# 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 A-C-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]

LF(B)=7, so LS(B)=7−2=5; ES(B)=0.

LF(C)=10, so LS(C)=4; 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 a15-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≤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 [0,2,0],[0,3,0],[1,0,4]. [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 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×$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±$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.