Glossary

A

Absolute maximum and minimum [p. 437]
For a continuous function f defined on an interval $[a, b]$:

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

Absolute value function [p. 490]

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$$

Acceleration [MM1&2] the rate of change of a particle's velocity with respect to time

Acceleration, average [MM1&2] 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 [MM1&2]

$$a = \frac{dv}{dt}$$

Addition rule for choices [p. 784] 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. 558] 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. 776] a finite, unambiguous sequence of instructions for performing a specific task

Amplitude of circular functions [p. 254]
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. 484] 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.

Approximations for the derivative [p. 351]
The value of the derivative of f at $x = a$ can be approximated by $f'(a) \approx \dfrac{f(a+h) - f(a)}{h}$
or $f'(a) \approx \dfrac{f(a+h) - f(a-h)}{2h}$
for a small value of h.

Arrangements [p. 785] counted when order is important. The number of ways of selecting and arranging r objects from a total of n objects is

$$\frac{n!}{(n-r)!} = n \times (n-1) \times (n-2) \times \cdots \times (n-r+1)$$

Average value [p. 516] The average value of a continuous function f for an interval $[a, b]$ is defined as $\dfrac{1}{b-a}\displaystyle\int_a^b f(x)\,dx$.

B

Bernoulli sequence [p. 600] a sequence of repeated trials with the following properties:

- Each trial results in one of two outcomes, usually designated as a success or a failure.
- The probability of success on a single trial, p, is constant for all trials.
- The trials are independent. (The outcome of a trial is not affected by outcomes of other trials.)

Note: The glossary contains some terms which were introduced in Mathematical Methods Units 1 & 2, but which are not explicitly mentioned in the Mathematical Methods Units 3 & 4 study design. The reference for these is given as [MM1&2].

Binomial distribution [p. 601] 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 $\binom{n}{x} = \dfrac{n!}{x!\,(n-x)!}$

Binomial expansion [p. 789]

$$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^{n-k} a^k$$
$$= x^n + \binom{n}{1} x^{n-1} a + \binom{n}{2} x^{n-2} a^2 + \cdots + a^n$$

The $(r+1)$st term is $\binom{n}{r} x^{n-r} a^r$.

Binomial experiment [p. 601] a Bernoulli sequence of n independent trials, each with probability of success p

Bisection method [MM1&2] 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.

C

Chain rule [p. 371] 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

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

Change of base [p. 218] $\log_a b = \dfrac{\log_c b}{\log_c a}$

Circle, general equation [p. 7] The general equation for a circle is $(x-h)^2 + (y-k)^2 = r^2$, where the centre is (h, k) and the radius is r.

Complement, A' [p. 558] the set of outcomes that are in the sample space, ε, but not in A. The probability of the event A' is $\Pr(A') = 1 - \Pr(A)$.

Composite function [p. 28] For functions f and g such that $\text{ran}\, f \subseteq \text{dom}\, g$, the composite function of g with f is defined by $g \circ f(x) = g(f(x))$, where $\text{dom}(g \circ f) = \text{dom}\, f$.

Conditional probability [p. 566] the probability of an event A occurring when it is known that some event B has occurred, given by

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

Confidence interval [p. 716] an interval estimate for the population proportion p based on the value of the sample proportion $\hat{p}$

Constant function [MM1&2] a function $f : \mathbb{R} \to \mathbb{R}, f(x) = a$

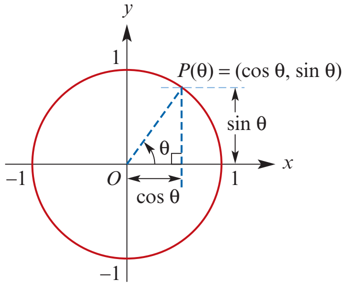
Continuous function [p. 400] A function f is continuous at the point $x = a$ if $f(x)$ is defined at $x = a$ and $\lim_{x \to a} f(x) = f(a)$.

Continuous random variable [p. 624] a random variable X that can take any value in an interval of the real number line

Coordinates [MM1&2] 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 and sine functions [p. 245]

- 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
- 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



Cubic function [p. 169] a polynomial of degree 3. A cubic function f has a rule of the form $f(x) = ax^3 + bx^2 + cx + d$, where $a \neq 0$.

Cumulative distribution function [p. 649] gives the probability that the random variable X takes a value less than or equal to x; that is, $F(x) = \Pr(X \le x) = \int_{-\infty}^{x} f(t)\, dt$

D

Definite integral [pp. 480, 496] $\int_a^b f(x)\, dx$ denotes the signed area enclosed by the graph of $y = f(x)$ between $x = a$ and $x = b$.

Degree of a polynomial [p. 153] given by the highest power of x with a non-zero coefficient; e.g. the polynomial $2x^5 - 7x^2 + 4$ has degree 5.

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Dependent trials [MM1&2] *see* sampling without replacement

Derivative function [p. 349] also called the gradient function. The derivative f' of a function f is given by

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

Derivatives, basic [pp. 375–387]

$f(x)$	$f'(x)$	
c	0	where c is a constant
x^a	ax^{a-1}	where $a \in \mathbb{R} \setminus \{0\}$
e^{kx}	ke^{kx}	
$\log_e(kx)$	$\frac{1}{x}$	
$\sin(kx)$	$k\cos(kx)$	
$\cos(kx)$	$-k\sin(kx)$	
$\tan(kx)$	$k\sec^2(kx)$	

Difference of two cubes [p. 163]
$x^3 - y^3 = (x - y)(x^2 + xy + y^2)$

Difference of two squares [MM1&2]
$x^2 - y^2 = (x - y)(x + y)$

Differentiable [p. 403] 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 [p. 353]

- Sum: $f(x) = g(x) + h(x)$, $f'(x) = g'(x) + h'(x)$
- Multiple: $f(x) = k\,g(x)$, $f'(x) = k\,g'(x)$

see also chain rule, product rule, quotient rule

Dilation from the *x*-axis [p. 97] 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. 98] 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. 400] A function is said to be discontinuous at a point if it is not continuous at that point.

Discrete random variable [p. 574] a random variable X which can take only a countable number of values, usually whole numbers

Discriminant, Δ, of a quadratic [p. 144] 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 [p. 2] Two sets A and B are disjoint if they have no elements in common, i.e. $A \cap B = \emptyset$.

Distance between two points [p. 70] The distance between points $A(x_1, y_1)$ and $B(x_2, y_2)$ is
$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Domain [p. 6] the set of all the first coordinates of the ordered pairs in a relation

E

Element [p. 2] 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, ∅ [p. 2] the set that has no elements

Equating coefficients [p. 155] Two polynomials P and Q are equal only if their corresponding coefficients are equal. For example, two cubic polynomials $P(x) = a_3x^3 + a_2x^2 + a_1x + a_0$ and $Q(x) = b_3x^3 + b_2x^2 + b_1x + b_0$ are equal if and only if $a_3 = b_3$, $a_2 = b_2$, $a_1 = b_1$ and $a_0 = b_0$.

Euler's number, *e* [p. 203] the natural base for exponential and logarithmic functions:

$$e = \lim_{n \to \infty} \left(1 + \frac{1}{n}\right)^n = 2.718\,281\ldots$$

Even function [p. 19] A function f is even if $f(-x) = f(x)$ for all x in the domain of f; the graph is symmetric about the y-axis.

Event [p. 556] a subset of the sample space (that is, a set of outcomes)

Expected value of a random variable, E(*X*) [pp. 582, 635] also called the mean, μ.
For a discrete random variable X:
$$E(X) = \sum_x x \cdot \Pr(X = x) = \sum_x x \cdot p(x)$$
For a continuous random variable X:
$$E(X) = \int_{-\infty}^{\infty} x f(x)\, dx$$

Exponential function [p. 197] 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

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F

Factor [MM1&2] a number or expression that divides another number or expression without remainder

Factor theorem [p. 161] If $\beta x + \alpha$ is a factor of $P(x)$, 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 [MM1&2] express as a product of factors

Formula [MM1&2] 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. 8] 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, many-to-one [p. 17] a function that is not one-to-one

Function, one-to-one [p. 15] 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.

Fundamental theorem of calculus [pp. 496, 520] If f is a continuous function on an interval $[a, b]$, then

$$\int_a^b f(x)\,dx = G(b) - G(a)$$

where G 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 [p. 70] 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. 16] 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

Independence [p. 569] Two events A and B are independent if and only if

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

Independent trials *see* sampling with replacement

Index laws [p. 207]

- To multiply two powers with the same base, add the indices: $a^x \times a^y = a^{x+y}$
- To divide two powers with the same base, subtract the indices: $a^x \div a^y = a^{x-y}$
- To raise a power to another power, multiply the indices: $(a^x)^y = a^{x \times y}$
- 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 [MM1&2] a mathematical statement that contains an inequality symbol rather than an equals sign; e.g. $2x + 1 < 4$

Integers [p. 3] $\mathbb{Z} = \{\ldots, -2, -1, 0, 1, 2, \ldots\}$

Integrals, basic [pp. 488–494, 503]

$f(x)$	$\int f(x)\,dx$	
x^r	$\frac{x^{r+1}}{r+1} + c$	where $r \in \mathbb{Q} \setminus \{-1\}$
$\frac{1}{ax+b}$	$\frac{1}{a}\log_e(ax+b) + c$	for $ax + b > 0$
e^{kx}	$\frac{1}{k}e^{kx} + c$	
$\sin(kx)$	$-\frac{1}{k}\cos(kx) + c$	
$\cos(kx)$	$\frac{1}{k}\sin(kx) + c$	

Integration, properties [p. 485]

- $\int f(x) + g(x)\,dx = \int f(x)\,dx + \int g(x)\,dx$
- $\int kf(x)\,dx = k\int f(x)\,dx$

Integration (definite), properties [p. 498]

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

Intersection of sets [pp. 2, 556] 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. 4] a subset of the real numbers of the form $[a, b]$, $[a, b)$, (a, ∞), etc.

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Inverse function [p. 32] 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. 3] a real number that is not rational; e.g. π and $\sqrt{2}$

K

Karnaugh map [p. 561] a probability table

L

Law of total probability [p. 567] In the case of two events, A and B:
$\Pr(A) = \Pr(A \mid B)\Pr(B) + \Pr(A \mid B')\Pr(B')$

Limit [p. 396] The notation $\lim_{x \to a} f(x) = p$ says that the limit of $f(x)$, as x approaches a, is p. We can also say: 'As x approaches a, $f(x)$ approaches p.'

Limits, properties [p. 397]

- Sum: $\lim_{x \to a} (f(x) + g(x)) = \lim_{x \to a} f(x) + \lim_{x \to a} g(x)$
- Multiple: $\lim_{x \to a} (k f(x)) = k \lim_{x \to a} f(x)$
- Product: $\lim_{x \to a} (f(x)\, g(x)) = \lim_{x \to a} f(x) \lim_{x \to a} g(x)$
- 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. 64] a polynomial equation of degree 1; e.g. $2x + 1 = 0$

Linear function [p. 74] a function $f \colon \mathbb{R} \to \mathbb{R}$, $f(x) = mx + c$; e.g. $f(x) = 3x + 1$

Literal equation [MM1&2] an equation for the variable x in which the coefficients of x, including the constants, are pronumerals; e.g. $ax + b = c$

Logarithm [p. 209] 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. 211]

- $\log_a(xy) = \log_a x + \log_a y$
- $\log_a\left(\dfrac{x}{y}\right) = \log_a x - \log_a y$
- $\log_a\left(\dfrac{1}{x}\right) = -\log_a x$
- $\log_a(x^p) = p \log_a x$

M

Margin of error, *M* [p. 720] the distance between the sample estimate and the endpoints of the confidence interval

Maximal domain [p. 17] 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.

Mean of a random variable, μ [pp. 582, 635] *see* expected value of a random variable, $E(X)$

Median of a random variable, *m* [p. 638] the middle value of the distribution. For a continuous random variable, the median is the value m such that $\int_{-\infty}^{m} f(x)\, dx = 0.5$.

Midpoint of a line segment [p. 70] If $P(x, y)$ is the midpoint of the line segment joining $A(x_1, y_1)$ and $B(x_2, y_2)$, then
$$x = \frac{x_1 + x_2}{2} \quad \text{and} \quad y = \frac{y_1 + y_2}{2}$$

Multiplication rule for choices [p. 784] When sequential choices are involved, the total number of possibilities is found by multiplying the number of options at each successive stage.

Multiplication rule for probability [p. 566] 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. 567] an experiment that could be considered to take place in more than one stage; e.g. tossing two coins

Mutually exclusive [p. 558] Two events are said to be mutually exclusive if they have no outcomes in common.

N

***n*!** [p. 785] read as 'n factorial', the product of all the natural numbers 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. 3] $\mathbb{N} = \{1, 2, 3, 4, \dots\}$

^nC_r [p. 785] the number of combinations of n objects in groups of size r:
$$^nC_r = \frac{n!}{r!\,(n-r)!}$$

Newton's method [p. 455] 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 distribution [p. 664] the distribution of a continuous random variable X with probability density function
$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$$
where μ is the mean of X and σ is the standard deviation of X

Glossary K → N

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Normal, equation of [p. 414] 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 $y - y_1 = \dfrac{-1}{f'(x_1)}(x - x_1)$

O

Odd function [p. 19] A function f is odd if $f(-x) = -f(x)$ for all x in the domain of f; the graph has rotational symmetry about the origin.

Ordered pair [p. 6] a pair of elements, denoted (x, y), where x is the first coordinate and y is the second coordinate

P

Percentile [p. 637] For a continuous random variable X, the value p such that $\Pr(X \le p) = q\%$ is called the qth percentile of X, and is found by solving $\int_{-\infty}^{p} f(x)\,dx = \dfrac{q}{100}$.

Period of a function [p. 254] 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.

- Sine and cosine have period 2π.
- Tangent has period π.
- A function of the form $y = a\cos(nx + \varepsilon) + b$ or $y = a\sin(nx + \varepsilon) + b$ has period $\dfrac{2\pi}{n}$.

Piecewise-defined function [p. 18] a function which has different rules for different subsets of its domain

Point estimate [p. 716] If the value of the sample proportion $\hat{p}$ is used as an estimate of the population proportion p, then it is called a point estimate of p.

Polynomial function [p. 153] 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 $a_0, a_1, \ldots, a_n$ are numbers called coefficients.

Population [p. 694] the set of all eligible members of a group which we intend to study

Population parameter [p. 698] a statistical measure that is based on the whole population; the value is constant for a given population

Population proportion, p [p. 697] the proportion of individuals in the entire population possessing a particular attribute

Power function [pp. 43, 300] a function of the form $f(x) = x^r$, where r is a non-zero real number

Probability [p. 556] 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 density function [p. 626] usually denoted $f(x)$; describes the probability distribution of a continuous random variable X such that $\Pr(a < X < b) = \int_a^b f(x)\,dx$

Probability function (discrete) [p. 575] denoted by $p(x)$ or $\Pr(X = x)$, a function that assigns a probability to each value of a discrete random variable X. It can be represented by a rule, a table or a graph, and must give a probability $p(x)$ for every value x that X can take.

Probability table [p. 561] a table used for illustrating a probability problem diagrammatically

Product of functions [p. 24] $(fg)(x) = f(x)\,g(x)$ and $\text{dom}(fg) = \text{dom}\, f \cap \text{dom}\, g$

Product rule [p. 389] Let $F(x) = f(x) \cdot g(x)$. If $f'(x)$ and $g'(x)$ exist, then
$F'(x) = f(x) \cdot g'(x) + g(x) \cdot f'(x)$
In Leibniz notation:
If $y = uv$, then $\dfrac{dy}{dx} = u\dfrac{dv}{dx} + v\dfrac{du}{dx}$

Pseudocode [pp. 776, 777] a notation for describing algorithms that is less formal than a programming language

Q

$\mathbb{Q}$ [p. 3] the set of all rational numbers

Quadratic formula [p. 143] $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ is the solution of the quadratic equation $ax^2 + bx + c = 0$

Quadratic function [p. 138] 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. 139] 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. 173] a polynomial of degree 4. A quartic function f has a rule of the form $f(x) = ax^4 + bx^3 + cx^2 + dx + e$, where $a \neq 0$.

Quotient rule [p. 393] Let $F(x) = \dfrac{f(x)}{g(x)}$, where $g(x) \neq 0$. If $f'(x)$ and $g'(x)$ exist, then

$$F'(x) = \frac{g(x) \cdot f'(x) - f(x) \cdot g'(x)}{[g(x)]^2}$$

In Leibniz notation:

If $y = \dfrac{u}{v}$, then $\dfrac{dy}{dx} = \dfrac{v\dfrac{du}{dx} - u\dfrac{dv}{dx}}{v^2}$

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R

$\mathbb{R}^+$ [p. 4] $\{ x : x > 0 \}$, positive real numbers

$\mathbb{R}^-$ [p. 4] $\{ x : x < 0 \}$, negative real numbers

$\mathbb{R} \setminus \{0\}$ [p. 4] the set of real numbers excluding 0

$\mathbb{R}^2$ [p. 91] $\{ (x, y) : x, y \in \mathbb{R} \}$; i.e. $\mathbb{R}^2$ is the set of all ordered pairs of real numbers

Radian [p. 243] 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. 556] an experiment, such as the rolling of a die, in which the outcome of a single trial is uncertain but observable

Random sample [p. 694] A sample of size n is called a *simple random sample* if it is selected from the population in such a way that every subset of size n has an equal chance of being chosen as the sample. In particular, every member of the population must have an equal chance of being included in the sample.

Random variable [p. 574] 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. 6] the set of all the second coordinates of the ordered pairs in a relation

Rational number [p. 3] a number that can be written as $\frac{p}{q}$, for some integers p and q with $q \neq 0$

Rational-root theorem [p. 163]
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. 44] The basic rectangular hyperbola has equation $y = \frac{1}{x}$.

Reflection in the *x*-axis [p. 102] 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. 102] 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. 6] a set of ordered pairs; e.g. $\{ (x, y) : y = x^2 \}$

Remainder theorem [p. 161]
When a polynomial $P(x)$ is divided by $\beta x + \alpha$, the remainder is $P\left(-\frac{\alpha}{\beta}\right)$.

S

Sample [p. 694] a subset of the population which we select in order to make inferences about the whole population

Sample proportion, $\hat{p}$ [p. 697] the proportion of individuals in a particular sample possessing a particular attribute. The sample proportions $\hat{p}$ are the values of a random variable $\hat{P}$.

Sample space, ε [p. 556] the set of all possible outcomes for a random experiment

Sample statistic [p. 698] a statistical measure that is based on a sample from the population; the value varies from sample to sample

Sampling distribution [p. 702] the distribution of a statistic which is calculated from a sample

Sampling with replacement [p. 600] 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

Sampling without replacement [MM1&2] 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

Selections [p. 785] counted when order is not important. The number of ways of selecting r objects from a total of n objects is

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

Set difference [p. 3] The set difference of two sets A and B is $A \setminus B = \{ x : x \in A \text{ and } x \notin B \}$.

Simulation [MM1&2] the process of finding an approximate solution to a probability problem by repeated trials using a simulation model

Simulation model [MM1&2] 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.

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Simultaneous equations [pp. 76, 79, 184] 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. 245] *see* cosine and sine

Standard deviation of a random variable, σ [pp. 586, 642] a measure of the spread or variability, given by $\text{sd}(X) = \sqrt{\text{Var}(X)}$

Standard normal distribution [p. 662] a special case of the normal distribution where $\mu = 0$ and $\sigma = 1$

Stationary point [p. 423] A point $(a, f(a))$ on a curve $y = f(x)$ is a stationary point if $f'(a) = 0$.

Straight line, equation given two points [p. 70] $y - y_1 = m(x - x_1)$, where $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

Straight line, gradient–intercept form [p. 70] $y = mx + c$, where m is the gradient and c is the y-axis intercept

Straight lines, perpendicular [p. 71] Two straight lines are perpendicular if and only if the product of their gradients is -1 (or if one is vertical and the other horizontal).

Strictly decreasing [pp. 43, 358] A function f is strictly decreasing on an interval if $x_2 > x_1$ implies $f(x_2) < f(x_1)$.

Strictly increasing [pp. 43, 358] A function f is strictly increasing on an interval if $x_2 > x_1$ implies $f(x_2) > f(x_1)$.

Subset [p. 2] A set B is called a subset of set A if every element of B is also an element of A. We write $B \subseteq A$.

Sum of functions [p. 24] $(f + g)(x) = f(x) + g(x)$ and $\text{dom}(f + g) = \text{dom}\, f \cap \text{dom}\, g$

Sum of two cubes [p. 163] $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

T

Tangent, equation of [p. 414] 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 $y - y_1 = f'(x_1)(x - x_1)$.

Tangent function [p. 245] $\tan\theta = \dfrac{\sin\theta}{\cos\theta}$

Translation [p. 91] 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 $h, k > 0$. The curve with equation $y = f(x)$ is mapped to the curve with equation $y - k = f(x - h)$.

Tree diagram [p. 567] a diagram representing the outcomes of a multi-stage experiment

U

Union of sets [pp. 2, 556] 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

Variance of a random variable, σ^2 [pp. 585, 642] a measure of the spread or variability, defined by $\text{Var}(X) = \text{E}[(X - \mu)^2]$. An alternative (computational) formula is $\text{Var}(X) = \text{E}(X^2) - [\text{E}(X)]^2$

Velocity, average [MM1&2]

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

Velocity, instantaneous [MM1&2] $v = \dfrac{dx}{dt}$

Vertical-line test [p. 8] If a vertical line can be drawn anywhere on the graph of a relation and it only ever intersects the graph a maximum of once, then the relation is a *function*.

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