COS10022 – DATA SCIENCE PRINCIPLES

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DECISION MAKING PRACTICAL PROBLEM – USING DECISION TREE

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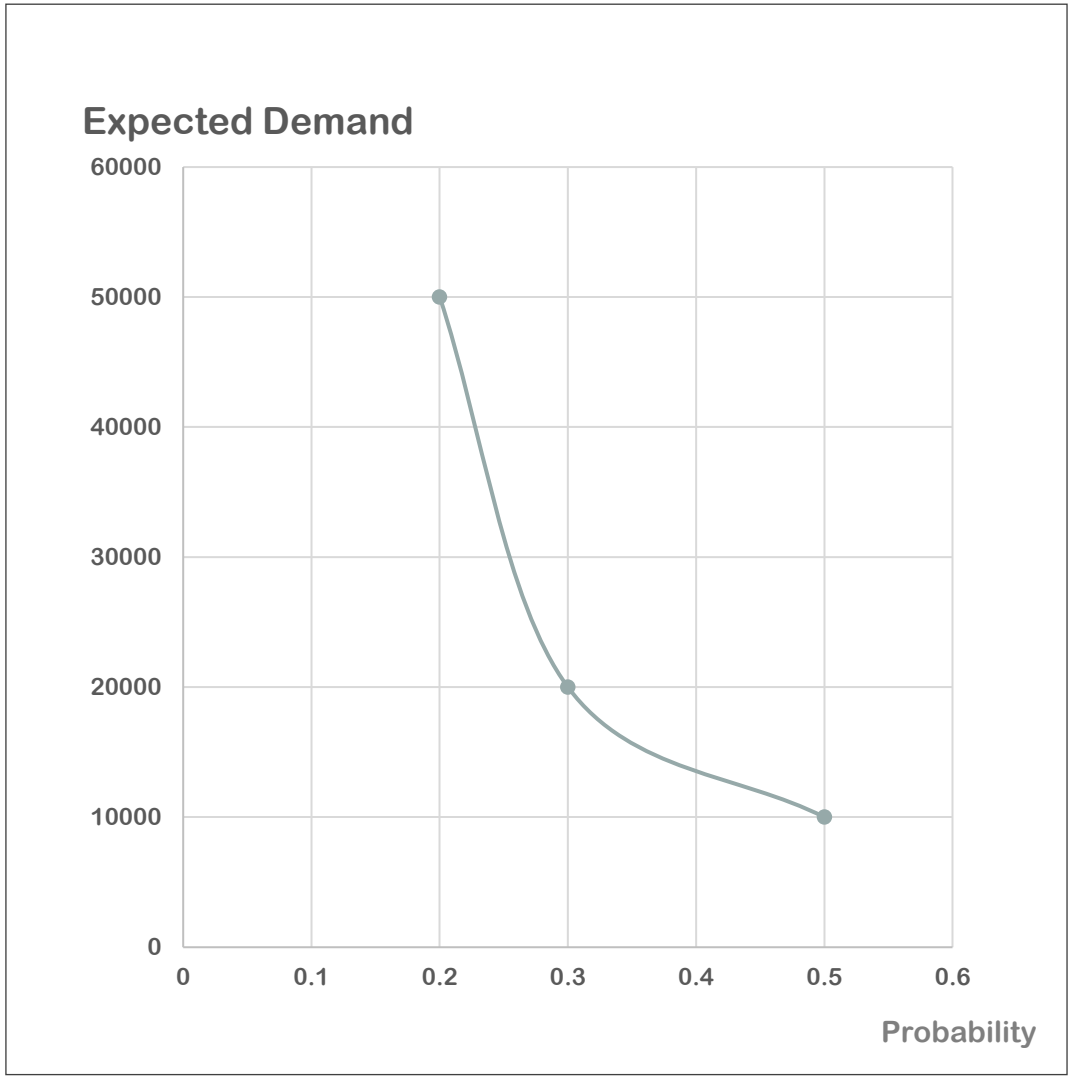
Background

- Alpha cookware Ltd. is a company producing multiple cookware.
- The managers are now considering the addition of a new cookware to the company's existing production line.
- To test this concept, they will perform a 1-month trial.
- Three alternative courses of action are available for them:
  a) Work overtime to meet the demand of the new cookware. The overtime expenses are estimated at AUD 20,000 per month.
  b) Install a new equipment for which fixed expenses per month are expected at AUD 80,000.
  c) Rent a machine at the rate of AUD 35,000 per month.
- Variable cost associated with the above three alternatives are AUD 9, 7, and 8 per cookware, respectively.
- The price per unit of the cookware, which is independent of the manufacturing alternative, is fixed at AUD 15.



Background (2)

- The expected demand for the new cookware is as given below:
  a) 10,000 pieces with a probability of 0.5.
  b) 20, 000 pieces with a probability of 0.3.
  c) 50,000 pieces with a probability of 0.2.
- Which alternative should the company adopt to manufacture the cookware?

APPLY DECISION TREE AS THE SOLVER

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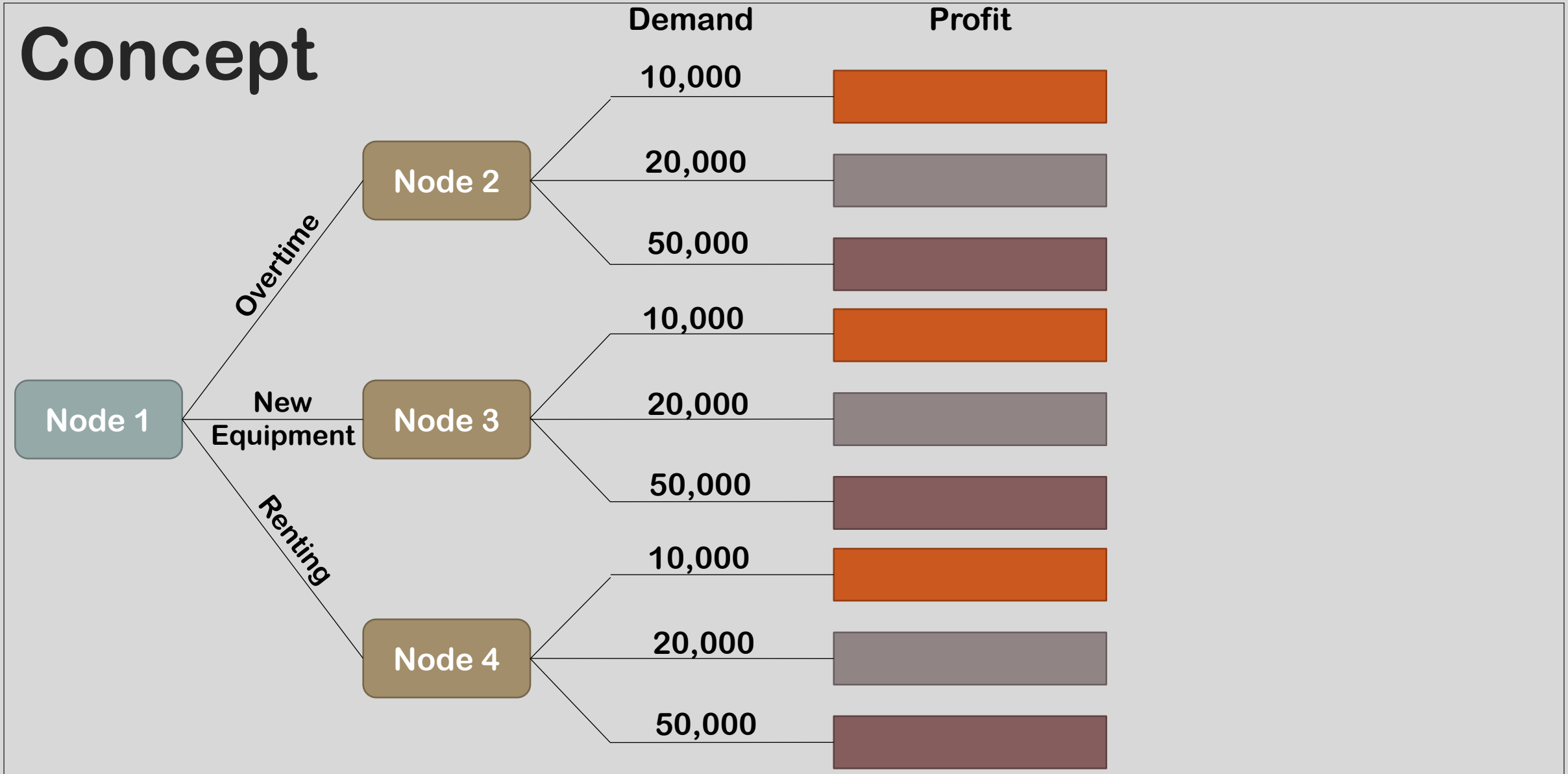
Concept


Demand
Profit
Node 1
Overtime
New Equipment
Renting
Node 2
Node 3
Node 4
10,000
20,000
50,000
10,000
20,000
50,000
10,000
20,000
50,000

Calculation

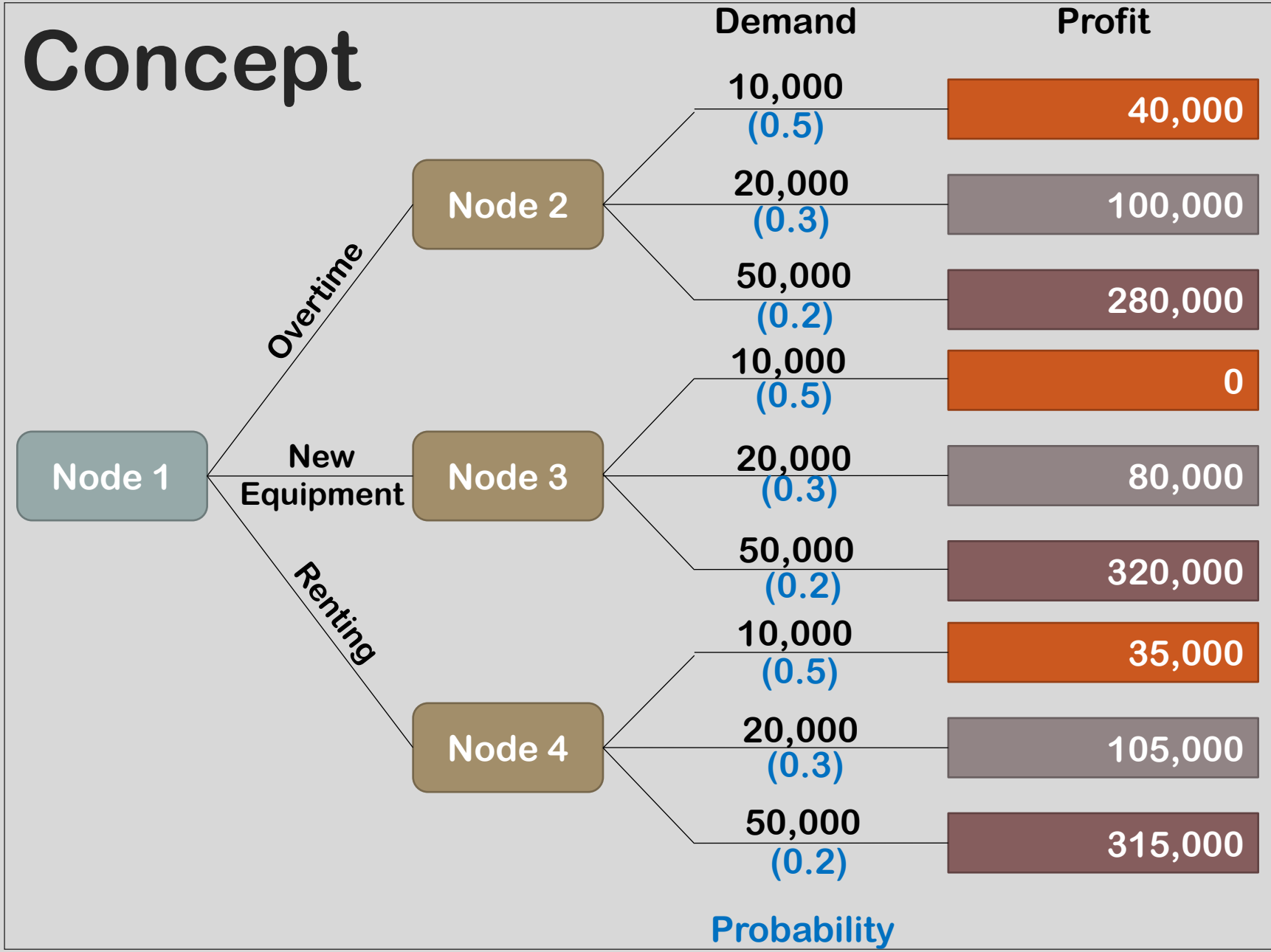
Alternative	Fixed Cost (A)	Selling Price (B)	Production Cost (C)	Monthly Demand (D)		
				10,000	20,000	50,000
Overtime	20,000	15	9	40,000	100,000	280,000
New Eq.	80,000	15	7	0	80,000	320,000
Rent	35,000	15	8	35,000	105,000	315,000

$$\text{Profit} = (B - C) \times D - A$$

$$\text{Profit} = (B - C) \times D - A$$
$$= (15 - 9) \times 10{,}000 - 20{,}000$$
$$= 40{,}000$$

$$\text{Profit} = (B - C) \times D - A$$
$$= (15 - 8) \times 20{,}000 - 35{,}000$$
$$= 105{,}000$$

Concept



$$E = \sum Prob \times Profit$$

$$E_{Node\ 2} = 0.5 \times 40{,}000 + 0.3 \times 100{,}000 + 0.2 \times 280{,}000 = 106{,}000$$

$$E_{Node\ 3} = 0.5 \times 0 + 0.3 \times 800{,}000 + 0.2 \times 320{,}000 = 88{,}000$$

$$E_{Node\ 4} = 0.5 \times 35{,}000 + 0.3 \times 105{,}000 + 0.2 \times 315{,}000 = 112{,}000$$

DECISION TREE FOR CLASSIFICATION

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Why there is a negative operator in the entropy calculation?

Entropy:

$$\mathrm{H}(p) = -\sum_{i=1}^{n} p_i \log_2 p_i$$

for $p \in \mathbb{Q}^n$

where H **(Greek capital letter eta) defines the entropy,** p_i **indicates the probability mass function, and** n **is the number of output states.**