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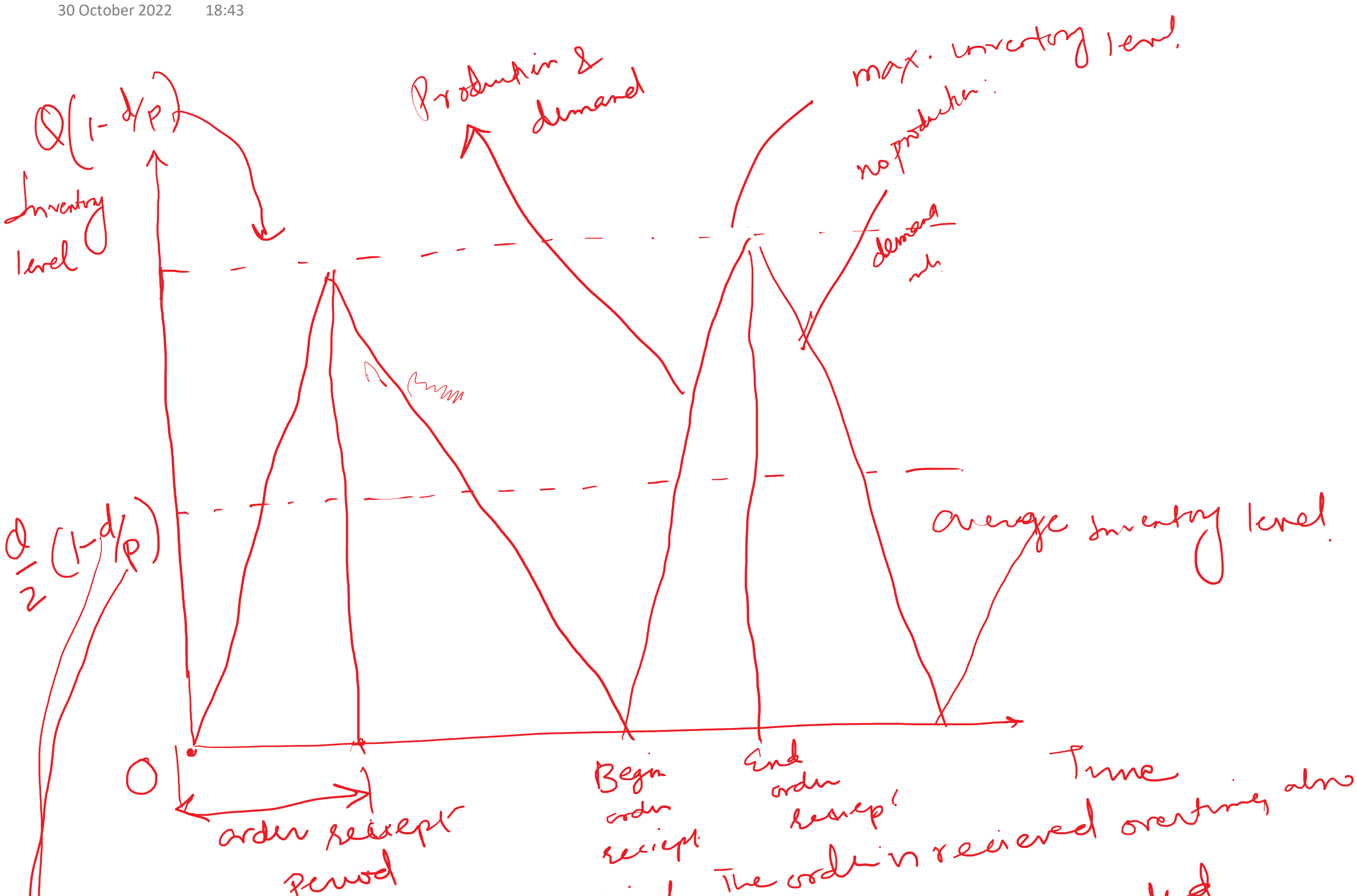


The order is recieved overtime, also

p = daily rate at which known as production rate

d = Daily rate at which inventory is demanded

The inventory level is gradually replenished as an order is received

In the basic EOQ model

Q = total Inv.

$Q/2$ = average Inv.

but in this model, the max. Inventory level is not simply Q, it is an amount somewhat lower ... That than Q $[Q(1-d/p)]$, adjusted for the fact, the order quantity is depleted during the order receipt period. $Q(1-d/p)$

$$\text{max. Inventory level} = \left[Q - \frac{Q}{p} \times d\right]$$
$$= Q\left[1 - d/p\right]$$

Since this is the max. Inv. level, the avg. inv. level is determined by half of max. Inv.

$$\text{avg. Inv} = \frac{1}{2}\left[Q(1-d/p)\right]$$

$$C_c = \frac{Q}{2} \times C_c$$

$$= \frac{Q}{2}(1-d/p)$$

$$\text{Total carrying cost} = C_c \times \frac{Q}{2} \times (1-d/p)$$

In this case the ordering cost C_0 is often the setup cost for production. $\frac{C_0 D}{Q}$

$$\underline{TC} = \frac{C_0 D}{Q} + \frac{C_c Q}{2}(1-d/p)$$

Optimal value of Q^*

$$Q^* = \sqrt{2 C_0 \times D} = \left(\frac{Q}{}\right) \times d$$

$$Q^* = \sqrt{\frac{2 C_o \times D}{C_c(1 - d/p)}} \quad \left(\frac{Q}{p}\right) \times d$$

$Q(1 - d/p)$

Q Assume, that ~~e~~ paint store has its own mfg. facility in which it produce Iron coat paint. The ordering cost 'C_o' is the cost of setting the production process to make paint. $C_o = \$150$. Also assume $C_c = \$0.75$ per gallon of paint. $D = 10{,}000$ gallon per year. The mfg. facility operates the same days the store is open only for 311 days in a year & produce 150 gallons of paint per day (Determine the optimal order size (Q^*), total ~~inventory~~ cost, the length of time to receive an order, no. of order per year & max. inventory level?)

Soln $D = 10000$ $C_o = \$150$, $C_c = \$0.75$ per gallon

$p = 150$ gallon/day $\quad d = \frac{D}{311} = \frac{10000}{311} = 32$ gallons per day

$$\sqrt{\frac{2 \times C_o \times D}{\quad}}$$

$$Q^* \text{ (optimal order size)} = \sqrt{\frac{2 \times C_o \times D}{C_c\left(1 - d/p\right)}}$$

$$= \sqrt{\frac{2 \times 150 \times 10{,}000}{0.75\left(1 - \frac{32}{150}\right)}}$$

$$\boxed{Q^* = 2935 \text{ gallons.}}$$

optional batch size for order.

$$\underline{\text{no. of production run for (order)}} = \frac{D}{Q^*} = \frac{10000}{2935}$$

= 3.4 per year

= 3 or 4 per year

The length of time to ~~to~~ recieve an order for this type of mfg. operation is commonly called the length of production run

$$\text{Production run} = \frac{Q^*}{p} = \frac{2935}{150}$$

= 19 or 20 days per order.

10,000 production | 3 x 4 hr

19 x 4 = $\underline{7}6$ days

$$\text{max. Inv. level} = Q^*\left(1 - d/p\right)$$

max. Inv. level $= Q\left(1 - \frac{d}{P}\right)$

$= 2935\left(1 - \frac{32}{150}\right)$

$= 2935 - 626$

$= 2309$ gallons (max. Inv. level)

Total min Annual Inv. Cost

$$TC_{(inv)\,min} = \frac{C_O D}{Q^*} + \frac{C_C \times Q^*}{2}\left(1 - \frac{d}{P}\right)$$

$$= \frac{150 \times 10000}{2935} + \frac{0.75 \times 2935}{2}\left(1 - \frac{32}{150}\right)$$

$= 511.1 + 865$

$= \$1376$

Carpet Manufacturer

Carpet mfgr. sells in its adjoining showroom store near the Anantnag District. Estimated annual demand is 20000 carpets with an annual C_c = $ 2.75 per carpet. The mfg. facility operates the same 365 days ~~open~~ & produce

400 carpets per day. Cost of setting up

the mfg. process for a production run is \$720.

1. Determine Q^* (optimal order size) — 3485 carpets
2. total inventory cost — \$8263
3. length of time to receive an order — 8.7 day | order.
4. Total no. of order
5. max. inventory level.

$$= 3485\left(1 - \frac{55.2}{400}\right)$$

$$d = \frac{D}{365} = 55.2$$

$$= 3004 \text{ carpets}.$$

order

$$\frac{D}{Q^*} = \frac{20000}{3485} = 5.74 \quad 5 \text{ or } 6 \text{ order} \mid \text{year}.$$

Total Inv. Cost $= \dfrac{C_0 D}{Q} + \dfrac{C_c Q}{2}\left(1 - \dfrac{d}{p}\right)$

$= \$8300$

max. inventory level $= Q\left(1 - \dfrac{d}{p}\right)$

$= 3004$ carpets

Reorder points (R)

level of inventory at which a new order should be placed.

$$Q = \sqrt{\frac{2C_oD}{C_c}}$$

The reorder point for our basic EOQ model with constant demand & constant lead time to recieve an order is equal to the amount demanded during the lead time

$$R = d \times L$$

& d = demand rate per period (daily, weekly, monthly, yearly)

L = lead time.

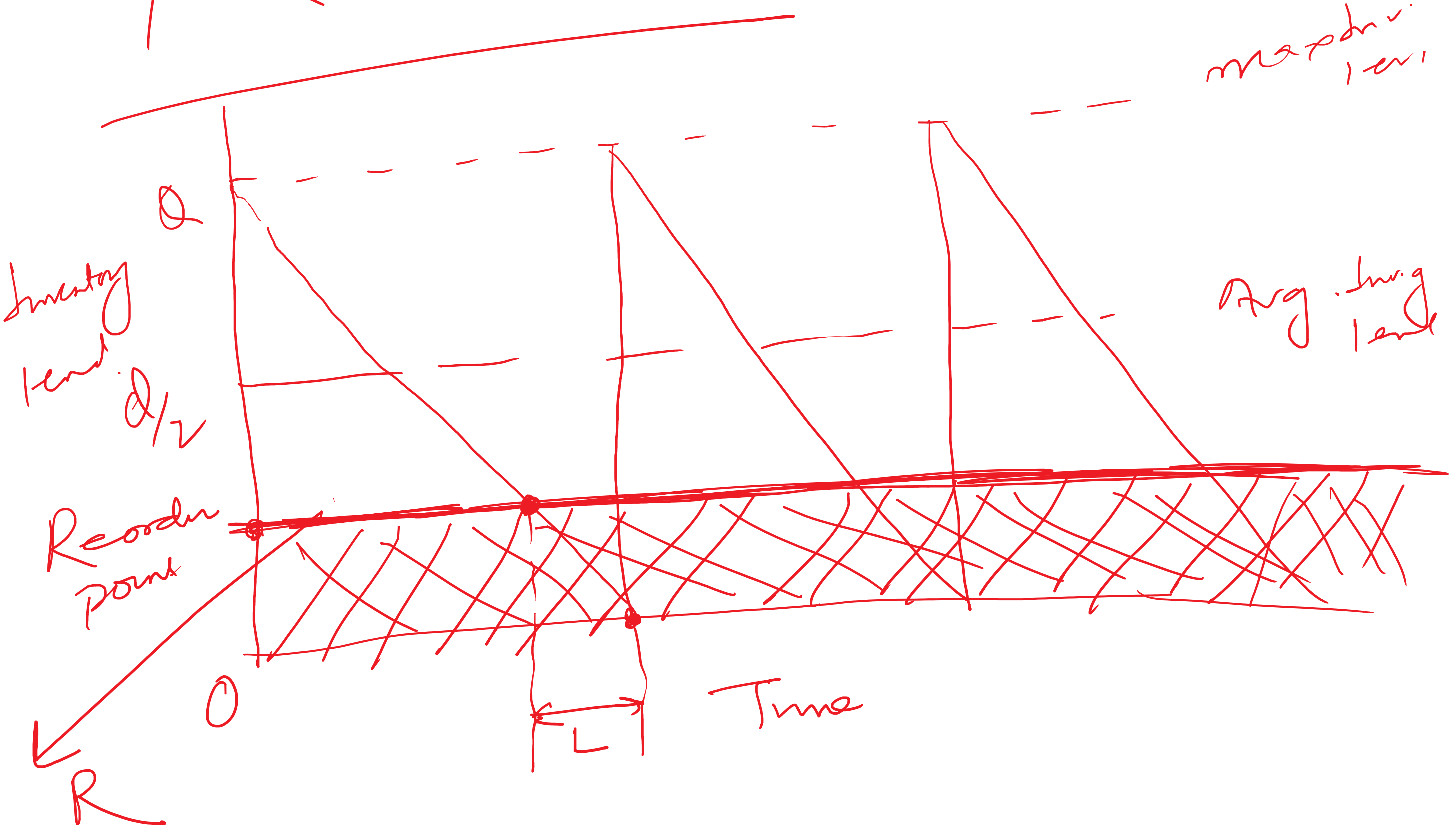
Carpet mfgr is open for all 365 days. If annual demand is 20000 carpet / year & the lead time to receive on is 20 days. determine the reorder point?

$$\underline{R = d \times L}$$

$d = \frac{D}{\text{no. of days production open}}$

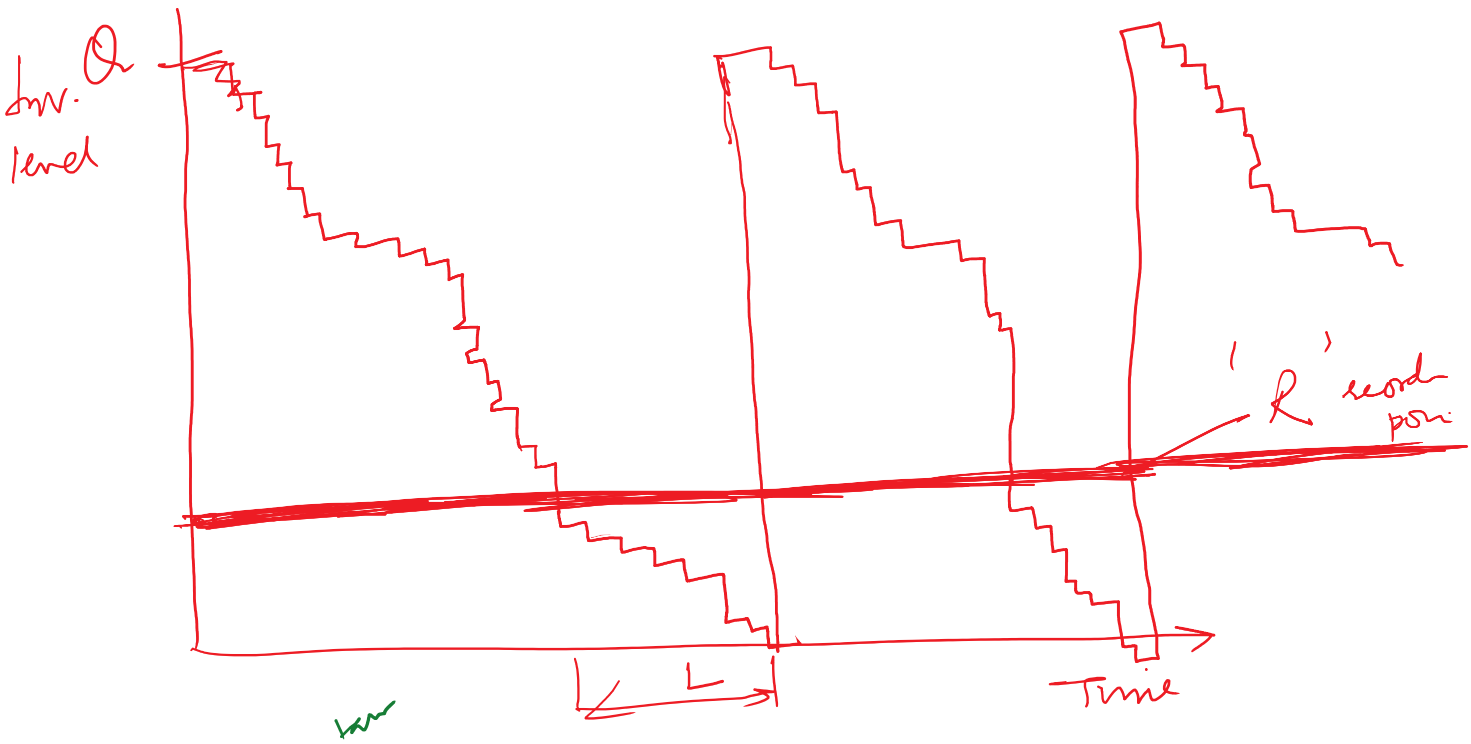
$$R = \frac{20000}{365} \times 20$$

$$\boxed{R = 1095 \text{ carpet}}$$



Safety stock:

It is defined as buffer added to the inventory on hand during ~~lead~~ lead time



Reorder point with Safety stock

Reorder point with Variable/uncertain Demand

To compute the reorder point with a safety stock that will meet specific service level.

- We will assume the demand during the each day of lead time is uncertain, independent & can be described by normal distribution.

- Avg. demand for the lead time is the sum of avg. daily demand for the days of the lead time which is also the product of avg. daily demand multiplied by lead time.

... tion is the

- Stdy the variation of the daily demand. sum of daily variance for the no. of days in the lead time.

Reorder point

$$R = \bar{d} \times L + Z\,\sigma_d \sqrt{L}$$

$\bar{d}$ = average daily demand

L = lead time.

σ_d = standard deviation of daily demand

Z = no. of standard deviation corresponding to the service level probability

$$\boxed{\text{Safety stock} = Z\,\sigma_d \sqrt{L}}$$

$\sigma_d \sqrt{L}$ in the safety stock formula for the reorder point is the square root of the sum of the daily variance during lead time

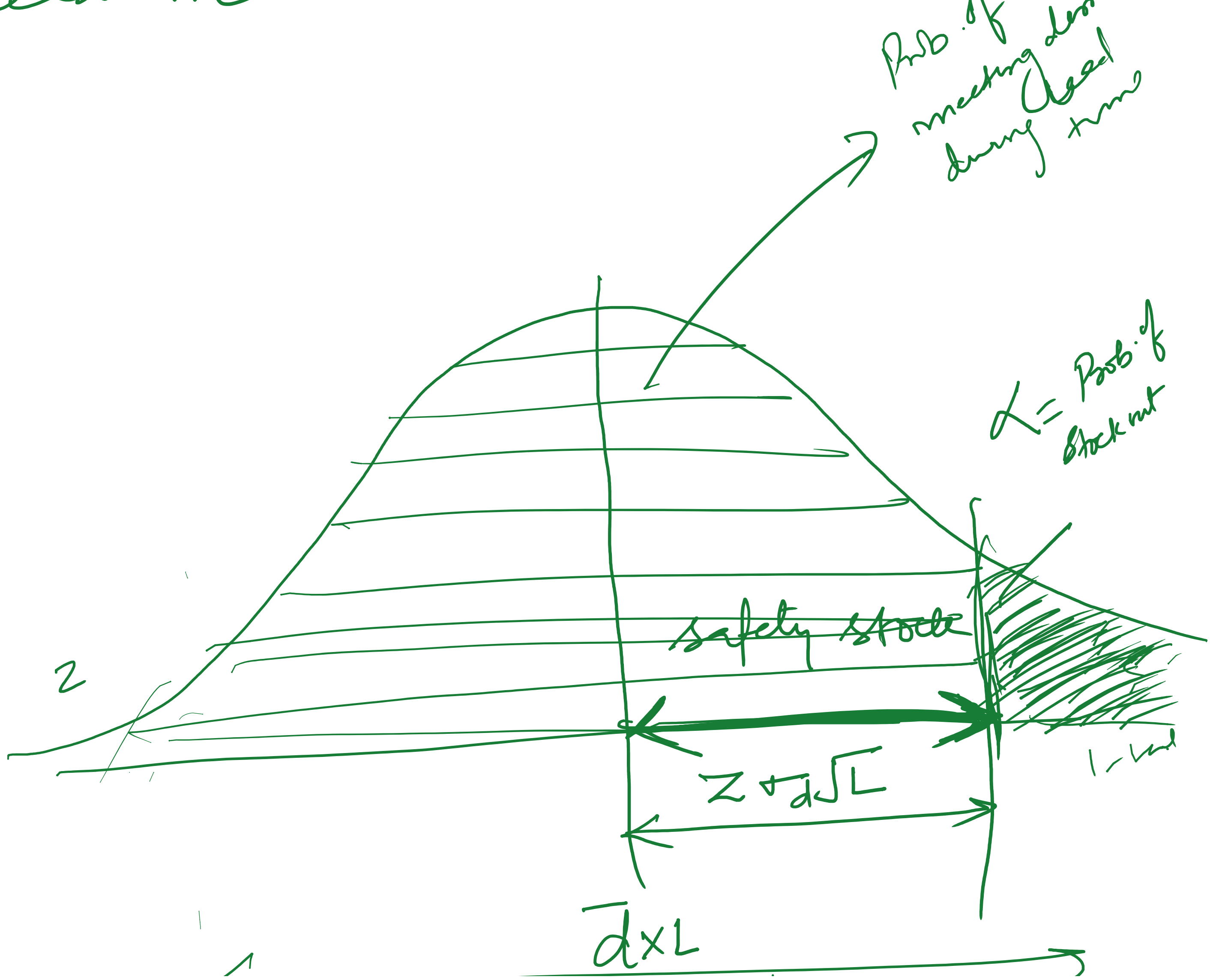
Variance = daily variance $\times$ no. of days during lead time)

$= \sigma_d^2 \times L$

Stand deviation $= \sqrt{\sigma_d^2 \times L}$

$= \sigma_d \sqrt{L}$

Service level : It is defined as the probability of meeting demand during the lead time.



$\bar{d} \times L$

Demand (D)

Q. For the e-paint store, we will assume that daily demand for Ironcoat paint is normally distributed with an average daily demand of 30 gallons & a standard deviation of 5 gallon of paints per day. The lead time for receiving a new order of paint is 10 days.

1. Determine the reorder point
2. Safety stock of the store want a service level of 95%. (Assume the prob. of stockout is 5%)

At service level 95% = 0.95

From normal distribution Table

The value of 'Z' against 0.95

= 1.65

$\bar{d}$ = 30 gallon per day

L = 10 days.

σ_d = 5 gallons per day

Safety stock = $Z \sigma_d \sqrt{L}$

$= 1.65 \times 5 \times \sqrt{10}$

$= 26$ gallons

Reorder point

$R = \bar{d} L + Z \sigma_d \sqrt{L}$

$= 30 \times 10 + 1.65 \times 5 \times \sqrt{10}$

$= 326.07$ gallons

Case 1

Honda mfg store stocks of Honda Jazz

distributed

& the daily demand is normally ... with a mean size of 1.6 Honda Jazz & a standard deviation of 0.4 Honda Jazz per day. The lead time to receive an order from the manufacturer is 15 days. Determine the safety stock to achieve a service level of 98% & reorder point?

$\bar{d} = 1.6$ Honda Jazz per day

$L = 15$ days

$\sigma_d = 0.4$ Honda Jazz per day

$Z = 2.05$ at 98% prob.

Safety stock $= Z \sigma_d \sqrt{L}$

$= 2.05 \times 0.4 \times \sqrt{15}$

$= 3.17$ Honda Jazz

Reorder point $= \bar{d} \times L +$ Safety stock

3.17

$= 1.6 \times 15 + 3.1 +$

$= 27.17$ hooks ~~for~~

* Order Quantity with Uncertain Demand

If the demand rate & lead time are const. then the fixed period model will have fixed order Quantity that will be made at specified time interval.. which is the same as the fixed Quantity (EOQ) model under similar condition.

When the demand is uncertain, then ~~fixed order Quantity~~ fixed period model react differently than fixed order model.

The order size for fixed period model given uncertain daily demand that is normally distributed by

$$Q = \bar{d}(T + L) + Z\sigma\sqrt{T_b + L} - I$$

normally distributed

$$Q = \bar{d}(t_b + L) + \underbrace{Z\sigma_d\sqrt{t_b+L}}_{\text{Safety stock}} - I$$

$\bar{d}$ = avg. daily demand

L = lead time

t_b = fixed time b/w order

σ_d = standard deviation of demand

I = inventory in stock

Case

The Sun Pharma stock a popular brand of ~~over the~~ Hepatitis & ~~T~~ Typhoid medicine. The average demand for the medicine is 6 box per day with a standard deviation of 1.2 box per day. A supplier of Sun pharma checks that Sun Pharma stock every 60 days. During one visit the ~~store~~ store have 8 to receive

box in stock. The lead time ...
an order is 5 days. 99%

Determine = ~~Lead time~~
1. safety stock
2. Reorder point (order size)

$\bar{d}$ = 6 box per day

σ_d = 1.2 box

t_b = 60 days

L = 5 days

Z = ? at 99% prob

I = 8 box

Q = ?

SS = ?

$$SS = 2.33 \times 1.2 \sqrt{60+5}$$

$$= 22.4$$

$$Q = \bar{d}(t_b + L) + \overset{SS}{22.4} - \overset{I}{8}$$

$$= \cancel{391.4}$$

$$= 6(60+5) + 22.4 - 8$$

$$= 6 \times 65 + 22.4 - 8$$

$$= 391 \text{ box}$$

Basic EOQ model

$$TC = \frac{C_o D}{Q^*} + \frac{C_c Q^*}{2}$$

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

$$Q^* = \sqrt{\frac{\cdots}{C_c}}$$

EOQ with ~~noon~~ non instantaneous receipt

Production Quantity model

$$\boxed{Q^* = \sqrt{\frac{2 C_0 D}{C_c(1 - d/p)}}}$$

$$TC = \frac{C_0 D}{Q} + \frac{C_c Q}{2}(1 - d/p)$$

Reorder point

$$\boxed{R = d \times L}$$

Reorder point with Uncertain Demand

$$\boxed{R = \bar{d} \times L + Z \sigma_d \sqrt{L}}$$

fixed ~~order~~ time period order Quantity with Uncertain Demand

$$Q = \bar{d}(t_b + L) + Z \sigma_d \sqrt{t_b + L} - I$$

$$Q = \bar{d}(t_b + L) + z\sigma_d\sqrt{t_b + L}$$