

**The George Washington University
School of Engineering and Applied Science
Department of Electrical and Computer Engineering
ECE 2110 –Tutorial 3**

Using MS Excel to solve a system of equations with linear regression

I Introduction:

In algebra you became familiar with solving a system of equation with two equations in two unknowns. For example, given these two equations:

$$\begin{aligned} 7 &= m(3) + b \\ 5 &= m(2) + b \end{aligned}$$

You could solve for b, set the two equations equal and find that $m=2$. Then plug m back in and find $b=1$.

But sometimes we have what is called an “overdetermined system,” where we have more equations than unknowns:

$$\begin{aligned} 7 &= m(3) + b \\ 5 &= m(2) + b \\ 9.5 &= m(4) + b \\ 11.5 &= m(5) + b \end{aligned}$$

In this case, solving just two of the equations won't work. Notice that plugging $m=2$ and $b=1$ into the 3rd equation is wrong.

For this problem we can make an approximation of what m and b are using a technique called linear regression. This is very helpful in engineering when you have more data than you have unknown values.

II Walkthrough:

By now you should have noticed that all the equations above are in the form: $y=mx+b$. Each one is an equation for a straight line. We could make a table of the data from the 2nd group of the four equations above as follows in MS Excel:

x	y
2	5
3	7
4	9.5
5	11.5

Now we can use excel to plot just the (x, y) datapoints themselves and then approximate a straight line that fits the (x,y) data in our table. Entering the data above into excel, we can select it and ask excel to plot a “**scatter with only markers**” style plot, as shown in figure 1 below.

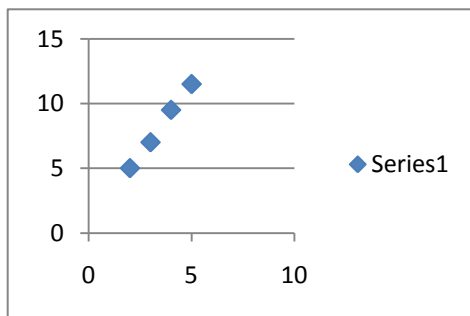


Fig 1 – Scatter plot with only markers

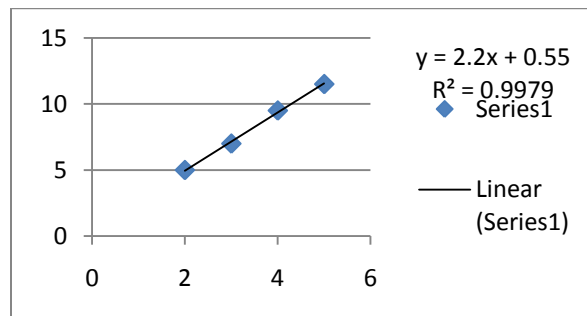


Fig 2 – Scatter plot with trendline equation

In excel, if we “**right click**” on any of the datapoints themselves, we can then click on “**add trendline.**” Using a ‘**linear**’ trendline and clicking on “**Display Equation on chart**” and “**Display R-squared value on chart**”, we get Fig #2.

Excel has generated a linear equation $y=2.2x + 0.55$, meaning $m=2.2$ and $b=0.55$. R^2 is a measure of how close our data is to the approximated trendline. This is very useful in engineering when you are trying to find values for variable using measured data that isn't 'exact.' You might measure a bunch of (x,y) values to try and find m and b.