

Section 10.3 - Define and Use Probability

Outcome the possible result of a situation

Event an outcome or collection of outcomes

Sample Space the set of all possible outcomes

Probability of an Event a number from 0 to 1 that tells you the likelihood an event will occur

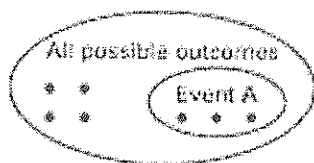


Theoretical Probability of an Event

When all outcomes are equally likely, the theoretical probability that an event A will occur is:

$$P(A) = \frac{\text{\# of outcomes in event A}}{\text{total \# of outcomes}}$$

The theoretical probability of an event is often simply called the probability of the event.



Example 1

You pick a card from a standard deck of 52 playing cards. Find the probability of:

← print card key

a. picking an 8

$$\frac{4}{52} = .0769 = \boxed{7.69\%}$$

b. picking a red king

$$\frac{2}{52} = .0385 = \boxed{3.85\%}$$

Example 2

You have an equally likely chance of choosing any integer from 1 through 20. Find the probability of the given event.

1, 4, 9, 16

1, 2, 3, 5, 6, 10, 15

a. A perfect square is chosen.

$$\frac{4}{20} = .2 = \boxed{20\%}$$

b. A factor of 30 is chosen.

$$\frac{7}{20} = .35 = \boxed{35\%}$$

Example 3

A community center hosts a talent contest for local musicians. On a given evening, 7 musicians are scheduled to perform. The order in which the musicians perform is randomly selected during the show.

- a. What is the probability that the musicians perform in alphabetical order by their last names?
(Assume that no two musicians have the same last name.)

$$\frac{1}{7!} = \frac{1}{5040} = .000198 \quad \uparrow \quad \boxed{.0198\%}$$

↪ order matters

- b. You are friends with 4 of the musicians. What is the probability that the first 2 performers are your friends?

$$\frac{{}_4C_2}{{}_7C_2} = \frac{6}{21} = \frac{2}{7} = .2857 \approx \boxed{28.57\%}$$

↪ order doesn't matter

Example 4

A cereal company plans to put 5 new cereals on the market: a wheat cereal, a rice cereal, a corn cereal, an oat cereal, and a multigrain cereal. The order in which the cereals will be introduced will be randomly selected. Each cereal will have a different price.

- a. What is the probability that the cereals are introduced in order of their suggested retail price?

$$\frac{1}{5!} = .0083 \approx \boxed{0.83\%}$$

- b. What is the probability that the first cereal introduced will be the multigrain cereal?

$$\frac{1}{5} = .2 = \boxed{20\%}$$

★ odds measure the chances *in favor* of an event occurring or the chances *against* an event occurring.

Odds in Favor of or Odds Against an Event

When all outcomes are equally likely, the odds in favor of an event A and the odds against an event A are defined as follows:

Odds in FAVOR event A = $\frac{\text{Number of outcomes in A}}{\text{Number of outcomes not in A}}$

Odds AGAINST event A = $\frac{\text{Number of outcomes not in A}}{\text{Number of outcomes in A}}$

You can write odds in favor or against an event in the form

$$\frac{a}{b} \text{ or } \{a:b\}$$

$$\frac{W}{L} = \text{odds in favor}$$

$$\frac{L}{W} = \text{odds against}$$

Example 5

A marble is drawn from a bag containing 6 red, 12 yellow, and 9 black marbles.

a. Find the odds in favor of drawing a red marble

$$\frac{6}{21} = \frac{2}{7}$$

$$\boxed{2:7 \text{ odds}}$$

b. Find the odds against drawing a black marble.

$$\frac{18}{9} = \frac{2}{1}$$

$$\boxed{2:1 \text{ odds}}$$

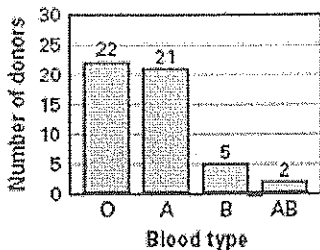
Experimental Probability of an Event

When an experiment is performed that consists of a certain number of trials, the experimental probability of an event A is given by:

$$P(A) = \frac{\# \text{ of trials where } A \text{ occurs}}{\text{total } \# \text{ of trials}}$$

Example 6

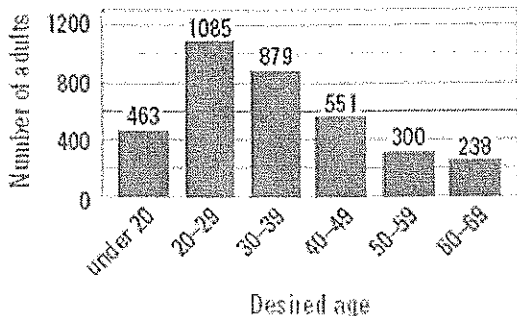
The blood types for a sample of donors at a blood drive are displayed in the bar graph. Find the experimental probability that a randomly selected blood donor would have blood type O.



$$\frac{22}{50} = .44 = \boxed{44\%}$$

Example 7

The bar graph shows how old adults in a survey would choose to be if they could choose any age. Find the experimental probability that a randomly selected adult would prefer to be at least 40 years old.



$$\frac{551 + 300 + 238}{3516} = \frac{1089}{3516}$$

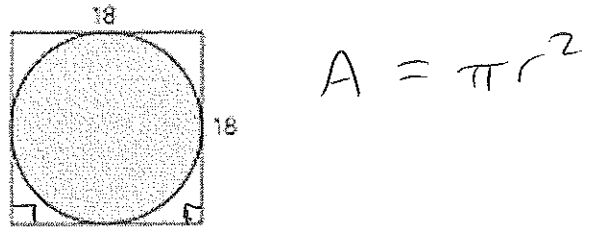
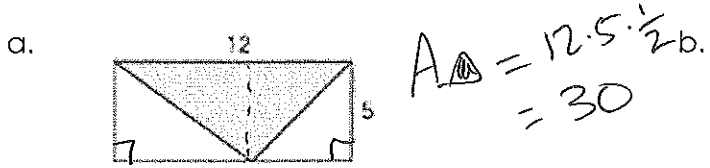
$$= \textcircled{.3097}$$

$$= \textcircled{30.97\%}$$

* geometric probability probability found by calculating a ratio of two lengths, areas, or volumes.

Example 8 (Find a geometric probability)

Find the probability that a dart thrown at the given target will hit the shaded region. Assume the dart is equally likely to hit any point inside the target.

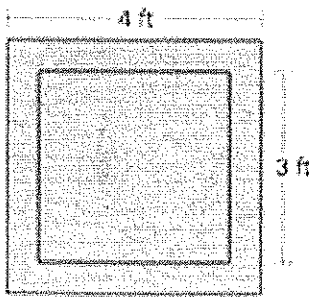


$$P = \frac{\text{area of } \triangle}{\text{area of board}}$$

$$= \frac{30}{60} = \frac{1}{2} \quad \boxed{\text{50\%}}$$

Example 9 (Find a geometric probability)

You throw a beanbag at a square board shown. Your beanbag is equally likely to hit any point on the board. Is the bag more likely to land outside the smaller square, or inside the smaller square?



$$\frac{\text{inside}}{\text{total}}$$

$$\frac{3 \cdot 3}{4 \cdot 4} = \frac{9}{16}$$

vs.

$$\frac{\text{outside}}{\text{total}} = \frac{\text{total} - \text{inside}}{\text{total}} = \frac{7}{16}$$

$$\frac{9}{16} > \frac{7}{16}$$

inside