



ANSWER BOOK

Decision analysis

Decision Mathematics 2 · Year FM

6 questions · 22 marks

NAVY EDITION

SECTION A · Warm-up

- A1** A square is a decision node, where you choose; a circle is a chance node, where the world chooses, with a probability on each branch. Costs are subtracted along the branch where they are incurred, not gathered up at the end, so that each option is compared net of what it costs to take. [2]
- A2** $0.4(250) + 0.6(60) = 100 + 36 = 136$, and subtracting the cost of 45 leaves an expected monetary value of 91. [2]

SECTION B · Standard

- B1** In-house: $0.5(200) + 0.3(90) + 0.2(20) = 100 + 27 + 4 = 131$, less 60 gives 71.
Licence: $0.7(110) + 0.3(40) = 77 + 12 = 89$, less 25 gives 64.
Do nothing: 0.
The highest is 71, so develop in-house, and the other two branches are struck through. [6]
- B2** With probability 0.2 the revenue is only 20 against a cost of 60, a loss of 40 thousand. Expected monetary value is an average over many repetitions, and this decision is made once. A firm that could not absorb a loss of 40 would rightly take the licence, whose worst outcome is $40 - 25 = 15$, a gain. The calculation is correct and still not the whole answer. [3]
- B3** Utility measures how much each outcome is actually worth to the decision maker, rather than its cash value, and for most people it rises less than proportionally with money.
The gamble's expected monetary value is $0.5(200) = 100$, above 80. Its expected utility is 0.5 times the square root of 200, about 7.07, while the certain 80 has utility the square root of 80, about 8.94. On utility the certain 80 wins, and the two criteria disagree. [3]

SECTION C · Stretch

- C1** After a favourable report, in-house is worth $0.7(200) + 0.2(90) + 0.1(20) = 140 + 18 + 2 = 160$, less 60 gives **100**, beating the licence's 64, so choose in-house.
After an unfavourable report, in-house is worth $0.2(200) + 0.4(90) + 0.4(20) = 40 + 36 + 8 = 84$, less 60 gives **24**, so choose the **licence** at 64 instead.
The survey's chance node is therefore $0.6(100) + 0.4(64) = 60 + 25.6 = 85.6$, less its cost of 10 gives **75.6**.
That beats the 71 available without a survey, so **commission it**. The survey is worth $75.6 - 71 = 4.6$ thousand, and the whole of that gain comes from the unfavourable branch, where it stops the firm developing in-house.
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