"Investing in Africa's Future"

COLLEGE OF BUSINESS, PEACE, LEADERSHIP AND GOVERNANCE

NMMS409: OPERATIONS RESEARCH

END OF SEMESTER EXAMINATION

NOVEMBER 2021

PROF S. MURAIRWA

TIME: 5 HOURS

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INSTRUCTIONS

Answer one question.

The marks allocated to each question are shown at the end of the question.

Credit will be given for logical, systematic and neat presentations.

1. The following table provides the information necessary to crash the project:

Activity	Preceding Activities	Duration	Crash cost ($)	Crash duration	Cost ($)
A	-	5	200	4	300
B	A	7	500	3	1000
C	A	6	800	4	1400
D	-	6	500	5	700
E	D	6	700	3	850
F	D	8	900	5	1050
G	D	9	1000	5	1240
H	-	8	1000	4	1320
I	H	7	600	4	900
J	H	7	800	6	1000
K	-	5	1000	4	1200
L	K	9	500	5	700
M	K	10	1200	8	1240
N	B	8	600	4	760
O	N,Q,S	14	1500	10	1780
P	R,U	15	2000	10	2500
Q	C,E,Y	10	2000	8	2400
R	C,E,Y	15	1500	7	1900
S	F,I	20	3000	15	3750
T	V,W	10	2000	7	3200
U	G,J,L	14	1800	9	2250
V	G,J,L	22	5000	13	7700
W	M	18	4000	10	5280
X	O,P,T	11	3000	9	4000
Y	H	3	300	2	350

a) Determine the free float time and slope for each activity. Identify the critical path and find the duration of the project using normal duration for each activity. [**25 Marks**]
b) Discuss the characteristics of Management Science. [**25 marks**]
c) Explain any five tools of Management Science that have been developed specifically for solving managerial problems. [**50 marks**]

2. A bakery has three production lines that supply bread to four universities (A, B, C, D). Each production line can supply the following numbers of loaves of bread per day; Line I (35 loaves), Line II (50 loaves), Line III (40 loaves). The maximum bread demand per day for each university is A (45 loaves), B (20 loaves), C (30 loaves) and D (30 loaves). The costs ($) of delivering a loaf of bread from the production lines to the universities are Line I [A-8; B-$6; C-$10; D-$9], Line II [A-$9; B-$12; C-$13; D-$7] and Line III [A-$14; B-$9; C-$16; D-$5].

a) Construct the network diagram of the transportation problem. Formulate the linear programming model to minimise the transportation cost of meeting the demands of the four universities. [**20 marks**]

b) Apply the following methods to determine the initial solution: [**15 marks**]
   i Northwest corner method
   ii Vogle's approximation method
   iii Russell's approximation method

c) Explain the application areas of Operations Research tools. [**25 marks**]

d) Explain how decision analysis techniques can be applied by the bakery company in this transportation problem [**40 marks**]

3. A company manufactures two types of products A and B and sells them at a profit of $2 on type A and $3 on type B. Each product is processed on two machines G and H. Type A requires one minute of processing on G and two minutes on H. Type B requires one minute on G and one minute on H. The machine G is available for not more than 6 hours 40 minutes while machine H is available for 10 hours during any working day. Formulate the problem as a linear programming model.

a) Discuss the steps in formulating the linear programming problems. Apply the steps to formulate the linear programming problem of the company. [**20 marks**]

b) Use the Dual Simplex method to solve the linear programming model that you formulated in (a). [**25 marks**]

c) Explain the useful aspects of duality. [**25 marks**]

d) Explain why linear programming method is the most useful tool in Operations Research. [**30 marks**]

End of paper