ME 209
Numerical Methods

Problem Hour 4

INTERPOLATION-REGRESSION-DIFFERENTIATION

1. Use the portion of the given steam table for superheated H_2O at 200 MPa to
   a) find the corresponding entropy ***s*** for a specific volume ***v*** of 0.108 m^3/kg with linear interpolation
   b) find the same corresponding entropy using quadratic interpolation

v (m^3/kg)	0.10377	0.11144	0.1254
s (kJ/(kg.K)	6.4147	6.5453	6.7664

2. Rather than using the base-***e*** exponential model, a common alternative is to use a base-10 model,

$$y = \propto_5 10^{\beta_5 x}$$

Use this model given above to fit the following data:

Table 1. Experimental data.

x	0.4	0.8	1.2	1.6	2	2.3
y	800	975	1500	1950	2900	3600

Hint:

$$y = a_0 + a_1 x$$

$$a_1 = \frac{n\sum_1^n x_i y_i - \sum_1^n x_i \sum_1^n y_i}{n\sum_1^n x_i^2 - (\sum_1^n x_i)^2}$$

$$a_0 = \bar{y} - a_1 \bar{x}$$

3. Compute forward and backward difference approximations of $O(h)$ (1st order approximation) and $O(h^2)$ (2nd order approximation), and central difference (two-step size) approximations of $O(h^2)$ (1st order approximation for centered) and $O(h^4)$ (2nd order approximation for centered) for the first derivative of $y = \sin x$ at $x = \pi/4$ using a value of $h = \pi/12$. Estimate the true percent relative error ε_t for each approximation.