InkMaths

ANSWER BOOK

Critical path analysis

Decision Mathematics 1 · Year FM

6 questions · 22 marks

NAVY EDITION

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SECTION A · Warm-up

A1 An arrow of zero duration that carries a dependency without representing any work. One reason is that two activities share some but not all of their predecessors, so a dummy is needed to keep the dependencies exact. A second is that two activities would otherwise run between the same pair of events, and every activity must have a unique pair. B1 for the zero-duration arrow carrying a dependency, B1 for either reason. [2]

A2 A finishes at **3** and B at **5**. C runs 3 to **7**, D runs 3 to **5**. E waits for the later of B and C, so it runs 7 to **13**; F runs 5 to **8**. G waits for the later of E and F, so it runs 13 to **15**: the project takes 15 days. M1 for taking the later of the incoming times, A1 for the early times through the network, A1 for 15 days. [3]

SECTION B · Standard

B1 Work back from 15. G must start by **13**. E and F must both finish by 13, so E starts by **7** and F by **10**. C must finish by 7, starting by **3**; D must finish by 10, starting by **8**; B must finish by 7, starting by **2**. A must finish by 3. Early and late starts agree for **A,** C, E and G, so that is the critical path, and 3 + 4 + 6 + 2 = 15 confirms it. M1 for working back from 15, A1 A1 for the late times, A1 for the critical path. Put both numbers in every event box. The backward pass takes the **smallest** late start of the following activities, and taking the largest is the commonest way to lose all four marks. [4]

B2 What matters is the total duration along a route, not how many activities it contains. Here A, C, E, G has four activities and takes 15 days, while A, D, F, G also has four and takes only 10. A route with more but shorter activities can easily be shorter overall. The critical path is defined by zero float, which is the same as being the longest route in time. B1 for duration mattering rather than the count, B1 for the comparison of the two four-activity routes, B1 for zero float or the longest route. [3]

B3 Its latest start is 13 − 4 = **9**, later than its earliest start of 6. The total float is 3 days, so the activity is **not** critical. M1 for the latest start 13 − 4, A1 for a float of 3 days, A1 for the conclusion. It could be delayed by up to three days without extending the project. [3]

SECTION C · Stretch

C1 B had a total float of 2 days, so 3 extra days uses it up and pushes past it. B now finishes at day 8, so E cannot start until 8 and finishes at 14, and G finishes at **16**. The project has lengthened by one day. [7]

The new critical path is **B,** E, G, with 8 + 6 + 2 = 16. A and C now carry a day of float, since C could finish at 8 rather than 7.

E cannot begin until both B and C are done, and C finishes at 7. So B governs the start of E only once its duration exceeds 7. For B of duration **7** days or less the path A, C, E, G still sets the duration, and at exactly 7 both paths are critical together. M1 for a fresh forward pass, A1 for 16 days, A1 for the new critical path, B1 for the float now carried by A and C, M1 for comparing B with the time C needs, A1 for 7 days, A1 for both paths being critical at exactly 7.

A change to a non-critical activity does nothing until it exceeds the float, and then it changes the critical path rather than simply lengthening the old one.