Homework 3 (**13a, 14a, 15**) – Assigned: January 28, 2026. Due: February 4, 2026

Homework 3 includes only questions 13(a), 14(a) and (15). The remaining questions 13(b), 13(c) and 14(b), 14(c) will be assigned later.

Constructing Decision Trees

13. An inventor has developed an electronic instrument to monitor the impurities in the metal produced by a smelting process. A company that markets this type of equipment is considering the purchase of the patent rights to this instrument for $40,000. The company feels that there is a 20% chance that the device will become a successful seller. It is estimated that, if the device is successful, it will produce net profit of $150,000 each year for the next 5 years. If the product is not a success, no profit will be received. The company's discount rate is 15%.

(a) Draw a decision tree describing the decision alternatives and determine the best decision policy.
(b) If there is a market research group that can provide perfect information about the success of this product, what would be the most the company should be willing to pay for their service?
(c) Suppose the market research group can make a market survey that with probability 0.7 will give a favorable result if the device will be a success, and with probability 0.9 will give an unfavorable result if the device will not sell. How much would this survey be worth to the company?

14. An electronics firm is trying to decide whether or not to manufacture a new communications device. The decision to produce the device means an investment of $5 million. The demand for such a device is not known.
If demand is *high*, the company expects a return of $2.0 million each year for 5 years.
If the demand is *moderate*, the return will be $1.6 million each year for 4 years.
If the demand is *light* the return will be $0.8 million each year for 4 years.
It is estimated that the probability of a *light* demand is 0.1, the probability of *moderate* demand is 0.4 and the probability of a *high* demand is 0.5. Interest is 10%.

(a) On the basis of expected present-worth, should the company make the investment?
(b) Someone has proposed that a survey be taken to establish the actual demand to be experienced. What is the maximum possible value of such a survey?
(c) A survey is available which has the characteristics shown in the table shown below. What is the most that the company should pay for this survey?
(d) If the survey costs $75,000, should the company pay to make this survey?
(e) What is the expected profit if the survey says unfavorable and the device is produced?
(f) Should the company produce the device if the survey says unfavorable?

		Survey results say *favorable* or *unfavorable* with the following probabilities:	
		Favorable	**Unfavorable**
If demand is:	**High**	0.9	0.1
	Moderate	0.5	0.5
	Low	0.0	1.0

15. A wholesaler is studying his warehouse needs for the next 8 years. At present three alternatives are under consideration: (a) A new warehouse can be built to replace the existing facility; (b) the existing facility can be expanded; or (c) the decision to expand can be postponed. If the decision is postponed, the wholesaler will wait four years, and *then* decide whether to expand the existing facility or to leave it as is. To expand the present facility now will cost $400,000. To build a new facility now will cost $700,000.

Consumer demand for the wholesaler's products is expected to be either high for all eight years (H1, H2), high for four years and low for the remaining four years (H1, L2), low for the first four years and high for the last four years (L1, H2) or low for all eight years (L1, L2). Depending on these demand levels, the following annual revenues are expected to be received from the two alternatives that require an investment now. The discount rate is 12%.

Annual Revenues ($/year)	Demand			
Decision Alternatives:	(H1, H2)	(H1, L2)	(L1, H2)	(L1, L2)
Build new warehouse now	$320,000	$160,000	$110,000	$80,000
Expand existing warehouse now	$200,000	$150,000	$100,000	$50,000

If the decision to construct additional warehouse capacity is postponed and will be made four years from now, the cost of expanding the warehouse four years from now is expected to be $600,000. In this case, it is anticipated that the annual revenues for high and low demand during the first four years will be $50,000 and $20,000, respectively. The annual revenues for the remaining four years are shown below.

Annual Revenues ($/year) (for years 5-8)	Demand	
Decision alternatives *to be chosen after 4 years*:	H2	L2
Expand	$400,000	$100,000
Do not expand	$80,000	$40,000

The probabilities that demand will be at a particular level through the 8-year period are:

	Demand			
	(H1, H2)	(H1, L2)	(L1, H2)	(L1, L2)
Probability	0.3	0.2	0.1	0.4

Using decision tree analysis determine the decision policy that should be followed so that the wholesaler's expected profits are maximized.

Note 1: The last table shows the joint probabilities for the demand in the first 4 years $\{H_1, L_1\}$ and the demand in the next 4 years $\{H_2, L_2\}$. Use these joint probabilities to compute the marginal probabilities for demand in the first 4 years $P[H_1]$, $P[L_1]$, and the conditional probabilities for demand in the next 4 years $P[H_2|H_1]$, $P[L_2|H_1]$, $P[H_2|L_1]$, $P[L_2|L_1]$. These are the probabilities needed for your decision tree.

Note 2: The alternative “to postpone the decision to construct additional warehouse capacity” means that no decision “to expand” or “not to expand” will be made now. Instead, the decision “to expand” or “not to expand” will be made 4 years from now, i.e., after the actual demand for the first 4 years (which could be either H_1 or L_1) will be known.