

Section 5.1 Ratios

A ratio compares two quantities by describing how the magnitude (the size) of first quantity relates to the second quantity. Ratios are written with a colon or the word “to” separating the two quantities which are written in the same order in which they appear. Ratios are also written as quotients in fraction format with the first quantity as the numerator and the second quantity as the denominator. If a ratio is a number larger than or equal to one when written in fraction format leave it as an improper fraction and do not convert it to a mixed number.

The **ratio** of the quantity A to quantity B is written below with a colon, using the word “to”, or as a fraction.

$$A:B \qquad A \text{ to } B \qquad \frac{A}{B}$$

Example 1 A class has 17 female and 14 male students. Find the ratio of female students to male students. Also, find the ratio of male students to the total students in the class.

The ratio of 17 female to 14 male students 17:14 17 to 14 $\frac{17}{14}$

Find the 31 total students in this class by adding the 17 female and 14 male students.

The ratio of 14 male to 31 total students 14:31 14 to 31 $\frac{14}{31}$

Example 2 A professional football team plays 16 total games and wins 11 of the these games, find the ratio of games won to games played. Also find the ratio of the number of wins to the number of loses.

The ratio of 11 wins to 16 games played 11:16 11 to 16 $\frac{11}{16}$

Find that the team lost 5 games by taking the difference of the 16 games played and the 11 games won.

The ratio of 11 wins to 5 loses 11:5 11 to 5 $\frac{11}{5}$

To **reduce a ratio**, write the ratio as a fraction and reduce the resulting fraction by cancelling out any common factors in the numerator and denominator.

Example 3 Write the following ratios in reduced form.

\$20:\$28 10 parts water to 4 parts flour \$0.45 to \$1.20

The ratio of \$20 to \$28 is written in reduced form as 5:7, 5 to 7 or 5/7.

$$\frac{\cancel{\$20}}{\cancel{\$28}} = \frac{\overset{5}{\cancel{20}}}{\underset{7}{\cancel{28}}} = \frac{5}{7}$$

10 parts water to 4 parts flour is written in reduced form as 5:2, 5 to 2 or 5/2.

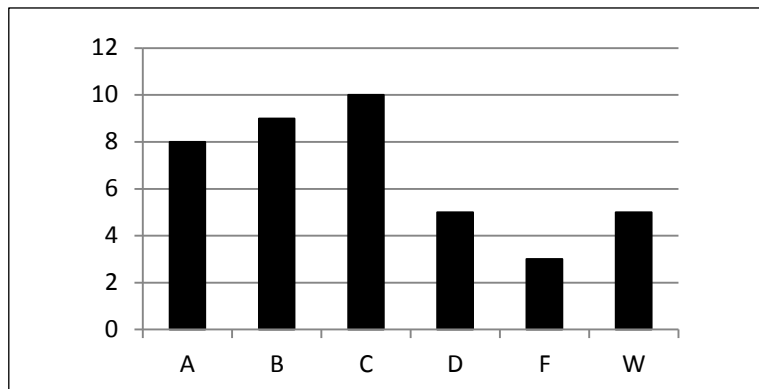
$$\frac{10 \cancel{\text{ part}}}{4 \cancel{\text{ part}}} = \frac{\overset{5}{\cancel{10}}}{\underset{2}{\cancel{4}}} = \frac{5}{2}$$

The ratio of \$0.45 to \$1.20 is written as the fraction 0.45/1.20 which when multiplied by one written as 100/100 moves the decimal point of both decimals two places to the right. Remember that multiplication by one leaves a number unchanged. The resulting fraction 45/120 reduces to 3/8. The ratio of \$0.45 to \$1.20 is written in reduced form as 3:8, 3 to 8 or 3/8.

$$\frac{\cancel{\$0.45}}{\cancel{\$1.20}} = \frac{0.45}{1.20} \times \underbrace{\left(\frac{100}{100}\right)}_{\text{equals one}} = \frac{45}{120} = \frac{\overset{9}{\cancel{45}}}{\underset{24}{\cancel{120}}} = \frac{\overset{3}{\cancel{3}}}{\underset{8}{\cancel{24}}} = \frac{3}{8}$$

In the above problem, the ratio involved two quantities measured in terms of the same unit dollars which are written and then canceled out in the fraction form. In future problems when ratios are written in fraction format the units will not be included since they are the same and will eventually cancel out.

Example 4 The final grade distribution in a class of 40 students is shown below. Find the ratio of students that earned an A grade to the total number of students in the class? Find the ratio of C students to D students? Find the ratio of successful to unsuccessful students? Write the final answers as fractions in reduced form.



The ratio of students who earned an A grade to the total students is 8 to 40. In fraction form the ratio $8/40$ reduces to $1/5$ which indicates one student with an A grade for every five students in the class.

$$8 \text{ students with an A grade to } 40 \text{ total students} = \frac{8}{40} = \frac{\overset{1}{\cancel{8}}}{\underset{5}{\cancel{40}}} = \frac{1}{5}$$

The ratio of students who earned a C grade to those that earned a D grade is 10 to 5. In fraction form the ratio $10/5$ reduces to $2/1$ which indicates two students with a C grade for every one student with a D grade in this class.

$$10 \text{ students with a C grade to } 5 \text{ students with a D grade} = \frac{10}{5} = \frac{\overset{2}{\cancel{10}}}{\underset{1}{\cancel{5}}} = \frac{2}{1}$$

First to find the 27 successful students in this course add the 8, 9 and 10 students that received an A, B, or C grade. Then to find the 13 unsuccessful students in this course add the 5, 3 and 5 students that received a D, F or W grade. Note, the 13 unsuccessful students can also be found by subtracting the 27 successful students from the 40 total students. The ratio of successful students to unsuccessful students in this class is 27 to 13 and the resulting fraction form $27/13$ is in reduced form.

$$27 \text{ successful student to } 13 \text{ unsuccessful students} = \frac{27}{13}$$

Exercises 5.1

1-29 Write the following ratios as fractions in reduced form.

- | | | | | | |
|----|---------------|----|------------------|----|----------------|
| 1. | 8 to 12 | 2. | 9:12 | 3. | 20 to 15 |
| 4. | 6 to 20 | 5. | \$24:\$14 | 6. | \$125 to \$200 |
| 7. | \$1.20:\$2.80 | 8. | \$0.42 to \$0.56 | 9. | \$2.25:\$1.75 |

10-11 Sacramento averages 188 sunny days per year.

10. The ratio of average sunny days in Sacramento to total days in a year.
11. The ratio of the average sunny days to non-sunny days in Sacramento.

12-13 A condominium development has 20 units of which 5 are occupied by renters and the rest are occupied by owners.

12. Find the ratio of rented condos to owner occupied condos in this development
13. Find the ratio of owner occupied condos to total condos in this development.

14-15 The college basketball team has 12 players. On that team, 6 are guards, 4 are forwards, and 2 are centers.

14. The ratio of centers to guards on this team.
15. The ratio of forwards to total players.

16-17 Alan weighed 180 pounds and when on a diet and lost 10 pounds

16. Find the ratio of Alan's new weight to her original weight.
17. Find the ratio of Alan's weight loss to her original weight.

18-20 At a farmers market, a local farm has for sale 5 crates of peaches, 3 crates of nectarines, 6 crates of tomatoes and 4 crates of peppers.

18. Find the ratio of crates of nectarines to crates of peaches.
19. Find the ratio of the crates of tomatoes to the total crates.
20. Find the ratio of the crates of fruit (peaches & nectarines) to the crate of vegetables (tomatoes and peppers).

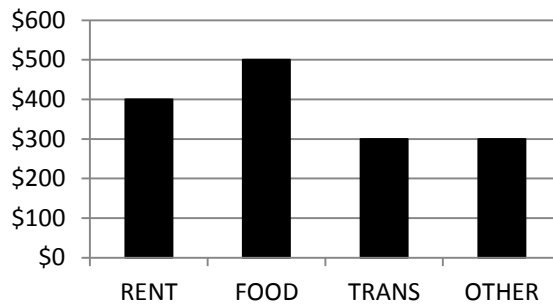
21-23 Answer the following based on the figure below.

- 21. Find the ratio of shaded to un-shaded boxes.
- 22. Find the ratio of shaded to total boxes.
- 23. Find the ratio of un-shaded to total boxes.



24-26 Answer the following based on the bar graph which gives a monthly budget for a student who lives with roommates.

- 24. Find the ratio of rent to food
- 25. Find the ratio of food to total budget
- 26. Find the ratio of transportation to total budget.



27-29 Answer the following based on the pie chart which gives the number of students in a class that are under 20 years old, between 20 and 25 years old, and older than 25.

- 27. Ratio of number of students under 20 to those over 25 years old.
- 28. Ratio of students between 20 and 25 years old to all the students in the class.
- 29. Ratio of students older than 25 to all the students in the class.

