

Quadratic Model Instructions

Quadratic Regression (QR)

Data: On a particular day in April, the outdoor temperature was recorded at 8 times of the day, and the following table was compiled.

Time of day (hour)	Temperature (degrees F.)
x	y
7	35
9	50
11	56
13	59
14	61
17	62
20	59
23	44

REMARKS: The times are the hours since midnight. For instance, 7 means 7 am, and 13 means 1 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. Just work with r^2 , not r .) 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 assigned by your instructor. Be sure to use the quadratic regression model to make the estimate (not the values in the data table). State your results clearly -- the time of day and the corresponding outdoor temperature estimate.
- (QR-5)** Using algebraic techniques we have learned, find the **maximum temperature predicted by the quadratic model** and find the **time when it occurred**. Report the time to the nearest quarter hour (i.e., __:00 or __:15 or __:30 or __:45). (For instance, a time of 18.25 hours is reported as 6:15 pm.) Report the maximum temperature to the nearest tenth of a degree. **Show work**.
- (QR-6)** Use the quadratic polynomial together with algebra to **estimate the time(s) of day when the outdoor temperature is a specific target temperature**. Each class member will work with a different target temperature, assigned by your instructor. Report the time(s) to the nearest quarter hour. Be sure to use the quadratic model to make the time estimates (not values in the data table). **Show work**. State your results clearly -- the target temperature and the associated time(s). **Show work**.

Please see the **Technology Tips** topic for additional information about generating the scatterplot and quadratic polynomial.

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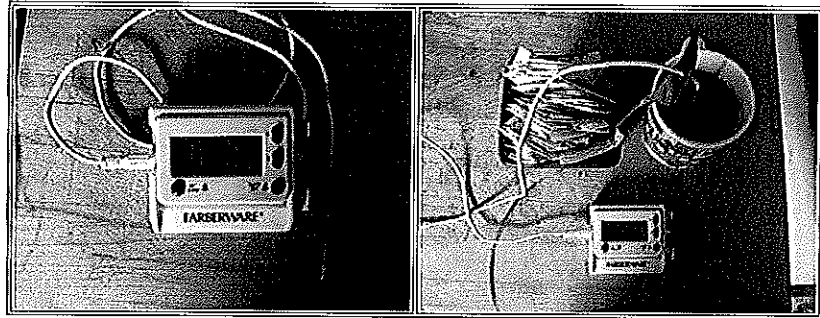
Activity Details

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Exponential Model Instructions

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.

Table 1:

Time Elapsed (minutes)	Coffee Temperature (degrees F.)
x	T
0	166.0
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.

Table 2

Time Elapsed (minutes)	Temperature Difference (degrees F.)
x	y
0	97.0
10	71.5
20	56.2
30	41.3
40	35.5
50	29.4
60	24.9

Tasks for Exponential Regression Model (ER)