

OLLSCOIL NA hÉIREANN, GAILLIMH
NATIONAL UNIVERSITY OF IRELAND, GALWAY.

SEMESTER 1 EXAMINATIONS

2000/2001

B.COMM DEGREE

THIRD YEAR INDUSTRIAL ENGINEERING & INFORMATION SYSTEMS

OPERATIONS RESEARCH

Dr. E. J. Wright
Prof. M.E.J. O'Kelly
Ms. M. Dempsey

Instructions: Time allowed: 2 Hours
Answer any three questions
Show all your work clearly.

- Q 1** Bagwell Distributor packages and distributes industrial supplies. A standard shipment can be packaged in a class A container, a class K container, or a class T container. A single class A container yields a profit of £8; a class K container, a profit of £6; and a class T container, a profit of £14. Each shipment prepared requires a certain amount of packing material and a certain amount of time, as seen in the following table:

Class of Container	Packing Material (Pounds)	Packing Time (Hours)
A	2	2
K	1	6
T	3	4
Total amount of resource Available each week	120 Pounds	240 hours

Bill Bagwell head of the firm, must decide the optimal number of each class of container to pack each week. He is bound by the previously mentioned restrictions, but he also decides that he must keep his six full-time packers employed all 240 (6 workers 40 hours) each week.

- (i) Formulate a linear programming model for this problem.
- (ii) Solve the problem using the Simplex Method

- Q 2 (a)** The Fast Cab Co. has a taxi waiting at each of four cab stands in Stand 1, Stand 2, Stand 3 and Stand 4. Four customers have called and requested service, The distances, in miles, from the waiting taxis to the customers are given in the following table.

CUSTOMER

CAB SITE	A	B	C	D
Stand 1	7	3	4	8
Stand 1	5	4	6	5
Stand 1	6	7	9	6
Stand 1	8	6	7	4

Use the Hungarian algorithm to determine the optimal assignment of taxis to customers so as to minimize driving distances to the customers.

- Q 2 (b)** The Hardrock Concrete Company has plants in three locations and is current ally working on three major construction projects, each located at a different site. The shipping cost per truckload of concrete, daily plant capacities, and daily project requirements are provided in the following table:

	Supply House 1	Supply House 2	Supply House 3	
Pineville	£3	£3	£2	25
Oak Ridge	£4	£2	£3	40
Mapletown	£3	£2	£3	30
Demand	30	30	35	

- Use the least cost method to establish an initial feasible shipping schedule and calculate its cost
- Use either the stepping stone or MODI method to test whether an improved solution is possible.

Q 3 a) Sales of Lanterns at See. Clear Co. over the past 13 months are as follows

<i>Year</i>	<i>Sales</i>
1	450
2	495
3	518
4	563
5	584
6	?

The sales Manager had predicted, before the business started, that year 1's sales would be 410 Lanterns.

- (i) Using exponential smoothing with a weight of 0.30, develop forecasts for years 2 through 6
- (ii) Using smoothing constants of 0.6 and 0.9, develop a forecast for the sales of See Clear Lanterns
- (iii) Which smoothing constant gives the most accurate forecast
- (iv) Using the trend projection method, develop a forecasting model for the sales of See Clear Lanterns.
- (v) What other factors might See Clear consider in forecasting sales?

Q 3 b) Data was collected as shown in the following table

<i>The Corrs TV Appearances</i>
3
4
7
6
8
5

- i) Graph these data to see whether a linear equation might describe the relationship between the group's television shows and bass drum sales
- ii) Use the least squares method to derive a forecasting equation
- iii) What is your estimate for bass drum sales if The Corrs performed on TV nine times last month

- Q 4** Shock Co. is a company that installs wiring and electrical fixtures in residential construction. The company has been concerned with the amount of time that it takes to complete wiring jobs. Some of the workers are very unreliable. A list of activities and their optimistic, their pessimistic, and their most likely completion times in days are given in the following table:

Activity	Immediate Predecessor	Most Optimistic	Most Probable	Most Pessimistic
A	-	3	6	8
B	-	2	4	4
C	-	1	2	3
D	C	6	7	8
E	B,D	2	4	6
F	A,E	6	10	14
G	A,E	1	2	4
H	F	3	6	9
I	G	10	11	12
J	C	14	16	20
K	H,I	2	8	10

- (i) Construct a network for this problem
- (ii) Calculate the expected times and variances for each activity.
- (iii) Calculate the ES, EF, LS, LF and slack for each activity.
- (iv) Determine the critical path and project completion time

Q 5 a) Dorsey Distributors has an annual demand for a metal detector of £1,400. The cost of a typical detector to Dorsey is £400. Carrying cost is estimated to be 20% of the unit cost, and the ordering cost is £25 per order. If Dorsey orders in quantities of 300 or more, it can get a 5% discount on the cost of the detectors. Should Dorsey take the quantity discount?

b) A road network joining 6 towns, A, B, C, D, E and F has the following capacity:

Direction	Capacity (Cars/hour)
A → B	2
B → A	4
A → C	3
C → A	2
B → C	0
C → B	1
B → D	4
D → B	4
C → E	2
E → C	1
B → E	0
E → B	1
C → D	1
D → C	1
D → E	5
E → D	4
E → F	2
F → E	2
D → F	1
F → D	3
B → F	4
F → B	10

i) Using the maximal flow algorithm determine the maximum number of cars per hour that can travel from A to F?

ii) What is the maximum number of cars per hour that can travel from F to A?