Modelling and Analytics for Supply Chain Management
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Lecture 31
Continuous Review System

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Goof afternoon and welcome to our session on continuous review system related to inventory modelling.

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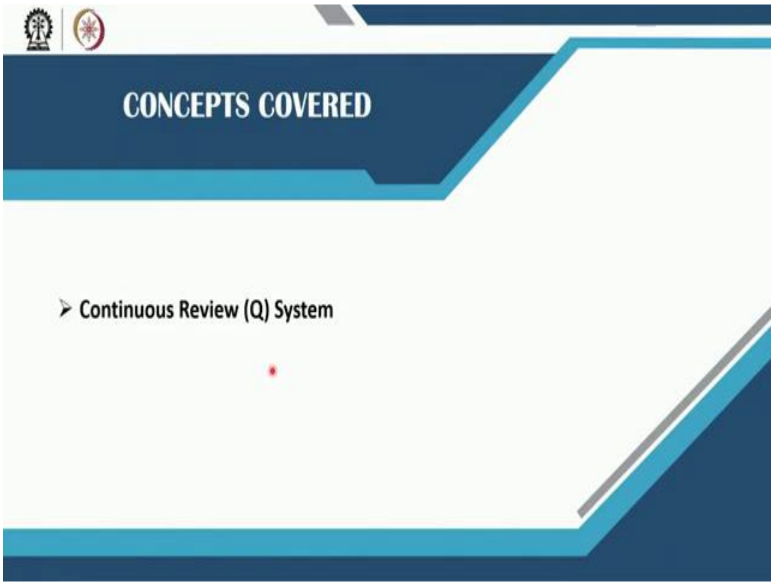

In this session, we will cover one very important inventory control system which is known as continuous review system or Q system.

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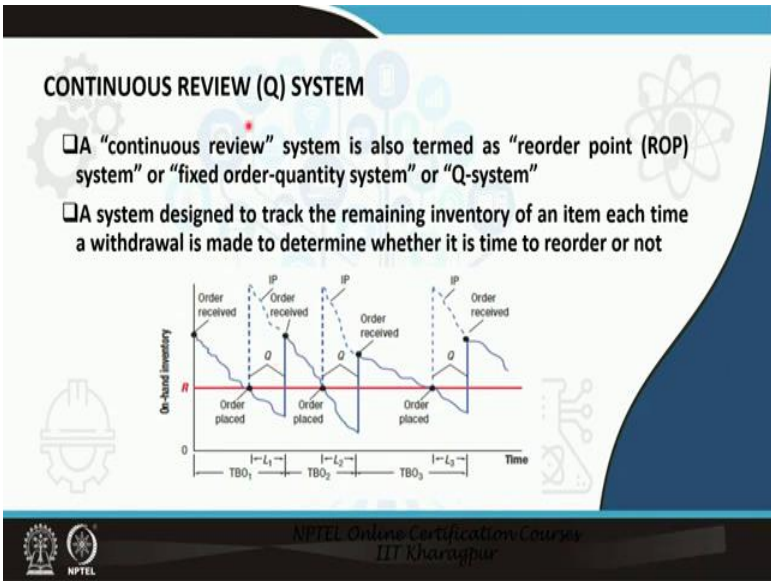

A continuous review system is also termed as a reorder point system, it is sometimes also known as fixed order quantity system or the Q system. It is a system which is designed to track the remaining inventory of an item each time a withdrawal is made to determine whether it is time to reorder or not.

In this system, the inventory position of an item, that is inventory's position of a stock keeping unit and item is also known as a stock keeping unit, and that inventory position is monitored on a continuous basis and the inventory position is known at all times. Now you will ask me, what do you mean by inventory position?

The inventory position which we denote by IP of an item is defined as the number of times a number of items held currently in stock, which is basically on hand inventory plus the number of items on order which is the schedule receipts minus the number of items on back order.

Back order is a order which you have to replenish as soon as a phrase lot of material comes in to your premises. Back order situation arose because the customer must have asked for say, 100 items and you had only 70 items in stock and the customer said, okay the balance 30 items you pay me later you send me later. So, the customer is prepared to wait, so the back order are here is 30 items.

So, as soon as the next supply comes, the first thing that organisations is to is that from that fresh lot, 30 items are kept reserved for that particular customer for which we could not supply the entire desired amount or entire amount demanded. If you look at this particular figure, here on hand inventory is plotted along the y axis, it maybe even inventory position also and time is plotted along the x axis.

This blue line basically represents the level of stock or the inventory position, and you see this is fluctuating with respect to time. Suppose we have at this particular point in time, we have received a fresh order, order received. From then onwards, the consumption is taking place and the stock is getting depleted. At this particular point in time, when the stock level is equal to a pre-determined level which is marked by this red line and this level this particular stock level is called the reorder level or the reorder point.

So, when the stock has just touched the reorder point, we place a fresh order amounting to Q, which is nothing but the economic order quantity. So, this order is placed on to the supplier at this particular point in time when the stock level has just touched the reorder point. So, when inventory position is less than equal to reorder level or the reorder point, of fresh order is placed on to the supplier whose value is equal to Q units and this Q units is nothing but the economic order quantity which we have discussed earlier in our modules.

The material comes in after a time, say L1. So you see, the order which is placed at this point comes in here, so we have received the order amounting to Q units. This time interval L1 is basically the time between placement of an order and the receipt of that same order, this is also called the lead time.

The stock again fluctuates again when it touches the reorder point another fresh order is being placed on to the supplier and this particular order is replenished at this point in time and the gap between this placement of order and the receipt of this order is this lead time L2. So, you see this lead time L1, L2, L3 they may be the same or they may vary, and in such a system what is happening that the time between these orders which is TB 01, or TBO 1, TBO 2, TBO 3 this time between orders they are varying.

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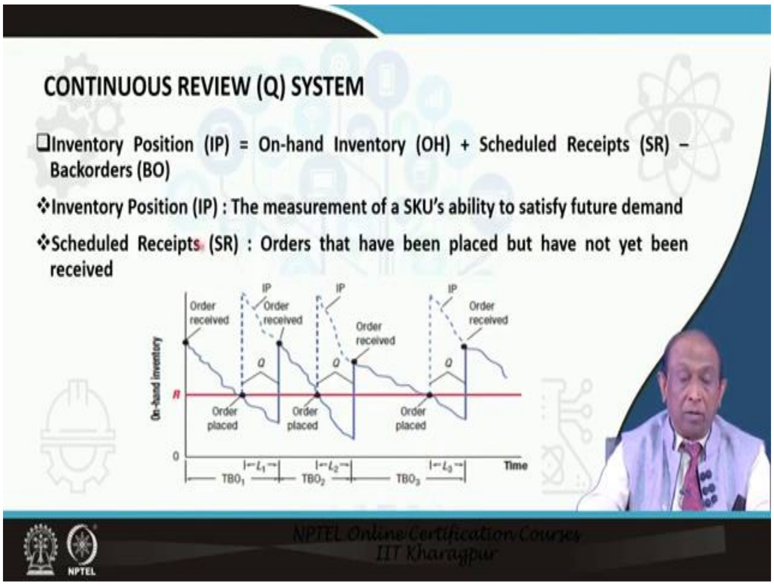

So, we have defined inventory position IP as on hand inventory plus scheduled receipts, that means we have placed order on to your suppliers and we will receive that particular amount after this lead time period schedule receipts SR, already some items maybe they are on order and the given the pipelines, so the pipeline stock is included in the scheduled receipts minus back orders.

Inventory position basically is a measure of a stock keeping units ability to satisfy future demand. Schedule receipts are basically orders that have been placed on to the suppliers but have not yet been received.

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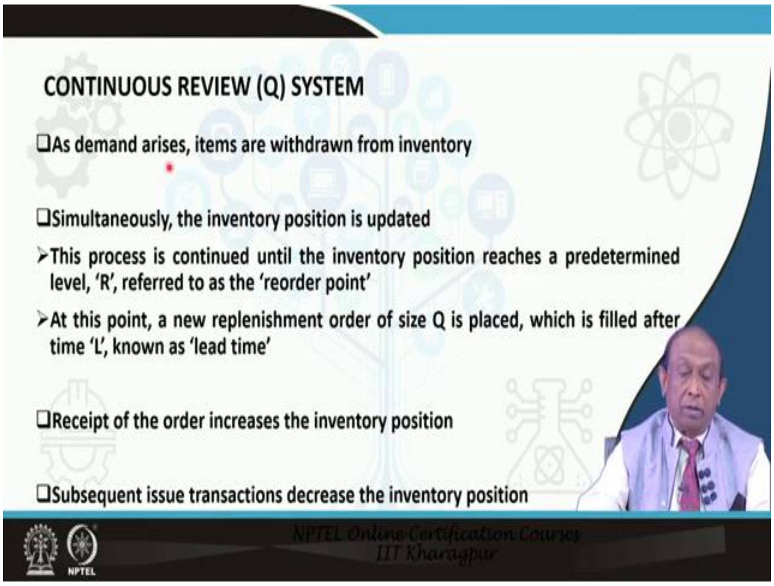

So, in this system as demand arises, items are withdrawn from inventory and simultaneously, the inventory position is updated. This process is continued until the inventory position reaches a predetermined level or which is referred to as the reorder point which I explained earlier. At this point, a new replenishment order of size Q is placed which is field after time L known as lead time. Receipt of the order increases the inventory position and subsequent issue transactions basically decrease the inventory position.

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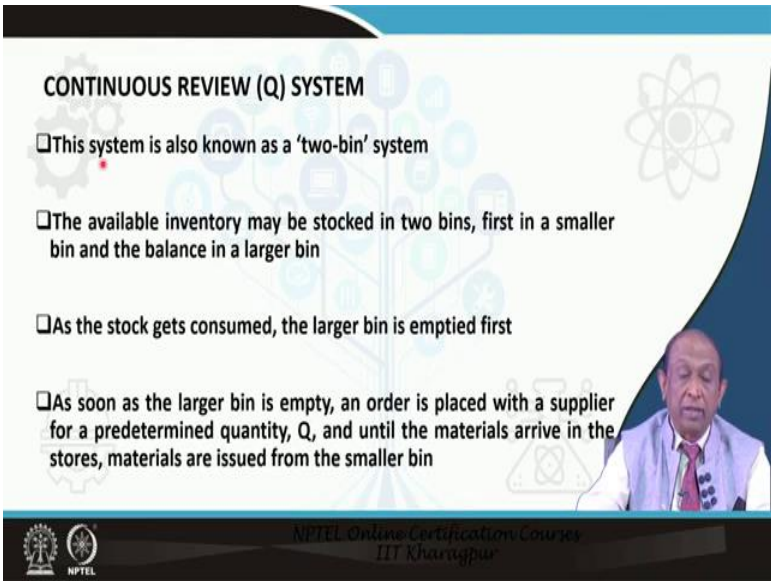

This system in practice is also known as a two-bin system. In practice, what is been followed is that the available inventory may be stocked in two bins, first in a smaller bin and the balance in a large bin. As the stock gets consumed, the larger bin is emptied first. As soon as the larger bin is empty, an order is placed with a supplier for a predetermined quantity Q, and until the fresh supply of material arrive in the stores, materials are issued from the smaller bin.

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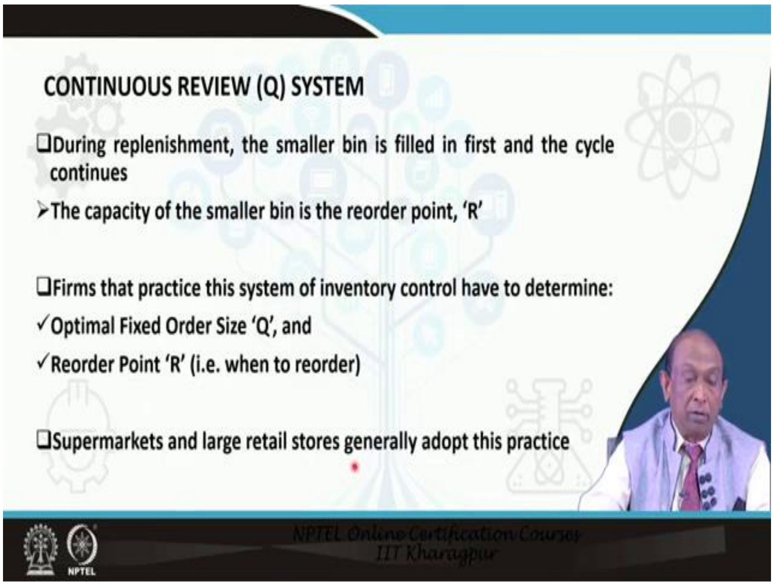

During replenishment, when the stock has already come from the supplier, the smaller bin is filled in fast and this particular cycle continuous. The capacity of the smaller bin is nothing but the reorder point R. Firms that practice this system of inventory control have to determine optimal fixed order size Q.

Which is the same every time and is equal to the economic order quantity and reorder point R, that is when to reorder because as soon as the inventory position or the stock level basically touches the reorder point, the fresh order is placed on to the supplier. So, what should be this value of this reorder point that is very important. Supermarkets and large retail stores they generally adopt this system of inventory control.

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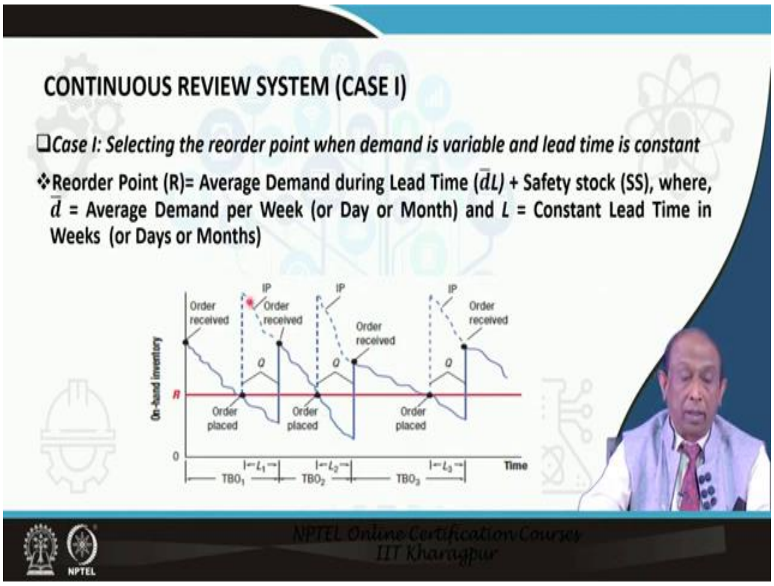

So now, let us determine the reorder point when demand is variable and lead time is constant, which is true in most cases. So, demand is variable and lead time is constant, so reorder point R is basically the average demand during lead time which we explained earlier in our module on safety stock plus the safety stock.

So, reorder point R is d bar into L plus safety stock SS, where d bar is a average demand per week or average demand per day or it can be expressed as average demand per month and L is a constant lead time in weeks or days or months, and this demand we can assume that, if sufficient data is available it will follow a normal distribution and we have made this assumption for convenience this demand can follow any other continuous distribution.

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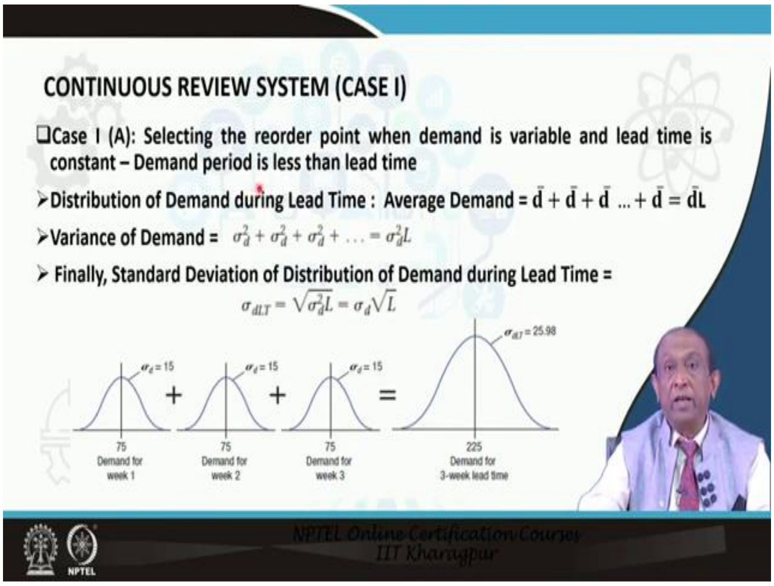

So, any distribution can be characterized by its parameters that is mean and standard deviation or variance. So, we will now discuss about a case where the demand period is less than the lead time period. For example, say we might be given that the distribution of demand is normal and it is a weekly distribution of demand. So, with a mean of say 75 units and standard deviation of 15 units per week.

And suppose the lead time is 3 weeks, so in this case the demand period one week is less than the given lead time period of 3 weeks. So, what we will have, that over this lead time period, we will have or we may have this 3 demand distributions, 3 weekly demand distributions and if you convolute, then you will get a resultant normal distribution like this, for which the mean will be 75 plus 75 plus 75 that is 225 units demand for 3 week lead time.

So, this resultant normal distribution is having a mean which is n times the average demand per week. So, this is nothing but d bar into L and this resultant distribution will have a variance which in this particular case will be sigma D square plus sigma D square plus sigma D square which is nothing but 3 times sigma D square that is 3 into 15 square, which in turn will give us a standard deviation of demand during lead time of 25.98.

In general, if during the period L, that is the lead time period, we have several such demand distribution, then the variance of demand is nothing but L times sigma D square which gives us the standard deviation of distribution of demand during lead time is nothing but sigma D into root over of L.

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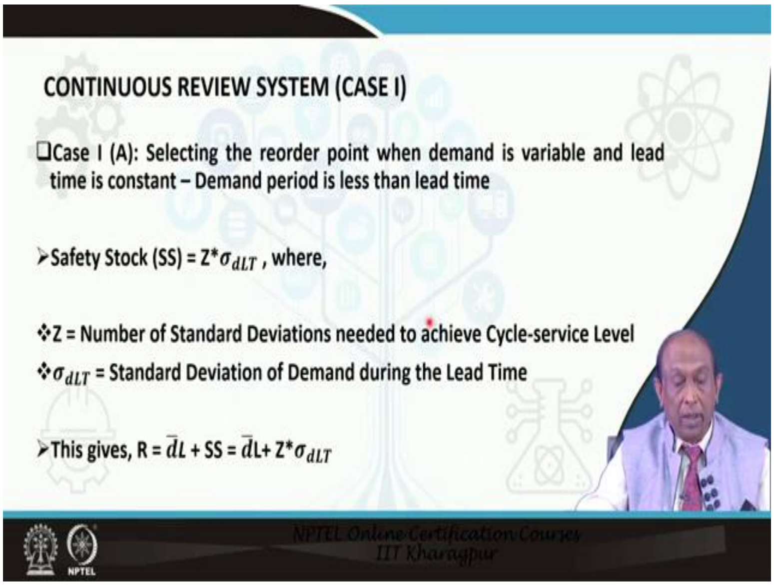

So, if we know the distribution of demand over lead time, then the expression for the new reorder point R is nothing but d bar into L, where d bar is the average demand into lead time plus z which is the number of standard deviations needed to achieve the cycle service level, and this is being specified the value of z will be found out based on the level of service specified by the management.

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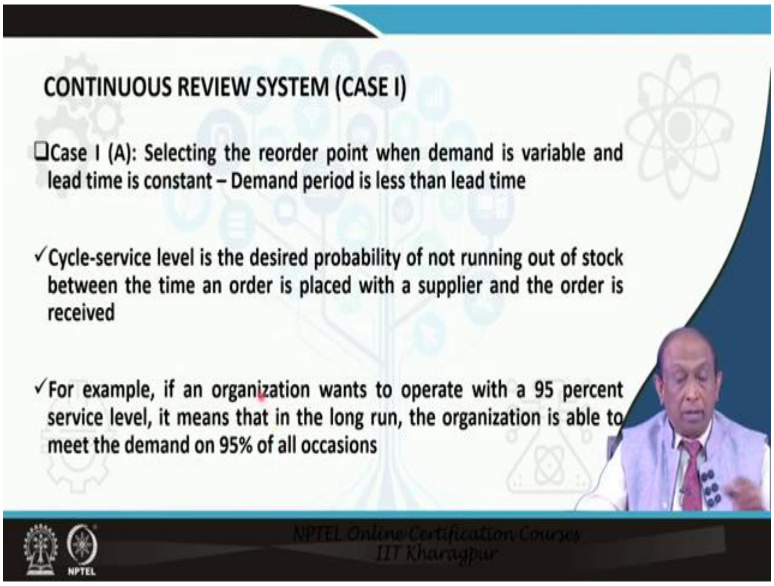

And this service level that the management basically specifies has got some significance. Cycle service level is basically the desired probability of not running out of stock between the time when order is placed with a supplier and the order is received. For example, if an organisation wants to operate with a 95 percent service level, it means that in the long run the organisation is able to meet the demand on 95 percent of the occasion.

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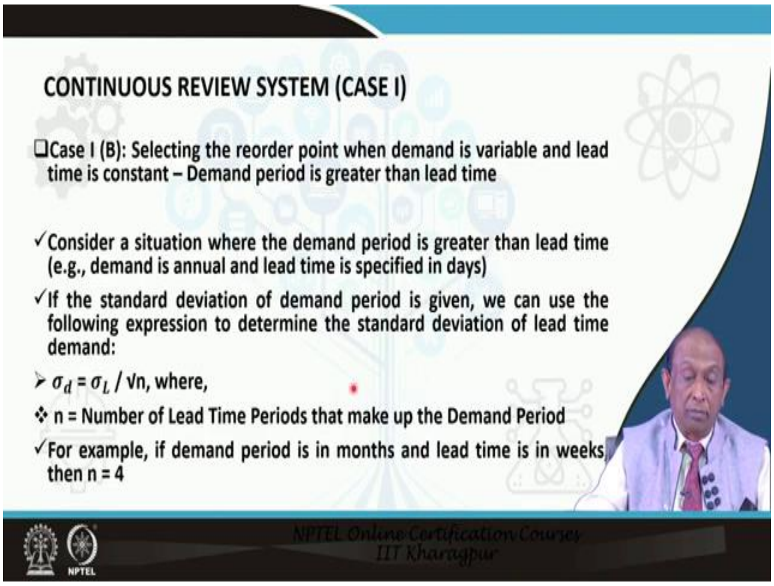

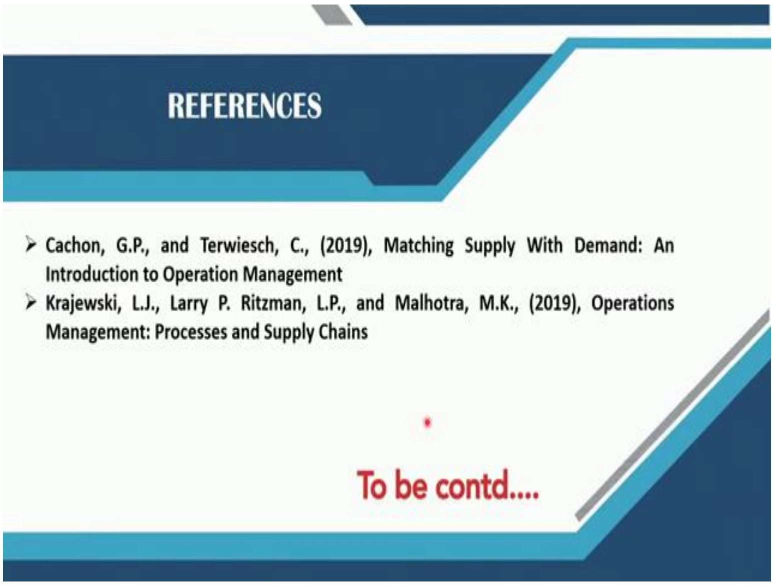

And if the demand follows normal distribution, then with protection the level of 95 percent or service level of 95 percent, the corresponding z value can be found from the standard normal distribution table and which is equal to 1.645. If the demand period is greater than the lead time, it may so happen that the distribution of demand is given as annual demand in any problem you might face, that the distribution of demand annual demand is given but the lead time is specified in terms of days and those the amount of the quantum of lead time is less than the demand period.

In that case, if the standard deviation of demand period is known or given, we can use the following expression to determine the standard deviation of lead time demand which is nothing but sigma we can use this particular formula sigma D equals sigma L by root n, where n is the number of lead time periods that make up the demand period. For example, if demand period is in months and the lead time is in weeks, then in that case n equals 4. Thank you all.