

Fundamental Mathematics for Robotics

Homework Set #14-2, Dr.T

- [1] Find a quadratic regression equation of the form $y = ax^2 + bx + c$ for the data in [3] of HW Set #14-1. Compare and discuss the rms errors here with that in [3].
- [2] Consider the following functions that are non-linear in design parameters. Your mission is to linearize those functions in terms of the design parameters so that the linear regression technique can be applied to find the optimum parameter values.
- (e) $y = Ae^{bx}$ (Parameters are A and b)
 - (f) $y = ax^b$ (Parameters are a and b)
 - (g) $y = 2\cos(\omega x + \phi)$ (Parameters are ω and ϕ)
 - (h) $y = e^{10^{ax+b}}$ (Parameters are a and b)
- [3] The following set of data represents atmospheric absorption of infrared wave. This type of data is used for the evaluation of infrared sensors. It is known that the data follows the double exponential law described by $y(x) = \exp\{10^{ax+b}\}$. Find the optimal set of values a^* and b^* that results in the LMS error.

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
y	0.96	0.94	0.91	0.87	0.81	0.73	0.62	0.48	0.33	0.19	0.08

- [4] Find two non-linear models for the following data. Note that the functions are not given this time. You must make up your own functions. Also, you must explain the reason why you chose your functions.

x	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
y	0.08	0.19	0.33	0.48	0.62	0.73	0.81	0.87	0.91	0.94	0.96