



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

SUPPLY CHAIN ANALYTICS

Example of using decision tree incorporating
uncertainty in single factor

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Decision Tree Methodology

1. Identify the duration of each period (month, quarter, etc.) and the number of periods T over the which the decision is to be evaluated.
2. Identify factors such as demand, price, and exchange rate, whose fluctuation will be considered over the next T periods.
3. Identify representations of uncertainty for each factor; that is, determine what distribution to use to model the uncertainty.
4. Identify the periodic discount rate k for each period.
5. Represent the decision tree with defined states in each period, as well as the transition probabilities between states in successive periods.
6. Starting at period T , work back to period 0, identifying the optimal decision and the expected cash flows at each step. Expected cash flows at each state in a given period should be discounted back when included in the previous period.



Decision Tree Methodology : ABC Logistics

- Decide whether to lease warehouse space for the coming three years and the quantity to lease
- Long-term lease is currently cheaper than the spot market rate
- The manager anticipates uncertainty in demand and spot prices over the next three years
- Long-term lease is cheaper but could go unused if demand is lower than forecast; future spot market rates could also decrease
- Spot market rates are currently high, and the spot market would cost a lot if future demand is higher than expected



ABC Logistics: Three Options

- Get all warehousing space from the spot market as needed
- Sign a three-year lease for a fixed amount of warehouse space and get additional requirements from the spot market
- Sign a flexible lease with a minimum change that allows variable usage of warehouse space up to a limit with additional requirement from the spot market

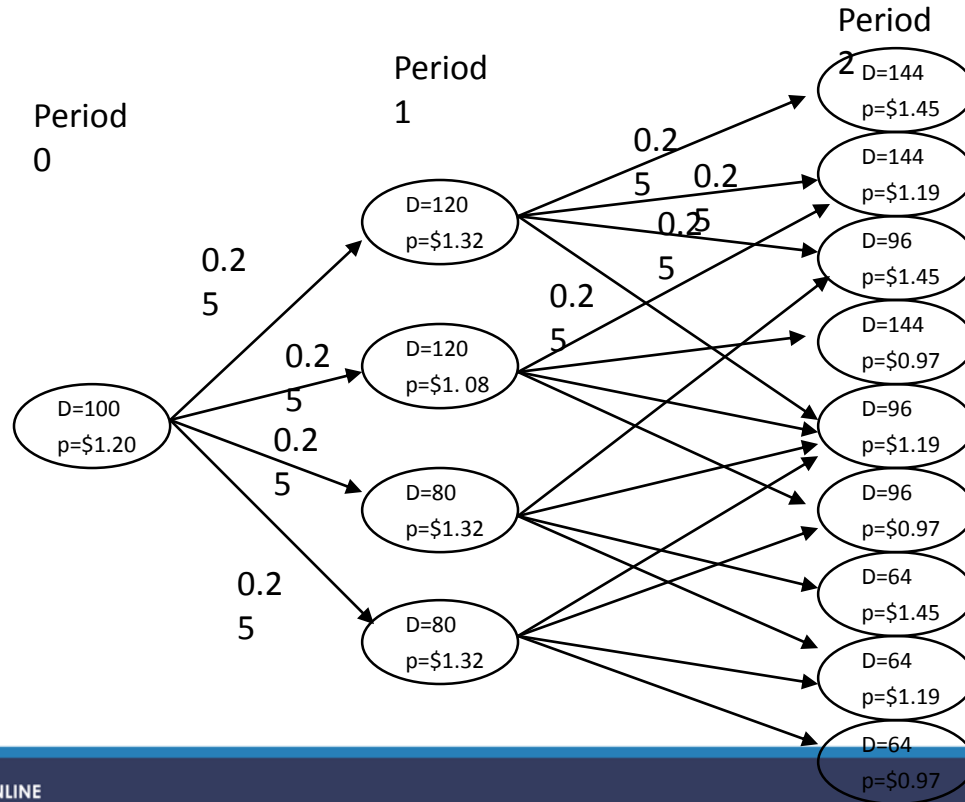


ABC Logistics

- 1000 sq. ft. of warehouse space needed for 1000 units of demand
- Current demand = 100,000 units per year
- Binomial uncertainty: Demand can go up by 20% with $p = 0.5$ or down by 20% with $1-p = 0.5$
- Lease price = \$1.00 per sq. ft. per year
- Spot market price = \$1.20 per sq. ft. per year
- Spot prices can go up by 10% with $p = 0.5$ or down by 10% with $1-p = 0.5$
- Revenue = \$1.22 per unit of demand
- $k = 0.1$



ABC Logistics Decision Tree



ABC Logistics Example

- Analyze the option of not signing a lease and obtaining all warehouse space from the spot market
- Start with Period 2 and calculate the profit at each node
- For $D=144$, $p=\$1.45$, in Period 2:
 $C(D=144, p=1.45, 2) = 144,000 \times 1.45 = \$208,800$
 $P(D=144, p = 1.45, 2) = 144,000 \times 1.22 -$
 $C(D=144, p=1.45, 2) = 175,680 - 208,800 = -\$33,120$



THANK YOU

