5.8 Quadratic Regression

1.) **PUMPKIN TOSSING** A pumpkin tossing contest is held each year in Morton, Illinois, where people compete to see whose catapult will send pumpkins the farthest. One catapult launches pumpkins from 25 feet above the ground at a speed of 125 feet per second. The table shows the horizontal distances (in feet) the pumpkins travel when launched at different angles. Use a graphing calculator to find the best-fitting quadratic model for the data.

Angle (degrees)	20	30	40	50	60	70
Distance (feet)	372	462	509	501	437	323

Step 1: Enter the data into two lists of a graphing calculator.

Step 2: Make a scatter plot of the data…watch your window. What do the points look like?

Step 3: Use the quadratic regression feature to find the model for the data.

Step 4: Check how well the model fits the data by graphing the model and the data in the same view screen on your calculator.

2.) **RUNNING** The table shows how wind affects a runner's performance in the 200 meter dash. Positive wind speeds correspond to tailwinds, and negative wind speeds correspond to headwinds. The change t in finishing time is the difference beween the runner's time when the wind speed is s and the runner's time when there is no wind.

Wind speed (m/sec), s	−6	−4	−2	0	2	4	6
Change in finishing time (sec), t	2.28	1.42	0.67	0	−0.57	−1.05	−1.42

a. Use a graphing calculator to find the best-fitting quadratic model.

b. Predict the change in finishing time when the wind speed is 10 m/sec.

3.) Using a graphing calculator and quadratic regression to find a model:
A study compared the speed x, in miles per hour and the average fuel economy y (in miles per gallon) for cars. The results are shown in the table. Find a quadratic model in standard form for the data.

Speed x	15	20	25	30	35	40	45	50	55	60	65	70
Fuel Economy y	22.3	25.5	27.5	29	28.8	30	29.9	30.2	30.4	28.8	27.4	25.3

a) Enter the data into two lists of your graphing.

b) Make a scatter plot of the data. Why is it a scatter plot and not a strict parabola?

c) Use the quadratic regression figure to find the best fitting quadratic model for the data. Write the equation then graph it to see how it matches the scatter plot.

d) What exactly does the quadratic function represent in terms of gas mileage and the speed?

e) Find the speed that maximizes the fuel economy.

→ Where is it located graphically?

→ Is it the x or the y coordinate? Why?

→ Find the maximum speed by hand.

→ Find the maximum speed on the calculator

f) Make a prediction about how much fuel you would use if you were going 42 mph?

How about 19 mph?

4.) The table shows how wind affects a runner's performance in the 200meter dash. Positive wind speeds correspond to tailwinds and negative winds corresponds to headwinds. Positive changes in finishing time mean worsened performance (your time is slower) and negative changes mean improve performance (your time got faster).

Wind Speed (m/sec) s	-6	-4	-2	0	2	4	6
Change in finishing time t	2.28	1.42	0.67	0	-0.57	-1.05	-1.42

a) What is the relationship between the headwinds and tailwinds and the times of the athletes?

b) Use your calculator to write a quadratic function for the change t, in finishing time as function of the wind speed, s.

c) Does it have a maximum or minimum vertex? What does this represent?

d) What is the wind speed if there is to be no change in the finishing time?

e) Predict the change in finishing time when the wind speed is -1. What about when the wind speed is 5 m/sec?

With the Graphing Calculators! – Keystrokes

To graph a scatter plot and create a regression line on the calculator, follow the directions below.

Ex: Create a scatter plot in your calculator and find the equation of the best-fit equation for the following data.

In TI 84: STAT
        1: EDIT ENTER
        Type in data from "x" into L1
        Type in data from "y" into L2.

      2nd y =   Stat Plot Key
      1: Plot 1 ENTER
           ON   ENTER
           TYPE: 1ST graph with dots (scatter plot) ENTER
           X LIST: L1 2ND 1
           Y LIST: L2 2ND 2
           MARK: ▫ + ·   Pick one of these.   ENTER

     ZOOM 9: ZOOMSTAT   ENTER

     STAT   CALC
         5: QuadReg ENTER

         QuadReg y = ax^2 + bx+c
             a =
             b =
             c =

Equation of Best Fit rewrite and then Type this in **y =**   **GRAPH.**

Practice:

WRITING IN STANDARD FORM Write a quadratic function in standard form for the parabola that passes through the given points.

31. $(-4, -3), (0, -2), (1, 7)$ **32.** $(-2, -4), (0, -10), (3, -7)$ **33.** $(-2, 4), (0, 5), (1, -11)$

37. $(-2, -13), (2, 3), (4, 5)$ **38.** $(-6, 29), (-4, 12), (2, -3)$ **39.** $(-3, -2), (3, 10), (6, -2)$

WRITING QUADRATIC FUNCTIONS Write a quadratic function whose graph has the given characteristics.

40. passes through: $(-0.5, -1), (2, 8), (11, 25)$ **41.** x-intercepts: $-11, 3$ passes through: $(1, -192)$ **42.** vertex: $(4.5, 7.25)$ passes through: $(7, -3)$