

Summer Ventures – Mathematical Ecology

A Simple Introduction to Graphing and Formulas in Excel

As with learning most new concepts, a particular example is very helpful. Here we'll rely on our m & m population simulation and results from Wednesday. We'll consider the "stage" to be our time, t , and the number of m & m 's to be our population at that time, $P(t)$ or P .

Plotting Point Values, $(t, P(t))$

1. First we need to enter the data. This is generally done in columns. For good Excel etiquette you should always use the top-most cell in the column as a label or description of your data.
 - (a) Put your time data in column A, with cell A1 holding the label for the data.
 - (b) Put your population size data in column B, with cell B1 holding the label for the data.
2. Now use your mouse and left mouse button select both columns (just click on the A and B immediately above the column).
3. Go to the **Insert** menu at the top and select **Chart** (or use the chart icon on the menu bar). This should bring up a pop-up box that will walk you through the creation of your chart.
4. Select the **XY (Scatter)** plot type, and then the Scatter Plot with values connected by smooth lines option, then click the **Next** button at the bottom of your pop-up box.
5. By selecting columns A and B before inserting the chart, Excel will find and have a display of your data plotted for you. If this did not work, under the **Data Range** tab, click in the Data Range box, then go back to your spreadsheet and select the two columns of numbers you have for time and population (note: to select the columns, simply go to one corner of your columns, hold down the left cursor and then move your cursor to the opposite corner of the data, then release your cursor). Click the **Next** button when this is done.
6. Fill in any titles for the graph or axes, then click **Next**.
7. Lastly, select the option to place your chart as an object in the sheet.
8. If the axes values are larger than your data values, adjust the axes values so that your graph stops at your last data point. To do this, double click on the numbers on the horizontal axis. A menu will pop up and you want to select the **Scale** tab. Type in the minimum and maximum values for your time variable (here 0 and 8) and hit enter.

Calculating Values of $P(n + 1)$

1. Put in column headings for n and $P(n)$ at the top of the two columns you're going to use. (We'll assume these are typed in cells D1 and E1 here.)
2. Enumerate the values of n you're going to use, making sure that you **START WITH YOUR INITIAL VALUE OF n** , here it's 0.

To make this easier than typing all of the numbers out, you can create a formula for increasing numbers and "drag" this formula down to the lower cells. To do this:

- (a) Type in your initial value of n in the first cell below your heading. (We'll assume this is typed in cell D2 here.)
- (b) In the next cell down, type

$$= [\text{Cell Address for Initial } n] + [\text{Step Size}]$$

In general your step size is 1, indicating you're adding 1 to the previous value of n to get your next n value. Rather than typing in the Cell Address for your Initial n value, you can simply "click" once on this cell with your cursor and the cell address will be inserted in your formula. For this particular example you'd type the following in cell D3:

$$= D2 + 1$$

- (c) Copy this formula down to the cells below by letting your cursor hover over the bottom right corner of cell D3 until it becomes a "+", then holding down your left mouse button (on a PC) drag the cursor down to the cells you want to copy this formula into. When you're over the last cell you want to fill, release the mouse button. Note, in doing this, Excel increments the cell address referenced to always be the cell directly above the cell the formula is typed in. This is called *relative addressing* in Excel.
3. Input your initial value of P in the first cell under your $P(n)$ heading.
(Here, type in the number of m & ms you started with in Stage 0 in cell E2).
 4. Calculate the subsequent values of $P(n)$ using a similar "formula drag" as you did for filling in the n values.

- (a) In the cell just below the initial P value, type the formula (thus you must start with an "=") for the right hand side of the difference equation, but everywhere you see a $P(n)$ replace this with the address of the P value in the cell directly above (recall, you can do this with a mouse click if you prefer).

For this particular example, you'd type the following in cell E3:

$$= E2 + 0.5*E2 \text{ (NOTE: the second/"change" part of this will differ for each group!!!)}$$

- (b) Now "drag" this formula down to the subsequent cells, by hovering the cursor over the lower right corner of the cell until it becomes a "+", holding down the left mouse button, and dragging the cursor to the lowest cell you want to fill in and releasing the mouse button.

Plotting Original Data and Difference Equation Results Together

1. Let's start a new chart by clicking anywhere on the spreadsheet that's blank and then inserting a new chart of the **XY(scatter)** type.
2. After selecting the **XY(scatter)** type, you'll get to the data page. Select the **Series** tab.
3. If there is anything there already (Excel tries to help you out), you will want to delete it using the **Remove** button.
4. Now **Add** a series, with name "Simulation". To select the **X values** click on the square at the end of the rectangular white box, this will take you to your spread sheet. Now, use your mouse and left mouse button to highlight the **TIME** values from the simulation, i.e. in cells A2 through A10, and hit enter. Now do the same in the **Y values** section, selecting the **POPULATION** values from the simulation, i.e. cells B2 through B10.
5. Now **Add** another series, with name "Diff Eq". Select **X values** from your **TIME** from the difference equation, i.e. cells D2 through D10. And Select **Y values** from your **POPULATION** from the difference equation, i.e. cells E2 through E10.
6. Once you've added these two series, click **Next** and finish labelling axes on your graph as before, and put the graph in your spreadsheet.