MAHATMA GANDHI UNIVERSITY

PRIYADARSHINI HILLS, KOTTAYAM- 685560

www.mgu.ac.in

RESTRUCTURED CURRICULUM
AND SYLLABI

FOR

U.G. PROGRAMMES
UNDER CHOICE BASED CREDIT AND SEMESTER
SYSTEM

IN

STATISTICS

2017

1. ACKNOWLEDGEMENT

The Choice Based Credit and Semester and direct grading system was introduced in various under graduate programmes of Mahatma Gandhi University in the year 2009-10 which was modified to indirect grading system in 2013-14. The Board of studies in Statistics has made serious and sincere attempt to make the curriculum of various undergraduate courses in Statistics and a draft curriculum of the core and complementary courses in Statistics was published in the year 2016. The Syndicate and Honourable Vice - Chancellor of the Mahatma Gandhi University take several initiatives to modify and update the draft curriculum.

There are many profound personalities whose relentless support and guidance made this syllabus restructuring 2017 a success. I take this opportunity to express my sincere appreciation to all those who were part of this endeavour for restructuring the syllabus U G course in Statistics under Mahatma Gandhi University, Kottayam.

I express profound gratitude to the Honourable Vice–Chancellor, Pro-Vice Chancellor, Registrar, Members of the Syndicate and Academic Council, for their sincere co-operation and guidance for completion of this work. I place on record my wholehearted gratitude to the members of Faculty of Statistics and Board of Studies for their untiring efforts. I also appreciate the efforts of University Academic Section and other staff.

I am also grateful to all teachers who participated in the workshop organised by the University at U C College, Aluva on 18-04-2017 for restructuring the Syllabus. I also place on record my gratitude to all professionals, academicians and other stakeholders who gave valuable suggestions in this regard.

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Kottayam   Dean - Faculty of Statistics

02-05-2017   Mahatma Gandhi University, Kottayam.

2. INTRODUCTION

Statistics as Data Science

It is through the scientific search for knowing new, and explaining those already in existence, Mankind has reached the present level of progress. All branches of science including Statistics have played their own roles in this Human progress. All the luxuries and conveniences that we enjoy today are made possible by the scientific search for achieving them. The method of Statistics is to reach solutions through data evidence. Statistics aims at validating the conclusions of any search for new knowledge from any branch of science by extracting information from relevant data. This requires scientific methods for collecting, presenting, analyzing and interpreting data. Statistics deals with each of these objectives and hence, Statistics is the Data Science.

Statistics may be formally defined as a branch of science equipped with methods and methodologies for arriving at valid and logical conclusions to whatever problems under consideration affecting various spheres of human activities by analyzing sample data sets drawn from the relevant group(s). In brief, Statistics is the science for extracting information and learning from data.

Data scientists or learners of statistics must familiarize with various statistical methods for achieving the four goals namely, collecting, presenting, analyzing and interpreting data. Statistics has developed a wide variety of theories, methods and methodologies for reaching the four goals.

The Real Challenge

Though several methods and methodologies have been developed al- ready to meet the above four goals, most of them are, in fact, either completely unused or serious attention has not been given in properly applying them in real-life contexts. These theories and methods have been formulated to meet hypothetical situations, and hence the real challenge lies not in understanding them but in their proper application and interpretation. It is found that many people are good at understanding the theories, proofs and derivations already

developed, but poor in deciding the appropriate techniques and its proper use in given contexts. Conclusions of many studies go wrong because of the inadequate and improper use of techniques and technologies. Hence, the real challenge of Data Scientists and learners of Statistics lies most in acquiring the expertise in selecting and using appropriate techniques in real-life contexts than in verifying their proofs or derivations. This Syllabus Revision aims at achieving these challenges from the part of the learners

The Thrust Area of this Syllabus Revision

Undergraduate learning time is a period where learners for the first time are opened to the world of statistics formally. They are to understand the theories, methods and methodologies for achieving the four goals mentioned above, but above all the skill in deciding and using the appropriate ones. It is found that most of the students are good
at understanding the theories and derivations, but poor at applying them in problems selected from real life contexts. Hence, this syllabus revision at UG level gives more importance in giving training in respect of expertise in deciding and applying appropriate techniques and their manipulation, and drawing valid and logical conclusions than in introducing new topics or completely overhauling the existing syllabus or ensuring the theoretical knowledge alone. If a student has to take advantage of Statistical Science in his life or elsewhere, he has to know the appropriateness of various techniques in a given context and its proper use.

Results Expected

This change in the Learning process is required to be understood both by Learners and Facilitators, from the nature of the questions contained in the Model Question Papers attached. This may be taken only as a set of questions alone, and similar questions enabling the students to enhance their ability in deciding and applying appropriate technique and their use, be prepared and solved by both Students and Facilitators.

We expect that students undertaking a training in the spirit of the Model Question Papers attached, will be able to solve problems of even moderate difficulty arising from various real-life contexts, and also qualify all tests conducted for employment or higher studies by any national or international agency.

3. AIMS AND OBJECTIVES

As Statistics being Data Science for learning from data in the light of what is already said in the last section, this curriculum revision at UG level had set the following aims while preparing the learning and evaluation tools especially the syllabus and model questions :

1. Introduce a curriculum that imparts the real spirit with which a beginner may approach the learning of any scientific stream, not alone Statistics.
2. Introduce a curriculum that attracts the learners to understand theusefulness of various statistical tools in making their everyday life useful.
3. Introduce Statistics as a branch of science for solving everyday problems by analyzing relevant data.
4. Introduce standard Statistical sciences and techniques like probability in a very attractive and enjoyable way.
5. Introduce a curriculum which really prompts the learners to understand that statistical conclusions are possible from every day data from everybody's life.
6. Introduce a curriculum that motivates the learners to understand the rationality behind every technique, and in what way that rationality be used in their lives.
7. A curriculum that stresses the importance of equipping the learners with the expertise in applying appropriate statistical tools in a given context and in arriving at valid and reasonable conclusions.
8. A curriculum that gives more importance to the practical side of applying various techniques than their proof and derivations.
9. Introduce a testing mechanism which calls for understanding of various topics from the part of the learners up to a level that can ensure a good level of knowledge

10. Introduce a curriculum which enables the learners to continue their future study or employment in a very competing manner.
11. A curriculum that attracts the fresher's in Statistics to the World of Statistics where numbers are transformed into information.

4. PROGRAMME DESIGN

The U.G. programme in Statistics shall include (a) Common Courses (CC) I and II, (b) Core Course(s) (CR) of both compulsory and Choice –Based (CB), (c) Complementary (CM)Courses, and (d) Open Course (OP). The program shall have a project work in the sixth semester.

There shall be one Open course paper in the fifth semester with a choice of one out of three elective courses from any UG programme or from the Physical Education Department. Students can opt for any one of the Open Courses offered by different departments of the college in fifth semester (subject to the availability of vacancy in the concerned discipline). Selection of students in the Open Course will be done in the college based on merit and interest of the students. There shall be one Choice Based course in the sixth semester with a choice of one out of three choice-based core courses.

Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one University to continue their education in another University without break

A separate minimum of 30% marks each for internal and external and aggregate minimum of 35% are required for a pass for a course. For a pass in a programme, a separate minimum of Grade D is required for all the individual courses. If a candidate secures F Grade for any one of the courses offered in a Semester/Programme, only F grade will be awarded for that Semester/ Programme until he/she improves this to D Grade or above within the permitted period. A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme.

CONSOLIDATED SCHEME - I TO VI SEMESTERS

Semester Number	Title with Course Code	Course Category	Hours Per Week	Credits	Marks	
					Internal	External
I	(English) – Course I	Common I	5	4	20	80
	(English)- Course II	Common I	4	3	20	80
	(Second Language) - Course I	Common II	4	4	20	80
	ST1CRT01 - Descriptive Statistics -Course I	Core	4	3	20	80
	(Mathematics) – Course I	Complementary	4	3	20	80
	(Physics/Computer Science) - Course I (Theory)	Complementary	2	2	10	60
	(Physics/Computer Science) - Course III (Practical)	Complementary	2	External practical examination of this course may be conducted at the end of semester II			
	Total		25	19	110	460

Semester Number	Title with Course Code	Course Category	Hours Per Week	Credits	Marks	
					Internal	External
II	(English) – Course III	Common I	5	4	20	80
	(English)- Course IV	Common I	4	3	20	80
	(Second Language) - Course II	Common II	4	4	20	80
	ST2CRT02 - Basics in Probability Theory and Applied Statistics –CourseII	Core	4	3	20	80
	(Mathematics) - Course II	Complementary	4	3	20	80
	(Physics/Computer Science) - Course II	Complementary	2	2	10	60
	(Physics/Computer Science) - Course III (Practical)	Complementary	2	2	20	40
	Total		25	21	130	500

Semester Number	Title with Course Code	Course Category	Hours Per Week	Credits	Marks	
					Internal	External
III	(English) – Course V	Common I	5	4	20	80
	(Second Language) - Course III	Common II	5	4	20	80
	ST3CRT03 - FUNDAMENTALS OF RANDOM VARIABLES-Course III	Core	5	4	20	80
	(Mathematics) - Course III	Complementary	5	4	20	80
	(Physics/Computer Science) - Course I V	Complementary	3	3	10	60
	(Physics/Computer Science) - Course VI (Practical)	Complementary	2	External practical examination of this course may be conducted at the end of semester IV		
	Total		25	19	90	380

Semester Number	Title with Course Code	Course Category	Hours Per Week	Credits	Marks	
					Internal	External
IV	(English) – Course VI	Common I	5	4	20	80
	(Second Language) - Course IV	Common II	5	4	20	80
	ST4CRT04 - PROBABILITY DISTRIBUTIONS– Course IV	Core	5	4	20	80
	(Mathematics) - Course IV	Complementary	5	4	20	80
	(Physics/Computer Science) - Course V (Theory)	Complementary	3	3	10	60
	(Physics/Computer Science) - Course VI (Practical)	Complementary	2	2	20	40
	Total		25	21	110	420

Semester Number	Title with Course Code	Course Category	Hours Per Week	Credits	Marks	
					Internal	External
V	ST5CRT05 - STATISTICAL ESTIMATION THEORY	Core	5	4	20	80
	ST5CRT06 - MATHEMATICAL METHODS FOR STATISTICS	Core	5	4	20	80
	ST5CRT07 -SAMPLING TECHNIQUES AND INDIAN OFFICIAL STATISTICS	Core	5	4	20	80
	ST5CRT08 – ENVIRONMENTAL STUDIES, HUMAN RIGHTS AND VITAL STATISTICS	Core	5	4	20	80
	Open Course	Open	4	3	20	80
	ST6PRT01- PROJECT	Core	1	External project evaluation may be conducted at the end of semester VI		
	Total		25	19	100	400

Semester Number	Title with Course Code	Course Category	Hours Per Week	Credits	Marks	
					Internal	External
VI	ST6CRT09-TESTING STATISTICAL HYPOTHESES	Core	5	4	20	80
	ST6CRT10-ANALYTICAL TOOLS FOR STATISTICS	Core	5	4	20	80
	ST6CRT11-DESIGN AND ANALYSIS OF EXPERIMENTS		5	4	20	80
	ST6CRT12 - STATISTICAL COMPUTING USING R SOFTWARE	Core	5	4	20	80
	ST6CBT01/ST6CBT02/ ST6CBT03 - OPERATIONS RESEARCH/MATHEMATICAL ECONOMICS/ STATISTICAL QUALITY CONTROL	Core	4	3	20	80
	ST6PRT01- PROJECT	Core	1	2	20	80
	Total		25	21	120	480

Credit Distribution of Various Courses of B. Sc. Statistics Programme in I to VI Semesters

Semester	English-Common I	Second Lanuage-Common II	Core Course	Complementary Courses		Open Course	Total Credit
				Mathe-matics	Computer Science/ Physics		
I	7	4	3	3	2		19
II	7	4	3	3	4		21
III	4	4	4	4	3		19
IV	4	4	4	4	5		21
V			16			3	19
VI			21				21
Total Credit	22	16	51	14	14	3	120

5. FACULTY

The curriculum of B. Sc. Statistics (Model I) Programme comes under the Faculty of Science of MG University.

6. ELIGIBILITY CRITERIA FOR ADMISSION

Eligibility for admission, norms for admission and reservation of seats for various Undergraduate Programmes shall be according to the regulations framed/orders issued by the University in this regard, from time to time.

7. DURATION OF THE PROGRAMME

The duration of U.G. programmes shall be 6 semesters and hence, the Programme takes 3 years to complete. There shall be two Semesters in an academic year, the 'ODD' semester commences in June and on completion, the 'EVEN' Semester commences after a semester-break of three days with two months vacation during April and May. (The commencement of first semester may be delayed owing to the finalization of the admission processes.)

A student may be permitted to complete the Programme, on valid reasons, within a period of 12 continuous semesters from the date of commencement of the first semester of the programme

8. ATTENDENCE

Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the University on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the semester along with the next batch after obtaining readmission.

9. MEDIUM OF INSTRUCTION

Medium of Instruction shall be English or Malayalam

10.   EXAMINATION DETAILS

The evaluation of each course shall contain two parts:

(i) Internal or In-Semester Assessment (ISA)

(ii) External or End-Semester Assessment (ESA)

The internal to external assessment ratio shall be 1:4.   There shall be a maximum of 20 marks for internal evaluation and a maximum of 80 marks for external evaluation. Both internal and external marks are to be mathematically rounded to the nearest integer.

MARKS DISTRIBUTION FOR EXTERNAL EXAMINATION AND INTERNAL EVALUATION

The external theory examination of all semesters shall be conducted by the University at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses (theory and practical) total marks of external examination is   80 and total marks of internal evaluation is 20.

Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

FOR ALL THEORY COURSES

a) Marks of External Examination   :   80

 b) Marks of Internal Evaluation   :   20

INTERNAL EVALUATION

All the following three components of the Internal Assessment are mandatory :

Components of Internal Evaluation of Theory Courses

Component	Marks
Attendance	5
Assignment /Seminar/Viva	5
Test paper(s) (1 or 2) (1x10=10; 2x5=10)	10
Total	20

FOR ATTENDANCE

Marks for attendance for all courses shall be as follows:

% of attendance	Marks
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

Decimals are to be rounded to the next higher whole number.

ASSIGNMENTS/SEMINAR/VIVA

Assignments are to be done from 1st to 6th Semesters. At least one assignment should be done in each semester for all courses. A student shall present a seminar in the 5th semester for each course and appear for Viva-Voce in the 6th semester for each course.

Further Division of Internal Marks of Assignments/Seminar/Viva:

For Assignment

Component	Marks
Punctuality	2
Content	2
Conclusion/Reference	1
Total	5

For Seminar

Component	Marks
Content	2
Presentation	2
Conclusion/Reference	1
Total	5

For Viva

Component	Marks
Knowledge	3
Clarity of Answers	2
Total	5

TEST PAPERS

At least one internal test-paper is to be attended in each semester for each course. One Test Paper for 10 marks or two Test Papers for 5 marks each may be given. The evaluations of all components are to be published and are to be acknowledged by the candidates. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the paper.

EXTERNAL EXAMINATION

The external theory examination of all semesters shall be conducted by the University at the end of each semester. There will be no supplementary exams. For reappearance/ improvement, the students can appear along with the next batch. A student who registers his/her name for the external examination for a semester will be eligible for promotion to the next semester. A student who has completed the entire curriculum requirement, but could not register for the

Semester examination can register notionally, for getting eligibility for promotion to the next semester. A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the University examination for the same semester, subsequently.

FOR PROJECTS

All students are to do a project in the area of core course. This project can be done individually or in groups (not more than five students) for all subjects which may be carried out in or outside the campus. The projects are to be identified during the II semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department in the sixth semester and are to be produced before the examiners appointed by the University. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

There shall be both internal and external examinations for projects.

a) Marks of external Examination : 80
b) Marks of internal evaluation : 20

Internal Evaluation

All the following four components of the internal assessment are mandatory:

Components of Internal Evaluation of project

Component	Marks
Punctuality	5
Experimentation/Data collection	5
Knowledge	5
Report	5
Total	20

External Evaluation

Components of External Evaluation of Project

Component	Marks
Dissertation (External)	50
Viva-Voce (External)	30
Total	80

External evaluation of the project work (both Dissertation and Viva – Voce) is compulsory, and may be conducted by a team of two Examiners (one internal and one External) .

11.   CONDUCT OF STATISTICAL COMPUTING EXAMINATIONS

One Choice-Based Core course in the VI semester of B.Sc. Statistics programme is with title Statistical Computing with R-software. This course may be taught by using computing facilities like computers with softwares and Statistical Tables. For this course also there will be both internal and external evaluation components with maximum marks 20 and 80 respectively. External examination of this course may be conducted at those examination halls of the examination centers where computing facilities are available, but NO External Examiner is needed. Also, the 5 marks earmarked for viva/seminar of the Internal component may be given for maintaining a Record Book for solving a minimum number of 10 problems, using R-code from the 4 modules taught in the VI semester. But, courses exclusively for computing purposes are not conceived for complementary courses in Statistics.

12. Syllabi

12(a). Syllabi of Core /Elective/Open Courses of B.Sc. Statistics Programme

Structure of 18 Theory Courses offered in B.Sc. Statistics(Model 1) Programme

Sl.No.	Semester	Courses Type	Courses Code and Title	Credit	Lecture Hours	
					Per Week	Total
1	I	CORE (CR)	ST1CRT01 - DESCRIPTIVE STATISTICS	3	4	72
2	II	CORE (CR)	ST2CRT02 - BASICS IN PROBABILITY THEORY AND APPLIED STATISTICS	3	4	72
3	III	CORE (CR)	ST3CRT03 - FUNDAMENTALS OF RANDOM VARIABLES	4	5	90
4	IV	CORE (CR)	ST4CRT04 - PROBABILITY DISTRIBUTIONS	4	5	90
5	V	CORE (CR)	ST5CRT05 - STATISTICAL ESTIMATION THEORY	4	5	90
6	V	CORE (CR)	ST5CRT06 - MATHEMATICAL METHODS FOR STATISTICS	4	5	90
7	V	CORE (CR)	ST5CRT07 - SAMPLING TECHNIQUES AND INDIAN OFFICIAL STATISTICS	4	5	90
8	V	CORE (CR)	ST5CRT08 – ENVIRONMENTAL STUDIES, HUMAN RIGHTS AND VITAL STATISTICS	4	5	90
9	V	OPEN (OP)		3	4	72

Structure of 18 Theory Courses offered in B.Sc. Statistics(Model 1) Programme

Sl.No.	Semester	Courses Type	Courses Code and Title	Credit	Lecture Hours	
					Per Week	Total
10	VI	CORE (CR)	ST6CRT09-TESTING STATISTICAL HYPOTHESES	4	5	90
11	VI	CORE (CR)	ST6CRT10- ANALYTICAL TOOLS FOR STATISTICS	4	5	90
12	VI	CORE (CR)	ST6CRT11-DESIGN AND ANALYSIS OF EXPERIMENTS	4	5	90
13	VI	CORE (CR)	ST6CRT12 - STATISTICAL COMPUTING USING R SOFTWARE	4	5	90
14	VI	ELECTIVE (CB)	ST6CBT01 - OPERATIONS RESEARCH	3	4	72
15	VI	ELECTIVE (CB)	ST6CBT02 - MATHEMATICAL ECONOMICS	3	4	72
16	VI	ELECTIVE (CB)	ST6CBT03 - STATISTICAL QUALITY CONTROL	3	4	72

OPEN COURSES

Sl.No.	Semester	Courses Type	Courses Code and Title	Credit	Lecture Hours	
					Per Week	Total
1	V	OPEN (OP)	ST5OPT01 - APPLIED STATISTICS	3	4	72
2	V	OPEN (OP)	ST5OPT02 -ACTUARIAL STATISTICS	3	4	72
3	V	OPEN (OP)	ST5OPT03 –ELEMENTS OF STOCHASTIC PROCESSES	3	4	72

Core Course of B. Sc. Statistics Programme
Semester I- Core Course I

ST1CRT01 - DESCRIPTIVE STATISTICS

Hours per week – 4
Number of credits -3

Module I: Methodology -Origin and meaning of Statistics, limitations and misuses of Statistics. Concepts of statistical population and sample. Census and sampling. Primary and secondary data. Different types of data – quantitative, qualitative, geographical and chronological. Continuous and discrete data. Methods of collection and editing of primary data. Designing of a questionnaire and schedule. Classification and tabulation of data. Frequency distributions. Stem and leaf chart.

(13L)

Module II:Measures of Central Tendency- Arithmetic mean, median, mode, geometric mean and harmonic mean. Partition values – quartiles, deciles and percentiles. Box - plot.

(20L)

Module III: Measures of Dispersion-Range, quartile deviation, mean deviation and standard deviation. Properties of these measures, relative measures of dispersion, coefficient of variation.

(18L)

Module IV: Moments- Raw and central moments, relation between central and raw moments, Sheppard's corrections. Skewness and kurtosis, Karl Pearson's measure of skewness, Bowley's measure of skewness, moment measure of skewness, measures of kurtosis.

(21L)

Books for study

1. Gupta,S.C.and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
2. Kapur,J.N. and Saxena,H.C.(2010).*Mathematical Statistics*, S. Chand.

References

1. Pillai, R.S.N. and Bagavathi (2015).*Statistics: Theory and Practice*, S.Chand.
2. Spiegel, M.R. andStephensL.J. (2014). *Statistics*, (5[th]ed.) Schaum's outlines, McGraw-Hill Education.
3. GuptaS.P. (2014).*Statistical Methods*, Sultan Chand & Sons, New Delhi.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	4	2	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		6	6	7	6	25	129	18	80
Total Mark		21	31	33	44	129			

Core Course of B. Sc. Statistics Programme
Semester II- Core Course II

ST2CRT02 - BASICS IN PROBABILITY THEORY AND APPLIED STATISTICS

Hours per week – 4
Number of credits -3

Module I: Probability: Random experiments, sample space, events. Mutually exclusive events, exhaustive events and equally likely events. σ-field of events. Classical, frequency and axiomatic definitions of probability, probability space. Properties of probability, addition theorem (up to three events).

(18L)

Module II Conditional Probability-Conditional probability and independence of events, pairwise independence and mutual independence. Multiplication theorem, total probability rule. Bayes' theorem and applications.

(18L)

Module III: Index Numbers-Simple and weighted index numbers, criteria of a good index number, cost of living index number, Laspeyere's, Paasche's, Marshall-Edgeworth's and Fisher's indices, base shifting, splicing, deflating, fixed and chain base indices.

(18L)

Module IV: Time series analysis- Components of a time series, measurement of trend and seasonal variation.

(18L)

Books for study

1. Gupta,S.C.and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
2. GuptaS.P. (2014).*Statistical Methods*, Sultan Chand & Sons, New Delhi.

References

1. Medhi, J. (2013): *Statistical Methods: An Introductory Text*,(Revised 2nd ed.), New Age International Publishers
2. Spiegel, M.R. and Stephens L.J. (2014). *Statistics*, (5th ed.), Schaum's outlines, McGraw-Hill Education.
3. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).*An Introduction to Probability and Statistics*, (3rd ed.),John Wiley & Sons Inc.
4. Ross.S. (2013). *A First Course in Probability*,(9th ed.), Pearson Education Publication.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	4	2	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	7	5	25	129	18	80
Total Mark		36	31	33	29	129			

Core Course of B. Sc. Statistics Programme

Semester III-Core Course III

ST3CRT03 - FUNDAMENTALS OF RANDOM VARIABLES

Hours per week – 5
Number of credits -4

Module I:Random Variables- Discrete and continuous random variables, functions of random variables. Probability mass function and probability density function with illustrations. Distribution function and its properties. Transformation of random variables.

Bivariate Random Variables- Bivariate distribution and statement of its properties. Joint, marginal and conditional distributions. Independence of random variables. Transformation of bivariate random variables.

(20L)

Module II: Mathematical Expectation-Definition and properties, mean and variance of a random variable. Addition and multiplication theorems on expectation. Raw and central moments. Examples of random variables for which moments do not exist. Mode and median of discrete and continuous random Variables. Covariance and correlation coefficient. Cauchy-Schwartz's inequality. Conditional expectation (regression function) and conditional variance.

(25L)

Module III: Generating Functions- Probability generating function, moment generating function, cumulant generating function, characteristic function and their Properties. Methods of Computing Mean and Variance from the moment generating function and Characteristic function with suitable examples.

(20L)

Module IV: Correlation and Regression-Curve fitting, principle of least squares, fitting of straight lines, parabolas, exponential curves. Bivariate linear correlation – Scatter diagram. Pearsons correlation coefficient, Spearman's rank correlation coefficient. Bivariate linear

regression – regression lines, coefficients of regression. Multiple and partial correlation for three variables (without proof).

(25L)

Books for study

1. Gupta,S.C.and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
2. GuptaS.P. (2014).*Statistical Methods*, Sultan Chand & Sons, New Delhi.

References

1. Spiegel, M.R. and Stephens L.J. (2014). *Statistics*, (5[th]ed.), Schaum's outlines, McGraw-Hill Education.
2. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).*An Introduction to Probability and Statistics*, (3rd ed.),John Wiley & Sons Inc.
3. Ross.S. (2013). *A First Course in Probability*, (9th ed.), Pearson Education Publication.
4. Hogg,R.V.,McKean,J.W.andCraig,A.T.(2014).*Introduction to Mathematical Statistics,* (7th ed.),Pearson Education Publication.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Core Course of B. Sc. Statistics Programme

Semester IV-Core Course IV

ST4CRT04 - PROBABILITY DISTRIBUTIONS

Hours per week – 5
Number of credits -4

Module I: Discrete Distributions-Degenerate, Uniform, Bernoulli, Binomial, Hyper geometric, Negative binomial, Geometric, Poisson - mean, variance, m.g.f, their properties-fitting of Binomial and Poisson, memory less property of Geometric distribution.

(25L)

Module II: Continuous Distributions-Uniform, Beta two types, Exponential, Gamma, Cauchy and Laplace - mean, variance, m.g.f, characteristic function, their properties - memory less property of exponential distribution.

(20L)

Module III: Normal Distribution -Properties, fitting of normal distribution, linear combination of normal variates, use of standard normal tables for various probability computation. Bivariate normal- marginal and conditional distributions.

(20L)

Module IV: Law of Large Numbers and Central Limit Theorem-Chebyshevs inequality, convergence in probability, Chebyshevs and Bernoulli's forms of weak law of large numbers, Lindberg-Levy form of Central Limit Theorem -Normal distribution as a limiting case of binomial and Poisson under suitable assumptions.

(25L)

Books for Study

1. Hogg,R.V.,McKean,J.W.andCraig,A.T.(2014).*Introduction to Mathematical Statistics,*

(7th ed.),Pearson Education Publication.

2. Gupta,S.C.and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.

References

1. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).*An Introduction to Probability and Statistics*, (3rd ed.),John Wiley & Sons Inc..

2. Johnson, N.L., Kotz, S. and Balakrishnan. (1994).*Continuous Univariate Distributions, Vol*. I, (2nd ed.). John Wiley, New York.

3. Johnson, N.L., Kemp, A.W. and Kotz, S. (2005).*Univariate Discrete Distributions*,(3rd ed.) John Wiley, New York.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	5	3	2	2	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		9	6	5	5	25	129	18	80
Total Mark		40	31	29	29	129			

Core Course of B. Sc. Statistics Programme

Semester V- Core Course V

ST5CRT05 - STATISTICAL ESTIMATION THEORY

Hours per week – 5
Number of credits -4

Module I:Sampling Distributions-Concept of random sample and statistic, sampling distribution of a statistic, standard error, sampling distributions of the mean and variance of a random sample arising from a normal population. χ^2, t and F distributions- derivations, properties, uses and inter relationships.

(25L)

Module II: Point Estimation-Describe properties of a good estimator – unbiasedness, consistency, sufficiency and efficiency. Cramer-Rao inequality and its application, Minimum variance bound estimator Rao – Blackwell Theorem. Completeness property of an estimator.

(20L)

Module III: Methods of Estimation-Method of moments, Method of maximum likelihood properties of maximum likelihood estimation (statement only), Method of minimum variance, uniqueness of minimum variance unbiased estimator.

(20L)

Module IV: Interval Estimation-Basic concepts, confidence interval, confidence coefficient. Construction of confidence intervals for the mean, difference of means, variance and ratio of variances based on normal, t, χ^2 and F distributions. Large sample confidence intervals for mean, difference of means, proportion and difference of proportions.

(25L)

Books for study

1. Hogg,R.V.,McKean,J.W.and Craig,A.T.(2014).*Introduction to Mathematical Statistics,* (7th ed.),Pearson Education Publication.

2. Gupta,S.C.and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.

References

1. Spiegel, M.R. and Stephens L.J. (2014). *Statistics*, (5th ed.), Schaum's outlines, McGraw-Hill Education.

2. Lehmann,E.L.and Casella,G.(2003).*Theory of Point Estimation*,(2nd ed.),Springer.

3. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).*An Introduction to Probability and Statistics*, (3rd ed.),John Wiley & Sons Inc..

4. Mood A.M., Graybill F.A. and Boes D.C. (2001).*Introduction to the Theory of Statistics*,(3rd ed.),McGraw Hill Education (India) Private Limited.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	4	3	3	2	12	24	10	20
B	5	2	2	3	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	7	5	25	129	18	80
Total Mark		33	31	36	29	129			

Core Course of B. Sc. Statistics Programme

Semester V-Core Course VI

ST5CRT06 - MATHEMATICAL METHODS FOR STATISTICS

Hours per week – 5
Number of credits -4

Module I:Sets and Sequences-Bounded and unbounded sets, supremum and infimum, neighbourhood of a point, limit point of a set, derived set, Bolzano-Weierstrass theorem (without proof),open and closed sets (definitions only).

Sequences-Convergence and divergence of sequences, Bolzano-Weierstrass theorem, limit inferior and limit superior (Definitions and examples only), Cauchy's general principle of convergence, Cauchy sequences. Limits of some special sequences such as $r^n, (1+\frac{1}{n})^n$ and $n^{\frac{1}{n}}$ .Algebra of sequences, Sandwich theorem. Cauchy's first and second theorems on limits, Monotonic sequences, Monotone convergence theorem.

(25L)

Module II: **Infinite Series** –Definition, positive term series, tests for convergence -comparison test, Cauchy's root test, D'Alembert's ratio test, Raabe's test, logarithmic test, alternating series, Leibnitz test for the convergence of alternating series, absolute convergence and conditional convergence.

(20L)

Module III:-Functions of a Single Variable-I - Limits of a function, continuous functions, continuity at a point, continuity in an interval, discontinuous functions, types of discontinuity, functions continuous on closed intervals, uniform continuity.

(20L)

Module IV: Functions of a Single Variable-II–Derivatives, derivability at a point, derivability in an interval, Darboux's theorem(without proof), intermediate value theorem for derivatives,

Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean value theorem, Uniform convergence of sequences and series of functions, tests for uniform convergence of sequence and series of functions.

(25L)

Book for study

1. Malik,S.C. and Arora, S. (2014*). Mathematical Analysis*, Fourth Edition, New Age International limited, New Delhi.

   Chapter – 1; Section 3   Chapter – 2; Sections 1-3Chapter – 3; Sections 1-9

   Chapter – 4; Sections 1-7, 10.1, 10.2Chapter – 5; Sections 1-4

   Chapter – 6; Sections 1-7 Chapter – 12; Sections 1-3.

References

1. Bali, N.P (2009). *Real Analysis*, Laxmi Publications (P) Ltd, New Delhi.

2. Shanti Narayan and Raisinghania, M.D. (2014).*Elements of Real Analysis*,(17th ed.), S.Chand & Company, New Delhi

3. Rudin,W.(2013).*Principles of Mathematical Analysis*,(3rded.),TMH.

4. Apostal,T.M.(2002).*Mathematical Analysis*,(2nd ed.), Narosa Publishing House, New Delhi.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	2	2	3	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	6	7	25	129	18	80
Total Mark		31	31	31	36	129			

Core Course of B. Sc. Statistics Programme

Semester V- Core Course VII

ST5CRT07 - SAMPLING TECHNIQUES AND INDIAN OFFICIAL STATISTICS

Hours per week – 5
Number of credits -4

Module I:Basic Concepts-Census and sampling, types of sampling – probability and non-probability sampling, advantages and disadvantages, principal steps in a sample survey, sampling and non-sampling errors, organizational aspects of sample survey.

Indian Official Statistics-Methods of collection of official Statistics. Role of Ministry of Statistics & Programme Implementation(MOSPI),Central Statistical Office (CSO), National Sample Survey Office(NSSO) and National Statistical Commission (NSC). Government of India's principal publications containing data on the topics such as population, industry and finance.

(25L)

Module II: Simple Random Sampling-Simple random sampling with and without replacement, procedures of selecting a sample, unbiased estimates of the population mean and population total-their variances and estimates of the variances, confidence interval for population mean and total, simple random sampling for attributes, determination of the sample size based on desired accuracy for variables and attributes.

(25L)

Module III: Stratified Random Sampling-Estimation of the population mean and population total-their variances and estimates of the variances, proportional allocation and Neyman allocation of sample sizes, cost function – optimum allocation, comparison with simple random sampling.

(20L)

Module IV: Systematic and Cluster Sampling- Linear and circular systematic sampling, estimates of the population mean and population total, comparison of systematic sampling with simple random sampling. Cluster sampling – clusters with equal sizes –estimation of population mean and total – their variances and estimates of the variances.

(20L)

Books for Study

1. Gupta,S.C. and. Kapoor,V.K .(2014).*Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.
2. Cochran, W.G. (2007).*Sampling Techniques*, (3rd ed.),John Wiley and Sons.
3. http://mospi.nic.in

References

1. Singh,D. and Choudhary,F.S.(2013)*Theory and Analysis of sample survey Designs*, New Age International Publishers.
2. Mukhopadhyay, P. (2008). *Theory and Methods of Survey Sampling*, (2nd ed.) Prentice-Hall of India.
3. Sampath,S.(2005).*Sampling Theory and Methods*,(2nd ed.),Alpha Science International Limited.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Core Course of B. Sc. Statistics Programme
Semester V- Core Course VIII

ST5CRT08–ENVIRONMENTAL STUDIES, HUMAN RIGHTS AND VITAL STATISTICS

Hours per week – 5
Number of credits -4

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and World Summit on Sustainable Development at Johannesburg in 2002 have drawn the attention of people around the globe to the deteriorating condition of our environment. It is clear that no citizen of the earth can afford to be ignorant of environment issues..

India is rich in biodiversity which provides various resources for people. Only about 1.7 million living organisms have been described and named globally. Still many more remain to be identified and described. Attempts are made to conserve them in ex-situ and in-situ situations. Intellectual property rights (IPRs) have become important in a biodiversity-rich country like India to protect microbes, plants and animals that have useful genetic properties. Destruction of habitats, over-use of energy resource and environmental pollution have been found to be responsible for the loss of a large number of life-forms. It is feared that a large proportion of life on earth may get wiped out in the near future.

In spite of the deteriorating status of the environment, study of environment have so far not received adequate attention in our academic programme. Recognizing this, the Hon'ble Supreme Court directed the UGC to introduce a basic course on environment at every level in college education. Accordingly, the matter was considered by UGC and it was decided that a six months compulsory core module course in environmental studies may be prepared and compulsorily implemented in all the University/Colleges of India.

The syllabus of environmental studies includes five modules including human rights. The first two modules are purely environmental studies according to the UGC directions. The second two modules are strictly related with the core subject and fifth module is for human rights.

Objectives

- Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental issues by developing and

enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.

- Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future. It encourages character building, and develop positive attitudes and values.
- To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment and helps to protect the nature and natural resources.

To help the students in acquiring the basic knowledge about environment and the social norms that provide unity with environmental characteristics and create positive attitude about the environment.

Module I:

Unit 1 :Multidisciplinary nature of environmental studies

Definition, scope and importance   **(2 L)**
Need for public awareness.

Unit 2 : Natural Resources :

Renewable and non-renewable resources : Natural resources and associated problems.

a) **Forest resources** : Use and over-exploitation, deforestation, case studies.

Timber extraction, mining, dams and their effects on forest and tribal people.

b) **Water resources** : Use and over-utilization of surface and ground water,

floods, drought, conflicts over water, dams-benefits and problems.

c) **Mineral resources** : Use and exploitation, environmental effects of extracting

and using mineral resources, case studies.

d) **Food resources** : World food problems, changes caused by agriculture and

overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water

logging, salinity, case studies.

e) **Energy resources**: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.

f) **Land resources**: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

- Role of individual in conservation of natural resources.
- Equitable use of resources for sustainable life styles.   (**10 L**)
- **Unit 3: Ecosystems**
- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the given ecosystem:- Forest ecosystem

(**6 L**)

Module II:

Unit 1: Biodiversity and its conservation

- Introduction
- Biogeograhical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- India as a mega-diversity nation
- Hot-sports of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
- Endangered and endemic species of India

(**8 L**)

Unit 2: Environmental Pollution

Definition

Causes, effects and control measures of: -

a.   Air pollution
b.   Water pollution
c.   Soil pollution
d.   Marine pollution
e.   Noise pollution
f.   Thermal pollution
g.   Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides.   **(8 L)**

Unit 3:   Social Issues and the Environment

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people: its problems and concerns, Case studies
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and holocaust, Case studies
- Consumerism and waste products
- Environment Protection Act
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness   **(10 L)**

Module III:

Measurement of Mortality-Introduction and sources of collecting data on vital statistics, Census, Registration, adhoc surveys, hospital records. Measurement of mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality Rate (IMR) and Standardized Death Rates.   **(20L)**

Module IV:

Measurement of Fertility-Crude Birth Rate, General Fertility rate, age-specific fertility rate, Total Fertility rate. Measurement of Population Growth: Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate(NRR).

                                                                                              (13L)

Module V:

Unit 1- Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2 Human Rights and United Nations – contributions, main human rights related organs- UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit-3 Environment and Human Rights - Right to Clean Environment and Public   Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

(8 L)

Internal: Field study

- Visit to a local area to document environmental grassland/ hill /mountain
- Visit a local polluted site – Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds etc
- Study of simple ecosystem-pond, river, hill slopes, etc

(Field work Equal to 5 lecture hours)

Books for study

1. Bharucha, E. (2010). *Text Book for Environmental studies for undergraduate Courses*, University Grants Commission, New Delhi.

2. Gupta, S.C. and. Kapoor, V.K .(2014). *Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.

3. Goon, A.M. Gupta,M.K. and Das Gupta, B. (2001): *Fundamentals of Statistics*, Vol. II, World press, Calcutta.

4. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.

5. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)

References

1. Agarwal, K. C. (2001). *Environmental Biology,* Nidi Publishers Ltd, Bikaner.

2. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .

3. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb

4. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p

5. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p

6. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co.

7. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p

8. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p

9. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016

10. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut

11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science

12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media

13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication

14. Shrivastava, O.S. (1983).*A Text Book of Demography*, Vikas Publishing House, New Delhi.

15. Benjamin B (1960).*Elements of Vital Statistics*, Quadrangle Books.

16. Law Relating to Human Rights, Asia Law House,2001.

17. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,

18. S.K.Khanna, Children And The Human Rights, Common Wealth Publishers,1998. 2011.

19. Sudhir Kapoor, Human Rights in 21st Century,Mangal Deep Publications, Jaipur,2001.

20. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total	Total Marks	To be answered	
		Module							No. of Questions	Total Marks
		1	2	3	4	5				
A	2	2	2	4	3	1	12	24	10	20
B	5	1	2	3	2	1	9	45	6	30
C	15	1	1	1	1	0	4	60	2	30
Total Questions		4	5	8	6	2	25	129	18	80
Total Mark		24	29	38	31	7	129			

Core Course of B. Sc. Statistics Programme
Semester V-Open Course- I
ST5OPT01 - APPLIED STATISTICS

Hours per week – 4

Number of credits -3

Module I: Index Numbers-Meaning, classification and construction of Index numbers. Simple and weighted index numbers. Laspeyere's, Paasche's, Marshall-Edgeworth's and Fisher's, Dorbish-Bowley's andKelly's indices. Quantity Index Numbers.

(20L)

Module II: Tests on Index Numbers- Factor reversal test, Time Reversal test, Circular test. Chain Index Numbers, Base shifting, splicing and Deflating of Index Numbers. Consumer price Index Numbers.

(20L)

Module III: Time Series - Concept of time Series, components of time series, additive and multiplicative models, measurement of trend using graphical, semi-average, moving average methods and least square method (Straight line only)

(20L)

Module IV: Measurement of Seasonal Variation – Ratio to moving average, ratio to trend, link relative method.

(12L)

Book for study
1. Gupta S.P.()*Statistical methods,* Sultan Chand and Sons, New Delhi
2. Kapur J.N and Saxena H.C.() *Mathematical Statistics*, Sultan Chand and Sons, New Delhi.

3. S.C. Gupta and V.K. Kapoor() *Fundamentals of Applied Statistics*, Sultan Chand and Sons.

References

1. Goon A.M, Gupta M.K. and Das Gupta() *Fundamentals of StatisticsVol. II*, The world press, Calcutta.
2. Agarwal B.L.( ) *Basic Statistics*, Wiley Eastern Ltd, New Delhi

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	4	4	1	12	24	10	20
B	5	1	5	2	1	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		5	10	7	3	25	129	18	80
Total Mark		26	48	33	22	129			

Core Course of B. Sc. Statistics Programme

Semester V- Open Course- II

ST5OPT02 -ACTUARIAL STATISTICS

Hours per week – 4
Number of credits -3

Module I: Introductory Statistics and Insurance Applications- Discrete, continuous and mixed probability distributions. Insurance applications, sum of random variables. Utility theory: Utility functions, expected utility criterion, types of utility function, insurance and utility theory.

(20L)

Module II: Principles of Premium Calculation- Properties of premium principles, examples of premium principles. Individual risk models: models for individual claims, the sum of independent claims, approximations and their applications.

(17L)

Module III: Survival Distribution and Life Tables- Uncertainty of age at death, survival function, time until-death for a person, curate future lifetime, force of mortality, life tables with examples, deterministic survivorship group, life table characteristics, assumptions for fractional age, some analytical laws of mortality.

(18L)

Module IV: Life Insurance- Models for insurance payable at the moment of death, insurance payable at the end of the year of death and their relationships. Life annuities: continuous life annuities, discrete life annuities, life annuities with periodic payments. Premiums: continuous and discrete premiums.

(17L)

 Book for study

4. Dickson, C. M. D. (2010): *Insurance Risk and Ruin* (International Series on Actuarial Science), Cambridge University Press.

References

1. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A. And Nesbitt, C. J. (1997): *Actuarial Mathematics*, Society of Actuaries, Itasca, Illinois, U.S.A.

2. Dickson, C. M. D., Hardy, S.C. and Waters, H.R. (2013).*Actuarial Mathematics for Life Contingent Risks, (*2[nd]ed.), Cambridge University Press.

3. Gerber, H.U. (1990). *Life Insurance Mathematics*, Springer.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	4	2	12	24	10	20
B	5	2	2	2	3	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	7	6	25	129	18	80
Total Mark		31	31	33	34	129			

Core Course of B. Sc. Statistics Programme

Semester V- Open Course- III
ST5OPT03 –ELEMENTS OF STOCHASTIC PROCESSES

Hours per week – 4
Number of credits -3

Module I: Stochastic Process – Definition, Classification with examples, Markov Chains – Transition Probabilities Transition Probability Matrix – Properties, Chapman Kolmogorov equations, Examples and Computation.

(20L)

Module II: First Passage Probabilities-Probability Generating Functions. Relationship between First Passage and Transition Probabilities, Classification of States – Recurrent, Transient Ergodic State, Accessibility, Communication, Periodic Stationary Distribution.

(18L)

Module III: Random Walk – Absorbing Elastic and Reflecting Barriers – Gambler's Ruin Problem. Ultimate Ruin Probability, Brownian motion.

(17L)

Module IV: Poisson Process – Axiomatic derivation, inter-arrival distribution, relation to binomial, geometric and gamma distribution. Pure Birth Process – Difference Differential Equation Yule Process [as example].

(17L)

Books for study
1. Medhi J. (2009).*Stochastic Processes*. (3rd ed.), New Age Science Ltd.
2. Basu, A.K. (2005): *Introduction to Stochastic Processes*, Narosa Publishing.
3. Ross,S.M.(1983). *Stochastic Processes*, John Wiley.

References

1. Feller, W.(2008).*An Introduction in Probability and its Application,* Vol.II, (2nd ed.),
   Wiley India Pvt.Ltd.

2. Bhat B.R. (2002*) Stochastic Processes, (2nd ed.)*, New Age Publication.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	4	2	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	7	5	25	129	18	80
Total Mark		36	31	33	29	129			

Core Course of B. Sc. Statistics Programme
Semester VI- Core Course IX

ST6CRT09-TESTING STATISTICAL HYPOTHESES

Hours per week – 5
Number of credits -4

Module I: Statistical Hypothesis – Simple and Composite hypotheses, null and alternative hypotheses, test of a hypothesis, two types of errors, critical region, significance level and power of a test. Unbiased test; uniformly most powerful test, p-value.

(25L)

Module II: Neyman-Pearson Theorem and its Application- Likelihood ratio tests - test for the mean, test for equality of means (common with unknown variance), test for the variance and test for equality of variances.

(20L)

Module III: Large Sample Tests and Small Sample-Tests concerning means, equality of means, proportion and equality of proportions. Test based on χ^2 distribution for goodness of fit, independence and homogeneity. Small sample tests for the mean and equality of means. Paired t – tests. Tests based on χ^2 distribution for variance and F distribution for the equality of variances. Tests concerning correlation coefficients.

(25L)

Module IV: Non Parametric Tests (All Tests as Techniques Only)-Basic ideas, sign test for one sample and two sample cases, signed rank tests for one sample and two sample cases, run test for randomness, Wald-Wolfowitz run test, Mann-Whitney U-test, Kolmogorov-Smirnov tests for one sample and two samples, Median test for two independent samples.

(20L)

Books for Study

1. Hogg,R.V.,McKean,J.W.and Craig,A.T.(2014).*Introduction to Mathematical Statistics,* (7ᵗʰ ed.),Pearson Education Publication.

2. Gupta,S.C.and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.

3. Gibbons J.D.(1993).*Nonparametric Statistics: An Introduction*, Sage Publications.

References

1. Spiegel, M.R. and Stephens L.J. (2014). *Statistics*, (5ᵗʰed.), Schaum's outlines, McGraw-Hill Education..

2. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).*An Introduction to Probability and Statistics*, (3ʳᵈ ed.),John Wiley & Sons Inc..

3. Mood A.M., Graybill F.A. and Boes D.C (2001).*Introduction to the Theory of Statistics*,(3ʳᵈ ed.),McGraw Hill Education (India) Private Limited.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	4	3	3	2	12	24	10	20
B	5	2	2	2	3	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		33	31	31	31	129			

Core Course of B. Sc. Statistics Programme

Semester VI- Core Course X

ST6CRT10- ANALYTICAL TOOLS FOR STATISTICS

Hours per week – 5
Number of credits -4

Module I: Numerical Analysis- Operators E, Delta, backward difference operator central difference operator and their basic properties. Separation of symbols, Divided differences. Newton's forward and backward interpolation formulae.

(25L)

Module II: Interpolation for Unequal Intervals-Lagrange's formula, Newton's divided difference formula, Central difference formulae- Stirling's, Bessel's and Everett's formulae. Numerical quadrature- Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules and Weddle's rule.

(20L)

Module III:**Complex Analysis-** Analytic functions – Cauchy Riemann equations, Complex Integration – Cauchy' theorem, Cauchy's integral formula, Morera's theorem, Liouville's theorem,Poles and Singularities Cauchy' residue theorem(Statement only of all the theorems).

(20L)

Module IV: Riemann Integral- Definition and examples of Riemann integral, Properties of Riemann integral, Integral as a limit of sums, integrability of continuous and monotonic functions, Integration and differentiation, Fundamental Theorem of Integral Calculus, First Mean Value Theorem of Integral Calculus.

(25L)

Books for study

1. Saxena, H.C. (1988).*Finite Differences and Numerical Analysis,* S.Chand*.*

2. Tyagi, B.S. (2008).*Functions of a Complex Variable*, Kedar Nath Ram Nath Educational Publishers.

3. Malik,S.C. and Savita Arora (2014*). Mathematical Analysis*, Second Edition, New Age International limited, New Delhi.

Chapter – 9; Sections 1-10

References

1. Scarborough, J.B. (1958)*Numerical Mathematical Analysis*, Oxford and IBH Publishing Co.Pvt.Ltd.

2. Milne- Thomson, L.M. (2000).*The Calculus of Finite Differences*, AMS Chelsea Publishing..

3. Churchill, R. and Brown, J.(2013). Complex Variables and Applications, (9th ed.),McGraw-Hill Education.

4. Kasana, H.S.(2005). *Complex Variables: Theory and Applications*, (2nd ed.), Prentice-Hall of India Pvt.Ltd. New Delhi.

5. Bali, N.P (2009). *Real Analysis*, Laxmi Publications (P) Ltd, New Delhi.

6. Shanti Narayan and Raisinghania, M.D. (2014).*Elements of Real Analysis*,(17th ed.), S.Chand & Company, New Delhi

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	5	0	4	3	12	24	10	20
B	5	4	1	2	2	9	45	6	30
C	15	0	2	1	1	4	60	2	30
Total Questions		9	3	7	6	25	129	18	80
Total Mark		30	35	33	31	129			

Core Course of B. Sc. Statistics Programme

Semester VI- Core Course XI

ST6CRT11-DESIGN AND ANALYSIS OF EXPERIMENTS

Hours per week – 5
Number of credits -4

Module I: Linear Estimation and Testing of Linear Hypotheses-Linear parametric function estimability, necessary and sufficient condition for estimability of a linear parametric function. Gauss-Markov set-up, fixed effects model, random effects model, mixed effects model and analysis of variance model(definitions only). BLUE, Gauss-Markov Theorem (without proof) and simple problems. Testing of linear hypotheses.

(20L)

Module II: Analysis of Variance-Definition, models and assumptions used in analysis of variance. Contrasts and analysis of variance, orthogonal contrasts. Analysis of variance of one-way classified data. Analysis of variance of two-way classified data (with single observation per cell).Analysis of covariance in one-way classified data with one covariate.

(20L)

Module III: Experimental Designs- Absolute and comparative experiments, terminology, experimental error, uniformity trials. Basic principles of designs of experiments-Randomization, Replication and Local control. Basic designs-Completely Randomized Design(CRD), Randomized Block Design(RBD) and Latin Square Design (LSD)-Layout. Model and statistical analysis. Relative efficiency of designs, estimation and analysis of missing observations.

(20L)

Module IV: Factorial Experiments – Definition and use of factorial experiments, definitions of symmetrical and asymmetrical factorial experiments, illustrations. Main effects and interaction effects. Analysis in 2^2 , 2^3 and 2^n experiments in the set up of RBD.

(20L)

Books for study

1. Gupta,S.C. and. Kapoor,V.K .(2014).*Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.

2. Joshi,D.D. (2009).*Linear Estimation and Design of Experiments*,New Age International (P) Limited Publishers.

3. Das, M.N. and Giri, N.C. (2008).*Design and Analysis of Experiments*,New Age International (P) Limited Publishers.

   Chapter – 1; Sections 1.1-1.9, Chapter – 2; Sections 2.1-2.5

   Chapter – 3; Sections 3.1-3.5

4.MontgomeryD.C. (2013).*Design and Analysis of Experiments: International Student Version*, Wiley India Pvt. Ltd.

Chapter-15;Sections15.3, 15.3.1

 References

1. Cochran, W.G. and Cox, G.M. (1992). *Experimental Designs*, WileyClassics Library.
2. Hinkelmann, K.andKempthrone, O. (2008).*Design and Analysis of Experiments*, Vol.I, John Wiley and Sons.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	2	3	4	3	12	24	10	20
B	5	2	2	3	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		5	6	8	6	25	129	18	80
Total Mark		29	31	38	31	129			

Core Course of B. Sc. Statistics Programme

Semester VI-Core Course XII

ST6CRT12 -STATISTICAL COMPUTING USING R SOFTWARE

Hours per week – 5
Number of credits -4

This course is intended to give the students a first-hand training on writing and run the R-code for the computation of various statistical tools and drawing of different charts, graphs and diagrams. This may be practiced in a computing laboratory. No external examiner is needed for conducting the end semester examinations, but may be conducted in a computing laboratory, where computers with softwares and Statistical Tables available.

Module I: - Descriptive Statistics Using R– Diagrammatic and Graphical representation of data – bar diagram, histogram, pie diagram, box plot, Q-Q plot, the plot function and curve function; Measures of central tendency, Measures of dispersion, Measures of skewness and Kurtosis, Selection of representative samples, Scatter diagram.

(25L)

Module II: Probability Distributions Using R – Probability distributions, some special discrete distributions (Binomial, Poisson), Continuous probability distribution, some special continuous distributions (Normal, exponential); Methods for generating random variables– Introduction, random generation of standard uniform, standard normal and other common probability distributions in R, the inverse transform method, quantiles, transformation methods.

(25L)

Module III: **Correlation and Regression Analysis** – Correlation, inference procedures for correlation coefficient, linear regression, the coefficient of determination, inference procedures for simple linear model.

(20L)

Module IV: Statistical Inference (R Commands and implementation only) Obtaining MLE using available data, confidence intervals for mean, difference of means, variance and proportion, hypothesis testing – the p-value –definition and interpretation, Tests for mean: Z-test, Z test for comparing means, one sample t-test, two sample t-test, paired t-test, χ^2-test for variance, F- test for comparing variances, χ^2- test of Goodness of fit, χ^2-test for independence , χ^2-test for homogeneity, one way ANOVA and two way ANOVA.

(20L)

Book for study

1. Purohit, S.G, Gore, S.D and Deshmukh, S.R. (2015).*Statistics Using R*, (2nd ed.), Narosa Publishing House.

References

1. Zuur, A.F, Leno, E.N.andMeesters, E.H.W.G. (2009): *Use R*, Springer.
2. Rizzo, M.L. (2007).*Statistical Computing with R*, Chapman and Hall/CRC.
3. Dalgaard,P. (2008).*Introductory Statistics with R*, Springer.

SCHEME OF QUESTION PAPER

For this course 5 questions are to be answered from a set of 8 questions each carrying 16 marks.

Two questions from each module are included in the question paper.

Computers with R software and Statistical tables allowed

Core Course of B. Sc. Statistics Programme

Semester VI-Core Course XIII-Elective- I

ST6CBT01 - OPERATIONS RESEARCH

Hours per week – 4
Number of credits -3

Module I: Operations Research and LPP- Origin and Development of OR, Objectives of OR, Modeling and types of models in OR. Linear Programming: Mathematical formulation of LPP, graphical solutions of a L.P.P. Simplex method for solving LPP.

(25L)

Module II: Artificial Variables-Two phase method, Big M-method, Concept of Duality in L.P.P, Dual simplex method.

(20L)

Module III: Transportation and Assignment Problems-General transportation problem. Methods for finding initial basic feasible solutions by North West corner rule, Least cost method and Vogel's approximation method (VAM). MODI method to find the optimal solution. Unbalanced transportation problem and degeneracy (definitions and simple problems only). Assignment problem-Hungarian method to find optimal assignment.

(25L)

Module IV: Network Analysis-Drawing the Network Diagram – Analysis of Network, Calculation of Critical Path – PERT, Expected Completion Time and its Variance.

(20L)

Book for study

1. Kanti Swarup, Gupta P.K., Man Mohan (2010): *Operations Research*, Sultan Chand and Sons, New Delhi.

References.

1. Taha, H.A. (2014).*Operations Research*, Pearson Education Publication.
2. Gupta R.K. (2010): *Operations Research*, Krishna Prakashan Media (P) Ltd., Meerut.
3. Bronson, R.and Naadimuthu, G. (1997). *Operation Research*,Schaum's Outline Series,McGraw-Hill Education.
4. Mittal, S.K.and.Goel, B.S. (1990): *Operations Research*, Pragati Prakashan, Meerut.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	2	3	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	7	6	24	129	18	80
Total Mark		31	31	36	31	129			

Core Course of B. Sc. Statistics Programme

Semester VI-Core Course XIII-Elective- II

ST6CBT02 - MATHEMATICAL ECONOMICS

Hours per week – 4
Number of credits -3

Module I: Demand and Supply Analysis-Concept of demand, demand function, elasticity of demand, elasticity of substitution, relation between elasticity of demand, price, average revenue, total.

(20L)

Module II: Consumer Behaviour-Concept of utility, cardinal and ordinal utility, maximization of utility, budget constraint and equilibrium of consumer, income and substitution effects of a price change, Sluky equation.

(25L)

Module III: Production Theory-Output and input relation, total, average, marginal products in case of production with single variable input, production isoquants and economic region of production. Meaning and nature of production functions, returns to scale, linearly homogeneous production functions and its properties, Euler's theorem and its applications for various standard production functions.

(25L)

Module IV: Markets-Price determination in perfect competition, in monopoly, discriminating monopoly, duopoly and oligopoly. Production cost, optimum combination of inputs, constrained cost minimization, profit maximization.

(20L)

Books for study

1. Koutsoyiannis,A.(2008).*Modern Micro Economics*,(2[nd]ed.), Macmillan publishers
2. Allen R.G.D. (2014).*Mathematical Analysis for Economists,* Trinity Press.

References

1. Henderson, J.M. and Quandt, R.E (2003).*Micro EconomicTheory: A Mathematical Approach*, (3[rd]ed.), McGraw-Hill Education (India) Pvt.Ltd.
2. Simon, C.P.and Blume, L. (2010): *Mathematics for Economists*,(1st ed.),Viva Books.
3. Madnani, G.M.K.andMehta, B.C (2014).*Mathematics for Economists*, Sultan Chand & Sons, New Delhi.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	4	2	12	24	10	20
B	5	2	2	2	3	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	7	6	25	129	18	80
Total Mark		31	31	33	34	129			

Core Course of B. Sc. Statistics Programme

Semester VI-Core Course XIII- Elective- III

ST6CBT03 - STATISTICAL QUALITY CONTROL

Hours per week – 4
Number of credits -3

Module I:Meaning of Statistical Quality Control- Processcontrol and product control, assignable and chances causes, definition of quality control and statistical quality control. Need for statistical quality control techniques in industry, causes of quality variation. control charts, operation and uses of control charts, probability limits, specification limits, tolerance limits, 3 sigma limits and warning limits.

(25L)

Module II: Control Charts for Variables- $\overline{X}$ - Chart, R-chart, purpose of the charts, rational of sub grouping, plotting of $\overline{X}$ and R charts, standard out of control pattern on control charts, interpretation of control charts.

(25L)

Module III: Control Chart for Attributes-Construction and operation of P-chart, np- chart, C - chart and U- chart. Choices between various attribute charts. Comparison between variable and attribute charts.

(20L)

Module IV: Product Control-Principles of acceptance sampling, stipulation of good and bad lots, producers and consumers risks, concepts of AQL and LTPD, simple and double sampling plans, their O.C and ASN functions, rectifying inspection plans, concepts of AOQ, AOQL,ATIand sampling inspection plans.

(20L)

Books for study

1. Montgomery, D.C. (2010).*Statistical Quality Control: A Modern Introduction*,(6th ed.), Wiley India Pvt. Ltd.
2. Gupta, S.C. and. Kapoor, V.K .(2014). *Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.

References

1. Grant E.L. and Leavenworth, R.S. (2008).*Statistical Quality Control*,(7[th]ed.) Tata McGraw-Hill.
2. Duncan A.J. (1986).*Quality Control and Industrial Statistics,*Irwin.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	2	2	3	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	6	7	25	129	18	80
Total Mark		31	31	31	36	129			

12(b). Syllabi of Complementary Courses in Statistics

12(b)(i)Syllabi of Complementary Courses in Statistics of B. Sc. Mathematics (Model I) Programme

The Structure of the 4 Complementary Courses in Statistics offered for B.Sc. Mathematics (Model I) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
1	Complementary	ST1CMT01 - Descriptive Statistics	3	4	72
2	Complementary	ST2CMT02 - Probability Theory	3	4	72
3	Complementary	ST3CMT03 - Probability Distributions	4	5	90
4	Complementary	ST4CMT04 - Statistical Inference	4	5	90

Complementary Course to B. Sc. Mathematics Programme

Semester I - Course I

ST1CMT01 - DESCRIPTIVE STATISTICS

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications Programme)

Hours per week - 4

Number of credits - 3

Module I:Different aspects of data, and its collection

Statistics as collected facts and figures, and as a science for extracting information from data. Concepts of a statistical population and sample. Different types of characteristics and data- qualitative and quantitative, cross-sectional and time-series, discrete and continuous, frequency and non-frequency. Different types of scale- nominal and ordinal, ratio and interval. Collection of data- census and sampling. Different types of random samples- simple random sample, systematic, stratified and cluster (description only).

(20L)

Module II :Central tendency and Dispersion

Averages- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted averages..Absolute Measures of dispersion- Range, Quartile Deviation, Mean Deviation and Standard Deviation. Combined mean and standard deviation, C.V, relative measures of dispersion, Ogives and Box plot.(problems based on the above topics)

(20L)

Module III :, Moments, Skewness and Kurtosis

Raw moments, central moments and their inter relation. Skewness- Pearson's, Bowly's and moment measures of skewness. Kurtosis- percentile and moment measure of kurtosis(problems based on the above topics)..   (15L)

Module IV : Index Numbers

Definition of Index Numbers. Price Index Numbers. Price Index Numbers as Simple (A. M.,G. M.)and Weighted averages (A. M.)of price relatives. Laspeyer's, Paasche's and Fisher's Index Numbers. Time-Reversal and Factor-Reversal tests. Cost of living index numbers-family budget and aggregate expenditure methods. An introduction to Whole sale Price Index and Consumer Price Index.(problems based on the above topics)..

(17L).

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the

question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon, A. M.,Gupta M. K. and Dasgupta,B(1986).Fundamentals of Statistics,Volume1, world press, Kolkota

2. Gupta, S. C. and Kapoor, V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Gupta, S. C. and Kapoor, V. K.(2007).Fundamentals of applied Statistics,SultanChandand Sons.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

8. Mukhopadhya, P. (1999). Applied Statistics, New central book agency private limited, Kolkata

9. Seemon, T.(2014). Basic Statistics.Narosa Publishing House

Note: The 5 marks for the Assignment component of Internal assessment
may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Mathematics Programme

Semester II - Course II

ST2CMT02 - PROBABILITY THEORY

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 4

Number of credits - 3

Module I : Probability

Random experiments. Complement, union and intersection of events and their meaning. Mutually exclusive, equally likely and Independent events. Classical, Frequency and Axiomatic approaches to probability. Monotone property, Addition theorem (up to 3 events. Conditional probability. Multiplication theorem(up to 3 events). Independence of events.. Bayes' theorem.(problems based on the above topics)   (20L)

Module II : Probability Distribution of Univariate Random Variables

Concept of random variables. discrete and continuous random variables. Probability mass and density functions, and cumulative distribution functions. Evaluation of conditional and unconditional probabilities. Change of variables- methods of jacobian and cumulative distribution function (one variable case).

(problems based on the above topics)   (17L)

Module III : Probability Distribution of Bivariate Random Variables

Concept of a two-component random vector. Bivariate probability mass and density functions. Marginal and conditional distributions. Independence of bivariate random variables.(problems based on the above topics).   (15L)

Module IV : Correlation and Regression

Bivariate data. types of correlation. scatter diagram. Karl Pearson's product- moment
and Spearman's rank correlation coefficients. regression equations- fitting of polynomial

equations of degree one and two ; exponential curve, power curve. Two type of regression curves, Identification of regression equations. (problems based on the above topics).

(20L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.
2. Hogg R. V., Mckean J. W., and Craig A. T.(2014) Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.
3. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.
4. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.
5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Ross, S.(2003). A first comes in probability Pearson, Education Publishers, Delhi

Note: The 5 marks for the Assignment component of Internal assessment
may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Mathematics Programme

Semester III - Course III

ST3CMT03 - PROBABILITY DISTRIBUTIONS

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 5

Number of credits - 4

Module I : Mathematical Expectation

Expectation of random variables and their functions. Definition of - Raw moments, central moments and their interrelation, A.M, G.M, H.M, S.D, M.D., covariance, Pearson's correlation coefficient in terms of expectation.MGF and characteristic function and simple properties. Moments from mgf. (Problems based on these topics)

(20L)

Module 2 : Standard Probability Distributions

Uniform(discrete/continuous), Bernoulli, binomial, Poisson, geometric, hyper-geometric, exponential, gamma- one and two parameter(s),beta(type I and type II),- mean, variance, mgf, additive property, lack of memory property. Normal distribution with all properties.(Problems based on these topics)

(25L)

Module 3 - Law of Large Numbers and Central Limit Theorem

Chebychev's inequality, Weak Law of Large Numbers- Bernoulli's and Chebychev's form.
Central Limit Theorem(Lindberg- Levy form with proof).(Problems based on these topics)

(20L)

Module 4 - Sampling Distributions

Concept of sampling from a probability distribution .i.i.d. observations. Concept of sampling distributions, Statistic(s) and standard error(s). Mean and variance of sample mean when sampling is from a finite population. Sampling distribution of mean and variance from normal distribution. Chi-square, t, F distributions and statistics following these distributions. Relation

among Normal, Chi-square, t and F distributions.(Problems based on these topics)

(25L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	2	0	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. II, 8th edition, World Press, Kolkatta.

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

Note: The 5 marks for the Assignment component of Internal assessment
may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Mathematics Programme

Semester IV - Course IV

ST4CMT04 - STATISTICAL INFERENCE

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 5

Number of credits - 4

Module I : Point Estimation

Concepts of Estimation, Estimators and Estimates. Point and interval estimation. Properties of good estimators- unbiasedness, efficiency, consistency and sufficiency. factorization theorem(statement). (problems based on these topics).

(25L)

Module II : Methods of Estimation, Interval Estimation

Methods of moments, maximum likelihood. Invariance property of ML Estimators (without proof).minimum variance. Cramer-Rao inequality(statement only) $100(1-\alpha)$% confidence intervals for mean, variance and proportions(problems based on these topics)

(20L)

Module III : Testing of Hypotheses, Large Sample Tests

Statistical hypotheses, null and alternate hypotheses, simple and composite hypotheses, type-I and type-II errors. Critical Region. Size and power of a test, p-value, Neyman-Pearson approach. Large sample tests - z-tests for means, difference of means, proportion and difference of proportion, chi-square tests for independence, homogeneity.

(25L)

Module IV : Small Sample Tests

Normal tests for mean, difference of means and proportion (when σ known), t-tests for mean and difference of means(when σ unknown), paired t-test, test for proportion(binomial), chi-square test, F-test for ratio of variances. (derivation not required)

(20L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. I, 8th edition, World Press, Kolkatta.

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

Note: The 5 marks for the Assignment component of Internal assessment may be given for mini group project with some real life data Primary or secondary. This gives the students an opportunity to understand the application of the statistical methods they have studied.

12(b)(ii).Syllabi of Complementary Courses in Statistics of B. Sc. Physics (Model I)Programme

The Structure of the 4 Complementary Courses in Statistics offered for B.Sc. Physics (Model I) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
1	Complementary	ST1CMT01 - Descriptive Statistics	3	4	72
2	Complementary	ST2CMT02 - Probability Theory	3	4	72
3	Complementary	ST3CMT03 - Probability Distributions	4	5	90
4	Complementary	ST4CMT04 - Statistical Inference	4	5	90

Complementary Course to B. Sc. Physics Programme

Semester I - Course I

ST1CMT01 - DESCRIPTIVE STATISTICS

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 4

Number of credits - 3

Module I:Different aspects of data, and its collection

Statistics as collected facts and figures, and as a science for extracting information from data. Concepts of a statistical population and sample. Different types of characteristics and data- qualitative and quantitative, cross-sectional and time-series, discrete and continuous, frequency and non-frequency. Different types of scale- nominal and ordinal, ratio and interval. Collection of data- census and sampling. Different types of random samples- simple random sample, systematic, stratified and cluster (description only).

(20L)

Module II :Central tendency and Dispersion

Averages- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weightedaverages..Absolute Measures of dispersion- Range, Quartile Deviation, Mean Deviation and Standard Deviation. Combined mean and standard deviation, C.V, relative measures of dispersion, Ogives and Box plot.(problems based on the above topics)

(20L)

Module III :, Moments, Skewness and Kurtosis

Raw moments, central moments and their inter relation. Skewness- Pearson's, Bowly's and moment measures of skewness. Kurtosis- percentile and moment measure of kurtosis(problems based on the above topics)..   (15L)

Module IV : Index Numbers

Definition of Index Numbers. Price Index Numbers. Price Index Numbers as Simple (A. M.,G. M.)and Weighted averages (A. M.)of price relatives. Laspeyer's, Paasche's and Fisher's Index

Numbers. Time-Reversal and Factor-Reversal tests. Cost of living index numbers-family budget and aggregate expenditure methods. An introduction to Whole sale Price Index and Consumer Price Index.(problems based on the above topics)

(17L).

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the
question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon, A. M.,Gupta M. K. and Dasgupta,B(1986).Fundamentals of Statistics,Volume1, world press, Kolkota

2. Gupta, S. C. and Kapoor, V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Gupta, S. C. and Kapoor, V. K.(2007).Fundamentals of applied StatisticsSultanChandand Sons.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

8. Mukhopadhya, P. (1999). Applied Statistics, New central book agency private limited, Kolkata

9. Seemon, T.(2014). Basic Statistics. Narosa Publishing House

Note: The 5 marks for the Assignment component of Internal assessment
may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Physics Programme

Semester II - Course II

ST2CMT02 - PROBABILITY THEORY

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 4

Number of credits - 3

Module I : Probability

Random experiments. Complement, union and intersection of events and their meaning. Mutually exclusive, equally likely and Independent events. Classical, Frequency and Axiomatic approaches to probability. Monotone property, Addition theorem (up to 3 events. Conditional probability. Multiplication theorem(up to 3 events). Independence of events.. Bayes' theorem.(problems based on the above topics)   (20L)

Module II : Probability Distribution of Univariate Random Variables

Concept of random variables. discrete and continuous random variables. Probability mass and density functions, and cumulative distribution functions. Evaluation of conditional and unconditional probabilities. Change of variables- methods of jacobian and cumulative distribution function (one variable case).(problems based on the above topics)

(17L)

Module III : Probability Distribution of Bivariate Random Variables

Concept of a two-component random vector. Bivariate probability mass and density functions. Marginal and conditional distributions. Independence of bivariate random variables.(problems based on the above topics).   (15L)

Module IV : Correlation and Regression

Bivariate data. types of correlation. scatter diagram. Karl Pearson's product- moment

And Spearman's rank correlation coefficients. regression equations- fitting of polynomial

equations of degree one and two ; exponential curve, power curve. Two type of regression

curves, Identification of regression equations. (problems based on theabove topics)

(20L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

2. Hogg R. V., Mckean J. W., and Craig A. T.(2014) Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

3. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

4. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Ross, S.(2003). A first comes in probability Pearson, Education Publishers, Delhi

Note: The 5 marks for the Assignment component of Internal assessment

may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Physics Programme

Semester III - Course III

ST3CMT03 - PROBABILITY DISTRIBUTIONS

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 5

Number of credits - 4

Module I : Mathematical Expectation

Expectation of random variables and their functions. Definition of - Raw moments, central moments and their interrelation, A.M, G.M, H.M, S.D, M.D., covariance, Pearson's correlation coefficient in terms of expectation.MGF and characteristic function and simple properties. Moments from mgf. (Problems based on these topics)

(20L)

Module 2 : Standard Probability Distributions

Uniform(discrete/continuous), Bernoulli, binomial, Poisson, geometric, hyper-geometric, exponential, gamma- one and two parameter(s),beta(type I and type II),- mean, variance, mgf, additive property, lack of memory property. Normal distribution with all properties.(Problems based on these topics). (25L)

Module 3 - Law of Large Numbers and Central Limit Theorem

Chebychev's inequality, Weak Law of Large Numbers- Bernoulli's and Chebychev's form. Central Limit Theorem(Lindberg- Levy form with proof).(Problems based on these topics).

(20L)

Module 4 - Sampling Distributions

Concept of sampling from a probability distribution i.i.d. observations. Concept of sampling distributions, Statistic(s) and standard error(s). Mean and variance of sample mean when sampling is from a finite population. Sampling distribution of mean and variance from normal distribution. Chi-square, t, F distributions and statistics following these distributions. Relation among Normal, Chi-square, t and F distributions.(Problems based on these topics).

(25L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	2	0	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. II, 8th edition, World Press, Kolkatta.

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

Note: The 5 marks for the Assignment component of Internal assessment

may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Physics Programme

Semester IV - Course IV

ST4CMT04 - STATISTICAL INFERENCE

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 5

Number of credits - 4

Module I : Point Estimation

Concepts of Estimation, Estimators and Estimates. Point and interval estimation. Properties of good estimators- unbiasedness, efficiency, consistency and sufficiency. factorization theorem(statement). (problems based on these topics).

(25L)

Module II : Methods of Estimation, Interval Estimation

Methods of moments, maximum likelihood. Invariance property of ML Estimators (without proof).minimum variance. Cramer-Rao inequality(statement only) $100(1-\alpha)\%$ confidence intervals for mean, variance and proportions(problems based on these topics).

(20L)

Module III : Testing of Hypotheses, Large Sample Tests

Statistical hypotheses, null and alternate hypotheses, simple and composite hypotheses, type-I and type-II errors. Critical Region. Size and power of a test, p-value, Neyman-Pearson approach. Large sample tests - z-tests for means, difference of means, proportion and difference of proportion, chi-square tests for independence, homogeneity.

(25L)

Module IV : Small Sample Tests

Normal tests for mean, difference of means and proportion (when σ known), t-tests for mean and difference of means(when σ unknown), paired t-test, test for proportion(binomial), chi-square test, F-test for ratio of variances. (derivation not required)

(20L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. I, 8th edition, World Press, Kolkatta.

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson EducationInc.

6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

Note: The 5 marks for the Assignment component of Internal assessment may be given for mini group project with some real life data Primary or secondary. This gives the students an opportunity to understand the application of the statistical methods they have studied.

12(b)(iii). Syllabi of Complementary Courses in Statistics of B. Sc. Psychology (Model I)Programme

The Structure of the 4 Complementary Courses in Statistics offered for B.Sc. Psychology (Model I) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
1	Complementary	ST1CMT01 - Basic Statistics	2	3	54
2	Complementary	ST2CMT02 - Statistical Tools	2	3	54
3	Complementary	ST3CMT03 - Probability and Probability Distributions	2	3	54
4	Complementary	ST4CMT04 - Statistical Inference	2	3	54

Complementary Course to B. Sc. Psychology Programme

Semester I–Course I

ST1CMT01 - BASIC STATISTICS

Hours per week-3

Number of credits -2

Module I :

Introduction to Statistics-Introduction to Statistics. Need and importance of Statistics in Psychology. Variables and attributes, Levels of Measurement: Nominal, Ordinal, Interval and Ratio. Collection of data-primary and secondary, census and sampling, classification and tabulation, grouped and ungrouped frequency table .Diagrammatical and graphical representation of data- bar diagram, pie diagram, frequency polygon and curve, histogram, ogives (20L)

Module II:

Census and Sampling. Different methods of sampling. Requisites of a good sampling method. Advantages of sampling methods. Simple random sampling, Stratified sampling. Systematic sampling (15L)

Module III

Measures of central tendency- mean, median and mode- properties, merits and demerits (20L)

Core Reference:

Gupta.S.P., Statistical Methods. Sulthan Chand and Sons New Delhi.

Additional References

1. Aron, A., Aron. R., & Coups, E. J. (2006).*Statistics for Psychology*.

(4thed). New Delhi: Pearson Education (ISBN: 81-317-1464-20.

2. Mangal, S. K. (2002). *Statistics in Psychology and Education*. (2nded).

New Delhi: Prentice-Hall of India Private Limited. (ISBN: 978-81-203-8).

3. Hentry E Garett – Statistics in Psychology &Education

4. J.F. Guilford Fundamentals of Statistics in Psychology & Education-McGraw-Hill

5. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

6. Fundamentals of Statistics: DN Elhance, KitabMahal , Allahabad.

SCHEME OF QUESTION PAPER

(The number of questions from the 3 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Note: The 5 marks for the Assignment component of Internal assessment may be given for solving problems from the above syllabus, at least two assignment.

Complementary Course to B. Sc. Psychology Programme

Semester II - Course II

ST2CMT02 - STATISTICAL TOOLS

Hours per week-3

Number of credits -2

Module I

Measures of dispersion-Range, quartile deviation, mean deviation, standard deviation-properties ,merits and demerits, coefficient of variation **(17L)**

Module II

Raw Moments, Central Moments, Inter Relationships (First Four Moments), Skewness – Measures – Pearson, Bowley and Moment Measure, Kurtosis-Measures of Kurtosis – Moment Measure. **(20L)**

Module III

Karl Pearson's Coefficient of Correlation, Scatter Diagram, Interpretation of Correlation Coefficient, Rank Correlation, Regression, Regression Equation, Identifying the Regression Lines **(17L)**

Core Reference:

Gupta.S.P., Statistical Methods. Sulthan Chand and Sons New Delhi.

Additional References

1. Aron, A., Aron. R., & Coups, E. J. (2006).*Statistics for Psychology*. (4thed). New Delhi: Pearson Education (ISBN: 81-317-1464-20.

2. Mangal, S. K. (2002). *Statistics in Psychology and Education*. (2nded). New Delhi: Prentice-Hall of India Private Limited. (ISBN: 978-81-203-8).

3. Hentry E Garett – Statistics in Psychology &Education

4. J.F. Guilford Fundamentals of Statistics in Psychology & Education-
McGraw-Hill

5. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical
Statistics, Sultan Chand and Sons.

6. Fundamentals of Statistics: DN Elhance, KitabMahal , Allahabad.

SCHEME OF QUESTION PAPER

(The number of questions from the 3 modules to be included in the 3 parts of
the question paper)

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

**Note: The 5 marks for the Assignment component of Internal assessment may be given for
solving problems from the above syllabus, at least two assignment.**

Complementary Course to B. Sc. Psychology Programme

Semester III - Course III

ST3CMT03 - PROBABILITY AND PROBABILITY DISTRIBUTIONS

Hours per week-3

Number of credits - 2

Module-I

Probability: Basic concepts, different approaches, conditional probability, independence, addition theorem, multiplication theorem (without proof) for two events, simple examples. **(17L)**

Module-II

Random variables, Discrete and Continuous, p.m.f and p.d.f., c.d.f of discrete r.v. Mathematical Expectation of a discrete r.v., Mean and Variance of a discrete r.v. **(17L)**

Module-III

Binomial distribution- mean and variance, simple examples. Normal distribution - definition, p.d.f. simple properties, calculation of probabilities using standard normal tables, simple problems. **(20L)**

Core Reference:

1. Gupta.S.P., Statistical Methods. Sulthan Chand and Sons New Delhi

Additional References

1. Aron, A., Aron. R., & Coups, E. J. (2006).*Statistics for Psychology*. (4th ed). New Delhi: Pearson Education (ISBN: 81-317-1464-20.

97

2. Mangal, S. K. (2002). *Statistics in Psychology and Education*. (2nded).
New Delhi:Prentice-Hall of India Private Limited.(ISBN:978-81-203-8).

3. Hentry E Garett – Statistics in Psychology &Education

4. J.F. Guilford Fundamentals of Statistics in Psychology & Education-
McGraw-Hill

5. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics,
Sultan Chand and Sons.

6. Fundamentals of Statistics: DN Elhance, KitabMahal , Allahabad.

SCHEME OF QUESTION PAPER

(The number of questions from the 3 modules to be included in the 3 parts of
the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

**Note: The 5 marks for the Assignment component of Internal assessment may be given for
solving problems from the above syllabus, at least two assignment.**

Complementary Course to B. Sc. Psychology Programme

Semester IV –Course IV

ST4CMT04 - STATISTICAL INFERENCE

Hours per week – 3

Number of credits - 2

Module I

Testing of hypothesis- Statistical hypothesis, Simple and composite hypothesis Null and Alternate hypothesis, Type I and Type II errors, Critical Region, Size of the test, P value. **(17L)**

Module II

Large sample tests - z-tests for means, difference of means, proportion and difference of proportion, chi-square tests for independence, homogeneity **(17L)**

Module III : Small Sample Tests

Normal tests for mean, difference of means and proportion (when σ known), t-tests for mean and difference of means (when σ unknown), paired t-test, test for proportion (binomial), chi-square test for variance, F-test for ratio of variances.

(20L)

Core Reference:

Gupta.S.P., Statistical Methods. Sulthan Chand and Sons New Delhi.

Additional References

1. Aron, A., Aron. R., & Coups, E. J. (2006).*Statistics for Psychology*. (4th ed). New Delhi: Pearson Education (ISBN: 81-317-1464-20.

2. Mangal, S. K. (2002). *Statistics in Psychology and Education*. (2nd ed). New Delhi: Prentice-Hall of India Private Limited. (ISBN: 978-81-203-8).

3. Hentry E Garett – Statistics in Psychology &Education

4. J.F. Guilford Fundamentals of Statistics in Psychology & Education- McGraw Hill

5. S.C. Gupta and V.K. Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons.

6. Fundamentals of Statistics: DN Elhance, KitabMahal,Allahabad.

SCHEME OF QUESTION PAPER

(The number of questions from the 3 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Note: The 5 marks for the Assignment component of Internal assessment may be given for mini group project with some real life data Primary or secondary. This gives the students an opportunity to understand the application of the statistical methods they have studied.

12(b)(iv).Syllabus of Complementary Course in Statistics of B.Sc. Electronics (Model III) Programme

The Structure of the Complementary Course in Statistics offered for B.Sc. Electronics (Model III) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
3	Complementary	ST3CMT01 - Probability and Statistics	3	4	72

Complementary Course to B.Sc. Electronics Programme

Semester III

ST3CMT01 - PROBABILITY AND STATISTICS

Hours per week : 4

Number of credits : 3

Aim of the Course: To get an in-depth knowledge of probability theory and statistics which will complement the studies in Electronics and communication theory.

Unit I – Descriptive Statistics (15 Hours)

Statistics as collected facts and figures, and as a branch of science for extracting information from data. Statistical population and sample. Census and sampling. Primary and secondary data. Data collection by - direct investigation, using third parties, sending questionnaire, by mail / phone. Methods

Diagrammatic representation of data, π diagram only. Graphical representation of data - histogram and ogive, Measures of central tendency-mean, median and mode. Measures of dispersion-variance and coefficient of variation, Measures of skewness and Kurtosis - measures in terms of moments only. Sampling techniques for the selection of representative samples-probability sampling and non probability sampling.

Unit II – Probability and probability distributions (16 Hours)

Introduction, definition of probability, probability distribution, discrete distributions- Poisson and binomial, Continuous distributions - normal distributions. Problems based on normal distribution.

Unit III – Statistical Inference (15 Hours)

Introduction, Sampling distribution, Estimation of parameter – point estimation only, Testing of hypothesis – large sample-Testing mean and proportion only. Goodness of fit.

Unit IV – Correlation (8 Hours)

Introduction, Correlation, types of correlation. Methods of finding correlation – scatter diagram, Kurl Pearson's coefficient of correlation, Spearman's rank correlation coefficient

Unit V- Regression analysis (8 Hours)

Regression analysis, Methods of finding regression line – least square method, by taking deviations from mean, Properties of regression coefficients.

Books for references
1) S.C. Gupta, V.K. Kapoor(Sulthan Chand & sons) –Fundamentals of Mathematical Statistics
2) S.P. Gupta - (Sulthan Chand & sons) – Elementary Statistical methods

Books for further reading
1) A.K. Sharma – Text book of elementary statistics
2) Schaum's series – Probability and Statistics
3) Purna Chandra Biswal - Probability and Statistics
4) Johnson Richard A – Miller and Freund's - Probability and Statistics for Engineers.

SCHEME OF QUESTION PAPER

(The number of questions from the 4 modules to be included in the 4 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of	Total
		1	2	3	4			Questions	Marks
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

12(b)(v). Syllabi of Complementary Courses in Statistics of BCA (Model III) Programme

The Structure of the 2 Complementary Courses in Statistics offered for BCA (Model III) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
1	Complementary	ST1CMT01 - Basic Statistics and Introductory Probability Theory	3	4	72
3	Complementary	ST3CMT02 - Advanced Statistical Methods	4	4	72

Complementary Course to BCA Programme

Semester I - Course I

ST1CMT01 - BASIC STATISTICS AND INTRODUCTORY PROBABILITY THEORY

Hours per week -4

Number of credits -3

BRIDGE COURSE(This topics is for internal evaluation only. **Quick review** and give internal assessment from this topics. **Not included in the external examination**)…………………………………………………………(**5 Hours)** Introduction to Statistics, Population and Sample, Collection of Data, Census and Sampling, Methods of Sampling Simple Random Sampling (with and without replacement) stratified sampling systematic sampling (Method only), Types of data quantitative, qualitative, Classification and Tabulation, Diagrammatic representation - Bar diagram, Pie diagram;…………… (**12 Hours)**

Module I

Graphical representation histogram; frequency polygon; frequency curve; ogives and stem and leaf chart. Measures of Central Tendency -Mean, Median, Mode, Quantile points-quartiles, Percentiles, Deciles. Measures of Dispersion - Range, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of Variation. Box Plot……………………………………………………. **(12 Hours)**

Module II

Introduction to bivariate data , Scatter Diagram ,Curve Fitting by the Method of Least Squares (without proof) Fitting of Straight Lines, Exponential Curve, Power Curve, Linear Correlation CovarianceMethod(formula only) and simple problems, Linear Regression-Regression Equations identification of regression

lines and properties ……………………………………………………**(13 Hours)**

Module III

Probability Concepts Random Experiment, Sample Space, Events, Probability Measure, Approaches to Probability- Classical, Statistical and Axiomatic, Addition Theorem (upto 3 events) Conditional Probability, Independence of events, Multiplication theorem (upto 3 events), Total Probability Law, Bayes Theorem and its applications……………………………………… **(15 Hours)**

Module IV

Random variables and distribution functions Random variables, probability density (mass) function, distribution function- properties, expectation of a discrete and continuous random variables-properties (without proof) mean and standard deviation of different probability density function, moment generating function, important properties (without proof)………………………..**(15 Hours)**

Core Reference

1. S.P. Gupta: Statistical Methods (Sultan Chand & Sons Delhi).
2. S.C. Gupta and V.K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
3. B.L. Agarwal: Basic Statistics, New Age International (p) Ltd.

Additional References

1. ParimalMukhopadhya: Mathematical Statistics, New Central Book Agency (p) Ltd, Calcutta
2. Murthy M.N.: Sampling theory and Methods, Statistical Publishing Society, Calcutta.

SCHEME OF QUESTION PAPER

(The number of questions from the 4 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Complementary Course to BCA Programme

Semester III–Course II

ST3CMT02 - ADVANCED STATISTICAL METHODS

Hours per week -4

Number of credits -4

Module I

Theoretical distributions. Discrete distribution(Uniform, Bernoulli, binomial and Poisson), mean, variance, moment generating functions and fitting of data. Continuous distribution- Uniform and normal distribution-important properties (without proof) of the distribution (mean, variance, moments, mgf, M.D. and Q.D Area under the normal curve-related problems………………………... **(16Hours)**

Module II

Sampling Distributions. definition, Statistic, Parameter, Standard Error,

Sampling Distributions of Mean of the sample from Normal population and

distribution of Variance(form alone), statement of the form of the distributions χ^2, t and F (without derivation), properties, Inter relationships……………**(16 Hours)**

Module III

Estimation of parameters- Point Estimation and Interval estimation, properties

of Point Estimation- Unbiasedness, Efficiency; Consistency; Sufficiency,

Methods of estimation-method of moments and method of maximum likelihood.

Interval Estimation for Mean, Variance of normal population and Proportion of

binomial population…………………………………………………. **(20Hours)**

Module IV

Testing of hypotheses- Statistical hypotheses, Simple and composite hypotheses.

Null and Alternate hypothesis, Two types of errors, Critical Region, Size of the

test, Significance level P value, Power, Large Sample test Z test-,t test Chi-Square test-goodness of fit, test of independence……………………………..**(20 Hours)**

References:

1. S.C. Gupta and V.K. Kapoor: *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons

2. S.C Gupta*: Fundamentals of Mathematical Statistics*, Sultan Chand and Sons.

3. V.K. Rohatgi: *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern

SCHEME OF QUESTION PAPER

(The number of questions from the 4 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

12(b)(vi). Syllabus of Complementary Course in Statistics of B.Sc. Computer Science (Model III) Programme

The Structure of the Complementary Course in Statistics offered for B.Sc. Computer science (Model III) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
3	Complementary	ST3CMT01 - Statistical Methods and Probability Theory	3	4	72

Complementary Course to B. Sc. Computer Science Programme

Semester III - Course I

ST3CMT01–Statistical Methods and Probability Theory

Hours per week - 4

Number of credits - 3

Module I: Different aspects of data, and its collection

Concepts of a statistical population and sample. Different types of characteristics and data-qualitative and quantitative, cross-sectional and time-series, discrete and continuous, frequency and non-frequency. Different types of scale- nominal and ordinal, ratio and interval. Collection of data- census and sampling. Different types of random samples- simple random sample, systematic, stratified and cluster (description only).

(16 Hours)

Module II :Central tendency and Dispersion

Averages- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted averages. Quantiles- quartiles, deciles, percentiles. Measures of absolute dispersion - Range, Quartile Deviation, Mean Deviation and Standard Deviation. Box plot. relative measures. C.V.

(16 Hours)

Module III : Probability

Random experiments. Complement, union and intersection of events and their meaning. Mutually exclusive, equally likely and Independent events. Classical, Frequency and Axiomatic approaches to probability. Monotone property, Addition theorem (up to 3 events).Conditional probability. Multiplication theorem(up to 3 events). Independence of events. Total probability law. Bayes' theorem. Expectation of random variables and their functions. mean and variance.

(20 Hours)

Module IV : Standard Probability Distributions

Uniform(discrete/continuous), Bernoulli, binomial, Poisson. Normal distribution with all properties.

(20 Hours)

REFERENCES

1. Goon, A. M.,Gupta M. K. and Dasgupta,B(1986).Fundamentals of Statistics,Volume1, world press, Kolkota

2. Gupta, S. C. and Kapoor, V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Gupta, S. C. and Kapoor, V. K.(2007).Fundamentals of applied Statistics,Sultan Chand and Sons.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

8. Mukhopadhya, P. (1999). Applied Statistics, New central book agency private limited, Kolkata

9. Seemon, T.(2014). Basic Statistics.Narosa Publishing House

SCHEME OF QUESTION PAPER

(The number of questions from the 4 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

 Note: The 5 marks for the Assignment component of Internal assessment may be given for solving problems from the above syllabus, at least two.

12(b)(vii). Syllabi of Complementary Courses in Statistics of B.A Economics (Model II)Programme

The Structure of the Complementary Course in Statistics offered for B.A. Economics (Model II) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
3	Complementary	ST3CMT01 – Quantitative Techniques for Economic Analysis I	5	6	108
4	Complementary	ST4CMT02 – Quantitative Techniques for Economic Analysis II	5	6	108

Complementary Course in Statistics of B.A Economics (Model II) Programme

Semester III - Course I

ST3CMT01 – Quantitative Techniques for Economic AnalysisI

Hours per week - 6

Number of credits - 5

Learning Objectives

The major objective of this course is to impart students a clear idea about the basic tools and their applications in analyzing economic issues and finding solutions.

Module I

Role of Statistics in Economics – Functions–limitations.Methods of primary data collection-census and sampling methods - Preparation of schedules and questionnaires, sample designs – random sampling and non-random sampling (SRS, systematic, stratified, cluster and multistage sampling).

Classification and Tabulation of Statistical data: Characteristics and types of classification- types of tables-difference between classification and tabulation. Presentation of data using charts and diagrams. (Histogram, Polygon, frequency curve, Bar chart, Pie diagram, Ogives)

(22Hrs)

Module II

Central tendency: Various Measures - Properties, merits & demerits of Arithmetic mean, median, mode, geometric mean and harmonic mean – applications in economics.

Dispersion: Various Measures, absolute and relative measures – Range, quartile deviation, mean deviation, standard deviation – Lorenz curve and its economic applications. Skewness, Kurtosis,

Moments: Types of skewness –measurement - Kurtosis – Definition and types (graphic presentation) Moments: central and raw moments (for ungrouped data only).

<div align="center">(40 Hrs)</div>

Module III

Correlation and Regression Analysis: Correlation- significance and types– measurement: scatter diagram, Karl Pearson's correlation coefficient, (for ungrouped data only) and Rank correlation. Cause and effect relationships:

Regression- meaning and significance-regression equations/regression lines-the line of best fit – prediction based on regression equations. Relation between correlation and regression.

<div align="center">(22 Hrs)</div>

Module IV

Basic Mathematics for Economic Analysis – Basic concepts: variables, constants, parameters, equations, exponents and logarithms, sequences and progressions - arithmetic and geometric. Applications of progressions in economics: problems relating to simple interest, compound interest, depreciation of assets and Net Present value. The real number system: properties of real numbers and types of numbers.

<div align="center">(24Hrs)</div>

Readings:

1. Gupta S.P. *Statistical methods*. New Delhi: Sultan Chand & Sons.
2. Sharma J.K. *Business statistics*. Noida, India: Pearson Education.
3. Richard I Levin et.al. *Statistics for management*. India: Pearson Education.
4. Srivastava U.K et.al. *Quantitative techniques for managerial decisions*. New Delhi: New Age International Publishers.
5. Chiang A.C. (2005). *Fundamental methods of mathematical Economics*. McGraw Hill.
6. Allen R.G.D. *Mathematical analysis for economists*. Palgrave Mac Millan.
7. Monga G.S. *Mathematics and statistics for economists*. New Delhi: Vikas Publishing House.

8. Bradley Terasa. *Essential mathematics for economics and business.* New Delhi Wiley India Edn.

SCHEME OF QUESTION PAPER

(The number of questions from the 4 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Complementary Course in Statistics of B.A Economics (Model II)Programme

Semester IV - Course II

ST4CMT02 – Quantitative Techniques for Economic AnalysisII

Hours per week - 6

Number of credits - 5

Learning Objectives

In order to understand economic problems clearly, the knowledge on theory of index numbers, time series and the concept of probability and theoretical distribution is necessary. This course is meant to train the student in this direction.

Module I

Time series: meaning, definition, uses, components – additive and multiplicative models, measurement of trend- free hand method, semi average, moving average and least square methods.   (12 Hrs)

Module II

Index Numbers – Different types – Importance and limitations, Problems in construction – Weighted and Unweighted price index numbers – Different methods of constructing price indices– Simple aggregative, simple average of price relatives, Weighted aggregative: Laspeyre's, Paasche's, Fisher's and Marshall Edgeworth's indices, weighted average of price relatives methods. Cost of living index numbers: significance, uses and methods of construction – aggregate expenditure method and family budget methods-WPI. Tests of index numbers

(20 Hrs)

Calculus- Limits & Continuity, Derivatives: Meaning and significance - Rules of differentiation – First order and second order derivatives – Maxima and Minima of functions. Applications in economics.   (25 Hrs.)

Module III

Set theory - types of sets -set operations – Venn diagrams. Relations and functions: ordered pairs and Cartesian product. Functions: Types - Important economic functions. Linear and Quadratic-Solution to system of equations up to three unknowns- Matrices-Types, Matrix manipulations and their rules, Order of Matrix, Transpose of Matrix-Determinants up to order 3x3- Properties and Value of determinant, Minor and Cofactor, Inverse and Cramer's Rule.

(28 hrs)

Module IV

Theory of Probability - Scope of probability in Economics- the case of uncertainty - Concepts – Rules of probability (addition and multiplication theorem – statement only) – Different approaches – Important terms related to probability (Random experiments, sample space, events) – Simple economic problems based on probability theorems – Probability distributions – binomial and normal – estimation of probabilities using binomial theorem standard normal table - their properties and uses and applications in Economics.

(23 Hrs.)

Readings

1. Gupta S.P. *Statistical methods*. New Delhi: Sultan Chand & Sons.
2. Sharma J.K. *Business statistics*. Noida, India: Pearson Education.
3. Richard I Levin et.al. *Statistics for management*. India: Pearson Education.
4. Srivastava U.K et.al. *Quantitative techniques for managerial decisions*. New Delhi: New Age International Publishers.
5. Chiang A.C. (2005). *Fundamental methods of mathematical Economics*. McGraw Hill.
6. Allen R.G.D. *Mathematical analysis for economists*. Palgrave Mac Millan.
7. Monga G.S. *Mathematics and statistics for economists*. New Delhi: Vikas Publishing House.
8. Bradley Terasa. *Essential mathematics for economics and business*. New Delhi: Wiley India Edn.

SCHEME OF QUESTION PAPER

(The number of questions from the 5 modules to be included in the 3 parts of the question paper)

Use of non-programmable calculator and statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

12(c). Syllabi of Core Courses in Statistics of B.Sc. Computer Applications (Model III) Programme

The Structure of the 6 Core Courses in Statistics offered for B.Sc. Computer Applications (Model III) Programme is as given under :

Semester	Course Type	Course Code with Title	Credits	Lecture Hours	
				Per Week	Total
1	CORE (CR)	ST1CRT01 - Descriptive Statistics	3	4	72
2	CORE (CR)	ST2CRT02 - Probability Theory	3	4	72
3	CORE (CR)	ST3CR03 - Probability Distributions	4	5	90
4	CORE (CR)	ST4CRT04 - Statistical Inference	4	5	90
5	CORE (CR)	ST4CRT05 - Sample Survey Designs	4	5	90
6	CORE (CR)	ST5CRT06 - Environmental Studies, Human Right and Design of Experiment	4	5	90

Core Course to B. Sc. Computer Applications Programme

Semester I - Course I

ST1CRT01 - DESCRIPTIVE STATISTICS

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 4

Number of credits - 3

Module I:Different aspects of data, and its collection

Statistics as collected facts and figures, and as a science for extracting information from data. Concepts of a statistical population and sample. Different types of characteristics and data- qualitative and quantitative, cross-sectional and time-series, discrete and continuous, frequency and non-frequency. Different types of scale- nominal and ordinal, ratio and interval. Collection of data- census and sampling. Different types of random samples- simple random sample, systematic, stratified and cluster (description only).

(20L)

Module II :Central tendency and Dispersion

Averages- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted averages. Absolute Measures of dispersion- Range, Quartile Deviation, Mean Deviation and Standard Deviation. Combined mean and standard deviation, C.V, relative measures of dispersion, Ogives and Box plot.(problems based on the above topics)

(20L)

Module III :, Moments, Skewness and Kurtosis

Raw moments, central moments and their inter relation. Skewness- Pearson's, Bowly's and moment measures of skewness. Kurtosis- percentile and moment measure of kurtosis(problems based on the above topics). (15L)

Module IV : Index Numbers

Definition of Index Numbers. Price Index Numbers. Price Index Numbers as Simple (A. M.,G. M.)and Weighted averages (A. M.)of price relatives. Laspeyer's, Paasche's and Fisher's Index Numbers. Time-Reversal and Factor-Reversal tests. Cost of living index numbers-family budget

and aggregate expenditure methods. An introduction to Whole sale Price Index and Consumer Price Index.(problems based on the above topics)

(17L).

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the four parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon, A. M.,Gupta M. K. and Dasgupta,B(1986).Fundamentals of Statistics,Volume1, world press, Kolkota
2. Gupta, S. C. and Kapoor, V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.
3. Gupta, S. C. and Kapoor, V. K.(2007).Fundamentals of applied Statistics,SultanChandand Sons.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

8. Mukhopadhya, P. (1999). Applied Statistics, New central book agency private limited, Kolkata

9. Seemon, T.(2014). Basic Statistics.Narosa Publishing House

Note: The 5 marks for the Assignment component of Internal assessment
may be given for solving problems from the above syllabus, at least two assignment.

Core Course to B. Sc. Computer Applications Programme

Semester II - Course II

ST2CRT02 - PROBABILITY THEORY

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 4

Number of credits - 3

Module I : Probability

Random experiments. Complement, union and intersection of events and their meaning. Mutually exclusive, equally likely and Independent events. Classical, Frequency and Axiomatic approaches to probability. Monotone property, Addition theorem (up to 3 events. Conditional probability. Multiplication theorem(up to 3 events). Independence of events.. Bayes' theorem.(problems based on the above topics)   (20L)

Module II : Probability Distribution of Univariate Random Variables

Concept of random variables. discrete and continuous random variables. Probability mass and density functions, and cumulative distribution functions. Evaluation of conditional and unconditional probabilities. Change of variables- methods of jacobian and cumulative distribution function (one variable case).(problems based on the above topics)

(17L)

Module III : Probability Distribution of Bivariate Random Variables

Concept of a two-component random vector. Bivariate probability mass and density functions. Marginal and conditional distributions. Independence of bivariate random variables.(problems based on the above topics).   (15L)

Module IV : Correlation and Regression

Bivariate data. types of correlation. scatter diagram. Karl Pearson's product- moment

And Spearman's rank correlation coefficients. regression equations- fitting of polynomial

equations of degree one and two ; exponential curve, power curve. Two type of regression

curves, Identification of regression equations. (problems based on the above topics)

(20L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

2. Hogg R. V., Mckean J. W., and Craig A. T.(2014) Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

3. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

4. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

6. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.

7. Ross, S.(2003). A first comes in probability Pearson, Education Publishers, Delhi

Note: The 5 marks for the Assignment component of Internal assessment

may be given for solving problems from the above syllabus, at least two assignment.

Core Course to B. Sc. Computer Applications Programme

Semester III - Course III

ST3CRT03 - PROBABILITY DISTRIBUTIONS

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 5

Number of credits - 4

Module I : Mathematical Expectation

Expectation of random variables and their functions. Definition of - Raw moments, central moments and their interrelation, A.M, G.M, H.M, S.D, M.D., covariance, Pearson's correlation coefficient in terms of expectation.MGF and characteristic function and simple properties. Moments from mgf. (Problems based on these topics)

(20L)

Module 2 : Standard Probability Distributions

Uniform(discrete/continuous), Bernoulli, binomial, Poisson, geometric, hyper-geometric, exponential, gamma- one and two parameter(s),beta(type I and type II),- mean, variance, mgf, additive property, lack of memory property. Normal distribution with all properties.(Problems based on these topics).   (25L)

Module 3 - Law of Large Numbers and Central Limit Theorem

Chebychev's inequality, Weak Law of Large Numbers- Bernoulli's and Chebychev's form. Central Limit Theorem(Lindberg- Levy form with proof).(Problems based on these topics).

(20L)

Module 4 - Sampling Distributions

Concept of sampling from a probability distribution .i.i.d. observations. Concept of sampling distributions, Statistic(s) and standard error(s). Mean and variance of sample mean when sampling is from a finite population. Sampling distribution of mean and variance from normal distribution. Chi-square, t, F distributions and statistics following these distributions. Relation among Normal, Chi-square, t and F distributions.(Problems based on these topics)

(25L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module						No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	0	1	1	2	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

REFERENCES

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol.II, 8th edition, World Press, Kolkatta.

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to MathematicalStatistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson EducationInc.

6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

Note: The 5 marks for the Assignment component of Internal assessment
may be given for solving problems from the above syllabus, at least two assignment.

Core Course to B. Sc. Computer Applications Programme

Semester IV - Course IV

ST4CRT04 - STATISTICAL INFERENCE

(Common to B. Sc. Mathematics, B.Sc. Physics and B. Sc. Computer Applications

Programme)

Hours per week - 5

Number of credits - 4

Module I : Point Estimation

Concepts of Estimation, Estimators and Estimates. Point and interval estimation. Properties of good estimators- unbiasedness, efficiency, consistency and sufficiency. factorization theorem(statement). (problems based on these topics).   (25L)

Module II : Methods of Estimation, Interval Estimation

Methods of moments, maximum likelihood. Invariance property of ML Estimators (without proof).minimum variance. Cramer-Rao inequality(statement only) $100(1-\alpha)\%$ confidence intervals for mean, variance and proportions(problems based on these topics).

(20L)

Module III : Testing of Hypotheses, Large Sample Tests

Statistical hypotheses, null and alternate hypotheses, simple and composite hypotheses, type-I and type-II errors. Critical Region. Size and power of a test, p-value, Neyman-Pearson approach. Large sample tests - z-tests for means, difference of means, proportion and difference of proportion, chi-square tests for independence, homogeneity.

(25L)

Module IV : Small Sample Tests

Normal tests for mean, difference of means and proportion (when σ known), t-tests for mean and difference of means (when σ unknown), paired t-test, test for proportion(binomial), chi-square test, F-test for ratio of variances. (derivation not required)

(20L)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the four parts of the

question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions				Total	Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	4	3	4	2	1	10	40	6	24
B	6	3	2	3	2	10	60	6	36
C	10	0	1	1	2	4	40	2	20
Total Questions		6	7	6	5	24	140	14	80
Total Mark		30	38	36	36	140			

REFERENCES

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol. I, 8th edition, World Press, Kolkatta.

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson EducationInc.

6. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

Note: The 5 marks for the Assignment component of Internal assessment

may be given for a mini group project using real life data (primary or secondary). This

gives the students an opportunity to understand the application of the statistical

Techniques they studied.

Core Course to B. Sc. Computer Applications Programme

Semester IV - Course V

ST4CRT05 - SAMPLE SURVEY DESIGNS

Hours per week - 5

Number of credits - 4

Module I:Basic Concepts-Census and sampling, types of sampling – probability and non-probability sampling, advantages and disadvantages, principal steps in a sample survey, sampling and non-sampling errors, organizational aspects of sample survey.

Indian Official Statistics-Methods of collection of official Statistics. Role of Ministry of Statistics &Programme Implementation (MOSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO) and National Statistical Commission (NSC).Government of India's principal publications containing data on the topics such as population, industry and finance.

Module II: Simple Random Sampling-Simple random sampling with and without replacement, procedures of selecting a sample, unbiased estimates of the population mean and population total-their variances and estimates of the variances, confidence interval for population mean and total, simple random sampling for attributes, determination of the sample size based on desired accuracy for variables and attributes.

Module III: Stratified Random Sampling-Estimation of the population mean and population total-their variances and estimates of the variances, proportional allocation and Neyman allocation of sample sizes, cost function – optimum allocation, comparison with simple random sampling.

Module IV: Systematic and Cluster Sampling- Linear and circular systematic sampling, estimates of the population mean and population total, comparison of systematic sampling with simple random sampling. Cluster sampling – clusters with equal sizes –estimation of population mean and total – their variances and estimates of the variances.

Books for Study

1. Gupta,S.C. and. Kapoor,V.K .(2014).*Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.
2. Cochran, W.G. (2007).*Sampling Techniques*, (3rd ed.),John Wiley and Sons.
3. http://mospi.nic.in

References

1. Singh,D. andChoudhary,F.S.(2013)*Theory and Analysis of sample survey Designs*, New Age International Publishers.
2. Mukhopadhyay, P. (2008). *Theory and Methods of Survey Sampling*, (2nded.) Prentice-Hall of India.
3. Sampath,S.(2005).*Sampling Theory and Methods*,(2nd ed.),Alpha Science International Limited.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	3	2	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		7	6	6	6	25	129	18	80
Total Mark		36	31	31	31	129			

Core Course to B. Sc. Computer Applications Programme

Semester V - Course VI

ST5CRT06–ENVIRONMENTAL STUDIES, HUMAN RIGHTS AND DESIGN OF EXPERIMENTS

Hours per week – 5

Number of credits -4

The importance of environmental science and environmental studies cannot be disputed. The need for sustainable development is a key to the future of mankind. Continuing problems of pollution, solid waste disposal, degradation of environment, issues like economic productivity and national security, Global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues. The United Nations Conference on Environment and Development held in Rio de Janerio in 1992 and World Summit on Sustainable Development at Johannesburg in 2002 have drawn the attention of people around the globe to the deteriorating condition of our environment. It is clear that no citizen of the earth can afford to be ignorant of environment issues..

India is rich in biodiversity which provides various resources for people. Only about 1.7 million living organisms have been described and named globally. Still many more remain to be identified and described. Attempts are made to conserve them in ex-situ and in-situ situations. Intellectual property rights (IPRs) have become important in a biodiversity-rich country like India to protect microbes, plants and animals that have useful genetic properties. Destruction of habitats, over-use of energy resource and environmental pollution have been found to be responsible for the loss of a large number of life-forms. It is feared that a large proportion of life on earth may get wiped out in the near future.

In spite of the deteriorating status of the environment, study of environment have so far not received adequate attention in our academic programme. Recognizing this, the Hon'ble Supreme Court directed the UGC to introduce a basic course on environment at every level in college education. Accordingly, the matter was considered by UGC and it was decided that a six months compulsory core module course in environmental studies may be prepared and compulsorily implemented in all the University/Colleges of India.

The syllabus of environmental studies includes five modules including human rights. The first two modules are purely environmental studies according to the UGC directions. The second two modules are strictly related with the core subject and fifth module is for human rights.

Objectives

- Environmental Education encourages students to research, investigate how and why things happen, and make their own decisions about complex environmental issues by developing and

enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.

- Environmental Education helps students to understand how their decisions and actions affect the environment, builds knowledge and skills necessary to address complex environmental issues, as well as ways we can take action to keep our environment healthy and sustainable for the future. It encourages character building, and develop positive attitudes and values.
- To develop the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment and helps to protect the nature and natural resources.

To help the students in acquiring the basic knowledge about environment and the social norms that provide unity with environmental characteristics and create positive attitude about the environment.

Module I:

Unit 1 : Multidisciplinary nature of environmental studies

Definition, scope and importance **(2 L)**
Need for public awareness.

Unit 2 : Natural Resources :

Renewable and non-renewable resources : Natural resources and associated problems.

a) **Forest resources** : Use and over-exploitation, deforestation, case studies.

Timber extraction, mining, dams and their effects on forest and tribal people.

b) **Water resources** : Use and over-utilization of surface and ground water,

floods, drought, conflicts over water, dams-benefits and problems.

c) **Mineral resources** : Use and exploitation, environmental effects of extracting

and using mineral resources, case studies.

d) **Food resources** : World food problems, changes caused by agriculture and

overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water

logging, salinity, case studies.

e) **Energy resources**: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, Case studies.

f) **Land resources**: Land as a resource, land degradation, man induced landslides, soil erosion and desertification

- Role of individual in conservation of natural resources.
- Equitable use of resources for sustainable life styles.   (**10 L**)

Unit 3: Ecosystems
- Concept of an ecosystem
- Structure and function of an ecosystem
- Producers, consumers and decomposers
- Energy flow in the ecosystem
- Ecological succession
- Food chains, food webs and ecological pyramids.
- Introduction, types, characteristic features, structure and function of the given ecosystem:- Forest ecosystem

                                (**6 L**)

Module II:

Unit 1: Biodiversity and its conservation

- Introduction
- Biogeograhical classification of India
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- India as a mega-diversity nation
- Hot-sports of biodiversity
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
- Endangered and endemic species of India

                                (**8 L**)

Unit 2: Environmental Pollution

Definition

Causes, effects and control measures of: -

h.   Air pollution
i.   Water pollution
j.   Soil pollution
k.   Marine pollution
l.   Noise pollution
m.   Thermal pollution
n.   Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies
- Disaster management: floods, earthquake, cyclone and landslides.   (**8 L**)

Unit 3:   Social Issues and the Environment

- Urban problems related to energy
- Water conservation, rain water harvesting, watershed management
- Resettlement and rehabilitation of people: its problems and concerns, Case studies
- Environmental ethics: Issues and possible solutions
- Climate change, global warming, acid rain, ozone layer depletion , nuclear accidents and holocaust, Case studies
- Consumerism and waste products
- Environment Protection Act
- Air (Prevention and Control of Pollution) Act
- Water (Prevention and control of Pollution) Act
- Wildlife Protection Act
- Forest Conservation Act
- Issues involved in enforcement of environmental legislation
- Public awareness   (**10 L**)

Module III: Principle of Experimentation, Linear Estimation. Estimability of parametric functions, BLUE, Gauss-Markov Theorem (without Proof), Testing of Linear Hypothesis, ANOVA of one-way classified data, ANOVA of two-way classified data with multiple and equal number of observation per cell.

(20L)

Module IV: Layout and Analysis of the basic designs CRD, RBD and LSD. Missing plot Techniques, Relative Efficiency of Designs**.**

(13L)

Module V:

Unit 1- Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2 Human Rights and United Nations – contributions, main human rights related organs-UNESCO,UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit-3 Environment and Human Rights - Right to Clean Environment and Public   Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

(8 L)

Internal: Field study

- Visit to a local area to document environmental grassland/ hill /mountain
- Visit a local polluted site – Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds etc
- Study of simple ecosystem-pond, river, hill slopes, etc

(Field work Equal to 5 lecture hours)

Books for study

1. Bharucha, E. (2010). *Text Book for Environmental studies for undergraduate Courses*, University Grants Commission, New Delhi.

2. M.N.Das and N.C.Giri(1986). *Design and Analysis of Experiment*. Wiley Eastern Limited.

3. D.D.Joshi (1987): *Linear Estimation and Design of Experiment*, Wiley Eastern Limited.

4. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.

5. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)

References

1. Agarwal, K. C. (2001). *Environmental Biology,* Nidi Publishers Ltd, Bikaner.

2. Gupta, S.C. and. Kapoor, V.K .(2014). *Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.

3. Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)

4. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M.T.2001 Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p .(Ref)

5. Dc A.K.Enviornmental Chemistry, Wiley Eastern Ltd.(Ref)

6. Down to Earth, Centre for Science and Environment (Ref)

7. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)

8. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)

9. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)

10. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)

11. Odum.E.P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)

12. Rao.M.N & Datta.A.K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)

13. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)

14. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)

15. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)

16. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)

17. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)

18. Law Relating to Human Rights, Asia Law House,2001.

19. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt.Ltd, New Delhi,

20. S.K.Khanna, Children And The Human Rights, Common Wealth Publishers,1998. 2011.

21. Sudhir Kapoor, Human Rights in 21st Century,Mangal Deep Publications, Jaipur,2001.

22. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

SCHEME OF QUESTION PAPER

Use of non-programmable calculator and statistical tables allowed

Part	Marks of each Question	No. of Questions					Total	Total Marks	To be answered	
		Module							No. of Questions	Total Marks
		1	2	3	4	5				
A	2	2	2	4	3	1	12	24	10	20
B	5	1	2	3	2	1	9	45	6	30
C	15	1	1	1	1	0	4	60	2	30
Total Questions		4	5	8	6	2	25	129	18	80
Total Mark		24	29	38	31	7	129			

12(d). Syllabi of Complementary Courses in Statistics of B. Sc. Mathematics (Model II) Programme

The Structure of the 4 Complementary Courses in Statistics offered for B.Sc.

Mathematics Vocational (Model II) Programme is as given under :

| Semester | Course Type | Course Code with Title | Credits | Lecture Hours | |
				Per Week	Total
1	Complementary	ST1CMT01 - Descriptive Statistics	3	3	54
2	Complementary	ST2CMT02 – Random Variables and Probability Distributions	3	3	54
3	Complementary	ST3CMT03 - Statistical Inference	3	3	54
4	Complementary	ST4CMT04 - Applied Statistics	3	3	54

Complementary Course to B. Sc. Mathematics (Model II) Programme

Semester I – Statistics Course I

ST1CMT01 - DESCRIPTIVE STATISTICS

Hours per week - 3

Number of credits - 3

Module I:Different aspects of data and its collection

Introduction, scope and importance of statistics . Collection of data , census and sampling. Different types of random sampling – simple random sample, systematic, stratified and cluster (description only). Primary and secondary data.

(12 hrs)

Module II :Presentation of data , central tendency

Classification and tabulation- one-way and two-way classified data. Preparation of frequency distribution. Relative frequency and cumulative frequency distributions. Stem –and leaf chart, line diagram, bar diagram, pie diagram, histogram, frequency polygon, frequency cure, ogives, averages, Arithmetic mean , median, mode, geometric mean, harmonic mean and weighted averages. Quantiles - quartiles, deciles, percentiles (problems based on the above topics)

(13 hrs)

Module III : Disperson, Moments, Skewness and Kurtosis

Raw and Central moments, interrelationship among first four moments. Skewness-Pearson's – Bowley's and moment measure . Kurtosis

(14 hrs)

Module IV :Probability

Sample Space ,Events, Classical, Statistical and Axiomatic approach to probability, Addition theorem, Conditional Probability, Independence of Events, Multiplication theorem(up to 3 events). Bayes' theorem(Problems based on above topics)

(15 hrs)

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the
question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	3	2	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	7	6	6	25	129	18	80
Total Mark		31	36	31	31	129			

REFERENCES

1. S P Gupta Statistical methods

2. Gupta, S. C. and Kapoor, V. K.(2002). Fundamentals of Mathematical Statistics, 11th
edition, Sultan Chand and Sons.

3. Gupta, S. C. and Kapoor, V. K.(2007).Fundamentals of applied Statistics SultanChandand
Sons.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Seemon, T.(2014). Basic Statistics. Narosa Publishing House

Complementary Course to B. Sc. Mathematics (Model II) Programme

Semester II – Statistics Course II

ST2CMT02 - RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS

Hours per week - 3

Number of credits - 3

Module I

Random variables, Discrete and continuous, Probability distribution, Probability mass function, Probability density function and cumulative probability distribution function and their properties, Bivariate random variables, marginal and conditional distributions, independence of random variables. [15 hrs]

Module II

Mathematical expectations of a random variable, moments in terms of expectations, moment generating function (m.g.f) and its properties. Characteristics function and its simple properties, conditional expectations. [12 hrs]

Module III

Uniform, (discrete/continuous), Bernoulli, binomial, poisson, Mean, Variance, mgf, additive property, Normal distribution with all its properties, Fitting binomial, poisson and normal distributions,. Standard normal distribution and use of standard normal area tables. (Problems based on the above topics) [12hrs]

Module IV :

Bivariable data, types of correlation, scatter diagram, Karl Pearson's product-moment and spearman,s rank correlation coefficients.. Fitting of polynomial equations of degree one and two, exponential curve, power curve (problems based on above topics)

[15 hrs]

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	2	3	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	7	6	25	129	18	80
Total Mark		31	31	36	31	129			

REFERENCES

1. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

2. Hogg R. V., Mckean J. W., and Craig A. T.(2014) Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

3. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

Complementary Course to B. Sc. Mathematics (Model II) Programme

Semester III – Statistics Course III

ST3CMT03 - STATISTICAL INFERENCE

Hours per week - 3

Number of credits - 3

Module I

Law of Large Numbers- Tcheby Cheff's inequality - Bernoulli's Law of Large Numbers – Lind berg – Levy form of central limit- Theorem(Statement only). Problems related to the above topic.

[10 L]

Module 2

Sampling distributions. Distribution of sample mean and sample variants from a Normal population. Definition and statement of the form of the distribution of t, F and Chi-square-Inter relations- Use of tables. Problems related to the above topic. [12 L]

Module 3

Point Estimation. Desirable properties unbiasedness- consistency- efficiency and sufficiency. Fisher Neyman Factorisation theorem of sufficiency (without proof) and condition for its attainment- Method of Estimation. Interval Estimation- Interval Estimation of mean and variance of normal population. [15 L]

Module 4

Testing od hypotheses, Large sample tests Statistical hypotheses, null and alternative hypotheses, simple and composite hypotheses, type I and type II errors. Critical region. Size and power of a test. Proportion and difference of proportion. Chi-square tests for independence, homogeneity and goodness of fit. [17 L]

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	2	2	3	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	6	7	25	129	18	80
Total Mark		31	31	31	36	129			

REFERENCES

1. S.P.Gupta ,Statistical methods

2. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

3. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

4. R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

5. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.

Complementary Course to B. Sc. Mathematics (Model II) Programme

Semester IV- Course IV

ST4CMT04 - APPLIED STATISTICS

Hours per week - 3

Number of credits - 3

Module I

Normal tests for mean, difference of means and proportion (When σ known), t tests for mean and difference of means (When σ unknown); Chi-square test, F–test for ratio of variances. Test for proportion binomial.

[15L]

Module II

Analysis of variance-one way analysis of variance, one way analysis with unequal sample size. Two way analysis of variance. Two way analysis of variance with one observation per cell

[12L]

Module III

Analysis of Time series, components of time series, measurement of trend using Free hand methods, method of moving averages, the method of least squares, changing the unit value and shifting the origin. Seasonal and cyclical movement seasonal variation

[15L]

Module IV :Statistical quality control.

Control charts, 3-σ control limits, Tool for SQC. Control chart for variables. Control chart of range or R-Chart. Control chart for SD attributes. Fraction defective, P chart for variable sample size .Control Chart for number of defectives per unit-c-Chart acceptance sampling plan. Double sample plans. Sequential sampling plan curves for sampling plans.

[12L]

SCHEME OF QUESTION PAPER

(The number of questions from the four modules to be asked in the 3 parts of the question paper)

Use of non - programmable Calculator and Statistical tables allowed.

Part	Marks of each Question	No. of Questions					Total Marks	To be answered	
		Module				Total		No. of Questions	Total Marks
		1	2	3	4				
A	2	3	3	3	3	12	24	10	20
B	5	2	2	3	2	9	45	6	30
C	15	1	1	1	1	4	60	2	30
Total Questions		6	6	7	6	25	129	18	80
Total Mark		31	31	36	31	129			

REFERENCES

1. Gupta S. C. and Kapoor V. K.(2002). Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Sons.

2. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.

3 R.S.N. Pillai, Bagavathi(2010). STATISTICS- Theory and Practice, S.Chand publications.

4. S. P Guptha, Statistical methods, Sultan Chand and Sons Delhi.

5. GuptaS.C and Kapoor V.K,(2007)Fundamentals of applied statistics..Sultan chand and sons,

6.Goon, A.M. Gupta,M.K. and Das Gupta, B. (2001): *Fundamentals of Statistics*, Vol. II, World press, Calcutta.