3.1 Decision Trees and Quantitative Decision-Making

Total Marks

AQA 7132 · Calculators not allowed · about 50 minutes · Write-in edition

Name: _____ Date: ____ / ____ / _____

Answer ALL questions in the spaces provided. Show working for every calculation. Where a question uses the Green Brew Ltd case, the necessary figures are given in that question's prompt.

1 Which one of the following best describes a 'decision tree' in a business decision context?

- ☐ A) A table showing monthly cash flows
- ☐ B) A diagram showing decision and chance nodes with outcomes and probabilities
- ☐ C) A marketing plan that lists possible product names
- ☐ D) A staff rota showing shift patterns

(Total for Question 1 is 1 mark)

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2 In a decision tree diagram for a business like Green Brew Ltd, label which node is a decision node and which is a chance node. Give one-word labels for each.

(Total for Question 2 is 1 mark)

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3 Green Brew Ltd Option B: do nothing, keep current operations with no cost and no extra revenue. State the expected value and net gain for Option B.

(Total for Question 3 is 1 mark)

4 State one non-numeric factor Green Brew Ltd should consider that a decision tree does not capture when choosing between Option A, B and C.

(Total for Question 4 is 1 mark)

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5 Define the term 'expected value' as used when completing a decision tree in business decision-making.

(Total for Question 5 is 2 marks)

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6 Green Brew Ltd considers a low-cost marketing test costing £100 that has a 0.5 probability of increasing sales by £300 and a 0.5 probability of making no gain. Calculate the expected value of the test (not net gain). Show your working.

(Total for Question 6 is 2 marks)

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7 Green Brew Ltd considers a third option, Option C: rent a small kiosk for £500. The kiosk has a 0.7 probability of producing an extra net revenue of £1,500 and a 0.3 probability of producing an extra net revenue of £200. Calculate the expected value at the chance node for Option C (not net gain). Show your working.

(Total for Question 7 is 2 marks)

8 Which option gives the highest net gain for Green Brew Ltd, using the figures in this pack? Choose one option and give its net gain in pounds.

(Total for Question 8 is 1 mark)

9 Explain briefly why the accuracy of a decision tree's recommendation depends on the probabilities used. Use Green Brew Ltd as the context in your explanation.

(Total for Question 9 is 1 mark)

10 Using your results for Option A from question 13, state one reason, based on the numbers, why Option A might be attractive to Green Brew Ltd. Use the case in your explanation.

(Total for Question 10 is 1 mark)

11 Using your answer to question 7, calculate the net gain for Option C (expected value minus the £500 cost). Show your working.

(Total for Question 11 is 2 marks)

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12 Green Brew Ltd might combine options, for example run the kiosk first and if that succeeds later buy the van. State one practical limit of using decision trees to model such sequential or combined strategies.

(Total for Question 12 is 1 mark)

13 Green Brew Ltd case: Green Brew Ltd will decide between two options to expand sales. Option A is to buy a coffee van for £3,000. If successful (probability 0.6) the extra revenue net of variable costs is £8,000; if unsuccessful (probability 0.4) the extra revenue net of variable costs is £2,000. Complete the decision tree for Option A and calculate the expected value at the chance node and the net gain for Option A (expected value minus the £3,000 cost). Show all steps.

(Total for Question 13 is 8 marks)

14 Evaluate the limitations of decision-tree analysis as a tool for business decision-making, using examples and figures from the Green Brew Ltd case where relevant. You should consider both numeric and non-numeric limitations and reach a justified conclusion.

(Total for Question 14 is 12 marks)

Mark scheme · 3.1 Decision Trees and Quantitative Decision-Making

Question 1

B cao **B1**

Answer: B

Question 2

Decision node = 'Decision', Chance node = 'Chance' or 'Probability' (either phrasing) **B1**

Answer: Decision node: Decision. Chance node: Chance.

Question 3

states EV = 0 and net gain = 0 **B1**

Answer: Expected value = £0; Net gain = £0.

Question 4

any valid non-numeric factor, e.g. effect on brand image, staff workload, customer convenience, regulatory issues, or long-term strategic fit **B1**

Answer: For example, effect on brand image: a coffee van may improve local presence but could distract from the core cafe brand.

Question 5

a clear statement that expected value is the probability weighted average of outcomes **B1**

or equivalent, e.g. sum of each outcome multiplied by its probability **B1**

Answer: Expected value is the sum of each possible outcome multiplied by its probability, the probability weighted average of outcomes.

Question 6

0.5 x 300 + 0.5 x 0 seen **M1**

£150 cao **A1**

Answer: £150.

Question 7

0.7 x 1,500 + 0.3 x 200 seen **M1**

£1,110 cao **A1**

Answer: £1,110.

Question 8

identifies Option A and gives £2,600, or identifies Option C and gives £610, or Option B with 0, but correct highest is Option A 2,600 **B1**

Answer: Option A, net gain £2,600.

Question 9

explains that if probabilities are wrong the expected values will be wrong, e.g. if the 0.6 success probability for the van is overestimated then the EV and net gain will be too high and option choice may be wrong **B1**

Answer: If the 0.6 probability of van success is too high, the EV of £5,600 is overstated and the net gain £2,600 is misleading, so the recommended option could be wrong.

Question 10

states that the net gain is positive, e.g. net gain of £2,600 so expected returns exceed the cost **B1**

Answer: The net gain is positive: expected net gain is £2,600, so the expected returns exceed the £3,000 cost.

Question 11

1,110 - 500 seen (ft from question 7) **M1**

£610 cao **A1**

Answer: £610.

Question 12

states a practical limit, e.g. trees become complex with many branches and changing probabilities, making them hard to draw and unreliable **B1**

Answer: Decision trees become complex and hard to manage for sequential or combined strategies, and probabilities for later stages may change, reducing reliability.

Question 13

multiplies 0.6 by 8,000 or shows 0.6 x 8000 **M1**

£4,800 cao for 0.6 x 8,000 **A1**

multiplies 0.4 by 2,000 or shows 0.4 x 2000 **M1**

£800 cao for 0.4 x 2,000 **A1**

adds the two products, 4,800 + 800 **M1**

£5,600 cao for the expected value at the chance node **A1**

subtracts the cost 3,000 from the expected value or shows 5,600 - 3,000 **M1**

£2,600 cao for the net gain of Option A **A1**

Answer: Expected value = £5,600; Net gain = £2,600.

Question 14

Level 1 Makes simple, undeveloped points about limitations of decision trees with little or no use of the case figures and no clear judgement. **1-4**

Level 2 Develops several points about limitations, uses some case figures or examples, and offers a partial judgement but does not fully balance strengths and weaknesses. **5-8**

Level 3 Provides a well developed evaluation of the limitations, applies case figures and examples (for example the 0.6 probability and the £3,000 cost for the van), analyses implications for Green Brew Ltd and reaches a balanced, justified conclusion. **9-12**

Indicative content:

- Numeric limitations: decision trees depend on estimated probabilities and monetary outcomes; if the 0.6 success probability for the van is uncertain or biased, the EV of £5,600 and net gain of £2,600 are unreliable.
- Numeric limitations continued: decision trees usually ignore risk preferences and variance; two options with similar EVs may differ in risk, for example Option A has a wide outcome range 8,000 or 2,000, whereas Option C outcomes are smaller, so EV alone hides volatility.
- Practical limitations: complex or sequential decisions make trees large and impractical, and probabilities for later nodes may change after earlier decisions, reducing predictive value for strategies like 'test kiosk then buy van'.
- Qualitative factors: decision trees omit non-financial considerations such as brand impact, customer experience, staff capacity, or strategic fit, which might favour the van despite numbers or rule it out despite a positive net gain.
- Data availability and time: accurate probabilities and outcomes require good market research, which can be costly and time-consuming; small firms like Green Brew Ltd may lack reliable data, making estimates speculative.
- Behavioural limitations: managers may be overconfident about probabilities or influenced by bias, leading to inappropriate weighting of outcomes, so a numerically superior option in the tree might be rejected for intuitive reasons and vice versa.
- Counterbalance: decision trees are still useful as a structured, transparent way to compare options numerically; they force explicit assumptions and make it easier to test sensitivity by changing probabilities and figures.
- Conclusion guidance: a balanced conclusion might say decision trees are valuable as a decision aid but their output should not be followed blindly; for Green Brew Ltd the positive net gain for Option A is persuasive, but the firm should check the probability estimates, consider risk tolerance and qualitative factors before committing.