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University Examinations 2013/2014

SECOND YEAR, SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF COMMERCE

HBC 2210/2122: OPERATIONS RESEARCH I

DATE: DECEMBER 2013   TIME: 2HOURS

INSTRUCTIONS: *Answer question **one** and any other **two** questions*

QUESTION ONE – (30 MARKS)

a) Write a brief history of operation research.   (4 Marks)

b) Find the dual linear program of

$minimize\ z = 20x_1 + 30x_2$
$Subject\ to:\ 2x_1 + x_2 \le 80$
$\qquad\qquad x_1 + 2x_2 \le 60$
$\qquad\qquad x_1 \ge 10, x_2 \ge 15$

               (3 Marks)

c) Solve the following linear programming problem using simplex method

$maximize\ z = 60x_1 + 40x_2$
$Subject\ to:\ 7x_1 + 8x_2 \le 1600$
$\qquad\qquad 8x_1 + 12x_2 \le 1600$
$\qquad\qquad 15x_1 + 16x_2 \le 1600$
$\qquad\qquad x_1,\ x_2 \ge 0$ (10 Marks)

d) Find the initial basic feasible solution to the following transportation problem using least cost entry method.   (9 Marks)

Source	Destination			Available
	1	2	3	
	50	30	190	10
	80	45	150	30
	220	180	50	40
Requirement	40	20	20	

e) At a certain refinery, the refining process requires the production of at least two gallons of petrol for each gallon of crude oil. To meet the anticipated increased fuel demands, at least 3 million gallons of crude oil a day needs to be produced. The demand for petrol on the other hand, is not more than 6.4 million gallons a day. If petrol is selling at $1.90 per gallon and crude oil sells for $1.50 per gallon. Formulate the underlying linear programming problem that seeks to find how much of each should be produced in order to maximize revenue.

(4 Marks)

QUESTION TWO – (20 MARKS)

A company wants to supply materials from three plants to three new projects. Project I requires 50 truck loads, project II requires 40 truck loads and project III requires 60 truck loads. Supply capacities for the plants P_1, P_2 and P_3 are 30, 55 and 45 truck loads.

The table of transportation costs and initial BFs using Vogels' approximation method is given in the table below

		To		
		I	II	III
From	P_1	7	10	12
	P_2	8	12	7
	P_3	4	9	10
	P_4	0	0	0

Find the optimal solution.

QUESTION THREE (20 MARKS)

a) A company is faced with the problem of assigning 4 jobs to 5 persons. The expected profit in rupees for each person on each job are as follows

Persons	Job			
	J$_1$	J$_2$	J$_3$	J$_4$
I	86	78	62	81
II	55	79	65	60
III	72	65	63	80
IV	86	70	65	71
V	72	70	71	60

Find the assignment of persons to jobs that will result in a maximum profit. (10 Marks)

b) Goods have to be transported from source S_1, S_2 and S_3 to destinations D_1, D_2 and D_3. The transportation cost per unit, capacitances of the sources and requirements of the destinations are given in the following table.

	D$_1$	D$_2$	D$_3$	Capacity
S$_1$	8	5	6	120
S$_2$	15	10	12	80
S$_3$	3	9	10	80
	150	80	50	

Obtain the initial basic feasible solution using North – West Corner Rule. (10 Marks)

QUESTION FOUR (20 MARKS)

a) Arrivals at a service counter are considered Poisson with an average time of 10 minutes between arrivals. The length of service is assumed to be distributed exponentially with a mean of 3 minutes.

   i. Calculate the utilization of the counter. (4 Marks)

   ii. What is the average time spends in the system. (4 Marks)

b) A fast food canteen serves food to university students over lunch hour. On busy days, the canteen receives students at a rate of 140 per hour. Each students order takes 25 seconds to put together and to have it served. Assuming that students arrivals are Poisson distributed with exponential service rate in a single counter $(m|m|1|)$. Determine

   i. Proportion of time that the counter is busy. (3 Marks)

   ii. Average number of students in the system. (2 Marks)

   iii. Average number of students in the queue. (3 Marks)

   iv. Average time spent in the system. (3 Marks)

QUESTION FIVE (20 MARKS)

a) Explain the following terms as used in network analysis

   i. Loops and dangling. (2 Marks)

   ii. Critical path (2 Marks)

   iii. Optimistic time (2 Marks)

   iv. Pessimistic time (2 Marks)

b) A project has been broken down into 10 activities with the following predecessors and duration.

Activity	Predecessor	Duration (weeks)
A	-	5
B	-	7
C	A,B	8
D	-	10
E	C	10
F	B	5
G	C,F,H	8
H	D	12
I	D	7
J	I	9

Draw the network diagram and identify the critical path. (12 Marks)