MAR ATHANASIUS COLLEGE (AUTONOMOUS)

KOTHAMANGALAM, KERALA – 686666

College with Potential for Excellence

NAAC Accredited 'A+' Grade Institution

Email: mac@macollege.in

www.macollege.in

REGULATION, SCHEME AND SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

(MAC- UG-CBCS 2021)

B. Sc STATISTICS
(MACUGSSTA1005)

EFFECTIVE FROM THE ACADEMIC YEAR 2021-22

MAR ATHANASIUS COLLEGE (AUTONOMOUS)

KOTHAMANGALAM, KERALA – 686666

College with Potential for Excellence

NAAC Accredited 'A+' Grade Institution

Email: mac@macollege.in

www.macollege.in

REGULATION, SCHEME AND SYLLABUS

FOR

UNDERGRADUATE PROGRAMME

UNDER CHOICE BASED CREDIT SYSTEM

(MAC- UG-CBCS 2021)

B. Sc STATISTICS
(MACUGSSTA1005)

EFFECTIVE FROM THE ACADEMIC YEAR 2021-22

BOARD OF STUDIES IN STATISTICS(UG)

ACADEMIC COUNCIL

COMPOSITION – With Effect From 01-06-2020

Chairperson : Dr. Shanti. A. Avirah

Principal

Mar Athanasius College (Autonomous), Kothamangalam

Experts/Academicians from outside the College representing such areas as Industry, Commerce, Law, Education, Medicine, Engineering, Sciences etc.

1. **Dr. Winny Varghese**

   Secretary
   Mar Athanasius College Association Kothamangalam

2. **Prof. Dr. V.N. Rajasekharan Pillai**

   Former Vice-Chairman
   University Grants Commission, New Delhi.

3. **Dr. R.K. Chauhan**

   Former Vice-Chancellor
   Lingaya's University, Faridabad, Haryana -121002

4. **Dr. Sheela Ramachandran**

   Pro-Chancellor
   Atmiya University Rajkot.

5. **Prof. Kuruvilla Joseph**

   Senior Professor and Dean,
   Indian Institute of Space Science and Technology (IIST),
   Department of Space, Govt. of India, Valiyamala, Thiruvananthapuarm

6. **Dr. M.C. Dileep Kumar**

   Former Vice Chancellor
   Sree Sankaracharya Sanskrit University Kalady, Kerala, India

7. **Dr. Mathew. K**.

Principal
Mar Athanasius College of Engineering, Kothamangalam, Kerala - 686 666

8. **Adv. George Jacob**

Senior Advocate High Court of Kerala

Nominees of the University not less than Professors

9. **Dr. Biju Pushpan**

SAS SNDP Yogam College
Konni

10. **Dr. Suma Mary Sacharia**

UC College
Aluva

11. **Dr. V.B. Nishi**

Associate Professor
Sree Shankara College, Kalady.

Member Secretary

12. **Dr. M.S.Vijayakumary**

Dean – Academics
Mar Athanasius College (Autonomous)
Kothamangalam

Four teachers of the college representing different categories of teaching staff by rotation on the basis ofseniority of service in the college.

13. **Dr. Bino Sebastian. V** (Controller of Examinations)

14. **Dr. Manju Kurian**, Asst. Professor, Department of Chemistry

15. **Dr. Smitha Thankachan**, Asst. Professor, Department of Physics

16. **Dr. Asha Mathai**, Asst. Professor, Department of Malayalam

Heads of the Departments

17. Dr. Jayamma Francis, Head, Department of Chemistry

18. Dr. Mini Varghese, Head, Department of Hindi

19. Ms. Shiny John, Head, Department of Computer Science

20. Dr. Igy George, Head, Department of Economics

21. Dr. Rajesh.K. Thumbakara, Head, Department of Mathematics

22. Dr. Aji Abraham, Head, Department of Botany

23. Dr. Selven S., Head, Department of Zoology

24. Dr. Deepa. S, Head, Department of Physics

25. Dr. Aswathy Balachandran, Head, Department of English

26. Dr. Diana Ann Issac, Head, Department of Commerce

27. Ms. Seena John, Head, Department of Malayalam

28. Ms. Diana Mathews, Head, Department of Sociology

29. Ms. Sudha. V, Head, Department of Statistics

30. Dr. Jani Chungath, Head, Department of History

31. Sri. Haary Benny Chettiamkudiyil, Head, Department of Physical Education

32. Ms. Shari Sadasivan, Head, Department of Marketing and International Business

33. Dr. Julie Jacob, Head, Department of Biochemistry

34. Ms. Nivya Mariyam Paul, Head, Department of Microbiology

35. Ms. Jaya VinnyEappen, Head, Department of Biotechnology

36. Ms. ShaliniBinu, Head, Department of Actuarial Science

37. Ms. Simi. C.V, Head, Post Graduate Department of History

38. Ms. Sari Thomas, Head, Post Graduate Department of Statistics

39. Ms. Sheeba Stephen, Head, Department of B.Com Model III- Tax Procedure and Practice

40. Ms. Dilmol Varghese , Head, Post Graduate Department of Zoology

41. Ms. Bibin Paul, Head, Post Graduate Department of Sociology

BOARD OF STUDIES IN STATISTICS

SL. NO.	NAME	OFFICIAL ADDRESS
	CHAIRMAN	
1	SUDHA V.	Assistant Professor and Head Department of Statistics Mar Athanasius College, Kothamangalam
	EXPERTS (2)	
3	Dr. RANI SEBASTIAN	Assistant Professor Department of Statistics St Thomas College, Thrissur
4	Dr. G. RAJESH	Associate Professor Department of Statistics Cochin University of Science & Technology Kalamassery, Kochi.
	UNIVERSITY NOMINEE	
5	Dr. JAMES KURIEN	Associate Professor and Head. Department of Statistics, Maharajas College, Ernakulam
	MEMBER FROM INDUSTRY	
6	Dr. D. DHANURAJ	Chairman, Centre for Public Policy Research, Kochi
	MERITORIOUS ALUMNUS	
7	Dr. ABDUL SATHAR E. I.	Professor, Department of Statistics, Kerala University, Kariavattom
	MEMBER	
7	Dr. NIDHI P RAMESH	Assistant Professor, Department of Statistics, Mar Athanasius College, Kothamangalam
	SPECIAL INVITEES	
8	Smt. SARI THOMAS	Assistant Professor, Department of Statistics Mar Athanasius College, Kothamangalam
9	Smt. GIGI PAULOSE	Assistant Professor, Department of Statistics Mar Athanasius College, Kothamangalam

10	Smt. ELBY ALIAS	Assistant Professor, Department of Statistics Mar Athanasius College, Kothamangalam
11	Mr. ANU V A	Assistant Professor, Department of Statistics Mar Athanasius College, Kothamangalam

Contents

PREFACE

Statistics may be formally defined as a branch of science equipped with methods and tools 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.

Though several methods and tools have been developed already 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. 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 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.

LIST OF UNDERGRADUATE PROGRAMMES
MAR ATHANASIUS COLLEGE(AUTONOMOUS)

KOTHAMANGALAM

Sl. No	Programme	Degree	Faculty
1	ENGLISH	BA	LANGUAGE AND LITERATURE
2	HINDI	BA	LANGUAGE AND LITERATURE
3	ECONOMICS	BA	SOCIAL SCIENCES
4	SOCIOLOGY	BA	SOCIAL SCIENCES
5	HISTORY	BA	SOCIAL SCIENCES
6	MATHEMATICS	B Sc	SCIENCE
7	CHEMISTRY	B Sc	SCIENCE
8	PHYSICS	B Sc	SCIENCE
9	BOTANY	B Sc	SCIENCE
10	ZOOLOGY	B Sc	SCIENCE
11	STATISTICS	B Sc	SCIENCE
12	COMMERCE (Model 1)	B Com	COMMERCE
13	COMMERCE (Model III)	B Com	COMMERCE
14	FINANCE AND TAXATION	B Voc	COMMERCE
15	DATA ANALYTICS AND MACHINE LEARNING	B Voc	STATISTICS

AIMS AND OBJECTIVES OF THE PROGRAMME

As Statistics being one of the pillars of Data Science, this syllabus at UG level had set the following aims while preparing the learning and evaluation tools:

1. Introduce Statistics as a branch of science for solving everyday problems by analyzing relevant data.
2. Introduce a curriculum that imparts the real spirit with which a beginner may approach the learning of any scientific stream, not alone Statistics.
3. Introduce a curriculum that attracts the learners to understand the usefulness of various statistical tools in making their everyday life useful.
4. 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.
5. A curriculum that gives more importance to the practical side of applying various techniques than their proof and derivations.
6. Introduce a curriculum which enables the learners to continue their future study or employment in a very competing manner.
7. A curriculum that attracts the freshers in Statistics to the World of Statistics where numbers are transformed into information.

REGULATIONS FOR UNDERGRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM- 2021 ADMISSION ONWARDS

MAR ATHANASIUS COLLEGE (AUTONOMOUS)
KOTHAMANGALAM, KERALA – 686666

PREAMBLE

Education prepares a man to live with dignity and liberty. The ultimate aim of education is to deepen man's understanding of the universe and of himself-in body, mind and spirit –and to disseminate this understanding throughout society and to apply it in the service of mankind. This aim is accomplished when quality is ensured in the process of learning. Ever since Independence there has been several attempts on the part of Central and State Governments, University Grants Commission, AICTE and similar regulatory bodies as well as universities and colleges to improve the quality of instruction offered. However, because of heavy demand for access and consequent expansion of colleges and universities together with constraints on resources, standards of education could not cope with expansion. The affiliating system, which played a useful role in managing access in the past, occupied disproportionate time on administration of the system and undermined the capacities of universities and colleges to work towards research and development. Even curricular reform took a back seat in many universities. While there is no alternative in the present context to the system of affiliation, there is a felt need to seek fresh strategies for innovation and experimentation in the entire range of higher education activities at the institutional level. In this scenario, Government of India by Resolution dated 14 July 1964 appointed the Education Commission to advise Government on the national pattern of education and policies for the development of education at all stages and in all aspects. The Education Commission (1964 – 66) recommended "Autonomy" to Universities and colleges as instrumental in achieving and promoting academic excellence in higher education (Chapter XIII). In consonance with this recommendation, the University Grants Commission prepared Guidelines for Autonomy (Annexure II) during XIth plan and the same has been revised subsequently during XIIth plan. In the context of UGC Guidelines, the Committee set up by the Kerala State Higher Education Council in December 2012 to recommend criteria for selection and steps for operationalization of "Autonomous Colleges" in Kerala, deliberated on the subject extensively. Accordingly, the 13th Kerala State Legislative Assembly as per the "the University Laws (Third Amendment) Bill, 2014 resolved to provide Autonomy to colleges and Universities in Kerala. Mar Athanasius College, Kothamangalam, in its pursuit of academic excellence, was accorded Autonomous Status as per the Letter No. F.22 – 1/2016 (AC), dated 9th March, 2016. Following the attainment of autonomous status, the expert committee constituted by the Principal has undertaken the task of designing a draft Regulations and Guidelines of all Undergraduate Programmes in the institution in 2016. During the academic year 2016-17(For the 2016 admission) the then prevailing M. G. University regulations was accepted by the institution without any change. In the academic year 2017 the institution prepared UG regulations after making necessary modifications. The total credit, internal assessment, evaluation of answer sheets, Question paper pattern and conduct of examination were strictly adherent to the parent university regulations. The modified regulation came in to force in academic year 2018(with effect 2018 admission onwards) and the same regulation continued until 2020-21. In due course as per the recommendations of the academic council held on 19.06.2020, the 2018 UG regulations has been hitherto, modified by incorporating the modifications put forward by M.G. University as per U.O No. 1417/AC A9/2020 MGU

Dated10.03.2020. The framework of the Common Guidelines and regulations are presented in the ensuing pages.

1. TITLE

1.1. These regulations shall be called **"REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, 2021 (MAC-UG-CBCS 21)"** of Mar Athanasius College (Autonomous), Kothamangalam.

2. SCOPE

2.1 Applicable to all Undergraduate Programmes conducted by Mar Athanasius College (Autonomous), Kothamangalam with effect from 2021-22 admissions.

2.2 Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

3. DEFINITIONS

3.1. ***'Academic Week'*** is a unit of five working days in which distribution of work is organized from Day One to Day Five, with five contact hours of one hour duration on each day.

3.2 '***Semester'*** means a term consisting of a minimum of 90 working days, inclusive of tutorials, examination days and other academic activities, within a period of six months.

3.3 ***'Programme'*** means a three year programme of study with examinations spread over six semesters. The successful completion of the programme leads to the award of a Bachelor Degree.

3.4 ***'Course'*** means a portion of a subject, which will be taught and evaluated in a semester (similar to a paper under Annual scheme). Each Course is to be designed under lectures / tutorials / laboratory / fieldwork / seminar/ project / practical training / assignments and evaluation etc., to meet effective teaching and learning needs.

3.5 ***'Common Course I'*** means a course that comes under the category of courses for English.

3.6 ***'Common Course II'*** means additional language (Malayalam or Hindi).

3.7 ***'Core Course'*** means a course in the subject of specialization within an Under Graduate Programme.It includes a course on environmental studies and human rights.

3.8 ***'Complementary Course'*** means a course which would enrich the study of core courses.

3.9 ***'Choice Based Course'*** means a course that enables the students to familiarise the advanced areas of Core Course.

3.10 ***'Open course'*** means an optional course which the student is free to take at his/her will.

Open Course shall be a non-major elective course offered by the Departments other than parent Department.

3.11 *'**Certificate Course / Diploma Course**'* means courses that permit an opportunity to the students for academic enrichment in an area other than the traditional programmes to which he/she is admitted. Such courses will lead the candidate toward entry level employment in a professional field. The duration and general frame of the courses are subject to the regulations prescribed by the UGC from time to time. Certificate/Diploma courses shall be conducted over and above regular working hours.

3.12 *'**Credit**'* is the numerical value assigned to a course according to the relative importance of the syllabus of the programme**.**

3.13 ***'Grade'*** means a letter symbol (e.g: A, B, C, etc.) that indicates the broad level of performance of a student in a course/ semester/programme.

3.14 ***'Grade Point' (GP)***is the numerical indicator of the percentage of marks awarded to a student in a course.

3.15 **Institutional Average (IA)** means average marks secured (Internal + External) for a course at the college level

3.16 ***'Credit Point (CP)'***of a course is the value obtained by multiplying the Grade Point (GP) by the Credit (C) of the course. CP=GP x C.

3.17 ***'Cumulative Credit Point Average (CCPA)'*** is the value obtained by dividing the sum of credit points in all the courses taken by the student for the entire programme by the total number of credits.

3.18 ***'Department'*** means any Teaching Department in the College.

3.19 '***Parent Department'*** means the department which offers core courses within an Under Graduate Programme.

3.20 ***'Department Council'*** means the body of all teachers of a department in the college.

3.21 *'**Department Co-ordinator**'* means a teacher from the parent department nominated by the Department Council, who will advise the student in the academic matters.

3.22 ***'College Coordinator'*** is a teacher nominated by the Principal to co-ordinate the continuous evaluation undertaken by various departments within the college.

3.23 '***Grace Marks'*** means marks awarded to the candidates as per the orders issued by Mahatma Gandhi University, Kottayam, from time to time.

3.24 ***'Skill Enhancement Programme'*** means Programme intended to assist the students to acquire additional practical skill which should be conducted over and above the regular working hours.

3.25 Words and expressions used and not defined in this regulation shall have the same meaning assigned to them in the Act and Statutes of the Mahatma Gandhi University.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

4.1 Eligibility and Norms for admission and reservation of seats for various Under Graduate Programmes shall be according to the rules framed by the Mahatma Gandhi University/State Government from time to time.

5. DURATION

5.1 The duration of UG programmes shall be ***6 semesters***.

5.2 There shall be two semesters in an academic year. The **ODD** semester commences in **June** and on completion, the **EVEN** semester commences. There shall be two months' vacation during April and May in every academic year.

5.3 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.

6. REGISTRATION

6.1 The strength of students for each course shall remain as per existing regulations as approved by Mahatma Gandhi University, Kottayam.

6.2 The college shall send a list of students registered for each programme in each semester giving the details of courses registered to the University in the prescribed form within 45 days from the commencement of the Semester.

6.3 Those students who possess the required minimum attendance and progress during a semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned, enabling them to get promoted to the next class.

7. SCHEME AND SYLLABI

7.1.The UG programmes shall include (a) Common courses I and II, (b) Core courses, (c) Complementary Courses, (d) Choice Based Course and(e) Open Course. Common course II is exempted in the case of B.Com Model III.

7.2.There shall be one Choice Based course (Elective Course) in the sixth semester. In the case of B.Com Programme there shall be an elective stream from third semester onwards.

7.3. 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 College to continue their

education in another College without break. Credit transfer shall be permitted as per the University Rules.

7.4. A separate minimum of 30% marks each for internal and external (for both theory and practical) and an aggregate minimum of 35% are required to pass 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.

7.5. Students who complete the programme with "D" Grade under **"REGULATIONS FOR UNDERGRADUATE (UG) PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM, 2021"** of Mar Athanasius College (Autonomous), Kothamangalam will have **one betterment chance within 12 months**, immediately after the publication of the result of the whole programme.

7.6 The UG Board of Studies concerned shall design all the courses offered in the UG programme. The Boards shall design new courses and modify or re-design existing courses to facilitate better exposure and training for the students.

7.7 The syllabus of a course shall include the title of the course, contact hours, the number of credits and reference materials.

7.8 Students discontinued from previous regulations CBCS 2018 of Mar Athanasius College (Autonomous), Kothamangalam can pursue their studies in the Mar Athanasius College (Autonomous) Kothamangalam under "Regulations for Under Graduate Programmes under Choice Based Credit System 2021"after obtaining readmission. These students have to complete the programme as per the Mar Athanasius College (Autonomous)"Regulations for Under Graduate Programmes under Choice Based Credit System 2021".

7.9 The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which are in need of conducting practical examinations at the end of odd semesters

8. PROGRAMME STRUCTURE

The structure of UG Programmes is as follows

Model I B.A/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from **common course I**	22
d	Credits required from **common course II**	16
e	Credits required from Core Course and Complementary Course including Project	79
f	Credits required from Open course	3
g	Minimum attendance required	75%

Model I B Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from **common course I**	14
d	Credits required from **common course II**	8
e	Credits required from Core Course and Complementary Course	95
f	Credits required from Open course	3
g	Minimum attendance required	75%

Model III B Com

a	Programme Duration	6 semesters
b	Total Credits required for successful completion of the programme	120
c	Credits required from **Common Course I**	8
d	Credits required from Core + Complementary + Vocational courses including Project	109
e	Credits required from Open Course	3
f	Minimum attendance required	75%

9. EXAMINATIONS

9.1 The evaluation of each course shall contain two parts:

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

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

The in-semester to end semester assessment ratio shall be 1:4.

Both Internal and External marks are to be rounded to the next integer.

9.2 For all courses (theory & practical), grades are given on a **10- point scale,** based on the total percentage of marks ***(ISA+ESA)*** as given below:

Percentage of Marks	**Grade**		**Grade Point (GP)**
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above average	6
45 to below 55	C	Satisfactory	5
35 to below 45	D	Pass	4
Below 35	F	Failure	0
	Ab	Absent	0

10. CREDIT POINT(CP)AND CREDIT POINT AVERAGE (CPA)

Credit Point (CP)

Credit Point (CP) of a paper is calculated using the following formula.

CP = C * GP

Where: C is the Credit and GP is the Grade point

1. Credit Point Average (CPA)

Credit Point Average (CPA) of a Course (Common Course I, Common Course II, complementary Course I, Complementary Course II, and Core Course) is calculated using the following formula.

CPA = TCP/TC

Where: TCP is the Total Credit Point of course and TC is the Total Credit of that category of course

2. Semester Credit Point Average (SCPA)

Semester Credit Point Average (SCPA) of a Semester is calculated using the following formula.

SCPA = TCP/TC

Where: TCP is the Total Credit Point of that semester and TC is the Total Credit of that semester

3. Cumulative Credit Point Average (CCPA)

Cumulative Credit Point Average (CCPA) is calculated using the following formula.

CCPA = TCP/TC

Where; TCP is the Total Credit Point of that Programme and TC is the Total Credit of that programme

Grades for the different semesters and overall programme are given based on the corresponding CPA as shown below:

CPA	**Grade**	
9.5 and above	S	Outstanding
8.5 to below 9.5	A^+	Excellent
7.5 to below 8.5	A	Very Good
6.5 to below 7.5	B^+	Good
5.5 to below 6.5	B	Above average
4.5 to below 5.5	C	Satisfactory
4to below 4.5	D	Pass
Below 4	F	Failure

11. MARK DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATION

The end semester examinations of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without 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:

11.1 FOR ALL COURSES WITHOUT PRACTICAL

a) Marks of External Examination : 80
b) Marks of Internal Evaluation : 20

All the four components of the internal assessment are mandatory.

Components of Internal Evaluation of theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5)	**10**
Total	**20**

11.2 FOR ALL COURSES WITH PRACTICAL

a) Marks of External Examination :60
b) Marks of Internal Evaluation : 15

11.2.1 FOR THEORY

Components of In-Semester Evaluation of Theory	**Marks**
Attendance	**5**
Assignment /Seminar/Viva	**2**
Test papers (2x4)	**8**
Total	**15**

11.2.2 FOR PRACTICAL EXAMINATION

a) External 40

b) Internal 10

Components of In-Semester Evaluation of Practical	**Marks**
Attendance	2
Test papers (1x4)	4
Record*	4
Total	**10**

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are Mandatory.

11.3 PROJECT EVALUATION: (Maximum Marks 100)

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. Special sanction shall be obtained from the Principal to those new generation programmes and programmes on performing arts where students have to take projects which involve larger groups. 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 at the sixth semester and are to be produced before the examiners (Internal and External) appointed by the Controller of Examinations. External Project evaluation and Viva / Presentation is compulsory for all subjects and will be conducted at the end of the programme.

For Projects

a) Marks of External Evaluation :80

b) Marks of Internal Evaluation : 20

Components of External Evaluation of Project	**Marks**
Dissertation (**External)**	50
Viva - Voce (**External)**	30
Total	**80**

*Marks for Dissertation may include study tour report if proposed in the syllabus

***Components of Internal Evaluation of Project**	**Marks**
Punctuality	5
Experimentation/Data collection	5
Knowledge	5
Report	5
Total	**20**

11.4 ATTENDANCE EVALUATION FOR ALL COURSES (Theory/Practical)

Percentage of attendance	**Marks**
90 and above	5
85 - 89	4
80-84	3
76-79	2
75	1
Below 75	0

(Decimals are to be rounded to the next higher whole number)

12. ASSIGNMENTS

Assignments are to be done from first to fourth Semesters. At least one assignment should be done in each semester.

13. SEMINAR/VIVA VOCE

A student shall present a seminar in the Fifth semester for each course and appear for Viva-voce in the sixth semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

Two Test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents

of internal assessments are to be kept in the college for one year and shall be made available for verification. The responsibility of evaluating the internal assessment is vested on the teacher (s), who teaches the course.

14.1 GRIEVANCE REDRESSAL MECHANISM

Internal assessment shall not be used as a tool for personal or other type of vengeance.

A student has every right to know, how the teacher arrived at the marks. In order to address the grievance of students, a three -level Grievance Redressal Mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

Level 1: At the level of the concerned Course Teacher

Level2: Department Level: The Department cell chaired by the Head of the Department, Faculty Advisor and the Course Teacher concerned as members.

Level 3: **College level**: A committee with the Principal as Chairman, and HOD of concerned Department, Academic Coordinator, and two teachers of the College Grievance Cell as members.

14.2 Academic coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of first semester.

14.3 The in-semester evaluation report in the prescribed format should reach the Controller of Examinations as per the academic calendar.

14.4 The evaluation of all components is to be published in the Department and is to be acknowledged by the candidates. All academic records of in-semester assessments are to be kept in the Department for three years and shall be made available for verification. The responsibility of evaluating the in-semester assessment is vested on the teacher(s), who teach the course.

15. EXTERNAL EXAMINATION

The end semester examination of all Programmes shall be conducted by the College at the end of each semester.

15.1 Students having a minimum of 75% average attendance for all the courses only can register for the examination. A candidate having a shortage of attendance of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme can apply for Condonation in prescribed form on genuine grounds. This Condonation shall not be counted for internal assessment. Condonation of shortage of attendance, if any, should be obtained at least 7 days before the commencement of the concerned semester examination.

It shall be the discretion of the Principal to consider such applications and condone the shortage on the merit of each case in consultation with the concerned Faculty Advisor and Head of the Department.

Unless the shortage of attendance is condoned, a candidate is not eligible to appear for the examination.

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 to attend the end semester examination due to shortage of attendance, even with Condonation, should take re-admission along with the next batch.

15.2 Those candidates who cannot appear for End Semester Examination or who have failed in the end semester examinations of Fifth and Sixth Semester shall be eligible to appear for supplementary examination by paying separate fees. For reappearance/ improvement, for other semesters the students can appear along with the next batch. Notionally registered candidates can also apply for the said supplementary examinations.

15.3 A student who registers his/her name for the end semester examination will be eligible for promotion to the next semester.

15.4 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.

15.5 A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the End Semester examination for the same semester, subsequently. There shall be no improvement for internal evaluation.

15.6 Answer scripts of the external examination shall be made available to the students for scrutiny on request and revaluation/scrutiny of answer scripts shall be done as per the request of the candidate by paying fees.

16. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/she shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

Pattern of Questions for External Examination for Course without Practical

Sl. No.	Pattern	Marks	Choice of questions	Total Marks
1	Short answer/ Problem Type	2	10/12	20
2	Short essay/ Problems	5	6/9	30
3	Essay/Problem	15	2/4	30
Total				80

Pattern of Questions for End Semester Examination for Course with Practical

Sl. No.	Pattern	Marks	Choice of questions	Total Marks
1	Short answer/ Problem Type	1	10/12	10
2	Short essay/ Problems	5	6/9	30
3	Essay/Problem	10	2/4	20
Total				60

17. RANK CERTIFICATE

The institution publishes rank list of top 3 candidates for each programme after the publication of 6th semester results. Rank certificate shall be issued to the candidate who secure first position in the rank list. Candidates shall be ranked in the order of merit based on the CCPA scored by them. Grace marks awarded to the students should not be counted fixing the rank/position. Rank certificate shall be signed by the Principal and Controller of Examinations.

18. MARK CUM GRADE CARD

The College under its seal shall issue to the students a MARK CUM GRADE CARD on completion of each semester, which shall contain the following information:

(a) Name of the University
(b) Name of the College
(c) Title & Model of the Under-Graduate Programme
(d) Name of the Semester
(e) Name and Register Number of the student
(f) Code, Title, Credits and Maximum Marks (Internal, External and Total) of each course opted in the semester.
(g) Internal, External and Total Marks awarded, Grade, Grade point and Credit point in each course opted in the semester
(h) Institutional average of the Internal Exam and Average of the External Exam in each course.
(i) The total credits, total marks (Maximum and Awarded) and total credit points in the semester
(j) Semester Credit Point Average (SCPA) and corresponding Grade.
(k) Cumulative Credit Point Average (CCPA), CPA corresponding to Common courses I and II, Core Course, Complementary Course and Open Course.
(m) The final Mark cum Grade Card issued at the end of the final semester shall contain the details of all courses taken during the final semester examination

and shall include the final grade(SCPA) scored by the candidate from **1st to 5th** semesters, and the overall grade for the total programme.

19. MONITORING COMMITTEES

There shall be 2 level monitoring committees for the successful conduct of the scheme. They are:

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior most teachers as members.
2. College Level Monitoring Committee (CLMC), comprising Principal, College Council secretary and A.O/Superintendent as members.

20. SKILL ENHANCEMENT PROGRAMME

In addition to the requirement prescribed for the award of Bachelor degree, each student shall participate in the Skill Enhancement Programme (SEP) conducted by each department for a total duration of 40 hours spread over Semester I to Semester VI of all Programmes. SEP is intended to train the students and to inculcate extra skills that enable them to be competent in academic and non-academic matters equally. Separate certificate shall be issued by the institution to the candidate on successful completion of the programme. SEP shall be conducted over and above the regular working hours of each programme.

21. CERTIFICATE/DIPLOMA COURSES:

Certificate/Diploma courses such as basics of accounting, animation, photography, garment designing, etc. may be conducted for all Programmes as per the discretion of the Board of Studies of the concerned department. The Board of Studies should prepare the curriculum and Syllabi of Certificate/Diploma courses including contact hours and reference materials. Separate certificate will be issued to the candidate on successful completion of the course. An extra Credit of 2 will be awarded to all the candidates on successful completion of the certificate courses and same shall be inscribed in the cumulative grade card and the degree certificate of each candidate.

22. FACTORY VISIT / FIELD WORK/VISIT

A factory visit / field work/visit to a reputed research institute/ student interaction with renowned academicians may be conducted for all Programmes.

23. TRANSITORY PROVISION

Notwithstanding anything contained in these regulations, the Principal shall, for a period of one year from the date of coming into force of these regulations, have the power to provide by order that these regulations shall be applied to any Programme with such modifications as may be necessary from time to time.

ANNEXURES

Annexure I - Model Mark cum Grade Card

Mar Athanasius College(Autonomous) Kothamangalam

Kothamangalam College P.O. Kothamangalam.

Section:
Student ID:
Date:

MARK CUM GRADE CARD

Name of candidate :
Name of College :
Permanent Register Number (PRN) : Degree:
Name of the Programme :
Name of Examination : First Semester Exam Month &Year
Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP)	Credit point (CxGP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (E+i)	Maximum	Awarded (I)	Maximum					
	Common Course I												
	Common Course II												
	Core Course												
	Complementary Course I												
	Complementary Course												
	II/ Vocational Course												
	Total												
	Total credit points (TCP)												
	Total credit (TC)												
	SCPA:												
	Grade:												

Annexure II Model Mark cum Grade Card (VI Semester)

Mar Athanasius College (Autonomous) Kothamangalam
Kothamangalam College P.O. Kothamangalam.

Section:
Student ID:
Date:

MARK CUM GRADE CARD

Name of candidate :
Name of College :
Permanent Register Number (PRN) : Degree:
Name of the Programme :
Name of Examination :Sixth Semester Exam Month &Year
Date of publication of result :

Course Code	Course Title	Credit (C)	Marks						Percentage of total marks	Grade awarded (G)	Grade point (GP)	Credit point (CxGP)	Result
			External		Internal		Total						
			Awarded (E)	Maximum	Awarded (E+i)	Maximum	Awarded (I)	Maximum					
	Core 9 Core 10 Core 11 Core 12 Choice Based Course Project SCPA Grade												

		Credit	CPA	Grade	Month & Year	Result
	Semester I Semester II Semester III Semester IV Semester V Semester VI					

	Common Course I Common Course II Complementary Course I Complementary Course II Core Course Open Course					
	Overall programme CCPA:					

Annexure III

Reverse side of the Mark cum Grade Card
(COMMON TO ALL SEMESTERS)
Description of the Evaluation Process
Grade and Grade Point

The Evaluation of each Course comprises of Internal and External Components in the ratio 1:4 for all Courses.

Grades and Grade Points are given on a 10-point Scale based on the percentage of Total Marks (Internal + External) as given in Table 1.

(Decimals are to be rounded to the next whole number)

Credit point and Credit point average. Grades for the different Semesters and overall Programme are given based on the corresponding CPA, as shown in Table I.

Table 1

Percentage of Marks	**Grade**		**Grade Point (GP)**
95 and above	S	Outstanding	10
85 to below 95	A+	Excellent	9
75 to below 85	A	Very Good	8
65 to below 75	B+	Good	7
55 to below 65	B	Above average	6
45 to below 55	C	Satisfactory	5
35 to below 45	D	Pass	4
Below 35	F	Failure	0
	Ab	Absent	0

Credit point (CP) of a paper is calculated using the formula CP = C x G P, where C is the Credit;

GP is the Grade Point.

Credit Point Average (CPA) of a Course/ Semester or Programme (cumulative) etc. is calculated using the formula CPA =TCP/TC; where TCP is the Total Credit Point; TC is the Total Credit.

For converting SCPA into Percentage, multiply secured SCPA by 10 (SCPA x 10)

For converting CCPA into percentage, multiply secured CCPA by 10 (CCPA x 10)

CPA	**GRADE**
Equal to 9.5 and above	S Outstanding
Equal to 8.5 and < 9.5	A+ Excellent
Equal to7.5 and < 8.5	A Very Good
Equal to 6.5 and < 7.5	B+ Good
Equal to5.5 and < 6.5	B Above Average
Equal to4.5 and < 5.5	C Satisfactory
Equal to 4 and < 4.5	D Pass
Below 4	F Failure

Note: A separate minimum of **30%** marks each for internal and external (for both theory and practical) 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.

PROGRAMME STRUCTURE

COURSE DESIGN

The UG programme in Statistics shall include (a) Common courses I & II (b) Core courses (c) Complementary Courses (d) Choice Based Course and (e) Open Course. There shall be one Choice based Open Course 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 paper 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.

PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

PROGRAMME OUTCOMES FOR UNDERGRADUATE PROGRAMMES

PO1: Understand the discipline at both theoretical and application levels.

PO2: Achieve an aim to expand their studies in the discipline at higher level.

PO3: Work as a team with enhanced communication and coordination skills.

PO4: Attain skills for employment in their programme related professions.

PO5: Acquire awareness on socio-cultural and environmental issues.

PO6: Develop entrepreneurship and leadership abilities.

PO7: Inculcate a sense of ethics, discipline, time management, emotional intelligence and self-awareness.

PO8: Expand the mindset to pursue lifelong learning.

PROGRAMME SPECIFIC OUTCOMES FOR B.Sc STATISTICS

PSO1: Formulate and analyse statistical problems, precisely define the key terms, and draw conclusions based on statistical analysis.

PSO2: Use statistical techniques to solve well defined problems and present their theoretical background, both in oral and written format to various audiences.

PSO3: Read, understand and construct correct mathematical and statistical proofs and use the library and electronic data-bases to locate information on statistical problems.

PSO4: Explain the importance of Statistics and its techniques to solve real life problems and understand the limitations of such techniques and the validity of the results.

PSO5: Formulate new statistical problems and use software packages and / or computer programming to solve them.

PSO6: Develop skills via group projects, assignments, seminar presentations and viva voce sessions.

PSO7: Continue to acquire statistical knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in Statistics.

CHOICE-BASED CREDIT SYSTEM

B. Sc. STATISTICS PROGRAMME – MODEL - I

DETAILED DISTRIBUTION OF COURSES

Semester	Title of the Course	Hours per Week	Credit	Marks	
				Internal	External
I	English I	5	4	20	80
	English Common I	4	3	20	80
	Second Language I	4	4	20	80
	ELEMENTARY STATISTICS	4	3	20	80
	Complementary I (1)	4	3	20	80
	Complementary II(1)	4	2	15	60
II	English II	5	4	20	80
	English Common II	4	3	20	80
	Second Language II	4	4	20	80
	PROBABILITY THEORY AND APPLIED STATISTICS	4	3	20	80
	Complementary I (2)	4	3	20	80
	Complementary II(2)	4	2	15	60
	PRACTICAL		2	10	40
III	English III	5	4	20	80
	Second Language Common I	5	4	20	80
	THEORY OF RANDOM VARIABLES	5	4	20	80
	Complementary I (3)	5	4	20	80

	Complementary II (3)	5	3	15	60

Semester	Title of the Course	Hours per Week	Credit	Marks	
				Internal	External
IV	English IV	5	4	20	80
	Second Language Common II	5	4	20	80
	PROBABILITY DISTRIBUTION	5	4	20	80
	Complementary I (4)	5	4	20	80
	Complementary II (4)	5	3	15	60
	PRACTICAL		2	10	40
V	THEORY OF ESTIMATION	5	4	20	80
	MATHEMATICS FOR STATISTICS-I	6	4	20	80
	SAMPLING TECHNIQUES	5	4	20	80
	ENVIRONMENTAL STUDIES AND VITAL STATISTICS	5	4	20	80
	Open Course**	4	4	20	80
VI	TESTING OF STATISTICAL HYPOTHESIS	6	4	20	80
	MATHEMATICS FOR STATISTICS-II	5	4	20	80
	DESIGN AND ANALYSIS OF EXPERIMENTS	5	4	20	80
	STATISTICAL COMPUTING USING R SOFTWARE	5	4	20	80
	Choice Based Course**	4	3	20	80

	Project	-	1	20	80
	TOTAL	150	120	660	2640

B. Sc. STATISTICS PROGRAMME – MODEL - I
CORE, COMPLEMENTARY, CHOICE-BASED & OPEN COURSES

Sl No	Semester	Course Code	Course	Title	Hours/Week	Credit
1	I	UG21ST1CR01	Core I	Elementary Statistics	4	3
2	II	UG21ST2CR01	Core II	Probability Theory and Applied Statistics	4	3
3	III	UG21ST3CR01	Core III	Theory of Random Variables	5	4
4	IV	UG21ST4CR01	Core IV	Probability Distribution	5	4
5	V	UG21ST5CR01	Core V	Theory of Estimation	5	4
6	V	UG21ST5CR02	Core VI	Mathematics for Statistics-I	5	4
7	V	UG21ST5CR03	Core VII	Sampling Techniques	5	4
8	V	UG21ST5CR04	Core VIII	Environmental Studies and Vital Statistics	5	4
9	V	UG21ST5OC01	Open Course I	Applied Statistics	5	4
10	V	UG21ST5OC02	Open Course II	Spread Sheet Calculations and Elementary Data Analysis	5	4
11	V	UG21ST5OC03	Open Course III	Actuarial Statistics	5	4
12	V	UG21ST5OC04	Open Course IV	Mathematical Economics	5	4
13	VI	UG21ST6CR01	Core IX	Testing of Statistical Hypothesis	5	4
14	VI	UG21ST6CR02	Core X	Mathematics for Statistics-II	5	4
15	VI	UG21ST6CR03	Core XI	Design and Analysis of Experiments	5	4
16	VI	UG21ST6CR04	Core XII	Statistical Computing using R Software	5	4
17	VI	UG21ST6CB01	Core XIII Elective I	Operations Research	4	3
18	VI	UG21ST6CB02	Core XIII Elective II	Elements of Stochastic Process	4	3
19	VI	UG21ST6CB03	Core XIII	Econometrics	4	3

			Elective III			
20	I	UG21ST1CM01	Comp I	Descriptive Statistics	4	3
21	II	UG21ST2CM01	Comp II	Probability Theory	4	3
22	III	UG21ST3CM01	Comp III	Probability Distributions	5	4
23	IV	UG21ST4CM01	Comp IV	Statistical Inference	5	4

TOTAL CREDITS FOR CORE AND COMPLEMENTARY - 78
OPEN COURSE - 4

82

* One course to be selected from the list of Open Courses.

** One course to be selected from the list of Core-Choice Based.

LIST OF COMPLEMENTARY COURSES

The following Complementary courses are selected by the department of Statistics for B Sc Statistics Programme without affecting the existing work load.

1. Mathematics
2. Computer Science

OPEN COURSES

The department has chosen the following course as its open course

1. Applied Statistics (UG21ST5OC01)

CORE - CHOICE BASED COURSES

One core course can be chosen from among the following three courses.

1. Operations Research(UG21ST6CB01)
2. Elements of Stochastic Process(UG21ST6CB02)
3. Econometrics(UG21ST6CB03)

COMPLEMENTARY COURSES (STATISTICS) FOR OTHER BSC PROGRAMMES

Course 1: Descriptive Statistics (UG21ST1CM01)

Course 2: Probability Theory (UG21ST2CM01)

Course 3: Probability Distributions (UG21ST3CM01)

Course 4: Statistical Inference (UG21ST4CM01)

DETAILED SYLLABUS
B. Sc. STATISTICS
CORE, OPEN AND CHOICE BASED ELECTIVE

FIRST SEMESTER COURSES

SEMESTER I- CORE COURSE I

UG21ST1CR01-ELEMENTARY STATISTICS

Course Code	**UG21ST1CR01**
Title of the Course	**ELEMENTARY STATISTICS**
Semester in which the course is to be taught	I
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce the basics of Statistics to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Identify Statistics as a scientific discipline
2. Deal with the collection, classification, analysis and interpretation of numerical data.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Identify Statistics as a scientific discipline, dealing with the collection, classification, analysis and interpretation of numerical data.	K2	PSO4
2	CO 2: Understand the basic concepts of Statistical methodologies for data collection.	K2	PSO3
3	CO3: Compare and use various data collection methods in primary data collection.	K3	PSO1, PSO2
4	CO 4: Identify various sources of secondary data.	K3	PSO2,PSO3
5	CO 5: Use descriptive measures and graphs to represent and compare numerical data.	K4	PSO1, PSO2
6	CO 6: Construct frequency distribution and related tables from a given dataset.	K5	PSO2
7	CO 7: Prepare well-structured questionnaires.	K6	PSO1, PSO2, PSO6

8	CO8: Design systematic small scale surveys for data collection.	K6	PSO1, PSO2, PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Introduction-Statistics-origin , meaning, limitations and misuses , statistical population and sample, census and sampling, Different types of data –primary and secondary data; quantitative, qualitative, geographical and chronological data; continuous and discrete data. Designing of a questionnaire and schedule, methods of collection and editing of primary data, Classification and tabulation of data, frequency distributions. Diagrammatic presentation- line diagram, bar diagrams, pie diagram, pictogram and cartogram. Graphical representation of frequency distribution-histogram, frequency polygon, frequency curve, ogives. Stem and leaf chart.

(20 hours)

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

(25 hours)

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

(25 hours)

Module IV: Moments, Skewnwss& Kurtosis- 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.

(20 hours)

Books for study

1. Gupta,S.C.andKapoor, 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. and StephensL.J. (2014). *Statistics*, (5^{th} ed.) Schaum'soutlines, McGraw-Hill Education.
3. GuptaS.P. (2014).*Statistical Methods*, Sultan Chand & Sons, New Delhi.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	0	21
II	3	2	1	31
III	4	2	1	33
IV	2	2	2	44
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SECOND SEMESTER COURSES

SEMESTER II- CORE COURSE II

UG21ST2CR01-PROBABILITY THEORY& APPLIED STATISTICS

Course Code	**UG21ST2CR01**
Title of the Course	**PROBABILITY THEORY& APPLIED STATISTICS**
Semester in which the course is to be taught	II
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce the students to the basics of Probability Theory, Index Numbers and Time series analysis

Objectives of the Course

On completion of the course, the student should be able to:

1. Identify probability theory as the backbone of Statistical Science
2. Recognize the applications of statistical methodologies from the study of index numbers and time series analysis.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Identify probability theory as the backbone of Statistical Science.	K2	PSO4
2	CO2: Understand the fundamentals of probability theory, index numbers and time series analysis.	K2	PSO1, PSO4
3	CO3: Recognize the applications of statistical methodologies from the study of index numbers and time series analysis.	K3	PSO2, PSO4
4	CO4: Compare the classical and Bayesian approaches in Statistics.	K2	PSO4
5	CO 5: Implement the concept of index numbers in many real-life problems for comparison purposes.	K3, K4	PSO1, PSO2
6	CO6: Judge the merits of statements consisting of different index numbers from the governmental and non-governmental agencies.	K4, K5	PSO2, PSO7

7	CO7: Classify and study the various components of a time series data and its applications.	K3, K4	PSO1,PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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).

(20 hours)

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

(25 hours)

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

(25 hours)

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

(20 hours)

Books for study

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

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	4	2	1	33
IV	2	2	1	29
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

THIRD SEMESTER COURSES

SEMESTER III-CORE COURSE III

UG21ST3CR01-THEORY OF RANDOM VARIABLES

Course Code	**UG21ST3CR01**
Title of the Course	**THEORY OF RANDOM VARIABLES**
Semester in which the course is to be taught	III
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce the students to the basics of Random variables, Mathematical Expectation, Correlation and Regression

Objectives of the Course

On completion of the course, the student should be able to:

1. Understand the concept of random variables, its properties and the concept of Mathematical expectation
2. Model bivariate data using correlation and regression techniques

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Describe the concept of random variables and its properties.	K2	PSO1, PSO4
2	CO 2 : Apply the concept of mathematical expection, its properties and various statistical measures in terms of expectation of random variables.	K3	PSO2, PSO3
3	CO 3: Explain the different generating functions and their applications.	K3	PSO3,PSO4
4	CO 4 : Understand the significance of correlation and regression in statistical analysis	K2	PSO1, PSO3
5	CO 5: Analyse bivariate data using correlation and regression techniques.	K4	PSO1, PSO2, PSO7
6	CO 6: Fitting of curves using the principle of least squares.	K6	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(20 hours)

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. 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.

(25 hours)

Module III: Bivariate Random Variables- Bivariate distribution and statement of its properties. Joint, marginal and conditional distributions. Independence of random variables. Transformation of bivariate random variables. Covariance and correlation coefficient. Cauchy-Schwartz's inequality. Conditional expectation (regression function) and conditional variance.

(20 hours)

Module IV: Correlation and Regression- Curve fitting, principle of least squares, fitting of straight lines, parabolas, exponential curves. Bivariate linear correlation – Scatter diagram. Pearson's correlation coefficient, Spearman's rank correlation coefficient. Bivariate linear regression – regression lines, coefficients of regression. Multiple and partial correlation for three variables (without proof).

(25 hours)

Books for study

1. Gupta, S.C. and Kapoor, V.K. (2014).*Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
2. Gupta S.P. (2014). *Statistical Methods*, Sultan Chand & Sons, New Delhi.
3. Gupta, S.C. and. Kapoor, V.K .(2014). *Fundamentals of Applied Statistics*, Sultan Chand & Co. 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*, (3^{rd} ed.),John Wiley & Sons Inc.
3. Ross.S. (2013). *A First Course in Probability*, (9^{th} ed.), Pearson Education Publication.
4. Hogg,R.V.,McKean,J.W. and Craig,A.T.(2014).*Introduction to Mathematical Statistics*, (7^{th} ed.), Pearson Education Publication.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	3	2	1	31
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

FOURTH SEMESTER COURSES

SEMESTER IV-CORE COURSE IV

UG21ST4CR01-PROBABILITY DISTRIBUTIONS

Course Code	**UG21ST4CR01**
Title of the Course	**PROBABILITY DISTRIBUTIONS**
Semester in which the course is to be taught	IV
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce the students to the basics of Probability distributions

Objectives of the Course

On completion of the course, the student should be able to:

1. Describe various probability distributions - discrete and continuous, their properties and applications
2. Model data using distribution fitting techniques

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Describe various probability distributions - discrete and continuous, their properties and applications	K1	PSO4, PSO2
2	CO 2 : Explain various discrete distributions such as Binomial, Poisson, Geometric etc., their properties and their applications.	K2	PSO4, PSO3
3	CO 3 : Understand various continuous distributions such as Exponential, Gamma, Beta, Normal etc., their properties and their applications.	K2	PSO3
4	CO 4 : Model data using distribution fitting techniques	K5	PSO1, PSO2
5	CO 5: Describe normal distribution, its properties and solve problems using normal tables.	K3	PSO4
6	CO 6: Understand the theory of Law of large numbers, Central limit theorem and its applications.	K3	PSO4, PSO3

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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, multinomial distributions and its applications.

(30 hours)

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

(20 hours)

Module III: Normal and Lognormal Distributions-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. (20 hours)

Module IV: Law of Large Numbers and Central Limit Theorem-Chebyshev's inequality, convergence in probability, Chebyshev's 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.

(20 hours)

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. 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*, (3rded.) John Wiley, New York.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	5	3	1	40
II	3	2	1	31
III	2	2	1	29
IV	2	2	1	29
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

FIFTH SEMESTER COURSES

SEMESTER V- CORE COURSE V

UG21ST5CR01-THEORY OF ESTIMATION

Course Code	**UG21ST5CR01**
Title of the Course	**THEORY OF ESTIMATION**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce the students to the basics of Statistical Estimation theory

Objectives of the Course

On completion of the course, the student should be able to:

1. Understand the basic concepts of sampling distributions and application in real life situation
2. Apply the different methods of estimation in finding point and interval estimators of parameters of different populations.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO1: Describe the basic concepts of sampling distributions and application in real life situation .	K2	PSO3
2	CO2: Identify the role of sampling distributions such as t , F ,Chi-square and their inter relationships .	K2	PSO4
3	CO 3 :Understand the uses of standard error in Statistical Inference.	K2	PSO2, PSO4
4	CO4: Apply the various sampling distributions in finding solution to real life situations.	K4	PSO1, PSO2, PSO4
5	CO5: Understand the concept of point estimation, characteristics of a good estimator and their properties.	K2	PSO4
6	CO6: Apply the different methods of estimation in finding point estimators of parameters of different populations.	K4	PSO1, PSO2
7	CO7: Evaluate confidence interval of parameters of various populations	K4	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(25 hours)

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.

(25 hours)

Module III: Methods of Estimation-Method of moments, Method of maximum likelihood properties of maximum likelihood estimators (statement only), Method of minimum variance, uniqueness of minimum variance unbiased estimator. (20 hours)

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.

(20 hours)

Books for study

1. Hogg, R.V.,McKean, J.W. and Craig,A.T.(2014). *Introduction to Mathematical Statistics,* (7^{th} 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*, (5^{th}ed.),Schaum's outlines, McGraw-Hill Education.
2. Lehmann,E.L. and Casella,G.(2003).*Theory of Point Estimation*,(2^{nd}ed.),Springer.
3. Rohatgi, V.K. and Saleh, A.K.MD.E.(2015).*An Introduction to Probability and Statistics*, (3^{rd} ed.),John Wiley & Sons Inc..
4. Mood A.M., Graybill F.A. and Boes D.C. (2001).*Introduction to the Theory of Statistics*,(3^{rd} ed.),McGraw Hill Education (India) Private Limited.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	4	2	1	33
II	3	2	1	31
III	3	3	1	36
IV	2	2	1	29
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V-CORE COURSE VI

UG21ST5CR02-MATHEMATICS FOR STATISTICS-I

Course Code	**UG21ST5CR02**
Title of the Course	**MATHEMATICS FOR STATISTICS-I**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to make the students aware of the role and use of mathematical analysis in theoretical Statistics

Objectives of the Course

On completion of the course, the student should be able to:

1. Improve their mathematical ability for the upcoming semesters
2. Apply the concepts of mathematical analysis in theoretical Statistics

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Identify the role and use of mathematical analysis in theoretical Statistics.	K2	PSO4
2	CO 2: Improve their mathematical ability for the upcoming semesters.	K2	PSO3, PSO7
3	CO 3: Understand the important aspects of set theory, sequences and series and differential calculus.	K2	PSO3, PSO7
4	CO 4: Classify sequences and series based on their nature of convergence.	K4	PSO3
5	CO 5: Implement the results in calculus for checking the continuity and differentiability of statistical functions.	K3	PSO1
6	CO 6: Use the results on the convergence of sequences and series to determine various statistical properties of random variables.	K4	PSO2, PSO3

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I:Sets and Sequences-Bounded and unbounded sets, supremum and infimum, neighborhood 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.

(28 hours)

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.

(24 hours)

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.

(18 hours)

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.

(20 hours)

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 1-3 Chapter – 3; Sections 1-9
   Chapter – 4; Sections 1-7, 10.1, 10.2 Chapter – 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

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	2	1	31
II	3	2	1	31
III	3	2	1	31
IV	3	3	1	36
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V- CORE COURSE VII

UG21ST5CR03- SAMPLING TECHNIQUES

Course Code	**UG21ST5CR03**
Title of the Course	**SAMPLING TECHNIQUES**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce various probability sampling techniques to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Use statistical methodologies for organizing a Statistical Investigation
2. Draw representative samples and calculate the descriptive measures using SRS, Stratified, Cluster and Systematic Sampling.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1 : Describe various probability sampling techniques	K2	PSO4
2	CO 2: Understand census and sampling methods for conducting a field survey.	K2	PSO4
3	CO 3: Acquire basic knowledge on various probability sampling techniques such as Simple random Sampling , Stratified random sampling , Systematic sampling and Cluster sampling .	K2	PSO3, PSO4
4	CO 4: Choose a representative sample and calculate the descriptive measures using SRS, Stratified, Cluster and Systematic Sampling.	K3	PSO1, PSO2
5	CO 5: Calculate required minimum sample size of each strata using different allocation procedures in stratified random sampling.	K3	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(15 hours)

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, confidence interval for population proportion. (30 hours)

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.

(25 hours)

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 and stratified random sampling. Cluster sampling – clusters with equal and unequal sizes – estimation of population mean and total – their variances and estimates of the variances.

(20 hours)

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. Sampling (University)

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*, (2nded.) Prentice-Hall of India.
3. Sampath,S.(2005).*Sampling Theory and Methods*,(2nd ed.),Alpha Science International Limited.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	3	2	1	31
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V- CORE COURSE VIII

UG21ST5CR04-ENVIRONMENTAL STUDIES AND VITAL STATISTICS

Course Code	**UG21ST5CR04**
Title of the Course	**ENVIRONMENTAL STUDIES AND VITAL STATISTICS**
Semester in which the course is to be taught	V
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce vital statistics to the students and to make them aware about the need of conserving the environment

Objectives of the Course

On completion of the course, the student should be able to:

1. Use the various measures of mortality and fertility
2. Understand the natural environment as a system and how human activities affects that system

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Understand the various measures of mortality and fertility.	K2	PSO4
2	CO 2: Explain the components of population growth	K2	PSO2, PSO4
3	CO 3: Construct abridged life table using various methods.	K6	PSO1, PSO2
4	CO 4: List the uses of life tables and demography.	K2	PSO3
5	CO 5: Distinguish between direct and indirect standardization techniques in mortality.	K4	PSO2, PSO3
6	CO 6: Understand the natural environment as a system and how human activities affects that system	K2	PSO7
7	CO 7: Acquire specific skills necessary to achieve understanding of solutions to environmental problems	K3	PSO7
8	CO 8: Define different concepts of human rights.	K2	PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Environmental Awareness: Basic ideas on Environment**,** Definition, principle scope and objectives of environment science, environment day and its significance, Natural Resources-Forest resources, water resources, mineral resources, food resources, energy resources and land resources. Environmental Pollution-Types of pollution-air pollution, water pollution, noise pollution, radiation and soil pollution, Solid Waste Management: Causes, effects and control measures of urban and industrial waste, Human Rights- Introduction, meaning, concept and development, fundamental rights and duties, environment and human rights- right to clean environment and public safety, protection of environment.

(24 hours)

Module II:Vital Statistics- Introduction and sources of collecting data on vital statistics, Census, Registration, adhoc surveys, hospital records. Functions of Vital Statistics, Measurement of population, rate and ratio of vital events. Measurement of mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates.

(24 hours)

Module III: Life Tables-Complete life tables and its characteristics, Abridged life tables and its characteristics, principal methods of construction of abridged life tables, Reed Merrell's method, Greville's method. Stationary and Stable population, Central Mortality Rates and Force of Mortality**.**

(22 hours)

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).

(20 hours)

Books for study

1. Gupta, S.C. and. Kapoor, V.K .(2014). *Fundamentals of Applied Statistics*, Sultan Chand & Co. New Delhi.
2. Goon, A.M. Gupta, M.K. and Das Gupta, B. (2001): *Fundamentals of Statistics*, Vol. II, World press, Calcutta.
3. Bharucha, E.(2010). *Text Book for Environmental Studies for undergraduate courses*, University Grants Commission, New Delhi.
4. AmartyaSen, *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
6. Bryan F J Manly .*Statistics for Environment Science and Management*, second edition, CRC Press,Taylor and Francis Group
7. Marquita K Hill. (1997): *Understanding Environmental Pollution*, Cambridge University Press

References

1. Shrivastava, O.S. (1983). *A Text Book of Demography*, Vikas Publishing House, New Delhi.
2. Benjamin B (1960). *Elements of Vital Statistics*, Quadrangle Books.
3. S C Santra, *Environmental Science,* New Central Book Agency.
4. Cunningham AndSaigo(1999), *Environmental Science,* WCB McGraw Hill.
5. Agarwal, K.C. (2001). *Environmental Ecology,* Nidi Publishers Ltd, Bikaner.
6. Jadhav, H. &Bhosale, V. M. 1995. *Environment Protection and Laws*. Himalaya Pub. House, Delhi 284p
7. Miller, T.G. Jr.,*Environment Science,* Wadsworth Publishing Co.
8. Rao, M.N &Datta, A.K 1987, *Waste Water Treatment,* Oxford and IBII Publication Co.Pvt Ltd.345 p
9. Rajagopalan, R. *Environment Studies from crisis and cure*, Oxford University Press, Published 2016.
10. *Law relating to Human Rights*, Asia Law House, 2001.
11. SudhirKapoor, *Human Rights in 21st century*, Mangal Deep Publications, Jaipur, 2001.

Note: The 5 marks for the Assignment component of Internal assessment may be given for doing any individual environment activity and submitting the report.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C(15marks)	
I	3	2	1	31
II	3	2	1	31
III	3	3	1	36
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V- OPEN COURSE I

UG21ST5OC01-APPLIED STATISTICS

Course Code	**UG21ST5OC01**
Title of the Course	**APPLIED STATISTICS**
Semester in which the course is to be taught	V
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce the students to index numbers, vital statistics, time series and their applications

Objectives of the Course

On completion of the course, the student should be able to:

1. Use index numbers and vital statistics for comparative studies
2. Use time series analysis to find out the trends in various time series data

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Describe the concept of Index numbers and time series analysis.	K2	PSO4
2	CO 2: Understand the role of index numbers in diversified fields and construction of different types of index numbers	K3	PSO4, PSO2
3	CO 3: Verify various tests for consistency of index numbers.	K3	PSO3
4	CO 4: Apply the processes base shifting, splicing and deflating in real data.	K3	PSO3, PSO2
5	CO 5: Explain the basic concepts of time series and its applications in various fields.	K2	PSO4, PSO2
6	CO 6: Analyze time series data by measuring trend using graphical, semi average, moving average and least square methods.	K4	PSO1, PSO2
7	CO 7: Understand the various measures of mortality and fertility.	K2	PSO4

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Index Numbers-Meaning, classification, Construction of Index numbers. Unweighted INs, Weighted INs, Laspeyre's, Paasche's, Dorbish-Bowley's, Fisher's, Marshall-Edgeworth's and Kelly's methods, Quantity INs.

(15 hours)

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

(20 hours)

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 and least square methods.

(22 hours)

Module IV: Vital Statistics: Introduction and sources of collecting data on vital statistics, Census, Registration, adhoc surveys, hospital records. Measures of mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR), Maternal Mortality Rate (MMR). Measures of Fertility: Crude Birth Rate, General Fertility rate, age-specific fertility rate, Total Fertility rate, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR)-(definitions only)

(15 hours)

Books 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 Statistics Vol. II, The world press, Calcutta.
2. Agarwal B.L.: Basic Statistics, Wiley Eastern Ltd, New Delhi

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	1	1	26
II	2	3	2	49
III	3	2	1	31
IV	4	3	0	23
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V-OPEN COURSE – II

UG21ST5OC02-SPREAD SHEET CALCULATIONS AND ELEMENTARY DATA ANALYSIS

Course Code	**UG21ST5OC02**
Title of the Course	**SPREAD SHEET CALCULATIONS AND ELEMENTARY DATA ANALYSIS**
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce statistical data analysis using Excel to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Formulate statistical hypothesis for research problems and check the validity of the hypothesis from sample data using statistical hypothesis testing procedures in Excel
2. Use the estimation procedures for suggesting an estimate of an unknown parameter and to create statistical models for studying the relationship between variables, using Excel

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Identify the role of statistical softwares and packages in statistical data analysis.	K2	PSO5
2	CO 2: Understand the features and functions in Excel	K2	PSO5
3	CO 3: Use Excel for getting descriptive measures of datasets.	K3	PSO5, PSO2
4	CO 4: Implement Excel in creating graphical representations of data.	K4	PSO5, PSO2
5	CO 5: Create statistical models for studying the relationship between variables, using Excel	K4	PSO5, PSO2
6	CO 6: Construct artificial data using random number generators for simulating real life phenomena.	K6	PSO5, PSO2
7	CO 7: Use the estimation procedures for suggesting an estimate of an unknown parameter.	K4	PSO5, PSO2
8	CO 8: Formulate statistical hypothesis for research problems and check the validity of the	K6	PSO5, PSO7

	hypothesis from sample data using statistical hypothesis testing procedures in Excel		

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Excel Basics- Introduction to electronic spread sheets, Working with work books, Formula basics, Editing formulas, Writing multiple copies of a formula, Usage of built in functions (Database functions, Lookup and Reference functions, Math and Trigonometry functions, Text functions, Statistical functions), Formatting, saving and printing.

(12 hours)

Module II: Charts and Pivot Tables- Creating charts with chart wizard, Picking and reviewing Chart types (line charts, bar charts, Pie charts, Scatter charts), Modifying charts, saving, printing and Sharing charts, Customizing Charts, Using Pivot table wizard, Modifying Pivot tables, Working with data in pivot tables, Using Pivot tables to create charts, Importing data into a pivot table, Combining Worksheets in pivot tables.

(20 hours)

Module III: Descriptive Statistics Using Excel- Introduction to data analysis tool pack, Frequency distribution and histogram, Computation of summary measures, cross tabulation and pivot tables.

(16 hours)

Module IV: Elementary Statistical analysis using Excel- Statistical tests concerning means (One sample Z test for mean, One sample t test for mean, Two sample Z test for means, Two sample t test for means, Paired t test), The F test for variance, Correlation Analysis, Simple Regression analysis, Fitting of Trend line.

(24 hours)

Books for Study

1. Stephen L Nelson and Julia Kelly (2001) The complete Reference Office XP, Tata McGraw-Hill
2. Sarma KVS (2001), Statistics Made Simple Do It Yourself on PC, Prentice Hall of India.

References

1. Richard Johnson (2006), Miller &Freunds Probability and Statistics for Engineers.
2. Bharat Kolluri, Micheal J Panik, Rao N Sigamsetti. *Introduction to Quantitative Methods in Business with Applications using Microsoft Offie Excel* Wiley

3. Microsoft Office Online Help

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	0	21
II	3	2	1	31
III	4	2	1	33
IV	2	2	2	44
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Lab Sessions, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms
Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V- OPEN COURSE-III

UG21ST5OC03-ACTUARIAL STATISTICS

Course Code	**UG21ST5OC03**
Title of the Course	**ACTUARIAL STATISTICS**
Semester in which the course is to be taught	V
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce Actuarial Statistics to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Develop a greater understanding of statistical principles and their application in Actuarial Science
2. Improve analytical skills for interpreting and analysing actuarial and statistical information

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Recognise the important role of statistical principles and their application in Actuarial Science	K2	PSO4
2	CO 2: Demonstrate the necessary analytical skills for interpreting and analysing actuarial and statistical information	K3	PSO4, PSO2
3	CO 3: Critically engage with and evaluate actuarial and statistical problems	K5	PSO1, PSO2
4	CO 4: Increase management skills for dealing with organisations, teams and policy issues	K3	PSO7
5	CO 5: Gain greater insight into the international financial markets	K2	PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(18 hours)

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.

(20 hours)

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.

(18 hours)

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.

(16 hours)

Book for study

1. 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.andWaters, H.R. (2013).*Actuarial Mathematics for Life Contingent Risks, (*2nded.), Cambridge University Press.
3. Gerber, H.U. (1990). *Life Insurance Mathematics*, Springer.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	2	1	31
II	3	2	1	31
III	4	2	1	33
IV	2	3	1	34
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER V -OPEN COURSE-IV

UG21ST5OC04-MATHEMATICAL ECONOMICS

Course Code	**UG21ST5OC04**
Title of the Course	**MATHEMATICAL ECONOMICS**
Semester in which the course is to be taught	V
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce the students to Mathematical Economics

Objectives of the Course

On completion of the course, the student should be able to:

1. Recognize how to use scientific method in Economics
2. Critically assess the statistical analysis of other researchers

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Recognize how to use scientific method in Economics	K2	PSO4
2	CO 2: Present an economic argument in quantitative terms	K3	PSO4, PSO2
3	CO 3: Construct a data set of economic variables and to calculate, present, and discuss descriptive statistics.	K5	PSO1, PSO2
4	CO 4: Be able to conduct economic analysis using equations and graphs	K3	PSO7
5	CO 5: Formulate empirically testable hypotheses	K2	PSO7
6	CO6: Critically assess the statistical analysis of other researchers	K4	PSO1,PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(18 hours)

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, Slutsky equation.

(20 hours)

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.

(18 hours)

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.

(16 hours)

Books for study

1. Madnani, G.M.K. and Mehta, B.C (2014).*Mathematics for Economists*, Sultan Chand & Sons, New Delhi.
2. Allen R.G.D. (2014).*Mathematical Analysis for Economists*, Trinity Press.

References

1. Koutsoyiannis,A.(2008).*Modern Micro Economics*,(2nded.), Macmillan publishers
2. Henderson, J.M. and Quandt, R.E (2003).*Micro Economic Theory: A Mathematical Approach*, (3rded.), McGraw-Hill Education (India) Pvt.Ltd.
3. Simon, C.P.and Blume, L. (2010): *Mathematics for Economists*,(1st ed.),Viva Books.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	0	21
II	3	2	1	31
III	3	2	2	46
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SIXTH SEMESTER COURSES

SEMESTER VI- CORE COURSE IX

UG21ST6CR01-TESTING OF STATISTICAL HYPOTHESES

Course Code	**UG21ST6CR01**
Title of the Course	**TESTING OF STATISTICAL HYPOTHESES**
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce the basic concepts of testing of hypothesis, theory and application of various tests of importance in statistical inference to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Understand the concept of testing of hypothesis and to apply different types of parametric and non-parametric tests used in statistical data analysis.
2. Analyze quantitative data, interpret the result and give conclusion to the real life situations

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO1: Describe the basic concepts of testing of hypothesis, theory and application of various tests of significance in statistical data analysis	K2	PSO4
2	CO2: Explain the concept of testing of hypothesis and different types of parametric tests used in statistical data analysis.	K2	PSO4
3	CO3: Test the significance of various statistical measures such as mean, variance, correlation coefficient etc.	K3	PSO1, PSO2
4	CO4: Compare statistical measures like mean and variance of different datasets using testing of hypothesis	K4	PSO1, PSO2
5	CO5: Understand some basic non-parametric tests used in data analysis	K2	PSO4
6	CO6: Apply the different non-parametric tests in interpreting results in data analysis	K3	PSO1, PSO2
7	CO7: Analyze quantitative data, interpret the result and give conclusion to the real life situations	K4	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(20 hours)

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.

(20 hours)

Module III:Large Sample Tests- 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. Testing equality of means using paired data. Tests based on χ^2 distribution for variance and F distribution for the equality of variances. Tests concerning correlation coefficients.

(30 hours)

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.

(20 hours)

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*, (5th 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. 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

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	4	2	1	33
II	3	2	1	31
III	3	2	1	31
IV	2	3	1	34
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER VI- CORE COURSE X

UG21ST6CR02-MATHEMATICS FOR STATISTICS-II

Course Code	**UG21ST6CR02**
Title of the Course	**MATHEMATICS FOR STATISTICS-II**
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce the basic concepts of Numerical methods, Integration and Complex numbers to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Acquire basic knowledge in numerical methods.
2. Understand the fundamental concepts of complex analysis, Riemann integration and their role in other applied statistical and mathematical contexts.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Acquire basic knowledge in estimating the missing data through various interpolation methods.	K2	PSO4
2	CO 2: Understand basics of numerical analysis and Reimann Integration.	K2	PSO3, PSO7
3	CO 3: Explain the fundamental concepts of complex analysis and their role in other applied statistical and mathematical contexts.	K2	PSO3, PSO7
4	CO 4: Understand the concept of Riemann integral as a limit of sums.	K2	PSO3, PSO7
5	CO 5: Find the area under the curve using Fundamental Theorem of Integral Calculus.	K4	PSO1, PSO2
6	CO 6: Find the average value of function using the Mean Value Theorem.	K4	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Numerical Analysis- Operators E, Delta, backward difference operator central Newton's forward and backward interpolation formulae. (20 hours)

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.
(25 hours)

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
(20 hours)

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.
(20 hours)

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*, KedarNath Ram Nath Educational Publishers.
3. Malik, S.C. and SavitaArora (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, (9^{th} ed.),McGraw-Hill Education.
4. Kasana, H.S.(2005). *Complex Variables: Theory and Applications*, (2^{nd} 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*,(17^{th} ed.), S.Chand& Company, New Delhi

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	5	4	0	30
II	0	1	2	35
III	4	2	1	33
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER VI-CORE COURSE-XI

UG21ST6CR03-DESIGN AND ANALYSIS OF EXPERIMENTS

Course Code	**UG21ST6CR03**
Title of the Course	**DESIGN AND ANALYSIS OF EXPERIMENTS**
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce the basic concepts of Experimental Designs and their analyses to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Apply the principles of experimental designs for planning experiments
2. Analyze the experimental data using statistical procedures and to draw inferences

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO1: Understand the estimability of parametric function.	K2	PSO4
2	CO2: Understand the principles of design of experiments.	K2	PSO4, PSO3
3	CO 3: Acquire knowledge about Analysis of variance and its application in agricultural experiments, industry, education, Psychology, business, etc.	K3	PSO3, PSO4
4	CO 4: Explain some of the simple but highly useful types of experimental designs such as CRD, RBD, LSD, etc.	K4	PSO1, PSO2
5	CO 5: Understand the basics of factorial experiments and its applications.	K3	PSO1, PSO2
6	CO 6: Apply the design and analysis in field experiments.	K6	PSO1, PSO2, PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(20 hours)

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.

(20 hours)

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.

(30 hours)

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.

(20 hours)

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*, Wiley Classics Library.
2. Hinkelmann, K.and Kempthrone, O. (2008).*Design and Analysis of Experiments*, Vol.I, John Wiley and Sons.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	2	2	1	29
II	3	2	1	31
III	4	3	1	38
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

Semester VI-Core Course XII

UG21ST6CR04-STATISTICAL COMPUTING USING R SOFTWARE

Course Code	**UG21ST6CR04**
Title of the Course	**STATISTICAL COMPUTING USING R SOFTWARE**
Semester in which the course is to be taught	VI
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce Statistical programming for data analyses to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Formulate statistical hypothesis for research problems and check the validity of the hypothesis from sample data using statistical hypothesis testing procedures in R
2. Use the estimation procedures for suggesting an estimate of an unknown parameter and to create statistical models for studying the relationship between variables, using R

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Identify the role of statistical softwares and packages in statistical data analysis.	K2	PSO5
2	CO 2: Understand the features and syntax of R programming.	K2	PSO5
3	CO 3: Use R programming for getting descriptive measures of datasets.	K3	PSO5, PSO2
4	CO 4: Implement R in creating graphical representations of data.	K4	PSO5, PSO2
5	CO 5: Create statistical models for studying the relationship between variables, using R.	K4	PSO5, PSO2
6	CO 6: Construct artificial data using random number generators for simulating real life phenomena.	K6	PSO5, PSO2
7	CO 7: Use the estimation procedures for suggesting an estimate of an unknown parameter.	K4	PSO5, PSO2
8	CO 8: Formulate statistical hypothesis for research problems and check the validity of the hypothesis from sample data using statistical hypothesis testing procedures in R.	K6	PSO5, PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(16 hours)

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.

(18 hours)

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

(18 hours)

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.

(20 hours)

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 EXAMINATION

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.

Learning Pedagogy : Class Room Lecture, Lab Sessions, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms
Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Project

SEMESTER VI- CORE COURSE XIII- ELECTIVE I

UG21ST6CB01-OPERATIONS RESEARCH

Course Code	**UG21ST6CB01**
Title of the Course	**OPERATIONS RESEARCH**
Semester in which the course is to be taught	VI
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce Operations Research as a highly applied field of knowledge to the students.

Objectives of the Course

On completion of the course, the student should be able to:

1. Formulate and solve real-life decision-making problems using methods in Operations Research
2. Understand the role of Operations research in finding solution to complex real-life decision-making problems.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO1: Describe the origin of Operations Research as a discipline and various models and different solution methods.	K2	PSO4
2	CO2: Understand the role of Linear Programming Problem in finding solution to complex real-life situations.	K2	PSO3
3	CO3: Formulate real-life decision-making problems as linear programming problems	K4	PSO1
4	CO4: Solve linear programming problems using graphical and simplex method	K4	PSO1, PSO2
5	CO5: Solve transportation problems using MODI method and stepping stone methods	K4	PSO1, PSO2
6	CO6: Understand thoroughly the application of assignment problems and solve them.	K3	PSO4
7	CO7: Explain how to draw a network diagram of a project and calculate project completion time using CPM and PERT.	K4	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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.

(25 hours)

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

(20 hours)

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.

(25 hours)

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

(20 hours)

Book for study

1. KantiSwarup, 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

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	2	1	31
II	3	2	1	31

III	3	3	1	36
IV	3	2	1	31
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER VI- CORE COURSE XIII- ELECTIVE II

UG21ST6CB02-ELEMENTS OF STOCHASTIC PROCESSES

Course Code	**UG21ST6CB02**
Title of the Course	**ELEMENTS OF STOCHASTIC PROCESSES**
Semester in which the course is to be taught	VI
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce the students to Stochastic processes

Objectives of the Course

On completion of the course, the student should be able to:

1. Define basic concepts from the theory of Markov chains and present proofs for the most important theorems.
2. Identify classes of states in Markov chains and characterize the classes.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO1: Define basic concepts from the theory of Markov chains and present proofs for the most important theorems.	K2	PSO4, PSO7
2	CO2: Compute probabilities of transition between states and return to the initial state after long time intervals in Markov chains.	K2	PSO3
3	CO3: Identify classes of states in Markov chains and characterize the classes.	K3	PSO3
4	CO4: Determine limit probabilities in Markov chains after an infinitely long period.	K3	PSO4
5	CO5: Derive differential equations for time continuous Markov processes with a discrete state space.	K4	PSO4

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Stochastic Process – Definition, Classification with examples, Markov Chains – Transition Probabilities Transition Probability Matrix – Properties, Chapman Kolmogorov equations, Examples and Computation. (25 hours)

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.

(25 hours)

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

(20 hours)

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].

(20 hours)

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

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	4	2	1	33
IV	2	2	1	29
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER VI-CORE COURSE XIII- ELECTIVE III

UG21ST6CB03-ECONOMETRICS

Course Code	**UG21ST6CB03**
Title of the Course	**ECONOMETRICS**
Semester in which the course is to be taught	VI
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to provide a simple and straightforward introduction to Econometrics

Objectives of the Course

On completion of the course, the student should be able to:

1. Construct, test, and analyze econometric models, using variables and relationships commonly found in studies of economic theory
2. Identify key classical assumptions in the field of Econometrics, explain their significance, and describe the effects that violations of the classical assumptions can have

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO1: Construct, test, and analyze econometric models, using variables and relationships commonly found in studies of economic theory	K6	PSO1, PSO2, PSO7
2	CO2: Collect, organise, and analyse economic data, and interpret results from statistical analyses	K5	PSO1, PSO2
3	CO3: Identify the desirable properties of estimators.	K2	PSO3
4	CO4: Identify key classical assumptions in the field of econometrics, explain their significance, and describe the effects that violations of the classical assumptions can have	K5	PSO4
5	CO5: Use the least squares method in evaluating the relationship of one explanatory variable to the dependent variable and the relationships of multiple explanatory variable to the dependent variable	K3	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I: Introduction-Objective behind building econometric models, nature of econometrics, model building, role of econometrics, structural and reduced forms. General linear model (GLM). Estimation under linear restrictions. OLS method of estimation. Identification problems in simultaneous equation models.

(25 hours)

Module II: Multicollinearity-Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity, specification error. (25 hours)

Module III: Generalized Least Squares Estimation-Aitken estimators, Autocorrelation, Durbin-Watson test, concept, consequences of autocorrelated disturbances, detection and solution of autocorrelation.

(20 hours)

Module IV: Heteroscedastic Disturbances-Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity. Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity. Autoregressive and Lag models, Dummy variables, Qualitative data, Improvement of the model

(20 hours)

Books for study

1. Gujarati, D. and Sangeetha, S. (2007): *Basic Econometrics*, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972): *Econometric Methods*, 2nd Edition, McGraw Hill International.

References

1. Koutsoyiannis, A. (2004): *Theory of Econometrics*, 2nd Edition, Palgrave Macmillan Limited ,
2. Maddala, G.S. and Lahiri, K. (2009*): Introduction to Econometrics*, 4th Edition, John Wiley & Sons.
3. Theil H. (1982).*Introduction to the Theory and Practice of Econometrics*, John Wiley.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B (5 marks)	Part C (15 marks)	
I	3	2	1	31
II	3	2	1	31

III	3	2	1	31
IV	3	3	1	36
Total	12	9	4	129

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

COMPLEMENTARY COURSES
TO
B. Sc. MATHEMATICS PROGRAMME

SEMESTER-I

UG21ST1CM01 - DESCRIPTIVE STATISTICS

Course Code	**UG21ST1CM01**
Title of the Course	**DESCRIPTIVE STATISTICS**
Semester in which the course is to be taught	I
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce Statistics as a scientific discipline and to identify its applications in diversified fields

Objectives of the Course

On completion of the course, the student should be able to:

1. Understand Statistics as a scientific discipline and to identify its applications in diversified fields
2. Apply the different statistical tools like measures of Central tendency, Dispersion, Skewness and Kurtosis, index numbers and time series analysis in data analysis

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Understand Statistics as a discipline and identify its applications in diversified fields.	K2	PSO4
2	CO 2: Acquire basic knowledge on sampling and different types of sampling techniques.	K2	PSO4
3	CO 3 : Outline the graphic and diagrammatic presentation of frequency distribution.	K2	PSO4
4	CO 4 : Apply the different statistical measures of Central tendency , Dispersion, Skewness and Kurtosis in data analysis	K3	PSO2
5	CO 5: Understand index numbers and its applications and to construct different types of index numbers.	K3	PSO1, PSO2

6	CO 6: Estimate trend in a time series data using different methods like semi average and moving average.	K4	PSO1, PSO2

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I : Introduction to Statistics

Statistics :Introduction to Statistics, concepts of a statistical population and sample, Data types-qualitative and quantitative, discrete and continuous, primary and secondary. Different types of scale- nominal and ordinal, ratio and interval. Collection of data- census and sampling, Sampling techniques- SRS, systematic, stratified and cluster(description only), schedule and questionnaire. Data collection: direct, using third parties, sending questionnaire, by mail/telephone, Classification and tabulation - One-way and two-way classified data, Preparation of frequency distribution, relative frequency and cumulative frequency distributions. Stem-and-leaf chart, Histogram, Frequency polygon, Frequency curve and Ogives

(20 hours)

Module II : Central tendency

Averages- Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and Weighted averages. Quantiles- quartiles, deciles, percentiles.

(problems based on the above topics) (15 hours)

Module III : Dispersion, Moments, Skewness and Kurtosis

Absolute and relative measures dispersion - Range, Quartile Deviation, Mean Deviation and Standard Deviation, Co-efficient of variation, Box plot, Raw moments, central moments and their inter relation, skewness- Pearson's, Bowley's and moment measures of skewness, Kurtosis-percentile and moment measure of kurtosis.(problems based on the above topics)

(20 hours)

Module IV : Index Numbers, Time series

Index Numbers - Definition, Simple and Weighted Index Numbers –Laspeyer's, Paasche's and Fisher's Index Numbers, Tests of Index Numbers, Construction of Index Numbers, Cost of Living Index Numbers -Family Budget Method, Aggregate Expenditure Method. Time Series-Components of time series, Estimation of trend by semi-average and moving average methods. (problems based on the above topics)

(17 hours)

Books for Study

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

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

References

1. Goon, A. M., Gupta M. K. and Dasgupta, B.(1986). Fundamentals of Statistics, Volume 1, world press, Kolkota
2. Lalitha R. Pillai. Complementary Statistics, Part 1, Sai publishers, Alapuzha
3. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.
4. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.
5. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.
6. Mukhopadhyay, P. (1999). Applied Statistics, New central book agency private limited, Kolkata
7. Seemon, T.(2014). Basic Statistics. Narosa Publishing House

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2marks)	Part B(5 marks)	Part C (15marks)	
I	3	3	1	36
II	3	2	1	31
III	3	2	1	31
IV	3	2	1	31
Total	12	9	4	129

Use of non - programmable Calculator and Statistical tables allowed.

Note: The 5 marks for the Assignment component of Internal assessment may be given for maintaining the Practical Record Book for solving problemsfrom the above syllabus or as given below:

1. Preparation of questionnaires.
2. Graphical representation of data
3. Measures of central tendency
4. Measures of dispersion
5. Measures of skewness and kurtosis
6. Moments
7. Index numbers.
8. Trend analysis

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms
Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER -II

UG21ST2CM01 - PROBABILITY THEORY

Course Code	**UG21ST2CM01**
Title of the Course	**PROBABILITY THEORY**
Semester in which the course is to be taught	II
No. of credits	3
No. of contact hours	72

Aim of the Course

The course is intended to introduce Probability theory, Random variables, probability distribution and measures of association

Objectives of the Course

On completion of the course, the student should be able to:

1. Understand the concepts of probability theory, random variables and probability distribution
2. Use the modelling techniques to extract the underlying relationship between various factors contributing to an observed phenomenon

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Understand the concepts of random experiment, probability, different probability definitions and Bayes' theorem.	K2	PSO4
2	CO2 : Explain univariate random variables and its properties.	K2	PSO3
3	CO 3: Describe Bivariate random variables and their properties	K2	PSO4, PSO3
4	CO 4 : Gain knowledge on Correlation , Rank correlation and its application.	K3	PSO3, PSO4
5	CO 5 : Calculate the simple linear regression equation for a set of data.	K4	PSO1, PSO2

6	CO 6 : Fit polynomial equations of degree one and two to suitable data sets.	K6	PSO1, PSO2, PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I : Probability

Random experiments-Algebra of events- Mutually exclusive, Equally likely and Independent events. Classical, Frequency and Axiomatic approaches to probability. Monotone property, Addition theorem (up to 3 events), Boole's inequality (finite case), and other simple properties. Conditional probability. Multiplication theorem (up to 3 events). Independence of events. Total probability law. Bayes' theorem.

(problems based on the above topics) (20 hours)

Module II : Probability Distribution of Univariate Random Variables

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

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

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) (15 hours)

Module IV : Correlation and Regression

Bivariate data- types of correlation, scatter diagram, Karl Pearson's product- moment and Spearman's rank correlation coefficients. Computation of correlation coefficient from two-way tables, coefficient of determination, regression equations- fitting of polynomial equations of degree one and two ; exponential curve, power curve. (problems based on the above topics)

(20 hours)

Books for Study

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

References

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

2. Lalitha R. Pillai.(2013). Complementary Statistics Part II. Sai publishers, Alapuzha.
3. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.
4. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.
5. Mood, A. M., Graybill, F.A. and Bose, F.A.(1974).Introduction to Theory of Statistics, Oxford and IBH publishers.
6. Ross, S.(2003). A first comes in probability Pearson, Education Publishers, Delhi

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	3	2	1	31
IV	3	2	1	31
Total	12	9	4	129

Use of non - programmable Calculator and Statistical tables allowed.

Note: The 5 marks for the Assignment component of Internal assessment may be givenfor maintaining the Practical Record Book for solving problems from the above syllabus or as given below as in first semester.

1. Probability ; Addition Theorem, Multiplication theorem, Conditional probability, Independence of events, Total probability law and Bayes theorem.
2. Uunivariate probability distributions ; computation of p.d.f., p.m.f., c.d.f., Probabilities of various events, Change of variables.
3. Bivariate probability distributions ; probability evaluation in bivariate p.d.f., p.m.f., Conditional distributions, Marginal distributions.
4. Correlation Analysis ; Scatter diagram, Problems on Karl Pearson correlation co-efficient (with/without change of scale and origin), Spearman's rank correlation with/without ties,
5. Regression Analysis; Lines of regression, regression coefficients, angle between lines and estimated values of variables.
6. Correlation and regression lines from two-way tables.
7. Fitting of polynomials and exponential curves.

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms
Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER-III

UG21ST3CM01- PROBABILITY DISTRIBUTIONS

Course Code	**UG21ST3CM01**
Title of the Course	**PROBABILITY DISTRIBUTIONS**
Semester in which the course is to be taught	III
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce standard probability distributions and their associated relations

Objectives of the Course

On completion of the course, the student should be able to:

1. Identify and compare the commonly used probability distributions and their properties.
2. Create a probabilistic model for a phenomenon dataset available at hand, using the distribution fitting techniques.

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Understand the concept of mathematical expectation.	K2	PSO4
2	CO 2: Identify and compare the commonly used probability distributions and their properties.	K2	PSO3
3	CO3: Create a probabilistic model for a phenomenon dataset available at hand, using the distribution fitting techniques.	K6	PSO1, PSO2
4	CO 4: Recognize the importance and usefulness of sampling distributions.	K2	PSO4
5	CO 5: Construct various statistics following the popular sampling distributions.	K3	PSO3
6	CO6: Use statistical tables to compute probabilities.	K3	PSO3, PSO4

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

Module I : Mathematical Expectation

Expectation of random variables and their functions. Definition of - Raw moments, central moments and their inter-relation, covariance, Pearson's correlation coefficient in terms of expectation. MGF and characteristic function and simple properties. Moments from mgf. conditional mean and variance.

(Problems based on these topics) (20 hours)

Module 2 : Standard Probability Distributions

Uniform(discrete/continuous), Bernoulli, binomial, Poisson, 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, lognormal distribution. Fitting of binomial, Poisson and normal distributions.(Problems based on these topics)

(25 hours)

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)

(20 hours)

Module 4: Sampling Distributions

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)

(25 hours)

Books for Study

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

References

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol.II, 8th edition, World Press, Kolkatta.
2. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.
3. Lalitha R. Pillai. Complementary StatisticsPart 3.Sai publishers, Alapuzha

4. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.
5. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes.

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	3	2	1	31
IV	3	2	1	31
Total	12	9	4	129

Use of non - programmable Calculator and Statistical tables allowed.

Worksheet:

1. Mathematical Expectation ; moments, conditional mean and variance.
2. Distributions-Evaluation of probability using various distribtuions.
3. Fitting of binomial, Poisson, normal distribution
4. Weak Law of Large Numbers and Central Limit Theorem.
5. Sampling Distributions-Evaluation of probability using sampling distributions.

ASSIGNMENT COMPONENT OF INTERNAL ASSESSMENT

The 5 Marks for the Assignment component may be given for collecting a primary data in connection with a simple project work, say of the following types:

1. To study the correlation between height and weight of the students of your class.
2. To study the correlation between the SSLC and Plus Two marks of the students of your class.
3. To study the correlation between the marks in English and Mathematics for SSLC and Plus2.
4. A study to understand the time spent by the students for studying in the evening.
5. A study to understand the distance from which the students of your class come.
6. A study to understand the price of mobile phones owned by the students of your class.
7. A study to understand the gender pattern of children of your family.
8. A socio-economical study of the students of your class.
9. A study to understand the land area owned by the parents of the students of your class.
10. A study to understand the food preferences of the students of your class.

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms

Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

SEMESTER -IV

UG21ST4CM01- STATISTICAL INFERENCE

Course Code	**UG21ST4CM01**
Title of the Course	**STATISTICAL INFERENCE**
Semester in which the course is to be taught	IV
No. of credits	4
No. of contact hours	90

Aim of the Course

The course is intended to introduce statistical inference procedures

Objectives of the Course

On completion of the course, the student should be able to:

1. Identify the role of statistical inferential procedures in data analysis.
2. Formulate statistical hypothesis for real life problems, check the validity of the hypothesis from sample data using statistical hypothesis testing and estimate the unknown parameters using estimation procedures

Sl. no	Expected Course Outcomes	Knowledge Level	Programme Specific Outcome Linkage
1	CO 1: Identify the role of statistical inferential procedures in data analysis.	K2	PSO4
2	CO2: Distinguish between deductive and inductive inferential procedures.	K2	PSO3
3	CO3: Examine the desirable properties in the case of a proposed estimator.	K2	PSO3
4	CO4: Compare the properties of point and interval estimates and determine the suitable among them, for a given situation.	K3	PSO2

5	CO5: Use the estimation procedures for suggesting an estimate of an unknown parameter.	K3	PSO1, PSO2
6	CO 6: Recognize the concept of testing of hypothesis and its role in many real life problems.	K3	PSO4
7	CO7: Formulate statistical hypothesis for real life problems and check the validity of the hypothesis from sample data using statistical hypothesis testing.	K6	PSO1, PSO2, PSO7

Knowledge Levels: K1-Remembering, K2-Understanding, K3-Applying K4- Analyzing K5-Evaluating and K6 Creating

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)

(25 hours)

Module II : Methods of Estimation, Interval Estimation

Methods of moments, maximum likelihood. Invariance property of ML Estimators (without proof).minimum variance. Cramer-Rao inequality(without proof) 100(1-α)% confidence intervals for mean, variance, proportion, difference of means and proportions and variances (problems based on these topics)

(20 hours)

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 and goodness of fit.

(25 hours)

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), t-test for r = 0, paired t-test, test for proportion (binomial), chi-square test, F-test for ratio of variances. One-way ANOVA for testing the equality of means (derivation not required). (20 hours)

Books for Study

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

References

1. Goon A. M., Gupta M. K., and Dasgupta B.(2005). Fundamentals of Statistics, Vol.I, 8th edition, World Press, Kolkatta.
2. Hogg R. V., Mckean J. W., and Craig A. T.(2014). Introduction to Mathematical Statistics, 6th edition, Pearson Education Inc.
3. Lalitha R. Pillai. Complementary Statistics Part 3, Sai publishers, Alapuzha
4. Miller, I. and Miller, M.(2014). Mathematical Statistics, 8th edition, Pearson Education Inc.
5. Medhi J.(2006). Statistical Methods, 2nd edition, New Age International Publishes

SCHEME OF QUESTION PAPER

Module	Distribution of Questions			Total Marks
	Part A (2 marks)	Part C (5 marks)	Part D (15 marks)	
I	3	3	1	36
II	3	2	1	31
III	3	2	1	31
IV	3	2	1	31
Total	12	9	4	129

Use of non - programmable Calculator and Statistical tables allowed.

Worksheet:

1. Moment and Maximum Likelihood methods of Estimation
2. Confidence intervals for mean, variance, proportion, ratio of variances, difference of means and proportions
3. Testing of hypotheses: problems for computing the size and power of a test.
4. Large Sample Tests ; Z- Tests, Chi-square tests for Independence and homogeneity and goodness of fit.
5. Small sample tests ; Z- Tests for mean and difference of means, T-tests for mean and difference of means, T-test for r=0, Paired T-test, Tests for proportion, variance and ratio of variances, one-way ANOVA

ASSIGNMENT COMPONENT OF INTERNAL ASSESSMENT

The 5 Marks for the Assignment component may be given for analyzing and presenting the data collected in third semester.

Learning Pedagogy : Class Room Lecture, Seminar, Group Discussions, PPT, ICT based classes, Self – Study and Classes through MOOC Platforms
Assessment Tools : Test Papers, Assignments, Quiz Assignments, Terminal Examinations and Group Discussions

PROJECT REPORT GUIDELINES

All students are to do a project in the area of Statistics. 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. Special sanction shall be obtained from the Principal to those new generation programmes and programmes on performing arts where students have to take projects which involve larger groups. 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 at the sixth semester and are to be produced before the examiners (Internal and External) appointed by the Controller of Examinations. External Project evaluation and Viva / Presentation is compulsory and will be conducted at the end of the programme.

For Projects

a) Marks of External Evaluation :80

b) Marks of Internal Evaluation : 20

Components of External Evaluation of Project	**Marks**
Dissertation (**External)**	50
Viva - Voce (**External)**	30
Total	**80**

*Marks for Dissertation may include study tour report if proposed in the syllabus

***Components of Internal Evaluation of Project**	**Marks**
Punctuality	5
Experimentation/Data collection	5

Knowledge	5
Report	5
Total	**20**

COMPREHENSIVE VIVA-VOCE GUIDELINES

A student should appear for the Viva-Voce at the end of the B.Sc Statistics programme, during which the student has to present his project and defend his/her project report in front of the panel. 30 marks are assigned to the external Viva-Voce component.

ZERO CREDIT COURSES- STUDY TOUR/INDUSTRIAL VISIT/INTERNSHIP

In addition to the requirement prescribed for the award of Bachelor degree, each student shall participate in the Certificate courses offered by various departments and various online platforms. They are also bound to participate in the factory visit / field work/visit to a reputed research institute/ student interaction with renowned academicians, organized by the department.

MODEL QUESTION PAPERS

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FIRST SEMESTER
Core Course-I –UG21ST1CR01- (Statistics)
ELEMENTARY STATISTICS

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10** questions. Each question carries **2** marks.

1. Mention any two limitations of statistics.
2. What is meant by Ogives?
3. What is meant by classification?
4. What is the arithmetic mean of the first 25 natural numbers?
5. Define weighted arithmetic mean.
6. Find the geometric mean of 4 and 9.
7. What do you mean by dispersion?
8. Define range**.**
9. Which measure of dispersion can be calculated in the case of open-end class intervals?
10. Define coefficient of variation
11. Define the r^{th} central moment.
12. What is meant by skewness?

(10× 2=20)

PART B

Answer any **6** questions. Each question carries **5** marks.

13. Distinguish between grouped and ungrouped frequency distributions.

14. Explain various methods of collecting primary data
15. Briefly explain Frequency curve and Frequency polygon .
16. Obtain the arithmetic mean of first 'n' natural numbers.
17. What do you mean by partition values? Explain.
18. Distinguish between absolute and relative measures of dispersion. Give any *one* relative measure of dispersion.
19. In a data if each observation is multiplied by 5 and 2 is added, how do it affect variance?
20. The first two moments of a distribution about the value 5 of a variable are 2 and 20. Find the mean and variance.
21. Explain the different methods to measure skewness?

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. Following is the distribution of marks in Statistics obtained by 100 students.

Marks (more than)	:	0	10	20	30	40	50
Number of Students	:	100	85	80	35	20	4

Calculate the mean marks. If 60% of the students pass the test, find the minimum mark obtained by a passed candidate.

.

23. Calculate the mean deviation about median and compare the variability of the two series X and Y:

X:	725	700	750	675	725	625	675	800	625	725	700	725	675
Y:	575	625	600	575	675	600	650	575	625	550	680	550	560

24. Calculate the Karl Pearson's coefficient of skewness from the following data

Class:	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
Freq:	2	3	5	10	30	15	11	10	8	6

25. For a frequency distribution the mean is 10, variance is 16, γ_1 is +1 and β_2 is 4. Find the first four moments about the origin and comment upon the nature of distribution.

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
SECOND SEMESTER
Core Course -II–UG21ST2CR01- (Statistics)

PROBABILITY THEORY AND APPLIED STATISTICS

Time: Three Hours **MaximumMarks:80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks**.**

1. Define sample space.
2. What is meant by probability space?
3. Give the axiomatic definition of probability.
4. If P(A) =$\frac{2}{3}$, P(B) =$\frac{3}{4}$, P(A/B) =$\frac{2}{3}$, find P (B/A).
5. Define conditional probability.
6. What do you mean by mutual independence of three events A, B and C?
7. Define Fisher's ideal index number.
8. Explain circular test.
9. What is base shifting?
10. What is meant by splicing?
11. Define a time series.
12. What is meant by secular trend?

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks**.**

13. If S = {1,2,3,4,5} and A = {1, 5} write down the σ-field generated by A.
14. If 4 coins are tossed, find the probability of exactly 2 heads turn up
15. State and prove multiplication theorem for three events.
16. Explain total probability rule.
17. Prove that mutual independence implies pair wise independence. Is the converse true?
18. Fisher's index number is an ideal index number. Justify.
19. Distinguish between fixed base and chain-based index numbers.
20. Explain any one method to determine trend in a time series.
21. What do you mean by cyclical variation?

(6× 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks**.**

22. (i) There are three addressed envelopes and three letters. If the letters are put in the envelopes (one letter in one envelope) at random, what is the probability that at least one of the letters is put in the correct envelopes?

(ii) What is the probability that at least 2 out of 3 people have the same birth day?

23. (i) State and prove Bayes theorem.

(ii) Two urns I and II contains 3 white 7 black balls and 5 white 7 black balls respectively. A ball is transferred from urn I and urn II at random. Then a ball is drawn at random from urn II and it is found black. What is the probability that the transferred ball has been a black ball?

24. Find Laspeyer's and Paasche's index numbers and hence find the Fisher's index number.

Commodity	Price		Quantity	
	Base year	Current year	Base year	Current year
A	142	171	15	12
B	63	80	14	10
C	18	20	205	185
D	41	39	48	55
E	15	15	9	12
F	90	120	8	4

25. Fit a straight-line trend to the following series by the method of least squares.

Year	: 1994	1995	1996	1997	1998	1999	2000
Production of steel (000'tonnes)	: 10	13	12	14	12	16	14

Estimate the most likely production for the year 2002.

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
THIRD SEMESTER
Core Course -III–UG21ST3CR01-(Statistics)

THEORY OF RANDOM VARIABLES

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **3**marks**.**

1. What is a scatter diagram?
2. What is the relation between regression and correlation coefficients?
3. Define partial correlation.
4. Define a random variable.
5. Write down the essential properties of probability mass function.
6. When do we say that two random variables X and Y are independent?
7. X is a random variable with probability mass function f(x) =$\frac{1}{10}$, x = 1,2, 3,…..,10 . Find the arithmetic mean of X.
8. If V(X) = 4, find V(2X + 4).
9. Define conditional expectation.
10. Define a p. g. f. What is its use?
11. Define a moment generating function.
12. State any two properties of Characteristics function.

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks**.**

13. In a regression analysis we have $\sum X$ =-8, $\sum Y$ =0, $\sum X^2$ =66, $\sum XY$ =72.Find the regression of Y on X.
14. How can the two regression lines be identified?
15. The diameter X of an electric cable is assumed to be a random variable with
    p.d.f. f(x) = 6x(1-x), 0 < x < 1
    = 0 elsewhere.
    (i) Obtain the distribution function of X.
    (ii) Find P{ $\frac{1}{4} < X < \frac{3}{4}$ }.
16. If f(x) = $\frac{1}{2}$, -1 ≤ x ≤1. Find the p.d. f. of Y = 4 - $X^{2.}$
17. If f (x, y) is the joint p.d.f. of X and Y, define marginal p.d.f.s of X and Y, and the conditional densities.

18. Find the mean and variance of X if its p.d.f is f(x) = me^{-mx} , $0 \le x < \infty$, m>0
19. If X and Y are independent random variables prove that E(XY)= E(X).E(Y)
20. If $M_x(t)$ is the m.g.f. of X, what is the m.g.f. of aX + b ?
21. Find the characteristic function of f(x) = e^{-x}, 0< x < ∞.

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. Explain the method of fitting a regression curve of the form $y = ae^{bx}$ and obtain the equation representing the following data:-

X	:	1	2	3	4	5	6
Y	:	1.6	4.5	13.8	40.2	125	300

23. The joint p.d.f of (X, Y) is given in the following table. Find (1) the marginal distributions (2) f(x/y = 3) and f(y/ x = 2) (3) P[X ≥ 2] and P[X ≥ 2/Y ≥ 1]

X > / Y ∨	1	2	3
1	0.10	0.20	0.10
2	0.15	0.10	0.18
3	0.02	0.05	0.10

24. The joint pdf of X_1, X_2 is $f(x_1, x_2) = \frac{x_1 + x_2}{21}$. $x_1 = 1, 2, 3$ and $x_2 = 1, 2$ and 0 elsewhere.
Find the means of X_1 and X_2. Also find E ($X_1 \mid X_2$=1) and V ($X_1 \mid X_2$=1).
25. For the distribution $f(x) = \theta e^{-\theta x}$ $0 \le x < \infty$, $\theta > 0$, find the characteristic function. Hence Obtain the first four central moments.

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FOURTH SEMESTER
Core Course -IV–UG21ST4CR01-(Statistics)

PROBABILITY DISTRIBUTION

Time: Three Hours **MaximumMarks:80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks.

1. Write the pdf of binomial distribution whose mean and variance are 4 and 3 respectively.
2. Write down the condition under which a binomial distribution tends to a Poisson distribution.
3. Find P [X = 1], if 2 and 3 are the modes of a Poisson distribution.
4. Write the moment generating function of the geometric distribution.
5. Random variable X is uniformly distributed over (1, 2). Find the value of "k" such that
   P[X > k + 1.5] = 0.25
6. Define beta distribution of the first kind.
7. Define hyper geometric distribution.
8. Obtain the mean of Laplace distribution.
9. Obtain the mean of normal distribution.
10. The scores in a test follow normal distribution with mean 52 and standard deviation 10. Find the percentage of observation between 45 and 63.
11. State weak law of large numbers.
12. What is meant by convergence in probability?

(10 × 2=20)

PART B

Answer any **6** questions. Each question carries **5** marks.

13. If the probability of hitting a target is 10% and 10shots are fired independently; what is the probability that the target will be hit at least once?
14. Obtain the mode of the Poisson distribution.
15. State and prove the additive property of the Binomial distribution.
16. Show that Exponential distribution has lack of memory property.
17. Derive moment generating function of Gamma distribution with parameters m and p, and obtain mean and variance.
18. For normally distributed population 7% of the items have their values less than 35 and 89% have their values less than 63. Find their mean and variance.

19. Show that the point of inflection of a normal variable X with parameters μ and σ^2 occur at $x = \mu \pm \sigma$.

20. Two unbiased dice are thrown. If X is the sum of the numbers shown up, prove that

$$P[|X - 7| \geq 3] \leq \frac{35}{54}$$

21. Explain Lindberg- Levy form of central limit theorem.

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. Obtain the recurrence relation connecting the central moments of a Poisson distribution. Obtain the first four central moments and hence obtain the coefficients of skewness and Kurtosis.

23. If X_1 and X_2 are independent rectangular variates on [0, 1], find the distributions of

(i) $\frac{X_1}{X_2}$ and (ii) $X_1 X_2$.

24. Obtain the equation of the normal curve that may be fitted to the following data and estimate the theoretical frequencies.

Class	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100
Frequency	3	21	150	335	326	135	26	4

25. (a) If X_k is a r.v. which assumes values k and –k with equal probabilities, show that the law of large numbers cannot be applied to the sequence $X_1, X_2, \ldots X_n$.

(b)For f(x) = 1, $0 \leq x \leq 1$, determine $P[|X - E[X]| \geq 1.5\sigma]$. Compare this value with the value given by Tchebycheff's inequality.

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FIFTH SEMESTER
Core Course -V–UG21ST5CR01-(Statistics)
THEORY OF ESTIMATION

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks.

1. What is the distribution of the sample mean if the sample is taken from $N(\mu,\sigma^2)$?
2. Which sampling distribution is used for testing the significance of sample correlation coefficient?
3. Define sampling distribution.
4. Write the p.d.f of F distribution.
5. Define unbiased estimator.
6. Give an example of a statistic which is consistent but not unbiased.
7. Define the most efficient estimator.
8. What are the properties of moment estimators?
9. Define likelihood function
10. What is the MLE of μ ,if $X_1, X_2, ..., X_n$ is a random sample from N (μ,σ^2).
11. Give the 95% confidence interval for the population mean μ of a normal population.
12. What happens to the length of the interval when the confidence interval increases?

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks.

13. State the additive property of χ^2 distribution.
14. Write the inter relations between normal, χ^2 , t and F.
15. Define consistent estimator. Write the sufficient conditions for the consistency of an estimator.
16. State Cramer-Rao inequality.
17. Explain the method of moments.
18. Write the properties of M.L.E
19. Explain uniformly minimum variance unbiased estimators.
20. Distinguish between point estimation and interval estimation.
21. Explain confidence interval and confidence coefficient.

(6× 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks**.**

22. Show that the sample mean and sample variance are independent in the case of a normal distribution

23. A random sample of size n is taken from a normal population with mean μ and variance σ^2 .Examine whether $\frac{1}{n}\sum x_i^2$ is a minimum variance unbiased estimator of σ^2.

24. Explain the method of maximum likelihood. Obtain the maximum likelihood estimator of θ if the p.d.f of the population is $f(x)=\frac{1}{2}e^{-|x-\theta|}$ $,-\infty<x<\infty$.

25. (a) Explain the method of constructing confidence interval for the proportion of a population, when the sample is of large size.
(b) The mean and standard deviation of a sample of size 60 are found to be 145 and 40 respectively. Construct 95% confidence interval for the population mean.

(2× 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FIFTH SEMESTER
Core Course -VI–UG21ST5CR02-(Statistics)

MATHEMATICS FOR STATISTICS-I

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks

1. What is the limit point of the set A = $\left\{\frac{1}{n} : n \in N\right\}$?
2. What do you mean by supremum of a sequence?
3. Define a monotonic sequence.
4. What is an alternating series?
5. What is the condition for the series $\sum_{n=0}^{\infty} r^n$ to be convergent?
6. If $\sum_{n=1}^{\infty} u_n$ converges, then what is $\lim_{x\to\infty}(u_n)$?
7. What is a removable discontinuity?
8. What is meant by uniform continuity?
9. Prove that $\lim_{x\to 0} x\sin\frac{1}{x} = 0$
10. Define derivability of a function at $x = c$.
11. Show that the function $f(x) = |x|$ is not differentiable at the origin.
12. Define uniform convergence of sequence of functions on an interval.

(10 × 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks.

13. Explain open and closed sets with suitable examples.
14. What is a Cauchy sequence? Give examples
15. Describe Raabe's test.
16. Investigate the behavior of the series whose nth term is $\left(\sqrt{n^4+1} - \sqrt{n^4-1}\right)$
17. Define continuity of a function at $x = a$.

18. Examine the continuity of the function $f(x)=\begin{cases}\dfrac{x e^{\frac{1}{x}}}{1+e^{\frac{1}{x}}} & if \quad x\neq 0\\ 0 & if \quad x=0\end{cases}$

    at the origin.

19. Prove that a function which is derivable at appoint is necessarily continuous at that point. Is the converse true?

20. Discuss the differentiability of $f(x)=|x|+|x-1|$.

21. Examine the validity of the hypothesis and the conclusion of Rolle's theorem for the function

    $f(x)=x^3-4x$ on [-2,2]

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. If $\lim_{n\to\infty} a_n = l$,show that $\lim_{n\to\infty}\left(\dfrac{a_1+a_2+...+a_n}{n}\right)=l$

23. State and prove D'Alembert's ratio test for convergence of a series of positive terms.

24. A function f is defined on R by

$$f(x)=\begin{cases}-x^2 & if \quad x\leq 0\\ 5x-4 & if \quad 0<x\leq 1\\ 4x^2-3x & if \quad 1<x<2\\ 3x+4 & if \quad x\geq 2\end{cases}$$

    Examine f for continuity at $x=0, 1, and\ 2$. Also discuss the kind of discontinuity, if any.

25. State and prove first mean value theorem of differential calculus. Also examine the validity of the hypothesis and the conclusion of this theorem to the function $f(x)=x(x-1)(x-2)$ on $\left[0,\frac{1}{2}\right]$.

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FIFTH SEMESTER
Core Course -VII–UG21ST5CR03-(Statistics)
SAMPLING TECHNIQUES

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks.

1. What is a sample design?
2. Explain CSO.
3. Define the frame.
4. In SRSWOR, what is the probability of getting a specified sample?
5. Define sampling fraction.
6. What is finite population correction (fpc)?
7. In stratified random sampling, give an unbiased estimator of the population mean $\overline{Y}$.
8. Under proportional allocation, what is the sample size n_h from the h^{th} stratum?
9. What is meant by Neyman allocation?
10. Who introduced circular systematic sampling?
11. If N=nk, what is the probability of selecting a systematic sample?
12. What is the efficiency of cluster sampling with respect to SRSWOR of nM elements from the whole population ?

.

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks.

13. Describe the advantages of sample survey in comparison with a census.
14. What do you mean by non-sampling errors?
15. Explain National Sample Survey Office.
16. Distinguish between SRSWOR and SRSWR.
17. Show that for SRSWOR the sample variance, $s^2 = \frac{1}{n-1}\sum_{i=1}^{n}\left(y_i - \bar{y}\right)^2$ is an unbiased estimator of the population variance, $S^2 = \frac{1}{N-1}\sum_{i=1}^{N}\left(Y_i - \bar{Y}\right)^2$.
18. Show that in stratified random sampling $V(\bar{y}_{st})$ is minimum for fixed total size of the sample ‘n’ if $n_i \propto N_i S_i$..
19. Give an unbiased estimator of population mean under proportional allocation. What is its variance?
20. Prove that in population with linear trend, $V_{st} \le V_{sy} \le V_{ran}$.

21. Explain cluster sampling.

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15**marks.

22. Explain the principal steps in conducting a sample survey.

.

23. From a list of 3042 names and addresses, a simple random sample of 200 names showed on investigation 38 wrong addresses. Estimate the total number of addresses needing correction in the list and find the standard error of this estimate.

24. A sample of 30 students is to be drawn from a population consisting of 300 students belonging to two colleges A and B. The means and standard deviations of their marks are given below:

	Total No. of Students (N_i)	Mean $\bar{Y}_{N_i}$	S.D σ_i
College A	200	30	10
College B	100	60	40

How would you draw the sample using proportional allocation technique? Hence obtain the variance of the estimate of the population mean.

25. Obtain the relative efficiency of the systematic sampling with respect to stratified random sampling for the following data:

		Systematic samples				
		1	2	3	4	5
Strata						
1	…	1	1	2	5	4
2	…	8	9	10	13	12
3	…	19	20	20	24	23
4	…	30	31	31	33	32

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FIFTH SEMESTER
Core Course-VIII –UG21ST5CR04-(Statistics)
ENVIRONMENTAL STUDIES AND VITAL STATISTICS.

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks**.**

1. Define the term demography.
2. Explain the term rate of a vital event.
3. Explain G.F.R.
4. Define A. S. D.R.
5. Define N.R.R.
6. Explain nonrenewable resources
7. What are component of population growth?
8. What is food web
9. Write any one limitation of CBR.
10. Define Infant Mortality rate
11. Define Biosphere.
12. Define Habitat

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks**.**

13. Describe the values of Biodiversity
14. Define water pollution. Explain its causes and effects.
15. Explain purpose and procedure for standardizing death rates.
16. What are the various uses of Vital Statistics
17. How NRR differs from GRR?
18. The number of live births during 2010 in a rural area was 1475. The number of infant death during the same period was 543. Find the infant mortality rate for 2010.
19. Explain Oxygen cycle
20. Explain TFR.
21. Explain noise pollution.

(6× 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. Explain the structure and function of an ecosystem.
23. Define air pollution. Explain the causes, effects and control measures of air pollution.
24. Given below is the data regarding deaths in two districts. On the basis of the given data, calculate the standardized death rates. Give your comments.

Age rage	District A		District B		Age distribution of standard population
	Population	No. of deaths	Population	No.of deaths	
0-10	2000	50	1000	20	206
10-55	7000	75	3000	30	583
55 and above	1000	25	2000	40	211

25. Compute GFR, SFR, TFR from the data given below:

Age Group of Child bearing females	No of Women per '000	Total Births
15-19	16	240
20-24	16.5	2200
25-29	14.8	1900
30-34	15	1400
35-39	14.8	986
40-44	12	200
45-49	14.5	80

. Assume that the proportion of female birth is 46.2% , calculate GRR.

(2× 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
FIFTH SEMESTER
Open Course –UG21ST5OC01- (Statistics) –OPEN COURSE- I
APPLIED STATISTICS

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2**marks.

1. Define an Index number.
2. What is price relative?
3. Define Laspeyre's Index number.
4. What is a chain base Index number?
5. What is factor reversal test?
6. How do you calculate purchasing power of money?
7. What circular test ? Give an example of index number formula which satisfies circular test.
8. What is meant by time series?
9. What do you mean by cyclical variation?
10. What is meant by moving average?
11. What is de-seasonalisation of data?
12. What is a long term trend?

(10 × 2=20)

PART B

Answer any **6** questions. Each question carries **5** marks.

13. What are the uses of index numbers.
14. Explain Time Reversal Test and Factor Reversal test.
15. Construct the consumer price index number for 1996 on the basis of 1993 from the following data using Aggregate expenditure method.

Commodity	Quantity consumed	Price in 1993	Price in 1996
A	100	8	12
B	25	6	7
C	10	5	8
D	20	15	18

16. Using three-yearly moving averages, obtain the trend values for the following data :

Year	2000	2001	2002	2003	2004	2005	2006
Production (in metric ton)	68	63	60	62	64	68	67

17. The following table contains two series of index numbers. The first series is from 1996 to 2001 with 1990 as base the second series from 2001 to 2005 with base 2001. Splice
    a) Series i to Series ii and
    b) Series ii to series i

Year	Index with base 1990 (Series i)	Index with base 2001 (Series ii)
1996	155	
1997	180	
1998	175	
1999	181	
2000	185	
2001	188	100
2002		113
2003		124
2004		126
2005		159

18. Explain the Ratio-to-Moving average method for determining seasonal index.
19. Apply the method of semi-average of measuring trend; plot a straight line trend for the following data.

Year	1990	1991	1992	1993	1994	1995
Sale (Rs. in 1000)	20	24	22	30	28	32

20. What is meant by consumer price index number? What are its uses
21. The following are the index numbers of prices with 1968 as base year. Shift the base from 1968 to 1972 and recast the index numbers

Year	1967	1968	1969	1970	1971	1972
Index	95	100	105	92	105	120

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. Explain various problems in the construction of Index numbers.?
23. Explain briefly the four components of Time series and the models that are used for analyzing the time series.
24. The data below gives the average quarterly prices of a commodity for five years. Calculate the seasonal variation indices by the method of link relatives.

Year / Quarter	1995	1996	1997	1998	1999
I	30	35	31	31	34
II	26	28	29	31	36
III	22	22	28	25	26
IV	31	36	32	35	33

25. From the following calculate Fisher's Index number and prove that Fisher's Ideal Index number satisfies both Time Reversal an Factor Reversal Tests.

Commodity	Base Year		Current Year	
	Price	Expenditure	Price	Expenditure
A	6	300	10	600
B	2	200	2	240
C	4	240	6	360

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination,
SIXTH SEMESTER
Core Course-IX–UG21ST6CR01-(Statistics)
TESTING OF STATISTICAL HYPOTHESIS

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks.

1. What is statistical hypothesis?
2. Define null hypothesis.
3. What are the two types of errors in statistical tests?
4. What is a statistical test?
5. What is the test criterion in the LR test for testing the variance of a normal population?
6. What are the assumptions in small sample tests?
7. Write the test criterion in the paired t test.
8. Distinguish between parametric and non-parametric tests.
9. What is the test for median of a population?
10. What is a run?
11. Name two non-parametric tests for two samples.
12. What is run test for randomness?

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks.

13. Define most powerful test.
14. What are the properties of likelihood ratio test?
15. Describe the test procedure for testing the mean of a normal population when the sample is of small size?
16. Obtain the F-statistic for testing whether the two populations have the same variance for the two random samples of sizes 10 and 12 with the sum of the observations as 190 and 374 and sum of squares of the observations as 4226 and 13254 from two normal populations.
17. Explain what is meant by paired t-test.
18. Distinguish between large sample test and small sample test.
19. Explain χ^2 test of goodness of fit.
20. What are the disadvantages of N.P test?
21. Explain Wald-Wolfowitz run test.

(6× 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks**.**

22. Explain the L.R test for testing the equality of means of two normal populations having same variance.
23. Find Neyman-Pearson test of size α for $H_0 : \theta = 1$ against $H_1 : \theta = \theta_1$ when $\theta_1 > 1$ based on a sample of size 1 from the population

$$f(x,\theta) = \begin{cases} \theta x^{\theta-1} & 0 < x < 1 \\ 0 & \textit{elsewhere} \end{cases}$$

24. In a city A 20 are smokers out of 42 while in another sample of 48 from city B, 15 are smokers. Test whether the proportion of smokers is same in both cities. State your assumptions, if any.
25. Use the Wald-Wolfowitz run test for the equality of the distribution functions of the Following group of observations:

First group			second group		
227	55	184	202	271	63
176	234	147	14	151	284
252	194	88	165	235	53
149	247	161	171	147	228
16	92	171	292	99	271

(2 × 15=30)

MODEL QUESTION PAPER
B.SC. Degree (C.B.C.S.S) Examination.
SIXTH SEMESTER
Core Course –X - UG21ST6CR02 -(Statistics)
MATHEMATICS FOR STATISTICS-II

Time: 3hrs **Maximum : 80 Marks.**

Use of scientific calculators and statistical tables are permitted

Part A

Answer any **10**questions. Each question carries **2** marks**.**

1. If Δ is the difference operator and the interval of differencing being unity, then find Δa^x
2. If the interval of differencing being unity, then find $\Delta^n x^{(n)}$.
3. Let $f(x) = x^2$ for $x = 1, 2, 3, ..., 10$ and if $a = 2, \quad h = 1, \quad E$ as usual shift operator, then find $E^6 f(a)$
4. Define backward difference operator ∇.
5. Find the residue of $f(z)$ at $z = 1$,where

$$f(z) = \frac{2}{(z-1)^3}\left[\frac{1}{2} + \frac{2}{3}(z-1) + \frac{3}{4}(z-1)^2 + \frac{4}{5}(z-1)^3 + ...\right]$$

6. Define central difference operator δ.
7. Define analytic function.
8. Find the value of $\int_C \frac{dz}{z}$ where $c = \{z : 1 < |z| < 2\}$
9. Find the imaginary part of the function of complex variable $f(z) = e^{2z}$
10. What is meant by norm of a partition?
11. State fundamental theorem of integral calculus.
12. State Darboux's condition of Riemann integrability of function

(10 × 2=20)

Part B

Answer any **6**questions. Each question carries **5** marks**.**

13. Prove that n^{th} difference of a polynomial of degree n is constant when the values of the independent variable are at equal interval
14. Use Stirling's formula to find sin 52^o from the following table:

x	:	40^o	45^o	50^o	55^o	60^o
Sin x	:	0.6428	0.7071	0.7660	0.8192	0.8660

15. Prove that $\delta(x, y, z) = x + y + z$ for the function $f(x) = x^3$

16. Prove that $\Delta[f(x)\, g(x)] = f(x+h)\Delta g(x) + g(x)\Delta f(x)$

17. Use Newton's backward interpolation formula to find f(78) from the following table

x	:	60	65	70	75	80
f(x)	:	163.9	209.5	262.6	324.0	394.3

18. State Cauchy-Riemann condition.

19. Find the residue of $f(z) = \dfrac{z^2}{z^2 - a^2}$ at $z = a$

20. Show that a constant function k is integrable.

21. Give the necessary and sufficient condition for the integrability of a bounded function.

(6 × 5=30)

Part C

Answer any **2** questions. Each question carries **10** marks.

22. Obtain approximate value of integral $\int_0^1 \dfrac{dx}{1+x^2}$ by applying

(a) Weddle's Rule.

(b) Simpson's one third Rule.

Also compare the estimated value with actual value in each case.

23. Derive Simpson' $\dfrac{3}{8}$ rule . Using this rule evaluate $\int_0^6 \dfrac{1}{(1+x)} dx$ with n=6. Evaluate this integral using Trapezoidal rule and compare the results.

24. Define the following terms with one example each:

(a) Removable singularity.

(b) Essential singularity.

(c) Isolated singularity.

(d) Poles.

25. (a) Show that $\int_1^2 f\, dx = \dfrac{11}{2}$ where $f(x) = 3x + 1$

(b) Compute $\int_{-1}^1 f\, dx$ where $f(x) = |x|$

(2 × 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
SIXTH SEMESTER
Core Course –XI - UG21ST6CR03-(Statistics)
DESIGN AND ANALYSIS OF EXPERIMENTS

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks.

1. Define estimable parametric function.
2. What do you mean by testing of linear hypothesis?
3. Who developed the ANOVA technique?
4. What is the probability distribution of errors in a statistical model?
5. What is the statistical model used in the ANOVA of two-way classified data?
6. What are the basic principles of design of experiments?
7. What are the error degrees of freedom in a CRD with 'n' experimental units and 'p' treatments?
8. Give the layout of a LSD with 4 treatments A,B,C,D.
9. Give the formula for computing the row efficiency of LSD over RBD.
10. Which are the two types of effects measured in a factorial experiment?
11. How many factors are there in a 2^2 experiment?
12. Demonstrate an example of a symmetrical factorial experiment.

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5** marks.

13. State Gauss-Markov theorem
14. State and prove the necessary and sufficient condition for the estimability of a linear parametric function.
15. What are the assumptions made while using ANOVA?
16. Give a sketch of the ANOVA of two way classified data.
17. Explain how you would estimate two missing observations in RBD.
18. Obtain the raw and column efficiencies of LSD over RBD.
19. Give the advantages of CRD.
20. Explain the statistical analysis of 2^2 factorial experiments
21. Define main effect of a factorial experiment.

(6× 5=30)

PART C

Answer any **2** questions. Each question carries **15** marks.

22. Explain estimable linear parametric function for the model

$Y_1 = \theta_1 + \theta_2 + e_1$

$Y_2 = \theta_1 + \theta_3 + e_2$

$Y_3 = \theta_1 + \theta_2 + e_3$

Show that $c_1\theta_1 + c_2\theta_2 + c_3\theta_3$ is estimable if $c_1 = c_2 + c_3$. Also obtain the BLUE of $3\theta_1 + 2\theta_2 + \theta_3$

23. The data given below shows the effect of four fertilizers on the yield of a particular crop.

Fertilizer	Yield						
1	…….. 1.9	2.2	2.6	1.8	2.1	2.5	
2	…….. 2.5	1.9	2.3	2.6	2.3		
3	…….. 1.7	1.9	2.2	2	2.1		
4	…….. 2.1	1.8	2.5	2.3	2.4	2.6	2.7

Perform ANOVA and test whether there is any significant difference between the fertilizers.

24. The yield per plant of five varieties in RBD are given:

Variety	Rep. I	Rep. II	Rep. III
V_1	21.0	20.0	19.5
V_2	19.0	18.0	18.5
V_3	31.5	30.5	32.0
V_4	27.5	…	28.0
V_5	25.0	25.3	26.6

Analyse the data having one missing value and interpret the result.

25. Explain the analysis of 2^n factorial experiment by clearly specifying the main effects and interaction effects.

(2× 15=30)

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
SIXTH SEMESTER
Core Course –XII - UG21ST6CR04- (Statistics)
STATISTICAL COMPUTING USING R SOFTWARE

Time: Three Hours **Maximum Marks: 80**

The examination may be conducted in a computing laboratory, where computers with R software and Statistical Tables available.

Answer any **5**questions. Each question carries **16** marks.

1. Write the R code for finding mean and median of the following frequency distribution. Also write the values of each.

Value (X)	Frequency
147	4
152	6
157	28
162	58
167	64
172	30
177	5
182	5

2. a) Explain plot function in R software
   b) Find the Q_1, Q_2, Q_3, D_1, D_3 and D_7 of the following data:
   23, 54.3, 12.8, 87, 64.5, 43,112, 76.4, 32.8, 14.5, 42.4, 13.7, 53.9, 15.2, 63.1
   Also write the R command for each computation.
3. a) Explain how to generate a random number from binomial and Poisson distribution.
   b) Write a programme in R to draw 1000 samples of size 100 each from normal distribution with mean= 5 and S.D. = 2. Also obtain sample mean of each sample and find mean and variance of the sample means.
4. a) Explain the method of generating a random sample of size 50 from a normal distribution with mean = 2 and S.D. = 1
   b) Explain the method of generating random samples from exponential distribution with parameter 6.
5. Explain the method of obtaining covariance, coefficient of correlation and coefficient of determination of a simple linear model. Find covariance, coefficient of correlation, regression coefficients and coefficient of determination of the following data

x	50	54	55	59	64	61	71

y	31	44	33	36	32	24	11

6. Explain the inference procedures for simple linear model. Apply the procedure in the following data.

x :	47	52	52	54	56	58	59	60	60	62	64
x :	2.5	2.7	2.8	2.9	3.2	3.3	3.4	3.5	3.5	3.5	3.6

7. Explain how do you perform two independent sample t- test. Test whether the following two group have the same mean. Also construct 95% and 99% confidence interval for mean of the group.

Group I :	105	119	100	97	96	101	94	95	98
Group II :	96	99	94	89	96	93	88	105	88

8. Explain the method of one way ANOVA in R. Perform ANOVA and test whether there is any significant difference between the fertilizers.

Fertilizer	Yield						
1	…….. 1.9	2.2	2.6	1.8	2.1	2.5	
2	…….. 2.5	1.9	2.3	2.6	2.3		
3	…….. 1.7	1.9	2.2	2	2.1		
4	…….. 2.1	1.8	2.5	2.3	2.4	2.6	2.7

MODEL QUESTION PAPER
B.Sc. Degree (C.B.C.S.S.) Examination
SIXTH SEMESTER
Core Course-XIII -UG21ST6CB01-(Statistics) -Elective- I
OPERATIONS RESEARCH

Time: Three Hours **Maximum Marks: 80**

Use of Non-programmable calculator and Statistical Tables allowed

PART A

Answer any **10**questions. Each question carries **2** marks.

1. Give any definition of Operations Research.
2. What is an iconic model? Illustrate with examples.
3. What do you mean by basic feasible solution of a L.P.P?
4. What do you mean by artificial variables in L.P.P?
5. Explain auxiliary LPP in Two-Phase method.
6. Discuss about the duality in LPP.
7. What do you mean by a balanced transportation problem?
8. What is meant by basic feasible solution in transportation problem?
9. Write the name of the method for solving an assignment problem.
10. What do you mean by an activity in network analysis?
11. Define total float.
12. What is a critical path?

(10× 2=20)

PART B

Answer any **6**questions. Each question carries **5**marks.

13. Explain the basic assumptions of LPP.
14. What is degeneracy in L.P.P?
15. Find the dual of the primal:

Maximize $Z = 3x_1 + x_2 + 2x_3$

Subject to

$$x_1 + x_2 + x_3 \leq 5$$
$$2x_1 + x_3 \leq 10$$
$$x_2 + 3x_3 \leq 15$$
$$x_1, x_2, x_3 \geq 0$$

16. Explain Big-M method for solving LPP.
17. Explain loops in transportation tables.
18. Obtain an initial basic feasible solution to the following T.P. using the matrix minima method:

	D_1	D_2	D_3	D_4	Capacity
O_1	1	2	3	4	6
O_2	4	3	2	0	8
O_3	0	2	2	1	10
Demand	4	6	8	6	

where O_i and D_j denote i^{th} origin and j^{th} destination respectively

19. Give the mathematical formulation of an assignment problem.

20. Explain the term dangling in networks.

21. How are the times estimates made in the PERT model?

(6 × 5=30)

PART C

Answer any **2** questions. Each question carries **15**marks**.**

22. Use Simplex method to solve the following LPP:

Maximize Z= $4x_1 + 10x_2$ subject to the constraints:

$$2x_1 + x_2 \le 50$$
$$2x_1 + 5x_2 \le 100$$
$$2x_1 + 3x_2 \le 90$$
$$x_1 \ge 0, x_2 \ge 0$$

23. Explain Two-Phase method for solving LPP.

24. A department head has four tasks to be performed and three subordinates, the Subordinates differ in efficiency. The estimates of the time, each subordinate would take to perform, is given below in the matrix. How should he allocate the tasks one to each man, so as to minimize the total man-hours?

Task	Man 1	Man 2	Man 3
I	9	26	15
II	13	27	6
III	35	30	15
IV	18	30	20

25. A project schedule has the following characteristics:

Availability	Optimistic time	Most likely time	Pessimistic time
1-2	1	2	3
2-3	1	2	3
2-4	1	3	5
3-5	3	4	5
4-5	2	3	4
4-6	3	5	7
5-7	4	5	6
6-7	6	7	8
7-8	2	4	6
7-9	4	6	8
8-10	1	2	3
9-10	3	5	7

(a) Draw the network diagram for the project.
(b) Determine the critical path.
(c) What is the probability of completing the project in 30 weeks?

(2× 15=30)

COMPLEMENTARY

Model Question Paper
B.Sc. (CBCSS) Degree Examination
First Semester
Complementary Course - UG21ST1CM01 - DESCRIPTIVE STATISTICS
(Complementary Course to B.Sc. Mathematics Programme)

Time: Three Hours **Maximum: 80 Marks**

Use of Non-Programmable calculator and Statistical Tables allowed.

Part A (Answer any 10 questions. Each question carries 2 marks)

1. Define Statistics and population.
2. Distinguish between census and sampling.
3. Distinguish between nominal and ratio scale.
4. Distinguish between cluster sampling and systematic sampling.
5. Define Boxplot.
6. Define Partition values.
7. Distinguish between geometric mean and harmonic mean.
8. Define Skewness. Give the moment measure of skewness.
9. Find the mean and variance of the data if the first three moments of the data about the point 4 are 3, 25 and -110.
10. Distinguish between raw moments and central moments.
11. Define index numbers. Give the expression for Fisher's index number.
12. Define Time series.

(10 × 2 = 20 Marks)

Part B (Answer any 6 questions. Each question carries 5 marks)

13. Briefly explain simple random sampling and stratified sampling.
14. Briefly explain different types of data.
15. Find the range and quartile deviation for the data given below.

X	:	10	15	20	25	30
Frequency	:	2	13	15	17	3

16. Draw the ogive and hence find the median of the data. Also find the mean deviation about the median.

Class	:	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50
Frequency	:	7	13	20	10	5

17. Define relative measures of dispersion. Find the coefficient of variation of the data, 43, 32, 60, 12, 8, 4, 1.
18. Find the first three central moments of the data given below.

X	:	3	4	5	7	10
Frequency	:	13	16	21	18	13

19. Briefly explain the effect of change of origin and scale on the central moments.

20. Define cost of living index. Find the cost of living index for the data given below.

	Price in 2007	Price in 2017	% of usage
A	61	70	15
B	42	48	16
C	112	126	40
D	43	51	22
E	8	11	7

21. Briefly explain the tests for a good index number.

(6 × 5 = 30 Marks)

Part C (Answer any 2 questions. Each question carries 15 marks)

22. (1) Distinguish between primary and secondary data.
    (2) Explain the various methods to collect the primary data.
23. In a test given to two groups of students the scores obtained are as follows:
    Group 1: 23 11 19 26 35 46 53 18 36
    Group 2: 31 18 21 31 48 40 18 23 30
    (1) Which group is more consistent?
    (2) Find the mean and standard deviation.
24. (1) Define kurtosis of a data.
    (2) Briefly explain the various measures of kurtosis.
    (3) Find the coefficient of kurtosis of the data given below.

Class	: 0 – 4	4 – 8	8 – 12	12 – 16	16 - 20
Frequency:	2	3	11	3	1

25. (1) Find the Laspeyer's and Paasche's indices for the data given below.

Item	Base Year		Current Year	
	Price	Quantity	Price	Quantity
A	23	7	32	5
B	57	26	75	30
C	125	14	125	17
D	70	20	130	17

    (2) Show that the Fisher's index satisfies the time reversal test.

(2 × 15 = 30 Marks)

Model Question Paper
B.Sc. (CBCSS) Degree Examination
Second Semester
Complementary Course - UG21ST2CM01 - PROBABILITY THEORY
(Common to B.Sc. Mathematics, Physics and Computer Applications Programme)

Time: Three Hours **Maximum: 80 Marks**

Use of Non-Programmable calculator and Statistical Tables allowed.

Part A (Short Answer Questions)

Answer any **10** questions. *Each* question carries **2** marks.

1 Explain the terms (i) random experiments (ii) sample space, with examples.
2. An integer is chosen at random from the first 100 integers. An event A is said to happen if the chosen integer is divisible by 2 or 3. Write down the sample space and the event A.
3. What is frequency approach to probability. What are the limitations of the approach.
4. Show that A and B are independent iff P(B|A)=P(B|A')
5. Distinguish between discrete and continuous random variables. Give examples
6. Distribution function of random variable is given by $F(x)=1-(1+x)e^{-x}$, $x\geq 0$. Find the p d f of X.
7. For the density function $f(x)=ke^{-ax}$, $x\geq 0$, $a\geq 0$ and 0 elsewhere. Find the value of k.
8. X is a random variable with $p(x)=\frac{e^{-m}m^{x}}{x!}$, x=0,1,2…. Find the probability distribution of $y=x^2$.
9. Explain how you can get a joint p d f from the marginal and conditional p d f's.
10. When will you say two random variables are independent.
11. Find the marginal densities from the joint p d f f(xy)=2, $0<x<y<1$ and 0 elsewhere.
12. Explain how coefficient of correlation measures the linear dependence between two variables.

$10 \times 2 = 20$ Marks

Part B (Brief Answer Questions)

Answer any ***six*** questions. *5 marks* each.

13. Define sigma field. Show that probability measure is defined over a sigma field.
14. State and prove multiplication theorem for three events.
15. What do you mean by probability of an event. Probabilities that a husband and wife will be alive 20 years from now is given by 0.8 and 0.9 respectively. Find the probability that in 20 years (i) both (ii) neither (iii) at least one will be alive.
16. There are 3 bags each containing 4 white and 3 black balls and there are 4 bags each containing 2 white balls and 5 black balls. A bag is chosen and a ball is drawn. It was found to be black. What is the probability that the bag chosen was from the first set of bags.
17. A random variable X has the density function $f(x)=\frac{k}{1+x^2}$. Determine (i) k, (ii) $P(x\geq 0)$, (iii) Draw the graph of the corresponding distribution function.
18. The pdf of X is given by $f(x)= 2x$, $0<x<1$ and 0 elsewhere. Compute the probability, $P(x\leq 1/2 \mid 1/3\leq x\leq 2/3)$.
19. For the joint distribution function $f(xy)=\frac{2}{3}(1+x)e^{-y}$, $0<x<1$, $y>0$. Obtain the conditional distribution of x given y=1 and that of y given x=1/3.
20. Let X and Y denote the number of spades and hearts respectively in a hand of 13 cards. Find f(x,y).

21. If x and y are uncorrelated and u=x+y and v=x-y, find the coefficient of correlation between u and v in terms of the variances of x and y.

$6 \times 5 = 30$ Marks

Part C (Essay)

Answer any **two** questions

15 marks each

22. A random variable X has the following probability function

$$f(x)=k \text{ if } x=0$$
$$=2k \text{ if } x=1$$
$$=3k \text{ if } x=2$$
$$=0 \text{ o.w}$$

(i)Determine the value of k.
(ii)Find $P(X<2)$, $P(X\leq 2)$, and $P(0<X<2)$.
(iii)Write down the distribution function of X.
(iv) What is the smallest value of m for which $P(X<m)>1/2$.

23. For the p d f $f(xy)=x+y$, $0\leq x\leq 1$, $0\leq y\leq 1$. Find $f(x|y)$, $f(y|x)$ and $P(X>1/2 \,|Y>1/2)$. Examine whether X and Y are independent.

24. Fit a curve of the form $y=a+bx+cx^2$ to the data

x:	1	3	5	10	11	15
y:	0	11	20	42	60	90

and estimate the value of y when x=12.5.

25. From the following data calculate the correlation coefficient and the regression lines.

x:	51	54	55	59	65	60	70
y:	38	44	33	36	33	23	10.

$(2 \times 15 = 30$ Marks)

MODEL QUESTION PAPER
B.Sc. (C.B.C.S.S.) Degree Examination
Third Semester
Complementary Course - UG21ST3CM01 - PROBABILITY DISTRIBUTIONS
(Common to B.Sc. Mathematics, Physics and Computer Applications Programme)

Time: Three Hours **Maximum: 80 Marks**

Use of Non-Programmable calculator and Statistical Tables allowed.

Part A (Short Answer Questions)

Answerany**10** questions .Each question carries**2**marks.

1 S.T mean of a binomial distribution is greater than its variance.
2. State Bernoulli's law of large numbers.
3. What is the relationship between A.M, G.M and H.M?
4. Find out the 7 th central moment of N (μ,σ).
5. Define r th order central moment.
6. Write down the probability mass function of a Poisson distribution whose mean is 4.
7. What do you mean by statistic?
8. What is sampling distribution?
9. What is the relation between mean and variance of χ^2 distribution with ***n*** d.f. ?
10. Define gamma distribution.
11. Define mathematical expectation of a random variable and mention its properties.
12. How will you express Pearson's correlation coefficient in terms of expectation?

$10 \times 2 = 20$ Marks

Part B (Brief Answer Questions)

Answer any ***six*** questions. *5 marks* each.

13. If $X \sim B(n, p)$ then what is the distribution of $Y = n - X$?
14. Prove the sum of two independent Poisson variates is Poisson.
15. State and prove the properties of characteristic function of a random variable X.
16. Define the Beta distribution of 1st kind. What is its relationship with Beta distribution of 2nd kind?
17. What is 'F' random variable? Explain how it is related to't' and chi-square variables.
18. Define t distribution and find its mean.
19. State Lindberg-Levy form of Central limit theorem.
20. Obtain the mgf of two parameter gamma distribution and hence find its mean and variance.
21. Let X ~ N (0, 1). Find out which one is greater P (-0.5<X<0.1) or P (1<X<2).

$6 \times 5 = 30$ Marks

Part C (Essay)

Answer any **two** questions**15** marks each

22. If X ~ B (n, p), and μ_r denote the r[th] central moment, prove that

$$\mu_{r+1} = pq\left[\frac{d\mu_r}{dp} + nr.\mu_{r-1}\right]$$

23. (i)State and prove Tchebycheff's inequality.
(ii) Define convergence in probability.
(iii)Examine whether the law of large numbers holds for the sequence $\{X_k\}$ of independent random variables defined as follows.

$$P\left(X_k = \pm 2^k\right) = 2^{-(2k+1)}; \qquad P\left(X_k = 0\right) = 1 - 2^{-2k}$$

24. Obtain the recurrence relation for central moments of Poisson distribution and hence find the skewness and kurtosis.

25. What is sampling distribution? Give examples. What are the mean and variance of distribution of S^2?

(2 × 15 = 30 Marks)

MODEL QUESTION PAPER
B.Sc. (C.B.C.S.S.) Degree Examination
Fourth Semester
Complementary Course - UG21ST4CM01 - STATISTICAL INFERENCE
(Common to B.Sc. Mathematics, Physics and Computer Applications Programme)

Time: Three Hours **Maximum: 80 Marks**

Use of Non-Programmable calculator and Statistical Tables allowed.

Part A (Short Answer Questions)

Answerany**10** questions .Each question carries**2**marks.

1. What do you mean by sufficient estimator?
2. Obtain a consistent estimator for θ if the observations are from U(0, θ).
3. Is sample variance an unbiased estimator of population variance if sample is taken from $N(\mu, \sigma^2)$.
4. Show by an example that MLE need not be unbiased.
5. 1,5,2,4 is a sample from a population with p.d.f$(x) = p(1-p)^x$, x =0,1,2,… . Find an estimate for 'p' using the method of moments.
6. Differentiate between point estimation and interval estimation.
7. Briefly explain the Cramer- Rao lower bound for an unbiased estimator.
8. What do you mean by significance level and power of the test?
9. A continuous random variable 'x' has uniform distribution with parameter θ, ie, U(0,θ). . We have to test H_0: θ=1 against H_1: θ =2. If x≥0.95 is the critical region. Obtain P(Type I error) and P(Type II error)
10. What do you mean by paired t-test? When is it used?
11. What is the difference between point estimate or interval estimator?
12. Give one example each for simple and composite hypothesis.

10 × 2 = 20 Marks

Part B (Brief Answer Questions)

Answer any ***six*** questions.*5* marks each.

13. Give examples for unbiased but not consistent and consistent but not unbiased estimator.
14. Examine whether the variance of the normal population is greater than 15, if the following sample items are obtained:
    a. 14.5, 17.2, 20.7, 16.3, 18.0, 19.2, 25.0, 16.6, 20.2.
15. If the random variate 'X' has the p.d.f $f(x) = (1+\beta)x^{\beta}$, $0 \le x \le 1$, $\beta \ge 1$ obtain MLE of β, is it unbiased?
16. Find the Cramer- Rao lower bound for the variance of an unbiased estimator of λ, where λ is the parameter of Poisson distribution.
17. 'X' is normal variate with σ = 100. To test H_0:μ=100 against H_1:μ=110., the critical region suggested is $\bar{x} \ge k$ where $\bar{x}$ is the sample mean. How large a sample should be taken if the significance level is 0.05 and probability of type – II error is 0.02?

18. Distinguish between simple and composite hypothesis. Give examples for each and state the Neymann- Pearson lemma.
19. Is there any relationship between sufficient estimator and maximum likelihood estimator? if yes, establish it.
20. Define standard error , sampling distribution. Obtain the standard error of the mean when sample is large.
21. If 60 out of a group of 1000 insured persons died within a year, examine whether the assumption that only less than 4% are likely to die within a year is justifiable.

$6 \times 5 = 30$ Marks

Part C (Essay)

Answer any **two** questions**15** marks each

22 Let X follow Normal distribution with mean 'μ' is and variance 4. To test H_0:μ= -1 against H_1:μ=1 based on a sample of size 10 from the population, we use the critical region $x_1 + 2x_2 + 3x_3 + \cdots + 10x_{10} \geq 0$. Obtain the size and power of the test?

23 a) How do you determine the critical region for testing H_0:μ= μ_0 using large samples where μ is the mean. What modifications will you make depending on the alternating hypothesis?

b) The following table gives the performance in S.S.L.C and performance in Degree class for the same set of students. Discuss the association between the two attributes.

	Degree		
SSLC	Fair	Good	Excellent
Fair	73	67	10
Good	64	84	15
Excellent	5	24	28

24 a) A sample of size 8 from a normal population with SD 3 is 6,8,11,5,911,10,12. Examine whether the mean of the population is 7?

b)Discuss the F-test for testing the equality of two sample variances stating clearly the assumptions involved.

25 a) An IQ test was administered to 5 persons before and after they were trained. The results are as follows.

Candidate	A	B	C	D	E
IQ before training	110	120	123	132	125
IQ after training	120	118	125	136	121

Test whether there is any change in IQ after the training programme.

b) Discuss briefly the different applications of χ^2 as a test statistic.

($2 \times 15 = 30$ Marks)