Sultan Chand & Sons useful Books for
B.Com & BBM / BBA / BBS of All Indian Universities & Diploma Courses

Management

L.M. Prasad	*Principles and Practice of Management*
L.M. Prasad	*Organizational Behaviour*
L.M. Prasad	*Human Resource Management*
L.M. Prasad	*Strategic Management*
Amandeep Nahar, P.C.K. Rao & Rajesh Kumar Nigah	*Organisational Behaviour*
Y.K. Bhushan	*Fundamentals of Business Organisation & Management*
C.B. Gupta	*Business Organisation & Management*
C.B. Gupta	*Business Management*
C.B. Gupta	*Management : Theory & Practice*
C.B. Gupta & Rajan Nair	*Marketing Management*
C.B. Gupta	*Human Resource Management*
C.B. Gupta	*Entrepreneurial Development*
S.S. Khanka	*Creativity and Innovation in Entrepren.*
Madhurima Lall & Sultan Ahmad	*Export Import: Procedure and Documentation*
Madhurima Lall & Sultan Ahmad	*Fundamentals of Entrepreneurship and Project Planning*
Pardeep Kumar	*Management Principles and Applications* **(NEP)**
Pardeep Kumar	*Fundamentals of Marketing* **(NEP)**
Rajan N. Nair	*Marketing*
D.D. Sharma	*Marketing Research*
P.C. Tripathi	*Personnel Management and Ind. Relations*
S.N. Maheshwari	*Elements of Financial Management*
R.P. Rustagi	*Basic Financial Management*
R.P. Rustagi	*Investment Analysis and Portfolio Mangt.*
Dinkar Pagare	*Principles of Management*
C. Jeevanandam	*Foreign Exchange : Practice, Concepts & Control*
C. Jeevanandam	*Foreign Exchange and Risk Mangt.*

Law

N.D. Kapoor	*Elements of Mercantile Law*
N.D. Kapoor	*Elements of Company Law*
N.D. Kapoor	*Elements of Industrial Law*
N.D. Kapoor	*Company Law & Secretarial Practice*
N.D. Kapoor	*Business Law* **(NEP)**
P.C. Tripathi, Gupta and Kapoor	*Industrial Relations and Labour Laws*
P.N. Varshney	*Banking Law and Practice*
K.P.M. Sundharam & P.N. Varshney	*Banking Theory, Law & Practice*
Preeti Rani Mittal & Anshika Bansal	*Income Tax: Law & Practice*
Preeti Rani Mittal & Anshika Bansal	*Fundamentals of Income Tax Problems & Solutions*
V. Balachandran	*Indirect Taxation*
V. Balachandran & P.K. Ghosh	*An Outline of Company Secretarial Practice*
V. Balachandran	*Textbook of GST & Customs Law*
Vineet Gupta & N.K. Gupta	*Goods and Services Tax with Customs Law*

English

Rajendra Pal & Prem Lata Suri	*English Grammar & Composition*
Rajendra Pal & J.S. Korlahalli	*Essentials of Business Communication*
Rajendra Pal & J.S. Korlahalli	*Effective Business English*

Mathematics/Statistics

S.P. Gupta	*Statistical Methods* (All Courses)
S.P. Gupta & M.P. Gupta	*Business Statistics*
Kanti Swaroop P.K. Gupta & Man Mohan	*Operations Research*
V.K. Kapoor	*Operations Research*
D.C. Sancheti & V.K. Kapoor	*Business Mathematics* (All India)
D.C. Sancheti & V.K. Kapoor	*Statistics* (All India)
S.P. Gupta, Man Mohan & P.K. Gupta	*Business Statistics & Operations Research*
S.P. Gupta & P.K. Gupta	*Quantitative Techniques and Operations Research* **(NEP)**
S.C. Gupta & V.K. Kapoor	*Fundamentals of Mathematical Statistics*
S.C. Gupta & V.K. Kapoor	*Fundamentals of Applied Statistics*
S.C. Gupta & V.K. Kapoor	*Elementary Mathematical Statistics*

Accounting

R.L. Gupta & V.K. Gupta	*Principles and Practice of Accountancy*
R.L. Gupta & M. Radhaswamy	*Advanced Accountancy, Volume I & II*
M.P. Gupta & B.M. Agarwal	*Advanced Accountancy, Volume I & II*
M.P. Gupta B.M. Agarwal	*Financial Accounting* **(NEP)**
R.L. Gupta & M. Radhaswamy	*Corporate Accounting*
R.L. Gupta & V.K. Gupta	*Financial Accounting*
S.P. Iyengar	*Cost Accounting*
V.K. Saxena & C.D. Vashist	*Cost Accounting* (Textbook)
S.N. Maheshwari	*Fundamentals of Cost Accounting*
S.N. Maheshwari	*Problems & Solutions in Cost Accounting*
S.N. Maheshwari	*Elements of Management Accounting*
S.N. Maheshwari	*Principles of Management Accounting*
Dinkar Pagare	*Principles & Practice of Auditing*
Preeti Rani Mittal, Anshika Bansal & R.C. Bhatia	*Auditing and Corporate Governance*

Economics

P.L. Mehta	*Managerial Economics*
R.L. Varshney & K.L. Maheshwari	*Managerial Economics*
I.C. Dhingra	*Indian Economy* (All India)
I.C. Dhingra	*Concise Indian Economy* (BBA)
P.N. Varshney & D.K. Mittal	*Indian Financial System*
K.P.M. Sundharam & E.N. Sundharam	*Business Economics* (NEP)
Madhurima Lall	*Micro Economics* (NEP)
Madhurima Lall & Ali Mahdi Naqvi	*Public Finance* (NEP)

Sultan Chand & Sons
Publishers of Standard Educational Textbooks
23 Daryaganj, New Delhi-110002
Phones (S) : 011-23281876, 23266105, 41625022
(O) : 011-23247051, 40234454
Email : sultanchand74@yahoo.com
info@sultanchandandsons.com

Dedicated to the Service of Education • SULTAN • 1950

TC-555

ISBN 978-81-8054-612-9

STATISTICS
[Theory, Methods & Application]
D.C. Sancheti • V.K. Kapoor

Dedicated to the Service of Education • SULTAN • 1950

D.C. Sancheti • V.K. Kapoor

STATISTICS

[Theory, Methods & Application]

SULTAN CHAND & SONS

2328

COLLEGE OF AVIAN SCIENCES & MANAGEMENT
KVASU CAMPUS, THIRUVAZHAMKUNNU

Acc. No. 2328 Call No.....

This book should be returned on or before the date last given below.

...CHAND & SONS
Educational Publishers
New Delhi

SULTAN CHAND & SONS®
Educational Publishers
23, Daryaganj, New Delhi-110 002
Phones : 011-23281876, 23266105, 23277843 *(Showroom & Shop)*
011-40234454, 23247051 *(Office)*
E-mail : sultanchand74@yahoo.com; info@sultanchandandsons.com
Fax : 011-23266357; Website : www.sultanchandandsons.com

ISBN : **978-81-8054-612-9 (TC-555)**

Price : ₹ **695.00**

First Edition:
Seventh Edition: 2007, Reprint: 2010, 2014, 2017, 2019, 2022

EVERY GENUINE COPY OF THIS BOOK HAS A HOLOGRAM

In our endeavour to protect you against counterfeit/fake books, we have pasted a copper hologram over the cover of this book. The hologram displays the full visual image, unique 3D multi-level, multi-colour effects of our logo from different angles when tilted or properly illuminated under a single light source, such as 3D depth effect, kinetic effect, pearl effect, gradient effect, trailing effect, emboss effect, glitter effect, randomly sparking tiny dots, micro text, laser numbering, etc.

A fake hologram does not display all these effects.

Always ask the bookseller to put his stamp on the first page of this book.

All Rights Reserved: No part of this book, including its style and presentation, may be reproduced, stored in a retrieval system, or transmitted in any form or by any means – electronic, mechanical, photocopying, recording or otherwise without the prior written consent of the Publishers. Exclusive publication, promotion and distribution rights reserved with the Publishers.

Warning: The doing of an unauthorised act in relation to a copyright work may result in both civil claim for damages and criminal prosecution.

Special Note: Photocopy or Xeroxing of educational books without the written permission of Publishers is illegal and against Copyright Act. Buying and selling of pirated books is a criminal offence. Publication of key to this is strictly prohibited.

General: While every effort has been made to present authentic information and avoid errors, the author and the publishers are not responsible for the consequences of any action taken on the basis of this book.

Limits of Liability/Disclaimer of Warranty: The publisher and the author make no representation or warranties with respect to the accuracy or completeness of the contents of this work and specifically disclaim all warranties, including without limitation warranties of fitness for a particular purpose. No warranty may be created or extended by sales or promotional materials. The advice and strategies contained herein may not be suitable for every situation. This work is sold with the understanding that the publisher is not engaged in rendering legal, accounting, or other professional services. If professional assistance is required, the services of a competent professional person should be sought. Neither the publisher nor the author shall be liable for damage arising herefrom.

Disclaimer: The publisher have taken all care to ensure highest standard of quality as regards typesetting, proofreading, accuracy of textual material, printing and binding. However, they accept no responsibility for any loss occasioned as a result of any misprint or mistake found in this publication.

Author's Acknowledgement: The writing of a Textbook always involves creation of a huge debt towards innumerable authors and publications. We owe our gratitude to all of them. We acknowledge our indebtedness in extensive footnotes throughout the book. If, for any reason, any acknowledgement has been left out we beg to be excused. We assure to carry out correction in the subsequent edition, as and when it is known.

Printed at : Himani Print Solution, Badarpur, New Delhi-110044

Preface

TO THE SEVENTH EDITION

The book which was originally written some Twelve years ago has, during the intervening period, been revised and reprinted several times. The authors have, however been thinking, for the last several months that the book needed not only a thorough revision but rather a complete rewriting. They have been able to find time to rewrite the entire book and represent it to their readers. They now take great pleasure in presenting this is to the readers the *seventh completely* revised edition of the book. The subject-matter in the whole book has been re-written in the light of numerous *criticisms* and *suggestions* received from the users of the previous editions.

Some of the *major changes* are:

* During the course of rewriting, it, has been specially borne in mind that the subject develops in a smooth and coherent manner so as to provide an orderly presentation. The readers will find the study of the subject more interesting, relevant and convenient.
* The theoretical discussion throughout the text has been refined, restructured and updated retaining all the basic features of the previous editions especially the simplicity of exposition, practial orientation to business and economic situations.
* Various new solved examples have been added in each chapter. These examples have been selected in such a manner that, after carefully doing these examples, a student would be able to tackle all the questions asked in the set of exercises. Moreover these examples keep in view the trend of questions asked in the examination.
* Exercises at the end of each chapter are substantially reorganised. Many new questions are included in the exercise sets. Repetition of question of the same type (more than what is necessary) has been avoided, and

thus the number of questions has been reduced. Further in the sets of exercises, the questions have beeh carefully arranged and properly graded.

* In order that a student does not stuck up while trying questions, hints have been given for important questions not covered by solved examples.
* Solved examples and unsolved problems have been drawn from latest examination papers up to May, 1990.
* The subject-matter, has been presented in a rigorous manner, and in simple and effective language, so as to make the exposition clear and lucid even to a beginner.

All this has meant recasting of the entire book, and we earnestly hope that in its present form the book will prove more useful to the students. The authors are confident that the present edition like the earlier ones would enjoy the patronage of the readers.

Suggestions for the improvement in quality of the book and intimation ol error and misprints will be most gratefully received and will be duly incorporated in the future editions.

D.C. SANCHETI & V.K. KAPOOR

TO THE FIRST EDITION

In view of the growing emphasis on quantitative techniques of analysis and presentation, Statistics (theory and methods) has found place in many professional and academic course. To cater to these needs a larger number of books have come up in the market from many Indian and foreign authors. The books from Indian writers have a wide coverage but show a lack of insight in many advanced topics and invariably are found devoid of practical bias. In this respect the books by foreign writers are good where the treatment in respect to some aspects is really excellent but full justice is not done to all the topics. Above all, their treatment has no relevance to Indian situation.

Looking to these conditions, we decided to take up the writing of the present book. We were also encouraged by the excellent response our carlier work, *Business Mathematics* had from the readers. Some of the special features of the present book are stated briefly as follows :

* It is designed primarily for the students of C.A. (Intermediate), I.C.W.A. (Intermediate and Final), and managment courses to cater to their needs of conceptual clarity and practical application.

* To meet the above requirements the book covers theoretical, practical and applied aspects of statistics in a clear and exhaustive manner. The applications to various situations have invariably been shown initially in the form of a chart for quick grasp of the scope and later by a large number of practical illustrations and examples.
* The various concepts have been introduced nicely and their relevance explained with reference to practical business and economic situations Formal definitions of various concepts have also been given with suitable analytical comments.
* The theoretical discussion of each sub-section has been accompanied by simple illustrations and complex problems have been given thereafter as solved examples.
* A large number of exercises have been given at the end of each chapter for further practice. These cover most of the problems set at recent examinations of C.A., I.C.W.A., M.Com., M.A. (Econ.), B.A. (Econ.), M.B.A. of various institutes and universities.
* Special attention has been paid to advanced topics like probability, theoretical distributions, sampling and significance tests, analysis of time series, forecasting and business barometers, statistical quality control and statistical decision theory.

We trust our readers will find the presentation and exposition of the subject quite lucid and easy to understand. A conscious effort has been made all through to-keep the treatment simple and non-technical. The idea has been to impart insight into various statistical tools, that too without resort to undue technicality and verbosity. Mathematical proofs have been given only in the footnotes. It is expected that even those who have not studied statistics earlier will find the subject interesting. They will be able to grasp the basic concepts and will be able to acquire an ability to make use of these in their practical and professional career. We feel no tutorial guidance will be required if the study is taken up of each chapter from beginning till the end.

New Delhi

D.C. SANCHETI & V.K. KAPOOR

Book Summary at a Glance

Sl.	Chapter Name	Pages	Illustrations & Examples	Exercises
1.	Meaning and Scope	28	–	24
2.	Statistical Survey and Collection of Data	30	–	12
3.	Classification and Tabulation	50	14	32
4.	Diagrammatic and Graphic Presentation	64	18	39
5.	Measures of Central Tendency	160	93	163
6.	Measures of Dispersion	104	62	105
7.	Skewness, Moments and Kurtosis	52	32	79
8.	Correlation Analysis	84	41	89
9.	Regression Analysis	60	27	76
10.	Index Numbers	98	51	93
11.	Analysis of Time Series	106	49	101
12.	Association of Attributes	40	29	37
13.	Interpolation and Extrapolation	38	25	47
14.	Probability and Expected Value	100	72	156
15.	Statistical Decision Theory	34	15	28
16.	Theoretical Distributions	72	41	128
17.	Sampling and Designing of a Sample Survey	20	–	20
18.	Test of Hypothesis	96	57	162
19.	Chi-Square Test	42	16	49
20.	F-Test and Analysis of Variance	32	11	32
21.	Statistical Quality Control	44	18	35
22.	Partial and Multiple Correlation and Regression	16	8	12
23.	Vital Statistics	26	10	22
24.	Linear Programming	40	9	26
	Total	1,404	698	1,567

Acknowledgements

The authors and the publishers are grateful to the following persons for their contributions in the improvement of the book.

Shri Vidya Ratna, S.R. College of Commerce, Delhi.

Shri V.P. Gupta, Reserve Bank of India, Bombay.

Dr. Triptimoy Mukherjee, Vivekanand College, Calcutta.

Shri Abdulla, Farook College, Feroke.

Shri P. Chandrasekhar, Loyola College, Madras.

Shri P. Murugesan, Pachaippa's College, Madras.

Shri A.S. Sindekar, S.D.S.M. College, Palghat.

Shri V. Jagnathan, AVVM Shri Pushpam College, Thanjavur.

Shri S. Manoharan, Pioneer Kumarswamy College, Nagercoil.

Principal K.V. Ramanayya, Sri Subbaraya & Narayana College, Narasaraopet.

Shri B.M. Inamdar, Adarsha Shishana Samiti's College of Commerce Gadag.

Shri O.K. Gerorge, St. Thomas College, Trichur.

Principal P.B. Koshit, College of Commerce, Kolhapur.

Shri R.N. Kshirsagar, D.G. College of Commerce, Satara.

Shri N.H. Vyas, Shri Shivaji College, Akola.

Shri K.S. Shevade, Warana Mahavidyala, Waranagar.

Shri M.S. Balasubramaniyum, A.M. Jain College, Madras.

Shri S.C.R. Mathur, Shri Jain P.G. College, Bikaner.

Shri Antony Tharian, Nrimala College, Muvattupuzha.

Shri C.J. Patel, I.V. Patel College of Commerce, Nadiad.

Shri S.C. Sastry Anwaralulloom College, Hyderabad.
Shri M.S. Sreenivasa Rao, S.R.R. and C.V.R. Govt. College, Vijayawada.
Shri G.H. Hombal, Viajayanagar College, Hospet.
Shri K.K.S. Dutta, Adoni Arts and Science College, Adoni.
Shri Ramchandra Rao, Besant Theosophical College, Madanapalle.
Shri P. Vengal Rao, J.K.C. College, Guntur.
Shri Laxminarayan, Christ College, Irinjalakuda.
Shri A.A. Shaikh, Anjuman-a-Islam College, Bombay.
Shri. M.L. Sharma, S.D. Govt. College, Beawar.
Dr. N.S. Gupta, Dean, Deptt. of Commerce Jammu University, Jammu.
Dr. J.K. Irani, Dean, Deptt. of Commerce Mysore University, Mysore.
Shri R. Subramanyum, D. Banumaiah's College, Mysore.
Dr. S. Mehrotra, Dean, Deptt. of Commerce Gauhati University, Gauhati.
Shri J.N. Saikia, Nowgong College, Nowgong.
Shri R. Krishnan, A.M. Jain College, Madras
Shri Raj Krishna Mital, Govt. Arts College, Mangalore.
Shri K.S. Madhawa Rao, M.B.M. College, Udipi.
Shri D. Muthuraj, CBM College, Coimbatore.
Dr. G.V. Ramananamurthy, Andhra University, Waltair.
Shri M. Mohandas Pai, Bhandarkars College, Kundapura.
Shri N.M. Shah, Shri Ram College of Commerce, Delhi.
Dr. J.V. Prabhakar Rao, Deptt. of Commerce and Management Studies, Andhra University.
Dr. Y.P. Singh, Deptt. of Commerce, University of Delhi.
Dr. O.P. Gupta, Deptt. of Commerce, University of Delhi.
Dr. M.L. Kothari, Dean, Facility of Commerce & Business Administration Vikram University.
Dr. R.K. Grover, Deptt. of Commerce, Indira Gandhi University.
Dr. K.K. Saxena, Dean, Facility of Commerce, University of Lucknow.
Dr. P.L. Mehta, Shri Ram College of Commerce, Delhi

Contents

1. Meaning and Scope	1.1 – 1.28
Introduction	1.2
Definitions	1.2
Statistics as Data	1.3
Statistics as a Method	1.5
Subject-Matter of Statistics	1.7
Laws of Statistics	1.8
Functions of Statistics	1.9
Importance of Statistics	1.11
In State Affairs	1.11
In Economics	1.12
In Business	1.13
Limitations of Statistics	1.18
Distrust of Statistics	1.20
Fallacies in Statistics	1.21
2. Statistical Survey and Collection of Data	**2.1 – 2.30**
Introduction	2.2
Planning of a Statistical Survey	2.3
Collection of Data	2.4
Primary and Secondary Data	2.4
Methods of Collecting Primary Data	2.7
Sources of Secondary Data	2.20
Unit of Inquiry	2.24
Ways of Collection of Data	2.25
Processing of Data	2.26
3. Classification and Tabulation	**3.1 – 3.50**
Introduction	3.2
Classification	3.2
Objectives of Classification	3.2
Rules of Classification	3.3
Modes of Classification	3.4
Statistical Series	3.6

Frequency Distribution 3.9
Basic Components of a Frequency Distribution 3.11
Construction of a Grouped Frequency Distribution 3.16
Cumulative Frequency Distribution 3.21
Bivariate Frequency Distribution 3.26
Tabulation 3.32
Objectives of Tabulation 3.32
Components of a Table 3.34
Requisites of a Good Statistical Table 3.36
Types of Tables 3.38

4. Diagrammatic and Graphic Presentation **4.1 – 4.64**
Introduction 4.2
Diagrammatic Presentation 4.2
Rules for Constructing a Diagram 4.4
Types of Diagrams 4.5
One-Dimensional or Bar Diagrams 4.6
Two-Dimensional Diagrams 4.15
Three-Dimensional Diagrams 4.23
Graphic Presentation – Meaning 4.28
Time Series Graphs or Historigrams 4.32

5. Measures of Central Tendency **5.1 – 5.160**
Introduction 5.2
Definition 5.2
Objectives of Averaging 5.2
Characteristics of a Good Average 5.3
Type of Averages 5.5
Arithmetic Average (or Mean) 5.5
Mathematical Properties of the Arithmetic Average 5.20
Merits of Arithmetic Average 5.23
Demerits of Arithmetic Average 5.23
Weighted Arithmetic Average 5.25
Median 5.40
Merits of Median 5.53
Drawbacks of Median 5.54
Graphic Method of Locating the Value of Median 5.54
Further Partition or other Positional Values 5.56
Mode 5.74
Location of Mode – Graphically 5.85
Empirical Relationship Between Mean, Median and Mode 5.87
Merits of Mode 5.90
Drawbacks of Mode 5.90
Geometric Mean (G.M.) 5.96
Algebraic Properties of G.M. 5.101
Merits of G.M. 5.103
Drawbacks of G.M. 5.103
Harmonic Mean (H.M.) 5.106
Merits of H.M. 5.110
Drawbacks of H.M. 5.110

Choice of a Suitable Average 5.113

6. Measures of Dispersion **6.1 – 6.104**
Introduction 6.2
Definition of Dispersion 6.3
Objectives of Measuring Dispersion 6.3
Measures of Dispersion 6.4
Absolute and Relative Measures 6.5
Characteristics for an Ideal Measure of Dispersion 6.5
Range 6.5
Coefficient of Range 6.5
Merits and Demerits of Range 6.6
Uses 6.7
Semi Inter-Quartile Range or Quartile Deviation 6.7
Merits and Demerits of Quartile Deviation 6.8
Mean Deviation 6.13
Merits and Demerits of Mean Deviation 6.16
Standard Deviation 6.25
Merits and Demerits of Standard Deviation 6.26
Properties of Standard Deviation 6.27
Computation of Standard Deviation 6.28
Coefficient of Variation 6.50
Graphic Method of Dispersion 6.62
Choice of Suitable Measure of Variation 6.64

7. Skewness, Moments and Kurtosis **7.1 – 7.52**
Skewness Introduction 7.2
Definition 7.2
Tests of Skewness 7.3
Objectives of Skewness 7.4
Distinction between Dispersion and Skewness 7.4
Measures of Skewness 7.5
Karl Pearson's Coefficient of Skewness 7.5
Bowley's Coefficient of Skewness 7.16
Kelly's Measure of Skewness 7.19
Moments 7.22
Moments about the Mean 7.22
Importance of Moments 7.23
Sheppard's Correction for Moments 7.24
Kurtosis 7.25

8. Correlation Analysis **8.1 – 8.84**
Introduction 8.2
Meaning of Correlation 8.2
Definition of Correlation 8.2
Uses 8.3
Correlation and Causation 8.3
Types of Correlation 8.4
Methods of Studying Correlation 8.5
Graphic Method 8.5
Scatter Diagram 8.7

Algebraic Methods	8.10
Karl Pearson's Method	8.10
Probable Error and Standard Error	8.22
Coefficient of Determination	8.23
Correlation in Bivariate Frequency Table	8.30
Rank Correlation	8.38
Concurrent Deviation Method	8.48
9. Regression Analysis	**9.1 – 9.60**
Introduction	9.2
Meaning	9.2
Types of Regression Analysis	9.3
Utility of Regression Analysis	9.4
Correlation and Regression	9.4
Principles of Least Squares	9.6
Methods	9.7
Graphic Method	9.7
Algebraic Methods	9.10
Regression Coefficients	9.13
Computation of Regression Coefficients	9.15
Regression Equations in Group Frequency Distribution	9.23
Standard Error of an Estimate	9.36
Explained and Unexplained Variation	9.37
10. Index Numbers	**10.1 – 10.98**
Introduction	10.2
Definition	10.2
Characteristics and Uses of Index Numbers	10.3
Types of Index Numbers	10.4
Problems in Construction of Index Numbers	10.6
Notations	10.9
Methods of Constructing Index Numbers	10.10
Simple Aggregative Method	10.10
Weighted Aggregative Method	10.11
Simple Average of Price Relatives	10.19
Weighted Average of Relatives	10.21
Quantity Index Numbers	10.23
Tests of Adequacy of Index Numbers Formulae	10.27
Chain Index Numbers	10.39
Construction of Chain Indices	10.40
Base Shifting	10.46
Splicing	10.47
Deflating	10.49
Cost of Living Index Numbers	10.56
Limitations of Index Numbers	10.65
11. Analysis of Time Series	**11.1 – 11.106**
Introduction	11.2
Meaning	11.2
Utility of Time Series Analysis	11.2

Analysis of Time Series	11.4
Preparation of Data for Analysis	11.4
Components of Time Series	11.5
Secular Variations or Trend (T)	11.5
Seasonal Variations (S)	11.6
Cyclical Variations (C)	11.7
Irregular for Erratic Variations	11.8
Decomposition of Time Series Data	11.8
Methods of Finding Trend	11.10
Graphic Method	11.10
Statistical Methods	11.12
Algebraic Methods	11.15
Methods of Moving Averages (M.A.)	11.37
Measurement of Seasonal Variations	11.46
Method of Simple Averages	11.47
Ratio to Trend Method	11.49
Moving Averages Methods	11.51
Method of Link Relatives	11.56
De-seasonalisation of Data	11.59
Measurement of Cyclical Variations	11.63
12. Association of Attributes	**12.1 – 12.40**
Introduction	12.2
Classification of Data	12.2
Notation and Terminology	12.2
Class Frequencies	12.3
Number of Classes	12.3
Order of Classes	12.3
Relationship between Classes of Various Order	12.3
Consistency of Data	12.5
Meaning of Association	12.7
Types of Association	12.7
Methods of Measuring Association	12.7
Yule's Coefficient of Collignation	12.17
Association of Three Attributes	12.20
13. Interpolation and Extrapolation	**13.1 – 13.38**
Introduction	13.2
Definitions	13.2
Significance and Utility	13.2
Assumptions	13.3
Methods of Interpolation	13.3
Graphic Methods	13.4
Algebraic Methods	13.5
Newton's Formula of Advancing Differences	13.7
Newton-Gauss (Forward Method) Gauss	13.12
Newton-Gauss (Backward) Method	13.13
Newton's Method of Backward Differences	13.14
Binomial Expansion Method	13.15
Newton's Divided Difference Method	13.22

Lagrange's Method 13.23
Parabolic Curve Method 13.25
14. Probability and Expected Value **14.1 – 14.100**
Introduction 14.2
Probability in Everyday Life 14.2
Importance of Probability 14.2
Basic Terminology 14.3
Mathematical or Classical or 'a Priori' Probability 14.5
Statistical or Empirical Probability 14.7
Rules of Counting 14.8
Fundamental Rule of Counting 14.9
Permutations 14.10
Combinations 14.12
Modern Approach to Probability 14.13
Basic Probability Rules 14.29
Addition Rule 14.29
Multiplication Rule 14.36
Joint and Marginal Probability 14.43
Conditional Probability 14.49
Inverse Probability 14.53
Expected Value 14.60
Random Variable 14.60
Probability Distribution 14.61
Properties of Expected Value 14.62
Variance 14.66
15. Statistical Decision Theory **15.1 – 15.34**
Introduction 15.2
Meaning and Scope 15.2
Decision Framework 15.3
Decision Under Certainty when Event Probabilities are Known 15.8
Expected Opportunity Loss 15.10
Expected Value of Perfect Information 15.12
Decision Under Uncertainty 15.13
Use of Incremental Analysis (Newsboy Problem) 15.20
Bayesian Approach to Decision Making 15.21
16. Theoretical Distributions **16.1 – 16.72**
Introduction 16.2
Binomial Distribution 16.2
Probability Function of Binomial Distribution 16.3
Constants of Binomial Distribution 16.5
Poisson Distribution 16.14
Characteristics of Poisson Distribution 16.16
Constants of Poisson Distribution 16.17
Importance of Poisson Distribution 16.18
Fitting of Poisson Distribution 16.25
Normal Distribution 16.30
Properties of Normal Distribution 16.31

Importance of Normal Distribution 16.32
Standard Normal Distribution 16.34
Relationship Between Various Distributions 16.41
17. Sampling and Designing of a Sample Survey **17.1 – 17.20**
Introduction 17.2
Methods of Enumeration 17.2
Census Enumeration 17.2
Sample Enumeration 17.3
Methods of Sampling 17.6
Sampling and Non-Sampling Errors 17.13
Objectives of Sampling 17.15
Parameter and Statistic 17.16
Sampling Distribution of a Statistic 17.16
Standard Error of a Statistic 17.17
18. Test of Hypothesis **18.1 – 18.96**
Introduction 18.2
Procedure of Testing a Hypothesis 18.2
Test of Significance of a Mean – Large Sample 18.7
Test of Significance of Difference between Two Means (Large Sample) 18.11
Test of Significance of Difference Between Two Standard Deviations (Large Sample) 18.15
Test of Significance of a Sample Proportion 18.18
Test of Significance of Difference between Two Sample Proportions 18.24
Test of Significance of a Mean – Small Sample 18.32
Test of Significance of Difference between Two Means – Small Samples 18.38
Estimation of Parameters 18.51
Point Estimation 18.51
Interval Estimation 18.52
Determination of a Proper Sample Size 18.60
Sampling in Audit of Accounts 18.63
19. Chi-Square Test **19.1 – 19.42**
Introduction 19.2
Definition and Nature 19.2
Chi-Square Distribution 19.3
Properties of Chi-Square Distribution 19.4
Conditions Characterising the Chi-Square Test 19.4
Degrees of Freedom 19.5
Uses of Chi-Square Test 19.5
Test of Goodness of Fit 19.7
Test of Independence 19.17
Test for the Population Variance 19.28
20. F-Test and Analysis of Variance **20.1 – 20.32**
F-Distribution 20.2
F-Test 20.2
Assumptions in F-Test 20.3

Analysis of Variance	20.7
Variance Analysis in One-Way Classification	20.8
Variance Analysis in Two-Way Classification	20.14
21. Statistical Quality Control	**21.1 – 21.44**
Introduction	21.2
Definitions	21.2
Origin	21.3
Advantages of Statistical Quality Control	21.3
Causes of Variation	21.4
Type of Quality Control	21.4
Techniques Uses	21.5
Process Control	21.5
Control Chart	21.5
Advantages of Use of a Control Chart	21.7
Types of Control Chart	21.8
Mean Chart ($\bar{X}$ -Chart)	21.9
Range Chart (R-Chart)	21.10
Control Chart for Fraction Defective or P-Chart	21.19
D-Chart L, C	21.22
Control Chart For Number of Deffects per Unit (C-Chart)	21.26
Product Control	21.32
Sampling Inspection Plans	21.32
Single Sampling Plan	21.34
Double Sampling Plan	21.34
22. Partial and Multiple Correlation and Regression	**22.1 – 22.16**
Introduction	22.2
Partial Correlation	22.2
Multiple Correlation	22.5
Calculation of Multiple Correlation Coefficient	22.5
Multiple Regression Analysis	22.7
23. Vital Statistics	**23.1 – 23.26**
Introduction	23.2
Definition	23.2
Uses	23.2
Methods of Collection	23.3
Some Vital Statistics	23.4
Fertility Rate	23.6
Reproduction Rate	23.8
Mortality Rate	23.14
Life Table	23.21
24. Linear Programming	**24.1 – 24.39**
Introduction	24.2
Meaning	24.2
Applications	24.2
Graphic Method	24.11
Simplex Method	24.19
Duality In Linear Programming	24.33

1

Meaning and Scope

"Statistical thinking will one day be as necessary for effective citizenship as the ability to read and write."
—H.G. Wells

1·1. INTRODUCTION

1·2. DEFINITIONS

1·2·1. Statistics as Data

1·2·2. Statistics as a Method

1·2·3. Subject-matter of Statistics

1·3. LAWS OF STATISTICS

1·4. FUNCTIONS OF STATISTICS

1·5. IMPORTANCE OF STATISTICS

1·5·1. In State Affairs

1·5·2. In Economics

1·5·3. In Business

1·6. LIMITATIONS OF STATISTICS

1·7. DISTRUST OF STATISTICS

1·8. FALLACIES IN STATISTICS