

Lesson 14-4

Example 1 Random Variable

A toothpick company wants to put 250 toothpicks into each box. However, the number of toothpicks in each box varies from 248 to 252. Fifty boxes are taken off of the shelf and the number of toothpicks are counted. The results are shown in the table.

Number of Toothpicks	Number of Boxes
248	5
249	13
250	22
251	3
252	7

- a. Find the probability that a randomly-chosen box has 250 toothpicks.

There is only one outcome in which there are 250 toothpicks, and there are a total of 50 boxes.

$$\begin{aligned} P(X = 250) &= \frac{250 \text{ toothpicks}}{\text{total boxes}} \\ &= \frac{22}{50} \end{aligned}$$

The probability that a randomly-chosen box has 250 toothpicks is $\frac{22}{50}$ or 44%.

- b. Find the probability that a randomly-chosen box has at most 250 toothpicks.

There are $5 + 13 + 22$ or 40 outcomes in which a box contains at most 250 toothpicks.

$$P(X \leq 250) = \frac{40}{50}$$

The probability that a randomly-chosen box has at most 250 toothpicks is $\frac{40}{50}$ or 80%.

Example 2 Probability Distribution

The table below shows the probability distribution of motor vehicle production in the year 2000.

Motor Vehicle Production in the year 2000	
$X =$ Country	Probability
U.S.	0.21
Canada	0.05
Europe	0.30
Japan	0.17
Other	0.27

Source: *The World Almanac*

a. Show that the probability distribution is valid.

For each value of X , the probability is greater than or equal to 0 and less than or equal to 1.

$0.21 + 0.05 + 0.30 + 0.17 + 0.27 = 1$, so the probabilities add up to 1.

b. If a motor vehicle is chosen at random, what is the probability that it is made in a country other than the U.S.?

The probability of a compound event is the sum of the probabilities of each individual event. The probability of a motor vehicle having been produced in a country other than the U.S. is the sum of the probability of being made in Canada, Europe, Japan, or the other category.

$P(X \neq \text{U.S.})$

$$\begin{aligned} &= P(X = \text{Canada}) + P(X = \text{Europe}) + P(X = \text{Japan}) + P(X = \text{other}) \quad \text{Sum of individual probabilities} \\ &= 0.05 + 0.30 + 0.17 + 0.27 \quad \text{or } 0.79 \end{aligned}$$

$P(X = \text{Canada}) = 0.05,$
 $P(X = \text{Europe}) = 0.30,$
 $P(X = \text{Japan}) = 0.17,$
 $P(X = \text{other}) = 0.27$

c. Make a probability histogram of the data.

Draw and label the vertical and horizontal axes. Remember to use equivalent intervals on each axis. Include a title.

