GENG-8030 Computational Methods and Modeling for Engineering Applications

Summer-2023

Tutorial 5

All questions were taken from the course textbook:

Title	MATLAB for engineering applications
Author	William J. Palm
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Chapter 6: Model Building and Regression

6. The useful life of a machine bearing depends on its operating temperature, as the following data show. Obtain a functional description of these data. Plot the function and the data on the same plot. Estimate a bearing's life if it operates at 150°F.

Temperature (°F)	100	120	140	160	180	200	220
Bearing life $(\text{hours} \times 10^3)$	28	21	15	11	8	6	4

7. A certain electric circuit has a resistor and a capacitor. The capacitor is initially charged to 100 V. When the power supply is detached, the capacitor voltage decays with time, as the following data table shows. Find a functional description of the capacitor voltage v as a function of time t. Plot the function and the data on the same plot.

Time (s)	0	0.5	1	1.5	2	2.5	3	3.5	4
Voltage (V)	100	62	38	21	13	7	4	2	3

9. The following data give the drying time T of a certain paint as a function of the amount of a certain additive A.

a. Find the first-, second-, third-, and fourth-degree polynomials that fit the data, and plot each polynomial with the data. Determine the quality of the curve fit for each by computing J, S, and r^2.

b. Use the polynomial giving the best fit to estimate the amount of additive that minimizes the drying time.

A (oz)	0	1	2	3	4	5	6	7	8	9
T (min)	130	115	110	90	89	89	95	100	110	125

12. Obtain a linear model $y = a_0 + a_1x_1 + a_2x_2$ for the following data to describe the relationship.

y	x_1	x_2
2.85	10	8
4.2	16	12
4.5	18	14
3.75	22	24
4.35	26	28
4.2	28	34

17. The following function is linear in the parameters a_1 and a_2.

$$y(x) = a_1 + a_2 \ln(x)$$

Use least-squares regression with the following data to estimate the values of a_1 and a_2. Use the curve fit to estimate the values of y at $x = 2.5$ and at $x = 11$.

x	1	2	3	4	5	6	7	8	9	10
y	15	21	24	27	28	30	31.5	33	34.5	34.5

22. Consider the following data. Find the best-fit line that passes through the point $x_0 = 10, y_0 = 20$.

x	0	5	10
y	0.4	9.7	20