Notes 7.6 MODELING DATA

Description of Data Points in a Scatter Plot	Model	When to Use this Model
Lie on or near a line Sketch:	**Linear Function** $y = mx + b$ When using a graphing calculator LinReg $y = ax + b$ where a = slope	When rate of **increase or decrease** appears to be **constant**, and when the data in a scatter plot resembles a line
Increasing more and more rapidly Sketch:	**Exponential Function** $y = a \bullet b^x$ where: **b** is the rate at which the function increases (b>1), or decreases (0<b<1), and **a** is the initial value at x = 0 When using a graphing calculator ExpReg y = a∗b^x	This model is associated data that **increase** (growth) **or decrease** (decay) more and more **rapidly**. Typically associated with population, epidemics, and interest-bearing bank accounts
Increasing, although rate of increase is slowing down Sketch:	**Logarithmic Function** $y = \log_b x$ which is equivalent to: $b^y = x$ When using a graphing calculator LnReg y = a + blnx	When the graph **increases** from left to right, but **the rate of increase is slowing down** as the graph moves to the right. Often used to model growing phenomena with growth that is leveling off.
Decreasing and then Increasing Sketch:	**Quadratic Function** $y = ax^2 + bx + c$ where a > 0 The vertex is the minimum point in the parabola: $Vertex = \left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$ When using a graphing calculator QuadReg $y = ax^2 + bx + c$	When the data in the scatter plot shows **one turning point** (the vertex), and goes from **decreasing to increasing** as the graph moves to the right.
Increasing and then Decreasing Sketch:	**Quadratic Function** $y = ax^2 + bx + c$ where a < 0 The vertex is the maximum point in the parabola: $Vertex = \left(\frac{-b}{2a}, f\left(\frac{-b}{2a}\right)\right)$ When using a graphing calculator QuadReg $y = ax^2 + bx + c$	When the data in the scatter plot shows **one turning point** (the vertex), and goes from **increasing to decreasing** as the graph moves to the right.

COMPARING LINEAR AND EXPONENTIAL MODELS:

Ex 1) The data for world population are shown in the table below.
Enter the data into the graphing calculator. (Round numbers to three decimal places)

X, Number of years **after 1949**	Y, World population (billions)
1 (1950)	2.6
11 (1960)	3.0
21 (1970)	3.7
31 (1980)	4.5
41 (1990)	5.3
51 (2000)	6.1
59 (2008)	6.8

a) Graph the scatter plot. What function does the shape suggests as a good choice for a model?

b) Find the linear regression equation. Use f(x) to represent the linear regression

c) Find the exponential regression equation. Use g(x) to represent the exponential regression

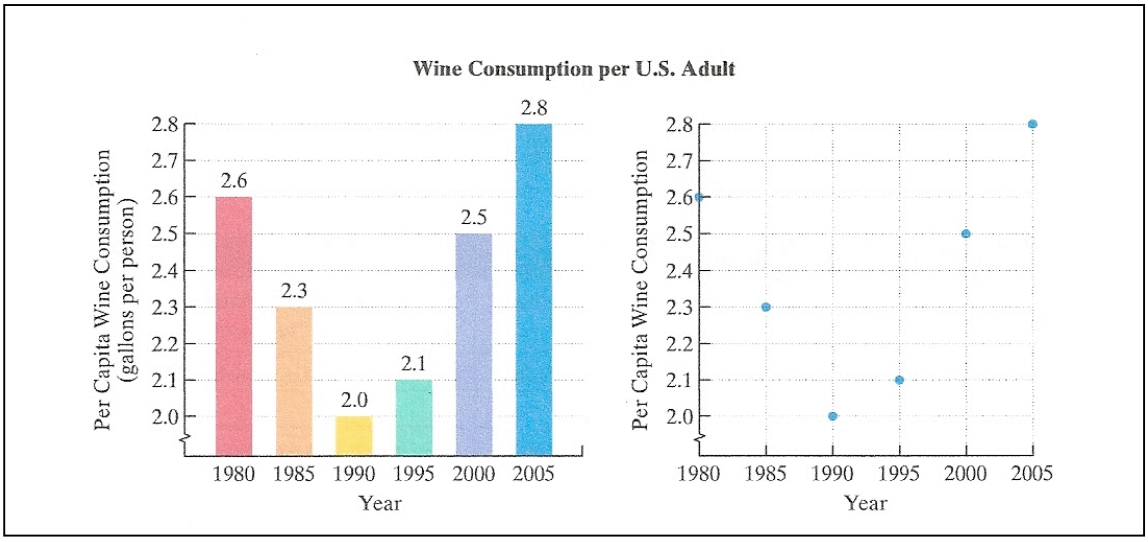
d) World population in 2000 was 6.1 billion. How well do the functions model world population for that year?

e) By one projection, world population is expected to reach 7 billion by 2012. Which function serves as a better model for this prediction?

Ex 2) Medical research indicates that the risk of having a car accident increases exponentially as the concentration of alcohol in the blood increases. The risk is modeled by $R = 6e^{12.77x}$ where x is the blood alcohol concentration and R, given as a percent, is the risk of having a car accident. In many states, it is illegal for drivers under 21 years old to drive with a blood alcohol concentration of 0.01 or greater.
a) What is the risk of a car accident with a blood alcohol concentration of 0.01?
b) What is the risk of a car accident with a blood alcohol concentration of .22?

MODELING WITH QUADRATIC FUNCTIONS:

Ex 3) The bar graph below shows per capita US adult wine consumption, in gallons per person, for selected years from 1980 to 2005. A scatter plot of the data is to the right.



a) What function does the shape suggests as a good choice for a model?

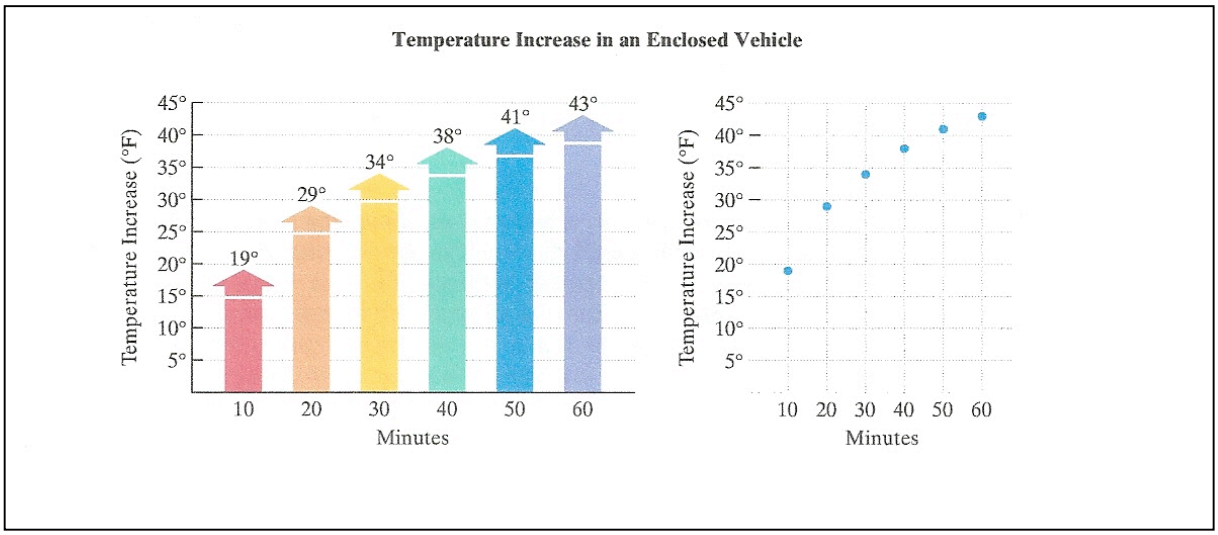
b) Using a graphing calculator, find the quadratic regression equation. Express the model in function notation *f(x)* with numbers rounded to three decimal places.

x years after 1980	*f(x)* wine consumption (gal/person)
0	
5	
10	
15	
20	
25	

c) According to the function in part (b), what was U.S. adult wine consumption in 1995? How well does this describe the value shown by the bar graph?

MODELING WITH LOGARITHMIC FUNCTIONS:

Ex 4) The bar graph below shows the increase in temperature inside an enclosed car over a period of 1 hour. A scatter plot of the data is to the right.



a) Observe the scatter plot and describe its behavior. What function does the shape suggests as a good choice for a model?

b) The graph shows the temperature increase throughout the hour. Use regression to find the logarithmic function. Organize those values in the table below. Express the model in function notation *f(x)* with numbers rounded to one decimal place.

X Time (in min)	*f(x)* Temperature (in °F)

c) Use the function to find the temperature increase, to the nearest degree, after 30 min. How well does the function model the actual increase shown in the bar graph?