

You are to create an Excel spreadsheet named **Excel02PUNetID**, using your own PUNetID in the filename. Your spreadsheet is to contain both of the following worksheets.

**Worksheet #1 – Newton’s Law of Cooling, or how Newton can ruin your coffee.**

Newton’s Law of Cooling describes how a heated object cools over time. The law is given thusly:

$$h(t) = T + (h_0 - T) e^{kt}, \quad k < 0$$

Where **T** is the constant temperature of the surrounding medium (the air, the water, etc), **h<sub>0</sub>** is the initial temperature of the object, **k** is a negative constant, and **t** is the time the object has been cooling.

$h(0)$  = the fully heated temperature without any cooling.

$h(1)$  = the temperature after 1 unit of time spent cooling.

Build a worksheet, named **Newton**, as described below:

1) Construct a worksheet that will allow the user to input a value for **h(0)**, **T**, and **k**. The worksheet should display a table to calculate all values from  $h(1)$  to  $h(40)$  in increments of 1. The table should have three columns, **t**, **h(t)**, **Amount of Cooling**. Display  $h(t)$  to three decimal places by using the ROUND() function. In the **Amount of Cooling** column display how much the object has cooled since the previous time step:

Cooled zero degrees	No Cooling
Cooled more than 0 but less than 2 degrees	Slow Cooling
Cooled 2 degrees or more but less than 3 degrees	Some cooling
Cooled 3 degrees or more	Fast Cooling

Use conditional formatting to color the background of the **h(t)** column red when  $h(t) = T$  to indicate that the object has stopped cooling.

2) Use  $h(0) = 50.0$ ,  $T = 25.0$ , and  $k = -0.29$  for your initial calculation. When you submit your Excel file, this is the data I want to see displayed.

3) In cell K2 place the answer to the following question: Given the input in 2), at what time, **t**, does the object stop cooling (find the minimum value of **t** where  $h(t) = T$ )? You should just type the answer into cell K2, you should not try to write a formula to fill in this cell. Be sure to place an appropriate label in K1 to describe the contents of K2. Make sure to format your worksheet correctly so the entire label in K1 is visible.

4) In cell K4 place the answer to the following question: If the temperature of the surrounding medium is lowered to 15, when does the object stop cooling, using the values for **h<sub>0</sub>** and **k** given above? Be sure to place a nice label in K3.

5) In cell K6 place the answer to the following question: The initial temperature of the object is 100.0. The temperature of the surrounding medium is 10.0. If we want the temperature of the object to be 80.0 at **t=40**, what should the value of **k** be? Be sure to place a nice label in K5.

6) Change the values for the inputs to those specified in 2). Build a line chart that shows the temperature of the object. Remember, the independent variable always goes on the x-axis and the dependent variable goes on the y-axis. Place this chart immediately below your data.

## Worksheet #2 iGadget Cost

A gadget company calculates the cost of producing  $N$  gadgets at

$$\text{totalCost}(N) = \text{StartUp} + \text{GadgetMultiplier} * \text{Ln}(N)$$

Build a worksheet, named **iGadget**, as described below:

1) Construct a worksheet that shows the total cost of production for all gadgets and the cost of production per gadget, and the total profit made by the company (assuming the company sells every gadget it produces). Build a table where  $N$  ranges from 10,000 to 240,000, in increments of 10,000. Be sure to label each column correctly. The user should have the ability to input the value for StartUp, GadgetMultiplier, and Selling Price. The initial values for StartUp, GadgetMultiplier, and Selling Price are \$25,000,000, 100, and \$250, respectively.

Use conditional formatting to highlight the Total Profit cells where the company has a positive profit.

2) In cell K2 place the answer to the following question: What is the cost of production per gadget when 50,000 gadgets are produced? Be sure to place an appropriate label in K1 to describe the contents of K2. Make sure to format your cell correctly so the entire label in K1 is visible.

3) The company thinks that consumers will pay \$250 for each gadget. In cell K4 place the answer to the following question: How many gadgets must be produced for \$250 to be a profitable price? Since gadgets are made in batches of 10,000, give your answer as the lowest multiple of 10,000 that is profitable at \$250. Be sure to label this data in cell K3.

4) The company wants to know how many gadgets it must sell to make a positive profit if consumers will only pay \$200 for a gadget. Place this value, properly labeled, in cell K6. Remember, gadgets can only be made in batches of 10,000. In cell K8, list how many gadgets the company must produce and sell at \$200 to be profitable, if StartUp is \$30,000,000.

### Notes:

Note1: Use Excel to find the above answers as you will not be allowed to use any calculators on the Midterm. Be sure to write formulas that you can drag down or across cells.

Note2: Make sure your worksheet looks professional, use appropriate labels and formatting. Use named cells where appropriate.

Note3: Make sure your graph is easy to read and properly labeled (i.e. properly labeled axes & headings). Don't use abbreviations. Also, the data points of the graph are to be connected in a way that is visually appealing and professional looking.

### How to Submit and Grading Policies

- A copy of your single Excel file (properly named) with the two worksheets (properly named) is to be placed in the CS130 Drop Box by 4:45pm on the due date to be considered on time.
- Grading will be based on:
  - Correctness of your results
  - Completeness of your results
  - Professional look of the worksheets as described above and discussed in class
  - Ability to perform a what-if analysis by changing any of the user input data with accurate results correctly displayed based on the changed data
  - Ability to extend the last row by simply selecting and dragging the cell info