

## Homework Sections 1.2

I. This problem discusses the relationship between the length of the femur and the height of the individual. The bullets below are instructions for using Microsoft Excel to solve this problem.

- Launch Microsoft Excel.
- The boxes are called Cells. Cells are named by their column and row. For example the top left cell is A1.

Anthropologists use a linear model that relates the length of a human's femur to his/her height. This model allows anthropologists to estimate the height of an individual when only a partial skeleton (including the femur) is present. In this problem we find the model by analyzing the data on femur length and height for the eight males given in the table.

Femur length (cm)	Height (cm)
50.1	178.5
48.3	173.6
45.2	164.8
44.7	163.7
44.5	168.3
42.7	165.0
39.5	155.4
38.0	155.8

- Click on the cell A1. A conspicuous border appears around the active cell.
- Type "Femur length (cm)," and push enter. The active cell becomes A2.
- Type 50.1 into cell A2, and push enter. Continue in the fashion to enter in the femur length data. Then click on cell B1, and type in the height data, beginning with its title. To adjust the column width, put your cursor over the line between the A and the B at the top of the first two columns. Your cursor will look like a vertical line with arrows pointing to the left and right. Click and drag the border between the two columns to the desired width.
- Click on the File in the menu bar at the top of the screen. Click on the Save As option. Save the sheet by giving it a name.
- Select the data (cells A2 to B9) by clicking on the cell A2, holding the button down, moving the cursor to cell B9, and releasing the button.
- Click on Insert in the menu bar at the top of the screen. Click Chart... A dialog box called "Chart Wizard – Step 1 of 4 – Chart Type" will appear. Click on x-y scatter plot. Click Next.
- The title of the dialog box changes to Step 2 of 4 – Chart Source Data. We will not use these options at this time. Click Next.
- Step 3 of 4 – Chart Options. Select the Titles tab, if it is not already selected. Type a title for your chart. For the Value (X) axis, type Femur Length (cm). For the Value (Y) axis, type Height (cm). Click the tab at the top of the dialog box that says Gridlines. Check Major gridlines under Value (X) axis and Value (Y) axis. Click Next.

- Step 4 of 4 – Chart Location. This dialog box allows you to choose whether the chart will appear in a new window, or as a part of the worksheet containing the data. Mark the “As an object in” radio button, if it is not already marked. Click Finish.
- The relationship between the x and y values on this graph appear linear. You will now add a least squares model, which is a line that is as close as possible to all of the data. Click on the chart to make it active (black squares will appear around its perimeter). From the menu bar, click the Chart menu and then select Add Trendline... A dialog box will appear.
- The Linear Trend/Regression type is marked. Click on the Options tab. Click in the box beside Display equation on chart. Click OK.
- A line of best fit should now appear, along with the equation of the line. You can click and drag the equation of the line to a convenient place on the chart.
- From the menu bar, choose File and Save.
- Click in cell A1. From the menu bar, choose File and then “Print preview.” You will see an image showing how the page will print. Click close. You will see dotted lines showing the page breaks in your document. Drag and drop the chart so that it fits entirely in the first page. You may need to adjust the chart’s size. Do this by clicking on the chart to activate it, and then clicking and dragging one of the corners of the chart, to adjust its size. Click in cell A1, and do Print preview again. If all is well, click print. From the menu bar, choose File and Save.
- Click on the chart to activate it. Do Print preview. If you wanted to print only the chart, and not the numerical data, you could do so in this way. Click Close.

In addition to your print out, write up answers to the following questions. For full credit, you must use complete sentences.

- A. Write the formula for your trendline as a function  $f(x)$  that yields the approximate height of an individual with femur length  $x$ . In your homework, write a sentence giving your formula and saying what the function yields.

If the formula were perfect, then when you plugged each femur length into the function, you would get the precise height of the person.

- B. Calculate  $f(44.7)$ . Write your answer in a sentence that includes what  $f(44.7)$  represents verbally. Compare your answer to what the data says the height of the man with a femur length of 44.7 cm really is.

If the formula were perfect, the line would pass directly through all of the data points. It is impossible for the model to pass through all of the points, since they are not precisely in a line. Instead, the least squares line is chosen to be as close as possible to all points simultaneously. Even though, when you plug in a femur length, you do not get the precise height of the individual, you do get an approximation.

- C. Calculate  $f(58)$ . What does  $f(58)$  represent verbally? Make sure your verbal description includes the word approximate.
- D. Anthropologists find a femur that is 42 cms long. Use your function to approximate the individual’s height.

- E. What is the slope of your line (including units)? In general, the slope of a line tells us how much the y-value increases or decreases if the x-value is increased by 1 unit. Write a sentence explaining what the slope represents in this model.

II. Read problem #6 page 27. Note that this model was published in a book called *Standards in Pediatric Orthopaedics*, by R. N. Hensinger.

- A. Use Excel to plot the data given in this problem, and fit a line to this data. Use part (I) of this assignment as a guide. Include a printout of your worksheet, showing the data and the scatter plot with your homework.
- B. Read the first paragraph of the Extended Application on page 75, describing the meaning of the vocabulary words interpolate and extrapolate. Explain what interpolate and extrapolate mean in your own words (using complete sentences, as usual).
- C. Give an example of a piece of information that you can get from the model in #6 page 27 using interpolation.
- D. Give an example of a piece of information that you can get from this model in #6 page 27 using extrapolation.
- E. What is the slope of your line (including units)? Write a sentence explaining what the slope represents in this model.