ECOR 2606 Assignment #7

1/. (Chapra 14.15) The following data represents the bacterial growth in a liquid culture over a number of days:

Days	0	4	8	12	16	20
Amount (millions)	67.38	74.67	82.74	91.69	101.60	112.58

Manually fit a straight line to the data. This work is not to be submitted but is just to give you some practice in case there is an exam question along these lines.

Use Matlab to fit a straight line and a quadratic to the data. Check your manually calculated straight line against the one you get using Matlab. Create a plot showing the given data points (use markers), the straight line fit, and the quadratic fit. Calculate the coefficients for both the straight line fit and the quadratic fit. Use the quadratic fit to predict the amount of bacteria that will exist after 30 days.

The correlation coefficient for the quadratic fit must be at least as good as the correlation coefficient for the linear fit. Why is this so? Add a comment that explains why at the end of your script file (to be called Q1.m).

2/. (Chapra 14.19) The table in the text gives the temperatures as being in Kelvin. This can't be correct as it's pretty hard to have liquid water at 0 K. The temperatures are presumably Celsius. The data is:

T (˚C)	0	10	20	30	40
Kw	1.164×10^{-15}	2.950×10^{-15}	6.846×10^{-15}	1.467×10^{-14}	2.929×10^{-14}

The following relationship between temperature *T* (in K) and *Kw* has been proposed:

$$-\log Kw = \frac{a}{T} + b \log T + cT + d$$

Use general least squares regression to find the "best fit" values for *a*, *b*, *c*, and *d*. The only real twist to this question (apart from the temperature scales) is that the *y* for regression is -log (*Kw*) rather than *Kw*. Basically you want to work with -log (*Kw*) versus the temperature in K.

Create a plot of -log (*Kw*) versus the temperature showing both the data points (use markers) and the fitted curve. Output a message of the form "The best fit is xxxx/T + xxxxlog(T) + xxxxT + xxxx" (with, of course, each xxxx replaced with the appropriate value).

3/. Produce a script file (to be called Q3.m) uses the data below and a third order interpolating polynomial to predict the values of *y* at *x* = 0.5, *x* = 1.5, and *x* = 2.5;

x:	0	1	2	3
y:	3	4	25	78

Have your script file output the interpolation polynomial as well as the predicted values.

Repeat the exercise manually using the Lagrange polynomial and Newton's polynomial. In both cases you need not completely simplify the polynomial. Just take things far enough that you can plug in *x* values and obtain *y* values. Verify that your polynomials are correct by comparing the results for *x* = 0.5, *x* = 1.5, and *x* = 2.5 with those produced by your script file.

P.S. Unless you read ahead, you will not be able to answer question 3 until after lecture 16.