Networks, scheduling and assignment - Test 4

Name: _____ Date: _____

10 questions | 54 marks | 75 minutes

Use inverse scheduling and expediting decisions, then justify assignment reductions and interpret operational restrictions.

A scientific calculator may be used.

1. Use the hall-restoration project. [7 marks]

Restoring a hall; durations are in days.

Activity	Duration	Immediate predecessors
A	4	None
B	6	None
C	3	A
D	5	A and B
E	4	C
F	2	D and E

(a) Find the earliest starts and finishes. [4 marks]

(b) List every critical path. [3 marks]

2. In the hall project, replace D's duration 5 by a nonnegative variable x. [7 marks]

Restoring a hall; durations are in days.

Activity	Duration	Immediate predecessors
A	4	None
B	6	None
C	3	A
D	5	A and B
E	4	C
F	2	D and E

(a) Write the project finish in terms of x. [3 marks]

(b) Find the greatest x that still permits a day-14 finish. [2 marks]

(c) For which x is the original 13-day minimum unchanged? [2 marks]

3. The hall project may be expedited using only these options: reduce B by 1 day for $90; reduce C by 1 day for $100; reduce F by 1 day for $250. Each option is available at most once. [6 marks]

Restoring a hall; durations are in days.

Activity	Duration	Immediate predecessors
A	4	None
B	6	None
C	3	A
D	5	A and B
E	4	C
F	2	D and E

(a) Explain why reducing B alone does not shorten the project. [2 marks]

(b) Find the least extra cost to achieve completion in 12 days. [3 marks]

(c) State an assumption behind this recommendation. [1 mark]

4. A project has paths P-R-T of 16 days and Q-S-T of 16 days. T is the only shared activity; other routes are shorter. [4 marks]

(a) Would reducing only R by 3 days reduce the finish? Explain. [2 marks]

(b) Reduce T by 2 days. Find the new finish, assuming shorter routes remain below 14. [2 marks]

5. Use the four-worker assignment costs. [6 marks]

Assignment costs ($). Each worker does one job.

Worker	1	2	3	4
A	8	3	7	6
B	5	9	4	8
C	6	7	2	5
D	7	4	8	3

(a) State an optimum and original cost. [3 marks]

(b) Add $2 to every entry of row A and subtract $1 from every entry of column 4. Does the optimal pairing change? Give its new total. [3 marks]

6. A reduced 3×3 matrix has rows $\begin{bmatrix} 2 & 0 & 2 \\ 1 & 0 & 5 \\ 0 & 0 & 0 \end{bmatrix}$. [6 marks]

(a) Give a minimum two-line cover of its zeros and the smallest uncovered entry. [2 marks]

(b) Carry out the adjustment and select independent zeros. [3 marks]

(c) Explain why the adjusted zeros do not tell you the actual original cost. [1 mark]

7. Maximise the contract profits below, but team B cannot take contract 1. [6 marks]

Contract profit in $1,000 units.

Team	1	2	3	4
A	14	18	12	11
B	16	13	15	12
C	10	16	14	17
D	15	11	18	14

(a) Find a feasible maximum-profit assignment and profit. [4 marks]

(b) Compare it with the unrestricted optimum. [2 marks]

8. Two workers have costs A:$[6, 4, 8]$ and B:$[5, 7, 3]$. All three jobs are compulsory, and each person can do at most one. [4 marks]

(a) Explain why the original assignment problem is infeasible. [2 marks]

(b) Give two operational changes that could make it feasible. [2 marks]

9. A square cost problem contains negative entries because some pairings earn a rebate. The smallest entry is -4. [4 marks]

(a) Explain why adding 4 to every entry preserves the optimum. [2 marks]

(b) A 3-row shifted problem has minimum total 20. Find the original minimum. [2 marks]

10. A project model assumes a task takes exactly 6 days, but its plausible duration is 5-9 days. [4 marks]

(a) Describe a defensible scheduling check. [2 marks]

(b) The task is not on the current critical path. Is checking it unnecessary? Explain. [2 marks]