Operations and Supply Chain Management
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Lecture No. - 21

Safety Stock – ROL for Normal Distribution of Lead Time Demand

In the previous lecture, we looked at probabilistic inventory model.

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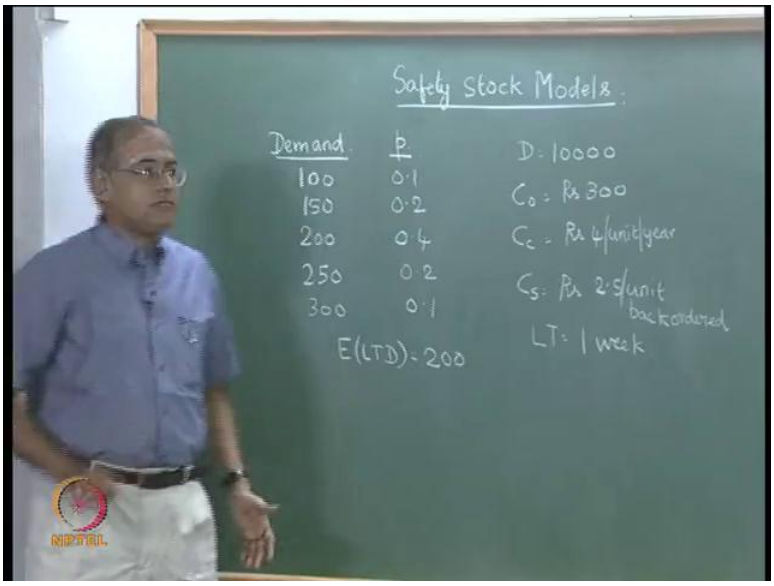

Where, we took the same numerical illustration and then we also spoke about the reorder level and the demand not being deterministic during the lead time. We took an example where the annual demand is 10000 and then if we assume that we work for 50 weeks in a year, then the average weekly demand is 200 and then we said that the demand is actually not 200 per week, every week. But, it can vary. And then we also said that, the lead time was 1 week in this example. And therefore, the demand during the lead time, was assumed to follow this discrete distribution, with an expected value of 200.

So, expected value was 200.We also define the reorder level, which is the level at which we will place the next order and we also define the safety stock to be the difference between the reorder level and the expected value of the lead time demand. And we showed the total cost computations for reorder level equal to 100, 150, 200 and 250 and 300 and then at the end we said that, reorder level of 250 was optimum.

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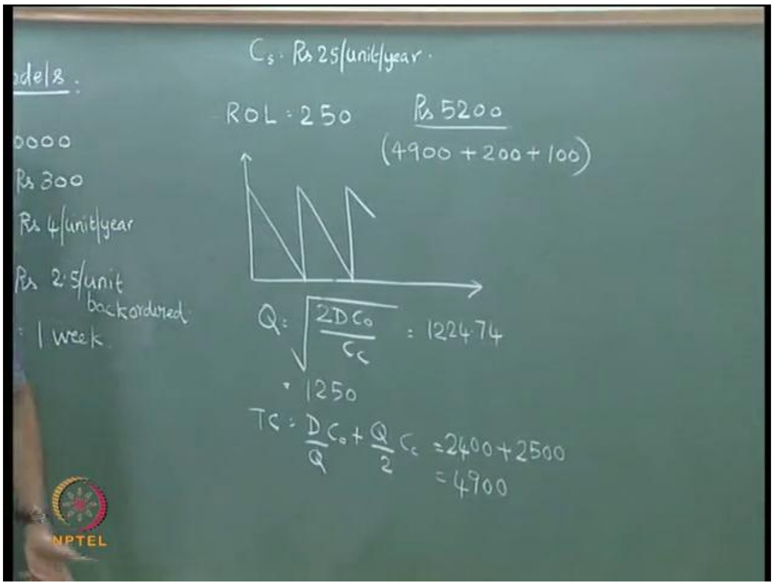

So, reorder level was found to be 250 which was optimum, which had the least annual cost of rupees 5200. We also explained, how we got that 5200. Now, and we compared it with the basic inventory model. So, if we looked at the basic inventory model which is our familiar Saw tooth model, so, the basic inventory model with continuous demand when we optimized, would give us Q equal to root over2 D C naught by C c. D is 10000 C naught is 300 C c is i into C which is 20 percent of rupees 20 which is 4. So, this would give us 1224.74, we also said that we would assume an order quantity of 1250 which would give us a total cost of D by Q C naught plus Q by 2 Cc, which would give us a total cost of, this would give us 8 orders per year.

So, D by Q into C naught will be 2400 plus Q by 2 C c will be 2500, which would give us a total cost of 4900 here. In this computation (Refer Slide Time: 00:19) we also assumed that the shortage cost was rupees 2.5 per unit backordered and we explained that this total cost of 5200, was actually could be split into 3 components which is 4900, which is the cost of the safety inventory of Q by 2 into C c plus D by Q into C naught, which came from here. The reorder level being 250 (Refer Slide Time: 00:19) and the expected lead time demand being 200. We have an excess stock or safety stock of 50, which is continuously carried. So, this 50 is carried at the rate of rupees 4 per unit per year.

So, that would give us an additional 200 and then we also said that the shortage would give us an additional cost of 100, which would give us a total of 5200 per year. So, we could explain all of these. Before we proceed further, let us look at another thing where, when we develop the basic inventory model, we also made an assumption to the basic inventory model that backordering could be allowed and then we derived model which allowed backorder explicitly. So, let us go to that model and try and compare and contrast this particular model and this and the result with the deterministic case when backordering is allowed. (Refer Slide Time: 01:51)

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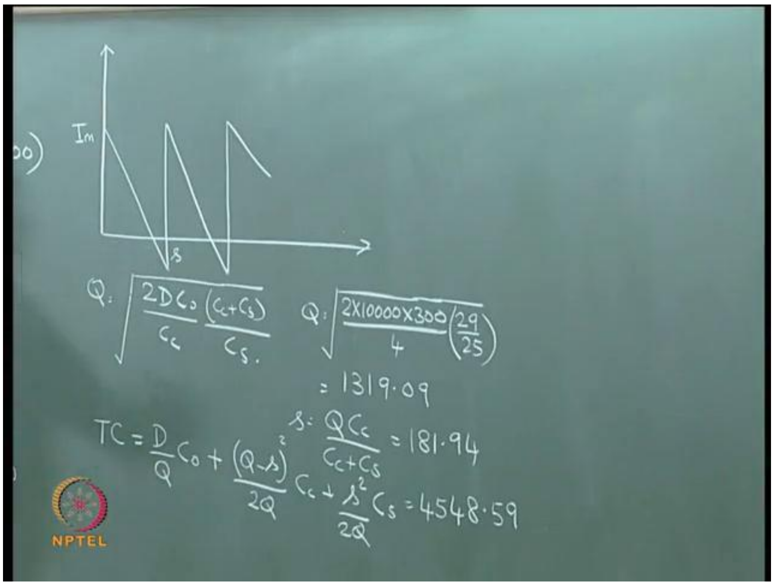

So, when we look at this problem and then when we look at the deterministic inventory where, we allowed backordering. In this case, where we would order a Q and then the demand is continuous it comes up to 0. Assuming instantaneous replenishment we do not place an order here, we allow certain amount ofbackorder to build and we call that backorder quantity as s. And then once we reach a backorder quantity of s, we place an order and because of instantaneous replenishment we would get that Q instantly. Instantly we replenish this s, which is the backorder that has been built and therefore, the top inventory is called I m maximum inventory that we hold and that is equal to Q minus s and this cycle proceeds.

We have, already derived an expression for this and that would be like, the economic order quantity Q there is given by root over 2 D C naught by C c into C c plus C s by C s.

And we worked out a numerical example, where (Refer Slide Time: 01:51) we took C s to be rupees 25 per unit per year and therefore, our Q in that case was root over, 2 into10,000 into 300 by 4 into C c plus C s by C s, which is 29 by 25 and this came to 1319.09. The shortage that we allowed, this s backorder quantity that we allowed sis given by Q C c by C c plus C s which comes to 181.94, while T C the total cost for this, would become D by Q into C naught plus Q minus s the whole square by 2 Q into C c plus s square by 2 Q into C s which was 4548.59.

Now, let us compare this model, which is a deterministic demand model with this model where the demand is probabilistic. Let us also try and understand the differences and try to explain them. (Refer Slide Time: 00:19) Now, this model when we optimize (Refer Slide Time: 01:51) the total expected annual cost is 5200 which included the cost of ordering, cost of holding the inventory, including the buffer and the expected shortage cost and the components were 4900, 200 and 100 The very minor approximation was there, because if we had ordered 1224.74 then, the total cost would work out to 4898.98. When we change the order quantity to 1250 for the sack of convenience, the very marginal rounding off error which was rounded off to 4900.

So, that is how this 4900 comes, cost of excess inventory is 200 the safety and expected shortage cost is 100. The first difference that we see is that in this model, the cost is actually lesser than 4898.98. Whereas, (Refer Slide Time: 01:51) in this model the cost is more than the value of 4900, that is the first difference. Second difference of course, is in even though we use the same notation C s, here C s is defined as (Refer Slide Time: 01:51) rupees per unit per year whereas, the C s that we used when we did those calculation (Refer Slide Time: 00:19) was rupees per unit backordered. This is not per year, this is unit backordered.

And therefore, when we work this out we multiplied this by another D by Q. Because this would be for a cycle, expected shortage in a cycle into the shortage or backorder cost and then the number of cycles per year. Whereas, when we derived this, we have conveniently defined C c and C s to have the same unit. So, that we could have C c plus C s by C s coming here, we could also have C c by C c plus C s coming here. So, C s is defined here as rupees per unit per year. Next is how do we explain that, the cost is higher here, cost is lower here in fact we even went ahead and said that as long as we have a C s - when C s is equal to infinity, then this would approach the basic model.

And as long as, we have any C s this model will be totally cheaper the total cost would be less than that of the basic model. The order quantity Q will be slightly higher, because this is 1 plus something and there will be a small s and as this C s keeps increasing, as C s keeps increasing C c plus C s by C s keeps decreasing. And therefore, this as C s equal to infinity it will eventually come to the old model, s will become 0 and T C will approach the other T C. Now, where is the difference? The difference is as follows; in this model the expected shortage cost was calculated, only when the demand exceeded the reorder level. So, there is an expected lead time demand, then there is an additional buffer.

And when the, actual demand exceeded that, then the shortage came into the picture. Whereas, this is still a deterministic case, where the demand is not going to exceed, it is going to be the same D. There is no additional buffer. Because there is no additional buffer, we do not have (Refer Slide Time: 01:51) this contribution of 200. This 200 contribution (Refer Slide Time: 00:19) in this model came because R O L was fixed at 250 expected L T D is 200, lead time demand is 200 and the differenceis 50, which is the additional inventory that is carrying.

Therefore, this component this 200 component does not exist in this model.This model actually has only 2 components which is this component and this component. So, when these two put together is 5000 we still seem to be getting a lesser value here, which we will try and explain now. (Refer Slide Time: 01:51) Actually this C s value is taken or slightly different here its rupees 25 per unit per year,(Refer Slide Time: 00:19) here it is actually 2.5 per unit backordered, which we generally multiply by the number of cycles. So, if the E O Q is 1250, we have 8 cycles in a year and this can be taken as 2.5 into 8 which is 20, which could be compared with 25 so, let us say they are comparable.

The real reason, why this value comes down is because here by building a certain backorder, by building a certain backorder and by incurring a certain backorder cost, we realize actually two things. We realize that, what is the other alternative for not building this backorder? The other alternative for not building this backorder, is to add it to the order quantity, do not allow the backorder, which means an additional quantity is going to be carried for the entire cycle. Now, the moment we build this backorder, we are actually going to carry lesser quantity in that cycle. So, there is a tradeoff between the inventory holding cost and this backorder cost, the inventory is not held for the entire cycle, the inventory is held for a smaller period.

The other, advantages as soon as Q, the economic quantity is received we instantly fill the backorder. Therefore, the maximum inventory that we hold will also come down. So, a lesser quantity of inventory is held for a lesser period so, inventory cost there will come down but, then the backorder cost is going to go up. So, if we find out that the inventory cost, backorder cost tradeoff is a gain, particularly when because of the backordering we are able to increase the length of the cycle. And therefore, decrease the number of orders per year and therefore, the order cost also comes down.

So, there is a gain in the order cost, there is a gain in the inventory holding cost, there is a loss in the backorder cost. So, essentially again the same 4898.98. We are now, dividing it adding another component, which is going to increase the cost a little bit but, we are going to gain from the order cost and from the carrying cost. And then we are able to show that by introducing this s, we are actually gaining a little bit. And therefore, this cost comes down. So, that is the explanation why this cost is even less than 4898.98 (Refer Slide Time: 01:51) whereas, this is more than 5200. But, the more important thing to note is that, here we do not look at case where the demand exceeds D.

The equivalent of D here (Refer Slide Time: 00:19) is 200 per week whereas, this model is centered around the possibility, that D is greater than 200 and it can even go up to 250 or 300. So, this is a probabilistic inventory model where demand can exceed the expected value with certain probabilities, here the demand does not exceeds the demand is D all the time with the probability of 1. So, this is the purely a deterministic model but, then one needs to understand the difference between this model, as well as the other model.

Now, let us proceed further to understand a few more things (Refer Slide Time: 00:19) in this model. Now, towards the end of the last lecture, we also introduced the service level and we said that by ordering (Refer Slide Time: 01:51) by keeping a reorder level of 250, which means (Refer Slide Time: 00:19) we will be able to meet the demand in every cycle as long as the demand is less than or equal to 250, which means we will be able to do it at a 90 percent service level. So, 0.1 plus 0.2, 0.3, 0.7 at 90 percent service level.

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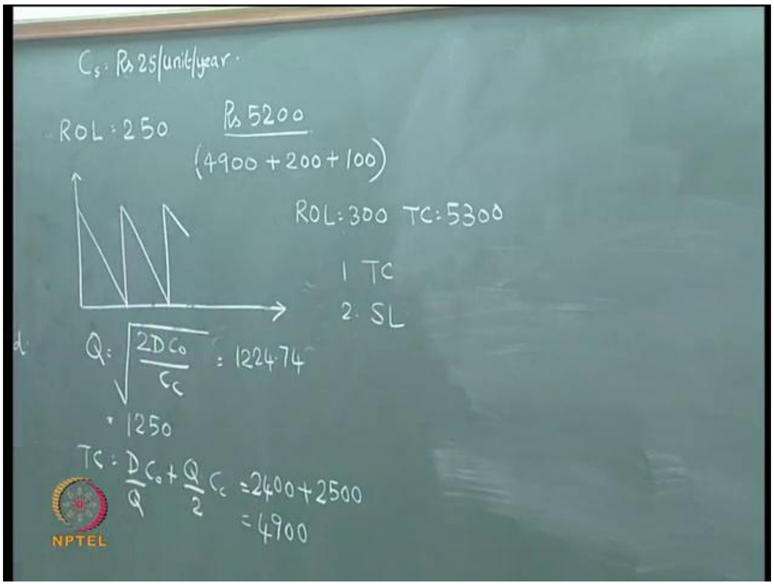

We also, in those computations found out that if R O L was 300, the total cost was 5300. So, the organization faces the next question (Refer Slide Time: 00:19) which is, do I actually fix it at 250? Because it is cheaper by 100 rupees or do I fix it at 300, what is the advantage of my 300? The advantage of 300 is that I will never encounter a shortage. If my reorder level is 300, this data shows that my lead time demand does not exceed 300. So, I will have a 100 percent service level, if I fix my reorder level at 300 (Refer Slide Time: 01:51) at an additional cost of rupees 100.

So, now should an organization, look at this cost of 5200 and decide on 250 or should it look at trying to give a service level of 100 percent (Refer Slide Time: 00:19) and with an additional cost of 100, which makes it 5300. Now, the answer comes in two ways, (Refer Slide Time: 01:51) one is this 5200 after all was computed

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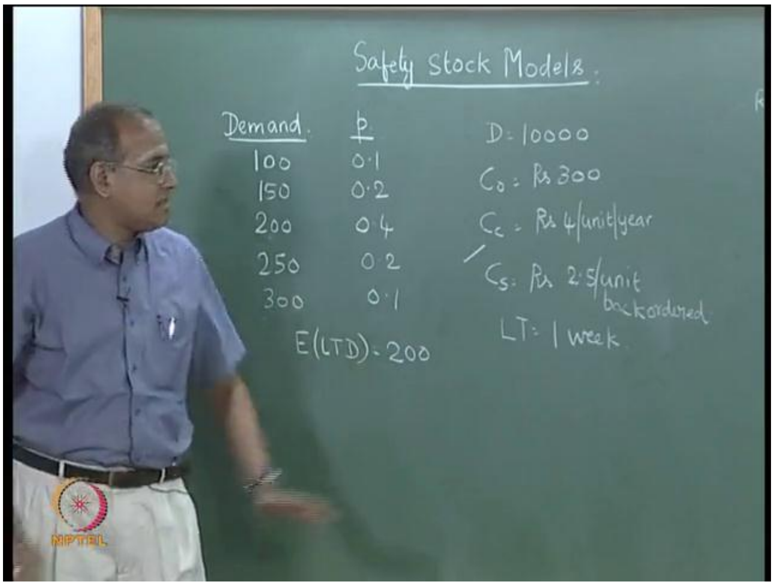

assuming that C s is rupees 2.5 per unit backorder, which means that the organization is pretty sure of what is the effect of backordering, it is under the assumption that this cost is not going to go up. For example, if this cost is going to go up and its going to become 3 per unit backordered say, we could go through the computations and for all we know we might find that 300 is the best value. Because as the backorder cost increases, you know that your buffer stock has to increase for the same service level, buffer stock has to increase which means that it will move from 250 to 300.

So, if the organization is very sure about the C s then (Refer Slide Time: 01:51) one could go back and look at choosing 250, ahead of 300. Otherwise, it is safe to say that well I know that my demand is not going to exceed 300. Therefore, I would rather go for a R O L of 300, which gives me a safety stock of 100 with an additional cost of rupees 100 per year. So, the organization does not most of the time make a decision only based on cost, it also makes a decision based on the expected service level. So, there are two things on which the organization makes a decision, one is total cost and the other is service level (Refer Slide Time: 18:55).

Alternately, if this organization says I am not happy with the 90 percent service level. I want a 100 percent service level or I want a 95 percent service level, then this would give us only 90 percent service level. If we want 95 percent service level, the next jump is here, which would give us actually 100 and then we would end up choosing 300 as the reorder level, incurring a cost of 5300. Now, let us look at it another way. Now,let us assume that this organization wants a 95 percent service level, or let us even say that this organization wants a 100 percent service level based on this data.

Now, let us assume we are looking at 95 percent service level is what this organization wants, the most economical value is 250 which gives us 90 percent. But, then we have to go to 300, if we want 95 percent service level. Now, with this assumption it would even give us a 100 percent service level. Now, what is the assumption? The assumption is that after all if we go back and see how we got this data? We said that we would possibly go back to the last 10 ordering cycles, let us say and then based on some data we would have said that in the last 10 ordering cycles, the lead time demand happen to be 100, 1 out of 10 times 150, 2 out of 10 times 200, 4 out of 10 times and so on. So, the proportion of times the lead time demand was 100, 150, 200, 250, 300.

Now, that became the probabilities at which we got this. Now, when we make this analysis and say that if we want 95 percent service level, then we moved from 250 to 300. Now, we are making an assumption that this demand is not going to exceed 300 at all. But, then we may encounter a situation where, this demand can also exceed 300. So, we look at that case, we have to look at another case. Now, let us assume in the last 10 cycles the demands were 100, 150, 200, 250 and 300 now, we did not have a case where the demand was 220 or 225.

Now, can we look at a demand of 220 or 225 in the future? How do we handle that? So, we try and address both these cases right now. So, one is to say that, if the demand for example exceeds this, what do we do? The other is we make a slight approximation and say that, can wehandle this 300 and so on. Now, just for the sake of explanation and make it very simple. To make it very simple, let us assume that it is 100, 150, 200, 250, 300 all with equal probabilities of 0.2, just for the sake ofmaking it simpler let all of them have same probability of 0.2.

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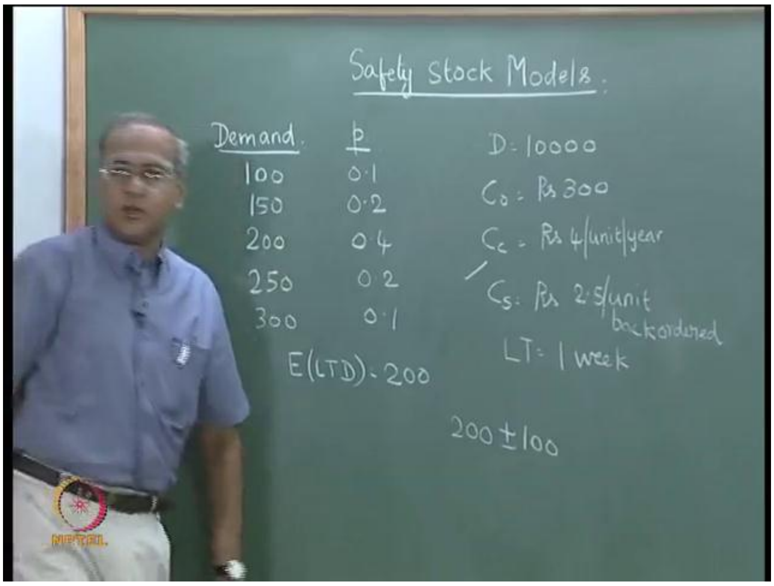

Now, in such a case we could possibly assume that it is a uniform distribution, with between 200 plus minus100. So, we could say that the demand could be anything between 200 and 300 with equal probability.

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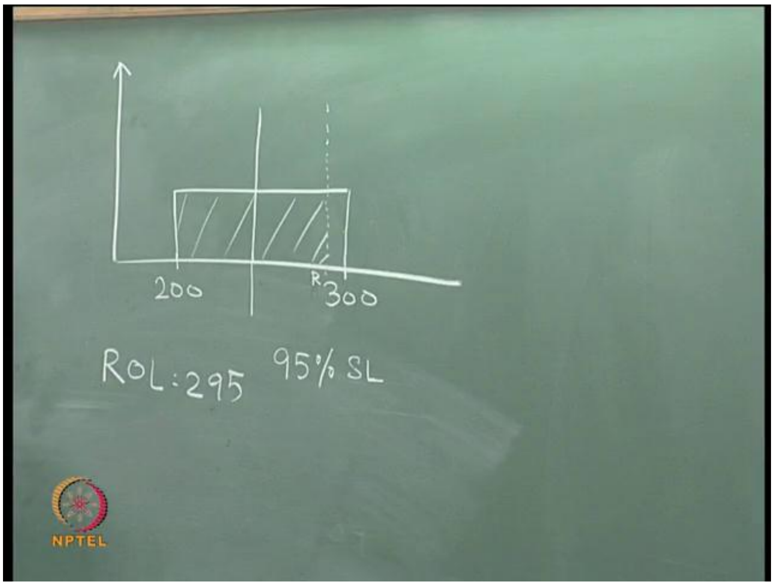

Now, if we look at such a case then our diagram will look like this, say this is 200, this is 300. Now, we could keep reorder level anywhere, this is the expected value is at 250. Now, if we want 95 percent service level,then we want our reorder level to be such that, we could use R or we could use small r as the case may be. Such that we want this area to be 95 percent of the total area so,100 percent is covered at 100. So, 95 percent will be covered at 95 therefore, our reorder level in this casewill be 295 if we wanted a 95 percent service level.

So, that is easy to do when we have a uniform distribution between two given values like 200 plus minus 100. If we want a 90 percent service level then it will become 290 and so on. Now, let us look at the other thing that if we actually plot this, we realize that at 200 the value is the highest and as you move to the left, the values are lower and as you move to the right the probabilities are also lower. So, if we try and plot it we realize that it is actually can be modeled close to a normal distribution. Now, when we start modeling it as a normal distribution, the only difference is that the demand can even exceed this 300.

So, now what happens if the demand exceeds 300 or it can be anything from minus infinity to plus infinity, assuming it is normally distributed? So, if you want to look at the cases where the demand can actually exceed 300, then we need to fit a corresponding continuous distribution and then do the analysis. So,let us we can have a situation where the demand can even be 400, how do we handle such a thing? Now,let us model this or approximate this to a normal distribution and then let us see what we do in order to find out the reorder level.

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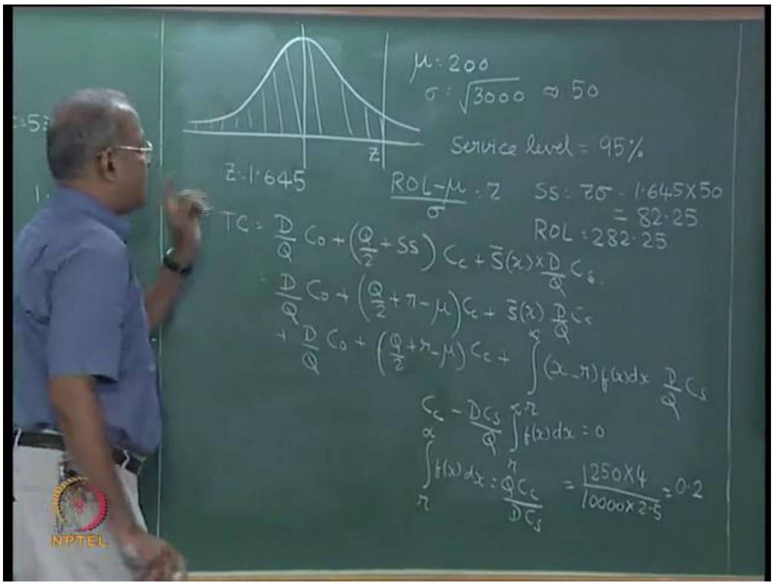

We assume, that the lead time demand is now, normally distributed with mu equal to 200(Refer Slide Time: 24:07) which is the same expected value of this distribution. So, 100 into 0.1 plus 150 into 0.2 plus 200 into 0.4, 250 into 0.2 plus 300 into 0.1 gives an expected value of 200. So, we assume that the normal distribution has mu equal to 200, for a meaningful comparison of results between you assuming a discrete distribution as well as assuming a normal distribution we now, try and compute the standard deviation of that.

So, the standard deviation of that would come to sigma equal to root of 3000 for this which we now approximate it to 50. So now, we assume that the normal distribution lead time demand follows a normal distribution with mu equal to 200 and sigma equal to 50. This figure is slightly more than 50 it comes to 54.77 but, for the sake of computation weassume that it is 50. Now, with this if we define a service level of 95 percent now, let us observe that in the earlier case (Refer Slide Time: 24:07).

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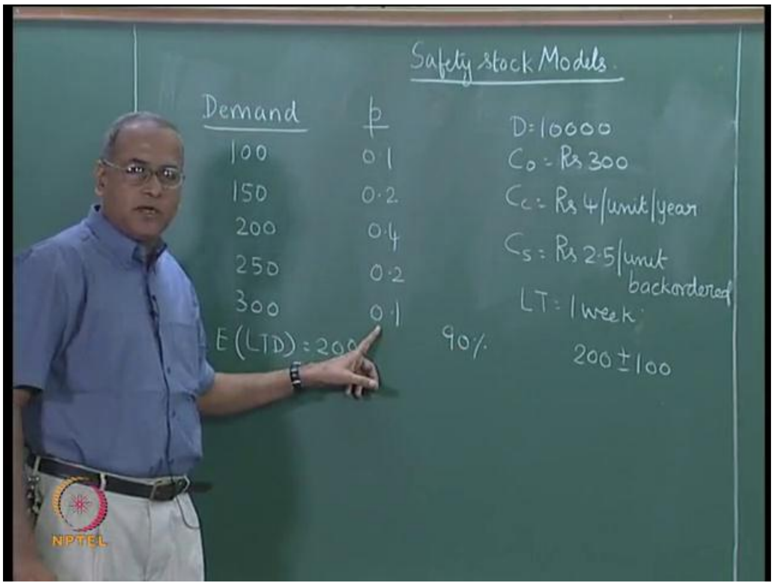

when we fix the reorder level at 250 here, we said that the service level is 90 percent. Because there is a 10 percent probability or a 0.1 probability, that the demand may exceed the reorder level of 250. Now, for a 90 percent service level with reorder level is equal to 250, we found out that the total cost was 5200. Now, in this case let us assume that we are interested in a service level of 95 percent. So, with the service level of 95 percent now, we have to find out the corresponding safety stock assuming the normal distribution. (Refer Slide Time: 28:42)

So, here when we then when we fix the reorder level at 250, the service level was 90 and the safety stock was 50 which is 50 more than which is a difference between the reorder level of 250 and the expected value of lead time demand of 200. Now, in this case we need to find out the service level, given the service level we need to find out the safety stock. Now, to do that we go back to the standard normal table and then find out that value of z, for which the area under the standard normal table, from the left most this is 0.95 because 0.95 comes from a 95 percent service level so, that happens at z is equal to 1.645.

So, this happens at z is equal to 1.645. Now, the safety stock is given by z into sigma or R O L minus mu by sigma is equal to z so, mu plus z sigma will be R O L. So, z sigma is the safety stock so, safety stock is z into sigma which is 1.645 into the assumed value of 50 which gives us a safety stock of 82.25. So, this gives us a safety stock of 82.25 and the reorder level therefore, will be 282.25 in this case. Now, when we have this reorder level equal to 282.25 then we can calculate the total cost now, the total cost will have three components. Now, total cost will beD by Q into C naught plus Q by 2 plus SS into C c plus S bar of x into D by Q into C s.

So, let me explain this expression now, total cost has three components this is the order cost component D by Q is the number of orders into order cost. This is the carrying cost component now, Q by 2 is the average inventory in the system which is multiplied by the cost of holding. Now, this safety stock as mentioned earlier is carried continuously therefore, there is no average there, the same safety stock will come here C c plus S bar of x into D by Q into C s now, having a service level of 95 percent now, there is a 5 percent probability that in a cycle we will not be able to meet the demand.

So we now, we have to find out the expected shortage multiply it with D by Q which is the number of cycles in a year and multiply with C s, C s is the cost of backordering which is taken as rupees 2.5 per unit backordered. Now, if we do all these three, then we will be able to find out the total costand then we will be able to compare this total cost with the optimal with the cost of 5200 (Refer Slide Time: 17:41) that we obtained in the earlier case.

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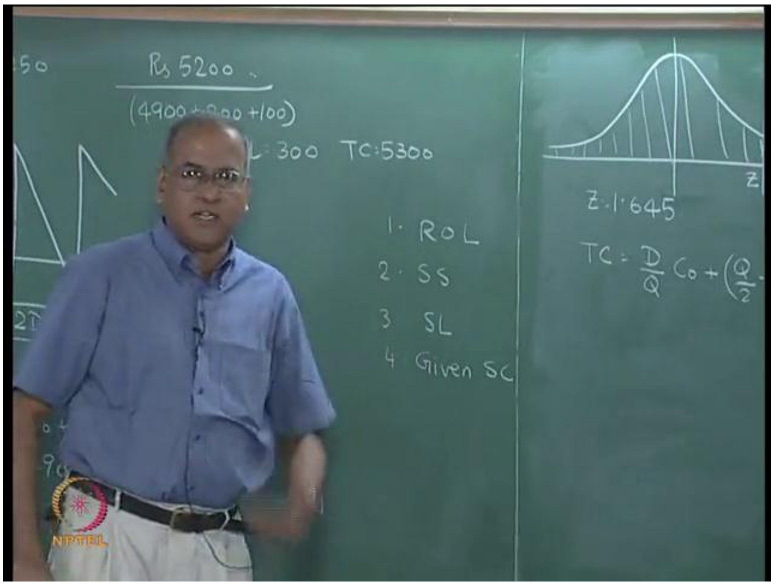

So, there are three dimensions or three aspects that we will have to consider so, the first one is the reorder level and the 2nd one is the safety stock, the 3rd one is the service level. We have seen the relationship among all of them (Refer Slide Time: 26:56). Now, here we defined a service level of 95 percent, for which we found out a safety stock of 82.25 which gave us a reorder level of 282.25. Now, once this safety stock is computed now, from this safety stock we can find out the expected shortage and then we can multiply to find out the shortage cost multiply it with the given shortage cost and find it.

Another way, of looking at the whole thing is, given a shortage cost or backorder cost as the case may be given. The shortage cost now, what is the correct value of the reorder level and the service level. So, let us do that assuming that our given shortage cost (Refer Slide Time: 28:42) is 2.5 per unit short or 2.5 per unit backordered. Now, in order to find out the best value of r the reorder level in this case. We need to differentiate this with respect to the reorder level and then try and get the best value of the reorder level as in this case now, if we try to do that we actually observe that this can be rewritten as D by Q into C naught plus Q by 2 into C c.

Now, safety stock is r minus expected value of lead time demand. For example, if the safety stock is 82.25, then reorder level became 282.25. Because expected value of lead time demand which is mu is 200 so, 200 plus 82.25 gives this. So, safety stock can always be written as r minus mu or r minus E of x into C c plus S bar of x into D by Q into C s. Now, we realize that r comes in this expression now, r is hidden somewhere in this expression. The reorder level is hidden somewhere in this expression because this now, can again be rewritten as D by Q into C naught plus Q by 2 plus r minus mu into C c plus.. What is s bar of x?

S bar of x is the expected shortage per cycle which is simply integral r to infinity x minus r f x d x into D by Q into C s. Now, this term is like the expected shortage now, the shortage occurs when the demand exceeds the reorder level. So, the extent of shortage is x minus r multiplied by the probability of occurrence which is the given by f x by d x and summed over which is given by the integral sign. Now, this term is equivalent to something here (Refer Slide Time: 28:42). Now, when we did this calculation if we say that the reorder level is 250, then we say that shortage can occur shortage quantity will be 50 with a probability of 0.1.Therefore, the expected shortage would be 5, when we did the calculation for R O L equal to 200. We would have said shortage can be 50 this difference into 0.2, plus this difference 100 into 0.1.

So, that summation is actually the integration here x minus r is the extent to which the demand exceeds the reorder level multiplied by the probability of occurrence. Therefore, we have this expression. Now, if we want to find out the best value of r let us partially differentiate this and set it to 0 so, we would get C c that comes from here now, here we will have minus D C s by Q and then we also need this integration that will come. So, r to infinity f x d x equal to 0, from which we would get this expression integral r to infinity f x d x will be equal to Q C c by D C s(Refer Slide Time: 26:56).

Now, if we actually observe it very carefully, integral r to infinity f x d x is the probability of occurrence of shortage, 1 minus that will be the service level.Therefore, if we do this calculation or the numbers that we actually have. Now, (Refer Slide Time: 26:56).Q is equal to 1250 C c is 4 demand is 10000, C s is 2.5. So, when we do this multiplication we would get 0.2. Now, this gives us that if we fix the shortage cost as 2.5(Refer Slide Time: 28:42) if the shortage cost is given as 2.5 the best service level that we would look at under this assumption is 80 percent. So, this would give us a service level of 80 percent.

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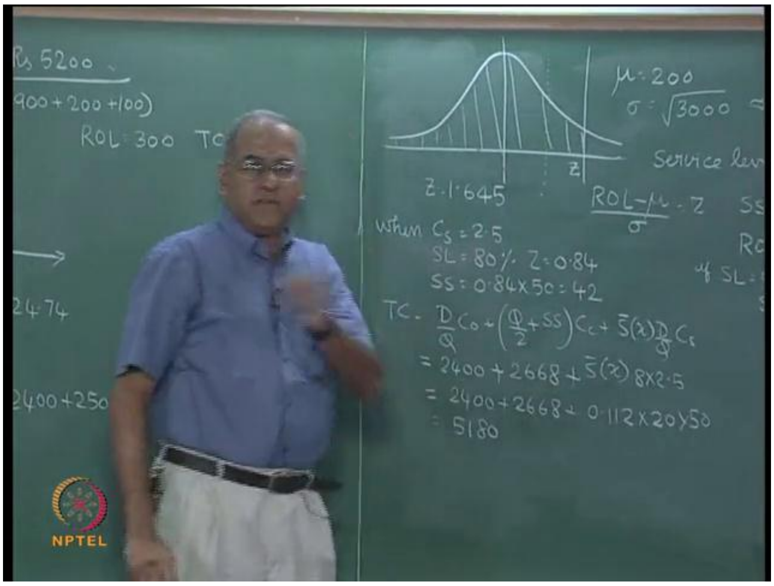

Now, for a service level of 80 percent we could go back so, we could now go back to service level is 80 percent. So, when we have service level 80 percent, then we once again go back to this one to this. Standard normal curve to find out what is the value of z for which the area under the standard normal curve is 0.8 and if we do that, we get z equal to 0.84, z is equal to 0.84. Now, based on that the safety stock will now, be z sigma which is 0.84 into 50 which is 42. So, now let us compare three situations or scenarios.

Now, the first one when we were here (Refer Slide Time: 28:42) when we said the service level is 90 percent, assuming this discrete distribution safety stock was 50. Now, when we moved to the normal distribution for a chosen service level of 95 percent, we found out that the safety stock was 82.25. Now, if we want to make a meaningful comparison (Refer Slide Time: 28:42) now, here service level was 90 percent. So, let us now look at the other one, if service level is 90 percent. Once again we can go back to the standard normal distribution and find out what is the value of Z now, Z is equal to 1.28 which would give us safety stock equal to 1.28 into 50 which is 64.

So now, you see here that the safety stock actually increases a little bit (Refer Slide Time: 28:42) when we compare the situation that is here. If we fix the service level at 95, safety stock is 82.25. If we now, do not fix the service level but, assume the shortage cost and then compute the best service level, then that service level is 80 percent for the 2.5 which gives us a safety stock of 42. Now, we have to find out the total cost now, total cost as I said has three components which is D by Q into C naught Q by 2 plus SS into C c plus S bar of x into D by Q into C s now, let us do this calculation because we have found out the best value of safety stock using this.

So, this would give us D by Q 10000 by an assumed value of 1250 which is 8, 8 into 300 is 2400. Q by2 is 1250 by 2 which is 625, 625 plus 42 is 667 into 4, 2668 plus we need to find those out. Now, in all this we know D by Q we know C s but, we do not know this S bar of x. So, this will become S bar of x into 8 into 2.5(Refer Slide Time: 17:41). Now, if we remember carefully we have 3 terms here and these 3 terms are very similar to this term, that we have from where we calculated 5200 for the discrete distribution. Now, this 4900 comes (Refer Slide Time: 17:41) out of this 2400 plus another 2500 out of this so, that is 4900. Now, the balance is 168 which is equivalent of this (Refer Slide Time: 17:41) and then we are going to have one more term here which is the shortage cost term which is equivalent of this term.

So, we really need to find out, what is the value of S bar of x corresponding to this 80 percent service level. That involves the little more detailed look at the normal distribution, which also means that we have to find out the y and so on. So, I am just going to give that figure here now, that s bar of x that we have when we have this normal distribution is given by 0.112 so, this will be 2400 plus 2668 plus 0.112 into 20 and this on multiplication gives us 0.112 into 50.

So, S bar of x is 0.112 that comes from the normal distribution that has to multiplied with the sigma to get 0.112 into 50, which is roughly about 6 as the expected shortage.(Refer Slide Time: 28:42) Whereas, in the other one we saw that the expected shortage was roughly 5 (Refer Slide Time: 28:42) because, 50 into 0.1 was 5. Now, here the expected shortage is 6. So, this gives us a total cost of 5180 now, the comparable cost here is 5180 as (Refer Slide Time: 17:41) against 5200 which was the optimal when we assumed this kind of a distribution.

But, then we also have to look at one thing we should not actually make a comparison between these two values. Because of several assumptions one of which of course, is the normal assumption, the assuming that the normal distribution has the same mu and sigma roughly of this.We also know that the actual value is 54.77 which was approximated to 50 so, we have another 5 units that could come out of this.Whichwill add to the safety stock so, plus 5 into 420 would give us about the same 5200.

But, then the way we look at this problem. Assuming the normal distribution and the mathematics of it is very different from looking at (Refer Slide Time: 28:42) how we solved it using the discrete distribution.The advantage of following this approach is that, this gives us the flexibility to model any value of lead time demand, which could be within this number (Refer Slide Time: 28:42) as well as which could be outside of the range of these numbers.