

Year 11 - Reasoning...

Multiplicative reasoning



What do I need to be able to do?

By the end of this unit you should be able to:

- Understand and use scale factors
- Understand direct and inverse proportion
- Calculate with pressure and density
- Complete ratio problems

Keywords

Scale factor: the multiplier of enlargement

Proportion: a comparison between two numbers

Direct proportion: as one variable is multiplied by a scale factor the other variable is multiplied by the same scale factor.

Inverse proportion: as one variable is multiplied by a scale factor the other is divided by the same scale factor.

Pressure = Force \div Area

Density = Mass \div Volume

Ratio: a ratio shows the relative size of two variables

Direct Proportion

As one variable changes the other changes at the same rate.



4 cans of pop = £2.40

$\times 0.5$ \leftarrow 4 cans of pop = £2.40
 \leftarrow 2 cans of pop = £1.20 \leftarrow $\times 50$

This multiplier is the same in the same way that this would be for ratio

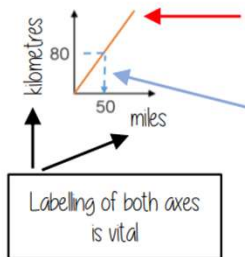
This is a multiplicative change

$\times 3$ \leftarrow 4 cans of pop = £2.40
 \leftarrow 12 cans of pop = £7.20 \leftarrow $\times 3$

Sometimes this is easiest if you work out how much one unit is worth first e.g. 1 can of pop = £0.60

Conversion Graphs

Compare two variables



This is always a straight line because as one variable increases so does the other at the same rate

To make conversions between units you need to find the point to compare - then find the associated point by using your graph. Using a ruler helps for accuracy. Showing your conversion lines help as a "check" for solutions

Inverse Proportion

As one variable is multiplied by a scale factor the other is divided by the same scale factor

Examples of inversely proportional relationships

Time taken to fill a pool and the number of taps running

Time taken to paint a room and the number of workers

T is inversely proportional to G. When T=2 then G=20

T	1	2	8
G	40	20	5

Annotations: $\div 2$ (from 1 to 2), $\times 4$ (from 2 to 8), $\times 2$ (from 20 to 40), $\div 4$ (from 20 to 5)

Direct and inverse proportion equations

g is directly proportional to h .

When $g = 120$, $h = 40$

- 1) Work out the constant of proportionality

$$g = kh$$

$$120 = 40k$$

$$k = \frac{120}{40} = 3$$

$$g = 3h$$

- 2) Work out the value of g when $h = 25$

$$g = 3h$$

$$g = 3 \times 25$$

$$g = 75$$

- 3) Work out the value of h when $g = 25$

$$g = 3h$$

$$25 = 3h$$

$$h = \frac{25}{3}$$

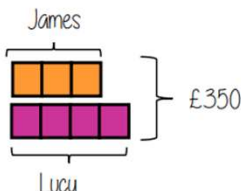
Sharing a whole into a given ratio



James and Lucy share £350 in the ratio 3:4. Work out how much each person earns

Model the Question

James: Lucy
3 : 4



$$£350 \div 7 = £50$$

\square = one part = £50

Find the value of one part

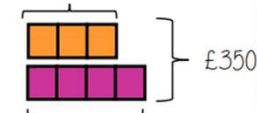
Whole: £350
7 parts to share between (3 James, 4 Lucy)

Put back into the question

James: Lucy

\leftarrow $\times 50$ 3 : 4 $\times 50$ \leftarrow
 \leftarrow £150 : £200 \leftarrow

$$\text{James} = 3 \times £50 = £150$$



$$\text{Lucy} = 4 \times £50 = £200$$

Finding a value given 1:n (or n:1)

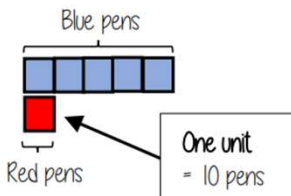


Inside a box are blue and red pens in the ratio 5:1. If there are 10 red pens how many blue pens are there?

Model the Question

Blue : Red
5 : 1

\square = one part = 10 pens

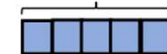


Put back into the question

Blue : Red

\leftarrow $\times 10$ 5 : 1 $\times 10$ \leftarrow
 \leftarrow 50 : 10 \leftarrow

$$\text{Blue pens} = 5 \times 10 = 50 \text{ pens}$$



$$\text{Red pens} = 1 \times 10 = 10 \text{ pens}$$

There are 50 Blue Pens



g is inversely proportional to h .

When $g = 12$, $h = 4$

- 1) Work out the constant of proportionality

$$g = \frac{k}{h}$$

$$12 = \frac{k}{4}$$

$$k = 12 \times 4 = 48$$

$$g = \frac{48}{h}$$

- 2) Work out the value of g when $h = 3$

$$g = \frac{48}{h}$$

$$g = \frac{48}{3}$$

$$g = 16$$

- 3) Work out the value of h when $g = 6$

$$g = \frac{48}{h}$$

$$6 = \frac{48}{h}$$

$$h = \frac{48}{6}$$

$$h = 8$$

Year 11 - Reasoning...

Geometric reasoning

What do I need to be able to do?

By the end of this unit you should be able to:

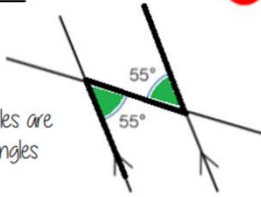
- Understand angles facts
- Calculate exterior/interior angles of polygons
- Proving geometric facts
- Problem solving with angles
- **Circle Theorems (H)**

Keywords

- Angle:** the amount of turn between two lines around their common point
- Parallel:** straight lines always the same distance apart and never touch. They have the same gradient
- Bearing:** the angle in degrees measured clockwise from North. Given as 3 digits
- Interior angles:** angles inside the shape
- Exterior angles:** angles outside the shape on a straight line. Int + ext = 180
- Polygon:** A 2D shape made with straight lines
- Regular:** when a shape is regular all sides are the same length and all angles are the same
- Irregular:** shape with sides of different lengths and angles of different sizes
- Sum:** total, add all the angles together

Alternate angles

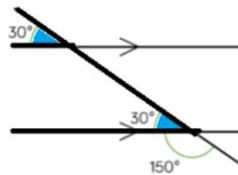
Because alternate angles are equal the highlighted angles are the same size



R

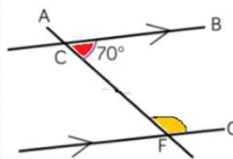
Corresponding angles

Because corresponding angles are equal the highlighted angles are the same size



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Co-interior angles



Because co-interior angles have a sum of 180° the highlighted angle is 110°

As angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

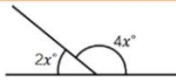
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Solving angle problems

Angles on a straight line



Link angle facts to algebra



Form an equation

$$2x + 4x = 180^\circ$$

State the reason

The sum of angles on a straight line is 180°

Solve

$$2x + 4x = 180^\circ$$

$$6x = 180^\circ$$

$$x = 30^\circ$$

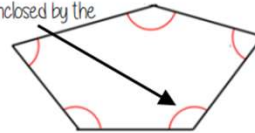
Vertically opposite angles
Equal

Angles around a point
360°

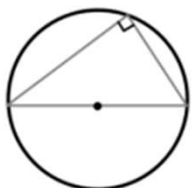
Triangles
Sum of angles is 180°

Isosceles have the same base angles

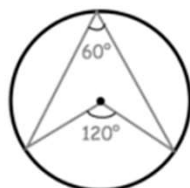
Interior Angles
The angles enclosed by the polygon



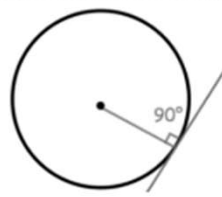
$$(\text{number of sides} - 2) \times 180$$



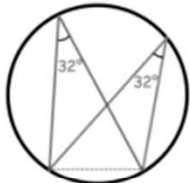
The angle in a semi-circle is 90°



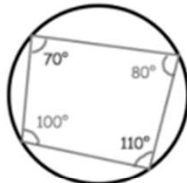
The angle in the centre is double the angle at the circumference



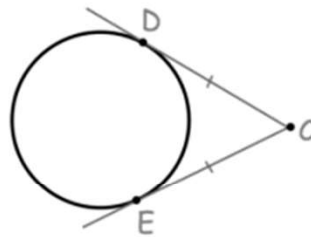
A radius and a tangent meet at 90°



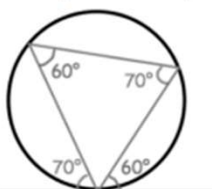
Angles in the same segment are equal



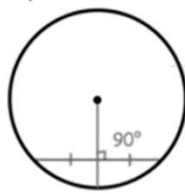
Opposite angles in a cyclic quadrilateral add up to 180°



Tangents to a point are the same length



The Alternate Segment Theorem



The perpendicular bisector of a chord is a radius

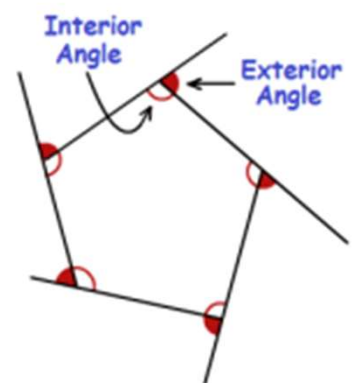


Interior and exterior angles

The sum of exterior angles in any polygon is 360°

The size of each exterior angle in a regular polygon is $360^\circ \div \text{number of sides}$

Interior + exterior angle = 180°



Year 11 - Reasoning...

Algebraic reasoning

What do I need to be able to do?

By the end of this unit you should be able to:

- Simplify expressions
- N^{th} term for linear sequences
- N^{th} term for quadratic sequences
- Solve simultaneous equations

Keywords

Expression:

Sequence: items or numbers put in a pre-decided order

Term: a single number or variable

Position: the place something is located

Linear: the difference between terms increases/decreases by a constant each time

Non-Linear: the difference between terms increases/decreases in different amounts

Quadratic: where the highest power of the variable is squared (x^2)

Difference:

Co-efficient: number in front of the variable

Linear and Non Linear Sequences

Linear Sequences – increase by addition or subtraction and the same amount each time

Non-linear Sequences – do not increase by a constant amount – quadratic, geometric and Fibonacci

- Do not plot as straight lines when modelled graphically
- The differences between terms can be found by addition, subtraction, multiplication or division

Fibonacci Sequence – look out for this type of sequence

0 | 1 | 1 | 2 | 3 | 5 | 8 | ...

Each term is the sum of the previous two terms.



Solve Simultaneous Equations

1. Linear

$$\textcircled{1} \quad 2a + c = 34.45$$

$$\textcircled{2} \quad 2a + 3c = 52.35$$

$$\textcircled{2} - \textcircled{1} \quad 2c = 17.90$$

$$c = 8.95$$

2. With one quadratic

$$y = x^2$$

$$x^2 = x + 2$$

$$y = x + 2$$

$$x^2 - x - 2 = 0$$

y
x^2

$$(x - 2)(x + 1) = 0$$

$$x = 2, x = -1$$

y
$x + 2$

$$y = x^2$$

$$y = (2)^2$$

$$y = 4$$

$$y = (-1)^2$$

$$y = 1$$

$$x = 2 \text{ and } y = 4$$

$$x = -1 \text{ and } y = 1$$

Sequences from algebraic rules

This is substitution!

$$3n + 7$$

$$3n^2 + 7$$

This will be linear - note the single power of n. The values increase at a constant rate

This is not linear as there is a power for n

$$2n - 5 \longrightarrow$$

Substitute the number of the term you are looking for in place of 'n'

eg

$$1^{\text{st}} \text{ term} = 2(1) - 5 = -3$$

$$2^{\text{nd}} \text{ term} = 2(2) - 5 = -1$$

$$100^{\text{th}} \text{ term} = 2(100) - 5 = 195$$

Checking for a term in a sequence

Form an equation

Is 201 in the sequence $3n - 4$?

$$3n - 4 = 201 \quad \leftarrow \text{Term to check}$$

Algebraic rule

Solving this will find the position of the term in the sequence. ONLY an integer solution can be in the sequence.

More details on the next page ☺

Finding the algebraic rule

This is the 4 times table \longrightarrow 4, 8, 12, 16, 20...

$$4n$$

$$7, 11, 15, 19, 22$$

This has the same constant difference – but is 3 more than the original sequence

$$4n + 3$$

$$4n + 3$$

This is the constant difference between the terms in the sequence

This is the comparison (difference) between the original and new sequence

Year 11 - Reasoning...

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Simultaneous Equations

What do I need to be able to do?

By the end of this unit you should be able to:

- Determine whether (x,y) is a solution
- Solve by substituting a known variable
- Solve by substituting an expression
- Solve graphically
- Solve by subtracting/ adding equations
- Solve by adjusting equations
- Form and solve linear simultaneous equations

Keywords

Solution: a value we can put in place of a variable that makes the equation true

Variable: a symbol for a number we don't know yet

Equation: an equation says that two things are equal - it will have an equals sign =

Substitute: replace a variable with a numerical value

LCM: lowest common multiple (the first time the times table of two or more numbers match)

Eliminate: to remove

Expression: a maths sentence with a minimum of two numbers and at least one math operation (no equals sign)

Coordinate: a set of values that show an exact position

Intersection: the point two lines cross or meet

Is (x, y) a solution?

x and y represent values that can be substituted into an equation

Does the coordinate (1,8) lie on the line $y=3x+5$?

This coordinate represents $x=1$ and $y=8$

$$y = 3x + 5$$

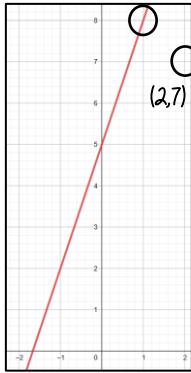
$$8 = 3(1) + 5$$

As the substitution makes the equation correct the coordinate (1,8) IS on the line $y=3x+5$

Is (2,7) on the same line?

$$7 \neq 3(2) + 5$$

No 7 does NOT equal $6+5$



Substituting known variables

A line has the equation $3x + y = 14$

Two different variables, two solutions

Stephanie knows the point $x = 4$ lies on that line. Find the value for y

$$3x + y = 14$$

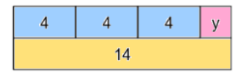
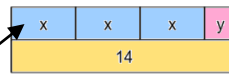
$$3(4) + y = 14$$

$$12 + y = 14$$

$$-12 \quad -12$$

$$y = 2$$

$$x = 4$$



Substituting in an expression

Substitute 2y in place of the x variable as they represent the same value

$$x = 2y$$



$$x + y = 30$$



$$x = 2y$$

$$x + y = 30$$



$$3y = 30$$



$$3y = 30$$

$$\div 3 \quad \div 3$$

$$y = 10$$

$$x = 2y$$



$$x = 20$$

Pair of simultaneous equations (two representations)

Solve graphically

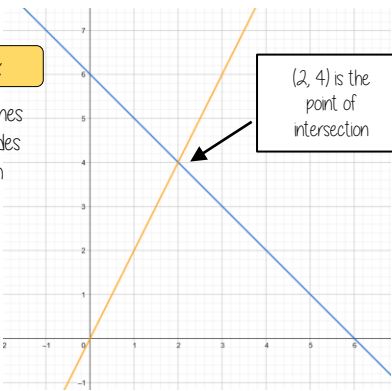
$$x + y = 6$$

$$y = 2x$$

Linear equations are straight lines. The point of intersection provides the x and y solution for both equations

The solution that satisfies both equations is

$$x = 2 \text{ and } y = 4$$



(2, 4) is the point of intersection

Solve by subtraction

$$3x + 2y = 18$$

$$3x + 2y = 18$$

$$- \quad x + 2y = 10$$

$$2x = 8$$

$$\div 2 \quad \div 2$$

$$x = 4$$

$$x + 2y = 10$$

$$(4) + 2y = 10$$

$$-4 \quad -4$$

$$2y = 6$$

$$\div 2 \quad \div 2$$

$$y = 3$$

$$x = 4$$

$$y = 3$$

$$\begin{array}{c} x \ x \ x \ y \ y = 18 \\ x \ y \ y = 10 \\ \hline \end{array}$$

$$\begin{array}{c} x \ x \ x \ y \ y = 18 \\ x \ y \ y = 10 \\ \hline \end{array}$$

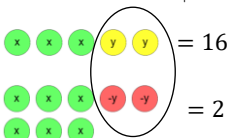
$$x \ x = 8$$

$$x = 4$$

$$y = 3$$

Solve by addition

Addition makes zero pairs



$$x = 2$$

$$y = 5$$

$$3x + 2y = 16$$

$$+ 6x - 2y = 2$$

$$9x = 18$$

$$\div 9 \quad \div 9$$

$$x = 2$$

$$3x + 2y = 16$$

$$3(2) + 2(y) = 16$$

$$6 + 2y = 16$$

$$-6 \quad -6$$

$$2y = 10$$

$$y = 5$$

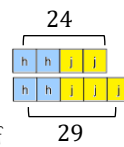
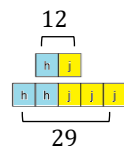
Solve by adjusting one

$$\begin{array}{l} h + j = 12 \\ 2h + 2j = 29 \end{array}$$

$$2h + 2j = 24$$

$$2h + 2j = 29$$

By proportionally adjusting one of the equations - now solve the simultaneous equations choosing an addition or subtraction method



Solve by adjusting both

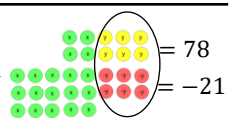
$$\begin{array}{l} 2x + 3y = 39 \\ 5x - 2y = -7 \end{array}$$

Use LCM to make equivalent x OR y values. Because of the negative values using zero pairs and y values is chosen choice

$$\begin{array}{l} 4x + 6y = 78 \\ 15x - 6y = -21 \end{array}$$

Now solve by addition

Addition makes zero pairs



Year 11 - Reasoning...

Transforming & Constructing

What do I need to be able to do?

By the end of this unit you should be able to:

- Draw and measure angles
- Construct scale drawings
- Find locus of distance from points, lines, two lines
- Construct perpendiculars from points, lines, angles
- Identify congruence
- Identify congruent triangles

Keywords

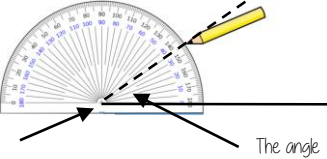
- Protractor:** piece of equipment used to measure and draw angles
- Locus:** set of points with a common property
- Equidistant:** the same distance
- Discorectangle:** (a stadium) — a rectangle with semi circles at either end
- Perpendicular:** lines that meet at 90°
- Arc:** part of a curve
- Bisector:** a line that divides something into two equal parts
- Congruent:** the same shape and size

Draw and measure angles



Draw a 35° angle

Make a mark at 35° with a pencil and join to the angle point (use a ruler)



The angle

Make sure the cross is at the end of the line (where you want the angle)

Scale drawings



A picture of a car is drawn with a scale of 1:30

For every 1cm on my image is 30cm in real life

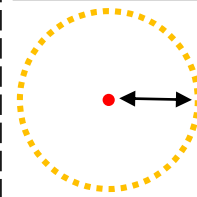
The car image is 10cm



Image: Real life
1cm : 30cm
 $\times 10$ \leftarrow 10cm : 300cm $\leftarrow \times 10$

Locus of a distance from a point

All points are equidistant (the same distance) from the fixed point in the middle



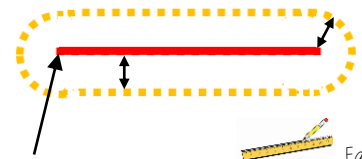
If the point is in the corner it can only make a quarter circle



Equipment needed
The radius is the distance from the fixed point

Locus of a distance from a straight line

All points are equidistant (the same distance) from line



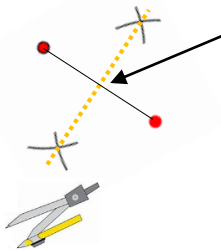
The ends of the line are fixed points



Equipment needed
The line is straight so a ruler is used for the straight lines parallel to your original line

Locus equidistant from two points

Also a perpendicular bisector
Because if the points are joined this new line intersects it at a 90°

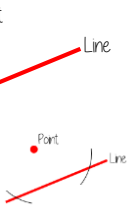


Join the intersections with a ruler.
All points on this line are equidistant from both points

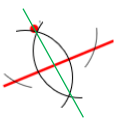
Construct a perpendicular from a point



Use a compass and draw an arc that cuts the line. Use the point to place the compass



Keep the compass the same distance and now use your new points to make new intersecting arcs



Connecting the arcs makes the bisector

If P is a point on the line the steps are the same

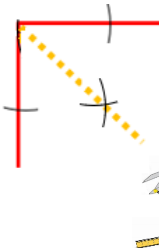
Locus of a distance from two lines

Also an angle bisector
This cuts the angle in half

From the angle vertex draw two arcs that cut the lines forming the angle

Keep the compass the same size and use the new arcs as centres to draw intersecting arcs in the middle

Join the vertex to the intersection

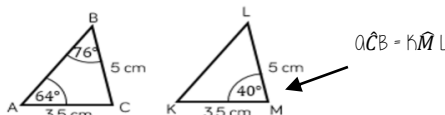


Congruent figures

Congruent figures are identical in size and shape — they can be reflections or rotations of each other



Congruent shapes are identical — all corresponding sides and angles are the same size



Because all the angles are the same and $AC=KM$ $BC=LM$ triangles ABC and KLM are congruent

Congruent triangles

Side-side-side

All three sides on the triangle are the same size

Angle-side-angle

Two angles and the side connecting them are equal in two triangles

Side-angle-side

Two sides and the angle in-between them are equal in two triangles (it will also mean the third side is the same size on both shapes)

Right angle-hypotenuse-side

The triangles both have a right angle, the hypotenuse and one side are the same

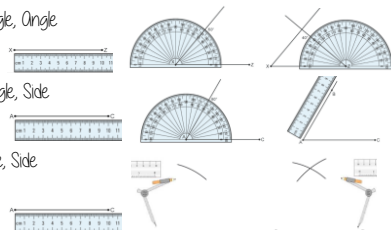
Constructing Triangles

Link to steps R

Side, Angle, Angle

Side, Angle, Side

Side, Side, Side



Year 11 - Listing & describing...

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Collecting, representing and interpreting

What do I need to be able to do?

By the end of this unit you should be able to:

- Construct and interpret frequency tables and polygon two-way tables, line, bar, & pie charts
- Find and interpret averages from a list and a table
- Construct and interpret time series graphs, stem and leaf diagrams and scatter graphs

Keywords

- Population:** the whole group that is being studied
- Sample:** a selection taken from the population that will let you find out information about the larger group
- Representative:** a sample group that accurately represents the population
- Random sample:** a group completely chosen by chance. No predictability to who it will include
- Bias:** a built-in error that makes all values wrong by a certain amount
- Primary data:** data collected from an original source for a purpose
- Secondary data:** data taken from an external location. Not collected directly
- Outlier:** a value that stands apart from the data set

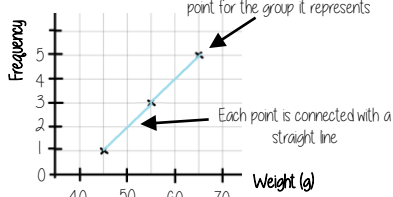
Frequency tables and polygons

x Weight(g)	Frequency
$40 < x \leq 50$	1
$50 < x \leq 60$	3
$60 < x \leq 70$	5

We do not know from grouped data where each value is placed so have to use an estimate for calculations

MID POINTS

Mid-points are used as estimated values for grouped data. The middle of each group



The data about weight starts at 40 So the axis can start at 40

Mid-point
Start point + End point
2

Two way tables

60 people visited the zoo one Saturday morning
26 of them were adults 13 of the adults' favourite animal was an elephant 24 of the children's favourite animal was an elephant

Extract information to input to the two-way table

	Adult	Child	Total
Elephant	13	24	37
Other	13	10	23
Total	26	34	60

Subgroups each have their own heading
Needs subgroup totals
Overall total

Draw and interpret Pie Charts

Type of pet	Dog	Cat	Hamster
Frequency	32	25	3

There were 60 people asked in this survey (Total frequency)

$\frac{32}{60}$ "32 out of 60 people had a dog"

This fraction of the 360 degrees represents dogs

$\frac{32}{60} \times 360 = 192^\circ$



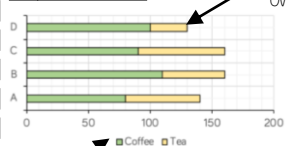
Use a protractor to draw
This is 192°

Multiple method
As 60 goes into 360 - 6 times
Each frequency can be multiplied by 6 to find the degrees (proportion of 360)

Comparing Pie Charts
You NEED the overall frequency to make any comparisons

Bar and line charts

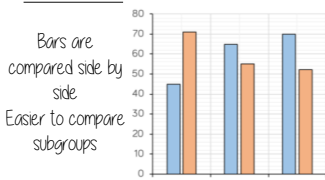
Composite bar charts



Categories clearly indicated

Compare the bars green compared to yellow. The size of each bar is the frequency. Overall total easily comparable

Dual bar charts



Bars are compared side by side
Easier to compare subgroups

Categories clearly indicated

Averages from a table

Non-grouped data

Number of Siblings	0	1	2
Frequency	6	8	6
Subtotal	0	8	12

Overall Frequency: 20

Total number of siblings: 20

The data in a list: 0,0,0,0,0,1,1,1,1,1,1,1,2,2,2,2,2,2,2

Mean: $\frac{\text{total number of siblings}}{\text{Total frequency}} = 1$

Grouped data

x Weight(g)	Frequency	Mid Point	MP x Freq
$40 < x \leq 50$	1	45	45
$50 < x \leq 60$	3	65	195
$60 < x \leq 70$	5	65	325

Overall Frequency: 9

Overall Total: 565

Mean: 62.8g

The data in a list: 45, 55, 55, 55, 65, 65, 65, 65, 65

Averages from lists

The Mean

A measure of average to find the central tendency... a typical value that represents the data

24, 8, 4, 11, 8

Find the sum of the data (add the values)

55

Divide the overall total by how many pieces of data you have

$55 \div 5$

Mean = 11

The Mode (The modal value)

This is the number OR the item that occurs the most (it does not have to be numerical)

24, 8, 4, 11, 8

Mode = 8

This can still be easier if the data is ordered first

The Median

The value in the center (in the middle) of the data

24, 8, 4, 11, 8

Put the data in order

4, 8, 8, 11, 24

Find the value in the middle

4, 8, 8, 11, 24

Median = 8

NOTE: If there is no single middle value find the mean of the two numbers left

For Grouped Data

The modal group - which group has the highest frequency

YEAR 10 — DELVING INTO DATA...

Collecting, representing and interpreting

@whisto_maths

What do I need to be able to do?

By the end of this unit you should be able to:

- Construct and interpret frequency tables and polygon two-way tables, line, bar, & pie charts
- Find and interpret averages from a list and a table
- Construct and interpret time series graphs, stem and leaf diagrams and scatter graphs

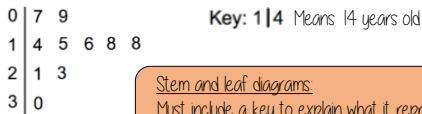
Keywords

- Population:** the whole group that is being studied
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Stem and leaf

0 way to represent data and use to find averages

This stem and leaf diagram shows the age of people in a line at the supermarket



Stem and leaf diagrams
Must include a key to explain what it represents
The information in the diagram should be ordered

Back to back stem and leaf diagrams

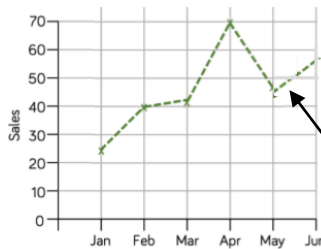
Girls	Boys
5	14
7, 5, 5, 5, 4	15 3, 8, 9
8, 4, 2, 1, 0	16 2, 5, 7, 7, 8, 8, 9
9, 8, 7, 6, 6, 4, 2, 1, 1, 0, 0	17 0, 2, 3, 6, 6, 7, 7
	18 0, 1, 4, 5

15 | 3,
Means 153 cm tall

Back to back stem and leaf diagrams
Allow comparisons of similar groups
Allow representations of two sets of data

Time-Series

This time-series graph shows the total number of car sales in £1000 over time



Look for general trends in the data. Some data shows a clear increase or a clear decrease over time.

Readings in-between points are estimates (on the dotted lines). You can use them to make assumptions.

Comparing distributions

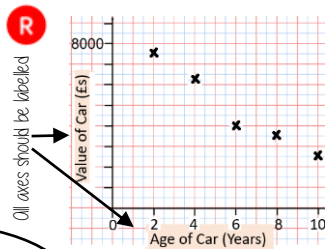
Comparisons should include a statement of average and central tendency, as well as a statement about spread and consistency

- Mean, mode, median — allows for a comparison about more or less average
- Range — allows for a comparison about reliability and consistency of data

Draw and interpret a scatter graph

Age of Car (Years)	2	4	6	8	10
Value of Car (£s)	7500	6250	4000	3500	2500

- This data may not be given in size order
- The data forms information pairs for the scatter graph
- Not all data has a relationship



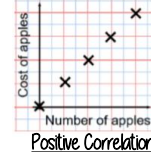
All axes should be labelled

The axis should fit all the values on and be equally spread out

"This scatter graph shows as the age of a car increases the value decreases"

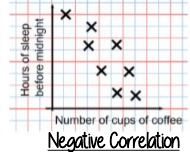
The link between the data can be explained verbally

Linear Correlation



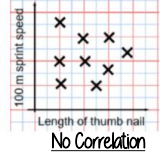
Positive Correlation

As one variable increases so does the other variable



Negative Correlation

As one variable increases the other variable decreases



No Correlation

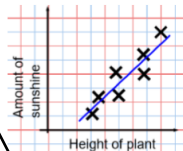
There is no relationship between the two variables

The line of best fit

The Line of best fit is used to make estimates about the information in your scatter graph

Things to know:

- The line of best fit **DOES NOT** need to go through the origin (The point the axes cross)
- There should be approximately the same number of points above and below the line (It may not go through any points)
- The line extends across the whole graph



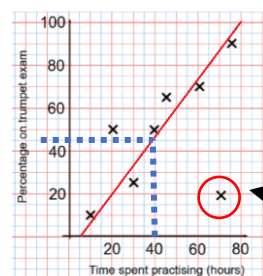
It is only an estimate because the line is designed to be an average representation of the data

It is always a straight line.

Using a line of best fit

Interpolation is using the line of best fit to estimate values inside our data point

e.g. 40 hours revising predicts a percentage of 45



Extrapolation is where we use our line of best fit to predict information outside of our data

This is not always useful — in this example you cannot score more than 100%. So revising for longer can not be estimated

This point is an "outlier" It is an outlier because it doesn't fit this model and stands apart from the data

Year 11 - Listing & describing

Probability

@whisto_maths

What do I need to be able to do?

By the end of this unit you should be able to:

- Add, Subtract and multiply fractions
- Find probabilities using likely outcomes
- Use probability that sums to 1
- Estimate probabilities
- Use Venn diagrams and frequency trees
- Use sample space diagrams
- Calculate probability for independent events
- Use tree diagrams

Keywords

Event: one or more outcomes from an experiment

Outcome: the result of an experiment

Intersection: elements (parts) that are common to both sets

Union: the combination of elements in two sets

Expected Value: the value/ outcome that a prediction would suggest you will get

Universal Set: the set that has all the elements

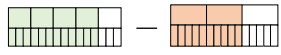
Systematic: ordering values or outcomes with a strategy and sequence

Product: the answer when two or more values are multiplied together.

Add, Subtract and multiply fractions

Addition and Subtraction

$$\frac{4}{5} - \frac{2}{3}$$



$$\frac{12}{15} - \frac{10}{15} = \frac{2}{15}$$

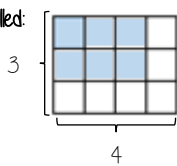
Multiplication

$$\frac{3}{4} \times \frac{2}{3}$$

$$\frac{3}{4} \times \frac{2}{3} = \frac{6}{12}$$

Parts shaded

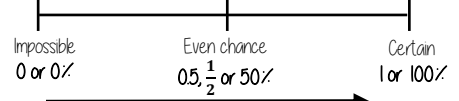
Modelled:



Total number of parts in the diagram

Use equivalent fractions to find a common multiple for both denominators

Likelihood of a probability



The more likely an event the further up the probability it will be in comparison to another event (it will have a probability closer to 1)

Sum to 1

Probability is always a value between 0 and 1

The probability of getting a blue ball is $\frac{1}{5}$

∴ The probability of NOT getting a blue ball is $\frac{4}{5}$

The sum of the probabilities is 1



Experimental data

Theoretical probability

What we expect to happen

Experimental probability

What actually happens when we try it out

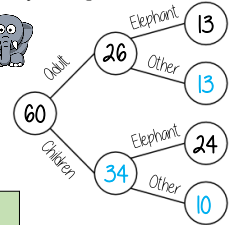
The more trials that are completed the closer experimental probability and theoretical probability become

The probability becomes more accurate with more trials.
Theoretical probability is proportional

Tables, Venn diagrams, Frequency trees

Frequency trees

60 people visited the zoo one Saturday morning. 26 of them were adults. 13 of the adults' favourite animal was an elephant. 24 of the children's favourite animal was an elephant.



Frequency trees and two-way tables can show the same information

The total columns on two-way tables show the possible denominators

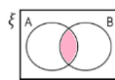
$$P(\text{adult}) = \frac{26}{60}$$

$$P(\text{Child with favourite animal as elephant}) = \frac{13}{37}$$

Two-way table

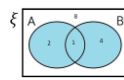
	Adult	Child	Total
Elephant	13	24	37
Other	13	10	23
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Venn diagram



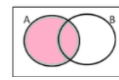
in set A AND set B

$$P(A \cap B)$$



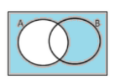
in set A OR set B

$$P(A \cup B)$$



in set A

$$P(A)$$



NOT in set A

$$P(A')$$

Sample space

The possible outcomes from rolling a dice

The possible outcomes from tossing a coin

	1	2	3	4	5	6
H	1H	2H	3H	4H	5H	6H
T	1T	2T	3T	4T	5T	6T

$$P(\text{Even number and tails}) = \frac{3}{12}$$

Independent events

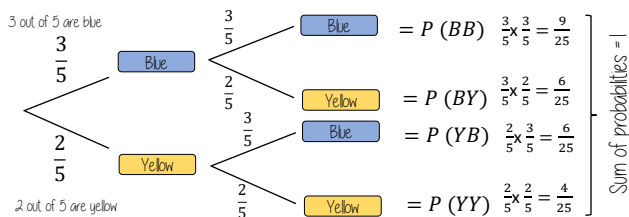
The outcome of two events happening. The outcome of the first event has no bearing on the outcome of the other

$$P(A \text{ and } B) = P(A) \times P(B)$$

Tree diagram for independent event

Isobel has a bag with 3 blue counters and 2 yellow. She picks a counter and replaces it before the second pick.

Because they are replaced the second pick has the same probability

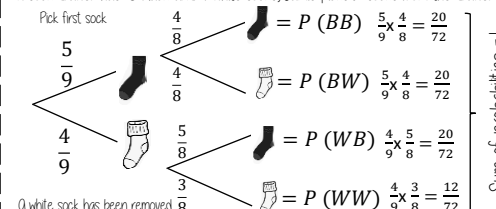


Dependent events

Tree diagram for dependent event

The outcome of the first event has an impact on the second event

A sock drawer has 5 black and 4 white socks. Jamie picks 2 socks from the drawer.



NOTE: as 'socks' are removed from the drawer the number of items in that drawer is also reduced ∴ the denominator is also reduced for the second pick