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SPEAKERS

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Hello, and welcome to our video on compositions of functions. In this video, we're going to solve these functions that you can see on the screen in front of you. We've got our revenue function, we've got an hours worked function, and then the bottom function there is combining the two into one function, which we did in a previous video. Now, I'm going to assume that you have not seen any of our other Excel videos, or this is your first one with me anyway. And so we're going to plug in some values to these placeholders. And then we're going to figure out which combination of values maximizes government revenue. As we go, I'm going to teach you some of the commands on Excel. So if you're ready, keep watching and we'll get started.

Now, if you're new to working with Excel, or maybe you're working with Google Spreadsheets, looking at the screen in front of me, you can see that we've got columns and the columns are denominated by alphabetic letters. So we've got column E, column G, column I. If I click on the letter corresponding to the column, I highlight the entire column itself and it becomes active. Similarly, we have rows, and the rows are numeric. One up to a very large number, if I click on eleven, I can highlight the entire row. Now as we get started, I'm going to keep these equations here just so you can kind of remember what we're trying to solve for and what we're working through. But on your version of Excel, or you could be used Google Spreadsheets, or many other free spreadsheet programs available out there. You don't need those equations, it's sufficient to have them on the screen, as long as you remember what those equations are.

Now, before we go much further, I want to make sure that I don't hurt my eyes. So I'm going to highlight the cells that we're going to be working with. And I think we'll go, how about columns E to L. Now I'm going to click on this Home button up here, you might already see some of these commands, and I want to change the text size to 14, I think that'll make it easier for you to see. Or maybe actually we'll go all the way to 16. And I want to also center it. So I'm going to click this button right here. So that all the numbers I put in our center, because I think generally that looks nicer than having them aligned in a different way. Now, maybe we want to remind ourselves what we're working on. So we're going to have, I can click on this cell E one, and I can type text into it. So I'm going to type in a simple model of the Laffer curve. And you notice that it looks kind of funny. So it's centered, so it's spilling out to the left and these other cells, there's nothing in those cells. So one thing I could

do is I can highlight all the way over to here, I'm going to highlight E one all the way to L one. And then I'm going to click the home button again. And I'm going to click this little button here, merge and center. And if I click that button, and I go back, you can see that they've all these cells have been merged into one, I've got kind of a nice title to work with. And if I hit Ctrl B, I could even Ctrl B and make it bold. Or I could go to Home, click the Bold button that's right here.

Now I think we're ready to get started. You might want to name your columns. So why don't we start with F, I'll leave P blank so we don't get our numbers too close to these equations over here. Now we want to plug in numbers. So we can put text into an Excel cell, one of the cells, but we could also put in values we input in numbers. So let's start off we'll start, we know that we need H and the question, the original question told us that H was equal to 16. So in the cell F3, I'm going to put 16 here. And maybe I will highlight this F here, a few others this top row, and I will make them all bold. So we know that they are in fact titles. Now what else do we need? Well, the tax rate. So we've got the tax. That's our T variable. And we're not we're not giving any tax but we want to find out which tax is going to maximize this bottom expression right here, this G of T here. So we can just say, well, maybe we want the first tax to be zero. And we want the next tax to be 0.01. And you can see, we can just put a list of all the possible tax rates that we want to evaluate moving by whole percentages. So maybe we don't like the decimals here. So I'll go to, I'll highlight the entire column G, and I'm going to right click on where I've highlighted, I'm going to click formats, I'm going to go to number, might just have gone automatically to number for you. And I'm going to choose percentage with no decimal places. And you can see that we've got 0% and 1% or 0.01, that rate has become a percentage.

Now what other tax rates might we want to evaluate? Well, if I click on the cell G five, and I hit the equal sign, now one way I can populate this and say, well, I want you to take whatever is in the cell, G four, click on G four, you can type in G four if you wanted to. And I want to add 0.01. And now we've got our 2% tax rate. Now maybe we want to evaluate all the tax rates from zero to 100%. If I want to do that, I'm going to highlight the cell G five, I'm going to click on this little square down here in the bottom right, and I'm going to just drag it all the way down. Go down, down down, notice the row numbers changing in the left side of the screen. And I want to evaluate it all the way. I'm going to get rid of these, I'm going to highlight them, right click and click on Clear Contents, contents, Clear Contents, because of course, don't want to try and have a tax rate more than 100%. As the expression goes, you can't get blood from a stone. And so we want to evaluate all these tax rates from zero to 100% at 1% intervals. And we populated all these values in this G column. Now if I hit control up arrow, up arrow on my keyboard, I can take myself right back to the top where we started.

Now there's a few things we can do going forward. What else do we need we need? Well, maybe we want to just calculate one minus T. Now I'm going to hit the equal sign. And I want to calculate one minus the tax rate. Well, I'll press one minus, and then I'll just click on this cell G three, like so hit enter, and there one minus the tax rate is just equal to one or 100%. And now I can populate this column just like we did before, and there we've got one minus on the tax rate. Now if I hit control up arrow, I can get us back to the top here. Now you saw that we were scrolling down, and when we scroll down, we lost the title of our cells. So one thing we can do if we want to freeze these top two cells, so that we can always see them wherever we go on the Excel spreadsheet, what we're going to do is we're going to click on the third row, so press the three button right there. And we're going to go to View in the top menu here. And we're going to select Freeze Panes. And when I click Freeze Panes, I'm just going to click Freeze Panes. And Excel is going to know that I mean, I wanted to freeze the

top two. We don't want top row, we don't want the first column. We want to freeze the panes exactly where we are. So I click that. Now go back to the Excel spreadsheet, click on that. And if we click on one of the cells, and I'm pressing the down arrow, and down I go, you can see that we get to keep our titles. Lost a little bit of the functions there, but that's probably okay.

Now, what else do we need to solve this? Well, we can calculate things separately, so we could calculate H of T. And how are we going to do that? Well make sure you've got the cell I three highlighted, hit the equal sign, and then we're going to use this equation range here. So we want H, click on the H value 16, and cell three F three, and we're going to multiply that by our one minus T value right here. And if we then hit enter, we're going to get 16. Now we put in a equation, we've got it up here, F three cell F three times cell H three. And suppose we want to copy that and populate it all the way down for different tax rates. If I click on this little square in the bottom right of the cell and drag it down, oops, you see, something seems to have gone wrong, that's not the right value, it shouldn't be zero. For all these values, what went wrong? Well, when we populated the cell, it just, and if you click on this work tab, up here, you can see the cells that are active. And you can see that the cell F four and H four are active. But that's not exactly what we wanted, we wanted one minus the tax rate multiplied by H, not multiplied by zero, or a blank space that you can see right here. So one way to fix this is let's go back to our original formula, we've got the cells up here in the tool toolbar. And every time I copy and paste this formula, I don't want the third row to change. So I'm going to add a dollar sign, you see this dollar sign up here, really neat command, that's going to freeze the row exactly where it is. So I've added in this dollar sign right here, I'm going to hit Enter. I'm going to clear these all the way. I didn't necessarily have to, but I'll clear them away.

Now I'm going to copy and paste this cell. And you can see that it is now focused on the 16 H. So if I click on the command here, you can see we're properly multiplying 16 by one minus the tax rate. And if I click this cell here, and that little square in the bottom right corner, I can drag it all the way down to here. Now we have a value for our little H hours worked. Now returning to the top, you might ask yourself, well, couldn't I just have plugged in 16 down here and just copied and pasted all these cells down there? I could have. But there are often situations where we don't necessarily want to do that. And this is a neat way. Because now notice, look, I could change H, what if H was 24, I can change 24. Excel updates. Unless you've changed your options, Excel automatically updates changes the values of little H for us. But let's go back to 16 and keep it at 16 for now.

Now that we've calculated the hours worked, we can go ahead and calculate government revenue. So let me. This is hours worked. Now notice it doesn't look very nice when I do that. So what can we do to make this look prettier? Well, let's take a look at this column here the I column. I'm going to put my cursor over to the right of this column and I'm going to double left click, double left click will automatically resize the column so that it's easy to to read. In fact, I could highlight multiple columns and double click on them. Or double click to the right of the column I want to double click to the right, and it will resize it automatically based on what largest value is in that column. So it's, so this I column has been resized to fit hours worked without spreading outside into other cells. So things are looking a little bit prettier. Now what else do we need to calculate, we need to calculate government revenue. And that's going to be G of T. Again, I can take the J column. I don't even need to highlight it. I'm just gonna move my cursor to the left or sorry, excuse me to the right of the J. Double click and there it's been resized, so we can read the government revenue.

What's government revenue? Well, J three, I hit the equal sign so Excel knows I'm going to make it do a calculation. I want to take little H which is right here in the I column. And I'm going to multiply that by the tax rate T, which is in our G column. I hit Enter, no tax rate means no tax income for the government. So that's good. That looks all right. I can populate this column like we did before just selecting a little box dragging all the way down. Now something's happened. We've got like, you know, kind of a lot of these little fractions here, maybe we want it to look pretty. So let's go to right click on the cell click Format Cells, I'll click on the number, I don't know what it is, could or maybe we want it to be a currency. Let's go with a currency. Let's go with two decimal places. And let's hit OK. There. Now we've got some dollars to recognize that this is a revenue, and it's going to be measured in dollars or pounds or whatever your local currency might be. Now, it's kind of hard to see. Right? So we've got government revenue, you can see it's changing, and it depends on the tax rate. It also depends on hours worked. So how can we find the maximum? So how can we find the maximum amount of government revenue? Well, I'm going to use a command in Excel. So I'll hit equal sign here I'm on, I'm in cell J 104. But you can actually use any empty cell. And I'm going to notice that as I start typing in text, a bunch of commands start to appear. And the command that I'm interested in is max, I want Excel to find me the maximum value in the column J. And specifically, from J three, cell J three, all the way to J 103. And notice that I've added brackets, so we've got our command max, open parentheses. What area do we want Excel to look in for us? Well, we want it to look all the way from J three, down to J 103. And then close the parentheses. And when I hit Enter Excel tells me that the maximum value is $4.

So government revenue can be as high as $4, given the inputs that we put in, now, why is it so low? Why is it only $4? Well, you know, our very simple model here, we don't have a wage, we didn't put in a wage value. And we didn't tell how many workers there are in the economy. So that's why our number is small here, again, this this simple model, I want to keep it nice and simple for us, we can add in those extra things later, as a more detailed exercise. So what I could do now is just look through my column and look for four. There are those were bolded. So let's look through, see where we see four. Ah, so here are some $4. So we've got three tax rates that give us $4. Now, can we be sure that all of them is actually each of them is actually $4? Not so sure. I'm going to highlight these cells, I'm going to right click on them, and then go to format cells. And I'm going to increase the decimal places to five. And when I increase the decimal places to five, you can see that a tax rate of 50% right here. Tax rate of 50% maximizes government revenue. And maybe I want to write that out somewhere, say, tax rate 50% maximizes government revenue. And it looks kind of funny. Notice that it's, it's because it's centered, it's spilling out of the cell. There's a few things I can do. Some of them I showed you one simple thing would be just go to home and make it left aligned, or align left. And I'm going to click that button there. Now you can read it. And this is our answer to the problem.