

8.2 Estimating Likelihood

- ▶ Find a theoretical probability.
- ▶ Find an experimental probability.
- ▶ Estimate a probability using historical results.

Study Tip

When counting the number of possible outcomes, be sure that each is *equally likely*. If they are not, you cannot apply the formula at the right.

Finding a Theoretical Probability

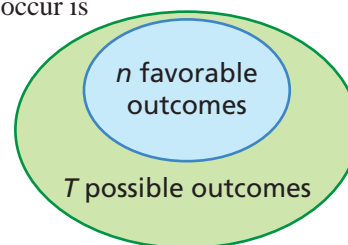
Here are three ways to estimate (or find exactly) the probability that an event will occur.

1. **Theoretical probability** is used in cases where all possible outcomes of an event are known and can be counted. Gambling is a common example.
2. **Experimental probability** is used in cases where a representative sample can be taken and counted. Quality control is a common example.
3. **Historical probability** is used in cases where past occurrences are assumed to be representative of future occurrences. Weather prediction is a common example.

Theoretical Probability

Suppose an event can occur n ways out of a total number T of equally likely outcomes. The **probability** that the event will occur is

$$\begin{aligned} \text{Probability} &= \frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}} \\ &= \frac{n}{T} \end{aligned}$$



EXAMPLE 1 Finding a Theoretical Probability

The Daily Number is a common type of state lottery. To play, you choose a 3-digit number. Find the probability of winning for the following cases.



- a. You pick one 3-digit number. b. You pick ten 3-digit numbers.

SOLUTION

There are 1000 possible numbers (000 to 999) that players can select.

a. Probability = $\frac{1}{1000}$

b. Probability = $\frac{10}{1000} = \frac{1}{100}$

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The Daily Number pays \$500 for a \$1 winning ticket. Suppose you buy ten \$1 tickets each day for 100 days. How many times do you expect to win? During the 100 days, how much do you spend? How much do you win?



Most states have some form of state lottery. Altogether, these lotteries bring in about \$52 billion annually. Of this amount, about \$32 billion is paid out in prize money. The remainder is retained by the states.