EXCELing with Mathematical Modeling
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Week – 01
Lecture – 05 (Basics of EXCEL I)

Hello, welcome to the course Excelling with Mathematical Modelling.

Today, we will be learning about the basics of this Microsoft Excel.

As you have noticed that in mathematical modeling, we use numerical solutions where we need to visualize the graph and from the graph, we need to conclude about our model.

Generally, softwares are used to solve the differential equations or difference equations like Mathematica or Matlab.

Here we will be using Microsoft Excel. So assuming that you have no idea that how Microsoft Excel works, we will start from the very, very beginning.

When you open a spreadsheet, that is when you open this Microsoft Excel, the one which you see here is called a spreadsheet.

So what you need to know that in Microsoft Excel, everything work on the cells.

So, by cell, I mean this particular area.
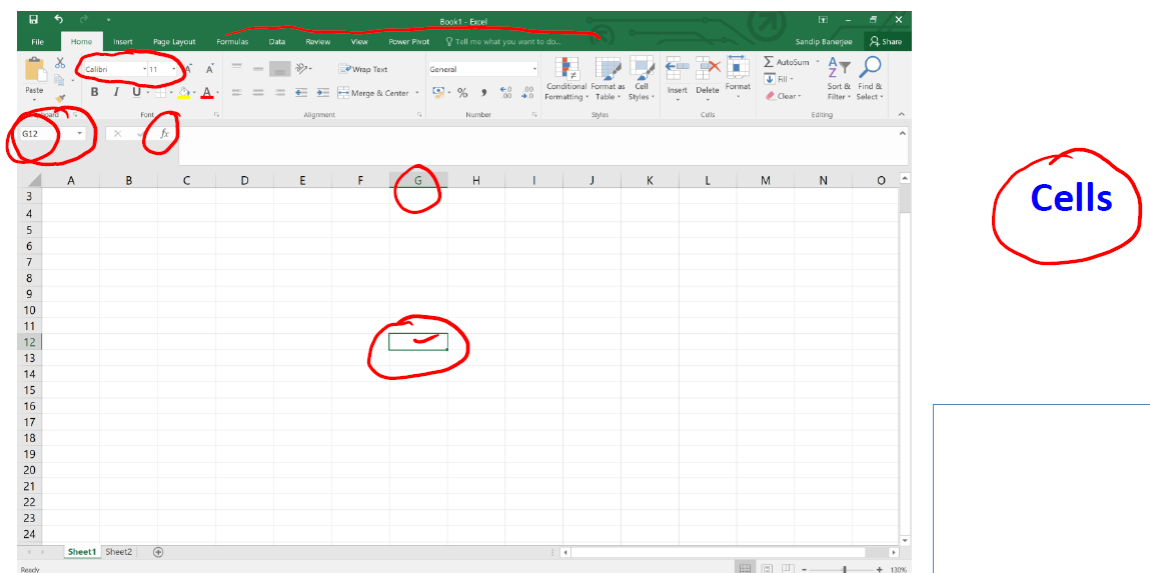
So, you put a number if you want to add you have to add the cells and I will show you how it happens.

There are so many things which you can see on here you do not need to know each of them it will be need to know basis.

What is the important thing that you need to know is that we can change the font size and the font from here that is number 1.

Here will be the formula that we will be using that is number 2.

Here is the number of cell where your cursor will be, like here, it is in G 12.

So you can see G here and your 12 is coming here.

So G 12 which is displayed here.

If I go to the insert, the important thing that we need to know is how to generate the graphs.

So here, if you insert you can see there are lots of charts and graphs are here.

One of them is the recommended chart, others are either bar chart or pie chart or a smooth curve or a scattered diagram, like that there are many things.

We will be generally going for a smooth curve and I will show you how it is done.

So, the formula part as I was explaining, this is your fx and if you put an equal to a window, small window like this will open and here you type what function you want.

If you want an "average", you just type "average".

If you want a sine, you want type sine and click this go, here that particular function will be displayed.

So with this much of the basics, let's try with the Microsoft Excel spreadsheet because a hand-on will always be more helpful than just, you know, explaining the spreadsheet on display.

So let me open a Microsoft Excel spreadsheet. I have 2016. You may have any version.

You just click it and it will open. So you get a blank workbook like this. You double click it and you get your spreadsheet.

The very first thing which I will do is I will increase the font size a little. So I will make the font size say to be 20. So that it is easy to understand and easy to visualize.

So the first thing which I will show that how to add and subtract, even product, finding the mean, finding the variance, finding the standard deviation, in this Microsoft Excel.

So what do you do is I put a variable so this is highlighted I just type standard this is your x values, say, 2 to 7, so you move the cursor right, this is down, this is right, this is left, this is up.

So this is 227, then 235, 255, 269, 292, 299, 312, 321, 333, and 348.

This is 333.

So I have the corresponding F values.

If you want them in the middle, you just click the left mouse button and drag it with the cursor and click this one.

So this one gives you the left, the right alignment and this is the middle alignment. So I put everything in the middle.

The next thing is, say, I put some Y values, say, 15, 22, 27, 11, 23, 21, 14, 25, 19 and 17.

So let me quickly format this to the middle also.

So everything when I type it will be justified.

To highlight these two, the X and the Y values I make them bold.

Here is the bold thing and they become bold.

Now suppose I want the sum of this X. So all I have to do is so here let me write "sum".

So I have to put an equal to, the command for addition is "sum".

I open a first bracket and then I highlight this. I click this, I press the shift button and then the cursor down and until all the numbers are highlighted.

So it is C3 to C12, which means that this one was in C3, C3 and this one was in C12.

So, you add all this and you get the sum of C3 to C12 which is 2891.
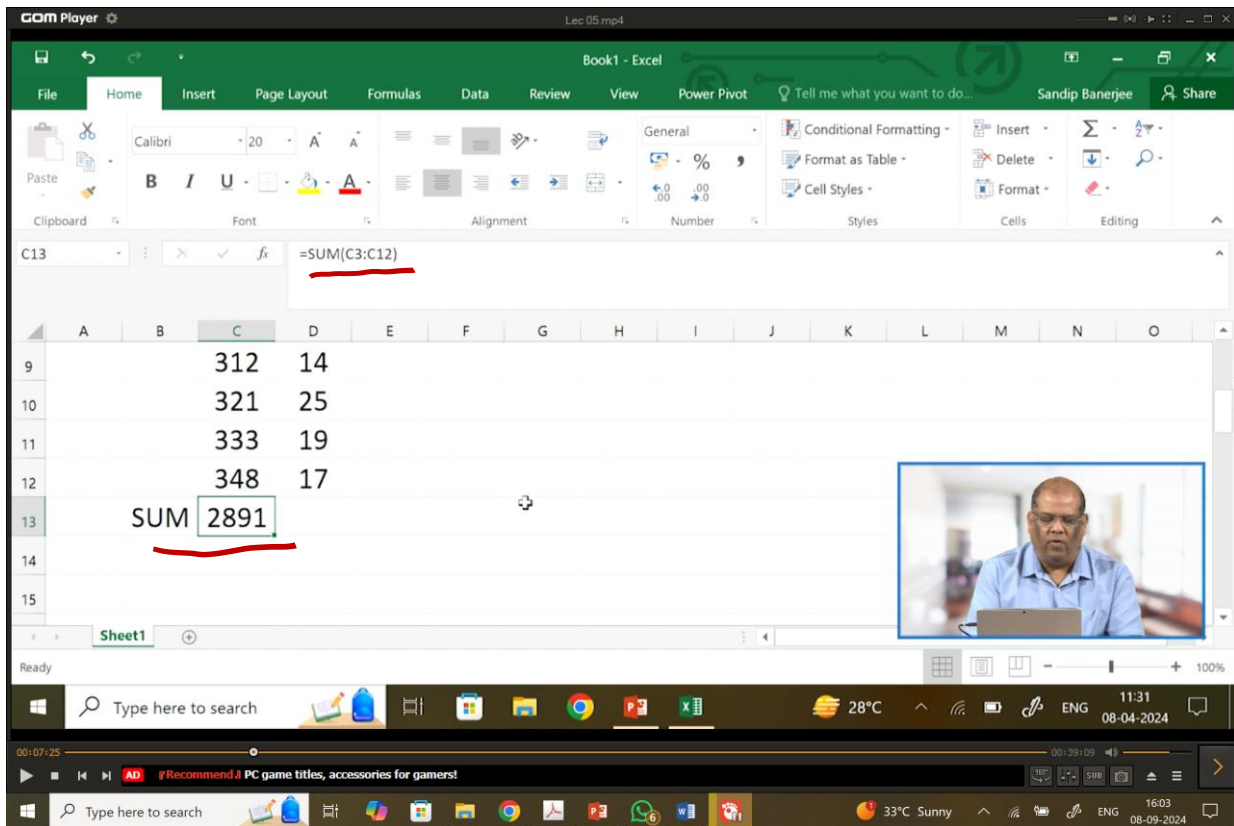
If you want say X square, so I write X, and this is the notation for making it square in Microsoft Excel. I make them bold.

So it works on each cell. So what you have to do, is you put an equal to and your formula thing is activated.

You click this X and make it square. You take the mouse outside the cursor outside this cell and just click it, and you get the number.

So once again what you have to do is, I choose the cell, I put it " = ", I choose the value which need to be squared which is in this cell C3, I make it square and then enter and I get the value.

Then what you have to do is if you see the cursor here, it is a plus sign.

But then this plus sign becomes less thicker. Then you click the left mouse and drag this till the number. And all of them are converted to squares. So that's how in Microsoft Excel it works.

So here it is, 1 into 10 to the power 5. However, if I increase this cell, I get the actual number.

So, sometimes this cell need to be increased either to the top or to the bottom.

So, all you have to do is go here and you will see this kind of bracket is appearing here like this one. So, you have to either reduce it or you can extend it.

So, if you extend it, the actual number is now displayed which is 103041.

If I want to make a product X square into Y it is the same way I put an equal to I have this X value, I square it and I multiply it which is the star sign with the Y value, and I enter and here is the number.

So I will click this cell here again the thick plus sign when you bring this closer to this particular dot, you will see it becomes a reduced plus sign, you click the left mouse button and drag it till here, and all your numbers are displayed and as I told you if you want the actual number you just come here and increase the cell size and you those numbers are now displayed.

Next let us come to the mean value.

See if I want to calculate the mean, say of the Y values

So I will come to this cell, I put an equal to and I look for the particular command.

So, I click this fx. So, when you click this fx, you will see this kind of window opens.

So here you have to type the function.

So let me type "mean" and go. It doesn't give anything. So "mean" is not the command.

So I look for another command, say another synonym for mean, which will be "average".

And you see that there is an "average".

So, "average" is the command for calculating the mean.

So, "average" from which cell to which cell.

So either you write it from D3 to D13, that is, from here you press the shift and it will go and as you go down you can see here the cell number is changing.

So, from D3 it is moving till D12 and you click OK.

So you have selected and your mean is calculated from D3 to D12.
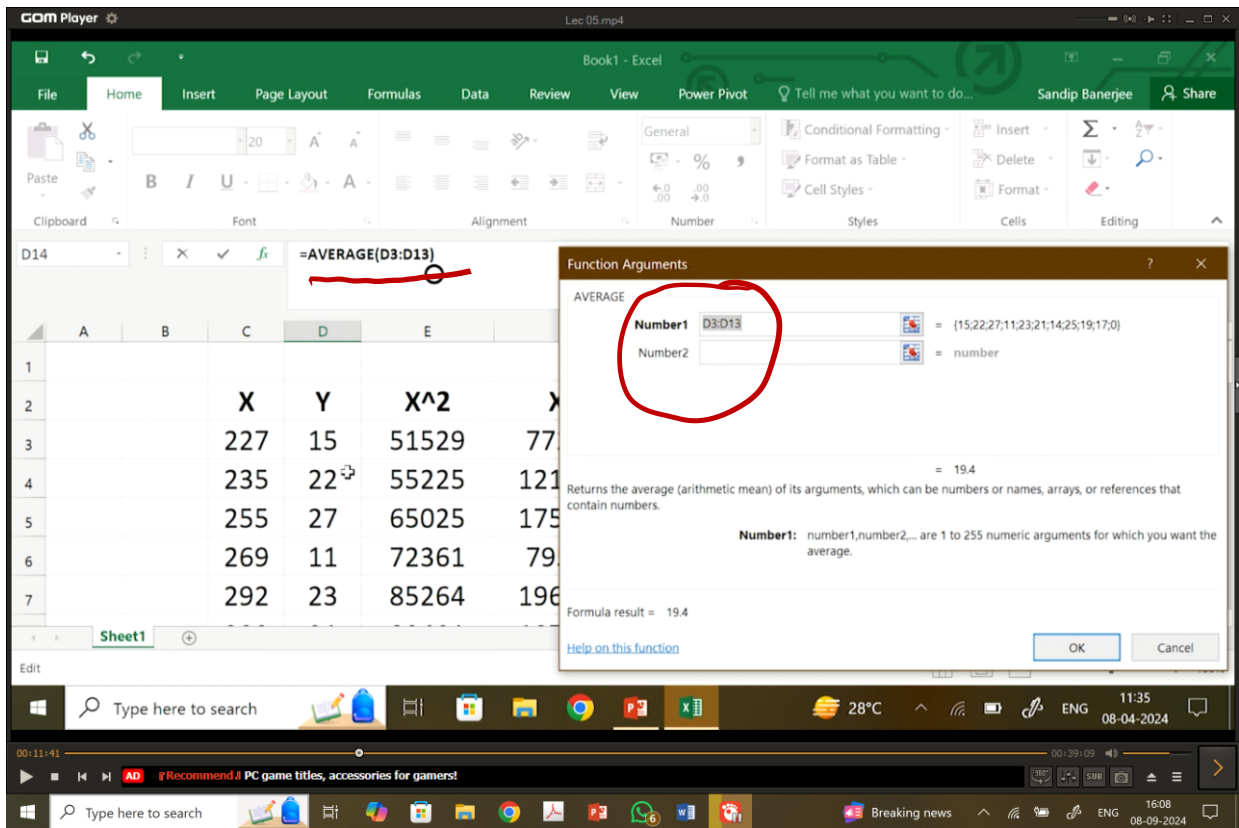
So, here what formula you are using will be displayed and the mean is 19.4.

If you want the variance, so, if you see that this whole typing is going out of the cell all you have to do is either increase the cell size or come here and double click, automatically this will adjust.

So if you want a variance, again it is equal to you click this fx type var go so there is a variance and you can see there is variance var.s, var.p, so var.p is for the population, VAR dot S is for the sample.

If you are familiar with this, then you will understand otherwise this VAR will do. So you calculate the variance which starts from 15 and goes till this 17.

So again from D3 to D12 you give okay and you calculate the variance to be 26.3 if you want a standard deviation, so standard deviation is again equal to you click this gives with a short one st nothing is coming then s dot dev that is actually here st dev. So, standard deviation either s or standard deviation of the population.

So, if I click this then it is come to be the sample I will change it to population and it starts again from D3 press the shift and this goes down up to D12 okay you get the value but I want that of a population.

So I replace this by P and enter so standard deviation is 4.86.
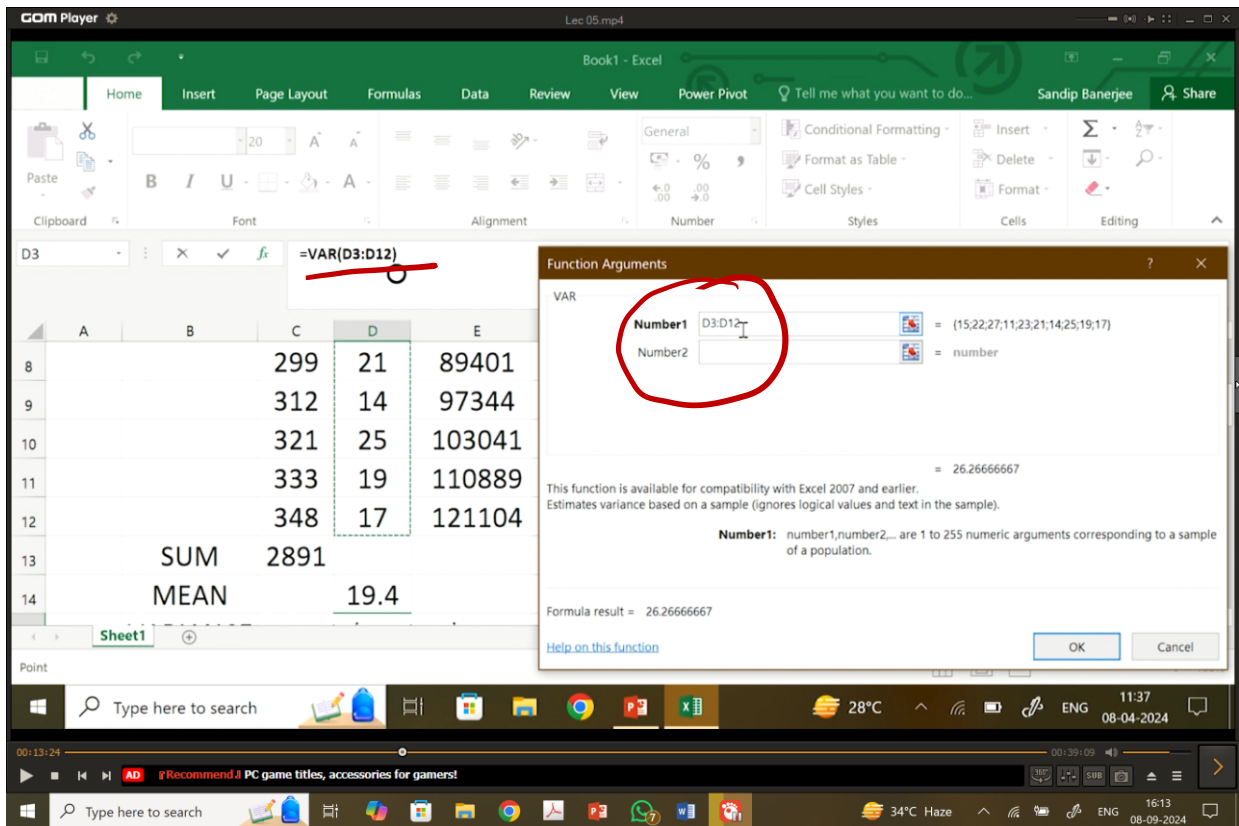
So that is how your Microsoft Excel works for this simple kind of calculations.

Our next thing is how to draw the graphs.

Now to draw the graphs, I open another sheet.

So this is sheet 1. So if I click this plus, another sheet has opened.

I will format them quickly. I make this 20 and I make it justified.

So, now again I need the X values and the Y values to get the graph.

So, for example, if I take these two values, say X and Y. So, I copy them from here up to this much, control C, I go to the sheet.

I click this cell and I enter. So I get the X and the Y values. Suppose I want to border them.

So I select up to this much. So the selecting is you click the left mouse and just drag the mouse to the area how much you want to select.

So your border comes from here, this particular icon. So you click here. So there are so many options. I will choose all borders and hence you will see this whole cell, all the cells are now bordered.

So if I want to plot this diagram X against Y, so I will again select the data using the left mouse button or shift and then you drag the cursor up to the data, it is there.

So all the X and Y data's have been selected. Then you go to this insert and you can see there are so many charts.

So what you have to do is you have to click here, this particular figure.

And there are so many options. This is the scattered diagram. This is the graph. This is the smooth graph.

So let me pick this one. So if I do that, I get a chart like this.
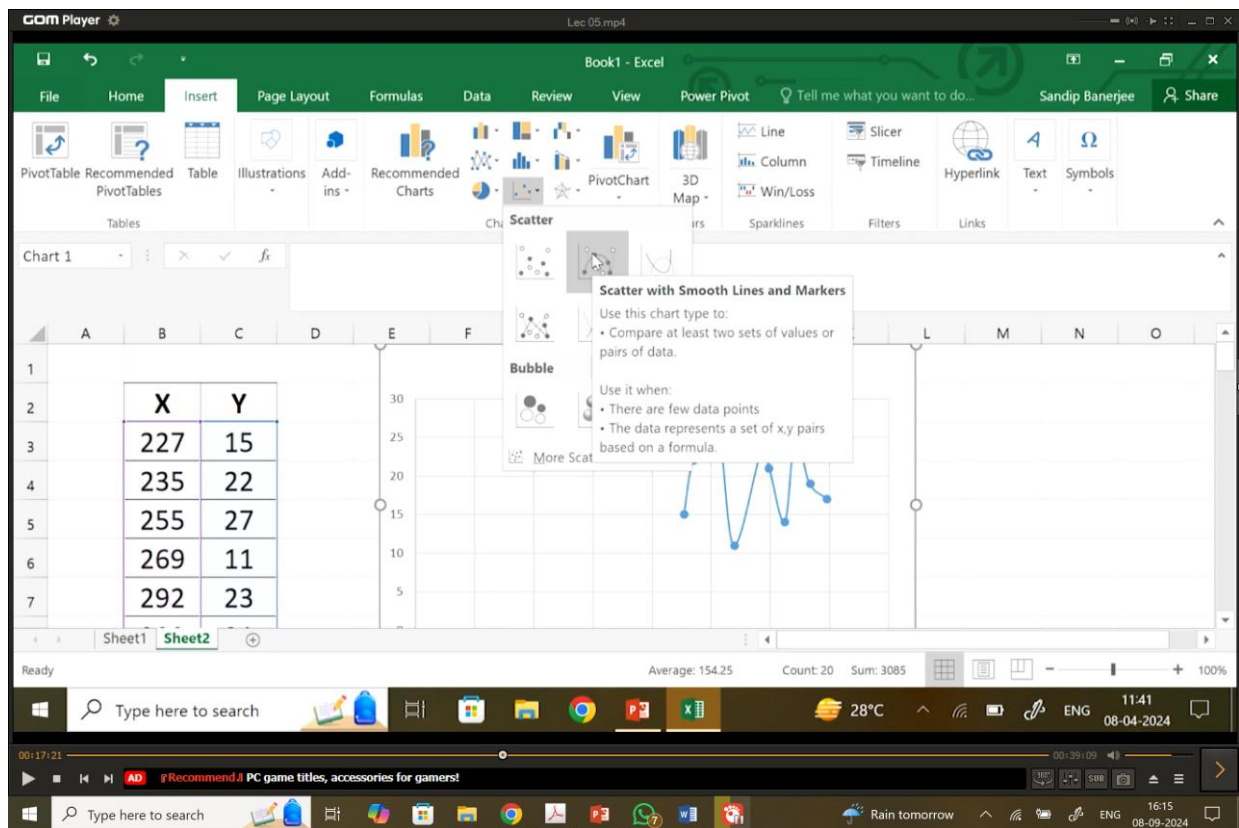
So this is my X values and this is my Y values and the chart has come like this.

If you want to remove the dots and just want a smooth curve, all you have to do is click and go to this smooth curve.

So your curve all the dots are removed, otherwise dot represents this particular values the corresponding X and the Y values.

Now once you get the chart obviously you want to do some levelling so you come here plus So as you can see, first thing is grid lines.

I don't like the grid lines. If you like, you can keep. So these are called grid lines. Otherwise, I will click this one and you see your grid line is gone.

But you need the chart title, which is already here. And I need the legends.

So this graph represents this series one. I can change this to anything. I can write it here.

I can drag it to the up and I can change this series one to something else.

I can delete it whatever totally up to you.

And then what I need is the axis title.

So I need what is in the X axis and what is in the Y axis.

So here I can write say X values and since it is coinciding with the numbers I drag it and I put it say somewhere here.

So here it is the X values and here it is the Y values.

So you do not have to bother this you just type and it will automatically come.

So if I want to delete them, and then write Y values.

So, you get a particular curve if you want to change the chart title say if I write display some display.

And you get this X values, Y values and the curve.

So that is how you get a curve in a Microsoft Excel.

Suppose you want multiple curves in this particular figure.

Say I put some Y square. Y square.

So I want the value of Y.

Y square, Y minus 5 and so on.

So, I put them again in the border.

So, already you have chosen the border.

So, it is already there.

So, this "all borders" is already here.

So, I will just click and all border will come.

So now I have to calculate what is Y squared and what is Y minus 5.

So you put an equal to, you go to Y and you square it.

You press enter, you get the value and you drag this till the end and all the values are turned to squares.

The same thing is here, you put an equal to, you click a Y cell, you subtract 5. You put enter. You get the value. You then drag this.

So all the cells are applied the same formula, Y minus 5.

So now I want to display this X against these values.

So I have to select all, shift.

Either you use the mouse or shift and move the cursor right and down. You will select all these values.

So you go to insert, so there are so many I want it if you want a chart here is the recommended charts if you click that there are so many recommendations, you can want this, you can want this, you can want this or you can have this, we will generally choose this one.

So we come here either you want them in points or you want them in graphs.

Yeah, so the problem was that here we have a Y square which is a very large number, so other two graphs are sort of subsided.

Okay, so if you want to change, suppose you want

So I can delete this one.

Suppose I want X, Y and Y minus 5.

So what you have to do is first you highlight this using your mouse up to this much.

Then you press control and you go here and press shift and go down.

So in that way what happened is your X is selected, your Y is selected, your Y minus 5 is selected but Y square is not selected.

And you go to insert, you go to this scattered diagram and you display.

So now you can see that your X, the Y and Y minus 5 has been displayed and it looks something like this.

If you press this plus sign you will get axis title so I will put here again the X values here the Y values. Here you write display of variables X, Y, Y minus 5 and here it is series 1 and series 2.

If you want text outline, you can go for an outline like this solid line and it will look like this, otherwise no line.

Make this a bit smaller and you have the display of the chart.

So that's how your graph works in Microsoft Excel.
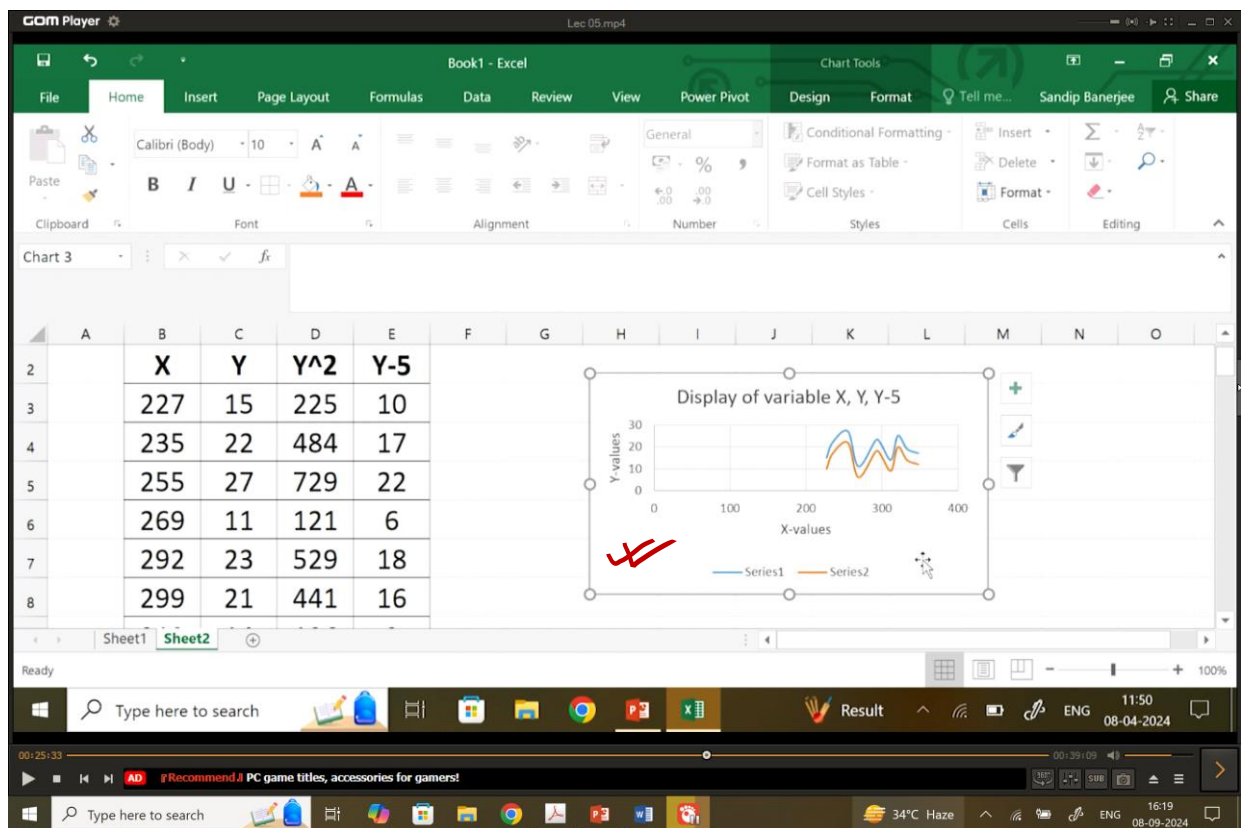
Our next thing is how to solve equation.

So how to find the roots of an equation?

So I go to sheet 3, I again change this to say 20, make it justified and you have the cells.

So if I want to solve an equation of the form, say,

$$2\,x^2 + 3\,x - 4 = 0$$

This is a simple quadratic equation, I can use the formula that is not an issue, but if I can change it to 2x is cube plus 3x square minus 4 again, so what I am trying to say is that if you have an algebraic equation like this how you will be able to solve for the roots.

For that what we use is called a solver.

Now you have to click this data and you will see that there is this solver.

Now in many you will find this solver and in many sheet you will not find this solver.

That means you have to bring that solver somewhere here.

Now how to bring that solver?

So for that you go to file, you go to options, then this add in.

The moment you click add in, here it will come Excel add in.

There are any other option, you just go to this Excel add in and then click go.

So the moment you go here you will see what are the other add-ins that can be here.

So this solver has been checked in.

In your case if it is checked out then you have to check it in and then go for okay and you will see that this solver is coming under this data.

So we will be using this solver to solve this quadratic equation in this case.

So what you have to do first is you take the x value, you take the fx.

So your fx is $2\,x^2 + 3\,x - 4$.

So I have to put an initial guess of the x, say I put it is equal to 1 and then I calculate fx which is $2\,x^2 + 3\,x - 4$. So, it is $2\,x^2 + 3\,x - 4$ and I give enter.

So again it comes to be 1. So as you can see if I put x equal to 1, this is, 2 plus 3 minus 4, 5 minus 4, which is 1. So this will come to 1.
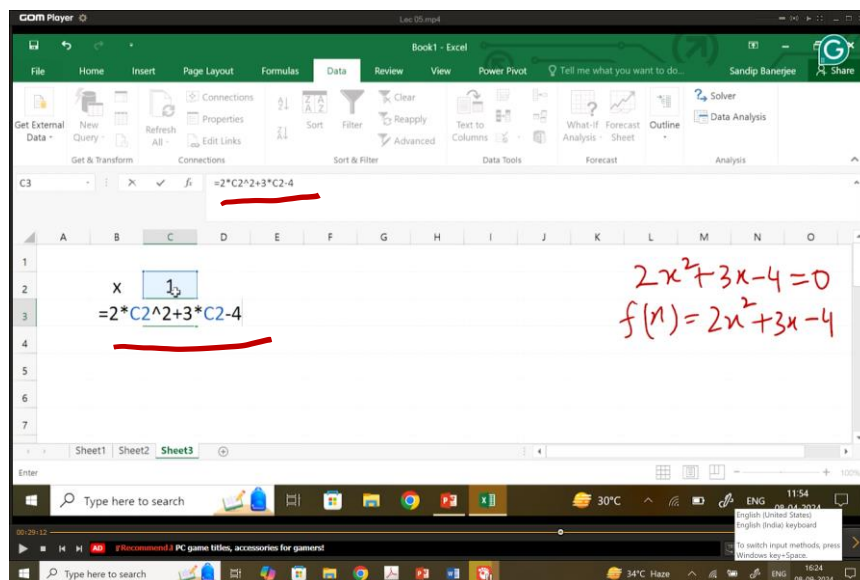
The next step is you highlight this and you click this solver.

Now, the idea is that this particular fx will turn to 0, because if x equal to some value, say x0, if it is a root, so if I substitute that particular value here, then the value of fx must be 0.

So in this particular case, I have taken an approximate value 1 and I have calculated the value of fx to be 1.

But my aim is to make this particular value 1 to be 0.

So this solver now takes this cell which is, so set objective you have to put this cell which is C3.

So this particular cell and I have to make them the value 0.

So I click this, this value is 0, by changing what variable by changing x equal to 1.

So I will play with this one I mean this software will play with this 1 and will make the value of f to be 0 by adjusting the values of x. Here it is subject to constrain, well sometimes you need to put constraints here, but this is a simple equation we do not need that, and here make unconstrained variables non-negative. We sometimes, we need the positive value so you click this but in case you are finding the roots you just uncheck this this you keep it as grg non-linear and you just solve, keep solver solution, you click ok and here you got so this value has turned to be 0 and the value which will satisfy or which is the root is 0.85.
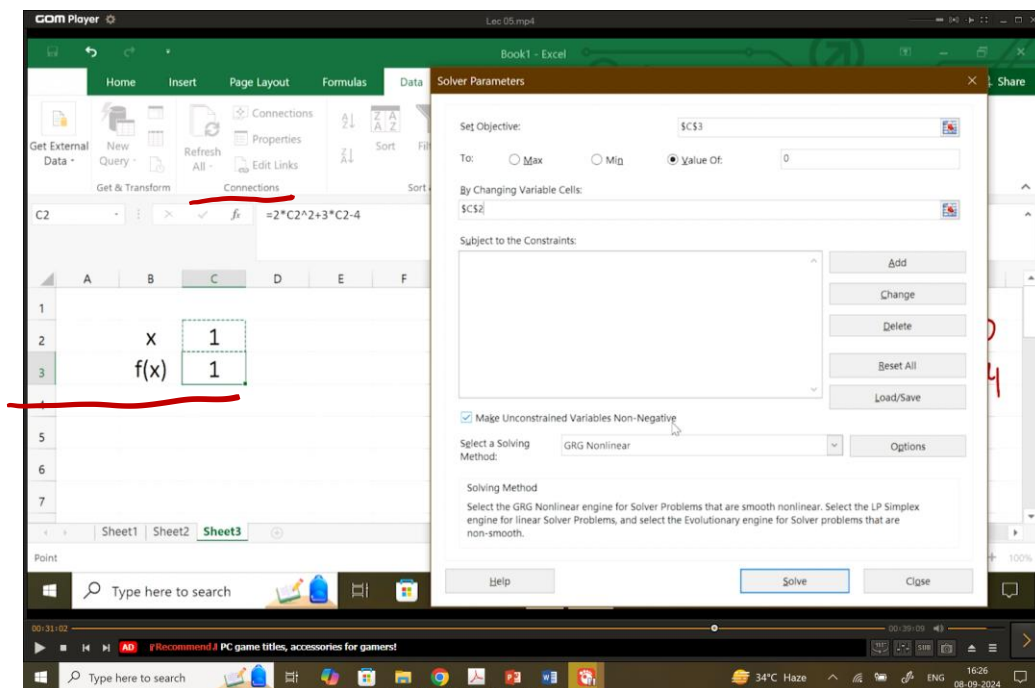
Now you got a minus here, why because this value is actually this, so which means minus 2.65191 into 10 to the power minus 7.

Now if you want to convert it in a decimal

That way it looks good.

So you right click it, right click the mouse and go to this format cell.

In this format cell, you click the number and here the number comes.

So here you can see the decimal places up, to two decimal places.

You make it up to say four or five, whichever you like.

Let's make it four, and you can see up to 4, it is always 0, you can change it to 5 also.

So, till 5 places of decimal, this value is 0.

You can easily take the value as 0.851 or 0.85, which is perfectly okay.

But here is the question, how to take the initial guess?

Well, the easy way would be that you solve that graphically.

So what does that mean?

That I already have the function which is something like this and I need an approximate location of the root.

So if I need the approximate location of the root, I have to draw this function.

And how to draw this function?

Say I take here to be the x value and the fx value.

So I choose some, minus 5.

Now if I want to give an equal increment, so the next value which I choose equal to minus 5 plus 1.

Enter. So you get it to be minus 4.

And then I will drag this to some 10, 12 values and you get something like this.

And this is equal to this function, so 2 times x square plus 3 times x minus 4, sorry, so mistake is I put an x.

So here it has to be this cell and you get to be 31.

So you drag it and go up to 7.

So you get the x values and the y values.

So now I will plot them.

So if you plot them, go to the graph.

So I get an approximate with the graphical representation of the function.

So if you see that where it so by finding the roots I mean where the curve intersects the x-axis.

So you can see it is somewhere here and somewhere here.

So already you got the positive root 0.85 I have taken that to be 1.

So it is close to 0.85.

So it gives this.

If you want the negative root, which is somewhere here, then you have to choose a value which is close to this value.

Say I choose that value x equal to say minus 1.5.

And then I use the same technique that I will calculate my fx for x equal to minus 1.5, which is equal to the function is 2x square plus 3x minus 4.

So, equal to 2 times x square 2 times x square plus 3 times x minus 4, 2 times x square plus 3x minus 4.

So I get the value minus 4 here.

So the aim is to make this value 0, for certain values of x, which will be the root.

You go to "data", you go to "solver".

So now I will choose.

So whatever cell is here, you delete it with backspace and you choose this cell which is C6 here.

I have to make the value 0, by adjusting the value or changing the variable cell, here, which is C5.

No constraint, no non-negativity and I click solve.

Keep the solver solution, and now you see that this has come to be minus 2.35 which is you can see from here is approximately equal to that value and if you want this fx to look like 0, either you click this because the formatting has already been done in this cell.

If you want that format to repeat here so there is a easy way you just highlight this go to home and you see this brush this is format you just click this and come here and click this.

So, immediately whatever format in this particular cell has been transferred to this particular cell.

So, till 5 places of decimal again it is fine.

So, you can easily say the root is minus 2.35.
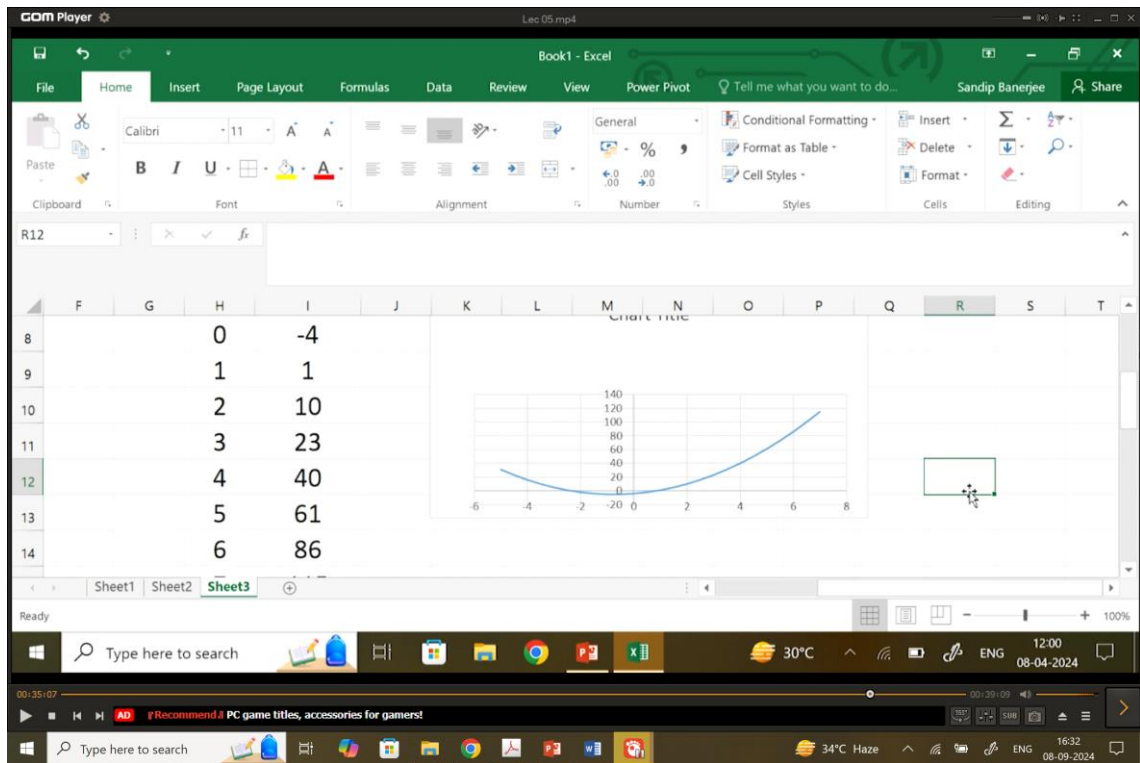
So, that is how you can solve equation or you can find a root of an equation using this Microsoft Excel.

We stop here today and in my next class, you will be learning how to solve a system of equations, a system of linear equations, a system of nonlinear equations, differential equations and difference equations.

Till then, bye-bye.