

AP Statistics Formula Sheet

Move from a formula to a defensible statistical method. Use this original reference to connect descriptive statistics, probability, sampling distributions, inference and regression with their assumptions and interpretations.

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Scope and review status

Main quantitative relationship groups for selected 2026–27 AP Statistics learning: descriptive data, probability and binomial models, sampling distributions, proportion and mean inference, categorical association, and regression description. Not complete course coverage or a reproduction of College Board’s reference booklet. Removed legacy topics are explicitly excluded.

Official reference pages and revision scope were checked; original calculations and explanations require separate independent review. Qualified educator approval is not claimed.

Independent content review: peer checked. Qualified educator review: pending.

This is an original study resource, not an official examination, endorsement, score prediction or certification.

<https://openexam.site/exams/ap-statistics/formula-sheet/>

Quick-reference index

Find a relationship here, then read its variables, conditions, exam-reference status and worked example in the detailed sections.

FORMULA / RELATIONSHIP	QUICK REFERENCE / CHECK CONDITIONS BELOW
Sample mean	$\bar{x} = (x_1 + \dots + x_n) / n$.
Sample standard deviation	$s = \sqrt{\sum ((x_i - \bar{x})^2) / (n - 1)}$.
IQR and the 1.5-IQR outlier fences	$IQR = Q_3 - Q_1$; lower fence = $Q_1 - 1.5 \cdot IQR$; upper fence = $Q_3 + 1.5 \cdot IQR$.
Standardize a value or recover a normal-model cutoff	$z = (x - \mu) / \sigma$; $x = \mu + z \cdot \sigma$.
Complement and addition rules	$P(\text{not } A) = 1 - P(A)$; $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.
Conditional probability and the general multiplication rule	$P(A \text{ given } B) = P(A \text{ and } B) / P(B)$; $P(A \text{ and } B) = P(B) \cdot P(A \text{ given } B)$.
Mean and SD of a discrete random variable	$\mu_X = \sum (x_i \cdot p_i)$; $\sigma_X = \sqrt{\sum ((x_i - \mu_X)^2 \cdot p_i)}$.
Binomial count probability	$P(X = k) = C(n, k) \cdot p^k \cdot (1 - p)^{(n - k)}$.

FORMULA / RELATIONSHIP	QUICK REFERENCE / CHECK CONDITIONS BELOW
Mean and SD of a binomial count	For $X \sim \text{Binomial}(n, p)$, $\text{mean} = n \cdot p$ and $\text{SD} = \sqrt{n \cdot p \cdot (1 - p)}$.
Spread of a sample proportion	Mean of $\hat{p} = p$; $\text{SD}(\hat{p}) = \sqrt{p \cdot (1 - p)/n}$; estimated $\text{SE} = \sqrt{\hat{p} \cdot (1 - \hat{p})/n}$.
Spread of a sample mean	Mean of $\bar{x} = \mu$; $\text{SD}(\bar{x}) = \sigma/\sqrt{n}$; estimated $\text{SE} = s/\sqrt{n}$.
Confidence-interval structure	estimate $\pm$ critical multiplier $\cdot$ standard error.
One-proportion z interval	$\hat{p} \pm z\text{-star} \cdot \sqrt{\hat{p} \cdot (1 - \hat{p})/n}$.
One-proportion z test statistic	$z = (\hat{p} - p_0) / \sqrt{p_0 \cdot (1 - p_0)/n}$.
Plan a proportion interval sample size	$n \geq (z\text{-star}^2) \cdot \tilde{p} \cdot (1 - \tilde{p}) / (\text{desired margin}^2)$, rounded up.
Two independent proportions: interval	$(\hat{p}_1 - \hat{p}_2) \pm z\text{-star} \cdot \sqrt{\hat{p}_1 \cdot (1 - \hat{p}_1)/n_1 + \hat{p}_2 \cdot (1 - \hat{p}_2)/n_2}$.
Two independent proportions: pooled null test	pooled $\hat{p} = (x_1 + x_2) / (n_1 + n_2)$; $z = (\hat{p}_1 - \hat{p}_2) / \sqrt{\text{pooled} \cdot (1 - \text{pooled}) \cdot (1/n_1 + 1/n_2)}$.
One-mean t interval and test statistic	Interval: $\bar{x} \pm t\text{-star} \cdot (s/\sqrt{n})$; test $t = (\bar{x} - \mu_0) / (s/\sqrt{n})$, $df = n - 1$.
Paired observations: one t procedure on differences	For one difference per pair, $t = (\text{mean difference} - \text{null mean difference}) / (\text{SD of differences} / \sqrt{\text{number of pairs}})$; $df = \text{number of pairs} - 1$.
Independent means: unpooled standard error	$\text{SE} = \sqrt{s_1^2/n_1 + s_2^2/n_2}$; $t = ((\bar{x}_1 - \bar{x}_2) - \text{null difference}) / \text{SE}$; interval $= (\bar{x}_1 - \bar{x}_2) \pm t\text{-star} \cdot \text{SE}$.
Expected count under no association	Expected cell count $= (\text{row total} \cdot \text{column total}) / \text{grand total}$.
Chi-square statistic and table degrees of freedom	$\text{chi-square} = \sum ((\text{observed} - \text{expected})^2 / \text{expected})$ across all cells; $df = (\text{number of rows} - 1) \cdot (\text{number of columns} - 1)$.
Fitted line and residual	predicted $y = a + b \cdot x$; residual $= \text{observed } y - \text{predicted } y$.
Coefficient of determination in simple linear regression	For simple least-squares linear regression with an intercept, $R\text{-squared} = r^2$.

Conditions and worked examples

A reference for the revised 2026–27 course

This original learning reference follows the revised five-unit AP Statistics framework and the 13-page College Board reference booklet marked ©2026. It explains the main quantitative relationships with variables, conditions and independently written examples. It is not a reproduction of the official booklet, a complete course or an official exam simulation.

The official formula pages are physical pages 4–5 of that booklet. Those pages provide some formulas directly and others as general inference structures with standard errors. We label those distinctions rather than implying that every worked substitution is printed in the official reference. Probability tables and digital-entry notation remain in the official booklet; they are linked, not republished here.

- Not included as current-course topics: geometric distributions, combining random variables, chi-square goodness-of-fit and inference for a regression slope. These were explicitly removed in the 2026–27 revision.
- Regression description/prediction and chi-square tests of independence or homogeneity remain relevant; removal of slope inference or goodness-of-fit does not remove all regression or all chi-square work.
- Sampling design, investigative questions, experiment design and interpretation require reasoning beyond any formula.
- Independent qualified educator review is pending; linked catalog questions retain their published foundation scope.

Describe quantitative data and relative position

Distinguish a sample summary from a population parameter. A statistic describes the observations you have; the sampling design determines whether it supports a broader claim.

Sample mean

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Plain text: $\bar{x} = (x_1 + \dots + x_n) / n$.

Variables: x_i : the i th observed numerical value; n : positive number of observations; $\bar{x}$: sample mean

Conditions: Use numerical observations in consistent units and include every observation.; The mean is sensitive to extreme values; it does not describe shape or spread by itself.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 4 (Formulas for AP Statistics), prints this relationship.

Worked example

Four original delivery times are 2, 5, 8 and 9 minutes. Find the mean.

1. Sum the times: $2+5+8+9=24$ minutes.
2. Divide by $n=4$: $24/4=6$ minutes.

Answer: 6 minutes

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Sample standard deviation

$$s = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}}$$

Plain text: $s = \sqrt{\text{sum}((x_i - \bar{x})^2) / (n - 1)}$.

Variables: x_i : sample values; $\bar{x}$: sample mean; $n > 1$: sample size; s : sample standard deviation in the original units

Conditions: This is the sample SD with denominator $n-1$; a population SD uses its own population definition.; Do not average signed deviations: they sum to zero. Square first, add, divide, then take the square root.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 4 (Formulas for AP Statistics), prints this relationship.

Worked example

Find the sample standard deviation of 1, 3 and 5 cm.

1. The mean is 3 cm. Squared deviations are 4, 0 and 4 cm^2 .
2. Divide their sum 8 by $n-1=2$ to get sample variance 4 cm^2 .
3. Take the square root: $s=2$ cm.

Answer: 2 cm

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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IQR and the 1.5-IQR outlier fences

$$\text{IQR} = Q_3 - Q_1, \quad L = Q_1 - 1.5 \text{ IQR}, \quad U = Q_3 + 1.5 \text{ IQR}$$

Plain text: $\text{IQR} = Q_3 - Q_1$; lower fence $= Q_1 - 1.5 * \text{IQR}$; upper fence $= Q_3 + 1.5 * \text{IQR}$.

Variables: Q_1, Q_3 : first and third quartiles using the stated convention; L, U : lower and upper fences

Conditions: A value below L or above U is flagged by this rule; a flag is not permission to delete it.; Use a consistent quartile convention, especially for small samples. This formula does not choose that convention.

Exam reference: Not printed as a standalone formula in the 2026 reference booklet, physical pages 4–5. This is a supplemental learning relationship; use the official booklet and current course framework together.

Worked example

For a distribution with $Q1=12$ and $Q3=20$, find the fences and decide whether 35 is flagged.

1. $IQR=20-12=8$.
2. $L=12-1.5(8)=0$; $U=20+1.5(8)=32$.
3. $35>32$, so 35 is an upper flagged value.

Answer: Fences 0 and 32; 35 is flagged.

Reference: AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Standardize a value or recover a normal-model cutoff

$$z = \frac{x - \mu}{\sigma}, \quad x = \mu + z\sigma$$

Plain text: $z=(x-\mu)/\sigma$; $x=\mu+z*\sigma$.

Variables: x : value or cutoff; μ : population/model mean; $\sigma>0$: population/model SD; z : standardized value

Conditions: Standardization itself does not make data normal. Use normal-table probabilities only when a normal model is appropriate.; A z score is unitless; the recovered x has the original measurement units.

Exam reference: Not printed as a standalone formula in the 2026 reference booklet, physical pages 4–5. This is a supplemental learning relationship; use the official booklet and current course framework together.

Worked example

Under a stated normal model with mean 64 and SD 3, standardize 70 and recover the cutoff with $z=-1.5$.

1. For 70, $z=(70-64)/3=2$.
2. For $z=-1.5$, $x=64+(-1.5)(3)=59.5$.
3. Interpret 70 as 2 model SDs above the mean, not as a probability.

Answer: $z=2$; cutoff 59.5.

Reference: AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Probability and random variables

Specify the chance process and the event before computing. Mutually exclusive events and independent events are different ideas: disjoint nonzero-probability events cannot be independent.

Complement and addition rules

$$P(A^c) = 1 - P(A), \quad P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Plain text: $P(\text{not } A) = 1 - P(A)$; $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$.

Variables: A, B: events; A^c : complement of A; union means at least one event occurs

Conditions: The overlap term prevents double counting.; Set $P(A \text{ and } B) = 0$ only if the events are disjoint, not merely because their descriptions differ.

Exam reference: The addition rule is printed on physical page 4. The complement rule is a supplemental fundamental probability relationship, not printed there as a standalone formula.

Worked example

Suppose $P(A) = 0.35$, $P(B) = 0.40$ and $P(A \text{ and } B) = 0.10$. Find $P(A \text{ or } B)$ and $P(\text{not } A)$.

1. $P(A \text{ or } B) = 0.35 + 0.40 - 0.10 = 0.65$.

2. $P(\text{not } A) = 1 - 0.35 = 0.65$.

Answer: Both requested probabilities are 0.65.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Conditional probability and the general multiplication rule

$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}, \quad P(A \cap B) = P(B)P(A \mid B)$$

Plain text: $P(A \text{ given } B) = P(A \text{ and } B) / P(B)$; $P(A \text{ and } B) = P(B) * P(A \text{ given } B)$.

Variables: A, B: events; $P(B) > 0$: probability of the conditioning event

Conditions: The conditioning event changes the denominator.; Replace $P(A \text{ given } B)$ with $P(A)$ only when independence is justified.

Exam reference: The conditional-probability formula is printed on physical page 4; the multiplication rule shown here is its algebraic rearrangement.

Worked example

If $P(B) = 0.30$ and $P(A \text{ and } B) = 0.18$, find $P(A \text{ given } B)$ and check the product rule.

1. $P(A \text{ given } B) = 0.18 / 0.30 = 0.60$.

2. The product 0.30×0.60 returns $P(A \text{ and } B) = 0.18$.

Answer: $P(A \text{ given } B) = 0.60$.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Mean and SD of a discrete random variable

$$\mu_X = \sum_i x_i p_i, \quad \sigma_X = \sqrt{\sum_i (x_i - \mu_X)^2 p_i}$$

Plain text: $\mu_X = \sum(x_i \cdot p_i)$; $\sigma_X = \sqrt{\sum((x_i - \mu_X)^2 \cdot p_i)}$.

Variables: x_i : possible numerical outcomes; $p_i = P(X=x_i)$: nonnegative outcome probabilities summing to 1; μ_X : expected value; σ_X : long-run SD

Conditions: The outcomes and probabilities must define a valid distribution.; Expected value is a long-run weighted mean, not necessarily a possible single-trial outcome.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 4 (Formulas for AP Statistics), prints this relationship.

Worked example

An original random variable takes 0, 2 and 4 with probabilities 0.25, 0.50 and 0.25. Find its mean and SD.

1. $\mu = 0(0.25) + 2(0.50) + 4(0.25) = 2$.
2. $\text{Variance} = (0-2)^2(0.25) + (2-2)^2(0.50) + (4-2)^2(0.25) = 2$.
3. $\text{SD} = \sqrt{2}$, approximately 1.414.

Answer: Mean 2; SD $\sqrt{2}$, approximately 1.414.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Binomial count probability

$$P(X = k) = \binom{n}{k} p^k (1 - p)^{n-k}$$

Plain text: $P(X=k) = C(n,k) \cdot p^k \cdot (1-p)^{(n-k)}$.

Variables: n : fixed number of trials; p : common success probability; k : integer success count from 0 through n ; $C(n,k)$: number of ways to choose the k successful trials

Conditions: Check fixed n , binary outcomes, independent trials and constant success probability.; X counts successes, not the number of trials until a first success. The latter geometric model is outside this revised resource.; For the displayed power calculation assume $0 < p < 1$. At $p=0$ the count is always 0; at $p=1$ it is always n , handled directly rather than by an undefined 0^0 expression.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 4 (Formulas for AP Statistics), prints this relationship.

Worked example

Five independent trials each succeed with probability 0.4. Find the probability of exactly two successes.

1. The stated process satisfies the binomial conditions with $n=5$, $p=0.4$ and $k=2$.
2. $C(5,2)=10$, so $P(X=2)=10(0.4)^2(0.6)^3$.
3. Evaluate $10 \times 0.16 \times 0.216 = 0.3456$.

Answer: 0.3456

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Mean and SD of a binomial count

$$\mu_X = np, \quad \sigma_X = \sqrt{np(1-p)}$$

Plain text: For $X \sim \text{Binomial}(n, p)$, $\text{mean} = n \cdot p$ and $\text{SD} = \sqrt{n \cdot p \cdot (1-p)}$.

Variables: n : number of independent trials; p : fixed success probability; X : number of successes

Conditions: All binomial conditions must hold, not just a known n and p ; These quantities describe counts. For a sample proportion X/n , divide count mean and SD by n .

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 4 (Formulas for AP Statistics), prints this relationship.

Worked example

For 50 independent trials with $p=0.2$, find the mean and SD of the success count.

1. $\text{Mean} = 50 \times 0.2 = 10$.
2. $\text{SD} = \sqrt{50 \times 0.2 \times 0.8} = \sqrt{8}$, approximately 2.828.

Answer: Mean 10 successes; SD approximately 2.828 successes.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Sampling distributions: distinguish SD from estimated SE

A population SD describes the repeated-sampling spread under specified population parameters. A standard error substitutes sample information to estimate that spread. Neither quantity is the spread of all individual measurements in one sample.

Spread of a sample proportion

$$\mu_{\hat{p}} = p, \quad \sigma_{\hat{p}} = \sqrt{\frac{p(1-p)}{n}}, \quad SE_{\hat{p}} = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Plain text: Mean of $\hat{p}$ = p ; $SD(\hat{p})=\sqrt{p(1-p)/n}$; estimated $SE=\sqrt{\hat{p}(1-\hat{p})/n}$.

Variables: p : population success proportion; $\hat{p}$: sample success proportion; n : sample size

Conditions: Independent Bernoulli observations with common p give the displayed SD; a small sampling fraction can support the approximation when sampling without replacement.; Normal approximation also needs adequate expected success and failure counts; a correct SD formula alone does not establish a normal shape.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 5 (sampling distributions), prints these standard-deviation/standard-error relationships.

Worked example

For independent samples of size 100 with true $p=0.4$, find $SD(\hat{p})$. In one sample $\hat{p}=0.45$; find its estimated SE.

1. True-model $SD=\sqrt{0.4 \times 0.6/100}=\sqrt{0.0024}$, approximately 0.04899.
2. Estimated $SE=\sqrt{0.45 \times 0.55/100}=\sqrt{0.002475}$, approximately 0.04975.
3. The SD uses true p ; the SE estimates it from $\hat{p}$.

Answer: SD approximately 0.04899; estimated SE approximately 0.04975.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Spread of a sample mean

$$\mu_{\bar{x}} = \mu, \quad \sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}, \quad SE_{\bar{x}} = \frac{s}{\sqrt{n}}$$

Plain text: Mean of $\bar{x}$ = μ ; $SD(\bar{x})=\sigma/\sqrt{n}$; estimated $SE=s/\sqrt{n}$.

Variables: μ, σ : population mean and SD; s : sample SD; n : sample size

Conditions: Use independent observations with a finite population variance; a small finite-population sampling fraction supports the usual approximation without replacement.; A normal sampling approximation requires a normal population or an adequately large sample for the situation; these spread formulas alone do not imply normality.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 5 (sampling distributions), prints these standard-deviation/standard-error relationships.

Worked example

A population has SD 12 and independent samples of size 36 are drawn. In one such sample $s=15$. Find $SD(\bar{x})$ and its estimated SE.

1. The model SD is $12/\sqrt{36}=12/6=2$.
2. The sample-based SE is $15/\sqrt{36}=15/6=2.5$.

Answer: SD 2; estimated SE 2.5, in the measurement units.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Confidence intervals and tests for proportions

Write the population parameter and alternative direction before using a calculator. An interval uses estimated uncertainty around the observed estimate; a test uses uncertainty under its null model. Pool proportions only when the null hypothesis warrants it.

Confidence-interval structure

$$\hat{\theta} \pm c^* SE(\hat{\theta})$$

Plain text: estimate +/- critical multiplier*standard error.

Variables: θ -hat: estimate of the target parameter; c^* : critical multiplier for the chosen method and confidence level; SE: appropriate standard-error estimate

Conditions: Choose the method before choosing the multiplier; z^* and t^* are not interchangeable.; A confidence level describes the long-run coverage of the procedure, not a probability that the fixed parameter changes after this interval is computed.

Exam reference: Yes. The 2026 AP Statistics reference booklet, physical page 4 (Formulas for AP Statistics), prints this relationship.

Worked example

For an appropriate stated method, an estimate is 72, its SE is 3 and the supplied critical multiplier is 2. Find the interval.

1. Margin of error= $2 \times 3=6$.
2. Endpoints are $72-6=66$ and $72+6=78$.
3. No confidence level is inferred from the supplied multiplier alone.

Answer: (66,78)

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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One-proportion z interval

$$\hat{p} \pm z^* \sqrt{\frac{\hat{p}(1 - \hat{p})}{n}}$$

Plain text: $\hat{p} \pm z\text{-star} \cdot \sqrt{\hat{p}(1 - \hat{p})/n}$.

Variables: $\hat{p}$ =x/n: observed success proportion; n: sample size; z^* : standard-normal critical value

Conditions: Use data from a random sample or a suitably randomized experiment; the design limits the population/causal conclusions. For sampling without replacement, check $n \leq 10\%$ of the population to approximate independence.; For the usual normal approximation, check observed successes $n \cdot \hat{p} \geq 10$ and observed failures $n \cdot (1 - \hat{p}) \geq 10$.; Use the unpooled sample proportion in the interval SE, not a hypothesized null p_0 .

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

A random sample of 400 from a much larger population contains 240 successes. Build a 95% interval using $z^*=1.96$.

1. $\hat{p}=240/400=0.60$; observed counts 240 and 160 exceed 10.
2. $SE=\sqrt{0.6 \times 0.4/400}=0.0244949$.
3. $\text{Margin}=1.96 \times 0.0244949 \approx 0.0480100$. Endpoints are approximately 0.55199 and 0.64801.

Answer: Approximately (0.5520, 0.6480) for the population proportion.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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One-proportion z test statistic

$$z = \frac{\hat{p} - p_0}{\sqrt{p_0(1 - p_0)/n}}$$

Plain text: $z=(\hat{p}-p_0)/\sqrt{p_0(1-p_0)/n}$.

Variables: p_0 : proportion specified by H_0 ; $\hat{p}$: observed sample proportion; n: sample size

Conditions: Use data from a random sample or a suitably randomized experiment; the design limits the population/causal conclusions. For sampling without replacement, check $n \leq 10\%$ of the population to approximate independence.; Require $0 < p_0 < 1$ and adequate null expected counts $n \cdot p_0 \geq 10$ and $n \cdot (1 - p_0) \geq 10$ for the usual normal approximation.; The null SE uses p_0 ; the alternative determines the appropriate p-value tail.

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

In a random sample of 200 from a much larger population, 120 are successes. For $H_0: p=0.5$, calculate z .

1. $\hat{p}=120/200=0.60$. Null expected successes and failures are both 100.
2. Null $SE=\sqrt{0.5 \times 0.5/200}=\sqrt{0.00125} \approx 0.0353553$.
3. $z=(0.60-0.50)/0.0353553 \approx 2.8284$.

Answer: $z \approx 2.8284$; select a p -value tail from the prespecified alternative.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Plan a proportion interval sample size

$$n \geq \frac{(z^*)^2 \tilde{p}(1 - \tilde{p})}{m^2}$$

Plain text: $n \geq (z\text{-star}^2) \cdot \tilde{p}(1-\tilde{p}) / (\text{desired margin}^2)$, rounded up.

Variables: $m > 0$: desired margin of error; $\tilde{p}$: planning estimate of the population proportion; z^* : critical value for the confidence level

Conditions: This is a normal-approximation planning calculation; it does not guarantee that a realized interval has a particular margin.; If no defensible planning proportion is available, 0.5 gives the largest $p(1-p)$ and the conservative usual sample-size estimate.; Round the required sample size up, and still plan a valid sampling design.

Exam reference: Not printed as a standalone formula in the 2026 reference booklet, physical pages 4–5. This is a supplemental learning relationship; use the official booklet and current course framework together.

Worked example

Plan a 95% proportion interval with margin at most 0.05 using $z^*=1.96$ and the conservative planning value 0.5.

1. Compute $n \geq 1.96^2 \times 0.5 \times 0.5 / 0.05^2 = 384.16$.
2. Round upward to the next whole observation.

Answer: At least 385 observations under the planning approximation.

Reference: AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Two independent proportions: interval

$$(\hat{p}_1 - \hat{p}_2) \pm z^* \sqrt{\frac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \frac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}$$

Plain text: $(\hat{p}_1 - \hat{p}_2) \pm z\text{-star} \cdot \sqrt{(\hat{p}_1(1-\hat{p}_1)/n_1 + \hat{p}_2(1-\hat{p}_2)/n_2)}$.

Variables: $\hat{p}_1, \hat{p}_2$: sample success proportions in the stated order; n_1, n_2 : sample sizes; z^* : normal critical value

Conditions: The two groups must be independent and each must have a suitable random collection/assignment design.; For sampling without replacement check each sample is at most 10% of its population.; Observed success and failure counts must each be at least 10 in each group for the usual normal interval. Do not pool for this interval.

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

Two independent random samples from much larger populations each have size 200. Their success proportions are 0.60 and 0.45. Find a 95% interval for $p_1 - p_2$ using $z^* = 1.96$.

1. Estimate = $0.60 - 0.45 = 0.15$. Success/failure counts are 120/80 and 90/110.
2. $SE = \sqrt{0.24/200 + 0.2475/200} = \sqrt{0.0024375} \approx 0.0493710$.
3. Margin $\approx 1.96 \times 0.0493710 = 0.0967672$. Add and subtract from 0.15.

Answer: Approximately (0.0532, 0.2468) for $p_1 - p_2$.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Two independent proportions: pooled null test

$$\hat{p}_c = \frac{x_1 + x_2}{n_1 + n_2}, \quad z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}_c(1 - \hat{p}_c)(1/n_1 + 1/n_2)}}$$

Plain text: pooled $\hat{p} = (x_1 + x_2)/(n_1 + n_2)$; $z = (\hat{p}_1 - \hat{p}_2)/\sqrt{\text{pooled} \times (1 - \text{pooled}) \times (1/n_1 + 1/n_2)}$.

Variables: x_i : success count in group i ; n_i : sample size in group i ; $\hat{p}_i = x_i/n_i$; $\hat{p}_c$: estimated common null proportion

Conditions: This pooled formula tests $H_0: p_1 = p_2$, equivalently a null difference of zero; do not use it for an arbitrary nonzero null difference.; Use independent groups and suitable random designs; apply the 10% condition for each finite-population sample when appropriate.; Check the null expected success and failure counts $n_i \times \hat{p}_c$ and $n_i \times (1 - \hat{p}_c)$, each at least 10 for the usual approximation.

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

Two independent random samples from large populations have 60 successes out of 100 and 40 out of 100. Test $H_0: p_1 = p_2$ by calculating the pooled proportion and z .

1. The pooled proportion is $(60 + 40)/(100 + 100) = 0.50$; each null expected count is 50.
2. $SE_0 = \sqrt{0.5 \times 0.5 \times (1/100 + 1/100)} \approx 0.0707107$.
3. $z = (0.60 - 0.40)/0.0707107 \approx 2.8284$.

Answer: Pooled proportion 0.50; $z \approx 2.8284$.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Means: one sample, paired differences or independent groups

The observational unit chooses the method. Before-and-after measurements on the same person are paired, so analyze one difference per person; two unrelated samples use an independent two-sample method.

One-mean t interval and test statistic

$$\bar{x} \pm t_{n-1}^* \frac{s}{\sqrt{n}}, \quad t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$$

Plain text: Interval: $\bar{x} \pm t^*(s/\sqrt{n})$; test $t=(\bar{x}-\mu_0)/(s/\sqrt{n})$, $df=n-1$.

Variables: $\bar{x}$, s : sample mean and sample SD; $n>1$: sample size; μ_0 : null mean; t^* : critical value with $n-1$ degrees of freedom

Conditions: Use data from a random sample or a suitably randomized experiment; the design limits the population/causal conclusions. For sampling without replacement, check $n \leq 10\%$ of the population to approximate independence.; Population SD is unknown and s estimates it. Assess the normality/large-sample condition; small samples need especially careful attention to nonnormality and outliers.; Use the chosen confidence level and df to obtain t^* ; use the prespecified alternative for a test's p -value.; The test statistic requires $s>0$. A zero estimated SE does not produce a defined t statistic; do not divide by zero.

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

A random sample of 25 from a much larger, approximately normal population has mean 52 and sample SD 10. Use $t^*=2.064$ for a 95% interval, and compute t for $H_0:\mu=50$.

1. $SE=10/\sqrt{25}=2$; $df=24$.
2. $\text{Margin}=2.064 \times 2=4.128$, so the interval is (47.872, 56.128).
3. The test statistic is $t=(52-50)/2=1$.

Answer: 95% interval (47.872, 56.128); test statistic $t=1$ with $df=24$.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Paired observations: one t procedure on differences

$$d_i = \text{after}_i - \text{before}_i, \quad t = \frac{\bar{d} - \mu_{d,0}}{s_d/\sqrt{n}}$$

Plain text: For one difference per pair, $t=(\text{mean difference}-\text{null mean difference})/(\text{SD of differences}/\sqrt{\text{number of pairs}})$; $df=\text{number of pairs}-1$.

Variables: d_i : within-pair difference in a stated direction; $\bar{d}$, s_d : mean and sample SD of differences; n : independent pairs, not number of measurements; $\mu_{d,0}$: null population mean difference

Conditions: Preserve each pair and use a consistent subtraction direction.; The pairs should be independently and suitably collected; assess normality/large-sample conditions for the distribution of differences, not the two raw measurement distributions separately.; Use the sample SD of differences; the two marginal SDs cannot simply be substituted.; The test statistic requires a positive sample SD of differences; it is undefined

when that estimated SE is zero.

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

For four independently sampled pairs, after-minus-before differences are 2, 4, 6 and 8. Assume the population of differences is approximately normal. Calculate t for $H_0: \mu_d = 0$.

1. Mean difference=5. Squared deviations from 5 sum to $9+1+1+9=20$.
2. Sample $SD = \sqrt{20/3} \approx 2.58199$; $SE = \sqrt{20/3}/\sqrt{4} \approx 1.29099$.
3. $t = (5-0)/1.29099 \approx 3.87298$, with $df=3$.

Answer: $t \approx 3.873$ with $df=3$.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Independent means: unpooled standard error

$$SE = \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}, \quad t = \frac{(\bar{x}_1 - \bar{x}_2) - \Delta_0}{SE}, \quad (\bar{x}_1 - \bar{x}_2) \pm t^* SE$$

Plain text: $SE = \sqrt{s_1^2/n_1 + s_2^2/n_2}$; $t = ((\bar{x}_1 - \bar{x}_2) - \text{null difference})/SE$; $\text{interval} = (\bar{x}_1 - \bar{x}_2) \pm t^* SE$.

Variables: $\bar{x}_1, \bar{x}_2$: independent sample means; s_1, s_2 : sample SDs; n_1, n_2 : sample sizes; Δ_0 : hypothesized population mean difference

Conditions: Groups and observations must support the independent-samples model and suitable random collection/assignment.; For sampling without replacement check the 10% condition separately; assess shape/large-sample requirements in each group.; This is the unequal-variance (unpooled) method. Use technology's appropriate degrees of freedom for its p -value or critical t ; do not use $n_1 + n_2 - 2$ without equal-variance justification.; The test statistic requires a positive combined SE; do not divide by zero if both sample variances are zero.

Exam reference: The reference booklet supplies the general confidence-interval/test-statistic structure and relevant standard errors on physical pages 4–5. The method-specific substitution below is explained here rather than printed as a standalone formula.

Worked example

Two independent random samples from much larger populations have $(n_1, \text{mean}_1, s_1) = (40, 24, 6)$ and $(n_2, \text{mean}_2, s_2) = (50, 20, 8)$, with suitable distribution conditions. Calculate SE and t for a null difference of 0.

1. Estimate $= 24 - 20 = 4$.
2. $SE = \sqrt{6^2/40 + 8^2/50} = \sqrt{0.9 + 1.28} = \sqrt{2.18} \approx 1.47648$.
3. $t = 4/1.47648 \approx 2.70914$; use the unequal-variance procedure's degrees of freedom for a p -value.

Answer: $SE \approx 1.4765$; $t \approx 2.7091$.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Chi-square for independence or homogeneity

Use a two-way count table, not percentages as if they were counts. Independence investigates two categorical variables within a sample; homogeneity compares a categorical outcome across populations or treatment groups. The data collection, not just the table shape, distinguishes them.

Expected count under no association

$$E_{ij} = \frac{(\text{row } i \text{ total})(\text{column } j \text{ total})}{N}$$

Plain text: Expected cell count=(row total*column total)/grand total.

Variables: E_{ij} : expected count in row i and column j ; $N>0$: grand total count

Conditions: This expected-count calculation is for an independence/homogeneity table under the no-association/equal-distribution null.; Expected counts can be fractional. They are not observed counts and should not be rounded before the test calculation.

Exam reference: Not printed as a standalone formula in the 2026 reference booklet, physical pages 4–5. This is a supplemental learning relationship; use the official booklet and current course framework together.

Worked example

In a 100-observation two-way table, a cell's row total is 20 and column total is 30. Find its expected count under independence.

1. Multiply the marginal totals: $20 \times 30 = 600$.
2. Divide by the grand total: $E = 600/100 = 6$.

Answer: Expected count 6.

Reference: AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Chi-square statistic and table degrees of freedom

$$\chi^2 = \sum_{i,j} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}, \quad df = (R - 1)(C - 1)$$

Plain text: chi-square=sum((observed-expected)^2/expected) across all cells; df=(number of rows-1)*(number of columns-1).

Variables: O_{ij}, E_{ij} : observed and null-expected cell counts; R, C : table dimensions; df : degrees of freedom

Conditions: Use suitably random, independent observations; each observation contributes to one cell. Apply the finite-population sampling fraction condition where appropriate.; For the usual chi-square approximation, every expected cell count should be at least 5; checking observed counts is not the same condition.; The df formula assumes an ordinary contingency table without structural zeros or extra fitted constraints. This resource does not teach the removed goodness-of-fit procedure.

Exam reference: The chi-square statistic is printed on physical page 4. The contingency-table df relationship is a supplemental course relationship, not separately printed on formula pages 4–5.

Worked example

A suitable random sample of 100 gives a 2×2 table with rows [30,20] and [20,30]. Find the independence-test chi-square statistic and df.

1. Every row and column total is 50, so each expected count is $50 \times 50 / 100 = 25$. All are at least 5.
2. Each cell contributes $(5^2)/25 = 1$; the four contributions sum to 4.
3. $df = (2-1)(2-1) = 1$. A test decision additionally needs the right-tail p-value and stated significance level.

Answer: chi-square=4 with df=1.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Regression prediction, residuals and explained variation

The revised course retains regression analysis. A line summarizes association and supports predictions within an appropriate domain; it does not establish causation. The removed topic is inference for a population regression slope.

Fitted line and residual

$$\hat{y} = a + bx, \quad e = y - \hat{y}$$

Plain text: predicted $y = a + b \cdot x$; residual = observed y - predicted y .

Variables: a: fitted y-intercept; b: fitted slope; x: explanatory value; y: observed response; y-hat: predicted response

Conditions: Use a linear model only when the relationship and residual evidence make it appropriate; avoid unjustified extrapolation.; The official reference prints $y\text{-hat} = a + b \cdot x$. The residual subtraction is a supplemental definition.; Interpret b in response units per explanatory unit. A positive residual means observed is above predicted.

Exam reference: The fitted-line form is printed on physical page 4. The residual definition is explained here; coefficients and correlation are obtained with technology in the current framework.

Worked example

An original fitted model is $y\text{-hat} = 12 + 1.5x$. At $x = 8$, the observed response is 22. Find the prediction and residual.

1. Prediction = $12 + 1.5(8) = 24$.
2. Residual = $22 - 24 = -2$.
3. The observation is 2 response units below the model.

Answer: Prediction 24; residual -2.

Reference: AP Statistics Exam Reference Information (©2026 College Board, 13-page reference booklet retrieved 2026-10-28); AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Coefficient of determination in simple linear regression

$$R^2 = r^2$$

Plain text: For simple least-squares linear regression with an intercept, $R\text{-squared}=r^2$.

Variables: r : sample correlation, between -1 and 1 ; R^2 : proportion of response variation explained by the fitted linear relationship

Conditions: This interpretation uses the simple linear regression setting with an intercept.; r^2 does not give the percent of responses predicted exactly, and it does not show causation.; Squaring removes the direction: read the sign of r or the slope separately.

Exam reference: Not printed as a standalone formula in the 2026 reference booklet, physical pages 4–5. This is a supplemental learning relationship; use the official booklet and current course framework together.

Worked example

For a suitable simple linear regression fit with $r=-0.8$, calculate r^2 and interpret it.

1. $r^2=(-0.8)^2=0.64$.
2. About 64% of the variation in the response is explained by its fitted linear relationship with the explanatory variable.
3. The negative r indicates a decreasing association; 0.64 itself has no direction.

Answer: $r^2=0.64$, or 64% explained variation in this model.

Reference: AP Statistics Course and Exam Description (Revised 2026–27 course framework; retrieved 2026-10-28)

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Choose the method before the numbers

First state the parameter: one proportion, a difference of proportions, one mean, a mean paired difference, a difference of independent means, or a categorical association. Then check how data were collected and what independence/shape conditions the selected method needs.

For an interval, report endpoints and interpret the population parameter in context. For a test, state the null and alternative, use the correct tail, compare a p -value with the prespecified significance level, and describe the evidence without saying that a nonsignificant result proves the null. A small p -value does not measure the size or practical importance of an effect.

Question structure	Method family	Uncertainty to use
One binary outcome, one population	One-proportion z interval/test	Interval uses $\hat{p}$; test uses null p_0
Two independent binary-outcome groups	Two-proportion z interval/test	Unpooled interval SE; pooled null SE only for equal-proportion test
One quantitative group	One-sample t	Sample SD divided by $\sqrt{n}$
Before/after or matched units	One-sample t on paired differences	SD of differences, and n counts pairs
Two independent quantitative groups	Unequal-variance two-sample t	$\sqrt{s_1^2/n_1 + s_2^2/n_2}$

Question structure	Method family	Uncertainty to use
Two categorical variables or comparison of category distributions	Chi-square independence/homogeneity	Null expected cell counts, not observed counts

REFERENCE TRAIL

Sources, version and scope

The linked materials are references for the independently authored explanation and task design. Public access does not imply permission to reproduce an official examination bank.

AP Statistics Exam Reference Information

<https://apcentral.collegeboard.org/media/pdf/ap-statistics-formula-tables-sheet.pdf>

Reference version: ©2026 College Board, 13-page reference booklet retrieved 2026-10-28

Locator: Physical page 4: descriptive statistics, probability/distributions, generic inference, chi-square statistic. Physical page 5: sampling-distribution SD/SE for proportions and means. Both formula pages visually checked.

AP Statistics Course and Exam Description

<https://apcentral.collegeboard.org/media/pdf/ap-statistics-course-and-exam-description.pdf>

Reference version: Revised 2026–27 course framework; retrieved 2026-10-28

Locator: Units 1–5; physical pp45–46 summary statistics, pp93–112 proportion inference, pp115–118 categorical association, pp129–145 mean inference, pp158–159 regression.

AP Statistics Revisions

<https://apcentral.collegeboard.org/courses/ap-statistics/future-revisions>

Reference version: Revisions effective 2026–27; current page retrieved 2026-10-28

Locator: Course Revisions and Exam Revisions; removed geometric distributions, combining random variables, goodness-of-fit and inference for slopes; five-unit framework.