ENG1060: COMPUTING FOR ENGINEERS

PASS 8 – Week 10

2020 OCT NOV

TASK 1

Download the xy_data.dat file from Moodle and import the data into MATLAB. Open the file to have a look at the structure before completing the following:

A. Plot y against x as red diamonds.
B. Calculate **by hand** the "linear" line of best fit constants a_0 and a_1, and the coefficient of determination R^2. Use fprintf to print statements for:
    - The equation for the linear line of best fit
    - The coefficient of determination
C. Using the polyfit() function in MATLAB to verify the values you obtained in part B.
D. Use the polyval() function to interpolate/extrapolate the values of y for the following x values: 2, 10, 17, 25. Plot these points as blue diamonds on the same figure from part A.

TASK 2

The data supplied for Task 1 corresponds to the average size of nanocrystals growing inside a metal alloy. The mechanical properties of the metal depend critically on the size of nanocrystals and it is therefore important to understand how quickly they grow.

The line of best fit calculated in Task 1 did provide a good fit. However, it is argued that an exponential curve of the form $y=\alpha e^{\beta x}$ would be more appropriate.

A. **Without using polyfit()**, write an m-file that uses the linear regression equations to calculate the constants α and β, and the determination of coefficient R^2. Print your answers using fprintf.
B. **Use polyfit()** to verify the values of α, β. Also verify the R^2 calculated in part A. Print your answers using fprintf.

TASK 3

It is believed that the following data can be modelled using an exponential curve with the equation

$$y = \beta e^{kx}$$

x	7	16	26	38	50	62	77	86
y	17	70	248	555	630	783	886	967

A. Show **by hand with pen and paper** the linearisation of this nonlinear model. You will need to present this work for marking.
B. Plot the data set as black diamonds.
C. Use the linreg() function you've created to calculate the constants β, *k* and r^2. Use fprintf to print these values.
D. Use the polyfit function in MATLAB to calculate β and *k*, and then determine the r^2 of the fit. Use fprintf to print these values and compare your answers with Part C.
E. Plot the nonlinear function as a blue dashed line on the figure produced in part B, using x as a vector from 0 to 90 with increments of 1.

TASK 4

Experimental data for force (N) and velocity (m/s) from a wind tunnel experiment is shown below.

v (m/s)	10	20	30	45	50	60	70	80
F (N)	25	70	380	550	610	1220	830	1450

Create a 5-by-1 subplot figure.

A. In each subplot, plot the data as black circles.
B. Use polyfit to fit the data using polynomial orders 1, 2, 3, 4 and 5. Then use polyval to interpolate/extrapolate the force values for velocities from 0 to 90m/s in increments of 0.5m/s. Plot each of these as magenta dashed lines separate subplots. E.g. top subplot contains polynomial order 1, next subplot contains polynomial order 2, etc. Include the polynomial degree in your legends and place your legends in the north-west.

TASK 5

A pharmaceutical company has developed bacteria that produces chemicals which inhibit the H1N1 flu strain, including swine flu. However, there is a problem. The chemists can control the bacteria's rate of formation over time d*N*/d*t*, but they are unsure when to stop the reaction. Download the measurements of the rate of formation as a function of reaction time (days) in a text file named experimental_dNdt.txt from Moodle. As is the case with all real-word experimental data, the measurements contain noise.

A. Load in the data from the text file and plot the bacteria formation rate (d*N*/d*t*) as a black line.
B. Inspect the plot to identify segments where you will perform curve fitting. You may want to use the "data cursor" tool (found in the figure window) to approximate the start and end times of each segment. Once you have identified the segments, perform the curve fitting for each segment and use fprintf to print out the equations of each segment.
C. Plot the curve fit of each segment as a different coloured dots on the same figure produced in part A.