into each of three chambers. The balls in the first chamber are colored pink, the balls in the second chamber are blue, and the balls in the third chamber are yellow. One ball of each color is randomly drawn, with the official order as pink–blue–yellow. In Play 4, a fourth chamber with orange balls is added, and the official order is pink–blue–yellow–orange. Since the draws of the colored balls are random and independent, we can apply an extension of the probability rule for the intersection of two independent events to find the odds of winning Cash 3 and Play 4. The probability of matching a numbered ball being drawn from a chamber is 1/10; therefore,

$$\begin{aligned} P(\text{Win Cash 3}) &= P(\text{match pink } \textit{and} \text{ match blue } \textit{and} \text{ match yellow}) \\ &= P(\text{match pink}) \times P(\text{match blue}) \times P(\text{match yellow}) \\ &= (1/10)(1/10)(1/10) = 1/1000 = .001 \end{aligned}$$

$$\begin{aligned} P(\text{Win Play 4}) &= P(\text{match pink } \textit{and} \text{ match blue } \textit{and} \text{ match yellow } \textit{and} \text{ match orange}) \\ &= P(\text{match pink}) \times P(\text{match blue}) \times P(\text{match yellow}) \times P(\text{match orange}) \\ &= (1/10)(1/10)(1/10) \\ &= 1/10{,}000 = .0001 \end{aligned}$$

Although the odds of winning one of these daily games is much better than the odds of winning Lotto 6/53, there is still only a 1 in 1,000 chance (for Cash 3) or 1 in 10,000 chance (for Play 4) of winning the daily game. And the payoffs ($500 or $5,000) are much smaller. In fact, it can be shown that you will lose an average of 50¢ every time you play either Cash 3 or Play 4!

ACTIVITY 3.2: *Keep the Change:* Independent Events

Once again we return to the Bank of America *Keep the Change* savings program, presented in Activity 1.1 (p. 12). This time, we look at whether certain events involving purchase totals and amounts transferred to savings are independent. Throughout this activity, the experiment consists of randomly selecting one purchase from a large group of purchases.

1. Define events *A* and *B* as follows:
   A: {Purchase total ends in $0.25.}
   B: {Amount transferred is less than $0.50.}
   Explain why events *A* and *B* are not independent. Are events *A* and *B* mutually exclusive? Use this example to explain the difference between independent events and mutually exclusive events.

2. Now define events *A* and *B* in this manner:
   A: {Purchase total is greater than $10.}
   B: {Amount transferred is less than $0.50.}
   Do you believe that these events are independent? Explain your reasoning.

3. To investigate numerically whether the events in Question 2 are independent, we will use the data collected in Activity 1.1. Pool your data with the data from other students or from the entire class so that the combined data set represents at least 100 purchases. Complete the table by counting the number of purchases in each category.

Distribution of Purchases

	Purchase Total		
Transfer Amount	≤ $10	> $10	Totals
$0.00–$0.49			
$0.99–$0.99			
Totals			

Compute appropriate probabilities based on your completed table to test whether the events of Question 2 are independent. If you conclude that the events are not independent, can you explain your conclusion in terms of the original data?

Exercises 3.58–3.93

Understanding the Principles

3.58 Explain the difference between an unconditional probability and a conditional probability.

3.59 Give the multiplicative rule of probability for two independent events.

3.60 Give the formula for finding $P(B|A)$.

3.61 Give the multiplicative rule of probability for any two events.

3.62 Defend or refute each of the following statements:
   a. Dependent events are always mutually exclusive.
   b. Mutually exclusive events are always dependent.
   c. Independent events are always mutually exclusive.

Learning the Mechanics

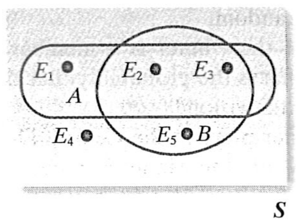
3.63 NW For two events A and B, $P(A) = .4$, $P(B) = .2$, an $P(A \cap B) = .1$.
   a. Find $P(A|B)$. .5
   b. Find $P(B|A)$. .25
   c. Are A and B independent events? No

3.64 For two events A and B, $P(A) = .4$, $P(B) = .2$, an $P(A|B) = .6$.
   a. Find $P(A \cap B)$. .12
   b. Find $P(B|A)$. .3

5 For two independent events A and B, $P(A) = .4$ and $P(B) = .2$.
a. Find $P(A \cap B)$. .08
b. Find $P(A|B)$. .4
c. Find $P(A \cup B)$. .52

6 An experiment results in one of three mutually exclusive events A, B, and C. It is known that $P(A) = .30$, $P(B) = .55$, and $P(C) = .15$, Find each of the following probabilities:
a. $P(A \cup B)$ .85 **b.** $P(A \cap B))$ 0
c. $P(A|B)$ 0 **d.** $P(B \cup C))$ .70
e. Are B and C independent events? Explain. No

7 Consider the experiment defined by the accompanying V Venn diagram, with the sample space S containing five sample points. The sample points are assigned the following probabilities: $P(E_1) = .1$, $P(E_2) = .1$, $P(E_3) = .2$, $P(E_4) = .5$, $P(E_5) = .1$.



a. Calculate $P(A)$, $P(B)$, and $P(A \cap B)$. .4; .4; .3
b. Suppose we know that event A has occurred, so the reduced sample space consists of the three sample points in A: E_1, E_2, and E_3. Use the formula for conditional probability to determine the probabilities of these three sample points given that A has occurred. Verify that the conditional probabilities are in the same ratio to one another as the original sample point probabilities and that they sum to 1. .25; .25; .5
c. Calculate the conditional probability $P(B|A)$ in two ways: First, sum $P(E_2|A)$ and $P(E_3|A)$, since these sample points represent the event that B occurs given that A has occurred. Second, use the formula for conditional probability:

$$P(B|A) = \frac{P(A \cap B)}{P(A)}$$

Verify that the two methods yield the same result. .75

68 An experiment results in one of five sample points with the following probabilities: $P(E_1) = .22$, $P(E_2) = .31$, $P(E_3) = .15$, $P(E_4) = .22$, and $P(E_5) = .1$. The following events have been defined:

A: $\{E_1, E_3\}$
B: $\{E_2, E_3, E_4\}$
C: $\{E_1, E_5\}$

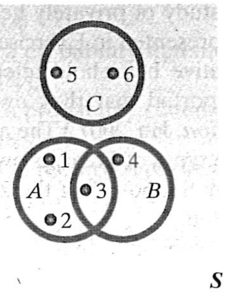
Find each of the following probabilities:
a. $P(A)$ .37 **b.** $P(B)$ .68 **c.** $P(A \cap B)$ .15
d. $P(A|B)$ .221 **e.** $P(B \cap C)$ 0 **f.** $P(C|B)$ 0
g. Consider each pair of events A and B, A and C, and B and C. Are any of the pairs of events independent? Why? No

69 Two fair dice are tossed, and the following events are defined:

A: {The sum of the numbers showing is odd.}
B: {The sum of the numbers showing is 9, 11, or 12.}

Are events A and B independent? Why? No

3.70 A sample space contains six sample points and events A, B, and C, as shown in the accompanying Venn diagram. The probabilities of the sample points are $P(1) = .20$, $P(2) = .05$, $P(3) = .30$, $P(4) = .10$, $P(5) = .10$, and $P(6) = .25$.



a. Which pairs of events, if any, are mutually exclusive? Why? (A, C), (B, C)
b. Which pairs of events, if any, are independent? Why? None
c. Find $P(A \cup B)$ by adding the probabilities of the sample points and then by using the additive rule. Verify that the answers agree. Repeat for $P(A \cup C)$.

3.71 A box contains two white, two red, and two blue poker chips. Two chips are randomly chosen without replacement, and their colors are noted. Define the following events:

A: {Both chips are of the same color.}
B: {Both chips are red.}
C: {At least one chip is red or white.}

Find $P(B|A)$, $P(B|A^c)$, $P(B|C)$, $P(A|C)$, and $P(C|A^c)$.

APPLET Applet Exercise 3.5

Use the applet entitled *Simulating the Probability of Rolling a 6* to simulate conditional probabilities. Begin by running the applet twice with $n = 10$, without resetting between runs. The data on your screen represent 20 rolls of a die. The diagram above the *Roll* button shows the frequency of each of the six possible outcomes. Use this information to find each of the following probabilities:
a. The probability of 6 given that the outcome is 5 or 6
b. The probability of 6 given that the outcome is even
c. The probability of 4 or 6 given that the outcome is even
d. The probability of 4 or 6 given that the outcome is odd

Applying the Concepts—Basic

3.72 Treating brain cancer. According to the Children's Oncology NW Group Research Data Center at the University of Florida, 20% of children with neuroblastoma (a form of brain cancer) undergo surgery rather than the traditional treatment of chemotherapy or radiation. The surgery is successful in curing the disease 95% of the time. (*Explore*, Spring 2001.) Consider a child diagnosed with neuroblastoma. What are the chances that the child undergoes surgery and is cured? .19

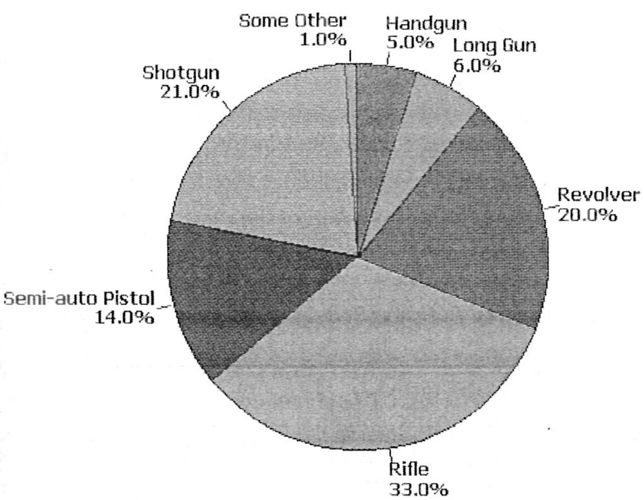
3.73 Speeding linked to fatal car crashes. According to the National NW Highway Traffic and Safety Administration's National Center for Statistics and Analysis (NCSA), "Speeding is one of the most prevalent factors contributing to fatal traffic crashes." (*NHTSA Technical Report*, Aug. 2005.) The probability that speeding is a cause of a fatal crash is .3. Furthermore, the probability that speeding and missing a curve are causes of a fatal crash is .12. Given that speeding is a cause of a fatal crash, what is the probability that the crash occurred on a curve? .4

3.74 National Firearms Survey. Refer to the Harvard School of Public Health study of privately held firearm stock in the United States, presented in Exercise 2.6 (p. 34). Recall that in a representative household telephone survey of 2,770 adults, 26% reported that they owned at least one gun. (*Injury Prevention*, Jan. 2007.) The accompanying pie chart summarizes the types of firearms owned by those who own at least one gun. Suppose 1 of the 2,770 adults surveyed is randomly selected.

a. What is the probability that the adult owns at least one gun? .26

b. Given that the adult does own at least one gun, what is the probability that the adult owns a revolver? .20

c. What is the probability that the adult owns at least one gun and the gun is a handgun? .013



Source: Hepburn, M., Miller, D. A., and Hemenway, D. "The US gun stock: Results from the 2004 national firearms survey," *Injury Prevention*, Vol. 13, No. 1, Jan. 2007 (Figure 1).

3.75 Testing a psychic's ability. Consider an experiment in which 10 identical small boxes are placed side by side on a table. A crystal is placed at random inside one of the boxes. A self-professed "psychic" is asked to pick the box that contains the crystal.

a. If the "psychic" simply guesses, what is the probability that she picks the box with the crystal? 1/10

b. If the experiment is repeated seven times, what is the probability that the "psychic" guesses correctly at least once? .522

c. A group called the Tampa Bay Skeptics recently tested a self-proclaimed "psychic" by administering the preceding experiment seven times. The "psychic" failed to pick the correct box all seven times. (*Tampa Tribune*, Sept. 20, 1998.) What would you infer about this person's psychic ability?

3.76 Herbal medicines survey. Refer to *The American Association of Nurse Anesthetists Journal* (Feb. 2000) study on the use of herbal medicines before surgery, presented in Exercise 1.20 (p. 20). Recall that 51% of surgical patients use herbal medicines against their doctor's advice prior to surgery.

a. What is the probability that a randomly selected surgic patient will use herbal medicines against his or her dc tor's advice? .51

b. What is the probability that in a sample of two inc pendently selected surgical patients, both will use hert medicines against their doctor's advice? .2601

c. What is the probability that in a sample of five inc pendently selected surgical patients, all five will u herbal medicines against their doctor's advice? .034!

d. Would you expect the event in part **c** to occur? Explai

3.77 World Series winners. The New York Yankees, a member
NW the Eastern Division of the American League in Maj League Baseball (MLB), recently won three consecuti World Series. The accompanying table summarizes the MLB World Series winners from 1990 to 2006 by divisi and league. (There was no World Series in 1994, due tc players' strike.) One of these 16 World Series winners is be chosen at random.

a. Given that the winner is a member of the Americ League, what is the probability that the winner plays the Eastern Division? .70

b. If the winner plays in the Central Division, what is t probability that the winner is a member of the Natioı League? .50

c. If the winner is a member of the National League, wl is the probability that the winner plays in either the Cє tral or Western Division? .50

		League	
		National	American
Division	Eastern	3	7
	Central	2	2
	Western	1	1

Source: Major League Baseball.

3.78 Study of ancient pottery. Refer to the *Chance* (Fall 20(study of ancient pottery found at the Greek settlement Phylakopi, presented in Exercise 2.12 (p. 35). Of the 8 pottery pieces uncovered at the excavation site, 183 wє painted. These painted pieces included 14 painted ir curvilinear decoration, 165 painted in a geometric deco tion, and 4 painted in a naturalistic decoration. Suppose 1 the 837 pottery pieces is selected and examined.

a. What is the probability that the pottery piece is pai ed? .219

b. Given that the pottery piece is painted, what is the pro bility that it is painted in a curvilinear decoration? .07

Applying the Concepts—Intermediate

3.79 Are you really being served red snapper? Red snapper i rare and expensive reef fish served at upscale restauraı Federal law prohibits restaurants from serving a cheap look-alike variety of fish (e.g., vermillion snapper or lε snapper) to customers who order red snapper. Researcher: the University of North Carolina used DNA analysis to exa ine fish specimens labeled "red snapper" that were purcha: form vendors across the country. (*Nature*, July 15, 2004.) 1 DNA tests revealed that 77% of the specimens were not snapper, but the cheaper, look-alike variety of fish.

a. Assuming that the results of the DNA analysis are va what is the probability that you are actually served snapper the next time you order it at a restaurant? .23

b. If there are five customers at a restaurant, all who have ordered red snapper, what is the probability that at least one customer is actually served red snapper? .7293

3.80 Fighting probability of fallow deer bucks. Refer to the *Aggressive Behavior* (Jan./Feb., 2007) study of fallow deer bucks fighting during the mating season, presented in Exercise 3.53 (p. 136). Recall that researchers recorded 167 encounters between two bucks, one of which clearly initiated the encounter with the other. A summary of the fight status of the initiated encounters is provided in the accompanying table. Suppose we select 1 of these 167 encounters and note the outcome (fight status and winner).

a. Given that a fight occurs, what is the probability that the initiator wins? .4063

b. Given no fight, what is the probability that the initiator wins? .7767

c. Are the events "no fight" and "initiator wins" independent? No

	Initiator Wins	No Clear Winner	Initiator Loses	Totals
Fight	26	23	15	64
No Fight	80	12	11	103
Totals	106	35	26	167

Source: Bartos, L. et al. "Estimation of the probability of fighting in fallow deer (*Dama dama*) during the rut," *Aggressive Behavior*, Vol. 33, Jan./Feb., 2007.

NZBIRDS

3.81 Extinct New Zealand birds. Refer to the *Evolutionary Ecology Research* (July 2003) study of the patterns of extinction in the New Zealand bird population, presented in Exercise 2.18 (p. 36). Consider the data on extinction status (extinct, absent from island, present) for the 132 bird species. The data are saved in the **NZBIRDS** file and are summarized in the accompanying MINITAB printout. Suppose you randomly select 10 of the 132 bird species (without replacement) and record the extinction status of each.

a. What is the probability that the first species you select is extinct? (*Note*: Extinct = Yes on the MINITAB printout.) .2879

b. Suppose the first 9 species you select are all extinct. What is the probability that the 10th species you select is extinct? .236

Tally for Discrete Variables: Extinct

```
Extinct  Count  Percent
 Absent     16    12.12
     No     78    59.09
    Yes     38    28.79
     N=    132
```

3.82 Requirements for high school graduation. In Italy, all high school students must take a high school diploma (HSD) exam and write a paper in order to graduate. In *Organizational Behavior and Human Decision Processes* (July 2000), University of Milan researcher L. Macchi provided the following information to a group of college undergraduates. *Fact 1*: In Italy, 360 out of every 1,000 students fail their HSD exam. *Fact 2*: Of those who fail the HSD, 75% also fail the written paper. *Fact 3*: Of those who pass the HSD, only 20% fail the written paper. Define events A and B as follows:

$$A = \{\text{The student fails the HSD exam.}\}$$
$$B = \{\text{The student fails the written paper.}\}$$

a. Write Fact 1 as a probability statement involving events A and/or B. $P(A)$

b. Write Fact 2 as a probability statement involving events A and/or B. $P(B|A)$

c. Write Fact 3 as a probability statement involving events A and/or B. $P(B|A^c)$

d. State $P(A \cap B)$ in the words of the problem.

e. Find $P(A \cap B)$. .27

3.83 Intrusion detection systems. A computer intrusion detection system (IDS) is designed to provide an alarm whenever someone intrudes (e.g., through unauthorized access) into a computer system. A probabilistic evaluation of a system with two independently operating intrusion detection systems (a double IDS) was published in the *Journal of Research of the National Institute of Standards and Technology* (Nov.–Dec. 2003). Consider a double IDS with system A and system B. If there is an intruder, system A sounds an alarm with probability .9 and system B sounds an alarm with probability .95. If there is no intruder, the probability that system A sounds an alarm (i.e., a false alarm) is .2 and the probability that system B sounds an alarm is .1.

a. Use symbols to express the four probabilities just given.

b. If there is an intruder, what is the probability that both systems sound an alarm? .855

c. If there is no intruder, what is the probability that both systems sound an alarm? .02

d. Given that there is an intruder, what is the probability that at least one of the systems sounds an alarm? .995

3.84 Cigar smoking and cancer. The *Journal of the National Cancer Institute* (Feb. 16, 2000) published the results of a study that investigated the association between cigar smoking and death from tobacco-related cancers. Data were obtained for a national sample of 137,243 American men. The results are summarized in the accompanying table. Each male in the study was classified according to his cigar-smoking status and whether or not he died from a tobacco-related cancer.

a. Find the probability that a randomly selected man never smoked cigars and died from cancer. .006

b. Find the probability that a randomly selected man was a former cigar smoker and died from cancer. .0007

c. Find the probability that a randomly selected man was a current cigar smoker and died from cancer. .001

d. Given that a male was a current cigar smoker, find the probability that he died from cancer. .018

e. Given that a male never smoked cigars, find the probability that he died from cancer. .006

	Died from Cancer		
Cigars	Yes	No	Totals
Never Smoked	782	120,747	121,529
Former Smoker	91	7,757	7,848
Current Smoker	141	7,725	7,866
Totals	1,014	136,229	137,243

Source: Shapiro, J. A., Jacobs, E. J., and Thun, M. J. "Cigar smoking in men and risk of death from tobacco-related cancers." *Journal of the National Cancer Institute*, Vol. 92, No. 4, Feb. 16, 2000 (Table 2).

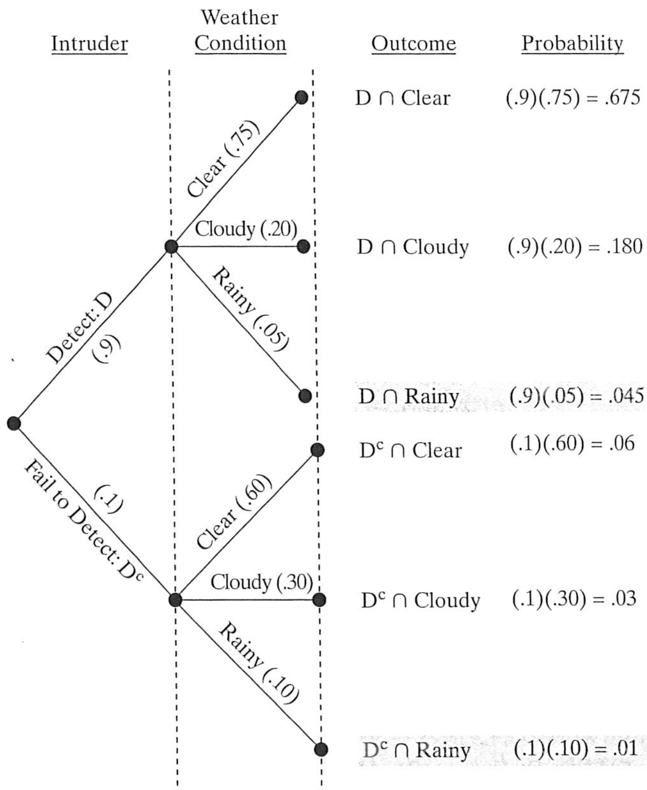


FIGURE 3.23
Tree Diagram for Example 3.34

Exercises 3.128–3.140

Understanding the Principles

3.128 Explain the difference between the two probabilities $P(A|B)$ and $P(B|A)$

3.129 Why is Bayes's rule unnecessary for finding $P(B|A)$ if events A and B are independent?

3.130 Why is Bayes's rule unnecessary for finding $P(B|A)$ if events A and B are mutually exclusive?

Learning the Mechanics

3.131 Suppose the events B_1 and B_2 are mutually exclusive and complementary events such that $P(B_1) = .75$ and $P(B_2) = .25$. Consider another event A such that $P(A|B_1) = .3$ and $P(A|B_2) = .5$.

a. Find $P(B_1 \cap A)$. .225

b. Find $P(B_2 \cap A)$. .125

c. Find $P(A)$, using the results in part **a** and **b**. .35

d. Find $P(B_1|A)$. .643

e. Find $P(B_2|A)$. .357

3.132 Suppose the events B_1, B_2, and B_3 are mutually exclusive and complementary events such that $P(B_1) = .2$, $P(B_2) = .15$, and $P(B_3) = .65$. Consider another event A such that $P(A|B_1) = .4$, $P(A|B_2) = .25$, and $P(A|B_3) = .6$. Use Bayes's rule to find

a. $P(B_1|A)$ .158

b. $P(B_2|A)$ .074

c. $P(B_3|A)$ .768

3.133 Suppose the events B_1, B_2, and B_3 are mutually exclusive and complementary events such that $P(B_1) = .2$, $P(B_2) = .15$,and $P(B_3) = .65$. Consider another event A such that $P(A) = .4$. If A is independent of B_1, B_2, and B_3, use Bayes's rule to show that $P(B_1|A) = P(B_1) = .2$. .2

Applying the Concepts—Basic

3.134 **Reverse-engineering gene identification.** In *Molecular Systems Biology* (Vol. 3, 2007), geneticists at the University of Naples (Italy) used reverse engineering to identify genes. They calculated $P(G|D)$, where D is a gene expression data set of interest and G is a graphical identifier. Several graphical identifiers were investigated. Suppose that, for two different graphical identifiers G_1 and G_2, $P(D|G_1) = .5$ and $P(D|G_2) = .3$. Also, $P(D) = .34$, $P(G_1) = .2$, and $P(G_2) = .8$.

a. Use Bayes's rule to find $P(G_1|D)$.

b. Use Bayes's rule to find $P(G_2|D)$.

3.135 **Drug testing in athletes.** Due to inaccuracies in drug-testing procedures (e.g., false positives and false negatives), in the medical field the results of a drug test represent only one factor in a physician's diagnosis. Yet when Olympic athletes are tested for illegal drug use (i.e., doping), the results of a single test are used to ban the athlete from competition. In *Chance* (Spring 2004), University of Texas biostatisticians D. A. Berry and L. Chastain demonstrated the application of Bayes's Rule to making inferences about testosterone abuse among Olympic athletes. They used the following example: In a population of 1,000 athletes, suppose 100 are illegally using testosterone. Of the users, suppose 50 would test positive for testosterone. Of the nonusers, suppose 9 would test positive.

a. Given that the athlete is a user, find the probability that a drug test for testosterone will yield a positive result. (This probability represents the sensitivity of the drug test.) .50

b. Given that the athlete is a nonuser, find the probability that a drug test for testosterone will yield a negative result. (This probability represents the specificity of the drug test.) .99

c. If an athlete tests positive for testosterone, use Bayes's rule to find the probability that the athlete is really doping. (This probability represents the *positive predictive value* of the drug test.) .847

DDT

136 **Contaminated fish.** Refer to the U.S. Army Corps of Engineers' study on the DDT contamination of fish in the Tennessee River (in Alabama), presented in Example 1.4 (p. 12). Part of the investigation focused on how far upstream the contaminated fish have migrated. (A fish is considered to be contaminated if its measured DDT concentration is greater than 5.0 parts per million.)

a. Considering only the contaminated fish captured from the Tennessee River, the data reveal that 52% of the fish are found between 275 and 300 miles upstream, 39% are found from 305 to 325 miles upstream, and 9% are found from 330 to 350 miles upstream. Use these percentages to determine the probabilities $P(275 - 300)$, $P(305 - 325)$, and $P(330 - 350)$. .52, .39, .09

b. Given that a contaminated fish is found a certain distance upstream, the probability that it is a channel catfish (CC) is determined from the data as $P(CC|275 - 300) = .775$, $P(CC|305 - 325) = .77$, and $P(CC|330 - 350) = .86$. If a contaminated channel catfish is captured from the Tennessee River, what is the probability that it was captured 275 – 300 miles upstream? .516

137 **Errors in estimating job costs.** A construction company employs three sales engineers. Engineers 1, 2, and 3 estimate the costs of 30%, 20%, and 50%, respectively, of all jobs bid on by the company. For $i = 1, 2, 3$, define E_i to be the event that a job is estimated by engineer i. The following probabilities describe the rates at which the engineers make serious errors in estimating costs:

$P(\text{error}|E_1) = .01$, $P(\text{error}|E_2) = .03$, and $P(\text{error}|E_3) = .02$

a. If a particular bid results in a serious error in estimating job cost, what is the probability that the error was made by engineer 1? .158

b. If a particular bid results in a serious error in estimating job cost, what is the probability that the error was made by engineer 2? .316

c. If a particular bid results in a serious error in estimating job cost, what is the probability that the error was made by engineer 3? 526

d. Based on the probabilities, given in parts **a–c** which engineer is most likely responsible for making the serious error? 3

Applying the Concepts—Intermediate

3.138 **Nondestructive evaluation.** Nondestructive evaluation (NDE) describes methods that quantitatively characterize materials, tissues, and structures by noninvasive means, such as X-ray computed tomography, ultrasonics, and acoustic emission. Recently, NDE was used to detect defects in steel castings. (JOM, May 2005.) Assume that the probability that NDE detects a "hit" (i.e., predicts a defect in a steel casting) when in fact, a defect exists is .97. (This is often called the probability of detection.) Assume also that the probability that NDE detects a "hit" when, in fact, no defect exists is .005. (This is called the probability of a false call.) Past experience has shown that a defect occurs once in every 100 steel castings. If NDE detects a "hit" for a particular steel casting, what is the probability that an actual defect exists?

3.139 **Intrusion detection systems.** Refer to the *Journal of Research of the National Institute of Standards and Technology* (Nov.–Dec. 2003) study of a double intrusion detection system with independent systems, presented in Exercise 3.83 (p. 151). Recall that if there is an intruder, system A sounds an alarm with probability .9 and system B sounds an alarm with probability .95. If there is no intruder, system A sounds an alarm with probability .2 and system B sounds an alarm with probability .1. Now, assume that the probability of an intruder is .4. If both systems sound an alarm, what is the probability that there is an intruder? .966

3.140 **Repairing a computer system.** The local area network (LAN) for the College of Business computing system at a large university is temporarily shut down for repairs. Previous shutdowns have been due to hardware failure, software failure, or power failure. Maintenance engineers have determined that the probabilities of hardware, software, and power problems are .01, .05, and .02, respectively. They have also determined that if the system experiences hardware problems, it shuts down 73% of the time. Similarly, if software problems occur, the system shuts down 12% of the time; and, if power failure occurs, the system shuts down 88% of the time. What is the probability that the current shutdown of the LAN is due to hardware failure? software failure? power failure? .2362; .1942; .5696

KEY TERMS

Note: Items marked with an asterisk (*) are from the optional sections in this chapter.