

# 1 Assignment 3 - Interpolation and Curve Fitting

1. Fitting noisy data to  $y = 5xe^{-3x}$ .

- The following MATLAB code segment creates a synthetic data set by adding noise to  $g(x) = 5xe^{-3x}$ . You should supply the value of  $n$ , which is the number of data points to be generated.

```
% --- Generate synthetic data
x0 = 0.01;           % Starting point ~ = 0 avoids log(0)
noise = 0.05;        % Magnitude of noise
x = linspace(x0,2,n);
y = 5*x.*exp(-3*x); % Create the true function y = g(x)
yn = y + noise*(rand(size(x))-0.5); %Noise multiplies
                                % random values v in the range
                                % -0.5 <= v <= 0.5
yn = abs(yn);        % Make sure all data are positive
```

- Now, we have a table (assume that obtained from an experiment). It is proposed that an unknown function has the form

$$f(x) = c_1 x e^{c_2 x}$$

- Write a MATLAB program to solve the normal equations to find the values of  $c_1$  and  $c_2$  for the given data set.

**Hint:** Nonlinear function is transformed to linear function as  $v = \alpha u + \beta$  and

$$\begin{aligned} v &= \ln(x/y) & u &= x \\ \beta &= \ln c_1 & \alpha &= c_2 \end{aligned}$$

- Your program should generate the data set, fit the data by using least-square approximation and plot the fitted and original functions.
- Study with different  $n$  values (say 50,100,200). Discuss the effect of increasing  $n$  on the fitted curve.

2. Write a MATLAB program to fit a cubic to the data which is generated in the previous question. Evaluate the cubic on the data. Compare this polynomial with the functions ( $f(x)$  and  $g(x)$ ) used in the previous question by plotting all these functions on the same graph.