

## Probability Distributions

A **random variable** is a variable whose value is determined by the outcomes of a probability experiment. For example, when you roll a six-sided die, you can define a random variable  $x$  that represents the number showing on the die. So, the possible values of  $x$  are 1, 2, 3, 4, 5, and 6. For every random variable, a *probability distribution* can be defined.

### Probability Distributions

A **probability distribution** is a function that gives the probability of each possible value of a random variable. The sum of all the probabilities in a probability distribution must equal 1.

$x$	1	2	3	4	5	6
$P(x)$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$	$\frac{1}{6}$

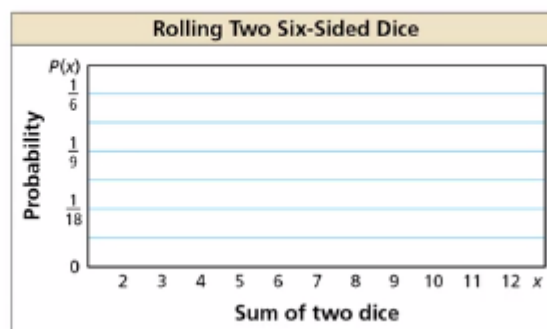
### TEACHER EXAMPLE # 1

Let  $x$  be a random variable that represents the sum when two six-sided dice are rolled. Make a table and draw a histogram showing the probability distribution for  $x$ .

**Step 1** Make a table. The possible values of  $x$  are the integers from 2 to 12.

$x$ (sum)	2	3	4	5	6	7	8	9	10	11	12
Outcomes											
$P(x)$											

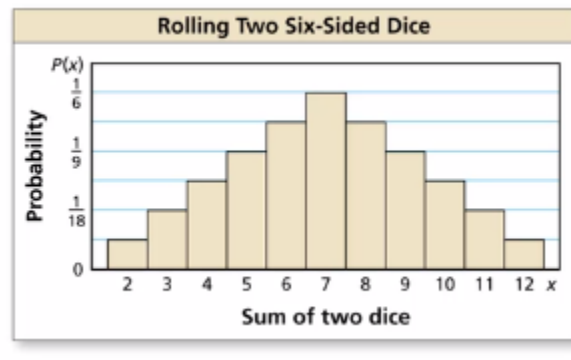
**Step 2** Draw a histogram where the intervals are given by  $x$  and the frequencies are given by  $P(x)$ .



## TEACHER EXAMPLE 2:

a. What is the most likely sum  
When rolling two six-sided dice?

b. What is the probability that the  
Sum of the two dice is at least 10?

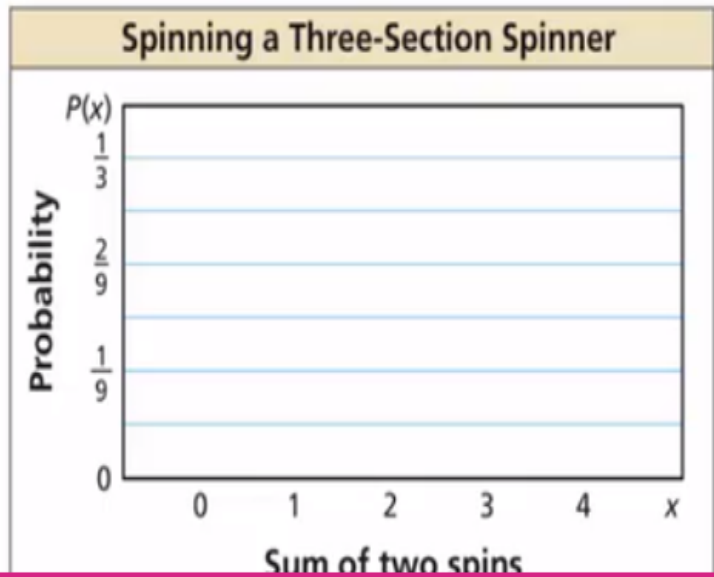


## STUDENT YOU TRY IT:

The spinner is divided into three equal parts. Let  $x$  be a random variable that represents the sum when the spinner is spun twice. Make a table and draw a histogram showing the probability distribution for  $x$ .



$x$ (sum)	0	1	2	3	4
Outcomes					
$P(x)$					



- a. What is the most likely sum when spinning a 3 section spinner twice?
  
- b. What is the probability that the sum of the two spins is odd?

## Binomial Distributions

One type of probability distribution is a **binomial distribution**. A binomial distribution shows the probabilities of the outcomes of a *binomial experiment*.

### Binomial Experiments

A **binomial experiment** meets the following conditions.

- There are  $n$  independent trials.
- Each trial has only two possible outcomes: success and failure.
- The probability of success is the same for each trial. This probability is denoted by  $p$ . The probability of failure is  $1 - p$ .

For a binomial experiment, the probability of exactly  $k$  successes in  $n$  trials is

$$P(k \text{ successes}) = {}_n C_k p^k (1 - p)^{n-k}.$$

### TEACHER EXAMPLE # 3

According to a survey, about 33% of people ages 16 and older in the U.S. own an electronic book reading device, or e-reader. You ask 6 randomly chosen people (ages 16 and older) whether they own an e-reader. Draw a histogram of the binomial distribution for your survey.

In the solution process we will use the formula:

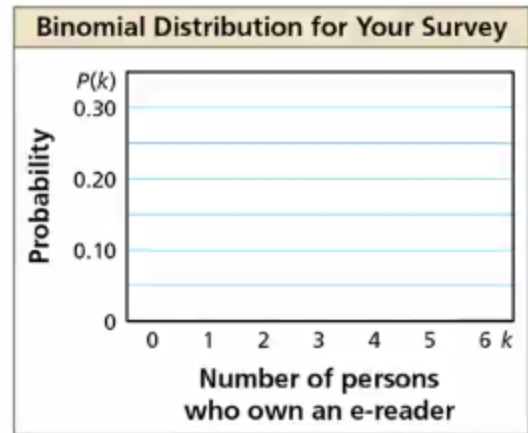
$$P(k \text{ successes}) = {}_n C_k p^k (1 - p)^{n-k}.$$

The probability that a randomly selected person has an e-reader is  $p = 0.33$ .  
Because you survey 6 people,  $n = 6$ .

We now will use the formula to find:

$P(K=0)$ ,  $P(K=1)$ ,  $P(k=2)$ ,  $P(k=3)$ ,  $P(K=4)$

$P(K=5)$ ,  $P(K=6)$

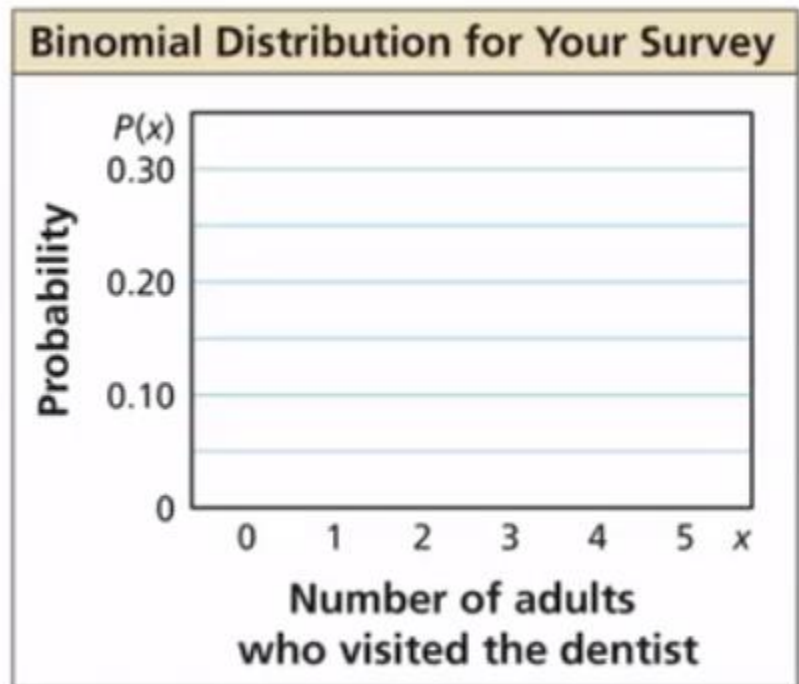


Use the binomial distribution in Example 3 to answer each question.

- What is the most likely outcome of the survey?
- What is the probability that at most 2 people have an e-reader?

**STUDENT YOU TRY IT:**

According to a survey, about 62% of adults have visited a dentist in the past year. You ask 5 randomly selected adults whether they have had a dentist visit in the past year. Draw a histogram of the binomial distribution for your survey.



- a. What is the most likely outcome of the survey?

---

- b. What is the probability that more than 3 people surveyed have visited a dentist in the past year?