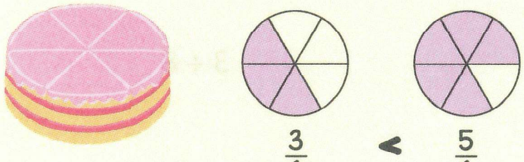
Ordering fractions and decimals

Ordering fractions

Fractions can only be compared when the denominator is the same; this is called a **common denominator**. If fractions have the same denominator, the value of the numerator will determine which fraction is bigger than another.

To compare and order fractions, the denominator must first be the same.



$\frac{3}{6} < \frac{5}{6}$

$\frac{3}{6}$ of a cake is less than $\frac{5}{6}$ of a cake.

You can't easily compare fractions if they have different denominators.

Order the fractions from least to greatest.

$\frac{1}{2}$ $\frac{3}{4}$ $\frac{3}{8}$ $\frac{4}{5}$

First find a common denominator by finding a common multiple of 2, 4, 8 and 5. In this case, a common multiple is 40 (any common multiple will work; it doesn't have to be the lowest).

Now use equivalent fractions to express each fraction with a denominator of 40.

$\frac{1}{2} = \frac{20}{40}$ (× 20) $\frac{3}{4} = \frac{30}{40}$ (× 10) $\frac{3}{8} = \frac{15}{40}$ (× 5) $\frac{4}{5} = \frac{32}{40}$ (× 8)

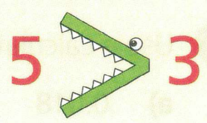
Ordering by numerators: $\frac{15}{40}, \frac{20}{40}, \frac{30}{40}, \frac{32}{40}$

Written in original form: $\frac{3}{8}, \frac{1}{2}, \frac{3}{4}, \frac{4}{5}$

Ordering decimals

To order decimal numbers, compare the digits in each place value from left to right. Write each number so that they have the same number of decimal places, e.g. if one number has its last digit in the thousandths place, write the other numbers to the thousandths place by inserting zeros to the right of the last digit.

If asked to use inequality symbols, remember that the alligator eats the larger number:
- $<$ is less than
- $\leq$ is less than or equal to
- $>$ is greater than
- $\geq$ is greater than or equal to.



Order the decimals from smallest to largest using inequality symbols: 0.19 2.08 0.09 0.1

Write each number so that they have the same number of decimal places, so 0.1 becomes 0.10

Ones	•	tenths	hundredths
0	•	1	9

0.19 has the same ones and tenths values as 0.10 but its hundredths value is greater.

Ones	•	tenths	hundredths
2	•	0	8

2.08 is the largest number as it has the largest ones value.

Ones	•	tenths	hundredths
0	•	0	9

0.09 is the smallest number as it has no values in its ones or tenths columns.

Ones	•	tenths	hundredths
0	•	1	0

0.10 is greater than 0.09 because its highest value is in the tenths rather than the hundredths column.

In order from smallest to largest: $0.09 < 0.1 < 0.19 < 2.08$

Ordering fractions and decimals

To order fractions and decimals, they must first be in the same form. Either convert the fractions to decimals (which is usually easier) or the decimals to fractions, then order them.

Order $\frac{19}{45}$, 1.38, 0.98, $\frac{26}{20}$ from greatest to least.

Convert the fractions to decimals.

$\frac{19}{45} = 19 \div 45 = 0.4\dot{2}$ $\frac{26}{20} = 1\frac{6}{20} = 1\frac{30}{100} = 1.30$

Now order the decimals: 1.38, 1.30, 0.98, $0.4\dot{2}$

$1.38 > \frac{26}{20} > 0.98 > \frac{19}{45}$ Values written in their original form.

RETRIEVE

6 Ordering fractions and decimals

Ordering fractions

1. Order the fractions from least to greatest: $\frac{5}{7}$ $\frac{1}{3}$ $\frac{8}{21}$ $\frac{5}{6}$

....

2. Order the fractions from greatest to least: $\frac{8}{6}$ $\frac{7}{12}$ $\frac{2}{3}$ $\frac{1}{2}$

Give your answer using inequality symbols.

....

Ordering decimals

3. Order the decimals from least to greatest: 1.7 0.07 1.07 0.17

....

4. Order the decimals from greatest to least: 5.90 0.509 0.95 1.59

....

Ordering fractions and decimals

5. Order the following from least to greatest: $\frac{6}{9}$ 0.6 $\frac{17}{6}$ 1.06

....

6. Order the following from greatest to least: 0.26 $\frac{2}{6}$ $\frac{18}{6}$ 2.6

....

ORGANISE 1

Estimating calculations by rounding and limits of accuracy

Estimating calculations, including in real-life situations

Estimating is rounding **before** doing the calculation rather than after.

Imagine you are at an ice cream van and want to make sure you have enough cash for your order. Instead of adding up each item's exact price, you can round and estimate instead.

For two ice lollies, you could round each to £3, then 2 × £3 = £6. This is an **overestimate** – it is more than the actual price.

You will often need to estimate to the nearest power of 10 (e.g. 10, 100, or 1000), to 1 s.f., or to the nearest measurement.

$$\frac{(21.7 \times 11.5) + 9.8}{10.1} = ?$$

a) **Estimate the answer to the calculation by rounding each number to 1 s.f.**

21.7 is 20 to 1 s.f. 11.5 is 10 to 1 s.f.
9.8 is 10 to 1 s.f. 10.1 is 10 to 1 s.f.

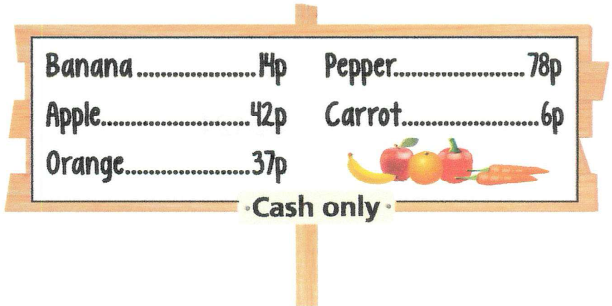
$$\frac{(21.7 \times 11.5) + 9.8}{10.1} \approx \frac{(20 \times 10) + 10}{10} \approx \frac{210}{10} = 21$$

b) **Calculate the actual answer.**

$$\frac{(21.7 \times 11.5) + 9.8}{10.1} = 25.68 \text{ to 2 d.p.}$$

c) **Is the estimate an overestimate or an underestimate?**

It is an underestimate as 21 is less than 25.68



a) **Kian wants to buy 3 apples, 2 bananas and 4 carrots. By rounding to the nearest 5p, estimate the total.**

42p apple rounded to the nearest 5p is 40p.
14p banana rounded to the nearest 5p is 15p.
6p carrot rounded to the nearest 5p is 5p.

(40p × 3) + (15p × 2) + (5p × 4)

= 120p + 30p + 20p = 170p = £1.70

b) **Find the actual total.**

(42p × 3) + (14p × 2) + (6p × 4)

= 126p + 28p + 24p = 178p = £1.78

c) **Is the estimate an overestimate or an underestimate?**

It is an underestimate.

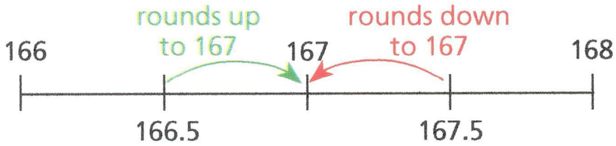
It is less than the actual value as the prices of the apples and carrots have been rounded down by more than the bananas have been rounded up.

Accuracy

Nothing can be measured exactly. It is measured to a certain degree of accuracy. Even if the degree of accuracy is very small, it is not an exact measurement.

The degree of accuracy can be inferred by the way the measurement is written. For example, a measurement of 167 cm was recorded to the nearest cm while a measurement of 1.2 cm was recorded to the nearest tenth of a cm, or mm.

A measurement can also be expressed using **error intervals** to show the possible values it could be. A table measured as 167 cm won't be **exactly** 167 cm.



Numbers greater than 166.5 round to 167.

166.5 also rounds to 167, so use an 'or equal to' symbol, ≤. This is the **lower bound**, i.e. 166.5 is the absolute smallest the actual measurement could be in order to be rounded to 167.

Numbers less than 167.5 also round to 167.

However, 167.5 itself rounds to 168, so use a strictly 'less than' symbol, <. This is the **upper bound**, as it means all numbers **up to** 167.5.

To write the bounds in error interval notation:

$166.5 \text{ cm} \leq \text{length of table} < 167.5 \text{ cm}$

A quick way to find the bounds is to divide the degree of accuracy by 2. Then subtract that from the measurement to find the lower bound and add it to the measurement to find the upper bound.

RETRIEVE 1

Estimating calculations by rounding and limits of accuracy

Estimating calculations, including in real-life situations

1 Estimate the answer to the calculation by rounding to the given amount. Before calculating, decide whether rounding will give an overestimate or an underestimate. Give your estimate as a fraction if appropriate.

$$108.3 \div 6.24 =$$

a) **i)** Estimate the calculation by rounding to 1 significant figure. ....

ii) Will this be an overestimate or an underestimate? ....

b) **i)** Estimate the calculation by rounding to the nearest integer. ....

ii) Will this be an overestimate or an underestimate? ....

c) Use a calculator to find the actual value of the calculation. ....

2 Sophia orders two lattes, one hot chocolate and three teas for her friends. The prices are shown.

COFFEE CORNER	
Latte	£3.97
Hot chocolate	£2.95
Tea	£3.17
Flavoured syrup	£0.23

a) **i)** Estimate the total cost of Sophia's order by rounding to the nearest integer. ....

ii) Will this be an overestimate or an underestimate? ....

b) Use a calculator to find the actual cost of her order. ....

Accuracy

3 Write these measurements using error interval notation. Each is measured to the nearest unit.

a) The height of a jug measured to be 32 cm ....

b) The volume of milk in a glass measured to be 107 ml ....

c) The distance from London to Boston measured as 5264 km ....

ORGANISE

2 Addition and subtraction

Adding and subtracting positive and negative integers

Addition is the process of combining two or more values.

Subtraction is finding the difference between values.

> **Addition is commutative**, so $a + b = b + a$.
> For example, 2 + 3 = 5 and 3 + 2 = 5

A positive number is greater than zero. A negative number is less than zero.

Adding a positive number increases a value:

8 + **2** = 10 8 + **1** = 9

Adding zero does not change a number's value:

8 + **0** = 8

Adding a negative number decreases a value:

8 + **−1** = 7 8 + **−2** = 6

Subtracting a positive number decreases a value:

9 − **2** = 7 9 − **1** = 8

Subtracting zero does not change a number's value:

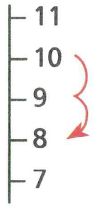
9 − **0** = 9

Subtracting a negative number increases a value:

9 − **−1** = 10 9 − **−2** = 11

Work out:

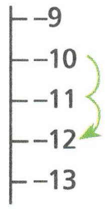
a) 10 + −2



The value of 10 decreases by 2 so the result is closer to zero.

10 + −2 = 8

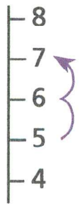
b) −10 + −2



The value of −10 decreases by 2 so the result is further away from zero.

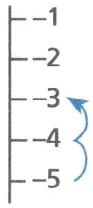
−10 + −2 = −12

c) 5 − −2



5 − −2 = 7

d) −5 − −2



−5 − −2 = −3

Adding and subtracting decimals

When adding or subtracting decimal numbers using the column method, align the decimals.

> The decimal points must be aligned before adding or subtracting. Use 0 as a placeholder value to make sure that the numbers that are in line have the same place value.

Calculate:

a) 2.043 + 7.238

```
  2 . 0 4 3
+ 7 . 2 3 8
-----------
  9 . 2 8 1
        1
```

b) 9.24 − 2.32

```
  ⁸9̸ . ¹2 4
−  2 .  3 2
-----------
   6 .  9 2
```

c) 1.6 + 3.94

```
  1 . 6 0
+ 3 . 9 4
---------
  5 . 5 4
  1
```

Use a zero as a placeholder.

d) 6.5 − 4.21

```
  6 . ⁴5̸ ¹0
− 4 .  2  1
-----------
  2 .  2  9
```

e) 76 + 9.17

```
  7 6 . 0 0
+   9 . 1 7
-----------
  8 5 . 1 7
  1
```

f) 23 − 2.31

```
  2 ²3̸ . ⁹1̸0 ¹0
−    2 .   3  1
---------------
  2  0 .   6  9
```

RETRIEVE

2 Addition and subtraction

Adding and subtracting positive and negative integers

1 Work out:

a) 4 + –1 ....

b) 13 + –5 ....

c) 25 + –11 ....

d) 1 + –17 ....

2 Work out:

a) –9 + –6 ....

b) –15 + –4 ....

c) –38 + –13 ....

d) –4 + –20 ....

3 Work out:

a) 15 – –2 ....

b) 61 – –12 ....

c) 23 – –23 ....

d) 45 – –15 ....

4 Work out:

a) –12 – –8 ....

b) –7 – –22 ....

c) –3 – –31 ....

d) –19 – –1 ....

Adding and subtracting decimals

5 Work out using the column method:

a) 6.46 + 4.81

b) 7.8 + 3.2

c) 7.098 + 5.472

d) 0.602 + 1.086

e) 7.4 + 5.09

f) 9.452 + 8.6

g) 5 + 0.81

h) 20 + 5.314

6 Work out using the column method:

a) 8.25 – 6.13

b) 7.479 – 3.264

c) 6.4 – 2.9

d) 2.32 – 1.93

e) 5.6 – 2.11

f) 3.243 – 1.4

g) 13 – 5.91

h) 7 – 4.3

ORGANISE

2 Multiplication and division

Multiplying and dividing with positive and negative integers

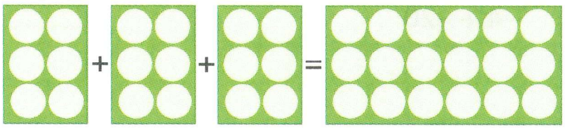
When multiplying or dividing a **positive** number by a **negative** number, the result is **negative**.

When multiplying or dividing a **negative** number by a **negative** number, the result is **positive**.

$5 \times 1 = 5$	$-2 \times 1 = -2$
$5 \times 0 = 0$	$-2 \times 0 = 0$
$5 \times -1 = -5$	$-2 \times -1 = 2$

Multiplication is commutative, so $a \times b = b \times a$.
For example, $4 \times 3 = 12$ and $3 \times 4 = 12$

a) Calculate 6×3



$6 \times 3 = 18$

When multiplying a positive number by a positive number, the result is positive ($+ \times + = +$).
6×3 is the same as adding 3 lots of 6.

b) Calculate -8×3

$-8 \times 3 = -24$ $\quad - \times + = -$

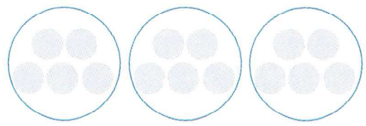
c) Calculate 8×-3

$8 \times -3 = -24$ $\quad + \times - = -$

d) Calculate -7×-4

$-7 \times -4 = 28$ $\quad - \times - = +$

e) Calculate $15 \div 5$



There are 15 dots with 5 dots in each group.
There are 3 groups of dots.

$15 \div 5 = 3$

f) Calculate $-20 \div 4$

$-20 \div 4 = -5$ $\quad - \div + = -$

g) Calculate $20 \div -4$

$20 \div -4 = -5$ $\quad + \div - = -$

h) Calculate $-28 \div -7$

$-28 \div -7 = 4$ $\quad - \div - = +$

Multiplying and dividing with decimals

When multiplying a number by another number that is less than 1, the value decreases.

Work out 0.09×0.7

0.09×0.7

$\times 100$ ↓ ↓ $\times 10$

$9 \times 7 = 63$

↓ $\div 1000$

$= 0.063$

Multiply both numbers so they are whole numbers.

$100 \times 10 = 1000$, so divide 63 by 1000 to get 0.063

A **divisor** is a number that divides another number and may leave a remainder.

A **dividend** is the number that is being divided.

dividend		divisor		quotient
20	÷	4	=	5

A **quotient** is the result of dividing one number by another.

When dividing with decimals, multiply each number by 10 until the divisor is a whole number.

a) Work out $1.8 \div 0.2$

$1.8 \div 0.2$

$\times 10$ ↓ ↓ $\times 10$

$18 \div 2 = 9$

$1.8 \div 0.2 = 9$

2 goes into 18 nine times.

2	2	2	2	2	2	2	2	2

0.2 also goes into 1.8 nine times.

0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2

The calculations are equivalent.

b) Work out $1.36 \div 0.4$

$1.36 \div 0.4$

$\times 10$ ↓ ↓ $\times 10$

$13.6 \div 4$

```
   0 3 . 4
4 | 1 ¹3 . ¹6
```

Ensure that the decimal points are lined up.

So, $1.36 \div 0.4 = 3.4$

RETRIEVE

2 Multiplication and division

Multiplying and dividing with positive and negative integers

1 Work out:

a) 7×8 ....
b) 9×6 ....
c) -6×2 ....
d) -5×10 ....

2 Work out:

a) 7×-2 ....
b) 4×-8 ....
c) -2×-3 ....
d) -12×-8 ....

3 Work out:

a) $12 \div 2$ ....
b) $18 \div 9$ ....
c) $-49 \div 7$ ....
d) $-63 \div 7$ ....

4 Work out:

a) $108 \div -12$ ....
b) $30 \div -6$ ....
c) $-90 \div -9$ ....
d) $-56 \div -7$ ....

Multiplying and dividing with decimals

5 Work out:

a) 8×0.3 ....
b) 0.5×0.7 ....
c) 0.03×0.9 ....
d) 32×0.1 ....
e) 0.9×0.6 ....
f) 0.11×0.4 ....

6 Work out:

a) $8 \div 0.4$ ....
b) $12 \div 0.6$ ....
c) $3.2 \div 0.8$ ....
d) $8.8 \div 0.11$ ....
e) $6.4 \div 0.08$ ....
f) $2.14 \div 0.2$ ....

ORGANISE

2 Order of operations

Calculating using the order of operations

The **order of operations** is the sequence in which mathematical equations with multiple operations should be solved. Without having this rule, equations with multiple operations could give different answers.

This order is called **BIDMAS** or **BODMAS**.

Brackets
Indices / **O**rder (powers and square roots)
Division
Multiplication
Addition
Subtraction

From left to right, start with division and multiplication and continue with addition and subtraction.

Work out:

a) $8 + 3 \times 2$

$8 + 3 \times 2$
$= 8 + 6$
$= 14$

b) $7 - 15 \div 3$

$7 - 15 \div 3$
$= 7 - 5$
$= 2$

If a calculation has addition and subtraction in it, perform them from left to right. It doesn't matter which order they are in.

Work out:

a) $9 + 7 \times 3 - 10$

$9 + 7 \times 3 - 10$
$= 9 + 21 - 10$
$= 20$

b) $6 - 2 \div 1 + 4$

$6 - 2 \div 1 + 4$
$= 6 - 2 + 4$
$= 4 + 4$
$= 8$

If a calculation has division and multiplication in it, perform them from left to right. It doesn't matter which order they are in.

Work out:

a) $5 + 8 \times 3 \div 2$

$5 + 8 \times 3 \div 2$
$= 5 + 24 \div 2$
$= 5 + 12$
$= 17$

b) $10 - 6 \div 2 \times 4$

$10 - 6 \div 2 \times 4$
$= 10 - 3 \times 4$
$= 10 - 12$
$= -2$

If the calculation includes brackets, work out that part first. It doesn't matter if the brackets contain a division, multiplication, addition or subtraction.

Work out:

a) $36 \div (9 - 3)$

$36 \div (9 - 3)$
$= 36 \div 6$
$= 6$

b) $8 \times 2 - (4 + 3)$

$8 \times 2 - (4 + 3)$
$= 8 \times 2 - 7$
$= 16 - 7$
$= 9$

If the calculation includes indices (powers), work out this value after any brackets, and before any multiplication, division, addition or subtraction.

Work out:

a) $3 \times 2^2 + (5 - 3)$

$3 \times 2^2 + (5 - 3)$
$= 3 \times 2^2 + 2$
$= 3 \times 4 + 2$
$= 12 + 2$
$= 14$

b) $8 + (4 \times 3^3 - 5)$

$8 + (4 \times 3^3 - 5)$
$= 8 + (4 \times 27 - 5)$
$= 8 + (108 - 5)$
$= 8 + 103$
$= 111$

Using brackets in calculations

a) **Put brackets in the calculation to make the result true.** $2 \times 3 + 1 = 8$

Try some different ideas: $(2 \times 3) + 1 = 7$

$2 \times (3 + 1) = 8$ ✔

b) **Put brackets in the calculation to make the result true.** $3 \times 2 + 4 + 5 - 3 = 30$

Try some different ideas: $3 \times 2 + (4 + 5) - 3 = 12$

$3 \times (2 + 4 + 5 - 3) = 24$

$3 \times (2 + 4 + 5) - 3 = 30$ ✔

RETRIEVE

2 Order of operations

Calculating using the order of operations

1 Calculate:

a) $4 + 6 \times 7$ ....

b) $10 - 4 \div 2$ ....

c) $12 \times 6 - 20$ ....

d) $30 \div 10 + 5$ ....

2 Calculate:

a) $8 + 9 \times 2 - 13$ ....

b) $18 - 45 \div 5 + 7$ ....

c) $1 - 7 \times 2 + 6$ ....

d) $16 + 12 \div 3 - 10$ ....

3 Calculate:

a) $4 + 6 \times 8 \div 2$ ....

b) $9 - 14 \div 2 \times 10$ ....

c) $12 + 8 \times 3 \div 6$ ....

d) $6 - 16 \div 4 \times 7$ ....

4 Calculate:

a) $18 \div (2 + 4)$ ....

b) $5 \times 2 - (6 - 1)$ ....

c) $(4 \div 2) \times 9 + 1$ ....

d) $2 + (3 \times 7 + 4) \div 5$ ....

5 Calculate:

a) $7 + 10^2 \div 5$ ....

b) $32 \div 2^3 - (3 + 2)$ ....

c) $10 - (6 \times 3^2 - 4)$ ....

Using brackets in calculations

6 Put brackets in each calculation to make the result true.

a) $6 + 5 \times 8 = 88$

b) $12 \div 2 + 4 = 2$

c) $4 - 2 + 8 = -6$

d) $12 \div 2 + 1 + 3 \times 4 = 8$

e) $4 + 2 \times 5 - 12 = 18$

f) $9 - 5 + 10 \div 2 + 3 = 2$

ORGANISE 6

Measures of central tendency and spread

Measures of central tendency

A measure of central tendency is a single value that attempts to describe a set of data by identifying its central position. **Mean**, **median** and **mode** are measures of central tendency:

- The mean is an **arithmetic average** found by adding together the values and dividing the total by the number of values in the data set.
- The median is the **middle value** when the data is ordered.
- The mode is the **most common** value in the data set.

The number of goals that were scored in 7 football matches are recorded. Find the mean number of goals scored.

1 3 4 6 6 7 8

To determine the mean, divide the total sum by the total number of items in the data set.

1 + 3 + 4 + 6 + 6 + 7 + 8 = 35

35 ÷ 7 = 5

The mean is 5 goals per game.

Find the median of this data set showing the number of goals scored in 7 football matches.

1 6 7 4 6 8 3

To find the median, put the numbers in **ascending** or **descending** order, and find the **middle value** by crossing out the numbers at each end of the data set.

~~1~~ ~~3~~ ~~4~~ **6** ~~6~~ ~~7~~ ~~8~~

The median is 6 goals.

Find the median of the data set.

9 9 9 10 10 14 15 16 19 20

To find the median of a data set that has an even number of values, find the two middle numbers, add the two numbers together and divide the total by 2.

~~9~~ ~~9~~ ~~9~~ ~~10~~ **10 14** ~~15~~ ~~16~~ ~~19~~ ~~20~~

10 + 14 = 24

24 ÷ 2 = 12

Median = 12

Find the mode of this data set showing the number of goals scored in 7 football matches.

1 3 4 6 6 7 8

To find the mode, look for the value that occurs the most often (i.e. the value that repeats more than any other value).

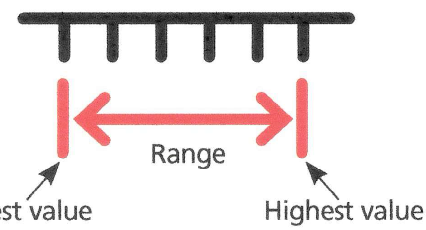
6 is the only value that is repeated in this data set.

The mode is 6 goals.

It is possible to have more than one mode or no mode at all.

Measuring the spread of data

The range measures the **spread** of the data set. To find the range, work out the difference between the highest and lowest values in the data set.



Find the range of this data set showing the number of goals scored in 7 football matches.

1 3 4 6 6 7 8

Range = highest value – lowest value

Range = 8 – 1

Range = 7 goals

RETRIEVE 6

Measures of central tendency and spread

Measures of central tendency

1 The number of hours that 5 students spent studying in one week was recorded as follows:

10 5 3 5 7

a) Work out the mean.

....

b) Work out the median.

....

c) Work out the mode.

....

2 The shoe sizes of 8 students were recorded as follows:

3 3 5 4 3 4 7 3

a) Work out the mean.

....

b) Work out the median.

....

c) Work out the mode.

....

Measuring the spread of data

3 The number of hours that 5 students spent studying in one week was recorded as follows:

10 5 1 5 7

Work out the range.

....

4 The shoe sizes of 8 students were recorded as follows:

3 3 5 4 3 4 7 3

Work out the range.

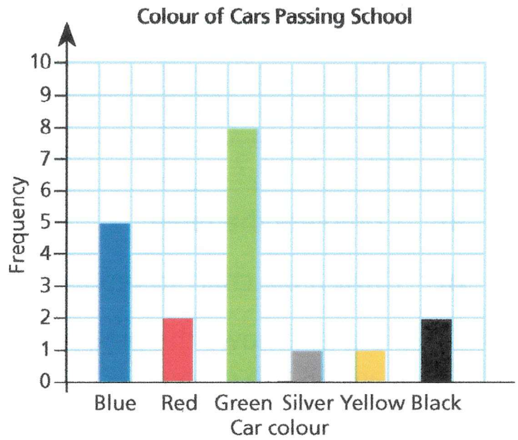
....

ORGANISE

6 Interpreting statistical representations

Interpreting statistical measures and representations

The bar chart shows information about the colour of cars passing a school over a 10-minute period.



a) How many blue cars drove past?

Read off the frequency from the y-axis of the blue car category.

5 blue cars drove past.

b) How many more green cars than silver cars drove past?

Find how many cars of each colour drove past and find the difference between them by **subtracting**.

7 more green cars than silver cars drove past.

c) What colour of car drove past the most?

Green cars had the highest frequency, so green cars drove past most often. This is the **mode**.

d) How many cars drove past in total?

19 cars drove past in total. To find the total, add together the frequencies of each colour of car.

Choosing an appropriate statistical measure

When choosing an appropriate statistical measure, consider the advantages and disadvantages of each.

Measure of central tendency	Advantage	Disadvantage
Mean	Takes account of every value	Affected by very large or very small values
Median	Unaffected by very large or very small values	May not be an actual number in the data set
Mode	Only average that can be used for qualitative data	There may be more than one mode or no mode

The salaries of five employees in a company are:

£23000 £25000 £30000 £33000 £120000

Which statistical measure should be used to represent the average?

The **median** should be used because it is unaffected by very large or very small values. £120 000 is a very large value compared to the others.

A shop wants to find the average size of shoe sold to help it to decide which size it needs most stock of. The sizes sold on a particular day are:

3, 4, 4, 5, 6, 7, 8, 8, 9, 9, 9, 9, 9, 10, 10, 11, 12, 14

Which statistical measure should be used for the average?

The **mode** (9) should be used because it shows which shoe size is in greatest demand.

The heights of some Year 8 students, in metres, are:

1.72, 1.54, 1.57, 1.50, 1.55, 1.46, 1.63, 1.61

Which statistical measure should be used for the average height?

The **mean** should be used because it takes account of every value and there are few very large or very small values in the data set.

The range is not a measure of central tendency. It measures the spread of the data set.

The daily temperatures across March last year for two cities are summarised in this table.

City	Mean maximum daily temperature	Range of maximum daily temperature
A	22°C	6°C
B	22°C	13°C

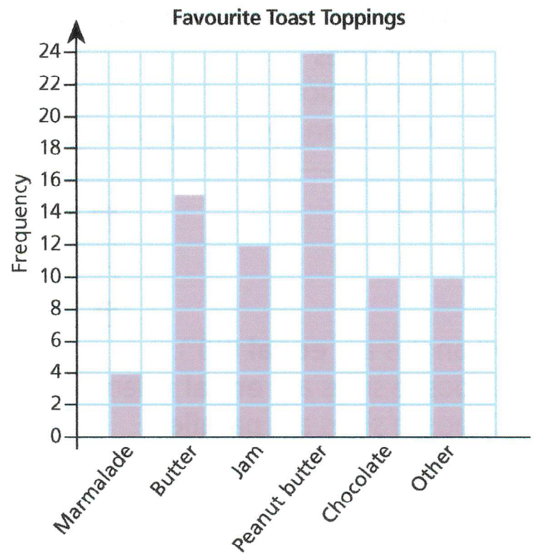
Which city should you choose if you want to enjoy high temperatures? Justify your answer.

City A should be the city you choose to visit. Both cities have the same mean, but city A has the smaller range. This means that the temperature is more consistently high in city A compared to city B.

Interpreting statistical representations

Interpreting statistical measures and representations

1 The bar chart shows the preferred toast toppings of a group of students.



a) How many students prefer chocolate on their toast? ....

b) How many students prefer marmalade on their toast? ....

c) How many more students prefer butter on their toast than jam? ....

d) What is the mode of this data? ....

e) How many students took part in the survey? ....

Choosing an appropriate statistical measure

2 A boutique had daily sales of **£326, £540, £385, £450, £2435, £459** and **£493** over the last week.

Is the mean or median a more reliable measure of central tendency? Justify your answer.

....

....

3 The favourite subjects of some students were collected and recorded:

French, PE, Maths, Science, Maths, ICT, Maths, DT, Maths

Which measure of central tendency can best be used to describe this data? Justify your answer.

....

....

4 The daily temperatures across March last year for two cities are summarised in this table.

City	Mean maximum daily temperature	Range of maximum daily temperature
C	12°C	8°C
D	21°C	8°C

Which city should you choose to visit if you want to enjoy high temperatures? Justify your answer.

....

....

6 Frequency tables

Data types and frequency tables

Data is a set of information that can be analysed. Data can be collected by using tables, which makes it easier to read and understand.

Qualitative data is data that describes something (e.g. colour of hair; colour of eyes).

Quantitative data is data that is numerical (e.g. height; shoe size).

There are two types of quantitative data:

- **Discrete** data can only take certain values (e.g. the number of people in a room; the number of pages in a book).
- **Continuous** data can take any value (e.g. the time taken to run a race; the mass of an object).

A **grouped** frequency table is used to organise and simplify a large set of data into smaller groups. A frequency table containing **ungrouped** data has data that has not been put into categories or simplified.

The heights of 16 students were recorded in centimetres. Organise the heights into a grouped frequency table.

159 140 145 149 150 134 144 151
155 144 157 141 158 146 132 160

Height, h cm	Frequency
$130 < h \leqslant 140$	3
$140 < h \leqslant 150$	7
$150 < h \leqslant 160$	6
	Total = 16

The line underneath the 'less than' symbols means 'less than or equal to'. Notice that a height of 140 cm is included in the first group.

The test scores of 21 students were recorded. Organise the test scores in an ungrouped frequency table.

6 10 10 9 7 8 7 9 9 5 6 8 7
9 8 10 9 7 9 10 5

Test score	Tally	Frequency
5	||	2
6	||	2
7	||||	4
8	|||	3
9	~~||||~~ |	6
10	||||	4
		Total = 21

The **mean**, **median**, **mode** and **range** can be calculated from a frequency table.

Mean $= \dfrac{\text{sum of all values}}{\text{number of values}}$

$= \dfrac{(5 \times 2) + (6 \times 2) + (7 \times 4) + (8 \times 3) + (9 \times 6) + (10 \times 4)}{21}$

$= 8$

Median $= \dfrac{21 + 1}{2} = 11\text{th value}$

$= 8$

If the total frequency is odd, find the median by calculating $(n + 1) \div 2$, where n is the number of values in the data set and the result is the position of the middle number.

The **mode** is the most common value. This is the test score with the highest frequency.

The **mode** is 9.

Range = highest score – lowest score

= 10 – 5 = 5

Two-way frequency tables

A two-way frequency table is used to display data from two different categories.

Remember to include the totals for both categories in a two-way frequency table.

Primary and secondary students were asked if they eat breakfast in the mornings before school.
38 students in primary had breakfast. 12 students in primary did not have breakfast.
22 students in secondary had breakfast. 28 students in secondary did not have breakfast.
Record these results in a two-way frequency table.

	Breakfast	No breakfast	Total
Primary	38	12	50
Secondary	22	28	50
Total	60	40	100

RETRIEVE

6 Frequency tables

Data types and frequency tables

1 Here is a list of the colours of cars in a car park:

green, blue, green, red, red, green, yellow, yellow, blue, red, green, yellow, yellow, yellow, red, green, blue, red, red, yellow, green, yellow, green, blue, yellow, blue, blue, red, green, blue, yellow

a) Is this data quantitative or qualitative?

....

b) Display this data in a frequency table.

Colour	Tally	Frequency
		Total =

2 Here are the speeds of 20 vehicles, to the nearest mph:

45	**65**	**72**	**48**	**74**	**67**	**68**
46	**56**	**53**	**58**	**68**	**72**	**64**
62	**49**	**72**	**55**	**67**	**51**	

Complete the grouped frequency table.

Speed, x mph	Tally	Frequency
$40 < x \leqslant 50$		
$50 < x \leqslant 60$		
$60 < x \leqslant 70$		
$70 < x \leqslant 80$		

3 Here are the temperatures at midday for 7 days (in °C):

23, 24, 24, 23, 24, 25, 21

a) Display this data in an ungrouped frequency table.

b) What is the mean of this data? ....

c) What is the median of this data? ....

d) What is the mode of this data? ....

e) What is the range of this data? ....

Temperature	Tally	Frequency
21°C		
22°C		
23°C		
24°C		
25°C		

Two-way frequency tables

4 Students were asked what they ate for breakfast and lunch.

26 students who had porridge for breakfast had a sandwich for lunch.
14 students who had toast for breakfast had a sandwich for lunch.
10 students who had porridge for breakfast had a hot meal for lunch.
20 students who had toast for breakfast had a hot meal for lunch.

Complete the two-way frequency table.

	Sandwich	Hot meal	Total
Porridge			
Toast			
Total			