Outcome BasedCurriculum
For
Master of Science
Statistics Program

Academic Session: 2024-2025, 2025-2026 & 2026-2027

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Part A:

1. Comilla University at a Glance:

Comilla University is a public university located in Kotbari, Comilla, Bangladesh. It was established in 2006, and it is the 26th public university in Bangladesh. The university was founded with the goal of providing higher education opportunities to students all over the Bangladesh. The university has a beautiful and spacious campus covering an area of 250 acres. It is situated in a serene environment, surrounded by lush green trees, and is an ideal place for learning. The campus is equipped with all the necessary facilities and infrastructure required for students to excel in their academic pursuits. Comilla University offers undergraduate and graduate programs in various fields, including Arts, Science, Business Administration, Social Science, Engineering and Law. The university has a distinguished faculty, many of whom have earned their Ph.D. degrees from renowned universities around the world. The faculty members are committed to providing quality education to their students and have a strong focus on research. The university has a modern library with a vast collection of books, journals, and research papers. The library is a valuable resource for students and researchers who can access the latest information in their respective fields. The university also has well-equipped laboratories and computer facilities that cater to the needs of students and researchers. Apart from academic programs, Comilla University offers various extracurricular activities for students to engage in. The university has several clubs and organizations, including cultural, sports, and debate clubs. These clubs help students develop their leadership skills, socialize with their peers, and explore their talents outside the classroom. Comilla University has a vibrant and diverse student community, with students from different regions of Bangladesh and other countries. The university provides a welcoming and inclusive environment for all students, regardless of their background or beliefs.

2. Title of the Academic Program **:** Masters of Science in Statistics

3. Name of the University **:** Comilla University

4. Vision of the University **:** Comilla University is committed to empowering society, advancing development, promoting human welfare and a sustainable planet.

5. Mission of the University:

	UM1: To educate a wide variety of students through effective teaching-learning to achieve academic excellence **UM2:** To create an ambience for creative and innovative academic exercise through high quality research. **UM3:** To undertake actions regarding collaboration which entails opportunities for long-term interaction with academia and industry for producing competent graduate at workplace. **UM 4:** To develop human potential to its fullest extent so that intellectually capable and socially responsible leaders can emerge in a range of profession.

6. Name of the Program Offering Entity **:** Department of Statistics

7. Vision of the Department **:** The vision of the program is to face the challenges and utilize the advantages of statistics from a global aspect through building

up knowledge and IT-based skills aimed at achieving academic excellence.

8. Mission of the Department:

	M1: To produce graduates who have a sound knowledge of the major areas of statistical methodology, founded on rigorous theoretical principles which equip the graduate to acquire further knowledge and skills for the benefit of the country through their own study. **M2:** To promote the use and knowledge of Statistics in all fields of Agriculture, Industry, Engineering, Environment, Banking, Social sciences and in which Statistics can contribute to a better understanding of scientific and social phenomena and enhance the quality of decisions and conclusions made on the strength of the statistical approach. **M3:** To contribute to the body of fundamental statistical science through research.

8. Objectives of the Program Offering Entity (POE):

a. Facilitate learners linking statistical theories and practice with a view to solving real-life problems and contributing to socio-economic and community development
b. Promote understanding of knowledge of Statistics in all fields of Agriculture, Industry, Engineering, Environment, Banking, Social sciences and in which Statistics can contribute to a better understanding of scientific and social phenomena and enhance the quality of decisions and conclusions made on the strength of the statistical approach.
c. Nature a stimulating academic environment through exchange and research collaboration with renowned scholar's professionals.
d. Cultivate principles of ethics and social responsibility in the mindset of students.

9. Name of the Degree:

Master of Science in Statistics (Course work),
Master of Science in Statistics (Mixed mode),

10. Description of the Program:

The Department of Statistics at Comilla University is one of the most reputable departments of the university. It was established in 2010 with the aim of providing quality education in statistics and producing skilled statisticians who can contribute to the development of the country. The department offers undergraduate and graduate programs in statistics. The undergraduate program is a four-year Bachelor of Science degree, while the graduate program is a one-year or more Master of Science degree. Both programs are designed to provide students with a solid foundation in statistical theory and its practical applications. The faculty members of the Department of Statistics are qualified and experienced in their respective fields. They have earned their degrees from prestigious universities in Bangladesh and abroad. The department has two modern laboratories equipped with the latest statistical software and tools, where students can apply their theoretical knowledge to real-world problems. The laboratory is also used for research activities and collaborations with other departments and institutions.

The department has a strong focus on research and is involved in various activities. The department also organizes seminars, workshops, and conferences to promote research and provide opportunities for students and faculty members to present their research findings. Apart from academic activities, the department also provides extracurricular activities for students. The Department of Statistics has been the winner of the inter-university female badminton championship six times and has also emerged victorious in the football championship. The department has a statistics club, which organizes various activities such as quizzes, debates, and sports events. These activities help students develop their leadership skills, enhance their social skills, and foster a sense of community within the department.

The department, as per the rules of the university, conducts the academic activities of the graduate program based on a syllabus structure up to session 2023-24. The department has developed an OBE curriculum for the 2024-2025 session following the 'Bangladesh National Qualifications Framework (BNQF) for Higher Education' and the 'Semester System Ordinance' of the university under the guidance of the Institutional Quality Assurance Cell (IQAC), CoU.

The graduate program is an advanced stage of learning to be pursued after the successful completion of a B.Sc. (Honors) degree. The curriculum for the Graduate Program covers the requisite courses for the following degrees:

Table: Credit requirements and duration of each of the postgraduate programs

Program Type	**Credit Requirement**				**Program Duration**			
	Coursework (Min.)	Dissertation (Min.)	Dissertation (Max.)	**Total (Min.)**	Semester (Min.)	Year (Min.)	Semester (Max.)	Year (Max.)
Master's by Coursework	40	-	-	**40**	02	1.0	04	2.0
Master's by Mixed Mode	18 credits	30% of course credits	50% of course credits	**42**	3.0	1.5	06	3.0
Master's by Research	Non-credit (if offered)	45	60	**45**	4.0	2.0	06	3.0

Rationale of the Program

After completion of the Master's program, the students are expected to apply their reasoning and theoretical knowledge to establish their own contributions in planning and decision making globally.

(i) Master of Science in Statistics (Course work) Program

The courses for Master's (Course work) in Statistics are spread over two semesters with 21 credit courses offered in the first semester and 19 credit courses offered in the second semester. A student of the Master of Science in Statistics (Course work) will have to take all the courses of Semester – I and II. A student must complete a minimum of 40 credits for the Master of Science in Statistics (Course work) degree. Codes of the courses of each semester are arranged according to BNQF guidelines and the courses are divided into Core, General Education, Elective or Optional courses.

(ii) Master of Science in Statistics (Mixed mode) Program

The courses for the Master of Science in Statistics (Mixed mode) are spread over three semesters with 40 credit courses in Semester – I and II, and 12 credits Thesis in Semester – III. A student of the Master of Science in Statistics (Mixed mode) will have to complete Semester – III to carry out the dissertation. Selection of optional courses must be approved by the Graduate Studies Committee (GSC). A student

must complete a minimum of 42 credits for the Master of Science in Statistics (Mixed mode) degree. Codes for courses in each semester are arranged according to BNQF guidelines, and courses are divided into Core, General Education, Elective, or Optional.

(iii) Master of Science in Statistics (Research)

For the Master of Science in Statistics (Research)program, the GSC may suggest the theory courses for the fellows if necessary. The selection of the courses will be made by the GSC in consonance with the research field of the fellow. The GSC may waive all or some of the theory courses for the fellows if the courses have already been completed by the fellows. A student must complete a minimum of 56 credits for the Master of Science in Statistics (Research)**.**

11. Graduate Attributes (based on need assessment):

Code	Graduate Attributes	Domain
GA 01	Proficiency in advanced statistical methodologies	Fundamental skills
GA 02	Application of advanced knowledge in interdisciplinary areas.	Fundamental skills
GA 03	Ability to effectively communicate complex knowledge using appropriate methods with peers.	Social skills
GA 04	In-depth understanding of contemporary environmental sustainability issues at both regional and global levels.	Social skills
GA 05	Skillful analysis of a broad spectrum of specialized theories, concepts, principles, and intricate methods.	Thinking skills
GA 06	Proficiency in making decisions regarding complex challenges in academic, professional, or technical contexts.	Thinking skills
GA 07	Commitment to continuous personal and professional growth.	Personal skills
GA 08	Understanding of ethical considerations and the ability to take full responsibility for comprehensive research management.	Personal skills

12. Program Educational Objectives (PEOs):

PEO No.	Program Educational Objectives (PEOs)
PEO1	To impart advanced knowledge and understanding of statistical theories and applications.
PEO2	To foster innovative and critical thinking in tackling complex statistical concepts, serving as a foundation for research.
PEO3	To equip students with skills to design and implement sophisticated research methodologies addressing contemporary challenges.
PEO4	To develop leadership abilities that support critical analysis and effective decision-making.
PEO5	To prepare students for continuous professional growth and contribute positively to national development.

13. Program Learning Outcomes (PLOs): After successful completion of the program, the graduates are expected to come up with the ability to-

Category	PLO No.	Program Learning Outcomes (PLOs)
A. Fundamental Skills	PLO1	Apply comprehensive statistical knowledge to analyze real-world problems and draw evidence-based conclusions.

B. Social Skills	PLO2	Utilize statistical methods to critically assess and address important social issues at both national and international levels.
C. Thinking Skills	PLO3	Use statistical models and computational tools effectively to manage and analyze large datasets.
	PLO4	Identify and solve complex problems in academic, professional, and technological contexts using appropriate strategies.
D. Personal Skills	PLO5	Conduct independent study on relevant research topics of national importance while upholding responsibility and ethical standards.
	PLO6	Demonstrate initiative in career development and develop leadership skills.

14. Mapping mission of the university with PEOs

PEOs	UM1	UM2	UM 3
PEO 1	√	√	
PEO 2	√	√	
PEO 3		√	√
PEO 4	√	√	√
PEO 5		√	√

15. Mapping PLOs with the PEOs

	PEO 1	PEO 2	PEO 3	PEO 4	PEO 5
PLO 1	√	√	√		
PLO 2			√		√
PLO 3	√	√			
PLO 4		√		√	√
PLO 5				√	√
PLO 6		√		√	√

16. Mapping courses with the PLOs

Courses	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
0542 5101 (Stat-5101)	√	√			√	
0542 5102 (Stat-5102)	√	√			√	
0542 5103 (Stat-5103)	√	√	√	√		
0542 5104 (Stat-5104)	√	√	√	√	√	
0542 5105 (Stat-5105)	√	√	√		√	
0542 5106 (Stat-5106)	√	√	√		√	
0542 5107 (Stat-5107)	√	√		√	√	√
0542 5018 (Stat-5108)	√	√		√		√
0542 5109 (Stat-5109)	√		√	√	√	√
0542 5110 (Stat-5110)	√		√	√		√
0542 5201 (Stat-5201)	√	√	√		√	
0542 5202 (Stat-5202)	√	√	√	√		
06135203 (Stat-5203)	√	√	√	√	√	
0314 5204 (Stat-5204)	√	√	√			
0542 5205 (Stat-5205)	√	√	√	√	√	√
05425206 (Stat-5206)	√		√	√	√	√

0542 5207 (Stat-5207)	√		√	√	√	
03155208 (Stat-5208)	√	√			√	√
0542 5209 (Stat-5209)	√	√	√		√	√
0542 5210 (Stat-5210)	√		√	√		
0542 5211 (Stat-5211)	√	√	√		√	√
0542 5301 (Stat-5301)	√	√	√		√	√

Stat: Statistics; GED: General Education; SPS: School of Physical Sciences; 0542 indicates Statistical courses;

Part B
PART-I
PRELIMINARY

These regulations may be cited as "Regulations' for Master's Program of Comilla University (RMPCoU)". These regulations are prepared following the structure of Bangladesh National Qualifications Framework (BNQF). These regulations shall apply who register for Masters by Taught/Masters by Mixed-mode/Masters by Research that confers a master's degree on or after the effective date of the regulations. A Master's degree involves significantly specialized knowledge in a specific area or discipline and at the forefront of knowledge. Critical, systematic and creative thinking skills, research practice or advance professional practice, interpersonal skills with leadership and managerial skills are critical competencies particularly within multicultural or transnational work and learning environments. Departments under different faculties shall offer Master's program with specific mode subject to the fulfillment of the regulations as described hereunder and also of other regulations to be promulgated by the appropriate authority of the University i.e., Executive Committee (EC) of Faculty, Board of Advanced Studies (BOAS), Academic Council (AC) and Syndicate of the Comilla University. A Department/Institute/Program Offering Entity (POE) of Comilla University may add additional requirements (if any) each of their Master's programs in the light of this RMPCoU.

1.2 Modes of Study and Duration of the Program

There are **three** modes which are the following:

(a) Master by Coursework,
(b) Master by Mixed-mode
(c) Master by Research.

A Master's by research is a thesis/dissertation-based qualification and it may or may not have a taught component. However, the taught component will not be credit bearing and students will be assessed solely on their thesis/dissertation. A Mixed-mode Master's has a minimum of 18 credits in taught component and a research component involving a thesis/dissertation. A student's assessment is based on his/her performance in both components. Finally, a Master's by Coursework entails taught courses to a minimum of 40 credits. The duration at this level will range between one to two years of full-time study. All Master degree programs will be considered as modular under a semester system. It will be guided and assessed according to the credit point system and attainment of course learning outcomes (CLO) and program learning outcomes (PLO). As per BNQF guidance, unless otherwise mentioned, in these regulations a semester means academic curriculum and learning activities conducted for a period of six (06) months.

Table1.1: Program Type and Duration

Program Type	Program Duration

	Number of Semester	Duration in Year	
	Semester (Min.)	Year(Min.)	Year (Max.)
Master's by Course work	02	1.0	2.0
Master's by Mixed-mode	03	1.5	3.0
Master's by Research	04	2.0	4.0

An academic semester is comprised of six (06) months distributed as follows:

Table 1.2: Semester Activities with Duration

No.	Items	Duration
1	Teaching-Learning activities including continuous assessment/contact with supervisor	14 weeks
2	Preparatoryleaveforfinal examination.	02 weeks
3	SemesterFinalExamination(Includingpractical/field work/oral//Seminar/DefenseandResult preparation)	07Weeks (Maximum)
4	Semester Break	01Weeks
Total		24 Weeks

1.3 *Name of the Master's program and Degree with Branch and or Specialization in Master's Program (If any)*

The name of the program and degree (offered by concerned faculty/institute/department POE as per recommendations of committee of courses of the concerned faculty/institute department/POE followed by Executive Committee (EC) of concerned faculty or any appropriate body andAcademic Council (AC) of Comilla University) shall be:

Faculty	Department	DegreeAwarded	Abbreviatedin
FacultyofScience	Mathematics	Master of Science	MS(Taught)in(Subjectname) MS(Mixed-mode)in(Subjectname) MS (Research) in (Subject name).
	Physics	Master of Science	
	Statistics	Master of Science	
	Chemistry	Master of Science	
	Pharmacy	Master of Pharmacy	MP(Taught)in(Subjectname) MP(Mixed-mode)in(Subjectname). MP (Research) in (Subject name)
FacultyofArtsandHumanities	English	MasterofArts	MA(Taught)in(Subjectname) MA(Mixed-mode)in(Subjectname) MA (Research) in (Subject name)
	Bangla	MasterofArts	
Facultyof SocialScience	Economics,	Masterof Social Science	MSS(Taught)in(Subjectname) MSS(Mixed-mode)in(Subjectname) MSS (Research) in (Subject name)For Public
	Public Administration	MasterofSocial Science	

	Anthropology	Masterof Social Science	Administration MPA (Taught) in (Subject name) MPA(Mixed-mode)in(Subjectname) MPA (Research) in(Subject name)
	Archaeology	Masterof Social Science	
	Mass Communication and Journalism	MasterofSocial Science	
Facultyof Business Studies	Management Studies	MasterofBusiness Administration	MBA(Taught)in(Subjectname) MBA(Mixed-mode)in(Subject name) MBA(Research)in(Subjectname)
	Accountingand Information Systems	MasterofBusiness Administration	
	Marketing	MasterofBusiness Administration	
FacultyofEngineering	Computer Science and Engineering	MasterofSciencein Engineering	M.Sc.Engg.(Taught)in(Subject name) M.Sc.Engg.(Mixed-Mode)in (Subject name) M.Sc.Engg.(Research)in(Subject name)
	Informationand Communication Technology	MasterofSciencein Engineering	
Faculty of Law	Law	MasterofLaw	LL.M (Taught) in (Subject name) LL.M(Mixed-Mode)in(Subject name) LL.M(Research)in(Subjectname)

New subjects may be approved by the university authorities from time to time and assigned to the faculty by the academic council.

The Master's Degree Program for a department/institute may be arranged subject to the approval of competent authority under different branches and or specializations (if any) according to the recommendation of the committee of courses. A student can achieve a Master's degree with a branch/major in a specified field which will be mentioned in the certificates and transcript, e.g., MS (Taught) in Inorganic and Analytical Chemistry or MBA (Mixed-mode) in Management Studies (Human Resource Management). The curriculum of the concerned program shall provide details of such cases.

1.4 Curriculum and Learning Outcomes Domains

The curriculum for each program must be outcome-based and consistent with the Bangladesh National Qualifications Framework (BNQF) for higher education. It should be comprehensive enough to guide the faculty and students towards systematic attainment of learning outcomes and fulfillment of Program Educational Objectives (PEO) of the program. The concerned Department/Institute/POE will set the vision, mission, and objectives of the program by declaring post-graduate profile/attributes. Program learning outcomes and courses are aligned to make the content of the curriculum appropriate and adequate. The Learning Outcome Domains are comprised of Fundamental Domain, Social Domain,

Thinking Domain, and Personal Domain. Learner activities must be consistent with level (09) descriptors declared by BNQF. Such program-level objectives and learning outcomes need to be reported in the concerned Master's program curriculum.

1.5 Requirements for Master's Degree Program

(a) A Student is required to successfully attain all course learning outcomes (CLO) of the specific program and a minimum CGPA of 2.25 with total required credit points prescribed by the concerned department/institute/POE.

(b) Course Learning Outcomes (CLOs) attainment report should be submitted with result publication in each semester and Program Learning Outcomes (PLOs) attainment report should be submitted with result publication after completion (Annex-II).

(c) If a student fails to complete the defined Master's program of the required duration, he/she will be treated as an irregular student.

PART-II
ADMISSION REQUIREMENTS AND PROCESS

2.1 Qualifications for Admission in the Master's Program

For admission to the Master's Program in any subject, a student should have the following qualifications:

(a) Candidates having the four (04)/five (05) years bachelor's degree in the same or relevant subject (recognized by the Department) from Comilla University are eligible for admission to the Master's Program offered by concerned Department/POE.

(b) Candidates seeking admission into a specific Master's program must possess a three/four/five-year Bachelor's degree from a university (home and abroad) recognized by the Bangladesh University Grants Commission (UGC) and concerned department of the University with 16 years schooling and a minimum CGPA/Class as per Table-2.1. Candidate/s has to face an admission test as per requirements (if any) of the concerned department/institute/POE.

(c) Candidates seeking admission into a specific Master by Research program must have (i) either 'thesis' or similar type of course(s) in bachelor degree or (ii) publish at least one article in reputed journal (Recognized by the Department) as the first author and/or corresponding author minimum CGPA/Class as per Table-2.1

Table-2.1: Admission Requirements for Master's Program in Comilla University

Name of Faculty	Master's by Coursework (Minimum CGPA)	Master'sby Mixed-mode (MinimumCGPA)	Master'sby Research (MinimumCGPA)
Faculty of Science	2.25	3.50	3.50
Faculty of Arts and Humanities	2.25	3.25	3.25
Facultyof Social Science	2.25	3.50	3.50
Faculty of Business Studies	2.25	3.50	3.50

FacultyofEngineering	2.25	3.50	3.50
FacultyofLaw	2.25	3.25	3.25

(d) The student/s who appeared at the bachelor's degree final examination of Comilla University may be admitted provisionally to the Master's program offered by the Department/Institute/POE and their admission will be confirmed after their results are published and given that they have passed the examination. The attendance of the students will, however, be counted from the date on which their class begins. Students who have not been admitted within two (02) academic years after obtaining their four (04) years/five (05) years bachelor's degree are not eligible for direct admission into the specific Master's programs. However, he or she will be able to take admission after passing admission and or oral test conducted by the Department/Institute/POE.

(e) No of seats for admission as post-graduate student/s other than Comilla University will be decided by the Graduate Study Committee (GST) of the Department/Institute/POE on the basis of their seat capacity.

2.2 FormationofGraduateStudyCommittee(GSC)anditsfunction

(a) **The formation of GSC is the first and mandatory step to start a Graduate Program in any department/Institute.** The GSC will consist of all professors/associate professors of the department concerned with a minimum number of 3 professors/associate professors and the head of the Department/Institute as the chairman. When an adequate number of professors and associate professors will not be available in a Department/Institute, the Dean of the faculty/Director of Institute in consultation with the head of the department/appropriate authority will propose GSC to Board Of Advanced Study (BOAS). The chairman of the Department/Director of the Institute will select a teacher as Graduate Program Coordinator (GPC) through the departmental/institutional academic committee. Terms of References (ToRs) of the GPC shall be decided by the academic committee of the department/institute.

(b) **There must be an open circular for the admission of specific Master's program in Comilla University.** Selection of Candidates will be made through written and/or oral tests as deemed suitable to the GSC. Lists of selected candidates should be published on the Notice Board of the Department/Institute/POE and the website of the Department/Institute, and/or University. Candidates in service must produce clearance/permission from his/her authority. The office of the Registrar will serve as the Admission Office and will deal with the students' admission. Department/POE will prepare the admission requirements in light of the regulations of the Master's Program and send them to the registrar's office through the Dean of the concerned Faculty for circular

2.3 Conversion of Study Mode

Students attending a program undergone mode of studying may apply to convert to another modesubject to the following conditions:

(i) The application may only be made once during the period of study.
(ii) The application for conversion from one mode to another should within two weeks after completion of 1st semester.
(iii) Students need to fulfill the new mode entry eligibility requirements.
(iv) Regulations 3.6 are applicable for any credit transfer and course exemption.

(v) After conversion of study mode, course adjustment and or dissertation/project/Internship/practical/field work/any such type would be adjusted as recommendation/s of GSC following the curriculum instructions (if any).

2.4 Re-admission

A student failing to earn the requisite credit points (50% of the total credit) for promotion from current semester to the next, may seek re-admission with the following batch. For re- admission a student will have to apply following the announcement of the result of the previous semester.

PART-III
COURSEWORK, RESEARCH AND CREDIT DISTRIBUTION

3.1 Course Types and Structures

The taught components may compriseboth Theoretical Courses and Practical Courses/Field Work/Project/Monograph/Internship/Capstone Course/s. The courses included in the Master's curriculum may be categorized as

(i) Core Course
(ii) General Education (GED) Course
(iii) Elective Course and
(iv) Capstone Course.

In case of Master's degree program, the curriculum needs to include a minimum of 10% of total credits for General Education Courses with clearly defined course learning outcomes and mapped with PLOs and learning domains of BNQF complying generic attributes of the program.

3.2 Outcome-Based Curriculum Design and Instructions

(a) Outcome based curriculum should be comprehensive enough to guide faculty and students towards systematic attainment of learning outcomes and fulfillment of the mission and objectives of the PEO. Program learning outcomes (PLOs) are defined within the scope of the mission and objectives of the PEO and aligned with the declared post-graduate attributes of the specific Master's program. Program learning outcomes and courses are aligned to make the contents of the curriculum appropriate and adequate.

(b) The departmental academic committee will design the curriculum with the course types and credit requirements specifying instructions. The curriculum of the program is designed and reviewed following a well-defined procedure by a committee of courses with representation from the industry/employers and alumni. Before submitting to the Executive Committee (EC) of the faculty and Academic Council (AC), the curriculum of the program has to be sent to the Institutional Quality Assurance Cell (IQAC) of the university to check the structure of OBE and compliance with BNQF.

(c) Department/PoEmust maintain documented course files with course plans specifying the pre-requisite course(s) (if any), credit value, teaching learning & assessment methods and

facilities/resources that are mapped out as necessary to facilitate the attainment of course learning outcomes.

(d) A course is characterized by its learning outcomes which are translated into credit measured by Student Learning Time (SLT).

(e) The course teacher will provide course plan/outlines to the students to make them well informed about CLOs, topics to be discussed, teaching-learning and assessment strategies and rubrics that will be used to assess performance/attainment of learning outcomes, a schedule of class assessment and relevant information within the first week of the commencement of the semester.

(f) Some elective courses can be offered following the decision of the Academic Committee of the concerned department. In this case, an elective course should not be offered if the number of students is less than 5 (Five).

3.3 Dissertation under Mixed-mode

(a) Master's by Mixed-mode is comprised of taught and dissertation components. There will be two components of the Dissertation. Component–I will be *Research Proposal Preparation and Presentation* and/or comprehensive examination (if any) which is not credit bearing but has to pass the proposal defense and or comprehensive examination and component-II will be the dissertation with defined credit values as Table 3.2. Research proposal has to be submitted as per the prescribed template (Annex-III) and will be evaluated as per rubrics (Annex-IV). Dissertation/thesis has to be submitted as per the prescribed format (Annex-V).

(b) Research proposal preparation and presentation part and or comprehensive examination have to be completed within two weeks after completion of the 1st semester of the defined Master's program. After the successful completion of component-I, component-II will start and students have to complete it within a stipulated duration. The curriculum of the concerned program shall provide specific instruction on this issue.

(c) A student registered for Dissertation shall undertake research work under the guidance of a supervisor and a co-supervisor (if necessary).

(d) A thesis supervisor can supervise not more than five (05) thesis students. A thesis supervisor must not be below the rank of associate professor for mixed mode and in case of Master's by research, the supervisor must not be below the rank of associate professor with a PhD. However, an associate professor with an M.Phil./Master's by Research/PhD degree or a lecturer with a PhD is eligible to supervise/co-supervise a student. Co-supervision may also be allowed from other Departments/Institutes of Comilla University/other public Universities/Research Institutes with the agreement of the supervisor.

(e) Department/Institute head will send a list of students, dissertation title, name of the respective supervisor and co-supervisor (if any) to BOAS through EC of the concerned faculty before the end of the semester after which the students register for Dissertation Part.

(f) Pursuant to the leave rules of Comilla University, a supervisor can remain absent from Comilla University (not more than six months) while continuing supervision. The online defense may be arranged in such cases if deemed necessary. Otherwise, the co-supervisor (if any) or any other

competent person shall act as the supervisor as per the guidelines of the concerned examination committee.

(g) If any change is required in the title/supervisor/co-supervisor/examiner/etc. Department/Institute head will send it to the BOAS through EC.

(h) The research needs to be carried out in this University preferably or at the appropriate place/s approved by the supervisor in consultation with Department/Institute head.

3.4 Master's by Research

(a) Master's by Research is comprised of course work and dissertation. The course work in the taught component will not be credit bearing. There will be two components of the Dissertation. Component–I will be *research proposal preparation and presentation* and/or comprehensive examination (if any) which is not credit bearing but students have to pass the proposal defense and/or comprehensive examination (if any). Component-IIis the dissertation with defined credit values as Table 3.2. Research proposal has to be submitted as per the prescribed template (Annex-III) and will be evaluated as per rubrics (Annex-IV). Dissertation/thesis has to be submitted according to the specified format (Annex-V).

(b) Students will be assessed solely on their thesis/dissertation.

(c) Research proposal preparation and presentation part and or comprehensive examination have to be completed within two weeks after completion of the 1st semester of the defined Master's program. After successful completion of component-I, component-II will start and it will have to be completed within the stipulated duration. The curriculum of the concerned program will provide specific instruction on this issue.

(d) The students under the Master's by Research program have to register the required number of credit values for dissertation as per recommendation of committee of courses for curriculum of this program following Table 3.2 of these regulations.

(e) A comprehensive exam (if any) with specific learning outcomes must be devised by the curriculum committee which has to pass by the student/researcher to start the research work.

(f) Each student must persuade the examiners that s/he is capable of undertaking independent work and offer evidence of satisfactory knowledge related to theories and methods used in his/her research work.

(g) Every student submitting a dissertation in partial fulfillment of the requirements of a degree will be required to appear at 1st seminar after successful completion of component-I: research proposal preparation and presentation and/or comprehensive examination (if any) in 2nd semester. After completion of 1st seminar and on satisfactory research progress report in 2nd semester, a researcher will be promoted to 3rd semester and will be required to appear at 2nd seminar. After completion of 2nd semester and on satisfactory research progress report in 3rd semester, a researcher will be promoted to 4th semester. After the successful completion of two seminars and on satisfactory research progress report, the researcher has to submit and dissertation/thesis and face a defense board on the date fixed by the chairman of the examination committee in consultation with the supervisor(s). Such seminar presentation and defense may be arranged online if deemed necessary to the concerned authority.

(h) Researchproposalpresentationsandseminarswillbeconductedbytheexamination committee of the program and the supervisor along with the co-supervisor (if any).

(i) The examination committee and at least one external member (outside of the University) of the particular thesis student will conduct the defense board:

Defense Board

(i)	Chairman of the examination committee	Chairman
(ii)	Members(2) of the examination committee	Member
(iii)	External members (2) for the particular thesis	Member

The supervisor of a student will be requested to be present at the time of the presentation. He/she may participate in discussion but not in evaluation.

(j) Research progress report shall be submitted before the end of the semester, even if the supervisor is on leave; otherwise, student(s) shall not be allowed to register for the following semester.

(k) A student must publish (or at least be accepted for publication) an article in a recognized peer-reviewed journal or a peer-reviewed conference paper in order to complete Master's by Research degree.

3.5 Credit Values and Distribution

(a) The credit shall be the academic currency. The general measure of one credit is 40 notional hours. The calculation of notional hours is based on class contact time and self- learning time of a student.

Table 3.1: Learning-Teaching Activities and Suggested Notional Hours per Credit

No	Teaching-Learning Activities	Notional Hour for 1 Credits
1.	Theoretical Class Lecture, Tutorial, Seminar	40
2.	Laboratory, Capstone, Fieldwork, Study, Clinical work	60
3.	Internship/Project/Industrial/ Workplace Learning	80
4.	Dissertation/Thesis	*

** Notional hour means the estimated learning time taken by an 'average' student to achieve the specified learning outcomes of a program or a course. Notional hours which have tobe spent by students/researchers for dissertation/thesis shall be defined by the committee of courses. The documents regarding the required time spend by student/researcher are kept by the supervisor. These would be submitted to the chairman of the examination committee before the defense.*

Table 3.2: Credit Requirements and Distribution of the Program

Program Type	Credit Requirements			
	Coursework (Minimum)	Dissertation (Minimum) Credits	Dissertation (Max.) Credits	Total (Min.) Credits
Course Work	40 credits	-	-	40
Mixed-Mode	18 credits	30% of Course Credits	50% Course Credits	42
Research	-	45	60	45

3.6 Credit Transfer and Course Exemption

Credit transfers are allowed for equivalent courses in programs that have the same level (horizontal) according to the following categories:

(a) Students who change programs within the University.

(b) Students transferring from other universities.

(c) Students who have graduated from a program recognized by UGC, Bangladesh.

(d) The minimum passing grade of the course involved that may be transferred for credits is Grade B.

(e) The equivalent of course content must be not less than 80%.

(f) The equivalent course taken must not exceed five (5) years from the date of admission into the university.

(g) The Maximum percentage of credit transfer through APEL is 30% of the total credit of a program of study.

(h) There is no credit transfer limit if the student is an internal student at the university.

3.7 International Standard Classification of Education (ISCED) Code

(a) The first four digits indicate the International Standard Classification of Education (ISCED) code for each field of study. For example, 0541 for Mathematics, 0531 for Chemistry, 0311 for Economics 0421 for Law etc.

(b) The fifth digit corresponds to the year the students take the course

(c) The sixth digit corresponds to the semester in which the students take the course.

(d) The ninth and tenth digits will define a course with an odd number in tenth digit indicating a theoretical course and an even number for practical, capstone, dissertation, and viva voce.

(e) Course code such as CHEM-1101 or PA-1101 is presented in curriculum where the first digit corresponds to the year the students take the course, second digit corresponds to the semester in which the students take the course and third and fourth digits will define a course with an odd number in fourth digit indicating a theoretical course and an even number for practical, capstone, dissertation, and viva voce. Course code will be reflected in the curriculum.

(f) Both ISCED code and course code will be reflected in the curriculum whereas ISCED code will be reflected only in the transcript.

ISCEDCode	0	5	4	1	-	5	1	0	1
CourseCode	MATH		-	5	1	0	1		

3.8 Course Registration

A student has to register for his/her courses and pay necessary dues within the first two weeks of every semester. The departmental student advisor will advise every student about his/her courses and monitor

his/her performance. A student at any level is expected to register for the courses at his level provided he/she does not have any incomplete courses from previous levels. A student will not be allowed to appear in the examination if his/her semester and examination fee is not cleared.

PART-IV

EXAMINATIONANDASSESSMENT

4.1 Medium of Instruction and Examination

The medium of instruction and answer in the examination should be English or Bangla. The Academic Committee of the concerned department shall have the right to decide the medium of instruction.

(a) Formation of the Examination Committee

There shall be an examination committee for each mode of Master's program and the Committee shall be formed by the departmental academic committee. In case of good management of the offered program/s, department can form one committee for all offered mode or for two modes prior approval of the academic committee of the department. Examination Committee shall comprise of 4 (four) members, one of whom should be an expert member from outside the department/university, not below the rank of Associate Professor with PhD and three internal members from the department. The Academic Committee of the department may select a separate expert member for oral presentation and thesis defense. One cannot be a member of the Examination Committee if any of her/his relative is a student/examinee. In case of any vacancy, absence or inability on the part of any member of the examination committee, the examination work shall not be invalidated. The chairman of the Examination Committee must not be below the rank of Associate Professor. It is advised to form the Examination Committee at least two months before the commencement of the examination.

(b) Functions of the Examination Committee

(i) The relevant Examination Committee will send the names of the question setters and examiners from the previously approved panel of Examiners to the Controller of Examinations, who shall issue appointment letters to the examiners.

(ii) The Examination Committee will arrange moderation and make necessary arrangements to conduct thesis, practical and oral examination. The Examination Committee of the concerned Department/Institute is responsible for conducting examinations.

(c) Duration of Examination

The final examination of theory courses will be of 3-hour duration. The practical examination will be of a maximum of six (6) hours for each unit course of 3.0 credits of as suggested by the relevant examination committee.

(d) Question Setters and Examiners

There will be two question setters /examiners (1st and 2nd) in each of the theory courses. The course teacher will normally act as the 1st examiner for each course. The examination committee will select the 2nd examiner from the Panel of Examiners.

(e) Third Examiner

In case the marks awarded by the two examiners differ by more than 20%, the Examination Committee will recommend a third examiner and the arithmetic mean of the two nearest marks will be counted. In case both of the extreme marks differ from the middle mark by exa same margin, the arithmetic mean of the middle and higher extreme shall be taken. The viva voce will be conducted by the relevant examination committee. The third examiner should be appointed from the approved panel of Examiners other than any member of the examination committee, or any examiner of that particular course.

(f) Preservation of the Examination Documents

The Chairman of the Examination Committee, after finalizing the results, will hand over all relevant documents (all marks sheets, Tabulation sheets and Examination statements along with the resolutions of the Examination Committee) to the Controller of Examinations. The Controller of Examinations should send one copy of the published results to the Chairman of the concerned department to be preserved in the department office. The copies of all the examination documents belonging to the Examination Committee will be handed over to the chairman of the department to preserve for a certain period.

(g)Preservation of the Examination Script

The controller of examination will preserve all answer scripts both for summative (Final) and formative (Before final) as per the OBE template provided by UGC of each student for one more year after publication of the result.

4.2 Eligibility for Appearing at the Semester Final Examination

(a) To be eligible to appear at the semester final examination, a candidate is required to attend in all courses not less than 60% of the lectures as average. If class attendance of any student in any course is below 60%, but in the range of 40 to 59%, on special ground with documentary evidence he/she may be allowed to attend the examination only with the recommendation of the Academic Committee of the department. In such marginal cases, the candidate shall have to pay a fine for the shortage of attendance as fixed by the authority/department/Institute.

(b) A student with class attendance of less than 40% in any course will be debarred from appearing in the Semester Final Examination.

(c) The Controller of Examinations shall issue admit cards only to the eligible candidates and send these to the concerned department and the chairman shall distribute the same to the candidates. If the Examination Entry Forms remain incomplete, Admit Cards shall not be issued. The examination Form must reach to the Controller's office at least one week before the examination starts.

4.3 Assessment System

(a) Assessment will measure the achievement of learning outcomes. Students are required to achieve all learning outcomes to pass the course. The use of grades or classifications, such as credit, merit and distinction are indicative of the level of achievement of the learning outcomes. Assessment methods will consist of both formative and summative assessment. **Formative assessment** refers to tools that identify misconceptions, struggles, and learning gaps along the way and assess how to close those gaps. It includes effective tools for helping to shape learning and can even bolster students' abilities to take ownership of their learning when they understand that the goal is to improve learning, not apply final marks. It can include students assessing themselves, peers, or even the instructor, through writing, quizzes, conversation, and more. In contrast, **summative assessments** evaluate student learning, knowledge, proficiency, or success after an instructional period, like a unit, course, or program. Summative assessments are almost always formally graded and often heavily weighted (though they do not need to be).

(b) In addition to and in sync with formative assessment, summative evaluation can also be utilized very effectively. Teachers might examine a variety of strategies to integrate these approaches.

(c) Students will get timely feedback on their performance in all formative/continuous assessments for better learning and preparation for the summative test/semester final examination.

(d) Marks allocated for continuous assessment and semester final examination: Continuous Assessment (Formative Assessment): 40%

i. Class Test and/or Quiz and/or In-course and/or Sudden Test 5
ii. Mid-Semester (At least two mid-semester exams)- 20
iii. Assignment and/Term paper preparation & Presentation and/case study and/ Field work- 10
iv. Attendance- 5

Semester Final Examination (Summative Assessment): 60%

(e) Class Attendance: The marks allocated for class attendance shall be given as following proportions:

Attendance	Marks
90%and above	100%
85%to lessthan 90%	90%
80%to lessthan 85%	80%
75%to lessthan 80%	70%
70%to lessthan 75%	60%
65%to lessthan 70%	50%
60%to lessthan 65%	40%
Lessthan 60%	00%

(f) Practical Courses: For Laboratory courses students will be evaluated in two phases. The marks distribution shall be as follows:

ContinuousAssessmentasBeforeFinal:	40%
LabAttendance:	10%
LabPerformance:	20%
LabReportWriting	10%
FinalAssessment:	60%
EvaluationonExperiment:	50%
Viva-Voce:	10%

4.4 Project/Internship Evaluation:

Internship will be offered in the final semester for selected students. 03-06 credits will be allotted to the internship program in such cases. The assigned supervisor for this program will be a teacher with a post-graduate degree. The project/internship report shall also be evaluated by 1st and 2nd examiners within the department. 1st examiner will be the supervisor and 2nd examiner will be selected by the examination committee. A copy of the project/internship report must be preserved in the concerned Department.

4.5 Dissertation/Thesis Evaluation:

(a) A candidate for the Master's degree in the Mixed-mode group shall submit the required number of printed and soft copies of the dissertation/thesis in the approved format (by appropriate authority) through the supervisor to the Chairman of the examination committee by a date to

be fixed by the department within the period of study. This time may, however, can be extended with the recommendation of the academic committee of the concerned Department/Institute and approved by the Academic Council through EC of concerned faculty.

(b) The thesis shall be evaluated by two external examiners from outside this university to be appointed by the examination committee. One external member from a foreign university recognized by the dept. can be considered. Two copies of the dissertation will be sent by the chairman of the examination committee to the controller of examination who will arrange to send these to the examiners.

(c) The Dissertation will not be considered for evaluation if the plagiarism detection system yields a similarity index of more than 20% (excluding bibliography/references, quotes, and small sources with a source exclusion threshold of ten-word counts). This will apply to the dissertations written in English. The curriculum of the concerned program shall provide a specific guideline on this issue.

(d) Defense of the thesis students shall be conducted by the examination committee approved by the appropriate authority. The supervisor of a student will be requested to be present at the time of the presentation. He/she may participate in discussion but not in evaluation. One more external member may be included during the oral examination.

(e) A student must satisfy the examiners that s/he is capable of undertaking independent work and affording evidence of satisfactory knowledge related to the theory and techniques used in his/her research work.

(f) The chairman of the department shall arrange to preserve a copy of the dissertation/thesis, if approved, in the University Library and another in the seminar Library of the Department for future reference.

4.6 DistributionofMarks

The Marks/credits of the Master's Degree Program shall be distributed among the theoretical courses, Practical, Thesis/Dissertation, viva voce, Internship, Project and Field works.

CourseType	1/1.5/2 Credits	3 Credits	4 Credits	Marks	MarksforViva
Theory	50	100	100	-	-
Practical	50	100	100	-	-
Capstone	50	100	-	-	-
Internship	-	100	100	100	20
Project	-	80	80	80	20
Dissertation	-	-	-	80	20

4.8 Special Semester Examination

(a) Students who did not get the opportunity of removing ‘F’ in any course is allowed to sit for a special semester examination. This opportunity is allowed only for once/twice in one/Two academic sessions. In such cases, students have to apply to the Chairman of the department within 30 days after publication of Master 2nd/3rd semester result. The Chairman of the department shall take necessary administrative measures for arranging the special semester examinations by the respective Mode of Master’s examinations committee. All the expenses relating to this examination shall be borne by the candidate(s).

(b) If anybody is absent from the viva voce on any valid ground, a viva voce may be arranged once for her/him on condition that she/he shall bear all related expenses of the viva. In such cases, she/he has to apply to the chairman of the department within 30 days after the viva examination.

4.9Results Publication

(a) The course teacher will announce the results of the in-course marks before the final examination and submit the marks to the chairman of the Examination Committee and also a copy to the controller of examinations at least two weeks before the final examination.

(b) Tabulation work will start only after all the marks of the course final examinations for the semester are received by the Chairman of the Examination Committee. Marks received by the Chairman of the Examination Committee will remain in the sealed envelope as sent by the examiners until tabulation work is started and are to be opened in presence of the internal members of the Examination Committee.

(c) The Controller of Examinations will publish the semester-final result and the final result of the Master's Program, subject to the approval of the academic council. A copy of the tabulation sheets will be sent to the Chairman of the concerned Department duly signed by him with date.

(d) The Controller of Examinations shall also provide the transcript/grade sheet showing course-wise LG and the corresponding GP (the numerical marks shall not be shown), the CGPA, LG and the interpretation of the CGPA of the candidates for the Master's Degree. Final Grade must be spelled out clearly in the certificate/transcript.(Example: C+=`C' (C Plus), `A-=` (A minus); B=`B' (B regular)

(e) Result sheets of each examination prepared by the Controller of Examinations will be compared and signed by the chairman of the Examination Committee or his/her nominee who must be a member of the Examination Committee.

(f) In the Transcript/Grade sheet, only the Letter Grade and the Corresponding Grade points, and the final CGPA (in the 2nd Semester), not the numerical marks, will be shown.

Letter Grade and Grade point: Total marks obtained in each course, oral (viva-voce) examination, practical courses and thesis will be converted into LG (Letter Grade) and GP (Grade Point) as following:

NumericalGrade	LetterGrade		GradePoint	Interpretation
80%and above	A+	(APlus)	4.0	Outstanding
75%to lessthan 80%	A	(Aregular)	3.75	Excellent
70%to lessthan 75%	A-	(Aminus)	3.50	VeryGood
65%to lessthan 70%	B+	(BPlus)	3.25	Good
60%to less than 65%	B	(Bregular)	3.0	Satisfactory
55%to lessthan 60%	B-	(Bminus)	2.75	BelowSatisfactory
50%to lessthan 55%	C+	(C Plus)	2.50	Average
45%to lessthan 50%	C	(C regular)	2.25	Pass
40%to lessthan 45%	D	…….	2.0	Poor
Lessthan 40%	F	.....		Fail

4.10 Promotion

(a) Keeping consistence with the spirit of the semester system, semester-wise promotion shall be declared.

(b) For promotion from 1st semester to the 2nd semester, a student is required to earn a minimum of 50% of the total credit points in the 1st semester on condition that she/he has passed the viva voce.

4.11 Improvement of Grades

Only the removal of `F' (Fail) in any course is allowed. Removal of `F' in any course is permitted by sitting in the final examination only for one (1) time in the subsequent semester excluding the regular examination.

4.12 Drop Out

If a student re-admitted once in any semester fails to earn the minimum required credits for promotion, they will have to drop out from the program.

PART-V
General

5.1 Department/Faculty/Institute may formulate any guidelines as may be necessary for the purpose of implementing the provisions of these regulations with approval of the concerned academic committee/EC committee subject to the approval of Academic Council.

5.2 Examination Offences and Disciplinary Action: A student, who has adopted unfair means in any examination, assignment, semester paper, report, research monograph etc., might be expelled from that semester or any other punishment might be imposed on her/him by the recommendations of Examination Disciplinary Committee (EDC). Each such case must be reported to EDC by the chief invigilator through the chairman of the Examination Committee. The Instructions to the examinee on cover page of the answer script must be followed by the examinee. Violation of these instructions and/ or any clause under Section-4 of the "Regulation Regarding Examination Offences and Disciplinary Actions" (Appendix- III) will be treated as serious offence and punishable.

5.3 For any other matter not covered in this regulation, the existing examination rules and regulations of Comilla University will be applicable.

5.4 Amendment: In order to make any addition, alteration, change or modification in this rules that may be required for the program, it must be placed by the Academic Committee of the Department through the Faculty to the Academic Council and subsequently to the syndicate for approval.

5.5 Repeal: Rules for Master Degree Program (Effective from Academic Session:2010-11) is hereby repealed.

Annex-I

Regulation's Regarding Examination Offences and DisciplinaryAction

Formation of Examination Disciplinary Committee:

1. Disciplinary action against candidates involved in Examination offences shall betaken by the Syndicate on recommendations of the Examination DisciplineCommittee as constituted below:

(i)	The Vice-Chancellor	Convenor
(ii)	The Deans of the Faculties	Members
(iii)	Two provoststobenominatedbytheVice-Chancellor	Members
(iv)	ThreeteachersoftheUniversitytobenominatedbytheVice-Chancellor	Members
(v)	TwoHeadofDepartmentbenominatedbyVice-Chancellor	Members
(vi)	Proctor	Members
(vii)	TheController of Examinations	Member-Secretary

2. Members other than Vice-Chancellor shall hold office for a period of one year after formation of the committee.
3. Five members shall form the quorum
4. **The following shall be considered Examination offences:**
   (a) Communication or attempt to communication with any other candidate in the Examination Hall.
   (b) Writing in the examination hall, anything incriminating on the question paper or admit card, table, desk, bench, etc.
   (c) Possession of incriminating notes, books, map, chart, slip, chit or any other documents, in the examination hall.
   (d) Creating or inciting to create any nuisance or disturbance in the examination hall. (e)Copying or attempt to copy from incriminating documents or from another's script, or from any writing on the person or wearing apparel while appearing at the examination.
   (e) Taking the script out of the examination hall.
   (f) Changing the script or inserting unauthorized sheets in the script.
   (g) Approaching or influencing the Invigilator, Examiners, or members of the Examination Committee, Tabulators to gain undue favor or advantage in connection with examination.
   (h) Using abusive language or holding out threat to the invigilator or any other person engaged on examination duty inside or outside the examination hall.
   (i) (J)Assault or attempt to assault or use criminal force against Chief Invigilator or the Invigilator or any other person engaged on examination duty inside or outside the examination hall.

5.In making its recommendation, the EDC shall follow the following rules;

   (a) Candidates found guilty of offence or offences falling under Section 4 (a), (b) and (c) shall be penalized with the cancellation of the examination at which they commit offence or offences.
   (b) Candidates found guilty of offence falling under Section 4(d) shall in addition to cancellation of the examination at which the offence is committed, be debarred from appearing at the subsequent examination.
   (c) Candidates found guilty of offences falling under Section 4(e), (f), (g) and (h) shall be debarred depending on the gravity of the offence from appearing at course(s) or from that semester examination, in addition to the cancellation of the course examination at which the offence is committed.

(d) Candidates found guilty of offence falling under Section 4 (i) and (j) shall, in addition to the cancellation of the examination at which the offence is committed, be debarred from appearing at the subsequent examinations of the one or two semesters depending on the gravity of the offence.

6. Any other offence not covered by the above rules shall be dealt with by the Syndicate on the recommendation of the EDC as it deems fit.

7. Candidates committing offences except those falling under Section 4 (a), (b), (c), (d), (e) and (i) shall not be allowed to continue to appear in that paper, and their scripts shall not be sent for evaluation but shall be sent separately to the Controller of Examinations in sealed cover.

8. The Invigilator shall submit separate report for each case, regarding the nature of the offence and the circumstances in which it is alleged to have been committed, with all supporting documents underlining the copied portion in the script as well as in the incriminating documents in the case of actual copying.

9. The Chief Invigilator of the examination center shall forward the report of the invigilators and relevant documents with his expressed opinion along with the script. These reports and documents shall be preserved by the Controller of Examinations for a period of at least six months from the date of the publication of the penalty order list.

10. The following procedure shall be adopted in dealing with cases of candidates involved in examination offences:

    (i) On receipt of reports from the Chief Invigilator of the examination center, the Controller of Examinations shall call for explanation from the candidate concerned, asking her/him why disciplinary action shall not be taken against her/him for the alleged committed of examination offence. Such show-cause notice must be sent by registered post to her/his permanent address as recorded in the examination entry registration form. The candidate must be given ten days' time from the date of issuing show-cause notice to submit her/his explanation. If no explanation is received within the prescribed duration, the EDC may take necessary disciplinary action.

    (ii) The controller of examinations shall then place all relevant documents of the case together with the explanation of the candidate to the EDC for consideration. The proceedings of the Disciplinary Committee shall be forwarded to the registrar for reporting it before the Syndicate.

11. Provided that, in any emergency, notwithstanding the provisions of the Rules and Regulations on the subject, the Vice-Chancellor may in exercise of the powers vested in him in terms of clause (j) of Section 11 [of the Comilla University Act, 2006; take any disciplinary action considered necessary in the circumstances and report the same to the Syndicate for confirmation.

Annex-II

(a) Computation of Grade Point Average (GPA)and Cumulative Grade Point Average (CGPA)

The GPA and CGPA will be computed in the following formula: (Credit × Grade Points Secured)
GPA=Total Credits Offered in the Semester (Credit×GradePointsSecured)
CGPA=Total Number of Credits offered in the whole program

Example: GPA Calculation

Course	No. of credits	Letter Grade	Grade Points	Points secured	GPA
C-501	3	A	3.75	11.25	48.00/18 =2.67
C-502	3	B+	3.25	9.75	
C-503	3	F	0	0	
C-504	3	A-	3.5	10.5	
C-505	3	B	3.0	9.0	
C-506	3	C+	2.5	7.5	
	18			48.00	

(b)Course Learning Outcomes (CLOs) Attainment Report Format

Course Learning Outcomes (CLOs)	Assessment										
	SFE(Summative)80%				CA(Formative)20%						CLO Attainment (%)
	Mid- Semester (20%)		Final Examination (60%)		MCQ/MQ/Quiz (10%)		Assignment/Case Study (5%)		Presentation (5%)		
	AM	AC	AM	AC	AM	AC	AM	AC	AM	AC	
CLO1:											
CLO2											
CLO3											
CLO4											
CLO5											
CLO6											
CLO7											

AM: Actual Marks = (Given Marks/Total Given Marks of Component) × (% of the Course) AC: Assessment Contribution; M=Average Marks in % and W = Weightage=C/T. Attainment (A) = ∑M (Mi × Wi)

(c) Program Learning Outcomes report would be measured by indirect measurement (survey questioner)devised by the Program Offering Entity (POE)

Annex-III

ResearchProposalTemplate((Guidelines)

Instructions:

- When preparing an application for entry into a research higher degree program, it inecessaryto supply a clear statement describing the proposed area of research (a research proposal). Consultation with an academic staff member in the research area of interest is recommended prior to submission of an application. Liaising with an

academic allows you to frame the proposal to align with established disciplines and areas of supervisor capacity.

- You must write your research proposal and reference accordingly through consultation with your supervisor.
- Fromonetothreepagesis oftensuitable, dependingon the areaof research.

(1) ResearchTopic/Title:

(An initial working title should be provided and should describe the content and direction of your project.)

(2) Research Project Description:

(i) Background:

✔ What is already known (with references) and unknown?

✔ Set the scene for your research by summarizing the existing literature.

(ii) Justification/Significance/Rational:

✔ Why is it important? Establish the importance of your project by highlighting its originality or explaining why it is worth pursuing.

(iii) ProblemStatement:

✔ State a clear research question on which your research will be based.

(iv) Aims/Objectives:

✔ What do you want to know, prove, demonstrate, analyze, test, investigate, or examine?

(3) Methodologies:

✔ How do you anticipate achieving these aims?

✔ Mention the research design or experimental design (if any).

✔ What do you need? (Specify any special equipment, software, or materials.)

✔ List the names of required chemicals, apparatus, and accessories.

✔ Can you access the necessary data or expertise?

✔ Are there any barriers or pitfalls?

✔ Does the project involve human ethics, animal ethics, or safety implications?

✔ Is travel or fieldwork required? If so, where to, for how long, and at what intervals?

(4) ExpectedOutcomes:

✔ What do you expect the research will deliver?

✔ What are the expected outcomes?

✔ Highlight the benefits, positive expected outcomes, or innovative applications of knowledge.

(5) WorkactivitySchedule/Timetable

✔ Indicate the timeframe for each broad stage considering literature surveys, data application, production, modeling, review analysis, testing reporting chapter and thesis submission date

(6) Budget:

- ✔ Make a budget with a compatible manner.

(7) References:

- ✔ Listan appropriate number of reference materials.

(Note That: Research proposal isgenerally prepared as per format/template of inviting organization/funding authority.)

Declaration

(a) The same project has not been submitted to any other institutes/ agencies for financial support or academic purpose.

(b) Theresearch workproposedinthisprojectisnotaduplicateworkalreadydoneorbeingdoneinthe field (i.e.area of research).

Annex-IV

ResearchProposalPresentation(Oral)GradingRubric

Nonverbal Skills	**4–Exceptional**	**3–Admirable**	**2–Acceptable**	**1–Poor**
EyeContact	Holds attentionof entireaudiencewith the use of direct eye contact,seldom lookingatnotes or slides.	Consistentuse of direct eye contact with audience, but still returns to notes.	Displayed minimal eye contact with audience,while reading mostly from notes.	No eye contact with audience, as entire presentation is carried out throughreading note.
BodyLanguage	Movementsseem fluid and helptheaudience visualize. .	Made movementsor gestures thatenhance articulation.	Very little movementor descriptive gestures	Nomovementor descriptive gestures.
Poise	Displays relaxed, self-confident nature about self, with no-mistakes.	Makes minor mistakes, but quicklyrecovers from them; displays little or no tension.	Displays mild tension; has trouble recoveringfrom mistakes.	Tension and nervousness is obvious; has trouble recoveringfrom mistakes.
Verbal Skills	**4 – Exceptional**	**3 –Admirable**	**2 –Acceptable**	**1 – Poor**

Enthusiasm	Demonstrates strong, positive feeling about topic during entire presentation	Occasionally shows positive feelings about topic	Shows some negativity toward topic presented.	Shows absolutely no interest in topic presented.

Speaking Skills	Uses a clear voiceandspeaks atagoodpaceso audience members can hearpresentation. Doesnotread off slides.	Presenter's voice is clear. The pace is a little slow or fast at times. Mostaudience members can hear presentation.	Presenter'svoiceisl ow.The paceismuchtoo rapid/slow. Audience membershave difficulty hearing presentation.	Presenter mumbles,talks very fast,andspeaks too quietly foramajorityof students to hear& understand.
Timing	**4 – Exceptional**	**3 –Admirable**	**2 –Acceptable**	**1 – Poor**
Length of Presentation	Within two minutes of allottedtime+/-.	Within four minutes of allottedtime+/-.	Withinsix minutesof allotted time +/-	Toolongortoo short; ten or more minutes aboveorbelow allotted time.
Content	**4 – Exceptional**	**3 –Admirable**	**2 –Acceptable**	**1 – Poor**
Subject Knowledge	Anabundanceof material clearlyrelatedto the research is presented. Points areclearlymadeand evidence is usedtosupport claims	Sufficient informationwith many good points made, uneven balance and little consistency.	There is a great deal of informationthat is not clearly integrated or connectedtothe research.	Goalofresearch unclear, information included that doesnotsupport research claimsinany way.
Organization	Information is presented in a logical and interesting sequencewhich audience can follow. Flows well.	Information is presented in logicalsequence which audiencecan follow.	Audience has difficulty following presentation because the presentation jumps around andlacksclear transitions.	Audiencecannot understand presentation because there is no sequence of information.

Visuals	Excellentvisuals that are tied intotheoverall story of the research.	Appropriate visualsareused and explained by the speaker	Visualsareused but not explainedorput in context.	Littleorno visuals,too much text onslides.
Mechanics	Presentationhas no misspellingsor grammatical errors. .	Presentation has no more than twomisspellings and/or grammatical errors	Presentationhas three misspellings and/or grammatical errors.	Presentationhas many spellingand/or grammatical errors.

a) Graduating credits: Minimum 40 Credits (for Course work)
Minimum 52 Credits (for Mixed mode)
b) Total class weeks in a semester: 14
c) Minimum CGPA requirement for graduation: 2.00
d) Maximum academic years of completion:
Course work: 2 Years
Mixed mode: 3 Years
e) Category of Courses:

Course Category	**Course Type**	**Course Title**	**Credits**
Core Courses	Theory	1. Advanced Statistical Inference	3.0
		2. Advanced Multivariate Analysis	3.0
		3. Advanced Econometrics	3.0
		4. Categorical Data Analysis	3.0
		5. Advanced Biostatistics	3.0
	Lab	1. Advanced Statistical Inference Lab	2.0
		2. Advanced Multivariate Analysis Lab	2.0
		3. Advanced Econometrics Lab	2.0
		4. Categorical Data Analysis Lab	2.0
		5. Advanced Biostatistics Lab	2.0
	Total		**25.0**
Optional/ Elective Courses	Theory	1. Applied Stochastic Process and Stochastic Simulation	3.0
		2. Statistical Machine Learning Techniques	3.0
		3. Bioinformatics	3.0
		4. Big Data Analytics	3.0
		5. Meta Analysis	3.0
		6. Advanced Experimental Design	3.0
		7. Multilevel Modeling	3.0
		8. Planning, Monitoring and Evaluation of Research	3.0

	Lab	1. Applied Stochastic Process and Stochastic Simulation Lab	2.0
		2. Statistical Machine Learning Techniques Lab	2.0
		3. Bioinformatics Lab	2.0
		4. Big Data Analytics Lab	2.0
		5. Advanced Experimental Design Lab	2.0
		6. Multilevel Modeling Lab	2.0
GED Course **(chose 3 credits)**	Theory	1. Population Studies	3.0
		2. Banking Management and Financial Statistics	3.0
Total credits of theory courses with relevant labs (Optional)			**38.0**
Total (Core + Optional + GED) 14 Courses + 11 Labs			**67.0**
Capstone Courses		1. Project	3.0
		2. Dissertation	12.0
Viva-Voce			1.0

1. Year/Semester wise distribution of courses

Semester – I (20 Credits)

Core Course	**Course Title**	**Theory/Labs**		**Credits**
		Hours	**Week**	
0542 5101 (Stat-5101)	Advanced Statistical Inference	42	14	3.0
0542 5108 (Stat-5108)	Advanced Statistical Inference Lab (Group A)	8	4	2.0
0542 5102 (Stat-5102)	Advanced Multivariate Analysis	42	14	3.0
0542 5108 (Stat-5108)	Advanced Multivariate Analysis Lab (Group B)	8	4	2.0
0542 5103 (Stat-5103)	Advanced Econometrics	42	14	3.0
0542 5109 (Stat-5109)	Advanced Econometrics Lab (Group A)	8	4	2.0
Total				**15.0**
Choose one theory and related lab courses from optional / elective courses				**5.0**
0542 5104 (Stat-5104)	Applied Stochastic Process and Stochastic Simulation	42	14	3.0
0542 5109 (Stat-5109)	Applied Stochastic Process and Stochastic Simulation (Group B)	8	4	2.0
0542 5105 (Stat-5105)	Bioinformatics	42	14	3.0
0542 5110 (Stat-5110)	Bioinformatics Lab (Group A)	8	4	2.0
0542 5106 (Stat-5106)	Big Data Analytics	42	14	3.0
0542 5110 (Stat-5110)	Big Data Analytics Lab (Group B)	8	4	2.0
0542 5107 (Stat-5107)	Meta Analysis	42	14	3.0
Total				**20.0**
Total (Core + Elective)				**33.0**

Semester – II (20 Credits)

Core Course	**Course Title**	**Theory/Labs**		**Credits**
		Hours	**Week**	
0542 5201 (Stat-5201)	Categorical Data Analysis	42	14	3.0
0542 5209 (Stat-5209)	Statistical Data Analysis – IV (Categorical Data Analysis) Lab	4	4	2.0
0542 5202 (Stat-5202)	Advanced Biostatistics	42	14	3.0
0542 5209 (Stat-5209)	Statistical Data Analysis – IV (Advanced Biostatistics) Lab	4	4	2.0

Total				**10.0**
Choose one theory and related lab courses from optional / elective courses				**5.0**
0613 5203 (Stat-5203)	Statistical Machine Learning Techniques	42	14	3.0
0542 5210 (Stat-5210)	Statistical Data Analysis – V (Statistical Machine Learning Techniques) Lab	8	4	2.0
0542 5205 (Stat-5205)	Advanced Experiment Design	42	14	3.0
0542 5211 (Stat-5211)	Statistical Data Analysis – VI (Advanced Experiment Design) Lab	8	4	2.0
0542 5206 (Stat-5206)	Multilevel Modeling	42	14	3.0
0542 5211 (Stat-5211)	Statistical Data Analysis – VI (Multilevel Modeling) Lab	8	4	2.0
0542 5207 (Stat-5207)	Planning, Monitoring and Evaluation of Research	42	14	3.0
Choose one GED course				**3.0**
0314 5204 (Stat-5204)	Population Studies	42	14	3.0
0315 5208 (Stat-5208)	Banking Management and Financial Statistics	42	14	3.0
Total				**18.0**
Capstone course				
0542 5212 (Stat-5212)	Project			3.0
Viva-Voce				1.0
Total				**4.0**
Total (Core + GED + Elective + Capstone) 16 Courses				**38.0**

Semester – III (Mixed Mode) (12 Credits)

Course Code	Course Title	Course Category	Theory/Labs		Credits
			Hours	Week	
0542 5301 (Stat-5301)	Dissertation	Core		**24**	**12.0**

Course Work
First Semester = 20 Credits (Courses + Labs)
Second Semester = 22 Credits (Courses + Labs + Project + Viva Voce)
Total = 20+22 = 42 Credits

Mixed Mode
First Semester = 20 Credits (Courses + Labs)
Second Semester = 19 Credits (Courses + Labs + Viva Voce)
Third semester = 12 credit
Total = 20+19+12 = 51 Credits

Part C

19. Description of all courses of the program including the following information for each course:
Detailed Course Curriculum

Master of Science in Statistics First Semester Course Details:

Course Code: 0542 – 5101 (Stat-5101)	**Course Title: Advanced Statistical Inference**	
Marks: 100	**Credit: 03**	**Number of Classes: 42**

Rationale

This course provides advanced knowledge and practical skills in statistical inference, focusing on both classical and Bayesian approaches. It enables students to understand key estimation and hypothesis testing techniques, including robust and non-parametric methods. Emphasis is placed on real-world applications, model selection, and the use of statistical software such as R and STATA to solve complex data problems.

Objectives

1. Develop a solid understanding of advanced statistical inference concepts, including estimation and hypothesis testing.
2. Enhance skills to analyze data and draw valid conclusions using confidence intervals, robust, and Bayesian methods.
3. Build critical thinking to evaluate and apply techniques like shrinkage estimators, non-parametric methods, and model selection.
4. Strengthen practical abilities in using statistical software (R, STATA) for analysis and simulations.
5. Prepare students to tackle complex statistical problems in research and applied settings.

Course Learning Outcomes:

At the end of this course, students will be able to

CLO No.	Course Learning Outcome (CLO)
CLO1	Demonstrate a deep understanding of advanced statistical inference concepts, including theoretical properties and assumptions underlying estimation and testing methods.
CLO2	Critically analyze and evaluate advanced estimation techniques, such as shrinkage estimators, robust methods, and empirical Bayes approaches.
CLO3	Apply advanced inferential methods to complex real-world data using statistical software, and interpret the results accurately.
CLO4	Assess the performance and suitability of different inferential procedures, including hypothesis tests and confidence intervals, under various practical scenarios.
CLO5	Develop and implement statistical models that accommodate violations of standard assumptions and address challenging data analysis problems.
CLO6	Synthesize theoretical knowledge and computational tools to design and conduct rigorous statistical inference in research and applied contexts.
CLO7	Critically evaluate statistical hypotheses and model parameters using both frequentist and Bayesian frameworks.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	–	2	1	2	1
CLO2	3	2	3	2	1	–
CLO3	2	1	3	2	1	–
CLO4	3	2	2	3	2	–
CLO5	2	–	1	3	3	2

CLO6	3	–	3	3	3	2
CLO7	3	–	2	3	2	1

Course content, Teaching and Assessment Strategy

CLOs	**Content Area**	**Topics Covered**	**Teaching–Learning Strategy**	**Assessment Strategy**	**No. of lectures**
	Theory of Estimation				
CLO1, CLO2, CLO3	Point Estimation,	Review of Introductory Point Estimation, Principles of Data Reduction, Empirical Bayes (EB) Method, Bayes Conventional and Empirical Bayes Techniques, Approximation of Bayes and EB Method of Estimation for Prior Distribution, Application of EB Methods, Minimality and Admissibility in Exponential Families and their Properties, Bayesian Estimation in Linear Model, Predictive Inference with Reference to Bayesian Analysis, James Stein Estimator, Shrinkage Estimators, EM Algorithm.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	8
CLO1, CLO2, CLO5	Robust Statistics	Fundamental Concept and Example, Different types of robust estimators, One-Dimensional Estimation and Test of statistics Influence Functions, Classes of M-Estimators, L-Estimators, R-Estimators, Multidimensional Estimators, Application of Robust Estimators.			4
CLO3, CLO4	Confidence Sets	Length and Shortest Confidence Intervals, UMA & UMAU Confidence Sets, Randomized and Invariant Confidence Sets, Confidence Sets (Construction, Interpretation, Asymptotic and High-Order Properties), **Re-sampling techniques:** Bootstrap, Simultaneous Confidence Intervals (Bonferroni, Scheffé's, Tukey's Methods), Confidence Bands for CDFs			8

	Theory of Hypothesis Testing				
CLO5, CLO6, CLO7	Hypothesis Testing	Review of Hypothesis Testing, Generalized Neyman Pearson Lemma, Uniformly Most Powerful (UMP) Test, Locally Most Powerful (LMP) Test, Locally Uniformly Most Powerful Unbiased (LUMPU) Test, Optimal Test, Locally Best Test, Tests Under Restricted Alternatives, Similar Region and Neyman Structure, Most Powerful Similar Region (MPSR) Test, Uniformly most Powerful Similar Region (UMPSR) Test, Asymptotic Efficiency of Test, Sequential Probability Ratio Test (SPRT) for Three Hypotheses, Sobel and Wald Test, Lagrange Multiplier (LM) Test, Test in Presence of Nuisance Parameters, Union-Intersection and Intersection-Union Test, Armitage Method for Composite Hypotheses, Sequential T, and test. Empirical Bayes Testing of Multiple Hypothesis, Lindley's Procedure for Test of Significance, Lindley's Paradox, p-value and Bayesian Significance Probability, Bayes' Test in Linear Model.			16
	Model Selection Criteria				
CLO7	Information Criteria	Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Other Information Criteria.			6

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLO No.	Teaching–Learning Strategy	Assessment Strategy
CLO1	Lectures and class discussions on core ideas of statistical inference.	Quizzes and short written assignments on key concepts.

CLO2	Group work comparing estimation methods and their strengths.	Problem-solving tasks and short presentations.
CLO3	Lab sessions with real data using statistical software.	Data analysis projects and lab reports.
CLO4	Step-by-step demonstrations on confidence intervals and sets.	Practical assignments and case-based assessments.
CLO5	Group analysis of models dealing with non-standard assumptions.	Case studies and in-class presentations.
CLO6	Seminars on hypothesis testing and model selection.	Research-based projects and term exams.
CLO7	Class debates and peer reviews on Bayesian vs. frequentist methods.	Written exams and oral presentations comparing approaches.

Books

1. George, C. and Berger, R. L. (2003): *Statistical Inference*, 2nd edition, Thompson-Duxbury, USA.
2. Lehman, E. L. (1997): *Testing Statistical Hypothesis*, 2nd edition, Springer-Verlag, New York.

References

1. Lehman, E. and Cassela, G. (1998): *Theory of Point Estimation*, Springer Verlag, New York.
2. Hogg, R. H., Mckean, J. W. and Craig, A. T. (2007): *Introduction to Mathematical Statistics*, 6th edition, Pearson Education (Singapore) Pte Ltd.
3. O' Hagan, A and Forster, J. (2004): *Advanced Theory of Statistics, Bayesian Inferences*, Vol. 2B, Arnold.
4. Carlin, B. P. and Louis, T. A. (2002): *Bayes and Empirical Bayes Method for Data Analysis*, 2nd edition, CRC Press.
5. Kalbfleisch, J. G. (1985): *Probability and Statistical Inference*, Vol. 1 and Vol. II. 2nd edition, Springer-Verlag, New York.
6. Ghosh, M., Delampady, M., &Samanta, T. (2006). *An Introduction to Bayesian Analysis: Theory and Methods*. Springer.
7. Huber, P. J., &Ronchetti, E. M. (2009). *Robust Statistics* (2nd ed.). Wiley.

Course Code: 0542 – 5102(Stat-5102)	**Course Title: Advanced Multivariate Analysis**	
Marks: 100	**Credit: 03**	**Number of Classes: 42**

Rationale:

The purpose of the course is to cover advanced techniques of multivariate analysis, their application to real-life data, and the proper interpretation of the results. In addition, students will be able to use R, STATA, or Python to solve multivariate analysis problems.

Objectives:

1. Demonstrate multivariate normal distribution more intensively with more diverse field of application.
2. Develop and analyze multivariate regression models.
3. Condense information contained in a large number of variables into a smaller set of factors using principal component and factor analysis.
4. Search for distinguishable groups of objects using various classification techniques. Express cluster to discover natural grouping among items or variables.
5. Utilize standard software tools to ensure efficiency and accessibility in performing advanced multivariate techniques.

Course Learning Outcomes:

At the end of this course, students will be able to

CLO1	Perform exploratory analysis of multivariate data, Distance in Multivariate Analysis, calculating descriptive statistics, testing for multivariate normality;
CLO2	Conduct statistical inference about multivariate means including hypothesis testing, confidence ellipsoid calculation and different types of confidence intervals estimation. Create and evaluate models for multivariate regression. Modeling the relationship between a dependent variable and multiple independent variables.
CLO3	Analyze dimension reduction techniques including correspondence analysis, principal component analysis, and factor analysis.
CLO4	Apply Fisher's discriminant function and classification techniques for separating and classifying data from two or more populations;
CLO5	Grasping the fundamental concept of clustering as a multivariate technique to group similar objects or subjects into distinct subgroups based on a set of measured variables. Learning to apply common algorithms like k-means for partitional clustering and various linkage methods (e.g., for dendrograms) for hierarchical clustering.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2	2	2	2	1	
CLO2	2	2		1	1	1
CLO3	3	2	1	1		

CLO4	2	1		1		1
CLO5	1	1		1		

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	**Introduction:** Review on Multivariate Techniques**,** Concept and Objectives of Multivariate Analysis, Graphical Display of Multivariate Data, Concept of Distance in Multivariate Analysis, Different Measures of Distance with properties, Multivariate Normal Distribution, Inference regarding multivariate population mean.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance, and Final Examination.	10
CLO2	**Canonical Correlation and Canonical Variables**: Concepts of Canonical Variables and Canonical Correlation, Estimation of Canonical Correlation and Varieties, Large sample Statistical Inference of Canonical Correlation.			5
CLO3	**Principal Components Analysis and Factor Analysis:** Concept of principal component analysis with process and interpretation and application, Concept of factor analysis, methods of estimation (maximum likelihood estimates and principal factor analysis), selection of loadings and factor (factor rotation, varimax rotation, quartimax rotation, oblique rotations), factor scores, structural equation models. **Correspondence Analysis:** Concept of correspondence analysis, algebraic development of correspondence analysis, application of correspondence analysis for multiple factor analysis with contingency tables.			10
CLO4	**Discrimination and Classification:** separation and classification two populations, classification of two multivariate normal populations, evaluating classification functions, Fisher's discriminant function, classification with several populations,			5

	Fisher's method for discriminating several populations.			
CLO5	**Clustering:** similarity measures, hierarchical clustering methods, nonhierarchical clustering Methods, Multidimensional scaling			5
	Independent component analysis (ICA) Independent component analysis (ICA) or blind source separation (BSS) model. Estimation and inference, interpretation and discussion, Application.			

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Reflective Discussion	Quiz and Assignment,
CLO2	Lecture and Discussion	Assignment, Quiz and Summative Exam
CLO3	Lecture and Group Discussion	Mid-Semester and Summative Exam
CLO4	Lecture and Discussion	Mid-Semester, Assignment and Summative Exam
CLO5	Lecture and Discussion	Mid-Semester and Summative Exam

Text Book

1. Johnson, R.A. &Wichern, D.W. (2007): *Applied Multivariate Statistical Analysis*, Prentice–Hall Inc.
2. Anderson, T. W. (1984), *Introduction to Multivariate Analysis*, 2nd edition, 1984, John Wiley, New York.

Reference Books

1. Kendell. M.G.: *Multivariate Analysis*, New York,
2. Kshiragar, A.M: *Multivariate Analysis*, Marcell Dekker Inc. NewYork.
3. Hyvarinen, A., Karhunen, J. & Oja, E. (2001). *Independent Component Analysis*, Wiley, N.Y.

Course Code: 0542 – 5103(Stat-5103)	**Course Title: Advanced Econometrics**

Marks: 100	Credit: 03	Number of Classes: 42

Rationale:

The course Time Series Econometrics provides students with the theoretical foundation and practical tools to analyze time-dependent economic data. It covers essential topics such as non-linear regression, simultaneous equation models, time series modeling (ARIMA, VAR), and panel data analysis using advanced estimation techniques like GMM and GEE. By combining theory with real-world applications, the course equips students to model, estimate, and forecast dynamic economic relationships.

Objectives:

1. Develop a comprehensive set of tools and techniques in applied time series econometrics in the areas of Economics and time series analysis.
2. Obtain the models used for forecasting and policy formulation which is an essential part in any policy decision.
3. Demonstrate how to use econometric software EVIEWS for problems in time series econometrics.
4. Understand the econometric modeling and model selection.
5. Analyze and interpret multivariate time series models and apply them for forecasting and policy evaluation using econometric software.

Learning Outcomes

CLO1	State the review of multicollinearity and autocorrelations models and their remedial measures.
CLO2	Explain the role of Non-Linear model and input output analysis.
CLO3	Apply different methods of simultaneous equation.
CLO4	Estimate and conduct inferences with time series models and also identify the Generalized regression model, GEE and GMM.
CLO5	Apply different software applications to time series.
CLO6	Analyze and interpret multivariate time series models, including VAR, VECM, and SVAR, and apply them for forecasting.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	3	3	3	3	3	3	1
CLO2	3	3	3	3	3	3	3	
CLO3	3	3	3	3	2	3	2	1
CLO4	3	2	2	1		2		1
CLO5	3	2	2	1	3	2	1	1
CLO6	3	2	3	2	1	2	1	1

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.

CLO1	**Review:** The nature of Econometrics and the structure of economic data. Details study on nature, detection, consequence and remedy of Multicollinearity and Auto-correlation. Log-linear regression: Estimation and application of Cobb-Douglas production function.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	4
CLO2	**Non-linear Regression Equation**, Non-linear Regression Models, Estimators of Non-linear Regression Models, Hypothesis Testing and Parametric Restrictions, Box-Cox Transformation.			4
CLO3	**Simultaneous equation models**: Simultaneous equation bias; Inconsistency of OLS estimators; The identification problem, Types and rules of identification, A test of simultaneity, Estimation in simultaneous estimation methods; Method of indirect least square (ILS) two stage least square (2SLS), Three stage least square (3SLS).			8
CLO4	T**ime series econometrics:** Stationary; Unit roots and co integration; Spurious regression; Approaches to economic forecasting, AR, MA, and ARIMA modeling of time series data, the BJ methodology, VAR.			6
CLO5	**Panel data regression models:** Concepts, uses and application, Estimation of Panel data regression models, the fixed effects approach, the random effects approach, panel data regressions.			8
CLO6	**Multivariate Time Series:** Introduction to multivariate time series; VAR and VECM models; Granger causality; Impulse response and variance decomposition; Structural VAR; Forecasting and applications in macroeconomics and finance.			

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz and presentation
CLO2	DIY activities	Assignment and Presentation
CLO3	Discussion and slide show	Practice by doing exercise, Summative (Midterm)
CLO4	Audio Visual Lecturing	Summative Measure (Final Exam.)
CLO5	Educational podcasts	Summative Measure (Final Exam.)
CLO6	Lecture in classroom	Summative Measure (Final Exam.)

Text Book

1. Gujrati,D. (2019): *Basic Econometrics 6th*edition, McGraw-Hill, New York.

Reference Books

1. Greene, W.H. (2017): *Econometric Analysis***,** 8th Ed, Pearson Education
2. Desai, M. (1976): *Applied Econometrics*, Oxford Publication.
3. Kleim& Miller: An Introduction to Econometrics.

Course Code: 0542 – 5104 (Stat-5104)	**Course Title: Applied Stochastic Process and Stochastic Simulation**	
Marks: 100	**Credit: 03**	**Number of Classes: 42**

Rationale

This course provides an introduction to random processes and their diverse applications. It primarily adopts a discrete-time perspective, addressing the continuous-time case where applicable. The course begins with foundational concepts such as random variables, random vectors, stochastic processes, and random fields. It then explores various common random processes, including white noise, Gaussian processes, Markov processes, Poisson processes, Markov random fields, branching processes, social mobility, and stochastic simulation. Through this structure, the course offers a comprehensive understanding of these fundamental concepts and their real-world uses.

Objectives:

1) To develop students' abilities in understanding Markov chain models, martingale theory, and some basic presentation of Brownian motion, as well as diffusion and jump processes.
2) To present theory and techniques for the analysis of time variant data.
3) To enable students to learn variety of applications including statistical machine learning, operation research, mathematical biology, computational physics, as well as engineering sciences and financial mathematics Learning outcomes.

Course Learning Outcomes:

At the end of this course, students will be able to

CLO1	State the defining properties of various stochastic process models.
CLO2	Sample any type of continuous or discrete-time stochastic process on a computer.
CLO3	Identify appropriate stochastic process model(s) for the given research or applied problem.
CLO4	Provide logical and coherent proofs of important theoretical results.
CLO5	Apply the theory to model real phenomena and answer some questions in applied sciences.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	1	-	2	1	-	-
CLO2	2	2	2	1	-	-
CLO3	1	3	3	3	2	1
CLO4	1	2	3	2	-	-
CLO5	3	3	2	2	1	1

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	**Stochastic Process:** Basic Idea of Stochastic Process and Markov Chain, Time Reversible Markov Chain, Markov Chain Monte Carlo Methods, Markov Decision Processes. **Continuous Time Markov Chain**: Meaning, Birth and Death Process, Kolmogorov Forward and Backward Equation of Continuous Time Markov Chain and their Limiting Probabilities, Time Reversibility, Uniformization, Computation for Transition Probabilities, Generator Matrix to Determine Limiting Probabilities.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	5
CLO2	**Markov Chain Estimation and Hypothesis Testing Related to Finite Markov Chain:** Maximum Likelihood Estimates (MLE) of Transition Probabilities, Testing of Transition Probability Matrix, Stationarity of Transition Probability Matrix, Order of Markov Chain, First Order Markov Dependence. Confidence Interval of Arrival Rate, Service Rate and Server Utilization of an M/M/1 Queue Model.			8
CLO3	**Renewal Theory and Its Application:** Meaning of Renewal Process, Distribution and Limiting Properties of Renewal Process, Renewal Reward Process, Regenerative Process, Semi Markov Process, Renewal Process in Continuous Time, Wald's Equation, Stopping Time and Model Equation, Central Limit Theorem for Renewals, Delayed and Equilibrium Renewal Process, Two-Stage Renewal Process, Computation of Renewal Function, Application to Patterns.			4

CLO4	**Branching Process**: Meaning, Computing Mean and Variance, Properties of Generating Function of Branching Process. Total Number of Progeny and Its Distribution, Continuous Time Branching Process, Generalization of Classical Branching Process, Age Dependent Branching Process, Inference and Estimation Problem of Branching Process. Markov Models in Communication and Information Systems, Storage Requirements for Unpacked Messages, Buffer Behavior for Batch Arrivals, Transmission System, Probabilistic Model for Hierarchical Message Transfer.			12
CLO5	**Social and Behavioral Processes**: Social Mobility, Industrial Mobility for Labor, Educational Advancement, Labor Force Planning and Management, Analyzing Homogeneous Poisson Process, Non-homogeneous Poisson Process, Continuous Time Birth and Death Model, Renewal Process, Branching Process. By Monte Carlo and Stochastic Simulation, Multilevel Queuing System, Markov Model in Biological Sciences and Business Management. **Stochastic Simulation:** Analyzing Homogenous Poisson Process, Non-homogenous Poisson Process, Markov Chain, Continuous Time Birth and Death Model, Renewal Process, Branching Process, Multilevel Queuing System by Monte Carlo Simulation.			13

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion and interactive learning	Quiz and Assignment,
CLO2	Problem-solving activities and Collaborative learning spaces	Assignment, Quiz and Summative assessment
CLO3	Lecture, Current events quizzes, and Reflective Discussion	Mid-Semester and Summative assessment
CLO4	Lecture, Group discussion and Slide Show	Mid-Semester and Summative assessment
CLO5	Lecture and discussion	Summative assessment and Assignment

Texts

1. Ross, S. (2003): *Probability Models*, 8th edition, Academic Press, USA.
2. Bhat, U. N. (1984): *Elements of Applied Stochastic Processes*, 2nd edition, John Wiley and Sons, New York.
3. Banks, J. (2005): *Discrete Event System Simulation*, 4th edition, Prentice-Hall, New Delhi, India.

References

1. Medhi, J. (1994): *Stochastic Processes*, 2nd edition, New Age International (P) Ltd. Publisher, New Delhi.
2. Bhat, B. R. (2000): *Stochastic Models*, New Age International (P) Ltd. Publishers, New Delhi.
3. Minh, D. L. (2002): *Applied Probability Models*, Thomson-Duxbury, US

Course Code: Stat-5105		**Course Title: Bioinformatics**
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale:

The aim of this course is to give students an introduction to the basic techniques of bioinformatics. Emphasis will be given to the application of bioinformatics and biological databases to problem-solving in real research problems. The students will become familiar with the use of a wide variety of applications, biological databases and will be able to apply these methods to research problems.

Objectives:

1. Deliver descriptions of this rapidly evolving field, and facilitate user access to and manipulation of the biological data.
2. Include descriptions of genetic and biological databases and relevant tools available to retrieve and analyze the information within these.
3. Give insights of various techniques, such as evolutionary analysis, data mining, protein structure/function and computational drug discovery will be given.
4. Make evaluating data using bioinformatics, and to better identify potential uses and opportunities of this data within your industry context.
5. Develop an integrated understanding of subject matter, demonstrate advanced judgement in the selection of materials used to support discussions.

Course Learning Outcomes:

At the end of this course, students will be able to

CLO1	Explain the fundamental concepts of bioinformatics including biological database, sequence alignment, and genomics.
CLO2	Apply computational tools and algorithms for analyzing DNA, RNA, and protein sequences.
CLO3	Perform sequence alignment using appropriate bioinformatics software and interpret the results.
CLO4	Analyze and interpret biological data using relevant statistical and computational techniques.
CLO5	Demonstrate the ability to work with biological databases (e.g., NCBI, Uniports) and retrieve useful information.
CLO6	Communicate bioinformatics findings effectively in both written and oral forms, using appropriate scientific language.
CLO7	Integrate biological knowledge with computational approaches to solve real-world biological problems.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	1	2	1	1	1
CLO2	2		3	2	1	1
CLO3	2		3	2		
CLO4	3		3	3		
CLO5	2		2	2		
CLO6	1	3	2	2	2	3
CLO7	3	2	3	3	2	3

Course Content, Teaching and Assessment Strategy:

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	Basic concepts and importance of bioinformatics, Molecular OMCIS, Chromosome, Gene, Meiosis, Mitosis, Mandel's Laws, Linkage and Mapping, Quantitative genetics, Molecular markers, Genotype and Phenotype, Introduction to genetic linkage analysis, Mendelian segregation, Segregation patterns in a full-sib family, Basic methods of Sequencing, Introduction to QTL analysis, Introduction to different types of microarray gene expression data,	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	8

CLO2	Genotyping Technology, DNA/RNA sequences, Central dogma, Amino acids with its structure and functions, codons, protein/amino acid sequence, Preprocessing (Transformation, Normalization, Image analysis and filtering), Clustering and Classification for Gene Expression Data Analysis, Gene-set enrichment analysis			4
CLO3	DNA sequencing, sequencing, Whole genome sequencing, High-throughput sequencing (HTS) methods, Genome assembly, Next Generation Sequencing (NGS)			4
CLO4	Two-point analysis for backcross and F2-intercross, Three-point analysis, Multilocus likelihood and locus ordering, Estimation with many loci, Mixture likelihood and order probabilities, Map functions, Linkage analysis with controlled crosses and recombinant inbred lines, Identification of differential expressed (DE) genes in two or more groups using statistical tests, Inferring genetic regulatory networks from microarray experiment with Bayesian networks			10
CLO5	NCBI, Uniport-databases introduction and data retrieval, Genome browsers, Downloading Gene/Protein sequences for downstream analysis, annotating genes using databases, Database referencing and citations in research			4
CLO6	Writing scientific reports on sequencing or gene expression analysis, Visualization of results, Presentation of bioinformatics workflows and findings, writing abstract, introduction, and discussion in research paper, Comparative analysis report, Peer-to-peer scientific communication (oral/poster presentations, preparing lab reports on database searches or tool-			4

	based results, Explaining analysis outcomes to a non-technical audience (simplified summary writing)			
CLO7	Application areas of sequencing, Marker Analysis of Phenotypes, Whole Genome Marker Analysis, The structure of QTL Mapping (Population and Quantitative Genetic Structure of the Mixture Model), Interval Mapping Approaches for QTL Analysis(Linear regression and maximum likelihood approaches for QTL analysis with backcross and F2 populations), Composite and multiple interval mapping approaches for QTL analysis, Modelling genetic regulatory networks using gene expression profile			8

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion	Class test, Mid Term
CLO2	Expository sharing	Assignment and Presentation
CLO3	Classroom Discussion and Problem-solving activities	Class test, Mid Term, ,Quiz
CLO4	Lecture and Student Activity	Quiz, Assignment, Summative Measure and M
CLO5	Lecture and Reflective Discussion	Summative Measure (Final Exam.)
CLO6	Discussion and Slide Show	Summative Measure (Final Exam.)
CLO7	Discussion and Slide Show	Summative Measure (Final Exam.)

Text Book

1. Lesk, A. (2013). Introduction to bioinformatics. Oxford University Press.

2. Ben Hui Liu and Leming M Shi. (2013). Statistical Genomics and Bioinformatics, Chapman and Hall/CRC Press, 2nd edition, New York.

Reference Books

1. Baxevanis, A. D., & B. F. Ouellette (2004). Bioinformatics: a practical guide to the analysis of genes and proteins (Vol. 43). John Wiley & Sons.

2. Davis, J. W. (2007). Bioinformatics and computational biology solutions using R and Bioconductor. Journal of the American Statistical Association, 102(477).

3. Ferreira, M. A. R., Medland, S. E., & Posthuma, D. (2008). Statistical genetics: gene mapping through linkage and association. New York: Taylor & Francis.

Course Code: 0542-5106 (Stat-5106)		Course Title: Big Data Analytics
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale

The course is intended for second-degree students with a background in engineering, computer science, statistics, mathematics, economics, and management.

Objectives

1. More and more organizations these days use their data a decision-supporting tool and to build data-intensive products and services.
2. The collection of skills required by organizations to support these functions has been grouped under the term "Data Sciences".
3. This course will cover the basic concepts of big data, methodologies for analyzing structured and unstructured data with emphasis on the relationship between the Data Scientist and the business needs.

Course Learning Outcomes:

At the end of this course, students will be able to

CLO1	Understand and explain the fundamental concepts of big data, including characteristics, platforms, and analytics frameworks.
CLO2	Explain and apply the concept of database categories, perform basic operations on database objects, and analyze equivalence relations within database structures.
CLO3	Identify and apply appropriate statistical, machine learning, and data mining techniques for solving big data analytics problems.
CLO4	Design and implement big data solutions using tools and technologies such as Hadoop, MapReduce, R, Python, or Splunk.
CLO5	Evaluate and present real-world case studies involving customer behavior, finance, healthcare, and retail using big data analytics methodologies.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	2	1			
CLO2	3	2	2	1		
CLO3	2	3		3	3	
CLO4	2	2	3		3	2
CLO5	1	3		2		3

Course Content, Teaching and Assessment Strategy:

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures

CLO1	**Overview of big data analytics:** Introduction to big data, Big data analytics applications. Big data platforms, storage and analytics. Data analytics project life cycle and data analytics problems.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	3
CLO2	**Definition of Database (DB) Category:** Introduction to DB category, Basic operations for objects in DB, Equivalence Relations in DB Category.			4
CLO3	**Theory and methods for big data analytics:** Understanding big data analysis with machine learning. Supervised and unsupervised machine-learning algorithms. Selected machine learning and data mining methods (such as support vector machine and logistic regression), Statistical analysis techniques (such as conjoint analysis and correlation analysis), Time series analysis, Big data visualization, graph analytics. Deep learning-Intelligence from big data.			10
CLO4	**Technologies and tools for big data analytics:** Introduction to Map Reduce/ Hadoop/R/ Splunk/ Python. Big data analytics using Map Reduce/Hadoop/R/Splunk/Python.			10
CLO5	**Case studies on big data analytics:** Analytics applied in Customer Behavior, Spending Patterns, Banking Transactions, Insurance, Product Portfolio, Credit Information, Health Care, and Retail. **Big Data Mining:** Web Mining, Concepts of web content, structure and usage mining; text and social media mining; link analysis; tools and applications in business and research.			10

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lectures & Interactive Discussions on big data fundamentals.	Short written assignments explaining the stages of the data analytics life cycle.
CLO2	Group Activities to model and compare different DB structures.	Problem-solving exercises on basic DB operations.

CLO3	Assignments for implementation and visualization of ML models.	Project work implementing machine learning algorithms.
CLO4	Introduce concepts of Hadoop, MapReduce, R, Splunk, and Python using visual presentations and live demos.	Hands-on lab tests where students run analytics tasks using Hadoop, MapReduce, Python, R, or Splunk.
CLO5	Group Analysis & Presentations	Case study reports evaluating applications in domains like banking, insurance, healthcare.

Text Book

1. Bruce Ratner (2011); *Statistical and Machine-Learning Data Mining: Techniques for Better Predictive Modeling and Analysis of Big Data*, Second Edition

Reference book

1. D.P. Acharjya, Satchidananda Dehuri, Sugata Sanyal (eds.) (2015*); Computational Intelligence for Big Data Analysis: Frontier Advances and Applications*, 1st edition.
2. Holden Karau, Andy Konwinski, Patrick Wendell, Matei Zaharia (2015); Learning Spark: Lightning-Fast Big Data Analysis, 1st edition.

Course Code: 0542 5107 (Stat – 5107)		**Course Title: Meta-analysis**
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale:

Meta-analysis is a cornerstone of evidence-based research that synthesizes findings from multiple studies to provide stronger and more precise conclusions. This course equips students with theoretical understanding and practical skills to plan, conduct, analyze and interpret meta-analyses in health, social science, etc.

Objectives:

1. Understand the principles, purposes, and scope of meta-analysis within evidence-based research.
2. Identify and apply appropriate statistical models (fixed, random, Bayesian, mixed) to combine study results.
3. Evaluate study quality, heterogeneity, and publication bias, and apply methods to address these issues.
4. Conduct and report a meta-analysis using appropriate software and graphical techniques.
5. Interpret results and communicate findings according to international reporting standards.

Course Learning Outcomes:

At the end of this course, students will be able to

CLO1	Explain the concepts, development, and applications of meta-analysis and related outcome measures.
CLO2	Assess and quantify study heterogeneity and evaluate the validity of pooling results.

CLO3	Apply fixed-effect, random-effect, and Bayesian models to combine study results and estimate effect sizes.
CLO4	Detect and adjust for publication bias and assess study quality using established methods.
CLO5	Conduct a complete meta-analysis using R packages (meta, metafor, etc.) and present results following PRISMA guidelines.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	2	1	1	-	-
CLO2	3	2	2	2	-	-
CLO3	3	1	3	2	1	-
CLO4	3	2	2	3	2	1
CLO5	3	2	3	2	3	1

Course Content, Teaching and Assessment Strategy:

CLOs	**Course Content**	**Teaching Strategy**	**Assessment Strategy**	**No. of Lectures**
CLO1	Introduction to meta-analysis: development & uses, evidence-based healthcare, systematic reviews, outcome variables & effect sizes (binary, continuous, ordinal).	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	4
CLO2	Issues of meta-analysis: heterogeneity assessment, tests and causes of heterogeneity, methods of investigating/handling heterogeneity, quasi-empirical Bayes method.			5
CLO3	Fixed effects methods: inverse variance, Mantel–Haenszel, Peto's method, exact interval estimation. Random effects model: algebraic derivation, REML estimates, comparison of estimation methods, subgroup/meta-regression/mixed models. Bayesian methods: Bayesian health research, binary/continuous models, empirical Bayes.			10
CLO4	Publication bias: evidence & consequences, funnel plot, adjusting bias. Study quality: methodological factors, sensitivity analysis, quality effects model.			10
CLO5	Reporting results: structure of a report, graphical displays, PRISMA. Meta-analysis of different types of data			10

	(IPD, p-value combining, multiple outcomes). Software: meta, metafor, R packages, hands-on practice.			

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion	Interactive Question-Answer
CLO2	Expository sharing	Assignment and Presentation
CLO3	Classroom Discussion and Problem-solving activities	Practice by doing exercise, Summative (Midterm)
CLO4	Discussion and Slide Show	Summative Measure (Final Exam.)
CLO5	Lecture and Reflective Discussion	Summative Measure (Final Exam.)

Text Book

1. Sutton, A. J., Abrams, K. R., Jones, D. R., Sheldon, T. A., Song, F. (2000), Methods for Meta-Analysis in
Medical Research, John Wiley & Sons Ltd, West Sussex PO19 1UD, England.

Reference Books

1. Borenstein, M., Hedges, L. V. (2009), Introduction to meta-analysis, JohnWiley & Sons, Ltd.
2. Hedges, L. V., and Olkin, I. (1985), Statistical Methods for Meta-Analysis, John Wiley & Sons,
3. Hartung, J., Knapp, G., Sinha, B. S. (2008), Statistical Meta-Analysis with Applications, John Wiley & Sons,
4. Kulinskaya, E., Morgenthaler, S., Staudte, R. G. (2008), Meta Analysis: A Guide to Calibrating and Combining Statistical Evidence, John Wiley & Sons, Ltd.

Course Code: 0542-5108 (Stat-5108)		**Course Title: Statistical Data Analysis-I**
Marks: 100	**Credits: 04**	**Number of Class: 8+8=16**

Group A: Advanced Statistical Inference 50 (Credit 2)

Rationale:

This lab course complements the Advanced Statistical Inference theory course by providing hands-on experience with statistical software (R, STATA) to implement advanced estimation, hypothesis testing, and model selection techniques. Students will learn to analyze complex data, interpret results, and apply both frequentist and Bayesian methods to real-world problems.

Objectives

1. Develop practical skills in using R and STATA for statistical inference.
2. Apply advanced estimation techniques, including shrinkage and empirical Bayes methods.

3. Conduct hypothesis tests and evaluate confidence intervals using computational tools.
4. Implement robust, non-parametric, and Bayesian methods in real datasets.
5. Interpret results critically and present findings effectively.

Course Learning Outcomes (CLOs):

CLO No.	Course Learning Outcome (CLO)
CLO1	Perform advanced estimation techniques, including point estimation, shrinkage estimators, and empirical Bayes methods in R/STATA.
CLO2	Conduct robust statistical analysis and non-parametric methods using real datasets.
CLO3	Apply hypothesis testing procedures, confidence intervals, and model selection criteria in practical scenarios.
CLO4	Integrate theoretical concepts with computational tools to analyze complex datasets and interpret results accurately.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	2	3	2	–	2
CLO2	1	3	2	2	1	1
CLO3	3	2	3	3	2	2
CLO4	3	3	3	3	3	3

Course Content, Teaching and Assessment Strategy:

Week(s)	Content Area	Topics Covered	Teaching–Learning Strategy	Assessment Strategy	CLOs	No. of Lab Sessions
1–3	Advanced Estimation	Point estimation, James-Stein estimator, Shrinkage estimators, Empirical Bayes methods, EM Algorithm	Interactive Class, Open Discussion, Participatory Q/A Session, Online sources	Lab Performance, Lab Report Writing, Attendance and Final Examination.	CLO1 CLO2	4
4–5	Robust & Non-Parametric Methods	M-, L-, R-estimators, multidimensional robust estimation, Bootstrap and permutation methods				3

6–8	Confidence Intervals & Hypothesis Testing	Shortest CI, UMA & UMAU CI, bootstrap CI, simultaneous CI, Neyman-Pearson lemma, UMP tests, LMP, Bayesian testing			CLO3 CLO4	4
9–10	Model Selection & Integration	AIC, BIC, other information criteria, applying multiple methods in real datasets				4

Mapping of CLOs with Teaching–Learning & Assessment Strategy

CLO No.	Teaching–Learning Strategy	Assessment Strategy
CLO1	Guided coding labs on estimation techniques, shrinkage estimators, and empirical Bayes.	Lab reports, quizzes, assignments
CLO2	Interactive lab sessions applying robust and non-parametric methods to datasets.	Lab exercises, case-based assignments
CLO3	Step-by-step demonstration and practice of hypothesis testing, confidence intervals, and model selection.	Lab projects,practical exams
CLO4	Integrative sessions combining multiple methods on real-world datasets, group discussions, and problem-solving exercises.	Final project report and presentation, participation

Books

1. George, C. and Berger, R. L. (2003): *Statistical Inference,* 2nd edition, Thompson-Duxbury, USA.

2. Lehman, E.L.(1997):*Testing Statistical Hypothesis,* 2nd edition, Springer-Verlag, NewYork.

Group B: Advanced Multivariate Analysis-50 (Credit 2)

Rationale

Statistics deal with real-world data, and most of the time these data come in multivariate form. However, advanced multivariate techniques are required to extract distinguishable features from these data and interpret them properly. For this, students will use R, Stata or Python to solve these multivariate problems.

Objectives

1. Recognize the key characteristics of multivariate data.
2. Make appropriate use of both exploratory and confirmatory multivariate statistical techniques.
3. Integrate multivariate statistical techniques and methods efficiently and effectively.

Learning Outcomes

Upon the successful completion of the requirement of this course, students should have the knowledge and skills to:

CLO1	Analyze multivariate data and the dependence structure of variates to extract the useful information from a massive dataset. Formulate and test hypotheses using multivariate data and utilize the appropriate statistical tests.
CLO2	Apply suitable tools for exploratory data analysis, dimension reduction, and classification to formulate and solve real-life problems;
CLO3	Utilize statistical software for analysis, apply a variety of multivariate statistical techniques, interpret the results, critically assess findings, and clearly convey conclusions.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2	2	2	2	1	
CLO2	2	2		1	1	1
CLO3	3	2	1	1		1

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Reflective Discussion	Quiz and Assignment,
CLO2	Lecture and Discussion	Assignment, Quiz and Summative Exam
CLO3	Lecture and Group Discussion	Mid-Semester and Summative Exam

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1, CLO3	Different measures of distance, Assessing multivariate normality, Box-Cox Transformation, outlier detection, Test for a mean vector, Test for equality of Mean vectors, Hoteling T^2 , Confidence Region, Simultaneous confidence interval, Bonferroni Method of Multiple Comparison. Paired comparisons and repeated measures design, comparing mean vectors from two populations, comparing several multivariate populations means (MANOVA), simultaneous confidence	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Final Examination.	10

	interval for treatment effects, two-way multivariate analysis of variance, profile analysis, multivariate linear regression,			
CLO2, CLO3	Problems related to discrimination analysis, Principal component analysis, Factor Analysis and cluster analysis.			5

TextBooks

1. Johnson,R.A.&Wichern,D.W.(2007):*AppliedMultivariateStatisticalAnalysis*,Prentice–HallInc.

Course Code: 0542-5109 (Stat-5109)		**Course Title: Statistical Data Analysis-II**
Marks: 100	**Credits: 04**	**Number of Class: 8+8=16**

Group A: Advanced Econometrics -50 (Credit 2)

Rationale: Time Series Econometrics is interesting because it provides the tools to enable us to extract useful information about important economic policy depend on time issues from the available data. Time series Econometrics is a set of tools we can use to confront theory with real-world data.It is the application of statistical and mathematical theories in economics for the purpose of testing hypotheses and forecasting future trends.

Objectives:

1. Develop a comprehensive set of tools and techniques in applied time series econometrics in the areas of Economics and time series analysis.
2. To obtain the models used for forecasting and policy formulation which is an essential part in any policy decision.

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	Estimation of Log-linear regression, Estimation of Cobb-Douglas production function, Estimation in simultaneous estimation methods	Interactive Class, Open Discussion, Participatory Q/A Session, Online	Lab Performance, Lab Report Writing, Attendance and Final Examination	8
CLO2	Stationary and non-stationary Time series modeling, AR, MA, ARIMA and VAR modeling of time series data, ARCH and GARH models			7

CLO3	Indirect least square (ILS), two stage least square (2SLS), Three stage least square (3SLS), Estimation of Panel data regression models.			9

Learning Outcomes:
After successful completion of this course, students will be able to-

CLO1	Demonstrate how to use econometric software EVIEWS for problems in time series econometrics. Detect Log-linear regression, Estimation of Cobb-Douglas production, Identify structural equation model,
CLO2	Estimate a model in the presence of stationary and non-stationary
CLO3	**Use** Indirect least square (ILS), two stage least square (2SLS), Three stage least square (3SLS) and estimate Panel data regression models.

Mapping between PLOs and CLOs of Statistics program

	PLO1	PLO2	PLO3	PLO4	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	3	2	1	-	-	2	-	-
CLO2	3	3	2	-	3	-	2	-	2
CLO3	2	2	1	2	-	2	1	-	1

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lab Experiment	Lab Assessment
CLO2	Lecturing and Problem-solving activities.	Lab Assessment
CLO3	Lab Experiment	Lab Performance

Texts

1. Judge, G. G. (1988): *Introduction to the Theory and Practice of Econometrics*, 2nd edition, John Wiley and Sons, New York.
2. Gujrati,D. (2003): *Basic Econometrics* 4th edition, McGraw-Hill, New York.

Group B: Applied Stochastic Process and Stochastic Simulation-50 (Credit 2)

Rationale

Throughout the course, we mainly take a discrete-time point of view, and discuss the continuous-time case when necessary. We first introduce the basic concepts of random variables, random vectors, stochastic processes, and random fields. We then introduce common random processes including the white noise, Gaussian processes, Markov processes, Poisson processes, Markov random fields, Branching Process, Social Mobility and Stochastic Simulation.

Objectives

1. To develop students' abilities in understanding Markov chain models, martingale theory, and some basic presentation of Brownian motion, as well as diffusion and jump processes.
2. To present theory and techniques for the analysis of time variant data.
3. To enable students to learn variety of applications including statistical machine learning, operation research, mathematical biology, computational physics, as well as engineering sciences and financial mathematics Learning outcomes

Learning Outcomes:

After successful completion of this course students will be able to-

CLO1	State the defining properties of various stochastic process models.
CLO2	Sample on a computer any type of continuous or discrete time stochastic process.
CLO3	Identify appropriate stochastic process model(s) for a given research or applied problem.
CLO 4	Provide logical and coherent proofs of important theoretic results.
CLO5	Apply the theory to model real phenomena and answer some questions in applied sciences.

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1 CLO2	Continuous Time Markov Chain, Markov Chain Estimation and Hypothesis Testing Related to Finite Markov Chain,	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Lab Performance, Lab Report Writing, Attendance and Final Examination.	14
CLO3 CLO4	Renewal Theory and Its Application, Branching Process, Social and Behavioral Processes, Stochastic Simulation.			10

Texts

1. Ross, S. (2003): *Probability Models*, 8th edition, Academic Press, USA.

References

1. Bhat, B. R. (2000): *Stochastic Models*, New Age International (P) Ltd. Publishers, New Delhi.

Course Code: 0542-5110 (Stat-5110)	**Course Title: Statistical Data Analysis-III**	
Marks: 100	**Credits: 04**	**Number of Class: 8+8=16**

Group A: Bioinformatics 50 (Credit 2)

Rationale

This lab course provides hand-on experiences in bioinformatics by using computational tools to analyze biological data. Students will work with sequence alignment tools (BLAST,

ClustalW/MUSCLE), molecular visualization software (PyMoL, Chimera), and biological databases (NCBI, UniProt), These skills are essential for understanding gene/protein structure, function, and evolutionary relationships.

Objectives

1. Retrieve and analyze DNA, RNA, and protein sequences using bioinformatics databases and tools.
2. Perform sequence alignments and construct phylogenetic trees to understand evolutionary relationships.
3. Visualize molecular structures and analyze functional motifs in proteins.

Learning Outcomes

After successful completion of this course, students will be able to:

CLO1	Retrieve and organize biological data from NCBI and UniProt databases.
CLO2	Perform pairwise/multiple sequence alignments using BLAST and ClustalW/MUSCLE, and interpret results.
CLO3	Construct phylogenetic trees, visualize protein and structures using PyMoL/Chimera, and analyze functional motifs/domains

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	2	2	1	1	1
CLO2	2	2	3	2	1	1
CLO3	2	2	3	3	2	2

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	Introduction to bioinformatics databases (NCBI, EMBL, DDBJ, UniProt), Sequence retrieval techniques (DNA, RNA, Protein), Sequence annotation (gene names, functions, accession numbers).	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Final Examination.	5
CLO2	Basics of sequence alignment (global vs. local alignment), Pairwise alignment using BLAST (nucleotide BLAST, protein in BLAST), Multiple sequence alignment (MSA), ClustalW, MUSCLE, Interpreting alignment scores, identity, E-value, and gaps			5
CLO3	Concepts of molecular evolution and phylogeny, Phylogenic tree construction (Neighbpr-Joinning, Maximum Likelihood), Interpreting tree topology and evolutionary relationships, Protein structure databases(PDB), Protein			5

	visualization using PyMOL, Chimera, Functional annotations: motifs, domains, active sites (Pfam, PROSITE, InterPro).			

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion	Quiz and assignment
CLO2	Lecture and Reflective Discussion	Assignment, Quiz and Summative Exam
CLO3	Lecture and Group Discussion	Mid Term and Summative Exam

Text Book

1. Lesk, A. (2013). Introduction to bioinformatics. Oxford University Press.

Group B: Big Data Analytics 50 (Credit 2)

Rationale

This course provides practical experience in processing and analyzing large datasets using modern tools and frameworks. It enables students to apply theoretical concepts to real-world problems, develop data-driven solutions, and gain hands-on skills in distributed computing, data mining, and machine learning. This lab prepares students for research and industry applications in the era of big data.

Objectives

1. To develop students' hands-on skills in processing and managing large-scale datasets using big data tools and frameworks.
2. To enable students to apply data mining and machine learning techniques to extract insights from big data.
3. To equip students with the ability to visualize, interpret, and communicate results effectively for real-world applications.

Course Learning Outcomes

At the end of this course, students will be able to

CLO1	Import, clean, and preprocess large-scale datasets using big data tools.
CLO2	Apply distributed computing frameworks such as Hadoop and Spark for efficient data processing.
CLO3	Implement data mining and machine learning techniques on large datasets to extract meaningful insights.
CLO4	Visualize, interpret, and communicate the results of big data analysis effectively.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2		1		1	
CLO2	2		2	1	1	1
CLO3	2	1	2	1		1
CLO4	2	1	1	1	2	1

Course Content, Teaching, and Assessment Strategy:

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	*Introduction to Big Data Tools; Data Ingestion and Storage; Data Cleaning and Preprocessing.*	Lectures, Hands-on Labs, Software Demonstrations, Tutorials, Mini-Projects, Case Studies.	Lab Exercises, Assignments, Class Participation, Practical Exams, Project Work, Project Reports, Presentations.	3
CLO2	Map Reduce Programming; Spark RDDs, Data Frames, SQL Operations.			4
CLO3	Classification, Regression, Clustering; Feature Engineering; Machine Learning on Big Data.			5
CLO4	*Real-Time Data Analytics; Visualization using Tableau/ Matplotlib/ PowerBI; Mini Project.*			5

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lectures, Hands-on Labs, Software Demonstrations.	Lab Exercises, Assignments, Class Participation.
CLO2	Lectures, Hands-on Labs, Tutorials.	Practical Assignments, Lab Exercises.
CLO3	Lectures, Software Demonstrations, Mini-Projects.	Practical Exams, Project Work, Lab Assignments.
CLO4	Lectures, Case Studies, Software Demonstrations.	Project Reports, Presentations, Lab Exercises.

Texts:

1. Bruce Ratner (2011); *Statistical and Machine-Learning Data Mining: Techniques for Better Predictive Modeling and Analysis of Big Data*, Second Edition
2. N.D. Lewis, Practical Big Data Analytics: Hands-on Techniques to Implement Enterprise Analytics and Machine Learning Using Hadoop, Spark, NoSQL, and R

Semester II

Course Code: 0542-5201 (Stat-5201)		Course Title: Categorical Data Analysis
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale

This course introduces statistical methods for analyzing both univariate and multivariate categorical data and helps to determine when categorical data analysis should apply and choose appropriate methods.

Objectives

1. To develop students' abilities in understanding and solving practical statistical problems involving categorical data.
2. To present theory and techniques for the analysis of categorical data.
3. To enable students to learn how to choose appropriate techniques, to analyses categorical data, and present results.

Course Learning Outcomes

At the end of this course, students will be able to

CLO1	Explain and interpret the association between two or more variables using appropriate statistical and graphical methods.
CLO2	Apply partial and canonical correlation techniques to analyze complex relationships while controlling for extraneous variables.
CLO3	Test hypotheses related to multivariate associations, including the independence of variables and the significance of canonical correlations.
CLO4	Evaluate the goodness-of-fit of statistical models and test hypotheses related to associations and independence among categorical variables.
CLO5	Develop, assess, and refine multi-dimensional log-linear models using model selection strategies and diagnostic tools.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2		1	2		1

CLO2	1	1		1	1	2
CLO3	3		1	2	2	
CLO4	2	1				1
CLO5	3		2	1	1	

Course Content, Teaching and Assessment Strategy:

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	**Bivariate and Multivariate Association Analysis:** Measuring and Interpreting Association, Especially between Two Variables, Graphical Investigation of Many Associations.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	3
CLO2	**Controlling and Extending Correlation Analysis:** Correction of Correlation for Effects of Extraneous Variables, Measuring Association Between Two Sets of Variables,			4
CLO3	**Hypothesis Testing in Multivariate Correlation:** Testing Hypotheses about Sets of Associations, Test that All Population Correlations are Zero (Mutual Independence of All Variables), Test that All Population Canonical Correlations are Zero, Test that Some Population Canonical Correlations are Zero.			10
CLO4	**Multi-Dimensional Contingency Tables:** Log-Linear Models, Classification and Interpretation of Log-Linear Models, Choice of Model, Diagnostics, Model Search Strategies.			10
CLO5	Ordinal logistic, Multinomial Logistic regression, GEE, Generalised Linear Mixed Model (GLMM).			10

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Interactive lectures with visual aids.	Quiz on correlation concepts.

CLO2	Guided lab exercises and assignments on correlation analysis.	Lab exercises on partial and canonical correlation.
CLO3	Practical sessions performing hypothesis tests.	Written assignments on hypothesis testing procedures.
CLO4	Peer-assisted learning for model interpretation and diagnostics.	Group project: build and interpret log-linear models.
CLO5	Interactive tutorials on diagnostic tools and model search strategies.	Final project/report involving multi-dimensional data.

Texts

1. Anderson, T. W. (1984): *An Introduction to Multivariate Statistical Analysis*, 2nd edition, John Wiley, New York.
2. Agresti, A. (2002): Categorical Data Analysis, 2nd edition, John Wiley, New York.

References

1. Johnson, R. A. and Wichern, D. W. (2002): *Applied Multivariate Statistical Analysis*, 7th edition, John Wiley, New York.
2. Mardia, K. V., Kent, J. T., and Bibby, J. M. (1979): *Multivariate Analysis*, 3rd edition, Academic Press, London.

Course Code: 0542-5202 (Stat-5202)		**Course Title: Advanced Biostatistics**
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale:

Advanced Survival Analysis provides students with statistical foundation of the various problems of Biology. Students will learn to recognize the main features of the processes under investigation that could be analyzed in terms of survival analysis or general analysis of the paired data. Grading this course will help the future specialist to analyze the health-related phenomena in advanced statistical level.

Objectives

1. Understand the basic concepts and ideas of survival analysis
2. Know the properties and methods for standard survival time distributions
3. Learn to perform and interpret simple non-parametric survival analyses
4. Gather knowledge on semi-parametric and parametric regression models for survival data and understand the links between these approaches;
5. Get familiarize with generalized linear models for longitudinal data
6. Learn Marginal models and Random effect models.
7. Understand and apply methods for analyzing correlated lifetime data using frailty and random effects models.

Learning Outcomes:

After completion of this course students will be able to

CLO1	Infer from log-location-scale regression models (Accelerated Failure Time Models)
CLO2	Distinguish the difference between parametric and non-parametric survival models.

CLO3	Expand an understanding of the Cox proportional hazard model and its connection to the log linear model.
CLO4	Specify the model for multiple modes of failure, likelihood formulations, nonparametric methods, parametric methods.
CLO5	Estimate and compare efficiency of models.
CLO6	Instrumentalize Generalized linear models for longitudinal data, Marginal models and Random effect models in practical fields.
CLO7	Analyze correlated lifetime data using shared frailty and random effect models, interpret dependence structures, and apply appropriate survival modeling techniques to biomedical data.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	3	2	3		3
CLO2	3	3	1	1	1	3
CLO3	2	3	3	1	3	2
CLO4	3	1		2	2	3
CLO5	3	2		1	1	3
CLO6	2	1	1			2
CLO7	3	2		2	2	1

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	**Parametric regression models:** inference procedures for log-location-scale regression models (Accelerated Failure Time Models)	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	05
CLO2 CLO3	**Semi-parametric and multiplicative hazards regression models:** Methods of continuous multiplicative hazards regression models, methods for grouped lifetimes			10
CLO4	**Multiple Modes for failure:** Basic characteristics and model specifications, likelihood formulations, nonparametric methods, parametric methods for multiplicative Hazards models.			07
CLO5	**Goodness of fit tests:** General methods for testing fits, test of fit for specific distributions, test of fit with regression models.			05
CLO6	**Generalized linear models for longitudinal data:** marginal models, random effects models, transition models.			12

	Random effect models: Estimating for generalized linear mixed models, conditional likelihood, maximum likelihood estimation; logistic regression for binary responses, conditional likelihood approach, random effect models for binary responses; Count response; conditional likelihood method, random effect models for counts, Poisson-Gaussian random effects models			
CLO7	**Analysis of correlated life time data:** Concept of correlated survival times; dependence in multivariate survival data; shared frailty models and random effects approaches; estimation and interpretation of model parameters; applications in biomedical and reliability studies.			03

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion	Class Test, Mid Term, Quiz
CLO2	Lecturing and Reflective Discussion	Mid Term, Assignment, Presentation and Summative Measure (Final Exam.)
CLO3	Lecture and Reflective Discussion	Mid Term, Assignment, Presentation and Summative Measure (Final Exam.)
CLO4	Lecturing and Problem-solving activities.	Summative Measure (Final Exam.)
CLO5	Discussion and Slide Show	Summative Measure (Final Exam.)
CLO6	Discussion and Slide Show	Summative Measure (Final Exam.)
CLO7	Discussion and Slide Show	Summative Measure (Final Exam.)

Text Book

1. Kleinbaum, D.G, (1996): *Survival Analysis,*Springer,New York.

2. Therneau, T.M. and Grambsch, P.M. (2000): *Modeling Survival Data: Extending the Cox Model*. Springer, New York.

Reference Books

1. Cox, D.R and Oakes, D,(1988): *Analysis of Survival data,* Chapman and hall
2. Daniel W.W: *Bio-statistics: A Foundation for Analysis in the Health Science,* 7th Ed. John Wiley and Sons, New York.
3. Karim, M. R. and Islam, A. (2019). *Reliability and Survival Analysis*, Springer, Singapore.
4. Kalbfleisch, J.D. and Prentice, R.L. (2002). *The Statistical Analysis of Failure Time Data*, Wiley.

Course Code: 0613-5203 (Stat-5203)	**Course Title: Statistical Machine Learning Techniques**

Marks: 100	Credits: 03	Number of Class: 42

Rationale

Applied Machine Learning Techniques equip students with the essential knowledge and skills to analyze, model, and solve complex data-driven problems. The course emphasizes practical applications of supervised, unsupervised, and deep learning algorithms, as well as time series forecasting, evaluation, and optimization methods. Students will gain hands-on experience with programming libraries and software, preparing them for advanced research and industry roles.

Objectives

1. Introduce the scope, principles, and applications of applied machine learning.
2. Provide practical knowledge of supervised, unsupervised, and deep learning techniques.
3. Apply machine learning methods to time series, sequential data, and real-world problems.
4. Develop the ability to evaluate, optimize, and critically assess machine learning models, including their ethical and social implications.

Course Learning Outcomes (CLOs)

By the end of this course, students will be able to:

CLO No.	Course Learning Outcome (CLO)
CLO1	Explain the scope, principles, and types of machine learning, including their applications and implications.
CLO2	Apply supervised learning methods (regression and classification) to real-world problems.
CLO3	Implement unsupervised learning techniques such as clustering and dimensionality reduction for data exploration.
CLO4	Design and train neural networks and deep learning architectures for image, text, and sequential data.
CLO5	Develop models for time series forecasting and sequential data analysis using both classical and modern approaches.
CLO6	Evaluate and optimize machine learning models using performance metrics, cross-validation, and hyperparameter tuning.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	2	2	2	–	2
CLO2	3	2	3	3	–	2
CLO3	2	2	3	2	2	2
CLO4	2	2		3	2	3
CLO5	2	2	3	3	2	2
CLO6	2	2	3	3	2	3

Course Content, Teaching and Assessment Strategy

Content Area	Topics Covered	Teaching–Learning Strategy	Assessment Strategy	CLOs	Lec.
Introduction to Applied ML	Meaning and scope of machine learning, types of learning (supervised, unsupervised, reinforcement), core tasks (regression, classification, clustering, dimensionality reduction, sequence modeling, prediction), key algorithms, model evaluation, and optimization. Development of machine learning, application and social implications of machine learning.	Lectures, interactive classes, discussions, participatory Q/A, coding labs, lab practice, demonstrations, case-based learning, group work, and online resources, practical skills, engagement, and active participation.	Assignments, Class Tests, Presentation, Attendance and Final Examination.	CLO1	4
Supervised Learning	Regression; linear, multiple, polynomial regression, ridge, lasso. Classification; logistic regression, k-nearest neighbors, naïve Bayes, decision trees, random forest, gradient boosting (xgboost, lightgbm, catboost), SVM. Decision tree algorithms; ID3, C4.5, CART. Ensemble methods; Bagging, Random Forest, Gradient Boosting, AdaBoost, Stacking, hyperparameter tuning and cross-validation.			CLO2	12
Unsupervised Learning	Clustering techniques; k-means, hierarchical clustering, DBSCAN, PAM, mean-shift, spectral clustering, fuzzy C-means, Gaussian Mixture Models. Dimensionality reduction; PCA, t-SNE, UMAP, LDA. Handling outliers; Isolation Forest, Local Outlier Factor. Advanced clustering; clustering with neural networks and genetic algorithms. Applications in customer segmentation, anomaly detection, market basket analysis, document clustering, and image segmentation.			CLO3	8
Neural Networks & Deep Learning	Basic neuron model: perceptron, multilayer perceptron (MLP), backpropagation, activation functions, gradient descent. Convolutional neural networks (CNNs) for image processing.			CLO4	10

	Recurrent neural networks (RNNs, LSTM) for sequence modeling. Advanced networks: Hopfield networks, Boltzmann machine networks, Kohonen self-organizing maps (SOMs)—network structure, determining the winning neuron, and learning algorithms.				
Time Series & Sequential Data	Classical forecasting models: ARIMA, SARIMA, Prophet, and Holt-Winters exponential smoothing. Sequence modeling: recurrent neural networks (RNNs), LSTMs, and sequence-to-sequence models. State-space models: Kalman filters, seasonal-trend decomposition (STL)			CLO5	6
Model Evaluation & Optimization	Performance metrics: confusion matrix, precision, recall, F1-score, ROC/AUC for classification; RMSE, MAE, R^2 for regression. Cross-validation: k-fold, stratified, and bootstrap methods. Hyperparameter tuning: grid search, random search, Bayesian optimization, and automated tuning for model improvement.			CLO6	4

Mapping of CLOs with Teaching–Learning & Assessment Strategy

CLO No.	Teaching–Learning Strategy	Assessment Strategy
CLO1	Lectures and discussions on core concepts of machine learning.	Quizzes and short assignments on key ideas.
CLO2	Coding labs and group work on supervised learning methods.	Lab reports and project submissions.
CLO3	Lab sessions applying unsupervised learning techniques.	Case studies and data analysis reports.
CLO4	Step-by-step demonstrations in deep learning architectures.	Practical projects and midterm exams.
CLO5	Group analysis of time series forecasting methods.	Applied projects and in-class presentations.
CLO6	Seminars on model evaluation and optimization.	Quizzes and final project assessments.

Texts

1. Bishop, C. M. (2006). *Pattern Recognition and Machine Learning*. Springer.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.

3. Hastie, T., Tibshirani, R., & Friedman, J. (2009). *The Elements of Statistical Learning*. Springer.

References

1. Murphy, K. P. (2012). *Machine Learning: A Probabilistic Perspective*. MIT Press.
2. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd ed.). O'Reilly.
3. Shalev-Shwartz, S., & Ben-David, S. (2014). *Understanding Machine Learning: From Theory to Algorithms*. Cambridge University Press.
4. James, G., Witten, D., Hastie, T., &Tibshirani, R. (2021). *An Introduction to Statistical Learning with Applications in R* (2nd ed.). Springer.

Course Code: 0314-5204 (Stat-5204)	**Course Title: Population Studies**	
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale:

This course is designed to make the students oriented with most applied demographic components to be used in different field at advanced level.

Objectives

1. To know about social problems like Gender Based Domestic Violence (GBDV), its effects on Socio-economic and Reproductive health and mitigate social challenges.
2. Able to know about Social Development Indicators and to apply statistical models, analyze. Also make decisions by using data from different sectors.
3. Ensure ethical, professional, social issues and responsibilities.
4. Gather knowledge about Millennium Development Goal (MDG), Sustainable Development Goal (SDG), Population Aging and Population Projection by using related data.
5. Demonstrate the clear idea about monitoring and evaluation, Management Information System (MIS), Population Stabilization and health policy for national significance.

Course Learning Outcomes (CLO's)

After completion of the course, students will be able to-

CLO1	Explain Gender Based Domestic Violence (GBDV), its effects on Socio-economic and Reproductive health.
CLO2	Analyze the Couple Year Protection (CYP) and Effectiveness of Contraceptive uses.
CLO3	Work on Social Development Indicator.
CLO4	Demonstrate Millennium Development Goal (MDG) and SDG.
CLO5	Analyze Population Aging, Demographic Projection, Advocacy and health policy of Bangladesh by using data from different sources.
CLO6	Construct Bongarts Model, Gompertz Model and fitted these models by demographic data. Also, students will be ethically sound.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3		1		2	
CLO2	2			1	1	1
CLO3	1	2	1		1	
CLO4	1		3	1		1
CLO5	3	2		1	2	
CLO6	2		3			2

Course content, Teaching and Assessment Strategy

CLO's	Course Content	Teaching Strategy	Assessment Strategy	No. of Lecture
CLO1	**Gender Based Domestic Violence (GBDV):** Reasons of Domestic Violence, Types of Physical Violence, Socio- economic and Reproductive Health Implication of GBDV, Important Steps in Reducing Gender Based Domestic Violence.	Interactive class, Open discussion, Participatory Q/A session, Online resources and practical	Assignments, class tests, Quiz, Presentation and semester final examination	03
CLO2 CLO3 CLO5	**Social Development Indicator:** Human Capital Indicator, Population Policy, Social Capital Development/Social Capital, Gender and Development, Social Protection/Social Network. **Couple Year Protection:** Definition, Sterilization (Conversion Factor, Achievement Index, Prevalence Index), Tubectomy (Conversion Factor, Achievement Index, Prevalence Index), Intrauterine Device (IUD) (Conversion Factor, Achievement Index, Prevalence Index), Vasectomy (Conversion Factor, Achievement Index, Prevalence Index). **Effectiveness of Contraceptive Use:** Fecundability and Fecundity, Life Table Analysis of Contraceptive Failure, Construction of Single and Multiple Decrement Life Table. **Decomposition of Change in TFR between Two Time Periods**: Bongaart's Model, Target setting by Bongaart's Model, Relationship between Target Fertility and Contraceptive use.			08

CLO4	**Millennium Development Goal (MDG):** Rational of MDG, Motivation Behind MDG, Goal, Target, Indicator of MDG, and Current Situation of Bangladesh Considering Different Indicators. **Sustainable Development Goals (SDG)**: Rational of SDG, Motivation Behind SDG, Goal, Target, Indicator of SDG, and Current Situation of Bangladesh Considering Different Indicators. **Population Aging:** Elderly Situation, Aging Index, Support Ratio Index, Care Index, Elderly Situation in Bangladesh, Components (Elements) of Aging Policy in Bangladesh, Goals and Objectives of Aging Policy in Bangladesh. **Stable Population theory:** Theory and dynamics of stable populations (momentum of population growth and the speed of convergence to stability), and extensions to general dynamics models for populations with changing fertility and mortality rates, and their applications, time to stability, the Easterlin effect. **Demographic Projection:** Population estimates and projections, methods of population projections, projections of households and labor force.			09
CLO5	**Gender Preference:** Family Size, Ideal Family Size, Sex Preference of Family Size, Factors Affecting Sex Preference in Bangladesh, Relationship between Actual Fertility and Ideal Fertility, Fertility of Spacers and Limiters and their Effect, Effect of under Five Mortality or Infant Mortality on Desired Family Size. **Advocacy:** Advocacy, Components of Advocacy, Importance of Advocacy. **Monitoring and Evaluation:** Monitoring and Evaluation, Steps in Monitoring and Evaluation, Indicators of Monitoring and Evaluation. **Management Information System (MIS):** Purpose of Information, Purpose of Management Information System. **Urbanization:** Megacity, Urban Projection, Estimating Megacity Population and Implications on Basic Needs, Social, Economic and Demographic Implications.			10

	Gompertz Model: Assumption, Estimation of Process Advantages and Disadvantages, Derivation of Model Parameters. **Population Stabilization:** Population Stabilization, Tempo Effect, Quantum Effect, Implication of Population Stabilization If Replacement Fertility is Not Achieved, Population Momentum, Reduction of Population Momentum, Factors to be considered in Reduction of Population Momentum.			
CLO5 CLO6	**Demographic Benefits:** Achieved Replacement Fertility in Time, Its Benefit in Falling Fertility, Demographic Window/Bonus: Implication of Macro Economic Growth. **Health Policy of Bangladesh:** Definition, Reasons of Health Policy, Health Policy of Bangladesh, Health Infrastructure Information, Selected Health and Family Planning Indicators, National Health Policy (NHP), Objectives of National Health Policy, Principles of National Health Policy. **Truncation Estimator of Age at First Marriage:** Truncation or Censoring, Estimate Mean Age and Marriage of Truncated Distribution. **Disability Adjusted Life Years (DALY):** Necessity of Measuring DALY, Concepts, Principle and Philosophy of DALY, Measurement of DALY, Construction of Life Table of Disability Prevalence, Problems in DALY. **Influence of Age Structure on Fertility:** Estimation of Fertility When It is affected by Age Structure. **Manpower Planning:** Concept, importance, methods and techniques of manpower forecasting, manpower supply and challenges, development policy in Bangladesh.			10

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion and interactive learning	Quiz and Assignment,

CLO2	Problem-solving activities and Collaborative learning spaces	Assignment, Quiz and Summative assessment
CLO3	Lecture, Current events quizzes, and Reflective Discussion	Mid-Semester and Summative assessment
CLO4	Lecture, Group discussion and Slide Show	Mid-Semester and Summative assessment
CLO5	Lecture and Student Activity	Summative assessment
CLO6	Lecture and discussion	Summative assessment and Assignment

References

1. Chiang, C. L. (1984): *The Life Table and Its Applications*, Krueger Pule, John Wiley, New York.
2. Bongaarts, J. and, Potter, R. G. (1983): *Potter Fertility, Biology and Behaviour: An Analysis of the Proximate Determinants of Fertility*, Academic Press, Sandiego, California.
3. Colin, N. (1988): *Methods and Models in Demography*, Belhaven Press, London.
4. Selected articles from *Population Studies*, Demography, Population and Development Studies in Family Planning, etc.

Course Code: 0542-5205 (Stat-5205)	**Course Title: Advanced Experimental Design**	
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale:

This course is designed to make the students oriented with most applied experimental designs to be used in different field at advanced level.

Objectives:

1. Assist students in selecting an experimental design that takes into account the goals of the study and the limitations of the experiment.
2. Allow students the opportunity to experience more complex experimental designs, such as response surface, split-plot, strip-plot, and incomplete-block designs.
3. Guide students in confidently interpreting advanced experimental design and understanding the extent of the conclusions.

Course Learning Outcomes: At the end of this course students will be able to

CLO1	Describe the concepts of experimental design, Estimable functions, parametric functions and Relevant theorems.
CLO2	Choose appropriate experimental design techniques in context of the problem. Construction and analysis of 2^n and 3^n factorial experiments. Fractional factorial experiment Resolution III, IV and V design.
CLO3	Identify, analyze and report on a selection of advanced experimental designs such asIncomplete Block Design, Galois field, Split- plot design, Strip plot design, and Response surface design.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2	2	1	1	1	

CLO2	2	2	2	2	2	1
CLO3	2	2	1	1	1	

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	**Basic Concept and Linear Estimation**: Some Basic Definitions, Estimable functions, parametric functions, Relevant theorems, Test of hypothesis involving several linear functions of parameters.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	5
CLO2	**Factorial Experiments:** Construction and analysis of 2^n and 3^n factorial experiments, Confounding, Concept of simultaneous confounded effects, Construction of confounded s^n factorials in blocks of size s^r, Detailed study of Construction of balanced confounded asymmetrical factorial experiments, Analysis of variance of data in above confounded asymmetrical factorial experiments. Fractional factorial experiment, Resolution III, IV and V design, Construction of 2^{n-k} factorials.			15
CLO3	**Incomplete Block Design:** Detailed study of incomplete Block Design, Balanced Incomplete Block Design (Inter and Intra-Block Analysis) and Symmetrical Balanced Incomplete Block Design, Construction of some commonly used Balanced Incomplete Block Design, Orthogonal Latin Squares Design, Lattice Design, and Partially Balanced Incomplete Block Design. **Galois field:** Definition, application of Galois field in design of experiments, minimum function, technique of constructing minimum function. **Some other designs:** Split- plot design, Strip plot design, Response surface design.			15

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Student Activity	Quiz and Assignment,
CLO2	Lecture and Discussion	Assignment, Quiz and Summative Exam

CLO3	Lecture and Group Discussion	Mid-Semester and Summative Exam

Text

1. Montgomery, D. C. (2003): *Design and Analysis of Experiments*, 5th edition, John Wiley, New York.

References

1. Das, M. N. and Giri, N. C. (1997): *Design and Analysis of Experiments*, 2nd edition, New International (P) Ltd., India
2. Cochran, W.G. and Cox, G.M. (2000): *Experimental Design*, 2nd Edition, Wiley, New York.
3. John, P. W. M. (1971): *Statistical Design and Analysis of Experiments*, Wiley, New York.
4. D.D.Joshi: Linear Estimation and Design of Experiments.
5. Bhuiyan, M. R.: Experimental *Design.*
6. Yates: Factorial experiments.

Course Code: 0542-526 (Stat-526)	**Course Title: Multilevel Modeling**	
Marks: 100	**Credits: 03**	**Number of Class: 39-42**

Rationale:

This course is designed to introduce the students with an applied introduction to multilevel modeling. It will introduce the statistical features of multilevel models; deal with approaches to handling data which has clustered or hierarchical elements. The course also emphasizes the practical application of multilevel models, and seeks to convey both the attractions and limitations of a multilevel modeling approach.

Objectives:

1. Describe fundamental concepts and issues in multi-level modeling.
2. Provide students with a solid grounding in the application of multilevel models.
3. Help the students to develop a strong understanding of how multilevel models are formulated in statistical terms (and their relationship to other types of statistical model), with a fluency in handling data with clustered and hierarchical features.
4. Able the students to identify different analytical approaches to longitudinal data analysis and specify their strengths and limitations.
5. Help the students to develop and practice longitudinal model specification, estimation, evaluation, and modification skills.

Course Learning Outcomes:

At the end of this course students will be able to

CLO1	Explain the concepts, assumptions, and structures of multilevel models and distinguish them from classical regression models
CLO2	Formulate appropriate multilevel (hierarchical) models for nested and clustered data structures in social, biomedical, or experimental research
CLO3	Estimate and interpret parameters in two-level and three-level models using appropriate software
CLO4	Evaluate the model assumptions, diagnostics, and fit of multilevel models and suggest remedies or improvements

CLO5	Communicate statistical findings from multilevel analyses effectively in both written and oral formats, demonstrating clarity and statistical reasoning
CLO6	Apply multilevel modeling techniques to real-world research problems and contribute to a research report or paper

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	1	2	2		
CLO2	3	2	3	2	1	
CLO3	3	1	3	2		
CLO4	3	1	3	3		
CLO5	2	3	2	1	1	2
CLO6	2	2	3	2	3	

Course Content, Teaching and Assessment Strategy:

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	Intraclass Correlation, Pitfalls of Ignoring Multilevel Data structure, Multilevel Generalized Linear Model for Dichotomous, Multilevel Longitudinal Framework, Person Period Data Structure, Benefits of Using Multilevel Modeling for Longitudinal, Analysis	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	3
CLO2, CLO3	Nested Data and Cluster Sampling Designs, Multilevel Linear Models, Random Intercept, Random Slopes, Centering, Basics of Parameter Estimation with MLMs, Maximum Likelihood Estimation , Restricted Maximum, Likelihood Estimation, Overview of Two-Level MLMs, Overview of Three-Level MLMs , Overview of Longitudinal Designs and Their Relationship to MLMs ,Outcome Variable, Random Intercept Logistic Regression, Random Coefficient Logistic Regression, Inclusion of Additional Level 1 and Level 2 Effects to MLRM, Fitting Multilevel Dichotomous Logistic Regression, Using lme4, MGLM for Ordinal Outcome Variable, Random Intercept, Logistic Regression, MGLM for Count Data, Random Intercept, Poisson Regression, Random Coefficient, Poisson Regression Inclusion of Additional Level 2			15

	Effects in Multilevel, Poisson Regression Model, Fitting Multilevel Poisson Regression Using lme4 ,Fitting Two-level Models in R,Packages and Functions for Multilevel Modeling in R, The nlme Package , Simple (Intercept Only) Multilevel, Models Using nlme , Random Coefficient Models Using nlme, Interactions and Cross-Level Interactions Using nlme , The lme4 Package , Random Intercept Models Using lme4 Random Coefficient Models Using lme4 , Additional Options, Parameter Estimation Method , Estimation Controls, Confidence Intervals for Parameter Estimates, The nlme Package, Simple Three-Level Models, Simple Models with More Than Three Levels, Random Coefficient Models with Three or More Levels , lme4 for Three and More Levels, Fitting Longitudinal Models Using nlme and lme4 Packages			
CLO4	Assumptions Underlying MLMsPlots for Linear Models, Plotting Nested Data, Using the lattice Package, dotplot, xyplot, ,Summary, Centering Predictors, Chi Square Test for Comparing Model Fit,Changing Covariance Structures of Longitudinal Models,			7
CLO5	Interpreting Fixed and Random Effects in Multilevel Models, Reporting Multilevel Model Results in APA or Journal Style, Writing Interpretation Sections for Research Report, Oral Presentation or Seminar on Multilevel Modeling Results, Comparing Models and Explaining choice of Best-fit model			7
CLO6	Project-based Analysis Using Real Nested Longitudinal Datasets, Writing a Research Report Using Multilevel Models, End-of-Course Project with Data Cleaning, Model Fitting, Interpretation, and Conclusion, Software Implementation in R or Stata for Complex 3-level MLMs			7

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy

CLO1	Classroom Discussion	Interactive Question-Answer
CLO2	Expository sharing	Assignment and Presentation
CLO3	Classroom Discussion and Problem-solving activities	Practice by doing exercise, Summative (Midterm)
CLO4	Discussion and Slide Show	Summative Measure (Final Exam.)
CLO5	Lecture and Reflective Discussion	Summative Measure (Final Exam.)
CLO6	Lecturing	Summative Measure (Final Exam.)

Text Book

1. Steven P. Reise, NaihuaDuan (2002); Multilevel Modeling: Methodological Advances, Issues and Applications, 1 st edition.

Reference Books

1. Tom A.B. Snijders, Professor Roel Bosker (1999); Multilevel Analysis: An Introduction to Basic and Advanced Multilevel Modeling 1st edition

Course Code: 0542-5207 (Stat-5207)	**Course Title: Planning, Monitoring and Evaluation of Research**	
Marks: 100	**Credits: 03**	**Number of Class: 39-42**

Rationale:

This course gives the fundamental concepts of research methods, research proposal, research report and related materials. Student will gather concepts of research performance monitoring and evaluation system. Student will also earn necessary expertise to conduct a project planning, monitoring, evaluation and reporting. There is a particular focus on the contribution of statistical methods in both the design andanalysis of such studies.

Objectives:

1. Develop research plan and capable to conduct scientific research;
2. Elaborate a methodology to monitor the development of the research;
3. Clearly state what are the milestones of the research and what are the final outputs.

Learning Outcomes:

CLO1	define research terminology and identify the elements and steps of an M&E plan;
CLO2	identify M&E roles and responsibilities;
CLO3	create an analysis plan and reporting templates.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8
CLO1	3	2	1	1	2	2	1	1
CLO2	2	3	3	2	2	1	2	2
CLO3	3	3	3	2	1	1	2	1

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	Introduction: Designs for program evaluation and principle. Research, data analysis techniques and reporting, developing a M & E system, developing a term of reference and responding to proposals. Data sources and research methods, Performance monitoring, Theoretical framework, Statistical methods used in the analysis of data derived from such designs, in particular for the estimation and test of hypothesis.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	10
CLO2	Monitoring and Evaluation*:* Basic concept, Opportunities and Barriers, Purpose and benefits of planning, monitoring and evaluation. Introduction to the Logical Framework Approach (LFA), Steps of the LFA*:* Stakeholder analysis, Problem analysis, Objective's analysis, Alternative's analysis, Identification of indicators and means of verification, Identification of assumptions and risks, setting baselines and targets, Theory of Change, how to produce a plan of action. Key concepts and approaches in evaluations (including effectiveness, efficiency, impact, relevance and sustainability).Development practitioners, project leaders and decision makers responsible for designing, implementing, monitoring or evaluating development projects. Collecting, Analyzing, and Using Monitoring Data, Key Elements of M & E Work Plan, Comprehensive Monitoring and Evaluation Framework.			10
CLO3	*Evaluation of Research Question*: Outcome, Impact, Output, Input, Study Designs, Types and Objectives of Monitoring and Evaluation, Steps in Developing a Monitoring Plan, Country Monitoring and Evaluation Matrix. Planning, Monitoring and Evaluation for Development Projects.			10

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning & Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture	Quiz and presentation
CLO2	DIY activities	Assignment and Presentation

CLO3	Discussion and slide show	Practice by doing exercise, Summative (Midterm)
CLO4	Audio Visual Lecturing	Summative Measure (Final Exam.)
CLO5	Educational podcasts	Summative Measure (Final Exam.)

Text Book:

1. ESSENCE on Health Research. (2016). *Planning, Monitoring and Evaluation Framework for Research Capacity Strengthening.*

2. Tengan, C., Aigbavboa, C., &Thwala, W. D. (2021). *Construction Project Monitoring and Evaluation: An Integrated Approach*. Routledge.

Reference Books:

1. Mayne, R., Hamilton, J., & Hobson, K. (2013). *Step by Step Guide to Monitoring and Evaluation Resource*.

2. World Health Organization. (2016). *Planning, Monitoring, and Evaluation: Framework for Research Capacity Strengthening.* ESSENCE.

3. Patton, M.Q. (2017). *Managing for Sustainable Development Goals- An Integrated approach to planning, Monitoring and Evaluation, Priciples-Focussed Evaluation: The Guide.*

4. Rossi, P. H., Lipsey, M. W., & Henry, G. T. (2018). *Evaluation: A systematic approach*. Sage

Course Code: 0315-5208 (Stat-5208)	**Course Title: Banking Management and Financial Statistics**	
Marks: 100	**Credits: 03**	**Number of Class: 42**

Rationale

This course integrates banking, financial markets, investment analysis, accounting, and cost management to develop well-rounded finance professionals. It blends theoretical foundations with practical applications, ensuring that students can understand financial systems, analyze economic and market variables, manage financial resources, and make data-driven decisions. This comprehensive approach aligns with the needs of modern financial institutions, regulatory frameworks, and global financial markets.

Objectives

1. Understand banking, financial systems, and regulatory frameworks.
2. Develop skills in investment, stock market analysis, and portfolio management.
3. Apply accounting and financial management for effective decision-making.
4. Grasp global financial trends, monetary policies, and digital finance.

Course Learning Outcomes

At the end of this course students will be able to

CLO1	Explain functions, types, and regulations of commercial and central banks, including credit risk appraisal.
CLO2	Analyze money and capital markets, monetary policy, and digital money instruments.
CLO3	Evaluate bank fund management, portfolio allocation, and capital adequacy techniques.
CLO4	Apply stock market analysis, including fundamental, technical, and behavioral approaches.
CLO5	Compute investment returns and assess risk-return trade-offs using financial models.

CLO6	Record transactions and prepare financial statements and company accounts.
CLO7	Determine product costs and apply cost-volume-profit and relevant costing techniques.
CLO8	Prepare budgets and implement financial management for performance optimization.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3		2			
CLO2	2		2			
CLO3	2			3		
CLO4	2	2	3			
CLO5	3		2			
CLO6	2				3	
CLO7	2			2		
CLO8	2			3		2

Course Content, Teaching, and Assessment Strategy:

CLOs	**Course Content**	**Teaching Strategy**	**Assessment Strategy**	**No. of Lectures**
CLO1	Commercial & Central Banking: Definition & Functions of **Commercial** Bank, Commercial Bank Regulations: Banking Companies Act in Bangladesh. Types of Banks, Banker-Customer Relationship, Forms of Bank Credit - Secured and Unsecured Advances, Bill Discounts, Overdrafts-Cash Credit, Term Lending, Steps Involved in the Appraisal of Credit Risk. Nature and Functions of Central Bank in Developed and Undeveloped Countries.	Lectures, case studies, group/interactive discussions, problem-solving sessions, hands-on labs, practical exercises, software demonstrations, and tutorials.	Quizzes, assignments, case studies/analysis, presentations, projects, practical/lab exams, software exercises, class participation, and mid-term/final exams.	6
CLO2	**Money Market:** Covers time value of money, inflation, money supply and policy, money market instruments, digital money, regulations, behavioral economics, international monetary systems, and monetary management techniques.			5
CLO3	**Bank Fund Management:** Sources and Use of Fund- Portfolio Management: Primary Reserve, Secondary Reserve, Loans & Investment- Capital Adequacy: BASEL I, II & other techniques.			4
CLO4	Stock Market Analysis: Overview of stock markets, exchange structure, participants, and analysis techniques (fundamental, technical, behavioral). Covers portfolio theory, market			6

	efficiency, derivatives, indices, macroeconomic impacts, algorithmic trading, and practical applications.			
CLO5	Return Calculations: Overview of return concepts, risk-return measures, portfolio performance metrics (CAPM, Sharpe, Treynor, Jensen), equity and asset returns, dividend yield, EAR, and practical computation using financial data and software.			5
CLO6	Principles of Accounting: Transactions, Ledger Books, Cash Book, Accounting Procedure, Trial Balance, Financial Statements, Company Final Accounts.			6
CLO7 & CLO8	Cost & Financial Management: Elements of costs of products, Calculation of cost of production, Cost-volume-profit analysis, Relevant cost for Decision Making, Budget and Budgetary Control.			7

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lectures, case studies, group discussions	Quizzes, assignments, case analysis
CLO2	Lectures, interactive discussions, practical examples	Quizzes, written assignments, class participation
CLO3	Lectures, problem-solving sessions, case studies	Assignments, presentations, mid-term exam
CLO4	Lectures, hands-on labs, software demonstrations, case studies	Project work, software assignments, quizzes
CLO5	Lectures, practical exercises, financial software labs	Lab assignments, case studies, quizzes
CLO6	Lectures, practical exercises, tutorials	Practical exams, assignments, class participation
CLO7	Lectures, problem-solving, case studies	Assignments, case studies, mid-term/final exams
CLO8	Lectures, problem-solving, case studies	Assignments, case studies, mid-term/final exams

Texts:

1. Reed, E. W. (1963). Commercial bank management. Harper & Row.
2. Horngren, C. T., Datar, S. M., & Rajan, M. V. (2020). Horngren's Cost Accounting: A Managerial Emphasis (17th ed.). Pearson.

Reference Books:

1. L. R. Chowdhury : Loans and Advances.
2. Radhaswamy & Vasudvan : A Text Book of Banking.

3. R.S. Sayers : Modern Banking.
4. Shekhar : Banking Theory & Practice

Course Code: 0542-5209 (Stat-5209)	Course Title: Statistical Data Analysis - IV	
Marks: 100	**Credits: 03**	**Number of Class: 14**

Group A: Categorical Data Analysis 50 (Credit 2)

Rationale

This course provides an introduction to statistical methods for analyzing univariate and multivariate categorical data. It equips learners with the ability to identify situations where categorical data analysis is appropriate and to select suitable analytical methods accordingly.

Objectives

1. To enhance students' ability to understand and address practical statistical problems involving categorical data.
2. To provide a solid foundation in the theory and techniques used for categorical data analysis.
3. To develop students' skills in selecting appropriate analytical methods, conducting categorical data analysis, and effectively presenting results.

Course Learning Outcomes

At the end of this course students will be able to

CLO1	Recognize and appropriately summarize categorical data.
CLO2	Evaluate available methods for categorical data analysis and distinguish between appropriate and inappropriate techniques.
CLO3	Apply standard analytical methods for single and two-way classification data.
CLO4	Explain the structure and applications of generalized linear models, and demonstrate the ability to fit and interpret models such as log-linear and logistic regression.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2		1		1	
CLO2	2	1	1	1	1	
CLO3	2		2	1	1	1
CLO4	2		2	1	2	1

Course Content, Teaching, and Assessment Strategy:

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	***Analyzing association among variables; two- and three-way contingency tables.***	Lectures, Group Discussions, Case Studies, Problem-Solving Sessions, Hands-on Labs, Software Demonstrations, Tutorials, Examples.	Quizzes, Class Participation, Assignments, Midterm Test, Practical/Lab Exercises, Practical Exams, Project Work, Case Reports.	3
CLO2	Multi-Dimensional Contingency Tables; Evaluation of methods for categorical data analysis.			3
CLO3	Two- and Three-Way Contingency Tables; Multi-Dimensional Contingency Tables; Standard analytic methods.			4
CLO4	Log-Linear Models; Classification and Interpretation of Log-Linear Models; Choice of Model, Diagnostics, and Model Search Strategies; Multicategory Logistic Regression Model; Probit Model; Tobit Model.			5

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lectures, Group Discussions, Examples.	Quizzes, Class Participation, Short Assignments.
CLO2	Lectures, Case Studies, Problem-Solving Sessions.	Assignments, Midterm Test.
CLO3	Lectures, Hands-on Labs, Software Demonstrations.	Practical/Lab Exercises, Assignments.
CLO4	Lectures, Software Demonstrations, Tutorials, Case Studies.	Practical Exams, Project Work, Case Reports.

Texts:

- Anderson, T. W. (1984): *An Introduction to Multivariate Statistical Analysis*, 2nd edition, John Wiley, New York.
- Agresti, A. (2002): Categorical Data Analysis, 2nd edition, John Wiley, New York.

Group B: Advanced Biostatistics 50 (Credit 2)

Rationale:

The models that the students will learn under this course are essential for analyzing time-to-event data in many fields where traditional statistical methods are not sufficient, particularly when some observations are censored (i.e., the event hasn't happened by the end of the study)

Objectives

1. Provide a more intuitive and direct interpretation of "time."
2. Distinguish if a covariate "accelerates" or "decelerates" the event time.
3. Comprehend the risk of an event happening at any given moment, while accounting for various factors.

4. Treat a situation where a single survival model and treating all other outcomes as censored would lead to biased and overestimated results.
5. Evaluate the situations where the outcome variable is not normally distributed.

Learning Outcomes:

After completion of this course students will be able to

CLO1,2	Predict how different factors directly affect the time until an event occurs.
CLO3	Construct a situation where the risk of an event happening at any given moment is accounted for, while accounting for various factors.
CLO4	Expand the Cox proportional hazard model and its connection to the log-linear model.
CLO5	Specify the real-life situation to model for multiple modes of failure.
CLO6	Instrumentalize Generalized linear models for longitudinal data in practical fields.

Mapping between PLOs and CLOs of Statistics program:

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	3	2	3		
CLO2	3	3	1		1	1
CLO3	2	3		1	3	
CLO4	3	1	1	2	2	2
CLO5	3	2		1	1	3

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	**Parametric regression models:** inference procedures for log-location-scale regression models (Accelerated Failure Time Models)	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Assignments, Class Tests, Presentation, Attendance and Final Examination.	5
CLO2 CLO3	**Semi-parametric and multiplicative hazards regression models:** Methods of continuous multiplicative hazards regression models, methods for grouped lifetimes			10
CLO4	**Multiple models for failure:** Basic characteristics and model specifications, likelihood formulations, nonparametric methods, parametric methods			07
CLO5	**Generalized linear models for longitudinal data:** marginal models, random effects models, transition models. **Marginal models**: Binary responses, log-linear models, log-linear models for marginal means, generalized estimating equations: Count response, parametric modeling for count data, generalized estimating equation approach: Sample size calculations.			15

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom discussion and problem-solving activities	Summative measure (Final Exam)
CLO2	Classroom discussion and problem-solving activities	Summative measure (Final Exam)
CLO3	Classroom discussion and problem-solving activities	Summative measure (Final Exam)
CLO4	Classroom discussion and problem-solving activities	Summative Measure (Final Exam.)
CLO5	Classroom discussion and problem-solving activities	Summative Measure (Final Exam.)
CLO6	Discussion and Slide Show	Summative Measure (Final Exam.)

Text Book

1. Kleinbaum, D.G, (1996): *Survival Analysis,*Springer,New York.

Reference Books

2. Cox, D.R and Oakes, D,(1988): *Analysis of Survival data*, Chapman and hall
4. Daniel W.W: *Bio-statistics: A Foundation for Analysis in the Health Science,* 7th Ed. John Wiley and Sons, New York.
5. Karim, M. R. and Islam, A. (2019). *Reliability and Survival Analysis*, Springer, Singapore.

Course Code: 0542-5210 (Stat-5210)	**Course Title: Statistical Data Analysis - V**	
Marks: 50	**Credits: 02**	**Number of Class: 8-12**

Statistical Machine Learning Practical – 50 (Credit 2)

Rationale

Hands-on experience is essential to mastering machine learning. This practical course allows students to implement supervised, unsupervised, deep learning, and time series models using Python or R. Students will gain skills in data preprocessing, model training, evaluation, and presentation for real-world problems.

Objectives

1. Implement core supervised and unsupervised learning algorithms.
2. Develop deep learning and time series forecasting models.
3. Evaluate and optimize machine learning models for performance and interpretation.

Course Learning Outcome (CLOs)

CLO No.	Course Learning Outcome (CLO)
CLO1	Apply supervised learning methods to real datasets and evaluate their performance.
CLO2	Implement unsupervised learning techniques such as clustering and dimensionality reduction.

CLO3	Design and train neural networks and deep learning models for structured, sequential, or image data.
CLO4	Develop and optimize machine learning models, evaluate results, and present findings effectively.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	2	3	3	–	2
CLO2	2	3	3	2	2	2
CLO3	2	2	3	2	2	3
CLO4	2	3	3	3	3	3

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.
CLO1	Regression: linear, multiple, logistic; Decision trees, Random Forest, Gradient Boosting; Hyperparameter tuning	Interactive Class, Open Discussion, Participatory Q/A Session, online	Lab Performance, Lab Report Writing, Attendance and Final Examination.	6
CLO2	Clustering: k-means, hierarchical, DBSCAN; Dimensionality reduction: PCA, t-SNE, UMAP			4
CLO3	Neural networks: MLP, CNN, RNN, LSTM; Image, text, and sequential data			6
CLO4	Model evaluation metrics: RMSE, MAE, F1-score, ROC/AUC; Hyperparameter tuning; Cross-validation			4

Mapping of CLOs with Teaching–Learning & Assessment Strategy

CLOs	Teaching–Learning Strategy	Assessment Strategy
CLO1	Coding labs, interactive exercises	Lab reports, quizzes
CLO2	Lab sessions with datasets and group discussions	Case study analysis, assignments
CLO3	Step-by-step deep learning labs	Lab projects, practical exams
CLO4	Demonstrations, optimization exercises, group work	Final project report and presentation

Text Books

1. Géron, A. (2019). *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow* (2nd ed.). O'Reilly.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.

Course Code: 0542-5211 (Stat-5211)	Course Title: Statistical Data Analysis - VI

Marks: 100	Credits: 03	Number of Class: 16

Group A: Advanced Experimental Design 50 (Credit 2)

Rationale:

This course is designed to make the students oriented with designing and planning complex experimental setups, select appropriate advanced experimental designs, analyze data using specialist software, model and optimize complex systems, interpret results to make informed decisions, and effectively communicate findings.

Objectives:

1. Assist students in selecting advanced experimental such as response surface, split-plot, strip-plot, fractional factorial experiment and incomplete-block designs.
2. Guide students in confidently interpreting advanced experimental design and understanding the extent of the conclusions.
3. Apply learned knowledge and skills to solve problems in real-world scenarios and research projects.

Course Learning Outcomes: At the end of this course students will be able to

CLO1	Plan and execute experiments by identifying significant factors and their interactions, and determine appropriate factor and component levels. Construction and analysis of 2^n and 3^n factorial experiments. Fractional factorial experiment Resolution III, IV and V design.
CLO2	Use advanced mathematical techniques to construct and model response surfaces, and apply intra-block analysis for designs like BIBDs. Identify, analyze and report on a selection of advanced experimental designs such asGalois field, Split- plot design, Strip plot design, and Response surface design
CLO3	Apply an array of advanced experimental design procedures, analyze data using statistical tools, interpret the results, evaluate findings critically, and clearly articulate conclusions.

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	2	2	1	1	1	
CLO2	2	2	2	2	2	1
CLO3	2	2	1	1	1	

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Lecture and Student Activity	Summative Exam
CLO2	Lecture and Discussion	Summative Exam
CLO3	Lecture and Group Discussion	Summative Exam

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lec.

CLO1 and CLO3	Test of hypothesis involving several linear functions of parameters. Construction of confounded s^n factorials in blocks of size s^r . Confounded asymmetrical factorial experiments. Fractional factorial experiment, Resolution III, IV and V design, Construction of 2^{n-k} factorials.	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Final Examination.	5
CLO2 And CLO3	Construction of some commonly used Balanced Incomplete Block Design, Orthogonal Latin Squares Design, Lattice Design, and Partially Balanced Incomplete Block Design. **R**esponse surface design, split-plot design, strip plot design, and Galois field application in practical investigations.			15

Text

1. Montgomery, D. C. (2003): *Design and Analysis of Experiments*, 5th edition, John Wiley, New York.

References

1. Das, M. N. and Giri, N. C. (1997): *Design and Analysis of Experiments*, 2nd edition, New International (P) Ltd., India
2. Cochran, W.G. and Cox, G.M. (2000): *Experimental Design*, 2nd Edition, Wiley, New York.

Group B: Multilevel Modeling 50 (Credit 2)

Rationale

Multilevel modeling (hierarchical linear modeling) is essential for analyzing data with nested structures (e.g., students within schools, patients within hospitals). This lab course provides students with hands-on training in statistical software (R, Stata, SPSS, MLwiN) to conduct multilevel regression, interpret results, and communicate findings. It bridges theory and practice, preparing students for academic research and applied statistical work

Objectives

1. Introduce practical applications of multilevel modeling using real datasets.
2. Train students in software implementation of two-level and three-level models.
3. Enable students to critically interpret outputs and communicate statistical findings effectively.

Learning Outcomes

After successful completion of this course students will be able to:

CLO1	Apply statistical software(R/Stata/SPSS) to fit multilevel models with hierarchical data
CLO2	Analyze and interpret results from random intercept and random slope models
CLO3	Evaluate and report multilevel modeling outcomes with clarity, linking them to real-world research problems

Mapping between PLOs and CLOs of Statistics program

PLOs / CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6
CLO1	3	1	3	2	1	1
CLO2	2	2	3	3	2	1
CLO3	2	2	2	3	3	2

Course Content, Teaching and Assessment Strategy

CLOs	Course Content	Teaching Strategy	Assessment Strategy	No. of Lectures
CLO1	Introduction to multilevel data structures, preparing datasets, fitting random intercepts models in R/Stata/SPSS, Fitting random slope models	Interactive Class, Open Discussion, Participatory Q/A Session, Online resources and Practical	Final Examination.	5
CLO2	Comparing multilevel vs. single-level regression, Model diagnostics and goodness- of-fit tests, Three level modeling applications, Practical sessions with health/education datasets.			5
CLO3	Group project analysis (dataset chosen by students), Writing results: APA/academic reporting style, Project presentation and oral test.			5

Mapping of Course Learning Outcomes (CLOs) with the Teaching – Learning &Assessment Strategy

CLOs	Teaching-Learning Strategy	Assessment Strategy
CLO1	Classroom Discussion	Quiz and assignment
CLO2	Lecture and Reflective Discussion	Assignment, Quiz and Summative Exam
CLO3	Lecture and Group Discussion	Mid Term and Summative Exam

Text Book

Steven P. Reise, NaihuaDuan (2002); Multilevel Modeling Methodological Advances, Issues and Applications, 1st edition.

Course Code: 0542-5212 (Stat-5212)	**Course Title: Project**	
Marks: 100	**Credits: 03**	**Number of Weeks: 7**

Rationale

Statistics project reports allow students to communicate research findings, support hypotheses, and validate research methodology and conclusions. This course helps students develop the ability to evaluate data, present results clearly, and draw meaningful conclusions, enhancing their statistical

reasoning and practical research skills.

Objectives

- Describe the data sources accurately.
- Ensure precision in data analysis.
- Draw accurate conclusions and discussions.
- Present findings clearly and coherently.
- Demonstrate the significance and relevance of the study.

Learning Outcomes

By the end of the course, students will be able to:

CLO No.	Course Learning Outcome (CLO)
CLO1	Write a research proposal for the project.
CLO2	Identify a research gap in the chosen field.
CLO3	Collect and organize relevant data for analysis.
CLO4	Perform accurate statistical analysis of the data.
CLO5	Discuss results, draw conclusions, and provide recommendations.

Mapping Course Learning Outcomes (CLOs) with PLOs

	Fundamental Skill	Social Skill	Thinking Skill		Personal Skill	
(CLOs)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CLO 1	3	3	3	3	2	2
CLO 2	2	2	3	3	1	1
CLO 3	1	2	1	1	3	2
CLO 4	1	1	1	1	2	2
CLO 5	2	2	2	2	3	3

Course Contents

Each project student will be assigned to a principal supervisor by the department. The project students will determine the topic of the project in consultation with their supervisor and co-supervisors.

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lectures and books that CLO over thesis topic	Semester-end examination
CLO 2		Semester-end examination
CLO 3		Semester-end examination
CLO 4		Semester-end examination
CLO 5		Semester-end examination

Semester III

Master of Science in Statistics (Thesis) Third Semester Course Details

Course Code: 0542-5301 (Stat-5301)	**Course Title: Dissertation**	
Marks: 200	**Credits: 12**	**Number of Weeks: 24**

Rationale:

In addition to learning advanced theories in statistical science, graduate students in statistics should get the opportunity to undertake a thesis, involving an original piece of research work, allowing the students to dig into a topic in statistics and produce research findings that demonstrate how their knowledge has grown throughout the degree program.

Objectives:

1. Help students to build an excellent foundation in advanced statistical theories (the science of statistics) and data analysis (the practice of applying statistics),
2. Provide students with rigorous research training so that they can pursue a higher degree (such as MPhil/PhD) in statistical sciences or secure a research position in academia and industry.

Course Contents

Each thesis student will be assigned to a principal supervisor and one or more co-supervisors by the department. The thesis students will determine the topic of the thesis in consultation with their supervisor and co-supervisors.

Course Learning Outcomes (COs): By the end of the course, students will be expected to-

CO1	Examine and evaluate advanced knowledge in an area of statistical science;
CO2	Review existing literature in an area of statistical science and appraise critically the body of evidence;
CO3	Formulate the statistical research problems independently and in a team;
CO4	Write an independent scientific report to present an original statistical research work;
CO5	Present independent scientific statistical work.

Mapping Course Learning Outcomes (COs) with the POs

	Fundamental Skill	Social Skill	Thinking Skill		Personal Skill	
(CLOs)	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CLO 1	3	3	2	2	2	2
CLO 2	2	2	3	3	1	1
CLO 3	1	2	1	1	3	3
CLO 4	1	2	1	1	3	3
CLO 5	2	2	2	2	3	3

Mapping Course Learning Outcomes (COs) with the Teaching-Learning& Assessment Strategy

COs	**Teaching-Learning Strategy**	**Assessment Strategy**
CLO 1	Lectures and books that CLO over thesis topic	Semester-end examination
CLO 2		Semester-end examination
CLO 3		Semester-end examination
CLO 4		Semester-end examination
CLO 5		Semester-end examination

Part D

20. Grading/Evaluation: According to the ordinance of the university

1) Grading Scale and Grades:

Letter Grade and corresponding Grade-Point for a course will be awarded from the roundup marks of individual courses as follows:

Numerical Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	C-	2.00
Less than 40%	F	0.00