Elementary Statistics in a World of Applications

Third Edition

Ramakant Khazanie

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in a World of Applications

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Ramakant Khazanie
Humboldt State University

HarperCollins*Publishers*

To the memory of my grandparents, my father, and my brother, Suresh

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PREFACE

Statistical methodology has become an important component of scientific reasoning. It is now integral to such fields as engineering, education, agriculture, business, biology, medicine, fishery management, forestry, geology, communications, psychology, and ecology. Therefore, more and more academic disciplines require a course in introductory statistics. *Elementary Statistics in a World of Applications, Third Edition* acquaints students with the fundamentals of statistics and provides, by touching on diverse areas of interest, a basis for studying specialized methods within their fields.

In a first course such as this, students can hardly be expected to master the vast subject of statistics. The goal of this book, therefore, is to introduce students to some aspects of statistical methodology. Students who acquire a sound understanding of the topics developed here can realize the importance of statistical reasoning in work and in life, discern the basic statistical assumptions underlying a given situation, and pick an appropriate test if the problem falls within the framework of their introduction to the subject. But more than anything, I hope that students will be able to interpret the results of statistical investigation and decipher the daily barrage of statistical information.

APPROACH

The overriding concern in *Elementary Statistics* is to present material clearly so that students reading it on their own can do so with minimum difficulty. Each concept is introduced through an example, often drawn from a real-life situation, followed by numerous detailed examples. Many of these examples are based on hypothetical data. Exercises at the end of each section give students ample oppor-

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tunities to test their skills and to clarify understanding of the subject matter. These exercises serve an additional purpose—to show how pervasively statistical applications are used in everyday life.

Since, in general, students are not comfortable with the notions of discrete and continuous random variables, Chapter 4 (Probability Distributions) is developed with this in mind. More specifically, students are shown, through an example, why in the continuous case the probabilities are given as appropriate areas under the probability density curve.

Chapter 7 (Estimation—Single Population), Chapter 8 (Estimation—Two Populations), and Chapter 9 (Tests of Hypotheses) are by far the most important chapters. A concerted effort is made to convey all the basic concepts by appealing to students' intuition. Table summaries in these chapters provide a programmed approach to setting confidence intervals and carrying out tests of hypotheses.

The chapters on probability have been traditional sore spots for some students. Special efforts have been made to keep the presentation accessible and lucid.

CHANGES IN THE THIRD EDITION

The third edition preserves the basic format and topic order of the previous editions and builds on their style, clarity, and readability. The following significant changes characterize this edition.

1 Numerous new exercises adapted from recently published articles in applied research journals appear throughout the book, providing broader exposure to practical statistical applications.

2 A significant feature of this edition is the introduction of MINITAB* labs based on the latest version of the MINITAB software package (7.1). They appear (one per chapter) at the end of chapters to specifically explore and reinforce concepts developed in the chapters. The purpose of these labs is twofold. First, students can use them to ease computational drudgery. More importantly, however, students can use them to simulate samples in a relatively short time. Characteristics computed from samples closely reflect those in the population. As a bonus, students may become more proficient in handling the MINITAB software commands.

For those who prefer to teach without computer software, there is no mention of the labs within the chapter.

3 To further help the student, Key Terms and Expressions have been added to the summary of Key Formulas. Both should provide the student with the necessary structure for reviewing the subject matter discussed in each chapter. End of chapter

*MINITAB is a registered trademark of Minitab, Inc., 3081 Enterprise Drive, State College, Pennsylvania 16801; telephone 814/238-3280; telex: 881612; fax: 814/238-4383. The author would like to acknowledge Minitab, Inc.'s gracious help in cooperating with his development of the MINITAB Labs.

Review Exercises have replaced the Chapter Tests. Although these exercises may sometimes require more than an hour to complete, they cover all the principal ideas in the chapter and should enable students to test their understanding prior to an examination.

4 Chapter 2 includes a detailed treatment of computing quartiles and sketching boxplots in the section on measures of central tendency. Chapter 2 also discusses the Empirical Rule and Chebyshev's Rule together in the section on measures of dispersion.

5 In response to suggestions from current users, Chapter 3 contains an optional section on the theorem of total probability and Bayes' formula.

6 Chapter 6 introduces techniques that include simple random sampling, stratified samples, cluster samples, and systematic sampling.

7 A short discussion of computing confidence intervals for treatment of means and their differences supplements Chapter 12.

FLEXIBILITY IN USE

This textbook covers topics in elementary statistics that, in recent years, have been offered at the freshman-sophomore level in various colleges and universities. It appeals primarily to readers' common sense and employs mathematics at the most elementary level to stimulate interest among students who have no special interest in or taste for mathematical formalism. A background in high-school algebra would suffice, although a course in finite mathematics would help students attain a certain degree of maturity and self-confidence.

The contents in this book can be divided into three parts. The first part, consisting of Chapters 1–2, gives an account of descriptive statistics and is intended to familiarize students with field data summary. The second part, Chapters 3–6, covers elementary probability. In this part the goal is to build the tools essential to understanding the concepts of statistical inference. The third part, Chapters 7–9, deals with the inferential aspect of statistics and is by far the most important. Of the remaining chapters, the order of importance is as follows: Chapters 11, 10, 13, 12. This will vary, however, from instructor to instructor.

The topics treated in *Elementary Statistics* should prove adequate for an introductory one-semester course meeting three hours a week or a one-quarter course meeting four hours a week. In my teaching of a one-semester course meeting four hours a week, I have invariably covered the first nine chapters. Set aside additional time if MINITAB labs are covered. There is enough optional material from which to fashion a two-quarter course meeting three hours a week. The chapters on linear regression and linear correlations, goodness of fit, analysis of variance, and nonparametric methods are included to provide the flexibility needed in structuring such an offering.

SUPPLEMENTS

The *Instructor's Resource Manual* contains *solutions to all problems* in the text. In addition, the manual offers two test modules for each chapter.

Prepared by the author, the successful and helpful *Study Guide* features a new design and includes chapter-by-chapter review and reinforcement of the material presented in the textbook. More examples, additional exercises, and fill-in problems are available to enhance the student's study of statistics.

The *Statistical Toolkit* by Tony Patricelli, Northeastern Illinois University, has been updated, and both the IBM® and Apple® versions are now offered. This program has been class-tested and praised for its simplicity and ease of use. It is a versatile, two-sided disk intended for use in the first course in elementary statistics.

Students may wish to use this program to help them with tedious calculations or to show step-by-step solutions that facilitate understanding of the concepts in question, thus allowing for practice and immediate reinforcement.

Graphics portions of the program can be used by instructors for classroom demonstrations to illustrate various concepts, such as probability defined as areas under curves or the Central Limit Theorem. A site license will be available.

Transparencies for use in the classroom are available with this edition. The packet of fifty acetates, suitable for use in large classrooms, has been prepared with special attention to commonly used statistical graphs and concepts.

The *Scott, Foresman/Little, Brown Test Generator for Statistics* enables instructors to select questions by section or chapter or to use a ready-made test for each chapter. Instructors may generate tests in multiple-choice (IBM®/Macintosh® versions) or open-response formats, scramble the order of questions, and produce multiple versions of each test (up to nine with Apple II® and up to twenty-five with IBM® and Macintosh®). The system features a preview option that allows instructors to survey questions before printing, to regenerate variables, and to replace or skip questions.

ACKNOWLEDGMENTS

In the course of developing this edition, I have used many valuable suggestions made by my colleagues, the reviewers, and the users of the previous two editions. I express my thanks and appreciation to the following reviewers who have contributed to this third edition.

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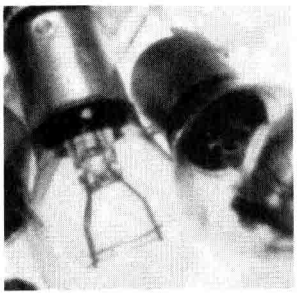
I am grateful to the Literary Executor of the late Sir Ronald A. Fisher, F.R.S., to Dr. Frank Yates, F.R.S. and to Longman Group, Ltd., London, for permission to reprint Table III from their book, *Statistical Tables for Biological, Agricultural and Medical Research* (6th edition, 1974).

R. K.

CONTENTS

1 ORGANIZATION OF DATA



INTRODUCTION 2

1-1 POPULATION, SAMPLE, AND VARIABLES 3

Exercises 9

1-2 FREQUENCY DISTRIBUTIONS 10

Exercises 17

1-3 GRAPHS AND CHARTS 21

Exercises 32

CHAPTER 1 SUMMARY 37

Chapter 1 Review Exercises 38

INTRODUCTION TO MINITAB 42

MINITAB LAB 1: ORGANIZATION OF DATA 44

2 MEASURES OF CENTRAL TENDENCY AND DISPERSION

INTRODUCTION 52

2-1 SUMMATION NOTATION 52

Exercises 54

2-2 MEASURES OF CENTRAL TENDENCY 56

Exercises 64

2-3 COMPARISON OF MEAN, MEDIAN, AND MODE 69

Exercises 71

2-4 MEASURES OF DISPERSION 72

Exercises 81

2-5 MEAN AND VARIANCE FOR GROUPED DATA 88

Exercises 91

CHAPTER 2 SUMMARY 95

Chapter 2 Review Exercises 97

MINITAB LAB 2: MEASURES OF CENTRAL TENDENCY AND DISPERSION 106

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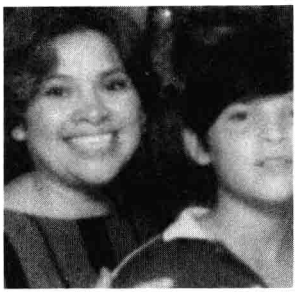
3 PROBABILITY



INTRODUCTION 114

3-1 THE EMPIRICAL CONCEPT OF PROBABILITY 114

Exercises 116

3-2 SAMPLE SPACE, EVENTS, AND THE MEANING OF PROBABILITY 116

Exercises 126

3-3 SOME RESULTS OF ELEMENTARY PROBABILITY 130

Exercises 136

3-4 COUNTING TECHNIQUES AND APPLICATIONS TO PROBABILITY (OPTIONAL) 139

Exercises 151

3-5 CONDITIONAL PROBABILITY AND INDEPENDENT EVENTS 154

Exercises 161

3-6 THE THEOREM OF TOTAL PROBABILITY AND BAYES' FORMULA (OPTIONAL) 166

Exercises 170

CHAPTER 3 SUMMARY 171

Chapter 3 Review Exercises 173

MINITAB LAB 3: PROBABILITY 175

4 PROBABILITY DISTRIBUTIONS

INTRODUCTION 180

4-1 RANDOM VARIABLES—THE DEFINITION 180

Exercises 182

4-2 DISCRETE RANDOM VARIABLES 183

Exercises 193

4-3 CONTINUOUS RANDOM VARIABLES 198

Exercises 204

CHAPTER 4 SUMMARY 208

Chapter 4 Review Exercises 209

MINITAB LAB 4: PROBABILITY DISTRIBUTIONS 212

5 THE BINOMIAL AND NORMAL PROBABILITY DISTRIBUTIONS

INTRODUCTION 218

5-1 *THE BINOMIAL DISTRIBUTION* 218

Exercises 228

5-2 *THE NORMAL DISTRIBUTION* 231

Exercises 247

5-3 *THE NORMAL APPROXIMATION TO THE BINOMIAL DISTRIBUTION* 251

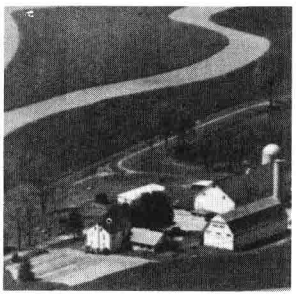
Exercises 257

CHAPTER 5 SUMMARY 259

Chapter 5 Review Exercises 260

MINITAB LAB 5: THE BINOMIAL AND NORMAL PROBABILITY DISTRIBUTIONS 263

6 SAMPLING DISTRIBUTIONS



INTRODUCTION 270

6-1 *SAMPLING DISTRIBUTION OF THE MEAN* 271

Exercises 285

6-2 *SAMPLING METHODS* 288

Exercises 291

CHAPTER 6 SUMMARY 291

Chapter 6 Review Exercises 292

MINITAB LAB 6: SAMPLING DISTRIBUTIONS 294

7 ESTIMATION—SINGLE POPULATION

INTRODUCTION 300

7-1 *POINT ESTIMATION—DEFINITION AND CRITERIA* 301

Exercises 305

7-2 *CONFIDENCE INTERVAL FOR* μ *WHEN* σ^2 *IS KNOWN* 307

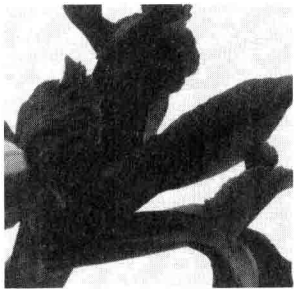
Exercises 319

7-3 *CONFIDENCE INTERVAL FOR* μ *WHEN* σ^2 *IS UNKNOWN* 321

Exercises 328

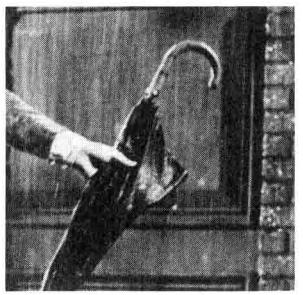
7-4 CONFIDENCE INTERVAL FOR THE POPULATION VARIANCE 332
Exercises 338
7-5 CONFIDENCE INTERVAL FOR THE POPULATION PROPORTION 342
Exercises 344
CHAPTER 7 SUMMARY 346
Chapter 7 Review Exercises 347
MINITAB LAB 7: ESTIMATION—SINGLE POPULATION 351

8 ESTIMATION—TWO POPULATIONS



INTRODUCTION 358
8-1 CONFIDENCE INTERVAL FOR THE DIFFERENCE OF POPULATION MEANS WHEN POPULATION VARIANCES ARE KNOWN 358
Exercises 362
8-2 CONFIDENCE INTERVAL FOR THE DIFFERENCE OF POPULATION MEANS WHEN THE VARIANCES ARE UNKNOWN BUT ARE ASSUMED EQUAL 365
Exercises 368
8-3 CONFIDENCE INTERVAL FOR THE DIFFERENCE OF POPULATION PROPORTIONS 373
Exercises 375
CHAPTER 8 SUMMARY 376
Chapter 8 Review Exercises 377
MINITAB LAB 8: ESTIMATION—TWO POPULATIONS 381

9 TESTS OF HYPOTHESES



INTRODUCTION 386
9-1 THE JARGON OF STATISTICAL TESTING 386
Exercises 391
9-2 THE MECHANICS OF CARRYING OUT TESTS OF HYPOTHESES 393
Exercises 405
9-3 TESTS OF HYPOTHESES (A SINGLE POPULATION) 408
Exercises 422

9-4 TESTS OF HYPOTHESES (TWO POPULATIONS) 428
Exercises 437
CHAPTER 9 SUMMARY 448
Chapter 9 Review Exercises 451
MINITAB LAB 9: TESTS OF HYPOTHESES 457

10 GOODNESS OF FIT AND CONTINGENCY TABLES

INTRODUCTION 464
10-1 A TEST OF GOODNESS OF FIT 464
Exercises 470
10-2 A TEST OF INDEPENDENCE 473
Exercises 478
10-3 A TEST OF HOMOGENEITY 480
Exercises 485
CHAPTER 10 SUMMARY 488
Chapter 10 Review Exercises 489
MINITAB LAB 10: GOODNESS OF FIT AND CONTINGENCY TABLES 490

11 LINEAR REGRESSION AND LINEAR CORRELATION

INTRODUCTION 496
11-1 LINEAR RELATION 497
Exercises 499
11-2 COMPUTATION OF A LINEAR CORRELATION COEFFICIENT AND FITTING OF A REGRESSION LINE 500
Exercises 510
11-3 REGRESSION ANALYSIS 518
Exercises 533
11-4 CORRELATION ANALYSIS 538
Exercises 546
CONCLUDING REMARKS 550
CHAPTER 11 SUMMARY 551
Chapter 11 Review Exercises 553
MINITAB LAB 11: LINEAR REGRESSION AND LINEAR CORRELATION 557

12 ANALYSIS OF VARIANCE

INTRODUCTION 564
12-1 ONE–WAY CLASSIFICATION—EQUAL SAMPLE SIZES 564
Exercises 576
12-2 ONE–WAY CLASSIFICATION—ARBITRARY SAMPLE SIZES 577
Exercises 583
CHAPTER 12 SUMMARY 589
Chapter 12 Review Exercises 590
MINITAB LAB 12: ANALYSIS OF VARIANCE 594

13 NONPARAMETRIC METHODS

INTRODUCTION 600
13-1 THE TWO–SAMPLE SIGN TEST FOR MATCHED PAIRS 600
Exercises 606
13-2 THE RANK–SUM TEST 609
Exercises 614
13-3 THE RUNS TEST 616
Exercises 620
13-4 RANK CORRELATION 622
Exercises 628
CHAPTER 13 SUMMARY 631
Chapter 13 Review Exercises 632
MINITAB LAB 13: NONPARAMETRIC METHODS 634

APPENDIX I POISSON DISTRIBUTION

INTRODUCTION 638
Exercises 640
Table I Poisson Probabilities 641

APPENDIX II TABLES

Table A–1 Binomial probabilities, denoted b(x; n, p) 643
Table A–2 The standard normal distribution (area from 0 to z, z positive) 647
Table A–3 The standard normal distribution (areas in the right tail) 648
Table A–4 Values of t for given probability levels 649
Table A–5 Values of the chi-square for given probability levels (α is area in the right tail) 650
Table A–6 Percentage points of the F distribution 651
Table A–7 Random digits 659

ANSWERS TO ODD–NUMBERED EXERCISES 664

APPLICATIONS INDEX 704

INDEX 711

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