reSolve MATHS BY INQUIRY Sports Stats

Y4

Summary of learning goals

- Students recognise variability in a dataset and develop an understanding of 'average' as being the equal distribution of data.

Australian Curriculum: Mathematics (Year 4)

ACMSP095: Select and trial methods for data collection, including survey questions and recording sheets.

ACMSP096: Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values.

ACMSP097: Evaluate the effectiveness of different displays in illustrating data features, including variability.

Summary of lessons

Who is this sequence for?

- It is assumed that students have collected and analysed data in previous grades. Students also require an understanding of division as an efficient way to fairly distribute a collection between multiple groups.

Lesson 1: Sports Stats

Students explore statistical questions involving numerical data to develop an interpretation of the mean and to begin to explore quantifying variability in data, within the context of sports results.

reSolve: Mathematics by Inquiry is funded by the Australian Government and is managed by the Australian Academy of Science.

Australian Academy of Science

Reflection on this sequence

Rationale

The *Guidelines for assessment and instruction in statistics education (GAISE)* report emphasises a statistical problem-solving process that involves: (1) formulating a question that can be addressed with data; (2) collecting data to address the question; (3) analysing the data; and (4) interpreting the results. This sequence uses this process to introduce the concept of 'fair shares', otherwise known as an average or mean. Students are asked to answer statistical questions involving numerical data. This allows students to explore the ways in which they might quantify variability within a given dataset.

reSolve mathematics is purposeful

- The lesson builds students' understanding of data variation as they are asked the ways in which they might quantify variability in a dataset.
- The context of sport often uses 'averages' and is easily accessible to students.

reSolve tasks are inclusive and challenging

- The collaborative, hands-on nature of this task provides access for all students.
- Students are asked to draw conclusions of varying complexity based on the data presented.

reSolve classrooms have a knowledge-building culture

- The task is completed as a class, allowing students to learn from others' contributions. This allows students to build on the collective knowledge of the class while also extending their individual understanding.

Acknowledgements

This sequence is based on the article: Franklin C & Mewborn D, 2008, Statistics in the elementary grades: Exploring distributions of data, *Teaching Children Mathematics*, 15(1), 10–16.

LESSON 1

reSolve MATHS BY INQUIRY Sports Stats

Sports Stats

Y4

About this lesson

Students explore statistical questions involving numerical data to develop an interpretation of the mean and to begin to explore quantifying variability in data, within the context of sports results.

Australian Curriculum: Mathematics (Year 4)

ACMSP095: Select and trial methods for data collection, including survey questions and recording sheets.

ACMSP096: Construct suitable data displays, with and without the use of digital technologies, from given or collected data. Include tables, column graphs and picture graphs where one picture can represent many data values.

ACMSP097: Evaluate the effectiveness of different displays in illustrating data features, including variability.

Mathematical purpose

- To recognise variability in a dataset and to develop an understanding of 'average' as the equal distribution of data.

Learning intention

- To recognise the difference between sporting scores.

Time

A lesson of approximately 1 hour.

Resources

- Student Sheet 1 – Soccer Scores (one per student)
- Unifix cubes

Vocabulary

- average
- variation

reSolve: Mathematics by Inquiry is funded by the Australian Government and is managed by the Australian Academy of Science.

Total goals scored?

Ask students: *What sports do we play or watch on the weekend? In what ways can we compare how well our teams do?*

Students are likely to suggest that one way that their teams are compared is by the number of goals scored by the student's team.

Pose the question: *What is the total number of goals scored in soccer games?*

Collecting data

Present the following hypothetical context or use data collected from the class' own weekend sports.

Last Saturday morning I watched my brother/sister/cousin/neighbour play their soccer match. They were so excited because their team scored three goals, which was the best they had done all season. My little brother/sister/cousin/neighbour was one of the goal scorers, scoring their first goal for the team! They did not mind that the other team scored four goals — that team has been winning lots of games this season.

The table on the right lists the total number of goals scored by each team on that day. Each team played one game.

Team	Number of goals
Cool Cats	3
Little Sharks	1
Blue Lightning	5
The Aztecs	7
Mini Cyclones	4
The Strikers	7
Wild Things	9
Dream Team	3
Gully District	4

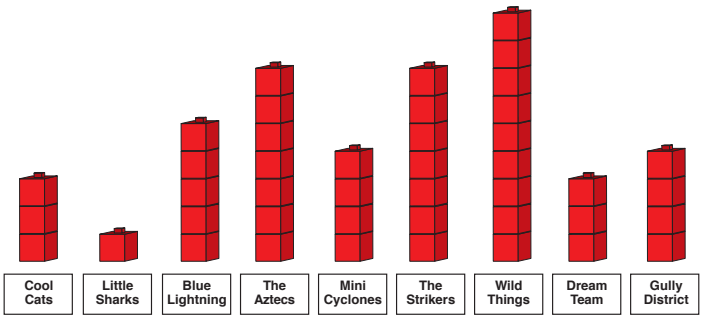
Resources: Hand out Student Sheet 1 – Soccer Scores, which has the same table.

Ask students to represent the data in the table using Unifix cubes, then to represent the data as a graph on the student sheet.

Analysing data

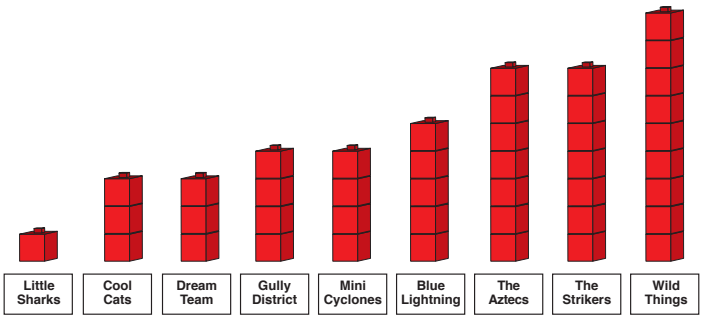
Ask students what they notice about the data. Some example observations:

- The lowest score was 1.
- The highest score was 9.
- Scores of 3, 4 and 7 were each scored by two different teams.



Teacher notes:

- The Unifix cube towers can be rearranged for ease of comparison.
- It is important for students to notice that **variation** between the scores exists, and that this variation is typical.



Pose the question: *Based on the total number of goals presented in the data, if all the teams had the same score, what would that score be?*

We will call this score the 'fair share value'.

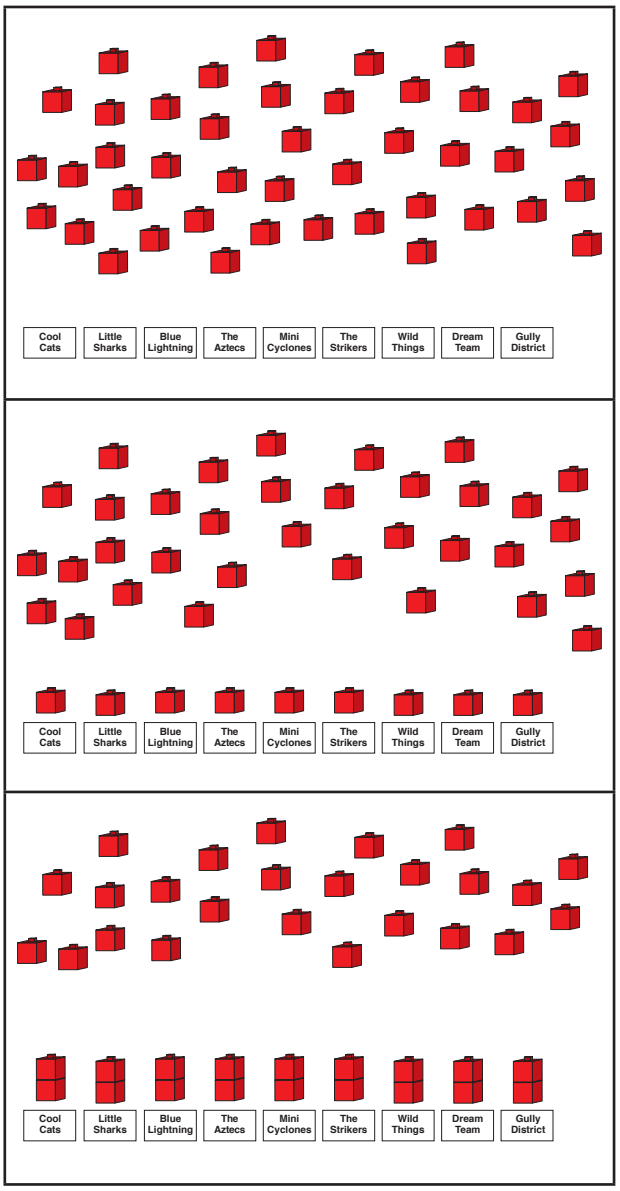
Allow students time to solve the problem. Have the students share the strategies that they use.

Teacher notes:

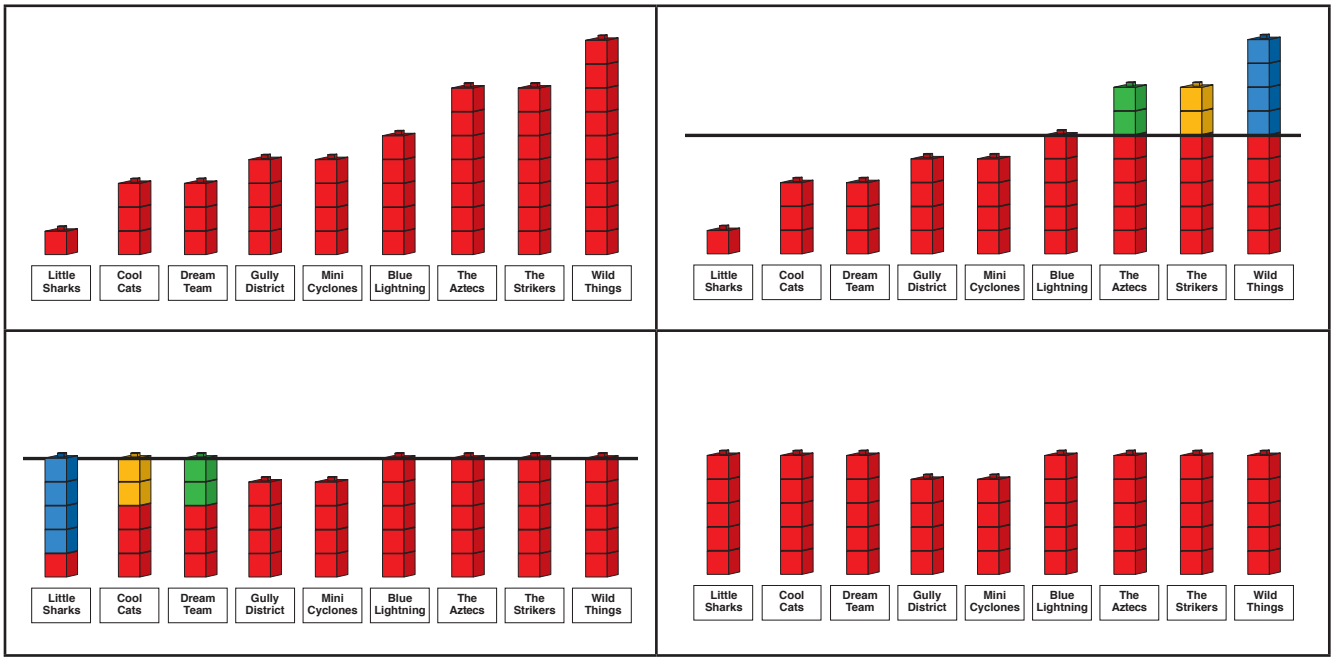
- A 'fair share' with this dataset is 4 and $\frac{7}{9}$ or 4 remainder 7. Students will need to interpret this remainder within the context of the problem.
- As all goals need to be accounted for and it is not possible to score $\frac{7}{9}$ of a goal, the closest we can come to having a fair share value is for seven teams to have a score of 5 and the two remaining teams to have a score of 4.

Possible student responses:

- *Combine all the goals scored into a large group of goals (dismantling cube towers to one group of individual cubes). This shows there was a total of 43 goals scored. Remove nine cubes from the whole group and arrange them to represent a single goal scored by each team. Continue doing this until there are no cubes left. This will show seven of the teams will have a score of 5 and two teams will have a score of 4.*
  - This process mirrors the algorithm for finding the mean:
    - Combining all goals at the start (step 1 above) is equivalent to adding all of the data points:
      $3 + 2 + 5 + 6 + 4 + 7 + 9 + 3 + 4 = 43$
    - Distributing the goals one at a time is equivalent to dividing that total by the number of data points:
      $\frac{43}{9} = 4\frac{7}{9}$



- *Even out the scores by moving some cubes from those teams that scored a lot of goals to those teams that scored a few goals. Reallocating the cubes from the three top-scoring teams to the three lowest-scoring teams averages out all the scores.*



Interpreting the data

Explain that the 'fair share value' is more often called the **average**. Ask students:

- *Would we expect each team to score the exact same number of goals next weekend? Why/why not?*
- *If we did this activity again next week, would the average score be the same?*
- *Would the data look different if it came from high school teams instead of primary school teams?*
- *What if we collected data early in the season or late in the season? Would we expect different averages each week?*
- *Could we predict what the averages for the whole season might be?*
- *Why is the average score useful to find? What information does it tell us?*
  - ◊ Examples of useful averages in sport are highlighted in the Further activities section on the next page.

Further activities

Activity 1

Pose the question: *If we know that the average score for nine teams is 6, how many goals might have been scored by each team?*

The simplest distribution is for each of the nine teams to score 6 goals. Encourage students to look for other solutions.

Place some restrictions, such as:

- None of the teams scored 6 goals.
- Two of the teams scored 10 goals.
- One team scored no goals, and another three teams scored fewer than 6 goals.

Discuss the range of possibilities that students create and the strategies that they used to find different solutions.

Activity 2

Discuss the ways in which the average is commonly used in sporting contexts. Some examples include:

- average runs in cricket
- average points in basketball
- average speed in car racing
- average score in gymnastics, ice skating and diving.

Use one or more of these contexts and explore the ways in which the average is calculated. Look at some of the conditions that effect the average in the following examples.

- A batting average in cricket is the number of runs scored divided by the number of times a batsman is out. This means that if a batsman was to not get out in a number of consecutive games, it would greatly influence their batting average.
- Diving is scored by seven judges. The highest and lowest scores are eliminated and the average of the remaining five judges' scores is given as the overall score. Eliminating the highest and lowest scores reduces bias. Ice skating is similar.

Activity 3

Have students look at and graph their own scores achieved during sport. Results from a school athletics or swimming carnival might be used. Graph the results and look at the variation in the data. Look at the ways in which the average might be calculated. What does the average tell us in this context? Is the average helpful? When is an average in sport useful?

Soccer Scores

Name: _____

Team	Number of goals
Cool Cats	3
Little Sharks	1
Blue Lightning	5
The Aztecs	7
Mini Cyclones	4
The Strikers	7
Wild Things	9
Dream Team	3
Gully District	4

Represent the data as a graph.