

Contents

Preface xi

Chapter 1 Getting Started: Introduction to JMP 1

Goals of Data Analysis: Description and Inference 1
Types of Data 2
Starting JMP 4
A Simple Data Table 5
Hot Spots 9
Analysis Platforms—A First Descriptive Analysis 10
Row States 13
Exporting JMP Results to a Word-Processor Document 15
Saving Your Work 16
Leaving JMP 17

Chapter 2 Understanding Data 19

Populations, Processes, and Samples 20
Representativeness and Sampling 21
 Simple Random Sampling 21
 Stratification, Clustering, and Complex Sampling 23
 Non-Random Sampling 26
Cross-Sectional and Time Series Sampling 27
Study Design: Experimentation, Observation, Surveying 27
 Experimental Data—An Example 28
 Observational Data—An Example 31
 Survey Data—An Example 31
Loading Data into a Data Table 34
 Entering Data from the Keyboard 34
 Moving Data from Excel Files into a JMP Data Table 38
Application 39

Chapter 3 Describing a Single Variable 41

- The Concept of a Distribution 41
- Variable Types and Their Distributions 42
- Distribution of a Categorical Variable 43
- Distribution of a Quantitative Variable 47
 - Subsetting a Data Table 48
 - Constructing a Histogram for Continuous Data 49
 - Taking Advantage of Linked Graphs and Tables to Explore Data 54
 - Customizing Scale and Bars in a Histogram 54
 - Stem and Leaf Plots 55
- Summary Statistics for a Single Variable 56
- Outlier Box Plots 58
- Application 59

Chapter 4 Describing Two Variables at a Time 63

- Two-by-Two: Bivariate Data 63
- Describing Covariation: Two Categorical Variables 64
- Describing Covariation: Two Continuous Variables 70
- Comparing Two Groups: One Continuous, One Categorical Variable 74
- Visualizing Covariation with the Graph Builder 75
- Application 78

Chapter 5 Elementary Probability and Discrete Distributions 83

- Probability Theory and Data Analysis 84
- Elements of Probability Theory 84
 - Probability of an Event 85
 - Rules for Two Events 85
 - Assigning Probability Values 86
- Contingency Tables and Probability 87
- Discrete Random Variables: From Events to Numbers 91

- Three Common Discrete Distributions 91
 - Integer 92
 - Binomial 93
 - Poisson 95
- Simulating Random Variation with JMP 96
- Application 98

Chapter 6 The Normal Model 103

- Continuous Data and Probability 103
- Density Functions 104
- The Normal Model 106
- Normal Calculations 107
 - Solving Cumulative Probability Problems 108
 - Solving Inverse Cumulative Problems 110
- Checking Data for Suitability of Normal Model 111
 - Normal Quantile Plots 111
- Simulating Normal Data 115
- Application 116

Chapter 7 Sampling and Sampling Distributions 119

- Why Sample? 119
- Methods of Sampling 120
- Using JMP to Select a Simple Random Sample 121
- All Possible Samples: Sampling Distributions 124
- Extent of Sampling Variation 126
 - Sampling Distribution of the Sample Proportion 126
 - From Simulation to Generalization 130
 - Sampling Distribution of the Sample Mean 131
 - The Central Limit Theorem 134
- Application 137

Chapter 8 Inference for a Single Categorical Variable 141

- Two Inferential Tasks 141
- Statistical Inference Is Always Conditional 142
- Confidence Intervals 143
- Using JMP to Estimate a Population Proportion 143
 - Working with Casewise Data 144
 - Working with Summary Data 145
- Using JMP to Conduct a Significance Test 146
- A Few Words About Error 150
- Application 151

Chapter 9 Inference for a Single Continuous Variable 155

- Conditions for Inference 155
- Using JMP to Estimate a Variable's Mean 156
- Using JMP to Conduct a Significance Test 158
 - More About *P*-Values 160
 - The Power of a Test 162
- What If Conditions Aren't Satisfied? 164
- Matched Pairs: One Variable, Two Measurements 165
- Application 167

Chapter 10 Two-Sample Inference for a Continuous Variable 171

- Conditions for Inference 171
- Using JMP to Compare Two Means 172
 - Assuming Normal Distributions or CLT 172
 - Using Sampling Weights 176
 - Equal vs. Unequal Variances 176
 - Dealing with Non-Normal Distributions 177
- Using JMP to Compare Two Variances 179
- Application 181

Chapter 11 Chi-Square Tests 185

- Further Inference for Categorical Variables 185
- Chi-Square Goodness-of-Fit Test 186
 - What Are We Assuming? 189
- Inference for Two Categorical Variables 189
- Contingency Tables Revisited 189
- Chi-Square Test of Independence 191
 - What Are We Assuming? 193
- Application 194

Chapter 12 Analysis of Variance 197

- What Are We Assuming? 197
- One-Way ANOVA 199
 - Checking the Validity of Assumptions 201
 - Factorial Analysis for Main Effects 203
- Approaches When Conditions Are Not Satisfied 206
- Two-Way ANOVA 207
 - Evaluating Assumptions 209
 - Interaction and Main Effects 210
- Application 213

Chapter 13 Simple Linear Regression 217

- Fitting a Line to Bivariate Continuous Data 217
- The Simple Regression Model 222
 - Thinking About Linearity 224
 - Random Error 224
- What Are We Assuming? 224
- Interpreting Regression Results 225
 - Summary of Fit 226
 - Lack of Fit 226
 - Analysis of Variance 226
 - Parameter Estimates and t -tests 227

Testing for a Slope Other Than Zero 228
Application 231

Chapter 14 Regression Conditions and Estimation 235

Conditions for Least Squares Estimation 235
Residual Analysis 236
 Linearity 238
 Normality 242
 Constant Variance 243
 Independence 243
Estimation 245
 Confidence Intervals for Parameters 246
 Confidence Intervals for $Y|X$ 247
 Prediction Intervals for $Y|X$ 248
Application 249

Chapter 15 Multiple Regression 253

The Multiple Regression Model 253
Visualizing Multiple Regression 255
Fitting a Model 257
A More Complex Model 260
Residual Analysis in the Fit Model Platform 262
Collinearity 263
 An Example Free of Collinearity Problems 264
 An Example of Collinearity 266
 Dealing with Collinearity 268
Evaluating Alternative Models 269
Application 271

Chapter 16 Categorical and Non-Linear Regression Models 275

Introduction 275
Dichotomous Independent Variables 276

- Dichotomous Dependent Variable 279
- Non-Linear Relationships 282
 - Whole Model Test 282
 - Parameter Estimates 283
 - Effect Likelihood Ratio Tests 283
 - Quadratic Models 283
 - Logarithmic Models 287
- Application 291

Chapter 17 Basic Forecasting Techniques 295

- Detecting Patterns Over Time 295
- Smoothing Methods 298
 - Simple Exponential Smoothing 299
 - Linear Exponential Smoothing (Holt's Method) 301
 - Winters' Method 302
- Trend Analysis 303
- Autoregressive Models 305
- Application 307

Chapter 18 Elements of Experimental Design 313

- Experimental and Observational Studies 313
- Goals of Experimental Design 314
- Factors, Blocks, and Randomization 315
- Multi-factor Experiments and Factorial Designs 316
- Blocking 323
- Fractional Designs 325
- Response Surface Designs 329
- Application 332

Chapter 19 Quality Improvement 339

- Processes and Variation 339
- Control Charts 340
 - Run Charts for Individual Observations 341

Charts for Means	342
Charts for Proportions	348
Capability Analysis	351
Pareto Charts	354
Application	356

Appendix A Data Sources 361

Introduction	361
Data Tables and Sources	362

Bibliography 365

Index 369