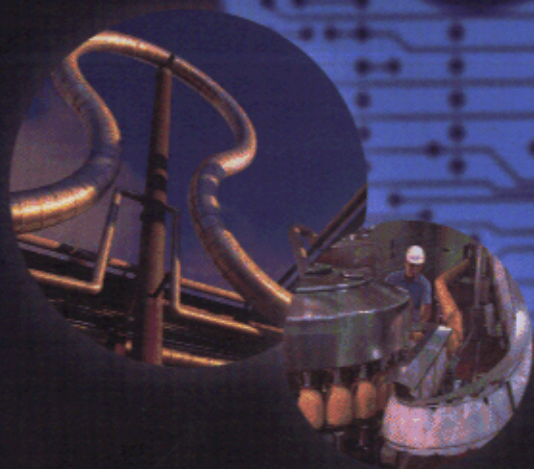


GEOFFREY VINING
SCOTT M. KOWALSKI

Statistical
Methods for

ENGINEERS

Second Edition



Contents

	<i>Preface</i>	ix
❖ Chapter 1	<i>Overture: Engineering Method and Data Collection</i>	1
	1.1 Need for Statistical Methods in Engineering	1
	1.2 Engineering Method and Statistical Thinking	3
	1.3 Statistical Thinking and Structured Problem Solving	7
	1.4 Models	9
	1.5 Obtaining Data	11
	1.6 Sampling	18
	1.7 Basic Principles of Experimental Design	22
	1.8 Examples of Engineering Experiments	27
	1.9 Purpose of Engineering Statistics	32
	1.10 Case Study: Manufacture of Writing Instruments	33
	1.11 Ideas for Projects	34
	References	34
❖ Chapter 2	<i>Data Displays</i>	41
	2.1 Importance of Data Displays	41
	2.2 Stem-and-Leaf Displays	43
	2.3 Boxplots	58
	2.4 Using Computer Software	69
	2.5 Using Boxplots to Analyze Designed Experiments	80
	2.6 Case Study	84
	2.7 Need for Probability and Distributions	88
	2.8 Ideas for Projects	89
	References	89

➤ Chapter 3	<i>Modeling Random Behavior</i>	91
3.1	Probability	91
3.2	Random Variables and Distributions	101
3.3	Discrete Random Variables	103
3.4	Continuous Random Variables	124
3.5	The Normal Distribution	135
3.6	Random Behavior of Means	143
3.7	Random Behavior of Means When the Variance Is Unknown	154
3.8	Normal Approximation to the Binomial	164
3.9	Case Study	169
	References	171
➤ Chapter 4	<i>Estimation and Testing</i>	173
4.1	Estimation	173
4.2	Hypothesis Testing	187
4.3	Inference for a Single Mean	209
4.4	Inference for Proportions	221
4.5	Inference for Two Independent Samples	228
4.6	The Paired t -Test	239
4.7	Inference for Variances	249
4.8	Transformations and Nonparametric Analyses	260
4.9	Case Study	268
4.10	Ideas for Projects	271
	References	272
➤ Chapter 5	<i>Control Charts</i>	275
5.1	Overview	275
5.2	Specification Limits and Capability	292
5.3	\bar{X} - and R -Charts	295
5.4	\bar{X} - and s^2 -Charts	312
5.5	\bar{X} -Chart	321

5.6	np -Chart	329
5.7	c -Chart	335
5.8	Average Run Lengths	341
5.9	Standard Control Charts with Runs Rules	344
5.10	CUSUM and EWMA Charts	347
5.11	Case Study	355
5.12	Ideas for Projects	360
	References	361
❖ Chapter 6	<i>Linear Regression Analysis</i>	363
6.1	Relationships Among Data	363
6.2	Simple Linear Regression	365
6.3	Multiple Linear Regression	394
6.4	Residual Analysis	412
6.5	Collinearity Diagnostics	438
6.6	Case Study	446
6.7	Ideas for Projects	451
	References	451
❖ Chapter 7	<i>Introduction to 2^k Factorial-Based Experiments</i>	453
7.1	The 2^2 Factorial Design	453
7.2	The 2^k Factorial Design	467
7.3	Half Fractions of the 2^k Factorial	489
7.4	Case Study	512
7.5	Ideas for Projects	513
	References	514
❖ Chapter 8	<i>Introduction to Response Surface Methodology</i>	517
8.1	Sequential Philosophy of Experimentation	517
8.2	Central Composite Designs	522
8.3	Multiple Responses	537

Contents

8.4	Experimental Designs for Quality Improvement	547
8.5	Case Study	564
8.6	Ideas for Projects	564
	References	567
❖ Chapter 9	<i>Coda</i>	569
9.1	The Themes of This Course	569
9.2	Integrating the Themes	571
9.3	Statistics and Engineering	573
	<i>Appendix</i>	575
	<i>Answers to Selected Exercises</i>	587
	<i>Index</i>	595