Slide 1

We solve two main problems, when service level is known and we were looking for reorder point and safety stock, and the other when reorder point and safety stock was knows and we were looking for service level.

Now we solve three other problems that can be transferred into the other problems we solved.

In these three problems we will go through a couple of initial steps then we will be able to translate these problems into the problem we have already solved.

We solved two main problems in one service level was known and we found safety stock and reorder point.

In the other re order point and safety stock was known and we found service level.

Now we solve three other problems which have a lot of similarities that we solved where we knew the service level and looked for safety stock and reorder point.

While these problems are very similar we need sever initial steps some initial manipulations to become that problem, as soon as they become that problem we know how to solve.

Let’s look at this situation where lead time is fixed and demand per period is variable.

We use one for lead time and it is fixed when a variable is fixed, so it has a standard deviation of zero therefore that variable and its average is always the same.

Demand in this situation, demand for the period is variable. As always use the **R** from the random variable in bold. Then we use the same notation to show the average of that random variable. We have the random variable of **R**, that is the demand per period per day per hour per week, and we have the average of that random variable as R.

We also need the standard deviation of that random variable. We show it as σR, standard deviation of the period. So if L is lead time and R is average demand per period, then average demand during lead time is average demand per period \* the number of periods.

Average demand during lead time is L\*R. That is avg demand during lead time. If standard deviation of demand per period is σR, then there is a relationship between standard deviation of demand per period and standard deviation of demand during lead time.

If σLTD is standard deviation of demand during lead time and lead time is L days or time periods or if σR is standard deviation of demand per period, then the relationship of these two using the term element will be defined as σLTD of standard deviation of demand during lead time is square root of L \* σR.

So, now I do have avg demand during L and standard deviation of demand during the lead time. Now this problem is exactly the same as the two first problems we already solved.

We knew avg demand during L, we knew service level.

Slide 2

Avg demand of product is 50 tons per week, standard deviation of demand is 3 tons, L is 2 weeks, and risk is 10% maximum.

If risk is 10%, service level is 90%, and we find relative z value equals 1.28. LT is 2 weeks, R 50 tons, standard deviation of demand 3 tons per week.

L \* D = LTD

LTD=2(50) = 100

This average demand during lead time. SD of demand during lead time is square root of L \* **D** of demand per period square root of 2 \* **D**. That is a square root of 2 \* 3 = 4.24

Now we have avg demand during lead time, standard deviation of demand during lead time, and also z.

The order point is equal to the avg demand during lead time, plus z, times standard deviation of demand during lead time. And therefore the order point is 100 + z \* **D** during lead time.

This is I safety, and this is avg demand. If I reorder when inventory on demand is 100, there is 50% probability I cannot satisfy the demand. However if I put in an order when inventory is 105.43 then probability of being out of stock is 10%

Slide 3

Let’s look at a different situation where demand for period is fixed, and Lead time is variable. When something is fixed we do not talk about the standard deviation, the standard deviation is zero. Demand per period is R, Lead time is **L** bold, L is average lead time.

If demand for period is R and lead time is L, then average demand during lead time LTD is

L \* R.

σL is standard deviation of lead time. Standard deviation of demand during lead time is LDT, there is a relationship between these two. You may have expected square root but that does not exist here. Mathematically we can prove why. The relationship between these two, standard deviation of lead time demand equals R \* **R**. We are back to the part of the problem where we have already solved it.

Slide 4

Demand is fixed and is 50 tons per week. We don’t talk about standard deviation of demand. The avg lead time is 2 weeks. Standard deviation of L is .5. That means we may see L to be 1.5 days 1 day half day 2.5 days, 3.5 days. In general it is in between .5 and 3.5 days. Service level is 10%. Compute the order point and the safety stock.

So since service level is 90% therefore we go to table and look for 90% and look at the row we will see 9.2 and look at the column and see 1.2 and we see z = 1.28.

Demand per week is 50, L is 2 weeks, σL is half week.

Lead time demand is lead time times demand per period. And it is two times 50 equals 100. Standard deviation of lead time demand is R \* σL. R is 50, σL is .5 therefore σLTD and LTD is 50 \* .5 = 25.

Now we have avg LTD and standard deviation of LTD and we have solved this problem several times. We can easily compute safety stock by multiplying these two. And we get reorder point. 100+1.28x25 equals average LTD.

Slide 5

Let’s look at a situation where demand for period is variable, so we talk about avg and standard deviation. Lead time is variable so we talk about avg and standard deviation. And we want to use these two pieces of information and come with the information we need here to be able to compute safety stock and reorder point.

As usual LTD is equal to L\*R

SD of LTD is square root of L\* standard deviation of demand per period + square root of demand per period \* square root of standard deviation of L.

Lead time is variable with mean of 10 and standard deviation of 2 days. Demand per day has mean of 2000 and standard deviation of 1581. Service level is 95%. R avg demand rate is 2000 units, standard deviation of 1581, L = 10 days, standard deveiation of L = 2 days. LTD = RL = 10\*2000 = 20000

Standard deviation of LTD is computed using this formula. L is 10, sig R is 1581. I square it, R square root is 2000. I square it, σL standard deviation of L is 2 days I square it, and then I compute it. SD of LTD is 6402.87.

Now I have avg LTD, and also I have standard deviation of LTD, the rest is history. I can easily use my knowledge on the pervious problems to compute safety stock which is z \* standard deviation of LTD. And that would be 10565. This is safety stock, if I add it to this 20000, I add these two together then it will be ROP.