# When it’s fair to compare the pair

Students use statistics to compare the performance of elite Australian professional footballers. They establish a need for and learn to calculate quantities as percentages of other quantities, including goals scored as a percentage of shots taken.

## Visible learning

### Learning intentions

* To understand the need to use fractions, decimals and percentages to compare quantities.
* To be able to find one quantity as a percentage of another.

### Success criteria

* I can explain why a given statistic needs to be compared with another.
* I can use a calculator to find one quantity as a percentage of another.
* I can use equivalent fractions or percentages to compare statistics fairly.

## Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* represents and operates with fractions, decimals and percentages to solve problems **MA4-FRC-C-01**

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Please use the associated PowerPoint *When it’s fair to compare the pair* to display images in this lesson.

## Activity structure

### Launch

1. Pose the question ‘Is Sam Kerr the best female Australian soccer player?’
2. Display Table 1 for students on the teacher screen. This table is also available on slide 2 of the *When it’s fair to compare the pair* PowerPoint.

Table 1 – goals scored by Matilda’s forwards for the club in 2022–2023

|  |  |  |
| --- | --- | --- |
| Player | Club | Goals scored in 2022–2023 |
| Sam Kerr | Chelsea | $$12$$ |
| Hayley Raso | Manchester City | $$1$$ |
| Caitlin Foord | Arsenal | $$6$$ |
| Mary Fowler | Manchester City | $$1$$ |
| Cortnee Vine | Sydney FC | $$7$$ |
| Katrina Gorry | Brisbane Roar | $$3$$ |

1. Explain to students that the table shows the goals scored by female Australian soccer players for their club this season.
2. Have students engage in a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) to consider the answer to the following questions.
3. Who is the best player in the table?
4. Can you rank the players?
5. Is there anything other than the goals they have scored that you might use to compare the players?

Students might raise that the number of games played, the number of goal scoring opportunities and the competitions the players play in could all have an impact on their ability to score goals.

1. Display Table 2 for students on the teacher screen. This table is also available on slide 3 of the *When it’s fair to compare the pair* PowerPoint.

Table 2 – goals scored and shots taken by Matilda’s forwards for the club in 2022–2023

|  |  |  |  |
| --- | --- | --- | --- |
| Player | Club | Goals scored in 2022–2023 | Shots taken |
| Sam Kerr | Chelsea | $$12$$ | $$79$$ |
| Hayley Raso | Manchester City | $$1$$ | $$14$$ |
| Caitlin Foord | Arsenal | $$6$$ | $$51$$ |
| Mary Fowler | Manchester City | $$1$$ | $$5$$ |
| Cortnee Vine | Sydney FC | $$7$$ | $$40$$ |
| Katrina Gorry | Brisbane Roar | $$3$$ | $$38$$ |

1. Students will have a further discussion in their pairs about whether this new information changes their opinion about the ranked order of these players.

The data above was collected midway through the 2022–2023 season from the ‘Football statistics and history’ ([bit.ly/Fbref](https://bit.ly/Fbref)). Teachers may wish to collect and display data from other sources, depending on the interests of their students. Goal kicking statistics can be found for the NRL at the website ‘Rugby League Project’ ([bit.ly/RugbyLP](https://bit.ly/RugbyLP)) and for the AFL at the website 'Footy Wire’ ([bit.ly/FootyWire](https://bit.ly/FootyWire)).

### Explore

1. Instruct students to write each player’s goal scored as a fraction of their shots taken.

Highlight to students the importance of the word ‘of’ in this sentence. This word usually precedes the quantity that will be the denominator of a fraction.

1. After an appropriate time, display Table 3 for students on the teacher screen. This table is also available on slide 4 of the *When it’s fair to compare the pair* PowerPoint.

Table 3 – goals scored as a fraction of shots taken by Matilda’s forwards for the club in 2022–2023

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Player | Club | Goals scored in 2022–2023 | Shots taken | Goals scored as a fraction of shots taken |
| Sam Kerr | Chelsea | $$12$$ | $$79$$ | $$\frac{12}{79}$$ |
| Hayley Raso | Manchester City | $$1$$ | $$14$$ | $$\frac{1}{14}$$ |
| Caitlin Foord | Arsenal | $$6$$ | $$51$$ | $$\frac{6}{51}$$ |
| Mary Fowler | Manchester City | $$1$$ | $$5$$ | $$\frac{1}{5}$$ |
| Cortnee Vine | Sydney FC | $$7$$ | $$40$$ | $$\frac{7}{40}$$ |
| Katrina Gorry | Brisbane Roar | $$3$$ | $$38$$ | $$\frac{3}{38}$$ |

1. Have students again engage in a Think-Pair-Share to consider the ranked order of these fractions, from smallest to largest.
2. Discuss with students the factors about these fractions that made these fractions easy or difficult to compare.

Students may be able to identify that $\frac{3}{38}$ is clearly smaller that $\frac{6}{51}$ as the $6$ is double $3$ but $51$ is much less than double $38$. If students can use methods to successfully compare all fractions, ask students how they might compare a player who scored $10$ goals from $59$ attempts for a fraction of $\frac{10}{59}$.

1. Students can be given the opportunity to compare the fractions in the table using the Desmos graph ‘Fraction comparison 2’ ([bit.ly/DesmosFCompare](https://bit.ly/DesmosFCompare)).
2. Use slides 5–8 from the *When it’s fair to compare the pair* PowerPoint for explicit teaching of finding one quantity as a percentage of another.

The explicit teaching technique used in the associated PowerPoint is ‘Your turn.’ The first slide is a worked example which should be displayed for the students and then use the following steps.

* + - 1. Reveal the question to students and its solution.
			2. Students read in silence.
			3. Students individually think and explain to themselves what is happening in each step.
			4. Students hold up a thumbs up to the teacher when they have finished reading and have some sort of understanding.
			5. Think-Pair-Share. Students explain the solution to their partner.
			6. In pairs students then answer the self-explanation questions.
			7. Finally, randomly select students to share their answers with the whole class.
1. Hand students Appendix A ‘Goal scoring statistics’. Have students represent each player’s goals scored as a percentage of the shots they have taken in the final column and compare their performance.
2. Conclude with students that what they have found is the accuracy of each of the players.

Teachers may wish to lead a discussion with students to consider the factors that make the percentages unable to be compared fairly. For example, we should consider where the shots were taken from, which foot they kicked with and other factors.

### Summarise

1. Students are to complete Appendix B ‘Quantities as percentages of other quantities’.

Students should use a calculator to find solutions and can use the Desmos graph ‘Fractions to percentages’ ([bit.ly/DesmosFtP](https://bit.ly/DesmosFtP)) to assist their calculations and representations.

1. Students should engage in a Think-Pair-Share to discuss the trends they noticed between the questions in Appendix B.
2. Students are to write notes to their future forgetful self ([bit.ly/notesstrategy](https://bit.ly/notesstrategy)), focusing on how to find a quantity as a percentage of another and how this can aid comparison.

### Apply

#### Percentage profit

1. Hand students Appendix C ‘Percentage profit’.
2. Explain to students that retailers, such as supermarkets and clothing stores, buy products from suppliers, increase the price and then sell the products to us.
3. Display the website or catalogue from any retailer and display a single product. Discuss where the product would be sourced from, and that the retailer would have purchased it for a cheaper price than what we can see advertised here.

For example, teachers can look at the price of apples on the website for a supermarket and discuss how these would’ve been purchased from a farmer at a cheaper price.

1. Have students calculate the percentage for which the price of each product has increased in Appendix C.
2. Once completed, instruct students to engage in a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)) to consider the following reflection questions.
3. What do you notice about the results in your table?
4. What do you wonder?
5. Do you believe all the amounts in the table are fair? Why or why not?
6. Return to the retailer website from step 3 and ask students to speculate on the amount the retailer paid for the product they are selling.

Students will hopefully identify an approximate average percentage increase of each of the products in Appendix C, or else teachers may need to lead them to this approach. Students may need to be shown that finding this percentage of the sale price and subtracting it will not give the desired result and instead be guided to a ‘guess and check’ approach to finding a cost price.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* A position-oriented driving question like ‘Is Sam Kerr the best female Australian soccer player?’ allows all students to select and attempt to justify an opinion.
* Students should be challenged to justify how they know that one fraction is less than or greater than another by considering equivalent fractions, for example we know $\frac{6}{51}>\frac{3}{39}$ because $\frac{3}{39}=\frac{6}{78}$ and $\frac{6}{51}>\frac{6}{78}$.

**Explore**

* The use of visual representations in the explicit teaching slides of the *When it’s fair to compare the pair* PowerPoint assists students to maintain connection with the underlying concept of fractions and percentages.

**Summarise**

* Students can continue to use the Desmos graphs ‘Fractions to percentages’ to complete Appendix C, again assisting them to maintain connection to the underlying concept and relationship between fractions and percentages.

### Suggested opportunities for assessment

**Launch**

* This activity provides an opportunity for teachers to assess students’ abilities to find and flexibly move between equivalent fractions to compare size. Students will also be using an understanding of the role the numerator and denominator each play in determining the size of an overall fraction.

**Summarise**

* Appendix B can be collected and used as evidence of students’ ability to convert fractions to percentages.

## **Appendix A**

### Goal scoring statistics

The goal scoring statistics of 6 female Australian soccer players are displayed below.

1. Complete the table by finding the number of goals scored as a percentage of the shots that have been taken by each player.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Player | Club | Goals scored in 2022–2023 | Shots taken | Goals scored as a percentage of shots taken |
| Sam Kerr | Chelsea | $$12$$ | $$79$$ |  |
| Hayley Raso | Manchester City | $$1$$ | $$14$$ |  |
| Caitlin Foord | Arsenal | $$6$$ | $$51$$ |  |
| Mary Fowler | Manchester City | $$1$$ | $$5$$ |  |
| Cortnee Vine | Sydney FC | $$7$$ | $$40$$ |  |
| Katrina Gorry | Brisbane Roar | $$3$$ | $$39$$ |  |

1. Order the 6 players from most accurate to least accurate.

## **Appendix B**

### One quantity as a percentage of another

Use a calculator to find each quantity as a percentage of the total amount.

|  |  |  |
| --- | --- | --- |
| Quantity | Total amount | Percentage |
| $$\$15$$ | $$\$100$$ | $$\frac{15}{100}×100=15\%$$ |
| $$\$30$$ | $$\$100$$ |  |
| $$\$30$$ | $$\$200$$ |  |
| $30$ goals | $200$ attempts |  |
| $30$ goals | $40$ attempts |  |
| $$\$31$$ | $$\$40$$ |  |
| $$\$2$$ | $$\$40$$ |  |
| $12$ kg | $40$ kg |  |
| $12$ kg | $120$ kg |  |
| $13.2$ kg | $120$ kg |  |
| $61.2$ kg | $120$ kg |  |
| $118.8$ metres | $120$ metres |  |
| $119.88$ metres | $120$ metres |  |

## **Appendix C**

### Percentage profit

Retailers who sell products to people in the community, such as supermarkets and clothing stores, are called retailers. They purchase these goods from suppliers, such as farmers, food production companies and clothing brands.

The table below shows examples of the cost price of items that a retailer might buy and the sale price that we pay for the item. The profit per item is the difference between the cost price and the sale price. Calculate the profit as a percentage of the cost price for each item.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Product | Cost price | Sale price | Profit per item | Percentage profit |
| 2L Milk | $$\$2.90$$ | $$\$4.30$$ | $$\$4.30-\$2.90=\$1.40$$ | $$\frac{1.40}{2.90}×100=48.3\%$$ |
| Strawberry punnet | $$\$4$$ | $$\$6$$ |  |  |
| A box of cereal | $$\$9$$ | $$\$12$$ |  |  |
| 200-page novel | $$\$12$$ | $$\$20$$ |  |  |
| Sunglasses | $$\$140$$ | $$\$218$$ |  |  |
| A dress | $$\$112$$ | $$\$180$$ |  |  |
| Running shoes | $$\$165$$ | $$\$230$$ |  |  |

1. What do you notice about the values in the table?
2. What do you wonder?

## Sample solutions

### Appendix A – goal scoring statistics

The goal scoring statistics of 6 female Australian soccer players are displayed below.

1. Complete the table by finding the number of goals scored as a percentage of the shots that have been taken by each player.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Player | Club | Goals scored in 2022–2023 | Shots taken | Goals scored as a percentage of shots taken |
| Sam Kerr | Chelsea | $$12$$ | $$79$$ | $$\frac{12}{79}×100=15.2\%$$ |
| Hayley Raso | Manchester City | $$1$$ | $$14$$ | $$\frac{1}{14}×100=7.1\%$$ |
| Caitlin Foord | Arsenal | $$6$$ | $$51$$ | $$\frac{6}{51}×100=11.8\%$$ |
| Mary Fowler | Manchester City | $$1$$ | $$5$$ | $$\frac{1}{5}×100=20\%$$ |
| Cortnee Vine | Sydney FC | $$7$$ | $$40$$ | $$\frac{7}{40}×100=17.5\%$$ |
| Katrina Gorry | Brisbane Roar | $$3$$ | $$39$$ | $$\frac{3}{39}×100=7.7\%$$ |

1. Order the 6 players from most accurate to least accurate.

Mary Fowler, Cortnee Vine, Sam Kerr, Caitlin Foord, Katrina Gorry, Hayley Raso.

### Appendix B – one quantity as a percentage of another

|  |  |  |
| --- | --- | --- |
| Quantity | Total amount | Percentage |
| $$\$15$$ | $$\$100$$ | $$\frac{15}{100}×100=15\%$$ |
| $$\$30$$ | $$\$100$$ | $$\frac{30}{100}×100=30\%$$ |
| $$\$30$$ | $$\$200$$ | $$\frac{30}{200}×100=15\%$$ |
| $30$ goals | $200$ attempts | $$\frac{30}{200}×100=15\%$$ |
| $30$ goals | $40$ attempts | $$\frac{30}{40}×100=75\%$$ |
| $$\$31$$ | $$\$40$$ | $$\frac{31}{40}×100=77.5\%$$ |
| $$\$2$$ | $$\$40$$ | $$\frac{2}{40}×100=5\%$$ |
| $12$ kg | $40$ kg | $$\frac{12}{40}×100=30\%$$ |
| $12$ kg | $120$ kg | $$\frac{12}{120}×100=10\%$$ |
| $13.2$ kg | $120$ kg | $$\frac{13.2}{120}×100=11\%$$ |
| $61.2$ kg | $120$ kg | $$\frac{61.2}{120}×100=51\%$$ |
| $118.8$ metres | $120$ metres | $$\frac{118.8}{120}×100=99\%$$ |
| $119.88$ metres | $120$ metres | $$\frac{119.88}{120}×100=99.9\%$$ |

### Appendix C – percentage profit

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Product | Cost price | Sale price | Profit per item | Percentage profit |
| 2L Milk | $$\$2.90$$ | $$\$4.30$$ | $$\$4.30-\$2.90=\$1.40$$ | $$\frac{1.40}{2.90}×100=48.3\%$$ |
| Strawberry punnet | $$\$4$$ | $$\$6$$ | $$\$6-\$4=\$2$$ | $$\frac{2}{4}×100=50\%$$ |
| A box of cereal | $$\$9$$ | $$\$12$$ | $$\$12-\$9=\$3$$ | $$\frac{3}{9}×100=33.3\%$$ |
| 200-page novel | $$\$12$$ | $$\$20$$ | $$\$20-\$12=\$8$$ | $$\frac{8}{12}×100=66.7\%$$ |
| Sunglasses | $$\$140$$ | $$\$218$$ | $$\$218-\$140=\$78$$ | $$\frac{78}{140}×100=55.7\%$$ |
| A dress | $$\$112$$ | $$\$180$$ | $$\$180-\$112=\$68$$ | $$\frac{68}{112}×100=60.7\%$$ |
| Running shoes | $$\$165$$ | $$\$230$$ | $$\$230-\$165=\$65$$ | $$\frac{65}{165}×100=39.4\%$$ |

## References

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