STUDY FORMULA BOOKLET

Edexcel International A Level Mathematics, Further Mathematics and Pure Mathematics formulae and statistical tables

The Edexcel IAL booklet gives formulae for P1 to P4, FP1 to FP3, M1 to M3 and S1 to S3, plus statistical tables. D1 has no formulae.

IN THE BOOKLET printed in the official booklet LEARN IT not printed: students must recall it

Based on the official **Pearson Edexcel International Advanced Subsidiary/Advanced Level in Mathematics, Further Mathematics and Pure Mathematics: Mathematical Formulae and Statistical Tables, Issue 2, January 2021**, with what to learn and exam tips added by CuratedPrep.

Introduction: D1 and the booklet

The booklet is arranged by unit. Formulae from earlier units can be needed in later ones, as the unit notes below say.

Decision Mathematics D1 The booklet states that no formulae are required for D1. Know the algorithms and results listed under 'What to learn'.	No formulae are given for D1	IN THE BOOKLET

P1 Mensuration

Surface area of a sphere r is the radius.	$A = 4\pi r^2$	IN THE BOOKLET
Curved surface area of a cone r is the radius of the base.	$A = \pi r \times \text{slant height}$	IN THE BOOKLET

P1 Cosine rule

Cosine rule a is the side opposite angle A.	$a^2 = b^2 + c^2 - 2bc\cos A$	IN THE BOOKLET

P2 Arithmetic series

nth term a is the first term, d the common difference.	$u_n = a + (n-1)d$	IN THE BOOKLET
Sum of n terms l is the last term.	$S_n = \frac{1}{2}n(a+l) = \frac{1}{2}n[2a + (n-1)d]$	IN THE BOOKLET

P2 Geometric series

nth term a is the first term, r the common ratio.	$u_n = ar^{n-1}$	IN THE BOOKLET
Sum of n terms	$S_n = \dfrac{a(1-r^n)}{1-r}$	IN THE BOOKLET
Sum to infinity Only valid when the series converges.	$S_\infty = \dfrac{a}{1-r} \quad \text{for } \lvert r\rvert < 1$	IN THE BOOKLET

P2 Logarithms and exponentials

Change of base	$\log_a x = \dfrac{\log_b x}{\log_b a}$	IN THE BOOKLET

P2 Binomial series

Binomial expansion, positive integer n	$(a+b)^n = a^n + \binom{n}{1}a^{n-1}b + \binom{n}{2}a^{n-2}b^2 + \cdots + \binom{n}{r}a^{n-r}b^r + \cdots + b^n \quad (n \in \mathbb{N})$	IN THE BOOKLET
Binomial coefficient	$\binom{n}{r} = {}^nC_r = \dfrac{n!}{r!\,(n-r)!}$	IN THE BOOKLET
Binomial expansion, any n Printed again under P4.	$(1+x)^n = 1 + nx + \dfrac{n(n-1)}{1\times 2}x^2 + \cdots + \dfrac{n(n-1)\ldots(n-r+1)}{1\times 2\times\cdots\times r}x^r + \ldots \quad (\lvert x\rvert < 1,\ n \in \mathbb{R})$	IN THE BOOKLET

P2 Numerical integration

Trapezium rule n is the number of strips, so there are n + 1 ordinates.	$\displaystyle\int_a^b y\,dx \approx \tfrac{1}{2}h\{(y_0+y_n) + 2(y_1+y_2+\cdots+y_{n-1})\}, \quad h = \dfrac{b-a}{n}$	IN THE BOOKLET

P3 Logarithms and exponentials

Candidates sitting P3 may also require the formulae listed under P1 and P2.

Exponential form of a power	$e^{x\ln a} = a^x$	IN THE BOOKLET

P3 Trigonometric identities

sin of a sum or difference	$\sin(A \pm B) \equiv \sin A\cos B \pm \cos A\sin B$	IN THE BOOKLET
cos of a sum or difference The sign changes between the two sides.	$\cos(A \pm B) \equiv \cos A\cos B \mp \sin A\sin B$	IN THE BOOKLET
tan of a sum or difference	$\tan(A \pm B) \equiv \dfrac{\tan A \pm \tan B}{1 \mp \tan A\tan B} \quad \left(A \pm B \neq \left(k+\tfrac{1}{2}\right)\pi\right)$	IN THE BOOKLET
Sum of sines	$\sin A + \sin B \equiv 2\sin\dfrac{A+B}{2}\cos\dfrac{A-B}{2}$	IN THE BOOKLET
Difference of sines	$\sin A - \sin B \equiv 2\cos\dfrac{A+B}{2}\sin\dfrac{A-B}{2}$	IN THE BOOKLET
Sum of cosines	$\cos A + \cos B \equiv 2\cos\dfrac{A+B}{2}\cos\dfrac{A-B}{2}$	IN THE BOOKLET
Difference of cosines	$\cos A - \cos B \equiv -2\sin\dfrac{A+B}{2}\sin\dfrac{A-B}{2}$	IN THE BOOKLET

P3 Differentiation

Derivative of tan kx	$\dfrac{d}{dx}(\tan kx) = k\sec^2 kx$	IN THE BOOKLET
Derivative of sec x	$\dfrac{d}{dx}(\sec x) = \sec x\tan x$	IN THE BOOKLET
Derivative of cot x	$\dfrac{d}{dx}(\cot x) = -\operatorname{cosec}^2 x$	IN THE BOOKLET

Derivative of cosec x	$\frac{d}{dx}(\operatorname{cosec} x) = -\operatorname{cosec} x \cot x$	IN THE BOOKLET
Quotient rule	$\frac{d}{dx}\left(\frac{f(x)}{g(x)}\right) = \frac{f'(x)g(x) - f(x)g'(x)}{(g(x))^2}$	IN THE BOOKLET

P3 Integration (+ constant)

Integral of sec squared kx	$\int \sec^2 kx \, dx = \frac{1}{k}\tan kx$	IN THE BOOKLET
Integral of tan x	$\int \tan x \, dx = \ln\lvert\sec x\rvert$	IN THE BOOKLET
Integral of cot x	$\int \cot x \, dx = \ln\lvert\sin x\rvert$	IN THE BOOKLET

P4 Binomial series

Candidates sitting P4 may also require the formulae listed under P1, P2 and P3.

Binomial expansion, any n For (a + bx)^n, take out the constant factor first to reach the (1 + x)^n form.	$(1+x)^n = 1 + nx + \frac{n(n-1)}{1\times 2}x^2 + \cdots + \frac{n(n-1)\ldots(n-r+1)}{1\times 2\times\cdots\times r}x^r + \ldots \quad (\lvert x\rvert < 1,\ n \in \mathbb{R})$	IN THE BOOKLET

P4 Integration (+ constant)

Integral of cosec x The two forms are equal.	$\int \operatorname{cosec} x \, dx = -\ln\lvert\operatorname{cosec} x + \cot x\rvert = \ln\left\lvert\tan\left(\frac{1}{2}x\right)\right\rvert$	IN THE BOOKLET
Integral of sec x The two forms are equal.	$\int \sec x \, dx = \ln\lvert\sec x + \tan x\rvert = \ln\left\lvert\tan\left(\frac{1}{2}x + \frac{1}{4}\pi\right)\right\rvert$	IN THE BOOKLET
Integration by parts	$\int u\frac{dv}{dx}\,dx = uv - \int v\frac{du}{dx}\,dx$	IN THE BOOKLET

FP1 Summations

Candidates sitting FP1 may also require the formulae listed under P1 and P2.

Sum of squares	$\sum_{r=1}^{n} r^2 = \frac{1}{6}n(n+1)(2n+1)$	IN THE BOOKLET
Sum of cubes	$\sum_{r=1}^{n} r^3 = \frac{1}{4}n^2(n+1)^2$	IN THE BOOKLET

FP1 Numerical solution of equations

Newton-Raphson iteration Solves f(x) = 0.	$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$	IN THE BOOKLET

FP1 Conics

Parabola and rectangular hyperbola. Foci and directrices of the rectangular hyperbola are not required in FP1.

	Parabola	Rectangular hyperbola
Standard form	$y^2 = 4ax$	$xy = c^2$
Parametric form	$(at^2, 2at)$	$\left(ct, \frac{c}{t}\right)$
Foci	$(a, 0)$	Not required
Directrices	$x = -a$	Not required

FP1 Matrix transformations

Anticlockwise rotation through angle θ about O Matrix of the rotation.	$\begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$	IN THE BOOKLET
Reflection in the line y = (tan θ)x Matrix of the reflection.	$\begin{pmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{pmatrix}$	IN THE BOOKLET

FP2 Area of a sector

Candidates sitting FP2 may also require the formulae listed under FP1, and under P1, P2, P3 and P4.

Area of a sector (polar coordinates) The booklet prints the integral without limits.	$A = \frac{1}{2}\int r^2\, d\theta$	IN THE BOOKLET

FP2 Complex numbers

Euler's relation	$e^{i\theta} = \cos\theta + i\sin\theta$	IN THE BOOKLET
De Moivre's theorem	$\{r(\cos\theta + i\sin\theta)\}^n = r^n(\cos n\theta + i\sin n\theta)$	IN THE BOOKLET
Roots of z^n = 1	$z = e^{\frac{2\pi k i}{n}}, \quad k = 0, 1, 2, \ldots, n-1$	IN THE BOOKLET

FP2 Maclaurin's and Taylor's series

Maclaurin series	$f(x) = f(0) + xf'(0) + \frac{x^2}{2!}f''(0) + \ldots + \frac{x^r}{r!}f^{(r)}(0) + \ldots$	IN THE BOOKLET
Taylor series in powers of (x - a)	$f(x) = f(a) + (x-a)f'(a) + \frac{(x-a)^2}{2!}f''(a) + \ldots + \frac{(x-a)^r}{r!}f^{(r)}(a) + \ldots$	IN THE BOOKLET
Taylor series for f(a + x)	$f(a+x) = f(a) + xf'(a) + \frac{x^2}{2!}f''(a) + \ldots + \frac{x^r}{r!}f^{(r)}(a) + \ldots$	IN THE BOOKLET
Series for e^x	$e^x = \exp(x) = 1 + x + \frac{x^2}{2!} + \ldots + \frac{x^r}{r!} + \ldots \quad \text{for all } x$	IN THE BOOKLET
Series for ln(1 + x)	$\ln(1+x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \ldots + (-1)^{r+1}\frac{x^r}{r} + \ldots \quad (-1 < x \leqslant 1)$	IN THE BOOKLET
Series for sin x x in radians.	$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots + (-1)^r\frac{x^{2r+1}}{(2r+1)!} + \ldots \quad \text{for all } x$	IN THE BOOKLET
Series for cos x x in radians.	$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \ldots + (-1)^r\frac{x^{2r}}{(2r)!} + \ldots \quad \text{for all } x$	IN THE BOOKLET
Series for arctan x	$\arctan x = x - \frac{x^3}{3} + \frac{x^5}{5} - \ldots + (-1)^r\frac{x^{2r+1}}{2r+1} + \ldots \quad (-1 \leqslant x \leqslant 1)$	IN THE BOOKLET

FP3 Vectors

Candidates sitting FP3 may also require the formulae listed under FP1, and under P1, P2, P3 and P4.

Resolved part of a in the direction of b	$\frac{\mathbf{a}\cdot\mathbf{b}}{\lvert\mathbf{b}\rvert}$	IN THE BOOKLET

Point dividing AB in the ratio λ : μ	$\dfrac{\mu\mathbf{a}+\lambda\mathbf{b}}{\lambda+\mu}$	IN THE BOOKLET
Vector product n-hat is the unit vector perpendicular to a and b.	$\mathbf{a}\times\mathbf{b}=\lvert\mathbf{a}\rvert\lvert\mathbf{b}\rvert\sin\theta\,\hat{\mathbf{n}}=\begin{vmatrix}\mathbf{i}&\mathbf{j}&\mathbf{k}\\a_1&a_2&a_3\\b_1&b_2&b_3\end{vmatrix}=\begin{pmatrix}a_2b_3-a_3b_2\\a_3b_1-a_1b_3\\a_1b_2-a_2b_1\end{pmatrix}$	IN THE BOOKLET
Scalar triple product	$\mathbf{a}\cdot(\mathbf{b}\times\mathbf{c})=\begin{vmatrix}a_1&a_2&a_3\\b_1&b_2&b_3\\c_1&c_2&c_3\end{vmatrix}=\mathbf{b}\cdot(\mathbf{c}\times\mathbf{a})=\mathbf{c}\cdot(\mathbf{a}\times\mathbf{b})$	IN THE BOOKLET
Cartesian equation of a line Line through A with position vector a = a1 i + a2 j + a3 k and direction vector b = b1 i + b2 j + b3 k.	$\dfrac{x-a_1}{b_1}=\dfrac{y-a_2}{b_2}=\dfrac{z-a_3}{b_3}\,(=\lambda)$	IN THE BOOKLET
Cartesian equation of a plane Plane through A with normal vector n = n1 i + n2 j + n3 k.	$n_1x+n_2y+n_3z+d=0,\quad d=-\mathbf{a}\cdot\mathbf{n}$	IN THE BOOKLET
Vector equation of the plane through A, B and C A, B and C are non-collinear points.	$\mathbf{r}=\mathbf{a}+\lambda(\mathbf{b}-\mathbf{a})+\mu(\mathbf{c}-\mathbf{a})=(1-\lambda-\mu)\mathbf{a}+\lambda\mathbf{b}+\mu\mathbf{c}$	IN THE BOOKLET
Plane through a, parallel to b and c	$\mathbf{r}=\mathbf{a}+s\mathbf{b}+t\mathbf{c}$	IN THE BOOKLET
Perpendicular distance from (alpha, beta, gamma) to a plane Distance to the plane n1 x + n2 y + n3 z + d = 0.	$\dfrac{\lvert n_1\alpha+n_2\beta+n_3\gamma+d\rvert}{\sqrt{n_1^2+n_2^2+n_3^2}}$	IN THE BOOKLET

FP3 Hyperbolic functions

Basic identity	$\cosh^2x-\sinh^2x\equiv1$	IN THE BOOKLET
sinh of a double angle	$\sinh2x\equiv2\sinh x\cosh x$	IN THE BOOKLET
cosh of a double angle	$\cosh2x\equiv\cosh^2x+\sinh^2x$	IN THE BOOKLET
Inverse hyperbolic cosine	$\operatorname{arcosh}x\equiv\ln\{x+\sqrt{x^2-1}\}\quad(x\geqslant1)$	IN THE BOOKLET
Inverse hyperbolic sine	$\operatorname{arsinh}x\equiv\ln\{x+\sqrt{x^2+1}\}$	IN THE BOOKLET
Inverse hyperbolic tangent	$\operatorname{artanh}x\equiv\frac{1}{2}\ln\left(\dfrac{1+x}{1-x}\right)\quad(\lvert x\rvert<1)$	IN THE BOOKLET

FP3 Conics

Ellipse, parabola, hyperbola and rectangular hyperbola.

	Ellipse	Parabola	Hyperbola	Rectangular hyperbola
Standard form	$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$	$y^2=4ax$	$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$	$xy=c^2$
Parametric form	$(a\cos\theta,b\sin\theta)$	$(at^2,2at)$	$(a\sec\theta,b\tan\theta);\ (\pm a\cosh\theta,b\sinh\theta)$	$\left(ct,\frac{c}{t}\right)$
Eccentricity	$e<1;\ b^2=a^2(1-e^2)$	$e=1$	$e>1;\ b^2=a^2(e^2-1)$	$e=\sqrt{2}$
Foci	$(\pm ae,0)$	$(a,0)$	$(\pm ae,0)$	$(\pm\sqrt{2}c,\pm\sqrt{2}c)$
Directrices	$x=\pm\frac{a}{e}$	$x=-a$	$x=\pm\frac{a}{e}$	$x+y=\pm\sqrt{2}c$
Asymptotes	none	none	$\frac{x}{a}=\pm\frac{y}{b}$	$x=0,y=0$

FP3 Differentiation

Derivative of arcsin x	$\frac{d}{dx}(\arcsin x) = \frac{1}{\sqrt{1-x^2}}$	IN THE BOOKLET
Derivative of arccos x	$\frac{d}{dx}(\arccos x) = -\frac{1}{\sqrt{1-x^2}}$	IN THE BOOKLET
Derivative of arctan x	$\frac{d}{dx}(\arctan x) = \frac{1}{1+x^2}$	IN THE BOOKLET
Derivative of sinh x	$\frac{d}{dx}(\sinh x) = \cosh x$	IN THE BOOKLET
Derivative of cosh x	$\frac{d}{dx}(\cosh x) = \sinh x$	IN THE BOOKLET
Derivative of tanh x	$\frac{d}{dx}(\tanh x) = \operatorname{sech}^2 x$	IN THE BOOKLET
Derivative of arsinh x	$\frac{d}{dx}(\operatorname{arsinh} x) = \frac{1}{\sqrt{1+x^2}}$	IN THE BOOKLET
Derivative of arcosh x	$\frac{d}{dx}(\operatorname{arcosh} x) = \frac{1}{\sqrt{x^2-1}}$	IN THE BOOKLET
Derivative of artanh x	$\frac{d}{dx}(\operatorname{artanh} x) = \frac{1}{1-x^2}$	IN THE BOOKLET

FP3 Integration (+ constant; a > 0 where relevant)

Integral of sinh x	$\int \sinh x\,dx = \cosh x$	IN THE BOOKLET
Integral of cosh x	$\int \cosh x\,dx = \sinh x$	IN THE BOOKLET
Integral of tanh x	$\int \tanh x\,dx = \ln\cosh x$	IN THE BOOKLET
Integral of 1 over root (a squared minus x squared)	$\int \frac{1}{\sqrt{a^2-x^2}}\,dx = \arcsin\left(\frac{x}{a}\right) \quad (\lvert x\rvert < a)$	IN THE BOOKLET
Integral of 1 over (a squared plus x squared)	$\int \frac{1}{a^2+x^2}\,dx = \frac{1}{a}\arctan\left(\frac{x}{a}\right)$	IN THE BOOKLET
Integral of 1 over root (x squared minus a squared) Two equivalent forms.	$\int \frac{1}{\sqrt{x^2-a^2}}\,dx = \operatorname{arcosh}\left(\frac{x}{a}\right),\ \ln\{x+\sqrt{x^2-a^2}\} \quad (x > a)$	IN THE BOOKLET
Integral of 1 over root (a squared plus x squared) Two equivalent forms.	$\int \frac{1}{\sqrt{a^2+x^2}}\,dx = \operatorname{arsinh}\left(\frac{x}{a}\right),\ \ln\{x+\sqrt{x^2+a^2}\}$	IN THE BOOKLET
Integral of 1 over (a squared minus x squared)	$\int \frac{1}{a^2-x^2}\,dx = \frac{1}{2a}\ln\left\lvert\frac{a+x}{a-x}\right\rvert = \frac{1}{a}\operatorname{artanh}\left(\frac{x}{a}\right) \quad (\lvert x\rvert < a)$	IN THE BOOKLET
Integral of 1 over (x squared minus a squared)	$\int \frac{1}{x^2-a^2}\,dx = \frac{1}{2a}\ln\left\lvert\frac{x-a}{x+a}\right\rvert$	IN THE BOOKLET

FP3 Arc length

Arc length (cartesian coordinates)	$s = \int \sqrt{1+\left(\frac{dy}{dx}\right)^2}\,dx$	IN THE BOOKLET

Arc length (parametric form)	$s = \int \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$	IN THE BOOKLET

FP3 Surface area of revolution

Surface area about the x-axis (cartesian)	$S_x = 2\pi \int y\, ds = 2\pi \int y\sqrt{1 + \left(\frac{dy}{dx}\right)^2}\, dx$	IN THE BOOKLET
Surface area about the x-axis (parametric form)	$S_x = 2\pi \int y\sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}\, dt$	IN THE BOOKLET

M1 Mechanics

Additional formulae for M1 The booklet says no formulae are given for M1 beyond those candidates are expected to know. M1 may also need the formulae listed under P1 and P2.	None printed	IN THE BOOKLET

M2 Centres of mass

Candidates sitting M2 may also require the formulae listed under P1, P2, P3 and P4.

Triangular lamina For uniform bodies.	$\frac{2}{3}$ along the median from the vertex	IN THE BOOKLET
Circular arc, radius r, angle at centre 2α For uniform bodies. Angle alpha in radians.	$\frac{r \sin \alpha}{\alpha}$ from the centre	IN THE BOOKLET
Sector of a circle, radius r, angle at centre 2α For uniform bodies. Angle alpha in radians.	$\frac{2r \sin \alpha}{3\alpha}$ from the centre	IN THE BOOKLET

M3 Motion in a circle

Candidates sitting M3 may also require the formulae listed under M2, and under P1, P2, P3 and P4.

Transverse velocity	$v = r\dot{\theta}$	IN THE BOOKLET
Transverse acceleration	$\dot{v} = r\ddot{\theta}$	IN THE BOOKLET
Radial acceleration Directed towards the centre.	$-r\dot{\theta}^2 = -\frac{v^2}{r}$	IN THE BOOKLET

M3 Centres of mass

Solid hemisphere, radius r For uniform bodies.	$\frac{3}{8}r$ from the centre	IN THE BOOKLET
Hemispherical shell, radius r For uniform bodies.	$\frac{1}{2}r$ from the centre	IN THE BOOKLET
Solid cone or pyramid of height h For uniform bodies.	$\frac{1}{4}h$ above the base, on the line from the centre of the base to the vertex	IN THE BOOKLET
Conical shell of height h For uniform bodies.	$\frac{1}{3}h$ above the base, on the line from the centre of the base to the vertex	IN THE BOOKLET

M3 Universal law of gravitation

Force between two masses d is the distance between the centres of the masses.	$\text{Force} = \dfrac{Gm_1m_2}{d^2}$	IN THE BOOKLET

S1 Probability

Candidates sitting S1 may also require the formulae listed under P1 and P2.

Addition rule	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	IN THE BOOKLET
Multiplication rule	$P(A \cap B) = P(A)\,P(B \mid A)$	IN THE BOOKLET
Bayes' theorem	$P(A \mid B) = \dfrac{P(B \mid A)\,P(A)}{P(B \mid A)\,P(A) + P(B \mid A')\,P(A')}$	IN THE BOOKLET

S1 Discrete distributions

Expectation (mean) For a discrete random variable X taking values xi.	$E(X) = \mu = \sum x_i\,P(X = x_i)$	IN THE BOOKLET
Variance	$\text{Var}(X) = \sigma^2 = \sum (x_i - \mu)^2 P(X = x_i) = \sum x_i^2\,P(X = x_i) - \mu^2$	IN THE BOOKLET
Expectation of a function	$E(g(X)) = \sum g(x_i)\,P(X = x_i)$	IN THE BOOKLET

S1 Continuous distributions

Normal N(μ, σ²): p.d.f.	$f(x) = \dfrac{1}{\sigma\sqrt{2\pi}}\,e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$	IN THE BOOKLET
Normal N(μ, σ²): mean	μ	IN THE BOOKLET
Normal N(μ, σ²): variance	σ^2	IN THE BOOKLET

S1 Correlation and regression

Sxx For a set of n pairs of values (xi, yi).	$S_{xx} = \sum (x_i - \bar{x})^2 = \sum x_i^2 - \dfrac{(\sum x_i)^2}{n}$	IN THE BOOKLET
Syy	$S_{yy} = \sum (y_i - \bar{y})^2 = \sum y_i^2 - \dfrac{(\sum y_i)^2}{n}$	IN THE BOOKLET
Sxy	$S_{xy} = \sum (x_i - \bar{x})(y_i - \bar{y}) = \sum x_i y_i - \dfrac{(\sum x_i)(\sum y_i)}{n}$	IN THE BOOKLET
Product moment correlation coefficient	$r = \dfrac{S_{xy}}{\sqrt{S_{xx}S_{yy}}} = \dfrac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\{\sum (x_i - \bar{x})^2\}\{\sum (y_i - \bar{y})^2\}}} = \dfrac{\sum x_i y_i - \frac{(\sum x_i)(\sum y_i)}{n}}{\sqrt{\left(\sum x_i^2 - \frac{(\sum x_i)^2}{n}\right)\left(\sum y_i^2 - \frac{(\sum y_i)^2}{n}\right)}}$	IN THE BOOKLET
Regression coefficient of y on x	$b = \dfrac{S_{xy}}{S_{xx}} = \dfrac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}$	IN THE BOOKLET
Least squares regression line of y on x	$y = a + bx \quad \text{where } a = \bar{y} - b\bar{x}$	IN THE BOOKLET

The normal distribution function

The tabulated function is Φ(z), defined as the area under the standard normal curve to the left of z. Printed in five column pairs, in step 0.01 up to 2.00, 0.02 up to 2.50, 0.05 up to 3.40, then 3.50 to 4.00 in steps of 0.10. The last row repeats the first value of the next column.

z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)
0.00	0.5000	0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.9772
0.01	0.5040	0.51	0.6950	1.01	0.8438	1.51	0.9345	2.02	0.9783
0.02	0.5080	0.52	0.6985	1.02	0.8461	1.52	0.9357	2.04	0.9793
0.03	0.5120	0.53	0.7019	1.03	0.8485	1.53	0.9370	2.06	0.9803
0.04	0.5160	0.54	0.7054	1.04	0.8508	1.54	0.9382	2.08	0.9812
0.05	0.5199	0.55	0.7088	1.05	0.8531	1.55	0.9394	2.10	0.9821
0.06	0.5239	0.56	0.7123	1.06	0.8554	1.56	0.9406	2.12	0.9830
0.07	0.5279	0.57	0.7157	1.07	0.8577	1.57	0.9418	2.14	0.9838
0.08	0.5319	0.58	0.7190	1.08	0.8599	1.58	0.9429	2.16	0.9846
0.09	0.5359	0.59	0.7224	1.09	0.8621	1.59	0.9441	2.18	0.9854
0.10	0.5398	0.60	0.7257	1.10	0.8643	1.60	0.9452	2.20	0.9861
0.11	0.5438	0.61	0.7291	1.11	0.8665	1.61	0.9463	2.22	0.9868
0.12	0.5478	0.62	0.7324	1.12	0.8686	1.62	0.9474	2.24	0.9875
0.13	0.5517	0.63	0.7357	1.13	0.8708	1.63	0.9484	2.26	0.9881
0.14	0.5557	0.64	0.7389	1.14	0.8729	1.64	0.9495	2.28	0.9887
0.15	0.5596	0.65	0.7422	1.15	0.8749	1.65	0.9505	2.30	0.9893
0.16	0.5636	0.66	0.7454	1.16	0.8770	1.66	0.9515	2.32	0.9898
0.17	0.5675	0.67	0.7486	1.17	0.8790	1.67	0.9525	2.34	0.9904
0.18	0.5714	0.68	0.7517	1.18	0.8810	1.68	0.9535	2.36	0.9909
0.19	0.5753	0.69	0.7549	1.19	0.8830	1.69	0.9545	2.38	0.9913
0.20	0.5793	0.70	0.7580	1.20	0.8849	1.70	0.9554	2.40	0.9918
0.21	0.5832	0.71	0.7611	1.21	0.8869	1.71	0.9564	2.42	0.9922
0.22	0.5871	0.72	0.7642	1.22	0.8888	1.72	0.9573	2.44	0.9927
0.23	0.5910	0.73	0.7673	1.23	0.8907	1.73	0.9582	2.46	0.9931
0.24	0.5948	0.74	0.7704	1.24	0.8925	1.74	0.9591	2.48	0.9934
0.25	0.5987	0.75	0.7734	1.25	0.8944	1.75	0.9599	2.50	0.9938
0.26	0.6026	0.76	0.7764	1.26	0.8962	1.76	0.9608	2.55	0.9946
0.27	0.6064	0.77	0.7794	1.27	0.8980	1.77	0.9616	2.60	0.9953
0.28	0.6103	0.78	0.7823	1.28	0.8997	1.78	0.9625	2.65	0.9960
0.29	0.6141	0.79	0.7852	1.29	0.9015	1.79	0.9633	2.70	0.9965
0.30	0.6179	0.80	0.7881	1.30	0.9032	1.80	0.9641	2.75	0.9970
0.31	0.6217	0.81	0.7910	1.31	0.9049	1.81	0.9649	2.80	0.9974
0.32	0.6255	0.82	0.7939	1.32	0.9066	1.82	0.9656	2.85	0.9978
0.33	0.6293	0.83	0.7967	1.33	0.9082	1.83	0.9664	2.90	0.9981
0.34	0.6331	0.84	0.7995	1.34	0.9099	1.84	0.9671	2.95	0.9984
0.35	0.6368	0.85	0.8023	1.35	0.9115	1.85	0.9678	3.00	0.9987
0.36	0.6406	0.86	0.8051	1.36	0.9131	1.86	0.9686	3.05	0.9989

z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)	z	Φ(z)
0.37	0.6443	0.87	0.8078	1.37	0.9147	1.87	0.9693	3.10	0.9990
0.38	0.6480	0.88	0.8106	1.38	0.9162	1.88	0.9699	3.15	0.9992
0.39	0.6517	0.89	0.8133	1.39	0.9177	1.89	0.9706	3.20	0.9993
0.40	0.6554	0.90	0.8159	1.40	0.9192	1.90	0.9713	3.25	0.9994
0.41	0.6591	0.91	0.8186	1.41	0.9207	1.91	0.9719	3.30	0.9995
0.42	0.6628	0.92	0.8212	1.42	0.9222	1.92	0.9726	3.35	0.9996
0.43	0.6664	0.93	0.8238	1.43	0.9236	1.93	0.9732	3.40	0.9997
0.44	0.6700	0.94	0.8264	1.44	0.9251	1.94	0.9738	3.50	0.9998
0.45	0.6736	0.95	0.8289	1.45	0.9265	1.95	0.9744	3.60	0.9998
0.46	0.6772	0.96	0.8315	1.46	0.9279	1.96	0.9750	3.70	0.9999
0.47	0.6808	0.97	0.8340	1.47	0.9292	1.97	0.9756	3.80	0.9999
0.48	0.6844	0.98	0.8365	1.48	0.9306	1.98	0.9761	3.90	1.0000
0.49	0.6879	0.99	0.8389	1.49	0.9319	1.99	0.9767	4.00	1.0000
0.50	0.6915	1.00	0.8413	1.50	0.9332	2.00	0.9772		

Percentage points of the normal distribution

The values z are those which a random variable Z ~ N(0, 1) exceeds with probability p; that is, P(Z > z) = 1 - Φ(z) = p.

p	z	p	z
0.5000	0.0000	0.0500	1.6449
0.4000	0.2533	0.0250	1.9600
0.3000	0.5244	0.0100	2.3263
0.2000	0.8416	0.0050	2.5758
0.1500	1.0364	0.0010	3.0902
0.1000	1.2816	0.0005	3.2905

S2 Discrete distributions

Candidates sitting S2 may also require the formulae listed under S1, and under P1, P2, P3 and P4.

Binomial B(n, p): probability	$P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$	IN THE BOOKLET
Binomial B(n, p): mean	np	IN THE BOOKLET
Binomial B(n, p): variance	$np(1-p)$	IN THE BOOKLET
Poisson Po(λ): probability	$P(X = x) = e^{-\lambda}\frac{\lambda^x}{x!}$	IN THE BOOKLET
Poisson Po(λ): mean	λ	IN THE BOOKLET
Poisson Po(λ): variance	λ	IN THE BOOKLET

S2 Continuous distributions

Expectation (mean) For a continuous random variable X with probability density function f.	$E(X) = \mu = \int x\, f(x)\, dx$	IN THE BOOKLET
Variance	$\mathrm{Var}(X) = \sigma^2 = \int (x-\mu)^2 f(x)\, dx = \int x^2 f(x)\, dx - \mu^2$	IN THE BOOKLET

Expectation of a function	$E(g(X)) = \int g(x)\, f(x)\, dx$	IN THE BOOKLET
Cumulative distribution function	$F(x_0) = P(X \leqslant x_0) = \int_{-\infty}^{x_0} f(t)\, dt$	IN THE BOOKLET
Uniform (rectangular) on [a, b]: p.d.f.	$f(x) = \dfrac{1}{b-a}$	IN THE BOOKLET
Uniform (rectangular) on [a, b]: mean	$\frac{1}{2}(a+b)$	IN THE BOOKLET
Uniform (rectangular) on [a, b]: variance	$\frac{1}{12}(b-a)^2$	IN THE BOOKLET

Binomial cumulative distribution function

The tabulated value is P(X ≤ x), where X has a binomial distribution with index n and parameter p.

n = 5

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.7738	0.5905	0.4437	0.3277	0.2373	0.1681	0.1160	0.0778	0.0503	0.0312
1	0.9774	0.9185	0.8352	0.7373	0.6328	0.5282	0.4284	0.3370	0.2562	0.1875
2	0.9988	0.9914	0.9734	0.9421	0.8965	0.8369	0.7648	0.6826	0.5931	0.5000
3	1.0000	0.9995	0.9978	0.9933	0.9844	0.9692	0.9460	0.9130	0.8688	0.8125
4	1.0000	1.0000	0.9999	0.9997	0.9990	0.9976	0.9947	0.9898	0.9815	0.9688

n = 6

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.7351	0.5314	0.3771	0.2621	0.1780	0.1176	0.0754	0.0467	0.0277	0.0156
1	0.9672	0.8857	0.7765	0.6554	0.5339	0.4202	0.3191	0.2333	0.1636	0.1094
2	0.9978	0.9842	0.9527	0.9011	0.8306	0.7443	0.6471	0.5443	0.4415	0.3438
3	0.9999	0.9987	0.9941	0.9830	0.9624	0.9295	0.8826	0.8208	0.7447	0.6563
4	1.0000	0.9999	0.9996	0.9984	0.9954	0.9891	0.9777	0.9590	0.9308	0.8906
5	1.0000	1.0000	1.0000	0.9999	0.9998	0.9993	0.9982	0.9959	0.9917	0.9844

n = 7

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.6983	0.4783	0.3206	0.2097	0.1335	0.0824	0.0490	0.0280	0.0152	0.0078
1	0.9556	0.8503	0.7166	0.5767	0.4449	0.3294	0.2338	0.1586	0.1024	0.0625
2	0.9962	0.9743	0.9262	0.8520	0.7564	0.6471	0.5323	0.4199	0.3164	0.2266
3	0.9998	0.9973	0.9879	0.9667	0.9294	0.8740	0.8002	0.7102	0.6083	0.5000
4	1.0000	0.9998	0.9988	0.9953	0.9871	0.9712	0.9444	0.9037	0.8471	0.7734
5	1.0000	1.0000	0.9999	0.9996	0.9987	0.9962	0.9910	0.9812	0.9643	0.9375
6	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998	0.9994	0.9984	0.9963	0.9922

n = 8

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.6634	0.4305	0.2725	0.1678	0.1001	0.0576	0.0319	0.0168	0.0084	0.0039
1	0.9428	0.8131	0.6572	0.5033	0.3671	0.2553	0.1691	0.1064	0.0632	0.0352
2	0.9942	0.9619	0.8948	0.7969	0.6785	0.5518	0.4278	0.3154	0.2201	0.1445
3	0.9996	0.9950	0.9786	0.9437	0.8862	0.8059	0.7064	0.5941	0.4770	0.3633
4	1.0000	0.9996	0.9971	0.9896	0.9727	0.9420	0.8939	0.8263	0.7396	0.6367
5	1.0000	1.0000	0.9998	0.9988	0.9958	0.9887	0.9747	0.9502	0.9115	0.8555
6	1.0000	1.0000	1.0000	0.9999	0.9996	0.9987	0.9964	0.9915	0.9819	0.9648
7	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998	0.9993	0.9983	0.9961

n = 9

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.6302	0.3874	0.2316	0.1342	0.0751	0.0404	0.0207	0.0101	0.0046	0.0020

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
1	0.9288	0.7748	0.5995	0.4362	0.3003	0.1960	0.1211	0.0705	0.0385	0.0195
2	0.9916	0.9470	0.8591	0.7382	0.6007	0.4628	0.3373	0.2318	0.1495	0.0898
3	0.9994	0.9917	0.9661	0.9144	0.8343	0.7297	0.6089	0.4826	0.3614	0.2539
4	1.0000	0.9991	0.9944	0.9804	0.9511	0.9012	0.8283	0.7334	0.6214	0.5000
5	1.0000	0.9999	0.9994	0.9969	0.9900	0.9747	0.9464	0.9006	0.8342	0.7461
6	1.0000	1.0000	1.0000	0.9997	0.9987	0.9957	0.9888	0.9750	0.9502	0.9102
7	1.0000	1.0000	1.0000	1.0000	0.9999	0.9996	0.9986	0.9962	0.9909	0.9805
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9992	0.9980

n = 10

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.5987	0.3487	0.1969	0.1074	0.0563	0.0282	0.0135	0.0060	0.0025	0.0010
1	0.9139	0.7361	0.5443	0.3758	0.2440	0.1493	0.0860	0.0464	0.0233	0.0107
2	0.9885	0.9298	0.8202	0.6778	0.5256	0.3828	0.2616	0.1673	0.0996	0.0547
3	0.9990	0.9872	0.9500	0.8791	0.7759	0.6496	0.5138	0.3823	0.2660	0.1719
4	0.9999	0.9984	0.9901	0.9672	0.9219	0.8497	0.7515	0.6331	0.5044	0.3770
5	1.0000	0.9999	0.9986	0.9936	0.9803	0.9527	0.9051	0.8338	0.7384	0.6230
6	1.0000	1.0000	0.9999	0.9991	0.9965	0.9894	0.9740	0.9452	0.8980	0.8281
7	1.0000	1.0000	1.0000	0.9999	0.9996	0.9984	0.9952	0.9877	0.9726	0.9453
8	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9995	0.9983	0.9955	0.9893
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9990

n = 12

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.5404	0.2824	0.1422	0.0687	0.0317	0.0138	0.0057	0.0022	0.0008	0.0002
1	0.8816	0.6590	0.4435	0.2749	0.1584	0.0850	0.0424	0.0196	0.0083	0.0032
2	0.9804	0.8891	0.7358	0.5583	0.3907	0.2528	0.1513	0.0834	0.0421	0.0193
3	0.9978	0.9744	0.9078	0.7946	0.6488	0.4925	0.3467	0.2253	0.1345	0.0730
4	0.9998	0.9957	0.9761	0.9274	0.8424	0.7237	0.5833	0.4382	0.3044	0.1938
5	1.0000	0.9995	0.9954	0.9806	0.9456	0.8822	0.7873	0.6652	0.5269	0.3872
6	1.0000	0.9999	0.9993	0.9961	0.9857	0.9614	0.9154	0.8418	0.7393	0.6128
7	1.0000	1.0000	0.9999	0.9994	0.9972	0.9905	0.9745	0.9427	0.8883	0.8062
8	1.0000	1.0000	1.0000	0.9999	0.9996	0.9983	0.9944	0.9847	0.9644	0.9270
9	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998	0.9992	0.9972	0.9921	0.9807
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9989	0.9968
11	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998

n = 15

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.4633	0.2059	0.0874	0.0352	0.0134	0.0047	0.0016	0.0005	0.0001	0.0000
1	0.8290	0.5490	0.3186	0.1671	0.0802	0.0353	0.0142	0.0052	0.0017	0.0005
2	0.9638	0.8159	0.6042	0.3980	0.2361	0.1268	0.0617	0.0271	0.0107	0.0037
3	0.9945	0.9444	0.8227	0.6482	0.4613	0.2969	0.1727	0.0905	0.0424	0.0176
4	0.9994	0.9873	0.9383	0.8358	0.6865	0.5155	0.3519	0.2173	0.1204	0.0592
5	0.9999	0.9978	0.9832	0.9389	0.8516	0.7216	0.5643	0.4032	0.2608	0.1509
6	1.0000	0.9997	0.9964	0.9819	0.9434	0.8689	0.7548	0.6098	0.4522	0.3036
7	1.0000	1.0000	0.9994	0.9958	0.9827	0.9500	0.8868	0.7869	0.6535	0.5000
8	1.0000	1.0000	0.9999	0.9992	0.9958	0.9848	0.9578	0.9050	0.8182	0.6964
9	1.0000	1.0000	1.0000	0.9999	0.9992	0.9963	0.9876	0.9662	0.9231	0.8491
10	1.0000	1.0000	1.0000	1.0000	0.9999	0.9993	0.9972	0.9907	0.9745	0.9408
11	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9995	0.9981	0.9937	0.9824
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9989	0.9963
13	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9995
14	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

n = 20

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.3585	0.1216	0.0388	0.0115	0.0032	0.0008	0.0002	0.0000	0.0000	0.0000
1	0.7358	0.3917	0.1756	0.0692	0.0243	0.0076	0.0021	0.0005	0.0001	0.0000
2	0.9245	0.6769	0.4049	0.2061	0.0913	0.0355	0.0121	0.0036	0.0009	0.0002
3	0.9841	0.8670	0.6477	0.4114	0.2252	0.1071	0.0444	0.0160	0.0049	0.0013
4	0.9974	0.9568	0.8298	0.6296	0.4148	0.2375	0.1182	0.0510	0.0189	0.0059
5	0.9997	0.9887	0.9327	0.8042	0.6172	0.4164	0.2454	0.1256	0.0553	0.0207
6	1.0000	0.9976	0.9781	0.9133	0.7858	0.6080	0.4166	0.2500	0.1299	0.0577
7	1.0000	0.9996	0.9941	0.9679	0.8982	0.7723	0.6010	0.4159	0.2520	0.1316
8	1.0000	0.9999	0.9987	0.9900	0.9591	0.8867	0.7624	0.5956	0.4143	0.2517
9	1.0000	1.0000	0.9998	0.9974	0.9861	0.9520	0.8782	0.7553	0.5914	0.4119
10	1.0000	1.0000	1.0000	0.9994	0.9961	0.9829	0.9468	0.8725	0.7507	0.5881
11	1.0000	1.0000	1.0000	0.9999	0.9991	0.9949	0.9804	0.9435	0.8692	0.7483
12	1.0000	1.0000	1.0000	1.0000	0.9998	0.9987	0.9940	0.9790	0.9420	0.8684
13	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9985	0.9935	0.9786	0.9423
14	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9984	0.9936	0.9793
15	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9985	0.9941
16	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9987
17	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

n = 25

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.2774	0.0718	0.0172	0.0038	0.0008	0.0001	0.0000	0.0000	0.0000	0.0000
1	0.6424	0.2712	0.0931	0.0274	0.0070	0.0016	0.0003	0.0001	0.0000	0.0000
2	0.8729	0.5371	0.2537	0.0982	0.0321	0.0090	0.0021	0.0004	0.0001	0.0000
3	0.9659	0.7636	0.4711	0.2340	0.0962	0.0332	0.0097	0.0024	0.0005	0.0001
4	0.9928	0.9020	0.6821	0.4207	0.2137	0.0905	0.0320	0.0095	0.0023	0.0005
5	0.9988	0.9666	0.8385	0.6167	0.3783	0.1935	0.0826	0.0294	0.0086	0.0020
6	0.9998	0.9905	0.9305	0.7800	0.5611	0.3407	0.1734	0.0736	0.0258	0.0073
7	1.0000	0.9977	0.9745	0.8909	0.7265	0.5118	0.3061	0.1536	0.0639	0.0216
8	1.0000	0.9995	0.9920	0.9532	0.8506	0.6769	0.4668	0.2735	0.1340	0.0539
9	1.0000	0.9999	0.9979	0.9827	0.9287	0.8106	0.6303	0.4246	0.2424	0.1148
10	1.0000	1.0000	0.9995	0.9944	0.9703	0.9022	0.7712	0.5858	0.3843	0.2122
11	1.0000	1.0000	0.9999	0.9985	0.9893	0.9558	0.8746	0.7323	0.5426	0.3450
12	1.0000	1.0000	1.0000	0.9996	0.9966	0.9825	0.9396	0.8462	0.6937	0.5000
13	1.0000	1.0000	1.0000	0.9999	0.9991	0.9940	0.9745	0.9222	0.8173	0.6550
14	1.0000	1.0000	1.0000	1.0000	0.9998	0.9982	0.9907	0.9656	0.9040	0.7878
15	1.0000	1.0000	1.0000	1.0000	1.0000	0.9995	0.9971	0.9868	0.9560	0.8852
16	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9992	0.9957	0.9826	0.9461
17	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998	0.9988	0.9942	0.9784
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9984	0.9927
19	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9996	0.9980
20	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9995
21	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999
22	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

n = 30

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.2146	0.0424	0.0076	0.0012	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.5535	0.1837	0.0480	0.0105	0.0020	0.0003	0.0000	0.0000	0.0000	0.0000
2	0.8122	0.4114	0.1514	0.0442	0.0106	0.0021	0.0003	0.0000	0.0000	0.0000
3	0.9392	0.6474	0.3217	0.1227	0.0374	0.0093	0.0019	0.0003	0.0000	0.0000
4	0.9844	0.8245	0.5245	0.2552	0.0979	0.0302	0.0075	0.0015	0.0002	0.0000
5	0.9967	0.9268	0.7106	0.4275	0.2026	0.0766	0.0233	0.0057	0.0011	0.0002

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
6	0.9994	0.9742	0.8474	0.6070	0.3481	0.1595	0.0586	0.0172	0.0040	0.0007
7	0.9999	0.9922	0.9302	0.7608	0.5143	0.2814	0.1238	0.0435	0.0121	0.0026
8	1.0000	0.9980	0.9722	0.8713	0.6736	0.4315	0.2247	0.0940	0.0312	0.0081
9	1.0000	0.9995	0.9903	0.9389	0.8034	0.5888	0.3575	0.1763	0.0694	0.0214
10	1.0000	0.9999	0.9971	0.9744	0.8943	0.7304	0.5078	0.2915	0.1350	0.0494
11	1.0000	1.0000	0.9992	0.9905	0.9493	0.8407	0.6548	0.4311	0.2327	0.1002
12	1.0000	1.0000	0.9998	0.9969	0.9784	0.9155	0.7802	0.5785	0.3592	0.1808
13	1.0000	1.0000	1.0000	0.9991	0.9918	0.9599	0.8737	0.7145	0.5025	0.2923
14	1.0000	1.0000	1.0000	0.9998	0.9973	0.9831	0.9348	0.8246	0.6448	0.4278
15	1.0000	1.0000	1.0000	0.9999	0.9992	0.9936	0.9699	0.9029	0.7691	0.5722
16	1.0000	1.0000	1.0000	1.0000	0.9998	0.9979	0.9876	0.9519	0.8644	0.7077
17	1.0000	1.0000	1.0000	1.0000	0.9999	0.9994	0.9955	0.9788	0.9286	0.8192
18	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998	0.9986	0.9917	0.9666	0.8998
19	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9996	0.9971	0.9862	0.9506
20	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9991	0.9950	0.9786
21	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998	0.9984	0.9919
22	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9996	0.9974
23	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9993
24	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998
25	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

n = 40

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.1285	0.0148	0.0015	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.3991	0.0805	0.0121	0.0015	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.6767	0.2228	0.0486	0.0079	0.0010	0.0001	0.0000	0.0000	0.0000	0.0000
3	0.8619	0.4231	0.1302	0.0285	0.0047	0.0006	0.0001	0.0000	0.0000	0.0000
4	0.9520	0.6290	0.2633	0.0759	0.0160	0.0026	0.0003	0.0000	0.0000	0.0000
5	0.9861	0.7937	0.4325	0.1613	0.0433	0.0086	0.0013	0.0001	0.0000	0.0000
6	0.9966	0.9005	0.6067	0.2859	0.0962	0.0238	0.0044	0.0006	0.0001	0.0000
7	0.9993	0.9581	0.7559	0.4371	0.1820	0.0553	0.0124	0.0021	0.0002	0.0000
8	0.9999	0.9845	0.8646	0.5931	0.2998	0.1110	0.0303	0.0061	0.0009	0.0001
9	1.0000	0.9949	0.9328	0.7318	0.4395	0.1959	0.0644	0.0156	0.0027	0.0003
10	1.0000	0.9985	0.9701	0.8392	0.5839	0.3087	0.1215	0.0352	0.0074	0.0011
11	1.0000	0.9996	0.9880	0.9125	0.7151	0.4406	0.2053	0.0709	0.0179	0.0032
12	1.0000	0.9999	0.9957	0.9568	0.8209	0.5772	0.3143	0.1285	0.0386	0.0083
13	1.0000	1.0000	0.9986	0.9806	0.8968	0.7032	0.4408	0.2112	0.0751	0.0192
14	1.0000	1.0000	0.9996	0.9921	0.9456	0.8074	0.5721	0.3174	0.1326	0.0403
15	1.0000	1.0000	0.9999	0.9971	0.9738	0.8849	0.6946	0.4402	0.2142	0.0769
16	1.0000	1.0000	1.0000	0.9990	0.9884	0.9367	0.7978	0.5681	0.3185	0.1341
17	1.0000	1.0000	1.0000	0.9997	0.9953	0.9680	0.8761	0.6885	0.4391	0.2148
18	1.0000	1.0000	1.0000	0.9999	0.9983	0.9852	0.9301	0.7911	0.5651	0.3179
19	1.0000	1.0000	1.0000	1.0000	0.9994	0.9937	0.9637	0.8702	0.6844	0.4373
20	1.0000	1.0000	1.0000	1.0000	0.9998	0.9976	0.9827	0.9256	0.7870	0.5627
21	1.0000	1.0000	1.0000	1.0000	1.0000	0.9991	0.9925	0.9608	0.8669	0.6821
22	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9970	0.9811	0.9233	0.7852
23	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9989	0.9917	0.9595	0.8659
24	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9996	0.9966	0.9804	0.9231
25	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9988	0.9914	0.9597
26	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9996	0.9966	0.9808
27	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9988	0.9917
28	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9996	0.9968
29	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9989
30	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
31	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999
32	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

n = 50

x	p = 0.05	p = 0.1	p = 0.15	p = 0.2	p = 0.25	p = 0.3	p = 0.35	p = 0.4	p = 0.45	p = 0.5
0	0.0769	0.0052	0.0003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.2794	0.0338	0.0029	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.5405	0.1117	0.0142	0.0013	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000
3	0.7604	0.2503	0.0460	0.0057	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.8964	0.4312	0.1121	0.0185	0.0021	0.0002	0.0000	0.0000	0.0000	0.0000
5	0.9622	0.6161	0.2194	0.0480	0.0070	0.0007	0.0001	0.0000	0.0000	0.0000
6	0.9882	0.7702	0.3613	0.1034	0.0194	0.0025	0.0002	0.0000	0.0000	0.0000
7	0.9968	0.8779	0.5188	0.1904	0.0453	0.0073	0.0008	0.0001	0.0000	0.0000
8	0.9992	0.9421	0.6681	0.3073	0.0916	0.0183	0.0025	0.0002	0.0000	0.0000
9	0.9998	0.9755	0.7911	0.4437	0.1637	0.0402	0.0067	0.0008	0.0001	0.0000
10	1.0000	0.9906	0.8801	0.5836	0.2622	0.0789	0.0160	0.0022	0.0002	0.0000
11	1.0000	0.9968	0.9372	0.7107	0.3816	0.1390	0.0342	0.0057	0.0006	0.0000
12	1.0000	0.9990	0.9699	0.8139	0.5110	0.2229	0.0661	0.0133	0.0018	0.0002
13	1.0000	0.9997	0.9868	0.8894	0.6370	0.3279	0.1163	0.0280	0.0045	0.0005
14	1.0000	0.9999	0.9947	0.9393	0.7481	0.4468	0.1878	0.0540	0.0104	0.0013
15	1.0000	1.0000	0.9981	0.9692	0.8369	0.5692	0.2801	0.0955	0.0220	0.0033
16	1.0000	1.0000	0.9993	0.9856	0.9017	0.6839	0.3889	0.1561	0.0427	0.0077
17	1.0000	1.0000	0.9998	0.9937	0.9449	0.7822	0.5060	0.2369	0.0765	0.0164
18	1.0000	1.0000	0.9999	0.9975	0.9713	0.8594	0.6216	0.3356	0.1273	0.0325
19	1.0000	1.0000	1.0000	0.9991	0.9861	0.9152	0.7264	0.4465	0.1974	0.0595
20	1.0000	1.0000	1.0000	0.9997	0.9937	0.9522	0.8139	0.5610	0.2862	0.1013
21	1.0000	1.0000	1.0000	0.9999	0.9974	0.9749	0.8813	0.6701	0.3900	0.1611
22	1.0000	1.0000	1.0000	1.0000	0.9990	0.9877	0.9290	0.7660	0.5019	0.2399
23	1.0000	1.0000	1.0000	1.0000	0.9996	0.9944	0.9604	0.8438	0.6134	0.3359
24	1.0000	1.0000	1.0000	1.0000	0.9999	0.9976	0.9793	0.9022	0.7160	0.4439
25	1.0000	1.0000	1.0000	1.0000	1.0000	0.9991	0.9900	0.9427	0.8034	0.5561
26	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9955	0.9686	0.8721	0.6641
27	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9981	0.9840	0.9220	0.7601
28	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9993	0.9924	0.9556	0.8389
29	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9966	0.9765	0.8987
30	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9986	0.9884	0.9405
31	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9995	0.9947	0.9675
32	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998	0.9978	0.9836
33	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9991	0.9923
34	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9997	0.9967
35	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9987
36	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9995
37	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9998
38	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Poisson cumulative distribution function

The tabulated value is $P(X \leq x)$, where X has a Poisson distribution with parameter λ.

x	λ = 0.5	λ = 1	λ = 1.5	λ = 2	λ = 2.5	λ = 3	λ = 3.5	λ = 4	λ = 4.5	λ = 5
0	0.6065	0.3679	0.2231	0.1353	0.0821	0.0498	0.0302	0.0183	0.0111	0.0067
1	0.9098	0.7358	0.5578	0.4060	0.2873	0.1991	0.1359	0.0916	0.0611	0.0404
2	0.9856	0.9197	0.8088	0.6767	0.5438	0.4232	0.3208	0.2381	0.1736	0.1247
3	0.9982	0.9810	0.9344	0.8571	0.7576	0.6472	0.5366	0.4335	0.3423	0.2650
4	0.9998	0.9963	0.9814	0.9473	0.8912	0.8153	0.7254	0.6288	0.5321	0.4405

x	λ = 0.5	λ = 1	λ = 1.5	λ = 2	λ = 2.5	λ = 3	λ = 3.5	λ = 4	λ = 4.5	λ = 5
5	1.0000	0.9994	0.9955	0.9834	0.9580	0.9161	0.8576	0.7851	0.7029	0.6160
6	1.0000	0.9999	0.9991	0.9955	0.9858	0.9665	0.9347	0.8893	0.8311	0.7622
7	1.0000	1.0000	0.9998	0.9989	0.9958	0.9881	0.9733	0.9489	0.9134	0.8666
8	1.0000	1.0000	1.0000	0.9998	0.9989	0.9962	0.9901	0.9786	0.9597	0.9319
9	1.0000	1.0000	1.0000	1.0000	0.9997	0.9989	0.9967	0.9919	0.9829	0.9682
10	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9990	0.9972	0.9933	0.9863
11	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9991	0.9976	0.9945
12	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9992	0.9980
13	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9993
14	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998
15	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999
16	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
17	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
18	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
19	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

x	λ = 5.5	λ = 6	λ = 6.5	λ = 7	λ = 7.5	λ = 8	λ = 8.5	λ = 9	λ = 9.5	λ = 10
0	0.0041	0.0025	0.0015	0.0009	0.0006	0.0003	0.0002	0.0001	0.0001	0.0000
1	0.0266	0.0174	0.0113	0.0073	0.0047	0.0030	0.0019	0.0012	0.0008	0.0005
2	0.0884	0.0620	0.0430	0.0296	0.0203	0.0138	0.0093	0.0062	0.0042	0.0028
3	0.2017	0.1512	0.1118	0.0818	0.0591	0.0424	0.0301	0.0212	0.0149	0.0103
4	0.3575	0.2851	0.2237	0.1730	0.1321	0.0996	0.0744	0.0550	0.0403	0.0293
5	0.5289	0.4457	0.3690	0.3007	0.2414	0.1912	0.1496	0.1157	0.0885	0.0671
6	0.6860	0.6063	0.5265	0.4497	0.3782	0.3134	0.2562	0.2068	0.1649	0.1301
7	0.8095	0.7440	0.6728	0.5987	0.5246	0.4530	0.3856	0.3239	0.2687	0.2202
8	0.8944	0.8472	0.7916	0.7291	0.6620	0.5925	0.5231	0.4557	0.3918	0.3328
9	0.9462	0.9161	0.8774	0.8305	0.7764	0.7166	0.6530	0.5874	0.5218	0.4579
10	0.9747	0.9574	0.9332	0.9015	0.8622	0.8159	0.7634	0.7060	0.6453	0.5830
11	0.9890	0.9799	0.9661	0.9467	0.9208	0.8881	0.8487	0.8030	0.7520	0.6968
12	0.9955	0.9912	0.9840	0.9730	0.9573	0.9362	0.9091	0.8758	0.8364	0.7916
13	0.9983	0.9964	0.9929	0.9872	0.9784	0.9658	0.9486	0.9261	0.8981	0.8645
14	0.9994	0.9986	0.9970	0.9943	0.9897	0.9827	0.9726	0.9585	0.9400	0.9165
15	0.9998	0.9995	0.9988	0.9976	0.9954	0.9918	0.9862	0.9780	0.9665	0.9513
16	0.9999	0.9998	0.9996	0.9990	0.9980	0.9963	0.9934	0.9889	0.9823	0.9730
17	1.0000	0.9999	0.9998	0.9996	0.9992	0.9984	0.9970	0.9947	0.9911	0.9857
18	1.0000	1.0000	0.9999	0.9999	0.9997	0.9993	0.9987	0.9976	0.9957	0.9928
19	1.0000	1.0000	1.0000	1.0000	0.9999	0.9997	0.9995	0.9989	0.9980	0.9965
20	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998	0.9996	0.9991	0.9984
21	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9998	0.9996	0.9993
22	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999	0.9997

S3 Expectation algebra

Candidates sitting S3 may also require the formulae listed under S1 and S2, and under P1, P2, P3 and P4.

Independent random variables X and Y

The variance rule needs X and Y independent. The variances always add, even for aX - bY.

$$E(XY) = E(X)E(Y), \quad \operatorname{Var}(aX \pm bY) = a^2 \operatorname{Var}(X) + b^2 \operatorname{Var}(Y)$$

IN THE BOOKLET

S3 Sampling distributions

Sample mean as an estimator of μ

For a random sample X1, X2, ..., Xn of n independent observations from a distribution with mean μ and variance σ².

$$\bar{X} \text{ is an unbiased estimator of } \mu, \quad \operatorname{Var}(\bar{X}) = \frac{\sigma^2}{n}$$

IN THE BOOKLET

Sample variance as an estimator of σ²	S^2 is an unbiased estimator of σ^2, $S^2 = \frac{\sum(X_i - \bar{X})^2}{n-1}$	IN THE BOOKLET
One sample from a normal distribution For a random sample of n observations from N(μ, sigma squared).	$\frac{\bar{X} - \mu}{\sigma/\sqrt{n}} \sim N(0,1)$	IN THE BOOKLET
Two independent samples from normal distributions Samples of nx observations from N(μx, σx²) and, independently, ny from N(μy, σy²).	$\frac{(\bar{X} - \bar{Y}) - (\mu_x - \mu_y)}{\sqrt{\frac{\sigma_x^2}{n_x} + \frac{\sigma_y^2}{n_y}}} \sim N(0,1)$	IN THE BOOKLET

S3 Correlation and regression

Spearman's rank correlation coefficient d is the difference between the two ranks of each pair.	$r_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$	IN THE BOOKLET

S3 Non-parametric tests

Goodness-of-fit test and contingency tables O is the observed and E the expected frequency. nu is the number of degrees of freedom.	$\sum \frac{(O_i - E_i)^2}{E_i} \sim \chi^2_\nu$	IN THE BOOKLET

Percentage points of the chi-squared distribution function

The values in the table are those which a random variable with the chi-squared distribution on v degrees of freedom exceeds with the probability shown.

v	0.995	0.990	0.975	0.950	0.900	0.100	0.050	0.025	0.010	0.005
1	0.000	0.000	0.001	0.004	0.016	2.705	3.841	5.024	6.635	7.879
2	0.010	0.020	0.051	0.103	0.211	4.605	5.991	7.378	9.210	10.597
3	0.072	0.115	0.216	0.352	0.584	6.251	7.815	9.348	11.345	12.838
4	0.207	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.412	0.554	0.831	1.145	1.610	9.236	11.070	12.832	15.086	16.750
6	0.676	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.548
7	0.989	1.239	1.690	2.167	2.833	12.017	14.067	16.013	18.475	20.278
8	1.344	1.646	2.180	2.733	3.490	13.362	15.507	17.535	20.090	21.955
9	1.735	2.088	2.700	3.325	4.168	14.684	16.919	19.023	21.666	23.589
10	2.156	2.558	3.247	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.816	4.575	5.580	17.275	19.675	21.920	24.725	26.757
12	3.074	3.571	4.404	5.226	6.304	18.549	21.026	23.337	26.217	28.300
13	3.565	4.107	5.009	5.892	7.042	19.812	22.362	24.736	27.688	29.819
14	4.075	4.660	5.629	6.571	7.790	21.064	23.685	26.119	29.141	31.319
15	4.601	5.229	6.262	7.261	8.547	22.307	24.996	27.488	30.578	32.801
16	5.142	5.812	6.908	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.265	7.015	8.231	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.844	7.633	8.907	10.117	11.651	27.204	30.144	32.852	36.191	38.582

v	0.995	0.990	0.975	0.950	0.900	0.100	0.050	0.025	0.010	0.005
20	7.434	8.260	9.591	10.851	12.443	28.412	31.410	34.170	37.566	39.997
21	8.034	8.897	10.283	11.591	13.240	29.615	32.671	35.479	38.932	41.401
22	8.643	9.542	10.982	12.338	14.042	30.813	33.924	36.781	40.289	42.796
23	9.260	10.196	11.689	13.091	14.848	32.007	35.172	38.076	41.638	44.181
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.558
25	10.520	11.524	13.120	14.611	16.473	34.382	37.652	40.646	44.314	46.928
26	11.160	12.198	13.844	15.379	17.292	35.563	38.885	41.923	45.642	48.290
27	11.808	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963	49.645
28	12.461	13.565	15.308	16.928	18.939	37.916	41.337	44.461	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.088	42.557	45.722	49.588	52.336
30	13.787	14.953	16.791	18.493	20.599	40.256	43.773	46.979	50.892	53.672

Critical values for correlation coefficients: product moment

These tables concern tests of the hypothesis that a population correlation coefficient ρ is 0. The values are the minimum values which need to be reached by a sample correlation coefficient in order to be significant at the level shown, on a one-tailed test.

Sample size	Level 0.10	Level 0.05	Level 0.025	Level 0.01	Level 0.005
4	0.8000	0.9000	0.9500	0.9800	0.9900
5	0.6870	0.8054	0.8783	0.9343	0.9587
6	0.6084	0.7293	0.8114	0.8822	0.9172
7	0.5509	0.6694	0.7545	0.8329	0.8745
8	0.5067	0.6215	0.7067	0.7887	0.8343
9	0.4716	0.5822	0.6664	0.7498	0.7977
10	0.4428	0.5494	0.6319	0.7155	0.7646
11	0.4187	0.5214	0.6021	0.6851	0.7348
12	0.3981	0.4973	0.5760	0.6581	0.7079
13	0.3802	0.4762	0.5529	0.6339	0.6835
14	0.3646	0.4575	0.5324	0.6120	0.6614
15	0.3507	0.4409	0.5140	0.5923	0.6411
16	0.3383	0.4259	0.4973	0.5742	0.6226
17	0.3271	0.4124	0.4821	0.5577	0.6055
18	0.3170	0.4000	0.4683	0.5425	0.5897
19	0.3077	0.3887	0.4555	0.5285	0.5751
20	0.2992	0.3783	0.4438	0.5155	0.5614
21	0.2914	0.3687	0.4329	0.5034	0.5487
22	0.2841	0.3598	0.4227	0.4921	0.5368
23	0.2774	0.3515	0.4133	0.4815	0.5256
24	0.2711	0.3438	0.4044	0.4716	0.5151
25	0.2653	0.3365	0.3961	0.4622	0.5052
26	0.2598	0.3297	0.3882	0.4534	0.4958
27	0.2546	0.3233	0.3809	0.4451	0.4869
28	0.2497	0.3172	0.3739	0.4372	0.4785
29	0.2451	0.3115	0.3673	0.4297	0.4705

Sample size	Level 0.10	Level 0.05	Level 0.025	Level 0.01	Level 0.005
30	0.2407	0.3061	0.3610	0.4226	0.4629
40	0.2070	0.2638	0.3120	0.3665	0.4026
50	0.1843	0.2353	0.2787	0.3281	0.3610
60	0.1678	0.2144	0.2542	0.2997	0.3301
70	0.1550	0.1982	0.2352	0.2776	0.3060
80	0.1448	0.1852	0.2199	0.2597	0.2864
90	0.1364	0.1745	0.2072	0.2449	0.2702
100	0.1292	0.1654	0.1966	0.2324	0.2565

Critical values for correlation coefficients: Spearman's

One-tailed test, as for the product moment table. 'none' means the booklet prints a dash, so no critical value exists for that sample size and level.

Sample size	Level 0.05	Level 0.025	Level 0.01
4	1.0000	none	none
5	0.9000	1.0000	1.0000
6	0.8286	0.8857	0.9429
7	0.7143	0.7857	0.8929
8	0.6429	0.7381	0.8333
9	0.6000	0.7000	0.7833
10	0.5636	0.6485	0.7455
11	0.5364	0.6182	0.7091
12	0.5035	0.5874	0.6783
13	0.4835	0.5604	0.6484
14	0.4637	0.5385	0.6264
15	0.4464	0.5214	0.6036
16	0.4294	0.5029	0.5824
17	0.4142	0.4877	0.5662
18	0.4014	0.4716	0.5501
19	0.3912	0.4596	0.5351
20	0.3805	0.4466	0.5218
21	0.3701	0.4364	0.5091
22	0.3608	0.4252	0.4975
23	0.3528	0.4160	0.4862
24	0.3443	0.4070	0.4757
25	0.3369	0.3977	0.4662
26	0.3306	0.3901	0.4571
27	0.3242	0.3828	0.4487
28	0.3180	0.3755	0.4401
29	0.3118	0.3685	0.4325
30	0.3063	0.3624	0.4251
40	0.2640	0.3128	0.3681
50	0.2353	0.2791	0.3293

Sample size	Level 0.05	Level 0.025	Level 0.01
60	0.2144	0.2545	0.3005
70	0.1982	0.2354	0.2782
80	0.1852	0.2201	0.2602
90	0.1745	0.2074	0.2453
100	0.1654	0.1967	0.2327

Random numbers

Twenty rows of twenty random digits, printed in pairs.

86 13	84 10	07 30	39 05	97 96	88 07	37 26	04 89	13 48	19 20
60 78	48 12	99 47	09 46	91 33	17 21	03 94	79 00	08 50	40 16
78 48	06 37	82 26	01 06	64 65	94 41	17 26	74 66	61 93	24 97
80 56	90 79	66 94	18 40	97 79	93 20	41 51	25 04	20 71	76 04
99 09	39 25	66 31	70 56	30 15	52 17	87 55	31 11	10 68	98 23
56 32	32 72	91 65	97 36	56 61	12 79	95 17	57 16	53 58	96 36
66 02	49 93	97 44	99 15	56 86	80 57	11 78	40 23	58 40	86 14
31 77	53 94	05 93	56 14	71 23	60 46	05 33	23 72	93 10	81 23
98 79	72 43	14 76	54 77	66 29	84 09	88 56	75 86	41 67	04 42
50 97	92 15	10 01	57 01	87 33	73 17	70 18	40 21	24 20	66 62
90 51	94 50	12 48	88 95	09 34	09 30	22 27	25 56	40 76	01 59
31 99	52 24	13 43	27 88	11 39	41 65	00 84	13 06	31 79	74 97
22 96	23 34	46 12	67 11	48 06	99 24	14 83	78 37	65 73	39 47
06 84	55 41	27 06	74 59	14 29	20 14	45 75	31 16	05 41	22 96
08 64	89 30	25 25	71 35	33 31	04 56	12 67	03 74	07 16	49 32
86 87	62 43	15 11	76 49	79 13	78 80	93 89	09 57	07 14	40 74
94 44	97 13	77 04	35 02	12 76	60 91	93 40	81 06	85 85	72 84
63 25	55 14	66 47	99 90	02 90	83 43	16 01	19 69	11 78	87 16
11 22	83 98	15 21	18 57	53 42	91 91	26 52	89 13	86 00	47 61
01 70	10 83	94 71	13 67	11 12	36 54	53 32	90 43	79 01	95 15

Learn these: not in the booklet

P1 quadratic formula

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

P1 discriminant

$b^2 - 4ac > 0 two real roots, b^2 - 4ac = 0 one repeated root, b^2 - 4ac < 0 no real roots$

P1 completing the square

$$ax^2 + bx + c = a\left(x + \frac{b}{2a}\right)^2 + \left(c - \frac{b^2}{4a}\right)$$

P1 laws of indices

$a^m \times a^n = a^{m+n}$, $a^m \div a^n = a^{m-n}$, $(a^m)^n = a^{mn}$, $a^{m/n} = \sqrt[n]{a^m}$

P1 straight line

$y - y_1 = m(x - x_1)$, $m = \frac{y_2 - y_1}{x_2 - x_1}$; parallel $m_1 = m_2$, perpendicular $m_1 m_2 = -1$

P1 sine rule

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

P1 area of a triangle

$\frac{1}{2}ab\sin C$

P1 arc length and sector area (radians)

$s = r\theta$, $A = \frac{1}{2}r^2\theta$

P1 trigonometric identities

$$\sin^2 A + \cos^2 A \equiv 1,\ \tan\theta \equiv \frac{\sin\theta}{\cos\theta}$$

P1 differentiation of a power

$$\frac{d}{dx}(x^n) = nx^{n-1}$$

P1 integration of a power

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + c,\ n \neq -1$$

P2 laws of logarithms

$$\log_a x + \log_a y \equiv \log_a(xy),\ \log_a x - \log_a y \equiv \log_a \frac{x}{y},\ k\log_a x \equiv \log_a x^k$$

P2 area under a curve

$$\int_a^b y\,dx\ (y \geqslant 0)$$

P2 circle

$$(x-a)^2 + (y-b)^2 = r^2,\ \text{centre } (a,b),\ \text{radius } r$$

P2 factor theorem

$f(a) = 0 \Rightarrow (x-a)$ is a factor; remainder theorem: remainder on dividing by $(x-a)$ is f(a)

P3 trigonometric identities

$$\sec^2 A \equiv 1 + \tan^2 A,\ \operatorname{cosec}^2 A \equiv 1 + \cot^2 A$$

P3 double angle

$$\sin 2A \equiv 2\sin A\cos A,\ \cos 2A \equiv \cos^2 A - \sin^2 A,\ \tan 2A \equiv \frac{2\tan A}{1-\tan^2 A}$$

P3 derivatives

$$\frac{d}{dx}\sin kx = k\cos kx,\ \frac{d}{dx}\cos kx = -k\sin kx,\ \frac{d}{dx}e^{kx} = ke^{kx},\ \frac{d}{dx}\ln x = \frac{1}{x},\ \frac{d}{dx}a^x = a^x \ln a$$

P3 product rule

$$\frac{d}{dx}\big(f(x)g(x)\big) = f'(x)g(x) + f(x)g'(x)$$

P3 chain rule

$$\frac{d}{dx}f(g(x)) = f'(g(x))\,g'(x)$$

P3 integrals

$$\int \cos kx\,dx = \frac{1}{k}\sin kx + c,\ \int \sin kx\,dx = -\frac{1}{k}\cos kx + c,\ \int e^{kx}dx = \frac{1}{k}e^{kx} + c,\ \int \frac{1}{x}dx = \ln|x| + c,\ \int a^x dx = \frac{a^x}{\ln a} + c$$

P3 integral of a function and its derivative

$$\int \frac{f'(x)}{f(x)}\,dx = \ln|f(x)| + c,\ \int f'(g(x))\,g'(x)\,dx = f(g(x)) + c$$

P4 vector as a column

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$$

P4 scalar product

$$\mathbf{a}\cdot\mathbf{b} = a_1b_1 + a_2b_2 + a_3b_3 = |\mathbf{a}||\mathbf{b}|\cos\theta$$

P4 vector equation of a line

$$\mathbf{r} = \mathbf{a} + t\mathbf{b} \ \text{ or } \ \mathbf{r} = \mathbf{c} + t(\mathbf{d}-\mathbf{c})$$

P4 volume of revolution about the x-axis

$$V = \pi\int_a^b y^2\,dx$$

P4 parametric differentiation

$$\frac{dy}{dx} = \frac{dy/dt}{dx/dt}$$

FP1 sum of the first n integers

$$\sum_{r=1}^{n} r = \tfrac{1}{2}n(n+1)$$

FP1 roots of a quadratic

$$ax^2 + bx + c = 0 \ \Rightarrow\ \alpha+\beta = -\frac{b}{a},\ \alpha\beta = \frac{c}{a},\ \alpha^3+\beta^3 \equiv (\alpha+\beta)^3 - 3\alpha\beta(\alpha+\beta)$$

FP1 complex numbers

$$z = x + iy = r(\cos\theta + i\sin\theta),\ |z| = \sqrt{x^2+y^2},\ z^* = x - iy,\ |z_1z_2| = |z_1||z_2|,\ zz^* = |z|^2$$

FP1 conjugate roots

if z_1 is a root of $f(z) = 0$ with real coefficients, then z_1^* is also a root

FP1 linear interpolation for f(x)=0 with a sign change on [a,b]

$$x \approx \frac{af(b) - bf(a)}{f(b) - f(a)}$$

FP1 2 by 2 determinant and inverse

$$\det\begin{pmatrix} a & b \\ c & d \end{pmatrix} = ad - bc,\ \mathbf{A}^{-1} = \frac{1}{ad-bc}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix},\ (\mathbf{AB})^{-1} = \mathbf{B}^{-1}\mathbf{A}^{-1}$$

FP1 parabola focus-directrix property

distance from P to the focus $=$ distance from P to the directrix

FP2 Euler form of cos and sin

$$\cos\theta = \tfrac{1}{2}\left(e^{i\theta} + e^{-i\theta}\right),\ \sin\theta = \frac{1}{2i}\left(e^{i\theta} - e^{-i\theta}\right)$$

FP2 de Moivre and powers

$$z = \cos\theta + i\sin\theta \ \Rightarrow\ z^n + z^{-n} = 2\cos n\theta,\ z^n - z^{-n} = 2i\sin n\theta$$

FP2 method of differences

$$\frac{1}{r(r+1)} \equiv \frac{1}{r} - \frac{1}{r+1}$$

FP2 loci in the Argand diagram

$|z-a| = b$ (circle), $|z-a| = |z-b|$ (perpendicular bisector), $\arg(z-a) = \beta$ (half-line)

FP2 integrating factor

$$\frac{dy}{dx} + Py = Q \;\Rightarrow\; \text{I.F.} = e^{\int P\,dx},\; y\,e^{\int P\,dx} = \int Q\,e^{\int P\,dx}\,dx$$

FP2 second order differential equation

$a\dfrac{d^2y}{dx^2} + b\dfrac{dy}{dx} + cy = f(x)$, auxiliary equation $a\lambda^2 + b\lambda + c = 0$, $y =$ complementary function $+$ particular integral

FP2 complementary function by type of root

$\lambda_1 \neq \lambda_2$: $Ae^{\lambda_1 x} + Be^{\lambda_2 x}$; $\lambda_1 = \lambda_2 = \lambda$: $(A + Bx)e^{\lambda x}$; $\lambda = p \pm iq$: $e^{px}(A\cos qx + B\sin qx)$

FP2 polar and cartesian coordinates

$x = r\cos\theta,\; y = r\sin\theta,\; r^2 = x^2 + y^2,\; \tan\theta = \dfrac{y}{x}$

FP3 hyperbolic functions

$\cosh x = \frac{1}{2}(e^x + e^{-x})$, $\sinh x = \frac{1}{2}(e^x - e^{-x})$, $\tanh x = \dfrac{\sinh x}{\cosh x}$, $\operatorname{sech} x = \dfrac{1}{\cosh x}$

FP3 other hyperbolic identity

$1 - \tanh^2 x \equiv \operatorname{sech}^2 x$

FP3 tangent to a conic

$y = mx + c$ touches $\dfrac{x^2}{a^2} + \dfrac{y^2}{b^2} = 1$ when $c^2 = a^2m^2 + b^2$, and $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ when $c^2 = a^2m^2 - b^2$

FP3 area and volume from vectors

area of triangle $OAB = \frac{1}{2}|\mathbf{a} \times \mathbf{b}|$, volume of parallelepiped $= |\mathbf{a} \cdot (\mathbf{b} \times \mathbf{c})|$

FP3 vector equations

line $(\mathbf{r} - \mathbf{a}) \times \mathbf{b} = \mathbf{0}$, plane $\mathbf{r} \cdot \mathbf{n} = p$

FP3 shortest distance between skew lines

$$\frac{|(\mathbf{a}_2 - \mathbf{a}_1) \cdot (\mathbf{b}_1 \times \mathbf{b}_2)|}{|\mathbf{b}_1 \times \mathbf{b}_2|}$$

FP3 matrix rules

$(\mathbf{AB})^T = \mathbf{B}^T\mathbf{A}^T$, $(\mathbf{AB})^{-1} = \mathbf{B}^{-1}\mathbf{A}^{-1}$

FP3 eigenvalues and eigenvectors

$\mathbf{Ax} = \lambda\mathbf{x}$, $\det(\mathbf{A} - \lambda\mathbf{I}) = 0$; orthogonal $\mathbf{P}$ with $\mathbf{P}^T\mathbf{AP} = \mathbf{D}$

M1 constant acceleration

$v = u + at,\; s = ut + \frac{1}{2}at^2,\; s = vt - \frac{1}{2}at^2,\; v^2 = u^2 + 2as,\; s = \frac{1}{2}(u + v)t$

M1 momentum and impulse

momentum $= mv$, impulse $= mv - mu$

M1 conservation of momentum

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

M1 Newton's second law and weight

$F = ma,\; W = mg$

M1 friction

$F \leqslant \mu R$ (equilibrium), $F = \mu R$ (moving or limiting)

M1 moment of a force

force $\times$ perpendicular distance from the pivot

M1 variable acceleration

$v = \dfrac{dr}{dt},\; a = \dfrac{dv}{dt} = \dfrac{d^2r}{dt^2}$

M2 kinetic and potential energy

$KE = \frac{1}{2}mv^2,\; PE = mgh$

M2 work done and power

$W = Fs\cos\theta,\; P = Fv$

M2 work-energy principle

work done by the driving force $= \Delta KE + \Delta PE +$ work against resistances

M2 projectile motion

$x = ut\cos\alpha,\; y = ut\sin\alpha - \frac{1}{2}gt^2$

M2 centre of mass of a system

$$\bar{x} = \frac{\sum m_i x_i}{\sum m_i}$$

M3 elastic string (Hooke's law)

$$T = \frac{\lambda x}{l}$$

M3 elastic potential energy

$$E = \frac{\lambda x^2}{2l}$$

M3 simple harmonic motion

$\ddot{x} = -\omega^2 x,\; x = a\cos\omega t$ or $x = a\sin\omega t,\; v^2 = \omega^2(a^2 - x^2),\; T = \dfrac{2\pi}{\omega}$

M3 circular motion

$v = r\omega$, acceleration towards the centre $= r\omega^2 = \dfrac{v^2}{r}$

M3 Newton's law of restitution

$$e = \frac{\text{speed of separation}}{\text{speed of approach}},\; 0 \leqslant e \leqslant 1$$

S1 mean

$$\bar{x} = \frac{\sum x}{n} \text{ or } \frac{\sum fx}{\sum f}$$

S1 standard deviation

$\sigma = \sqrt{\text{variance}}$, variance $= \dfrac{\sum x^2}{n} - \bar{x}^2$

S1 interquartile range

$$IQR = Q_3 - Q_1$$

S1 complement and independence

$P(A') = 1 - P(A)$; independent events: $P(B \mid A) = P(B)$, $P(A \cap B) = P(A)P(B)$

S1 linear coding

$E(aX + b) = aE(X) + b,\; \operatorname{Var}(aX + b) = a^2\operatorname{Var}(X)$

S1 cumulative distribution function (discrete)

$$F(x_0) = P(X \leqslant x_0) = \sum_{x \leqslant x_0} p(x)$$

S1 standardising a Normal variable

$$Z = \frac{X - \mu}{\sigma},\ X \sim N(\mu, \sigma^2)$$

S2 probability from a p.d.f.

$$P(a < X \leqslant b) = \int_a^b f(x)\,dx$$

S2 p.d.f. from the c.d.f.

$$f(x) = \frac{dF(x)}{dx}$$

S3 linear combination of independent Normal variables

$$aX \pm bY \sim N(a\mu_x \pm b\mu_y,\ a^2\sigma_x^2 + b^2\sigma_y^2)$$

$$D1 spanning tree on n nodes has n - 1 arcs;\ \text{sum of the degrees of the nodes} = 2 \times \text{number of arcs}$$

D1 bin packing lower bound

$$\left\lceil \frac{\text{total size of all items}}{\text{bin capacity}} \right\rceil$$

D1 total float of activity (i, j)

$$F(i, j) = l_j - e_i - \text{duration}(i, j)$$

Using the booklet in the exam

- Learn the recall list first: the quadratic formula, sine rule, area formulae, SUVAT, F = ma and the double angle identities are not printed.
- Tab the booklet before the exam: P3 identities and derivatives, S1 and S2 distributions and the statistical tables are the pages you will use most.
- In S1 to S3, check which table gives P(X <= x) and which gives an upper tail. The chi-squared table gives upper-tail points, and the normal percentage points table gives P(Z > z).
- For hypothesis tests, read the critical value table for a one-tailed test at the stated level, and halve the significance level for a two-tailed test.
- For M2 and M3 centre of mass questions, check whether the body is a shell or solid before you choose a printed fraction.
- For FP2 and FP3, the booklet prints the series, hyperbolic identities and inverse function derivatives and integrals, but not de Moivre applications, loci or differential equation methods, so learn those.

Based on: Pearson Edexcel International A Level Mathematics, Mathematical Formulae and Statistical Tables, Issue 2, January 2021 (Pearson Edexcel International Advanced Subsidiary/Advanced Level in Mathematics, Further Mathematics and Pure Mathematics). Statistical tables are calculated by CuratedPrep to the same layout. Updated 31 October 2026. Always practise with the version of the official booklet your exam uses. More free sheets and topic worksheets at curatedprep.com.