SOMAIYA VIDYAVIHAR

K J Somaiya College of Science & Commerce

Autonomous (Affiliated to University of Mumbai)

Somaiya TRUST

Learning Outcomes based Curriculum Framework

(LOCF)

For

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

Undergraduate Programme

From

Academic year

2023-24

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
1	Mr. Prashant Shah	Chairman	Head of the Department, 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	Mr. Prasad Patki	Head Department of Statistics	Bhavans college
2	Dr. Alok Dabade	Assistant Professor	University of Mumbai
Representative from Industry/Corporate sector/Allied area			
1	Mr. Lalit Kothawale	-	Willis Processing Services (India) Private Limited
2	Mr. Tanmay Ghanekar	Data Scientist	IT and Service industry
Meritorious Alumnus			
1	Mr. Salim Ramzanzli Shaikh	T.Y.B.Sc. (Statistics)	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

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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. with 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 1 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 three year Bachelor's degree, candidate 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 JAM
- 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 hypotheses to analyze 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
I	MJ I						
	MJ II						
	MN I	√		√	√	√	√
	MN II	√				√	√
	AE I						
	AE II						
	VA						
	CC						
	OE						
II	MJ I						
	MJ II						
	MN I	√		√	√	√	√
	MN II	√				√	√
	AE I						
	AE II						
	VA						
	IK						
	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 Semester 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 course helps a student to gain a broader understanding beyond the major discipline.
b) Students who take a sufficient number of courses in 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 AE 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 AE courses in semester 2 - English language of two credits and Modern Indian language of 1 credit.

f) There is one AE 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 1- 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 the semester I and II of two credit each.
c) Students can opt for one interdisciplinary Open Elective Course (OE) in each of the semester III and IV of three credit 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 credit 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 advance 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.

II. 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.

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

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

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.

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	I	MJ I		Course from Mathematics
2		MJ II		Course from Mathematics
3		MJ P		Based on MJ I and MJ II
4		MN I	23USISTMNIDES1	Descriptive Statistics-I
5		MN II	23USISTMN2PRR	Introduction To Probability and Random Variables
6		MN P	23USISTMNP	Based on MN I and MN II
7		AEC I		Communication in English Level I
8		AEC II		Modern Indian Language Level I (Hindi/Marathi)
9		VEC		Environmental Science I
10		CC I		NCC
11		CC II		Music/Yoga/Sports Training Program Level I/ Study Circle
12		OE		Economics
13	II	MJ I		Course from Mathematics
14		MJ II		Course from Mathematics
15		MJ P		Based on MJ I and MJ II
16		MN I	23US2STMNIDES2	Descriptive Statistics-II

17		MN II	23US2STMN2PRD1	Probability Distributions - I
18		MN P	23US2STMNP	Based on MN I and MN II
19		AEC I		Communication in English Level II
20		AEC II		Modern Indian Language Level II (Hindi/Marathi)
21		VEC		Environmental Science - II
22		IKS		Indian Cultural Heritage
23		CC I		NCC
24		CC II		Music/Yoga/Sports Training Program Level I/ Study Circle
25		OE		Economics

6.2 Credit distribution for B.Sc. Statistics

Semester	Course number	Course title	Credits		
			Theory	Practical	Total
I	MJ I	Course from Mathematics	2	1	3
	MJ II	Course from Mathematics	2	1	3
	MN I	Descriptive Statistics-I	2	1	3
	MN II	Introduction To Probability and Random Variables	2	1	3
	AEC I	Communication in English Level I	2		2

	AEC I	Modern Indian Language Level I	2		2
	VEC	Environmental Science I	2		2
	CC I		1		1
	CC II		1		1
	OE	Economics	2		2
	Total				**22**
II	MJ I	Course from Mathematics	2	1	3
	MJ II	Course from Mathematics	2	1	3
	MN I	Descriptive Statistics-II	2	1	3
	MN II	Probability Distributions - I	2	1	3
	AEC I	Communication in English Level II	2		2
	AEC II	Modern Indian Language Level II	1		1
	VEC	Environment Science - II	2		2
	IKS	Indian Cultural Heritage	1		1
	CC I		1		1
	CC II		1		1
	OE	Economics	2		2
	Total				**22**

6.3 Semester Schedule

Semester	Major Courses (MJ)	Minor Stream Courses (MN)	Ability Enhancement Courses (AEC)	Value Added Course (VEC)	Indian Knowledge System (IKS)	Co-Curricular Course (CC)	Open Elective (OE)
I	I]MJI Course from Mathematics 2] MJ II Course from Mathematics	I] MN I Descriptive Statistics-I 2] MN II Introduction To Probability and Random Variables	I] AEC I Communication in English Level I 2] AEC II Modern Indian Language Level I	Environment Science I	-	I] NCC II] Music/ Yoga/ Sports Training Program Level I/ Study Circle	Economics
II	I] MJI Course from Mathematics 2] MJ II Course from Mathematics	I] MN I Descriptive Statistics-II 2] MN II Probability Distributions - I	I] AEC I Communication in English Level II 2] AEC II Modern Indian Language Level II	Environment Science II	Indian Cultural Heritage	I] NCC II] Music/ Yoga/ Sports Training Program Level I/ Study Circle	Economics

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

F. Y. B.Sc. Syllabus with effect from the Academic year 2023–2024

Syllabus – F. Y. B.Sc. Statistics

Course No.	Course Title	Course Code	Credits	Periods (1 Hr)	Module	Lectures per module (1 hr)	Examination Marks		
							Internal	External	Total
SEMESTER I									
Minor courses THEORY									
I	Descriptive Statistics-I	23USISTMJIDESI	2	30	2	15	20	30	50
II	Introduction To Probability and Random Variables	23USISTMJ2PRR	2	30	2	15	20	30	50
Minor courses PRACTICAL									
		23USISTMJP	2	60			CIA		50
SEMESTER II									
Minor courses THEORY									
I	Descriptive Statistics-II	23US2STMJIDES2	2	30	2	15	20	30	50
II	Probability Distributions - I	23US2STMJ2PRDI	2	30	2	15	20	30	50
Minor Courses PRACTICAL									
		23US2STMJP	2	60			CIA		50

F.Y. B. Sc. (STATISTICS) SEMESTER I

Minor Course- I

COURSE TITLE: Descriptive Statistics-I

COURSE CODE: 23USISTMNIDES1 [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to: 1. Identify the data type, classify, tabulate and represent it graphically 2. Compute appropriate measure of central tendency to be used		
Module 1	**Data: Types, Collection and Management**	**[15L]**
Learning Objectives: The module is intended to 1. Understand the importance of the data and different data types. 2. Summarise and present the data in tabular / diagrammatic manner.		
Learning Outcomes: After the successful completion of the module, the learner will be able to: 1. Identify the data type, classify, tabulate and represent it graphically.		
1.1	Types of data: Qualitative and Quantitative data, Time series and Cross Sectional data, Discrete and Continuous data. Scale of Measurement: Nominal scale, Ordinal scale, Interval scale, Ratio scale. Classification and Tabulation of the data.	[3L]
1.2	Analysis of Categorical Data: Introduction to classes, Notations used, dichotomous classification, contingency tables for two and three attributes, order of the frequency,	[6L]

	proof of total number of frequencies in case of 'k' attributes is 3^k Consistency: Derivations of conditions of consistency of the data in case of two and three attributes Independence of the attributes: Derivations of the conditions of the independence of the two attributes. Conditions for positive and negative association Association of the two attributes: Coefficient of association, Yule's coefficient of colligation. Derivation of relationship between the two coefficients.	
1.3	Frequency Distribution: Univariate Frequency distribution for continuous and discrete variable, Relative frequency, cumulative frequencies Bivariate frequency distribution, marginal and conditional frequency distribution Graphical representation: Histogram, Frequency polygon, Frequency curve and Ogives. Diagrammatic representation: Bar, Rectangle, Square, Pyramid, Stem and Leaf diagram.	[6L]
Module 2	**Measures of Central Tendency or Location**	**[15L]**
Learning Objective: This module is intended to: 1. Introduce various measures of central tendencies		
Learning Outcomes: After the successful completion of the module, the learner will be able to		

1. Compute appropriate measures of central tendency to be used.		
2.1	Introduction to Measure of Central Tendency, Requisites of good measure of central tendency	[2L]
2.2	Arithmetic mean (A.M) and its properties, simple A.M, weighted A.M., Combined mean, merits and demerits	[4L]
2.3	Geometric Mean (G.M.), Harmonic Mean (H.M.), merits and demerits of G.M. and H.M. Relationship between A.M., G.M. and H.M.	[3L]
2.4	Positional Averages: Quantiles (Median, Quartiles, Deciles, Percentiles), Mode. Locating these averages graphically	[4L]
2.5	Empirical relationship between mean, median and mode, proper selection of an average.	[2L]

References:

- Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. I, The World Press Pvt. Ltd., Kolkata.
- Spiegel M.R.: Theory and Problems of Statistics, Schaum's Publications series Tata McGraw-Hill.
- Neil Weiss: Introductory Statistics: Pearson Publishers
- Surinder Kundu: Business Statistics
- K. V. S. Sarma: Statistics Made Simple: Do it yourself on PC. Prentice Hall of India Pvt. Ltd., New Delhi.
- Agarwal B.L. : Basic Statistics, New Age International Ltd.

Question paper Template

F.Y. B. Sc. (STATISTICS) SEMESTER I

Minor Course- I

COURSE TITLE: Descriptive Statistics-I

COURSE CODE: 23USISTMNIDES1 [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

F.Y. B. Sc. (STATISTICS) SEMESTER I

Minor Course- II

COURSE TITLE: Introduction To Probability and Random Variables

COURSE CODE: 23USISTMN2PRR [CREDITS - 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Explain different hierarchical approaches to be used to calculate probability in a given scenario. 2. Compute probability using addition and multiplication rules. 3. Distinguish between discrete and continuous random variables.

4. Define probability function and cumulative distribution function of discrete and continuous random variables
5. Apply various properties of expectations of discrete random variables

Module 1	Elementary Probability Theory	[15L]

Learning Objectives:

The module is intended to

1. Explain basic concepts in probability and different types of events
2. Compute probability using addition and multiplication rules.

Learning Outcomes:

After the successful completion of the module, the learner will be able to

1. Differentiate between different types of events.
2. Compute probability using different approaches such as Classical, Empirical and Axiomatic.
3. Apply probability rules such as addition, multiplication and Bayes' rule

1.1	Random Experiment, Sample Point & Sample Space, Definition of Event, Elementary Event, Algebra of Events (occurrence of at least one, none, all, exactly one event), mutually exclusive events, exhaustive events	[3L]
1.2	Classical, Empirical and Axiomatic definitions of probability.	[3L]
1.3	Conditional Probability, Independence of n Events (n = 2, 3), examples of pair-wise and complete independence. Addition theorem with proof.	[5L]

1.4	Multiplication Theorem and Bayes' rule (All theorems with proofs)	[4L]
Module 2	**Random Variables and Properties of Expectations of Random Variables**	**[15L]**

Learning Objectives:

This module is intended to:

1. Define different types of random variables.
2. Obtain probability function and cumulative distribution function for discrete and continuous random variables.
3. Explain properties of expectations of discrete and continuous random variables.

Learning Outcomes:

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

1. Distinguish between discrete and continuous random variables.
2. Apply properties of probability function and cumulative distribution function of discrete and continuous random variables.
3. Apply various properties of expectations of discrete random variables.

2.1	Definition: Univariate discrete and continuous random variables, probability function, cumulative distribution function of discrete and continuous random variables	[5L]
2.2	Theorems on Expectation and variance of univariate discrete and continuous random variables, Raw and Central Moments and their relationships (with proof).	[5L]

2.3	Bivariate discrete random variable, Joint probability mass function of two random variables, Marginal and Conditional probability distributions, Independence of two random variables.	[5L]

References:

- Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. I, The World Press Pvt. Ltd. Kolkata.
- M. N. Welling, P. P. Khandeparkar, R. J. Pawar and S. S. Naralkar: Descriptive Statistics, Manan Prakashan, 2nd Revised Edition 2014.
- Gupta Sc and V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons Publications, 10th Revised Edition 2000

Question Paper Template

F.Y. B. Sc. (STATISTICS) SEMESTER I

Minor Course- II

COURSE TITLE: Introduction To Probability and Random Variables

COURSE CODE: 23USISTMN2PRR [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	5	5	5	-	25
II	-	10	5	5	5	-	25
Total marks per objective	5	15	10	10	10		50
% Weightage	10	30	20	20	20	-	100

F. Y. B. Sc. (STATISTICS)

SEMESTER I - Practical

COURSE CODE: 23USISTMNP Credit- 02

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Classify, tabulate and represent the data graphically. 2. Compute appropriate measure of central tendency to be used 3. Calculate probability in a given scenario. 4. Distinguish between discrete and continuous random variables.

5. Apply various properties of expectations of discrete & continuous random variables
Learning Objectives: The Practical is intended to 1. Summarise and present the data in tabular / diagrammatic manner. 2. Calculate appropriate measure of central tendency to be used. 3. Obtain probability function and cumulative distribution function for discrete and continuous random variables.
Learning Outcomes: After the successful completion of the practical, the learner will be able to: 1. Present data in tabular / diagrammatic manner. 2. Calculate appropriate measure of central tendency to be used. 3. Apply properties of probability function and cumulative distribution function of discrete and continuous random variables.

Minor Course I	Descriptive Statistics-I
1. Classification and Tabulation 2. Theory of attributes 3. Diagrammatic and Graphical representation 4. Measures of Central tendency-I 5. Measures of Central tendency-II	

Minor Course II	Introduction To Probability and Random Variables
1. Basics of Probability. 2. Conditional Probability and Independence of events.	

3. Probability based on Bayes Theorem and Multiplication rule. 4. P.d.f and c.d.f of discrete variables. 5. P.d.f and c.d.f of continuous variables. 6. Expectation, Variance, Raw moments and Central moments.
References: • Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. I, The World Press Pvt. Ltd. Kolkata. • M. N. Welling, P. P. Khandeparkar, R. J. Pawar and S. S. Naralkar: Descriptive Statistics, Manan Prakashan, 2nd Revised Edition 2014. • Gupta Sc and V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons Publications, 10th Revised Edition 2000

F.Y. B. Sc. (STATISTICS) SEMESTER II

Minor Course- I

COURSE TITLE: Descriptive Statistics-II

COURSE CODE: 23US2STMNIDES2 [CREDITS - 02]

Course Learning Outcomes		
After the successful completion of the Course, the learner will be able to 1. Calculate various measures of absolute and relative dispersion 2. Measure the degree of correlation between two variables 3. Fit different types of curves to the data using the method of least square		
Module 1	**Absolute and Relative Measures of Dispersion**	**[15L]**
Learning Objectives: The module is intended to 1. Introduce various measures of variation		
Learning Outcomes: After the successful completion of the module, the learner will be able to 1. Calculate appropriate measure of variation.		
1.1	Range, Interquartile Range, Quartile Deviation, Mean Absolute Deviation, Standard Deviation (Variance) and their relative measures, Combined variance	[5L]
1.2	Raw and Central moments up to fourth order and the relationship between them (with proof)	[5L]
1.3	Measures of Skewness and Kurtosis	[5L]
Module 2	**Bivariate Correlation and Linear Regression**	**[15L]**

Learning Objectives:

This module is intended to:

1. Interpret the relationship between two variables using graphical and analytical methods.
2. Establish the relationship between the variables using regression analysis
3. Evaluate various properties of the regression and correlation coefficient.
4. Fit various curves using method of least squares

Learning Outcomes:

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

1. Compute degree of relationship between the two variables using different methods
2. Fit different types of curves to the data using the method of least square.

2.1	Scatter diagram, Covariance between two variables, Relationship between variance and covariance	[3L]
2.2	Product Moment correlation coefficient and its properties, graphical interpretation, Rank correlation Spearman's measure.	[3L]
2.3	Principle of least square fitting of a straight line, fitting of curves reducible to linear form by transformation and fitting of quadratic curve using method of least squares.	[4L]
2.4	Concept of linear regression, fitting of a linear regression line by method of least square. Relation between regression coefficients and correlation coefficient.	[5L]

References:

- Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. I, The World Press Pvt. Ltd., Kolkata.
- Spiegel M.R.: Theory and Problems of Statistics, Schaum's Publications series Tata McGraw-Hill.
- Neil Weiss: Introductory Statistics: Pearson Publishers
- Surinder Kundu: Business Statistics
- K. V. S. Sarma: Statistics Made Simple: Do it yourself on PC. Prentice Hall of India Pvt. Ltd., New Delhi.
- Agarwal B.L. : Basic Statistics, New Age International Ltd.

Question Paper Template

F.Y. B. Sc. (STATISTICS) SEMESTER II

Minor Course- I

COURSE TITLE: Descriptive Statistics-II

COURSE CODE: 23US2STMNIDES2 [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	10	5	5	2	3	-	25
II	10	5	5	-	3	2	25
Total marks per objective	20	10	10	2	6	2	50

% Weightage	40	20	20	4	12	4	100

F.Y. B. Sc. (STATISTICS) SEMESTER II

Minor Course- II

COURSE TITLE: Probability Distributions - I

COURSE CODE: 23US2STMN2PRD1 [CREDITS - 02]

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Compute probabilities using various discrete probability distributions 2. Compute probabilities using various continuous probability distributions

Module 1	Standard Univariate Discrete Probability Distributions	[15L]

Learning Objectives:

The module is intended to

1. Identify appropriate discrete probability distributions.
2. Explain the relationship amongst various discrete probability distributions.
3. Compute expected frequencies by estimating appropriate parameters of the given distribution.

Learning Outcomes:

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

1. Construct various discrete probability distributions
2. Examine properties, applications and relationships amongst various discrete probability distributions

3. Fit discrete probability distribution by estimating appropriate parameters		
1.1	Degenerate distribution, Bernoulli distribution, binomial distribution, hypergeometric distribution, derivation of its expectation and variance. Relation between binomial and hypergeometric distribution (With proof). Derivation of its recurrence relation to calculate binomial probabilities.	[6L]
1.2	Poisson distribution, derivation of its expectation and variance, Relation between binomial and poisson distribution (With proof), Derivation of its recurrence relation to calculate binomial probabilities.	[5L]
1.3	Uniform distribution, derivation of its expectation and variance.	[2L]
1.4	Fitting of binomial and poisson distributions	[2L]
Module 2	**Standard Univariate Continuous Probability Distributions**	**[15L]**

Learning Objectives:

This module is intended to:

1. Compute probabilities using Rectangular, Exponential probability distributions.
2. Explain the properties of Normal and standard normal distributions.
3. Compute probabilities of normal random variables using standard normal probability tables.

Learning Outcomes:

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

1. Compute probabilities using Rectangular, Exponential probability distributions.
2. Calculate normal probabilities using standard normal probability table.
3. Apply additive property of independent normal variates and Central limit theorem.
4. Apply normal approximation to binomial and Poisson distribution.

2.1	Rectangular distribution: Derivation of cumulative distribution function, mean, median and variance.	[3L]
2.2	exponential distribution: Derivation of cumulative distribution function, mean, median and variance	[4L]
2.2	Properties of normal distribution, normal curve (without proof), Normal Approximation to binomial and Poisson distributions (without proof).	[8L]

References:

- Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. I, The World Press Pvt. Ltd., Kolkata.
- Surinder Kundu: Business Statistics
- Gupta Sc and V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons Publications, 10th Revised Edition 2000
- R. J. Shah: Statistical Methods, Sheth Publication, Ist Edition 2010

Question Paper Template

F.Y. B. Sc. (STATISTICS) SEMESTER II

Minor Course- II

COURSE TITLE: Probability Distributions - I

COURSE CODE: 23US2STMN2PRD1 [CREDITS - 02]

Module	Remembering/ Knowledge	Understanding	Applying	Analysing	Evaluating	Creating	Total marks
I	5	5	5	5	5	-	25
II	-	10	5	5	5	-	25
Total marks per objective	5	15	10	10	10		50
% Weightage	10	30	20	20	20	-	100

F. Y. B. Sc. (STATISTICS)

SEMESTER II - Practical

COURSE CODE: 23US2STMNP Credit- 02

Course Learning Outcomes
After the successful completion of the Course, the learner will be able to: 1. Compute various absolute and relative measures of dispersion. 2. Compute correlation coefficient between two variables. 3. Fit curves, simple linear regression model to the given data. 4. Compute probabilities using various discrete and continuous probability distributions 5. Compute probabilities of normal random variables using standard normal probability tables.

Learning Objectives:

The practical is intended to

1. Introduce various measures of variation.
2. Establish the relationship between the variables using regression analysis
3. Evaluate various properties of the regression and correlation coefficient.
4. Fit various curves using method of least squares
5. Identify appropriate discrete probability distributions.

Learning Outcomes:

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

1. Compute various measures of dispersion.
2. Compute bivariate correlation coefficient.
3. Fit different curves to the data.
4. Fit a simple linear regression model to the data.
5. Compute probabilities using various standard discrete and continuous distributions.
6. Apply properties of normal variates and Central limit theorem.

Minor Course I	Descriptive Statistics-II

1. Measures of Dispersion-I
2. Measures of Dispersion-II
3. Correlation coefficient
4. Fitting of Curves
5. Simple linear regression

Minor Course II	Probability Distributions - I

1. Binomial Distribution

2. Hypergeometric Distribution
3. Poisson Distribution
4. Uniform Distribution
5. Exponential & Rectangular Distribution
6. Normal Distribution

References:

- Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. I, The World Press Pvt. Ltd., Kolkata.
- Surinder Kundu: Business Statistics
- Gupta Sc and V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons Publications, 10th Revised Edition 2000
- R. J. Shah: Statistical Methods, Sheth Publication, Ist Edition 2010

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 I 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

Minor Course	CIE	Experimental Report	Viva	Total
I	15 M	5 M	5 M	25 M
II	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.