inkMaths

ANSWER BOOK

Float, Gantt charts and scheduling

Decision Mathematics 1 · Year FM

6 questions · 22 marks

NAVY EDITION

SECTION A · Warm-up

A1 Total float = latest finish - earliest start - duration = 13 - 6 - 4 = **3** days. [2]
Equivalently, the latest start is 9 and the earliest is 6. M1 for the subtraction, A1 for 3 days.

A2 A, C, E and G are critical, so each has float **0**. B: 2 - 0 = **2**. D: 8 - 3 = **5**. F: 10 - 5 = **5**. B1 for the four zeros, B1 for B, B1 for D and F. [3]

SECTION B · Standard

B1 They lie on the same chain: F cannot start until D has finished. The five days is the slack available to the chain as a whole, not to each activity separately, which is what the word **total** in total float signals. Delaying D by five leaves F no room at all, and delaying both would push G, and so the whole project, five days late. B1 for the shared chain, B1 for the float belonging to the chain, B1 for the effect on the finish. [3]

B2 Total work = **25** worker-days over 15 days, so the lower bound is 25/15 = 1.67, rounded up to **2** workers. At earliest start times B runs from 0 to 5, C from 3 to 7 and D from 3 to 5, so all three overlap between days 3 and 5 and the histogram peaks at **3**, above the bound. Always round the bound up, whatever the decimal. M1 for 25/15, A1 for 2 workers, M1 for the overlap between days 3 and 5, A1 for a peak of three. [4]

B3 D has 5 days of float, so it can be delayed. Move D to run from day **5** to 7 instead of 3 to 5, which takes it out of the crowded stretch and leaves B and C alone there. F then runs from **7** to 10, within its own latest start of 10. [4]
The demand is now A and B to day 3, B and C to day 5, C and D to day 7, E and F to day 10, then E alone and finally G. It never exceeds **2**, which matches the lower bound, so the schedule is optimal and the project still finishes in 15 days. M1 for delaying D within its float, A1 for D from day 5 to day 7, A1 for F from day 7 to day 10, B1 for the demand never exceeding two.

SECTION C · Stretch

C1 Total work = 10 + 6 + 6 + 6 = **28** worker-days over 10 days, so the lower bound is 28/10 = 2.8, rounded up to **3** workers. [6]

Suppose three workers were enough. One must spend the whole 10 days on A, since A occupies its worker from day 0 to day 10 and cannot be split. That leaves two workers for B, C and D. Each of those has only 10 days available, and having completed one six-day activity a worker has 4 days left, too few for another. So two workers can finish at most two of the three, and **4** workers are needed.

The lower bound assumes work can be divided freely and every worker kept busy. It is a floor, not a promise, and an answer that quotes the bound as the answer to a scheduling question has stopped one step early.

M1 A1 for the total work, A1 for the bound of three workers, M1 for tying one worker to A, A1 for showing two workers cannot cover B, C and D, A1 for four workers.

