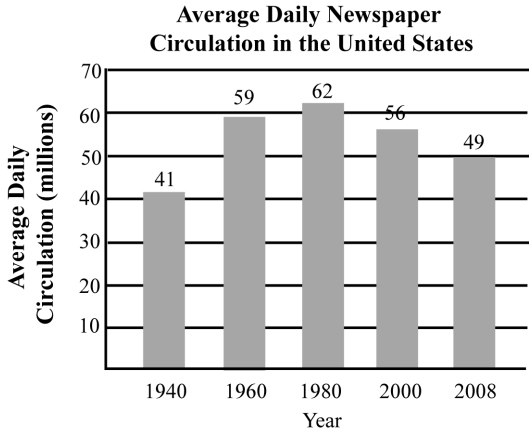
Section 9.3
The Quadratic Formula

Extra! Extra! Read All About It!!!!!!

Because of radio, television, and the Internet, the number of people reading newspapers is declining. The bar graph shows the average daily newspaper circulation in the United States, in millions, for five selected years.

This data can be modeled by a mathematical function that is quadratic. An application problem in this section of your textbook will explore this quadratic model to follow where this trend is leading.



Source: Newspaper Association of America

First Steps:

- ☐ **Take comprehensive notes** from your instructor's lecture and insert your notes into this section of the *Learning Guide*. Be sure to write down all examples, definitions, and other key concepts. Additional learning resources include the *Lecture Series on DVD*, the *PowerPoints*, and Section 9.3 of your textbook which begins on page 636.
- ☐ Complete the ***Concept and Vocabulary Check*** on page 643 of the textbook.

Guided Practice:

☐ Review each of the following ***Solved Problems*** and complete each ***Pencil Problem***.

Objective #1: Solve quadratic equations using the quadratic formula.

✔ *Solved Problem #1*

1a. Solve using the quadratic formula:

$$8x^2 + 2x - 1 = 0$$

Identify the values of a, b, and c:
$a = 8,\ b = 2,$ and $c = -1.$

Substitute these values into the quadratic formula and simplify to get the equation's solutions.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-2 \pm \sqrt{2^2 - 4(8)(-1)}}{2(8)}$$

$$= \frac{-2 \pm \sqrt{4 + 32}}{16}$$

$$= \frac{-2 \pm \sqrt{36}}{16}$$

$$= \frac{-2 \pm 6}{16}$$

$$x = \frac{-2 + 6}{16} \quad \text{or} \quad x = \frac{-2 - 6}{16}$$

$$= \frac{4}{16} = \frac{1}{4} \qquad = \frac{-8}{16} = -\frac{1}{2}$$

The solution set is $\left\{-\frac{1}{2}, \frac{1}{4}\right\}$.

✎ *Pencil Problem #1* ✎

1a. Solve using the quadratic formula:

$$6x^2 - 5x - 6 = 0$$

1b. Solve using the quadratic formula: $x^2 = 6x - 4$

Write the equation in standard form.

$$x^2 = 6x - 4$$

$$x^2 - 6x + 4 = 0$$

Identify the values of a, b, and c:

$a = 1$, $b = -6$, and $c = 4$.

Substitute these values into the quadratic formula and simplify to get the equation's solutions.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$x = \frac{-(-6) \pm \sqrt{(-6)^2 - 4(1)(4)}}{2(1)}$$

$$= \frac{6 \pm \sqrt{36 - 16}}{2}$$

$$= \frac{6 \pm \sqrt{20}}{2}$$

$$= \frac{6 \pm 2\sqrt{5}}{2}$$

$$= 3 \pm \sqrt{5}$$

The solution set is $\{3 \pm \sqrt{5}\}$.

1b. Solve using the quadratic formula: $x^2 - x = 14$

Objective #2: Determine the most efficient method to use when solving a quadratic equation.

✔ *Solved Problem #2*

2. What is the most efficient method for solving a quadratic equation of the form $ax^2 + c = 0$?

The most efficient method is to solve for x^2 and apply the square root property.

Pencil Problem #2

2. What is the most efficient method for solving a quadratic equation of the form $u^2 = d$, where u is a first-degree polynomial?

Objective #3: Solve problems using quadratic equations.

✔ *Solved Problem #3*

3. The percentage, p, of the United States population that was foreign-born x years after 1920 can be modeled by the formula $p = 0.004x^2 - 0.37x + 14.1$. According to this model, in which year will 25% of the United States population be foreign-born?

$$p = 0.004x^2 - 0.37x + 14.1$$
$$25 = 0.004x^2 - 0.37x + 14.1$$
$$0 = 0.004x^2 - 0.37x - 10.9$$

Identify the values of $a, b,$ and c:
$a = 0.004,\ b = -0.37,$ and $c = -10.9.$

Substitute these values into the quadratic formula and simplify to get the equation's solutions.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$x = \frac{-(-0.37) \pm \sqrt{(-0.37)^2 - 4(0.004)(-10.9)}}{2(0.004)}$$
$$\approx -23 \text{ or } 116$$

Reject the negative solution to the quadratic equation because the time cannot be negative.

25% of the United States population will be foreign-born 116 years after 1920, or 2036.

✎ *Pencil Problem #3* ✎

3. A football is kicked straight up from a height of 4 feet with an initial speed of 60 feet per second.

The formula $h = -16t^2 + 60t + 4$ describes the ball's height above the ground, h, in feet, t seconds after it is kicked. How long will it take for the football to hit the ground? Use a calculator and round to the nearest tenth of a second.

Answers for Pencil Problems *(Textbook Exercise references in parentheses)*:

1a. $\left\{-\frac{2}{3}, \frac{3}{2}\right\}$ *(9.3 #11)* **1b.** $\left\{\frac{1 \pm \sqrt{57}}{2}\right\}$ *(9.3 # 15)*

2. Use the square root property. *(9.3 #43)* **3.** about 3.8 seconds *(9.3 #53)*

Homework:

- ☐ **Review the Section 9.3 summary** on page 676 of the textbook.
- ☐ **Insert your homework** into this section of the *Learning Guide*. Show all work neatly and check your answers. Strive to work through difficulties when possible, making note of any exercises where you need additional help. Remember, even if your instructor assigns homework through *MyMathLab*, you should still write out your work.