

Name _____

Date _____

Unit 16 · Interpreting and discussing results — teaching slides

30 slides, formatted for printing.

16.1 Mode, median and range

Three words, three jobs

- Mode: the most common value.
- Median: the middle value, in order.
- Range: largest minus smallest.
- The first two are averages; the range is a measure of spread.

3, 7, 7, 2, 9, 5, 7

mode 7

median 7

range $9 - 2 = 7$

Finding the mode

- Count how often each value appears.
- The one with the highest count is the mode.
- If nothing repeats, there is no mode. Say so.
- It is the only average that works for categories.

4, 8, 6, 8, 10, 2, 8

8 appears three times

mode = 8

Finding the median

- Put the values in order. Always.
- Cross off from each end until one is left.
- With n values it is in position $(n + 1) \div 2$.
- Not sorting first is the commonest error in this topic.

3, 7, 7, 2, 9, 5, 7

→ 2, 3, 5, 7, 7, 7, 9

7 values, so the 4th

median = 7

An even number of values

- Now no single value is in the middle.
- Take the middle two.
- The median is halfway between them.
- So it may be a number that is not in the data at all.

```
4, 6, 6, 8, 9, 11
middle two: 6 and 8
6 + 8 = 14, then 14 ÷ 2 = 7
median = 7
```

The range

- Largest minus smallest.
- It measures spread, not an average.
- A big range means the values are far apart.
- It looks at only two values, so one odd reading changes it a lot.

```
180, 200, 210, 220, 240, 950
950 - 180 = 770
one house has stretched it
```

What each one is for

- Mode: what is most popular. Shoe sizes to restock.
- Median: a typical value that ignores extremes.
- Range: how consistent the data is.
- A good summary quotes an average **and** a spread.

```
shoe sizes → mode
house prices → median
consistency → range
```

16.2 The mean

What the mean is

- Add every value.
- Divide by how many there are.
- That is the mean.
- It shares the total out equally between them.

```
4, 6, 8, 10, 12
total 40
40 ÷ 5 = 8
mean = 8
```

Sharing out equally

- Five people have 4, 6, 8, 10 and 12 sweets.
- Put them all in one pile: 40 sweets.
- Share them out equally: 8 each.
- That is exactly what the arithmetic did.

before: 4, 6, 8, 10, 12
 after: 8, 8, 8, 8, 8
 same total, 40

Working backwards

- Mean = total $\div$ how many.
- So total = mean $\times$ how many.
- That single rearrangement answers most mean questions.
- Find the total first, then do whatever the question asks.

5 numbers, mean 12
 total $12 \times 5 = 60$
 four of them add to 48
 the fifth is $60 - 48 = 12$

The mean from a frequency table

- The frequency says how many times to count each value.
- So multiply value by frequency for each row.
- Add those products to get the grand total.
- Divide by the total frequency, not by the number of rows.

$0 \times 4 = 0$, $1 \times 7 = 7$
 $2 \times 5 = 10$, $3 \times 4 = 12$
 total 29 pets, 20 people
 $29 \div 20 = 1.45$

A mean need not be a real value

- The mean number of pets might be 1.6.
- Nobody owns 1.6 pets.
- That does not make the answer wrong.
- It is a summary of the set, not a member of it.

1.6 pets per person
 2.4 children per family
 both perfectly sensible means

Its weakness

- The mean uses every single value.
- So one very large or very small reading pulls it.
- The median hardly moves at all.
- Which one to quote is the next section's question.

180, 200, 210, 220, 240, 950
 mean 333
 median 215
 which describes these houses better?

16.3 Choosing the right average

Three averages, one question

- Mode, median and mean are all averages.
- They answer slightly different questions.
- Choosing well is a skill in its own right.
- And the reason for the choice is what gets the mark.

most popular? → mode
 typical, with an odd value? → median
 all values matter? → mean

When the mode is right

- Use it for words and categories.
- You cannot add up colours, so you cannot mean them.
- Use it for “which should I stock most of”.
- A mean shoe size of 7.3 helps nobody.

favourite colour
 shoe sizes sold
 most common pizza topping

When the median is right

- Use it when one value is far from the rest.
- House prices with one mansion on the street.
- Salaries with one very high earner.
- The median simply steps over the extreme value.

180, 200, 210, 220, 240, 950
 mean 333 – more than five of the six houses
 median 215 – describes the street

When the mean is right

- Use it when the values sit close together.
- Nothing distorts it, and it uses all the information.
- Test scores, parcel masses, daily temperatures.
- It is the average most often wanted, but not always.

12, 15, 18, 11, 14
total 70
mean 14 – a fair summary

Outliers

- An outlier sits a long way from the rest.
- It may be genuine, or it may be a recording error.
- Either way, notice it and comment on it.
- Never delete one quietly and say nothing.

4, 5, 6, 5, 40
with 40: mean 12
without 40: mean 5
median 5 either way

Always give the spread too

- An average alone is half an answer.
- Two classes can share a mean and be nothing alike.
- The range says how consistent the data is.
- Average and range together make a real summary.

class A: mean 12, range 4
class B: mean 12, range 20
same average, very different classes

16.4 Reading charts and graphs

Bar charts

- Each bar is one category.
- Its height is read against the vertical scale.
- Comparing heights compares categories directly.
- The scale must be labelled, and should start at zero.

Mon 12, Tue 18, Wed 9
Thu 15, Fri 21
highest Friday, lowest Wednesday
range $21 - 9 = 12$

Line graphs

- Used when the horizontal axis is time.
- The points are joined to show the trend.
- Rising line: the quantity is going up.
- One dip in a rising line is still worth noticing.

weeks 1–6: 4, 7, 9, 8, 12, 15
generally rising
but week 3 to 4 fell

Pie charts show shares

- The whole circle is the whole data set.
- Each sector is that category's share.
- The angles must add to 360° .
- The chart shows proportions, not totals.

walk 10, bus 5, car 3, cycle 2
20 people in all
sectors 180° , 90° , 54° , 36°
total 360°

The one pie-chart calculation

- Work out what one person is worth: $360 \div N$ degrees.
- Multiply by the frequency to get an angle.
- Divide an angle by it to get a frequency.
- That single number does all the work.

$N = 20$ people
one person = $360 \div 20 = 18^\circ$
5 people = $5 \times 18 = 90^\circ$
 $144^\circ = 144 \div 18 = 8$ people

Percentages and angles

- A percentage of the whole is a percentage of 360° .
- 25% is a quarter turn, 90° .
- 50% is a half turn, 180° .
- Unit 10's percentage work doing statistics.

40% of 360 = 144°
25% of 360 = 90°
 $180^\circ = 50\%$

Misleading charts

- A vertical scale that does not start at zero exaggerates.
- Two charts with different scales cannot be compared by eye.
- A pie chart with no total hides how many were asked.
- Read the numbers. Do not trust the picture.

bars 95 and 100
scale from 90: one looks twice the other
the real difference is about 5%

16.5 Comparing data sets and drawing conclusions

Two numbers, not one

- Comparing data sets needs an average and a range.
- The average says what is typical.
- The range says how much it varies.
- Quote both, every time.

A: mean 13.7, range 4
B: mean 14.0, range 17
similar typical score
very different consistency

Writing the comparison

- A bare pair of numbers is not a comparison.
- Say what they mean in the context.
- Use the words “on average” and “more consistent”.
- Two sentences will usually earn both marks.

“On average the two classes score about the same.”
“But A's range is much smaller, so A is more consistent.”

Consistency

- A small range means the values are packed together.
- That is often what actually matters.
- A bottling machine wants consistency, not just the right average.
- So does a bus timetable, and a football team.

machine 1: 22–26 ml, range 4
machine 2: 18–30 ml, range 12
same mean, keep machine 1

Trends

- A trend is the general direction over time.
- One value against the trend does not end it.
- Look at the whole shape, not a single step.
- And a trend describes the past, not the future.

4, 7, 9, 8, 12, 15
one fall, week 3 to 4
the trend is still upward

How the data was collected

- A small sample gives an unreliable conclusion.
- A biased sample gives a wrong one.
- Asking gym-goers about exercise is biased.
- No arithmetic can repair a badly chosen sample.

28 learners out of 900 is 3%
and all from one class
small and possibly biased

Sources of variation

- Why did the readings differ?
- The weather, the time of day, who was asked.
- The measuring instrument, and who read it.
- Naming these is part of a proper conclusion.

"Rainfall was measured on only 3 days."
"Those days may not be typical of the year."