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CHAPTER 3

- Population mean

$$\mu = \frac{\Sigma x}{N} \quad [3\text{–}1]$$

- Sample mean, raw data

$$\bar{x} = \frac{\Sigma x}{n} \quad [3\text{–}2]$$

- Weighted mean

$$\bar{x}_w = \frac{w_1 x_1 + w_2 x_2 + \cdots + w_n x_n}{w_1 + w_2 + \cdots + w_n} \quad [3\text{–}3]$$

- Geometric mean

$$GM = \sqrt[n]{(x_1)(x_2)(x_3) \ldots (x_n)} \quad [3\text{–}4]$$

- Geometric mean rate of increase

$$GM = \sqrt[n]{\frac{\text{Value at end of period}}{\text{Value at start of period}}} - 1.0 \quad [3\text{–}5]$$

- Range

$$\text{Range} = \text{Maximum value} - \text{Minimum value} \quad [3\text{–}6]$$

- Population variance

$$\sigma^2 = \frac{\Sigma(x - \mu)^2}{N} \quad [3\text{–}7]$$

- Population standard deviation

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

- Sample variance

$$s^2 = \frac{\Sigma(x - \bar{x})^2}{n - 1} \quad [3\text{–}9]$$

- Sample standard deviation

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

- Sample mean, grouped data

$$\bar{x} = \frac{\Sigma fM}{n} \quad [3\text{–}11]$$

- Sample standard deviation, grouped data

$$s = \sqrt{\frac{\Sigma f(M - \bar{x})^2}{n - 1}} \quad [3\text{–}12]$$

CHAPTER 4

- Location of a percentile

$$L_p = (n + 1)\frac{P}{100} \quad [4\text{–}1]$$

- Pearson's coefficient of skewness

$$sk = \frac{3(\bar{x} - \text{Median})}{s} \quad [4\text{–}2]$$

- Software coefficient of skewness

$$sk = \frac{n}{(n - 1)(n - 2)}\left[\sum\left(\frac{x - \bar{x}}{s}\right)^3\right] \quad [4\text{–}3]$$

CHAPTER 5

- Special rule of addition

$$P(A \text{ or } B) = P(A) + P(B) \quad [5\text{–}2]$$

- Complement rule

$$P(A) = 1 - P(\sim A) \quad [5\text{–}3]$$

- General rule of addition

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

- Special rule of multiplication

$$P(A \text{ and } B) = P(A)P(B) \quad [5\text{–}5]$$

- General rule of multiplication

$$P(A \text{ and } B) = P(A)P(B|A) \quad [5\text{–}6]$$

- Bayes' Theorem

$$P(A_1|B) = \frac{P(A_1)P(B|A_1)}{P(A_1)P(B|A_1) + P(A_2)P(B|A_2)} \quad [5\text{–}7]$$

- Multiplication formula

$$\text{Total arrangements} = (m)(n) \quad [5\text{–}8]$$

- Number of permutations

$$_nP_r = \frac{n!}{(n - r)!} \quad [5\text{–}9]$$

- Number of combinations

$$_nC_r = \frac{n!}{r!(n - r)!} \quad [5\text{–}10]$$

CHAPTER 6

- Mean of a probability distribution

$$\mu = \Sigma[xP(x)] \quad [6\text{–}1]$$

- Variance of a probability distribution

$$\sigma^2 = \Sigma[(x - \mu)^2 P(x)] \quad [6\text{–}2]$$

- Binomial probability distribution

$$P(x) = {_nC_x}\,\pi^x(1 - \pi)^{n - x} \quad [6\text{–}3]$$

- Mean of a binomial distribution

$$\mu = n\pi \quad [6\text{–}4]$$

- Variance of a binomial distribution

$$\sigma^2 = n\pi(1 - \pi) \quad [6\text{–}5]$$

- Hypergeometric probability distribution

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

- Poisson probability distribution

$$P(x) = \frac{\mu^x e^{-\mu}}{x!} \quad [6\text{–}7]$$

- Mean of a Poisson distribution

$$\mu = n\pi \quad [6\text{–}8]$$

CHAPTER 7

- Mean of a uniform distribution

$$\mu = \frac{a + b}{2} \quad \textbf{[7–1]}$$

- Standard deviation of a uniform distribution

$$\sigma = \sqrt{\frac{(b - a)^2}{12}} \quad \textbf{[7–2]}$$

- Uniform probability distribution

$$P(x) = \frac{1}{b - a} \quad \textbf{[7–3]}$$

if $a \le x \le b$ and 0 elsewhere

- Normal probability distribution

$$P(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\left[\frac{(x-\mu)^2}{2\sigma^2}\right]} \quad \textbf{[7–4]}$$

- Standard normal value

$$z = \frac{x - \mu}{\sigma} \quad \textbf{[7–5]}$$

- Exponential distribution

$$P(x) = \lambda e^{-\lambda x} \quad \textbf{[7–6]}$$

- Finding a probability using the exponential distribution

$$P(\text{Arrival time} < x) = 1 - e^{-\lambda x} \quad \textbf{[7–7]}$$

CHAPTER 8

- Standard error of mean

$$\sigma_{\bar{X}} = \frac{\sigma}{\sqrt{n}} \quad \textbf{[8–1]}$$

- z-value, μ and σ known

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \quad \textbf{[8–2]}$$

CHAPTER 9

- Confidence interval for μ, with σ known

$$\bar{x} \pm z\frac{\sigma}{\sqrt{n}} \quad \textbf{[9–1]}$$

- Confidence interval for μ, σ unknown

$$\bar{x} \pm t\frac{s}{\sqrt{n}} \quad \textbf{[9–2]}$$

- Sample proportion

$$p = \frac{x}{n} \quad \textbf{[9–3]}$$

- Confidence interval for proportion

$$p \pm z\sqrt{\frac{p(1 - p)}{n}} \quad \textbf{[9–4]}$$

- Sample size for estimating mean

$$n = \left(\frac{z\sigma}{E}\right)^2 \quad \textbf{[9–5]}$$

- Sample size for a proportion

$$n = \pi(1 - \pi)\left(\frac{z}{E}\right)^2 \quad \textbf{[9–6]}$$

CHAPTER 10

- Testing a mean, σ known

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} \quad \textbf{[10–1]}$$

- Testing a mean, σ unknown

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} \quad \textbf{[10–2]}$$

- Type II error

$$z = \frac{\bar{x}_c - \mu_1}{\sigma/\sqrt{n}} \quad \textbf{[10–3]}$$

CHAPTER 11

- Variance of the distribution of difference in means

$$\sigma^2_{\bar{x}_1 - \bar{x}_2} = \frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2} \quad \textbf{[11–1]}$$

- Two-sample test of means, known σ

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}} \quad \textbf{[11–2]}$$

- Pooled variance

$$s_p^2 = \frac{(n_1 - 1)\, s_1^2 + (n_2 - 1)\, s_2^2}{n_1 + n_2 - 2} \quad \textbf{[11–3]}$$

- Two-sample test of means, unknown but equal σ^2s

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{s_p^2\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad \textbf{[11–4]}$$

- Two-sample tests of means, unknown and unequal σ^2s

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad \textbf{[11–5]}$$

- Degrees of freedom for unequal variance test

$$df = \frac{[(s_1^2/n_1) + (s_2^2/n_2)]^2}{\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1}} \quad \textbf{[11–6]}$$

- Paired t test

$$t = \frac{\bar{d}}{s_d/\sqrt{n}} \quad \textbf{[11–7]}$$

CHAPTER 12

- Test for comparing two variances

$$F = \frac{s_1^2}{s_2^2} \quad \textbf{[12–1]}$$

- Sum of squares, total

$$\text{SS total} = \Sigma(x - \bar{x}_G)^2 \quad \textbf{[12–2]}$$

- Sum of squares, error

$$SSE = \Sigma(x - \bar{x}_c)^2 \quad \textbf{[12–3]}$$

- Sum of squares, treatments

$$SST = SS\ total - SSE \quad \textbf{[12–4]}$$

- Confidence interval for differences in treatment means

$$(\bar{x}_1 - \bar{x}_2) \pm t\sqrt{MSE\left(\frac{1}{n_1} + \frac{1}{n_2}\right)} \quad \textbf{[12–5]}$$

- Sum of squares, blocks

$$SSB = k\Sigma(\bar{x}_b - \bar{x}_G)^2 \quad \textbf{[12–6]}$$

- Sum of squares error, two-way ANOVA

$$SSE = SS\ total - SST - SSB \quad \textbf{[12–7]}$$

CHAPTER 13

- Correlation coefficient

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{(n - 1)\, s_x s_y} \quad \textbf{[13–1]}$$

- Test for significant correlation

$$t = \frac{r\sqrt{n-2}}{\sqrt{1 - r^2}} \quad \textbf{[13–2]}$$

- Linear regression equation

$$\hat{y} = a + bx \quad \textbf{[13–3]}$$

- Slope of the regression line

$$b = r\frac{s_y}{s_x} \quad \textbf{[13–4]}$$

- Intercept of the regression line

$$a = \bar{y} - b\bar{x} \quad \textbf{[13–5]}$$

- Test for a zero slope

$$t = \frac{b - 0}{s_b} \quad \textbf{[13–6]}$$

- Standard error of estimate

$$s_{y \cdot x} = \sqrt{\frac{\Sigma(y - \hat{y})^2}{n - 2}} \quad \textbf{[13–7]}$$

- Coefficient of determination

$$r^2 = \frac{SSR}{SS\ Total} = 1 - \frac{SSE}{SS\ Total} \quad \textbf{[13–8]}$$

- Standard error of estimate

$$s_{y \cdot x} = \sqrt{\frac{SSE}{n - 2}} \quad \textbf{[13–9]}$$

- Confidence interval

$$\hat{y} \pm t s_{y \cdot x}\sqrt{\frac{1}{n} + \frac{(x - \bar{x})^2}{\Sigma(x - \bar{x})^2}} \quad \textbf{[13–10]}$$

- Prediction interval

$$\hat{y} \pm t s_{y \cdot x}\sqrt{1 + \frac{1}{n} + \frac{(x - \bar{x})^2}{\Sigma(x - \bar{x})^2}} \quad \textbf{[13–11]}$$

CHAPTER 14

- Multiple regression equation

$$\hat{y} = a + b_1x_1 + b_2x_2 + \cdots + b_kx_k \quad \textbf{[14–1]}$$

- Multiple standard error of estimate

$$s_{y \cdot 123...k} = \sqrt{\frac{\Sigma(y - \hat{y})^2}{n - (k + 1)}} = \sqrt{\frac{SSE}{n - (k + 1)}} \quad \textbf{[14–2]}$$

- Coefficient of multiple determination

$$R^2 = \frac{SSR}{SS\ total} \quad \textbf{[14–3]}$$

- Adjusted coefficient of determination

$$R^2_{adj} = 1 - \frac{\dfrac{SSE}{n - (k + 1)}}{\dfrac{SS\ total}{n - 1}} \quad \textbf{[14–4]}$$

- Global test of hypothesis

$$F = \frac{SSR/k}{SSE/[n - (k + 1)]} \quad \textbf{[14–5]}$$

- Testing for a particular regression coefficient

$$t = \frac{b_i - 0}{s_{b_i}} \quad \textbf{[14–6]}$$

- Variance inflation factor

$$VIF = \frac{1}{1 - R_j^2} \quad \textbf{[14–7]}$$

CHAPTER 15

- Test of hypothesis, one proportion

$$z = \frac{p - \pi}{\sqrt{\dfrac{\pi(1 - \pi)}{n}}} \quad \textbf{[15–1]}$$

- Two-sample test of proportions

$$z = \frac{p_1 - p_2}{\sqrt{\dfrac{p_c(1 - p_c)}{n_1} + \dfrac{p_c(1 - p_c)}{n_2}}} \quad \textbf{[15–2]}$$

- Pooled proportion

$$p_c = \frac{x_1 + x_2}{n_1 + n_2} \quad \textbf{[15–3]}$$

- Chi-square test statistic

$$\chi^2 = \sum\left[\frac{(f_o - f_e)^2}{f_e}\right] \quad \textbf{[15–4]}$$

- Expected frequency

$$f_e = \frac{(Row\ total)(Column\ total)}{Grand\ total} \quad \textbf{[15–5]}$$

CHAPTER 16

- Sign test, $n > 10$

$$z = \frac{(x \pm .50) - \mu}{\sigma} \quad \textbf{[16–1]}$$

- Wilcoxon rank-sum test

$$z = \frac{W - \frac{n_1(n_1 + n_2 + 1)}{2}}{\sqrt{\frac{n_1 n_2(n_1 + n_2 + 1)}{12}}} \quad \textbf{[16–4]}$$

- Kruskal-Wallis test

$$H = \frac{12}{n(n+1)}\left[\frac{(\Sigma R_1)^2}{n_1} + \frac{(\Sigma R_2)^2}{n_2} + \cdots + \frac{(\Sigma R_k)^2}{n_k}\right] - 3(n+1) \quad \textbf{[16–5]}$$

- Spearman coefficient of rank correlation

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2 - 1)} \quad \textbf{[16–6]}$$

- Hypothesis test, rank correlation

$$t = r_s\sqrt{\frac{n-2}{1-r_s^2}} \quad \textbf{[16–7]}$$

CHAPTER 17

- Simple index

$$P = \frac{p_t}{p_0}(100) \quad \textbf{[17–1]}$$

- Simple average of price relatives

$$P = \frac{\Sigma P_i}{n} \quad \textbf{[17–2]}$$

- Simple aggregate index

$$P = \frac{\Sigma p_t}{\Sigma p_0}(100) \quad \textbf{[17–3]}$$

- Laspeyres' price index

$$P = \frac{\Sigma p_t q_0}{\Sigma p_0 q_0}(100) \quad \textbf{[17–4]}$$

- Paasche's price index

$$P = \frac{\Sigma p_t q_t}{\Sigma p_0 q_t}(100) \quad \textbf{[17–5]}$$

- Fisher's ideal index

$$\sqrt{(\text{Laspeyres' price index})(\text{Paasche's price index})} \quad \textbf{[17–6]}$$

- Value index

$$V = \frac{\Sigma p_t q_t}{\Sigma p_0 q_0}(100) \quad \textbf{[17–7]}$$

- Real income

$$\text{Real income} = \frac{\text{Money income}}{\text{CPI}}(100) \quad \textbf{[17–8]}$$

- Using an index as a deflator

$$\text{Deflated sales} = \frac{\text{Actual sales}}{\text{Index}}(100) \quad \textbf{[17–9]}$$

- Purchasing power

$$\text{Purchasing power} = \frac{\$1}{\text{CPI}}(100) \quad \textbf{[17–10]}$$

CHAPTER 18

- Linear trend

$$\hat{y} = a + bt \quad \textbf{[18–1]}$$

- Log trend equation

$$\log \hat{y} = \log a + \log b(t) \quad \textbf{[18–2]}$$

- Correction factor for adjusting quarterly means

$$\text{Correction factor} = \frac{4.00}{\text{Total of four means}} \quad \textbf{[18–3]}$$

- Durbin-Watson statistic

$$d = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} \quad \textbf{[18–4]}$$

CHAPTER 19

- Grand mean

$$\bar{\bar{x}} = \frac{\Sigma \bar{x}}{k} \quad \textbf{[19–1]}$$

- Control limits, mean

$$UCL = \bar{\bar{x}} + A_2\bar{R} \qquad LCL = \bar{\bar{x}} - A_2\bar{R} \quad \textbf{[19–4]}$$

- Control limits, range

$$UCL = D_4\bar{R} \qquad LCL = D_3\bar{R} \quad \textbf{[19–5]}$$

- Mean proportion defective

$$p = \frac{\text{Total number defective}}{\text{Total number of items sampled}} \quad \textbf{[19–6]}$$

- Control limits, proportion

$$\text{UCL and LCL} = p \pm 3\sqrt{\frac{p(1-p)}{n}} \quad \textbf{[19–8]}$$

- Control limits, *c*-bar chart

$$\text{UCL and LCL} = \bar{c} \pm 3\sqrt{\bar{c}} \quad \textbf{[19–9]}$$

CHAPTER 20

- Expected monetary value

$$\text{EMV}(A_i) = \Sigma[P(S_j) \cdot V(A_i, S_j)] \quad \textbf{[20–1]}$$

- Expected opportunity loss

$$\text{EOL}(A_i) = \Sigma[P(S_j) \cdot R(A_i, S_j)] \quad \textbf{[20–2]}$$

- Expected value of perfect information

EVPI = Expected value under conditions of certainty − Expected value of optimal decision under conditions of uncertainty **[20–3]**