Formulas and Tables by Mario F. Triola

Ch. 3: Descriptive Statistics

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

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

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

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

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

variance $= s^2$

Ch. 4: 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

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

$\frac{n!}{n_1!\, n_2! \cdots n_k!}$ Permutations (n_1 alike, . . .)

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

Ch. 5: 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.)

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

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

Ch. 6: Normal Distribution

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

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

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

Ch. 7: Confidence Intervals (one population)

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

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

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

where $E = z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$ (σ known)

or $E = t_{\alpha/2}\frac{s}{\sqrt{n}}$ (σ unknown)

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

Ch. 7: Sample Size Determination

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

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

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

Ch. 9: Confidence Intervals (two populations)

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

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

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

where $E = t_{\alpha/2}\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}$ (df = smaller of $n_1 - 1$, $n_2 - 1$)

(σ_1 and σ_2 unknown and not assumed equal)

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

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

(σ_1 and σ_2 unknown but assumed equal)

$E = z_{\alpha/2}\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

(σ_1, σ_2 known)

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

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

Ch. 8: Test Statistics (one population)

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

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$$ Mean—one population (σ known)

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$ Mean—one population (σ unknown)

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

Ch. 9: Test Statistics (two populations)

$$z = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{\bar{p}\bar{q}}{n_1} + \frac{\bar{p}\bar{q}}{n_2}}}$$ Two proportions $\bar{p} = \frac{x_1 + x_2}{n_1 + n_2}$

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

Two means—independent; σ_1 and σ_2 unknown, and not assumed equal.

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

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

Two means—independent; σ_1 and σ_2 unknown, but assumed equal.

$$z = \frac{(\bar{x}_1 - \bar{x}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$$ Two means—independent; σ_1, σ_2 known.

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

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

Ch. 11: Goodness-of-Fit and Contingency Tables

$$\chi^2 = \Sigma\frac{(O - E)^2}{E}$$ Goodness-of-fit (df $= k - 1$)

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

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

$$\chi^2 = \frac{(|b - c| - 1)^2}{b + c}$$ McNemar's test for matched pairs (df $= 1$)

Ch. 10: Linear Correlation/Regression

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

or $r = \frac{\sum(z_x z_y)}{n - 1}$ where z_x = z score for x, z_y = z score for y

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

or $b_1 = r\frac{s_y}{s_x}$

y-Intercept:

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

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

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

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

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

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

Ch. 12: One-Way Analysis of Variance

Procedure for testing H_0: $\mu_1 = \mu_2 = \mu_3 = \cdots$

1. Use software or calculator to obtain results.
2. Identify the P-value.
3. Form conclusion:

   If P-value $\leq \alpha$, reject the null hypothesis of equal means.

   If P-value $> \alpha$, fail to reject the null hypothesis of equal means.

Ch. 12: Two-Way Analysis of Variance

Procedure:

1. Use software or a calculator to obtain results.
2. Test H_0: There is no interaction between the row factor and column factor.
3. Stop if H_0 from Step 2 is rejected.
   If H_0 from Step 2 is not rejected (so there does not appear to be an interaction effect), proceed with these two tests:
   Test for effects from the row factor.
   Test for effects from the column factor.