ERA Distributors
Distributors of The MATHOMAT® Drawing Template
In conjunction with ∂φ Publishers

Hands-on: Useful formulae

Exponents

$a^0 = 1$ $\quad a^{-n} = \frac{1}{a^n}$

$a^m \times a^n = a^{m+n}$ $\quad (a^m)^n = a^{mn}$

$\frac{a^m}{a^n} = a^{m-n}$ $\quad \left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$

$(a \times b)^n = a^n \times b^n$

Surds

$\sqrt[n]{a} = a^{\frac{1}{n}}$ $\quad \sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$

$\sqrt[n]{a^m} = (\sqrt[n]{a})^m = a^{\frac{m}{n}}$ $\quad (\sqrt[n]{a})^n = \sqrt[n]{a^n} = a$

$\sqrt[n]{ab} = \sqrt[n]{a} \times \sqrt[n]{b}$ $\quad \sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$

Matrices

If $\boldsymbol{A} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ then

Transpose: $\boldsymbol{A}^T = \begin{pmatrix} a & c \\ b & d \end{pmatrix}$

Adjoint: adj $\boldsymbol{A} = \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

Determinant:
det $\boldsymbol{A} = |\boldsymbol{A}| = ad - bc$

Inverse: $\boldsymbol{A}^{-1} = \frac{1}{|A|}\begin{pmatrix} d & -b \\ -c & a \end{pmatrix} = \frac{\text{adj } A}{|A|}$

Identity: $\boldsymbol{I}_2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$

$\boldsymbol{I}\,\boldsymbol{A} = \boldsymbol{A}\,\boldsymbol{I} = \boldsymbol{A}$
$\boldsymbol{A}\,\boldsymbol{A}^{-1} = \boldsymbol{A}^{-1}\boldsymbol{A} = \boldsymbol{I}$

Simultaneous Equations:
If $\boldsymbol{AX} = \boldsymbol{B}$ then $\boldsymbol{X} = \boldsymbol{A}^{-1}\boldsymbol{B}$

Euler's number

$e = 1 + \frac{1}{1} + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \ldots$

Logarithms

$\log_b x = y \leftrightarrow x = b^y$

$\ln x = y \leftrightarrow x = e^y$

$\log x = y \leftrightarrow x = 10^y$

$\log_b mn = \log_b m + \log_b n$

$\log_b \frac{m}{n} = \log_b m - \log_b n$

$\log_b m^n = n \log_b m$

$\log_b N = \frac{\log_a N}{\log_a b}$

Power and exponential laws

For constants A and n:

Power	Exponential
$y = Ax^n$	$y = An^x$
Graph $\log y$ against $\log x$	Graph $\log y$ against x

Quadratic formulae

If $ax^2 + bx + c = 0$ then

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

Area of triangle

$A = \frac{1}{2}$ base $\times$ height

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

Heron's formula:

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

where $s = \frac{1}{2}(a + b + c)$

Greek alphabet

alpha	α	lambda	λ
beta	β	mu	μ
gamma	γ	pi	π
delta	δ	rho	ρ
epsilon	ε	sigma	σ
theta	θ	omega	ω
iota	ί	phi	ϑ

Straight lines

Slope: $m = \frac{y_2 - y_1}{x_2 - x_1}$

Point slope form:
$y - y_1 = m(x - x_1)$

Gradient form: $y = mx + b$

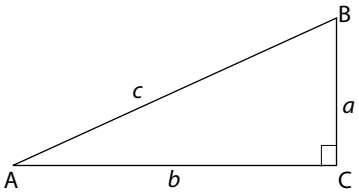
General form: $Ax + By + C = 0$

Intercept form: $\frac{x}{a} + \frac{y}{b} = 1$

Vertical line: $x = a$

Horizontal line: $y = b$

Theorem of Pythagoras



If $\boldsymbol{c}$ is the hypotenuse and $\boldsymbol{a}$ and $\boldsymbol{b}$ are the other two sides of a right-angled triangle then
$a^2 + b^2 = c^2$

Factoring

$ab + ac = a(b + c)$
$a^2 + 2ab + b^2 = (a + b)^2$
$a^2 - 2ab + b^2 = (a - b)^2$
$a^2 - b^2 = (a + b)(a - b)$

Exponential growth/ decay

$$A = A_0 e^{kt}$$

Circle

Circumference: $C = 2\pi r$

Area circle: $A = \pi r^2$

Length of arc: $s = r\theta$

Area of sector: $A_{sec} = \frac{1}{2} r^2\theta$

Length chord: $L = 2\, r\sin\frac{1}{2}\theta$

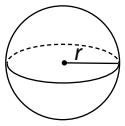
Area segment: $A_{seg} = \frac{1}{2} r^2 (\theta - \sin\theta)$

Polyhedra

Prism: $V = A_{base} \times$ height

Pyramid: $V = \frac{1}{3}A_{base} \times$ height

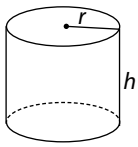
Sphere



$V = \frac{4}{3}\pi r^3$

$SA = 4\pi r^2$

Cylinder

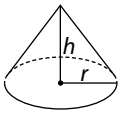


$V = \pi r^2 h$

$SA = 2\pi r^2 + 2\pi rh$

$= 2\pi r(r + h)$

Cone



$V = \frac{1}{3}\pi r^2 h$

$SA = \pi r(r + \sqrt{r^2 + h^2})$

Oblique triangles

Sine Rule for AAS, SSA*

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

Cosine Rule for SSA*, SAS, SSS

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

(*Ambiguous case)

Geometric sequence

$T_n = ar^{n-1}$

$S_n = \frac{a(1 - r^n)}{1 - r}$

$S_\infty = \frac{a}{1 - r}$

Arithmetic sequence

$T_n = a + (n - 1)d$

$S_n = \frac{n}{s}(a + 1)$

$S_n = \frac{n}{2}(2a + (n - 1)d)$

Variation

Direct: $y = kx^n$

Inverse: $y = \frac{k}{x^n}$

Mean

$\overline{X} = \frac{\Sigma X}{n}$

Mode

Most frequent score

Percentiles

P_n: The percentage of scores in a distribution below the score. There are 99 percentiles.

D_n: $D_1 = P_{10}$, $D_2 = P_{20}$ etc.

Q_n: $Q_1 = P_{25}$, $Q_2 = P_{50}$ etc.

Median

Middle quartile Q_2 i.e. middle score when scores are in order

Range

Highest – Lowest score

Interquartile range

Range of middle 50% of scores when scores are in order

$I.Q.R = Q_3 - Q_1$

Standard deviation

$$S = \sqrt{\frac{\Sigma(X - \overline{X})^2}{n}}$$

Alternative Formula:

$$S = \sqrt{\frac{\Sigma X^2}{n} - \overline{X}^2}$$

Variance

Square of standard deviation i.e. S^2

Grouped data

$$\overline{X} = \frac{\Sigma fx}{\Sigma f}$$

$$S = \sqrt{\frac{\Sigma fX^2}{\Sigma f} - \left(\frac{\Sigma fX}{\Sigma f}\right)^2}$$

Correlation coefficient

$$r = \frac{S_{XY}}{S_X S_Y}$$

where

$$S_{XY} = \frac{\Sigma(X - \overline{X})(Y - \overline{Y})}{n}$$

Alternative Formula:

$$S_{XY} = \frac{\Sigma XY}{n} - \overline{XY}$$

Regression

Equation of regression line with gradient b and y-intercept a for predicting Y from X is

$$Y = a + bX$$

where $b = \frac{S_{XY}}{S_X^2}$

and $a = \overline{Y} - b\overline{X}$

9 780994 668547