Decision Support System for Managers
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Lecture – 38
Decision Support Systems for Marketing: Decision Support Systems for Media Selection Model (Contd.)

Hello and welcome to "Decision Support System for Managers" and in this module – 'decision support system for marketing'. In the previous model, we had started with 'decision support system for media selection'. We had formulated the problem; we had also solved the problem.

And we saw that all the three constraints, all the three goals which we had set, could not be achieved. And that was something which we believe that, we will try to take that forward now through goal programming. And we also saw in the last class that two of the goals were approximate goals.

Now, using that knowledge we are moving ahead. In this class we are dealing with the step 2 of the problem for which the step 1 was covered, in the last class and we set up a goal programming problem. We solved the goal programming problem. We draw lessons from that and we then arrive at a usable solution. The same example continues and the step 2 follows.

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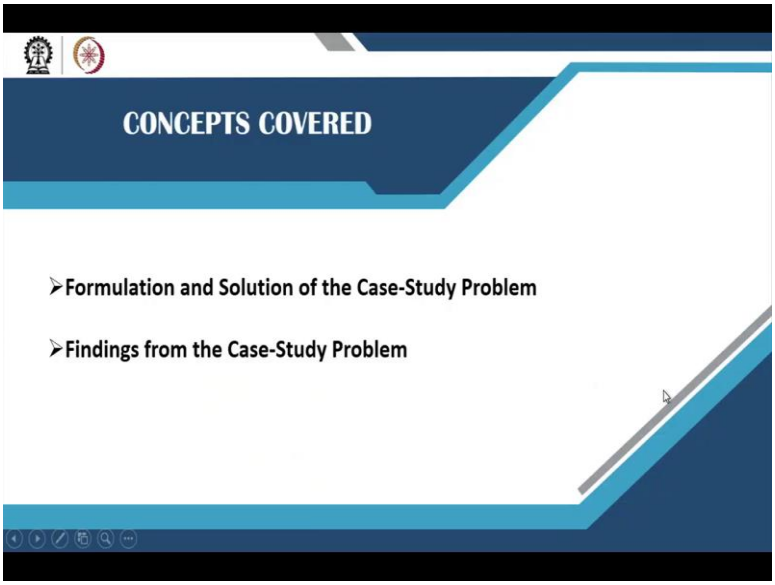

So, the same case which we did the Gizmo case, we are moving ahead with the formulation and the solution on the case study problem and then we will report the findings now, but in this case we are handling that approximation and we will try to achieve all the goals. So, we are coming back to the Gizmo company priorities and we are willing to accept deviations.

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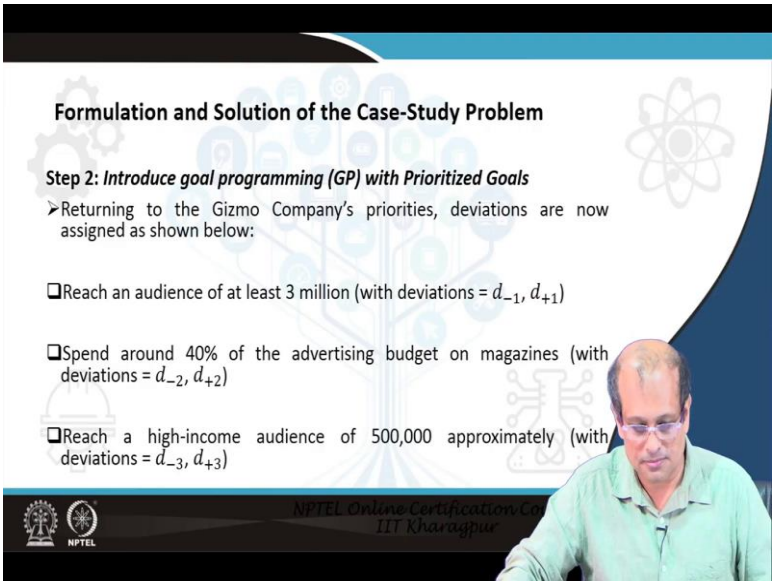

So, reach an audience of at least 3 million with deviations of d minus 1 and deviations of d sub plus 1; so, plus 1 in the subscript and minus 1 in the subscript. So, spend around 40 percent of the advertisement budget on magazines and we are willing to accept the deviations d minus 2 and d plus 2. So, this is the first deviation in the previous case and the second deviation in this case.

And reach high income audience of 500,000 approximately; again we are defining the deviations d minus 3 and d plus 3. So, we have defined a set of deviations d minus 1 plus 1, d minus 2 plus 2 and d minus 3 plus 3. This is a newness we are introducing in our problem statement; fine.

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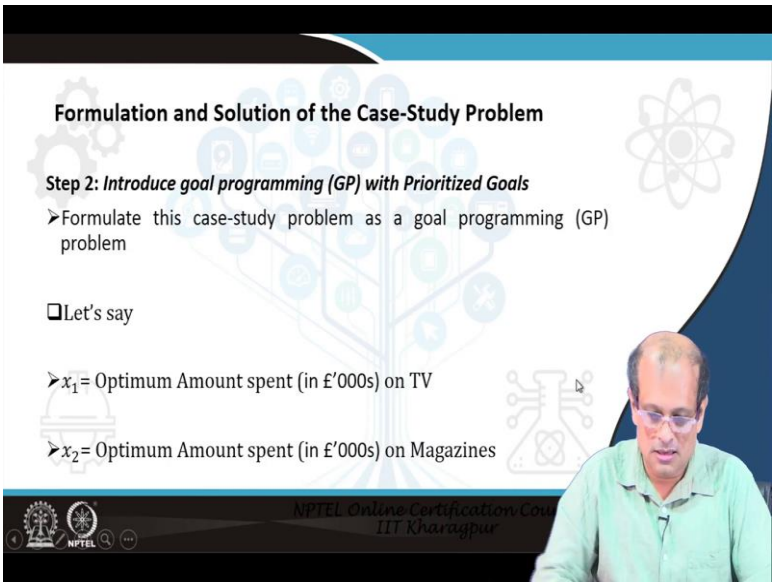

Now, we are moving on and we formulate this as a goal programming problem. So, again the same variable definitions which we used in the previous class; x 1 was the optimum amount spent in 1000s on TV and x 2 was the optimum amount spent on the magazines. This is the same definition we did in the last class also.

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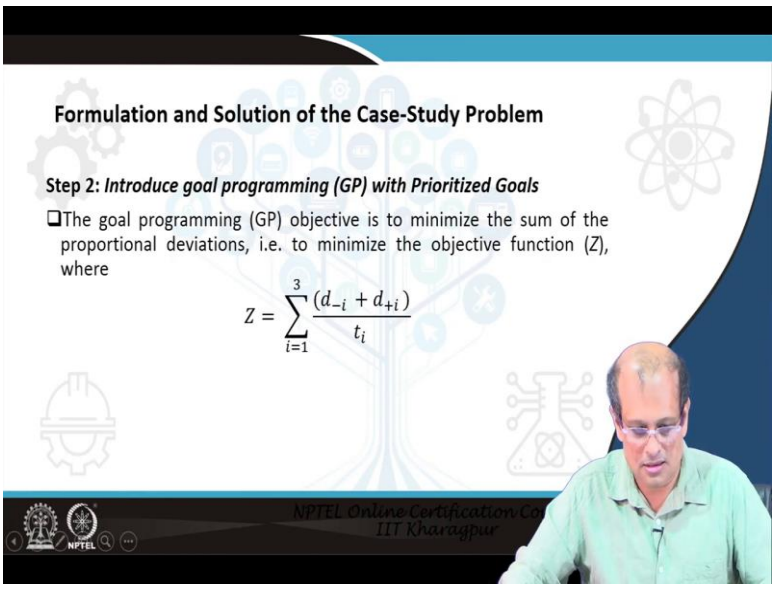

Now, we are introducing the goal programming with the prioritized goals. So, in goal programming, the objective is to minimize the sum of proportional deviations; that is we are minimizing the objective function, d minus i plus d plus i and i goes from 1 to 3

divide by the target. So, because we are dividing it by the target hence, we are calling it as proportional deviations.

So, the proportional deviations for the first set, second set, third set, divided by the target and we sum it across for all the sets right. So, this is what we do. So, it is d minus 1 plus d plus 1 divided by t 1 one part. Then, d minus 2 plus d plus 2 divided by t 2 and then d minus 3 plus d plus 3 divided by d 3. So, i goes from 1 to 3 in a summer in a summation.

So, this is what we are trying to do. So, and we are minimizing the sum of the proportional deviation. So, I think statement matches with the mathematical representation.

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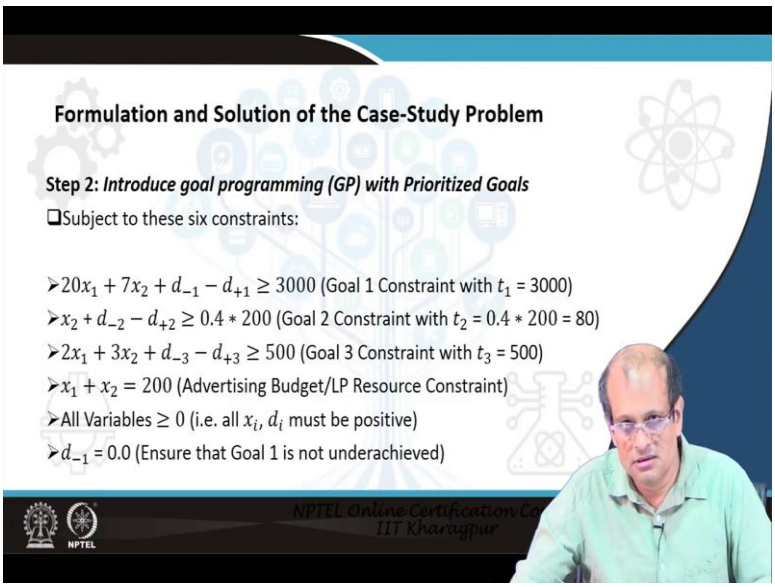

So, now, we look at the constraints which we are defining now in this changed scenario, where we are accepting the deviations. In the change scenario, the constraints look like this, 20x 1 plus 7x 2; this was already there in the previous case, but now we are introducing d minus 1 plus d minus d plus 1.

So, the two deviations are taken into account and this is greater than equal to 3000; so, constrained with t 1 equal to 3000. So, the goal 1 constraint with t 1 is 3000. Similarly, x 2 plus d minus 2 plus d plus 2; we have introduced a deviation here, is greater than 0.4 multiplied by 200. Again, we have a goal 2 constraint with t 2 equal to 0.4 into 200 is 80.

So, this is taken as a goal 2 constraint. Similarly, for the goal 3 constraint we have 2x 1 plus 3x 2, but again we have the deviations introduced in this problem, d minus 3 minus d plus 3 is greater than 500 and goal 3 constraint with the t 3 is 500. So, we have the three constraints defined. All of them accept the deviations, d plus i d minus i are introduced in this. Then we have, an LP resource constraint that is the advertisement budget constraint and that is x 1 plus x 2 is equal to 200. That was there in the previous one also.

So, the newness is in the, deviations which we have introduced, in the all the three goals. Then we have all the variables are greater than 0 that is, all x i and d i must be positive. So, variables cannot be less than 0; so, they are equal to or greater than 0. Now the last one is d minus 1 is equal to 0, this ensures that goal 1 is not underachieved. So, goal 1 d minus 1 is equal to 0; that means, in this case this deviation has to be 0, because this will ensure that there is no underachievement.

If you remember the case which we had stated, at least a particular number had to be reached. So, the deviation d minus 1 cannot then be underachieved. This d minus 1 equal to 0 is honouring that statement of constraint. So, we have now nicely written down the optimization problem in terms of a goal programming problem, moving on. So, again we take, took this and used a spreadsheet model and this is shown in the figure.

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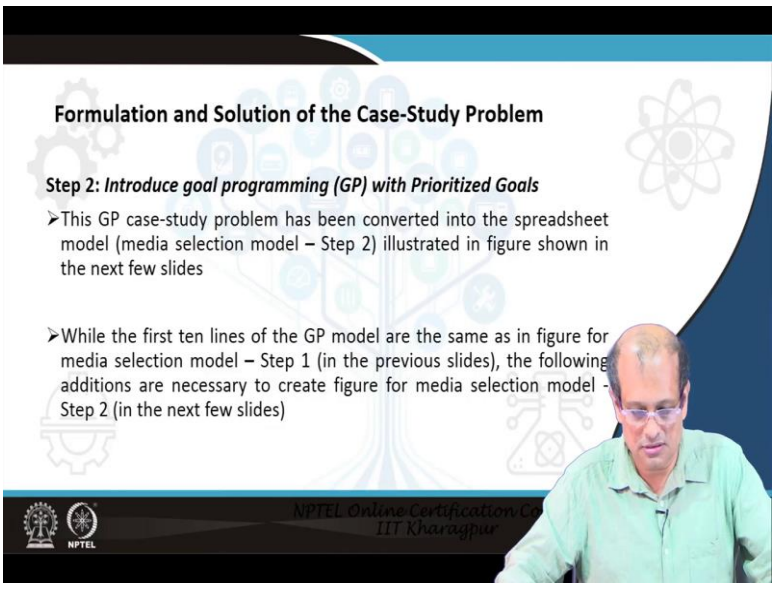

So, the initial lines of the GP are same as the step 1 and some additions we have done so, as to create the steps 2. So, we have just introduced that d minus 1 and d plus 1 d minus 2 d plus 2 d minus 3 d plus 3. This is introduced in the model. And, let us have a look at it.

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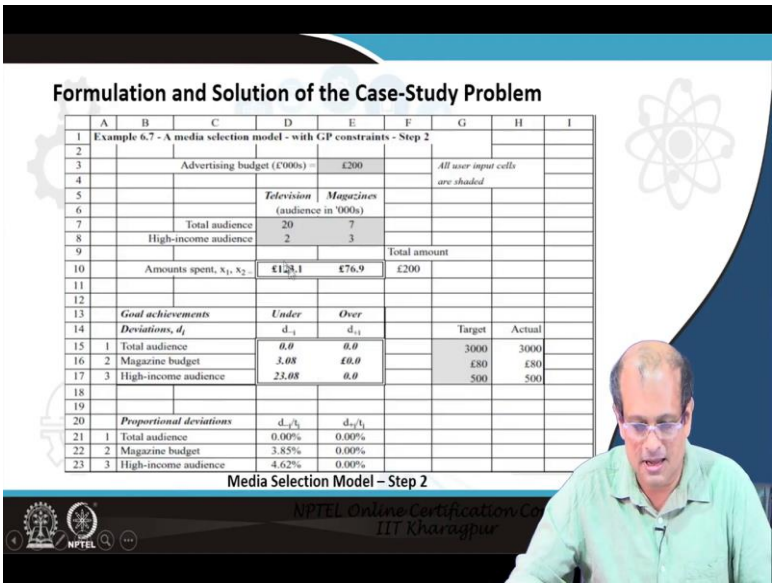

So, again as it was previously, the grey areas the input areas which are grey are all my user feed in data. So, we have the advertisement budget, we have the same 2 cross 2 matrix in which, the total audience is broken up into target and magazines and high income audiences also broken up into target and magazines, fine. So, similarly we have the target set here, fine. The change here is in the deviations, goal achievements under and over. So, d minus 1 and d plus 1 are there.

So, we can see that the total audience, the deviations are 0 0. In the magazine budget, we have d minus 1 and high income audience 23.08. So, the d minus i is what is given here, in each of the three deviations for the constraints. And thereby, we have also defined the proportional deviations moving on.

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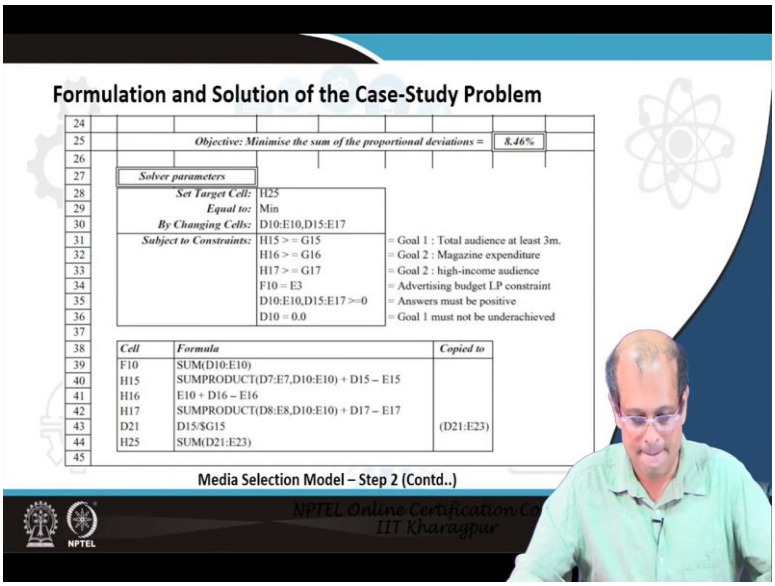

So, now the solver parameters are again, the target cell is H 25 and again in this case, the minimization is done remember. If we go back to the, goal programming objective was to minimize the sum of the proportional deviation. So, this becomes a minimization problem, the deviations are minimized, the sum of the proportional deviations are minimized; right.

So, and these are the changing cells which are given there. So, the constraints the first constraint H15 to G15 is the total audience of at least 3m. Then, the second is the second row is the magazine expenditure that is, the goal 2 then this is goal 3 the high income audience, this is 3. Then advertisement budget, LP constraint, then all the answers have to be positive and the last one is goal 1 must not be under achieved; fine.

So, the formula are then written on the cells and the results are copied to D21 to E23. Well so, this is pretty simple; we have been able to put this in a excel solver and solve it. We will move on.

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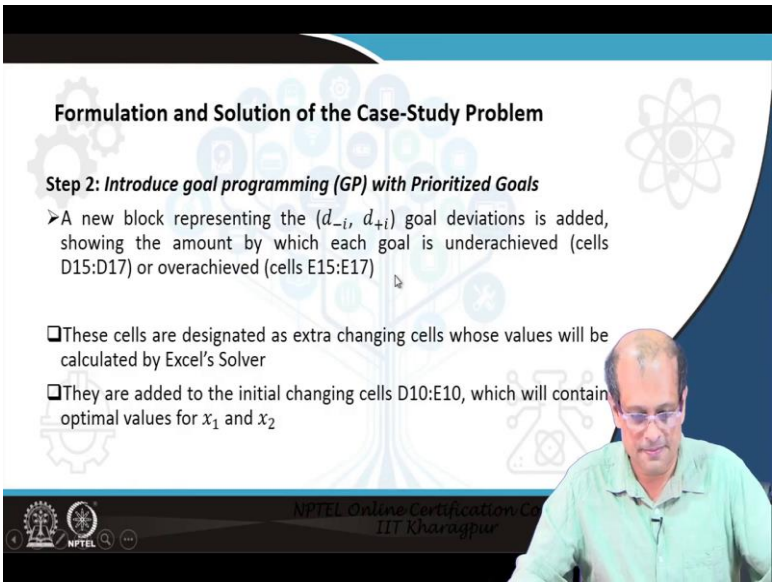

So, this is a newness we introduced. I will just talk about it once more. So, we introduced a new block and representing the d minus 1 and d plus 1 goal deviations. And this shows the amount by which the goal is underachieved, that is, cells D15 to D17 and the ones which are over achieved, that is the cells E15 to E17.

Now, these cells are they are designated, we are calling them as extra changing cells, whose values will be calculated by the excel solver. So, they are added to the initial changing cells, D10 to E10 which will contain the optimal values for x 1 and x 2. So, these steps are followed and then the extra changing cells are added to the initial changing cells. And, they will they contain the optimal values for x 1 and x 2.

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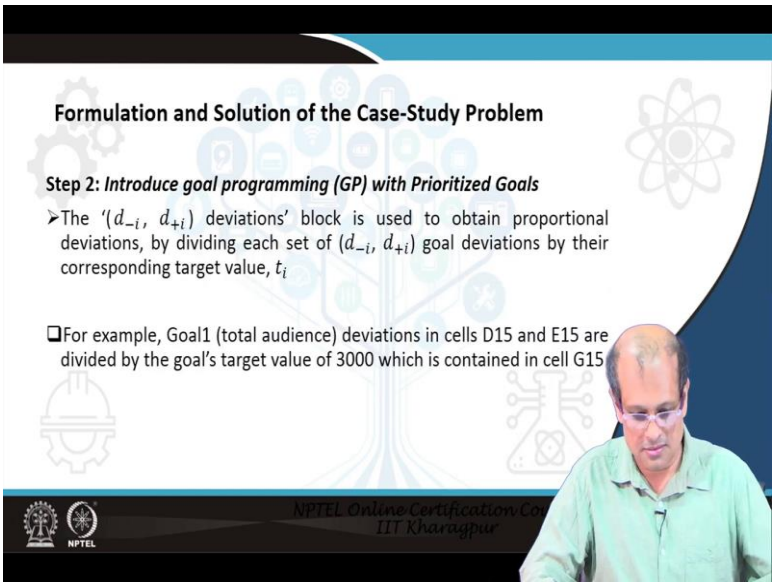

Then the d minus i and d plus i deviations block, that is used to obtain the proportional deviations, you saw that. I will show you once more. This is a proportional deviations in the excel sheet. And this is done by dividing each set d plus i d minus i goal divisions by their target value, their corresponding target value t sub i; right.

So, an example is been taught and that is the goal 1 total audience deviations, in the cells D15 and E15. They are divided by the goals target value of 3000, which is contained and given in the cell G15; fine; ok.

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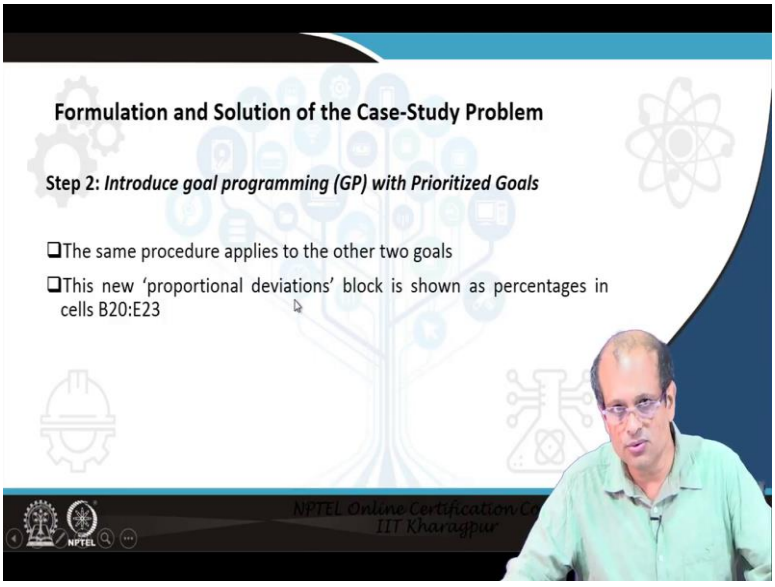

So, we have done that, let us move on. So, the other two goals also have the same procedure. We take the deviations. We then it talks about the amount by which the goal is under achieved or over achieved. Then these are called as extra changing cells. They are added to the initial changing cells, which actually contain the values of x 1 x 2.

Then again, the divisions are used proportion then converted to proportional deviations. The same thing is done for goal 2 and goal 3. So, the proportional divisions block is shown below, I showed you there, below in the excel sheet is shown as percentages in the cells, B20 to E23 fine; now, moving on.

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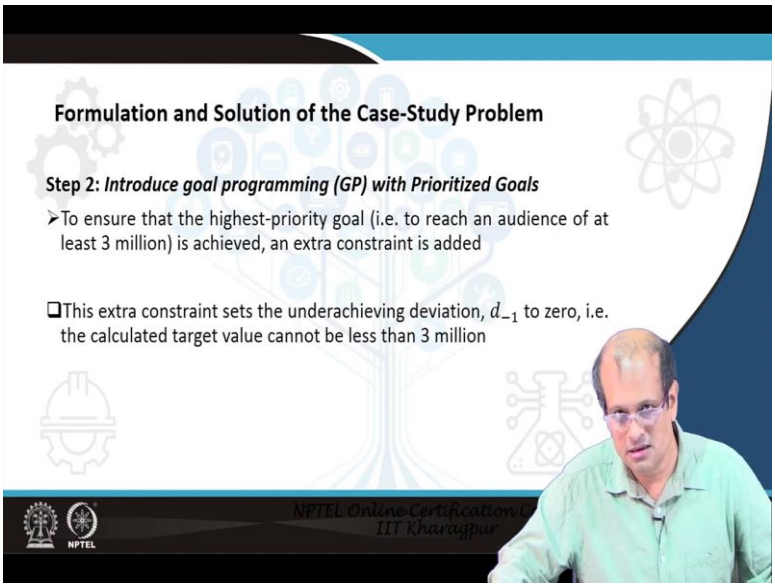

Now the highest priority goal in our case was, this is something which we had to honour; we could have not compromised it. That to reach an audience of at least 3 million, we added an extra constraint; this extra constraint, we talked of earlier also, was achieved because the underachieving deviation d minus 1 in this case is set to zero.

So, the calculated target value could not be less than 3 million. This is how we operationalized the constraint, which could have not had a deviation in the downside since. So, we had to ensure that, the calculated target value could not be less than 3 million. So, we created the d minus 1 deviation downside deviation and put it to zero, we included this as a constraint.

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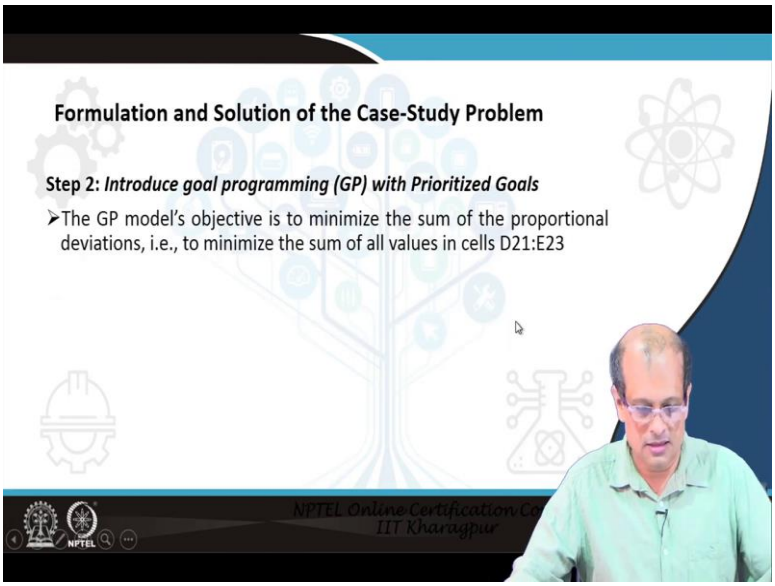

So, we had that extra constraint in our work, fine. So, overall the goal programming, the objective is to minimize the sum of the proportional deviations, that is, to minimize the sum of the values in the sense D21 to E23.

So, this is how we had formulated the problem, if you remember. We said that, the proportional deviations sum, proportional deviations sum not deviation sums divided by the target every time would be minimized.

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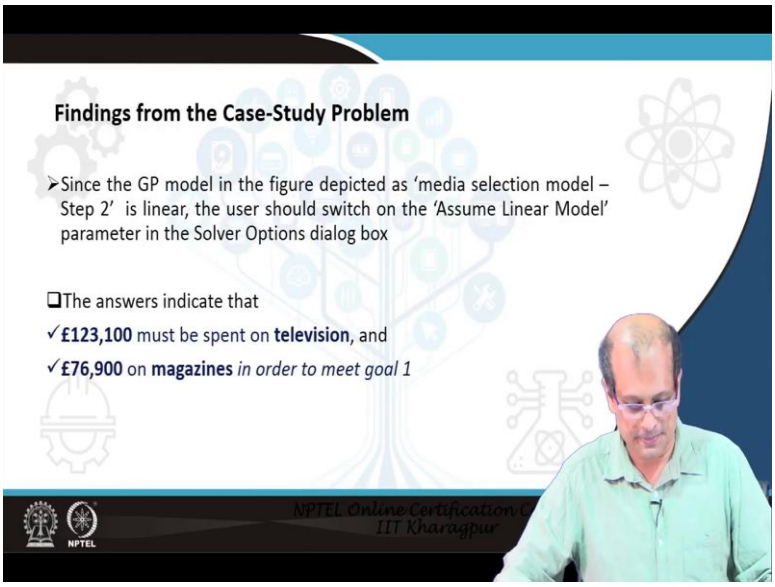

So, in this case we have taken the GP model, as a media selection model, that is the context in which we are handling this work. It is a linear problem. So, once we use it, we should switch on the 'Assume Linear Model' parameter in the Solver Options dialog box.

The answer which we get in this case, tells us that, dollar 100; this pound 123,100 must be spend on television and pound 76,900 on magazines in order to meet goal number 1; right.

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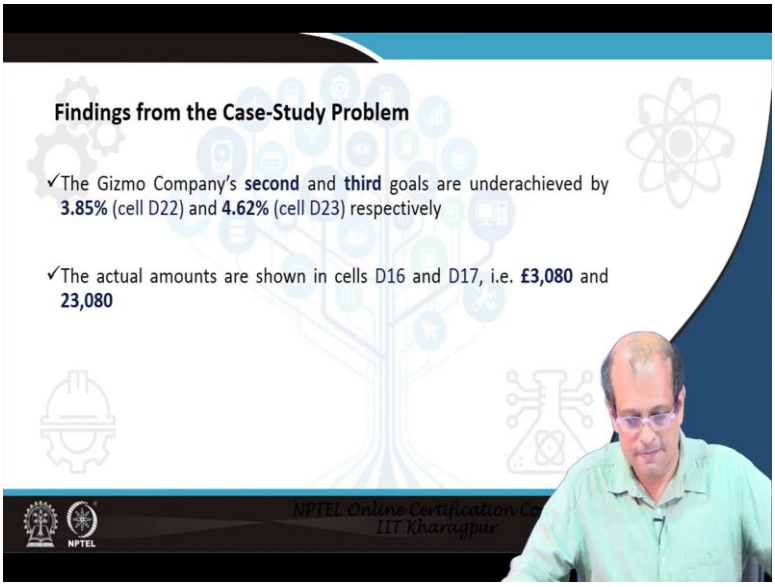

So, moving on; so, it also points out that the, the company's second and third goals they are underachieved and they are underachieved by 3.85 percent, which is given in cell D22 and 4.62 percent, which is given in cell D23. And the actual amounts; are given in cells D16 and D17, that is, pound 3,080 and 23,080 right. So, we have been able to get the data for the first, second and the third goal.

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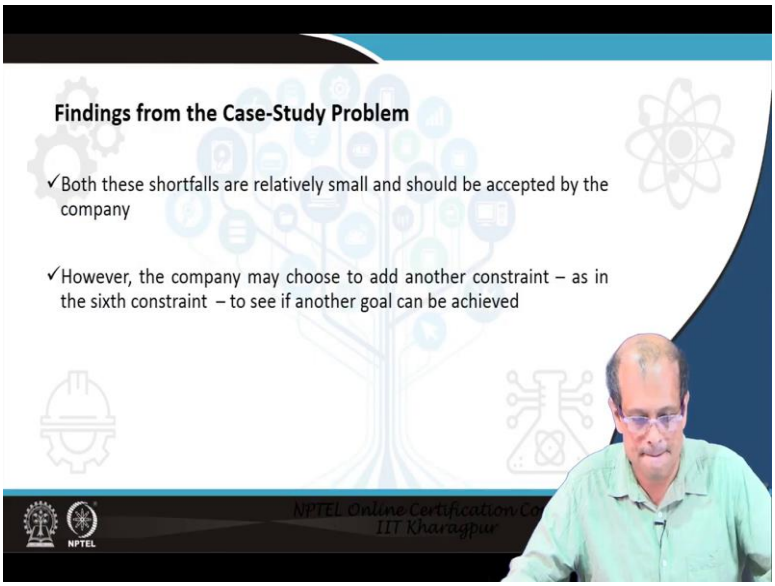

So, these shortfalls, we can see are relatively small and maybe accepted, this is a managerial decision may be accepted by the company. And if the company wants, it can add another constraint. So, more constraints can be added to this model right and we added the six constraints. So, we can add more constraints and we can see if another goal can be achieved. So, we can keep on adding constraints and we can adding we can keep on adding goals to this problem.

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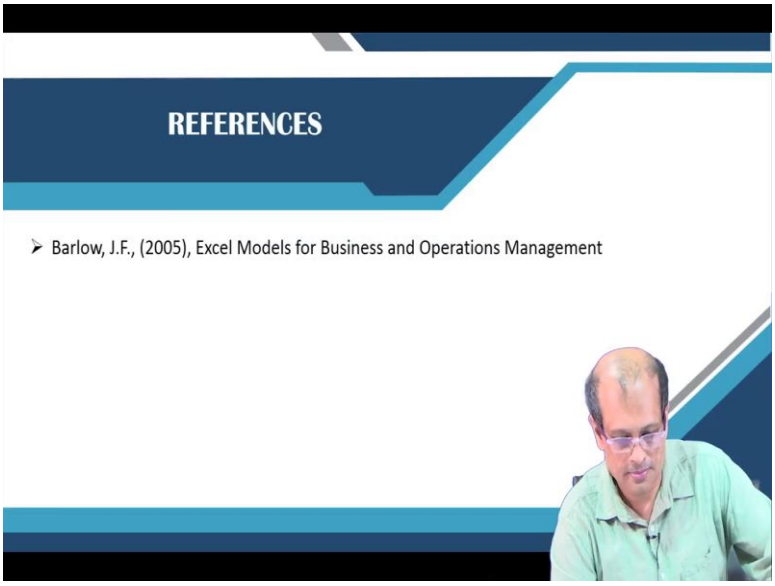

And, this work has been taken, continuing from the Excel Models for Business and Operations Management by J. F. Barlow 2005 edition. So, I will review this once quickly. I will start with the newness which we brought in this, over and above the previous case. The newness was that we were admitting deviations and the optimization problem was created using proportional deviations.

So, that is a newness which we brought in our work. So, and we wanted to minimize this proportional deviations, in terms of the sum of each of the goals proportional deviations. So, for the goal 1, it would be d plus 1 and plus d d minus 1 plus d plus 1 divided by t 1. Then, d plus minus 2 plus d plus 2 divided by t 2. Then, d plus minus 3 plus d plus 3 divided by t 3. So, these are the some of the proportional deviations which we had and we will try to minimize that, which means that we have defined d minus i and d plus i in the formulation.

And each of the goals, has been has had a d minus 1 and d plus 1 plus 1 for the first goal, d minus 2 and d plus 2 in the second goal and d minus 3 and d plus 3 in the third goal. And this is what is the newness with the goal programming mechanism really brings out which means that, I could have tried to bring in more goals and could have seen if, other goals could also be achieved. So, I can keep on adding more goals one by one to this problem.

The other thing is that, this problem which we solved was a linear problem. Then we also had another constraint, which is that the goal 1 could not be underachieved. So, because the goal 1 could not be underachieved, we defined d minus 1 equal to 0. So, this case study is a nice case study, because it deals with the idea that one of the goals cannot be underachieved. Also, it talks about multiple goals parallelly being met, in which one of the goals cannot be underachieved; right.

So, we as I said, we converted this into a spreadsheet model. And then, this is the newness again, this block is the new thing which comes in and proportional deviations is something again which comes in, fine. So, the grey areas are the user input cells and the formula I discussed, fine. So, we had this the third goal actually, 3 is the goal 3; so, third goal; so, all the three goals; right.

So, certain things I will talk about, before I close the class. I can talk in terms of the prioritization of goals in this case. So, every time I prioritize a goal, in a goal

programming model, I will be able to have an extra constraint which I can add. So, I can say there is no downside; like in this case I said d minus i to 0. So, I can also have an upside constraint in some case, some other goal. So, if I believe that there is a goal, which cannot be compromised, I can always add an extra constraint and handle this in a goal programming problem.

So, in this case as in, d minus 1 was set to zero, fine then ok. Then, we were able to get the answer, with a constraint on the minimum number of customers to be reached and the other goals being approximately being achieved and we got the spend on TV and the spend on the magazines. So, the first goal is the answer x 1 x 2 which we wanted. Then the second and third goals were underachieved, but we were able to live happily with it. Because we believe this is a very small deviation is 3.85 percent and 4.62 percent; fine.

But the first goal which was non-compromisable goal, in terms of the reach ability of the whole media campaign is achieved. So, we have achieved the objective, right. So, the other thing which we would like to talk about is that, another constraint can be added. We can keep on adding more goals in the goal programming problem and we can always try and see if more goals can be achieved. So, what are the other things you know we can do?

In this case this is a linear programming problem; because all the equations we wrote here, as you would see are L, this is an LP part, but in more advanced cases, we can move beyond linearity also. So, other directions in which this can go is, we can introduce some order in terms of prioritization, in terms of first prioritization if achieved, then we move to the second prioritization if achieved, then we can move to the third prioritization if achieved, then we can move to the fourth prioritization if achieved.

So, we can write a complex problem and we can have multiple prioritizations in multiple orders. And that can easily be handled by the goal programming problem; fine. So, we; this is the first two lectures on the case study which we did and which talked about a media selection problem. And we will move on in this course, with more decision support models on marketing; fine. And the assignments and the questions will be given.

Thank you very much!