Networks, scheduling and assignment - Test 5

10 questions | 55 marks | 75 minutes

Critique scheduling claims and test how deadlines, cost changes and ties affect recommendations.

Equivalent correct methods earn the corresponding marks.

1. Use the film-production project. [6 marks]

Producing a short film; durations are in days.

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

(a) Find all earliest activity start/finish times. [4 marks]

E waits for B and D, so starts at 7.

F waits for C and E, so starts at 10.

Answer: A: 0-3, B: 0-2, C: 3-9, D: 3-7, E: 7-10, F: 10-12.

(b) Identify the critical path and minimum completion. [2 marks]

$3+4+3+2=12$, longer than $\mathrm{A}-\mathrm{C}-\mathrm{F}=11$.

Answer: A-D-E-F;12 days.

2. Use the film project with a finish target of 12 days. [6 marks]

Producing a short film; durations are in days.

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

(a) Calculate the total floats of B and C. [3 marks]

$\mathrm{LF}(B) = 7$, so $\mathrm{LS}(B) = 7 - 2 = 5$; $\mathrm{ES}(B) = 0$.

$\mathrm{LF}(C) = 10$, so $\mathrm{LS}(C) = 4$; $\mathrm{ES}(C) = 3$.

Answer: B: 5 days; C: 1 day.

(b) Assess a separate extension of B from 2 to 8 days. [3 marks]

E starts at $\max(8, 7) = 8$ and ends 11.

F ends $\max(9, 11) + 2 = 13$.

Answer: Completion 13 days.

3. The film project's contracted deadline is day 15 rather than the earliest day 12. [5 marks]

Producing a short film; durations are in days.

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

(a) Find latest start times for B and C using the day 15 deadline. [3 marks]

F latest 13; E latest 10; B latest $10-2=8$.

C latest $13-6=7$.

Answer: B: 8 days; C: 7 days.

(b) Explain why these are later than the no-delay latest starts. [2 marks]

A backward scan answers the question set by its finish target.

Preserving a 15-day deadline is different from preserving the 12-day minimum.

Answer: They include the three-day overall deadline buffer.

4. Each alteration to the film project is made separately. [6 marks]

Producing a short film; durations are in days.

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

(a) Reduce D from 4 to 2 days. Find the new finish. [3 marks]

E ends $\max(2, 3+2)+3=8$.

C still ends 9; F ends 11.

Answer: 11 days.

(b) Increase C from 6 to 8 days. Find the finish and controlling route. [3 marks]

C ends $3+8=11$; E ends 10.

F ends 13.

Answer: 13 days; A-C-F.

5. Ali's cost for job 2 in the technician table changes from AUD 2 to x dollars, with $x \geq 0$; all other entries stay fixed. [6 marks]

Cost ($) of assigning one technician to each job.

Technician	Job 1	Job 2	Job 3
Ali	9	2	7
Bea	6	4	3
Chen	5	8	1

(a) Write the cost of Ali→2, Bea→1, Chen→3 in terms of x. [2 marks]

Add $x + 6 + 1$.

Answer: $x + 7$.

(b) Find the range of x for which this assignment remains optimal, and describe the boundary tie. [4 marks]

The best alternative not using Ali→2 costs 14.

The other Ali→2 allocation costs $x + 8$ and is always one higher.

Require $x + 7 \leq 14$.

Answer: $0 \leq x \leq 7$; at $x = 7$ it ties Ali→1, Bea→2, Chen→3 at $14.

6. Use the cost table with two optimal pairings. [6 marks]

Assignment costs ($).

Worker	1	2	3
A	4	4	9
B	4	4	9
C	9	9	1

(a) Find both minimum assignments. [3 marks]

Both give $4+4+1=9$.

Answer: A→1, B→2, C→3 or A→2, B→1, C→3; cost $9.

(b) Suppose A/job 1 is unavailable. Does the minimum cost change? [2 marks]

The restriction removes one optimum but not the other.

Answer: No; A→2, B→1, C→3 remains feasible at $9.

(c) Give one non-numerical criterion that could choose between tied optima when both are available. [1 mark]

It must not violate the original assignment constraints.

Answer: For example staff preference or resilience to a likely absence.

7. A reduced 3×3 matrix has rows $\begin{bmatrix} 0 & 2 & 0 \\ 0 & 3 & 0 \\ 1 & 0 & 4 \end{bmatrix}$. [5 marks]

(a) Find two complete independent-zero assignments. [3 marks]

Row 3 must use column 2.

Rows 1 and 2 can exchange columns 1 and 3.

Answer: Rows 1,2,3→columns 1,3,2 or 3,1,2.

(b) Do different zero assignments necessarily give different original totals? Explain. [2 marks]

Every complete assignment had the same constants subtracted.

Answer: No; when they are complete zero assignments after valid reductions, both attain the same minimum original total.

8. Use the net-profit table, whose units are \$100. [6 marks]

Net profit (\$100 units); negative entries are losses.

Team	1	2	3
A	5	-2	3
B	4	6	-1
C	-3	2	7

(a) Find the maximum original profit. [3 marks]

The feasible row maxima 5,6,7 sum 18.

Answer: $18 \text{ units} = \$1{,}800$, with A→1, B→2, C→3.

(b) A fixed \$300 fee is charged for every selected contract. Find the new maximum profit and say whether the pairing changes. [3 marks]

Three contracts incur $3 \times \$300 = \$900$ fees.

Every complete allocation loses the same amount, so $\$1{,}800 - \$900 = \$900$.

Answer: \$900; pairing unchanged.

9. A supervisor uses these statements about a project: 'The dummy lasts zero, so it can be deleted' and 'The shortest route is the critical path'. [4 marks]

(a) Correct the dummy statement. [2 marks]

Its logical effect can control when later work starts.

Answer: A zero-duration dummy may carry a required dependency and cannot simply be deleted.

(b) Correct the critical-path statement. [2 marks]

The whole project must wait for every necessary branch.

Answer: A longest required start-to-finish route controls the earliest completion.

10. An assignment table gives estimated costs within $\pm\$2$ per selected entry. Two feasible three-person allocations have predicted totals $40 and $41. [5 marks]

(a) Can the model's one-dollar preference guarantee that the first allocation is cheaper in practice? Explain. [2 marks]

Input uncertainty can outweigh the one-dollar predicted gap.

Answer: No.

(b) Describe a useful next check before making a recommendation. [2 marks]

Report the predicted optimum with its uncertainty, not as a guaranteed saving.

Answer: Obtain firmer costs for the differing pairings or compare plausible cost scenarios for both allocations.

(c) Why should the calculation still use exact supplied values before the interpretation? [1 mark]

Do not change inputs without stating the scenario.

Answer: It establishes the model's result clearly, allowing uncertainty to be discussed separately.