**Formula sheet and tables are on pages 6 - 13.**

**[2]** Two tests were given. The tests were designed with different scales. For test #1: the mean is one hundred and the standard deviation is twenty-five. On the other hand, for test #2: the mean is forty and the standard deviation is five.

Which is the better score, 130 on test #1 or 52 on test #2? (circle the correct answer)

(A) 130 on test #1 (B) 52 on test #2
(C) The relative scores are the same (D) Cannot be determined

**[3]** Calculate the probability that a couple with three children will have at least two girls.

The size of the sample space is ____________

The calculated probability is

(A) 1/3 (B) 1/2 (C) 2/3 (D) 3/2

**[4]** Of the 230 seats available on a flight to Osan, 30 are for smokers (15 aisle seats) and 200 are for nonsmokers (80 aisle seats). If you are randomly assigned a seat, what is the probability of getting an aisle seat or a smoking seat?

(A) 0.413 (B) 0.543 (C) 0.130 (D) 0.478

**[5]** Forty-eight-percent of eligible voters actually vote. If you survey four eligible voters what is the probability that they all vote?

(A) 0.0531 (B) 0.0833 (C) 0.120 (D) 0.00221

**[6]** Out of a test bank of 20 questions, 10 questions will be selected for an exam. How many different exams are possible if the order of test questions is not important?

The number of exams is ________________

**[7]** The average times required for each of twenty employees, chosen at random from a company's 217 assemblers, to do a certain assembly task are the following numbers of seconds: 71, 89, 104, 12, 86, 70, 58, 108, 80, 149, 140, 116, 46, 59, 76, 87, 72, 76, 79, 109.

On a separate sheet of paper, organize the data into a frequency distribution. From your frequency distribution create a histogram.

The number of classes you used is ____________

The class width you used is ____________

**[8]** Find the mean, median, mode and standard deviation of the data in problem 7.

The mean is ____________ The median is ____________

The mode is ____________ The standard deviation is ____________

**[9]** A home security system requires a secret 6-digit sequence to be disabled. Zero and one are not allowed to be the first or the last digit in the sequence.

How many 6-digit sequences are possible?

(A) 720 (B) 1,000,000 (C) 640,000 (D) 46,656

What is the probability of guessing the correct sequence?

(A) 0.00139 (B) 0.00000100 (C) 0.00000156 (D) 0.0000214

**[10]** According to a recent poll, 66.6% of people polled found statistics to be, *" more exciting than stale toast."* What is the probability that four or more people, out of a group of five randomly selected people, will think statistics is more exciting than stale toast?

(A) 0.460 (B) 0.329 (C) 0.131 (D) 0.800 (E) 0.197

**[11]** In a time-use study, sixty randomly selected people reported spending a mean of 4.9 hours a month daydreaming about food. The standard deviation was 2.6 hours. Construct the 97% confidence interval for the mean time spent daydreaming about food.

The critical value is ____________ The error is ____________

The confidence interval is ______________________________________

**[12]** According to a recent in-class survey of 121 men, 19.4% of men polled indicated that driving was their favorite aspect of a date. Test the claim that the true proportion is greater than 25%. Assume a significance level of 0.01.

The null hypothesis is

(A) $p = 0.25$ (B) $p \geq 0.25$ (C) $p \leq 0.25$ (D) $p = 0.194$ (E) $p \geq 0.194$ (F) $p \leq 0.194$

The alternative hypothesis is

(A) $p \neq 0.25$ (B) $p > 0.25$ (C) $p < 0.25$ (D) $p \neq 0.194$ (E) $p > 0.194$ (F) $p < 0.194$

The critical value is ____________ The value of the test statistic is ____________

The conclusion is

(A) There is sufficient evidence to reject the claim
(B) There is not sufficient evidence to reject the claim
(C) There is sufficient evidence to support the claim
(D) There is not sufficient evidence to support the claim

**[13]** *Bad Pasta Incorporated* distributes 12 oz cans of battery acid. Dr. Bailey randomly selected 16 cans, measured their contents, and obtained a sample mean of 11.82 oz and a sample standard deviation of 0.18 oz. Use a 0.01 significance level to test the claim that the company is cheating consumers.

The null hypothesis is

(A) $\mu = 12$ (B) $\mu \geq 12$ (C) $\mu \leq 12$ (D) $\mu = 11.82$ (E) $\mu \geq 11.82$ (F) $\mu \leq 11.82$

The alternative hypothesis is

(A) $\mu \neq 12$ (B) $\mu > 12$ (C) $\mu < 12$ (D) $\mu \neq 11.82$ (E) $\mu > 11.82$ (F) $\mu < 11.82$

The critical value is ____________ The value of the test statistic is ____________

The conclusion is

(A) There is sufficient evidence to reject the claim
(B) There is not sufficient evidence to reject the claim
(C) There is sufficient evidence to support the claim
(D) There is not sufficient evidence to support the claim

**[14]** The lengths of pregnancies are normally distributed with a mean of 268 days and a standard deviation of 15 days.

The probability of a pregnancy lasting longer than 300 days is ____________

**[15]** Six hundred hotdogs were inspected at the *Weenie Meats* factory. The mean weight of the dogs was 5.28 ounces, with a standard deviation of 0.53 ounces. If thirty-one dogs are randomly selected, find the probability that the mean weight of the dogs is between 4.82 and 5.33 ounces.

The probability is ____________

**[16]** A soap supply company did a survey of 413 people. Of the people surveyed 354 people indicated that they took hot showers. Construct the 90% confidence interval estimate of the true proportion of all adults that take hot showers.

The critical value is ____________ The error is ____________

The confidence interval is ________________________________________

# Formulas and Tables

for *Elementary Statistics, Seventh Edition*, by Mario F. Triola



**Ch. 2: Descriptive Statistics**

$\bar{x} = \dfrac{\Sigma x}{n}$ Mean

$\bar{x} = \dfrac{\Sigma f \cdot x}{\Sigma f}$ Mean (frequency table)

$s = \sqrt{\dfrac{\Sigma(x - \bar{x})^2}{n - 1}}$ Standard deviation

$s = \sqrt{\dfrac{n(\Sigma x^2) - (\Sigma x)^2}{n(n-1)}}$ Standard deviation (shortcut)

$s = \sqrt{\dfrac{n[\Sigma(f \cdot x^2)] - [\Sigma(f \cdot x)]^2}{n(n-1)}}$ Standard deviation (frequency table)

variance $= s^2$

**Ch. 3: Probability**

$P(A \text{ or } B) = P(A) + P(B)$ if $A$, $B$ are mutually exclusive

$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$ if $A$, $B$ are not mutually exclusive

$P(A \text{ and } B) = P(A) \cdot P(B)$ if $A$, $B$ are independent

$P(A \text{ and } B) = P(A) \cdot P(B|A)$ if $A$, $B$ are dependent

$P(\bar{A}) = 1 - P(A)$ Rule of complements

${}_nP_r = \dfrac{n!}{(n - r)!}$ Permutations (no elements alike)

$\dfrac{n!}{n_1!\, n_2! \ldots n_k!}$ Permutations ($n_1$ alike, ...)

${}_nC_r = \dfrac{n!}{(n - r)!\, r!}$ Combinations

**Ch. 4: Probability Distributions**

$\mu = \Sigma x \cdot P(x)$ Mean (prob. dist.)

$\sigma = \sqrt{[\Sigma x^2 \cdot P(x)] - \mu^2}$ Standard deviation (prob. dist.)

$P(x) = \dfrac{n!}{(n - x)!\, x!} \cdot p^x \cdot q^{n-x}$ Binomial probability

$\mu = n \cdot p$ Mean (binomial)

$\sigma^2 = n \cdot p \cdot q$ Variance (binomial)

$\sigma = \sqrt{n \cdot p \cdot q}$ Standard deviation (binomial)

$P(x) = \dfrac{\mu^x \cdot e^{-\mu}}{x!}$ Poisson Distribution where $e \approx 2.71828$

**Ch. 5: Normal Distribution**

$z = \dfrac{x - \bar{x}}{s}$ or $\dfrac{x - \mu}{\sigma}$ Standard score

$\mu_{\bar{x}} = \mu$ Central limit theorem

$\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$ Central limit theorem (Standard error)

**Ch. 6: Confidence Intervals (one population)**

$\bar{x} - E < \mu < \bar{x} + E$ Mean

where $E = z_{\alpha/2}\dfrac{\sigma}{\sqrt{n}}$ ($\sigma$ known or $n > 30$)

or $E = t_{\alpha/2}\dfrac{s}{\sqrt{n}}$ ($\sigma$ unknown and $n \leq 30$)

$\hat{p} - E < p < \hat{p} + E$ Proportion

where $E = z_{\alpha/2}\sqrt{\dfrac{\hat{p}\hat{q}}{n}}$

$\dfrac{(n-1)s^2}{\chi_R^2} < \sigma^2 < \dfrac{(n-1)s^2}{\chi_L^2}$ Variance

**Ch. 6: Sample Size Determination**

$n = \left[\dfrac{z_{\alpha/2}\sigma}{E}\right]^2$ Mean

$n = \dfrac{[z_{\alpha/2}]^2 \cdot 0.25}{E^2}$ Proportion

$n = \dfrac{[z_{\alpha/2}]^2 \hat{p}\hat{q}}{E^2}$ Proportion ($\hat{p}$ and $\hat{q}$ are known)

**Ch. 8: Confidence Intervals (two populations)**

$\bar{d} - E < \mu_d < \bar{d} + E$ (Dependent)

where $E = t_{\alpha/2}\dfrac{s_d}{\sqrt{n}}$ (df $= n - 1$)

$(\bar{x}_1 - \bar{x}_2) - E < (\mu_1 - \mu_2) < (\bar{x}_1 - \bar{x}_2) + E$ (Indep.)

where $E = z_{\alpha/2}\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}$ ← ($\sigma_1$, $\sigma_2$ known or $n_1 > 30$ and $n_2 > 30$)

$E = t_{\alpha/2}\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}$ (df = smaller of $n_1 - 1$, $n_2 - 1$) ← (reject $\sigma_1^2 = \sigma_2^2$ and $n_1 \leq 30$ or $n_2 \leq 30$)

$E = t_{\alpha/2}\sqrt{\dfrac{s_p^2}{n_1} + \dfrac{s_p^2}{n_2}}$ (df $= n_1 + n_2 - 2$) ←

$s_p^2 = \dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 - 1) + (n_2 - 1)}$

(fail to reject $\sigma_1^2 = \sigma_2^2$ and $n_1 \leq 30$ or $n_2 \leq 30$)

$(\hat{p}_1 - \hat{p}_2) - E < (p_1 - p_2) < (\hat{p}_1 - \hat{p}_2) + E$

where $E = z_{\alpha/2}\sqrt{\dfrac{\hat{p}_1\hat{q}_1}{n_1} + \dfrac{\hat{p}_2\hat{q}_2}{n_2}}$

# Formulas and Tables

for *Elementary Statistics, Seventh Edition*, by Mario F. Triola



### Ch. 7: Test Statistics (one population)

$z = \dfrac{\bar{x} - \mu}{\sigma/\sqrt{n}}$ Mean—one population ($\sigma$ known or $n > 30$)

$t = \dfrac{\bar{x} - \mu}{s/\sqrt{n}}$ Mean—one population ($\sigma$ unknown and $n \le 30$)

$z = \dfrac{\hat{p} - p}{\sqrt{\dfrac{pq}{n}}}$ Proportion—one population

$\chi^2 = \dfrac{(n-1)s^2}{\sigma^2}$ Standard deviation or variance—one population

### Ch. 8: Test Statistics (two populations)

$t = \dfrac{\bar{d} - \mu_d}{s_d/\sqrt{n}}$ Two means—dependent (df $= n - 1$)

$z = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{\sigma_1^2}{n_1} + \dfrac{\sigma_2^2}{n_2}}}$ Two means—independent ($\sigma_1, \sigma_2$ known or $n_1 > 30$ and $n_2 > 30$)

$F = \dfrac{s_1^2}{s_2^2}$ Standard deviation or variance—two populations (where $s_1^2 \ge s_2^2$)

$t = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$ (df = smaller of $n_1 - 1, n_2 - 1$

Two means—independent (reject $\sigma_1^2 = \sigma_2^2$ and $n_1 \le 30$ or $n_2 \le 30$)

$t = \dfrac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_p^2}{n_1} + \dfrac{s_p^2}{n_2}}}$ (df $= n_1 + n_2 - 2$)

where $s_p^2 = \dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$

Two means—independent (fail to reject $\sigma_1^2 = \sigma_2^2$ and $n_1 \le 30$ or $n_2 \le 30$)

$z = \dfrac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\dfrac{\bar{p}\bar{q}}{n_1} + \dfrac{\bar{p}\bar{q}}{n_2}}}$ Two proportions

### Ch. 10: Multinomial and Contingency Tables

$\chi^2 = \sum \dfrac{(O - E)^2}{E}$ Multinomial (df $= k - 1$)

$\chi^2 = \sum \dfrac{(O - E)^2}{E}$ Contingency table [df $= (r - 1)(c - 1)$]

where $E = \dfrac{\text{(row total)(column total)}}{\text{(grand total)}}$

### Ch. 9: Linear Correlation/Regression

Correlation $r = \dfrac{n\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma x^2) - (\Sigma x)^2}\sqrt{n(\Sigma y^2) - (\Sigma y)^2}}$

$b_1 = \dfrac{n\Sigma xy - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2}$

$b_0 = \bar{y} - b_1\bar{x}$ or $b_0 = \dfrac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2}$

$\hat{y} = b_0 + b_1 x$ Estimated eq. of regression line

$r^2 = \dfrac{\text{explained variation}}{\text{total variation}}$

$s_e = \sqrt{\dfrac{\Sigma(y - \hat{y})^2}{n - 2}}$ or $\sqrt{\dfrac{\Sigma y^2 - b_0\Sigma y - b_1\Sigma xy}{n - 2}}$

$\hat{y} - E < y < \hat{y} + E$

where $E = t_{\alpha/2} s_e \sqrt{1 + \dfrac{1}{n} + \dfrac{n(x_0 - \bar{x})^2}{n(\Sigma x^2) - (\Sigma x)^2}}$

### Ch. 11: One-Way Analysis of a Variance

$F = \dfrac{ns_{\bar{x}}^2}{s_p^2}$ $k$ samples each of size $n$ (num. df $= k - 1$; den. df $= k(n - 1)$)

$F = \dfrac{\text{MS(treatment)}}{\text{MS(error)}}$ $\leftarrow$ df $= k - 1$; $\leftarrow$ df $= N - k$

$\text{MS(treatment)} = \dfrac{\text{SS(treatment)}}{k - 1}$

$\text{MS(error)} = \dfrac{\text{SS(error)}}{N - k}$ $\text{MS(total)} = \dfrac{\text{SS(total)}}{N - 1}$

$\text{SS(treatment)} = n_1(\bar{x}_1 - \bar{\bar{x}})^2 + \cdots + n_k(\bar{x}_k - \bar{\bar{x}})^2$

$\text{SS(error)} = (n_1 - 1)s_1^2 + \cdots + (n_k - 1)s_k^2$

$\text{SS(total)} = \Sigma(x - \bar{\bar{x}})^2$

$\text{SS(total)} = \text{SS(treatment)} + \text{SS(error)}$

### Ch. 11: Two-Way Analysis of Variance

Interaction: $F = \dfrac{\text{MS(interaction)}}{\text{MS(error)}}$

Row Factor: $F = \dfrac{\text{MS(row factor)}}{\text{MS(error)}}$

Column Factor: $F = \dfrac{\text{MS(column factor)}}{\text{MS(error)}}$

### Ch. 13: No

$z = \dfrac{(x + 0.5}{\sqrt{}}$

$z = \dfrac{T - n}{\sqrt{n(n +}}$

$z = \dfrac{R - \mu_R}{\sigma_R}$

$H = \dfrac{12}{n(n + 1}$

Kruskal

$r_s = 1 - \dfrac{6}{n(n}$

(critical valu

$z = \dfrac{G - \mu_G}{\sigma_G}$

### Ch. 12: Con

R chart: Plot

UCL: $D_4\bar{R}$

Centerline

LCL: $D_3\bar{R}$

$\bar{x}$ chart: Plot

UCL: $\bar{\bar{x}}$ +

Centerline:

LCL: $\bar{\bar{x}}$ −

$p$ chart: Plot

UCL: $\bar{p}$ +

Centerline:

LCL: $\bar{p}$ −

la
nc.

ssion

$\frac{\Sigma x)(\Sigma y)}{\sqrt{n(\Sigma y^2) - (\Sigma y)^2}}$

$\frac{- (\Sigma x)(\Sigma xy)}{- (\Sigma x)^2}$

gression line

$\frac{- b_1 \Sigma xy}{2}$

$\frac{n(x_0 - \bar{x})^2}{(\Sigma x^2) - (\Sigma x)^2}$

/ariance

df $= k(n-1)$)

1
$\cdot\ k$

MS(total) $= \frac{\text{SS(total)}}{N-1}$

$\cdot \cdot + n_k(\bar{x}_k - \bar{\bar{x}})^2$

$_k - 1)s_k^2$

or)

riance

actor)
r)

## Ch. 13: Nonparametric Tests

$z = \frac{(x + 0.5) - (n/2)}{\sqrt{n}/2}$ Sign test for $n > 25$

$z = \frac{T - n(n+1)/4}{\sqrt{\frac{n(n+1)(2n+1)}{24}}}$ Wilcoxon signed ranks (two dependent samples for $n > 30$)

$z = \frac{R - \mu_R}{\sigma_R} = \frac{R - \frac{n_1(n_1 + n_2 + 1)}{2}}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}}$ Wilcoxon rank-sum (two independent samples)

$H = \frac{12}{n(n+1)}\left(\frac{R_1^2}{n_1} + \frac{R_2^2}{n_2} + \ldots + \frac{R_k^2}{n_k}\right) - 3(n+1)$

Kruskal-Wallis (chi-square df $= k - 1$)

$r_s = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)}$ Rank correlation

$\left(\text{critical value for } n > 30: \frac{\pm z}{\sqrt{n-1}}\right)$

$z = \frac{G - \mu_G}{\sigma_G} = \frac{G - \left(\frac{2n_1 n_2}{n_1 + n_2} + 1\right)}{\sqrt{\frac{(2n_1 n_2)(2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}}}$ Runs test for $n > 20$

## Ch. 12: Control Charts

R chart: Plot sample ranges

UCL: $D_4 \bar{R}$

Centerline: $\bar{R}$

LCL: $D_3 \bar{R}$

$\bar{x}$ chart: Plot sample means

UCL: $\bar{\bar{x}} + A_2 \bar{R}$

Centerline: $\bar{\bar{x}}$

LCL: $\bar{\bar{x}} - A_2 \bar{R}$

$p$ chart: Plot sample proportions

UCL: $\bar{p} + 3\sqrt{\frac{\bar{p}\bar{q}}{n}}$

Centerline: $\bar{p}$

LCL: $\bar{p} - 3\sqrt{\frac{\bar{p}\bar{q}}{n}}$

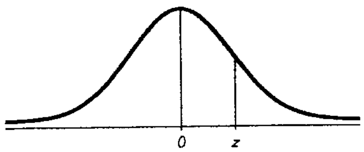
**TABLE A-6**
**Critical Values of the Pearson Correlation Coefficient *r***

| $n$ | $\alpha = .05$ | $\alpha = .01$ |
|---|---|---|
| 4 | .950 | .999 |
| 5 | .878 | .959 |
| 6 | .811 | .917 |
| 7 | .754 | .875 |
| 8 | .707 | .834 |
| 9 | .666 | .798 |
| 10 | .632 | .765 |
| 11 | .602 | .735 |
| 12 | .576 | .708 |
| 13 | .553 | .684 |
| 14 | .532 | .661 |
| 15 | .514 | .641 |
| 16 | .497 | .623 |
| 17 | .482 | .606 |
| 18 | .468 | .590 |
| 19 | .456 | .575 |
| 20 | .444 | .561 |
| 25 | .396 | .505 |
| 30 | .361 | .463 |
| 35 | .335 | .430 |
| 40 | .312 | .402 |
| 45 | .294 | .378 |
| 50 | .279 | .361 |
| 60 | .254 | .330 |
| 70 | .236 | .305 |
| 80 | .220 | .286 |
| 90 | .207 | .269 |
| 100 | .196 | .256 |

*NOTE:* To test $H_0$: $\rho = 0$ against $H_1$: $\rho \neq 0$, reject $H_0$ if the absolute value of $r$ is greater than the critical value in the table.

Control Chart Constants

| Subgroup Size $n$ | $A_2$ | $D_3$ | $D_4$ |
|---|---|---|---|
| 2 | 1.880 | 0.000 | 3.267 |
| 3 | 1.023 | 0.000 | 2.574 |
| 4 | 0.729 | 0.000 | 2.282 |
| 5 | 0.577 | 0.000 | 2.114 |
| 6 | 0.483 | 0.000 | 2.004 |
| 7 | 0.419 | 0.076 | 1.924 |



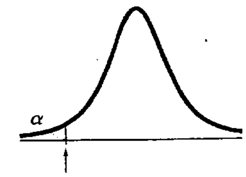




**TABLE A-2** Standard Normal (z) Distribution

| z | .00 | .01 | .02 | .03 | .04 | .05 | .06 | .07 | .08 | .09 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | .0000 | .0040 | .0080 | .0120 | .0160 | .0199 | .0239 | .0279 | .0319 | .0359 |
| 0.1 | .0398 | .0438 | .0478 | .0517 | .0557 | .0596 | .0636 | .0675 | .0714 | .0753 |
| 0.2 | .0793 | .0832 | .0871 | .0910 | .0948 | .0987 | .1026 | .1064 | .1103 | .1141 |
| 0.3 | .1179 | .1217 | .1255 | .1293 | .1331 | .1368 | .1406 | .1443 | .1480 | .1517 |
| 0.4 | .1554 | .1591 | .1628 | .1664 | .1700 | .1736 | .1772 | .1808 | .1844 | .1879 |
| 0.5 | .1915 | .1950 | .1985 | .2019 | .2054 | .2088 | .2123 | .2157 | .2190 | .2224 |
| 0.6 | .2257 | .2291 | .2324 | .2357 | .2389 | .2422 | .2454 | .2486 | .2517 | .2549 |
| 0.7 | .2580 | .2611 | .2642 | .2673 | .2704 | .2734 | .2764 | .2794 | .2823 | .2852 |
| 0.8 | .2881 | .2910 | .2939 | .2967 | .2995 | .3023 | .3051 | .3078 | .3106 | .3133 |
| 0.9 | .3159 | .3186 | .3212 | .3238 | .3264 | .3289 | .3315 | .3340 | .3365 | .3389 |
| 1.0 | .3413 | .3438 | .3461 | .3485 | .3508 | .3531 | .3554 | .3577 | .3599 | .3621 |
| 1.1 | .3643 | .3665 | .3686 | .3708 | .3729 | .3749 | .3770 | .3790 | .3810 | .3830 |
| 1.2 | .3849 | .3869 | .3888 | .3907 | .3925 | .3944 | .3962 | .3980 | .3997 | .4015 |
| 1.3 | .4032 | .4049 | .4066 | .4082 | .4099 | .4115 | .4131 | .4147 | .4162 | .4177 |
| 1.4 | .4192 | .4207 | .4222 | .4236 | .4251 | .4265 | .4279 | .4292 | .4306 | .4319 |
| 1.5 | .4332 | .4345 | .4357 | .4370 | .4382 | .4394 | .4406 | .4418 | .4429 | .4441 |
| 1.6 | .4452 | .4463 | .4474 | .4484 | .4495 * | .4505 | .4515 | .4525 | .4535 | .4545 |
| 1.7 | .4554 | .4564 | .4573 | .4582 | .4591 | .4599 | .4608 | .4616 | .4625 | .4633 |
| 1.8 | .4641 | .4649 | .4656 | .4664 | .4671 | .4678 | .4686 | .4693 | .4699 | .4706 |
| 1.9 | .4713 | .4719 | .4726 | .4732 | .4738 | .4744 | .4750 | .4756 | .4761 | .4767 |
| 2.0 | .4772 | .4778 | .4783 | .4788 | .4793 | .4798 | .4803 | .4808 | .4812 | .4817 |
| 2.1 | .4821 | .4826 | .4830 | .4834 | .4838 | .4842 | .4846 | .4850 | .4854 | .4857 |
| 2.2 | .4861 | .4864 | .4868 | .4871 | .4875 | .4878 | .4881 | .4884 | .4887 | .4890 |
| 2.3 | .4893 | .4896 | .4898 | .4901 | .4904 | .4906 | .4909 | .4911 | .4913 | .4916 |
| 2.4 | .4918 | .4920 | .4922 | .4925 | .4927 | .4929 | .4931 | .4932 | .4934 | .4936 |
| 2.5 | .4938 | .4940 | .4941 | .4943 | .4945 | .4946 | .4948 | .4949 * | .4951 | .4952 |
| 2.6 | .4953 | .4955 | .4956 | .4957 | .4959 | .4960 | .4961 | .4962 | .4963 | .4964 |
| 2.7 | .4965 | .4966 | .4967 | .4968 | .4969 | .4970 | .4971 | .4972 | .4973 | .4974 |
| 2.8 | .4974 | .4975 | .4976 | .4977 | .4977 | .4978 | .4979 | .4979 | .4980 | .4981 |
| 2.9 | .4981 | .4982 | .4982 | .4983 | .4984 | .4984 | .4985 | .4985 | .4986 | .4986 |
| 3.0 | .4987 | .4987 | .4987 | .4988 | .4988 | .4989 | .4989 | .4989 | .4990 | .4990 |
| 3.10 and higher | .4999 | | | | | | | | | |

*NOTE:* For values of z above 3.09, use 0.4999 for the area.
*Use these common values that result from interpolation:

| z score | Area |
|---|---|
| 1.645 | 0.4500 |
| 2.575 | 0.4950 |

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**TABLE A-3** t Dist

| Degrees of freedom | .0 (one .0 (two |
|---|---|
| 1 | 63.6 |
| 2 | 9.9 |
| 3 | 5.8 |
| 4 | 4.6 |
| 5 | 4.0 |
| 6 | 3.7 |
| 7 | 3.5 |
| 8 | 3.3 |
| 9 | 3.2 |
| 10 | 3.1 |
| 11 | 3.1 |
| 12 | 3.0 |
| 13 | 3.0 |
| 14 | 2.9 |
| 15 | 2.9 |
| 16 | 2.9 |
| 17 | 2.8 |
| 18 | 2.8 |
| 19 | 2.8 |
| 20 | 2.8 |
| 21 | 2.8 |
| 22 | 2.8 |
| 23 | 2.8 |
| 24 | 2.7 |
| 25 | 2.7 |
| 26 | 2.7 |
| 27 | 2.7 |
| 28 | 2.7 |
| 29 | 2.7 |
| Large (z) | 2.5 |

| .09 |
|---|
| 0359 |
| 0753 |
| 1141 |
| 1517 |
| 1879 |
| 2224 |
| 2549 |
| 2852 |
| 3133 |
| 3389 |
| 3621 |
| 3830 |
| 4015 |
| 4177 |
| 4319 |
| .4441 |
| .4545 |
| .4633 |
| .4706 |
| .4767 |
| .4817 |
| .4857 |
| .4890 |
| .4916 |
| .4936 |
| .4952 |
| .4964 |
| .4974 |
| .4981 |
| .4986 |
| .4990 |

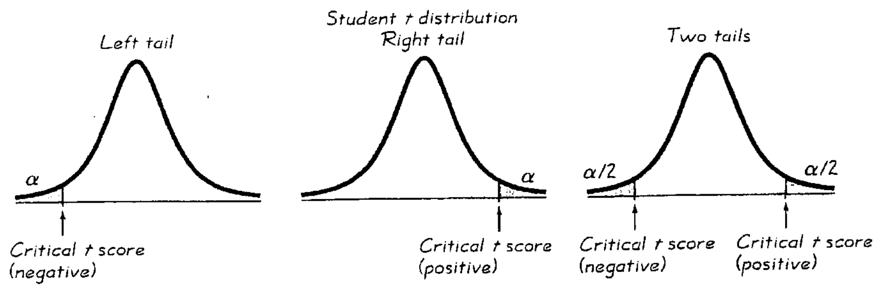


**TABLE A-3** *t* Distribution

| Degrees of freedom | α: .005 (one tail) .01 (two tails) | .01 (one tail) .02 (two tails) | .025 (one tail) .05 (two tails) | .05 (one tail) .10 (two tails) | .10 (one tail) .20 (two tails) | .25 (one tail) .50 (two tails) |
|---|---|---|---|---|---|---|
| 1 | 63.657 | 31.821 | 12.706 | 6.314 | 3.078 | 1.000 |
| 2 | 9.925 | 6.965 | 4.303 | 2.920 | 1.886 | .816 |
| 3 | 5.841 | 4.541 | 3.182 | 2.353 | 1.638 | .765 |
| 4 | 4.604 | 3.747 | 2.776 | 2.132 | 1.533 | .741 |
| 5 | 4.032 | 3.365 | 2.571 | 2.015 | 1.476 | .727 |
| 6 | 3.707 | 3.143 | 2.447 | 1.943 | 1.440 | .718 |
| 7 | 3.500 | 2.998 | 2.365 | 1.895 | 1.415 | .711 |
| 8 | 3.355 | 2.896 | 2.306 | 1.860 | 1.397 | .706 |
| 9 | 3.250 | 2.821 | 2.262 | 1.833 | 1.383 | .703 |
| 10 | 3.169 | 2.764 | 2.228 | 1.812 | 1.372 | .700 |
| 11 | 3.106 | 2.718 | 2.201 | 1.796 | 1.363 | .697 |
| 12 | 3.054 | 2.681 | 2.179 | 1.782 | 1.356 | .696 |
| 13 | 3.012 | 2.650 | 2.160 | 1.771 | 1.350 | .694 |
| 14 | 2.977 | 2.625 | 2.145 | 1.761 | 1.345 | .692 |
| 15 | 2.947 | 2.602 | 2.132 | 1.753 | 1.341 | .691 |
| 16 | 2.921 | 2.584 | 2.120 | 1.746 | 1.337 | .690 |
| 17 | 2.898 | 2.567 | 2.110 | 1.740 | 1.333 | .689 |
| 18 | 2.878 | 2.552 | 2.101 | 1.734 | 1.330 | .688 |
| 19 | 2.861 | 2.540 | 2.093 | 1.729 | 1.328 | .688 |
| 20 | 2.845 | 2.528 | 2.086 | 1.725 | 1.325 | .687 |
| 21 | 2.831 | 2.518 | 2.080 | 1.721 | 1.323 | .686 |
| 22 | 2.819 | 2.508 | 2.074 | 1.717 | 1.321 | .686 |
| 23 | 2.807 | 2.500 | 2.069 | 1.714 | 1.320 | .685 |
| 24 | 2.797 | 2.492 | 2.064 | 1.711 | 1.318 | .685 |
| 25 | 2.787 | 2.485 | 2.060 | 1.708 | 1.316 | .684 |
| 26 | 2.779 | 2.479 | 2.056 | 1.706 | 1.315 | .684 |
| 27 | 2.771 | 2.473 | 2.052 | 1.703 | 1.314 | .684 |
| 28 | 2.763 | 2.467 | 2.048 | 1.701 | 1.313 | .683 |
| 29 | 2.756 | 2.462 | 2.045 | 1.699 | 1.311 | .683 |
| Large (*z*) | 2.575 | 2.327 | 1.960 | 1.645 | 1.282 | .675 |

# Formulas and Tables

for *Elementary Statistics, Seventh Edition*, by Mario F. Triola


**TABLE A-4** Chi-Square ($\chi^2$) Distribution

| Degrees of freedom | Area to the Right of the Critical Value | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.995 | 0.99 | 0.975 | 0.95 | 0.90 | 0.10 | 0.05 | 0.025 | 0.01 | 0.005 |
| 1 | — | — | 0.001 | 0.004 | 0.016 | 2.706 | 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 | 11.071 | 12.833 | 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 | 5.578 | 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 | 28.299 |
| 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 |
| 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 | 45.559 |
| 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 | 14.257 | 16.047 | 17.708 | 19.768 | 39.087 | 42.557 | 45.722 | 49.588 | 52.336 |
| 30 | 13.787 | 14.954 | 16.791 | 18.493 | 20.599 | 40.256 | 43.773 | 46.979 | 50.892 | 53.672 |
| 40 | 20.707 | 22.164 | 24.433 | 26.509 | 29.051 | 51.805 | 55.758 | 59.342 | 63.691 | 66.766 |
| 50 | 27.991 | 29.707 | 32.357 | 34.764 | 37.689 | 63.167 | 67.505 | 71.420 | 76.154 | 79.490 |
| 60 | 35.534 | 37.485 | 40.482 | 43.188 | 46.459 | 74.397 | 79.082 | 83.298 | 88.379 | 91.952 |
| 70 | 43.275 | 45.442 | 48.758 | 51.739 | 55.329 | 85.527 | 90.531 | 95.023 | 100.425 | 104.215 |
| 80 | 51.172 | 53.540 | 57.153 | 60.391 | 64.278 | 96.578 | 101.879 | 106.629 | 112.329 | 116.321 |
| 90 | 59.196 | 61.754 | 65.647 | 69.126 | 73.291 | 107.565 | 113.145 | 118.136 | 124.116 | 128.299 |
| 100 | 67.328 | 70.065 | 74.222 | 77.929 | 82.358 | 118.498 | 124.342 | 129.561 | 135.807 | 140.169 |

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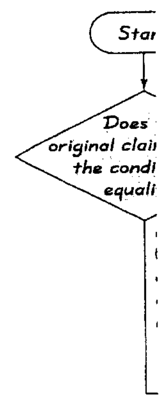
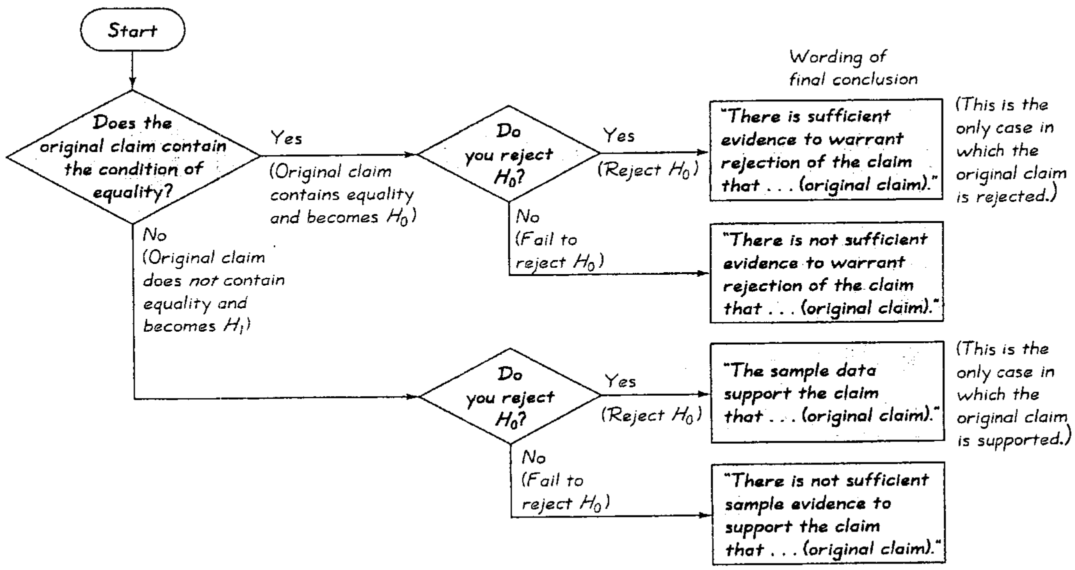


| 0.005 |
|---|
| 7.879 |
| 10.597 |
| 12.838 |
| 14.860 |
| 16.750 |
| 18.548 |
| 20.278 |
| 21.955 |
| 23.589 |
| 25.188 |
| 26.757 |
| 28.299 |
| 29.819 |
| 31.319 |
| 32.801 |
| 34.267 |
| 35.718 |
| 37.156 |
| 38.582 |
| 39.997 |
| 41.401 |
| 42.796 |
| 44.181 |
| 45.559 |
| 46.928 |
| 48.290 |
| 49.645 |
| 50.993 |
| 52.336 |
| 53.672 |
| 66.766 |
| 79.490 |
| 91.952 |
| 04.215 |
| 16.321 |
| 28.299 |
| 40.169 |

with

# HYPOTHESIS TEST: WORDING OF FINAL CONCLUSION



a
ıc.

ʼearson
t *r*

| $\alpha = .01$ |
|---|
| .999 |
| .959 |
| .917 |
| .875 |
| .834 |
| .798 |
| .765 |
| .735 |
| .708 |
| .684 |
| .661 |
| .641 |
| .623 |
| .606 |
| .590 |
| .575 |
| .561 |
| .505 |
| .463 |
| .430 |
| .402 |
| .378 |
| .361 |
| .330 |
| .305 |
| .286 |
| .269 |
| .256 |

nst $H_1$: $\rho \neq 0$,
of $r$ is greater
ble.

ants

| $D_3$ | $D_4$ |
|---|---|
| ·.000 | 3.267 |
| ·.000 | 2.574 |
| ·.000 | 2.282 |
| ·.000 | 2.114 |
| ·.000 | 2.004 |
| ·.076 | 1.924 |

1. Identify the specific claim or hypothesis to be tested and put it in symbolic form.
2. Give the symbolic form that must be true when the original claim is false.
3. Of the two symbolic expressions obtained so far, let the null hypothesis $H_0$ be the one that contains the condition of equality; $H_1$ is the other statement.
4. Select the significance level $\alpha$ based on the seriousness of a type I error. Make $\alpha$ small if the consequences of rejecting a true $H_0$ are severe. The values of 0.05 and 0.01 are very common.
5. Identify the statistic that is relevant to this test, and identify its sampling distribution.
6. Determine the test statistic, the critical values, and the critical region. Draw a graph and include the test statistic, critical value(s), and critical region.
7. Reject $H_0$ if the test statistic is in the critical region. Fail to reject $H_0$ if the test statistic is not in the critical region.
8. Restate this previous conclusion in simple, nontechnical terms.

# FINDING P-VALUES