it is a push and pull model. The carrying cost will be less because the inventory stored in the warehouse will be very less. It involves more transportation cost when compared to EOQ as the order is placed only for the requirement and the ordering cost may also be high as the order is placed only whenever there is a demand.

It is in a notion that JIT is always more cost effective than the EOQ as it does not need any space for storage and also deterioration will not be there.

But at the same time JIT has its own disadvantages as it should have an effective supply chain management otherwise there will be more stock out risk which is very difficult to handle. It is observed in some cases the EOQ model is more cost effective as it can be easily managed, the demand flow and with less stock out cases.

An attempt is made to find an indifference point (i.e. the point where the two costs are equal) for EOQ and JIT, so that it can be easily state that from this point on-wards EOQ is more cost effective or JIT is effective. For this purpose` `A Two Level Probabilistic Inventory Model With a Constraint on Holding Cost" discussed by the authors M.Nagasree, M.Madhavilata, A.Sailakumari, considered the paperby assuming a reduction in space by adopting JIT system.

II. Literature Survey

A two level of inventory model with probabilistic demand and uniform demand is considered by Pakkala[7] and discussed when the inventory is dependent on time and also with a constant age specific rate. S Kar and T Roy [4] made an attempt for a Multi-item inventory model with probabilistic price dependent demand and imprecise goal and constraints.

The author Hala [3] considered the stochastic uniform inventory model with varying cost and a constraint on the holding cost by considering the average inventory at any time `t'. Fergany[2] studied a continuous review model with lost sales case, varying order cost, a restriction on holding cost and also lead time demand is assumed as normal distribution. Sushilkumar [5] studied a probabilistic inventory model for deteriorating items with ramp type demand rate under inflation. An attempt is made by M.Nagasree [6] to extend the paper Hala [3] for a two warehouse by taking constant holding cost and also varying the number of items stored in OW and RW.

Fazel [1] in 1997 started comparison of EOQ models with JIT models. Schniederjans [8] in

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2000 presented a comparative model for EOQ model with quantity discounts and just-in-time (JIT) and calculated in difference point i.e the point where the total cost in EOQ equals to the total cost in JIT and concluded that EOQ system has to become a JIT system whenever very large annual demand levels are reached. Min Wu [9] in 2011 revised EOQ model by considering the fixed costs like rent, utilities staff salaries and also considered the penalty for moving from EOQ to JIT as the risk of out of stock is more in JIT system. The author summarized that JIT is not always cost effective but EOQ also can be cost effective whenever the demand is too low or risk of out of stock s high in JIT system.

III. ASSUMPTIONS AND NOTATIONS

N: reduction of the space by adopting JIT i.e Space required in EOQ -space required in JIT

PJ: Unit price under JIT system including transportation

TJ: Total cost under JIT

TE: Total cost under EOQ

H: Holding cost in OW

F: The holding cost in RW

IV. MODEL FORMULATION

It is assumed that by adopting JIT policy the storage space is reduced hence consequentially the carrying cost reduced. Let N square units of storage is reduced by adopting JIT. So that the total cost under JIT system is given by

TJ=S*PJ-FN

Based on the paper ` `A Two Level Probabilistic Inventory Model With a Constraint on Holding Cost" discussed by M.Nagasree, M.Madhavilata, A.Sailakumarithe total cost under EOQ is carried from the equation

$$W = \frac{4SF}{3H+5F}$$ ----------[1]

Let $B = \frac{4F}{3H+5F}$ ----------[2]

so that W= B*S

$$Z = CS + H\int_0^W \left(W - \frac{x}{2}\right) f(x)dx + F\int_W^S \left(S - W - \frac{x}{2}\right) f(x)dx + H\int_S^\infty \left(\frac{S^2}{2x}\right) f(x)dx - D * PJ + F * N$$

----------[3]

substituting W=SB in the equation [3] we get

$$Z = CS + H\int_0^{SB} \left(SB - \frac{x}{2}\right) f(x)dx + F\int_{SB}^S \left(S - SB - \frac{x}{2}\right) f(x)dx + H\int_S^\infty \left(\frac{S^2}{2x}\right) f(x)dx - D * PJ + F * N$$

----------[4]

h = H+F as the total holding cost

$$S = \sqrt{\frac{2CD}{h}} \text{ and } D = \frac{S^2 h}{2C}$$ ----------[5]

Substituting D and f(x) = 1/b in [4] and simplifying we get

$$Z = CS + \frac{3HS^2B^2}{4b} + \frac{F(3S^2+5B^2S^2-8BS^2)}{4b} + \frac{HS^2 \ln\left(\frac{b}{S}\right)}{b} - S * PJ + FN$$

---------[6]

on simplifying further, we get

$$Z = \frac{\alpha S^2}{b} + \frac{HS^2 \ln\left(\frac{b}{S}\right)}{b} + FN + CS$$ ----------[7]

Where $\alpha = \frac{3HB^2}{4b} + \frac{F(3+5B^2-8B)}{4b} - \frac{h*PJ}{2C}$ -------[8]

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On solving the equation for [5] for S using Newton Raphson Method and calculating demand using [6] which an indifference point from which we can conclude that either EOQ is better or JIT.

V. NUMERICAL ILLUSTRATION

, The demonstration has been done by taking the reference of the numerical example of the paper discussed by M.Nagasree [6] i.e. C= 3, F=7, H=5, K=40, b=25, N=20, PJ=18 and F=5.and calculated the indifference point and is found it to be 200.81 i.e. if the demand is less than 200.81 the Cost in EOQis less than the cost in JIT. So EOQ is better than JIT in such case.

VI. SENSITIVE ANALYSIS

A sensitive analysis is done for different values of F(Table I), N(Table II), PJ(TableIII) and tabulated below.

Case(i)N=20 and PJ=18 are fixed and F is varied from 5 to 13 with a step size of 2

Table I A Sensitive Analysis on the value of F

S.No	F	Indifference Point
1	5	200.81
2	7	264.5
3	9	312.5
4	11	392.5
5	13	882.0

From the above values it is clear that as the value of `F' is increasing the indifference point is also increasing.

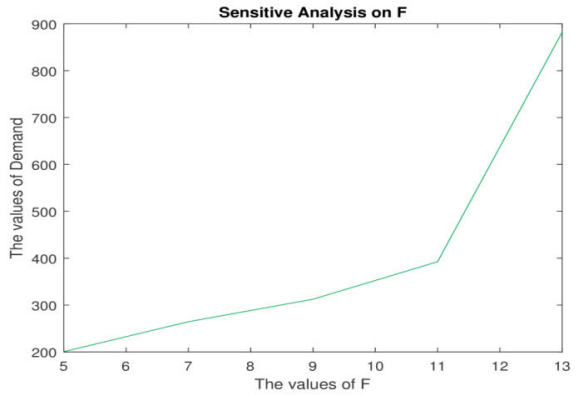

Figure I Sensitive Analysis on the value ofF

Case(ii) F=5, PJ=18 are fixed and N is varied from 2 to 20 with a step size of 2

Table II A Sensitive Analysis on the value of N

S.No	N	Indifference Point	S.No	N	Indifference Point
1	2	-	6	12	132.46
2	4	58.75	7	14	149.87
3	6	78.11	8	16	167.01
4	8	96.69	9	18	184.01
5	10	114.76	10	20	200.81

From the above values it is clear that as the value of `N' is increasing the indifference point is also increasing.

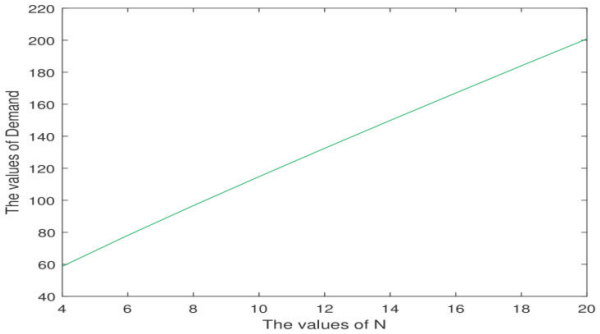

Figure II A Sensitive Analysis on the value of N

Case(iii) F=5, N=20 and PJ is varied from 2 to 20 with a step size of 2

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Table III A sensitive analysis on the value of PJ

S.No	PJ	Indifference Point	S.No	PJ	Indifference Point
1	2	12879.4	6	12	329.75
2	4	1313.8	7	14	277.6
3	6	79.5	8	16	237.56
4	8	548.69	9	18	200.81
5	10	414.03	10	20	176.9

From the above values it is clear that as the value of `F' is increasing the indifference point is also increasing

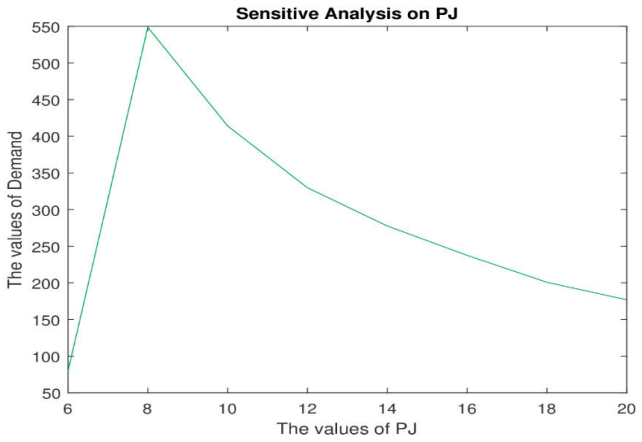

Figure III A Sensitive Analysis on the value of PJ

From the above values it is clear that as the value of `PJ' is increasing the indifference point is decreasing.

VII. CONCLUSIONS

JIT is another prominent technique for inventory models. In this paper a comparison was done for both EOQ and JIT models. An indifference point was calculated for the probabilistic inventory model which was discussed in the paper authored by M.Nagasree [6] by assuming adoption of JIT, the space is reduced so that carrying cost decreases. To illustrate the model a numerical example was discussed by considering the same values as in the numerical example in the paper discussed by M.Nagasree[6]. The result shows that the indifference point is 200.81. That implies that if the demand is less than 200.81 cost in EOQ system is adoptable. A sensitive analysis also was done to study on the variation in the indifference point. It was found that when the purchasing cost of item in JIT increase the indifference point decrease.

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