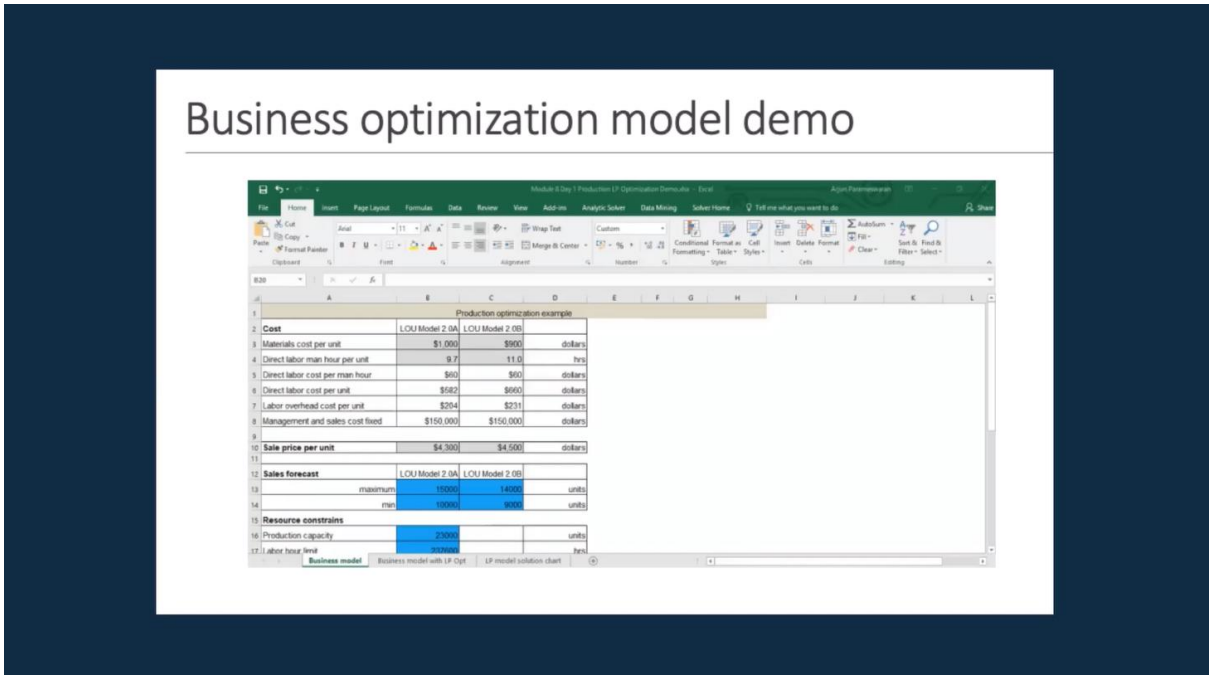
M7L2b. Linear Optimization

Slide #1

Slide #2



The video clip demonstrates the business model with Microsoft Excel. Production Optimization Example.

In this session, we will take a look at the optimization problem that is provided to you in the presentation and try to find an optimum solution for the problem.

So let us go through the problem.

Company XYZ makes laser optic units for OCT machines.

The company produces two recent models. LOU2.0A and LOU2.0B in its Houston plant.

The plant has a production capacity of making 23,000 LOU units per year.

There are 220 skillful employees working at the plant to make both products.

The marketing and sales unit projects the market demands on both units, and this projected demand is given to us.

In this problem, the decision that we need to estimate is how many units of model A and how many units of model B do we need to produce so that the plant achieves a maximum profit.

Now, let us look at the data that is provided to us.

So we have the material cost per unit for Model A and Model B in dollars.

That is, the cost of materials for producing one unit of Model A is $1,000 and it's $900 for Model B.

We know how many hours of labor it needs to produce one unit of Model A and one unit of Model B.

That is, in this case, it takes 9.7 man hours of labor to produce 1 unit of Model A and 11 hours for 1 unit of Model B.

We also know the cost per man hour of labor.

It is a constant value that is $60 per hour.

So we can calculate what is the direct labor cost per unit of model A and model B by simply multiplying the labor hours per unit and the cost per hour of labor.

That's how we reach these two values here. It is basically multiplication of these two cells. Similarly for A.

So in this example, the labor overhead cost, which is over and below the direct labor cost, is assumed to be 35% of the direct labor cost per unit, so that's what we do.

We multiply this B7 by 0.35, that is, get a 35% of this. And this is the labor overhead cost. So all these costs are calculated per unit of the model.

Now the management and sales cost is a fixed cost fixed at $150,000 for model A as well as model B.

This is irrespective of how many units of each model you produce.

Even if you produce zero models, you will still have to pay 150,000.

You will still incur a cost of 150,000 for each model.

The sales price per unit of each model is 150,000.

Model A sells for $4,300 and Model B sells for $4,500.

We have been provided with the sales forecast for both these models.

So we know the maximum and minimum expected demand.

That is, for model A, the maximum demand would be 15,000 units, and minimum would be 10,000 units.

For model B, it would be 14,000 units maximum, and minimum would be 9,000 units.

This means that we need to keep our production within these two values.

That is the range of our production.

The number of units we produced should be more than 10,000 and less than 15,000.

So the number of units produced should be within these two values.

We have certain constraints in the problem.

The first constraint is the production capacity as mentioned in the problem statement.

The plant capacity is 23,000 units per year. So the plant is physically capable of producing only 23,000 units.

You cannot produce more than that, and we have a limitation on the hours of labor available, which is again given to us.

So, considering all these constraints and parameters, we need to solve this problem to obtain the optimum number of units to be produced such that the plant achieves maximum profit.

So, we need to set up our model and enter data accordingly into the analytics solver.

Before doing that, let us go through the color coding of the model.

We will be following this color coding for all our models.

So the cell in violet, or say purple, this is the objective function.

This is the function that we are interested in and we need to optimize this.

The cells in green are the variables for which we need to find out the values, such that the objective function is satisfied.

The cells in orange are the business outcomes of our decision, and the cells in blue are the constraints that our decision outcomes must satisfy.

So please make a note of this color coding, as all other models in this course will follow the same color coding.

Now, let us take a look at how the model is set up.

Here, we have the two green cells, which I said is the variables that we need to find the value of.

It is currently blank because we don't know the optimum values.

So let me enter sample values just to understand how the formulas are set up in Excel.

Let's say I produce 10,000 units of model A and 15,000 units of model B. These are just random values. This does not mean the problem is solved.

I simply entered random values to explain how the model is set up.

Let us assume that I am producing 10,000 units of model A.

We have calculated revenue by just multiplying the number of units produced, the sales price that is given to us, that is 4,300 into 10,000 gives us this value.

So, this is just a direct multiplication. Let us look at the costs involved. Material cost per unit is given to us. This is simply a product of the number of units made and the material cost per unit. Similar calculation is done for B as well.

Direct labor man hour. We need to know how many hours of labor we need to produce 10,000 units. This is a product of the number of units and the number of hours per unit.

So we know how many hours of labor we need to produce this many units. In this case, 10,000. And what is the cost? The cost is obtained by multiplying the number of units and the direct labor cost per unit. It's a simple multiplication.

Similarly, the same thing is done for Model B as well. And labor overhead cost, again, it is the product of the number of units and overhead cost per unit.

As mentioned earlier, management and sales cost is a fixed cost and is $150,000 for each model, irrespective of the number of units you produce.

It is just a reference to the cell above that says 150,000.

We have our revenue and we have the cost. This is the total cost. This is a sum of material cost, direct labor cost, labor overhead cost, and management and sales cost.

Now that we have our total cost, we can calculate the total profit, which is a difference of revenue and total cost.

Similar formulas are applied for Model B as well.

This is our total profit, which is a sum of profits incurred from model A and model B, and our objective is to maximize this value.