Section 1.2 Rounding Whole Numbers

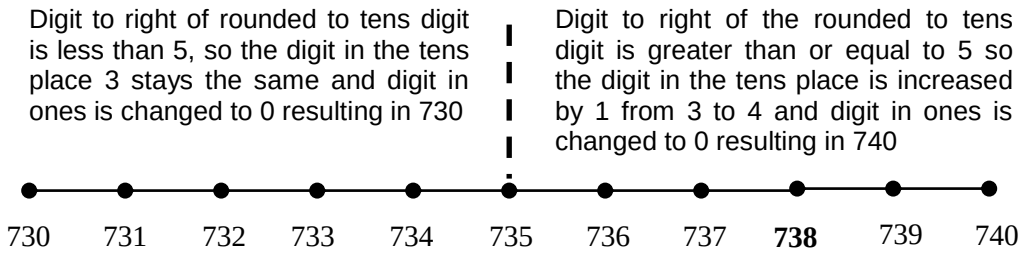
In applications involving large whole numbers, values are often rounded to create numbers which end with multiple zero digits. Also, rounding is useful to estimate answers resulting from basic arithmetic operations. To round a number to a given place value first locate the digit in the rounded to place value then circle it (*bolded and boxed in the textbook*) and draw a bar behind that digit. If the digit to the immediate right of the rounded to digit place is less than 5 the digit in the rounded to place value stay the same, but if it is 5 or larger the digit in the rounded to place value is increased by 1. All the digits to the right of the rounded to place value indicated by the bolded line are changed to 0 digits.

To round a whole number to a given place value

Case 1 If the digit to the immediate right of the rounded to place value is less than 5 the digit in the rounded to place value remains the same and all the digits to the right of the rounded to place value are changed to 0 digits.

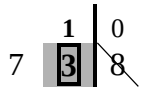
Case 2 If the digit to the immediate right of the rounded to place value is 5 or larger the digit in the rounded to place value is increased by 1 and all the digits to the right of the rounded to place value are changed to 0 digits.

To graphically illustrate the process in rounding 7**3**8 to the nearest **ten**, the number line shown below plots the whole numbers from 7**3**0 to 7**4**0. Halfway between 7**3**0 and 7**4**0 is 7**3**5 which serves as the cutoff point which determines whether 7**3**8 is closer to 7**3**0 or 7**4**0. Since the whole number 7**3**8 is closer to 7**4**0 when rounded to the tens place it becomes 7**4**0.



Example 1 Round the following numbers to the specified place value.

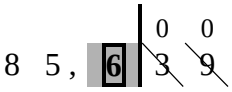
Round 738 to the nearest **ten**



7**4**0

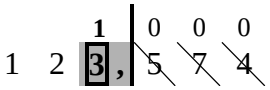
To the immediate right of the rounded to **tens** place is the digit 8 which is larger than or equal to 5 so the digit in the **tens** place is increased by 1 from 3 to 4 and all the digits to the right of the **tens** place are changed to zeros.

Round 85,**6**39 to the nearest **hundred** 85,**6**00



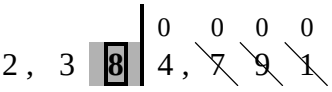
To the immediate right of the rounded to **hundreds** place is the digit 3 which is less than 5 so the digit in the **hundreds** place 6 stays the same and all the digits to the right of the **hundreds** place are changed to zeros.

Round 12**3**,574 to the nearest **thousand** 12**4**,000



To the immediate right of the rounded to **thousands** place is the digit 5 which is larger than or equal to 5 so the digit in the **thousands** place is increased by 1 from 3 to 4 and all the digits to the right of the **thousands** place are changed to zeros.

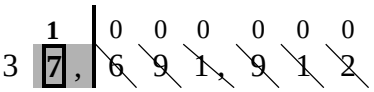
Round 2,3**8**4,791 to the nearest **ten-thousand** 2,3**8**0,000



To the immediate right of the rounded to **ten-thousands** place is digit 4 which is less than 5 so the digit in the **ten-thousands** place 8 stays the same and all the digits to the right of the **ten-thousands** place are changed to zeros.

Example 2 In the 2010 census, the population of California is 37,691,912 round this population to the nearest million.

Round 3**7**,691,912 to the nearest **million** 3**8**,000,000

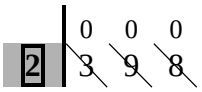


To the immediate right of the rounded to **millions** place is the digit 6 which is larger than or equal to 5 so the digit in the **millions** place is increased by 1 from 7 to 8 and all the digits to the right of the **millions** place are changed to zeros.

In the problem below, notice how the same number rounded to different place values results in different answers.

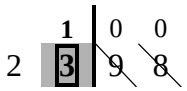
Example 3 Round 2398 to the thousands, hundreds, and tens place.

Round **2**398 to the nearest **thousand** **2**000



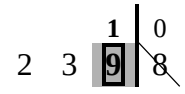
To the immediate right of the rounded to **thousands** place is the digit 3 which is less than 5 so the digit in the **thousands** place 2 stays the same and all the digits to the right of the **thousands** place are changed to zeros.

Round 2**3**98 to the nearest **hundred** 2**4**00



To the immediate right of the rounded to **hundreds** place is the digit 9 which is larger than or equal to 5 so the digit in the **hundreds** place is increased by 1 from 3 to 4 and all the digits to the right of the **hundreds** place are changed to zeros.

Round 23**9**8 to the nearest **ten** 24**0**0

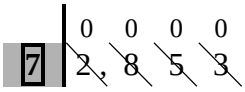


To the immediate right of the rounded to **tens** place is the digit 8 which is larger than or equal to 5 so the digit in the **tens** place is increased by 1 which changes 239 to 240 and all the digits to the right of the **tens** place are changed to zeros.

The **leading digit place** is the first non-zero digit located on the left which is also the largest place value containing a non-zero digit. To **front end round** a whole number, round it to the leading digit place. Front end rounding can be used to quickly estimate an addition, subtraction, or multiplication problem involving multi digit whole numbers by first front end rounding the numbers and then performing the indicated operation on the rounded numbers.

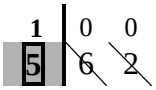
Example 4 Front end round the following numbers

Frond end round **7**2,853 **7**0,000



The leading digit is the 7 located in the ten-thousands place, so round 72,853 to the nearest ten thousand. To the immediate right of the rounded to ten-thousands place is the digit 2 which is less than 5 so the digit in the ten-thousands place 7 stays the same and all the digits to the right of the ten-thousands place are changed to zeros.

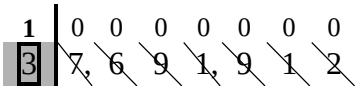
Front end round **5**62



The leading digit is the 5 located in the hundreds place, so round 562 to the nearest hundred. To the immediate right of the rounded to hundreds place is the digit 6 which is larger than or equal to 5 so the digit in the hundreds place is increased by 1 from 5 to 6 and all the digits to the right of the hundreds place are changed to zeros.

Example 5 In the 2010 census, the population of California is 37,691,912. Front end round California's 2010 population.

Front end round **3**7,691,912 **4**0,000,000



The leading digit is the 7 located in the ten-millions place, so round 37,691,912 to the nearest ten million. To the immediate right of the rounded to ten-millions place is the digit 7 which is larger than or equal to 5 so the digit in the ten millions place is increased by 1 from 3 to 4 and all the digits to the right of the ten millions place are changed to zeros.

Exercises 1.2

1-10 Round the following numbers to the indicated place.

1. Round 12,753 to the nearest hundred
2. Round 4731 to the nearest ten
3. Round 3576 to the nearest ten
4. Round 8932 to the nearest hundred
5. Round 29,631 to the nearest thousand
6. Round 143,421 to the nearest thousand
7. Round 7,835,397 to the nearest hundred-thousand
8. Round 5,457,090 to the nearest ten-thousand
9. Round 47,391,721 to the nearest million
10. Round 123,712,198 to the nearest million

11-20 Round the following numbers to the nearest indicated places.

11.	7352	thousand	hundred	ten
12.	8753	thousands	hundred	ten
13.	14,798	thousands	hundred	ten
14.	45,109	thousand	hundred	ten
15.	123,456	ten-thousand	thousand	hundred
16.	78,926	ten-thousand	thousand	hundred
17.	1,235,986	hundred-thousand	ten-thousand	thousand
18.	3,923,811	hundred-thousand	ten-thousand	thousand
19.	28,195,216	million	hundred-thousand	ten-thousand
20.	8,705,192	million	hundred-thousand	ten-thousand

21-26 Front end round the following numbers.

21.	17,905	22.	895	23.	23,099
24.	321,908	25.	1,456,851	26.	18,007,984

27. The population estimates in 2013 of the largest countries in North America are listed below. Round to the nearest million the population of each country.

Canada	Mexico	U.S.
35,236,000	118,419,000	316,102,000

28. The speed of light is 299,792,458 meters per second. Front end round the speed of light.

29. The 2014 payroll for the Oakland A's is $74,765,900 and for the San Francisco Giants is $147,738,612. Round to the nearest million the given payrolls.

30. The U.S. median household income in February 2014 is $53,093. Round to the nearest hundred the median household income.

31. On May 26, 2014 the price of gold is listed at $1293 per ounce. Round to the nearest ten this price of gold.

32. As of 2013, the population of the city of Fairfield is 105,321. Round to the nearest hundred the population of Fairfield.

33. The average distance between the earth and the sun is 149,669,180 kilometers. Round to the nearest million the distance.

34. For college students in 2012 the average cost is $1168 for textbooks and supplies. Round to the nearest ten this average cost.

35. In 2012, the median weekly earning per week for workers aged 25 or over is listed below according to their highest education level. Round to the nearest ten these weekly earning for each education level.

High School	AA degree	Bachelor's Degree
$638	$768	$1053