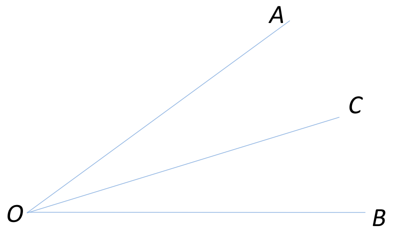
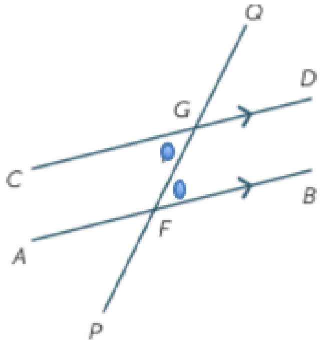
Additional Information to Support the Glossary

Terms	Definition
Adjacent angles	Two angles at a point are called **adjacent** if they share a common ray and a common vertex. Hence, in the diagram, • ∠AOC and ∠BOC are adjacent, and • ∠*AOB* and ∠AOC are adjacent. 
Algebraic expression	An **algebraic expression** is formed by combining numbers and algebraic symbols using arithmetic operations. The expression must be constructed unambiguously according to the rules of algebra. For example, $a^2 + 3ab - 2b^2$, and $(x + 1)e^x$ are algebraic expressions, but $2x + \div 3y$ is not because it is incomplete. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Algebraic fraction	An **algebraic fraction** is a fraction in which both the numerator and denominator are algebraic expressions. An algebraic fraction in which both the numerator and denominator are polynomials are called **rational functions**. For example, $\frac{x}{e^x+1}$ and $\frac{2x+3}{x^2+5}$ are algebraic fractions, and the latter is a rational function. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein, 2002
Algebraic term	An **algebraic term** is an algebraic expression that forms a 'separable' part of some other algebraic expression. For example, x^2 and $5x^{-1}$ are terms in the inequality $x^2 \leq 5x^{-1}$, and $2, 3x, 5x^2$ are terms of the polynomial $2 + 3x + 5x^2$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein, 2002

Alternate angles

In each diagram below, the two marked angles are called **alternate angles** (since they are on alternate sides of the transversal).

If the lines *AB* and *CD* are parallel, then each pair of alternate angles are equal.



Conversely, if the alternate angles are equal, then the lines are parallel.

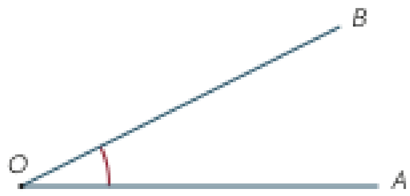
REFERENCE: The Concise Oxford Dictionary of Mathematics
Christopher Clapham and James Nicholson
2009

Angle

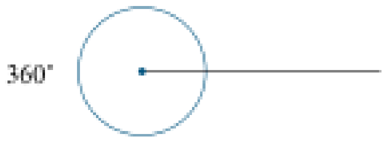
An **angle** is the figure formed by two rays sharing a common endpoint, called the vertex of the angle.

The size of an angle

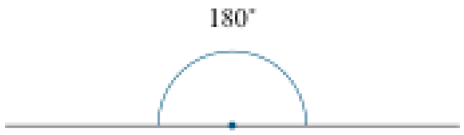
Imagine that the ray *OB* is rotated about the point *O* until it lies along *OA*.
The amount of turning is called the size of the angle *AOB*.



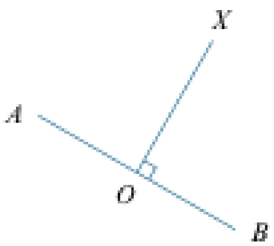
A **revolution** is the amount of turning required to rotate a ray about its endpoint until it falls back onto itself.
The size of 1 revolution is 360^o



A **straight angle** is the angle formed by taking a ray and its opposite ray. A straight angle is half of a revolution, and so has size equal to 180^o.



Right angle
Let *AOB* be a line, and let *OX* be a ray making equal angles with the ray *OA* and the ray *OB*.
Then the equal angles *AOX* and *BOX* are called right angles.



A right angle is half of a straight angle, and so is equal to 90^o.

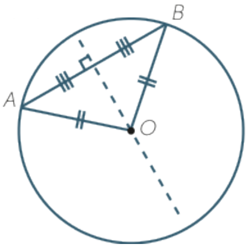
Classification of angles

Angles are classified according to their size.
We say that

- An angle with size α is **acute** if $0^o < \alpha < 90^o$,
- An angle with size α is **obtuse** if $90^0 < \alpha < 180^o$,
- An angle with size α is **reflex** if $180^0 < \alpha < 360^o$

REFERENCE: The Concise Oxford Dictionary of Mathematics
Christopher Clapham and James Nicholson
2009

Angle and Chord properties of circles	Six important results are given here. **Result 1** Let AB be a <u>chord</u> of a <u>circle</u> with centre O. The following three lines coincide:

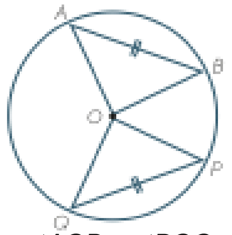


- The bisector of the angle $\angle AOB$ subtended at the centre by the chord.
- The <u>line segment</u> (interval) joining O and the midpoint of the chord AB.
- The perpendicular bisector of the chord AB.

This idea can be expressed purely in terms of isosceles triangles.

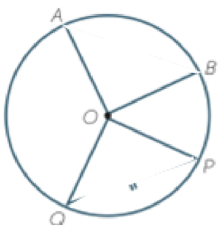
Result 2

- Equal chords of a circle subtend equal angles at the centre.



In the diagram above $\angle AOB = \angle POQ$.

- Equal arcs of a circle subtend equal angles at the centre.

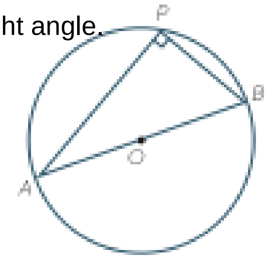


In the diagram above $\angle AOB = \angle POQ$.

Result 3

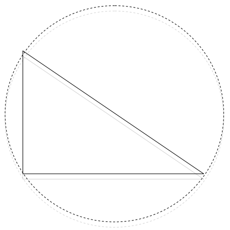
- An angle in a semicircle is a right angle.

Let *AOB* be a diameter of a circle with centre *O*, and let *P* be any other point on the circle. The angle ∠*APB* subtended at *P* by the diameter *AB* is called an **angle in a semicircle**.



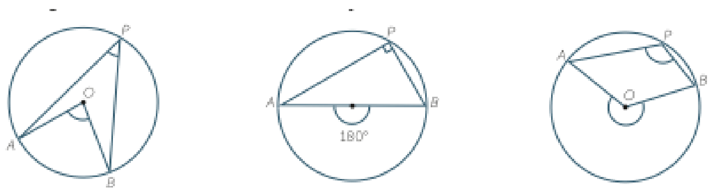
Converse

- The circle whose diameter is the hypotenuse of a right- angled triangle passes through all three vertices of the triangle.



Result 4

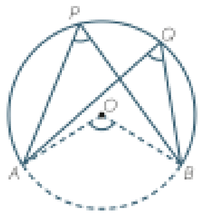
- An angle at the circumference of a circle is half the angle <u>subtended</u> at the centre by the same arc.



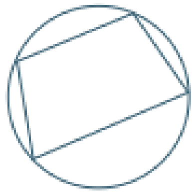
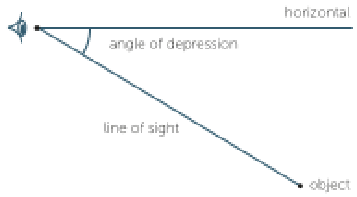
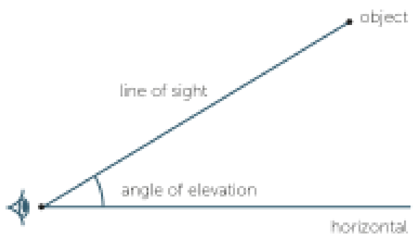
The arc *AB* <u>subtends</u> the angle ∠AOB at the centre. The arc also subtends the angle ∠*APB*, called an **angle at the circumference** subtended by the arc *AB*.

Result 5

- Two angles at the circumference subtended by the same arc are equal.



In the diagram above, the two angles ∠*APB* and ∠*AQB* are subtended by the same arc *AB*. This is because each of these angles is half of ∠*AOB.*

	Result 6 • The opposite angles of a cyclic quadrilateral are supplementary.  A **cyclic quadrilateral** is a quadrilateral whose vertices all lie on a circle. **Converse** • If the opposite angles of a quadrilateral are supplementary, then the quadrilateral is cyclic.
Angle of depression	When an observer looks at an object that is lower than 'the eye of' the observer', the angle between the line of sight and the horizontal is called the **angle of depression**.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Angle of elevation	When an observer looks at an object that is higher than 'the eye of' the observer', the angle between the line of sight and the horizontal is called the **angle of elevation**.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Array	An array is an ordered collection of objects or numbers. Rectangular arrays are commonly used in primary mathematics.

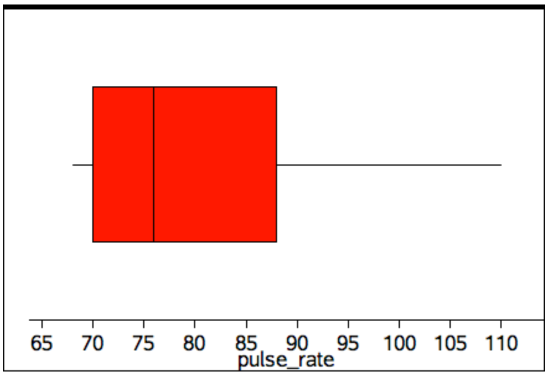
<table>
<tr><td></td><td>REFERENCES: De Klerk, J. (2010). Illustrated Maths Dictionary. Sydney: Pearson.
O'Brien, H. & Purcell, G. (2004). The New Primary Mathematics Handbook. St Leonards, NSW: Horwitz Education.
The Concise Oxford Dictionary of Mathematics, 4th edition. C Clapham & J. Nicholson, 2009</td></tr>
<tr><td>Associative l</td><td>A method of combining two numbers or algebraic expressions is associative if the result of the combination of three objects does not depend on the way in which the objects are grouped.
For example, addition of numbers is associative and the corresponding associative law is:
$(a + b) + c = a + (b + c)$ for all numbers a, b and c.
Multiplication is also associative: $(ab)c = a(bc)$ for all numbers $a,$ and $c,$ but subtraction and division are not, because, for example,
$(7 - 4) - 3 \neq 7 - (4 - 3)$ and $(12 \div 6) \div 2 \neq 12 \div (6 \div 2)$.
REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992</td></tr>
<tr><td>Average</td><td>See mean</td></tr>
<tr><td>Back – to - back stem-and –leaf plot</td><td>A back-to-back stem-and-leaf plot is a method for comparing two data distributions by attaching two sets of 'leaves' to the same 'stem' in a stem-and-leaf plot.

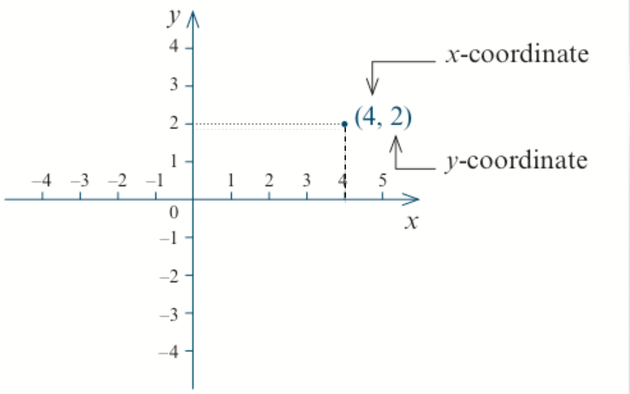
For example, the stem-and-leaf plot below displays the distribution of pulse rates of 19 students before and after gentle exercise.

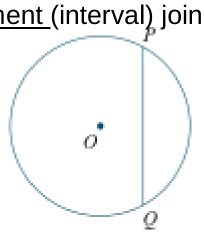
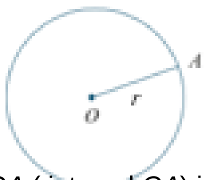
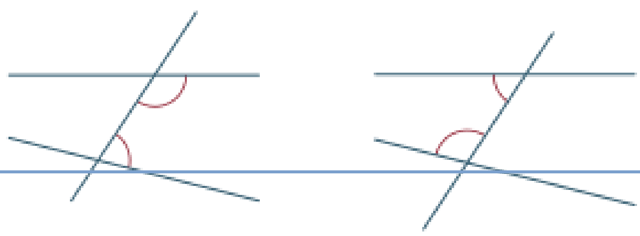
pulse rate
<table>
<tr><th>before</th><th></th><th>after</th></tr>
<tr><td>9 8 8 8</td><td>6</td><td></td></tr>
<tr><td>8 6 6 4 1 1 0</td><td>7</td><td></td></tr>
<tr><td>8 8 6 2</td><td>8</td><td>6 7 8 8</td></tr>
<tr><td>6 0</td><td>9</td><td>0 2 2 4 5 8 9 9</td></tr>
<tr><td>4</td><td>10</td><td>0 4 4</td></tr>
<tr><td>0</td><td>11</td><td>8</td></tr>
<tr><td></td><td>12</td><td>4 4</td></tr>
<tr><td></td><td>13</td><td></td></tr>
<tr><td></td><td>14</td><td>6</td></tr>
</table>

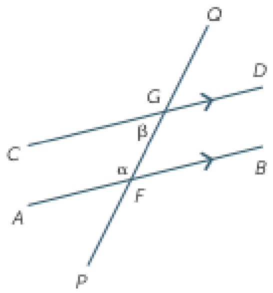
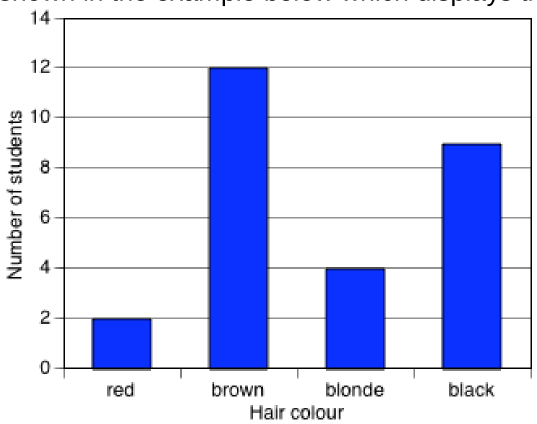
REFERENCE: The Cambridge Dictionary of Statistics
B. S. Everitt
1998</td></tr>
<tr><td>Bar graph</td><td>See column graph.</td></tr>
<tr><td>Bimodal data</td><td>Bimodal data is data whose distribution has two modes.

REFERENCE: The Cambridge Dictionary of Statistics
B. S. Everitt</td></tr>
</table>

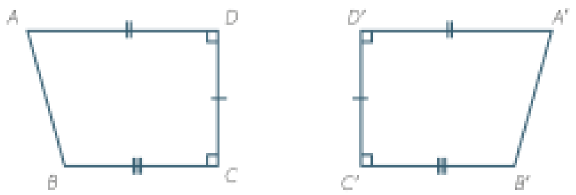
	1998
Bivariate data	**Bivariate data** is data relating to two variables, for example, the arm spans and heights of 16 year olds, the sex of primary school students and their attitude to playing sport. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Bivariate numerical data	**Bivariate data** is data relating to two numerical variables, for example height and weight.
Box plot	The term **box plot** is a synonym for a box-and-whisker plot
Box-and-whisker plot	A **box-and-whisker plot** is a graphical display of a five-number summary. In a box-and-whisker plot, the 'box' covers the interquartile range (IQR), with 'whiskers' reaching out from each end of the box to indicate maximum and minimum values in the data set. A vertical line in the box is used to indicate the location of the median. The box-and-whisker plot below has been constructed from the five -number summary of the resting pulse rates of 17 students.  The term 'box-and-whisker plot' is commonly abbreviated to 'box plot'. Showing **outliers:** In constructing box plots, it is common to designate data values that lie a distance of 1.5 × IQR from either box end as possible outliers. These values are then shown separately on the box plot. In such cases the whiskers extend to include all values except the outliers. See parallel box-and-whisker plots for an example of a box plot showing an outlier. See also, parallel box-and-whisker plots and back-to-back stem-and-leaf plots. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Capacity	**Capacity** is a term used to describe how much a container will hold. It is often used in relation to the volume of fluids. Units of capacity (volume of fluids or

	gases) include litres and millilitres. REFERENCE:The University of Chicago Mathematics Project Arthur Coxford, Zalman Usikin, Daniel Hirschorn 1991
Cartesian coordinate system	Two intersecting <u>number lines</u> are taken intersecting at right angles at their origins to form the axes of the coordinate system. The plane is divided into four quadrants by these perpendicular axes called the ***x*-axis** (horizontal line) and the ***y*-axis** (vertical line). The position of any point in the plane can be represented by an **ordered pair** of numbers (x, y). These ordered are called the coordinates of the point. This is called the **Cartesian coordinate system.** The plane is called the **Cartesian plane.** The point with coordinates (4, 2) has been plotted on the Cartesian plane shown. The coordinates of the origin are (0, 0).  REFERENCE: The University of Chicago Mathematics Project Arthur Coxford, Zalman Usikin, Daniel Hirschorn 1991
Categorical data	**Categorical data** is data associated with a categorical variable.
Categorical variable	A **categorical variable** is a <u>variable</u> whose values are categories. Examples: *blood group* is a categorical variable; its values are: A, B, AB or O. So too is *construction type* of a house; its values might be brick, concrete, timber, or steel. Categories may have numerical labels, for example, for the variable *postcode* the category labels would be numbers like 3787, 5623, 2016, etc, but these labels have no numerical significance. For example, it makes no sense to use these numerical labels to calculate the average postcode in Australia. When a categorical variable has ordered categories, for example, *car size*: small, medium or large, the term **ordinal variable** is sometimes used. Recognising that a categorical variable has ordered categories can be useful when preparing tables or graphs to display ordinal data. Another commonly used term for **categorical variable** (as defined here) is **qualitative variable**.

	REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Census	See population.
Chance experiment	See random experiment.
Chord	A **chord is a** line segment (interval) joining two points on a circle.  A **diameter** is a chord passing through the centre. The word diameter is also used for the length of the diameter. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Circle	The **circle** with **centre** *O* and **radius** *r* is the set of all points in the plane whose distance from *O* is *r*.  The line segment *OA* (interval *OA*) is also called a radius of the circle. Putting the point of a pair of compasses at the centre and opening the arms to the radius can draw a circle. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Cointerior angles	In each diagram the two marked angles are called **co-interior angles** and lie on the same side of the transversal. 

	If the lines *AB* and *CD* are parallel then $\alpha + \beta = 180^\circ$  Cointerior angles formed by parallel lines are supplementary. Conversely, if a pair of cointerior angles is supplementary then the lines are parallel.
Column graph	A **column graph** is a graph used in statistics for organising and displaying categorical data. To construct a column graph, equal width rectangular bars are constructed for each category with height equal to the observed frequency of the category as shown in the example below which displays the hair colours of 27 students.  Column graphs are frequently called **bar graphs** or **bar charts**. In a bar graph or chart, the bars can be either vertical or horizontal. See also, histogram. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Common factor	A **common factor** (or **common divisor**) of a set of numbers or algebraic expression is a factor of each element of that set. For example, 6 is a common factor of $24, 54$ and 66, and $x+1$ is a common factor of x^2-1 and x^2+5x+4. See also Greatest common divisor. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002

Commutative	A method of combining two numbers or algebraic expressions is **commutative** if the result of the combination does not depend on the order in which the objects are given. For example, addition of numbers is commutative, and the corresponding **commutative law** is: $a + b = b + a$ for all numbers a and b. Multiplication is also commutative: $ab = ba$ for all numbers a and b, but subtraction and division are not, because, for example, $5 - 3 \neq 3 - 5$ and $12 \div 4 \neq 4 \div 12$. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Complementary angles	Two angles that add to 90° are called **complementary**. For example, 23° and 67° are complementary angles. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Complementary events	Events *A* and *B* are **complementary** events, if A and B are mutually exclusive and Pr(*A*) + Pr(*B*) = 1. See also probability. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Composite number	A natural number that has a factor other than 1 and itself is a **composite number**. The first few composite numbers are $4,6,8,9,10,12,14,15,16,\cdots$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Compound interest	The interest earned by investing a sum of money (the principal) is **compound interest** if each successive interest payment is added to the principal for the purpose of calculating the next interest payment. For example, if the principal $\$P$ earns compound interest at the rate of r per period, then after n periods the principal plus interest is $\$P(1+r)^n$, and the accumulated compound interest is $\$P((1+r)^n - 1)$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Congruence	Two plane figures are called **congruent** if one can be moved by a sequence of translations, rotations and reflections so that it fits exactly on top of the other figure. Two figures are congruent when we can match every part of one figure with the corresponding part of the other figure. For example, the two figures below are congruent. Matching intervals have the same length, and matching angles have the same size.



REFERENCE: The Concise Oxford Dictionary of Mathematics
Christopher Clapham and James Nicholson
2009

Congruent triangles

The four standard congruence tests for triangles.

Two triangles are congruent if:

SSS: the three sides of one triangle are respectively equal to the three sides of the other triangle, or

SAS: two sides and the included angle of one triangle are respectively equal to two sides and the included angle of the other triangle, or

AAS: two angles and one side of one triangle are respectively equal to two angles and the matching side of the other triangle, or

RHS: the hypotenuse and one side of one right- angled triangle are respectively equal to the hypotenuse and one side of the other right- angled triangle.

REFERENCE: The University of Chicago Mathematics Project
Arthur Coxford, Zalman Usikin, Daniel Hirschorn
1991

Continuous data

Continuous data is data associated with a continuous variable.

Continuous variable

A **continuous variable** is a numerical variable that can take any value that lies within an interval. In practice, the values taken are subject to the accuracy of the measurement instrument used to obtain these values.

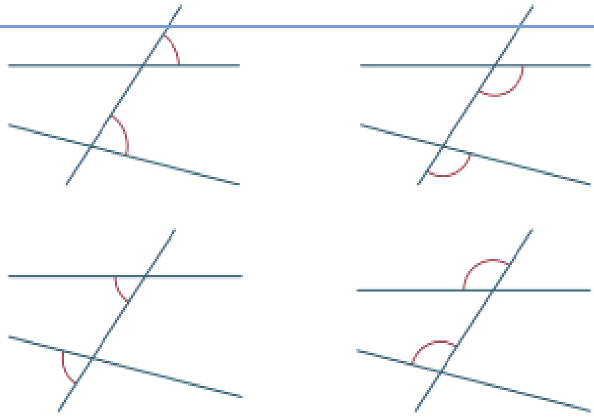
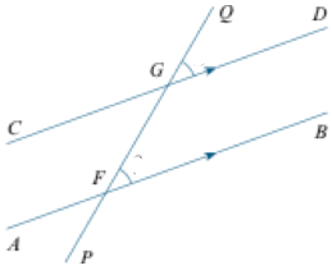
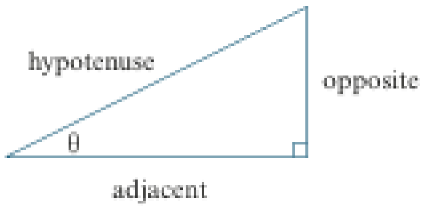
Examples include height, reaction time to a stimulus and systolic blood pressure.

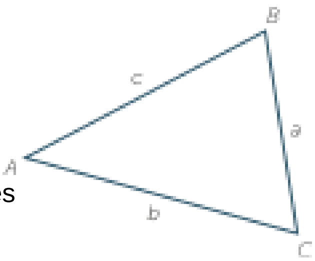
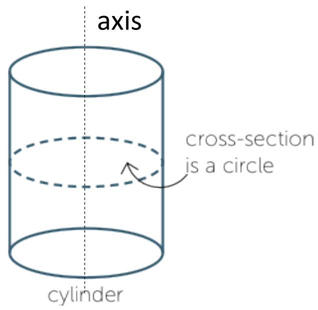
See also discrete statistical variable and variable (statistical).

REFERENCE: The Cambridge Dictionary of Statistics
B. S. Everitt
1998

Corresponding angles

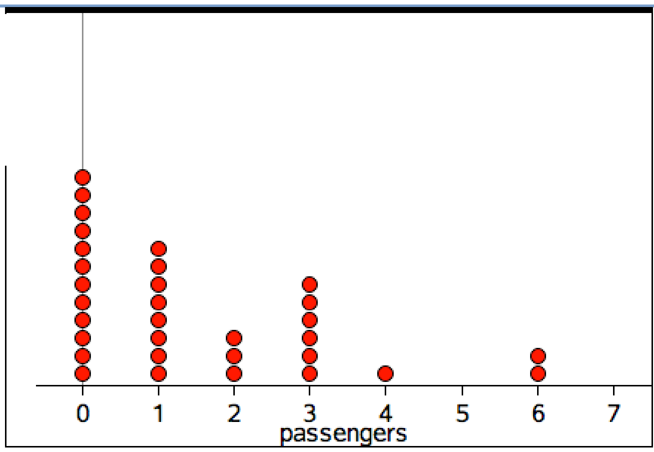
In each diagram the two marked angles are called **corresponding angles**.

	 If the lines are parallel, then each pair of corresponding angles are equal.  Conversely, If a pair of corresponding angles are equal, then the lines are parallel. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Cosine ratio	In any right-angled triangle, $\cos \theta = \dfrac{\text{adjacent}}{\text{hypotenuse}}$ where $0^{\circ} < \theta < 90^{\circ}$  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009

Cosine rule	In any triangle *ABC*, $c^2 = a^2 + b^2 - 2ab \cos C$  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Counting number	The **counting numbers** are the non-negative integers, that is, one of the numbers $0, 1, 2, 3, \cdots$, Sometimes it is taken to mean only a positive integer. See also <u>whole number</u>. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Counting on	Counting a collection, or reciting a sequence of number words, from a point beyond the beginning of the sequence. For example, when a child has counted to established that there are 6 objects in a collection and is then asked “How Many?” after several more are added might *count on* from 6 saying “7, 8, 9, ...” to reach the total. This is considered a more sophisticated strategy than counting the whole collection from 1. REFERENCE: McIntosh, A. & Dole, S. (2004). *Mental computation: A strategies approach*. Hobart: Department of Education, Tasmania.
Cylinder	A **cylinder** is a solid that has parallel circular discs of equal radius at the ends. Each cross-section parallel to the ends is a circle with the same radius, and the centres of these circular cross-sections lie on a straight line, called the **axis of the cylinder**.  Outside school, there are more general definitions of a cylinder. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Data	**Data** is a general term for a set of observations and measurements collected during any type of systematic investigation.

Data display	A **data display** is a visual format for organising and summarising data. Examples include, box plots, column graphs, frequency tables and stem plots.
Decimal	A **decimal** is a numeral in the decimal number system. The decimal expansion of a positive real number x is $$x = c_k \cdots c_1 c_0 . d_1 d_2 d_3 \cdots d_n \cdots,$$ where each c_i and each d_i is an Arabic numeral 0,1,2,3,4,5,6,7,8 or 9. The **integer part** of x is represented by $c_k \cdots c_0$, and the **fractional part** by $0. d_1 d_2 d_3 \cdots d_n \cdots$ For example, the decimal expansion of $6\frac{3}{4}$ is 6.75. The integer part is 6 and the fractional part is 0.75 A decimal is terminating if the fractional part has only finitely many decimal digits. It is non-terminating if it has infinitely digits. For example, 6.75 is a terminating decimal, whereas $0.3161616\cdots$, where the pattern 16 repeats indefinitely, is non-terminating. Non-terminating decimals may be recurring, that is, contain a pattern of digits that repeats indefinitely after a certain number of places. For example, $0.3161616\cdots$ is a recurring decimal, whereas $0.101001000100001\cdots$, where the number of 0's between the 1's increases indefinitely, is not recurring. It is common practice to indicate the repeating part of a recurring decimal by using dots or lines as superscripts. For example, $0.3161616\cdots$ could be written as $0.3\dot{1}\dot{6}$ or $0.3\overline{16}$. The decimal expansion of any rational number is either terminating or recurring. The decimal expansion of any irrational number is neither terminating and nor recurring. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Decimal number system	The **decimal number system** is the base 10, place-value system most commonly used for representing real numbers. In this system positive numbers are expressed as sequences of Arabic numerals 0 to 9, in which each successive digit to the left or right of the decimal point indicates a multiple of successive powers (respectively positive or negative) of 10. In the expansion $$x = c_k \cdots c_1 c_0 . d_1 d_2 d_3 \cdots d_n \cdots,$$ the digit c_i, occuring i places to the left of the decimal point, corresponds to the term $c_i \times 10^i$, and the digit d_i, occuring i places to the right of the decimal point, corresponds to the term $d_i \times 10^{-i}$. For example, the number represented by the decimal 12.345 is the sum $$1 \times 10^1 + 2 \times 10^0 + 3 \times 10^{-1} + 4 \times 10^{-2} + 5 \times 10^{-3}.$$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Denominator	In the fraction $\frac{a}{b}$, b is the **denominator**. It is the number of equal parts into which the whole is divided in order to obtain fractional parts. For example, if a line segment is divided into 5 equal parts, each of those parts is one fifth of the whole and corresponds to the unit fraction $\frac{1}{5}$. See also numerator. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992

Dependent variable	See independent variable
Difference	A difference is the result of subtraction one number or algebraic quantity from another. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002
Discrete numerical variable	A **discrete numerical variable** is a numerical variable, each of whose possible values is separated from the next by a definite 'gap'. The most common numerical variables have the counting numbers 0,1,2,3,… as possible values. Others are prices, measured in dollars and cents. Examples include the number of children in a family or the number of days in a month. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Distributive	Multiplication of numbers is **distributive** over addition because the product of one number with the sum of two others equals the sum of the products of the first number with each of the others. This means that we can multiply two numbers by expressing one (or both) as a sum and then multiplying each part of the sum by the other number (or each part of its sum.) For example, $8 \times 17 = 8 \times (10+7) = 8 \times 10 + 8 \times 7 = 80 + 56 = 136$ This **distributive law** is expressed algebraically as follows: $a(b+c) = ab + ac,$ for all numbers a, b and c REFERENCES: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002 Patilla, P. (2003). *Oxford primary maths dictionary*. Oxford: Oxford University Press.
Divisible	In general, a number or algebraic expression x is **divisible** by another y if there exists a number or algebraic expression q of a specified type for which $x = yq$. A natural number m is divisible by a natural number n if there is a natural number q such that $m = nq$. For example, 12 is divisible by 4 because $12 = 3 \times 4$. A polynomial $a(x)$ is divisible by a polynomial $b(x)$ if there is a polynomial $q(x)$ for which $a(x) = q(x)b(x)$. For example, $x^2 - 6x + 8$ is divisible by $x - 2$ because $x^2 - 6x + 8 = (x-4)(x-2)$. See also factor. REFERENCE: Mathematics Dictionary, 5th edition, James and James,1992
Dot plot	A **dot plot** is a graph used in statistics for organising and displaying numerical data. Using a number line, a dot plot displays a dot for each observation. Where there is more that one observation, or observations are close in value, the dots are stacked vertically. If there are a large number of observations, dots can represent more than one observation. Dot plots are ideally suited for organising and displaying discrete numerical data. The dot plot below displays the number of passengers observed in 32 cars stopped at a traffic light.



Dot plots can also be used to display categorical data, with the numbers on the number line replaced by category labels.

See also, histogram and stem plot.

REFERENCE: Chance encounters
A first course in data analysis and inference
Christopher J. Wild & George A. F. Seber
2000

Element

An **element** of a set is a member of that set. For example, the elements of the set $\{2,3,4,6,8\}$ are the numbers $2,3,4,6$ and 8. We write $x \in S$ to indicate that x is a member of the set S.
REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson 2009

Enlargement (Dilation)

An enlargement is a scaled up (or down) version of a figure in which the transformed figure is in proportion to the original figure. The relative positions of points are unchanged and the two figures are similar.

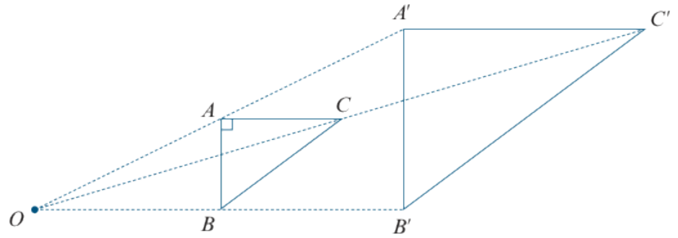
- An **enlargement** is specified by a **centre of enlargement** *O*, and an **enlargement factor** $k > 0$.
- The enlargement moves each point *P* to a point *P′* on the ray *OP*.
- The distance *OP′* is *k* times the distance *OP*. That is,

$$OP' = k \times OP.$$

- If $k > 1$, then the image of any plane figure is larger than the original.
  If $k < 1$, then the image of any plane figure is smaller than the original.
  If $k = 1$, then no point moves, and the image of any plane figure is the same as the original.

Properties of an enlargement

- The image of an interval is *k* times the length of the original interval.
- The image of an angle has the same size as the original angle.
- The image of an interval is parallel to the original interval.

	In the diagram below triangle *A′B′C′* is the image of triangle *ABC* under the enlargement with enlargement factor 2 and centre of enlargement *O*.  REFERENCE: The University of Chicago Mathematics Project Arthur Coxford, Zalman Usikin, Daniel Hirschorn 1991
Equally Likely outcomes	Equally likely outcomes occur with the same probability. For example, in tossing a fair coin, the outcome 'head' and the outcome 'tail' are equally likely. In this situation, Pr(head) = Pr(tail) = 0.5 REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Equation	An **equation** is a statement that asserts that two numbers or algebraic expressions are equal in value. An equation must include an equal sign. For example, $$3 + 14 = 11 + 6.$$ An **identity** is an equation involving algebraic expressions that is true for all values of the variables involved. For example $x^2 - 4 = (x - 2)(x + 2)$. A **conditional equation** is one that is true for only some values of the variables involved. For example, $x^2 - 3x - 10 = 0$ is a conditional equation; it is true only for $x = 5$ and $x = -2$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Equivalent fractions	Two fractions $\frac{a}{b}$ and $\frac{c}{d}$ are **equivalent** if they are equal, that is, $ad = bc$. Equivalent fractions are alternative ways of writing the same fraction. For example, $\frac{1}{2} = \frac{2}{4} = \frac{3}{6} = \cdots$ Every fraction is equivalent to infinitely many others. Of these, there is one in **simplest form**, that is, a fraction in which the numerator and denominator have no common factors (other than 1). The simplest form is obtained by dividing both the numerator and the denominator by their greatest common divisor. For example, the greatest common divisor of 96 and 120 is 24. So $\frac{96}{120}$ is equivalent to its reduced form $\frac{96 \div 24}{120 \div 24} = \frac{4}{5}$. REFERENCES: Mathematics Dictionary, 5th edition, James and James, 1992 Illustrated Maths Dictionary, J. De Klerk, 2010
Euler number e	The Euler number e is an irrational real number whose decimal expansion

	begins $$e = 2.718281828\cdots$$ As a number it perhaps as important for calculus as π is for geometry. It is the base used for natural logarithms. It can be approximated as closely as desired by evaluating $(1+\frac{1}{n})^n$ for large values of n. REFERENCES: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Estimate	In statistical terms, an **estimate** is information about a population extrapolated from a sample of the population. For example, the mean number of decayed teeth in a randomly selected group of eight-year old children is an estimate of the mean number of decayed teeth in eight-year old children in Australia. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Even number	A whole number is **even** if it is divisible by 2. The even whole numbers are $0,2,4,6,\cdots$. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Event	An **event** is a subset of the sample space for a random experiment. For example, the set of outcomes from tossing two coins is { HH,HT,TH,TT }, where H represents a 'head' and T a 'tail'. For example, if *A* is the event 'at least one head is obtained', then *A* = { HT,TH, HH }. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Expected frequency	An **expected frequency** is the number of times that a particular event is expected to occur when a chance experiment is repeated a number of times. For example, If the experiment is repeated *n* times, and on each of those times the probability that the event occurs is *p*, then the expected frequency of the event is *np*. For example, suppose that a fair coin is tossed 5 times and the number of heads showing recorded. Then the expected frequency of 'heads' is 5/2. This example shows that the expected frequency is not necessarily an observed frequency, which in this case is one of the numbers 0,1,2,3,4 or 5. See also frequency . REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998

Exponent	The **exponent** or index of a number or algebraic expression is the power to which the latter is be raised. The exponent is written as a superscript. Positive integral exponents indicate the number of times a term is to be multiplied by itself. For example, $a^3 = a \times a \times a$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Expression	Two or more numbers or variables connected by operations. For example, 17 – 9, 8 x (2 + 3), 2*a* + 3*b* are all expressions. Expressions do not include an equal sign. REFERENCE: Grimison, L. & Kerslake, D. (Eds.). (1986). *HBJ Dictionary of mathematics.* London: Harcourt, Brace, Jovanovich. De Klerk, J. (2010). *Illustrated Maths Dictionary*. Sydney: Pearson.
Factor	In general, a number or algebraic expression x is a **factor** (or **divisor**) of another y if there exists a number or algebraic expression q of a specified type for which $y = xq$. A natural number m is a factor of a natural number n if there is a natural number q such that $n = mq$. For example, 4 is a factor of 12 because $12 = 3 \times 4$. A polynomial $a(x)$ is divisible by a polynomial $b(x)$ if there is a polynomial $q(x)$ for which $a(x) = b(x)q(x)$. For example, $x - 2$ is a factor $x^2 - 6x + 8$ because $x^2 - 6x + 8 = (x - 4)(x - 2)$. See also divisible. REFERENCE: Mathematics Dictionary, 5th edition, James and James,1992
Factorise	To **factorise** a number or algebraic expression is to express it as a product. For example, 15 is factorised when expressed as a product: $15 = 3 \times 5$, and $x^2 - 3x + 2$ is factorised when written as a product: $x^2 - 3x + 2 = (x - 1)(x - 2)$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Factor theorem	According to the **factor theorem**, if $p(x)$ is a polynomial and $p(a) = 0$ for some number a, then $p(x)$ is divisible by $x - a$. This follows easily from the remainder theorem, because for $p(x) \div (x - a)$ the remainder is $p(a)$. So if $p(a) = 0$, the remainder is 0 and $p(x)$ is divisible by $x - a$. The factor theorem can be used to obtain factors of a polynomial. For example, if $p(x) = x^3 - 3x^2 + 5x - 6$, then it is easy to check that $p(2) = 2^3 - 3 \times 2^2 + 5 \times 2 - 6 = 0$. So by the factor theorem $x - 2$ is a factor of $x^3 - 3x^2 + 5x - 6$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Five-number-summary	A **five-number-summary** is a method for summarising a data set using five statistics, the minimum value, the lower quartile, the median, the upper quartile and the maximum value. The example below uses a five-number summary to compare the pulse rates of 19 students before and after engaging in gentle exercise.

	Pulse rate Before / After Minimum: 68 / 88 Lower quartile: 70 / 90 Median: 76 / 98 Upper quartile 82 / 104 Maximum: 110 / 146 The box-and-whisker plot is a graphical representation based on the five-number summary. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Formal unit	Formal units are part of a standardised system of units for measurement. For example, formal units for length include millimetres, centimetres, metres and kilometres which are all part of the Système Internationale d' Unités (SI system of units). REFERENCE: Booker, G., Bond, D., Sparrow, L. & Swan, P. (2004). *Teaching primary mathematics. 3rd ed.).* Frenchs Forest: Pearson.
Fraction	The **fraction** $\frac{a}{b}$ (written alternatively as a/b), where a is a non negative integer and b is a positive integer, was historically obtained by dividing a unit length into b equal parts and taking a of these parts. For example, $\frac{3}{5}$ refers to 3 of 5 equal parts of the whole, taken together. In the fraction $\frac{a}{b}$ the number a is the numerator and the number b is the denominator. It is a **proper fraction** if $a < b$ and an **improper fraction** otherwise. Ratios of algebraic expressions are also called regarded as fractions. See algebraic fraction. The rules for equality, addition, subtraction multiplication and division of fractions (of all types) are $\frac{a}{b} = \frac{c}{d} \leftrightarrow ad = bc, \quad \frac{a}{b} \pm \frac{c}{d} = \frac{ad \pm bc}{bd}, \quad \frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}, \text{ and } \frac{a}{b} \div \frac{c}{d} = \frac{ad}{bc}.$ REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002
Frequency	**Frequency**, or **observed frequency**, is the number of times that a particular value occurs in a data set. For grouped data, it is the number of observations that lie in that group or class interval. See also expected frequency, observed frequency and relative frequency**.** REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Frequency table	A **frequency table** lists the frequency (number of occurrences) of observations in different ranges, called class intervals.

The frequency distribution of the heights (in cm) of a sample of 42 people is displayed in the **frequency table** below

Height (cm)

Class interval	Frequency
155-<160	3
160-<165	2
165-<170	9
170-<175	7
175-<180	10
180-<185	5
185-<190	5
185-<190	5

Frequency distribution

A **frequency distribution** is the division of a set of observations into a number of classes, together with a listing of the number of observations (the frequency) in that class.

Frequency distributions can be displayed in tabular or graphical form.

See also, column graph, frequency table, dot plot, histogram and stem –and-leaf plot.

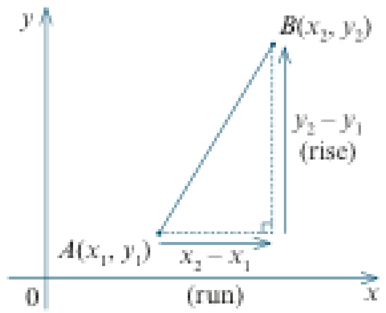
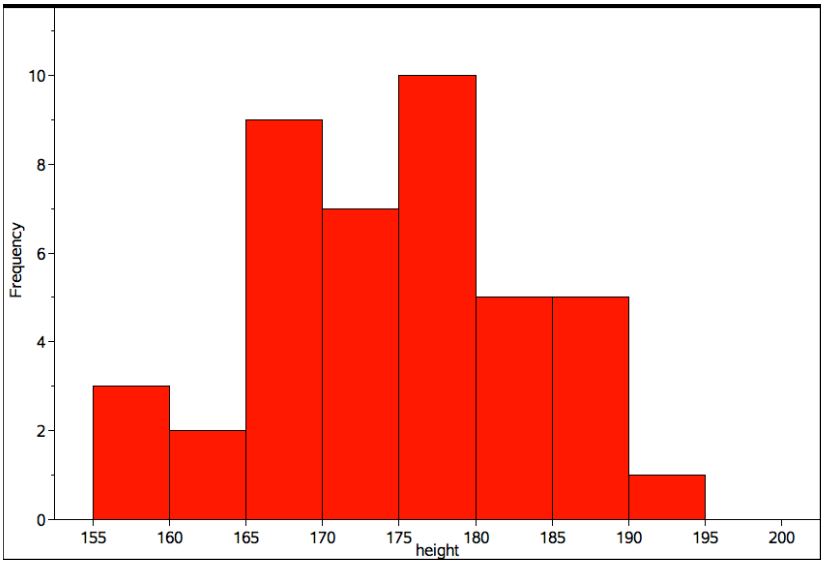
REFERENCE: The Cambridge Dictionary of Statistics
B. S. Everitt,
1998

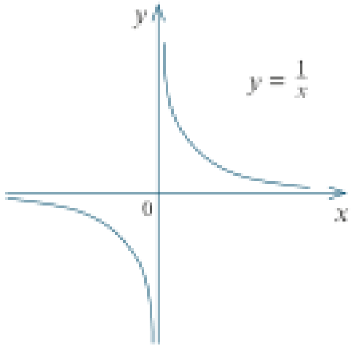
Function

A **function** f assigns to each element of one set S precisely one element of a second set T. The set S is the **domain** of the function, and T is the **codomain**. The element in T assigned by an element x in S is denoted by $f(x)$: it is "the **image** of x under f". This can be expressed as $f: x \to f(x)$, which is read as "f maps x to $f(x)$".
The functions most commonly encountered in elementary mathematics are real functions of real variables. For such functions, the domain and codomain are sets of real numbers.
Functions are usually defined by a formula for $f(x)$ in terms of x. For example, the formula $f(x) = x^2$ defines the 'squaring function' that maps each real number x to its square x^2.
The domain and codomain of a function f are often determined implicitly by the formula for $f(x)$. For example, for the 'square root' function $f(x) = \sqrt{x}$, the domain and codomain are usually taken to be the set of non-negative numbers, because $\sqrt{x}$ is defined only for non-negative numbers, and its value is always non-negative.
REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009

Gradient

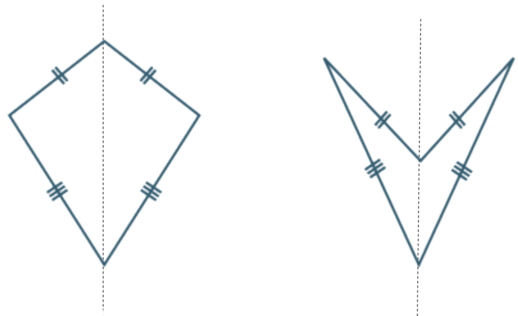
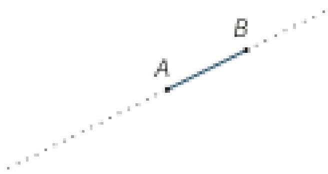
If $A(x_1,y_1)$ and points $B(x_2, y_2)$ are points in the plane, $x_2 - x_1 \neq 0$, the **gradient** of the line segment (interval) $AB = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$.

	 The **gradient of a line** is the gradient of any line segment (interval) within the line.
Greatest common divisor	The **greatest common divisor (**gcd), **greatest common factor** (gcf) or **highest common factor** (hcf), of a given set of natural numbers is the common divisor of the set that is greater than each of the other common divisors. For example, $1, 2, 3$, and 6 are the common factors of $24, 54$ and 66, and 6 is the greatest common divisor. See also common factor. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Histogram	A **histogram** is a statistical graph for displaying the frequency distribution of continuous data. A histogram is a graphical representation of the information contained in a frequency table. In a histogram, class frequencies are represented by the areas of rectangles centred on each class interval. The class frequency is proportional to the rectangle's height when the class intervals are all of equal width. The histogram below displays the frequency distribution of the heights (in cm) of a sample of 42 people with class intervals of width 5 cm. 

	See also, box-and-whisker plot, dot plot and stem-and-leaf plot. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Rectangular Hyperbola	The graph of $y = \frac{1}{x}$ is called a **rectangular hyperbola**. The *x* and *y* axes are asymptotes as the curve gets as close as we like to them.  The graphs of $y = \frac{c}{x}$ and $y = \frac{ax+b}{cx+d}$ are also rectangular hyperbolas. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Index	**Index** is synonymous with exponent. See also index law. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Index law	Index laws are rules for manipulating indices (**exponents**). They include $x^a x^b = x^{a+b}$; $(x^a)^b = x^{ab}$; and $x^a y^a = (xy)^a$ and $x^0 = 1$; $x^{-a} = \frac{1}{x^a}$; and $x^{1/a} = \sqrt[a]{x}$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Identity	An identity is an equation that is true for all values of the variables involved. Example: $x^2 - y^2 = (x-y)(x+y)$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Independent event	Two events are **independent** if knowing the outcome of one event tells us nothing about the outcome of the other event. In a probability context, two events *A* and *B* are said to be pairwise independent if Pr(*A* and *B*) = Pr(*A*) × Pr(*B*). See also probability. REFERENCE: The Cambridge Dictionary of Statistics

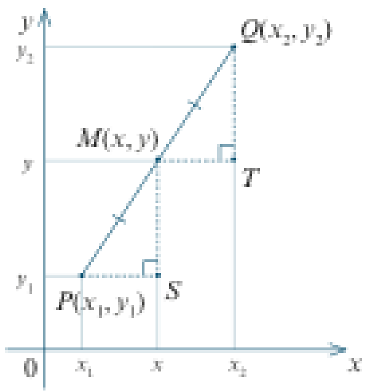
	B. S. Everitt, 1998
Independent variable	When investigating relationships in bivariate data, the **explanatory variable** is the variable that may explain or cause a difference in the r**esponse variable**. For example, when investigating the relationship between the temperature of a loaf of bread and the time it has spent in a hot oven, *temperature* is the response variable and *time* is the explanatory variable. With numerical bivariate data it is common to attempt to model such relationships with a mathematic equation and to call the response variable the **dependent variable** and the explanatory variable the **independent variable**. When graphing numerical data, the convention is to display the response (dependent) variable on the vertical axis and the explanatory (independent) variable on the horizontal axis. When there is no clear causal link between the events, the classification of the variables as either the dependent or independent variable is quite arbitrary. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Inequality	An **inequality** is a statement that one number or algebraic expression is less than (or greater than) another. There are four types of inequalities: The relation a is less than b is written $a < b$, a is greater than b is written $a > b$, a is less than or equal to b is written $a \leq b$, and a is greater than or equal to b is written $a \geq b$. An inequality may be conditional or absolute, depending on whether it is true just for some values of the variables involved or for all values. For example $2x + 5 < 11$ is conditional because it is true only for $x < 3$, whereas $2xy \leq x^2 + y^2$ is absolute because it is true for all real numbers x and y. REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
Informal unit	Informal units are not part of a standardised system of units for measurement. For example, an informal unit for length could paperclips of uniform length. An informal unit for area could be uniform paper squares of any size. Informal units are sometimes referred to as non-standard units. REFERENCE: Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: A developmental approach (7th ed.).* Boston: Pearson.
Integer	The **integers** are the 'whole numbers' $\cdots, -3, -2, -1, 0, 1, 2, 3, \cdots$. The set of integers is usually denoted by $\mathbb{Z}$. Integers are basic building blocks in mathematics. Knonecker said, 'God made the integers; everything else is the work of man.' REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition

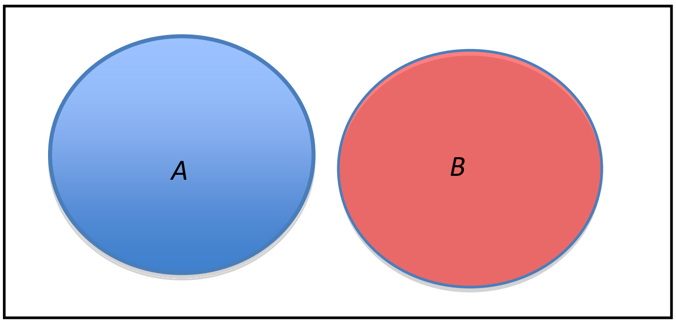
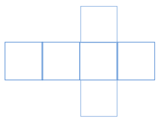
	C Clapham & J. Nicholson 2009
Interquartile range	The **interquartile range** (IQR) is a measure of the spread within a numerical data set. It is equal to the upper quartile (Q_3) minus the lower quartiles (Q_1); that is, $IQR = Q_3 – Q_1$ The IQR is the width of an interval that contains the middle 50% (approximately) of the data values. To be exactly 50%, the sample size must be a multiple of four. Unlike the standard deviation, the IQR is relatively unaffected by the shape of the data distribution and outliers. See also standard deviation. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Interval	An interval is a certain type of subset of the number line. A **finite interval** is the set of all real numbers between two given real numbers called the **end points** of the interval. The end points may or may not be included in the interval, and so there are four types of finite interval: $[a, b]$ denotes the interval consisting of real numbers x that satisfy the inequalities $a \le x \le b$, (a, b) denotes the interval consisting of real numbers x that satisfy the inequalities $a < x < b$, $[a, b)$ denotes the interval consisting of real numbers x that satisfy the inequalities $a \le x < b$, $(a, b]$ denotes the interval consisting of real numbers x that satisfy the inequalities $a < x \le b$, An **infinite** interval on the real line is the set of all real numbers that lie to one side of a given real number called the end point of the interval. The end point may or may not be included in the interval, and so there are four types of infinite interval: $[a, \infty)$ denotes the interval consisting of real numbers x that satisfy the inequality $a \le x$, (a, ∞) denotes the interval consisting of real numbers x that satisfy the inequality$a < x$, $(-\infty, a]$ denotes the interval consisting of real numbers x that satisfy the inequality $x \le a$, $(-\infty, a)$ denotes the interval consisting of real numbers x that satisfy the inequality $x < a$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Irrational number	An irrational number is a real number that is not rational. Some commonly used irrational numbers are π, e and $\sqrt{2}$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Irregular shape	An irregular shape can be a polygon. A polygon or polyhedron that is not regular is irregular. REFERENCES: Alchian, A. A., Beckenbach, E. F., Bell, C., Craig, H. V., James, G., James, R. C., Michal, A. D., & Sokolnikoff, I. S. (1968). *James &*

	James mathematics dictionary (3rd ed.). New York: Van Nostrand Reinhold. Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: A developmental approach (7th ed.).* Boston: Pearson.
Kite	A **kite** is a quadrilateral with two pairs of adjacent sides equal.  A kite may be convex as shown in the diagram above to the left or non-convex as shown above to the right. The **axis** of the kite is shown. **Properties of a kite** • A kite has an axis of symmetry called simply the axis. • The angles opposite the axis of a kite are equal. • The axis of a kite bisects the vertex angles through which it passes. • The axis of a kite is the perpendicular bisector of the other diagonal. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Line segment (Interval)	If *A* and *B* are two points on a line, the part of the line between and including *A* and *B* is called a **line segment** or **interval**. The **distance** *AB* is a measure of the size or length of *AB*.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Linear equation	A **linear equation** is an equation involving just linear terms, that is, polynomials of degree 1. The general form of a linear equation in one variable is $ax + b = 0$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Location(statistics)	A measure of **location** is a single number that can be used to indicate a central or 'typical value' within a set of data.

	The most commonly used measures of location are the mean and the median although the mode is also sometimes used for this purpose. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Logarithm	The **logarithm** of a positive number x is the power to which a given number b, called the **base**, must be raised in order to produce the number x. The logarithm of x, to the base b is denoted by $\log_b x$. Algebraically: $$\log_b x = y \leftrightarrow b^y = x$$ For example, $\log_{10} 100 = 2$ because $10^2 = 100$, and $\log_2\left(\frac{1}{32}\right) = -5$ because $2^{-5} = \frac{1}{32}$. The base b can be any positive number except 1. The most commonly used values of the base are 10, 2 and the Euler number e. Logarithms satisfy the following rules, commonly known as **logarithm laws**: $$\log_b(xy) = \log_b x + \log_b y,$$ $$\log_b 1 = 0, \quad \text{and}$$ $$\log_b x^n = n \log_b x,$$ REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Many-to-one correspondence	A **many-to-one correspondence** is a function or mapping that takes the same value for at least two different elements of its domain. For example, the squaring function $x \mapsto x^2$ is many-to-one because $x^2 = (-x)^2$ for all real numbers x. A many-to-one function does not have an inverse, since there is no way to define a function to return more than one value. However a many-to-one function can be restricted to a domain within which it is a one-to-one function, and for which an inverse exists. For example, the square root function $x \mapsto \sqrt{x}$ is the inverse of the squaring function restricted to $x \geq 0$. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Mean	The arithmetic **mean** of a list of numbers is the sum of the data values divided by the number of numbers in the list. In everyday language, the arithmetic mean is commonly called the **average**. For example, for the following list of five numbers { 2, 3, 3, 6, 8 } the mean equals $\frac{2+3+3+6+8}{5} = \frac{22}{5} = 4.4$ When every member of a population is sampled, the **population mean** μ can be determined by evaluating $$\mu = \frac{\sum_{i=1}^{n} x_i}{n}$$ where $x_1, x_2, \ldots, x_n$ are the n values that comprise the population data. It is usually neither possible nor practical to sample all members of a population. In such cases, it usual to estimate the population mean by taking

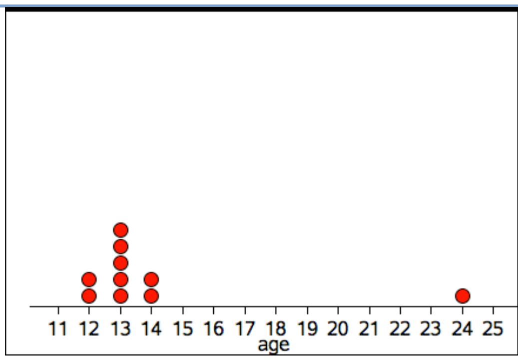
	a random sample from the population and calculating the **sample mean** $\overline{x}$ which is given by: $$\overline{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$ where x_1, x_2, …., x_n where x_1, x_2, …., x_n are the n values that comprise the sample data. The sample mean is used as a measure of location or central value of a continuous variable. It is most useful when the data values are symmetrically distributed and there are no outliers. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Median	The **median** is the value in a set of ordered data that divides the data into two parts. It is frequently called the 'middle value'. Where the number of observations is odd, the median is the middle value. For example, for the following ordered data set with an **odd** number of observations, the median value is five. 1 3 3 4 5 6 8 9 9 Where the number of observations is **even**, the median is calculated as the mean of the two central values. For example, in the following ordered data set, the two central values are 5 and 6, and median value is the mean of these two values, 5.5 1 3 3 4 5 6 8 9 9 10 The median provides a measure of location of a data set that is suitable for both symmetric and skewed distributions and is also relatively insensitive to outliers. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Midpoint	The **midpoint** *M* of a line segment (interval) *AB* is the point that divides the segment into two equal parts. Let $A(x_1, y_1)$ be points in the Cartesian plane. Then the **midpoint** *M* of line segment *AB* has coordinates $$\left(\frac{x_1 + x_2}{2}, \frac{x_1 + x_2}{2}\right).$$ This can be seen from the congruent triangles below.

	 REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Mode	The **mode** is the most frequently occurring value in a set of data. There can be more than one mode. When there are two modes, the data set is said to be **bimodal**. The mode is sometimes used as a measure of location. See also average, mean and median. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Monic	A **monic** polynomial is one in which the coefficient of the leading term is 1. For example, $x^3 + 2x^2 - 7$ is monic, but $4x^2 - x + 1$ is not. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002
Multiple	A multiple of a number is the product of that number and an integer. A multiple of a real number x is any number that is a product of x and an integer. For example, 4.5 and -13.5 are multiples of 1.5 because $4.5 = 3 \times 1.5$ and $13.5 = -7 \times 1.5$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002 Daintith, J. & Nelson, R. D. (Eds.). (1989). *The Penguin dictionary of mathematics.* London: Penguin Books.
Multiplicative situations	Multiplicative situations are problems or contexts that involve multiplication (or division). Calculating the number of seats in a theatre that has 30 rows of 24 seats, finding equivalent fractions, and working with ratios and percentages are all multiplicative situations. REFERENCE: Siemon, D., & Breed, M. (2006). *Assessing multiplicative thinking using rich tasks.* Paper presented at the annual conference of the Australian Association for Research in Education.

Mutually exclusive events	Two events *A* and *B* are **mutually exclusive** if one is incompatible with the other; that is, if they cannot be simultaneous outcomes in the same chance experiment. When events are considered as subsets of a sample space, their intersection is empty. For example, when a fair coin is tossed twice, the events 'HH' and 'TT' cannot occur at the same time and are, therefore, mutually exclusive. In a Venn diagram, as shown below, mutually exclusive events do not overlap. 
Natural numbers	A **natural number** is a positive integer or counting number. The natural numbers are $1,2,3,\cdots$. The set of natural numbers is usually denoted by $\mathbb{N}$. REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
Net	A **net** is a plane figure that can be folded to form a polyhedron. One possible net for a cube is shown to the right.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Number line	A **number line** gives a pictorial representation of real numbers. To construct

	a number line choose a point O on a horizontal line as origin, and a point A on the line to the right of O and at unit distance from O. Each positive number x corresponds to the point on the line to the right of O and whose distance from O is x units. Each negative number x corresponds to the point on the line to the left of O and whose distance from O is $-x$ units. The point O is called the origin, and corresponds to the number 0. The point A corresponds to the number 1. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Numeral	A figure or symbol used to represent a number. For example, -3, 0, 45, IX REFERENCES: O'Brien, H. & Purcell, G. (2004). *The New Primary Mathematics Handbook*. St Leonards, NSW: Horwitz Education. De Klerk, J. (2010). *Illustrated Maths Dictionary*. Sydney: Pearson.
Numerator	In the fraction $\frac{a}{b}$, a is the **numerator**. If an object is divided into b equal parts, then the fraction $\frac{a}{b}$ represents a of these parts taken together. For example, if a line segment is divided into 5 equal parts, each of those parts is one fifth of the whole and 3 of these parts taken together corresponds to the fraction $\frac{3}{5}$. See also denominator REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
Numerical data	**Numerical data** is data associated with a numerical variable.
Numerical variable	**Numerical variables** are variables whose values are numbers, and for which arithmetic processes such as adding and subtracting, or calculating an average, make sense. The distinction here is between numerical variables and categorical variables whose values have numerical labels. For example, for a group of students, *average age* and *height* are numerical variables, because it makes sense to calculate the average age of the group, or compute the difference in height between two students. However *address postcode* and *mobile phone number* are not numerical variables. It does not make sense to calculate the average postcode or the numerical difference of two mobile phone numbers. Another commonly used term for numerical variable is **quantitative variable**. Numerical variables can be further classified as discrete or continuous. See also categorical variable. REFERENCE: Chance encounters A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Observed	See frequency.

frequency	
Odd number	An **odd number** is an integer that is not divisible by 2. The odd numbers are $\cdots -5, -3, -1, 1, 3, 5, \cdots$. REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
One-to-one correspondence	In early counting development one-to-one correspondence refers to the matching of one and only one number word to each element of a collection. More generally it refers to a relationship between two sets such that every element of the first set corresponds to one and only one element of the second set. REFERENCE: Committee on Early Childhood Mathematics. (2009). *Mathematics in early childhood.* Washington, DC: The National Academies Press. Grimison, L. & Kerslake, D. (Eds.). (1986). *HBJ Dictionary of mathematics.* London: Harcourt, Brace, Jovanovich. Alchian, A. A., Beckenbach, E. F., Bell, C., Craig, H. V., James, G., James, R. C., Michal, A. D., & Sokolnikoff, I. S. (1968). *James & James mathematics dictionary (3rd ed.).* New York: Van Nostrand Reinhold. Daintith, J. & Nelson, R. D. (Eds.). (1989). *The Penguin dictionary of mathematics.* London: Penguin Books.
Operation	The process of combining numbers or expressions. In the primary years operations include addition, subtraction, multiplication and division. In later years operations include substitution and differentiation. REFERENCES: Grimison, L. & Kerslake, D. (Eds.). (1986). *HBJ Dictionary of mathematics.* London: Harcourt, Brace, Jovanovich.
Order of operations	A convention for simplifying expressions that stipulates that multiplication and division are performed before addition and subtraction and in order from left to right. For example, in 5 – 6 ÷ 2 +7, the division is performed first and the expression becomes 5 – 3 + 7 = 9. If the convention is ignored and the operations are performed in order, the incorrect result, 6.5 is obtained. REFERENCE: Alchian, A. A., Beckenbach, E. F., Bell, C., Craig, H. V., James, G., James, R. C., Michal, A. D., & Sokolnikoff, I. S. (1968). *James & James mathematics dictionary (3rd ed.).* New York: Van Nostrand Reinhold. Grimison, L. & Kerslake, D. (Eds.). (1986). *HBJ Dictionary of mathematics.* London: Harcourt, Brace, Jovanovich.
Outcome	See random experiment.
Outlier	An **outlier** is a data value that appears to stand out from the other members of the data set by being unusually high or low. The most effective way of identifying outliers in a data set is to graph the data. For example, in following list of ages of a group of 10 people, { 12, 12, 13, 13, 13, 13, 13, 14, 14, 14, 24 }, the 24 would be considered to be a possible outlier.



Outliers may simply reflect an error of recording, 24 written down rather than 14, or an individual who, in terms of age, does not naturally belong to this group. In this case the individual may be a teacher taking a group of 9 students on an excursion.

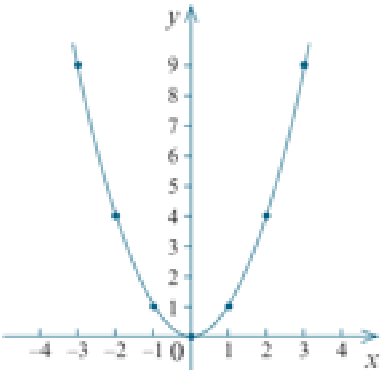
See also box-and-whisker plots.

REFERENCE: The Cambridge Dictionary of Statistics
B. S. Everitt,
1998

Parabola

Definition 1

The graph of $y = x^2$ is called a **parabola**. The point (0, 0) is called the **vertex** of the parabola and the y axis is the axis of symmetry of the parabola called simply the **axis**.



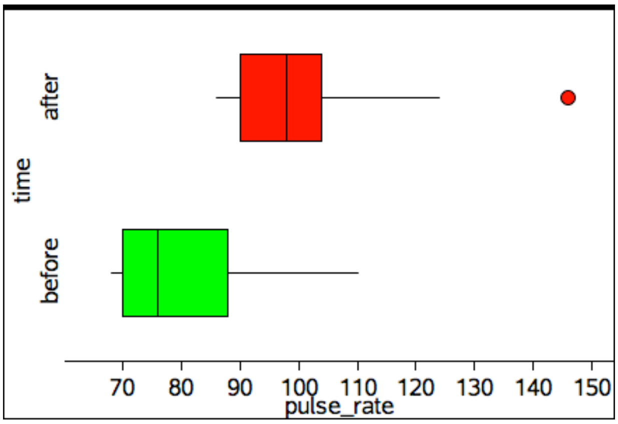
Some other parabolas are the graphs of $y = ax^2 + bx + c$ where $a \neq 0$.

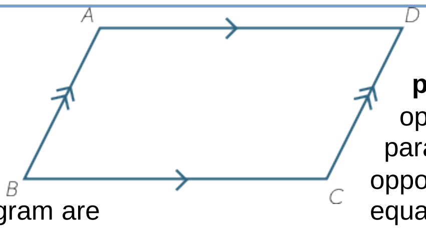
More generally, every **parabola** is similar to the graph of $y = x^2$.

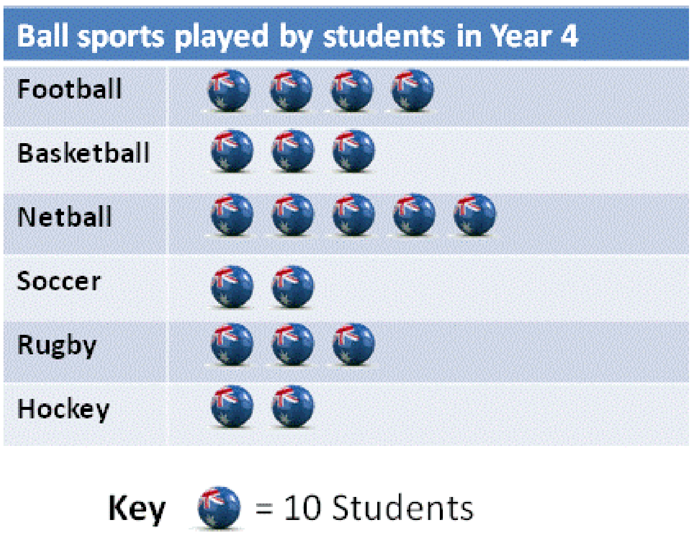
Definition 2

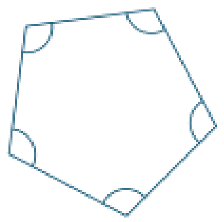
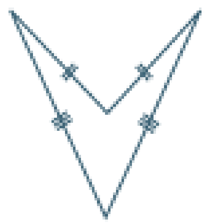
A parabola is the locus of all points P such that the distance from P to a fixed point F is equal to the distance from P to a fixed line l.

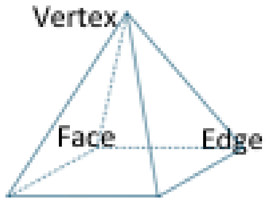
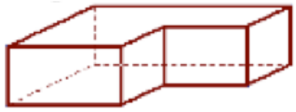
Definition 3

	A parabola is the conic section formed by a plane parallel to an edge of the conical surface. REFERENCE: The University of Chicago Mathematics Project Arthur Coxford, Zalman Usikin, Daniel Hirschorn 1991 REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Parallel box plots	**Parallel box-and-whisker-plots** are used to visually compare the five-number summaries of two or more data sets. For example, box-and-whisker-plots below can be used to compare the five-number summaries for the pulse rates of 19 students before and after gentle exercise.  Note that the box plot for pulse rates after exercise shows the pulse rate of 146 as a possible outlier (③). This is because the distance of this data point above the upper quartile 42 (146-104) is more than 21 (1.5 × IQRs = 1.5 × (104 – 90) = 1.5 × 14 = 21). The term 'parallel box-and-whisker plots' is commonly abbreviated to 'parallel boxplots'. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Parallelogram	A **parallelogram** is a quadrilateral whose opposite sides are parallel. Thus the quadrilateral *ABCD* shown below is a parallelogram because *AB* || *DC* and *DA* || *CB*.

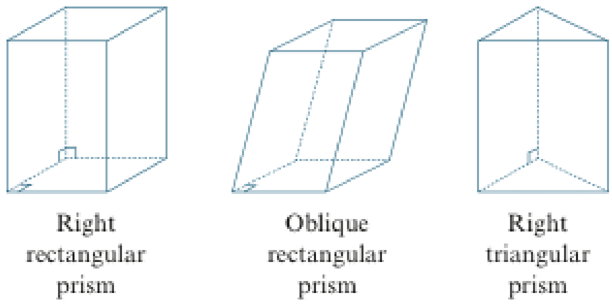
	 **Properties of a parallelogram** • The opposite angles of a parallelogram are equal. • The opposite sides of a parallelogram are equal. • The diagonals of a parallelogram bisect each other. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Partitioning	Dividing a quantity into parts. In the early years it commonly refers to the ability to think about numbers as made up of two parts, for example, 10 is 8 and 2. In later years it refers to dividing both continuous and discrete quantities into equal parts. REFERENCE: Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: A developmental approach (7th ed.).* Boston: Pearson. Siemon, D. Partitioning: The missing link in building fraction knowledge and confidence. Retrieved from http://www.ltag.education.tas.gov.au/focus/beingnumerate/Partitioning.pdf
Percentage	A **percentage** is a fraction whose denominator is 100. For example, 6 percent (written as 6%) is the percentage whose value is $6/100$. Similarly, 40 as a percentage of 250 is $\frac{40}{250} \times 100 = 16\%$ REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Percentile	**Percentiles** are the values that divide an ordered data set into 100 (approximately) equal parts. It is only possible to divide a data set into exactly 100 equal parts when the number of data values is a multiple of one hundred. There are 99 percentiles. Within the above limitations, the first percentile divides off the lower 1% of data values. The second, the lower 2% and so on. In particular,the **lower quartile** (Q_1) is the 25th percentile, the **median** is the 50th percentile and the **upper quartile** is the 75th percentile. In general, the *p*th percentile is a number that has *p*% of the data at or below its values and (100-p)% at or above that value. Thus a newly born baby with a body weight above the 65th percentile has a higher body weight than 65% of other newly born babies. A student whose test score on a national test is above the 90th percentile is placed in the top 10% of students sitting for this test. See also quartiles. REFERENCE: Chance encounters A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Perimeter	The **perimeter** of a plane figure is the length of its boundary.

	REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Pi	**Pi** is the name of the Greek letter π, that is used to denote the ratio of the circumference of any circle to its diameter. The number π is irrational, but $22/7$ is a rational approximation accurate to 2 decimal places. The decimal expansion of π begins $\pi = 3.141\ 592\ 653\ 589\ 79 \cdots.$ There is a very long history of attempts to estimate π accurately. One of the early successes was due to Archimedes (287–212 BC) who showed that $3\frac{10}{71} < \pi < 3\frac{1}{7}$. The decimal expansion of π has now been calculated to at least the first 10^{12} places. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Picture graphs	A **picture graph** is a statistical graph for organising and displaying categorical data. A pictograph is similar to a bar chart, but uses a number of identical graphic symbols (pictograms) to indicate the observed frequency rather than bar length. In a pictograph, each symbol can represent one or more data values. 
Place value	The value of digit as determined by its position in a number relative to the ones (or units) place. For integers the ones place is occupied by the rightmost digit in the number. For decimal numbers, the ones place is immediately to the left of the decimal point. The value of each place is ten times the value of the place immediately to its right and one tenth of the value of the place to its left. For example in the number 2 594.6 the 4 denotes 4 ones, the 9 denotes 90 ones or 9 tens, the 5 denotes 500 ones or 5 hundreds, the 2 denotes 2000 ones or 2 thousands,

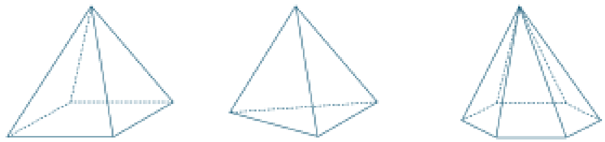
	and the 6 denotes $\frac{6}{10}$ of a one or 6 tenths. REFERENCES: Grimison, L. & Kerslake, D. (Eds.). (1986). *HBJ Dictionary of mathematics.* London: Harcourt, Brace, Jovanovich. Alchian, A. A., Beckenbach, E. F., Bell, C., Craig, H. V., James, G., James, R. C., Michal, A. D., & Sokolnikoff, I. S. (1968). *James & James mathematics dictionary (3rd ed.).* New York: Van Nostrand Reinhold.
Point	A **point** marks a position, but has no size. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Polygon	A **polygon** is plane figure bounded by line segments.  The figure shown above is a **regular pentagon.**_ It is a convex five-sided polygon. It is called a **pentagon** because it has five sides. It is called **regular** because all sides have equal length and all interior angles are equal.  The polygon shown above is a non-convex kite. A polygon is called **convex** if every diagonal lies within the polygon and it is called **non-convex** otherwise. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Polyhedron	A **polyhedron** is a solid figure bounded by plane polygonal faces. Two adjacent faces intersect at an edge and each edge joins two vertices.

	 The polyhedron shown above is a pyramid with a square base. It has 5 vertices, 8 edges and 5 faces. It is a convex polyhedron.  The figure above is a non-convex polyhedron. A **convex polyhedron** is a finite region bounded by planes, in the sense that the region lies entirely on one side of the plane. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Polynomial	A polynomial in one variable x (simply called a **polynomial**) is a finite sum of terms of the form ax^k, where a is a number and k is a non-negative integer. A non-zero polynomial can be written in the form $$a_0 + a_1 x + a_2 x^2 + \cdots + a_n x^n,$$ where n is a non-negative integer and $a_n \neq 0$. The numbers $a_0, a_1, a_2, \cdots, a_n$ are the **coefficients**. The **degree** of this polynomial is n, and its **leading term** is $a_n x^n$. For example, for the polynomial $2 - 3x + 5x^2 - 7x^3$, the coefficients are $2, -3, +5 \text{ and } -7$, the degree is 3 and the leading term is $-7x^3$. Polynomials of low degree are given special names. A polynomial of degree 1 is called a **linear polynomial**; its general form is $a + bx$, with $b \neq 0$, A polynomial of degree 2 is called a **quadratic polynomial**; its general form is $a + bx + cx^2$, with $c \neq 0$. A polynomial of degree 3 is called a **cubic polynomial**; its general form is $a + bx + cx^2 + dx^3$, with $d \neq 0$. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Population	A **population** is the complete set of individuals, objects, places, etc, that we want information about. A **census** is an attempt to collect information about the whole population. See also sample. REFERENCE: Chance encounters

	A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Population Parameter	A **population parameter** is a numerical characteristic of a population. Examples: The median cost of a house in Sydney, the number of students in a school in WA who support the Eagles football team. Sample statistics can be used to estimate the values of population statistics. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Primary data	**Primary data** is data collected by the user. **Secondary data** is data collected by others. Sources of secondary data include, web-based data sets, the media, books, scientific papers, etc.
Prime factor	A **prime factor** of a natural number n is a factor of n that is a prime number. For example, the prime factors of 330 are $2,3,5$ and 11. The **prime decomposition** of a natural number is the representation of the number as a product of prime numbers. Each natural number greater than 1 has such a decomposition, and it is unique. For example, the prime decomposition of 42 is $$42 = 2 \times 3 \times 7,$$ and the prime decomposition of 709800 is $$709800 = 2^3 \times 3 \times 5^2 \times 7 \times 13^2 .$$ REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Prime number	A prime number is a natural number greater than 1 that has no factor other 1 and itself. The first few prime numbers are $2,3,5,7,11,13,17,19,23, \cdots$. Prime numbers have a long and fascinating history. Euclid (in approximately 300BC) showed by a simple proof by contradiction that there are infinitely many primes. It is difficult to determine whether an arbitrary large natural number is prime or not. One of the largest known primes (as of 2001AD) is $2^{13466917} - 1$, whose decimal expansion has approximately 14-million digits. There are numerous unsolved problems concerning prime numbers. One of these is Goldbach's conjecture (1742AD), which is the claim that *Every even number greater than 2 is the sum of two prime numbers.* No proof of this conjecture has yet been discovered. However, it has been verified using computers that every even number greater than 2 and less than 10^{18} is indeed the sum of two prime numbers. REFERENCES: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002 http://mathworld.wolfram.com/GoldbachConjecture.html
Prism	A **prism** is a convex polyhedron that has two congruent and parallel faces and all its remaining faces are parallelograms. A right **prism** is a convex polyhedron that has two congruent and parallel faces and all its remaining faces are rectangles. A prism that is not a right prism is often called an **oblique prism**.

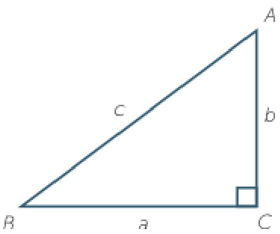
	Some examples of prisms are shown below.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Probability	**The probability** of an event is a number between 0 and 1 that indicates the chance of something happening. For example the probability that the sun will come up tomorrow is 1, the probability that a fair coin will come up 'heads' when tossed is 0.5, while the probability of someone being physically present in Adelaide and Brisbane at exactly the same time is zero. More formally, probability is a measure associated with an event *A* and denoted by Pr(*A*) which can take any value between 0 and 1. If an event cannot happen, Pr(*A*) = 0. If an event is certain, Pr(*A*) = 1. In general, the greater the value of Pr(*A*) the more likely that event A occurs. Numerical values can be assigned in simple cases by one of two methods. 1. If the sample can be divided into subsets of n ($n \geq 2$) equally likely outcomes and the event *A* is associated with m ($0 \leq m \leq n$) of these, then Pr(A) = m/n. 2. If a random experiment can be repeated a large number of times, n, and in m cases, event *A* occurs, then m/n is called the relative frequency of *A* occurring. If n is large the relative frequency is likely to be close to Pr(*A*). REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Product	A **product** is the result of multiplying together two or more numbers or algebraic expressions. For example, 36 is the product of 9 and 4, and $x^2 - y^2$ is product of $x - y$ and $x + y$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Proportion	Corresponding elements of two sets are in proportion if there is a constant ratio. For example, the circumference and diameter of a circle are in proportion because for any circle the ratio of their lengths is the constant π. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002

<table>
<tr><th></th><th></th></tr>
<tr><td>Pyramid</td><td>A **pyramid** is a convex polyhedron with a polygonal base and triangular sides that meet at a point called the vertex. The pyramid is named according to the shape of its base.


square-based pyramid triangular-based pyramid hexagonal-based pyramid

REFERENCE: The Concise Oxford Dictionary of Mathematics
Christopher Clapham and James Nicholson
2009</td></tr>
<tr><td>Pythagoras' theorem</td><td>**Pythagoras' theorem**

For a right-angled triangle
• The square of the hypotenuse of a right- angled triangle equals the sum of the squares of the lengths of the other two sides.

• In symbols, $c^2 = a^2 + b^2$.


The converse
If $c^2 = a^2 + b^2$ in a triangle *ABC*, then ∠C is a right angle.</td></tr>
<tr><td>Quadratic equation</td><td>The general quadratic equation in one variable is $ax^2 + bx + c = 0$, where $a \neq 0$.

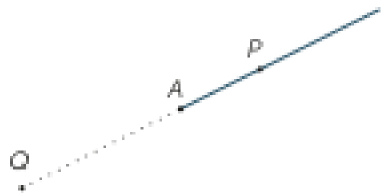
The roots are given by the quadratic formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

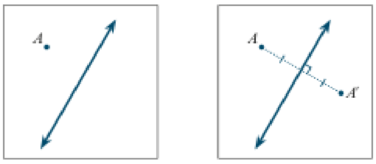
REFERENCE: Collins Dictionary of Mathematics, 2nd edition
E.J. Borowski & J.M. Borwein
2002</td></tr>
<tr><td>Quadratic expression</td><td>A **quadratic expression** or function contains one or more of the terms in which the variable is raised to the second power, but no variable is raised to a higher power. Examples of quadratic expressions include $3x^2 + 7$ and $x^2 + 2xy + y^2 - 2x + y + 5$.

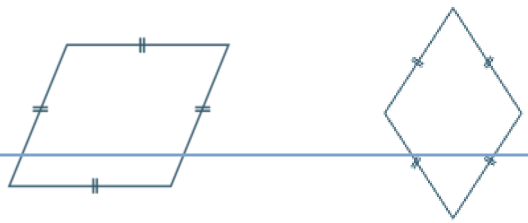
REFERENCE: Collins Dictionary of Mathematics, 2nd edition
E.J. Borowski & J.M. Borwein
2002</td></tr>
</table>

Quartile	**Quartiles** are the values that divide an ordered data set into four (approximately) equal parts. It is only possible to divide a data set into exactly four equal parts when the number of data of values is a multiple of four. There are three quartiles. The first, the **lower quartile** (Q_1) divides off (approximately) the lower 25% of data values. The second quartile (Q_2) is the median. The third quartile, the **upper quartile** (Q_3), divides off (approximately) the upper 25% of data values. There are several accepted ways of determining quartiles for a set of data. Fortunately all of these methods give very similar answers when the data set is large enough for the determination of quartiles to make sense. The following method is one of the simplest to apply and most commonly used. A method for locating quartiles: Split the ordered data into two equal sized groups. The group that is below the median and the group that is above the median. • The lower quartile (Q_1) is the median of the group that is below the median. • The upper quartile (Q_3) is the median of the group that is above the median. • When this rule is applied to the following ordered data set: 1 2 2 3 3 4 5 5 5 6 6 8 9 9 10 12 12 13 15 15 19 22 25 the three quartiles divide the ordered data set up into four equal sized groups each containing six data values. $Q_1 = 3.5$ $Q_2 = 8$ $Q_3 = 13$ 1 2 2 2 3 3 | 4 5 5 5 6 6 8 9 9 9 10 12 13 | 13 15 15 19 22 25 6 values 6 values 6 values 6 values See also, five-number summary and interquartile range. REFERENCE: Chance encounters Christopher J. Wild & George A. F. Seber 2000
Quotient	A **quotient** is the result of dividing one number or algebraic expression by another. See also remainder. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E.J. Borowski & J.M. Borwein 2002
Random number	A random number is one whose value is governed by chance; for example, the number of dots showing when a fair die is tossed. The value of a random number cannot be predicted in advance. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Range	The **range** is the difference between the largest and smallest observations in a data set.

	The range can be used as a measure of spread in a data set, but it is extremely sensitive to the presence of outliers and should only be used with care. See also, interquartile range and standard deviation. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Rate	A rate is particular kind of ratio in which the two quantities are measured in different units. For example, the ratio of distance to time, known as speed is a rate because distance and time are measured in different units (such as kilometres and hours). The value of the rate depends on the units in which of the quantities are expressed. REFERENCE: Grimison, L. & Kerslake, D. (Eds.). (1986). *HBJ Dictionary of mathematics.* London: Harcourt, Brace, Jovanovich. De Klerk, J. (2010). *Illustrated Maths Dictionary*. Sydney: Pearson.
Ratio	A **ratio** is a quotient or proportion of two numbers, magnitudes or algebraic expressions. It is often used as a measure of the relative size of two objects. For example the ratio of the length of a side of a square to the length of a diagonal is $1{:}\sqrt{2}$ that is, $1/\sqrt{2}$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E.J. Borowski & J.M. Borwein, 2002
Rational number	A real number is **rational** if it can be expressed as a quotient of integers. It is **irrational** otherwise. Rational numbers are the ones most commonly used in everyday life. Irrational numbers can be approximated as closely as desired by rational numbers, and most electronic calculators use a rational approximation when performing calculations involving an irrational number. REFERENCE: Collins Dictionary of Mathematics, 2nd edition E.J. Borowski & J.M. Borwein 2002
Ray	Any point *A* on a line divides the line into two pieces called rays. The **ray** *AP* is that ray which contains the point P (and the point A). The point *A* is called the **vertex** of the ray and it lies on the ray. 
Real number	The numbers generally used in mathematics, in scientific work and in everyday life are the **real numbers**. They can be pictured as points on a number line, with the integers evenly spaced along the line, and a real number b to the right of a real number a if $a < b$.

	A real number is either rational or irrational. Every real number has a decimal expansion. Rational numbers are the ones whose decimal expansions are either terminating or recurring. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition C Clapham & J. Nicholson 2009
Rectangle	A **rectangle** is a quadrilateral in which all angles are right angles.  **Properties of a rectangle** • A rectangle is a parallelogram - Its opposite sides are equal and parallel. - Its diagonals bisect each other. • The diagonals of a rectangle are equal in length REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Recursion	**Recursion** is the repeated application of a function or mathematical procedure, where the output at any stage is the input at the next stage. A recursive process consists of two parts, namely the base clause for getting the process started and a recursive formula that shows how it is continued. For example, the sequence $1,3,7,15,31,\cdots$ can be defined recursively by $f(0) = 1$ and $f(n) = 2f(n-1) + 1$ for $n > 0$. In this case the base clause is "$f(0) = 1$", and the recursive formula is "$f(n) = 2f(n-1) + 1$ for $n > 0$". REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein, 2002
Recurring decimal	A **recurring decimal** is a decimal that contains a pattern of digits that repeats indefinitely after a certain number of places. If the sequence of digits that repeats is $a_1 a_2 a_3 \cdots a_m$, then the recurring decimal is usually written $c_k \cdots c_1 c_0 . b_1 b_2 \cdots b_m \dot{a}_1 \dot{a}_2 \dot{a}_3 \cdots \dot{a}_m$, where $c_k, \cdots, c_1, c_0, b_1, b_2, \cdots, b_m$ are the digits that do not recur. For example, $0.1\dot{0}\dot{7} = 0.1070707 \cdots$, and this is the decimal expansion of the rational number

	$\frac{1}{10}+\frac{7}{1000}+\frac{7}{100000}+\frac{7}{10000000}+\cdots=\frac{1}{10}+\left(\frac{7/1000}{1-1/100}\right)=\frac{1}{10}+\frac{7}{990}=\frac{106}{990}$ Every recurring decimal is the decimal expansion of a rational number REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002
Reflection	To **reflect** the point *A* in an **axis of reflection,** a line has been drawn at right angles to the axis of reflection and the point A' is marked at the same distance from the axis of reflection as A, but on the other side.  The point *A′* is called the reflection image of *A*. A **reflection** is a transformation that moves each point to its reflection image. **Properties of reflections** When a reflection is applied. • Line segments move to line segments of the same length. • Angles move to angles of the same size. • All points on the axes of reflection are fixed points. • If the points *A*, *B*, *C*, ... are in a clockwise order, then the points *A*', *B*', *C*', ... will be in anticlockwise order, and vice versa. REFERENCE: The University of Chicago Mathematics Project Arthur Coxford, Zalman Usikin, Daniel Hirschorn 1991
Regular shape	A regular shape can be a polygon or a polyhedron. A polygon is regular if all of its sides are the same length and all of its angles have the same measure. REFERENCES: Alchian, A. A., Beckenbach, E. F., Bell, C., Craig, H. V., James, G., James, R. C., Michal, A. D., & Sokolnikoff, I. S. (1968). *James & James mathematics dictionary (3rd ed.).* New York: Van Nostrand Reinhold. Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: A developmental approach (7th ed.).* Boston: Pearson.
Related denominators	Denominators are related when one is a multiple of the other. For example, the fractions $\frac{1}{3}$ and $\frac{5}{9}$ have related denominators because 9 is a multiple of 3. Fractions with related denominators are more easily added and subtracted

	than fractions with unrelated denominators because only one needs to be renamed. For example to add $\frac{1}{3}$ and $\frac{5}{9}$ we can rename $\frac{1}{3}$ as $\frac{3}{9}$ and then compute $\frac{3}{9}+\frac{5}{9}=\frac{8}{9}$. REFERENCE: Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010). *Elementary and middle school mathematics: A developmental approach (7th ed.).* Boston: Pearson.
Relative frequency	**Relative frequency** is given by the ratio $\frac{f}{n}$, where *f* is the frequency of occurrence of a particular data value or group of data values in a data set and *n* is the number of data values in the data set. See also frequency and expected frequency. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Remainder	A **remainder** is the amount left over when one number or algebraic quantity a is divided by another b. If a is divisible by b then the remainder is 0. For example, when 68 is divided by 11, the remainder is 2, because 68 can be expressed as $68 = 6 \times 11 + 2$. In general, if a and b are integers and $b > 0$, then there are unique integers q and r such that $a = qb + r$, where $0 \le r < b$. Here q is the quotient and r is the remainder. For example, $43 = 10 \times 4 + 3$, so for $43 \div 4$ the quotient is 10 and the remainder is 3. If $a(x)$ and $b(x)$ are polynomials and $b(x)$ is non-constant, then there are unique polynomials $q(x)$ and $r(x)$, such that $a(x) = q(x)b(x) + r(x)$. where the degree of r(x) is less than the degree of $b(x)$, Here $q(x)$ is the quotient and $r(x)$ is the remainder. For example, $x^3 + x^2 + 5x - 7 = (x + 1)x^2 + 5x - 7$. So for $x^3 + x^2 + 5x - 7 \div x^2$, the quotient is $x + 1$ and the remainder is $5x - 7$. If $a(x)$ is divisible by $b(x)$ then the remainder is 0, and if $b(x)$ is a linear polynomial then the remainder is a constant. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992
Remainder theorem	According to the **remainder theorem**, if a polynomial $p(x)$ is divided by $x - a$, where a is any real number, the remainder is $p(a)$. That is, $p(x) = q(x)(x - a) + p(a)$, for some polynomial $q(x)$ See also factor theorem. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Rhombus	A rhombus is a quadrilateral with all sides equal. 

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Properties of a rhombus

- A rhombus is a parallelogram.
- Each diagonal of a rhombus bisects two vertex angles.
- The diagonals of a rhombus are perpendicular.

REFERENCE: The Concise Oxford Dictionary of Mathematics
Christopher Clapham and James Nicholson
2009

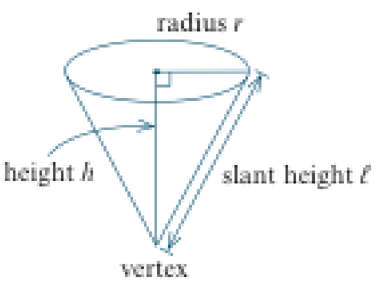
</td></tr>
<tr><td>Right Cone</td><td>

A **cone** is a solid that is formed by taking a circle called the base and a point not in the plane of the circle, called the vertex, which lies above or below the circle and joining the vertex to each point on the circle.

If the vertex is directly above or below the centre of the circular base, we call the cone a **right cone**.

The **height of the cone** is the distance from the vertex to the centre of the circular base.

The **slant height** of a cone is the distance from any point on the circle to the vertex to the circle.



REFERENCE: The University of Chicago Mathematics Project
Arthur Coxford, Zalman Usikin, Daniel Hirschorn
1991

</td></tr>
<tr><td>Rotation</td><td>

A **rotation** turns a figure about a fixed point, called the **centre of rotation**.

A rotation is specified by:

- the centre of rotation *O*
- the angle of rotation
- the direction of rotation (clockwise or anticlockwise).

In the first diagram below, the point A is rotated through 120^{o} clockwise about O. In the second diagram, it is rotated through 60^{o} anticlockwise about O.

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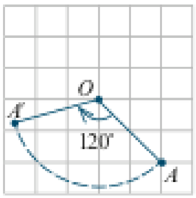
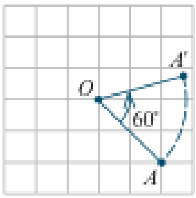
</table>

	 A **rotation** is a transformation that moves each point to its rotation image. **Properties of rotations** When a rotation is applied. • Line segments move to line segments of the same length. • Angles move to angles of the same size.
Rounding	The decimal expansion of a real number is **rounded** when it is approximated by a terminating decimal that has a given number of decimal digits to the right of the decimal point. Rounding to n decimal places is achieved by removing all decimal digits beyond (to the right of) the n^{th} digit to the right of the decimal place, and adjusting the remaining digits where necessary. If the first digit removed (the $(n+1)^{th}$ digit) is less than 5 the preceding digit is not changed. For example, 4.02749 becomes 4.027 when rounded to 3 decimal places. If the first digit removed is greater than 5, or 5 and some succeeding digit is non-zero, the preceding digit is increased by 1. For example, 6.1234506 becomes 6.12346 when rounded to 5 decimal places. There are various conventions for dealing with the case where the first digit removed is 5 and all succeeding digits are 0. In one of these the preceding digit is made even by leaving unchanged or by adding 1 as necessary. For example, 2.75 becomes 2.8 and 2.45 becomes 2.4 when rounded to 1 decimal place. REFERENCE: The Concise Oxford Dictionary of Mathematics, 4th edition, C Clapham & J. Nicholson, 2009
Sample	A **sample** is part of a population. It is a subset of the population, often randomly selected for the purpose of estimating the value of a characteristic of the population as a whole. For instance, a randomly selected group of eight-year old children (the sample) might be selected to estimate the incidence of tooth decay in eight-year old children in Australia (the population). REFERENCE: Chance encounters A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Sample space	A **sample space** is the set of all possible outcomes of a chance experiment. For example, the set of outcomes (also called **sample points**) from tossing two heads is { HH, HT, TH, TT }, where H represents a 'head' and T a 'tail'.

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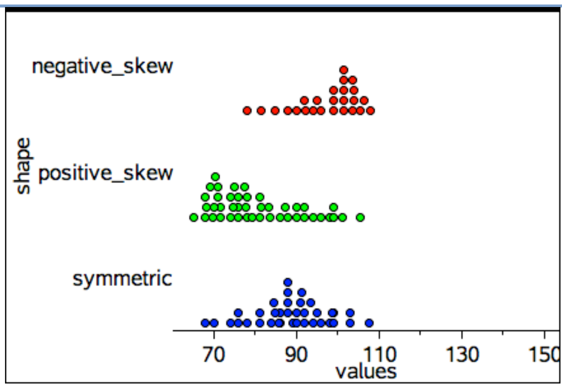
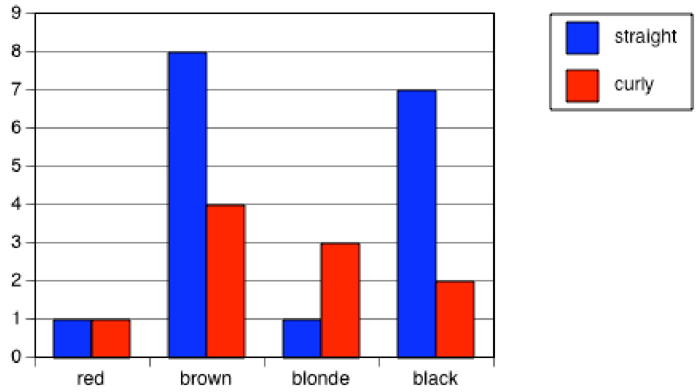
	REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Sample Statistic	**Sample statistic** is a numerical characteristic of a sample. Examples: The mean height of a football team, the range of test scores in a class. Sample statistics vary from sample to sample. Population parameters have a fixed value. Sample statistics are used to estimate the values of population parameters. See also population parameter. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt, 1998
Scientific notation	A positive real number is expressed in **scientific notation** when it is written as the product of a power of 10 and a decimal that has just one digit to the left of the decimal point. For example, the scientific notation for 3459 is 3.459×10^3, and the scientific notation for 0.000004567 is 4.567×10^{-6}. Many electronic calculators will show these as $3.459E3$ and $4.567E-6$ REFERENCE: Collins Dictionary of Mathematics, 2nd edition E. J. Borowski & J.M. Borwein 2002
Secondary data set	See primary data.
Shape (statistics)	The **shape** of a numerical data distribution is mostly simply described as **symmetric** if it is roughly evenly spread around some central point or **skewed**, if it is not. If a distribution is skewed, it can be further described as **positively skewed** (‘tailing-off’ to the upper end of the distribution) or **negatively skewed** (‘tailing-off’ to the lower end of the distribution). These three distribution shapes are illustrated in the parallel dot plot display below.

	 Dot plots, histograms and stem plots can all be used to investigate the shape of a data distribution. REFERENCE: Chance encounters A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Side-by-side column graph	A side-by-side **column graph** can be used to organise and display the data that arises when a group of individuals or things are categorised according to two or more criteria. For example, the side-by-side column graph below displays the data obtained when 27 children are categorised according to *hair type* (straight or curly) and *hair colour* (red, brown, blonde, black). The legend indicates that blue columns represent children with straight hair and red columns children with curly hair.  Side-by-side column graphs are frequently called **side-by-side bar graphs** or **bar charts**. In a bar graph or chart, the bars can be either vertical or horizontal. See also, back-to-back stem plots and parallel box plots.
Simple interest	**Simple interest** is the interest accumulated when the interest payment in each period is a fixed fraction of the principal. For example, if the principle $\$P$ earns simple interest at the rate of $i\%$ per period, then after n periods the accumulated simple interest is $\$Pni/100$. REFERENCE: Collins Dictionary of Mathematics, 2nd edition

E. J. Borowski & J.M. Borwein
2002

Similarity

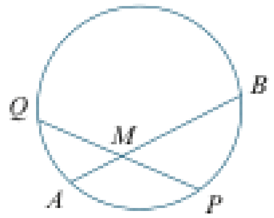
Two plane figures are called **similar** if an enlargement of one figure is congruent to the other.
That is, if one can be mapped to the other by a sequence of translations, rotations, reflections and enlargements.
Similar figures thus have the same shape, but not necessarily the same size.
When two figures are similar:

- matching angles are equal, and
- matching distances are in a constant ratio.
-

Here are three interesting results which can be proved with similarity.

Result 1

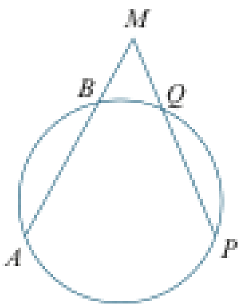
- When two chords of a circle intersect, the product of the lengths of the intervals on one chord equals the product of the lengths of the intervals on the other chord.

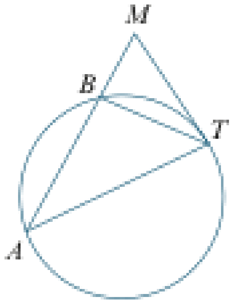


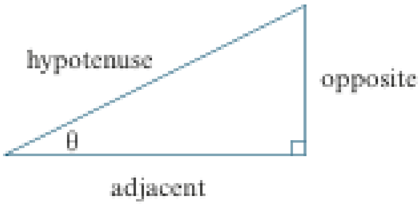
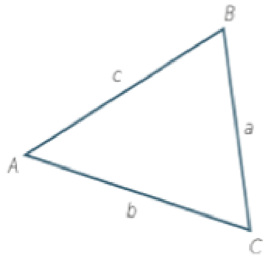
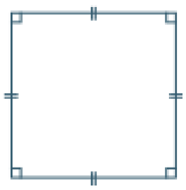
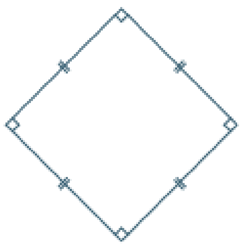
$$QM \times MP = AM \times MB$$

Result 2

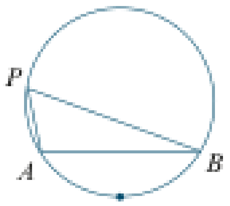
- Let secants from a point *M* external to the circle cut the circle at points *A* and *B* and *P* and *Q* as shown in the diagram then $AM \times BM = PM \times QM$.

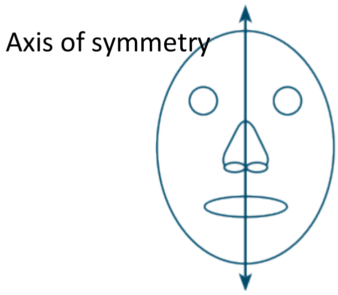


	Result 3 When a secant and a tangent are drawn to a circle from an external point, the square of the length of the tangent equals the product of the lengths of the intervals to the circle on the secant. That is, $AM \times BM = TM^2$ 
Similar triangles	**The four standard tests for two triangles to be similar.** **AAA**: If two angles of one triangle are respectively equal to two angles of another triangle, then the two triangles are similar. **SAS**: If the ratio of the lengths of two sides of one triangle is equal to the ratio of the lengths of two sides of another triangle, and the included angles are equal, then the two triangles are similar. **SSS**: If we can match up the sides of one triangle with the sides of another so that the ratios of matching sides are equal, then the two triangles are similar. **RHS**: If the ratio of the hypotenuse and one side of a right-angled triangle is equal to the ratio of the hypotenuse and one side of another right-angled triangle, then the two triangles are similar.
Simultaneous equations	Two or more equations form a set of **simultaneous equations** if they are conditions imposed simultaneously on all of the variables involved. A solution of a set of simultaneous equations is a set of values of the variables involved that satisfy each of the equations simultaneously. For example, the solutions of the simultaneous equations $y = x - 1$ and $x^2 + y^2 = 25$ are $(x, y) = (4,3)$, and $(x, y) = (-3, -4)$. These are the only points that lie on both the line $y = x - 1$ and the circle $x^2 + y^2 = 25$. A set of simultaneous equations may have no solution. For example, there is no value of x that satisfies $x^2 = 4$ and $2x = 7$ simultaneously. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992

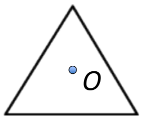
Sine ratio	In any right-angled triangle, $\sin\theta = \dfrac{\text{opposite}}{\text{hypotenuse}}$, where $0^{\circ} < \theta < 90^{\circ}$ 
Sine rule	In any triangle *ABC*, $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$  In words it says: Any side of a triangle over the sine of the opposite angle equals any other side of the triangle over the sine of its opposite angle.
Skewed data	See shape of a data distribution.
Square	A **square** is a quadrilateral that is both a rectangle and a rhombus.   A square thus has all the properties of a rectangle, and all the properties of a rhombus. • Opposite sides are parallel. • The diagonals meet each side at 45°. • The diagonals are equal in length, and bisect each other at right angles. • The two diagonals, and the two lines joining the midpoints of opposite sides, are axes of symmetry. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson

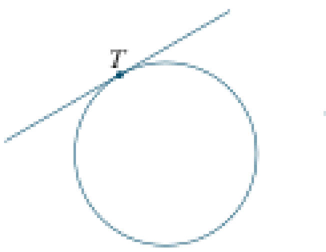
	2009
Standard deviation	**Standard deviation** is a measure of the variablity or spread of a data set. It gives an indication of the degree to which the individual data values are spread around their mean. When every member of a population is sampled, the **population standard deviation** σ can be determined by evaluating $$\sigma = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \mu)^2}{n}}$$ where x_1, x_2, …., x_n are the n values that comprise the population data and μ is the population mean. It is usually neither possible nor practical to sample all members of a population. In such cases, it is usual to estimate the population standard deviation by taking a random sample from the population and calculating the **sample standard deviation** s which is given by: $$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$ where x_1, x_2, …., x_n where x_1, x_2, …., x_n are the n values that comprise the sample data and $\bar{x}$ is their mean. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Stem and leaf plot	A **stem-and-leaf plot** is a method of organising and displaying numerical data in which each data value is split in to two parts, a 'stem' and a 'leaf'. For example, the stem-and-leaf plot below displays the resting pulse rates of 19 students. pulse rate 6 | 8 8 8 9 7 | 0 1 1 4 6 6 8 8 | 2 6 8 8 9 | 0 6 10 | 4 11 | 0 In this plot, the stem unit is '10' and the leaf unit is '1'. Thus the top row in the plot 6 | 8 8 8 9 displays pulse rates of 68, 68, 68 and 69. Stem-and-leaf plots contain all the information found in a histogram with the added advantage of displaying the individual data values. Unlike histograms, stem-and-leaf plots are quickly constructed by hand and are useful alternatives to histograms when working with small amounts of data, say 10 to 100 data values.

	The term 'stem-and-leaf plot' is commonly abbreviated to 'stem-plot'. See also back-to-back stem-and-leaf plots. REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Stemplot	**Stemplot** is a synonym for stem-and-leaf plot.
Subitising	Recognising the number of objects in a collection without consciously counting Reference: O'Brien, H. & Purcell, G. (2004). *The New Primary Mathematics Handbook*. St Leonards, NSW: Horwitz Education.
Subtend	Given a point *P*, and a line segment *AB* or arc *AB* the angle *APB* is said to be the angle **subtended** at *P* by *AB*.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Sum	A **sum** is the result of adding together two of more numbers or algebraic expressions. REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
Supplementary angles	Two angles that add to 180° are called **supplementary angles**. For example, 45° and 135° are supplementary angles. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Surd	A **surd** is a numerical expression involving one or more irrational roots of numbers. Examples of surds include $\sqrt{2}$, $\sqrt[3]{5}$, and $4\sqrt{3} + 7\sqrt[3]{6}$. REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
Symmetric data	See shape of a data distribution.

<table>
<tr>
<td>Symmetry</td>
<td>Line symmetry
A plane figure F has line symmetry in a line m if the image of F under the reflection in m is F itself. The line m is called the axis of symmetry.


Rotational symmetry

A plane figure F has rotational symmetry about a point O if there is a non-trivial rotation such that the image of F under the rotation is F itself.


A rotation of 120^0 around O moves the equilateral triangle onto itself.</td>
</tr>
<tr>
<td>Tangent</td>
<td>A tangent to a circle is a line that intersects a circle at just one point. It touches the circle at that point of contact, but does not pass inside it.


Here are two important properties of tangents.</td>
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</table>

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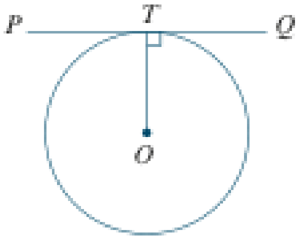
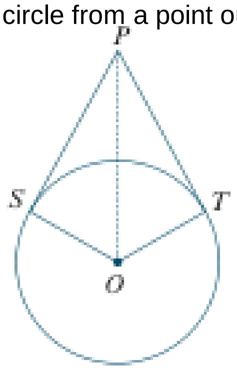
Result 1

- The line through a point on a circle perpendicular to the radius at that point is the only tangent at that point.



Result 2

The tangents to a circle from a point outside the circle have equal length.



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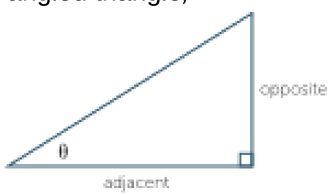
<tr><td>

Tangent ratio

</td><td>

In any right-angled triangle,



$\tan\theta = \dfrac{\text{opposite}}{\text{adjacent}}$, where $0° < \theta < 90°$.

</td></tr>
<tr><td>

Terminating decimal

</td><td>

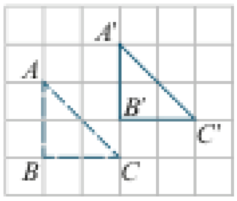
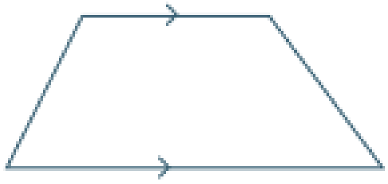
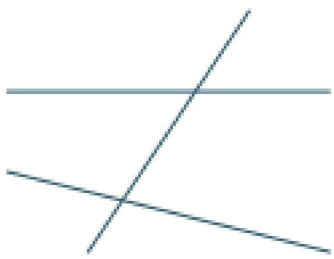
A **terminating decimal** is a decimal that contains only finitely many decimal digits.

Every terminating decimal represents a rational number m/n where the denominator n is a power of 10. For example, 54.321 is the decimal expansion of the sum

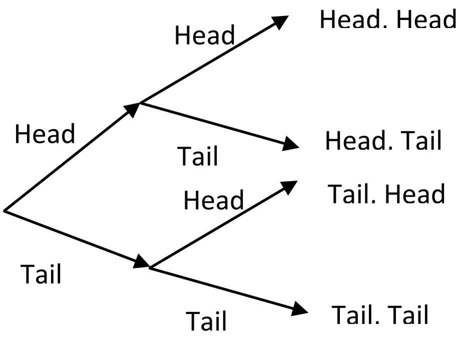
$$5 \times 10^{1} + 4 \times 10^{0} + 3 \times 10^{-1} + 2 \times 10^{-2} + 3 \times 10^{-3} = \frac{54321}{1000}$$

REFERENCE: Collins Dictionary of Mathematics, 2nd edition
E. J. Borowski & J.M. Borwein
2002

</td></tr>
</table>

Transformation	The transformations included in this glossary are enlargements, reflections, rotations and translations.
Translation	Shifting a figure in the plane without turning it is called **translation**. To describe a translation, it is enough to say how far left or right and how far up or down the figure is moved. In the diagram below, triangle *ABC* has been translated to triangle *A≠B≠C≠*.  A translation is a transformation that moves each point to its translation image. **Properties of translations** • Line segments move to line segments of the same length. • Angles move to angles of the same size.
Trapezium	A **trapezium** is a quadrilateral with one pair of opposite sides parallel.  REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Transversal	A **transversal** is a line that meets two or more other lines in a plane. 
Tree diagram	A **tree diagram** is a diagram that can used to enumerate the outcomes of a multi-step random experiment.

The diagram below shows a tree diagram that has been used to enumerate all of the possible outcomes when a coin is tossed twice This is an example of a **two-step random experiment**.



Triangular number

A triangular number is the number of dots required to make a triangular array of dots in which the top row consists of just one dot, and each of the other rows contains one more dot than the row above it. So the first triangular number is 1, the second is 3 $(= 1 + 2)$, the third is 6 $(= 1 + 2 + 3)$ and so on. In general, the n^{th} triangular number is

$$\frac{1}{2}n(n+1) = 1 + 2 + 3 + \cdots + n.$$

REFERENCE: Mathematics Dictionary, 5^{th} edition
James and James
1992

Trigonometric ratios

Sine, Cosine, Tangent

REFERENCE: The Concise Oxford Dictionary of Mathematics
Christopher Clapham and James Nicholson
2009

Two-way frequency table

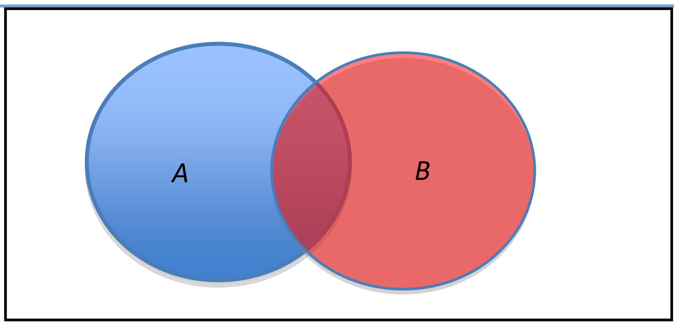
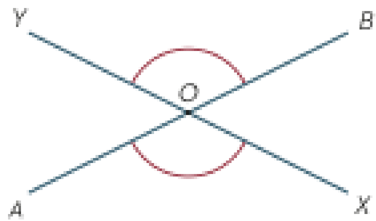
A **two-way frequency table** is commonly used to for displaying the two-way frequency distribution that arises when a group of individuals or things are categorised according to two criteria.

For example, the two-way table below displays the two-way frequency distribution that arises when 27 children are categorised according to *hair type* (straight or curly) and *hair colour* (red, brown, blonde, black).

Hair colour	Hair type		Total
red	1	1	2
brown	8	4	12
blonde	1	3	4
black	7	2	9
Total	17	10	27

The information in a two-way frequency table can also be displayed graphically using a side-by-side column graph.

	REFERENCE: Chance encounters A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Unit fraction	A unit fraction is a simple fraction whose numerator is 1, that is, a fraction of the form $1/n$, where n is a natural number. REFERENCE: Mathematics Dictionary, 5th edition James and James 1992
Univariate data	**Univariate data** is data relating to a single variable, for example, hair colour or the number of errors in a test. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson 2009
Variable (statistics)	A **variable** is something measurable or observable that is expected to either change over time or between individual observations. Examples of variables in statistics include the age of students, their hair colour or a playing field's length or its shape. See also categorical variable and numerical variable REFERENCE: Chance encounters A first course in data analysis and inference Christopher J. Wild & George A. F. Seber 2000
Variable (algebra)	A **variable** is a symbol, such as x, y or z, used to represent an unspecified member of some set. For example, the variable x could represent an unspecified real number. In equations variables can be used either **existentially** or **universally**. In conditional equations variables represent unknown quantities of which the values are to be found. For example, $x^2 = 2x + 15$ has solutions $x = 5$ or -3. However, in an identity such as $(x + y)^2 = x^2 + 2xy + y^2$, the stated relationship holds for all values of the variables x and y. REFERENCE: Collins Dictionary of Mathematics, 2nd edition, E. J. Borowski & J.M. Borwein, 2002
Venn diagram	A **Venn diagram** is a graphical representation of the extent to which two or more events, for example *A* and *B*, are mutually inclusive (overlap) or mutually exclusive (do not overlap).

	 REFERENCE: The Cambridge Dictionary of Statistics B. S. Everitt 1998
Vertically opposite angle	When two lines intersect, four angles are formed at the point of intersection. In the diagram, the angles marked $\angle AOX$ and $\angle BOY$ are called **vertically opposite**.  Vertically opposite angles are equal. REFERENCE: The Concise Oxford Dictionary of Mathematics Christopher Clapham and James Nicholson Fourth edition
Volume	The **volume** of a solid region is a measure of the size of a region. For a rectangular prism, *Volume* = *Length* × *Width* × *Height*
Whole number	A **whole number** is a non–negative integer, that is, one of the numbers $0,1,2,3,\cdots$, Sometimes it is taken to mean only a positive integer, or any integer. See also counting number. REFERENCE: Mathematics Dictionary, 5th edition, James and James, 1992