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SPEAKERS

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Take a moment to read the question in front of you carefully. You can see that we have two functions, two equations. The first is a revenue function, and it's going to tell us how much revenue the company earns, the more output it produces. Notice that it's a linear expression. So each additional unit of output produces two units of revenue. The second expression is a cost function, the cost function we have here is not linear, it's Q squared. It's got this parameter in front of it, that's going to keep it, make it smaller than it would be than if it's just q squared. But notice that with Q squared, the rate of increase is not constant. It's actually increasing. Now we're going to talk a lot more about the properties of increasing and decreasing functions when we get into the calculus component of the course. And we're going to learn how to use calculus to solve a problem like this by hand. But since we're not at that point in the course, why don't we solve this problem using Excel? We can solve, we can solve it with Excel by graphing these two expressions, and then looking at them to figure out well, where is profit maximized. So why don't we move over to Excel right now.

Here we are in Excel, you can see the equations that we're going to graph on the screen in front of you. Once again, I'm using Excel, hopefully, you're able to follow along and use Excel yourself. If you can't use Excel, because you don't have access to a computer, you can use Google Spreadsheets. And there are other free programs that are very similar to Excel. And if you don't have access to a computer, you're just watching the video, I hope that you'll find some time to try and follow along with these steps yourself later. Now as we get started, I always want to make sure that you can see clearly what I'm writing. So I might want to change the text, or the font size, I should say of all the texts on the screen. So if you look at my cursor. Now I'm moving my cursor over to near where the A1 cell is, there's this little shaded triangle. If I click on that, it will highlight all the cells. There's also a shortcut Ctrl A, that would, might do the same thing. It'll highlight all the cells. If I click on Home, here, we've got the text size, it's right now the font size, or I should say the font or the text size is at 11. So why don't we turn that up to 14. And so that should make things a little bit larger, and it looks like things are larger. Now like we always do, we want to start off with the X axis, our X axis is going to be the quantity Q and the Y axis.

We're going to have to series there's two functions we want to graph. And so we're going to have Y axis one and Y axis two. And although we've got two functions, we're gonna have revenue and cost.

Both of them are in units of dollars or units of currency, typically, so although one is revenue, one is cost, they're actually denominated in the same unit, so we can easily put them on a graph together. Now for the X axis, let's start with zero. We'll start with the origin, and let's just add one. So instead of, I could say in this cell zero, let this be the previous cell plus one like that. Excel is pretty good at figuring out what the next cell should be. So I'm going to highlight zero and one. And then I'm going to click on this little box, this little square in the bottom right corner of the cell E4. And as I pull it down, it's going to populate the cells according to what Excel thinks I want, so it likes the interval one, that's a good default for Excel. So we can just populate the cells that way.

Now we're ready to input the first function, first equation, so it's going to be equal to the quantity multiplied by two. Or if I want to write this exactly the way the equation is, two times the quantity, like so. So you can see that up here is where the function is, where we can edit the function. And as long as I input the function properly, I can just drag this box down and it will automatically update the rows. For me, now we've got a curve here, we've got an increasing function, a square function, so I'm going to press the equal sign, well first I'm clicking on cell G3, I hit the equal sign. And I'm going to type in 0.01. That's the parameter or the coefficient in front of the Q squared. I'm going to hit the, in my keyboard it's shift eight, first star, that's the multiply key. And I'm going to select the quantity on the X axis, which at this cell should be zero. And now we've got E3, that's the cell with a zero in it, and I want a square. So I'm going to use a circumflex on my keyboard, that's shift six, this little circumflex, that tells the computer, tells Excel that we want to raise E3 to the exponent two to the power two.

Now, if I've added it in correctly, I'm going, I can populate the cell and just pull down like so. And we can see that we've got these decimal places. If I want to create uniformity, maybe I want to change the format. So I'll right click on these highlighted cells, and I'll go to format cells. And I'll pick number and two decimal places seems, seems sufficient. And now there's a uniformity instead of just the four, we've got 4.00 down at the bottom. Now the way we've done it, so far, we've got revenue is equal to 40. And we've got a total cost of just \$4. Now when you start going further south, you start adding more and more rows, you lose the title. So if we want to keep the title here, I'm not sure we're going to be able to keep this formula, the way that I want it. But if I highlight the third row. Now let's see if we can make this work. So again, I'm going to click this three in the rows over here, that's going to highlight the entire row for me. And I'm going to click on View. And I'm going to go to freeze panes. And I'm going to select Freeze Panes. And it's going to keep, or it should keep the top two rows, in my view, even if I scroll very far down and start adding more rows. So let's click on that. And notice there's this solid line between the second and third row. Now as I scroll down, we're keeping the titles, the titles are still there, we still got our Q, our revenue and our cost. And remember last time, if I wanted to, we could even centre these, like so. It depends, I like looking at centred, you don't have to. Notice we kind of lost the, we kind of lost the equation there, but that's okay.

Now, if we look here, we've got revenue as \$40, and cost is \$4. I think maybe we want to keep adding Q in case, I'm not sure if we've maximized our profit yet. So let's highlight B23 to G23. And let's just keep going and maybe we'll go and add some more down there. Oh, we still, I'm going to keep going. Now let's highlight all the cells that we've created, including the names of our series. So we want our Q and our revenue and our cost. Once we've got them highlighted, we just go up to the top bar and click on Insert. And we want to find the scatterplot since we've got a series of ordered pairs. So let's click on that. Now we've got a diagram here. And we've got a diagram of revenue and cost. Now how

do we know where profit is maximized? Now profit is maximized here based on the distance between revenue and cost. The greater the difference between revenue and cost, the more profit you make. And when that distance is maximized, it is as big as possible, you've made the most profit possible. And looking at the diagram here, this seems to occur when the number of units produced is 100. So the distance from here to here is 100 units, 200 minus 100. And if we go further, it seems like it's getting smaller, but it's kind of hard to tell.

It's kind of hard to tell. So let's go back to the data that we've, we've created. And why don't we add in a profit column. And the profit column is just going to be revenue minus cost, like so. And maybe we'll change the format. And we'll get rid of, well, let's have one decimal place. And then we can populate all these cells with the formula we created. And we can just look at it, we could create a, we could have an Excel command if I wanted. So if I go down here, if I create equals the max command from, and I'm going to type this out, H3, that cell H3 to H153. Excel is going to bring out the maximum value for me. And so the maximum profit is 100. That's the, that's the most profit we can make. Notice here, it's only 75, where my cursor is, if I move up. We have a few candidates for 100. So why don't we add more decimal places here and make sure that we get the absolute highest profit. We don't want to leave even a penny on the table. And if I add more decimal places, you can see that profit is maximized when quantity is equal to 100. That means revenue is going to be 200, the cost is going to be 100. The profit is going to be 100.

Now, why don't we, why don't we go ahead and graph the profit function. So we could do something like this, let's highlight each cell, let's get rid of some of these decimal places, which we don't really need anymore. And I'm going to go right back to the top of the graph. I'll delete this chart for now. And we can do a few things. What I'll do is I'll highlight all four of the columns. So we'll have revenue cost and profit on one, one graph, ignoring that last cell, that was the maximum that was Excel trying to find us the maximum profit. Now I'll go to Insert scatterplot. And we want to scatter with smooth lines. I'm going to go back up to the top of my graph. And so you can see now there's this gray line here that represents profit. But what I could do is this, I'm moving the chart over to the right, let's make sure it's at the top. And we'll get rid of the chart title. And why don't we get rid of revenue and cost and apply.

So there we have only the profit. And you can see a little more clearly now, that profit is going to be maximized when quantity is equal to 100. Because we have of course, you can think of profit on the Y axis. So let me add in some axes titles. Over here, we're going to have profit. If I'm just going to show the profit here, I don't need a legend, I can just delete the legend. All I did is highlight it and press the Delete button. So it's gone. The axis title is going to be quantity. So we've got quantity produced down here. And we've got the profit there. I don't really like having it written vertically like that. It gives me a bit of a headache. So I'll move it accordingly. And now we've got a very nice graph showing us very clearly where profits going to be maximized, which is quantity is equal to 100. And if I wanted to, we could change the type of graph, I seem to like this one. And we can make all sorts of different changes to the graph and make it prettier if we want to.

For example, remember last time, go to Home. Remember, make sure that you've got the graph selected, so that these little six white circles tell us that it's been selected, click on Home, click on the font size. And we can make things a little bit bigger and a little easier to see, oh, we've got some

white space over here. Got some white space over here or black space, this case may be, right click on the graph itself in the middle of the graph, see this plot area option comes up. Let's change that to the horizontal value axis. And then over on this right hand side where these bars are, gives us the axis options, axis options again, and we could say that let's let the maximum be 150. If we wanted to, we could change the major units. So we add in more options down below. And we can close this. Move the graph up there if we wanted. Didn't like that. And we can make this thing bigger, like so, as big as we want. We can save, it we can copy and paste it into a Word document. And you can see the solution that we came up with graphically.