

# Contents

CHAPTER	PAGE
1 INTRODUCTION . . . . .	1
References . . . . .	3
2 PROBABILITY . . . . .	4
2.1 Classification of Data . . . . .	4
2.2 Sample Space . . . . .	4
2.3 Sample Space Probabilities . . . . .	5
2.4 Events . . . . .	6
2.5 Addition Theorem . . . . .	7
2.6 Multiplication Theorem . . . . .	8
2.7 Illustrations . . . . .	10
2.8 Combinatorial Formulas . . . . .	11
2.9 Random Variables . . . . .	15
2.10 Frequency Functions . . . . .	16
2.11 Joint Frequency Functions . . . . .	18
2.12 Continuous Frequency Functions . . . . .	19
2.13 Joint Continuous Frequency Functions . . . . .	25
References . . . . .	27
Exercises . . . . .	27
3 NATURE OF STATISTICAL METHODS . . . . .	29
3.1 Mathematical Models . . . . .	29
3.2 Testing Hypotheses . . . . .	30
3.3 Estimation . . . . .	38
References . . . . .	41
Exercises . . . . .	41
4 EMPIRICAL FREQUENCY DISTRIBUTIONS OF ONE VARIABLE . . . . .	43
4.1 Introduction . . . . .	43
4.2 Classification of Data . . . . .	44
4.3 Graphical Representation of Empirical Distributions . . . . .	46
4.4 Arithmetical Representation of Empirical Distributions . . . . .	47
References . . . . .	58
Exercises . . . . .	58
5 THEORETICAL FREQUENCY DISTRIBUTIONS OF ONE VARIABLE . . . . .	60
5.1 Discrete Variables . . . . .	60
5.2 Continuous Variables . . . . .	72
References . . . . .	94
Exercises . . . . .	94

## CONTENTS

CHAPTER	PAGE
<b>6 ELEMENTARY SAMPLING THEORY FOR ONE VARIABLE . . . . .</b>	<b>98</b>
6.1 Random Sampling . . . . .	98
6.2 Moments of Multivariate Distributions . . . . .	100
6.3 Sum of Independent Variables . . . . .	100
6.4 Distribution of $\bar{x}$ from a Normal Distribution . . . . .	101
6.5 Distribution of $\bar{x}$ from Non-Normal Distributions . . . . .	105
6.6 Distribution of the Difference of Two Means . . . . .	109
6.7 Distribution of the Difference of Two Proportions . . . . .	110
References . . . . .	113
Exercises . . . . .	113
<b>7 CORRELATION AND REGRESSION . . . . .</b>	<b>117</b>
7.1 Linear Correlation . . . . .	117
7.2 Linear Regression . . . . .	125
7.3 Multiple Linear Regression . . . . .	129
7.4 Curvilinear Regression . . . . .	132
References . . . . .	136
Exercises . . . . .	137
<b>8 THEORETICAL FREQUENCY DISTRIBUTIONS FOR CORRELATION AND REGRESSION . . . . .</b>	<b>140</b>
8.1 Discrete Variables . . . . .	140
8.2 Continuous Variables . . . . .	143
8.3 Normal Distribution of Two Variables . . . . .	149
8.4 Estimation of $\rho$ . . . . .	155
8.5 Normal Regression . . . . .	157
References . . . . .	160
Exercises . . . . .	160
<b>9 TESTING GOODNESS OF FIT . . . . .</b>	<b>163</b>
9.1 Multinomial Distribution . . . . .	163
9.2 The $\chi^2$ Test . . . . .	164
9.3 Limitations on the $\chi^2$ Test . . . . .	167
9.4 Applications . . . . .	168
9.5 Generality of the $\chi^2$ Test . . . . .	169
9.6 Frequency Curve Fitting . . . . .	170
9.7 Contingency Tables . . . . .	172
9.8 Indices of Dispersion . . . . .	175
References . . . . .	179
Exercises . . . . .	179
<b>10 GENERAL PRINCIPLES FOR TESTING HYPOTHESES AND FOR ESTIMATION . . . . .</b>	<b>182</b>
10.1 Testing Hypotheses . . . . .	182
10.2 Estimation . . . . .	196
References . . . . .	209
Exercises . . . . .	209
<b>11 SMALL SAMPLE DISTRIBUTIONS . . . . .</b>	<b>211</b>
11.1 Distribution of a Function of a Random Variable . . . . .	211
11.2 The $\chi^2$ Distribution . . . . .	215

## CONTENTS

xi

CHAPTER	PAGE
11.3 Applications of the $\chi^2$ Distribution . . . . .	219
11.4 Student's $t$ Distribution . . . . .	222
11.5 Applications of the $t$ Distribution . . . . .	226
11.6 The $F$ Distribution . . . . .	233
11.7 Applications of the $F$ Distribution . . . . .	235
11.8 Distribution of the Range . . . . .	237
11.9 Applications of the Range . . . . .	241
References . . . . .	242
Exercises . . . . .	242
12 STATISTICAL DESIGN IN EXPERIMENTS . . . . .	246
12.1 Randomization, Replication, and Sensitivity . . . . .	246
12.2 Analysis of Variance . . . . .	248
12.3 Sampling Inspection . . . . .	264
References . . . . .	277
Exercises . . . . .	278
13 NONPARAMETRIC METHODS . . . . .	281
13.1 Tolerance Limits . . . . .	282
13.2 Sign Test . . . . .	285
13.3 Median Test . . . . .	288
13.4 The $U$ Test . . . . .	291
13.5 Runs . . . . .	293
13.6 Serial Correlation . . . . .	299
References . . . . .	303
Exercises . . . . .	304
TABLES . . . . .	306
INDEX . . . . .	327