Research Methodology & Applications of SPSS in Social Science Research

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Foreword

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I am very much delighted to review "**RESEARCH METHODOLOGY AND APPLICATIONS OF SPSS IN SOCIAL SCIENCE RESEARCH**". SPSS, standing for Statistical Package for the Social Sciences, is a powerful, user-friendly software package for the manipulation and statistical analysis of data. The package contains an extensive range of both univariate and multivariate procedures much used in various disciplines. The authors have concentrated both on Research Methodology and Application of SPSS in Social Science and on how to use SPSS to get results and on how to correctly interpret these results. The basic theoretical background of many of the techniques used is also described in separately. The book deals a number of research techniques covering both qualitative and quantitative research methods and how these methods are practically used to understand the real world. Discriminate Analysis and an Overview of Structural Equation Model (SEM) are written in a very simple way with specific examples, to enable the reader to understand the concept and carry out the analysis easily and interpret the results. Throughout the book the authors have used screen snapshots of SPSS Data Editor with variable view and Data view, Dialog boxes and Outputs to illustrate finer aspects of the techniques. Our hope is that researchers and students with such a background will find this book a relatively self-contained means of using SPSS to analyze their data correctly. I congratulate the authors for their

strenuous efforts in bringing out this book as the book is aimed primarily at academic researchers, students of psychology, sociology, psychiatry, doctoral, masters and undergraduate students of mathematics, management and various other social science disciplines, practicing managers, marketing research professionals etc. In a nutshell, it is a simple book for the students who do not have adequate knowledge in the research process or in statistical analysis.

Prof. Dr. K. MUTHUCHELIAN

Preface

Research reveals a formalized interest in a branch of knowledge. It is poking and prying with a purpose. The concept of research has existed since time immemorial. Researchers have always tried to develop a better understanding of the worldly phenomena as well as explore solutions to problem faced by them. A Knowledge of research methodologies is reluctant for advancing our scientific knowledge. Research methodology is taught as a supporting subject in several ways in many academic disciplines such as health, education, psychology, social work, nursing, public health, library and marketing research. It is therefore hardly surprising that research methods have become a core subject in all postgraduate courses in management. The core ideological base for this book comes from the conviction that, although these disciplines vary in constant, their broad approach to a research enquiry is similar. This book "RESEARCH METHODOLOGY & APPLICATIONS OF SPSS IN SOCIAL SCIENCE RESEARCH", therefore, is addressed to these academic disciplines. The domain of research is ever-widening and new research methods emerge and researchers adopts them.

This book, therefore, has been written to provide information about various methods, procedures and techniques in a simple step-by-step manner. The techniques and procedures uses qualitative and/or quantitative approaches. This book intends to help readers get an in-depth understanding of the research methods and its processes and techniques used especially in Social Studies. The book contains a unique compilation of research methodology and SPSS tools with simple and understandable examples. It makes research scholars attain various insights. Though there are many research books, this book stands with its unique combination of parametric and non-parametric test.

"RESEARCH METHODOLOGY & APPLICATIONS OF SPSS IN SOCIAL SCIENCE RESEARCH" is specially designed to meet the requirements of researchers, students, Scholars, masters and undergraduate students of mathematics, management and various other social science disciplines, practicing managers, marketing research professionals etc. by presenting a comprehensive overview of the conceptual background of research, its process and the ways of analyzing data using univariate, bivariate and multivariate techniques. With this book, we hope that that researchers can analyze the data on their own and appreciate the real use of statistics.

Data Analysis is used with respect to statistical tools and it is mostly done with the help of Software package such as SPSS. The illustrations are based on SPSS 20.0 version. With this book, we hope that that researchers can analyze the data on their own and appreciate the real use of statistics. A stepwise explanation of entering the data and the method to be followed with respect to a particular technique

has also been given. This would enhance students' understanding about the usage of these software in organizations for making decisions. Numerous solved examples discussing the application of various techniques in the field have also been added in the chapters to support the text.

Coverage and Structure

The book on "RESEARCH METHODOLOGY AND APPLICATIONS OF SPSS IN SOCIAL SCIENCE RESEARCH" comprises of 34 chapters. Chapter 1 gives introduction of Research. It gives an overview of scientific research, objectives of research, purpose of research, characteristics of research, application of research and details of research methodology. Chapter 2, *Types of Research,* discusses the types of research and the various modus operandi with special reference to business management. Chapter 3, Steps in Research Process introduces the methodology to formulate the research problem, process and analyze data and the types of research problems encountered by the researcher. Chapter 4 discusses problem identification, Chapter 5 gives an overview of literature review and uses of Mendeley software, Chapter 6 discusses research design it elaborates on the various types of research designs used in both physical and social sciences. Chapter 7 gives an overview of methods of data collection, *Types, sources, and Instruments. It* covers different sources and instruments of data collection including questionnaires, surveys, interviews, and many other techniques. Relevance of these techniques for managerial decision-making has also been discussed in detail. Chapter 8 *Tests of Hypotheses (Parametric and Nonparametric)*, provides discussion on a few parametric and nonparametric statistics along with the test of hypothesis. Chapter 9 *Sampling and Its Application provides discussion on different types of sampling used in research and its application in different situation*. Chapter 10 Introduction to SPSS gives c*onceptualization of variables and Measurements,* explains the types of variables and measures of reliability and validity. Different sources of error while measuring variables and quantifying them have also been discussed.

Chapter 11 *Descriptive Statistics,* provides discussion on the meaning and uses of descriptive statistics and helps to understand the situations where this could be used. Chapter 12 Cronbach's Alpha test it helps to check the reliability and validity of the data. Chapter 13 gives the overview of the parametric test its advantages and disadvantages. Chapter 14, 15 and 16 deals on the meaning, assumption and applications of t-test. Chapter 17, 18 and 19 analyses one way ANOVA, Two way ANOVA, Factorial ANOVA and MANOVA and its application as tools for testing the hypotheses. Chapter 21 Chi-square Test provides a detailed analysis of basic concepts and its applications of Chi-square test using cross tabs with examples using SPSS. Chapter 22 introduces non-parametric test and states the difference between parametric and non-parametric test. Chapter 23, 24, 25 and 26 studies about Mann Whitney test, Wilcoxan test, Kruskal Wallis test and Friedman test. Chapter 27 Correlation Analysis, analysis the application of correlation analysis in business and social science and the data is analyzed using SPSS. Chapter 28 Multiple Regression Analysis, describes different forms and application of multiple regression. It also discuss the remedial measures when there is a problem in the process of estimation due to the violation of the assumptions. Chapter 29 Factor Analysis describes the logic and process of condensing different variables into few factors and their uses in decision-making. It also discusses situations where it can be applied. Chapter 30 Cluster Analysis discusses the basic feature of cluster analysis and the process of segmenting markets, customers, or objects using it. Chapter 31 Multi Dimensional Scaling, *Multidimensional Scaling,* explains the nature and process of conducting

this technique. Application of multidimensional scaling using software has also been covered in detail. Chapter 32 Discriminate Analysis distinguishes between simple and multiple discriminant functions and their uses and relates their results in the decision-making process in different situations. Chapter 33 Overview of Structural Equation Model (SEM), *deals* with the objectives of structural equation modeling and the situations where it is applied. Chapter 34 *Report Writing gives* a brief outline on various aspects of report writing and provides formats of different types of reports. It also explains the ethical perspective of research.

The text book provides theoretical information in operational manner about the various principles, methods and practices followed in Research. Researchers begin with a good question and then select a research method than can best help them answer their question. The sometimes-painstaking task of gathering evidence is only the beginning in the research process. Researchers and students must analyze the strengths and weaknesses of the method they have obtained the purpose of this book is to help the top management executives, undergraduate and post graduate students and other social scientists as well as practitioners to carry out research following methodologies.

From past experiences we have learned that research projects are excellent educational tools that have a positive benefit for students, supervisors and business partners. We wish you well in your courses involving research projects. The book will cover a broader audience by appealing beginners since each chapter is simple and clearly written.

P. Sundara Pandian
S. Muthulakshmi
T. Vijayakumar

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We submit with an overwhelming heart, our love for the compassionate and gracious God, whose mercy and faithfulness, displayed absolute control and power over us, with his mighty arm.

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We must also thank Dr. K. Muthuchelian for giving his foreword message and supporting us in all our endeavors. We fondly remember the help rendered by our beloved staff members of Commerce and Economics and the Heads of the Department for having generously accepted our proposal to bring out this book. I thank all the reviewers of our book for giving their valuable suggestions. It is through their sincere encouragement and depth reviews it is made possible to see the birth of this book.

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We are indebted to our family members for their encouragement helped us in caring out our writing work. At last we would like to express our gratitude to all those who gave us the possibility to complete this book, “RESEARCH METHODOLOGY & APPLICATIONS OF SPSS IN SOCIAL SCIENCE RESEARCH”.

Contents

Foreword **v**
Preface **iv**

1. Introduction to Research **1**
Meaning 1
Definition 1
Research: A Way of Thinking 2
Objectives of Research 2
Purpose of Research 2
Characteristics of Research 3
Significance of Research 3
Application of Research 4
Meaning of Research Methodology 6
Function of Research Methodologies 6
Aims and Objectives of Research Methodology 6
Summary 6
Review Questions 7

2. Types to Research **8**
Meaning 8
Pure Research 8
Applied Research 8
Policy Research 9
Action Research 9
Theoretical or Fundamental Research 9
Exploratory Research 10
Quantitative and Qualitative Research 10
Multidisciplinary Research 11
Diagnostic Study 11
Summary 11
Review Questions 12

3. Steps in Research Process **13**
Introduction 13
Steps in Research Process 13
Step 1: Formulating the Research Problem 14
Step 2: Extensive Literature Review 15
Step 3: Developing the Objectives 15
Step 4: Preparing the Research Design 16
Step 5: Collecting the Data 20
Step 6: Processing and Analyzing Data 20
Step 7: Reporting and Findings 22
Criteria of Good Research 22
Types of Research Problems Encountered by Researchers 22
Summary 23
Review Questions 23

4. Identification of Research Problems **24**
Introduction 24
Problem in Identification and Selection 26
Sources for Identification of Problems 26
Justification for Selecting a Problem 27
Criteria for Selecting a Problem 27
Defining the Problem 28
Steps in Defining a Problem 28
Statement of Problem 28
Delimitations 29
Summary 29
Review Questions 29

5. Review of Literature **30**
Introduction 30
Sources of Review of Literature 30
Need and Purpose of Review of Literature 31
How Review is Carried Out? 32
How A Review of Literature is Presented 32
Literature Management with Open Source Tool – Mendeley 33
Major Concerns 33
The Scenarios 33
Summary 62
Review Questions 62

6. Research Design **63**
Meaning 63
What is Research Design? 63

Components of Research Design 64
1. Sampling Design 64
2. Data Collection Design 64
3. Statistical Design 64
4. Research Design 64
Need for Research Design 64
Types of Research Designs 65
Exploratory Design 65
Exploratory vs. Formal Design 67
Descriptive Design 67
Diagnostic Design 68
Analytical Design 69
Experimental Design 69
Informal Experimental Designs 70
1. Before and After Without Control 70
2. After-only with Control 70
3. Before and After the Control 71
Formal Experimental Designs 71
Completely Randomized Design (Crd) 71
Randomized Complete Block Design (Rcbd) 72
Factorial Design 72
Case Study Method 72
Longitudinal vs. Cross-sectional Study 73
Summary 74
Review Questions 74

7. Methods of Data Collection 75
Meaning 75
Primary and Secondary Data 75
Choice Between Primary and Secondary Data 75
Documentary Sources 76
Meaning of Document 76
Classification of Documents 76
Advantages of Secondary Sources of Data 78
1. Provides An Insight Into Total Situation 78
2. Helps in the Formulation of Hypothesis 78
3. Helps in Testing Hypothesis 78
4. Provides Supplementary Information 78
Disadvantages of Secondary Sources of Data 78
1. Collected for A Specific Purpose 78
2. Old Data 78
3. Aggregation of Data in Inappropriate Unit 78

Primary Data 78
Survey Method 79
Observation 80
Process of Observation 80
Characteristics of Observation 80
Types of Observation 81
Casual and Scientific Observation 81
Questionnaire 85
Types of Questions 85
Distinction Between Open-ended Questions and Limited – Choice Questions 87
Distinction Between Ambiguous Questions and Filtered Questions 87
Distinction Between Open-ended Questions and Multiple-choice Questions 88
Questions (to be Avoided) Requiring More Diligence 88
Mail Questionnaire 90
Preliminary Steps to Construct A Questionnaire 90
Sixteen Commandments 90
Advantages of the Questionnaire Technique 91
Disadvantages / Limitations of the Questionnaire Technique 91
Summary 91
Review Questions 91

8. Hypothesis 92
Meaning 92
What is Hypothesis? 92
Definition 93
Sources of Hypothesis 93
Characteristics of A Good Hypothesis 93
Functions or Roles of Hypothesis 94
Types of Hypothesis 94
Types of Errors 98
Steps in Hypothesis Testing 98
Summary 99
Review Questions 99

9. Sampling Techniques 100
Meaning 100
Sampling Method 101
Census Method 101
Principles of Sampling 102
Factors Affecting the Inferences Drawn From A Sample 102
Need for Sample / Sampling 103
Characteristics of A Good Sampling Design 103
Terms Used in Sampling 103

Sample 104
Sampling Designs (Sampling Techniques or Sampling Methods) 105
Basis of Representation 105
Technique of Selection Units 105
(I) Probability Sampling 106
(A) Simple Random Sampling 106
(B) Complex Random Sampling Design 107
(C) Cluster Sampling 109
(D) Multi-stage Sampling 110
(E) Multi-stage vs. Multi-phase Sampling 111
(II) Non-probability Sampling 111
(A) Convenience Sampling 111
(B) Judgement Sampling (Deliberate or Purposive Sampling) 112
(C) Quota Sampling 112
(D) Snowball Sampling 113
Sampling and Non-sampling Errors 114
Sampling Error 114
Non-sampling Errors 115
Sample Size 115
Determinants of Sample Size 115
Approaches to Determine the Size of Sample 116
Sampling Distribution, Sampling Bias and Sampling Variance 117
Sampling Distribution 117
Sampling Bias 117
Sampling Variance 118
Confidence Intervals 118
The Normal Distribution 118
Limitations of Sampling 119
Summary 120
Review Questions 121

10. Introduction to Statistical Package for Social Sciences (SPSS) 122
Introduction to SPSS 122
What is Variable? 122
Types of Variable 122
I. Causal Relationship 122
II. From the Viewpoint of the Study Design 123
III. From the Viewpoint of the Unit of Measurement 123
Levels of Measurement or Scale of Measurement 124
Nominal Scale 124
Ordinal Measurement 125
Interval 126

Ratio 126
Opening a Data File in Spss 126
Spss Data Editor 127
Variable View 128
Data View 128
Entering Data into the Data Editor 128
Statistical Analysis 131
SPSS Output 132
Closing SPSS 132
Tutorials in SPSS 132
Importing Data 132
Summary 132
Review Questions 133

11. Descriptive Statistics 134
Meaning of Descriptive Statistics 134
Definition 134
Objectives 134
Measures of Central Tendency 135
Mean 135
Merits and Demerits of Arithmetic Mean 135
Median 136
Characteristics of Median 136
Merits and Demerits of Median 136
Mode 136
Characteristics of Mode 137
Relationship Among Mean, Median and Mode 137
Geometric Mean 138
Merits and Demerits of Geometric Mean 138
Harmonic Mean 138
Merits and Demerits of Harmonic Mean 138
Relationship Between A.M. G.M., H.M. 139
Measures of Variability 139
Purposes of Studying Dispersion 139
Absolute and Relative Measure of Dispersion 139
Measures of Dispersion 140
Range 140
Merits and Demerits of Range 140
Use of Range 140
Mean Deviation 140
Standard Deviation 141
Definition 141
Coefficient of Standard Deviation 141

Coefficient of Variation 142
Application of Descriptive Statistics Using Spss 142
Summary 147
Review Questions 147

12. Cronbach's Alpha Test 148
Introduction 148
Reliability 149
Construct Validity 150
Face Validity 150
Content Validity 150
Criterion-related Validity 150
Scaling 151
Generating Potential Items 151
Evaluating the Potential Items 151
Pilot Testing the Items 152
Scoring the Items 152
Item Analysis 153
Performing the Analysis with SPSS 153
Summary 155
Review Questions 155

13. Parametric Test 156
Introduction to Parametric Test 156
Key Points of Parametric Tests 156
Types of Parametric Tests 156
Applications of Parametric Tests 157
Advantages of Parametric Tests 157
Disadvantages of Parametric Tests 157
Summary 158
Review Questions 158

14. One Sample T-test 159
Meaning of One Sample t-test 159
Key Points 159
Types of Sample 'T' Statistics 159
Assumptions 160
Application Areas 160
One-sample t-test 160
Hypotheses for One Sample t-test 160
Summary 163
Review Questions 164

15. Two-sample T-test or Independent Sample t-test **165**
Meaning of Two-sample t-test 165
Assumptions 165
Application Areas 165
Hypotheses for Two-tailed Test 166
Summary 170
Review Questions 170

16. Paired Sample T-test **171**
Meaning of Paired Sample T-test 171
Purpose 172
Other Names of This Test 172
Assumptions 172
Application Areas 172
Dependent Variable 172
Hypotheses for Paired Sample t-test 172
Summary 175
Review Questions 175

17. Analysis of Variance (ANOVA) **176**
Meaning of Analysis of Variance (ANOVA) 176
Origin of ANOVA 176
Types of ANOVA 176
Uses 177
Hypothesis 177
Assumptions 177
Application Areas 177
Summary 181
Review Questions 181

18. Two-way ANOVA **182**
Meaning of Two-way ANOVA 182
Assumptions 182
Application Areas 183
Summary 191
Review Questions 191

19. Factorial Anova **192**
Meaning of Factorial ANOVA 192
Assumptions 192
Application Areas 193
Two-way Between-subjects ANOVA 193
Summary 200
Review Questions 200

20. Multivariate Analysis of Variance (MANOVA) 201
Meaning of Multivariate Analysis of Variance 201
Assumptions 201
Application Areas 202
Summary 206
Review Questions 206

21. Chi-square Test 207
Meaning of Chi-square Test 207
Basic Concepts 207
Chi-square Test for Goodness of Fit 208
Chi-square Test for Homogeneity 208
Chi-square Test of Independence 208
Characteristics of Chi-square Test 208
Properties of Chi-square 208
Assumptions 209
Application Areas 209
Hypothesis 209
Test for Goodness of Fit 209
Chi-square Test for Cross Tabs 213
Summary 217
Review Questions 217

22. Non-parametric Tests 218
Meaning of Non-parametric Tests 218
Advantages 218
Disadvantages 219
Characteristics 219
Differences Between Parametric and Non-parametric Tests 220
Summary 220
Review Questions 220

23. Friedman's Test 221
Meaning of Friedman's Test 221
Assumptions 221
Application Areas 221
Summary 224
Review Questions 225

24. Mann-whitney Test or U-test 226
Meaning of Mann-whitney Test or U-test 226
Assumptions 226
Application Areas 227
Characteristics 227

Summary 232
Review Questions 232

25. Wilcoxon Signed Rank Test 233
Meaning of Wilcoxon Signed Rank Test 233
Assumptions 233
Application Areas 234
Summary 237
Review Questions 237

26. Kruskal Wallis Test 238
Meaning of Kruskal Wallis Test 238
Assumptions 238
Application Areas 238
Summary 243
Review Questions 243

27. Meaning of Correlation Analysis 244
Application of Correlation Analysis in Business and Social Sciences 244
Correlation Coefficient 244
Nature of Variables 245
Purpose of Correlation Analysis 245
Assumptions 245
Application Areas 245
Hypothesis 246
Bivariate / Partial Correlation 246
Strengths of Correlations 246
Limitations of Correlations 246
Summary 249
Review Questions 249

28. Multiple Regression Analysis 250
Meaning of Multiple Regression Analysis 250
Multiple Regression Equation 250
Using Multiple Regression Analysis 251
Plotting The Scatter Diagram 251
Assumptions 252
Application Areas 253
Performing Multiple Regression Analysis 253
Statistics Associated With Multiple Regression Analysis 253
Limitations 254
Summary 262
Review Questions 263

29. Factor Analysis **264**
Meaning of Factor Analysis 264
Methods of Conducting Factor Analysis 265
Input Data 265
Exploratory and Confirmatory Factor Analysis 265
Extractions 266
Factor Loadings 266
Rotation 266
Communalities 266
Eigen Value and Scree Plot 266
Sample Size Consideration 267
Purpose 267
Assumptions 267
Application Areas 267
Limitations 267
Mathematical Application 268
Summary **279**
Review Questions **279**

30. Cluster Analysis **280**
Meaning of Cluster Analysis **280**
Assumptions 281
Application Areas 281
Application Areas 281
Methods 281
Hierarchical Clustering 282
Non-hierarchical (K-means) 282
Data 282
Purpose 282
Summary **287**
Review Questions 288

31. Multidimensional Scaling **289**
Meaning of Multidimensional Scaling **289**
Nature of Mds **290**
Features of Mds **290**
Assumptions **291**
Application Areas **291**
Summary **298**
Review Questions **299**
32. Discriminant Analysis **300**
Meaning of Discriminant Analysis **300**
Assumptions **300**
Application Areas **300**

Discriminant Analysis Model **301**
Summary **313**
Review Questions **313**

33. Structural Equations Modelling **314**
Introduction to Structural Equations Modelling 314
Research in Action 315
Sem and Other Multivariate Techniques 316
Nature and Objectives of SEM 316
Basic Terminologies of SEM 317
Manifest Variables 317
Latent Variables 317
Error 317
Disturbance 317
Exogenous or Dependent Variable 318
Endogenous or Dependent Variable 318
Measurement Model 318
Structural Model 318
Direct Effect 318
Indirect Effect 318
Confirmatory Factor Analysis 318
Covariance Structure 318
Mean Structure 318
Single-headed Arrow 318
Double-headed Arrow 319
Rectangle or Square 319
Circle or Eclipse 319
Components of Sem 319
Measurement Model (CFA) 319
Structural Model (Path Analysis) 319
Statistical Tests in SEM 319
Assessing the Measurement Model (Through CFA) 319
Check the Goodness of Fit of the Measurement Model 320
CMIN or df 320
CFI, GFI, and NFI 320
PCFI, PGFI and PNFI 320
RMSEA 320
Construct Validity 320
Convergent Validity 320
Rules of Thumb of Convergent Validity are as Follows 320
Discriminant Validity 320

Nomological Validity 321
Assessing The Structural Model 321
Summary 321
Review Questions 321

34. Interpretation and Report Preparation 322
Meaning of Interpretation 322
Need for Interpretation 322
Guidelines for Interpretation 323
Precautions in Interpretation 323
Report Writing 323
Meaning of Report Writing 323
Purpose or Functions of a Research Report 323
Characteristics of a Good Research Report 324
Types of Report 324
Format of Research Report/Project Report 325
Brief Description of the Various Items of a Report 326
Title Page 326
Example 1: Project Report Submitted by an MBA Student 326
Example 2: A Research Report Submitted by a Faculty Member to the AICTE 327
Research Declaration 327
Certificate of Authenticity 327
Acknowledgement 328
Table of Contents 328
Contents 328
Introduction 329
Introduction to Study 329
Introduction to the Organization, Industry or Situation 329
Need or Significances of the Problem 329
Statement of Problem 330
Scope of the Study 330
Objectives of the Study 330
Hypotheses 331
Review of Literature 331
Research Methodology 331
Research Design 331
Sources Of Data 332
Sampling Design 332
Data Collection 332
Data Analysis 332
Limitations of the Study 332

Analysis and Interpretation/Result and Discussion 332
Summary 332
Findings 332
Suggestions 333
Conclusion 333
Future Line of Work 333
References 333
References From Project Report/Dissertation/Thesis 334
Bibliography 334
Appendices 334
Annexures 335
Page Numbering 335
Recap of Salient Points in Executing a Research Project 335
Presentation of Research Report 335
Summary 335
Review Questions 336

Bibliography **337**

Glossary

1. **Adjusted R^2.** A measure of the loss of predictive power in regression analysis. The adjusted R tells us how much variance in the outcome would be accounted for, if the model has been derived from the population from which the sample was taken.
2. **Alternative hypothesis.** Any statement (hypothesis) which is complementary to null hypothesis. This states that the sample mean and population mean are not equal.
3. **ANOVA.** An acronym for the Analysis of Variance. By analyzing the variance in the data due to different sources (e.g. an independent variable or error) we can decide if our experimental manipulation is influencing the scores in the data.
4. **Asymp. Sig. (asymptotic significance).** An estimate of the probability of a nonparametric test statistic employed by computer statistical analysis programs. This is often used when the exact probability cannot be worked out quickly.
5. **Beta weight.** The average amount by which the dependent variable increases when the independent variable increases by one standard deviation (all other independent variables are held constant).
6. **Between subjects.** Also known as independent measures. In this design, the samples we select for each condition of the independent variable are *independent*, as a member of one sample is not a member of another sample.
7. **Bootstrapping.** A sample is used to estimate a population. New bootstrap samples are randomly selected from the original sample with replacement (so an item can be selected more than once). The bootstrap samples, often 1,000 or more, are then used to estimate the population sampling distribution.
8. **Bivariate correlation.** A correlation (relationship) between two variables.
9. **Categorical variable.** Any variable that consists of categories of objects or entities. Test results in a class is a good example because it is classified into pass and fail.
10. **Chi-square distribution.** A probability distribution of sum of squares of several normally distributed variables. It is used to test hypothesis about categorical variable.
11. **Chi-square test.** Generally refers to Pearson's Chi-square test. It is used to find the discrepancy between observed and expected frequency based on some model or to test the independence of two categorical variables.
12. **Confidence interval.** A range of values around that statistic (for example, mean) that are believed to contain, with a certain probability (95%), the true value of that statistic (i.e., mean of population).

13. **Contingency table.** A table classifying the individuals with respect to two or more categorical variables. The levels of each variable are arranged in rows and columns and the number of individuals falling into each category is noted in the cells of the table. for example, if the students in a college are classified with respect to gender and blood group, the contingency table will show the number of males in blood group A, the number of females in blood group B and so on.
14. **Correlation coefficient.** A decimal number between 0 and 1.00 that indicates the degree and direction to which two quantitative variables are related and represented by *r*.
15. **Covariance.** A measure of how much the deviations of two variables match.
16. **Covariate.** A variable that is related to the outcome variable that is measured. Basically, anything that has an impact on the dependent variable and that cannot be controlled for by design can be a covariate.
17. **Criterion variable.** The outcome variable (dependent) that is predicted in regression analysis or correlation research.
18. **Case.** A row in the Data Editor le; the data collected from a single participant.
19. **Chart Editor.** The feature in SPSS that allows the editing of charts and graphs.
20. **Comparisons.** The results of a statistical test with more than two conditions will often show a significant result but not where the difference lies. We need to undertake a comparison of conditions to see which ones are causing the effect. If we compare them two at a time this is known as pairwise comparison and if we perform unplanned comparisons after discovering the signicant finding these are referred are known as *post hoc* comparisons.
21. **Component.** The term used in the principal components method of factor analysis for a potential underlying factor.
22. **Condition.** A researcher chooses levels or categories of the independent variable(s) to observe the effect on the dependent variable(s). These are referred to as conditions, levels, treatments or groups. for example, 'morning' and 'afternoon' might be chosen as the conditions for the independent variable of time of day.
23. **Confidence interval.** In statistics we use samples to estimate population values, such as the mean or the difference in means. The confidence interval provides a range of values within which we predict lies the population value (to a certain level of confidence). The 95 per cent confidence interval of the mean worked out from a sample indicates that the population mean would fall between the upper and lower limits 95 per cent of the time.
24. **Contrasts.** With a number of conditions in a study we may plan a set of comparisons such as contrasting each condition with a control condition. These planned comparisons are referred to as contrasts. We can plan complex contrasts for example, the effects of conditions 1 and 2 against condition 3.
25. **Correlation.** The degree to which the scores on two (or more) variables co-relate. That is, the extent to which a variation in the scores on one variable results in a corresponding variation in the scores on a second variable. Usually the relation- ship we are looking for is linear. A multiple correlation examines the relationship between a combination of predictor variables with a dependent variable.
26. **Critical value.** We reject the null hypothesis after a statistical test if the probability of the calculated value of the test statistic (under the null hypothesis) is lower than the significance level (e.g. 0.05). Computer programs print out the probability of the calculated value (e.g.

0.023765) and we can examine this to see if it is higher or lower than the significance level. Textbooks print tables of the critical values of the test statistic, which are the values of the statistic at a particular probability. for example, if the calculated value of a statistic (i.e. a *t* test) is 4.20 and the critical value is 2.31 (at the 0.05 level of significance), then clearly the probability of the test statistic is less than 0.05.

27. **Cross tabulation.** Frequency data can be represented in a table with the rows as the conditions of one variable and the columns as the conditions of a second variable. This is a crosstabulation. We can include more variables by adding 'layers' to the crosstabulation in SPSS.
28. **Data Editor.** The feature in SPSS where data is entered. Saving the information from the Data Editor will produce an SPSS .sav le. There are two windows within the Data Editor: Data View and Variable View.
29. **Data View.** The Data View window within the Data Editor presents a spreadsheet style format for entering all the data points.
30. **Degrees of freedom.** When calculating a statistic we use information from the data (such as the mean or total) in the calculation. The degrees of freedom is the number of scores we need to know before we can work out the rest using the information we already have. It is the number of scores that are free to vary in the analysis.
31. **Dependent variable.** The variable measured by the researcher and predicted to be influenced by (that is, depend on) the independent variable.
32. **Descriptive statistics.** Usually we wish to describe our data before conducting further analysis or comparisons. Descriptive statistics such as the mean and standard deviation enable us to summarise a dataset.
33. **Discriminant function.** A discriminant function is one derived from a set of independent (or predictor) variables that can be used to discriminate between the conditions of a dependent variable.
34. **Distribution.** The range of possible scores on a variable and their frequency of occurrence. In statistical terms we refer to a distribution as a 'probability density function'. We use the mathematical formulae for known distributions to work out the probability of finding a score as high as or as low as a particular score.
35. **Data editor.** The main window in SPSS to name the variable, enter data and carry out analysis.
36. **Data view.** One of the two ways to view the contents of the data editor. The data view has a spreadsheet for entering data.
37. **Factor.** Another name for independent variable or predictor that is used in describing experimental designs.
38. **F-Ratio.** A test statistic with known probability distribution (F-distribution). It is the ratio of average variability in the data that a given model can explain to the average variability unexplained by the same model.
39. **Equality of variance.** *See* homogeneity of variance.
40. **General linear model.** The underlying mathematical model employed in parametric statistics. When there are only two variables, X and Y, the relationship between them is linear when they satisfy the formula $Y = a + bX$ (where a and b are constants). The general linear model is a general form of this equation allowing as many X and Y variables as we wish in our analysis.
41. **Grouping variable.** In analyzing data in SPSS we can employ an independent measures independent variable as a grouping variable. This separates our participants into groups (such as

introverts versus extroverts). It is important when inputting data into a statistical analysis program that we include the grouping variable as a column, with each group defined (i.e. introvert as '1' and extrovert as '2'). We can then analyse the scores on other variables in terms of these groups, such as comparing the introverts with the extroverts on, say, a monitoring task.

42. **Goodness of fit.** An index to find how well a model fits the data from which it was generated. Chi-square test is one of the tests to find the goodness of fit.
43. **Hypothesis testing.** A statistical procedure for testing the null hypothesis against alternate hypothesis. The statistical procedures in hypothesis testing include *t*, *F* and ÷ 2-square tests.
44. **Hypothesis.** In statistics, a hypothesis is a statement about a population, such as the nature of the distribution. (There are two kinds of hypothesis, **Null hypothesis** and **Alternate hypothesis**).
45. **Independent variable.** A variable under study, to determine whether it has a causal effect on the dependent variable. In regression studies, the term is used to denote a predictor variable or regressor.
46. **Inferential statistics.** Includes a set of statistical tools which enable the researcher to infer or reach conclusions about the data.
47. **Illustrative statistics.** Statistics that illustrate rather than analyse a set of data, such as the total number of errors made on a reading task. Often we illustrate a dataset by means of a graph or a table.
48. **Independent or independent measures.** A term used to indicate that there are different subjects (participants) in each condition of an independent variable; also known as 'between subjects'.
49. **Interaction.** When there are two or more factors in an analysis of variance, we can examine the interactions between the factors. An interaction indicates that the effect of one factor is not the same at each condition of another factor. for example, if we nd that more cold drinks are sold in summer and more hot drinks sold in winter, we have an interaction of 'drink temperature' and 'time of year'.
50. **Intercept.** A linear regression finds the best t linear relationship between two variables. This is a straight line based on the formula $Y = a + bX$, where b is the slope of the line and a is the intercept, or point where the line crosses the *Y*-axis. (In the SPSS output for an ANOVA the term 'intercept' is used to refer to the overall mean value and its difference from zero.)
51. **Item.** When we employ a test with a number of variables (such as questions in a questionnaire) we refer to these variables as 'items', particularly in reliability analysis where we are interested in the correlation between items in the test.
52. **Kurtosis.** The degree to which a distribution differs from the bell-shaped normal distribution in terms of its peakness. A sharper peak with narrow 'shoulders' is called leptokurtic and a matter peak with wider 'shoulders' is called platykurtic.
53. **Levels of data.** Not all data are produced by using numbers in the same way. Sometimes we use numbers to name or allocate participants to categories (i.e. labelling a person as a liberal, and allocating them the number 1, or a conservative, and allocating them the number 2). In this case the data is termed 'nominal'. Sometimes we employ numbers to rank order participants, in which case the data is termed 'ordinal'. Finally, when the data is produced on a measuring scale with equal intervals the data is termed 'interval' (or 'ratio' if the scale includes an absolute zero value). Parametric statistics require interval data for their analyses.
54. **Likert scale.** A measuring scale where participants are asked to indicate their level of agreement or disagreement to a particular statement on, typically, a 5- or 7-point scale (from strongly agree to strongly disagree).

55. **Linear correlation.** The extent to which variables correlate in a linear manner. for two variables this is how close their scatterplot is to a straight line.
56. **Linear regression.** A regression that is assumed to follow a linear model. for two variables this is a straight line of best t, which minimises the 'error'.
57. **MANOVA.** Multivariate analysis of variance. It is an analysis of variance (ANOVA) applicable to multivariate (a multivariate data set containing observations on three or more variables dependent variables) situation, for two or more independent variables.
58. **Main effect.** The effect of a factor (independent variable) on the dependent variable in an analysis of variance measured without regard to the other factors in the analysis. In an ANOVA with more than one independent variable we can examine the effects of each factor individually (termed the main effect) and the factors in combination (the interactions).
59. **Mean.** The average of a set of numbers or scores in a distribution. To get the mean, all the values are added up and the sum is divided by the total number of all the values.
60. **Measures of central tendency.** Single numbers that are used to describe a larger set of data in a distribution of scores. The measures of central tendency are mean, median and mode.
61. **Median.** The score or number, which falls directly in the middle of a distribution of numbers or divides the data into two equal parts.
62. **Mean square.** A term used in the analysis of variance to refer to the variance in the data due to a particular source of variation.
63. **Mode.** The number or score, which occurs most frequently in a distribution of numbers.
64. **Multiple correlation.** The correlation of one variable with a combination of other variables.
65. **Multiple regression.** An extension of simple regression in which an outcome is predicted by a linear combination of two or more predictor variables.
66. **Multivariate analysis.** Analysis of variance that involves more than one outcome variable that have been measured.
67. **Multivariate.** Analysis of variance involving more than one outcome variable (multivariate = many variables)
68. **Mixed design.** A mixed design is one that includes both independent measures factors and repeated measures factors. for example, a group of men and a group of women are tested in the morning and the afternoon. In this test 'gender' is an independent measures variable (also known as 'between subjects') and time of day is a repeated measures factor (also known as 'within subjects'), so we have a mixed design.
69. **Nonparametric test.** Statistical tests that do not use, or make assumptions about, the characteristics (parameters) of populations.
70. **Normal distribution.** A bell-shaped frequency distribution that appears to underlie many human variables. The normal distribution can be worked out mathematically using the population mean and standard deviation.
71. **Null hypothesis.** A prediction that there is no relationship between the independent and dependent variables.
72. **Negatively skewed.** Skewness is asymmetry in a distribution. A negatively skewed distribution has most of its scores bunched up at the higher end (right side) of the distribution.
73. **Nominal data.** A data set in which the numbers merely represent names, the numbers have no meaning other than the name.

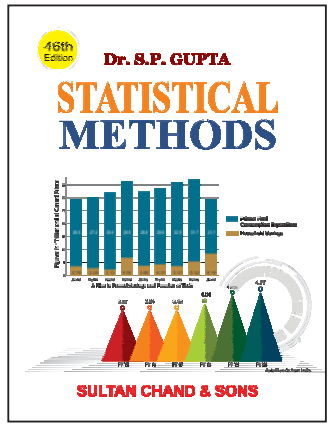
74. **One-tailed test.** One-tailed test is used to test if the sample mean is significantly greater than population mean or if it is significantly less than that, but not both.
75. ***P*-value.** The probability value (*p*-value) of a statistical hypothesis test. It is the probability of getting a value of the test statistic as extreme as that observed by chance alone. Small *p*-values suggest that the null hypothesis is not true. The smaller the *p*-value, the more convincing is the rejection of the null hypothesis. *p*-value indicates the strength of evidence for rejecting the null hypothesis H0.
76. **Percentile.** Any distribution could be described in terms of percentiles. 10th percentile is the value in a distribution below which 10% of the values lie. 90th percentile is the value below which 90% of the values lie. So 50th percentile is the median in a distribution.
77. **Positively skewed.** Skewness is asymmetry in a distribution. A positively skewed distribution has most of its scores bunched up at the lower end (left side) of the distribution.
78. **Post-hoc comparisons.** Unplanned comparisons, one wishes to make after the data have been gathered. It is usually carried out if there is significant difference between two groups (pairwise comparisons) covering the different levels of the variable under study.
79. **Predictor variable.** The variable from which the criterion variable is found out in a prediction study.
80. **Probability.** The term probability does not allow a concrete definition; it can be defined in different ways. In simple, probability is the ratio of favourable number of outcomes divided by total number of outcomes in any one trial or experiment.
81. **Qualitative variable.** A character or property, such as blood group, gender or nationality, which can be expressed in kind and not in numbers. It is an attribute and is descriptive in nature.
82. **Quantitative variable.** A variable whose differing status can be expressed in numbers. Characteristics like height, weight, length, etc. are measured quantitatively.
83. **Range.** The difference between the lowest score and the highest score.
84. **Rank.** When a set of data is ordered from lowest to highest, the rank of a score is its position in this order.
85. **Regression.** The prediction of scores on one variable by their scores on a second variable. The larger the correlation between the variables, the more accurate the prediction. We can undertake a multiple regression where the scores on one variable are predicted from the scores on a number of predictor variables.
86. **Reliability.** A reliable test is one that that will produce the same result when repeated (in the same circumstances). We can investigate the reliability of the items in a test (such as the questions in a questionnaire) by examining the relationship between each item and the overall score on the test.
87. **Repeated measures.** A term used to indicate that the same subjects (participants) are providing data for all the conditions of an independent variable; also known as 'within subjects'.
88. **Residual.** A residual is the difference between an actual score and a predicted score. If scores are predicted by a model (such as the normal distribution curve) then the residual will give a measure of how well the data t the model.
89. **Sample.** A smaller collection of units from a population used to determine the characterstics or truth of the population.
90. **Sampling distribution.** The probability distribution of a statistics. If a large number of samples are drawn from the population and some statistics calculated, for example mean, we would

create a frequency distribution of mean. The resulting distribution will form the sampling distribution of means.

91. **Scatterplot.** A scatterplot is a plot of points on coordinate axes (X and Y-axis) used to represent and illustrate the relationships between two quantitative variables.
92. **Skewed.** A distribution is skewed if majority of the scores are bunched up at one end or the other.
93. **Spearman's rho.** The most common correlation for use with two ordinal variables or an ordinal and an interval variable. Rho for ranked data equals Pearson's *r* for ranked data.
94. **Standard deviation.** An estimate of average spread (variability) of a set of data measured in the same units of measurement as the original data. It is the square root of variance.
95. **Standard error.** The standard deviation of the sampling distribution of a statistic. for example, mean is a statistic, standard error tells how much the sample means differ from the population mean. The larger the standard error the greater is the possibility that the sample may not be an accurate reflection of the population from which the sample came.
96. **String variable.** Variable involving words, i.e., letter strings (e.g., gender, blood group, etc.).
97. **Sum of squares.** An estimate of total variability of a set of data. First the deviation for each score is calculated and then this value is squared and summed up. It is denoted by SS.
98. **Syntax.** Pre-defined written commands that instruct SPSS what the user would like to do.
99. **SIG. (2-tailed).** The exact probability of the test statistic for a two tailed prediction.
100. **Significance level.** The risk (probability) of erroneously claiming a relationship between an independent and a dependent variable when there is not one. Statistical tests are undertaken so that this probability is chosen to be small, usually set at 0.05 indicating that this will occur no more than 5 times in 100.
101. **Simple main effects.** A significant interaction in a two factor analysis of variance indicates that the effect of one variable is different at the various conditions of the other variable. Calculating simple main effects tells us what these different effects are. A simple main effect is the effect of one variable at a single condition of the other variable.
102. **Skew.** The degree of symmetry of a distribution. A symmetrical distribution, like the normal distribution, has a skew of zero. The skew is negative if the scores 'pile' to the right of the mean and positive if they pile to the left.
103. **Sphericity.** An assumption we make about the data in a repeated measures design. Not only must we assume homogeneity of variance but homogeneity of covariance – that is, homogeneity of variance of the differences between samples. Essentially, we must assume the effect of an independent variable to be consistent across both conditions and subjects in these designs for the analysis to be appropriate.
104. **Standard deviation.** A measure of the standard ('average') difference (deviation) of a score from the mean in a set of scores. It is the square root of the variance. (There is a different calculation for standard deviation when the set of scores are a population as opposed to a sample.)
105. **Standard error of the estimate.** A measure of the 'average' distance (standard error) of a score from the regression line.
106. **Standard error of the mean.** The standard deviation of the distribution of sample means. It is a measure of the standard ('average') difference of a sample mean from the mean of all sample means of samples of the same size from the same population.

107. **Standard score.** The position of a score within a distribution of scores. It provides a measure of how many standard deviation units a specific score falls above or below the mean. It is also referred to as a *z* score.
108. **Statistic.** Specially, a characteristic of a sample, such as the sample mean. More generally, statistic and statistics are used to describe techniques for summarising and analysing numerical data.
109. **Statistics viewer.** The SPSS Statistics Viewer is the name of the le that contains all of the output from the SPSS procedures. Often referred to (as in this book) as the Output Window.
110. **Subject.** The term used for the source of data in a sample. If people are the subjects of the study it is viewed as more respectful to refer to them as participants, which acknowledges their role as helpful contributors to the investigation.
111. **Sums of squares.** The sum of the squared deviations of scores from their mean value.
112. ***t*-test.** A statistical procedure to find the significance of difference between two groups. The means of both groups are compared to each other.
113. **Test statistic.** The calculated value of the statistical test that has been undertaken.
114. **Two-tailed test.** A prediction that two samples come from different populations, but not stating which population has the higher mean value.
115. **Type I error.** The error of rejecting the null hypothesis when it is true. The risk of this occurring is set by the significance level.
116. **Type II error.** The error of not rejecting the null hypothesis when it is false.
117. **Total sum of squares** An estimate of total variability in a data set. It is the total squared deviations between each observation and from the overall mean of all observations.
118. **Univariate.** A term used to refer to a statistical test where there is only one dependent variable. ANOVA is a univariate analysis as there can be more than one independent variable but only one dependent variable.
119. **Variable view.** One of the two ways to view the contents of the data editor. It has a spreadsheet for entering the name and details of the variable.
120. **Variable.** A property or characteristic on which the data are collected. There are qualitative and quantitative variables.
121. **Variance.** The average amount of dispersion or spread in a distribution.The deviations from the mean are squared and summed up to find variance.
122. **Value labels.** Assigning value labels within the Variable View screen in SPSS ensures that the output is labelled appropriately when grouping variables are used – for example, 1 = males, 2 = females.
123. **Weighting/loading.** The contribution made to a composite value (such as a regression equation or a factor in a factor analysis) by a variable. We use the calculated size of the weighting to assess the importance of the variable to the factor in a factor analysis.
124. **Within subjects.** Also known as repeated measures. We select the same subjects (participants) for each condition of an independent variable for a within subjects design.
125. **Wilcoxon signed-rank test.** A non-parametric test which is used to test the difference between two related samples. It is a non-parametric equivalent to a matched pair *t*-test.
126. ***Z*-score.** A conversion of a raw score on a test to a standardized score represented in units of standard deviations. This is a commonly used statistical procedure that is used to compare scores of tests that might not be measured on the same scale.

Statistical Methods



S.P. Gupta

About the Book

Statistical Methods are playing an ever-increasing role in framing suitable policies in a large number of diversified fields covering natural, physical and social sciences. Statistics today has become indispensable in all phases of human endeavour. This book is primarily meant for undergraduate students of Commerce and Economics. This book entitled "Statistical Methods" was first published in 1969.

Salient Features

- The book is written in a very simple and lucid style.
- For the first time the book is being published in the broader form on the initiative of the publisher, Sultan Chand & Sons.
- It caters to the requirements of under-graduate as well as post-graduate students of Commerce, Economics and Management.
- The Engineering, Medical and Research students can also refer to the book to meet their specific requirements.
- The book is non-mathematical in character.
- Besides good theory it contains more than 1,500 Illustrations and about more than 2,000 exercise questions for better understanding of the subject.
- A large number of questions have been picked up from the examination papers of leading Universities.
- Hints to ticklish problems have been given wherever necessary.

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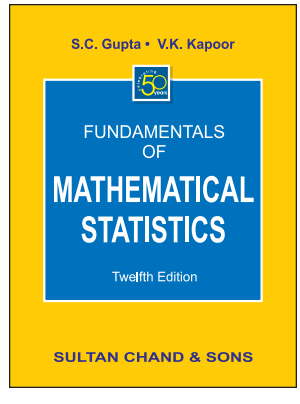
Fundamentals of MATHEMATICAL STATISTICS



S.C. Gupta • V.K. Kapoor

About the Book

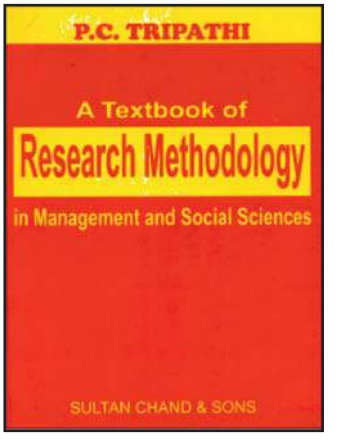
A textbook written completely on modern lines for undergraduate & post graduate courses in Statistics, Mathematics, Economics, Computer Science, Engineering and Indian Civil Services & Indian Statistical Service Examinations. The thoroughly revised, (Golden Jubilee) TWELFTH EDITION of this indispensable, authoritative, well-written & best selling textbook, while retaining its analytical and modern approach now includes a large number of new topics, extensively revised and rewritten material, updated information and various distinct new features.

Salient Features

- The book has been written in a very simple and lucid style. The text material is self-explanatory and even the students learning statistics through distance education can follow it without much stress and strain.
- The treatment is non-mathematical in character and the readers can easily understand the text material without much taxing their minds.
- Besides good theory the book contains a large number of solved illustrations (to be exact, 885). These illustrations have been very carefully selected mainly from the latest examination question papers of various Universities all over India and neighbouring countries.
- This book is primarily meant to cater to the needs of under-graduate and post-graduate students of Commerce, Economics, Management and Professional Courses.

Edition: 12th, 2020; *Pages: xx* + 1324; *Size:* 185 × 240 mm; ISBN: 978-93-5161-173-8 (TC 499)

A Textbook of Research Methodology in Management and Social Sciences



P.C. Tripathi

About the Book

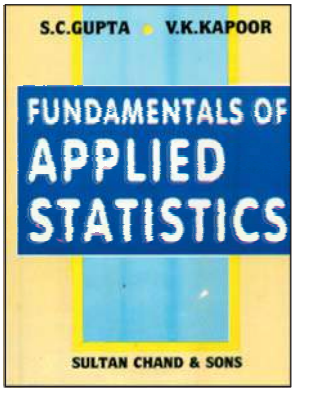
Research in social sciences has become very popular in our country in recent years. At the individual level, M.Phil., and Ph.D. programmes have added impetus to research. At the organisational level, new awareness has developed among corporate organisations to take research-based decisions instead of relying on institution. Social research involves a logical series of steps right from selecting a topic to writing a report.

Salient Features

- Comprehensive description of each topic
- Lucid and simple language
- Real world examples
- Solved exercises and objective questions (with answers)
- Conformity to the core syllabus

Edition: 7th, 2014; *Pages: xx* + 388; *Size:* 185 × 240 mm; ISBN: 978-93-5161-013-7 (TC 237)

Fundamentals of Applied Statistics



S.C. Gupta • V.K. Kapoor

About the Book

The 4th thoroughly revised edition is one of the best-selling textbook for all introductory and advance courses in Applied Statistics, while retaining its analytical and modern approach. The textbook has been written completely on modern lines for undergraduate and postgraduate courses in Statistics, Management, Engineering, Agriculture, Sciences, Economics, Computer Science Courses and Indian Civil Services and Indian Statistical Service Examination

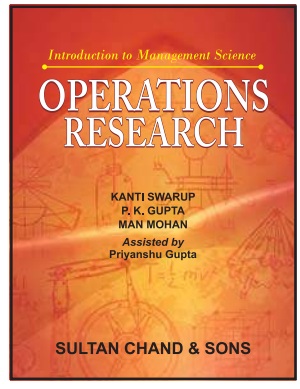
Salient Features

The book provides comprehensive and exhaustive theoretical discussion. All basic concepts have been explained in an easy and understandable manner. 125 stimulating problems selected from various university examinations have been solved. It conforms to the latest syllabi of B.Sc. (Hons.) and postgraduate examinations in Statistics, Agriculture and Economics.

Edition: 7th, 2019; *Pages: xx* + 708; *Size:* 185 × 240 mm; ISBN: 978-81-8054-708-8 (TC 502)

Operations Research

Kanti Swarup • P.K. Gupta • Man Mohan
Assisted by: Priyanshu Gupta



About the Book

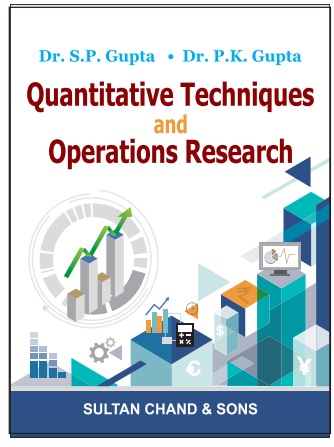
For over four decades, Operations Research : An Introduction to Management Science has provided its readers with a sound conceptual understanding of various mathematical approaches and techniques that have shaped management science. Operations research methods / techniques have laid the foundations for a scientific approach to managerial decision-making and have become increasingly popular in recent times. This book aims to make these concepts and methods easily understandable, enabling its readers to appreciate the role of 'Management Science' in the organizational decision-making processes. The book is intended to serve as a core textbook for the students who can equip themselves with a robust understanding of operations research concepts before applying them directly to real-life business problems.

Salient Features

- This thoroughly revised and enlarged edition of the book presents the fundamental concepts of Operations Research in a comprehensive yet easy-to-understand manner.
- The text uses simple language, lucid style, cogent presentation and clarity of exposition. It is self-contained and adopts a practical approach to learning.
- The book focuses on marrying theories and concepts with their practical applications. There is an adequate emphasis on real-life applications from different spheres of business.
- All the chapters have been reorganized and re-written to facilitate an easier grasp of the core concepts being discussed.
- A wide variety of examples and illustrations have been included in the chapters to give hands-on practice in applying the methodology of Operations Research to real-world scenarios.
- At the end of each chapter, conceptual questions in the form of "Test Your Understanding" and a "Review Exercise" are given for adequate practice.
- The chapter on 'Decision Theory' has been thoroughly revised to emphasize problem formulation and structuring of the decision-making problems.
- The chapter on 'Operations Scheduling' has been dealt with at greater length owing to its increasing importance in the current business environment.
- A new chapter on 'Statistical Quality Control' is a fresh addition to this edition of the book. This has been done to recognize the tremendous importance of maintaining the quality of output and processes to the survival of any industry / firm.
- All the critical steps of the computational procedure for the important techniques have been presented in a step-by-step algorithm format. It can not only ease learning but can also serve as a ready reckoner for decision-making situations.
- To enhance the understanding of the subject by readers of various disciplines, a conceptual approach is adopted wherein discussion and presentation of each concept are followed by numerous illustrations from different functional areas of management.
- A novel feature of this text is the inclusion of a chapter on 'Case Problems'. These have been derived from real-life examples of critical decision-making situations that management professionals have encountered.

Edition: 20th 2022; *Pages:* *xxiv* + 1160; *Size:* 185 × 240 mm; ISBN: 978-93-5161-183-7 (TC 525)

Quantitative Techniques and Operations Research



P.K. Gupta • S.P. Gupta

About the Book

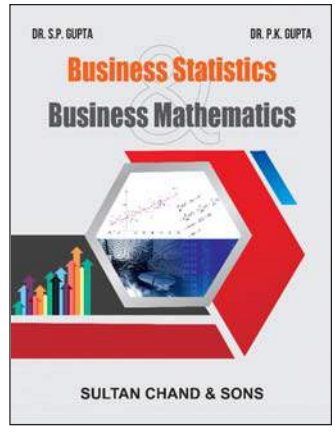
This book on Quantitative Techniques and Operations Research provides a conceptual understanding of basic quantitative techniques/methods used in solving managerial problems. It discusses comprehensively the essential topics of quantitative decision-making by using illustrations and examples. With revised and updated contents, this edition of the book will be useful to the students pursuing the undergraduate programme in Management and Commerce.

Salient Features

- The chapters on Linear Programming Problems are rewritten and have been designed to take the reader through gradual increase in complexity. Chapter 2 of part II is completely dealt with the formulation of linear programming models from business and economics.
- Given its importance in the current business environment, chapter on Operations Scheduling has been dealt with at length.

Edition: 4th, 2022; *Pages:* xvi + 592; *Size:* 185 × 240 mm; ISBN: 978-93-5161-182-0 (TC 1017)

Business Statistics & Business Mathematics



S.P. Gupta • P.K. Gupta

About the Book

This text book covers complete syllabus in Business Mathematics & Business Statistics paper of B.Com. 2nd year students. Book has been designed strictly according with the latest updated syllabus prescribed by University of Delhi. Besides revising and simplifying the text, a number of illustrations and examples are added to explain various concepts introduced in the text. Also, new problems mostly from recent university examinations have been added in this edition. At the same time old stereotype problems have been removed. In fact the whole book has been rewritten and given a new look altogether.

Salient Features

- Book covers complete syllabus in Business Mathematics & Business Statistics paper of B.Com. examination.
- There are detailed self-contained chapters on all the syllabus elements.
- Part I of the book starts with the introduction to Statistics and discusses measures of central tendency and of variation, correlation & regression analysis, index numbers, time series and interpretation of data.
- Part II of the book begins with introducing the concept of matrices and determinants. Their applications to business and economic problems are discussed in this chapter.
- Concept of differentiation & integration along with their applications are given in chapters 3 & 4 of part II.
- The language used in text is simple and the subject matter has been presented in a lucid and straightforward style.
  - Special care has been taken to develop the concepts in an easy to understand manner and are self explanatory.
  - The book does not require any previous knowledge of the subject.

Edition: 5th, 2022; *Pages:* *xxxvi* + 740 ; Size: 185 × 240 mm; ISBN: 978-93-5161-143-1 (TC 1131)

About the Book

The edition contains significant additional input in almost every chapter of the book. It provides enhanced insights into issues from emerging countries' business. The practical examples cover all aspects of parametric and non-parametric tests which are relevant for business in emerging countries. This edition includes several new cases and examples which would help students comprehend the research methodologies illustrated in each chapter. This edition will equip students with the knowledge of skills involved in this basic research process.

Overview of the Book

Research methodology is taught as a supporting subject in several ways in many academic disciplines such as education, psychology, social work, library studies and marketing research. The core philosophical base for this book comes from my conviction that, although these disciplines vary in content, their broad approach to a research enquiry is similar. This book, therefore, is addressed to these academic disciplines and business people. This textbook provides the readers with an understanding of the Introduction to Research, Types of Research, Steps in Research Process, Identification of Research Problems, Importance of Review of Literature, Research Design, Methods of Data Collection, Hypothesis, Sampling Techniques, Introduction to SPSS, Descriptive Statistics, Cross tabulation, One Sample t-Test, Paired Sample t-test, One Way ANOVA, Two Way ANOVA, Factorial ANOVA, MANOVA, Chi-Square Test, Non- Parametric Test, MANN Whitney Test, Wilcoxan Test, Kruskal -Wallis Test, Friedman Test, Correlation Analysis, Multiple Regression Analysis, Factor Analysis, Cluster Analysis, Multi - Dimensional Scaling, Discriminate Analysis , Canonical Correlation, Overview of Structural Equation Model (SEM) and Report Writing. It uses simple examples to demystify complex theories and methodologies. This well-organized book deals with the variety of research methods and tools used in management and social sciences with application of SPSS. A Handbook of Research Methodology is recommended for use in undergraduate and postgraduate courses focusing on research methodologies in various disciplines.

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