

Contents

About This Book	ix
About These Authors	xiii
Acknowledgments	xv
Chapter 1 Introduction	1
Chapter 2 Simple Comparative Experiments	5
Section 2.2 Basic Statistical Concepts.....	6
Section 2.4.1 Hypothesis Testing.....	10
Section 2.4.3 Choice of Sample Size	12
Section 2.5.1 The Paired Comparison Problem.....	17
Section 2.5.2 Advantages of the Paired Comparison Design	18
Chapter 3 Experiments with a Single Factor: The Analysis of Variance	21
Section 3.1 A One-way ANOVA Example	22
Section 3.4 Model Adequacy Checking.....	32
Section 3.8.1 Single Factor Experiment	46
Section 3.8.2 Application of a Designed Experiment.....	52
Section 3.8.3 Discovering Dispersion Effects.....	54
Chapter 4 Randomized Blocks, Latin Squares, and Related Designs	61
Section 4.2 Creating a Latin Square Design in JMP	67
Chapter 5 Introduction to Factorial Designs	77
Example 5.1 The Battery Design Experiment	78
Example 5.2 A Two-Factor Experiment with a Single Replicate.....	82
Example 5.3 The Soft Drink Bottling Problem	84
Example 5.4 The Battery Design Experiment with a Covariate	86
Example 5.5 A 3 ² Factorial Experiment with Two Replicates.....	89
Example 5.6 A Factorial Design with Blocking	97

Chapter 6 The 2^k Factorial Design	101
Section 6.2 The 2 ² design	102
Example 6.1 A 2 ³ Design	107
Example 6.2 A Single Replicate of the 2 ⁴ Design	109
Example 6.3 Data Transformation in a Factorial Design.....	114
Example 6.5 Duplicate Measurements on the Response	118
Example 6.6 Credit Card Marketing	125
Example 6.7 A 2 ⁴ Design with Center Points	128
Chapter 7 Blocking and Confounding in the 2^k Factorial Design.....	131
Example 7.1 A 2 ^k Replicated Factorial Design with Blocking.....	132
Example 7.2 Blocking and Confounding in an Unreplicated Design	132
Example 7.3 A 2 ³ Design with Partial Confounding	134
Chapter 8 Two-Level Fractional Factorial Designs	141
Example 8.1 A Half-Fraction of the 2 ⁴ Design	143
Example 8.2 A 2 ⁵⁻¹ Design Used for Process Improvement	147
Example 8.3 A 2 ⁴⁻¹ Design with the Alternate Fraction	152
Example 8.4 A 2 ⁶⁻² Design	153
Example 8.5 A 2 ⁷⁻³ Design	158
Example 8.6 A 2 ⁸⁻³ Design in Four Blocks	160
Example 8.7 A Fold-Over 2 ⁷⁻⁴ Resolution III Design	164
Example 8.8 The Plackett-Burman Design	167
Section 8.7.2 Sequential Experimentation with Resolution IV Designs.....	168
Chapter 9 Three-Level and Mixed-Level Factorial and Fractional Factorial Designs	173
Example 9.1 The 3 ³ Design	174
Example 9.2 The 3 ² Design Confounded in 3 Blocks.....	177
Example 9.3 The Spin Coating Experiment	178
Example 9.4 An Experiment with Unusual Blocking Requirements.....	181
Chapter 10 Fitting Regression Models.....	189
Example 10.1 Multiple Linear Regression Model.....	190
Example 10.2 Regression Analysis of a 2 ³ Factorial Design.....	195
Example 10.3 A 2 ³ Factorial Design with a Missing Observation	197
Example 10.4 Inaccurate Levels in Design Factors	198

Example 10.6 Tests on Individual Regression Coefficients	198
Example 10.7 Confidence Intervals on Individual Regression Coefficients	199
Chapter 11 Response Surface Methods and Designs	201
Example 11.1 The Path of Steepest Ascent	202
Example 11.2 Central Composite Design.....	204
Section 11.3.4 Multiple Responses	209
Example 11.4 Space Filling Design with Gaussian Process Model	214
Example 11.5 A Three-Component Mixture	218
Example 11.6 Paint Formulation	222
Chapter 12 Robust Parameter Design and Process Robustness Studies	227
Example 12.1 Two Controllable Variables and One Noise Variable	228
Example 12.2 Two Controllable Variables and Three Noise Variables	230
Chapter 13 Experiments with Random Factors.....	239
Example 13.1 A Measurement Systems Capability Study	240
Example 13.3 The Unrestricted Model	242
Example 13.5 A Three-Factor Factorial Experiment with Random Factors	244
Example 13.6 Approximate F Tests	245
Chapter 14 Nested and Split-Plot Designs.....	251
Example 14.1 The Two-Stage Nested Design.....	252
Example 14.2 A Nested-Factorial Design.....	254
Section 14.4 The Experiment on the Tensile Strength of Paper	256
Example 14.3 A 2^{5-1} Split-Plot Experiment.....	259
Chapter 15 Other Design and Analysis Topics.....	263
Example 15.1 Box-Cox Transformation.....	264
Example 15.2 The Generalized Linear Model and Logistic Regression.....	265
Example 15.3 Poisson Regression.....	267
Example 15.4 The Worst Yarn Experiment	269
Section 15.2 Unbalanced Data in a Factorial Design.....	270
Example 15.5 Analysis of Covariance.....	271
Section 15.3.4 Factorial Experiments with Covariates	273
Index	277