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## SUMMARY KEYWORDS

cell, interest rate, bond, excel, bond prices, column, maturity, drag, chart, exponent, format, click, equal, highlight, price, notice, decimal places, face, increase, coupon bonds

## SPEAKERS

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Hello, everyone, welcome. We're going to look at Excel, and we're going to use Excel to measure bond prices. We're going to use that duration formula where we were using the derivative really a linear approximation. We're going to make some graphs with Excel, we're going to look at different maturities of bonds, we're going to look at different interest rates. And I'll show you how to do some interesting graphical analysis with Excel. Let's start off working with an example where we calculate bond prices. And then we're going to graph those bond prices on a diagram, where we have the interest rate, the market interest rate on the X axis and the bond price on the Y axis. Now, as we get started, I'm just going to format these cells. So I clicked on E holding the Shift button on my keyboard, I'm going to right click and choose Format Cells. And I'm going to choose font, and I'm going to let default be Calibri body that's fine with me. And how about a font size of 16? So we'll do that. Now we want to calculate bond prices. So what do we need for bond prices? Well, we need to have a face value. So what's the bond going to pay off in the future, and we're going to be using zero coupon bonds here. So they don't make any payments, intermediate payments, it looks like we're having some formatting issues with the height of the cell. So what I'm going to do is I'm going to highlight some cells that I'm interested in. And then I'm just going to make sure that they are bigger by clicking on the gap between the numbers and then dragging down with my mouse.

So we're going to need a face value, why don't we have a face value of \$1,000, and I put in the dollar sign there, and Excel will change the format to a currency for me. We need to have an interest rate, so why don't we start with an interest rate of say, 5%? And what else do we need? Well, we need a time to maturity. And I'm going to put in a few different times to maturity, how about one year, five years, and 25 years. And notice that each of them is in its own column. Now we actually don't need this interest rate at 5% because I want to see how the bond price is going to change as the real rate of interest changes. So I'm going to need more than just one value for R, so why don't we clear, actually, why don't we choose Delete, and we'll move the cells up. We'll shift the cells up. So I will click OK here, and then notice the T, the time to maturity moves up and we have three options for time to maturity. We should have zero coupon bonds here. And maybe we will highlight all the cells where we want the zero coupon bonds to appear. I'll click on Home, click merge and center. And now getting back to interest rates. So we're gonna have a column for the market interest rate R, we'll call it market, we can just call this the interest rate.

And we're going to have a column for bond price. And I'm going to click up here because I want the bond price to be T equals one. And then I'm going to double click the gap between the K and the L column so that the, it's automatically spaced so we can read the entire header. And I want a bond price, T equals five, do the same thing. And then maybe I'll try dragging it over. I don't want T six though, Excel thinks I want to go from five to six. I want to go T equals 25. So I'll make that change. I'll make that change up here.

Now what is our interest rate going to be for real? Well, let's start with a 0% interest rate. So that seems reasonable. And then, then let's look at what happens if the interest rate is equal to say zero, which is in cell J3 plus point one or point 001. So we're moving by we're increasing the interest rate from zero to point 1%. Now I want to Make sure that the formatting of the percentage is correct, so it displays nicely. So I'll click on the J cell and highlight the whole cell, right click anywhere within the J cell. And then I'll choose Format Cells. I will go to number, and this is a percentage, and I want two, well maybe one decimal place is enough. Now notice that the formula I've used is equal to J3 plus point 001. And that's, point 001 is equal to point 1%. Now this cell, I can highlight it, click on the little square in the bottom right corner and start dragging that down. And you can see we're populating a whole bunch of cells within the column J. And I'm just gonna keep dragging this down. Oops, I went a little too far, I'm gonna go drag it down to well, we don't want quite that many, let's say 10%. So we're going to look at the value, we're going to look at bond prices when interest rates range from zero to 10% point 1% intervals. Now, we're way down here at row 103. What's a quick way to get back up? Well, as we may have seen in another video, let's press Control up and Control up will take us to the next populated cell. In this case, it takes us, since we are on a populated cell and takes us to the end, where the populated cells stop. And that stop, that last populated cell is J2. So it stopped just before we got to J one, which was an empty cell.

Now if we remember our bond pricing formula, we're ready to use that our bond pricing formula is going to be equal to the face value. So I've hit an equal sign in cell K3. Now I'm going to select cell F2, and we're going to multiply F2 by the natural exponent, which in Excel is the function exp. So I typed in exp, and I double click on the exponent exp. Notice that there's an open bracket, open parentheses here. What is to the exponent while the exponent is negative, the interest rate times the time to maturity T. And I'll close the parentheses and hit Enter. Now, if we want to populate other cells, with this function and have Excel updated for us, that which is going to make things easier, we also have to tell it what we want to have change or what we don't want to have change. So for example, we don't want the face value of the bond changing, we're looking at how the bond price changes as interest rates change. So we want to hold F constant. And to do that in Excel, I'm going to add dollar signs to the F, that means the column F is not allowed to change. And I'm going to add a \$ sign to the, in front of the two, which means the row is not allowed to change. So it's going to remain on row two, column F.

What about what about the time to maturity? Well, if I copy this cell down, I want the time to maturity to change. So I'll leave it, or sorry, as I move down, I don't want the time to maturity cell to change down. Notice there's just open cells below where T equals one is in F3. So I will put a \$ sign right here before the three, and then I will hit Enter. And now if I drag this down, it seems like our pricing formula works. If the interest rate is zero, there's no discounting the face value of the bond is equal to its current price. 1000 is equal to 1000. But if there's an interest rate, there's an opportunity cost

here, we could be earning more money. And so someone is going to pay less than \$1,000 for our bond. Now we see here that we've got kind of ugly numbers with lots of decimal places. So let's whoops cancel that. Let's highlight these cells. Let's right click on them. Let's choose Format Cells. Let's go to number and let's turn it into a currency. And the currency default is to have two decimal places. And now we can drag this all the way down. And we've got a column of bond prices for various interest rates when the time to maturity is equal to one. How can we check that? Well, we can highlight the cell click on the equation and you can see which cells it's calling upon, T is equal to one, the interest rates calling on the correct column and row, and the face value up there. Similarly I could select another cell, just double check, make sure we're calling on the right cells and everything is in order.

Now if I use those dollar signs correctly, and I want to know what the bond price is, when T is equal to five, and T is equal to 25, notice that I put them strategically right here in the columns G and H. And so I will try and drag click on this cell and see if I can drag it to the right. And, and I made a mistake, you can see that the cell is zero, I must have forgot something. Let's delete this cell. And we can see that what I forgot was that on the interest rate from column J, I don't want column J to change. I want to call on this column for interest rates. So I'm going to put a \$ sign there in front of the J. I'm going to hit Enter. And then now I'll try and pull this over, and I see that I've got the correct price that I expect. The interest rate is 0%, the bond price should be equal to the face value, the payout in the future. And everything seems to be in order. Clicking on the cell looks like it's calling on the right, I should say correct cell, so 25 25, and the other one was calling on the T equals five cell. I'll highlight both these cells and start dragging them down. Again, we want to change the format, I could have changed the format of all these earlier. But you can see it's not too difficult to change when you remember how to do it. And notice that as the interest rate gets higher, the bond price is falling. And this fall is more severe for the those bonds with a longer maturity. Now using my Ctrl up arrow key, I can take us back to the top. And maybe we want to put our title pages in bold here. And we might even want to increase increase their font size, you can see this little button with the A and the little exponent up arrow is going to increase the size for us. And if we select all the cells, double click on the area between the cells, it's going to increase their size for us as well.

Now I think we're ready to create a graph, remember that the column furthest to the left, Excel is going to treat that as the X axis variable. So we want the interest rate on the X axis. And we want the bond prices on the Y axis or the horizontal axis. So I will hold the Shift key. And I'll hit right three times. And then I'm going to hold the Shift and Ctrl key and press down. Oops, get that out of the way. Ctrl, Shift and down, and it's going to highlight all the area that we populated. I'll go to the Insert menu here. And we want to add a chart. And we want to add a scatterplot chart. And we can see all these nice options that we have. This one looks good to me, I can click on the cell. Now notice it's dropped the chart at the rows 88, 93, way down here, that might not be where we want it. I'm gonna highlight the cell and press Ctrl X. So I've cut the chart out. And maybe we want to drop it up here somewhere, so we can see it and find it easily in the future.

Now, we're going to do some graphical analysis, we're going to take a look at the chart. So we don't necessarily need to see all these numbers. And remember the chart title, this chart, it's kind of maybe a little hard to read, we could try a different format. If we go to chart design, I can click on the chart design. And maybe this one seems, seems to me anyway, this one's a little bit easier to read. I can drag it down and make it a little more square. So the aspect ratio was one to one. Notice that the Y

axis is a little bit shorter distance than the X axis at least in terms of the gridlines. And we've got our legend up here and says bond price. Yeah, three times. So maybe we want to change that. And maybe we just want to have T equals one, T equals five and T equals 25. So it's a little bit easier to read, still kind of a small font. Now maybe we want to increase the size of this chart. So if we highlight the legend, I shouldn't say chart, it's a legend. If we want to increase the size of the legend, all we have to do is select it. So notice it's selected, go to home. And we're going to use this increase font size button that I showed you before, and we can just make it bigger that way. And then we're also going to want to give it a little more room so we can see this more clearly. Maybe we don't need this. Well, instead of deleting the chart title, maybe we do want to use it, we could look at bond prices. And if we wanted, we could do the same thing here and increase the font size for those bond prices. Notice that when the time to maturity is shorter, the bond price is less influenced. It's less sensitive to changes in the interest rate, the market interest rate, as the time to maturity gets longer the bond becomes more sensitive to changes in the interest rate.