

---

# Contents

---

## **PART 1**

### Organizing Data and Some Simple Computations 1

- 1.1 Blocking and Tabling of Data 2
- 1.2 Range and Standard Deviation 4
- 1.3 Standard Error of the Mean 6
- 1.4 Sample Size and the Power of Hypothesis Tests 6
- 1.5 The *t*-Test for a Difference Between a Sample Mean and the Population Mean 7
- 1.6 The *t*-Test for a Difference Between Two Independent Means 9
- 1.7 The *t*-Test for Related Measures 12
- 1.8 Sandler's *A* Test 16

## **PART 2**

### Analysis of Variance 18

- 2.1 Completely Randomized Design 24
- 2.2 Factorial Design: Two Factors 27
- 2.3 Factorial Design: Three Factors 32
- 2.4 Treatments-by-Levels Design 39
- 2.5 Treatments-by-Subjects, or Repeated-Measures, Design 44
- 2.6 Treatments-by-Treatments-by-Subjects, or Repeated-Measures: Two-Factors, Design 48
- 2.7 Two-Factor Mixed Design: Repeated Measures on One Factor 55
- 2.8 Three-Factor Mixed Design: Repeated Measures on One Factor 62

2.9	Three-Factor Mixed Design: Repeated Measures on Two Factors	73
2.10	Latin Square Design: Simple	85
2.11	Latin Square Design: Complex	93
2.12	Analysis of Variance for Dichotomous Data	107
2.13	Analysis of Variance for Rank-Order Data	108

## PART 3

### Supplemental Computations for Analysis of Variance 110

3.1	Test for Difference Between Variances of Two Independent Samples (Test for Homogeneity of Independent Variances)	112
3.2	Test for Difference Between Variances of Two Related Samples (Test for Homogeneity of Related Variances)	113
3.3	Test for Differences Among Several Independent Variances ( <i>F</i> -Maximum Test for Homogeneity of Variances)	115
3.4	The <i>t</i> -Test for Differences Among Several Means	116
3.5	Duncan's Multiple-Range Test	119
3.6	The Newman-Keuls' Multiple-Range Test	122
3.7	The Tukey Test	124
3.8	Scheffé's Test	127
3.9	Dunnett's Test	130
3.10	<i>F</i> -Tests for Simple Effects	132
3.11	Use of Orthogonal Components in Tests for Trend	145

## PART 4

### Correlation and Related Topics 174

4.1	Pearson Product-Moment Correlation	176
4.2	Spearman Rank-Order Correlation ( <i>rho</i> )	180
4.3	Kendall Rank-Order Correlation ( <i>tau</i> )	183
4.4	Point-Biserial Correlation	187
4.5	The Correlation Ratio ( <i>eta</i> )	191
4.6	Partial Correlation: Three Variables	192
4.7	Partial Rank-Order Correlation (Using Kendall's <i>tau</i> )	194

4.8	Multiple Correlation: Three Variables	195
4.9	Simple Regression: X Variable to Predict Y	197
4.10	Multiple Regression: Two X Variables	200
4.11	Simple Analysis of Covariance: One Treatment Variable	204
4.12	Factorial Analysis of Covariance: Two Treatment Variables	210
4.13	Reliability of Measurement: The Test As a Whole (Test-Retest, Parallel Forms, and Split Halves)	222
4.14	Reliability of Measurement: The Individual Items (Kuder-Richardson and Hoyt)	223
4.15	Test for Difference Between Independent Correlations	226
4.16	Test for Difference Between Dependent Correlations	228

## **PART 5**

### Multivariate Analyses 230

5.1	Difference Between Sample Centroid and Population Values	231
5.2	Single-Sample Matched Pairs	236
5.3	Difference Between Two Independent Groups	239
5.4	Difference in the Change Scores of Two Groups	245
5.5	More Than Two Groups	250
5.6	Two-Factor Comparisons	256

## **PART 6**

### Nonparametric Tests, Miscellaneous Tests of Significance, and Indexes of Relationship 269

6.1	Test for Significance of a Proportion	271
6.2	Test for Significance of Difference Between Two Proportions	272
6.3	The Mann-Whitney <i>U</i> -Test for Differences Between Independent Samples	275
6.4	A Sign Test (Wilcoxon) for Differences Between Related Samples	278
6.5	Simple Chi-Square and the <i>Phi</i> Coefficient	280

6.6	Complex Chi-Square and the Contingency Coefficient (C)	283
6.7	Tests for Trends, Runs, and Randomness	288

## APPENDIXES 292

A	Normal-Curve Areas	292
B	Critical Values of "Student's" $t$ Statistic	294
C	Critical Values for Sandler's $A$ Statistic	296
D	Centile Values of the Chi-Square Statistic	298
E	Per Cent Points in the $F$ Distribution	300
F	Fisher's $z$ Transformation Function for Pearson's $r$ Correlation Coefficient	306
G	Critical Values of Pearson's $r$ Correlation Coefficient for Five Alpha Significance Levels	308
H	Critical Values of the $U$ Statistic of the Mann-Whitney Test	310
I	Critical Values for Hartley's Maximum $F$ -Ratio Significance Test for Homogeneity of Variances	313
J	Significant Studentized Ranges for Duncan's New Multiple-Range Test	315
K	Significant Studentized Ranges for the Newman-Keuls' and Tukey Multiple-Comparison Tests	320
L	Dunnett's Test: Comparison of Treatment Means with a Control	324
M	Critical Values of Wilcoxon's $T$ Statistics for the Matched-Pairs Signed-Ranks Test	326
N	Coefficients for Orthogonal Polynomials	327
O	Probability for Total Number of Runs Up or Down	328
P	Sample Computer Programs	331
	<i>P-1 Sums and sums of squares</i>	
	<i>P-2 Chi-squared for goodness of fit</i>	
	<i>P-3 Mean and standard deviation (Section 1.2)</i>	
	<i>P-4 Chi-squared for independence (Section 5.6)</i>	
	<i>P-5 Grouped frequency distribution, used with large distributions</i>	
	<i>P-6 Rank-ordered numbers, from small to large</i>	
	<i>P-7 Mann-Whitney <math>U</math>-test (Section 5.3)</i>	
	<i>P-8 <math>t</math>-test for independent groups (Section 1.6)</i>	
	<i>P-9 <math>t</math>-test for matched groups (Section 1.7)</i>	
	<i>P-10 The correlation coefficient (Section 4.1)</i>	
	<i>P-11 Intercorrelations—many variables</i>	
	<i>P-12 Percentile ranks and <math>z</math>-scores</i>	
	<i>P-13 Completely randomized design (Section 2.1)</i>	

- P-14 *Factorial design: Two factors (Section 2.2)*
- P-15 *Treatments-by-treatments-by-subjects design (Section 2.6)*
- P-16 *Factorial design: Three factors (Section 2.3)*
- P-17 *Type 1: Two-factor mixed design and TXS (Sections 2.5 and 2.7)*
- P-18 *Type 3: Three-factor mixed design—two between (Section 2.8)*
- P-19 *Type 6: Three-factor mixed design—two within (Section 2.9)*
- P-20 *Covariance analyses (Sections 4.10 and 4.11)*
- P-21 *Multiple regression: Two predictors (Section 4.9)*
- P-22 *MANOVA for sample and population (Section 5.1)*
- P-23 *MANOVA for one group: Matched pairs (Section 5.2)*
- P-24 *MANOVA for two independent groups (Section 5.3)*
- P-25 *MANOVA for two groups: Change scores (Section 5.4)*
- P-26 *MANOVA: More than two groups (Section 5.5)*

**TEXTBOOK REFERENCE CHART**      361

**INDEX**      368