Unit 10: Critical Path Analysis (part 2)

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SPECIFICATION REFERENCES

4.5 Construct resource histograms (including resource levelling) based on the number of workers required to complete each activity.

4.6 Scheduling the activities using the least number of workers required to complete the project.

PRIOR KNOWLEDGE

Covered so far

- Introduction to graph theory (Unit 1c)

KEYWORDS

Activities, events, precedence table, activity networks, source node, sink node, dummies, earliest event times, latest event times, critical path, critical activities, total float, Gantt (cascade) chart, resource histogram, scheduling, lower bound.

10a. Resource histograms (4.5)

Teaching time
5 hours

OBJECTIVES

By the end of the sub-unit, students should:

- be able to draw and interpret resource histograms;
- be able to level resource histograms.

TEACHING POINTS

Gantt charts showing activities against a time line can be adjusted using the float times to make the resources more efficient.

Use a simple example, for example:

> A project has one worker assigned to the critical path, duration 4 weeks. There are 3 further activities to schedule each with a duration of a week, with no dependencies.

Ask students to sketch as many Gantt charts as they can for this project. For each Gantt chart, construct a resource histogram and introduce the notion of levelling the resource histogram. Discuss situations where this may be required.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING

Schedule activities using early start times and then using late start times. For each schedule construct a resource histogram and decide what situation each would be best suited for, e.g. cost of overall project, shortest project time etc.

COMMON MISCONCEPTIONS/ EXAMINER REPORT QUOTES

Students should be aware that a resource histogram "builds" vertically up from the x-axis, so has no 'holes' in the middle of it and also has no blocks hanging out over gaps.

NOTES

The number of workers required to complete each activity of a project will be given.

10b. Scheduling (4.6)	Teaching time 5 hours

OBJECTIVES

By the end of the sub-unit, students should:

- be able to construct a scheduling diagram;
- be able to interpret and modify schedules to meet requirements.

TEACHING POINTS

Since there is no scheduling algorithm, this section is best learnt using lots of different examples. Students could be asked to draw up a schedule with different objectives, for example:

- to finish in the critical time with the minimum number of workers
- to find the minimum completion time with a set number of workers
- to schedule all activities at their earliest start times and determine the number of workers
- to schedule all activities at their latest start times and determine the number of workers.

Typically if there is a choice of tasks for a worker, we assign the one with the lowest value for its latest finish time.

Students should be able to calculate the lower bound (always round up), but be aware that the calculation does not take any overlap of activities into account.

OPPORTUNITIES FOR REASONING/PROBLEM SOLVING

Use one activity network and ask students to schedule the activities given different objectives – lowest cost, shortest time, fewest workers etc. Compare the solutions to the lower bound calculation in each case.

COMMON MISCONCEPTIONS/ EXAMINER REPORT QUOTES

Students may have difficulties explaining results and conclusions (such as why the number of workers needed is X) convincingly. Arguments need to be specific and state correct details.

Common errors include not using their cascade charts as directed, offering vague arguments, errors in duration and precedence, and confusing Gantt and scheduling diagrams.

NOTES

After completing a scheduling diagram, it is worth checking that all the dependency conditions for the activities are satisfied.

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