Instructions:

For this assignment, **two sets of data will be analyzed.** For this part of the project, you will be supplied with the data. You will carry out quadratic regression for the first data set and exponential regression for the second data set.

Quadratic Regression (QR):

Data: On a particular day in July, 2012, the outdoor temperature was recorded at 7 times of the day, and the following table was compiled.

Time of day (hour) x	Temperature (degrees F. y
5	70
8	75
11	86
14	91
17	91
20	84
23	77

REMARKS: The times are the hours since midnight. For instance, 5 means 5 am, and 14 means 2 pm.

The temperature is low in the morning, reaches a peak in the afternoon, and then decreases.

Tasks for Quadratic Regression Model (QR):

(QR-1) Plot the points (x, y) to obtain a **scatterplot**. Note that the trend is definitely non-linear. Use an appropriate scale on the horizontal and vertical axes and be sure to label carefully.

(QR-2) Find the **quadratic polynomial of best fit** and **graph** it on the scatterplot. State the **formula** for the quadratic polynomial.

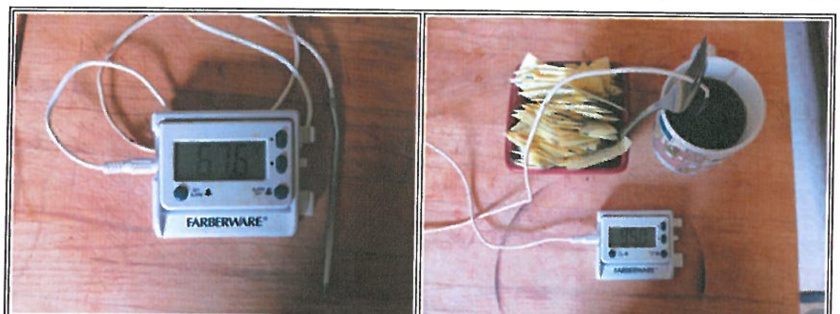
(QR-3) Find and state the value of r^2, the coefficient of determination. Discuss your findings. (r^2 is calculated using a different formula than for linear regression. However, just as in the linear case, the closer r^2 is to 1, the better the fit.) Is a parabola a good curve to fit to this data?

(QR-4) Use the quadratic polynomial to make an outdoor temperature **estimate**. Each class member will compute a temperature estimate for a different time of day. Look at the Class Members list in our Webtycho classroom, and look for the number "n" next to your name. Take your number n, multiply it by 0.5 and add to 6 to get a time x in hours; that is, compute $x = 0.5n + 6$. The value of x is the time you will substitute into the quadratic polynomial to make a temperature estimate. For instance, if your n is 15, then $x = 0.5(15) + 6 = 13.5$ hours (1:30 pm), and then you would substitute $x = 13.5$ into your polynomial equation to get the corresponding outdoor temperature estimate for 1:30 pm. State your results clearly -- the time of day and the corresponding outdoor temperature estimate.

(QR-5) Using algebra, find the **maximum temperature** predicted by the quadratic model and find the **time when it occurred. Show work.**

Exponential Regression (ER)

Data: A cup of hot coffee was placed in a room maintained at a constant temperature of 69 degrees.



The temperature of the coffee was recorded periodically, and the following table was compiled.

Time Elapsed (minutes) x	Coffee Temperature (deg F) T
0	166
10	140.5
20	125.2
30	110.3
40	104.5
50	98.4
60	93.9

REMARKS: Common sense tells us that the coffee will be cooling off and its temperature will decrease and approach the ambient temperature of the room, 69 degrees.

So, the temperature difference between the coffee temperature and the room temperature will decrease to 0.

We will be fitting the data to an exponential curve of the form $y = A e^{-bx}$. Notice that as *x* gets large, *y* will get closer and closer to 0, which is what the temperature difference will do.

So, we want to analyze the data where *x* = time elapsed and *y* = *T* - 69, the temperature difference between the coffee temperature and the room temperature.

Time Elapsed (minutes)	Temperature Difference (deg F)
x	*y* = *T* - 69
0	97
10	71.5
20	56.2
30	41.3
40	35.5
50	29.4
60	24.9

Tasks for Exponential Regression Model (ER)

(ER-1) Plot the points (*x*, *y*) in the second table to obtain a **scatterplot**. Note that the trend is definitely non-linear. Use an appropriate scale on the horizontal and vertical axes and be sure to label carefully.

(ER-2) Find the **exponential function of best fit** and **graph** it on the scatterplot. State the **formula** for the exponential function. It should have the form $y = A e^{-bx}$ where software has provided you with the numerical values for *A* and *b*.

(ER-3) Find and state the value of r^2, the coefficient of determination. Discuss your findings.(r^2 is calculated using a different formula than for linear regression. However, just as in the linear case, the closer r^2 is to 1, the better the fit.) Is an exponential curve a good curve to fit to this data?

(ER-4) Use the exponential function to make a **coffee temperature estimate**. Each class member will compute a temperature estimate for a different elapsed time. Look at the Class Members list in our Webtycho classroom, and look for the number "*n*" next to your name. Take your number *n*, multiply it by 6 to get an elapsed time *x*; that is, compute *x* = 6*n*. The value of *x* is the time (in minutes) you will substitute into the exponential function to make a temperature estimate. For instance, if your *n* is 14, then *x* = 6(14) = 84 minutes, and then you would substitute *x* = 84 minutes into your exponential function to get *y*, the corresponding temperature difference between the coffee temperature and the room temperature. Since *y* = *T* - 69, we have coffee temperature *T* = *y* + 69. Take your *y* estimate and add 69 degrees to get the coffee temperature estimate. State your results clearly -- the elapsed time and the corresponding estimate of the coffee temperature.

(ER-5) Use the exponential function together with algebra to **estimate the elapsed time when the coffee arrived at a particular target temperature**. Report the time to the nearest tenth of a minute. Each class member will work with a different target temperature. Take your "*n*" value from ER-4 and add it to 69 to get your target temperature *T*. For instance, if your *n* is 14, then your target temperature *T* is 69 + 14 = 83 degrees, and your goal is to find out how long it took the coffee to cool to 83 degrees. Note that 14 is the temperature difference between the coffee and the room, what we are calling *y*. So, for this particular target temperature, the goal is finding how long it took for the temperature difference *y* to reach 14 degrees; that is, solving the equation $14 = A e^{-bx}$ for *x*. In general, you are solving your equation $y = A e^{-bx}$ for *x*, where *y* = your particular temperature difference. **Show algebraic work** in solving your equation. State your results clearly -- your target temperature and the estimated elapsed time, to the nearest tenth of a minute.

Your completed project must include your name. You may submit all of your project in one document or a combination of documents, which may consist of word processing documents or spreadsheets or scanned handwritten work, provided it is clearly labeled where each checklist item can be found. Projects are graded on the basis of completeness, correctness, ease in locating all of the checklist items, and overall strength of the presentation.