

INTRO TO EXCEL SPREADSHEET (World Population)

Objectives:

- Become familiar with the Excel spreadsheet environment. (Parts 1-5)
- Learn to create and save a worksheet. (Part 1)
- Perform simple calculations, copy formulas, fill, and edit (part 2)
- Relative vs fixed references (part 2)
- Graphing Equations and Formatting text and graphs (part 2 and 3a,3b, and 3c)
- Learn to import data into Excel spreadsheet. (part 4) [parts 4&5 are in separate document]
- Learn to make a graph of spreadsheet data and to compare data with model. (part 5)
- Learn about world population (past, present, and future projections)

Most of the activity will have you actually use the Excel Environment and work through examples but if you are completely unfamiliar with the spreadsheet concept and utility, the link below is a good reference. There is some good information at this site that will not be covered very well in the rest of the assignment. <http://people.usd.edu/~bwjames/tut/excel/> However if you have a little idea of what Excel is about you should be able to work through these activities without any trouble. The reference above still might be of use to you sometime in your future



Part 1: Opening Excel and creating your first worksheet

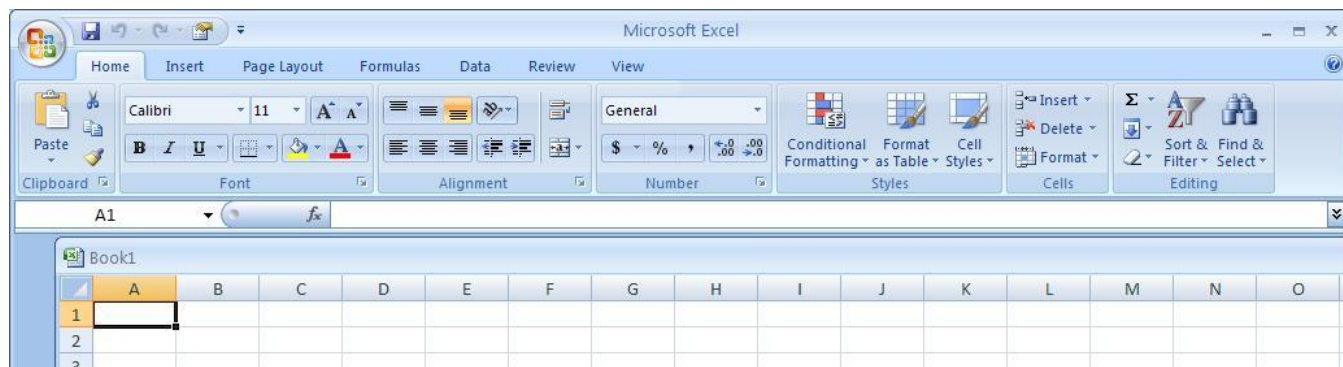
In this section, the text that you actually type in will appear as bold faced and pressing the enter key is indicated by **[E]**, which can usually be done with a click on the OK button in a dialog box or using the arrows up, down, right, or left. If you're using a Mac the command key is typically used when the control key **[Ctrl]** is designated for the PC.

Open the Excel program by double clicking on the Microsoft Excel icon or selecting it from programs on the start menu. Ask for help if you can't find it., or use the find file command (on start men for PC or Finder on Mac) to find it.



Excel

An empty worksheet should appear on your screen. If you are using a different version of Excel, the menu bar may not look exactly like the one shown below; this should not be a problem for this introductory tutorial.



First enter some labels in cells A2-A4.
Select cell A2 by pointing on the cell A2 and clicking once.

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Type in **Name:** [E]

The pointer is now in cell A3.

Type in **Date:** [E] and then Type in **Assignment:** [E] for cell A4

We use the *shorthand notation* below for the somewhat verbose instructions above to make this instruction guide easier to follow.

A2: **Name:**

A3: **Date:**

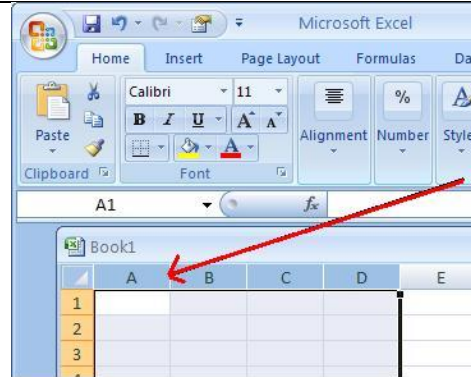
A4: **Assignment:**

Note: the enter key is not explicitly included in our shorthand notation but should be pressed.

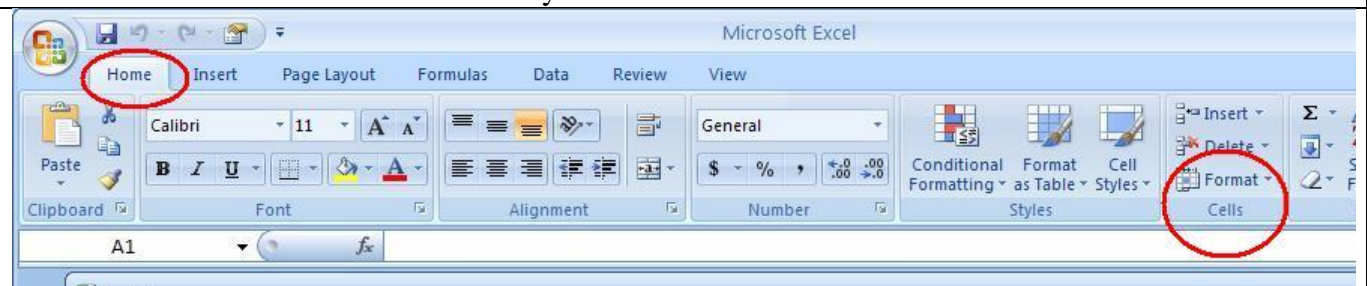
You may want to **change the column width** if your entries are too long for the default widths. You can do this by clicking on the A at the top of column A to select the whole column and then either:

- 1) moving the cursor to the line between A and B and clicking and dragging the width to a new size.

Easiest way for one or several columns side by side.



Or go to the **Format** menu (in the *cell* area of the **Home** tab) click with the mouse and then drag down to the **column-width**, and change the width value to a new width. **Home-Cell-Format - Column - Width box** is our short hand in this activity.



In cells B2 - B4 enter your name, date, and “World Population” for the assignment.

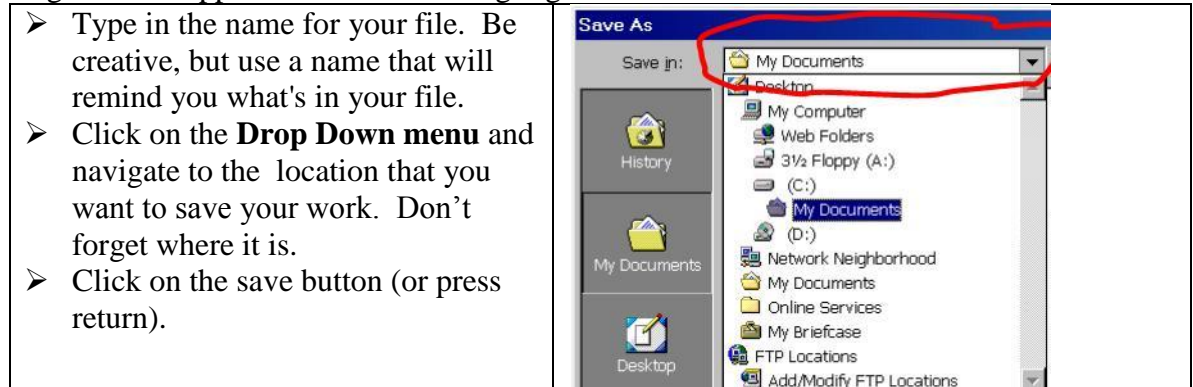
For practice, *save your new worksheet* to your disk or to a temporary space on your hard drive using the **Save As** command under the Office button. The **office button** is circled in red and the **file save** button is circled in blue.

Clicking the file save button will automatically use the save-as command if you have not yet saved the file and will resave the file once it has a name.



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A dialog box will appear that has *book1* highlighted.



If you save this Excel document to a removable disk you can take it with you or if you save it on the hard disk you can e-mail it to yourself as an attachment provided you have e-mail service and an internet connection.

Before going to the next section quickly glance through the last page on final notes regarding Excel.

Part 2. Doing repetitive calculations with Excel.

In this assignment we are going to create a table of values for world population from 1950 to 2050 assuming that it obeys the theoretical logistic growth function.

$$A(t) = \frac{A_0 e^{rt}}{1 + A_0(e^{rt} - 1)/K}$$

Here **A** is the population at any time **t**, **A₀** is the initial population at **t=0** [1950 in our case], **r** is the growth rate, and **K** is the maximum population or human carrying capacity of the Earth system.

We assume that we know **A₀** and **r** from measurement, and will use this analytical model to calculate the population for different values of time after 1950 (**t=year-1950**). Later we'll use this table to make a graph of the World Population (predicted from the logistic growth model) from 1950 to 2050.

In cells A6 - A8 enter:

A6: **initial population**

A7: **Carrying capacity**

A8: **initial growth rate**

In cells B6 - B8 enter:

B6: **A₀=**

B7: **K=**

B8: **r =**

In cells C6 - C8 enter:

C6: **=2.52**

C7: **=100**

C8: **=10**

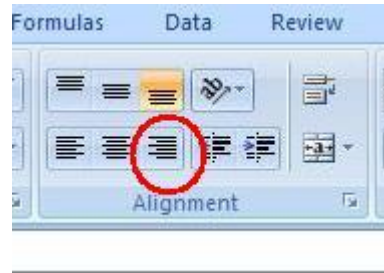
(the equal signs for C6, C7, & C8 are important) These original values are **Very unrealistic** for the Earth but we'll assume that they are okay for **Planet Xox**.

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Let's format the labels in cells B6-B8 to spiff up their appearance. **Select cells** B6 - B8 by: pointing on B6, pressing and holding the mouse button, dragging the pointer to cell B8.** (B6 - B8 should now be highlighted.)

— From the Home Tab click on the right justification icon under alignment.

** **Select Cells B6-B8**



The nice thing about the Excel environment is that when you set the mouse pointer on top of a toolbar icon a text box appears describing what that icon does.

Click on the box labeled **[B]** in the tool bar under the Home Tab (font) to make your labels in B6-B8 bold. *[they are still selected?]*



Make the labels in cell A2 - A4 Bold by following the same procedure as above (select and click on [B]

icon). Select cells C6 - C8 and left justify these cells using the left justify icon



OOPS! We made a mistake. We forgot to put **units** on the labels in cells B6 - B8. Units are always very important. Although Excel can only do calculations with numerical values, indicating what units these values are in is important so that the numbers are useful. No problem, we'll do it now.

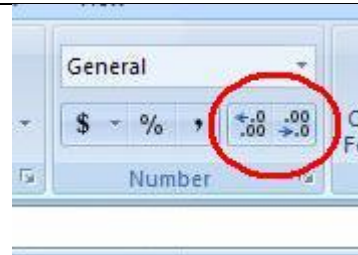
Select cell B6.

Position the cursor between the o and = sign of the **formula bar** at the very top of the screen and click. Now type **(Billions)** then **[R]**. This should give you **Po(Billions)=** in cell B6



In the same way include units for B8 (billions) and B9 (%/yr).

Use the **Home tab Number** command to increase or decrease the number of decimal places used. Select 2 for C6, c7, and c8 so your number appear as 2.52, 100.00, and 10.00 respectively




In cells B10 & C10, enter:

B10: **Year**

C10: **Population (Billions)**

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Make these labels bold and align them in the center with center alignment. 

Here's a sample problem that we'll solve using the Excel environment.

Given that the initial 1950 population is 2.52 billion people, the human carrying capacity of planet **Xox** is 100 billion people, and the growth rate is 10% per year, what is the estimated **Xox** population in 2000?

Enter B11: =2000 as the year. We will then use excel to put this value into our formula to calculate the population at this time.

Here we show the Excel equation and then right below we show the corresponding terms of the analytic formula.

Enter c11:

=C\$6* EXP(C\$8*0.01*(B11-1950)) / (1+(C\$6*(EXP(C\$8*0.01*(B11-1950))-1) / C\$7))
(again make sure to include the = sign and hit the enter key) Also you do not need to include the spaces. (if this document is an electronic version you can copy and paste from it directly into Excel.)

= $A_o e^{0.01r(t-1950)} / [1 + \{ A_o (e^{0.01r(t-1950)} - 1) / K \}$

** The \$s in the Excel version are optional right now but leave them in because they will be very useful soon. The 0.01r is needed if r is in %/year and the * is the multiply by symbol.*

If everything works correctly when you change B11 from 1950 to 2000 the value of C11 goes from 2.52 (billion) to 79.32 billion. (This is way too high for Earth but it may be right for **Xox**.)

When you change B11 from 2000 to 1980 the value of c11 becomes _____?

The above is great because we have created a calculator that allows us to put any value of time into cell B11 and have Excel calculate the population of planet **Xox** for that year and display it in cell C11. We can also change the values of **Ao**, **K**, and **r** by entering new values in c6, c7, or c8. This is a very handy tool for evaluating an equation. The advantage of this over a calculator is once the formula is typed in correctly it can easily be used over and over again. Another advantage is that if you type in the formula incorrectly, you don't have to start all over to fix it but can simply edit it in the formula bar.

Part 3. Doing multiple calculations in Excel and Graphing the results. (assumes that you've done part 2)

Part 3a. Making a table of values from an equation

It gets even better! We can use what we have to make a table theoretical of **Xox world** population from 1950 to 2050. This will make it easy to graph our results to help us visualize the behavior of this equation over a large range of years.

The first step is to generate a bunch of years between 1950 and 2050 that are equally spaced.

Enter:

B11: **1950** *(you should change it back to 1950 if you had change B11 to something else.)*

B12: **1955**

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B31: 2050

WAIT!!

You can do this an easy way or a hard way.

- 1) The hard way is to enter each number into each cell one at a time.
- 2) The easy way is to enter:

B11: 1950

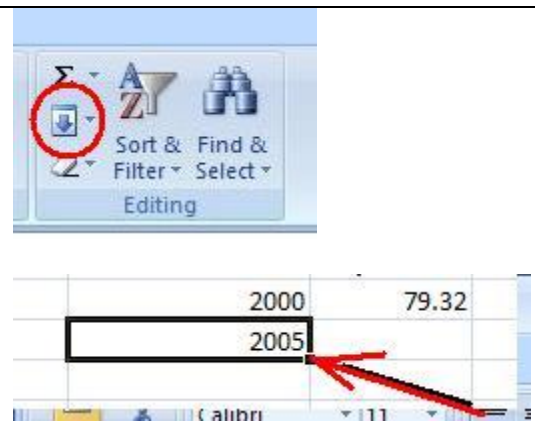
B12: = B11 + 5

Select cells B12 through B31 (*highlight them with the mouse by clicking and dragging*)

Use the **Home tab Editing- Fill- Down command** from the Edit file menu at the top of the Worksheet

Note: You can select the **Edit -Fill -Down command** by going to the **Edit Menu** drag down to **Fill** and select **Down** or by pressing the [CTRL] and D keys simultaneously.

Another easy way to fill down the equation written in cell B12 is to type it into B12 and press [R]. Then carefully move the mouse pointer to the lower right corner of cell B12 and when the pointer changes to a solid pointer you can click and then drag it down to cell B31. This automatically fills the cells B13 to B31 with the B12 formula. Try it, it's fun.



Click on cell B13 and let's take a look at it more closely.

Notice that when we used the **Fill -Down command** the equation that is in cell B12 (= B11 + 5) is copied into cell B13 as (= B12 + 5) [the value in cell B13 is 1960 but in the formula bar at the top you see the actual equation]. The cell assignment is **relative** as the equation is copied. Another way of looking at it is that the equation in B12 can be read as, add 5 to the cell above this location and make that the value of this cell. In cell B12, B11 is a **relative cell reference**. Below we describe **fixed cell references**, which are also useful.



Let's enter the equation for the **Xox World population** for the years 1950 to 2050 km into cells C12 through C31. Do this by copying (Fill Down) the formula in cell C11 to cells C12 through C31. Select cells C11 - C31 and use the **Edit Fill Down** command. That's all there is to it!! **Format Cell-number** to two decimal places in C11 to C31.

Select cell C12. Notice that the \$ in front of the row or column label fixes the row or column (or both) so that when the formula is copied the fixed cell reference does not change. This is a **fixed cell reference**. Depending on what you want to do, both **variable and fixed cell references** are very useful. The c\$6 reference will always go to row 6 of whatever column you're in. Whereas the \$b11 reference

Intro To Excel Spreadsheet for use in Introductory Sciences

will always go to column B of whatever row you're in (the row will be relative). Click on C12

In the formula bar C12 has

$=C\$6*EXP(C\$8*0.01*($B12-1950))/(1+(C\$6*(EXP(C\$8*0.01*($B12-1950))-1)/C\$7))$

Remember C11:

$=C\$6*EXP(C\$8*0.01*($B11-1950))/(1+(C\$6*(EXP(C\$8*0.01*($B11-1950))-1)/C\$7))$

That's all there is to it!! For each time value in column B a population is calculated in column C .
(Info alert: upper and lower case letters both work the same in Excel formula cell references).

Cells C11 - C31 now contain the **Xox** world population for the years between 1950 to 2050.

The worksheet is now in good shape. Resave it using the **File Save** command or by clicking on the disk icon of the top tool bar. You should **resave your work frequently**, even before the final version is complete. This could save you from turning a good day into a bad day if for some reason the computer crashed or (heaven forbid) the operator made a careless error.

This would be a good time to use the **Move or Copy Sheet>Create copy command** under Format from Cells region of the home tab. This will give you two sheets of what you just created so you can modify one of them following the instructions in Part 3b and not worry about losing what you've already done. Resave the whole worksheet again.

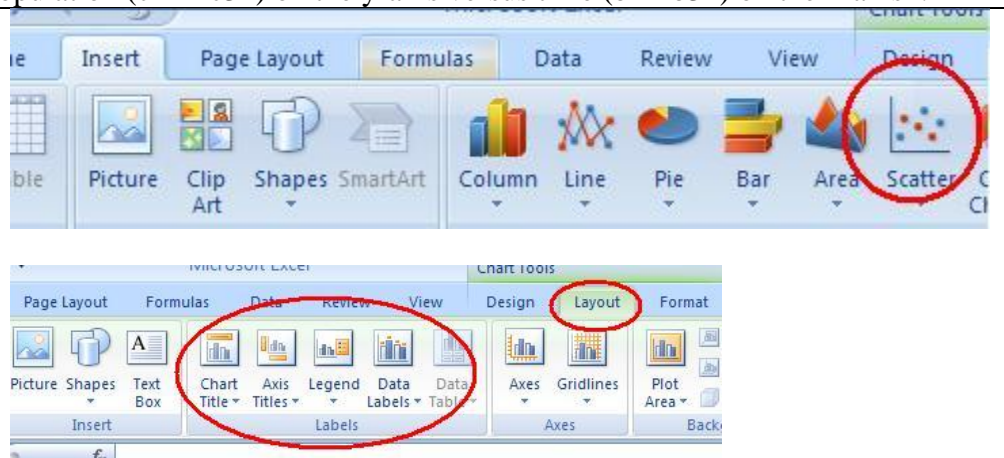


Part 3b. One of the nicest features of Excel is that you can easily make a **graph** of your results.

To make a **graph** of **Xox** Population (c11 - c31) on the y-axis versus time (b11-b31) on the x-axis*:

- Select cells B11 through C31 (2 columns)
- Click on the insert tab and then Scatter
- * The x-axis values are always in the first column on the left

You can enter the title and axes labels using the layout tab made visible when you select the chart (click inside the chart region). Turn off legends. Click on the other tabs to see what they



Intro To Excel Spreadsheet for use in Introductory Sciences

If you want to modify your graph after finishing it use items under **the design, layout or format tabs. To get the Chart tabs you have to first finish the graph (chart) and then click somewhere on it to select the whole graph.

The chart you have created is part of the worksheet. To select the chart itself so that you can modify it or print just it, mouse click anywhere in the chart. Do this now. If the legend box is still there click on it and hit the delete key. With the whole chart selected you can change the font size, style, .. with the font region on the Home tab or you can select part of the chart to change only it. Playing around in the Excel environment and sharing what you find out with friends is the best way to learn Excel more completely.

You can move the chart window to a new position so the table and graph are both clearly visible.

Locate the mouse pointer inside the chart, press and hold the mouse button, and drag the window to its new position. TRY THIS!

Move the chart window to the right side of the monitor screen so it and columns B and C can be seen.

You can change the size of the chart window by pointing on a corner of the window and dragging this corner to its new position. TRY THIS!

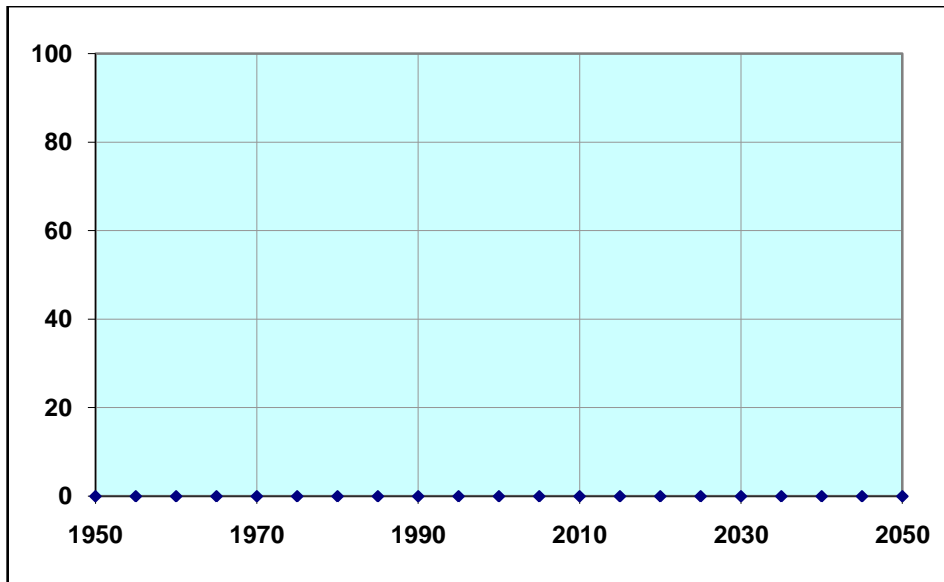
Let's add some *labels* to the axes and a *title* to the graph. If you already added these when you first made your chart follow the instructions here anyway so you will learn how to edit your titles and labels.

Use the **Labels region** of the **Layout tab** to edit or add title, legend, etc.

- For the x-axis label use: **Year**
- For the y-axis label use: **Xox population (billions)**
- Make up your own title.
- Play around with the other tab items in the Chart Options section to see what they can do. After you finish click okay.
- Right Click on an individual axis, title, plot region ... allows you to format that specific items
- Right Click on the y-axis to select it. With the y-axis selected, use the *Format axis* option to set the minimum y value to 0 and the maximum to 100.0. Doing this manually fixes the scale of the graph so that when you make changes in the input data the scale doesn't change. This makes it easier to see exactly what changes occur in the graph's appearance for a given input change. If the scale did change the true changes in the graph's appearance would be disguised somewhat. In the same way change the scale for the x-axis to from 1950 to 2050.
- Resave your worksheet.

Intro To Excel Spreadsheet for use in Introductory Sciences

- Carefully sketch your graph of Population versus year on the axes provided below. Label both axes, include units, and title the graph. Call this **graph 1**



With the worksheet selected, change **r**(cell C9) from 10 to 5.

Reselect the chart and sketch it on the same set of axes as above. Use a different color or line type to clearly and unambiguously distinguish your two curves and use a legend to the right of your graph above to indicate which line is which. Call this **graph 2**

With the worksheet selected, change **r**(cell C9) from 5 to 20. Sketch this on the same set of axes and make sure that this line is clearly labeled. Call this **graph 3**

Let's use Excel to check your answer for the sketch above and put three lines on one set of axes. This is pretty easy to do. Select cells C6 through C31 [*highlight these cells*], copy them with [*Edit-Copy-command*] or [Ctrl][C], and then select cell D6 and paste with [*Edit -Paste command*] or [Ctrl][V]. Select cell E6 and Paste again. Because of the fixed and relative references used, the year is always in column B and populations will be in columns C, D, and E. For each column calculation initial population, carrying capacity, and growth rates are in either C6-C8, D6-D8, or E6-E8 respectively.

Cell D11 has the formula

$$=D\$6*EXP(D\$8*0.01*($B11-1950))/(1+(D\$6*(EXP(D\$8*0.01*($B11-1950))-1)/D\$7))$$

and E11

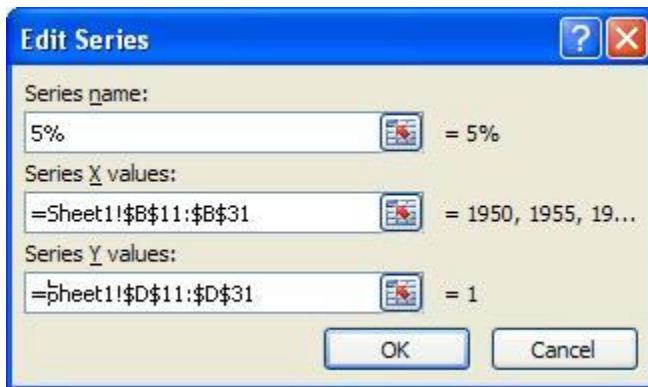
$$=E\$6*EXP(E\$8*0.01*($B11-1950))/(1+(E\$6*(EXP(E\$8*0.01*($B11-1950))-1)/E\$7))$$

Changing C6 –C8 to (2.52, 100, 10) will give you numbers in column C for graph 1 above
 Changing D6 –D8 to (2.52, 100, 5) will give you numbers in column D for graph 2 above
 and

Changing E6 –E8 to (2.52, 100, 20) will give you numbers in column E for graph 3 above

To add a new line to the chart, select the chart and go use the Design tab *Select data* item and use the *Add* option.

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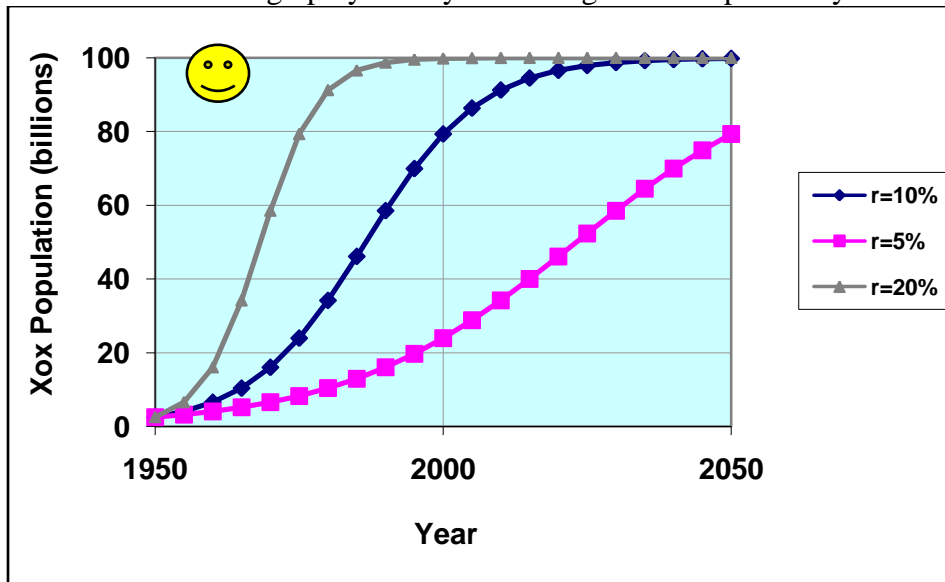
when asked for the Series x-values select B11-B31 on the worksheet by clicking and dragging with the mouse. Do the same for the series y-values.

Repeat for your third line E11-E31.

You'll have to select the edit option from Design tab *Select data* item to change the name of your first line (10%)

Remember, you can force the x-axis to go from 1950 to 2050. The same technique that we used before to force the y-axis to go from 0 to 100.

With 3 lines on one graph you may want a legend to help identify. *Use design tab options.*



The smiley face was added with Shapes under the Insert Tab. Try it.

By now you probably feel like you're in Excel heaven. With this fabulous tool, the spreadsheet, you can easily see what happens to the theoretical **Xox** population for different assumed growth rates. For numerical answers to specific questions, it's sometimes easiest to read the values right off the worksheet. This may involve using the *scroll bars* at the right side or bottom of the worksheet. To see how they work,

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- Click below the square box in the scroll bar on the right.
- Next drag the square box a little to see what happens.
- Finally, point (and click) to the arrows at the top or bottom of the scroll bar to see how this works.

- Play with the bottom scroll bar a little.

Questions: How does an increase in initial growth rate (**r**) influence:
The time it takes **X₀** to get reach its carrying capacity ?

The shape of the population curve.

Graphs: After you get your graph of population for the three initial growth rates in good shape print it out and turn it in.

Use the *Home tab Cells-Format create-copy command* and then resave the whole worksheet. This will give you two sheets of what you just created so you can modify one of them following the instructions below without losing what you just did.

Change B12 to be =B11+1 so that calculations are performed every year. Copy formula down to B31. Now select B31 to E31 and copy all three column down to row 111 so you get the full 100 years again. **If you click right on one of the lines of the graph you can change the 31 to 111 to modify the selected data series to graph the full 100 years.**

Save your work for possible future activities.

Final Notes and miscellaneous about Excel:

[Ctrl] [Z] is the *Edit-Undo command* and can save you head aches when you accidentally type the wrong thing.

Also the escape key (Esc) will get you out of a cell without making changes if you are typing something in and you know it's not right.

If you are in cell B12 and have typed =0.1+ you can make it =0.1+B11 by clicking on the cell B11. This is a bit of a time saver but this feature tends to work as it should at unexpected times and is a good reason to remember the esc key trick.

Double clicking on a line or the background or specific text brings up dialog boxes that allow you to

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change color, font type, line thickness,.....

All sorts of mathematical functions can be used click on f_x tool bar item of *Formulas Tab* to see what the possibilities are.

An automatic Sum of values can be obtained by clicking on the S tool bar item. Look carefully when using this to make sure it guessed which cells you wanted to sum correctly. If not simple edit to the correct value in the formula bar.

In addition to the mouse, the arrow keys on your key board can also help you move around within the spreadsheet.

Good Luck and have fun.

Save this activity so you can find it again later.

<http://www.baycongroup.com/el0.htm> Is another Excel tutorial that might be useful as a reference.