
Contents

Preface xiii

Introduction to JMP xvii

Part One Statistical Thinking Concepts..... 1

Chapter 1 Need for Business Improvement 3

Today's Business Realities and the Need to Improve 4

We Now Have Two Jobs: A Model for Business Improvement 7

New Management Approaches Require Statistical Thinking 10

Principles of Statistical Thinking 15

Applications of Statistical Thinking 18

Summary 20

Notes 20

Chapter 2 Statistical Thinking Strategy 23

Case Study: The Effect of Advertising on Sales 24

Case Study: Improvement of a Soccer Team's Performance 30

Statistical Thinking Strategy 39

Context of Statistical Thinking: Statistics Discipline as a System 43

Variation in Business Processes 45

Synergy between Data and Subject Matter Knowledge 50

Dynamic Nature of Business Processes 51

Summary 53

Project Update 53

Notes 54

Chapter 3 Understanding Business Processes 55

Examples of Business Processes 56

SIPOC Model for Processes 62

Identifying Business Processes 64

Analysis of Business Processes 65

Systems of Processes 79

Measurement Process 82

Summary 87

Project Update 88

Notes 89

Part Two Statistical Engineering: Frameworks and Basic Tools 91

Chapter 4 Statistical Engineering: Tactics to Deploy Statistical Thinking 93

Statistical Engineering 94

Case Study: Reducing Resin Output Variation 95

| | |
|--|------------|
| Case Study: Reducing Telephone Waiting Time at a Bank | 101 |
| Basic Process Improvement Framework | 105 |
| Case Study: Resolving Customer Complaints of Baby Wipe Flushability | 111 |
| Case Study: The Realized Revenue Fiasco | 117 |
| Basic Problem-Solving Framework | 123 |
| DMAIC Framework | 128 |
| DMAIC Case Study: Newspaper Accuracy | 130 |
| Summary | 137 |
| Project Update | 137 |
| Notes | 138 |
| Chapter 5 Process Improvement and Problem-Solving Tools | 139 |
| Stratification | 141 |
| Data Collection Tools | 142 |
| Basic Graphical Analysis Tools | 156 |
| Knowledge-Based Tools | 172 |
| Process Stability and Capability Tools | 205 |
| Summary | 226 |
| Project Update | 227 |
| Notes | 227 |
| Part Three Formal Statistical Methods | 229 |
| Chapter 6 Building and Using Models | 231 |
| Examples of Business Models | 232 |
| Types and Uses of Models | 235 |
| Regression Modeling Process | 238 |
| Building Models with One Predictor Variable | 246 |
| Building Models with Several Predictor Variables | 254 |
| Multicollinearity: Another Model Check | 261 |
| Some Limitations of Using Existing Data | 264 |
| Summary | 265 |
| Project Update | 267 |
| Notes | 267 |
| Chapter 7 Using Process Experimentation to Build Models | 269 |
| Why Do We Need a Statistical Approach? | 270 |
| Examples of Process Experiments | 273 |
| Statistical Approach to Experimentation | 279 |
| Two-Factor Experiments: A Case Study | 286 |
| Three-Factor Experiments: A Case Study | 292 |
| Larger Experiments | 299 |
| Blocking, Randomization, and Center Points | 301 |
| Summary | 303 |
| Project Update | 304 |
| Notes | 305 |
| Chapter 8 Applications of Statistical Inference Tools | 307 |
| Examples of Statistical Inference Tools | 310 |
| Process of Applying Statistical Inference | 314 |

| | |
|---|------------|
| Statistical Confidence and Prediction Intervals | 317 |
| Statistical Hypothesis Tests | 330 |
| Tests for Continuous Data | 339 |
| Test for Discrete Data: Comparing Two or More Proportions | 344 |
| Test for Regression Analysis: Test on a Regression Coefficient | 345 |
| Sample Size Formulas | 346 |
| Summary | 352 |
| Project Update | 353 |
| Notes | 353 |
| Chapter 9 Underlying Theory of Statistical Inference | 355 |
| Applications of the Theory | 356 |
| Theoretical Framework of Statistical Inference | 358 |
| Types of Data | 363 |
| Probability Distributions | 366 |
| Sampling Distributions | 382 |
| Linear Combinations | 389 |
| Transformations | 392 |
| Summary | 411 |
| Project Update | 411 |
| Notes | 412 |
| Chapter 10 Summary and Path Forward | 413 |
| A Personal Case Study by Tom Pohlen | 414 |
| Review of the Statistical Thinking Approach | 420 |
| Text Summary | 422 |
| Potential Next Steps to Deeper Understanding of Statistical Thinking | 425 |
| Project Summary and Debriefing | 427 |
| Notes | 427 |
| Appendix A Effective Teamwork | 429 |
| Appendix B Presentations and Report Writing | 439 |
| Appendix C More on Surveys | 445 |
| Appendix D More on Regression | 453 |
| Appendix E More on Design of Experiments | 467 |
| Appendix F More on Inference Tools | 479 |
| Appendix G More on Probability Distributions | 483 |
| Appendix H Process Design (Reengineering) | 491 |
| Appendix I <i>t</i> Critical Values | 497 |
| Appendix J Standard Normal Probabilities (Cumulative <i>z</i> Curve Areas) | 499 |
| Index | 503 |