9.4 Critical path analysis

Name: _____ Class: _____ Date: _____ **Total: 25 marks**

KEY WORDS critical path • total float

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Objective

Build activity-on-arc networks from precedence tables (with dummies), run forward and backward passes for event times, find the critical path, compute floats and draw Gantt charts (objectives 4.1–4.4).

1 Key knowledge and worked examples

Pipeline. Precedence table → activity network (activities on arcs, events as nodes; dummies where dependencies need them). Forward pass: earliest time of an event = max over arriving activities of (earliest of tail + duration). Backward pass: latest time = min over leaving activities of (latest of head − duration). Critical activities have zero total float: latest finish − earliest start − duration = 0; the critical path runs start to finish through them and its length is the project duration. Gantt bars run from each activity's earliest start for its duration, with float as trailing slack.

Worked example (original). A (3), B (4), C (4 after A), D (1 after B), E (5 after C and D). Chain A–C–E = 12, chain B–D–E = 10: critical path A–C–E, project duration 12 days; D's total float = 12 − (4 + 1 + 5) = 2 days.

2 Practice

2.1 Activities A (2), B (5), C (3 after A), D (1 after A and B). Draw the precedence table as an activity network description (list arcs into and out of each event) and find the project duration. [4]

2.2 For a project with earliest event times 0, 4, 7, 9 and latest times 0, 4, 7, 9 along one chain, state the float of each activity on the chain. [2]

2.3 An activity lasts 6 days, its earliest start is day 5 and its latest finish is day 16. Find its total float. [2]

3 Exam-style questions

3.1 *(Original.)* A project has activities A (4), B (3), C (6 after A), D (2 after A and B), E (5 after C and D), F (3 after D). (a) Draw an activity network for the project (from the precedence table), using a dummy where necessary, and describe where the dummy is needed. (b) Carry out a forward pass and a backward pass, listing the earliest and latest times for each event. (c) Find the critical path and the duration of the project. (d) Find the total float of F. [11]

3.2 *(Original.)* Using the project of 3.1: (a) draw a Gantt chart for the project, labelling the critical activities; (b) state the minimum number of workers needed to avoid delaying any critical activity; (c) explain why F can start as late as day 12. [6]