ESSENTIAL FORMULAS FOR SAT MATH

Linear Equations

Slope-Intercept Form: $\boldsymbol{y = mx + b}$

Slope = m

y-intercept = b

Point-Slope Form: $\boldsymbol{y - y_1 = m(x - x_1)}$

Standard Form: $\boldsymbol{Ax + By = C}$

Slope = $-\frac{A}{B}$

y-intercept = $\frac{C}{B}$

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

Midpoint Formula: $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

Distance Formula: $\boldsymbol{d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}}$

Systems of Equations

Intersecting lines → one solution

Parallel lines → no solutions

Same line → infinite solutions

Eliminate both variables!

Quadratic Equations / Parabolas

Standard/Quadratic Form: $\boldsymbol{f(x) = ax^2 + bx + c}$

x-value of vertex = $-\frac{b}{2a}$

y-value of vertex = $f\left(-\frac{b}{2a}\right)$

Minimum when $a > 0$

Maximum when $a < 0$

y-intercept = c → *"constant or coefficient"*

Vertex Form: $\boldsymbol{f(x) = a(x - h)^2 + k}$

Vertex: (h, k) → *"constants or coefficients"*

Minimum (when $a > 0$): k

Maximum (when $a < 0$): k

Factored Form: $\boldsymbol{f(x) = a(x - s)(x - t)}$

x-intercepts: s and t → *"constants or coefficients"*

x-value of vertex = $\frac{s + t}{2}$

y-value of vertex = $f\left(\frac{s + t}{2}\right)$

Minimum when $a > 0$

Maximum when $a < 0$

Circles

Arc Length = $\left(\frac{n}{360}\right)\boldsymbol{2\pi r}$ Sector Area = $\left(\frac{n}{360}\right)\boldsymbol{\pi r^2}$

n = central angle of arc/sector

Center-Radius Equation: $\boldsymbol{(x - h)^2 + (y - k)^2 = r^2}$

Center: (h, k) Radius = r

Powers/Exponents/Roots

$x^a \times x^b = x^{a+b}$ $x^{-a} = \frac{1}{x^a}$

$\frac{x^a}{x^b} = x^{a-b}$ $x^{\frac{a}{b}} = \sqrt[b]{x^a}$

$(x^a)^b = x^{ab}$ $(xy)^a = x^a y^a$

$\sqrt{xy} = \sqrt{x} \times \sqrt{y}$ $x^0 = 1$

$(-1)^n = \begin{cases} 1, if\ n\ is\ even \\ -1, if\ n\ is\ odd \end{cases}$

Exponential Equations

General Form: $\boldsymbol{f(x) = ab^x}$

- If $b > 1$, exponential growth
- If $0 < b < 1$, exponential decay

Growth/Decay Formula: $\boldsymbol{A(t) = P\left(1 + \frac{r}{100}\right)^t}$

- P = Principle (initial amount)
- r = % increase/decrease
- t = time interval (in any unit)

Trigonometry

$sine = \frac{opp}{hyp}$ $cosine = \frac{adj}{hyp}$ $tangent = \frac{opp}{adj}$

$if\ \angle A + \angle B = 90°,\ then\ \begin{cases} sinA = cosB \\ cosA = sinB \end{cases}$

Percentages

$\% = \frac{part}{whole} \times 100$ $\%\ change = \frac{new - old}{old} \times 100$

Miscellaneous

$Distance = Rate \times Time$

Quadratic Identities

$(x + a)(x + b) = x^2 + (b + a)x + ab$

$a^2 - b^2 = (a + b)(a - b)$

$(a + b)^2 = a^2 + 2ab + b^2$

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

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Components of Experiment Design

Population: A set of items of interest for some question or experiment.

Random Sample: A subset of the population that can reasonably be studied in which each item has an equal chance of being selected.

Required in order to generalize survey results to the entire population.

Sample Bias: When some members of population are less likely to be included than others.

Random sampling = no sample bias

Margin of Error: How many percentage points a sample's results will differ from the real population's value.

Confidence Interval: A 95% **confidence interval** with a 4% **margin of error** means that your statistic will be within 4 points of the real population value 95% of the time.

Statistical Measures

Mean: $\frac{sum\ of\ items}{\#\ of\ items}$

Median: The middle number of an ***ordered*** set of items.

Median # term: $\frac{n+1}{2}$, n = number of items in set.

Range: Maximum – minimum

Standard Deviation: Measures spread of data set

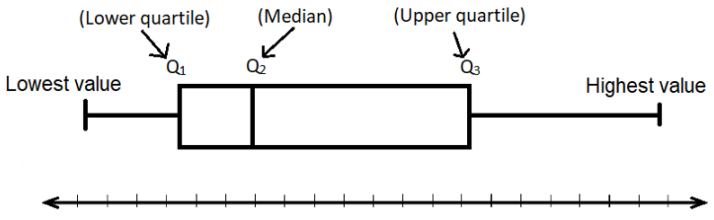
High SD: data spread out from mean
Low SD: data close to mean

Outlier: A value that is significantly larger or smaller than the rest of the data.

High Outlier: Mean > Median

Low Outlier: Mean < Median

Box Plots



Lower Quartile: Lowest 25% of data.

Upper Quartile: Highest 25% of data

Extra Geometry Formulas

Surface Area of Rectangular Prism $= 2(wl + hl + hw)$

Surface Area of Cylinder $= 2\pi r^2 + 2\pi rh$

Area of Equilateral Triangle $= \frac{\sqrt{3}}{4}s^2$

Complex Numbers

$i^1 = i$ $\quad i^2 = -1$ $\quad i^3 = -i$ $\quad i^4 = 1$

$i^5 = i$ $\quad i^6 = -1$ $\quad i^7 = -i$ $\quad i^8 = 1$

Direct/Inverse Variation

Direct Variation: $y = kx$

Inverse Variation: $y = \frac{k}{x}$

k = constant of variation

Complex Examples of Variation

$y = k\sqrt{x} : 9x \rightarrow 3y$ $\quad y = kx^2 : 3x \rightarrow 9y$

$y = \frac{k}{\sqrt{x}} : 9x \rightarrow \frac{1}{3}y$ $\quad y = \frac{k}{x^2} : 3x \rightarrow \frac{1}{9}y$

Arithmetic Sequences

$a_n = a_1 + (n-1)d$ $\quad S_n = \frac{n}{2}(a_1 + a_n)$