SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

Learning Outcomes based Curriculum Framework

(LOCF)

For

S.Y.B.Sc. Statistics (Minor)

Undergraduate Programme

From

Academic year

2024-25

Vision & Mission

Mission:

- Equip the student with knowledge and skills of their chosen vocation,
- Inculcate values.
- Provide them opportunities for all round growth and prepare them for life.

Vision:

- To equip the students with advanced knowledge and skills in their chosen vocation.
- To provide value-based education and opportunities to students.
- To help them to face challenges in life.
- To nurture a scientific attitude, temperament and culture among the students.
- To continually review, develop and renew the approach to build India of the Founder's dream.

Goals and Objectives:

- To build a strong Academia-Industry bridge.
- To provide flexibility in the courses offered and proactively adapt to the changing needs of students and the society.
- To establish a centre for multidisciplinary activities.
- To mould individuals who would nurture the cultural heritage of our country and contribute to the betterment of the society.

Board of Studies in Statistics

Undergraduate

	Name	Designation	Institute/Industry
Head of the Department			
1	Mr. Prashant Shah	Chairman	K J Somaiya College of Science and Commerce
Dean of Academics			
1	Dr. Smita Survase		K J Somaiya College of Science and Commerce
Subject Expert nominated by Vice-Chancellor			
1	Ms. Sucheta Ketkar	Head Department of Statistics	Ruia college
Subject experts			
1	Dr. Ujjvala Phatak	Head Department of Statistics	Bhavans college
2	Dr. Alok Dabade	Assistant Professor	University of Mumbai
3	Dr. S. B. Muley (Other University)	Assistant Professor	K. C. College, H.S.N.C. State Public University
Representative from Industry/Corporate sector/Allied area			
1	Mr. Salim Ramzanzli Shaikh	Assistant Vice President in Credit Risk Analytics and Innovation Unit	HDFC Bank
Meritorious Alumnus			
1	Ms. Shraddha Indulkar		K J Somaiya College of Science and Commerce
Current Academic Student (23-24)			

1	Ms. Safura Palekar	T.Y.B.Sc. Student	K J Somaiya College of Science and Commerce
Faculty of the Specialisation			
1	Ms. Madhavi Jardosh	Associate Professor	K J Somaiya College of Science and Commerce
2	Ms. Arati Kore	Assistant Professor	K J Somaiya College of Science and Commerce
3	Ms. Namrata Nagwekar	Assistant Professor	K J Somaiya College of Science and Commerce
4	Mr. Ashish Mhatre	Assistant Professor	K J Somaiya College of Science and Commerce

Foreword

Autonomy reflects efforts for excellence in academic performances, capability of self-governance and enhancement in the quality of education. In the year 2012, the UGC and University of Mumbai conferred the Autonomous Status to K J Somaiya College of Science and Commerce. Post this recognition and having several accolades to our credit, we made significant changes to our existing syllabi to reflect the changing business, industrial and social needs. A holistic education that provides opportunities to gain and share knowledge, experiment and develop beyond curriculum, is offered at our College.

Autonomous college carries a prestigious image for the students and the teachers and we have made a collaborative attempt to maintain a high level of quality in the standard of education that we impart.

Structured feedback obtained from the students, alumni and the experts from the industry and the changes suggested by them were duly incorporated in the syllabi. The Board of Studies constituted for each department meets to carry out in depth discussions about different aspects of the curriculum taking into cognizance the recent trends in the discipline.

The IQAC team has facilitated the conduct of a number of workshops and seminars to equip the faculty with the necessary skill set to frame the syllabi and competencies to deliver the same. Training was also provided to employ innovative evaluation methods pertaining to higher cognitive levels of revised Bloom's taxonomy. This ensured the attainment of the learning outcomes enlisted in the syllabus. Audits are conducted to critically review the practices undertaken in teaching, learning and evaluation. Innovative learning methodologies such as project-based learning, experiential learning and flip- class learning practiced by a committed fleet of faculty, supported by several hands have been our unique outstanding propositions. All efforts have been made to nurture the academic

ambitions as well as the skills in co-curricular activities of the most important stakeholder i. e. student.

With sincere gratitude, I acknowledge the constant support and guidance extended by Shri Samir Somaiya, President- Somaiya Vidyavihar, and all the esteemed members of the Governing board and Academic council of the College. I also would like to acknowledge the Heads of the Departments and all the faculty members for their meticulous approach, commitment and significant contribution towards this endeavour for academic excellence.

Dr. Pradnya Prabhu
Principal

Acknowledgement

At the outset, I would like to thank our Principal Dr. Pradnya Prabhu for her guidance and support during the curriculum restructuring process. I am also grateful to all the esteemed members of the Board of Studies, for their constructive suggestions and contributions.

Above all, I am deeply indebted to all the young and vibrant colleagues in the Department of Statistics for the long and arduous work they have put in during the compiling of the restructured syllabus.

Mr. Prashant Shah
Chairperson
Board of Studies in Statistics

Table of Contents

Preamble

The underlying philosophy of the B.Sc. Statistics course is to develop theoretical and analytical skills of the students so that they may be absorbed in the corporate world or be able to pursue higher studies at the Master's level in Statistics. In the rapidly changing globalised market scenario, the need was felt to equip students with the capability to understand and handle the dynamic of statistics and the business world.

In order to achieve the above-mentioned objectives, a comprehensive revised syllabus comprising of topics relating to statistics, quantitative techniques and business have been included in the syllabus, giving wider coverage to the course contents, better organisation to enable easier assimilation of the same by the students, and a more professional touch to the course.

Education is one of the most critical yardsticks in any country's development. The new National Education Policy (NEP) 2020 is an essential and comprehensive policy framework that aims to revamp the country's educational system from its foundation and to bring it at par with global standards. The larger aim of this policy is to transform the Indian education system by making it more inclusive, flexible and relevant to the changing needs of the society. Some of the key features of this policy are the introduction of vocational training, elective courses, and emphasis on cultural studies, development of global skill sets and the promotion of multilingualism.

The policy seeks to bring about significant changes in the Higher Education structure, such as introducing a four-year undergraduate degree Programme, establishing multidisciplinary education and research universities, pooled credit bank and creating a National Research Foundation to promote and support research activities in various fields. The new education policy enables every student

to get quality education irrespective of their socio-economic background, gender or disability. NEP 2020 enables teachers to use a variety of learning techniques and experiments.

In the current fast paced world, simply cascading the knowledge in the classroom is not sufficient especially when the global requirements keep changing. Every learner should be encouraged to exchange ideas and thoughts in a collaborative approach. This leads to develop an environment which is cognitive in nature and not a one-way information flow. Keeping all this in mind, the curriculum under Learning Outcome-based Curriculum Framework (LOCF) is designed.

This Learning Outcome-based Curriculum Framework (LOCF) supports the fundamental principle of providing quality education in India. Our focus is to involve young minds to participate, contribute and add value at each stage in the field of their study. The introduction of Choice Based Credit System (CBCS) has maximized the benefits of the newly designed curriculum in multiple folds.

The LOCF will certainly help teachers to envisage the outcome expected from the learners at the end of the programme. For students, it will be a guide which shows how this curriculum will help them acquire all the skills and knowledge which are essential in their personal and academic growth. Higher education qualifications such as Bachelor's Degree Programme are awarded on the basis of demonstrated achievement of outcomes and academic standards; and this is the very essence of this curriculum.

1. Introduction

B.Sc. programme in Statistics as a major subject, consists of 132 credits spread over three academic years; each academic year consists of two semesters of 22 credits each. Along with Statistics, students have to take Mathematics as a minor subject in Sem-1 to Sem-4. This programme emphasizes both theory and practical and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics. Besides this, students will attain various 21st century skills like critical thinking, problem solving, analytic reasoning, cognitive skills, self-directed learning etc.

2. Learning Outcome based Curriculum Framework

LOCF focuses on curriculum framework, curriculum aims, learning targets and objectives. The curriculum framework also provides examples of effective learning, teaching and assessment practices. As the curriculum development is a collaborative and an on-going enhancement process, the LOCF instructs periodic reviews and revisions of the curriculum in accordance with the ever changing needs of students, teachers and society.

The framework describes how students are given exposure towards core knowledge of the subject, specialisation, choice based learning and other skill enhancement courses ensuring development of an integrated personality and employability. The template defines expected outcomes for the programme like core competency, communication skills, critical thinking, affective skills, problem-solving, analytical, reasoning, research-skills, teamwork, digital literacy, moral and ethical awareness, leadership readiness along with specific learning course outcomes at the starting of each course. The Learning Outcomes based Curriculum Framework (LOCF) for B.Sc. Statistics will certainly be a valuable document in the arena of outcome-based curriculum design.

2.1 Nature and extent of B.Sc. Statistics

The B.Sc. (Statistics) Program has some unique features such as well-structured practical and project work. Statistical software namely R, SPSS, Python etc. are used in practical courses and project work. Skill Enhancement Course (SEC) such as Optimization techniques in Sem-III and IV; Vocational Skill Courses (VSC) such as SQL and Tableau, c-programming, R and Python programming; Discipline Specific Elective courses (DSE) such as Demography and Vital Statistics, Biostatistics, Operation research, Actuarial Statistics is introduced in B.Sc. (Statistics) Program under NEP structure.

2.2 Programme Education Objectives (PEOs)

The overall aims of bachelor's degree programme in Statistics are to:

1. Familiarize students with basic to high-level statistical concepts.
2. Perform statistical analysis of the data and interpret it.
3. To prepare students for jobs by making them do projects.
4. Appreciate crucial role of statistics in national development
5. Apply statistical software for data analysis.
6. Develop the ability to use statistical knowledge and skills in other disciplines.

3. Graduate Attributes in Statistics

Attributes expected from the graduates of B.Sc. Statistics Program are:

GA 1: Disciplinary knowledge: The proposed curriculum is expected to provide the students in depth knowledge of Statistics. As a result, they will be able to apply statistical techniques in the data analysis.

GA 2: Communication Skills: Students are expected to develop the ability to express thoughts and ideas effectively, present complex information in a clear and concise manner using graphical, tabular format during the presentations.

GA 3: Critical thinking: The B.Sc. Statistics Program is designed to enrich the students with the ability to examine basic statistical issues in a more logical and methodical manner. Students are expected to strengthen themselves computationally and analytically.

GA 4: Problem solving: The students are expected to apply the appropriate statistical technique to solve real world problems.

GA 5: Analytical and scientific reasoning: The students are expected to develop statistical reasoning to analyse and interpret socio-economic data from a variety of sources; draw valid unbiased and consistent conclusions by applying statistical knowledge.

GA 6: Research-related skills: The students should be able to develop original thinking for formulating new problems and providing their solutions. As a result, they will be able to develop thought provoking skills.

GA 7: Cooperation/Team work: The students should be able to work effectively and respectfully with diverse teams. They should be able to harmonize group activities within group members.

GA 8: Information/digital literacy: The proposed B.Sc. (Statistics) program contains use of appropriate statistical software for analysis of data. The students are

expected to equip themselves with in-depth knowledge of programming languages/ statistical software for statistical computing.

GA 9: Self-directed learning: The students are expected to be familiar with data collection, compilation, analysis, interpretation and writing project reports independently.

GA 10: Moral and ethical awareness/reasoning: Students will be capable of avoiding unethical behaviour such as falsification or misrepresentation of data or committing plagiarism, appreciating environmental and sustainability issues.

GA 11: Leadership readiness/qualities: The students will be capable of synchronizing group activities within group members, motivating and inspiring team members accordingly, and using management skills to guide members in the right direction smoothly and efficiently.

GA 12: Lifelong learning: After completion of the course, the students are expected to develop independent and decision making thoughts which will help them in their future life.

4. Qualification descriptors

Undergraduate degree programmes of either 3 or 4-year duration, with multiple entry and exit points and re-entry options, with appropriate certifications such as:

- A UG certificate is awarded to students who opt to exit after completing one year (2 semesters) of study in the chosen fields of study with having secured 44 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period of seven years.
- A UG diploma is awarded to students who opt to exit after 2 years (4 semesters) of study with having secured 88 credits and in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period of seven years.
- A bachelor's degree is awarded after a 3-year (6 semesters) programme of study in major discipline with having secured 132 credits and minimum credit requirements as follows

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Course	48
2	Minor Stream Course	20
3	Discipline Specific Elective Course	06

4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	20
10	Open Elective Course	10
Total		132

- After completing the requirements of a three year Bachelor's degree, candidates who meet the minimum CGPA of 7.5 shall be allowed to continue studies in the fourth year of undergraduate program to pursue and complete Bachelor's degree with honours/research (subject to change).
- A 4-year bachelor's degree (honours) is awarded after eight semesters programme of study with having secured 176 credits and minimum credit requirements as follows:

Sr. No.	Category of Courses	Minimum credit requirements
1	Major Course	76
2	Minor Stream Course	24

3	Discipline Specific Elective Course	14
4	Ability Enhancement Course	08
5	Skill Enhancement Course	06
6	Value Education Course	04
7	Vocational Skill Course	08
8	Indian Knowledge System	02
9	Co-curricular Course	24
10	Open Elective Course	10
Total		176

- They should do a research project or dissertation under the guidance of a faculty member of the University/College. The research project/dissertation will be in the major discipline. The students who secure 176 credits, including 12 credits from a research project/dissertation, are awarded UG Degree with Research.

The 4-year bachelor's degree programme is considered a preferred option since it would provide the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

The students who complete three years of full-time B.Sc. (Statistics) programme will be awarded a Bachelor's Degree. Some of the expected learning outcomes that a student should be able to demonstrate on completion of a degree-level programme include the following:

- Use knowledge, understanding and skills required for identifying statistical problems and issues, collection of relevant quantitative and/or qualitative data drawing on a wide range of sources, and their application, analysis and evaluation using statistical methodologies
- Communicate the results of projects undertaken in an academic field accurately in a range of different contexts using the graphical and tabular
- Apply statistical knowledge and skills to several contexts and to identify and analyze problems and issues and seek solutions to real-life problems
- Demonstrate subject-related and transferable skills that are relevant to some of the job trades and employment opportunities

The list below provides a synoptic overview of possible career paths provided by an undergraduate training in Statistics:

Statistics being an interdisciplinary subject, career opportunities are in almost every field wherever analysis of data is required. After completing this program students may have career prospects in:

- Pharmaceuticals
- I.T. industry
- Data analytics
- Statistical Quality control
- Actuaries
- Banking
- Academics
- Machine learning & Artificial intelligence
- To determine optimum strategies in military
- Government organizations such as NSSO, NSO

Job Roles for B.Sc. Statistics graduate:

- Main job role of B.Sc. Statistics student is to do data analysis

Higher Education options for B.Sc. Statistics graduate:

- M.Sc. in Statistics
- MBA
- MCA
- IIT
- Actuarial Statistics
- Machine learning & Artificial Intelligence
- Six-Sigma Techniques

The learners who complete three years of full-time study of an undergraduate programme of study will be awarded a Bachelor's degree in Statistics.

5. Programme Specific Outcomes (PSOs)

The student graduating with the B.Sc. (Statistics) program should be able to

PSO I: Define and formulate Statistics related problems to solve a wide range of socio-economic problems.

PSO II: State importance of statistical computing, and the role of estimation and testing hypothesis to analyze the real-life problems using various statistical techniques.

PSO III: Evaluate the results of projects undertaken accurately, using the graphical, diagrammatic and tabular format.

PSO IV: Model Statistical experiments to analyze and interpret data collected using appropriate sampling techniques.

PSO V: Demonstrate relevant generic skills such as problem-solving skills, analytical skills, and personal skills such as the ability to work both independently and in a group

PSO VI: Use of statistical softwares to solve statistical problems

5.1 Course Mapping

Semester	PSO / Course	I	II	III	IV	V	VI
III	MJ I						
	MJ II						
	MN	√		√		√	√
	SEC						
	VSC						
	IKS						
	AEC						

	CC						
	OE						
IV	MJ I						
	MJ II						
	MN	√	√		√	√	√
	SEC						
	VSC						
	CC						
	OE						

6. Structure of B.Sc. Statistics Programme

The curriculum framework is designed around the choice-based credit system (CBCS). The programme consists of three years UG six semesters (two semesters per year) or four years UG (Honours) having eight semesters (two semesters per year). Credit Distribution for Eight Semesters is as follows:

Semester	MJ	DSE	SEC	VSC	MN	AEC	VEC	IKS	CC	FP	INT/ APT	OE	Total
I	6	-	-	-	6	4	2	-	2	-	-	2	22
II	6	-	-	-	6	3	2	1	2	-	-	2	22
III	6	-	3	2	4	1	-	1	2	-	-	3	22
IV	6	-	3	2	4	-	-	-	2	2	-	3	22
V	12	-	-	-	-	-	-	-	-	2	8	-	22
VI	12	6	-	4	-	-	-	-	-	-	-	-	22

BSc with Honours – 22 credits in Sem VII and VIII

BSc with Research – 22 credits in Sem VII and VIII

To acquire a degree in B.Sc. statistics a learner must study

1. **Major Courses (MJ):**

a) A course which is required to be opted by a candidate as a major course. The course designed under this category aims to cover the basics that a student is expected to imbibe in that particular subject or discipline.

b) Students may be allowed to change major within the broad discipline at the end of the second semester by giving her/him sufficient time to explore interdisciplinary courses during the first year.
c) There are twenty four Major courses (MJ), two each, in semesters I II, III and IV; and four each in semesters V to VIII.
d) Each Major Course is compulsory.
e) Each Major Course from semester I to VI is comprised of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 1 credit for practical of two hours per week in every semester.
f) Each Major Course from semester VII and VIII is comprised of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 1.5 credit for practical of three hours per week in every semester.
g) The purpose of fixing major papers is to ensure that the institution follows a minimum common curriculum so as to adhere to common minimum standards with other universities/institutions.

2. **Minor Stream Course (MN):**

a) A course is chosen by a candidate from the interdisciplinary stream as a minor course. Minor Stream courses help a student to gain a broader understanding beyond the major discipline.
b) Students who take a sufficient number of courses in an interdisciplinary area of study other than the chosen major will qualify for a minor in that discipline.
c) Students may declare the choice of the minor stream course at the end of the second semester from within the courses selected in the first year.
d) There are two each Minor stream course (MN), in semesters I and II. This Minor stream is comprised of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 1 credit for practical of two hours per week in every semester.

e) There is one each Minor stream course (MN) in semester III and IV. This Minor stream is comprised of 2 credits for theory ie. 30 hours; 2 lectures of each 1 hr per week and 2 credits for practical of four hours per week in every semester.
f) Each Minor stream Course is compulsory.

3. Ability Enhancement Courses (AEC)

a) The courses aim at enabling the students to acquire and demonstrate the core linguistic skills, including critical reading, expository and academic writing skills. These courses help students articulate their arguments and present their thinking clearly and coherently and recognize the importance of language as a mediator of knowledge and identity.
b) Students are required to achieve competency in a Modern Indian Language (MIL) and in the English language with special emphasis on language and communication skills.
c) There are five AEC courses which spread over three semesters (I to III).
d) Each student is supposed to take two AE courses in semester I - English language and Modern Indian language of 2 credits each.
e) There are two AEC courses in semester 2 - English language of two credits and Modern Indian language of 1 credit.
f) There is one AEC course in semester 3 - Modern Indian language of 1 credit.

4. Value Education Courses (VEC)

a) The course seeks to equip students with the ability to apply the acquired knowledge, skills, attitudes and values required to take appropriate actions for mitigating the effects of environmental degradation, climate change, and pollution, effective waste management, conservation of biological diversity,

management of biological resources, forest and wildlife conservation, and sustainable development and living.

b) The VEC courses offered are:

VEC I- Environmental Science I (2 credits) (Semester I),

VEC II- Environmental Science II (2 credits) (Semester II)

5. Co-Curricular courses (CC):

a) They are designed to provide skill-based knowledge and contain both lab/hands on training/field work.

b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.

c) There are two CC each in semester I to III – NCC (compulsory 1 credit course) and Other one from Music/Sports training program/Yoga/ Study Circle

d) There are three CC each in semester IV – NCC (compulsory 1 credit course), second one from Music/Sports training program/Yoga/ Study Circle of 1 credit and third one is Field project of 2 credits.

e) There are two CC semester V – Internship/ Apprenticeship (8 credit) and Field project (2 credit)

6. Open Elective (OE)

a) They are designed to provide multidisciplinary education.

b) Students can opt for one interdisciplinary Open Elective Course (OE) in each of semester I and II of two credits each.

c) Students can opt for one interdisciplinary Open Elective Course (OE) in each of semester III and IV of three credits each.

d) Open courses are offered in cognate disciplines by different departments in the college.

7. Indian Knowledge System (IKS)

a) They are designed to recognize the rich heritage of ancient and eternal Indian knowledge and thought as a guiding principle.
b) Students can opt for one General IKS in semester II – Indian cultural Heritage of one credit.
c) There is one IKS based on major subject in semester III of 1 credit.

8. Skill Enhancement Course (SEC):

a) They are designed to provide skill-based knowledge pertaining to the Major course to the learner.
b) The main purpose of these courses is to provide life skills in hands-on mode to increase employability.
c) There are Two skill enhancement courses offered. Each student is supposed to take one SEC in each semester III and IV of 3 credits each (2 credit theory and 1 credit practical).

9. Discipline Specific Elective Courses (DSE):

a) Elective courses offered under the major course subject of study.
b) There are two discipline specific elective courses (DSE), offered in semesters VI of 2 credits theory and 1 credit practical.
c) There is one discipline specific elective course (DSE), offered in semesters VII and VIII each of 2 credits theory and 2 credit practical.
d) There is one advanced level disciplinary course – Research Methodology of 4 credits offered in semester VII.

10. Vocational Skill Course (VSC)

a) Vocational courses are designed to provide practical, hands-on training, competencies, and proficiency to students, ultimately enhancing their skills and employability.

b) These courses are tailored to prepare individuals for specific careers and industries.

c) There are two VSC offered, one each in semester III to IV, each one is of two credits.

d) There is one VSC offered in semester VI of 4 credits.

11. On Job Training (OJT)

a) On Job training of 4 credits is offered in semester VIII to enhance the specific skills and competencies required for a particular job

b) OJT bridges the gap between theory and practical application, promoting a deeper understanding of concepts.

12. Internship/ Apprenticeship

a) Internship/ Apprenticeship have a prominent role in linking higher education with the requirements of industry and the world of work. Students are offered an internship/ apprenticeship embedded degree program to fulfil the objective of improving employability and forming robust industry academia linkage.

b) Internship/Apprenticeship of 8 credits is offered in semester V.

c) Field based learning /project should provide opportunities for students to understand the different socio-economic contexts. It aims at giving the students exposure to development related issues in rural and urban settings.

d) Two field projects each 2 credits are offered one in each semester IV and V.

6.1 Content

Sr. No	Semester	Course number	Course Code	Course title
1	III	MJ I		Course from Mathematics
2		MJ II		Course from Mathematics
3		MJ P		Based on MJ I and MJ II
4		MN	24US3STMNPD2	Probability Distributions - II
5		MN P	24US3STMNP	Based on Minor
6		SEC		Course from Mathematics
7		SEC - P		Course from Mathematics
8		VSC		Course from Mathematics
9		IKS		Course from Mathematics
10		AEC		Modern Indian Language Level I (Hindi/Marathi)
11		CC	24US3CCEMI	Emotional Intelligence
12		OE	24US3OEFHR / 24US3OEIFM / 24US3OESCW	Fundamentals of Human Rights / Introduction to Financial Market /Scientific Writing
Sr. No	Semester	Course number	Course Code	Course title

13	IV	MJ I		Course from Mathematics
14		MJ II		Course from Mathematics
15		MJ P		Based on MJ I and MJ II
16		MN	24US4STMNEST	Theory of Estimation
17		MN P	24US4STMNP	Based on Minor
18		SEC		
19		SEC - P		
20		VSC		
21		FP		
22		CC I	24US4CCSOL	Science of Life
23		CC II	24US4CCSPT	Sports Training Program
24		OE	24US4OEIWC / 24US4OEEGI / 24US4OEISS	Basic Of Investment And Wealth Creation / Emerging Gender Issues in India / Introduction to Soft Skills

6.2 Credit distribution for B.Sc. Statistics

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
III	MJ I	Course from Mathematics	2	1	3

	MJ II	Course from Mathematics	2	1	3
	MN	Probability Distributions - II	2	2	4
	SEC	Course from Mathematics	2	1	3
	VSC	Course from Mathematics	-	2	2
	AEC	Modern Indian Language	1	-	1
	IKS	Course from Mathematics	1	-	1
	CC	Emotional Intelligence	2	-	2
	OE	Fundamentals of Human Rights / Introduction to Financial Market /Scientific Writing	3	-	3
	Total				**22**
IV	MJ I	Course from Mathematics	2	1	3
	MJ II	Course from Mathematics	2	1	3
	MN	Theory of Estimation	2	2	4
	SEC	Course from Mathematics	2	1	3
	VSC	Course from Mathematics	-	2	2
	FP	Course from Mathematics	2	-	2
	CC I	Science of Life	-	1	1
	CC II	Sports training Program	-	1	1

	OE	Basic Of Investment And Wealth Creation / Emerging Gender Issues in India / Introduction to Soft Skills	3		3
	Total				**22**

6.3 Semester Schedule

Semester	Major Courses (MJ)	Minor Stream Courses (MN)	Ability Enhancement Courses (AEC)	Field Project (FP)	Indian Knowledge System (IKS)	Co-Curricular Course (CC)	Open Elective (OE)
III	1]MJI Course from Mathematics 2] MJ II Course from Mathematics 3] SEC Course from Mathematics 4] VSC	1] MN Probability Distribution - II	1] AECI Modern Indian Language Level		Course from Mathematics	1]Emotional Intelligence	Fundamentals of Human Rights / Introduction to Financial Market Introduction to Financial Market / Scientific Writing

	Course from Mathematics						
IV	1] MJ I Course from Mathematics 2] MJ II Course from Mathematics 3] SEC Course from Mathematics 4] VSC Course from Mathematics	1] MN Theory of Estimation	-	Course from Mathematics	-	1] Science of Life II] Sports Training Program	Basic Of Investment And Wealth Creation / Emerging Gender Issues in India / Introduction to Soft Skills

6.4 Course Learning Objectives

The three-year undergraduate Statistics programme is designed to familiarize students with significant developments in Statistics. The objective of structured syllabus in Statistics is to make the concepts and basics of Statistics clear and interesting to students and also to ensure the development of vertical growth in the subject. The idea behind this is to enable students to develop analytical skills and critical thinking.

It is our attempt that students achieve this objective through systematic reading and class lectures and through feedback on their written work-assignments, project, presentations, discussions etc. our intention is to enable students to formulate cogent arguments, presenting the necessary evidence to establish these, based on a training in Statistics.

7. Detailed B.Sc. Statistics Syllabus

S. Y. B.Sc. Syllabus with effect from the Academic year 2024–2025

Syllabus – S. Y. B.Sc. Statistics

Course No.	Course Title	Course Code	Credits	Periods (1 Hr)	Module	Lectures per module (1 hr)	Examination		
							Internal Marks	External Marks	Total Marks
SEMESTER III									
Minor Stream Courses THEORY									
I	Probability Distributions - II	24US3STMNPD2	2	30	2	15	20	30	50
Minor Stream Courses PRACTICAL									
I	Statistics Practical MN	24US3STMNP	2	60			CIA		50
SEMESTER IV									
Minor Stream Courses THEORY									
I	Theory of Estimation	24US4STMNEST	2	30	2	15	20	30	50
Minor Stream Courses PRACTICAL									

I	Statistics Practical MN	24US4 STMN P	2	60			CIA	50

S.Y. B. Sc. (STATISTICS) SEMESTER III

Minor Course

COURSE TITLE: Probability Distributions - II

COURSE CODE: 24US3STMNPD2 [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to: 1. Evaluate various measures of the probability distributions such as Geometric, Negative Binomial, Trinomial and Multinomial distributions 2. Study the properties of bivariate, trinomial and multinomial distribution.		
Module 1	**Univariate Distributions**	**[17L]**
Learning Objectives: The module is intended to 1. Obtain various measures of the Geometric, NBD, Normal, Gamma and Beta distributions. 2. Apply MGF, CGF techniques in finding the various measures of the distributions.		
Learning Outcomes: After the successful completion of the module, the learner will be able to:		

1. Compute various measures of the Geometric, NBD, Normal, Gamma and Beta distributions. 2. Identify the the relationship between various distributions		
1.1	Geometric Distribution: Definition, mean, mode, variance, distribution function, MGF, CGF, moments. Cumulants, coefficient of skewness and kurtosis, lack of memory property, obtain the distribution of X1 = k/ X1 + X2=n	[2L]
1.2	Negative Binomial Distribution (NBD) Definition, derivation of p.m.f., alternate form of NBD, mean, variance, MGF, CGF, monets, cumulants, skewness and kurtosis, recurrence relationship for NBD probabilities, NBD(k, p) as sum of the 'k' i.i.d. geometric variables with parameter 'p', Poisson distribution as a limiting case of NBD, fitting of the distribution.	[3L]
1.3	Normal Distribution; Definition, MGF, CGF, Mean, Median, Mode, Standard deviation, MGF , CGF , Moments & Cumulants (up to fourth order), odd and even ordered central moments, skewness & kurtosis, Mean absolute deviation, distribution of linear function of independent Normal variables. Fitting of Normal Distribution. Central Limit Theorem for i.i.d. random variables with proof	[6L]
1.4	Gamma and Beta Distribution:	[7L]

	Beta Distribution of Type I : Definition, raw moments, mean, variance, mode Beta Distribution of Type II : Definition, raw moments, mean, variance, mode, interrelations between beta type I and type II distributions Gamma Distribution: Definition, Concept of degrees of freedom. Mean, Median, Mode, variance, MGF, CGF, additive property, Sampling distributions of sample mean and sample variance and their independence for a sample drawn from Normal distribution, distribution of U / V, U / (U+V) where U and Y are independent chi square variates.	
Module 2	**Bivariate, Trinomial and Multinomial Distributions**	**[12L]**
Learning Objective: This module is intended to: 1. Understand extension of binomial distribution to Trinomial and Multinomial distribution. 2. Derive marginal and conditional distribution and other properties of Trinomial and Multinomial distribution.		
Learning Outcomes: After the successful completion of the module, the learner will be able to 1. Apply Trinomial and Multinomial distributions in real life problems. 2. Understand properties of these distributions.		
2.1	Discrete and continuous bivariate random variables, their probability function along with the properties. Marginal and conditional Distributions. Independence of Random	[6L]

	Variables. Conditional Expectation & Variance. Regression Function. Coefficient of Correlation. Transformation of variables	
2.2	Trinomial and Multinomial (With MGF concept) i) Definition of joint probability distribution of (X, Y). ii) Joint moment generating function, moments μ_{rs} where r=O, I, 2 and s=O, I, 2. iii) Marginal & Conditional distributions. Their Means & Variances. Correlation coefficient between (X, Y). iv) Distribution of the Sum X+Y. v) Extension to Multinomial distribution with parameters (n, pI , p2,...pk-I) where pI+ p2,+...pk-I+ pk= I. vi) Expression for joint MGF. Derivation of: joint probability distribution of (Xi , Xj). vii) Conditional probability distribution of Xi given Xj =xj	[6L]

References:

- Introduction to the theory of statistics: A. M. Mood, F.A. Graybill, D. C. Boyes, Third Edition; McGraw-Hill Book Company. (1974)
- Introduction to Mathematical Statistics: R.V.Hogg, A.T. Craig; Fourth Edition; Collier McMillan Publishers. 5th Edition (1995)
- Introduction to Mathematical Statistics: P.G. Hoel; Fourth Edition; John Wiley & Sons Inc. (1971)
- Fundamentals of Mathematical Statistics: S.C. Gupta, V.K. Kapoor; Eighth Edition; Sultan Chand & Sons. 9th Edition (1994)
- Mathematical Statistics: J.N. Kapur, H.C. Saxena; Fifteenth Edition; S. Chand & Company Ltd.

- An Outline of Statistical Theory Vol. I: A.M. Goon, M.K. Gupta, B. DasGupta; Third Edition; TheWorldPress Pvt. Ltd.

Question paper Template

S.Y. B. Sc. (STATISTICS) SEMESTER III

Minor Course

COURSE TITLE: Probability Distributions - II

COURSE CODE: 24US3STMNPD2 [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	10	5	3	3	4	-	25
II	8	5	3	3	3	3	25
Total marks per objective	18	10	6	6	7	3	50
% Weightage	36	20	12	12	14	6	100

S.Y.B.Sc. (Statistics)

Semester III - Practical

Course Code: 24US3STMNP [Credits: 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Apply the proper method to Evaluate various measures of the probability distribution.

2. Evaluate different methods to obtain the distributions of the transformed variables
3. Apply the appropriate sampling technique for drawing a sample in a given situation.

Learning Objectives:

1. To implement the suitable method to obtain the various measures of the probability distributions
2. To derive the probability distribution of the transformed variables
3. To select the best sampling technique and estimate its parameters.

Learning Outcomes:

After the successful completion of the practical, the learner will be able to:

1. Determine the various statistical measures of probability distributions.
2. Apply the suitable techniques to obtain the probability distribution of the transformed variable.
3. Choose the appropriate sampling technique.
4. Calculate the expected value and its variance for any sampling technique.
5. Estimate the sample size in conducting a sampling survey.

Group A (30Hrs)		
1.	Geometric Distribution	[4]
2.	Negative Binomial Distribution (NBD)	[6]
3.	Normal Distribution	[6]
4.	Central Limit Theorem	[4]

5.	Gamma Distribution	[6]
6.	Beta Distribution - Type I and II	[4]
Group B (30Hrs)		
1.	Simple random sampling for variables	[6]
2.	Simple random sampling for attributes	[6]
3.	Stratified Random Sampling	[4]
4.	Stratified Random Sampling using Proportional Allocation	[4]
5.	Stratified Random Sampling using Optimum Allocation	[4]
6.	Systematic Sampling	[6]

S.Y. B. Sc. (STATISTICS) SEMESTER IV

Minor Course

COURSE TITLE: Theory of Estimation

COURSE CODE: 24US4STMNEST [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to: 1. Acquaint with estimator, estimates, estimation techniques 2. Analyse properties of the estimator.		
Module 1	**Point Estimation and its Properties**	**[15L]**
Learning Objectives: The module is intended to		

1. Understand the concept of point and interval estimation. 2. Analyse the estimate based on different properties		
Learning Outcomes: After the successful completion of the module, the learner will be able to 1. Check unbiasedness and consistency properties of the estimator. 2. Obtain Cramer Rao Lower Bound for the estimator. 3. Calculate the sufficiency and efficiency of the estimator.		
1.1	Definitions and Notations: Notion of a parameter and parameter space. General problem of estimation, Definitions of Statistic, Estimator and Estimate. Concept of Point and Interval estimation	[2L]
1.2	Properties of estimator a) Unbiasedness: Definition of an unbiased estimator, biased estimator, positive and negative bias, examples (these should include unbiased and biased estimators for the same parameters). Proofs of the following results regarding unbiased estimators. Two distinct unbiased estimators of $\varphi(\theta)$ give rise to infinitely many unbiased estimators. If T is an unbiased estimator of θ , then $\varphi(T)$ is unbiased estimator of $\varphi(\theta)$ provided $\varphi(.)$ is a linear function. b) Sufficiency: Definition of likelihood function as a function of the parameter θ for a random sample from discrete and continuous distributions. Concept and definition of Sufficiency, definition of sufficient statistic through (i) conditional distribution (ii) Fisher Neyman factorization	[13L]

	criterion. Obtain sufficient statistic for standard distributions c) Efficiency, Fisher information function: Amount of information contained in statistic T = T(X1, X2, ..., Xn). Cramer- Rao Inequality: Statement and proof, Cramer – Rao Lower Bound (CRLB), definition of minimum variance unbiased estimator (MVUE) of ø(θ) Comparison of variance with CRLB, relative efficiency of T1 w.r.t. T2. Efficiency of unbiased estimator T w.r.t. CRLB. d) Consistency: Definition. Proof of the following: An estimator is consistent if its bias and variance both tend to zero as the sample size tends to infinity. If T is consistent estimator of θ and φ(.) is a continuous function then φ(T) is consistent estimator of φ (θ)	
Module 2	**Methods of Estimation**	**[15L]**
Learning Objective: This module is intended to: 1. know the different methods of estimating the the parameters		
Learning Outcomes: After the successful completion of the module, the learner will be able to 1. Estimate the parameter/s using the appropriate method of estimation.		
2.1	Method of Maximum Likelihood Estimation (M.L.E.): Principle of M.L.E. Procedure to find M.L.E., Properties of M.L.E (without proof) Derivation of M.L.E. for parameters of standard distributions (case of one and two unknown	[5L]

	parameters). M.L.E. of θ in uniform distribution over i) (O, θ) ii) (- θ, θ) M.L.E. of θ in f(x ; θ)= Exp {-(x- θ)}, x > θ.	
2.2	Method of Moments for one and two parameter family: Definition, Derivation of moment estimators for standard distributions. Illustrations of situations where M.L.E. and Moment Estimators are distinct and their comparison.	[5L]
2.3	Method of Minimum Chi-square and Modified Minimum Chi-square: Definition, Simple examples	[5L]

References:

- R.V.Hogg, A.T. Craig (1995): Introduction to Mathematical Statistics, Fifth Edition, Prentice Hall Of India/ Phi
- R.V.Hogg, E. A.Tannis (2011): Probability and Statistical Inference, Pearson Education.
- Rohatgi V.K. and Ehsanes Saleh A. K. MD. (2003). An Introduction to Probability Theory and Mathematical Statistics, (Wiley Eastern, 2nd Ed.)
- John E. Freund"s Mathematical Statistics (2001): Fifth Edition; Phi (Eastern Eco. Ed.).
- P.G. Hoel: Introduction to Mathematical Statistics; Fourth Edition; John Wiley & Sons Inc.
- S.C. Gupta, V.K. Kapoor (2016): Fundamentals of Mathematical Statistics; Eighth Edition; Sultan Chand & Sons.
- J.N. Kapur, H.C. Saxena (2014): Mathematical Statistics; First Edition; S. Chand & Company Ltd.

Question paper Template

S.Y. B. Sc. (STATISTICS) SEMESTER IV

COURSE TITLE: Theory of Estimation

COURSE CODE: 24US4STMNEST [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	6	5	10	-	4	-	25
II	4	5	12	-	4	-	25
Total marks per objective	10	10	22	-	8	-	50
% Weightage	20	20	44	-	16	-	100

S.Y.B.Sc. (Statistics)

Semester IV - Practical

Course Code: 24US4STMNP [Credits: 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Estimate the parameter using different estimation methods. 2. Decide the best estimator based on the properties. 3. Evaluate various probabilities using sampling distributions. 4. Apply the proper sampling distributions to draw conclusions about problems that arise in applied statistics. 5. Construct the confidence intervals for the population parameter

Learning Objectives:

1. To know the different methods of estimation
2. To check the properties of the estimation
3. To know the various sampling distributions along with the relations between them.
4. To formulate the null hypothesis and carry out the test procedure based on the suitable sampling distribution.
5. To construct the confidence interval for the population parameter

Learning Outcomes:

After the successful completion of the practical, the learner will be able to:

1. Estimate the parameters of the probability distribution
2. Decide the best estimator
3. Use the different applications of the sampling distributions (t, F and χ^2) .
4. Draw the proper conclusions while testing the null hypothesis
5. Obtain the confidence intervals for the population parameter.

Group A (30Hrs)		
1.	Unbiasedness	[4]
2.	Consistency, Sufficiency	[8]
3.	Efficiency	[8]
4.	Method of Likelihood Estimation	[4]
5.	Method of Moments	[6]
Group B (30Hrs)		

1.	Chi Square distribution	[2]
2.	t - distribution	[4]
3.	F - distribution	[5]
4.	Testing of Hypothesis	[5]
5.	Applications of t, F and chi square distributions	[14]

8. Teaching learning process

The pedagogic methods adopted, involve direct lectures, tutorial discussions, as well as technology- supported presentations. We believe that education is interactive and all sessions between students and teachers are based upon reciprocity and respect.

I) The lectures (of 1 hr duration) delivered to one whole class at a time systematically deal with the themes of the syllabus. This constitutes the core of the teaching- learning process. The students are provided with bibliographic references and encouraged to go through at least some readings so that they could be more interactive and ask more relevant questions in the class. This also helps obtain knowledge beyond the boundaries of the syllabi.

2) Wherever needed, teachers use audio-video based technology devices (e. g. power point, YouTube videos) to make their presentations more effective. Some courses require that students see a documentary or feature film and course themes are structured so that discussions of these will further nuance the critical engagement of students with ideas introduced in their textual materials.

3) Remedial coaching, bridge courses are adopted to enhance the scope of learning for the learners. Remedial sessions are conducted to offer assistance on certain advanced topics. Bridge courses facilitate to develop a concrete basis for the topics to be learnt in the coming academic year.

9. Assessment Methods

Evaluation Pattern: Theory

- Assessments are divided into two parts: Mid Semester Examination (MSE) and End Semester Examination (ESE).
- The Mid Semester Examination shall be conducted by the College at the Mid of each semester (20 M) – Duration: 30 Min.
- The End Semester Examination shall be conducted by the College at the end of each semester. (30M) - Duration: 1 hour

End Semester Examination Paper Pattern

Question No	Module	Marks with Option	Marks without Option
1	I	5 M x 5 Q = 25 M	3 M x 5 Q = 15 M
2	II	5 M x 5 Q = 25 M	3 M x 5 Q = 15 M

Each question will have six sub questions a, b, c, d, e, f and out of which any three should be answered.

Evaluation pattern: Practical

- Continuous Assessment for 50 Marks throughout the entire semester.
- 50 Marks Evaluation as per the following rubrics

Major Course	CIE	Experimental Report	Viva	Total
MJ I	15 M	5 M	5 M	25 M
MJ I	15 M	5 M	5 M	25 M

10. Programme and Course Code Format

The course is coded according to following criteria:

1. First two numbers in each course code indicates year of implementation of syllabus (23- year of implementation is 2023-24)
2. Third letter 'U' designates undergraduate
3. Fourth letter 'S' designate Science discipline and the digit followed is for semester number (S1 – 1st Semester)
4. Letter 'ST' is for Statistics discipline (ST- Statistics). This forms the programme code 23USIST. For the further course codes programme code is amended as follows
5. To represent Major Course (MJ) followed by course number digit (1/2/3/4) and three lettered code representing the title of the course.
6. To represent Minor Stream Course (MN) followed by course number digit (1/2/3/4) and three lettered code representing the title of the course.
7. For Ability enhancement course code, (AE) alphabets followed by a digit (1/2) followed by 'EVS'-Environmental science are used.
8. For Value Added course code, (VA) alphabets followed by a digit (1/2) followed by 'EVS'-Environmental science are used.
9. For Indian Knowledge System course code, (IK) alphabets followed by a digit (1/2) followed by 'ICH'- Indian Cultural Heritage is used.
10. For Co-curricular course code, (CC) alphabets followed by a digit (1/2).
11. For Open Elective course code, (OE) alphabets followed by a digit (1/2).
12. 'P' followed by digit indicates practical course number. (Practical course number will be added for semesters only where there is more than one course.