

Section 12.2 Theoretical Probability

Equally likely outcomes

- roll a die
- pick a card out of a deck
- toss a coin
- pick a marble out of a bag

$$\text{Probability} = P(E) = \frac{\text{number of outcomes favorable to E}}{\text{Total number of possible outcomes}}$$

$\frac{S}{\text{Total}}$

Example: Roll a die

- a) $P(3) = \frac{1}{6}$
- b) $P(\text{even}) = \frac{3}{6} = \frac{1}{2}$
- c) $P(>2) = \frac{4}{6} = \frac{2}{3}$
- d) $P(7) = \frac{0}{6} = 0$
- e) $P(<7) = \frac{6}{6} = 1$

In any experiment, an event must either occur or not occur.

The sum of the probability of all possible outcomes of an experiment is 1

$$\frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{6}{6} = 1$$

$$P(A) + P(\text{not } A) = 1$$

$$\cdot \cdot \cdot - P(A)$$

or

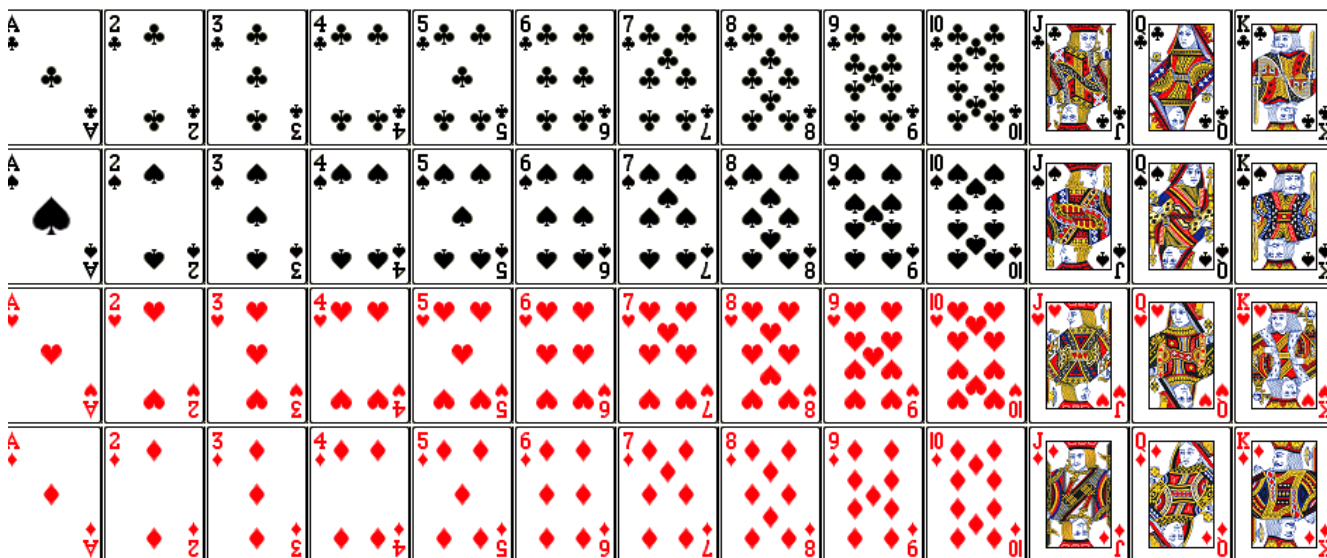
$$P(\text{not } A) = 1 - P(A)$$

$$P(2) \quad P(\text{not } 2)$$

$$\frac{1}{6} + \frac{5}{6} = 1$$

Example:

If the $P(A) = \underline{5/12}$, find the $P(\text{not } A)$ $1 - \frac{5}{12} = \frac{7}{12}$



Find the following:

$$P(5) = \frac{4}{52} = \frac{1}{13}$$

$$P(\text{not } 5) = 1 - \frac{1}{13} = \frac{12}{13}$$

$$P(\text{diamond}) = \frac{13}{52} = \frac{1}{4}$$

$$P(\text{face card}) = \frac{12}{52} = \frac{3}{13}$$

$$P(\text{heart or club}) = \frac{26}{52} = \frac{1}{2}$$

$$P(\text{greater than 6 and less than 9}) = \frac{8}{52} = \frac{2}{13}$$

$$P(\text{ace and red}) = \frac{2}{52} = \frac{1}{26}$$

$$P(\text{male face card}) = \frac{8}{52} = \frac{2}{13}$$

13 - each suite
 52 - over all
 26 - red
 26 - black
 face or picture card
 J's, Q's, K's
 Ace = 1 pts
 face = 10 pts

EXAMPLE 2 *Choosing One Bird from a List*

The names of 15 birds and their food preferences are listed in Table 12.3 on page 735. Each of the 15 birds' names is listed on a slip of paper, and the 15 slips are placed in a bag. One slip is to be selected at random from the bag. Find the probability that the slip contains the name of

- a) a finch (any type listed). $\frac{3}{15} = \frac{1}{5}$
- b) a bird that has a high attractiveness to cracked ~~corn~~. $\frac{12}{15}$
- c) a bird that has a low attractiveness to peanut kernels, *and* a low attractiveness to cracked ~~corn~~, *and* a high attractiveness to black-striped sunflower seeds. $\frac{4}{15}$
- d) a bird that has a high attractiveness to either peanut kernels *or* cracked corn (or both). $\frac{7}{15}$

Table 12.3 Birds and Their Food Preferences

| Bird | Peanut Kernels | Cracked Corn | Black-Striped Sunflower Seeds |
|------------------------|-------------------|-----------------|----------------------------------|
| American goldfinch | L | L | H ✓ |
| Blue jay | H | M | H |
| Chickadee | M | L | H |
| Common grackle | M | H | H |
| Evening grosbeak | L | L | H ✓ |
| House finch | M | L | H |
| House sparrow | L | M | M ✓ |
| Mourning dove | L | M | M |
| Northern cardinal | L | L | H ✓ |
| Purple finch | L | L | H |
| Scrub jay | H | L | H ✓ |
| Song sparrow | L | L | M |
| Tufted titmouse | H | L | H |
| White-crowned sparrow | H | M | H |
| White-throated sparrow | H | H | H |

Source: *How to Attract Birds* (Ortho Books)

Note: H = high attractiveness; M = medium attractiveness; L = low attractiveness.

PRACTICE THE SKILLS

13. **Multiple-Choice Test** A multiple-choice test has five possible answers for each question.

- a) If you guess at an answer, what is the probability that you select the correct answer for one particular question? $\frac{1}{5}$
- b) If you eliminate one of the five possible answers and guess from the remaining possibilities, what is the probability that you select the correct answer to that question? $\frac{1}{4}$

14. **Remote Control** A TV remote control has keys for channels 0 through 9. If you select one key at random,

- a) what is the probability that you press channel 6? $\frac{1}{10}$
- b) what is the probability that you press a key for an even number? $\frac{5}{10} = \frac{1}{2}$
- c) what is the probability that you press a key for a number less than 7? $\frac{7}{10}$

10
8
6
4
2
0 even

15. **Raffle** In a raffle where one number is chosen, determine the probability that you would win if you have a choice of 40 numbers to choose from. Explain your answer. $\frac{1}{40}$

16. **Raffle** In a raffle where one number is chosen, determine the probability that you would win if you have a choice of 52 numbers to choose from. Explain your answer. $\frac{1}{52}$

Select a Card In Exercises 17–26, one card is selected at random from a deck of cards. Determine the probability that the card selected is

17. a 5. $\frac{1}{13}$
18. a 5 or a 7. $\frac{2}{13}$
19. not a 5. $1 - \frac{1}{13} = \frac{12}{13}$
20. the five of diamonds. $\frac{1}{52}$
21. a black card. $\frac{26}{52} = \frac{1}{2}$
22. a diamond. $\frac{1}{4}$
23. a red card or a black card. 1
24. a red card and a black card. 0

25. a card greater than 4 and less than 9. $\frac{16}{52} = \frac{4}{13}$
26. a king and a club. $\frac{1}{52}$

Picnic In Exercises 31–34, a cooler at a picnic contains 100 cans of soda covered by ice. There are 30 cans of cola, 40 cans of orange soda, 10 cans of ginger ale, and 20 cans of root beer. The cans are all the same size and shape. If one can is selected at random from the cooler, determine the probability that the soda selected is

31. root beer. $\frac{1}{5}$

32. cola or orange soda. $\frac{7}{10}$

33. cola, root beer, or orange soda. $\frac{9}{10}$

34. ginger ale. $\frac{1}{10}$

