CONTENTS

Note from the Series Editor		iv
Foreword		v
Preface		vii
1	WHY STATISTICS?	1
1.1	Statistical Quality Control	1
1.2	Data: Statistics for Action	2
1.3	Patterns of Variation	3
1.4	Wide Applicability	3
1.5	Summary	4
2	CHARACTERISTICS OF DATA AND HOW TO DESCRIBE THEM	5
2.1	Two Basic Characteristics of Data	5
2.2	Measuring Average Level and Variability	6
2.3	Condensing Data into a Frequency Table	10
2.4	Sample Data versus Population	15
2.5	Interpretation of $\bar{x}$ and s	17
2.6	Efficient Calculation of $\bar{x}$ and s: Coding	18
2.7	Curve Shape	22
2.8	Population versus Sample Characteristics	23
2.9	Summary	24
	Problems	24
	Reference	26
3	SIMPLE PROBABILITY	27
3.1	Likelihood of an Event Occurring	27
3.2	Occurrence Ratio	28
3.3	Example 1 and Probability Laws	30
3.4	Example 2 and Equal Likelihood, Dependence	34
3.5	Example 3, Another Lot Probability Problem	36
3.6	Counting Samples: Combinations and Permutations	38
3.7	Approach of Occurrence Ratio d/n = p to p'	41
3.8	Further Examples of Probability	43
3.9	Summary	47
	Problems	47
4	THREE BASIC LAWS FOR ATTRIBUTE DATA	49
4.1	Counted Data: Defects or Defective Pieces in a Sample of n Pieces	49

4.2	The Binomial Distribution for Defectives	50
4.3	The Poisson Distribution for Defects	58
4.4*	The Hypergeometric Distribution for Defectives	66
4.5	Summary	70
	Problems	71
	References	72
5	CONTROL CHARTS IN GENERAL	75
5.1	Running Record Charts of Performance	75
5.2	Performance Varies	78
5.3	Unusual Performance Calls for Action	78
5.4	What Is Unusual?	79
5.5	Two Kinds of Causes	80
5.6	Control Charts	81
5.7	Interpretations of Points and Limits	84
5.8	Two Purposes of Control Charts	85
5.9	Process in Statistical Control	86
5.10	Advantages of a Process in Control	86
5.11	Summary	87
	Problems	88
	References	89
6	CONTROL CHARTS FOR ATTRIBUTES: PROCESS CONTROL	91
6.1	Charts for Defectives or Nonconforming Pieces	91
6.2	Charts for Defects	109
6.3	Summary	120
	Problems	122
7	CONTROL CHARTS FOR MEASUREMENTS: PROCESS CONTROL	127
7.1	Two Characteristics We Desire to Control	127
7.2	An Example, $\bar{x}$, R Charts for Past Data	129
7.3	An Experimental Example, $\bar{x}$, R Charts for Past Data	133
7.4	Some Population Distributions for Sampling Experiments	140
7.5	The Normal Distribution	142
7.6	Control Charts for $\bar{x}$ and R, Standards Given	147
7.7	Control Charts for Standard Deviations, s	148
7.8	Comparison of a Process with Specifications	151
7.9	Continuing the Charts	156
7.10	When and How to Set Standard Values	157
7.11	Examples	158
7.12	Some Background of Control Charts	167
7.13	Summary	169
	Problems	170
	References	179
8	FURTHER TOPICS IN CONTROL CHARTS AND APPLICATIONS	181
8.1	Types of Sampling	181
8.2	Tool Wear, Slanting Limits	192

8.3	Charts for Individual x's and Moving Ranges	197
8.4	Percent Defective of Bulk Product	200
8.5*	Average Run Length for a Point Out	202
8.6*	Chart for Demerits, Rating Quality	206
8.7	Some Typical Applications	208
	Problems	219
	References	222
9	ACCEPTANCE SAMPLING FOR ATTRIBUTES	223
9.1	Why Use a Sample for a Decision on a Lot?	223
9.2	Levels of Inspecting or Testing a Lot	224
9.3	The Operating Characteristic of a Plan	225
9.4	Attribute Sampling Inspection	225
9.5	Characteristics of Single Sampling Plans	226
9.6	Double Sampling Plans and Their Characteristics	234
9.7	Acceptance Sampling for Defects	244
9.8	Finding a Single Sampling Plan to Match Two Points on the OC Curve	245
9.9	Some Principles and Concepts in Sampling by Attributes	247
9.10	Summary	256
	Problems	256
	References	257
10	SOME STANDARD SAMPLING PLANS FOR ATTRIBUTES	259
10.1	The ABC Standard or Military Standard 105D	259
10.2	The Dodge-Romig Sampling Tables	294
10.3	Other Sampling Inspection Plans	296
10.4	Continuous Sampling Plans	297
10.5*	Chain Sampling Plan, ChSP-1	300
10.6*	Skip-Lot Sampling Plan, SkSP-1	302
10.7	Summary	304
	Problems	304
	References	306
11	SAMPLING BY VARIABLES	307
11.1	Knowledge of Distribution Type	308
11.2	General Aim: To Judge Whether Distribution Is Satisfactory	309
11.3	Decisions on Lot Mean, Known σ, Normal Distribution	309
11.4	Decisions on Lot by Measurements, σ Unknown, Normal Distribution	320
11.5	Single-Sample Test on Variability	322
11.6	Description of Military Standard MIL-STD 414	324
11.7	Checking a Process Setting	327
11.8	Summary	328
	Problems	329
	References	331

12	TOLERANCES FOR MATING PARTS AND ASSEMBLIES	333
12.1	An Example of Bearing and Shaft	333
12.2	An Example of an Additive Combination	337
12.3	General Formulas	339
12.4	Setting Realistic Tolerances	340
12.5	Relations Other Than Additive-Subtractive	342
12.6	Summary	342
	Problems	343
	Reference	346
13	STUDYING RELATIONSHIPS BETWEEN VARIABLES BY LINEAR CORRELATION AND REGRESSION	347
13.1	Two General Problems	347
13.2	First Example--Estimation	348
13.3	Second Example--Correlation	355
13.4	Simplifying the Calculations	360
13.5	Interpretations and Precautions	363
13.6	Some Applications	365
	Problems	367
	References	369
14	A FEW RELIABILITY CONCEPTS	371
14.1	Reliability in General	371
14.2	Definitions of Reliability	372
14.3	Time to First Failure, the Geometric Distribution	373
14.4	Lower Confidence Limit on Reliability	375
14.5	The Exponential Distribution for Length of Life	377
14.6	Reliability of Complex Equipment	380
14.7	Summary	382
	Problems	383
	References	384
Appendix:	Tables of Statistical and Mathematical Functions	385
Answers to Odd-Numbered Problems		405
Index		411