Production and Operation Management
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Lecture 28
Material Requirements Planning (MRP): Examples II

Welcome friends, in our last session, we were discussing about examples of material requirement planning. We discussed that MRP is very very important part of managing the inventory of various dependent items. And normally in any organization you will realize that the number of final products are very less. Company maybe producing 10 types of cars, but each car require thousand types of components. So, the MRP is more important part of our discussion and it is also very important thing to know that the whole journey of MRP is not only limited to MRP.

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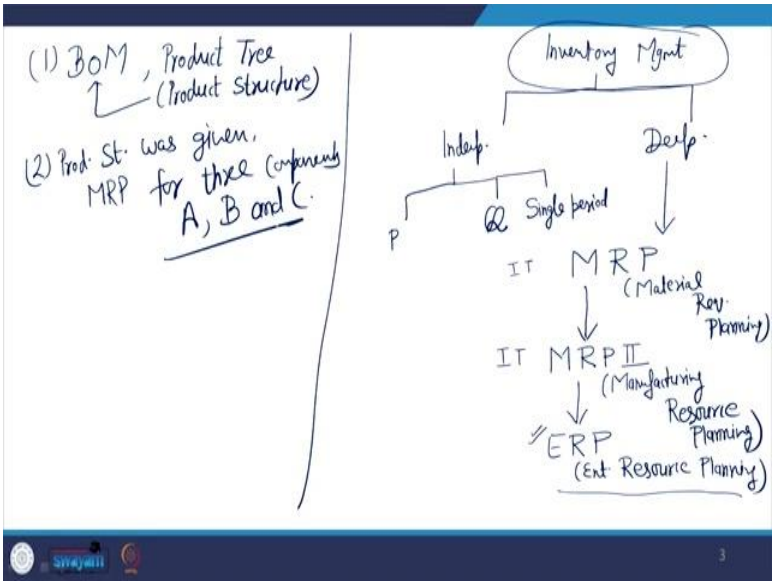

If I just show you that the discussions are that you have issue of inventory management and in that inventory management, we discussed that there are 2 types of inventory management issues, the independent and dependent. Now, in the independent we discussed that, we have p type of inventory and Q type of inventory and then there are certain special cases where we have the single period cases which are also like type of P inventory systems.

And in the dependent inventory management, we started our discussions with MRP which is a material requirement planning. But then people, practitioners, they thought that only the management of inventory of subcomponents, spare parts is not sufficient, we need to have better productivity we need to have better efficiency of our production systems.

So, they included some other resources, which are part of your manufacturing process like you require machines for making the parts for fabrication purpose, you require various types of cutting tools also. You require various kinds of oils, coolants additives etc. So, there are various other resources which are required in your manufacturing process, which are not directly used in the assemblies, but without them the production process is not possible.

So, we enlarge the scope of MRP by introducing another concept, which is known as MRP 2 which is a more bigger concept, which is a vital concept and it includes other resources which are required in manufacturing activity. So, the name becomes manufacturing resource planning which is known as MRP 2 very popularly.

Then at the same time it is IT dependent, it is also IT dependent and more and more development in the field of information systems were going on and better computing algorithms, more computing power than another important thing, cloud computing networking all these things became possible in the development process. And those developments helped us in further enlarging the scope of a manufacturing resource planning. And that more enlarged view becomes ERP which is enterprise resource planning.

So, now you can understand that presenting ERP is a very known term to all of us, but we understand ERP as a subject matter of information science, but the generation of ERP is basically from this issue of inventory management, that how the inventory management of dependent items led to creation of ERP, where you have considered the organization wide the entire enterprise wide planning of resources.

So, whether it is monetary resources, whether it is human resources, whether it is physical resources, so there are different types of resources are available in the organization. So, how to use those resources effectively and efficiently for your organization that is the widest form of resource planning.

So, this is nowadays becoming popular that we want to have ERP in the organization. In India we are slightly late in adoption of ERP. But nevertheless, now most of the organizations not only manufacturing organizations, but service organizations also you go to hospitals, you go to banks, you go to educational setups everywhere you will find the application of ERP.

So, the basic origin of ERP is from inventory management, but obviously, the bigger driver to adopt ERV solutions is Information Science by the development of better software, by the

development of better computing powers and by reducing the cost of hardware, it was possible it enabled the use of ERP at a widespread level.

Now coming back to the discussion which we were doing in our previous class that we discussed in that previous class, we discussed the application of MRP in the numerical form. So, we discuss the case of 1 where we developed a bill of material, some information was given and we developed a product tree or you can say product structure and with the help of that product structure, we calculated that how many units are required of each sub assembly that is bill of material.

In the second example, you remember, we have a product structure and we developed MRP for 3 components A, B and C. So, that is what we did in 2 examples. Now, in this class, we will discuss more about lot sizing that we have discussed there are different types of lot sizing techniques. And here we will see that how those lot sizing techniques will be applicable.

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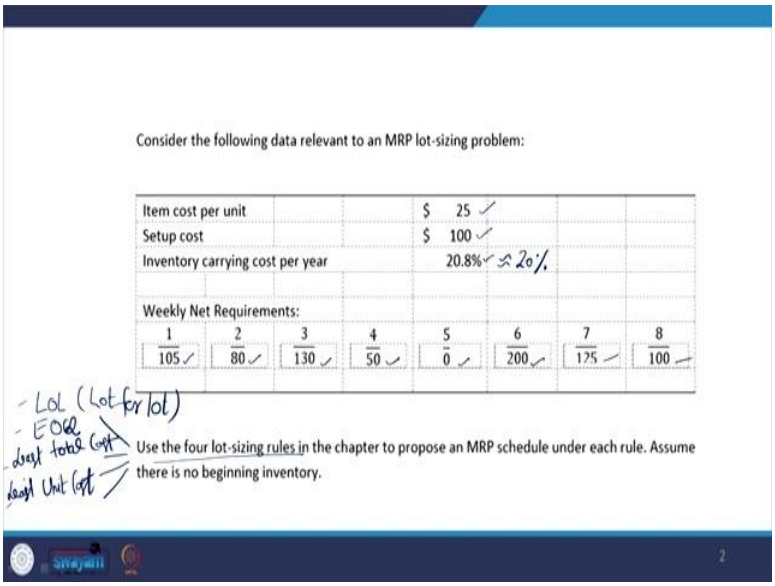

So, you see that data available to us is given that item cost per unit is 25 dollar. The setup cost is 100 dollar and inventory carrying cost per year is 20.8 percent you can take it to 20 percent also, for the sake of simplification of your calculation. The weekly net requirements are available 105, 80, 130, 50, 0, 200 to 1 to 5 and 100 for 8 weeks.

Now, we need to apply different lot sizing rules. So, just to get you familiar with those different kinds of lot sizing rules, the first was LOL that is lot for lot. The second was EOQ, then least total cost and then least unit cost. So, these are the 4 different rules we have and

based on that, whichever rule gives us a minimum cost of inventory that is our rule for giving the orders in our MRP discussion.

In the previous example, which we did in the last session, we remember that for item A, the fixed order quantity was of 20 units for item B, the fixed order quantity was 40 units and for item C, there was no fixed order quantity, there is LOL, whatever is the requirement we use to place order of that quantity. So, there are different types of situations and these are determined based on these different kind of lot sizing rules. Now, let us see that how do we do the calculation for these different kind of rules.

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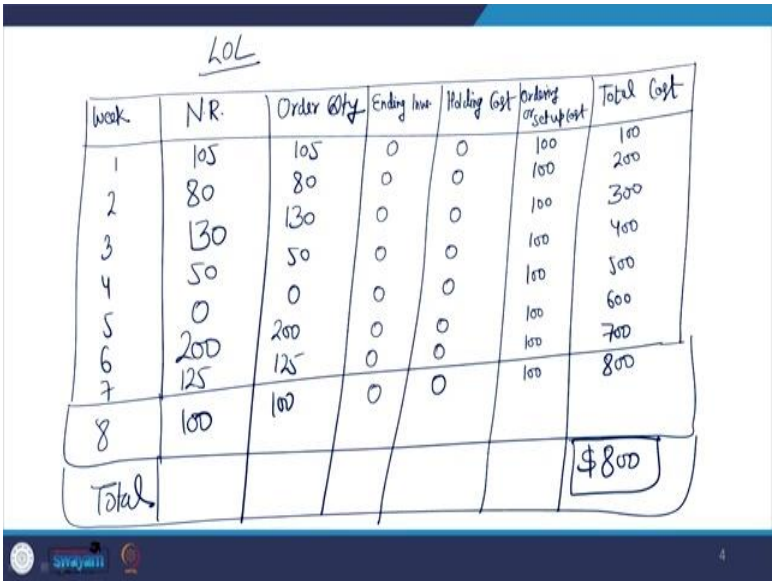

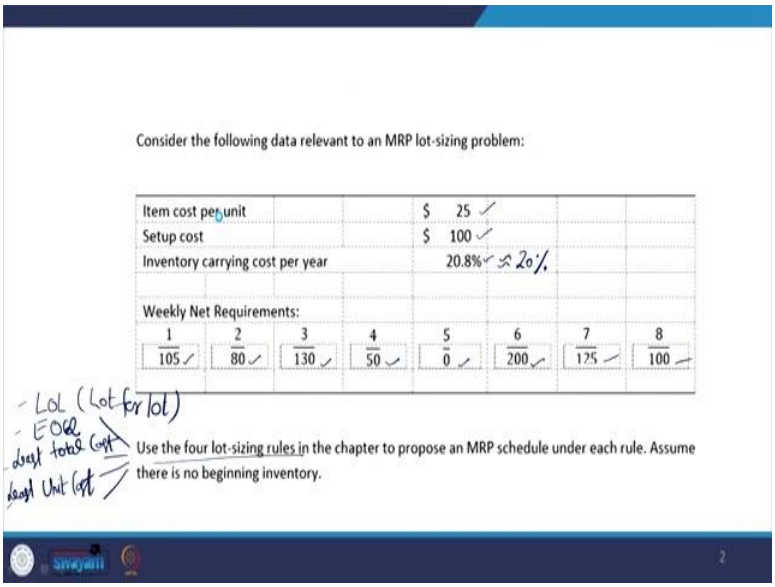

First is LOL so if I develop the table for LOL here you can have a detailed table and these are the weak 1, 2, 3, 4, 5, 6, 7 and 8 and then for total net requirement. So, let us copy the data

105, 80, 130, 105, 80, 130 then 50, 0, 200 and then 125 and 100, so that is the data available to us. Now, when this data is available so our order quantity under the LOL will be exactly the same whatever is the net requirement that is going to be the order quantity.

Then another column I will prepare for the ending inventory since I am giving order of that quantity which is required in the week one, so the ending inventory is 0 and that is so for all these periods and therefore, I will calculate next is the holding cost though the holding cost is given to me as 20 percent of item cost, but since there is no ending inventory.

So, holding cost will also come as 0 for all the periods. Now, the next is ordering or setup cost. So, the ordering cost is given as 100 dollars or the setup cost is given as 100 dollars. So, whenever I am placing an order whenever I am setting a new order I incur 100 dollars and that I am going to write here. So, my total cost will come here and the total cost is 100, 200, 300, 4, 5, 6, 7 and 800 so by the total cost of this system is 100 dollars. This is when I am following LOL system.

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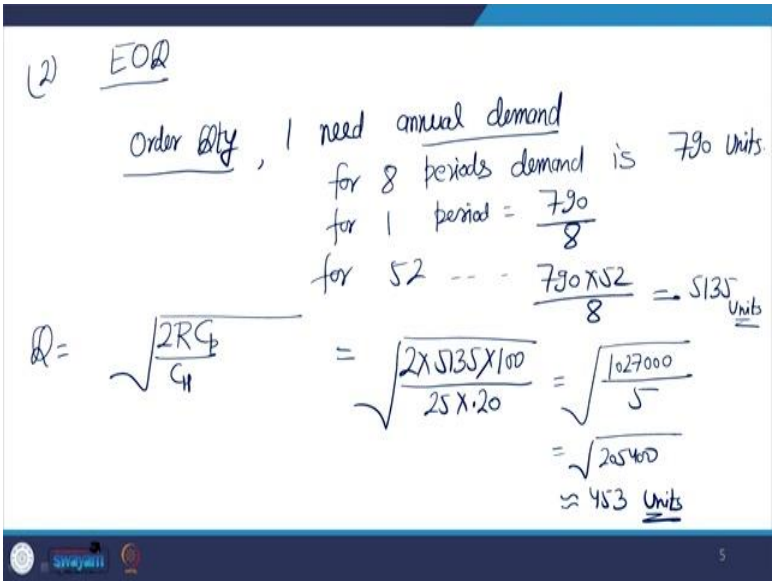

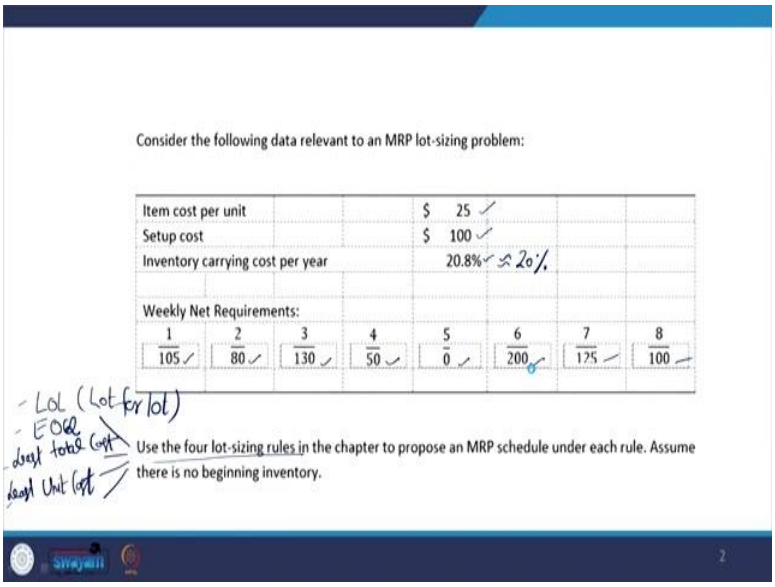

Now, let us see other system. The second system which I am going to follow that is EOQ. Now, for EOQ to decide my order quantity I need annual demand, what is my annual demand? Now, I have the demand for 8 weeks. So, the demand for 8 week I will do the summation 105 plus 80 plus 130 plus 50 plus 200 plus 125 plus 100.

So, for 8 periods it is coming 790, for 8 periods demand is 790 units. So, on the pro data basis when for 8 periods, demand is 790. So, for 1 period it will be 790 by 8 and for 52 periods that will be 790 into 52 divided by 8. So, 790 into 52 divided by 8 it comes out to be 5135 units. That is my annual requirement.

Now, when I have the annual requirement 5135 units, I can now calculate my Q that is under root 2RCP upon CH and using this formula, my annual requirement 5135. Cost of placing the order is 100 dollars and the material cost was mentioned as 25 dollars. So, 25 into 0.20 that is the 20 percent of 25. So, 25 into this is 1027000 divided by 25 into 0.2 that becomes 5. So, 1027100 divided by 5 that comes to be under root 205400 and then I take the under root of 205400 that becomes 453 units. So, whenever I will place the order I will place order of 453 units.

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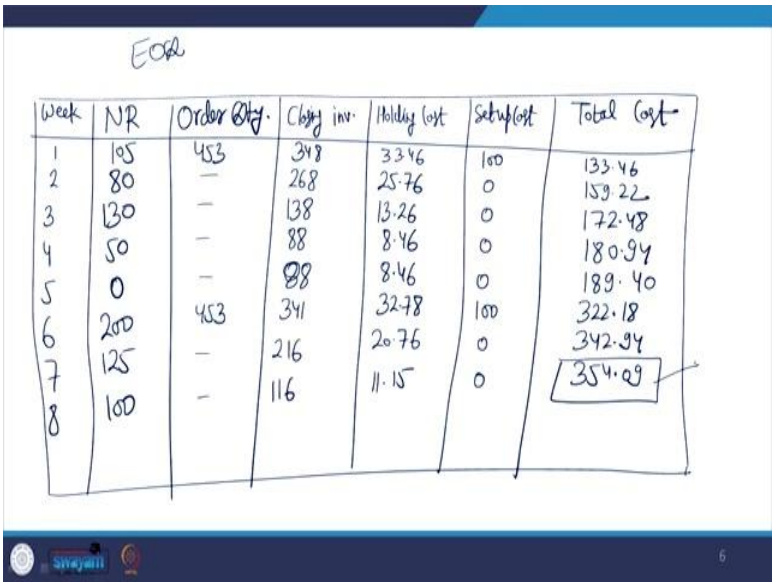

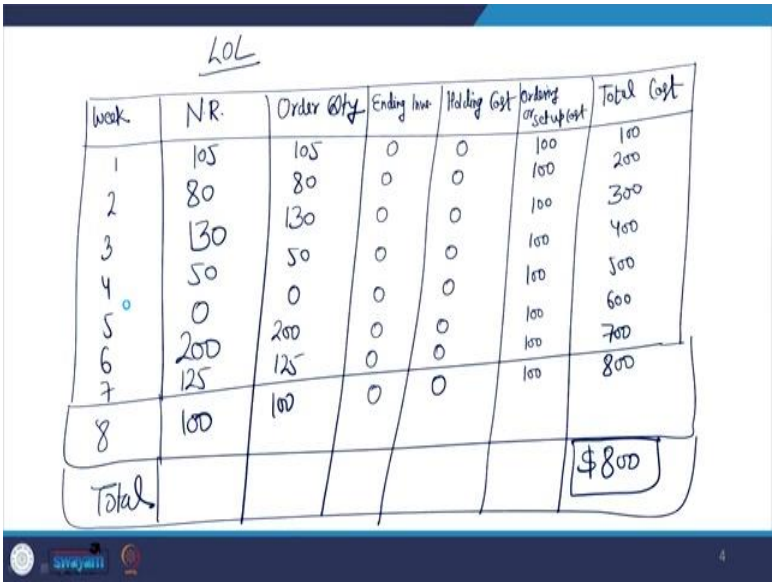

Now, let us see the calculation part again I will make the table these are week 1, 2, 3, 4, 5, 6, 7, 8 net requirement let me copy from some old table 105, 80, 130, 50, 0, 200 and 125 and 100. So, these are the net requirements. Now, interesting thing is order quantity. If you see the previous table, the third column was of the order quantity same will be here that order quantity, but the order quantity is now governed by EOQ and my EOQ value came 453 units. Now, you see the 4th column that is the closing end inventory. So, out of 453 which you have in the first week, you will consume 453 minus 105.

So, at the end of first week, you have 348 units left with you, then at the end of second period, you have also consumed 80 units out of it. So, it becomes 268 units, then at the end of third period, you have consumed 130 units. So, you are left with 138 units, then you have

consumed 50 units, you are left with 88 units, then there is no requirement 0 and then in the 6th period you require 200 units, but you are having only 88 units.

So, 88 units are available to you and you will place an order of 453 units again so you have 88 plus 453 that will be the total and out of that 200 will be consumed. So, you have finally 341 left with you from 341 you will consume 125 in the next period. So, you are left with the 216 and then you will consume 100 you are left with 160 whatever is left over we understand that this system is going on perpetual basis. So, it will be consumed in the ninth period. So, you are making only 2 orders know we calculate the holding cost.

Now, the holding cost is given on annual basis at the rate of 20 percent annual cost is given on the basis of annual basis that is the per year 20 percent. So, we can calculate the holding cost for 1 week also so when it is 348 into 0.2 into 25. This is holding cost for 1 year divided by 52.

That will give us for 1 week 33.46 268 into 0.2 into 25 1350 divided by 52. This is 25.76, 138 into 0.2 into 25, 690 divided by 52 this is 13.26, 88 into 5 divided by 52 that is 8.46 again 8.46, 341 into 5 divided by 52 32.78, 216 into 5 divided by 52 20.76, 116 into 5 divided by 52 11.15.

And then comes the set of cost, 1 set of cost is here, here it is 0 0 0 0 then another set of cost is here then further 0 and 0 so the total cost is 133.46 then 133.46 plus 25.76 that becomes 159.22 plus 13.26 172.48 plus 8.46 180.94 plus 8.46 189.40 plus 100 plus 32.78 it becomes 322.18 plus 20.76 342.94 plus 11.15 that is 354.09. So, this is the total cost in case of economic order quantity. Now, you remember that in our LOL the cost was 800 and now the cost has come down to 354.09. So, there is a drastic reduction in the total cost by applying a better scientific method of lot sizing that is EOQ.

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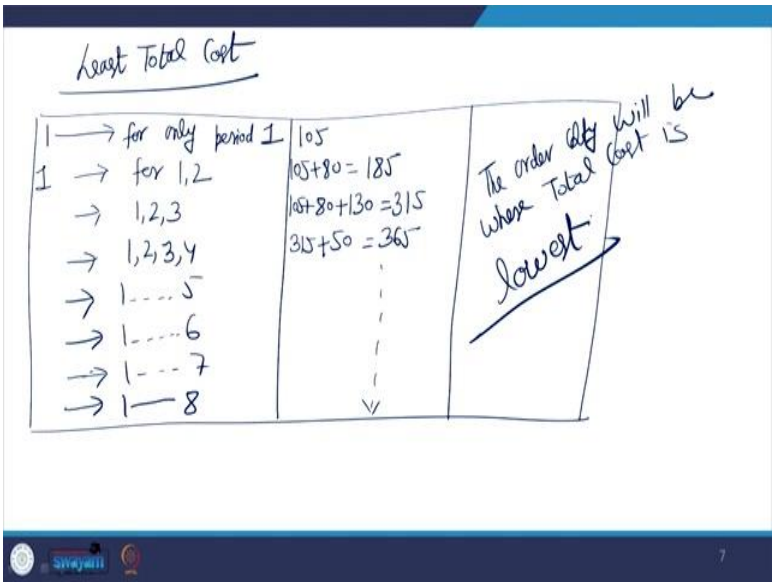

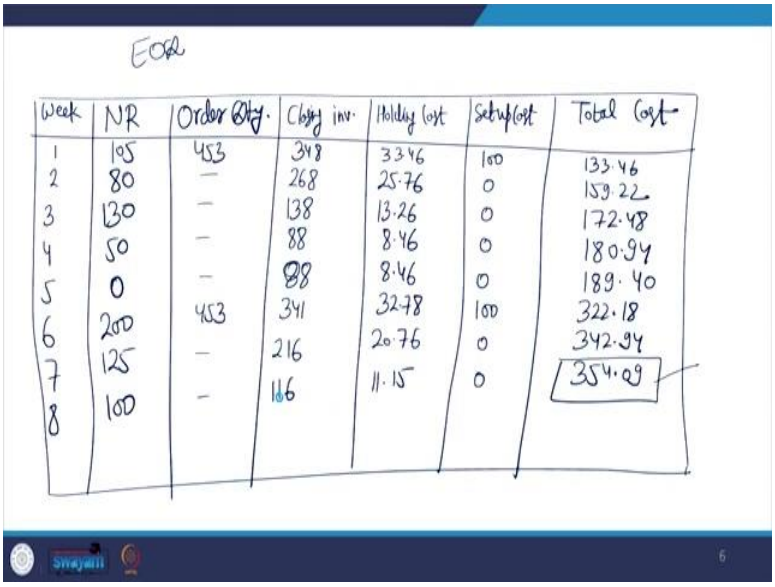

Then you can also go for least total cost. Least total cost is a dynamic method, it is a dynamic method earlier 2 methods were not so dynamic though to some extent, your LOL is a dynamic method, but EOQ is a static method because every time you are giving order of same quantity in LOL, it is dynamic because the order quantity is varying in each order depending upon how much is required.

Now, in the least cost method, our method is based on comparing the different combinations, we compare the different combinations, like what I am trying to say that in period one, you can order period 1 you can order for only period one. In period one, you can order for 1 and 2 you can order for 1, 2, 3 you can order for 1, 2, 3, 4 you can order for 1 to 5, you can order for 1 to 6, you can order for 1 to 7 and you can order for 1 to 8.

Now, when you are ordering for period 1 only, your order quantity will be 105. When you are ordering for 1 and 2, in that case your order quantity will be 105 plus 80 that is 185. Now, in this case 105 will be consumed in first period and 80 will remain at the end of the first period. So, you will incur holding cost for 80 units for 1 week.

Now, let us come to 1, 2, 3 here you will have 105 plus 80 and plus what is required in the third period that is 130. So, that becomes 185 plus 130 315. Now, out of 315, you are stocking 80 units for 1 week and 130 units for 2 weeks. So, accordingly your holding cost will increase 1, 2, 3, 4. So, up to 3 week this is 315 plus the demand of 4th week, that is 50. So, 365 here, this additional 50 units you will stalk for 3 periods.

So, you will incur holding costs on these 50 units for 3 periods and so on. The order quantity will be where total cost is lowest. Now, this total lowest cost maybe for 4 period, maybe for 5 periods, maybe for some other period. So, that will become your first order. The second order will come after that many number of periods for fulfilling the demand of the remaining period. So, you have to repeat this process again and then after identifying the cost for different periods, you can create the similar kind of table.

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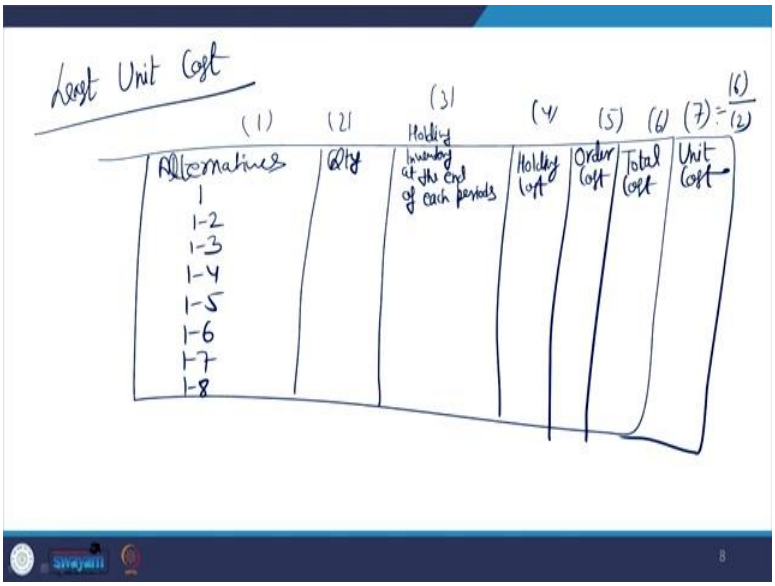

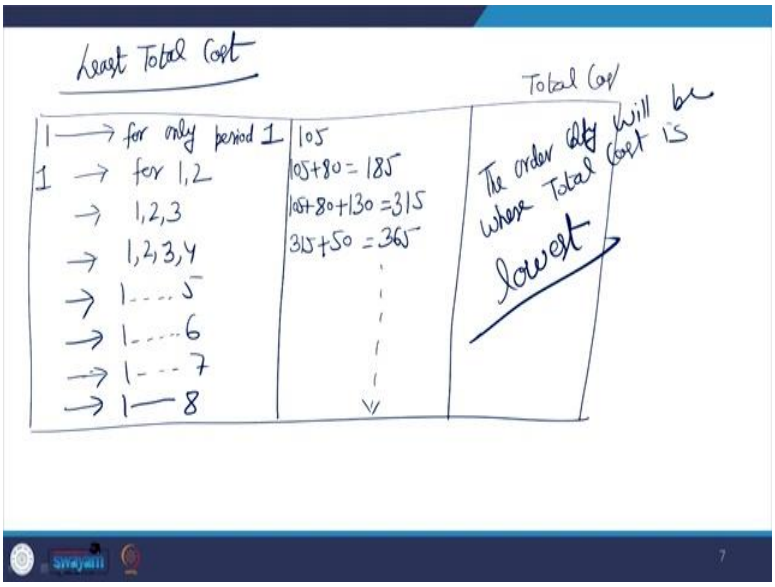

Then, another system is the least unit cost. It is similar to the least total cost system, the only difference between total cost and unit cost is that in the previous method, you are calculating the total cost in the final column. Now, in this particular case the first column is of alternatives, 1 period 1 to 2, 1 to 3, 1 to 4, 1 to 5, 1 to 6, 1 to 7, 1 to 8. So, the first column is of the alternatives, the second column according to alternatives, what will be the quantities the third column will be of holding inventory, holding inventory at the end of each period.

The holding cost, the order cost, the total cost and then we divide the total cost by the quantity. So, it gives you the unit cost, total cost divided by quantity that is going to give you the unit cost. So, therefore it is column number 1, 2, 3, 4, 5, 6. So, the values in 7 will be the result of 6 divided by 2.

And here you select the quantity which has the least unit cost So, this is an extension of our previous method, the least total cost, it is the expansion of that model, where we are not limiting to total cost rather we are interested in least unit cost. And then we see the total cost as we have prepared the table for 2 methods LOL for and EOQ.

Similarly, you will prepare cables for least total cost and least unit cost and then we see that which particular system gives you the minimum cost and we are going to adopt that system of lot sizing. All these systems have advantages which are in connection to the various kinds of cost parameters. So, in some situation LOL is better in some other situation EOQ may be better in some other situation least total cost system is better. So, we need to see the comparisons of all the systems.

Then only for a particular situation, we will select we will adopted a particular method and I request that you please make tables for all these 4 alternatives and put those tables, the screenshot of those tables on our forum page, so that we can compare the solution processes and we will also post the correct and final solution, so that you can compare your solutions with the right solution.

So, it can also become the part of your 1 assignment activity that you complete this problem and compare the various kind of lot sizing decisions, and then you see which decision is most profitable or most economical one. So, with this we come to end of this session. Thank you very much.