Chapter 3 Describing Data: Numerical Measures

- **Population mean**

$$\mu = \frac{\Sigma X}{N} \qquad [3\text{–}1]$$

- **Sample mean**

$$\bar{X} = \frac{\Sigma X}{n} \qquad [3\text{–}2]$$

- **Weighted mean**

$$\bar{X}_w = \frac{w_1X_1 + w_2X_2 + w_3X_3 + \cdots + w_nX_n}{w_1 + w_2 + w_3 + \cdots + w_n} \qquad [3\text{–}3]$$

- **Geometric mean**

$$GM = \sqrt[n]{(X_1)(X_2)\cdots(X_n)} \qquad [3\text{–}4]$$

$$GM = \sqrt[n]{\frac{\text{Value at end of period}}{\text{Value at beginning of period}}} - 1 \qquad [3\text{–}5]$$

- **Range**

$$\text{Range} = \text{Largest value} - \text{Smallest value} \qquad [3\text{–}6]$$

- **Mean deviation**

$$MD = \frac{\Sigma|X - \bar{X}|}{n} \qquad [3\text{–}7]$$

- **Population variance**

$$\sigma^2 = \frac{\Sigma(X - \mu)^2}{N} \qquad [3\text{–}8]$$

- **Population standard deviation**

$$\sigma = \sqrt{\frac{\Sigma(X - \mu)^2}{N}} \qquad [3\text{–}9]$$

- **Sample variance, deviation formula**

$$s^2 = \frac{\Sigma(X - \bar{X})^2}{n - 1} \qquad [3\text{–}10]$$

- **Sample variance, direct formula**

$$s^2 = \frac{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}{n - 1} \qquad [3\text{–}11]$$

- **Sample standard deviation direct formula**

$$s = \sqrt{\frac{\Sigma X^2 - \frac{(\Sigma X)^2}{n}}{n - 1}} \qquad [3\text{–}12]$$

- **Pearson's coefficient of skewness**

$$sk = \frac{3(\bar{X} - \text{Median})}{s} \qquad [3\text{–}14]$$

- **Location of a percentile**

$$L_p = (n + 1)\frac{P}{100} \qquad [3\text{–}15]$$

Chapter 4 A Survey of Probability Concepts

- **Multiplication formula**

$$\text{Total number of arrangements} = (m)(n) \qquad [4\text{–}2]$$

- **Permutation formula**

$$_nP_r = \frac{n!}{(n - r)!} \qquad [4\text{–}3]$$

- **Combination formula**

$$_nC_r = \frac{n!}{r!(n - r)!} \qquad [4\text{–}4]$$

- **Special rule of addition**

$$P(A \text{ or } B) = P(A) + P(B) \qquad [4\text{–}5]$$

- **Complement rule**

$$P(A) = 1 - P(\sim A) \qquad [4\text{–}6]$$

- **General rule of addition**

$$P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B) \qquad [4\text{–}7]$$

- **Special rule of multiplication**

$$P(A \text{ and } B) = P(A)P(B) \qquad [4\text{–}8]$$

- **General rule of multiplication**

$$P(A \text{ and } B) = P(A)P(B|A) \qquad [4\text{–}9]$$

Chapter 5 Discrete Probability Distributions

- **Mean of a probability distribution**

$$\mu = \Sigma[xP(x)] \qquad [5\text{–}1]$$

- **Variance of a probability distribution**

$$\sigma^2 = \Sigma[(x - \mu)^2 P(x)] \qquad [5\text{–}2]$$

- Binomial probability distribution

$$P(x) = {}_nC_x p^x (1-p)^{n-x} \qquad [5\text{–}3]$$

- Mean of a binomial distribution

$$\mu = np \qquad [5\text{–}4]$$

- Variance of a binomial distribution

$$\sigma^2 = np(1-p) \qquad [5\text{–}5]$$

- Hypergeometric distribution

$$P(x) = \frac{({}_SC_x)({}_{N-S}C_{n-x})}{{}_NC_n} \qquad [5\text{–}6]$$

- Poisson distribution

$$P(x) = \frac{\mu^x e^{-\mu}}{x!} \qquad [5\text{–}7]$$

Chapter 6 The Normal Probability Distribution

- Standard normal value

$$z = \frac{X-\mu}{\sigma} \qquad [6\text{–}1]$$

Chapter 7 Sampling Methods and the Central Limit Theorem

- Standard error of the mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} \qquad [7\text{–}1]$$

- Find the z-value of $\bar{X}$ when the population standard deviation is known

$$z = \frac{\bar{X}-\mu}{\sigma/\sqrt{n}} \qquad [7\text{–}2]$$

- Sample proportion

$$\bar{p} = \frac{X}{n} \qquad [7\text{–}3]$$

- Standard error of the proportion

$$\sigma_p = \sqrt{\frac{p(1-p)}{n}} \qquad [7\text{–}4]$$

- Find the z-value of $\bar{p}$ when the population proportion is known

$$z = \frac{\bar{p}-p}{\sqrt{\frac{p(1-p)}{n}}} \qquad [7\text{–}5]$$

Chapter 8 Estimation and Confidence Intervals

- Confidence interval for the population mean, σ known

$$\bar{X} \pm z\frac{\sigma}{\sqrt{n}} \qquad [8\text{–}1]$$

- Confidence interval for the population mean, σ unknown

$$\bar{X} \pm t\frac{s}{\sqrt{n}} \qquad [8\text{–}2]$$

- Confidence interval for a population proportion

$$\bar{p} \pm z\sqrt{\frac{p(1-p)}{n}} \qquad [8\text{–}3]$$

- Standard error of the sample proportion

$$s_p = \sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \qquad [8\text{–}4]$$

- Confidence interval for a sample proportion

$$\bar{p} \pm z\sqrt{\frac{\bar{p}(1-\bar{p})}{n}} \qquad [8\text{–}5]$$

- Sample size for estimating the population mean

$$n = \left(\frac{z\sigma}{E}\right)^2 \qquad [8\text{–}9]$$

- Sample size for the population proportion

$$n = p(1-p)\left(\frac{z}{E}\right)^2 \qquad [8\text{–}10]$$

Chapter 9 One-Sample Tests of a Hypothesis

- Testing a mean, σ known

$$z = \frac{\bar{X}-\mu}{\frac{\sigma}{\sqrt{n}}} \qquad [9\text{–}1]$$

- Testing a mean, σ unknown

$$t = \frac{\bar{X}-\mu}{\frac{s}{\sqrt{n}}} \qquad [9\text{–}2]$$

- Test of hypothesis, one proportion

$$z = \frac{\bar{p}-p}{\sqrt{\frac{p(1-p)}{n}}} \qquad [9\text{–}4]$$

Chapter 10 Two-Sample Tests of Hypothesis

- Variance of the distribution of differences in means

$$\sigma^2_{\bar{x}_1-\bar{x}_2} = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2} \quad [10\text{–}1]$$

- Two Sample test of means, known σ

$$z = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \quad [10\text{–}2]$$

- Two-sample test of proportions

$$z = \frac{\bar{p}_1 - \bar{p}_2 - (p_1 - p_2)}{\sqrt{\frac{p_c(1-p_c)}{n_1} + \frac{p_c(1-p_c)}{n_2}}} \quad [10\text{–}3]$$

- Pooled proportion

$$p_c = \frac{X_1 + X_2}{n_1 + n_2} \quad [10\text{–}4]$$

- Pooled sample variance

$$s_p^2 = \frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2} \quad [10\text{–}5]$$

- Two-sample test of means, unknown but equal σ

$$t = \frac{\bar{X}_1 - \bar{X}_2 - (\mu_1 - \mu_2)}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad [10\text{–}6]$$

- Paired t Test

$$t = \frac{\bar{d} - \mu_d}{s_d/\sqrt{n}} \quad [10\text{–}7]$$

Chapter 11 Analysis of Variance

- Test statistic for comparing two variances

$$F = \frac{s_1^2}{s_2^2},\ s_1^2 > s_2^2 \quad [11\text{–}1]$$

- SS total

$$\Sigma(X - \bar{X}_G)^2 \quad [11\text{–}2]$$

- SSE

$$\Sigma(X - \bar{X}_c)^2 \quad [11\text{–}3]$$

- SST = SS total − SSE [11–4]

- Confidence interval for the difference in treatment means

$$(\bar{X}_1 - \bar{X}_2) \pm t\sqrt{\text{MSE}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \quad [11\text{–}5]$$

Chapter 12 Linear Regression and Correlation

- Linear regression equation

$$Y' = a + bX \quad [12\text{–}1]$$

- Slope of the regression line

$$b = \frac{n(\Sigma XY) - (\Sigma X)(\Sigma Y)}{n(\Sigma X^2) - (\Sigma X)^2} \quad [12\text{–}2]$$

- Y-intercept of the regression line

$$a = \frac{\Sigma Y}{n} - b\frac{\Sigma X}{n} \quad [12\text{–}3]$$

- Standard error of estimate

$$S_e = \sqrt{\frac{\Sigma(Y - Y')^2}{n-2}} \quad [12\text{–}4]$$

$$S_e = \sqrt{\frac{\text{SSE}}{n-2}} \quad [12\text{–}13]$$

$$S_e = \sqrt{\frac{\Sigma Y^2 - a(\Sigma Y) - b(\Sigma XY)}{n-2}} \quad [12\text{–}5]$$

- Confidence interval for the mean of Y, given X

$$Y' \pm tS_e\sqrt{\frac{1}{n} + \frac{(X - \bar{X})^2}{\Sigma(X - \bar{X})^2}} \quad [12\text{–}6]$$

- Prediction interval for Y, given X

$$Y' \pm tS_e\sqrt{1 + \frac{1}{n} + \frac{(X - \bar{X})^2}{\Sigma(X - \bar{X})^2}} \quad [12\text{–}7]$$

- Correlation coefficient

$$r = \frac{n(\Sigma XY) - (\Sigma X)(\Sigma Y)}{\sqrt{[n(\Sigma X^2) - (\Sigma X)^2][n(\Sigma Y^2) - (\Sigma Y)^2]}} \quad [12\text{–}9]$$

- t-test for the coefficient of correlation

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad \text{with } n-2 \text{ degrees of freedom} \quad [12\text{–}10]$$

- **Coefficient of determination**

$$r^2 = \frac{\text{Explained variation}}{\text{Total variation}} = \frac{\Sigma(Y' - \bar{Y})^2}{\Sigma(Y - \bar{Y})^2} \quad [12\text{–}11]$$

$$r^2 = \frac{\text{SSR}}{\text{SST}} = 1 - \frac{\text{SSE}}{\text{SST}} \quad [12\text{–}12]$$

Chapter 13 Multiple Regression and Correlation Analysis

- **Multiple regression equation**

$$Y' = a + b_1X_1 + b_2X_2 + \cdots + b_kX_k \quad [13\text{–}1]$$

- **Multiple standard error of estimate**

$$S_{e \cdot 12 \cdots k} = \sqrt{\frac{\Sigma(Y - Y')^2}{n - k - 1}} \quad [13\text{–}2]$$

- **Coefficient of multiple determination**

$$R^2 = \frac{\text{SSR}}{\text{SS total}} \quad [13\text{–}3]$$

- **Global test**

$$F = \frac{\text{SSR}/k}{\text{SSE}/[n - k - 1]} \quad [13\text{–}4]$$

- **Testing individual regression coefficients**

$$t = \frac{b_i - 0}{S_{b_i}} \quad [13\text{–}5]$$

Chapter 14 Chi-Square Applications for Nominal Data

- **Chi-square test statistic**

$$\chi^2 = \Sigma\left[\frac{(f_o - f_e)^2}{f_e}\right] \quad [14\text{–}1]$$

- **Expected frequency**

$$f_e = \frac{\text{(Row total)(Column total)}}{\text{Grand total}} \quad [14\text{–}2]$$