From this information we can compute three additional probabilities that we need to solve the problem:

$$P(\text{UF}) = 1 - P(\text{SF}) = 1 - 0.4 = 0.6$$
$$P(\text{RU} \mid \text{SF}) = 1 - P(\text{RF} \mid \text{SF}) = 1 - 0.9 = 0.1$$
$$P(\text{RF} \mid \text{UF}) = 1 - P(\text{RU} \mid \text{UF}) = 1 - 0.8 = 0.2$$

Now we can put these values into Bayes' theorem to compute the desired probability, as shown in the following table:

OUTCOMES	CONDITIONAL PROBABILITY		PRIOR PROBABILITY		JOINT PROBABILITY	POSTERIOR PROBABILITY
Favorable market	0.9	×	0.4	=	0.36	0.36 / 0.48 = 0.75
Unfavorable market	0.2	×	0.6	=	0.12	0.12 / 0.48 = 0.25
					0.48	

The probability of a successful driving range, given a favorable research result, is 0.36 / 0.48, or 0.75.

DISCUSSION QUESTIONS AND PROBLEMS

Discussion Questions

8-1 Give an example of a good decision that you made that resulted in a bad outcome. Also give an example of a bad decision that you made that had a good outcome. Why was each decision good or bad?

8-2 Describe what is involved in the decision-making process.

8-3 What is an alternative? What is an outcome?

8-4 Discuss the differences between decision making under certainty, decision making under risk, and decision making under uncertainty.

8-5 State the meanings of EMV and EVPI.

8-6 Under what conditions is a decision tree preferable to a decision table?

8-7 What is the difference between prior and posterior probabilities?

8-8 What is the purpose of Bayesian analysis? Describe how you would use Bayesian analysis in the decision-making process.

8-9 What is the purpose of utility theory?

8-10 Briefly discuss how a utility function can be assessed. What is a standard gamble, and how is it used in determining utility values?

8-11 How is a utility curve used in selecting the best decision for a particular problem?

8-12 What is a risk seeker? What is a risk avoider? How do the utility curves for these types of decision makers differ?

Problems

8-13 Kenneth Brown is the principal owner of Brown Oil, Inc. After quitting his university teaching job, Ken has been able to increase his annual salary by a factor of over 100. At the present time, Ken is forced to consider purchasing some more equipment for Brown Oil because of competition. His alternatives, outcomes, and payoffs (profits) are shown in the following table:

EQUIPMENT	FAVORABLE MARKET	UNFAVORABLE MARKET
Sub 100	$300,000	−$200,000
Oiler J	$250,000	−$100,000
Texan	$ 75,000	−$ 18,000

(a) Ken has always been a very optimistic decision maker. Which alternative is best from Ken's point of view?

(b) Although Ken is the principal owner of Brown Oil, his brother Bob is credited with making the company a financial success. Bob attributes his success to his pessimistic attitude about business and the oil industry. Which alternative is best from Bob's point of view?

(c) The *Lubricant* is an expensive oil newsletter to which Ken subscribes. In the latest issue, the newsletter describes how the demand for oil products will be extremely high. Apparently, the American consumer will continue to use oil products even if the price of these products doubles. Indeed, one of the articles in the *Lubricant* states that the chance of a favorable market for oil products is 70%. If Ken uses these probabilities in determining the best decision, which alternative is best?

8-14 Bob's Bike Shop is considering three options for its facility next year. Bob can expand his current shop, move to a larger facility, or make no change. With a good market, the annual payoff would be \$56,000 if he expands, \$70,000 if he moves, and \$30,000 if he does nothing. With an average market, his payoffs will be \$21,000, \$35,000, and \$10,000, respectively. With a poor market, his payoff will be −\$29,000, −\$45,000, and \$5,000, respectively.

(a) Which option should Bob choose if he uses the maximax criterion?
(b) Which option should Bob choose if he uses the maximin criterion?
(c) Which option should Bob choose if he uses the equally likely criterion?
(d) Which option should Bob choose if he uses the criterion of realism with $\alpha = 0.6$?
(e) Which option should Bob choose if he uses the minimax regret criterion?

8-15 Bob (see Problem 8-14) has gathered some additional information. The probabilities of good, average, and poor markets are 0.25, 0.45, and 0.3, respectively.

(a) Using EMVs, what option should Bob choose? What is the maximum EMV?
(b) Using EOL, what option should Bob choose? What is the minimum EOL?
(c) Compute the EVPI and show that it is the same as the minimum EOL.

8-16 Debbie Gibson is considering three investment options for a small inheritance that she has just received—stocks, bonds, and money market. The return on her investment will depend on the performance of the economy, which can be strong, average, or weak. The returns for each possible combination are shown in the following table:

Investment	Strong	Average	Weak
Stocks	12%	6%	−10%
Bonds	7%	4%	1%
Money market	4%	3%	2%

Assume that Debbie will choose only one of the investment options.

(a) Which investment should Debbie choose if she uses the maximax criterion?
(b) Which investment should Debbie choose if she uses the maximin criterion?
(c) Which investment should Debbie choose if she uses the equally likely criterion?
(d) Which investment should Debbie choose if she uses the criterion of realism with $\alpha = 0.5$?
(e) Which investment should Debbie choose if she uses the minimax regret criterion?

8-17 After reading about economic predictions, Debbie Gibson (see Problem 8-16) has assigned the probability that the economy will be strong, average, and weak at 0.2, 0.35, and 0.45, respectively.

(a) Using EMVs, what option should Debbie choose? What is the maximum EMV?
(b) Using EOL, what option should Debbie choose? What is the minimum EOL?
(c) Compute the EVPI and show that it is the same as the minimum EOL.

8-18 Helen Murvis, hospital administrator for Portland General Hospital, is trying to determine whether to build a large wing onto the existing hospital, a small wing, or no wing at all. If the population of Portland continued to grow, a large wing could return \$150,000 to the hospital each year. If the small wing were built, it would return \$60,000 to the hospital each year if the population continued to grow. If the population of Portland remained the same, the hospital would encounter a loss of \$85,000 if the large wing were built. Furthermore, a loss of \$45,000 would be realized if the small wing were constructed and the population remained the same. Unfortunately, Helen does not have any information about the future population of Portland.

(a) Construct a decision table.
(b) Using the equally likely criterion, determine the best alternative.
(c) Hardie Lord, Helen's boss, thinks of himself as a realist and believes that Helen should use a coefficient of realism of 0.75 in determining the best alternative. What is the best decision according to Hardie?

8-19 Jeff Park sells newspapers on Sunday mornings in an area surrounded by three busy churches. Assume that Jeff's demand can either be for 100, 200, or 300 newspapers, depending on traffic and weather. Jeff has the option to order 100, 200, or 300 newspapers from his supplier. Jeff pays \$1.25 for each newspaper he orders and sells each for \$2.00.

(a) How many papers should Jeff order if he chooses the maximax criterion?
(b) How many papers should Jeff order if he chooses the maximin criterion?
(c) How many papers should Jeff order if he chooses the equally likely criterion?
(d) How many papers should Jeff order if he chooses the criterion of realism with $\alpha = 0.4$?
(e) How many papers should Jeff order if he chooses the minimax regret criterion?

8-20 Jeff Park (see Problem 8-19) has done some research and discovered that the probabilities for demands of 100, 200, and 300 newspapers are 0.4, 0.35, and 0.25, respectively.

(a) Using EMVs, how many papers should Jeff order?
(b) Using EOL, how many papers should Jeff order?
(c) Compute Jeff's EVwPI and EVPI.

8-21 Waldo Books needs to decide how many copies of a new hardcover release to purchase for its shelves. The

store has assumed that demand will be 50, 100, 150, or 200 copies next month, and it needs to decide whether to order 50, 100, 150, or 200 books for this period. Each book costs Waldo $20 and can be sold for $30. Waldo can sell any unsold books back to the supplier for $4.

(a) Which option should Waldo choose if it uses the maximax criterion?
(b) Which option should Waldo choose if it uses the maximin criterion?
(c) Which option should Waldo choose if it uses the equally likely criterion?
(d) Which option should Waldo choose if it uses the criterion of realism with $\alpha = 0.7$?
(e) Which option should Waldo choose if it uses the minimax regret criterion?

8-22 After researching the market, Waldo Books (see Problem 8-21) has concluded that the probabilities of selling 50, 100, 150, and 200 books next month are 0.2, 0.35, 0.25, and 0.2, respectively.

(a) Using EMVs, how many books should Waldo order?
(b) Using EOL, how many books should Waldo order?
(c) Compute Waldo's EVwPI and EVPI.

8-23 Megley Cheese Company is a small manufacturer of several different cheese products. One of the products is a cheese spread that is sold to retail outlets. Jason Megley must decide how many cases of cheese spread to manufacture each month. The probability that the demand will be six cases is 0.1, for seven cases is 0.3, for eight cases is 0.5, and for nine cases is 0.1. The cost of every case is $45, and the price that Jason gets for each case is $95. Unfortunately, any cases not sold by the end of the month are of no value, due to spoilage. How many cases of cheese should Jason manufacture each month?

8-24 Even though independent gasoline stations have been having a difficult time, Susan Solomon has been thinking about starting her own independent gasoline station. Susan's problem is to decide how large her station should be. The annual returns will depend on both the size of her station and a number of marketing factors related to the oil industry and demand for gasoline. After a careful analysis, Susan developed the following payoff (profit) table:

Size	Good Market	Fair Market	Poor Market
Small	$ 50,000	$20,000	−$ 10,000
Medium	$ 80,000	$30,000	−$ 20,000
Large	$100,000	$30,000	−$ 40,000
Very large	$300,000	$25,000	−$160,000

(a) What is the maximax decision?
(b) What is the maximin decision?
(c) What is the equally likely decision?
(d) What is the criterion of realism decision, using $\alpha = 0.8$?
(e) What is the minimax regret decision?

8-25 Dorothy Stanyard has three major routes to take to work. She can take Tennessee Street the entire way, she can take several back streets to work, or she can use the expressway. The traffic patterns are, however, very complex. Under good conditions, Tennessee Street is the fastest route. When Tennessee is congested, one of the other routes is usually preferable. Over the past two months, Dorothy has tried each route several times under different traffic conditions. This information is summarized (in minutes of travel time to work) in the following table:

Route	No Congestion	Mild Congestion	Severe Congestion
Tennessee Street	15	30	45
Back roads	20	25	35
Expressway	30	30	30

In the past 60 days, Dorothy has encountered severe traffic congestion 10 days and mild traffic congestion 20 days. Assume that the past 60 days are typical of traffic conditions.

(a) Which route should Dorothy take? Remember that Dorothy would like to find the fastest route.
(b) Dorothy is about to buy a radio for her car that will tell her the exact traffic conditions before she starts to work each morning. On average, how much time, in minutes, would Dorothy save by buying the radio?

8-26 A group of medical professionals is considering constructing a private clinic. If patient demand for the clinic is high, the physicians could realize a net profit of $100,000. If the demand is low, they could lose $40,000. Of course, they don't have to proceed at all, in which case there is no cost. In the absence of any market data, the best the physicians can guess is that there is a 50–50 chance that demand will be good.

(a) Construct a decision tree to help analyze this problem. What should the medical professionals do?
(b) The physicians have been approached by a market research firm that offers to perform a study of the market at a fee of $5,000. The market researchers claim that their experience enables them to use Bayes' theorem to make the following statements of probability:

probability of high demand given a positive study result = 0.82
probability of low demand given a positive study result = 0.18
probability of high demand given a negative study result = 0.11
probability of low demand given a negative study result = 0.80
probability of a postive study result = 0.55
probability of a negative study result = 0.45

Expand the decision tree in part (a) to reflect the options now open with the market study. What should the medical professionals do now?

(c) What is the maximum amount the physicians would be willing to pay for the market study?
(d) What is the efficiency of the market study's information?

8-27 In Problem 8-26, you helped a group of medical professionals analyze a decision, using EMV as the decision criterion. This group has also assessed its utility for money: $U(-\$45{,}000) = 0$, $U(-\$40{,}000) = 0.1$, $U(-\$5{,}000) = 0.7$, $U(\$0) = 0.9$, $U(\$95{,}000) = 0.99$, and $U(\$100{,}000) = 1$.

(a) Are the medical professionals risk seekers or risk avoiders? Justify your answer.
(b) Use expected utility as the decision criterion and determine the best decision for the medical professionals (including the option to use the market research firm).

8-28 Jerry Young is thinking about opening a bicycle shop in his hometown. Jerry loves to take his own bike on 50-mile trips with his friends, but he believes that any small business should be started only if there is a good chance of making a profit. Jerry can open a small shop, a large shop, or no shop at all. Because there will be a five-year lease on the building that Jerry is thinking about using, he wants to make sure that he makes the correct decision.

Jerry has done some analysis about the profitability of the bicycle shop. If Jerry builds the large bicycle shop, he will earn \$60,000 if the market is good, but he will lose \$40,000 if the market is bad. The small shop will return a \$30,000 profit in a good market and a \$10,000 loss in an bad market. At the present time, he believes that there is a 59% chance that the market will be good.

Jerry also has the option of hiring his old marketing professor for \$5,000 to conduct a marketing research study. If the study is conducted, the results could be either favorable or unfavorable. It is estimated that there is a 0.6 probability that the survey will be favorable. Furthermore, there is a 0.9 probability that the market will be good, given a favorable outcome from the study. However, the marketing professor has warned Jerry that there is only a probability of 0.12 of a good market if the marketing research results are not favorable.

(a) Develop a decision tree for Jerry and help him decide what he should do.
(b) How much is the marketing professor's information worth? What is the efficiency of this information?

8-29 Kuality Komponents buys on–off switches from two suppliers. The quality of the switches from the suppliers is as follows:

Percentage Defective	Probability for Supplier A	Probability for Supplier B
1	0.70	0.30
3	0.20	0.40
5	0.10	0.30

For example, the probability of getting a batch of switches that are 1% defective from supplier A is 0.70. Because Kuality Komponents orders 10,000 switches per order, this would mean that there is a 0.7 probability of getting 100 defective switches out of the 10,000 switches if supplier A is used to fill the order. A defective switch can be repaired for 50 cents. Although the quality of supplier B is lower, it will sell an order of 10,000 switches for \$37 less than supplier A.

(a) Develop a decision tree to help Kuality Komponents decide which supplier it should use.
(b) For how much less would supplier B have to sell an order of 10,000 switches than supplier A for Kuality Komponents to be indifferent between the two suppliers?

8-30 You have been hired by the No Flight Golf Company, and your first task is to decide whether to market a new golf ball utilizing breakthrough technology and, if so, determine the price. The payoff of your decision will be affected by whether your competitor will market similar balls and the price of their golf balls after you go to market. The cost to market the golf balls is \$80,000, and the probability that your competitor will enter the market is 0.75. The following table describes the payoffs of each pricing combination, assuming that No Flight will have competition:

	Competitor's Price		
Our Price	High	Medium	Low
High	\$400,000	\$250,000	\$ 25,000
Medium	\$475,000	\$325,000	\$175,000
Low	\$350,000	\$250,000	\$125,000

If No Flight sets its price high, the probability that the competition will set its price high, medium, and low is 0.3, 0.55, and 0.15, respectively. If No Flight sets its price medium, the probability that the competition will set its price high, medium, and low is 0.2, 0.7, and 0.1, respectively. Finally, if No Flight sets its price low, the probability that the competition will set its price high, medium, and low is 0.15, 0.25, and 0.6, respectively.

If No Flight has no competition for its new golf balls, its expected payoff for setting the price high, medium, and low is \$600,000, \$500,000, and \$400,000, respectively, excluding marketing costs. Do you recommend marketing the new golf balls? If so, what is your pricing recommendation?

8-31 After observing the heavy snow that his town received the previous winter, Ajay Patel, an enterprising student, plans to offer a snow-clearing service in his neighborhood this winter. If he invests in a new heavy-duty blower, Ajay forecasts a profit of \$700 if snowfall this winter is heavy, a profit of \$200 if it is moderate, and a loss of \$900 if it is light. As per the current weather forecasts, the probabilities of heavy, moderate, and light snowfall this winter are 0.4, 0.3, and 0.3, respectively.

Rather than purchase a new blower, Ajay could get his father's blower repaired and just accept smaller jobs. Under this option, Ajay estimates a profit of $350 for a heavy snowfall, a profit of $100 for a moderate snowfall, and a loss of $150 for a light snowfall. Ajay, of course, has the option of choosing neither of these options.

The local weather expert, Samantha Adams, is Ajay's good friend. For $50, she is willing to run sophisticated weather models on her computer and tell Ajay whether she expects this winter to be unseasonably cold. For the sake of solving this problem, assume that the following information is available. There is a 45% chance that Samantha will predict this winter to be unseasonably cold. If she does say this, the probabilities of heavy, moderate, and light snowfall are revised to 0.7, 0.25, and 0.05, respectively. On the other hand, if she predicts that this winter will not be unseasonably cold, these probabilities are revised to 0.15, 0.33, and 0.52, respectively

Draw the decision tree for the situation faced by Ajay. Fold back the tree and determine the strategy you would recommend he follow. What is the efficiency of Samantha's information?

8-32 Oscar Weng is planning to raise funds to pay for a scouting trip by running a concession stand during tomorrow's high school soccer game. Oscar needs to decide whether to rent a large insulated thermos from the local rental store and sell cocoa at the game, or to rent a large refrigerated container and sell lemonade. Unfortunately, Oscar does not have the resources to rent both items. Sales depend on whether it is sunny or rainy during the game. If the weather is sunny, Oscar will make a profit of $60 from lemonade but only $20 from cocoa. If, however, it is rainy, Oscar will make a profit of $80 from cocoa but only break even if he brings lemonade. Based on the local newspaper's prediction, Oscar thinks there is a 60% chance of it being sunny tomorrow.

Oscar's friend Susan is a budding meteorologist who claims she can predict the weather more accurately than the newspaper. For only $4, she offers to study the weather and tell him if there is a "good chance" or "bad chance" of it being sunny tomorrow. Assume that the following data are available about the accuracy of Susan's information:

- The probability that she will say "good chance" is 0.7.
- If she says "good chance," then there is a 0.83 probability that it will actually be sunny tomorrow.
- If she says "bad chance," then there is only a 0.25 probability that it will actually be sunny tomorrow.

(a) Draw the complete decision tree for Oscar's problem and fold it back to help him decide what he should do.
(b) How much is Susan's information actually worth?

8-33 Rob Johnson is a product manager for Diamond Chemical. The firm is considering whether to launch a new product line that will require building a new facility. The technology required to produce the new product is yet untested. If Rob decides to build the new facility and the process is successful, Diamond Chemical will realize a profit of $650,000. If the process does not succeed, the company will lose $800,000. Rob estimates that there is a 0.6 probability that the process will succeed.

Rob can also decide to build a pilot plant for $50,000 to test the new process before deciding to build the full-scale facility. If the pilot plant succeeds, Rob feels the chance of the full-scale facility succeeding is 85%. If the pilot plant fails, Rob feels the chance of the full-scale facility succeeding is only 20%. The probability that the pilot plant will succeed is estimated at 0.6. Structure this problem with a decision tree and advise Rob what to do.

8-34 Rob Johnson (see Problem 8-33) has some revised information concerning the accuracy of the pilot plant probabilities. According to his new information, the probability that the pilot plant will be successful, given that the full-scale facility will work, is 0.8. The probability that the pilot plant will fail, given that the full-scale facility will fail, is 0.85. Calculate the posterior probabilities and reevaluate the decision tree from Problem 8-33. Does this new information affect Diamond Chemical's original decision?

8-35 Your regular tennis partner has made a friendly wager with you. The two of you will play out one point in which you can serve. The loser pays the winner $100. If your first serve is not in play, you get a second serve. If your second serve is not in play, you lose the point. You have two kinds of serves: a hard one and a soft one. You know that your hard serve is in play 60% of the time and, when it is in play, you win the point 70% of the time. You put your soft serve in play 85% of the time and, when it is in play, you win the point 25% of the time. Should you accept the wager? If so, should you use your hard or soft serve?

8-36 You are reconsidering your analysis of the tennis wager between you and your partner (see Problem 8-35) and have decided to incorporate utility theory into the decision making process. The following table describes your utility values for various payoffs:

Monetary Value	Utility
−$100	0.00
−$ 50	0.50
$ 0	0.80
$ 50	0.95
$100	1.00

(a) Redo Problem 8-35 using this information.
(b) How can you best describe your attitude toward risk? Justify your answer.

8-37 Shamrock Oil owns a parcel of land that has the potential to be an underground oil field. It will cost $500,000 to drill for oil. If oil does exist on the land, Shamrock

will realize a payoff of $4,000,000 (not including drilling costs). With current information, Shamrock estimates that there is a 0.2 probability that oil is present on the site. Shamrock also has the option of selling the land as is for $400,000, without further information about the likelihood of oil being present. A third option is to perform geological tests at the site, which would cost $100,000. There is a 30% chance that the test results will be positive, after which Shamrock can sell the land for $650,000 or drill the land, with a 0.65 probability that oil exists. If the test results are negative, Shamrock can sell the land for $50,000 or drill the land, with a 0.05 probability that oil exists. Using a decision tree, recommend a course of action for Shamrock Oil.

8-38 Shamrock Oil (see Problem 8-37) has some revised information concerning the accuracy of the geological test probabilities. According to this new information, the probability that the test will be positive, given that oil is present in the ground, is 0.85. The probability that the test will be negative, given that oil is not present, is 0.75. Calculate the posterior probabilities and reevaluate the decision tree from Problem 8-37. Does this new information affect Shamrock Oil's original decision?

8-39 Shamrock Oil (see Problem 8-37) has decided to rely on utility theory to assist in the decision concerning the oil field. The following table describes its utility function; all monetary values are in thousands of dollars:

Monetary Value	Utility
−$ 600	0.00
−$ 500	0.03
−$ 50	0.10
$ 400	0.15
$ 550	0.17
$3,400	0.90
$3,500	1.00

(a) Redo Problem 8-37 using this information.
(b) How can you best describe Shamrock Oil's attitude toward risk? Justify your answer.

8-40 Jim Sellers is thinking about producing a new type of electric razor for men. If the market is good, he would get a return of $100,000, but if the market for this new type of razor is poor, he would lose $60,000. Because Ron Bush is a close friend of Jim Sellers, Jim is considering the possibility of using Bush Marketing Research to gather additional information about the market for the razor. Ron has suggested two options to Jim. The first alternative is a sophisticated questionnaire that would be administered to a test market. It will cost $5,000. The second alternative is to run a pilot study. This would involve producing a limited number of the new razors and trying to sell them in two cities that are typical of American cities. The pilot study is more accurate but is also more expensive. It will cost $20,000. Ron has suggested that it would be a good idea for Jim to conduct either the questionnaire or the pilot before making the decision concerning whether to produce the new razor. But Jim is not sure if the value of either option is worth the cost.

For the sake of solving this problem, assume that Jim has the following probability estimates available: the probability of a successful market without performing the questionnaire or pilot study is 0.5, the probability of a successful market given a positive questionnaire result is 0.78, the probability of a successful market given a negative questionnaire result is 0.27, the probability of a successful market given a positive pilot study result is 0.89, and the probability of a successful market given a negative pilot study result is 0.18. Further, the probability of a positive questionnaire result is 0.45 and the probability of a positive pilot study result is also 0.45.

(a) Draw the decision tree for this problem and identify the best decision for Jim.
(b) What is the value of the questionnaire's information? What is its efficiency?
(c) What is the value of the pilot study's information? What is its efficiency?

8-41 Jim Sellers (see Problem 8-40) has been able to estimate his utility for a number of different values, and he would like to use these utility values in making his decision. The utility values are $U(-\$80{,}000) = 0$, $U(-\$65{,}000) = 0.5$, $U(-\$60{,}000) = 0.55$, $U(-\$20{,}000) = 0.7$, $U(-\$5{,}000) = 0.8$, $U(\$0) = 0.81$, $U(\$80{,}000) = 0.9$, $U(\$95{,}000) = 0.95$, and $U(\$100{,}000) = 1$.

(a) Solve Problem 8-40(a) again using utility values.
(b) Is Jim a risk avoider or risk seeker? Justify your answer.

8-42 Jason Scott has applied for a mortgage to purchase a house, and he will go to settlement in two months. His loan can be locked in now at the current market interest rate of 7% and a cost of $1,000. He also has the option of waiting one month and locking in the rate available at that time at a cost of $500. Finally, he can choose to accept the market rate available at settlement in two months at no cost. Assume that interest rates will either increase by 0.5% (0.3 probability), remain unchanged (0.5 probability), or decrease by 0.5% (0.2 probability) at the end one month.

Rates can also increase, remain unchanged, or decrease by another 0.5% at the end on the second month. If rates increase after one month, the probability that they will increase, remain unchanged, and decrease at the end of the second month is 0.5, 0.25, and 0.25, respectively. If rates remain unchanged after one month, the probability that they will increase, remain unchanged, and decrease at the end of the second month is 0.25, 0.5, and 0.25, respectively. If rates decrease after one month, the probability that they will increase, remain unchanged, and decrease at the end of the second month is 0.25, 0.25, and 0.5, respectively.

Assuming that Jason will stay in the house for 5 years, each 0.5% increase in the interest rate of his mortgage will cost him $2,400. Each 0.5% decrease in the rate will likewise save him $2,400. What strategy would you recommend?

8-43 Jason Scott (see Problem 8-42) has decided to incorporate utility theory into his decision with his mortgage application. The following table describes Jason's utility function:

Monetary Value	Utility
−$4,800	0.00
−$2,900	0.10
−$2,400	0.12
−$1,000	0.15
−$ 500	0.19
$ 0	0.21
$1,900	0.26
$2,400	0.30
$4,800	1.00

(a) How can you best describe Jason's attitude toward risk? Justify your answer.
(b) Will the use of utilities affect Jason's original decision in Problem 8-42?

8-44 Sue Reynolds has to decide whether she should get information (at a cost of $20,000) to invest in a retail store. If she gets the information, there is a 0.6 probability that it will be favorable. If the information is favorable, there is a 0.9 probability that the store will be a success. If the information is not favorable, the probability of a successful store is only 0.2. Without any information, Sue estimates that the probability of a successful store will be 0.6. A successful store will give a return of $100,000. If the store is built but is not successful, Sue will see a loss of $80,000. Of course, she could always decide not to build the retail store.

(a) What do you recommend?
(b) How much is the information worth? What is its efficiency?

8-45 Replace all monetary values in Sue Reynolds' problem (see Problem 8-44) with the following utilities:

Monetary Value	Utility
$100,000	1.00
$ 80,000	0.40
$ 0	0.20
−$ 20,000	0.10
−$ 80,000	0.05
−$100,000	0.00

(a) What do you recommend based on expected utility?
(b) Is Sue a risk seeker or a risk avoider? Justify your answer.

8-46 The Jamis Corporation is involved with waste management. During the past 10 years it has become one of the largest waste disposal companies in the Midwest, serving primarily Wisconsin, Illinois, and Michigan. Bob Jamis, president of the company, is considering the possibility of establishing a waste treatment plant in northern Mississippi. From past experience, Bob believes that a small plant would yield a $500,000 profit, regardless of the demand for the plant. The success of a medium-sized plant would depend on demand. With a low demand for waste treatment, Bob expects a $200,000 profit. A fair demand would yield a $700,000 profit, and a high demand would return $800,000. Although a large plant is much riskier than a medium-sized one, the potential rewards are much greater. With a high demand, a large plant would return $1,000,000. However, the plant would yield a profit of only $400,000 with a fair demand, and it would actually lose $200,000 with a low demand. Looking at the current economic conditions in northern Mississippi, Bob estimates that the probabilities of low, fair, and high demands are 0.15, 0.4, and 0.45, respectively.

Because of the large potential investment and the possibility of a loss, Bob has decided to hire a market research team that is based in Jackson, Mississippi. This team will perform a survey to get a better feel for the probability of a low, medium, or high demand for a waste treatment facility. The cost of the survey is $50,000, and the survey could result in three possible outcomes—low, fair, and high. To help Bob determine whether to go ahead with the survey, the marketing research firm has provided Bob with the following information regarding the conditional probabilities, i.e., P(Survey results | Possible outcomes):

	Survey Results		
Possible Outcome	Low	Fair	High
Low demand	0.7	0.2	0.1
Fair demand	0.4	0.5	0.1
High demand	0.1	0.3	0.6

For example, P(Low survey result|Low demand) = 0.7. What should Bob do?

8-47 Before market research was done, Peter Martin believed that there was a 50–50 chance that his food store would be a success. The research team determined that there was a 0.8 probability that the market research would be favorable, given a successful food store. Moreover, there was a 0.7 probability that the market research would be unfavorable, given an unsuccessful food store. This information is based on past experience.

(a) If the market research is favorable, what is Peter's revised probability of a successful food store?
(b) If the market research is unfavorable, what is Peter's revised probability of a successful food store?

8-48 A market research company has approached you about the possibility of using its services to help you

decide whether to launch a new product. According to its customer portfolio, it has correctly predicted a favorable market for its clients' products 14 out of the last 16 times. It has also correctly predicted an unfavorable market for its clients' products 9 out of 11 times. Without this research company's help, you have estimated the probability of a favorable market at 0.55. Calculate the posterior probabilities, using the track record of the research firm.

8-49 Lathum Consulting is an econometrics research firm that predicts the direction of the gross national product (GNP) during the next quarter. More specifically, it forecasts whether the GNP will grow, hold steady, or decline. The following table describes Lathum's track record from past predictions by displaying the probabilities of its predictions, given the actual outcome:

	GNP Prediction		
Actual GNP	Growth	Steady	Decline
Growth	0.75	0.08	0.05
Steady	0.18	0.80	0.12
Decline	0.07	0.12	0.83

For example, the chance that Lathum will predict that the GNP will grow when it actually is steady is 18%. Your company is considering a contract with Lathum Consulting to assist in predicting the direction of next quarter's GNP. Prior to enlisting Lathum's services, you have assessed the probability of the GNP growing, holding steady, and declining at 0.3, 0.45, and 0.25, respectively. Calculate the posterior probabilities, using the services of Lathum Consulting.

8-50 In the past few years, the traffic problems in Lynn McKell's hometown have gotten worse. Now, Broad Street is congested about half the time. The normal travel time to work for Lynn is only 15 minutes when Broad Street is used and there is no congestion. With congestion, however, it takes Lynn 40 minutes to get to work. If Lynn decides to take the expressway, it takes 30 minutes, regardless of the traffic conditions. Lynn's utility for travel time is $U(15 \text{ minutes}) = 0.9$, $U(30 \text{ minutes}) = 0.7$, and $U(40 \text{ minutes}) = 0.2$.

(a) Which route will minimize Lynn's expected travel time?
(b) Which route will maximize Lynn's utility?
(c) When it comes to travel time, is Lynn a risk seeker or a risk avoider? Justify your answer.

CASE STUDY

Ski Right

After retiring as a physician, Bob Guthrie became an avid downhill skier on the steep slopes of the Utah Rocky Mountains. As an amateur inventor, Bob was always looking for something new. With the recent deaths of several celebrity skiers, Bob knew he could use his creative mind to make skiing safer and his bank account larger. He knew that many deaths on the slopes were caused by head injuries. Although ski helmets have been on the market for some time, most skiers considered them boring and basically ugly. As a physician, Bob knew that some type of new ski helmet was the answer.

Bob's biggest challenge was to invent a helmet that was attractive, safe, and fun to wear. Multiple colors, using the latest fashion designs, would be a must. After years of skiing, Bob knew that many skiers believed that how you looked on the slopes was more important than how you skied. His helmets would have to look good and fit in with current fashion trends. But attractive helmets were not enough. Bob had to make the helmets fun and useful. The name of the new ski helmet, Ski Right, was sure to be a winner. If Bob could come up with a good idea, he believed that there was a 20% chance that the market for the Ski Right helmet would be excellent. The chance of a good market should be 40%. Bob also knew that the market for his helmet could be only average (30% chance) or even poor (10% chance).

The idea of how to make ski helmets fun and useful came to Bob on a gondola ride to the top of a mountain. A busy executive on the gondola ride was on his cell phone, trying to complete a complicated merger. When the executive got off the gondola, he dropped the phone, and it was crushed by the gondola mechanism. Bob decided that his new ski helmet would have a built-in cell phone and an AM/FM stereo radio. All the electronics could be operated by a control pad worn on a skier's arm or leg.

Bob decided to try a small pilot project for Ski Right. He enjoyed being retired and didn't want a failure to cause him to go back to work. After some research, Bob found Progressive Products (PP). The company was willing to be a partner in developing the Ski Right and sharing any profits. If the market was excellent, Bob would net $5,000. With a good market, Bob would net $2,000. An average market would result in a loss of $2,000, and a poor market would mean Bob would be out $5,000.

Another option for Bob was to have Leadville Barts (LB) make the helmet. The company had extensive experience in making bicycle helmets. Progressive would then take the helmets made by Leadville Barts and do the rest. Bob had a greater risk. He estimated that he could lose $10,000 in a poor market or $4,000 in an average market. A good market for Ski Right would result in a $6,000 profit for Bob, and an excellent market would mean a $12,000 profit.

A third option for Bob was to use TalRad (TR), a radio company in Tallahassee, Florida. TalRad had extensive experience in making military radios. Leadville Barts could make the helmets, and Progressive Products could do the rest. Again, Bob

would be taking on greater risk. A poor market would mean a $15,000 loss, and an average market would mean a $10,000 loss. A good market would result in a net profit of $7,000 for Bob. An excellent market would return $13,000.

Bob could also have Celestial Cellular (CC) develop the cell phones. Thus, another option was to have Celestial make the phones and have Progressive do the rest of the production and distribution. Because the cell phone was the most expensive component of the helmet, Bob could lose $30,000 in a poor market. He could lose $20,000 in an average market. If the market was good or excellent, Bob would see a net profit of $10,000 or $30,000, respectively.

Bob's final option was to forget about Progressive Products entirely. He could use Leadville Barts to make the helmets, Celestial Cellular to make the phones, and TadRad to make the AM/FM stereo radios. Bob could then hire some friends to assemble everything and market the finished Ski Right helmets. With this final alternative, Bob could realize a net profit of $55,000 in an excellent market. Even if the market were just good, Bob would net $20,000. An average market, however, would mean a loss of $35,000. If the market was poor, Bob would lose $60,000.

Discussion Questions

1. What do you recommend?
2. What is the opportunity loss for this problem?
3. Compute the expected value of perfect information.
4. Was Bob completely logical in how he approached this decision problem?

CASE STUDY

Blake Electronics

In 1969, Steve Blake founded Blake Electronics in Long Beach, California, to manufacture resistors, capacitors, inductors, and other electronic components. During the Vietnam War, Steve was a radio operator, and it was during this time that he became proficient at repairing radios and other communications equipment. Steve viewed his four-year experience with the army with mixed feelings. He hated army life, but that experience gave him the confidence and the initiative to start his own electronics firm.

Over the years, Steve kept the business relatively unchanged. By 1984, total annual sales were in excess of $2 million. In 1988, Steve's son, Jim, joined the company after finishing high school and two years of courses in electronics at Long Beach Community College. Jim had always been aggressive in high school athletics, and he became even more aggressive as general sales manager of Blake Electronics. This aggressiveness bothered Steve, who was more conservative. Jim would make deals to supply companies with electronic components before he bothered to find out if Blake Electronics had the ability or capacity to produce the components. On several occasions, this behavior caused the company some embarrassing moments when Blake Electronics was unable to produce the electronic components for companies with which Jim had made deals.

In 1992, Jim started to go after government contracts for electronic components. By 1994, total annual sales had increased to more than $10 million, and the number of employees exceeded 200. Many of these employees were electronics specialists and graduates of electrical engineering programs from top colleges and universities. But Jim's tendency to stretch Blake Electronics to contracts continued as well, and by 2001, Blake Electronics had a reputation with government agencies as a company that could not deliver what it promised. Almost overnight, government contracts stopped, and Blake Electronics was left with an idle workforce and unused manufacturing equipment. This high overhead started to melt away profits, and in 2003, Blake Electronics was faced with the possibility of sustaining a loss for the first time in its history.

In 2005, Steve decided to look at the possibility of manufacturing electronic components for home use. Although this was a totally new market for Blake Electronics, Steve was convinced that this was the only way to keep Blake Electronics from dipping into the red. The research team at Blake Electronics was given the task of developing new electronic devices for home use. The first idea from the research team was the Master Control Center. The basic components for this system are shown in Figure 8.14.

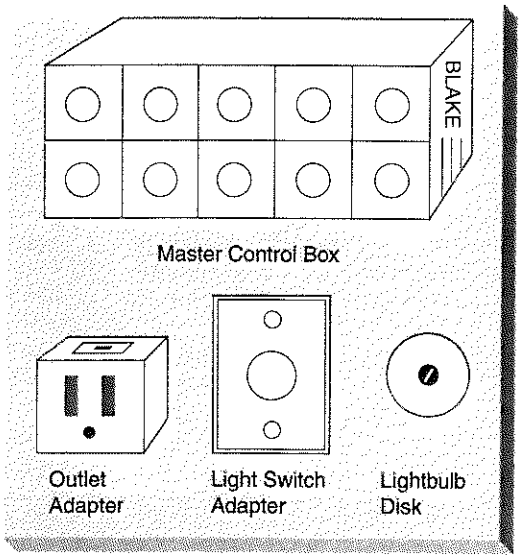
The heart of the system is the master control box. This unit, which would have a retail price of $250, has two rows of five buttons. Each button controls one light or appliance and can be set as either a switch or a rheostat. When set as a switch, a light finger touch on the bottom either turns a light or appliance on or off. When set as a rheostat, a finger touching the bottom controls the intensity of the light. Leaving your finger on the button makes the light go through a complete cycle, ranging from off to bright and back to off again.

To allow for maximum flexibility, each master control box is powered by two D-sized batteries that can last up to a year, depending on usage. In addition, the research team has developed three versions of the master control box—versions A, B, and C. If a family wants to control more than 10 lights or appliances, another master control box can be purchased.

The lightbulb disk, which would have a retail price of $2.50, is controlled by the master control box and is used to control the intensity of any light. A different disk is available for each button position for all three master control boxes. By inserting the lightbulb disk between the lightbulb and the socket, the appropriate button on the master control box can completely control the intensity of the light. If a standard light switch is used, it must be on at all times for the master control box to work.

FIGURE 8.14

Master Control Center



One disadvantage of using a standard light switch is that only the master control box can be used to control the particular light. To avoid this problem, the research team developed a special light switch adapter that would sell for $15. When this device is installed either the master control box or the light switch adapter can be used to control the light.

When used to control appliances other than lights, the master control box must be used in conjunction with one or more outlet adapters. The adapters are plugged in to a standard wall outlet, and the appliance is then plugged in to the adapter. Each outlet adapter has a switch on top that allows the appliance to be controlled from the master control box or the outlet adapter. The price of each outlet adapter would be $25.

The research team estimated that it would cost $500,000 to develop the equipment and procedures needed to manufacture the master control box and accessories. If successful, this venture could increase sales by approximately $2 million. But would the master control boxes be a successful venture? With a 60% chance of success estimated by the research team, Steve has serious doubts about trying to market the master control boxes even though he liked the basic idea. Because of his reservations, Steve decided to send requests for proposals (RFPs) for additional marketing research to 30 marketing research companies in southern California.

The first RFP to come back was from a small company called Marketing Associates, Inc. (MAI), which would charge $100,000 for the survey. According to its proposal, MAI has been in business for about three years and has conducted about 100 marketing research projects. MAI's major strengths appeared to be individual attention to each account, experienced staff, and fast work. Steve was particularly interested in one part of the proposal, which revealed MAI's success record with previous accounts. This is shown in Table 8.13.

The only other proposal to be returned was by a branch office of Iverstine and Kinard, one of the largest marketing research firms in the country. The cost for a complete survey would be $300,000. Although the proposal did not contain the same success record as MAI, the proposal from Iverstine and Kinard did contain some interesting information. The chance of getting a favorable survey result, given a successful venture, was 90%. On the other hand, the chance of getting an unfavorable survey result, given an unsuccessful venture, was 80%. Thus, it appeared to Steve that Iverstine and Kinard would be able to predict the success or failure of the master control boxes with a great amount of certainty.

Steve pondered the situation. Unfortunately, the two marketing research teams gave different types of information in their proposals. Steve concluded that there would be no way

TABLE 8.13

Success Figures for MAI

	SURVEY RESULTS		
OUTCOME	FAVORABLE	UNFAVORABLE	TOTAL
Successful venture	35	20	55
Unsuccessful venture	15	30	45

that the two proposals could be compared unless he got additional information from Iverstine and Kinard. Furthermore, Steve wasn't sure what he would do with the information and whether it would be worth the expense of hiring one of the marketing research firms.

Discussion Questions

1. Does Steve need additional information from Iverstine and Kinard?
2. What would you recommend?

INTERNET CASE STUDIES

See our Internet home page at www.prenhall.com/balakrishnan for these additional case studies:

- Starting Right Corporation
- Drink-at-Home Inc.
- Ruth Jones' Heart By-Pass Operation
- Toledo Leather Company

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