

**EXAMPLE 6** *Raffle Tickets*

One thousand raffle tickets are sold for \$1 each. One grand prize of \$500 and two consolation prizes of \$100 will be awarded. The tickets are placed in a bin. The winning tickets will be selected from the bin. Assuming that the probability that a given ticket selected for the grand prize is  $\frac{1}{1000}$  and the probability that any given ticket selected for a consolation prize is  $\frac{2}{1000}$ , determine

a) Irene Drew's expectation if she purchases one ticket.

b) Irene's expectation if she purchases five tickets.

$$a) E(x) = \left(\frac{1}{1000}\right)(499) + \left(\frac{2}{1000}\right)(99) + \left(\frac{997}{1000}\right)(-1) = -.30$$

$$b) E(x) = 5 \cdot (-.30) = \$-1.50$$

The *fair price* is the amount to be paid that will result in an expected value of \$0. The fair price may be found by adding the *cost to play* to the *expected value*.

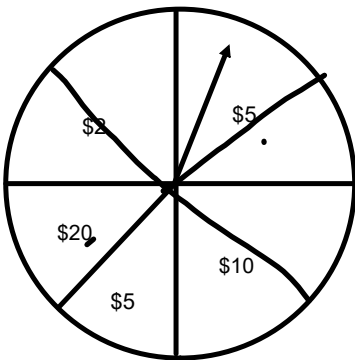
**Fair price = expected value + cost to play**

$$= -.30 + 1 = \$ .70$$

**EXAMPLE 7** *Expectation and Fair Price*

Suppose that you are playing a game in which you spin the pointer shown in the figure in the margin and you are awarded the amount shown under the pointer. If it costs \$8 to play the game, determine

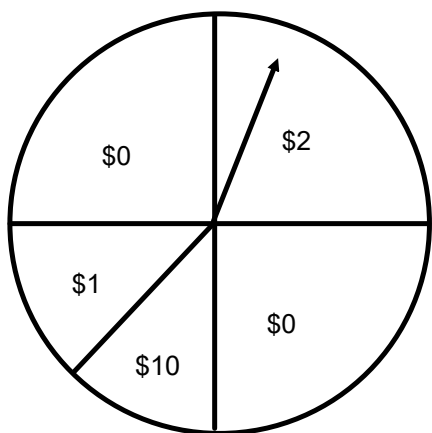
- a) the expectation of a person who plays the game.
- b) the fair price to play the game.



Outcomes	\$2	\$5	\$10	\$20
Probability	$\frac{2}{8}$	$\frac{3}{8}$	$\frac{2}{8}$	$\frac{1}{4}$
Amount won or lost	-6	-3	+2	+12

$$E(x) = \frac{1}{4}(-6) + \frac{3}{8}(-3) + \frac{1}{4}(2) + \frac{1}{8}(12)$$

$$E(x) = - .625 \text{¢}$$



Let's play a game .... or not!

It only cost \$1 to play.

Outcomes	0	1	2	10
Probability	$\frac{4}{8}$	$\frac{1}{8}$	$\frac{2}{8}$	$\frac{1}{8}$
Amount won or lost	-1	0	1	9

$$E(x) = \frac{1}{2}(-1) + \frac{1}{8}(0) + \frac{2}{8}(1) + \frac{1}{8}(9) = 0.875$$

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**Expected Attendance** For an outdoor concert of the Los Angeles Philharmonic Orchestra at the Hollywood Bowl, concert organizers estimate that 14,000 people will attend if it is not raining. If it is raining, concert organizers estimate that 8400 people will attend. On the day of the concert, meteorologists predict a 70% chance of rain. Determine the expected number of people who will attend this concert.



▲ The Hollywood Bowl

$$E(x) = \overset{\text{rain}}{.70} (8400) + \overset{\text{not}}{.30} (14000) = 10,080$$

#12

**A New Business** In a proposed business venture, Stephanie Morrison estimates that there is a 60% chance she will make \$80,000 and a 40% chance she will lose 20,000. Determine Stephanie's expected value.

$$E(x) = .60 (80000) + .40 (-20000) = 340,000$$

#13

**Basketball** Candace Parker is a star player for the University of Tennessee Volunteers women's basketball team. She has injured her ankle, and it is doubtful that she will be able to play in an upcoming game. If Candace can play, the coach estimates that the Volunteers will score 78 points. If Candace is not able to play, the coach estimates that they will score 62 points. The team doctor estimates that there is a 50% chance Candace will play. Determine the number of points the team can expect to score.



$$E(x) = .50(78) + .50(62) = 70$$

17. **Investment Club** The Triple L investment club is considering purchasing a certain stock. After considerable research, the club members determine that there is a 60% chance of making \$10,000, a 10% chance of breaking even, and a 30% chance of losing \$7200. Determine the expectation of this purchase.

\$ 3840

18. **Clothing Sale** At a special clothing sale at the Crescent Oaks Country Club, after the cashier rings up your purchase, you select a slip of paper from a box. The slip of paper indicates the dollar amount, either \$5 or \$10, that is deducted from your purchase price. The probability of selecting a slip indicating \$5 is  $\frac{7}{10}$ , and the probability of selecting a slip indicating \$10 is  $\frac{3}{10}$ . If your original purchase before you select the slip of paper is \$200, determine

- a) the expected dollar amount to be deducted from your purchase.
- b) the expected dollar amount you will pay for your purchase.

$$a) E(x) = \frac{7}{10}(5) + \frac{3}{10}(10) = 6.50$$

$$b) 200 - 6.50 = 193.50 \leftarrow$$

**PRACTICE THE SKILLS/PROBLEM SOLVING**

0. **Three Tickets** On a \$1 lottery ticket, Marty Smith's expected value is  $-\$0.40$ . What is Marty's expected value if he purchases three lottery tickets?

0. **Expected Value** If on a \$1 bet, Paul Goldstein's expected value is \$0.30, what is Paul's expected value on a \$5 bet?

1. **Expected Attendance** For an outdoor concert of the Los Angeles Philharmonic Orchestra at the Hollywood Bowl, concert organizers estimate that 14,000 people will attend if it is not raining. If it is raining, concert organizers estimate that 8400 people will attend. On the day of the concert, meteorologists predict a 70% chance of rain. Determine the expected number of people who will attend this concert.



▲ The Hollywood Bowl

. **A New Business** In a proposed business venture, Stephanie Morrison estimates that there is a 60% chance she will make \$80,000 and a 40% chance she will lose \$20,000. Determine Stephanie's expected value.

. **Basketball** Candace Parker is a star player for the University of Tennessee Volunteers women's basketball team. She has injured her ankle, and it is doubtful that she will be able to play in an upcoming game. If Candace can play, the coach estimates that the Volunteers will score 78 points. If Candace is not able to play, the coach estimates that they will score 62 points. The team doctor estimates that there is a 50% chance Candace will play. Determine the number of points the team can expect to score.



▲ Candace Parker (left) and Brittany Hunter

14. **Career Fair Attendance** For a Nursing and Allied Health Care Career Fair, organizers estimate that 50 people will attend if it does not rain and 65 will attend if it rains. The weather forecast indicates that there is a 40% chance it will not rain and a 60% chance it will rain on the day of the career fair. Determine the expected number of people who will attend the fair.

15. **TV Shows** The NBC television network is scheduling its fall lineup of shows. For the Thursday night 8 P.M. slot, NBC has selected the show *Heroes*. If its rival network CBS schedules the show *CSI: Crime Scene Investigation* during the same time slot, NBC estimates that *Heroes* will get 1.2 million viewers. However, if CBS schedules the show *The Unit* during that time slot, NBC estimates that *Heroes* will get 1.6 million viewers. NBC believes that the probability that CBS will show *CSI* is 0.4 and the probability that CBS will show *The Unit* is 0.6. Determine the expected number of viewers for the show *Heroes*.

16. **Seattle Greenery** In July in Seattle, the grass grows  $\frac{1}{2}$  in. a day on a sunny day and  $\frac{1}{4}$  in. a day on a cloudy day. In Seattle in July, 75% of the days are sunny and 25% are cloudy.

- a) Determine the expected amount of grass growth on a typical day in July in Seattle.
- b) Determine the expected total grass growth in the month of July in Seattle.

17. **Investment Club** The Triple L investment club is considering purchasing a certain stock. After considerable research, the club members determine that there is a 60% chance of making \$10,000, a 10% chance of breaking even, and a 30% chance of losing \$7200. Determine the expectation of this purchase.

18. **Clothing Sale** At a special clothing sale at the Crescent Oaks Country Club, after the cashier rings up your purchase, you select a slip of paper from a box. The slip of paper indicates the dollar amount, either \$5 or \$10, that is deducted from your purchase price. The probability of selecting a slip indicating \$5 is  $\frac{7}{10}$ , and the probability of selecting a slip indicating \$10 is  $\frac{3}{10}$ . If your original purchase before you select the slip of paper is \$200, determine

- a) the expected dollar amount to be deducted from your purchase.
- b) the expected dollar amount you will pay for your purchase.

19. **Fortune Cookies** At the Royal Dragon Chinese restaurant, a slip in the fortune cookies indicates a dollar amount that will be subtracted from your total bill. A bag of 10 fortune cookies is given to you from which you will select one. If seven fortune cookies contain "\$1 off," two contain "\$2 off," and one contains "\$5 off," determine the expectation of a selection.



12.4 EXPECTED VALUE (EXPECTATION) 75

20. **Pick a Card** Mike and Dave play the following game. Mike picks a card from a deck of cards. If he selects a heart, Dave gives him \$5. If not, he gives Dave \$2.
- Determine Mike's expectation.
  - Determine Dave's expectation.
21. **Roll a Die** Alyssa and Gabriel play the following game. Alyssa rolls a die. If she rolls a 1, 2, or 3, Gabriel gives Alyssa \$3. If Alyssa rolls a 4 or 5, Gabriel gives Alyssa \$2. However, if Alyssa rolls a 6, she gives Gabriel \$14.
- Determine Alyssa's expectation.
  - Determine Gabriel's expectation.
22. **Blue Chips and Red Chips** A bag contains 3 blue chips and 2 red chips. Chi and Dolly play the following game. Chi selects one chip at random from the bag. If Chi selects a blue chip, Dolly gives Chi \$5. If Chi selects a red chip, Chi gives Dolly \$8.
- Determine Chi's expectation.
  - Determine Dolly's expectation.
23. **Multiple-Choice Test** A multiple-choice exam has five possible answers for each question. For each correct answer, you are awarded 5 points. For each incorrect answer, 1 point is subtracted from your score. For answers left blank, no points are added or subtracted.
- If you do not know the correct answer to a particular question, is it to your advantage to guess? Explain.
  - If you do not know the correct answer but can eliminate one possible choice, is it to your advantage to guess? Explain.



24. **Multiple-Choice Test** A multiple-choice exam has four possible answers for each question. For each correct answer, you are awarded 5 points. For each incorrect answer, 2 points are subtracted from your score. For answers left blank, no points are added or subtracted.

- If you do not know the correct answer to a particular question, is it to your advantage to guess? Explain.
  - If you do not know the correct answer but can eliminate one possible choice, is it to your advantage to guess? Explain.
25. **Raffle Tickets** Five hundred raffle tickets are sold for \$ each. One prize of \$400 is to be awarded.
- Raul Mondesi purchases one ticket. Determine his expected value.
  - Determine the fair price of a ticket.
26. **Raffle Tickets** One thousand raffle tickets are sold for \$ each. One prize of \$800 is to be awarded.
- Rena Condos purchases one ticket. Determine her expected value.
  - Determine the fair price of a ticket.
27. **Raffle Tickets** Two thousand raffle tickets are sold for \$3.00 each. Three prizes will be awarded: one for \$1000 and two for \$500. Assume that the probability that any given ticket is selected for the \$1000 prize is  $\frac{1}{2000}$  and the probability that any given ticket is selected for the \$500 prize is  $\frac{2}{2000}$ . Jeremy Sharp purchases one of these tickets.
- Determine his expected value.
  - Determine the fair price of a ticket.
28. **Raffle Tickets** Ten thousand raffle tickets are sold for \$ each. Four prizes will be awarded: one for \$5000, one for \$2500, and two for \$1000. Assume that the probability any given ticket is selected for the \$5000 prize is  $\frac{1}{10,000}$ , probability that any given ticket is selected for the \$2500 prize is  $\frac{1}{10,000}$ , and the probability that any given ticket selected for a \$1000 prize is  $\frac{2}{10,000}$ . Sidhardt purchases one of these tickets.
- Determine his expected value.
  - Determine the fair price of a ticket.

**Spinners** In Exercises 29 and 30, assume that a person spins the pointer and is awarded the amount indicated by the pointer. Determine the person's expectation.

