Glossary

A

Acceleration [p. 642] the rate of change of a particle's velocity with respect to time

Acceleration, average [p. 642] The average acceleration of a particle for the time interval $[t_1, t_2]$ is given by $\dfrac{v_2 - v_1}{t_2 - t_1}$, where v_2 is the velocity at time t_2 and v_1 is the velocity at time t_1.

Acceleration, instantaneous [p. 642]
$$a = \frac{dv}{dt}$$

Addition rule for choices [p. 364] To determine the total number of choices from disjoint alternatives, simply add up the number of choices available for each alternative.

Addition rule for probability [p. 324] The probability of A or B or both occurring is given by
$$\Pr(A \cup B) = \Pr(A) + \Pr(B) - \Pr(A \cap B)$$

Algorithm [p. 735] a finite, unambiguous sequence of instructions for performing a specific task

Amplitude of circular functions [p. 487] The distance between the mean position and the maximum position is called the amplitude. The graph of $y = \sin x$ has an amplitude of 1.

Antiderivative [p. 595] To find the general antiderivative of $f(x)$: If $F'(x) = f(x)$, then
$$\int f(x)\,dx = F(x) + c$$
where c is an arbitrary real number.

Antidifferentiation rules [pp. 596, 687]

- $\int x^n\,dx = \dfrac{x^{n+1}}{n+1} + c, \quad n \in \mathbb{Q} \setminus \{-1\}$
- $\int f(x) + g(x)\,dx = \int f(x)\,dx + \int g(x)\,dx$
- $\int kf(x)\,dx = k\int f(x)\,dx$

Arrangements [p. 367] counted when order is important. The number of ways of selecting and arranging r objects from a total of n objects is
$$\frac{n!}{(n-r)!} = n \times (n-1) \times (n-2) \times \cdots \times (n-r+1)$$

Asymptote [pp. 138, 690] A straight line is an asymptote of the graph of a function $y = f(x)$ if the graph of $y = f(x)$ gets arbitrarily close to the straight line. An asymptote can be horizontal, vertical or oblique.

B

Binomial distribution [p. 397] The probability of observing x successes in n independent trials, each with probability of success p, is given by
$$\Pr(X = x) = \binom{n}{x} p^x (1-p)^{n-x}, \quad x = 0, 1, \dots, n$$
where $\dbinom{n}{x} = \dfrac{n!}{x!\,(n-x)!}$

Binomial experiment [p. 397]

- The experiment consists of a number, n, of identical trials.
- Each trial results in one of two outcomes, which are usually designated either a success, S, or a failure, F.
- The probability of success on a single trial, p, is constant for all trials.
- The trials are independent (so that the outcome of any trial is not affected by the outcome of any previous trial).

Bisection method [p. 253] A numerical method for solving polynomial equations. If the values of $f(a)$ and $f(b)$ have opposite signs, where $a < b$, then the equation $f(x) = 0$ has a solution in the interval $[a, b]$. The method is to bisect the interval and replace it with one half or the other.

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C

Chain rule [p. 679] The chain rule can be used to differentiate a complicated function $y = f(x)$ by transforming it into two simpler functions, which are 'chained' together:

$$x \xrightarrow{h} u \xrightarrow{g} y$$

Using Leibniz notation, the chain rule is stated as

$$\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$$

Circle, general equation [p. 148] The general equation for a circle is

$(x - h)^2 + (y - k)^2 = r^2$

where the centre of the circle is the point (h, k) and the radius is r.

Circular functions [pp. 478, 480] the sine, cosine and tangent functions

Circular functions, exact values [p. 484]

θ	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$
$\sin\theta$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
$\cos\theta$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
$\tan\theta$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	undef

Coefficient [p. 206] the number that multiplies a power of x in a polynomial. E.g. for $2x^5 - 7x^2 + 4$, the coefficient of x^2 is -7.

Combinations [p. 373] *see* selections

Complement, A' [pp. 309, 322] the set of outcomes that are in the sample space, ε, but not in A. The probability of the event A' is

$\Pr(A') = 1 - \Pr(A)$

Complementary relationships [p. 503]

$$\sin\left(\frac{\pi}{2} - \theta\right) = \cos\theta \qquad \sin\left(\frac{\pi}{2} + \theta\right) = \cos\theta$$

$$\cos\left(\frac{\pi}{2} - \theta\right) = \sin\theta \qquad \cos\left(\frac{\pi}{2} + \theta\right) = -\sin\theta$$

Conditional probability [p. 331] the probability of an event A occurring when it is known that some event B has occurred, given by

$$\Pr(A \mid B) = \frac{\Pr(A \cap B)}{\Pr(B)}$$

Constant function [p. 177] a function $f\colon \mathbb{R} \to \mathbb{R}, f(x) = a$

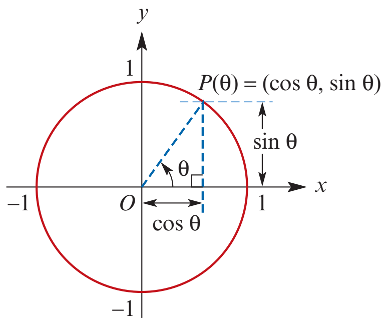
Continuous function [p. 604] A function f is continuous at the point $x = a$ if the following conditions are met:

- $f(x)$ is defined at $x = a$
- $\lim_{x \to a} f(x) = f(a)$

We say that a function is continuous everywhere if it is continuous for all real numbers.

Coordinates [p. 32] an ordered pair of numbers that identifies a point in the Cartesian plane; the first number identifies the position with respect to the x-axis, and the second number identifies the position with respect to the y-axis

Cosine function [p. 478] cosine θ is defined as the x-coordinate of the point P on the unit circle where OP forms an angle of θ radians with the positive direction of the x-axis.



Cubic function [p. 205] A polynomial of degree 3 is called a cubic, and is a function f with rule $f(x) = ax^3 + bx^2 + cx + d$, where $a \neq 0$.

D

Definite integral [pp. 703, 708] $\int_a^b f(x)\,dx$ denotes the signed area enclosed by the graph of $y = f(x)$ between $x = a$ and $x = b$.
See also fundamental theorem of calculus

Degree of a polynomial [pp. 76, 206] given by the highest power of x with a non-zero coefficient. For example, the polynomial $2x^5 - 7x^2 + 4$ has degree 5.

Dependent trials or events [p. 393] The probability of one event is influenced by the outcome of another event. *See* sampling without replacement

Derivative function [p. 571] also called the gradient function. The derivative f' of a function f is given by

$$f'(x) = \lim_{h \to 0} \frac{f(x + h) - f(x)}{h}$$

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Desk check [p. 739] To carry out a desk check of an algorithm, you carefully follow the algorithm step by step, and construct a table of the values of all the variables after each step.

Difference of two cubes [p. 222]
$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$

Difference of two squares [pp. 79, 83]
$x^2 - y^2 = (x - y)(x + y)$

Differentiable [p. 607] A function f is said to be differentiable at the point $x = a$ if $\lim_{h \to 0} \frac{f(a + h) - f(a)}{h}$ exists.

Differentiation rules [pp. 576, 684]
- Power: $f(x) = x^n$, $f'(x) = nx^{n-1}$, for $n \in \mathbb{Q} \setminus \{0\}$
- Constant: $f(x) = c$, $f'(x) = 0$
- Sum: $f(x) = g(x) + h(x)$, $f'(x) = g'(x) + h'(x)$
- Multiple: $f(x) = k\,g(x)$, $f'(x) = k\,g'(x)$

Dilation from the *x*-axis [p. 270] A dilation of factor b from the x-axis is described by the rule $(x, y) \to (x, by)$. The curve with equation $y = f(x)$ is mapped to the curve with equation $y = bf(x)$.

Dilation from the *y*-axis [p. 270] A dilation of factor a from the y-axis is described by the rule $(x, y) \to (ax, y)$. The curve with equation $y = f(x)$ is mapped to the curve with equation $y = f\left(\frac{x}{a}\right)$.

Discontinuity [p. 604] A function is said to be discontinuous at a point if it is not continuous at that point.

Discrete random variable [p. 387] a random variable X which can take only a countable number of values, usually whole numbers

Discriminant, Δ, of a quadratic [p. 110] the expression $b^2 - 4ac$, which is part of the quadratic formula. For the quadratic equation $ax^2 + bx + c = 0$:
- If $b^2 - 4ac > 0$, there are two solutions.
- If $b^2 - 4ac = 0$, there is one solution.
- If $b^2 - 4ac < 0$, there are no real solutions.

Disjoint sets [pp. 165, 323] If sets A and B have no elements in common, we say A and B are disjoint and write $A \cap B = \varnothing$.

Displacement [p. 640] The displacement of a particle moving in a straight line is defined as the change in position of the particle.

Distance between two points [p. 34] The distance between points $A(x_1, y_1)$ and $B(x_2, y_2)$ is
$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Division of polynomials [p. 211] When we divide the polynomial $P(x)$ by the polynomial $D(x)$ we obtain two polynomials, $Q(x)$ the quotient and $R(x)$ the remainder, such that
$P(x) = D(x)Q(x) + R(x)$
and either $R(x) = 0$ or $R(x)$ has degree less than $D(x)$.

Domain [p. 169] the set of all the first coordinates of the ordered pairs in a relation

E

Element [p. 165] a member of a set.
- If x is an element of a set A, we write $x \in A$.
- If x is *not* an element of a set A, we write $x \notin A$.

Empty set, ∅ [pp. 165, 322] the set that has no elements

Even function [p. 245] A function f is even if $f(-x) = f(x)$. This means that the graph is symmetric about the y-axis.

Event [p. 305] a subset of the sample space. It may consist of a single outcome, or it may consist of several outcomes.

Exponential function [p. 424] a function $f(x) = ka^x$, where k is a non-zero constant and the base a is a positive real number other than 1

F

Factor [p. 211] a number or expression that divides another number or expression without remainder

Factor theorem [p. 218] If $\beta x + \alpha$ is a factor of a polynomial $P(x)$, then $P\left(-\frac{\alpha}{\beta}\right) = 0$. Conversely, if $P\left(-\frac{\alpha}{\beta}\right) = 0$, then $\beta x + \alpha$ is a factor of $P(x)$.

Factorise [p. 82] express as a product of factors

Formula [p. 22] an equation containing symbols that states a relationship between two or more quantities; e.g. $A = \ell w$ (area = length × width). The value of A, the subject of the formula, can be found by substituting given values of ℓ and w.

Function [p. 175] a relation such that for each x-value there is only one corresponding y-value. This means that, if (a, b) and (a, c) are ordered pairs of a function, then $b = c$.

Function, one-to-one [p. 183] different x-values map to different y-values. For example, the function $y = x + 1$ is one-to-one. But $y = x^2$ is not one-to-one, as both 2 and −2 map to 4.

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Fundamental theorem of calculus [p. 705]
If f is a continuous function on an interval $[a, b]$, then
$\int_a^b f(x)\,dx = F(b) - F(a)$
where F is any antiderivative of f and $\int_a^b f(x)\,dx$ is the definite integral from a to b.

G

Gradient function *see* derivative function

Gradient of a line [pp. 36, 37] The gradient is
$$m = \frac{\text{rise}}{\text{run}} = \frac{y_2 - y_1}{x_2 - x_1}$$
where (x_1, y_1) and (x_2, y_2) are the coordinates of two points on the line. The gradient of a vertical line (parallel to the y-axis) is undefined.

H

Horizontal-line test [p. 183] If a horizontal line can be drawn anywhere on the graph of a function and it only ever intersects the graph a maximum of once, then the function is *one-to-one*.

Hybrid function *see* piecewise-defined function

I

Implied domain *see* maximal domain

Indefinite integral *see* antiderivative

Independent events [p. 339] Two events A and B are independent if $\Pr(A \cap B) = \Pr(A) \times \Pr(B)$ or $\Pr(A \mid B) = \Pr(A)$ or $\Pr(B \mid A) = \Pr(B)$

Independent trials *see* sampling with replacement

Index laws [p. 425]

- To multiply two powers with the same base, add the indices: $a^m \times a^n = a^{m+n}$
- To divide two powers with the same base, subtract the indices: $a^m \div a^n = a^{m-n}$
- To raise a power to another power, multiply the indices: $(a^m)^n = a^{m \times n}$
- Rational indices: $a^{\frac{m}{n}} = (\sqrt[n]{a})^m$
- For base $a \in \mathbb{R}^+ \setminus \{1\}$, if $a^x = a^y$, then $x = y$.

Inequality [p. 19] a mathematical statement that contains an inequality symbol rather than an equals sign; e.g. $2x + 1 < 4$

Integers [p. 166] $\mathbb{Z} = \{\dots, -2, -1, 0, 1, 2, \dots\}$

Integration (definite), properties [p. 712]

- $\int_a^b f(x)\,dx = \int_a^c f(x)\,dx + \int_c^b f(x)\,dx$
- $\int_a^a f(x)\,dx = 0$
- $\int_a^b k\,f(x)\,dx = k\int_a^b f(x)\,dx$
- $\int_a^b f(x) \pm g(x)\,dx = \int_a^b f(x)\,dx \pm \int_a^b g(x)\,dx$
- $\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx$

Intersection of sets [pp. 165, 322] The intersection of two sets A and B, written $A \cap B$, is the set of all elements common to A and B.

Interval [p. 167] a subset of the real numbers of the form $[a, b]$, $[a, b)$, (a, ∞), etc.

Inverse function [p. 191] For a one-to-one function f, the inverse function f^{-1} is defined by $f^{-1}(x) = y$ if $f(y) = x$, for $x \in \operatorname{ran} f$, $y \in \operatorname{dom} f$.

Irrational number [p. 166] a real number that is not rational; e.g. π and $\sqrt{2}$

L

Law of total probability [p. 334] In the case of two events, A and B:
$\Pr(A) = \Pr(A \mid B)\Pr(B) + \Pr(A \mid B')\Pr(B')$

Leading term [p. 206] The leading term, $a_n x^n$, of a polynomial is the term of highest index among those terms with a non-zero coefficient. E.g. the leading term of $2x^5 - 7x^2 + 4$ is $2x^5$.

Limit [p. 601] The notation $\lim_{x \to a} f(x) = \ell$ says that the limit of $f(x)$, as x approaches a, is ℓ. We can also say: 'As x approaches a, $f(x)$ approaches ℓ.'

Limits, properties [p. 602]

- Sum: $\lim_{x \to a} \big(f(x) + g(x)\big) = \lim_{x \to a} f(x) + \lim_{x \to a} g(x)$
- Multiple: $\lim_{x \to a} \big(k f(x)\big) = k \lim_{x \to a} f(x)$
- Product: $\lim_{x \to a} \big(f(x)\,g(x)\big) = \lim_{x \to a} f(x)\ \lim_{x \to a} g(x)$
- Quotient: $\lim_{x \to a} \dfrac{f(x)}{g(x)} = \dfrac{\lim_{x \to a} f(x)}{\lim_{x \to a} g(x)}$, if $\lim_{x \to a} g(x) \neq 0$

Linear equation [p. 2] a polynomial equation of degree 1; e.g. $2x + 1 = 0$

Linear function [p. 177] a function $f : \mathbb{R} \to \mathbb{R}$, $f(x) = mx + c$; e.g. $f(x) = 3x + 1$

Literal equation [p. 5] an equation for the variable x in which the coefficients of x, including the constants, are pronumerals; e.g. $ax + b = c$

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Logarithm [p. 445] If $a \in \mathbb{R}^+ \setminus \{1\}$ and $x \in \mathbb{R}$, then the statements $a^x = y$ and $\log_a y = x$ are equivalent.

Logarithm laws [p. 445]

- $\log_a(mn) = \log_a m + \log_a n$
- $\log_a\left(\dfrac{m}{n}\right) = \log_a m - \log_a n$
- $\log_a\left(\dfrac{1}{n}\right) = -\log_a n$
- $\log_a(m^p) = p\log_a m$
- $\log_a 1 = 0$ and $\log_a a = 1$

Logarithms, change of base [p. 450]

$$\log_a c = \frac{\log_b c}{\log_b a}$$

M

Maximal domain [pp. 173, 184] When the rule for a relation is given and no domain is specified, then the domain taken is the largest for which the rule has meaning.

Maximum and minimum value [p. 635] For a continuous function f defined on an interval $[a, b]$:

- if M is a value of the function such that $f(x) \le M$ for all $x \in [a, b]$, then M is the *absolute maximum* value of the function
- if N is a value of the function such that $f(x) \ge N$ for all $x \in [a, b]$, then N is the *absolute minimum* value of the function.

Midpoint of a line segment [p. 33] If $P(x, y)$ is the midpoint of the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$, then

$$x = \frac{x_1 + x_2}{2} \quad \text{and} \quad y = \frac{y_1 + y_2}{2}$$

Monic polynomial [p. 206] a polynomial whose leading term has coefficient 1; e.g. $x^3 + 4x^2 + 5$

Multiplication rule for choices [p. 365] When sequential choices are involved, the total number of possibilities is found by multiplying the number of choices at each successive stage.

Multiplication rule for probability [p. 333] the probability of events A and B both occurring is

$$\Pr(A \cap B) = \Pr(A \mid B) \times \Pr(B)$$

Multi-stage experiment [p. 317] a random experiment that could be considered to take place in more than one stage; e.g. tossing two coins

Mutually exclusive [p. 323] Two events A and B are said to be mutually exclusive if they have no outcomes in common, i.e. if $A \cap B = \emptyset$.

N

$n!$ [p. 369] The notation $n!$ (read as 'n factorial') is an abbreviation for the product of all the integers from n down to 1:

$$n! = n \times (n-1) \times (n-2) \times (n-3) \times \cdots \times 2 \times 1$$

Natural numbers [p. 166] $\mathbb{N} = \{1, 2, 3, 4, \dots\}$

^nC_r [p. 374] the number of combinations of n objects in groups of size r:

$$^nC_r = \frac{n!}{r!\,(n-r)!}$$

An alternative notation for ^nC_r is $\dbinom{n}{r}$.

Newton's method [p. 649] A method for finding successive approximations to a solution of an equation $f(x) = 0$ using the iterative formula

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$$

Normal line, equation [p. 617] Let (x_1, y_1) be a point on the curve $y = f(x)$. If f is differentiable at $x = x_1$, the equation of the normal at (x_1, y_1) is

$$y - y_1 = \frac{-1}{f'(x_1)}(x - x_1)$$

Null factor theorem [p. 87] If $ab = 0$, then $a = 0$ or $b = 0$.

O

Odd function [p. 245] A function f is odd if $f(-x) = -f(x)$. The graph of an odd function has rotational symmetry about the origin.

Ordered pair [p. 169] a pair of elements, denoted (x, y), where x is the first coordinate and y is the second coordinate

P

Period of a function [p. 487] A function f with domain $\mathbb{R}$ is periodic if there is a positive constant a such that $f(x + a) = f(x)$ for all x. The smallest such a is called the period of f. For example, the period of the sine function is 2π, as $\sin(x + 2\pi) = \sin x$.

Permutations [p. 367] *see* arrangements

Piecewise-defined function [p. 187] a function which has different rules for different subsets of its domain

Polynomial function [p. 206] A polynomial has a rule of the type

$$y = a_n x^n + a_{n-1}x^{n-1} + \cdots + a_1 x + a_0, \quad n \in \mathbb{N} \cup \{0\}$$

where $a_0, a_1, \dots, a_n$ are numbers called coefficients.

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Position [pp. 554, 639] For a particle moving in a straight line, the position of the particle relative to a point O on the line is determined by its distance from O and whether it is to the right or left of O. The direction to the right of O is positive.

Power function [p. 245] a function of the form $f(x) = x^r$, where r is a non-zero real number

Probability [p. 304] a numerical value assigned to the likelihood of an event occurring. If the event A is impossible, then $\Pr(A) = 0$; if the event A is certain, then $\Pr(A) = 1$; otherwise $0 < \Pr(A) < 1$.

Probability distribution [p. 388] a function, denoted $p(x)$ or $\Pr(X = x)$, which assigns a probability to each value of a discrete random variable X

Probability table [p. 327] a table used for illustrating a probability problem diagrammatically

Pseudocode [pp. 735, 747] a notation for describing algorithms that is less formal than a programming language

Pythagorean identity [p. 504]
$\cos^2\theta + \sin^2\theta = 1$

Q

$\mathbb{Q}$ [p. 166] the set of all rational numbers

Quadratic formula [p. 106] The solutions of the quadratic equation $ax^2 + bx + c = 0$, where $a \neq 0$, are given by

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

Quadratic function [p. 76] A quadratic has a rule of the form $y = ax^2 + bx + c$, where a, b and c are constants and $a \neq 0$.

Quadratic, turning point form [p. 91] The turning point form of a quadratic function is $y = a(x - h)^2 + k$, where (h, k) is the turning point.

Quartic function [p. 205] A polynomial of degree 4 is called a quartic, and is a function f with rule $f(x) = ax^4 + bx^3 + cx^2 + dx + e$, where $a \neq 0$.

R

$\mathbb{R}^+$ [p. 167] $\{ x : x > 0 \}$, positive real numbers

$\mathbb{R}^-$ [p. 167] $\{ x : x < 0 \}$, negative real numbers

$\mathbb{R} \setminus \{0\}$ [p. 167] real numbers excluding 0

$\mathbb{R}^2$ [p. 266] $\{ (x, y) : x, y \in \mathbb{R} \}$; i.e. $\mathbb{R}^2$ is the set of all ordered pairs of real numbers

Radian [p. 475] One radian (written 1^c) is the angle subtended at the centre of the unit circle by an arc of length 1 unit.

Random experiment [p. 305] an experiment, such as the rolling of a die, in which the outcome of a single trial is uncertain but observable

Random variable [p. 387] a variable that takes its value from the outcome of a random experiment; e.g. the number of heads observed when a coin is tossed three times

Range [p. 169] the set of all the second coordinates of the ordered pairs in a relation

Rational number [p. 166] a number that can be written as $\frac{p}{q}$, for some integers p and q with $q \neq 0$

Rational-root theorem [p. 220]
Let $P(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0$ be a polynomial of degree n with all coefficients a_i integers. Let α and β be integers such that the highest common factor of α and β is 1. If $\beta x + \alpha$ is a factor of $P(x)$, then β divides a_n and α divides a_0.

Rectangular hyperbola [p. 138] The basic rectangular hyperbola has equation $y = \frac{1}{x}$.

Reflection in the x-axis [p. 271] A reflection in the x-axis is described by the rule $(x, y) \to (x, -y)$. The curve with equation $y = f(x)$ is mapped to the curve with equation $y = -f(x)$.

Reflection in the y-axis [p. 271] A reflection in the y-axis is described by the rule $(x, y) \to (-x, y)$. The curve with equation $y = f(x)$ is mapped to the curve with equation $y = f(-x)$.

Relation [p. 169] a set of ordered pairs; e.g. $\{ (x, y) : y = x^2 \}$

Remainder theorem [p. 216]
When a polynomial $P(x)$ is divided by $\beta x + \alpha$, the remainder is $P\left(-\frac{\alpha}{\beta}\right)$.

Repeated factor of a polynomial [p. 235]
a factor that occurs more than once in the factorised form of a polynomial. For example, $x - a$ is a repeated factor of $P(x) = (x - a)^3(x - b)$.

S

Sample space, ε [p. 305] the set of all possible outcomes for a random experiment

Sampling with replacement [p. 396] selecting individual objects sequentially from a group of objects, and replacing the selected object, so that the probability of obtaining a particular object does not change with each successive selection

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Sampling without replacement [p. 393] selecting individual objects sequentially from a group of objects, and not replacing the selected object, so that the probability of obtaining a particular object changes with each successive selection

Secant [p. 544] a straight line that passes through two points $(a, f(a))$ and $(b, f(b))$ on the graph of a function $y = f(x)$

Selections [p. 373] counted when order is not important. The number of ways of selecting r objects from a total of n objects is

$${}^nC_r = \frac{n!}{r!\,(n-r)!}$$

An alternative notation for ${}^nC_r$ is $\binom{n}{r}$.

Set difference [p. 166] The set $A \setminus B$ contains all the elements of A that are not in B.

Set notation [p. 165]

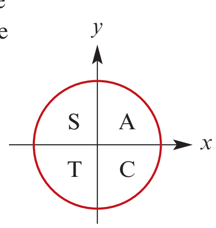
- $\in$ means 'is an element of'
- $\notin$ means 'is not an element of'
- $\subseteq$ means 'is a subset of'
- $\cap$ means 'intersection'
- $\cup$ means 'union'
- $\varnothing$ is the empty set, containing no elements

Sets of numbers [p. 166]

- $\mathbb{N}$ is the set of natural numbers
- $\mathbb{Z}$ is the set of integers
- $\mathbb{Q}$ is the set of rational numbers
- $\mathbb{R}$ is the set of real numbers

Signs of circular functions [p. 481]

1st quadrant	all are positive
2nd quadrant	sin is positive
3rd quadrant	tan is positive
4th quadrant	cos is positive

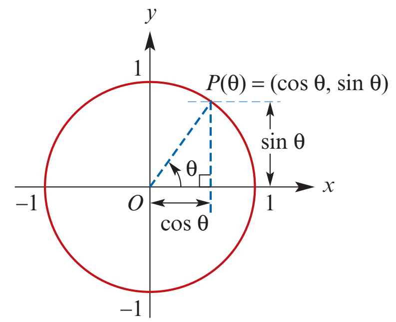


Simulation [p. 346] the process of finding an approximate solution to a probability problem by repeated trials using a simulation model

Simulation model [p. 346] a simple model which is analogous to a real-world situation. For example, the outcomes from a toss of a coin (head, tail) could be used as a simulation model for the sex of a child (male, female) under the assumption that in both situations the probabilities are 0.5 for each outcome.

Simultaneous equations [p. 11] equations of two or more lines or curves in the Cartesian plane, the solutions of which are the points of intersection of the lines or curves

Sine function [p. 478] sine θ is defined as the y-coordinate of the point P on the unit circle where OP forms an angle of θ radians with the positive direction of the x-axis.



Speed [p. 641] the magnitude of velocity

Speed, average [pp. 543, 641]

$$\text{average speed} = \frac{\text{total distance travelled}}{\text{total time taken}}$$

Stationary point [pp. 624, 627] A point with coordinates $(a, f(a))$ on a curve $y = f(x)$ is said to be a stationary point if $f'(a) = 0$.

Straight line, equation given two points [p. 45] $y - y_1 = m(x - x_1)$, where $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

Straight line, gradient–intercept form [p. 42] The gradient–intercept form of the equation of a straight line is $y = mx + c$, where m is the gradient and c is the y-axis intercept.

Straight lines, parallel [p. 54] Two straight lines are parallel to each other if and only if they have the same gradient (or if both are vertical).

Straight lines, perpendicular [p. 55] Two straight lines are perpendicular to each other if and only if the product of their gradients is -1 (or if one is horizontal and the other vertical).

Strictly decreasing [p. 589] A function f is strictly decreasing on an interval if $a < b$ implies $f(a) > f(b)$.

Strictly increasing [p. 589] A function f is strictly increasing on an interval if $a < b$ implies $f(a) < f(b)$.

Subset [p. 165] A set B is called a subset of a set A if every element of B is also an element of A. We write $B \subseteq A$.

Sum of two cubes [p. 222]
$x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

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T

Tangent function [p. 480] The tangent function is given by

$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

Tangent line, equation [p. 616] Let (x_1, y_1) be a point on the curve $y = f(x)$. Then, if f is differentiable at $x = x_1$, the equation of the tangent at (x_1, y_1) is given by

$$y - y_1 = f'(x_1)(x - x_1)$$

Translation [p. 266] A translation of h units in the positive direction of the x-axis and k units in the positive direction of the y-axis is described by the rule $(x, y) \to (x + h, y + k)$, where h and k are positive numbers. The curve with equation $y = f(x)$ is mapped to the curve with equation $y - k = f(x - h)$.

Tree diagram [pp. 319, 334] a diagram representing the outcomes of a multi-stage experiment

U

Union of sets [pp. 165, 322] The union of two sets A and B, written $A \cup B$, is the set of all elements which are in A or B or both.

V

Velocity [pp. 557, 640] the rate of change of a particle's position with respect to time

Velocity, average [pp. 555, 640]

$$\text{average velocity} = \frac{\text{change in position}}{\text{change in time}}$$

Velocity, instantaneous [pp. 557, 640]

$$v = \frac{dx}{dt}$$

Venn diagram [pp. 165, 322] a diagram showing sets and the relationships between sets

Vertical-line test [p. 175] used to identify whether a relation is a function or not.
If a vertical line can be drawn anywhere on the graph and it only ever intersects the graph a maximum of once, then the relation is a *function*.

Z

$\mathbb{Z}$ [p. 166] the set of all integers

Zero polynomial [p. 206] The number 0 is called the zero polynomial.

Glossary T → Z

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