Practice Making Models

Classwork: #25, 26, 31 (Don't make graphs - just look at them in the calculator)

25. Soup A student doing a Science Fair experiment put a hot bowl of soup in the refrigerator and checked the temperature of the soup every 2 minutes:

Time (min)	0	2	4	6	8	10	12	14	16	18	20
Temp (°C)	72	54.2	39.5	30.9	22.2	16.3	13.0	9.0	6.4	5.2	4.5

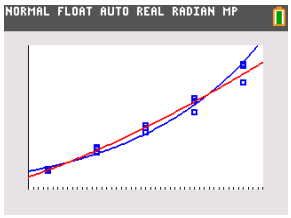
a) Create a model describing how the soup cools. Be sure to look at the residuals to verify that your model is appropriate.
b) Explain what the two values in the equation suggest about the soup.
c) Estimate the temperature of the soup after 3 minutes.
d) Estimate the temperature of the soup after 25 minutes.
e) How much confidence do you place in those estimates. Why?

26. Brakes The following table shows stopping distances in feet for a car tested 3 times at each of 5 speeds. We hope to create a model that predicts *Stopping Distance* from the *Speed* of the car.

Speed (mph)	Stopping Distances (ft)
20	64, 62, 59
30	114, 118, 105
40	153, 171, 165
50	231, 203, 238
60	317, 321, 276

a) Explain why a linear model is not appropriate. Curved

b) Create an appropriate model. DIST: $.85(x)^{1.43}$



c) Estimate the stopping distance for a car traveling 55 mph. DIST $= .85(55)^{1.43} = 262$ ft

d) Estimate the stopping distance for a car traveling 70 mph. DIST $= .85(70)^{1.43} = 370$ ft.

e) How much confidence do you place in these predictions? Why?

31. How old is that tree? One can determine how old a tree is by counting its rings, but that requires cutting the tree down. Can we estimate the tree's age simply from its diameter? A forester measured 27 trees of the same species that had been cut down, and counted the rings to determine the ages of the trees.

Diameter (in.)	Age (yr)	Diameter (in.)	Age (yr)
1.8	4	10.3	23
1.8	5	14.3	25
2.2	8	13.2	28
4.4	8	9.9	29
6.6	8	13.2	30
4.4	10	15.4	30
7.7	10	17.6	33
10.8	12	14.3	34
7.7	13	15.4	35
5.5	14	11.0	38
9.9	16	15.4	38
10.1	18	16.5	40
12.1	20	16.5	42
12.8	22		

a) Create a scatterplot and describe the association.

b) Create the linear model. $\widehat{age} = -.97 + 2.21(diam)$

c) Check the residuals. Explain why a linear model is probably not appropriate. curved

EXP d) Create a new model. $\widehat{age} = 4.779(1.138)^{diam}$

e) Check the residuals plot for this new model. Is this model more appropriate? Why? yes

f) Estimate the age of a tree 18 inches in diameter.

$\widehat{age} = 4.779(1.138)^{18} = 49$ yrs. old

Homework: #32, 34, 35, 36 (Don't make graphs - just look at them in the calculator)

32. Brightness People purchasing projectors for use in conference rooms, classrooms, or home theaters are concerned about the brightness of the image, which will vary depending on how far from the screen the projector will be placed. The table shows the relationship between image brightness (measured in candlepower) and distance (in feet) for one projector model.

Distance (ft)	Brightness (cp)
3	3450
4	1910
5	1225
6	850
7	625
8	475
9	375
10	300
12	210
15	135
20	75

a) Do you think the relationship between *Brightness* and *Distance* is linear? Explain.
b) Create an appropriate model and justify your choice.
c) Based on your model, estimate the brightness of the image this projector would produce in a classroom where it would be 18 feet from the screen.
d) What does the model's value of b reveal about this relationship?

34. Down the drain Most water tanks have a drain plug so that the tank may be emptied when it's to be moved or repaired. How long it takes a certain size of tank to drain depends on the size of the plug, as shown in the table. Create a useful model.

Plug Dia (in.)	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{3}{4}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2
Drain Time (min.)	140	80	35	20	13	10	5

35. Pressure Scientist Robert Boyle examined the relationship between the volume in which a gas is contained and the pressure in its container. He used a cylindrical container with a moveable top that could be raised or lowered to change the volume. He measured the *Height* in inches by counting equally spaced marks on the cylinder, and measured the *Pressure* in inches of mercury (as in a barometer). Some of his data are listed in the table. Create an appropriate model.

Height	48	44	40	36	32	28
Pressure	29.1	31.9	35.3	39.3	44.2	50.3
Height	24	20	18	16	14	12
Pressure	58.8	70.7	77.9	87.9	100.4	117.6

36. Baseball salaries 2005 Ballplayers have been signing ever larger contracts. The highest salaries (in millions of dollars per season) for some notable players are given in the following table.

Player	Year	Salary (million $)
Nolan Ryan	1980	1.0
George Foster	1982	2.0
Kirby Puckett	1990	3.0
Jose Canseco	1990	4.7
Roger Clemens	1991	5.3
Ken Griffey, Jr.	1996	8.5
Albert Belle	1997	11.0
Pedro Martinez	1998	12.5
Mike Piazza	1999	12.5
Mo Vaughn	1999	13.3
Kevin Brown	1999	15.0
Carlos Delgado	2001	17.0
Alex Rodriguez	2001	22.0
Manny Ramirez	2004	22.5
Alex Rodriguez	2005	26.0

a) Examine a scatterplot of the data. Does it look straight?
b) Find the linear model for *Salary* vs. *Year* (use year since 1980) and plot the residuals. Do they look straight?
c) What model would you use for the trend in salaries?