Homework 3

Create a script file and include all of the following problems with each one being on section. Use the MATLAB publish feature to publish script to a word or pdf file.

Problem 1. The temperature of the ground at a depth x for surface temperature T_s and initial temperature T_i is given as

$$\frac{T-T_s}{T_i-T_s}=erf\left(\frac{x}{2\sqrt{\alpha t}}\right)$$

t=60*24*3600

T_s=-15 C

T_i=20 C

T=0 C

α=1.38*10^{-7} m^2/s

How deep should a water main be buried if we want to keep the water from freezing if the surface is at -15 C for 60 days?

Problem 2. Chemists and engineers must be able to predict the changes in chemical concentration in a reaction. A model used many single-reactant processes is

Rate of change of concentration= $-kC^n$

where C is the chemical concentration and k is the rate constant. The following data describe the reaction

$$(CH_3)_3CBr + H_2O \rightarrow (CH_3)_3COH + HBr$$

Use these data to obtain a least-squares fit to estimate the value of k

Time t (h)	C(mol of $(CH3)_3$ CBr/L)
0	0.1039
3.15	0.0896
6.20	0.0776
10.0	0.0639
18.3	0.0353
30.8	0.0207
43.8	0.0101

Problem 3. The following represents pressure samples, in pounds per square inch (psi), taken in a fuel line once every second for 10 sec.

Time (sec)	Pressure (psi)	Time (sec)	Pressure (psi)
1	26.1	6	30.6
2	27.0	7	31.1
3	28.2	8	31.3
4	29.0	9	31.0
5	29.8	10	30.5

a. Fit a first-degree polynomial, a second-degree polynomial, and a third-degree polynomial to these data. Plot the curve fits along with the data points
b. Use the results from part a to predict the pressure at $t = 11$ sec. Explain which curve fit gives the most reliable prediction. Consider the coefficients of determination and the residuals for each fit in making your decision.

Problem 4. Computer controlled machines are used to shape a car fender. Use interpolation to define the entire fender.

Fender Data

X (ft)	0	.25	.75	1.25	1.5	1.75	1.875	2	2.125	2.25
Y	1.2	1.18	1.1	1	0.92	0.8	0.7	0.55	0.35	0

Problem 5. The following data defines the sea-level concentration of dissolved oxygen for fresh water as a function of temperature:

T, °C	0	8	16	24	32	40
o, mg/L	14.621	11.843	9.870	8.418	7.305	6.413

Estimate $o(27)$ using **(a)** linear interpolation, **(b)** Newton's interpolating polynomial, and **(c)** cubic splines. Note that the exact result is 7.986 mg/L.

Problem 6. Generate eight equally-spaced points from the function

$$f(t) = \sin^2 t$$

from $t = 0$ to 2π. Fit this data with **(a)** a seventh-order interpolating polynomial and **(b)** a cubic spline.

Problem 7. Trace of My hand

Download and run **handdata.m**

Plot x vs. y

Let t=1:76

Interpolate x vs. t and y vs. t

Now plot curve for hand vs. data