Many of you have some experience with EXCEL already. Today, we’ll introduce another technical plotting and scientific computing program called PSI-Plot. We will be using both programs (EXCEL & PSIPlot) during the semester. After gaining experience with these programs, you may find it useful to use them together in problem solving activities. The following instructions are meant to take you step-by-step through the generation and plotting of a data set. In future exercises, you will learn how to fit straight lines and polynomials of higher order to specific data sets. Today, we will take more of a conceptual look at linear relationships. We will also reformat plots into a log-log scale.

**GETTING INTO PSI-Plot**

PSI-Plot runs in the PC windows environment. Double click on the PSI-Plot icon. When the PSI-Plot window opens up, **click on FILE** then on **Import Data**. Navigate over to the common drive (the H:/Drive) and copy the folder *FittingLabData* folder over to your G:/Drive. *We’ll spend some time in class reviewing all this (take notes!)*. For today’s lab, select the data set *DepthAge.dat* and click the open button. A spreadsheet or window containing the depth and age data will appear on the screen.

The data in the spreadsheet were taken from Chapter 2 of Waltham's text (page 37, problem 2.11). The problem states -

2.11 The following data were taken from the Troll 3.1 well in the Norwegian North Sea.

<table>
<thead>
<tr>
<th>Depth</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.75</td>
<td>1490</td>
</tr>
<tr>
<td>407</td>
<td>10510</td>
</tr>
<tr>
<td>545</td>
<td>11160</td>
</tr>
<tr>
<td>825</td>
<td>11730</td>
</tr>
<tr>
<td>1158</td>
<td>12410</td>
</tr>
<tr>
<td>1454</td>
<td>12585</td>
</tr>
<tr>
<td>2060</td>
<td>13445</td>
</tr>
<tr>
<td>1158</td>
<td>12410</td>
</tr>
<tr>
<td>2263</td>
<td>14685</td>
</tr>
</tbody>
</table>


For future reference, if you want to **Rename** a column, click on the column title, and type in the preferred column name. Hit return to enter the new name.

Follow along and **MAKE NOTES** as we go through these examples.
GRAPHING AND PLOTTING!

Let's plot up this series of numbers.

*Click on PLOT* (a menu drops down)
*Click on 2D Curve>* (menu opens to right)

*Click on XY Lines* (2D XY-Lines window opens up)
Note that in this case, X>> defaults to Depth, and Y>> to Age.

*Click on ADD CURVE>>, then OK*
Pat yourself on the back you are on your way to mastery.
**ODDS and ENDS** -
Move the mouse arrow down into the plot area and **Click** it in an empty area of the plot. Note that the plot will be highlighted (e.g. square dots appear on the plot margins). You can **resize** the plot by clicking on the highlighted edge or corner points. You can move the plot around by **clicking** within the bounds of the plot and **dragging** it to a desired location. **Try it.**

To close your plot, move the mouse over to the upper left corner and **click on the X** sign. Then **click on CLOSE**, then **click on NO** (you don’t want to save it). This will return you to your spreadsheet.

**NOTES! NOTES!**
Learned one - now do one. Here are some things to try on your own.

PLOT

2D CURVE

XYLINES

- but, this time click on STYLE>> and select another symbol.
Click on COLOR>> and select another color.
Double click on the little window next to Symbol Size:, and enter 0 (only the line will appear).

Don’t forget to click on ADD CURVE, then OK.

Note that the plots default to a landscape layout. Let’s change that to portrait.
Click on FILE (Menu drops down - note variety of selections. Experiment later.)
Click on Printer Setup.
Click on Portrait, then
Click on OK

Resize the graph to fit in the upper third of the sheet.

Double click on the graph title Sheet Untitled.
Sheet untitled will be highlighted in blue. You can type in any title you’d like. Do so now, and also note the
other options in this window, including Font, Size, Italic, etc.
Click on OK.

You can change axis labels the same way.

Note the tool box off to the right.
Click on the abc button
Bring the cross hairs over to a suitable place on your graph.
Click and drag: Hold down the left mouse button and drag open a rectangular box to place a label.
When you release the left mouse button, a text format window will open up. You can enter a relevant label as
you did for the title and axes above. Note there are lots of formatting options available to you in this window.
Click on OK when done.

NOTES:

Click on your label, and move it around.
Click on an open space within the graph. Note that the graph is highlighted. Now
Click on the label you entered above. Note that the graph remains highlighted.
In the newer releases this is not a problem, but if you should have problems re-editing your label you may have
to push the graph or other active object “back.” To do this -
Go to VIEW (a window drops down).
Click on Push Back. (This will push the active window back and give you access to other foreground plot
elements.)
Now click on your label. There you go!
**Back to Problem 2.11:** From the graph and data listing (i) estimate the sedimentation rate for the last 10,000 years, (ii) the sedimentation rate for the preceding 5,000 years, and (iii) the time since sedimentation ceased.

Compute \( \frac{\Delta \text{Depth}}{\Delta \text{Age}} \) from data points with depths extending from 19.75 cm to 407 cm and ages of 1,490 years to 10,510 years. This yields 

\[
- \frac{387.25}{9020} = 0.043 \text{ cm/year} \quad (\text{or} \quad 23.29 \text{ years/cm}).
\]

**Complete parts ii and iii on your own**
GENERATING A LOG-LOG PLOT-

Remember from our in-class discussions of possible age depth relationships we suggested that the result of compaction and porosity reduction could be variable through time and have the effect of increasing the amount of time represented by a unit thickness (for example, a meter or ten meters) of strata at greater and greater depths of burial. We might suspect that age might increase non-linearly with increasing depth, and that since porosity decreases exponentially with depth in many sedimentary deposits, perhaps age increases exponentially with depth such that \( A = A_0e^{ad} \).

As we do this though, think what you would get if you took the natural logarithm of both sides of this equation. What kind of equation results from this operation?

Let's check it out.

Double Click on the x axis (Depth axis in this case). An Axis Format window will open up. Go over to the axis mode, click on the down arrow, and change linear norm to ln (natural). Click OK. Note that the Age axis will be rescaled into logarithmic (base e) intervals.

Does your plot look more like a straight line?

This has just been a basic run through on some of the options available through PLOT. We will return for more later in this DEMO. But the best way to learn will be to experiment.
Saving your data.

Once you're finished you can save your data. I suggest that you save your data in the **g:drive**.

*Take Notes on how to do this!*

**Click on File - Save As**

*And select the g:drive from the saving plot window.*

Give your file a name you will remember like problem2-11. I suggest using a - or an underscore _ instead of a . since the computer will consider words separated by periods as extensions.

When you save on the g:drive you can go to another computer and access your data. If you save on the c:drive (the default save drive) you will only be able to access your data from that machine.

Plot files have a PGW extension (G for Graphics), while data files have a PDW extension (D for Data).

Save your plot, close the plot window (click on the x in the upper corner of your plot window -NOT THE PSI PLOT WINDOW!!)

You should now be back in your spreadsheet. Also save it also and close.

MORE NOTES
**Problem 2.12**
As crystals settle out of magmas, the element concentrations ($C$ in formula below) in the remaining liquid change according to the equation

$$C = C_0 F^{(d-1)}$$

where $C_0$ is the initial concentration of the element in the liquid before crystallization began, $F$ is the fraction of liquid remaining and $D$ is a constant (known as the distribution coefficient). Calculate the concentration of an element after 50% crystallization (i.e. $F = 0.5$) if its initial concentration was 200ppm and $D=6.5$.

Let's take a different approach to the solution of Problem 2.12. Rather than solving $C$ for just one value of $F$ let's solve $C$ for a range of $Fs$ extending from 0 to 1 at intervals of 0.05.

This will give us a total of 21 computations of $C$. Sounds like a lot of work, but with the help of PsiPlot, we can probably do all that in the time it would take you to do one computation by hand.

First -
Open up a blank spreadsheet. Click on the short-cut button just below the File option (see right)

This will open up a brand new spreadsheet.

Now we want to generate a column of numbers corresponding to $F$ (the fraction of liquid remaining) that range from 0 to 1 in increments of 0.05. To do this, click on Data, Fill Selection and then Algebraic (see illustration at right).

Another window will pop up (see right). We are placing values of $F$ in column 1. The values will occupy cells 1 through 21, The first cell has a value $F = 0$ and each consecutive cell will have a value $F$ incremented by 0.05
Rename that column F so that your spreadsheet looks like that right

Now go to Math Transform (right) and enter the equation

\[ C = 200 \times F^{5.5} \]

* represents the multiplication operator

\(^\) represents the exponentiation or power operator

The equation says

\[ C = C_0 F^{(D-1)} \].

What would you get if you took the natural log of C (i.e. ln (C))? What would you get if you took the base 10 log of C (i.e. log(C))?
Hit the enter key and the column next to F will be filled with values and labeled C as shown at right.

| 1  | 0.0000 | 0.0000 |
| 2  | 0.0500 | 0.0000 |
| 3  | 0.1000 | 0.0000 |
| 4  | 0.1500 | 0.0000 |
| 5  | 0.2000 | 0.0000 |
| 6  | 0.2500 | 0.0000 |
| 7  | 0.3000 | 0.0000 |
| 8  | 0.3500 | 0.0000 |
| 9  | 0.4000 | 0.0000 |
| 10 | 0.4500 | 0.0000 |
| 11 | 0.5000 | 0.0000 |
| 12 | 0.5500 | 0.0000 |
| 13 | 0.6000 | 0.0000 |
| 14 | 0.6500 | 0.0000 |
| 15 | 0.7000 | 0.0000 |
| 16 | 0.7500 | 0.0000 |
| 17 | 0.8000 | 0.0000 |
| 18 | 0.8500 | 0.0000 |
| 19 | 0.9000 | 0.0000 |
| 20 | 0.9500 | 0.0000 |
| 21 | 1.0000 | 0.0000 |
| 22 |    |       |
| 23 |    |       |

How does concentration (C) vary with liquid fraction (F)? Remember how to generate a plot?

Complete Problems 2.11 and 2.12 and hand in next Thursday.