

Chapter 2

PROBABILITY AND STATISTICS

Therefore, the company's expected annual fine is

$$\begin{aligned} \$200,000 \cdot P(x \geq 12) &= (\$200,000)(.0197) \\ &= \$3,940 \end{aligned}$$

Problems

1. Indicate which of the following probabilities are objective and which are subjective. (Note that in some cases, the probabilities may not be entirely one or the other.)
- The probability of snow tomorrow
 - The probability of catching a fish
 - The probability of the prime interest rate rising in the coming year
 - The probability that the Cincinnati Reds will win the World Series
 - The probability that demand for a product will be a specific amount next month
 - The probability that a political candidate will win an election
 - The probability that a machine will break down
 - The probability of being dealt four aces in a poker hand

2. A gambler in Las Vegas is cutting a deck of cards for \$1,000. What is the probability that the card for the gambler will be the following?
- A face card
 - A queen
 - A spade
 - A jack of spades

3. Downhill Ski Resort in Colorado has accumulated information from records of the past 30 winters regarding the measurable snowfall. This information is as follows:

Snowfall (in.)	Frequency
0-19	2
20-29	7
30-39	8
40-49	8
50+	5
	30

- Determine the probability of each event in this frequency distribution.
 - Are all the events in this distribution mutually exclusive? Explain.
4. Employees in the textile industry can be segmented as follows:

Employees	Number
Female and union	12,000
Female and nonunion	25,000
Male and union	21,000
Male and nonunion	42,000

- Determine the probability of each event in this distribution.
 - Are the events in this distribution mutually exclusive? Explain.
 - What is the probability that an employee is male?
 - Is this experiment collectively exhaustive? Explain.
5. The quality control process at a manufacturing plant requires that each lot of finished units be sampled for defective items. Twenty units from each lot are inspected. If five or more defective units are found, the lot is rejected. If a lot is known to contain 10% defective items, what is the probability that the lot will be rejected? accepted?

Exodus 14 Over 200,000

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Markedly
Exclusive
90 35

$$X=3$$

$$N=10$$

$$P=.1$$

$$p(X \geq 3) = 1 - p(X < 3)$$

$$p(3 \geq 3) = 1 - .1(3 < 3)$$

$$.1(3)$$

$$.1 = 1 - .1$$

$$3$$

|||||

6. A manufacturing company has 10 machines in continuous operation during a workday. The probability that an individual machine will break down during the day is .10. Determine the probability that during any given day 3 machines will break down.
7. A polling firm is taking a survey regarding a proposed new law. Of the voters polled, 30% are in favor of the law. If 10 people are surveyed, what is the probability that 4 will indicate that they are opposed to the passage of the new law?
8. An automobile manufacturer has discovered that 20% of all the transmissions it installed in a particular style of truck one year are defective. It has contacted the owners of these vehicles and asked them to return their trucks to the dealer to check the transmission. The Friendly Auto Mart sold seven of these trucks and has two of the new transmissions in stock. What is the probability that the auto dealer will need to order more new transmissions?
9. A new county hospital is attempting to determine whether it needs to add a particular specialist to its staff. Five percent of the general hospital population in the county contracts the illness the specialist would treat. If 12 patients check into the hospital in a day, what is the probability that 4 or more will have the illness?
10. A large research hospital has accumulated statistical data on its patients for an extended period. Researchers have determined that patients who are smokers have an 18% chance of contracting a serious illness such as heart disease, cancer, or emphysema, whereas there is only a .06 probability that a nonsmoker will contract a serious illness. From hospital records, the researchers know that 23% of all hospital patients are smokers, while 77% are nonsmokers. For planning purposes, the hospital physician staff would like to know the probability that a given patient is a smoker if the patient has a serious illness.
11. Two law firms in a community handle all the cases dealing with consumer suits against companies in the area. The Abercrombie firm takes 40% of all suits, and the Olson firm handles the other 60%. The Abercrombie firm wins 70% of its cases, and the Olson firm wins 60% of its cases.
 - a. Develop a probability tree showing all marginal, conditional, and joint probabilities.
 - b. Develop a joint probability table.
 - c. Using Bayes' rule, determine the probability that the Olson firm handled a particular case, given that the case was won.
12. The Senate consists of 100 senators, of whom 34 are Republicans and 66 are Democrats. A bill to increase defense appropriations is before the Senate. Thirty-five percent of the Democrats and 70% of the Republicans favor the bill. The bill needs a simple majority to pass. Using a probability tree, determine the probability that the bill will pass.
13. A retail outlet receives radios from three electrical appliance companies. The outlet receives 20% of its radios from A, 40% from B, and 40% from C. The probability of receiving a defective radio from A is .01; from B, .02; and from C, .08.
 - a. Develop a probability tree showing all marginal, conditional, and joint probabilities.
 - b. Develop a joint probability table.
 - c. What is the probability that a defective radio returned to the retail store came from company B?
14. A metropolitan school system consists of three districts—north, south, and central. The north district contains 25% of all students, the south district contains 40%, and the central district contains 35%. A minimum-competency test was given to all students; 10% of the north district students failed, 15% of the south district students failed, and 5% of the central district students failed.
 - a. Develop a probability tree showing all marginal, conditional, and joint probabilities.
 - b. Develop a joint probability table.
 - c. What is the probability that a student selected at random failed the test?
15. A service station owner sells Goodroad tires, which are ordered from a local tire distributor. The distributor receives tires from two plants, A and B. When the owner of the service station receives

