Unit-III

02 TUESDAY JULY
(183-182) WK 27

2 Thousand

Inventory Control.

In competitive world, it is not possibee for any firm to refuse the customer demand just due to 'out of stock' condition of raw material.

"Firms have to keep raw material in an ideal condition, which is called Inventory'.
So inventory can be referred as ideal resource of raw material kept in order to meet the regular or sudden demand of the customer.

Objectives of Inventory Control:—

→ To keep better customer satisfaction

→ Maintain smooth and efficient production flow

→ To ensure against delays in deliveries

→ To ensure against scarcity of materials in the market

M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

→ To take the advantage of quantity discounts.

→ To allow for possible increase in output

→ To have better utilization of men and machinery

→ Act as shield against rejection of material

Inventory Costs:—

→ Purchase cost
→ Storage Cost
→ Ordering Cost
→ Shortage "

C – Purchased (or manufacturing) cost (Rs. per unit)

Co – Ordering cost (or set up) cost (Rs. per order)

r = Inventory carrying rate (Expressed in terms of rupee value of inventory)

Ch – Holding cost = C.r

Cn = Shortage cost (Rs. per unit time)

D → Annual demand

Q → Quantity ordered / per

TC → Total inventory cost (Rs)

TVC → Total variable inventory cost (RS)

ROL = Re order level (in un

LT – Replenishment lead time

n – Number of order per unit time period

t → Time interval b/w suc orders.

tp → Production time period

rp – Production rate.

Optimum Order Quantity (in units) $= Q^* = D \cdot t$

$$= \sqrt{\frac{2 C_0 D}{C_h}}$$

) Total variable inventory cost

$$TVC = \sqrt{2 C_0 D C \cdot r}$$

Total inventory cost

Total cost $= D * C + TVC$

$$= D * C + \sqrt{2 C_0 D C \cdot r}$$

$$= D * C + \frac{D}{Q} \cdot C_0 + \frac{Q}{2} \cdot C \cdot r$$

06 SATURDAY
JULY
(187-178) WK 27

A shopkeeper has 500 units of refrigerators to be supplied per year to his customers. The demand is fixed. The inventory holding cost is Rs. 200 per unit and the ordering cost is Rs. 80. Determine

(i) Optimum lot size
(ii) optimal total variable cost
(iii) Optimal period of order to be placed at
(iv) no. of total orders to be placed in a year.

Sol

From the given data

$D = 500$ units

$C_h =$ Rs 200 per unit

$C_o =$ Rs. 80 per order

07 SUNDAY

Optimum lot size

$$Q = \sqrt{\frac{2C_oD}{C_h}} = \sqrt{\frac{2 \times 80 \times 500}{200}}$$

T W T F S S M T W T F S S M T W T F S S M T
1 2 3 4 5 6 7 8 9 10 11 12

(ii) total variable cost
TVC = $\sqrt{2 C_0 \cdot D C_h}$
= $\sqrt{2 \times 20 \times 500 \times 20}$
= Rs. 4000 per year

(iii) Optimal period of order to be placed, $t = \frac{Q^*}{D} = \frac{20}{500}$
= 0.04 × 52 wee
= 2.08 weeks

(iv) Num. of orders to be placed, $n_0 = \frac{D}{Q^*} = \frac{500}{20}$
= 25 orders per year

If the annual demand for inventory item(s) expressed in rupee value then the equation for EOQ is changed as follows

Q^* (in Rupees value)

$$= \sqrt{\frac{2 C_o D C}{C_h}} = \sqrt{\frac{2 C_o D}{C_i R}}$$

Optimum Economic Order Quantity in Rupees

$$= C \sqrt{\frac{2 C_o D}{C_i R}}$$

No. of orders per year = $\frac{\text{Yearly consumption (in Rs.)}}{\text{EOQ (in Rs.)}}$

= ~~4500~~

* A firm uses Rs. 4500 of an item during this year. The ordering cost is Rs. 25 per order and carrying cost is 10% of the average inventory value. Find EOQ and number of orders per year.

Sol^n C_o = Rs. 25, C_h = 10% average inventory value = C.2

firm uses Rs 4500 of an item during the year. So it is product of demand and the unit cost of the item.

$C \cdot D = 4500$

Optimum lot size :

$$Q^* = \sqrt{\frac{2 C_o D}{C_h}}$$

optimum EOQ in Rupees

$$= C \sqrt{\frac{2 C_o C \cdot D}{C \cdot 2}}$$

$$= \sqrt{\frac{2 \times 4500 \cdot 25}{0.10}}$$

$$= 1500 \text{ Rs.}$$

No. of orders per year

$$= \frac{\text{Yearly Consumption (in Rs.)}}{\text{EOQ (in Rs.)}}$$

$$= \frac{4500}{1500} = 3 \text{ orders per year}$$

28 WEDNESDAY
(240-125) WK 35 AUGUST

Inventory Problems. — Contd.

A stockist has to supply 400 units of a product every monday to his customers. He gets the product at Rs. 50 per unit from the manufacturer. The cost of ordering and transportation from the manufacturer is Rs. 75 per order. The cost of carrying the inventory is 7.5 % per year of the cost of the product. Find the
(i) Economic lot size
(ii). Total optimal cost including cost of purchase per week
(iii) Total weekly profit if the item is sold for Rs. 55 per unit

$D = 400$ units per week
$= 400 \times 52 = 20800$ per year

$C =$ Rs. 50/- per unit

$C_o = 75$ Rs. per order

$C_h = 7.5\%$ of cost of product

$= \frac{7.5}{100} \times 50 \quad \frac{15}{4} = 3.75$

Optimum lot size

$Q^* = \sqrt{\frac{2 C_0 D}{C_h}}$

$= \sqrt{\frac{2 \times 75 \times 20800}{3.75}}$

= 912 units per year,

Total optimal cost per year

$= D \times C + \sqrt{2 C_0 D C_h}$

$= 20800 \times 50 + \sqrt{2 \times 20800 \cdot 50 \cdot 75 \cdot 0.075}$

= 1040000 + 3421

= 1043,421 per year

i) optimal cost per week

$= \frac{1043421}{52}$

= 20065

iii) Weekly profit

= S.P × units − optimal cost per week

= 55 × 400 − 20065

= 1935 Rs

Q. The annual demand for an item is 3200 units. The unit cost is Rs. 6 and inventory carrying charges 25% per annum. If the cost of one procurement is Rs. 150, then determine the following

(i) EOQ
(ii) No. of orders per year
(iii) Time b/w two consecutive orders
(iv) The optimal cost

Sol^n

$D = 3200$ units/year
Cost of unit = Rs 6/-
order cost $C_o = 150$/order
Carrying cost = C_h = 25% of cost
$= 0.25 \times 6 =$ Rs. 1.5 per annum

(1) $EOQ = \sqrt{\frac{2 C_o D}{C_h}}$

$= \sqrt{\frac{2 \times 150 \times 3200}{1.5}}$

$=$ [illegible]

2/ The optimal order cycle time = $\frac{800}{3200}$ = 0.25 year.

= 3 month.

3 N.o f orders = 4

4 Optimal cost = OC + TVC

= ~~D +~~ 3200×C

+ $\sqrt{2 \times 3200 \times 150 \times 1.5}$

= Rs 19440 per year

Monte carlo Simulation:-

The monte carlo Simulation technique conducting repetitive experiments on the model of system under study, with some known probability distribution to draw random samples (observations) using random numbers.

If a system cannot be described by a standard probability distribution such as, poisson, exponential, gamma etc, an empirical probability distribution can be constructed. The Monte carlo ~~step~~ Simulation technique consists of following steps:

→ Setting up a probability distribution from variables to be analysed.

→ Building a cumulative probability distribution for each random variable.

→ Generating random numbers and then assigning an appropriate set of random numbers to represent value or range (interval) of value for each random variable

→ Conducting the simulation experiment using random sampling

→ Repeating step 4 until the required number of simulation runs has been generated.

→ Designing and implementing a course of action and maintaining control.

<u>Random Number Generation</u>

Monte carlo simulation requires the generation of a sequence of random numbers. This sequence of random numbers help in choosing random observations (samples) from probability distribution.

Arithmetic Computation! — The random number r_n, consisting of k digits, generated by using multiplicative congruential method is given by

$$r_n = p \cdot r_{n-1} \text{ (modulo m)}$$

where p and m are positive integers, p < m, r_{n-1} is a k-digit number and modulo m means that r_n is the remainder when $p \cdot r_{n-1}$ is divided by m. This means r_n and $p r_{n-1}$ differ by an integer multiple of m.

To start the process of generating random numbers, the first random number (also called seed) r_0 is specified by the user. Then using above recurrence relation a sequence of k digit random no. with period $h < m$ at which point the number r_0 occurs can be generated again.

$r_n = P \cdot r_{n-1}$ (modulo m)

Let $P = 35$, $m = 100$ and $r_0 = 57$

$m-1 = 99$ is a 2 digit no.

Therefore it will generate 2 digit random numbers,

$r_1 = P \cdot r_0$ (modulo m)

$= 35 \times 57$ (modulo 100)

$= 1{,}995/100 = 95$, remainder.

$r_2 = P \cdot r_1$ (modulo m)

$= 35 \times 95$ (modulo 100)

$= 3{,}325/100 = 25$, remaind.

$r_3 = 35 \times 25$ (modulo 100)

$= 875/100 = 75$, remain.

The number generated through this process are pseudo random numbers because these are reproducible and hence not random

Computer Generator:— The random numbers that are generated by using computer software are uniformly distributed decimal fractions from 0 and 1. Software works on the concept of cumulative distribution fun^n for random variables for which we seek to generate random numbers.

Ex $f(x) = \alpha e^{-\alpha x}$, $0 < x < \infty$

the cumulative distribution fun^n is given

$$F(x) = \int_0^x \alpha e^{-\alpha x} dx = 1 - e^{-\alpha x}$$

$$e^{-\alpha x} = 1 - F(x)$$

Taking log on both sides

$$-\alpha x = \log[1 - F(x)]$$

$$x = -(1/\alpha) \log[1 - F(x)]$$

If $r = F(x)$ is a uniformly distributed random decimal fraction b/w 0 and 1. The exponential variable associated with r is

$x_n = -(1/d) \log(1-r_i)$
$= -(1/d) \log r_i$

This is an exponential process generator since $1-r_i$ is a random no. and can be replaced by r_i.

C program to generate random numbers.

```
#include <stdio.h>
#include <stdlib.h>
#include <time.h>

void main()
{
// This program will create diff. sequence of random no. on every program run
// use current time as seed for random generator
srand(time(0));
for(int i=0; i<5; i++)
  printf(" %d", rand());
}
```

Note This program will create different sequence of random numbers on every program run.

O/P 1 453 1432 325

out-2 8976 21284 45

srand sets the seed which is used by rand to generate random numbers

memory allocation, process control, conversion

/* C++ program to generate random numbers. */

```
#include<iostream.h>
#include <stdlib.h>
void main()
{
  int i, num;   // store random
  randomize();   // Call it once to generate random
```

```
for (i=1; i<=10; i++)
{
    num= rand()%100;   //get random no.
    cout << num << "\t";
}
}
```