MMT-009: Mathematical Modeling

Sessions 1 and 2

1. An electric utility is interested in developing a model relating peak hour demand (y) to total energy usage during the month (x). Data for 53 residential customers for the month of August, 2005 are shown in Table 1.

Table 1

Customer	x(KWH)	y(KW)	Customer	x(KWH)	y(KW)
1	679	.79	27	837	4.20
2	292	.44	28	1748	4.88
3	1012	.56	29	1381	3.48
4	493	.79	30	1428	7.58
5	582	2.70	31	1255	2.63
6	1156	3.64	32	1777	4.99
7	997	4.73	33	370	.59
8	2189	9.50	34	2316	8.19
9	1097	5.34	35	1130	4.79
10	2078	6.85	36	463	.51
11	1818	5.84	37	770	1.74
12	1700	5.21	38	724	4.10
13	747	3.25	39	808	3.94
14	2030	4.43	40	790	.96
15	1643	3.16	41	783	3.29
16	414	.50	42	406	.44

17	354	.17	43	1242	3.24
18	1276	1.88	44	658	2.14
19	745	.77	45	1746	5.71
20	435	1.39	46	468	.64
21	540	.56	47	1114	1.90
22	874	1.56	48	413	.51
23	1543	5.28	49	1787	8.33
24	1029	.64	50	3560	14.94
25	710	4.00	51	1495	5.11
26	1434	.31	52	2221	3.85
			53	1526	3.93

Write a program in C-language to

a) find a linear model that best fit the data using the least squares estimates and estimate the peak hour demand for a total of 2050 KWH energy usage.

b) find R^2 for the model.

2. A manufacturer of particle boards is interested in the strength of particle boards as a function of the baking temperature. The data from an experiment designed to study this relation are given in Table 2.

Table 2

Strength	Temp.	Strength	Temp.
66.30	40	75.78	55
64.84	40	72.57	55
64.36	40	76.64	55

69.70	45	78.87	60
66.26	45	77.37	60
72.06	45	75.94	60
73.23	50	78.82	65
71.40	50	77.13	65
68.85	50	77.09	65

Write a programme in C-language to

a) obtain a best fit line using the least squares estimates.
b) fit a quadratic model using the least squares estimates.
c) compare the models in a) and b) above by finding R^2 for each of them.

3. When gasoline is pumped into the tank of a car, vapors are vented into the atmosphere. An experiment was conducted to determine whether y, the amount of vapour, can be predicted using the following four variables based on initial conditions of the tank and the dispensed gasoline:

x_1 = tank temperature

x_2 = gasoline temperature

x_3 = vapour pressure in tank

x_4 = vapour pressure of gasoline

The data are given in Table 3.

Table 3

y	x_1	x_2	x_3	x_4	y	x_1	x_2	x_3	x_4
29	33	53	3.32	3.42	40	90	64	7.32	6.70
24	31	36	3.10	3.26	46	90	60	7.32	7.20
26	33	51	3.18	3.18	55	92	92	7.45	7.45

22	37	51	3.39	3.08	52	91	92	7.27	7.26
27	36	54	3.20	3.41	29	61	62	3.91	4.08
21	35	35	3.03	3.03	22	59	42	3.75	3.45
33	59	56	4.78	4.57	31	88	65	6.48	5.80
34	60	60	4.72	4.72	45	91	89	6.70	6.60
32	59	60	4.60	4.41	37	63	62	4.30	4.30
34	60	60	4.53	4.53	37	60	61	4.02	4.10
20	34	35	2.90	2.95	33	60	62	4.02	3.89
36	60	59	4.40	4.36	27	59	62	3.98	4.02
34	60	62	4.31	4.42	34	59	62	4.39	4.53
23	60	36	4.27	3.94	19	37	35	2.75	2.64
24	62	38	4.41	3.49	16	35	35	2.59	2.59
32	62	61	4.39	4.39	22	37	37	2.73	2.59

Write a program in C-language to

a) fit a linear regression model to the data using the least squares estimates.
b) find the 'hat' matrix.
c) find the residual error.
d) find R^2 for the model.

Session 3

Program 1

Program in 'C' language to find the initial basic feasible solution of a transportation problem using North-west corner method and Matrix-Minimum method.

Program 2

Program in 'C' language to find the operational measures using queueing model.