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SPEAKERS

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Today we're going to talk about compositions of functions. So you know what a function is. And one thing that we can do with functions is we can add them, we can subtract them, we can combine them in a variety of ways. And a particularly useful way to combine functions is to plug one into another. And that's a way to combine them. So to demonstrate to you what I mean, when I say plug one function into another, I want us to return to an example that we looked at in an earlier video, or at least I explained to you in an earlier video. And that has to do with the Laffer curve. The Laffer curve comes from an economist by the name of Arthur Laffer. And his insight had to do with taxes and government revenue. It is a fallacy to think that an increase in the tax rates say an income tax is always going to increase government revenue. The reason for this is because the income tax rate may affect individual's choice of how much to work. So if the tax rate gets too high, this is going to cause a disincentive to work. And if that disincentive becomes too powerful, too strong, it's going to cause individuals to work less, they're going to earn less money. And there's going to be less of what we call a taxable base upon which taxes can build or we're going to have a decrease in taxable income if you're a student of accounting.

Now, let's carry forward and look at a very simple model of a Laffer curve to demonstrate this insight and to demonstrate how we can combine functions together. Now let's look at a simple Laffer curve. And when I say simple, I mean, it's a simple model, we could make it more complicated, and I might talk about more complicated features, we could add to it, but I wanted to make it as simple as possible. So it's as easy for you to follow as possible. Now, government income is going to depend on the tax rate. And it also depends on hours worked right here or this age variable. Now, as an economist or someone studying the social sciences, it would be a mistake to take that as given. So before Laffer a number of economists, would just take the hours worked as given, and they just looked at the tax rate and how change in the tax rate would affect government income. So Arthur Laffer comes along. He says, yes, government revenue, well, government income is going to depend on the tax rate. So we have $H \times T$, $H \times T$.

But Arthur Laffer says, well, there's a little bit more to the story. Hours worked, H , also depends on the tax rate T . So this H rate here is actually a function, or we could write it out as a function. And one

way we could do that is to say, Well, little H , hours worked, is going to depend on the tax rate. So if the tax rate goes up, hours worked will go down. And then maybe we can add in a positive parameter or a positive coefficient, H , which is just some positive real number. So those are the two functions. Now let's combine these two functions into one, one function or one expression. Here is our government revenue. And we've got our hours worked.

And we could just say, well, you know, H is going to be equal to H of T . That's implied. And so I, one thing that might be worth to say is that economists have referred to this as an implicit function. Maybe not mathematicians, but economists sometimes refer to that as an implicit function where H is not just a constant. H is actually a function, which gives us this thing down here. Now I can combine these together and write G of T is equal to H of T , T , which is going to give us H one minus the tax rate T multiplied by T .

Now, if we knew what the tax rate was, and if we knew what this constant parameter coefficient H was, we could actually calculate government revenue. Here's the expression again. As an exercise, let me demonstrate to you how we could solve this expression, this function, with a value for H in this case, the value is going to be 16. And we can go ahead and use Excel to find the tax rate that's going to maximize government revenue. And so we're going to end up trying a whole bunch of different tax rates. And then we're going to pick the one that gives us the highest government revenue. How are we going to do that? We're going to use a spreadsheet program like Excel.