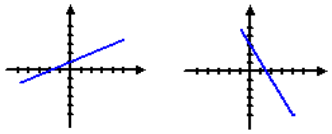
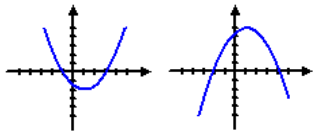
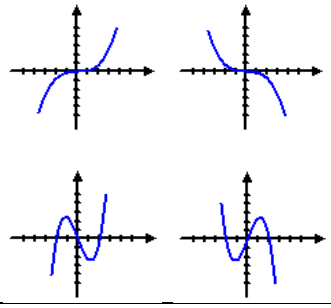
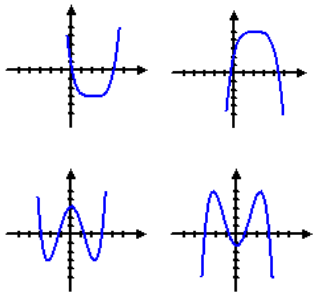
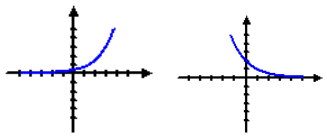
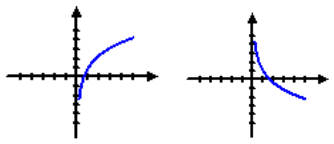
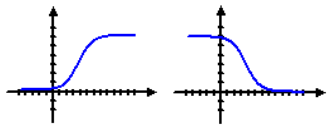
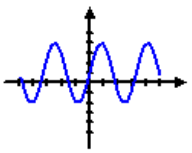
Sec 4.7 – Using Mathematical Models
Other Regression Models

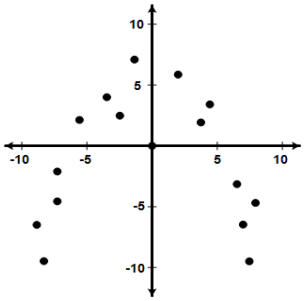
Name:

Common Function Models:

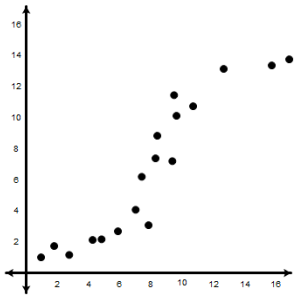
LINEAR	QUADRATIC	CUBIC	QUARTIC
			

EXPONENTIAL	LOGARITHMIC	LOGISTICS	SINUSOIDAL
			

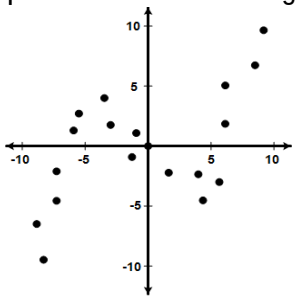
1. Which model do you think is the most appropriate for the following data sets?



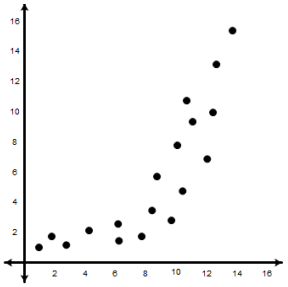
Model: QUADRATIC



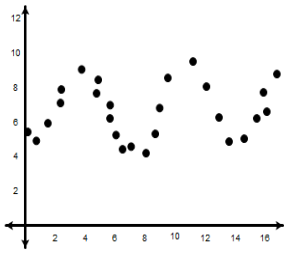
Model: LOGISTICS



Model: CUBIC



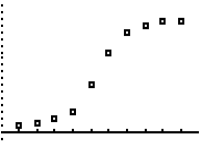
Model: EXPONENTIAL



Model: SINUSOIDAL

2. Determine which model would be best for each of the following data sets and then determine an equation.

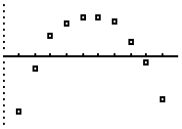
x	1	2	3	4	5	6	7	8	9	10
y	1	1.5	2	3	7	12	15	16	16.5	16.6



Model: LOGISTICS

Equation: $y = \frac{16.884}{1 + 273.698\,e^{-1.071x}}$

x	1	2	3	4	5	6	7	8	9	10
y	-9	-2	3	5	6	6.1	5.5	2	-1	-7



Model: QUADRATIC

QuadReg
$y=ax^2+bx+c$
a=-.7079545455
b=7.918409091
c=-15.435
R^2=.9887878991

Equation: $y = -.708x^2 + 7.918x - 15.435$

Logistic
y=c/(1+ae^(-bx))
a=273.0986873
b=1.070766789
c=16.88450464

Make a graph of the data on your calculator and o

i. Press STAT ENTER

ii. If there is OLD data already in the lists that needs to be cleared press the up arrow, ↑, to highlight L1 and then press CLEAR ENTER to clear out the old data. Do the same for L2 if it has OLD data that needs to be cleared.

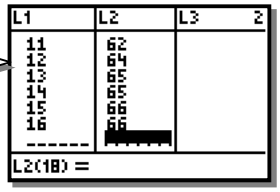
iii. Next, enter all of the ~~Cost~~ in L1 and the ~~Number Sold~~ in L2.

iv. After entering the data, press 2nd Y= ENTER and select all of the options shown in the screen at the right. To do this move the cursor to the appropriate option (On, ,)and press ENTER. To change the Xlist to L_1 if needed move the cursor to Xlist and press 2nd 1 and to the Ylist and press 2nd 2 .

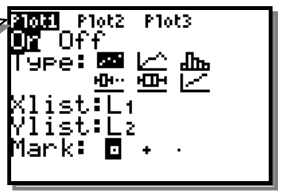
v. Finally, press ZOOM 9. To make further adjustments to the graph window press WINDOW .

vi. Additionally, you can type the equation you calculated earlier in the Y= to see the scatter plot and regression equation

Enter the data from the chart into L1 and L2



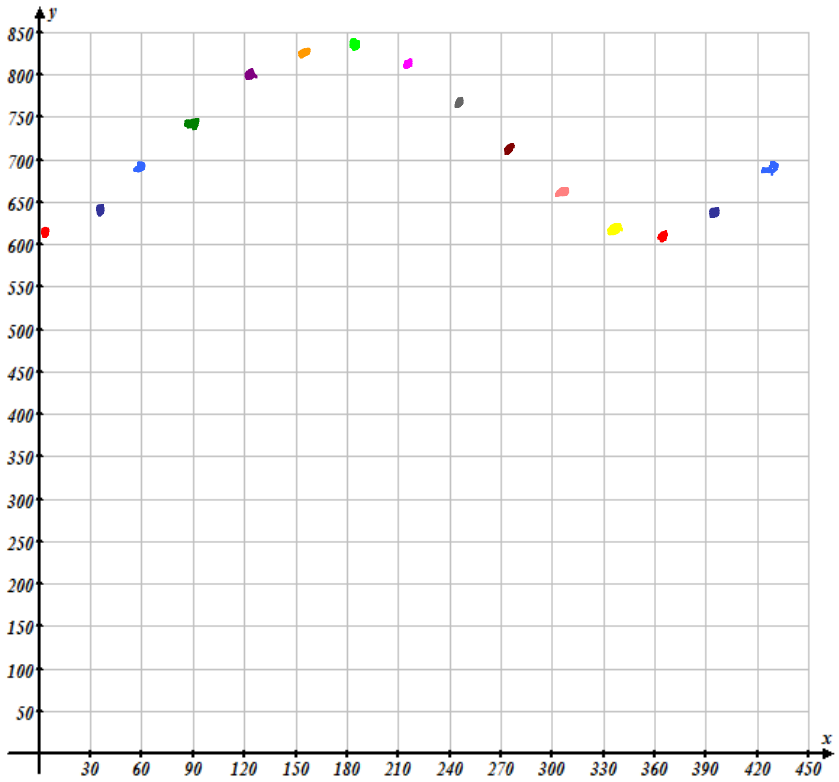
Select each of the following options by moving your cursor to each and Pressing ENTER.



3. Make a scatter plot of the length of daylight by day number for Houston on the blank grid.

(Length of Daylight for Cities).
To make the graph easier, make January 1 = Day 1 and December 31 = Day 365. In addition, graph the length of daylight in terms of minutes.

Date	Day Number	Houston	
		HH:MM	Min.
Jan. 1	1	10:17	617
Feb. 1	32	10:48	648
March 1	60	11:34	694
Apr. 1	91	12:29	749
May 1	121	13:20	800
June 1	152	13:57	837
July 1	182	14:01	841
Aug. 1	213	13:33	813
Sept. 1	244	12:45	765
Oct. 1	274	11:52	712
Nov. 1	305	11:00	660
Dec. 1	335	10:23	623



a. Continue plotting data points for the second year as they would repeat beginning with the first day of the second year of 366 would again have the length of a day of 617 minutes (Day 397, 648 min)

b. Which mathematical model would be most appropriate? SINUSOIDAL

c. Enter the data into the stat lists of your graphing calculator. Use the calculator to make a scatter plot of the length of daylight by day number for Houston.

vii. Under the Stat menu, press [STAT] [5] [ENTER] *(This just resets the stat menu.)*

viii. Press [STAT] [ENTER]

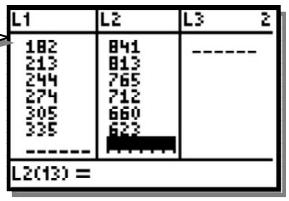
ix. If there is OLD data already in the lists that needs to be cleared press the up arrow, [↑], to highlight L1 and then press [CLEAR] [ENTER] to clear out the old data. Do the same for L2 if it has OLD data that needs to be cleared.

x. Next, enter all of the Cost in L1 and the Number Sold in L2.

xi. After entering the data, press [2nd] [Y=] [ENTER] and select all of the options shown in the screen at the right. To do this move the cursor to the appropriate option (On , ,)and press [ENTER]. To change the Xlist to L_1 if needed move the cursor to Xlist and press [2nd] [1] and to the Ylist and press [2nd] [2].

xii. Finally, press [ZOOM] [9]. To make further adjustments to the graph window press [WINDOW].

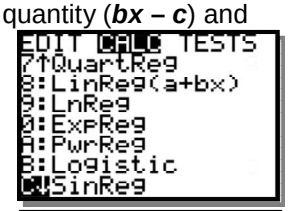
Enter the data from the chart into L1 and L2



Select each of the following options by moving your cursor to each and Pressing ENTER.

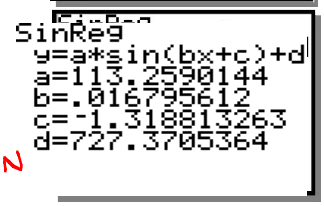
d. Use your calculator to generate a sinusoidal regression model. Record the equation (round values to the nearest hundredth) in the Summary Table at the end of this activity sheet. Factor the value of ***b*** from the quantity (***bx – c***) and include that form of the equation as well.

Return to the home screen by pressing [2nd] [MODE] and then to calculate the **Sinusoidal** regression press [STAT] [▶] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [▼] [ENTER] [ENTER]



Scroll down to choice "C:SinReg"

$$y = \underset{a}{113.26}\ sin\left(\underset{b}{.01680}\,x + \underset{c}{-1.3188}\right) + \underset{d}{727.37}$$



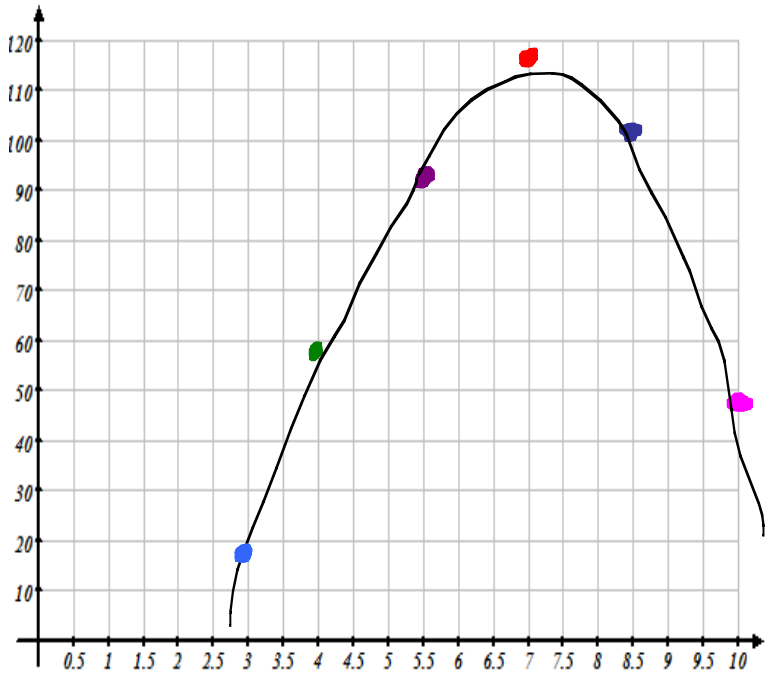
e. Based on the model, predict the length of day 185 ($113.26\sin(.0168(185)+-1.3188)+727.37$). ≈ 838 MIN

837.9394602

4. A company in California is test marketing a new line of lipsticks. The lipstick only costs the company $0.90 to make due to the volume production. The company located several different cities with approximately the same demographics and sold the exact same lipstick at different prices. They wanted to know which price would yield the largest profit. The following table shows the prices at which they were sold and the number sold at that price over a period of 3 months.

Cost	$3.00	$4.00	$5.50	$7.00	$8.50	$10.00
Number Sold	19	59	91	117	101	48

a. Make a Scatter Plot.



b. Draw a trend line or curve if more appropriate.

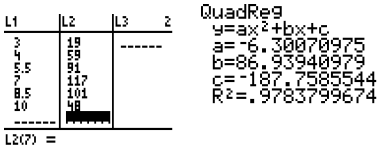
c. What type of association does the data show? (Is it linear?)

QUADRATIC

d. Explain why you think the data looks the way it does.

PROBABLY DUE TO THE IDEA THAT MOST PEOPLE ASSOCIATE PRICE WITH QUALITY. SO, NOT TOO MANY PEOPLE PURCHASED THE LIP STICK WHEN IT WAS TOO CHEAP OR TOO EXPENSIVE.

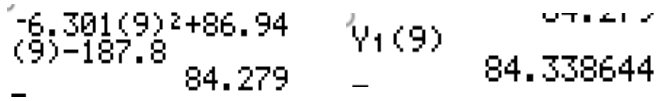
e. The TI-83/84 is capable of calculating quadratic, cubic, and quartic regression equations. Determine an appropriate regression model using the data.



$y = -6.301x^2 + 86.94x - 187.8$

(y: # SOLD, x: PRICE, x: PRICE)

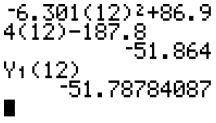
f. According to your model, what might be the suggested number sold if the store charges $9?



$y = -6.301(9)^2 + 86.94(9) - 187.8$

≈ 84 SOLD

g. According to your model, what might be the suggested number sold if the store charges $12?



$y = -6.301(12)^2 + 86.94(12) - 187.8$

≈ -52 SOLD ??

↑ WHAT WOULD THIS SUGGEST?

h. What constraints should be put on your model?

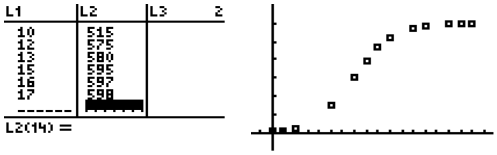
OUR MODEL IS PROBABLY ONLY REASONABLE FOR A DOMAIN OF SOMETHING LIKE $3 \le x \le 11$

5. A rancher has decided to dedicate a 400-square-mile portion of his ranch as a black bear habitat. Working with his state, he plans to bring 10 young black bears to the habitat in an effort to grow the population. His research shows that the annual growth rate of black bears is about 0.8. Black bears thrive when the population density is no more than about 1.5 black bears per square mile.

After bringing the initial 10 bears. The researcher noticed the following population growth:

Year	1995	1996	1997	2000	2002	2003	2004	2005	2007	2008	2010	2011	2012
Years after 1995	0	1	2	5	7	8	9	10	12	13	15	16	17
Number of Bears	10	18	30	148	302	391	465	515	575	580	595	597	598

a. Which model would be best? LOGISTICS



b. Determine a regression model using the calculator.

```
Logistic
 y=c/(1+ae^(-bx))
 a=59.82538309
 b=.5898228684
 c=599.9494612
```

$$y = \frac{599.95}{1 + 59.825e^{-0.58982x}}$$

y: POP; x: # OF YEARS AFTER 1995

c. What appears to be the maximum population of bears? (Hint: just predict the number of bears far off in to the future and see if it levels out. You could predict the number of bears in 2055 where x = 60)

```
(599.95)/(1+59.8
25e^(-0.58982*60
)
          599.95
```

```
Y1(60)
      599.9494612
```

≈ 600 BEARS