Mth 111 Lab #5 (10 pts) NAME

This lab is intended to review some of the things we have done so far. You are encouraged to work together. As necessary, attach additional paper but put your final answer on this paper. Your work will be graded on completeness, neatness, accuracy and punctuality. You must show your work!

CSI (Bend)

If we know the underlying equation form for a relationship we only need some data points to get a fairly accurate model using regression! For instance, if we put a bowl of soup on the table and record the temperature (T) of the soup every few minutes. (t = time temperature is taken) we'll get a graph similar to the one shown (assuming the room temperature is 70°). This graph represents *exponential decay*.

The regression choice for exponentials in the TI has the form $y = ab^x$. As you may recall, $y = ab^x$ is always asymptotic to the x-axis so the above graph cannot match the TI's regression choice. However, all is not lost.

If the above graph were to be shifted down by 70° then it would be asymptotic to the t-axis and we could use the TI's regression. For Example:

Suppose the soup mentioned above has this data (see above graph). Decide which should be the independent/dependent variables. Before entering the data into you TI, drop each "y" entry by 70°.

Original Data

0	10	20	30	40	50	60
212	155	121	100	88	81	77

Now enter the modified data into your TI.

Modified Data

0	10	20	30	40	50	60
142	85	51	30	18	11	7

Run exponential regression: You should get $y = 139.89*(0.95068)^x$

Shift the function up by 70°. $y = 139.89*(0.95068)^x + 70$. Graph and compare with the original data set.

Now let's put it to use:

Frank is found dead, on the dining room floor, by the maid, at 7:35 pm and calls the police. Detective Joe arrives at 8:10 pm and wisely takes the temperature of the bowl of soup still at the table where Frank sits slumped in his chair. The soup looks untouched. The cook says he served the soup at 7:00 pm sharp. Detective Joe craftily asks him to serve up a fresh bowl of soup. He takes its temperature as it's served and once again every 5 minutes. Here is what Detective Joe found.

Frank's soup was 143°F @ 8:10 pm when he arrived. The fresh soup was 196°F when served at 8:15 pm but 5 min later it had dropped to 184°F, then 174°, 165° and finally 157° in 5 minute intervals. Room temperature is 68°F. The cook claims to have served the soup steaming hot at 7:00 pm sharp. **Now to check the cook's story!**

1) Write the original data set.

8:15	8:20	8:25	8:30	8:35
196	184	174	165	157

2) Fill in the modified data set.

$x = L_1$	8.25				
Y = L2	128				

Note HH:MM = HH + MM/60 in decimal time

3) Use regression to find $y = a*b^x$ Write it here and store it in Y_1.

4) Adjust for room temperature to get a new function. Write it here and store it in Y_2.

5) Now use your new function to determine what time Frank's soup was actually served.

6) Find the equation of the form $y = A(b^x) + C$ given: an asymptote at $y = -3$, a y-intercept at (0, 5) and $y(-3) = -2$.

7) Smalltown's population is given by $P(t) = 250(1.04)^t$ where t is the number of years since 2000.

(a) What was the initial population in 2000?

(b) What does $P(5) = 304$ mean?

(c) What was the population in 2007?

(d) When will the population reach 500? That is, solve $P(t) = 500$.

8) The population of Chub in Phish Lake is given by the "logistic model": $P(t) = \dfrac{1200}{1 + 11e^{-t/5}}$

Assume 't' is measured in years and the fish were introduced into the lake at $t = 0$.

(a) What does $P(0) = 100$ mean?

(b) Graph P(t) in $[0, 60] \times [0, 1200]$. Summarize the overall growth of the Chub population for $t > 50$.

9) Solve for x: $y = 2 + Ke^{ax + b}$

10) Solve for x: $y = K \ln(mx + b) - 2$

BONUS

$P(t) = P_0e^{-kt}$ gives the amount of Naffzium after t minutes. Assume you start with 100 grams of Naffzium ($P_0 = 100$) and after 90 minutes you only have 60 grams left. To find the value for 'k' we must plug in the values we know and solve for k: $60 = 100e^{-k\,90}$

(a) Find 'k' <u>exactly</u> and store in 'K' K ≈

(b) Find the half-life of Naffzium? That is, using your recently determined value for 'k', solve $\frac{1}{2} = e^{-k\,t}$

half-life ≈