Glossary

A

Adjacency matrix [p. 482] A square matrix that uses a zero or a positive integer to record the number of edges connecting each pair of vertices in the graph.

Ambiguous case (trigonometry) [p. 718] Occurs when it is possible to draw two different triangles that both fit the given information.

Angle of depression [p. 704] The angle between the horizontal and a direction *below* the horizontal.

Angle of elevation [p. 703] The angle between the horizontal and a direction *above* the horizontal.

Arc [p. 633] The part of a circle between two given points on the circle. The length of the arc is given by

$$S = \frac{\pi r \theta}{180}$$

where r is the radius of the circle and θ is the angle subtended by the arc of the centre of the circle.

Area [p. 622] The area of a shape is a measure of the region enclosed by its boundaries, measured in square units.

Area formulas [p. 622] Formulas used to calculate the areas of regular shapes, including rectangles, triangles, parallelograms, trapeziums and circles.

Area of a triangle rules [p. 622]

- $Area = \frac{1}{2} \times base \times height$
- $Area = \frac{1}{2}bc \sin A$
- Heron's rule: $Area = \sqrt{s(s-a)(s-b)(s-c)}$ and $s = \frac{1}{2}(a+b+c)$ where a, b and c are side lengths.

Arithmetic sequence [p. 144] A sequence in which each new term is made by adding a constant amount (D), called the common difference, to the current term. Given the value of the first term in an arithmetic sequence (a) and the common difference, there are rules for finding the nth term.

B

Back-to-back stem plot [p. 113] A back-to-back stem plot is used to compare two related numerical data sets, constructed with a single stem and two sets of leaves (one for each group).

Bar chart [p. 40] A statistical graph used to display the frequency distribution of categorical data, using vertical bars.

Bearing [p. 710] *See* Three-figure bearing.

Bivariate data [p. 401] Data which is recorded on two variables from the same subject.

BODMAS An aid for remembering the order of operations: **B**rackets first; **O**rders (powers, square roots) and fractions **O**f numbers; **D**ivision and **M**ultiplication, working left to right; **A**ddition and **S**ubtraction, working left to right.

Boxplot [p. 100] A plot of numerical data constructed using the 5-number summary, and showing outliers if present.

Bridge [p. 479] A single edge in a connected graph that, if removed, leaves the graph disconnected. A graph can have more than one bridge.

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C

Categorical data [p. 35] Data generated by a categorical variable, and where the data values are the names of categories.

Categorical variable [p. 37] Variables that classify or name a quality or attribute, and which generate data values which are the names of categories. Categorical variables are either nominal or ordinal.

Causation [p. 426] When the change in the value of one variable causes a change in the value of a second variable. A high correlation between two variables cannot be assumed to mean they are causally related.

Circuit [p. 500] A walk with no repeated edges that starts and ends at the same vertex. *See also* Walk.

Circumference [p. 628] The circumference of a circle is the length of its boundary. The circumference, C, of a circle with radius, r, is given by $C = 2\pi r$.

Column matrix [p. 221] A matrix with only one column.

Common difference [p. 144] The fixed amount (D) that is added to make each new term in an arithmetic sequence.

Common ratio [p. 168] The fixed number (R) that multiplies the current term to make the next term in a geometric sequence.

Compound interest [p. 183] Under compound interest, the interest paid on a loan or investment is credited or debited to the account at the end of each period. The interest earned for the next period is based on the principal plus previous interest earned. The amount of interest earned increases each year.

Connected graph [p. 478] A graph is connected if there is a path between each pair of vertices.

Continuous data [p. 36] Numerical data that can take any value, sometimes in an interval, and often arises from measuring.

Correlation coefficient, *r* [p. 420] A statistical measure of the strength of the linear association between two numerical variables.

Cosine ratio (cos θ) [p. 684] In right-angled triangles, the ratio of the side adjacent to a given angle (θ) to the hypotenuse.

Cosine rule [p. 726] In non-right-angled triangles, a rule used to find:

- the third side, given two sides and an included angle
- an angle, given three sides.

For triangle ABC and side a, the rule is:

$$a^2 = b^2 + c^2 - 2bc \cos A$$

or $\cos A = \dfrac{b^2 + c^2 - a^2}{2bc}$

Similar rules exist for sides b and c.

Cycle [p. 500] A walk with no repeated vertices that starts and ends at the same vertex. *See also* Walk.

D

Data [p. 35] Information collected about a variable.

Degree of a vertex (deg(*A*)) [p. 469] The number of edges that are attached to the vertex. The degree of a loop is two. The degree of vertex A is written as $\deg(A)$.

Depreciation [p. 159] Depreciation occurs when the value of an asset decreases over time.

Direction of association [p. 410] The direction of an association is positive if the values of the response variable tend to increase as the values of the explanatory variable increase, and negative if the values of the response variable tend to decrease as the values of the explanatory variable increase.

Direct variation [p. 553] Exists between any two variables when one quantity is directly dependent on the other. An increase in one quantity leads to an increase in the other whilst a decrease in one quantity leads to a decrease in the other quantity. The ratio of the two quantities remains the same, i.e. $= k$.

Discrete data [p. 36] Data which only take particular numerical values, usually whole numbers, and often arises from counting.

Discrete variable [p. 37] A variable which generates discrete numerical data, such as the number of people in a queue.

Distribution [p. 47] The pattern in a set of data values. It reflects how frequently different data values occur.

Dot plot [p. 69] A plot used for small sets of numerical data, where individual data values are plotted as dots on a number line.

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E

Edge [p. 468] A line joining one vertex in a graph or network to another vertex or to itself (a loop).

Elements of a matrix [p. 220] The numbers or symbols displayed in a matrix.

Eulerian circuit [p. 504] An Eulerian trail that starts and finishes at the same vertex. To have an Eulerian circuit, the graph must have all even vertices.

Eulerian trail [p. 504] A trail in a connected graph that includes every edge. To have an Eulerian trail (but not an Eulerian circuit), the graph must have *exactly two* odd vertices. The trail starts at one odd vertex and finishes at the other.

Euler's formula [p. 490] The formula $v - e + f = 2$, which relates the number of vertices (v), edges (e) and faces (f) in a connected planar graph.

Explanatory variable [p. 401] When investigating associations in bivariate data, the explanatory variable (EV) is the variable used to explain or predict the value of the response variable (RV).

Extrapolation [p. 449] Using an equation to predict the value of the response variable using a value of the explanatory variable which is outside the range of the values used to determine that equation.

F

Face [p. 489] An area in a graph or network that can only be reached by crossing an edge. One face is always the infinite area surrounding a graph.

Fitting a line by eye [p. 433] A line drawn on a scatterplot with a ruler that aims to capture the linear trend of the data points.

Five-number summary [p. 100] A list of the five key points in a data distribution: the minimum value (Min), the first quartile (Q_1), the median (M), the third quartile (Q_3) and the maximum value (Max).

Flat-rate depreciation [p. 159] Flat-rate depreciation is an example of linear decay where a constant amount that is subtracted from the value of an item at regular intervals of time.

Form of association [p. 412] The description of the association between variables as linear or non-linear.

Formula [p. 300] A mathematical relation connecting two or more variables, for example, $C = 5t + 20, P = 2L + 2W, A = \pi r^2$.

Frequency [p. 39] The number of times a value or a group of values occurs in a data set. Sometimes known as the count.

Frequency table [p. 39] A listing of the values that a variable takes in a data set along with how often (frequently) each value occurs. Frequency can also be recorded as a percentage.

G

Geometric sequence [p. 168] A sequence in which each new term is made by multiplying the current term by a constant called the common ratio (R).

Gradient of a straight line [p. 323] *See* Slope of a straight line.

Graph [p. 468] In a specific mathematical sense, as opposed to its common usage, a graph is a diagram that consists of a set of points called vertices that are joined by a set of lines called edges. Each edge joins two vertices.

Greedy algorithm [p. 528] A greedy algorithm is a simple, intuitive set of rules that can be used to solve optimisation problems.

Grouped data [p. 52] Where there are many different values of a numerical variable, the data is generally grouped into intervals such as 0-9, 10-19,...

GST [p. 16] GST (goods and services tax) is a tax, currently at the rate of 10%, that is added to most purchases of goods and services.

H

Hamiltonian cycle [p. 510] A Hamiltonian path that starts and finishes at the same vertex.

Hamiltonian path [p. 509] A path in a connected graph that passes through every vertex in the graph once only. It may or may not start and finish at the same vertex.

Heron's rule (Heron's formula) [p. 622] A rule for calculating the area of a triangle from its three sides.

$$A = \sqrt{s(s-a)(s-b)(s-c)}$$

where $s = \frac{1}{2}(a + b + c)$ and is called the semi-perimeter.

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Histogram [p. 56] A statistical graph used to display the frequency distribution of a numerical variable; suitable for medium-sized to large-sized data sets.

Hypotenuse [p. 612] The longest side in a right-angled triangle.

I

Identity matrix (I) [p. 245] A matrix that behaves like the number one in arithmetic, represented by the symbol I. Any matrix multiplied by an identity matrix remains unchanged.

Inequality [p. 78] A mathematical relation involving the use of $<, \leq, >, \geq$ or $\neq$, for example, $2x \leq 7,\ 3x + 5y > 9,\ -1 \leq x < 2$.

Inflation [p. 199] The tendency of prices to increase with time, resulting in the loss of purchasing power.

Intercept–slope form of the equation of a straight line [p. 330] A linear equation written in the form, $y = a + bx$, where a and b are constants. In this equation, a represents the y-intercept and b represents the slope. For example, $y = 5 - 2x$ is the equation of a straight line with y-intercept of 5 and the slope of -2.

Interest [p. 157] An amount of money paid (earned) for borrowing (lending) money over a period of time. It may be calculated on a simple or compound basis.

Interest rate [p. 157] The rate at which interest is charged or paid. It is usually expressed as a percentage of the money owed or lent.

Interpolation [p. 448] Using an equation to predict the value of the response variable using a value of the explanatory variable which is within the range of the values used to determine that equation.

Interquartile range (IQR) [p. 86] A summary statistic that measures the spread of the middle 50% of values in a data distribution. It is defined as $\text{IQR} = Q_3 - Q_1$.

Inverse matrix (A^{-1}) [p. 250] A matrix that, when multiplied by the original matrix, gives the identity matrix (I). For a matrix A, the inverse matrix is written as A^{-1} and has the property that $A^{-1}A = AA^{-1} = I$.

Inverse trigonometric ratios ($\sin^{-1}, \cos^{-1}, \tan^{-1}$) [p. 693] Used to find an angle θ when given the value of $\sin\theta$, $\cos\theta$, $\tan\theta$.

Inverse variation [p. 560] If one variable increases, the other will decrease, whilst if one variable decreases, the other increases. The product of the corresponding values of the variables is constant, (i.e. the constant of proportionality).

Isomorphic graphs [p. 480] Equivalent graphs or networks; graphs that have the same number of edges and vertices, identically connected.

K

Kruksal's algorithm [p. 526] An algorithm (procedure) for determining a minimum spanning tree in a connected graph or network.

L

Least squares method [p. 435] A method of fitting a line to a scatterplot, based on minimising the sum of the squares of the residuals.

Linear decay [p. 163] When a recurrence rule involves subtracting a fixed amount, the terms in the resulting sequence are said to decay linearly.

Linear equation [p. 308] An equation that has a straight line as its graph. In linear equations, the unknown values are always to the power of 1, for example, $y = 2x - 3, y + 3 = 7, 3x = 8$.

Linear growth [p. 163] When a recurrence rule involves adding a fixed amount, the terms in the resulting sequence are said to grow linearly.

Linearisation [p. 566] The process of transforming data to linearity. The squared, reciprocal and logarithmic transformations may be used.

Linear regression [p. 433] The process of fitting a straight line to bivariate data.

Line of good fit [p. 433] A line used to approximately model the linear relationship between two variables. It is needed when the data values do not lie exactly on a straight line. Also known as a regression line.

Logarithm ($\log_{10} x$) [p. 578] A way of writing numbers as a power of ten. For example, if $x = 100 = 10^2$, then $\log_{10} x = 2$.

Loop [p. 469] An edge in a graph or network that joins a vertex to itself.

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M

Matrix [p. 219] *A* rectangular array of numbers or symbols set out in rows and columns within square brackets. (Plural – matrices.)

Matrix multiplication [p. 239] The process of multiplying a matrix by a matrix.

Maximum (Max) [p. 67] The largest value in a set of numerical data.

Mean ($\bar{x}$) [p. 77] A summary statistic that can be used to locate the centre of a symmetric distribution. The mean is given by $\bar{x} = \frac{\Sigma x}{n}$, where Σx is the sum of the data values and n is the number of data values.

Median (*M*) [p. 78] The midpoint of an ordered data set that has been divided into two equal parts, each with 50% of the data values. It is equal to the middle value (for an odd number of data values) or the average of the two middle values (for an even number of data values). It is a measure of the centre of the distribution.

Minimum (Min) [p. 67] The smallest value in a set of numerical data.

Minimum spanning tree [p. 522] The spanning tree of minimum length in a connected weighted graph or network. A graph may have more than one.

Modal category or interval [p. 42] The category or data interval that occurs most frequently in a data set.

Mode [p. 42] The most frequently occurring value in a data set. There may be more than one.

Multiple edges [p. 469] Two or more edges that connect the same two vertices in a graph or network.

N

Negative association (bivariate data) [p. 410] An association where the values of the explanatory variable tend to decrease as the values of the response variable increase.

Negatively skewed distribution [p. 68] A data distribution that has a long tail to the left. In negatively skewed distributions, the majority of data values fall to the right of the mean.

Negative slope [p. 323] A straight-line graph with a negative slope represents a decreasing y-value as the x-value increases. For the graph of a straight line with a negative slope, y decreases at a constant rate with respect to x.

Network [p. 514] A set of points called vertices and connecting lines called edges, enclosing and surrounded by areas called faces.

No association [p. 68] A state of no consistent change in the value of the response variable when the values of the explanatory variable change.

Nominal data [p. 35] A type of categorical data where data values are the names of groups.

Nominal variable [p. 37] A type of categorical variable where the values of the variable are the names of groups.

Non-linear equation [p. 588] An equation with a graph that is *not* a straight line. In non-linear equations, the unknown values are not all to the power of 1, for example, $y = x^2 + 5, 3y^2 = 6, b^3 = 27$.

Numerical data [p. 36] Data obtained by measuring or counting some quantity. Numerical data can be discrete (for example, the *number* of people waiting in a queue) or continuous (for example, the *amount of time* people spent waiting in a queue).

O

Order of a matrix [p. 219] An indication of the size and shape of a matrix, written as $m \times n$, where m is the number of rows and n is the number of columns.

Order of magnitude [p. 580] The quantity of powers of 10 in a number.

Ordinal data [p. 36] A type of categorical data where the values of the variable are the names of groups, and there is an inherent order in the categories.

Ordinal variable [p. 37] A type of categorical variable where when the values of the variable are the names of groups, and there is an inherent order in the categories.

Outliers [p. 102] Data values that appear to stand out from the main body of a data set. Using box plots, possible outliers are defined as data values greater than $Q_3 + 1.5 \times \text{IQR}$ or less than $Q_1 - 1.5 \times \text{IQR}$.

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P

Parallel boxplot [p. 114] A statistical graph in which two or more boxplots are drawn side by side. Used to compare distributions in terms of shape, centre and spread.

Path [p. 498] A walk with no repeated vertices or edges. *See also* Walk.

Pearson's correlation coefficient [p. 420] *See* Correlation coefficient.

Percentage [p. 2] The number as a proportion of one hundred, indicated by the symbol %. For example, 12% means 12 per one hundred.

Percentage change [p. 8] The amount of the increase or decrease of a quantity expressed as a percentage of the original value.

Percentage frequency [p. 39] Frequency of a value or group of values, expressed as a percentage of the total frequency.

Perimeter [pp. 300, 621] The distance around the edge of a two-dimensional shape.

Piecewise linear graph [p. 361] A graph made up of two or more parts of different straight-line graphs, each representing different intervals on the x-axis. Sometimes called a segmented linear graph.

Planar graph [p. 488] A graph or network that can be drawn in such a way that no two edges intersect, except at the vertices.

Positive association (bivariate data) [p. 410] An association where the values of the explanatory variable and the response variable tend to increase together.

Positively skewed distribution [p. 68] A data distribution that has a long tail to the right. In positively skewed distributions, the majority of data values fall to the left of the mean.

Positive slope [p. 323] A positive slope represents an increasing y-value with increase in x-value. For the graph of a straight line with a positive slope, y increases at a constant rate with respect to x.

Prim's algorithm [p. 523] An algorithm (procedure) for determining a minimum spanning tree in a connected graph or network.

Principal (P) [p. 157] The initial amount of money borrowed, lent or invested.

Pronumeral [p. 244] A symbol (usually a letter) that stands for a numerical quantity or variable.

Pythagoras' theorem [p. 612] A rule for calculating the third side of a right-angled triangle given the length of the other two sides. In triangle ABC, the rule is: $a^2 = b^2 + c^2$, where a is the length of the hypotenuse.

Q

Quartiles (Q_1, Q_2, Q_3) [p. 86] Summary statistics that divide an ordered data set into four equal-sized groups, each containing 25% of the scores.

R

Radius [p. 628] The distance from the centre of a circle (or sphere) to any point on its circumference (or surface); equal to half the diameter.

Range (R) [p. 85] The difference between the smallest (minimum) and the largest (maximum) values in a data set: a measure of spread.

Recurrence relation [p. 141] A rule that enables the next term in a sequence to be generated using one or more previous terms. For example, 'Starting with 3, each new term is made by adding 5 to the current term'. Written as: $t_0 = 3$ and $t_{n+1} = t_n + 5$. Gives: $3, 8, 13, 18, \ldots$

Regression line [p. 433] *See* Line of good fit.

Response variable [p. 401] When investigating associations (relationships) between two variables, the response variable (RV) is the variable we are trying to explain or predict, using values of the explanatory variable.

Right angle [p. 612] An angle equal to 90°.

Rise [p. 323] *See* Slope of a straight line.

Row matrix [p. 221] A matrix with only one row.

Run [p. 323] *See* Slope of a straight line.

S

(s) [p. 622] *See* Heron's rule.

Scalar multiplication [p. 231] Multiplying a matrix by a number.

Scale factor (areas) [p. 657] The scale factor, k^2, by which the area of a two-dimensional shape is scaled (increased or decreased) when its linear dimensions are scaled by a factor of k.

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Scale factor (lengths) [p. 657] The scale factor, k, by which lengths are scaled (increased or decreased) to find corresponding lengths in a similar shape.

Scale factor (volumes) [p. 666] The scale factor, k^3, by which the volume of a solid shape is scaled (increased or decreased) when its linear dimensions are scaled by a factor of k.

Scatterplot [p. 403] A statistical graph used for displaying bivariate data. Data pairs are represented by points on a coordinate plane, with the EV plotted on the horizontal axis and the RV plotted on the vertical axis.

Scientific notation (standard form) [p. 606] Numbers are expressed as a value between 1 and 10 multiplied by a power of 10. Namely as, $a \text{ times } 10^n$, where $1 \leq a < 10$ and n is an integer. For example, 23.45180 written in scientific notation is 2.345180×10^1.

Sector [p. 633] The area bounded by two radii and an arc of a circle. The area, A, of a sector of a circle with a radius r, where the arc of the sector subtends an angle of θ at the centre, is given by

$$A = \frac{\pi r^2 \theta}{360}$$

Sequence [p. 133] A list of numbers or symbols written down in succession, for example, 5, 15, 25.

Shortest path [p. 516] The path through a graph or network with minimum length.

Significant figures [p. 608] Are used as an expression of the accuracy claimed for a measurement. Write the number in scientific notation, then round to the required number of significant figures.

Similar figures [p. 656] Figures that have exactly the same shape but differ in size.

Similar triangles [p. 662] Different sized triangles in which the corresponding angles are equal. The ratios of the corresponding pairs of sides are always the same.

Simple interest [p. 157] Interest that is calculated for an agreed period and paid only on the original amount invested or borrowed. Also called flat-rate interest.

Simultaneous linear equations [p. 350] Two or more linear equations in two or more variables, for values that are common solutions to all equations. For example, $3x - y = 7$ and $x + y = 5$ are a pair of simultaneous linear equations in x and y, with the common solution $x = 3$ and $y = 2$.

Sine ratio (sin θ) [p. 684] In right-angled triangles, the ratio of the side opposite a given angle (θ) to the hypotenuse.

Sine rule [p. 715] In non-right-angled triangles, a rule used to find:

- an unknown side, given the angle opposite and another side and its opposite angle
- an unknown angle, given the side opposite and another side and its opposite angle.

For triangle ABC the rule is:

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}.$$

Skewness [p. 68] Lack of symmetry in a data distribution. It may be positive or negative.

Slope of a straight line [p. 323] The ratio of the increase in the dependent variable (y) to the increase in the independent variable (x) in a linear equation. Also known as the gradient.

$$\text{slope} = \frac{\text{rise}}{\text{run}}.$$

SOH–CAH –TOA [p. 684] A memory aid for remembering the trigonometric ratio rules.

Solution [p. 24] A value that can replace a variable and make an equation or inequality true.

Spanning tree [p. 521] A subgraph of a connected graph or network that contains all the vertices of the original graph, but without any multiple edges, circuits or loops.

Spread of a distribution [p. 85] A measure of the degree to which data values are clustered around some central point in the distribution. Measures of spread include standard deviation (s), interquartile range (IQR) and range (R).

Square matrix [p. 221] A matrix with the same number of rows as columns.

Standard deviation (s) [p. 88] A summary statistic that measures the spread of the data values around the mean. It is given by:

$$s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}.$$

Stem plot (stem-and-leaf plot) [p. 70] A display of a numerical data set, formed by splitting the actual data values into two parts, a stem and a leaf; suitable for small to medium-sized data sets.

Strength of an association (relationship) [p. 414] The degree of association between two variables, classified as weak, moderate or strong. It is determined by observing the degree of scatter in a scatterplot or calculating a correlation coefficient.

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Summary statistics [p. 77] Statistics that give numerical values to special features of a data distribution, such as centre and spread. Summary statistics include the mean, median, range, standard deviation and IQR.

Surface area [p. 650] The total of the areas of each of the surfaces of a solid.

Symmetric distribution [p. 67] A data distribution in which the data values are evenly distributed around the mean. In a symmetric distribution, the mean and the median are equal.

T

Tangent ratio (tan θ) [p. 684] In right-angled triangles, the ratio of the side opposite a given angle θ to the side that is adjacent to the angle.

Term [p. 133] One value in a sequence or series; or one value in an algebraic expression.

Three-figure bearing [p. 710] An angular direction, measured clockwise from north and written with three digits, for example, 060°, 324°. Also called a true bearing.

Total surface area (TSA) [p. 650] The total surface area (TSA) of a solid is the sum of the surface areas of all of its faces.

Trail [p. 498] A walk with no repeated edges. *See also* Walk.

Tree [p. 520] A connected graph with no circuits, multiple edges or loops.

Trigonometric ratios [p. 684] In right-angled triangles, the ratios

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}, \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}, \tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

True bearing [p. 710] *See* Three-figure bearing.

U

Undefined [p. 325] Has no meaning; has no value. The slope, or gradient, of a vertical line is undefined because $\frac{rise}{run}$ gives a zero denominator.

Unit-cost depreciation [p. 161] Unit-cost depreciation is an example of linear decay that is calculated based on units of use rather than by time. The value of the asset declines by a constant amount for each unit of use (e.g. per 100 kilometres).

V

Variable [p. 300] A quantity that can have many different values in a given situation. Symbols such as x, y and z are commonly used to represent variables.

Variation [p. 553] A relationship between two or more variables.

Vertex [p. 468] The points in a graph or network. (Plural – vertices).

Volume [p. 638] The volume of a solid is a measure of the amount of space enclosed within it, measured in cubic units.

Volume formulas [p. 638] Formulas used to calculate the volumes of solids, including cubes, cuboids, prisms, pyramids, cylinders, cones and spheres.

W

Walk [p. 497] A sequence of edges, linking successive vertices, that connects two different vertices in a graph.

Weighted graph [p. 514] A graph in which a number is associated with each edge. These numbers are called weights. When the numbers represent the size of some quantity (such as distance or time), a weighted graph is often called a network.

Y

y-intercept [p. 329] The point at which a graph cuts the y-axis.

Z

Zero matrix (*O*) [p. 228] A matrix that behaves like zero in arithmetic, represented by the symbol O. Any matrix with zeros in every position is a zero matrix.

Zero slope [p. 325] A horizontal line has zero slope. The equation of this line has the form $y = c$ where c is any constant.

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