Now we have set the stage to solve this problem. We have been introduced to basic solve reorder point and to the relationship between normal variable and standard normal variable. Here demand during lead-time is 50 tons; standard deviation of demand during lead-time is 5 tons. We expected maximum risk of 5 percent, of being we out of stock and we want to compute safety stock and reorder point. Average demand during lead time, LTD equal to 50. Standard deviation of demand during lead-time, Sigma LTD is equal to 5. Risk is 5 percent; therefore service level is 95 percent. All we need is to go to standard normal table. Look for the probabilities. Find ninety-five percent probability, or something, which is closest to the 95 compared to all other numbers. And then read z, look at the row get 1.6, look at the column get .05,and that would be 1.65. Now we have the z and we should map it into our normal variable, which has a mean of 50 and standard deviation of 5. Safety stock is z time’s standard deviation of lead-time demand. Z was 1 .65 standard deviation of lead-time demand is 5 so the multiplication is 8.33. Safety stock or Isafety is 8.63 and Reorder point is average demand during lead-time plus safety stock. Average demand during lead-time is 50, z is 1.65, standard deviation of demand during lead-time is 5, the result is 58.3. Now we can add a little bit to our knowledge, we can see here as risk goes down service level goes up, as service level go up z value goes up, as z goes up because safety stock is equal to z times standard deviation of lead time demand if z goes up safety stock goes up. Higher service level means higher z and that higher z means higher safety stock. Therefore higher service level means higher safety stock. And higher safety stock means higher costs. We should have more inventory here. And this is the trade off between two things if you want to have a better service level then you need to have more safety stock and incur more costs.

Now let us look at another example. This is very similar to the previous example we still have demand during lead-time. And we have standard deviation during lead-time, but risk here is 10 percent compare to 5 percent; which was the situation in the previous example. Solution is exactly the same. Service level is 90 percent and z value of 90 percent; we go to the table we find the closest to probability to 90 percent. Then we look to the row and column and put them together and we will get z equal to 1.28. Safety stock is z multiplied by standard deviation of demand during lead-time. Therefore safety stock would be 12.8. And Reorder point is average demand during lead-time plus safety stock and that is 87.8.

Now lets look at the problem, which is a little different. Demand during lead-time is 20,000, standard deviation during lead-time is 5,000 and Reorder point is 24,000. Whenever inventory on hand reaches 24,000 we order something, EOQ or something. As we see the difference between reorder point and average lead-time demand is 24,000 minus 20,000, which gives us 4,000. So our safety stock is 4,000. For this safety stock we want to know we are under what service level, where we know the standard deviation of lead-time demand is 5,000. So we do have ROP, we do have average demand during lead-time, and we do have standard deviation of demand during lead-time. We have safety stock, and we know that safety stock is z time standard deviation of demand during lead-time. Then we can compute z. After we compute z we can find z is related to what probability, and that would be our service level. We all know this formula. We replace those numbers Isafety, safety stock is 4,000, and we know Isafety is z times standard deviation of demand during lead-time. So 4,000 is equal to z times 5,000 and therefore z is equal to 0.8. Know we go to normal table in a row we find 0.8 and go to the first column of that row and that is the probability of standard normal variable. Being less than or equal 0.8 we find the probability and that is our service level. So we have z equal to 0.8 given z, given standard normal table, we want the table to return us the probability of being less than equal to the specific z. Less or equal to 0.8, this is z table I will go to the first column and I will find in one of the rows I will find 0.8 and I will go to the next column which correspond to 0 and that would be the second digit and I will look for z equal to 0.80 and find the probability that probability would be 0.7881. Please try it and go to the table and make sure you have no difficulty finding that probability. Therefore service level is 0.7881.

Alternatively we can go to excel, we have z value equal to 0.8 we are looking for probability. Probability of having a standard normal variable being less than equal to 0.8. You will type function: norm standard distribution, norm standard distribution. We have z we want to find probability. In the previous situation when we selected norm standard inverse, in that case we did have probability or service level and we were looking for z. In this case we do have z and we are looking for probability and we click on norm standard distribution. Click ok and select that cell and click ok and it will give you 0.788145, which is probability of our standard normal variable to be less than or equal to 0.8 that probability is almost 0.79.

Now lets generalize this problem. Service level is probability of our demand of random variable demand to be less than equal to what we have. Please note that when I write some notation in a little bit bold form that means it’s a random variable. If I write it in regular font it is average of that random variable. Our demand during lead-time is **Lead Time Demand** that is a random variable. If I want to refer to the average of this lead-time I don’t write it bold, I write it like this Lead-Time Demand. That means average lead-time demand; this is a random variable, which its average is this one. Don’t worry we will not be confused by these two I promise you. So service level is defined as probability of random variable to be less than equal to what we have. That random variable is normally distributed. It has an average and standard deviation. So here when I have written it a little bit darker that is the random variable, which has this mean and this standard deviation. Reorder point is equal to average demand during lead-time plus Isafety, safety stock. Reorder point is equal to average demand during lead-time plus z times standard deviation of demand during lead-time. Therefore Isafety is equal to z.