Board of Studies Meeting

Department of Statistics

July 10, 2018 (Tuesday)

A meeting of the Board of Studies for the Master's Degree in Statistics was held under the Chairmanship of Prof. Arun Kumar Sinha in the old VC's Chamber of the Central University of South Bihar.

The following persons were present:

1. Prof. Arun Kumar Sinha (Chair)
2. Prof. Umesh Singh (External member)
3. Dr. H. K. Nigam (Cognate Member)
4. Mr. N. C. Rathore (Cognate Member)
5. Dr. Richa Vatsa (Member)
6. Dr. Mukesh Kumar (Member)

The proposed course structure and the syllabuses according to choice based credit system (CBCS) was discussed and the corresponding core courses, elective courses as well as SWAYAM and skill based/self-study courses (Non-credit) have been approved. The list is attached herewith.

The courses offered for other Departments were also discussed and the corresponding proposed syllabuses have been finalized and approved. The list is attached herewith.

The Ordinance and Regulations Governing M.Sc. (Statistics) Degree program effective from the Academic Session 2018-2019, has also been discussed.

The meeting ended with vote of thanks to the Chair.

Mukesh Kumar 10/07/18.

Richa Vatsa

N. C. Rathore 10/07/18

H. K. Nigam 10-07-2018

Umesh Singh 10.7.2018

Arun Kumar Sinha

CENTRAL UNIVERSITY OF SOUTH BIHAR

ORDINANCE AND REGULATIONS GOVERNING

M. Sc. (Statistics) Degree Programme

(Effective from the Academic Session 2018-2019)

Department of Statistics

School of Mathematics, Statistics and Computer Science

TABLE OF CONTENTS

ORDINANCE AND REGULATIONS GOVERNING

M.Sc. (STATISTICS) DEGREE PROGRAMME OF CENTRAL UNIVERSITY OF SOUTH BIHAR UNDER CHOICE BASED CREDIT SYSTEM

(Effective from Academic Session 2018-19)

Under the powers conferred by The Central Universities Act, 2009- section 28(1) (b)], as amended, Central University of South Bihar, hereby, institutes the four semester Post Graduate Degree Programme for the Award of M.Sc. (Statistics) Degree by the Department of Statistics under the School of Mathematics, Statistics and Computer Science of the University under the choice based credit system. The following ordinance for governing admission, course of study, examinations and other matters relating to M.Sc.(Statistics) under Department of Statistics of the Central University of South Bihar are hereby laid to come in force w.e.f. the Academic Session 2018-19 onwards till further amended.

1. Definitions of Key Words:

1.1 **'Choice-Based Credit System (CBCS)':** The CBCS provides choice for the students to select course from the prescribed courses (Elective or Soft-skill courses). It provides a 'cafeteria' approach in which the students can take courses of their choice, learn at their own pace, study additional courses and acquire more than the minimum required credits, and adopt an inter-disciplinary approach to learning.

1.2 **'Academic Year':** Two consecutive (one odd + one even) semesters shall constitute one academic year.

1.3 **'Course':** Course, usually referred to as paper having specific title and code number, is a component of a Programme. It consists of a list of topics /points /concepts /theories /principles etc. which a student has to learn and master during the Programme of study. Each Course generally shall be of 04 credits. Each course should define the learning objectives/ learning outcomes. A course may be designed to be delivered through lectures/tutorials/laboratory work/field work/outreach activities/project work/vocational training/viva/seminars/ term papers/assignments /presentations / self-study work etc., or a combination of some of these.

1.4 **'Course Teacher':** The course teacher generally will be the teacher who has primarily conceived the course, developed its contents, taken up the responsibility of teaching it and evaluating the performance of the students in that course.

1.5 **'Credit':** A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (lecture or tutorial) or two hours of practical work/field work per week.

1.6 **'Credit Point':** It is the product of the grade point and the number of credits for a course.

1.7 **'Grade Point':** It is a numerical weight allotted to each letter grade on a 10-point scale.

1.8 **'Letter Grade':** It is an index of the performance of students in a said course. Grades are denoted by letters O, A+, A, B+, B, C, P and F. A letter grade is assigned to a student on the basis of evaluation of her/his performance in a course on a ten point scale.

1.9 **'Programme':** An educational Programme leading to the award of a Degree, Diploma or Certificate.

1.10 **'Credit-Based Semester System (CBSS)':** Under the CBSS, the requirement for awarding a degree or diploma or certificate is prescribed in terms of number of credits to be completed by the students.

1.11 **'Semester':** Each Semester shall consist of 15-18 weeks of academic work equivalent to 90 actual teaching days. The odd semester may be scheduled from July to December and even semester from January to June. The credit-based semester system provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching.

1.12 **'Semester Grade- Point Average (SGPA)':** It is a measure of performance of the work done in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester. It shall be expressed up to two decimal places.

1.13 **'Cumulative Grade Point Average (CGPA)':** It is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It shall be expressed up to two decimal places.

1.14 **'Transcript'/ 'Grade Card' 'or Certificate':** Based on the grades earned, a grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the course details (code, title, number of credits, grade and/or marks secured) along with SGPA of that semester.

1.15 **'The University'**: 'The University' in this Ordinance means the Central University of South Bihar.

2. Admission and Other General Provisions:

2.1 The Programme of study leading to M.Sc. (Statistics) Degree of Central University of South Bihar shall be of two year (Four Semesters) duration which may be completed in a maximum duration of four years (Eight Semesters).

2.2 The intake to the (M.Sc. (Statistics)) Programme shall be as decided by the UATEC/Academic Council of the University from time to time.

2.3 The admission to the M.Sc. (Statistics) Programme shall be governed by the provisions as laid down by the UATEC/Academic Council of the University from time to time.

2.4 Reservation of seats for admission in M.Sc. (Statistics) Programme shall be as per reservation policy of Government of India and as notified by GoI/UGC from time to time.

2.5 In accordance with the Reservation Rules of Government of India (GOI) for admission in Central Higher Educational Institutes, reservations of seats in M.Sc.(Statistics). Degree Programme are as follows:

S. No.	Category	Reservation
1	SC Candidates	15 % of the intake
2	ST Candidates	7.5% of the intake
3	OBC Candidates	27% of the intake
4	Divyang Candidates	5% of the intake *(on horizontal reservation basis)*
5	Dependents/Wards of Defence Personnel and Kashmiri Migrants/NCC Cadets	As per the GOI rules

(a) The candidates seeking admission under the above categories shall be required to fulfill the prescribed eligibility condition of admission of the programme and shall submit requisite documents in support of their claim, as prescribed by the GOI from time to time.

(b) The SC/ ST/OBC candidates must enclose attested copy of the latest caste certificate as per GOI norms along with their Admission

Form/Enrolment form stating that the candidate belongs to SC/ST/OBC Category.

The following are empowered to issue SC/ST/OBC Certificates:

(i) District magistrate/ Additional District Magistrate/ Collector/ Deputy Commissioner/ Addl. Deputy Commissioner/Deputy Collector /Ist Class Stipendiary Magistrate/City Magistrate/Sub Divisional magistrate/ Taluka Magistrate/ Executive Magistrate /Extra Assistant Commissioner.

(ii) Chief Presidency Magistrate/ Addl. Chief Presidency Magistrate/ Presidency Magistrate.

(iii) Revenue Officer not below the rank of Tehsildar.

(iv) Sub - Divisional Officer of the area where the candidate and/or his family normally resides.

(v) Administrator/Secretary to the Administrator/ Development Officer (Lakshadweep Islands).

(vi) Candidate must note that certificate from any other person/authority shall not be accepted generally.

(c) 5% seats on horizontal reservation basis shall be reserved for Divyang Candidates (Benchmark Category) and shall be further sub-divided into different categories of Divyangs as per the GOI rules.

A candidate applying under Divyang category must attach a certificate by CMO, District Hospital. However, she/he shall be considered under Divyang category only after verification from the University Medical Board, if necessary.

(d) Vacant seats reserved for SC/ST/OBC candidates, if any, may be filled up as per the GOI /UGC rules. In case in any one of the two categories of candidates viz., SC/ST, the required number of candidates for admission is not available (i.e., the list of respective category has been exhausted), then candidates belonging to the other category (SC or ST as the case may be, if available), shall be called for admission in order of merit so as to make up the deficiency in the required number in any of the aforesaid two categories. This provision shall be applicable to candidates belonging to SC & ST categories only.

(e) If sufficient number of candidates are not available in OBC category (i.e., OBC category list has been exhausted), such vacant seats shall be transferred to the general category.

2.6 Mere appearance in the admission test shall not entitle a candidate to be considered for admission to the Programme unless she/he fulfills the eligibility conditions. Applicants must fully satisfy themselves about their eligibility before filling the application form.

2.7 Provisional admission shall be offered to the candidates in order of merit list and the availability of seat in the Programme on the date of admission.

2.8 In case there is more than one candidate securing equal ranks as obtained by the last candidate in order of merit in the list of candidates to be called for admission, the following *inter-se* ranking rules of the University shall be applicable.

In case the candidates have equal/tie ranks then the marks obtained in the qualifying examination shall be the deciding factor and if, that is also same or result of both the candidates is not declared, then a senior candidate on the basis of date of birth shall be given preference. However, in a case of tie rank, if the result of qualifying examination of one candidate is declared then she/he will be given preference, provided she/he fulfills other eligibility conditions. In case of any dispute the decision of the Chairman, UATEC shall be final.

2.9 If the result of the qualifying examination is not declared by a university/board till the date of admission, the mark-sheet of the qualifying examination by a candidate can be submitted on or before 30th September of the admission year. In exceptional cases, further extension may be given by the Competent Authority on cogent reason(s). However, it may be noted that this clause cannot be extended to the candidate(s) whose result is being withheld or not declared by the university/board due to some specific reasons particularly related to the candidate(s). Furthermore, if the result of qualifying examination is not declared by a university/board in general then the aggregate percentage of marks/grades of the completed semesters/years of the qualifying examination (e.g. three years/seven semesters of BA.BEd/BSc.BEd or one year/three semesters of B.Ed. in case of admission in M.Ed.) must be not less than the required percentage of marks/grades in the qualifying examination.

2.10 At the time of reporting for admission, the candidates are required to be present in person and bring the documents in original as well as a set of photocopy duly attested as notified by the Admission Committee/Controller of Examinations (CoE) from time to time.

2.11 A candidate provisionally selected for admission shall be required to fill the prescribed form, submit the required documents, collect her/his admit card or any other equivalent document for admission to the Programme from the office of the Department/School/University after paying the fees on or before a date fixed for the purpose, otherwise the offer made to her/him will automatically stand cancelled.

2.12 In case any provisionally selected candidate fails to deposit the fee by the date prescribed, her/his provisional admission shall be cancelled and the seat thus falling vacant shall be offered to the next candidate in order of merit under the specified category.

2.13 Notwithstanding anything contained in this ordinance, a candidate who is qualified under the foregoing ordinance for admission to the University, and who is a student of some other Indian University/Institution, shall not be admitted to the University without the production of a Leaving or Transfer Certificate and/or Migration Certificate (as the case may be) issued by the last college/university attended and Certifying to the satisfactory conduct of the student mentioning the highest examination she/he has passed. However, in certain cases if the candidates are not in position to submit the Transfer Certificate and/or Migration Certificate and the character certificate at the time of admission, they should submit the same as early as possible, but not later than 30th September of the year of admission in M.Sc. (Statistics) failing which the University reserves the right to cancel their admission. In exceptional cases, further extension may be given by the Competent Authority on cogent reason(s). However, it may be noted that this clause cannot be extended to the candidate(s) whose result is being withheld or not declared by the university/board due to some specific reasons particularly related to the candidate(s).

2.14 A waitlisted candidate shall be offered admission strictly on the basis of ranking, provided there is a vacancy in the Programme. Such waitlisted candidates shall have to deposit their fees latest by the date fixed by the Admission Committee/ Competent Authority.

2.15 The candidates enjoying employed status and selected for admission to M.Sc. (Statistics) Programme in the University, are required to produce Leave Sanction /Relieving Order at the time of Admission/Registration from their employer for the duration of the Programme permitting them to pursue their studies at the University, failing which the offer of admission may stand withdrawn. In case of any dispute the decision of the competent authority shall be final.

2.16 The admission of any candidate is liable to be cancelled without giving any further notice forthwith or at any time during the period of the concerned Programme of Study, if it is detected that the candidate has /had produced fake / forged certificate(s) /document(s) or indulged in any act of misconduct/indiscipline or has /had concealed any other relevant information at the time of admission.

2.17 The admission of the candidate to the M.Sc. (Statistics) Programme shall be subject to such ordinances, rules and regulations as may be framed from time to time by the University.

2.18 Foreign students shall be admitted as per the rules of the University.

2.18 Only the High Court of Patna shall have jurisdiction in case of any dispute relating to the provisional admission in the Programme.

3. Eligibility Conditions

The eligibility conditions for admission into the M.Sc. (Statistics) Degree Programme shall be as follows:
Bachelor's (NewUGC.) Hons. Degree from any recognized University with Statistics/Bachelor's Degree with Statistics/ Mathematics /Computer Science but must have studied both Mathematics and Statistics as subjects for at least 2 years with a minimum of 50 % marks for General / OBC candidates and 45% marks for SC/ST candidates in the qualifying degree.

However, the eligibility conditions for admission into M.Sc. (Statistics) Programme and intake of the programme shall be decided by the University Admission, Teaching and Evaluation Committee (UATEC) from time to time.

4. Medium of Instruction of the Programme:

The medium of instruction and examination shall be English for M.Sc. (Statistics). Programme.

5. Programme Fee:

5.1 The semester-wise fee structure of M.Sc. (Statistics). Programme is given below: To be provided by the University

5.2 The mode and schedule of payment of fees shall be decided by the university from time to time.

5.3 The fee structure of M.Sc. (Statistics). Programme under Department of Statistics may be changed by the University prospectively. Such changed fee structure shall be declared in the admission prospectus of the concerned academic session.

6. Conduct of the Programme:

6.1 To qualify for the M.Sc. (Statistics) Degree, a candidate must earn 96 credits as contained in the Programme structure/Syllabus of M.Sc. (Statistics). Degree as annexed with this ordinance. This Programme structure/Syllabus is subject to update/change/modify from time to time as prescribed by the Board of Studies (BoS) of the Department and need not to follow the procedure prescribed for updating the ordinances.

6.2 A student of the M.Sc. (Statistics) Programme shall not be permitted to seek admission concurrently to any other equivalent or higher degree or diploma examination in this University or any other University, subject to rules/regulations of UGC or equivalent body in this regard and adoption of the same by the University.

6.3 The maximum period allowed to complete the M.Sc. (Statistics) Programme will be four years (Eight Semesters).

6.4 The Department shall offer courses as per its schedule and available resources and can decide to offer or not to offer a particular course in a particular semester. To earn additional or lesser credits in a semester from the Department than the prescribed in the syllabus and to earn credits from other Departments/Schools shall be the sole responsibility of the student. S/he has to choose the courses in such a way that it becomes feasible for her/him to earn the credits.

7. Type of Courses:

The M.Sc. (Statistics) Programme of the University has three types of courses, viz,. Core courses, Elective courses, and Self-study/Skill-based courses

7.1 Core courses:

7.1.1. The core courses are those courses whose knowledge is deemed essential for the students registered for the M.Sc. (Statistics) Programme. Where feasible and necessary, two or more Programmes (like, degree, diploma and certificate etc.) may prescribe one or more common core courses.

7.1.2 All the core courses prescribed for M.Sc. (Statistics) Degree Programme offered by the Department of Statistics under the School of Mathematics, Statistics and Computer Science shall be mandatory for all the students registered in the M.Sc. (Statistics) Programme.

7.1.3 A core course of the Programme may be an elective course for any other Programme.

7.2 Elective courses:

7.2.1 The elective courses can be chosen from a pool of courses (papers). These courses are intended to:

- allow the student to specialize in one or more branches of the broad subject area;
- help the student to acquire knowledge and skills in a related area that may have applications in the broad subject area;
- help the student to bridge any gap in the curriculum and enable acquisition of essential skills (e.g. statistical, computational, language or communication skills etc.); and
- help the student to pursue an area of interest.

7.2.2 Along with the elective courses prescribed for the M.Sc. (Statistics) Degree Programme offered by the Department of Statistics, a student has to register herself/himself in different elective courses in such a way that she/he ensures earning of minimum eight credits as elective from the other Departments/Schools.

7.2.3 The student may also choose additional elective courses offered by the University to enable her/him to acquire extra credits from the discipline, or across the disciplines. However, up to only 16 credit courses with best grades completed from the other Departments/Schools shall be considered for calculating CGPA of the Programme of study.

7.3 Self-study/Skill-based Courses:

The self-study/skill-based courses are optional, not mandatory. Being non-credit courses, the performance of students in these courses shall be indicated either as "satisfactory" or as "unsatisfactory", instead of the Letter Grade and this shall not be counted for the computation of SGPA/CGPA. These courses may also be taken by a student from other Departments/Schools.

Moreover, if the BoS of the Department feels that the Programme of study of M.Sc. (Statistics) requires certain academic backgrounds to pursue the Programme effectively, it may recommend some course(s) without credit(s)

to meet the purpose as compulsory part of the syllabus.

Note: A course (Core/Elective/Self-study/Skill-based) may also be offered by the department in the form of a Dissertation, Project work, Practical training, Field work or Internship/Seminar etc.

8. Mobility Options and Credit Transfers:

The students shall be permitted to opt inter-disciplinary and horizontal mobility and can take courses of their choice, learn at their paces, enroll for additional courses, acquire more than the required credits, and adopt an interdisciplinary approach to learning, subject to the provisions made in this ordinance.

8.1. A student may be allowed to take course/courses of any other University/Organization/Institution, the courses of whom are duly accredited by the Department of Statistics/School of Mathematics, Statistics and Computer Science under MoU or otherwise and approved by the Academic Council. (Note: The Department of Statistics/School of Mathematics, Statistics and Computer Science shall try to ensure accreditation of relevant courses of other Universities/Organizations/Institutions including MOOCs and increase the choice basket of M.Sc. (Statistics). Programme).

8.2. A student availing inter-university mobility shall continue to be a bonafide-student of the University where she/he initially got admission and in case she/he earns credits from a different university, the credits so earned shall be transferred to her/his parent University.

8.3. It shall be the responsibility of the student to assess the feasibility and practicality of vertical mobility (across universities), as it doesn't entitle a student to be exempted or relaxed from any of the requisites (sessional, attendance, assignments, end-semester examinations and Programme duration etc.) for the completion of the Programme.

8.4. The mobility option should not be interpreted as inter-university migration.

8.5. The mobility across the disciplines is also subject to availability of desired elective course, faculty, infrastructure and number of students (as fixed by the University/Department from time to time) opting for that elective course.

8.6. The mobility shall be permissible from the Regular Mode Programme to the Regular Mode Programme of learning only, and cannot be replaced by Open/Distance/Online Programme.

8.7 A student of some other University shall in any case be admitted only at the beginning of the particular Programme/Course which she/he proposes to take in the University subject to the fulfillment of other conditions.

9. Credits:

A credit defines the quantum of contents/syllabus prescribed for a course and determines the number of hours of instruction required per week. Thus, in each

course, credits are assigned on the basis of the number of lectures/tutorials/laboratory work/field work and other forms of learning required for completing the contents in 15-18 week schedule. 2 hours of laboratory work/field work is generally considered equivalent to 1 hour of lecture.

(i) 1 credit = 1 hour of instruction per week (1 credit course = 15 contact hours of instruction per semester)

(ii) 4 credits = 4 hours of instruction per week (4 credit course = 60 contact hours of instruction per Semester)

(iii) 1 credit = 1 hour of tutorial per week (1 credit course = 15 contact hours of instruction per semester)

(iv) 1 credit = 2 hours of laboratory work/field work per week (1 credit course = 30 hours of laboratory work/field)

Number(s) of credit(s) assigned to a particular course are mentioned in the detailed syllabus of the courses.

10. Course Coding:

Each course offered by the Department of Statistics is identified by a unique course code comprising of twelve letters/numbers indicating Programme/level of Programme (first two letters in uppercase), Discipline/Subject (Next three letters in uppercase), Semester (next digit ranging from 1 to 4), Course Number (next three digits starting from 001 for each semester), Nature of Course for the Programme (next letter in uppercase i.e. C = Core Course; E = Elective Course, S = Self-study/Skill course), total number of credits for the course (next two digits starting from 00), respectively.

For example, the course code for second core course of the M.Sc. (Statistics). Programme in the Third semester in the Department carrying 4 credits shall be ***MSSTS3002C04***.

Every time when a new course is prepared by the BoS of the Department (merely changing minor content and not the course title shall also be considered as a new course) it shall be assigned a new course code.

However, the University may decide a different course codification pattern for any Programme in future as per the demand of the situation.

11. Duration of the Programme:

The minimum duration for completion of M.Sc. (Statistics). Programme shall be four consecutive semesters (two odd and two even semesters). *The maximum period for completion shall be eight semesters.*

Provided that (i) a semester or a year may be declared by the Controller of Examinations as a zero semester or a zero year for a student if she/he could not continue with the academic work during that period due to terminal illness

and hospitalization of longer duration, or due to accepting a scholarship/fellowship, with due permission of the University, subject to the fulfillment of requirements laid down in this respect by the rules or regulations of the University. Such a zero semester/year shall not be counted for calculation of the duration of the Programme in the case of such a student.

(ii) Hostel and other related facilities shall not be given to a student after completion of minimum duration, i.e., four semesters required for M.Sc. (Statistics). Programme.

12. Student Mentor:

The Department shall appoint a Mentor for each student from amongst the faculty members of the Department. All faculty members of the Department shall function as Student Mentors and shall generally have more or less equal number of students. The Student Mentor shall advise the student in choosing courses and render all possible support and guidance to her/him.

13. Course Registration:

13.1. The registration for courses shall be the sole responsibility of the student. No student shall be allowed to do a course without registration, and no student shall be entitled to any credits in the course, unless she/he has been registered for the course by the scheduled date fixed by the Department/School/University.

13.2. Every student has to register in each semester (in consultation with her/his Student Mentor) for the courses she/he intends to undergo in that semester by applying in the prescribed proforma in triplicate (one copy each for student, for the student's file to be maintained in the departmental office and for the office of the Controller of Examinations), duly signed by her/him, the Student Mentor, the concerned Course Teacher and finally approved by the Head/In charge of the Department of Statistics, within the deadline notified for the purpose by the Department/School/University.

13.3. Registration done in different courses within the stipulated period of time by a student shall not ordinarily be permitted to be changed. However, in exceptional cases, a student may be allowed by the Head/In charge of the Department of Statistics to add a course, substitute a course for another course of the same type (elective or self-study/skill-based) or withdraw from a course, for valid reasons by applying on prescribed proforma (in triplicate as mentioned above in 13.2) with the consent of the Student Mentor not later than one week from the last date of course registration in a particular semester. Further, withdrawal from a course shall be permitted only if the courses registered after the withdrawal shall enable the student to earn a minimum of 20 credits. This duly approved change/withdrawal shall be notified by the office of the Department of Statistics to all concerns like

Controller of Examinations, both the Course Teachers etc.

13.4. A student shall register for a minimum of 20 credits and can register for a maximum of 32 credits in a semester unless specified otherwise by the University for a Programme of study.

13.5. If a student registers herself/himself for more elective courses than the prescribed in the Programme, while calculating the Cumulative Grade Point Average (CGPA), only the prescribed number of elective courses for the Programme of study shall be included in the descending order of the grades obtained by her/him ensuring the presence of minimum 8 and maximum 16 credits from the electives of other Departments/Schools.

13.6. A student shall have the option to choose an elective course from other Departments/Schools irrespective of the semester in which the course is offered, remaining other conditions same subject to condition that the course is being offered by the particular Department in that semester. For example; a student of third Semester can opt an elective course of other department offered in the first/third semester provided the course is being offered by the particular Department.

14. **Examination and Promotion:**

(A) The examination of all the courses required for the M.Sc. (Statistics). degree shall be internal in nature and generally consisting of Continuous Internal Assessment and End-Semester Examination. For the preparation of final grade in a particular course, the Continuous Internal Assessment (Formative in nature) and the End-Semester Examination (Summative in nature) shall have the weightage of 30% and 70%, respectively.

(B) Each course, irrespective of credits assigned to it, shall be evaluated out of 100 points. These points should not be confused with traditional system of marks. The points obtained by a student in a course are indicator of percentage of marks and not the raw marks. Since, the University has adopted the system of grading, hence, the marks shall not be reflected in a grade sheet of a student. However, for wider uses, and if required, the students or the prospective employer or end user may take the following reference for calculating maximum marks and obtained marks for a Programme/Course:

For Maximum Marks –

1 Credit Course = 25 marks course

2 Credit Course= 50 marks course

3 Credit Course= 75 marks course

4 Credit Course= 100 marks course

and so on.

For obtained marks –

The obtained points may be converted into marks by taking them as percentage of marks. For example:

(i) If a student has obtained 80 points in a 4 Credit Course, then it may be converted as: *80 marks out of 100.*

(ii) If a student has obtained 80 points in a 2 Credit Course, then it may be converted as: *40 marks out of 50.*

(iii) If a student has obtained 80 points in a 1 Credit Course, then it may be converted as: *20 marks out of 25.*

In such course(s), where direct numerical grades are awarded in place of points, these numerical grades shall be converted into marks by using the following formula:

Point in the Course = Numerical grade in the Course x 10

However, any change may be recommended in this pattern by the UATEC, from time to time.

14.1. Continuous Internal Assessment:

14.1.1 The Continuous Internal Assessment of the students' learning and performance shall be carried out by the Course Teacher(s). Considering the nature of the course, the teacher(s) shall decide the mode of Continuous Internal Assessment, which may include one or more assessment tools, such as student's class performance, assignments, class tests, take-home tests, term paper(s), presentations, oral-quizzes, case studies and laboratory work etc.

14.1.2 Each Course Teacher shall design the Continuous Internal Assessment system for the course she/he offers with the approval of the Departmental Committee (DC). This approved design of Continuous Internal Assessment shall be announced to the students of the respective courses at the beginning of each semester by the concerned teacher.

14.1.3 Generally, each course shall be taught by one teacher only, who shall maintain all the records related to attendance, teaching and assessment in a systematic manner. In an exceptionally rare case, if a teacher is assisted in teaching by other teacher, the teacher (in-charge of the course) shall be responsible for coordinating teaching and assessment, including award of final grade.

14.1.4 In case a student fails to appear in any Continuous Internal Assessment, it will be taken care by the concerned Course Teacher at her/his level.

14.2. End-Semester Examination:

14.2.1 Generally, End-Semester theory question paper shall include a limited number of very short answer type questions followed by short and long questions covering the entire syllabus in such a way that the question paper ensures assessing students' knowledge, understanding, application and analysis-synthesis/reflection of the subject. Thus, a standard model format of the End-Semester Examination paper consisting of 70 points shall be as under –

Section-A: 15 very short questions of 02 points each = 30 points
(Short specific questions covering the entire syllabus to be given which should be answered in approximately 50 words by the examinee).

Section-B: 04 short questions of 05 points each = 20 points
(05 short questions to be given out of which 04 questions are to be attempted in approximately 200 words by the examinee).

Section-C: 02 long questions of 10 points each = 20 points
(03 long questions to be given out of which 02 questions are to be attempted in approximately 500 words by the examinee).

However, a different format of the End-Semester question paper for some particular course (e.g., project, dissertation or laboratory/field work etc.) may be prescribed by the Board of Studies (BoS) of the Department which shall come into force only after the approval of the competent authority of the University.

14.2.2 The duration of the End-Semester theory examination generally shall be of three hours.

14.2.3 The DC shall appoint one or more team(s), as per the need, of preferably three faculty members in each team for moderation of question papers of End-Semester Examinations and communicate the same to the Controller of Examinations. The task of moderation shall be organized by the Controller of Examinations.

The paper setter and the moderator(s) shall ensure and certify that question paper is comprehensive to cover all important topics/themes/course and fit for assessing the mastery of the entire course. They shall also ensure and certify that not more than 10% questions from the previous year question paper have been repeated.

14.3 In exceptional cases, depending upon the nature of a particular course, a totally different mode of assessment and evaluation may be prescribed by the BoS of the Department for the course, which shall come into force only after the approval of the competent authority of the University. However, it must be reflected in the detailed syllabus of the course and be available to the students at the beginning of the semester.

14.4 Any partial or complete change in the system of examination (Assessment & Evaluation) may be recommended by the UATEC which shall be implemented only after the approval of the competent authority.

14.5 A student is required to secure a minimum of 'P' grade in the Continuous Internal Assessment and in the End-Semester Examination, taking together, in a course.

14.6 Making Evaluated Answer-scripts Available to the Students:

14.6.1 All the examination answer-scripts shall be made available to the students after evaluation by the respective teachers as per the schedule decided by the concerned teachers or the University. In case of the End-Semester Examination, the evaluated answer scripts shall be made available to the students within 7 days of the last examination for the semester. Thereafter, within a week, all the answer books along with the statement of marks

shall be sent by the concerned teacher through her/his Department to the Office of the Controller of Examinations for declaration of the results.

14.6.2 If a student is not satisfied with the evaluation of her/his answer script, s/he must submit a written objection to the concerned Head of the Department (offering the course) within 8 days from the last examination for the semester. Such complaint shall be looked after by a panel of three faculty members, including the concerned teacher, to be nominated by the concerned Head of the Department, whose decision shall be final. The revised points, if any, shall be submitted by the panel to the concerned Head of Department who shall further submit it to the Controller of Examinations. This complete process of grievance redressal by the panel and the further submission of marks by the Head of Department, generally, should not take more than 7 days from the date of receipt of the grievance. However, in case of any controversy, the matter shall be referred to the Vice-Chancellor for final decision and action.

14.6.3 Once evaluated answer books are submitted to the Controller of Examinations, there shall be no re-evaluation/re-totaling thereafter.

14.7 Letter Grades and Grade Points:

An absolute grading system shall be adopted to grade the students.

14.7.1. Under the absolute grading system, points shall be converted to grades based on pre-determined class intervals.

14.7.2. In the End-Semester theory or practical examinations, the examiner shall award the points and these points after adding the points of Continuous Internal Assessment shall be further converted into Grades/Grade points in accordance with the provisions of this ordinance.

14.7.3. Detail Grade Sheet issued by the Controller of Examinations office at the end of the semester shall carry points /percentage and equivalent grades (numerical and letter) both.

14.7.4. The 10-point Grading System, with the Letter Grades as given under shall be followed:

Letter Grade	Numerical Grade Point	Class Interval (in %)
O (Outstanding)	10	Above 90 and ≤ 100
A+ (Excellent)	9	Above 80 and ≤ 90

A (Very Good)	8	Above 70 and ≤ 80
B+ (Good)	7	Above 60 and ≤ 70
B (Above Average)	6	Above 50 and ≤ 60
C (Average)	5	Above 45 and ≤ 50
P (Pass)	4.5	40 to 45
F (Fail)	0	< 40
Ab (Absent)	0	Absent

Note:

(i) F= Fail, and the students graded with 'F' in a Programme or Course shall be required to re-appear in the examination.

(ii) The minimum qualifying points for a course shall be 45% (i.e., 'P' grade).

(iii) The students shall have to qualify in the Continuous Internal Assessment and the End-Semester examinations taking together.

(iv) Before awarding numerical grade to the points obtained in a course, only the total of Continuous Internal Assessment and End-Semester Examination shall be rounded off to remove the decimal point. Thus, no separate rounding off shall be done of the points obtained in different components of Continuous Internal Assessment and End-Semester Examination.

(v) There shall be rounding off of SGPA/CGPA up to two decimal points.

(vi) The SGPA/CGPA obtained by a student shall be out of a maximum of 10 points.

(vii) In order to be eligible for the award of the M.Sc. (Statistics). Degree of the University, a student must obtain CGPA of 4.50 at the end of the Programme.x

(viii) Provided that the student who is otherwise eligible for the award of the M.Sc. (Statistics). Degree but has secured a CGPA of less than 4.50 at the end of the minimum permissible period of semesters may be allowed by the Department to reappear or repeat as the case may be the same course(s) or other courses of the same type in lieu thereof in the extra semesters provided in Clause 11 related to the duration of Programme.

(ix) The Cumulative Grade Point Average (CGPA) obtained by a student shall be classified into the following division/Class:

CGPA	**Class/ Division**
Above 9	Outstanding
Above 8 to 9	First Class (With Distinction)

6 to 8	First Class
5.5 to < 6	High-Second Class
5 to < 5.5	Second Class
4.5 to < 5	Third Class

14.8. Re-appear in the End-Semester Examination:

14.8.1 Once a student has fulfilled the attendance requirements in a course as per the provisions mentioned in this ordinance but has failed to score minimum grade required to qualify the Course or failed to appear in the End-Semester Examination of the course, may be allowed to re-appear in the End-Semester Examination, in such course, in the extra semesters provided under the Clause 11 on duration of Programme.

14.8.2. Such student may avail the chance to re-appear only within the maximum duration of the Programme. The re-appearance shall be permitted only in the End-Semester Examination of the concerned course(s) and the marks obtained by the student in the Continuous Internal Assessment conducted earlier for the particular course(s) shall be carried forward to be added with the marks obtained by her/him in the latest End-Semester Examination of the respective course(s).

14.8.3. The re-appear examination of even semesters shall be conducted along with the End-Semester Examinations of even semesters. Similarly, the re-appear examinations of odd semesters shall be conducted along with the End-Semester Examinations of odd semesters.

14.8.4. The re-appear examination shall be based on the syllabi of the course in force at the time of initial registration to the course.

14.8.5 A student who is re-appearing for the End-Semester Examination as per the clause 14.8.1 above; can re-appear in the subsequent semester(s), whenever the examination of a particular course is held, on payment of Rs. 2000/- (may be revised time to time by the University) per course in addition to the prescribed semester fee of the semester in which she/he has been promoted/provisionally promoted, if applicable, within the maximum permissible duration for the Programme.

14.8.6 A student who has got the Migration/Transfer Certificate issued from the University shall not be allowed to re-appear in the End-Semester Examination.

14.9 Re-appear in the End-Semester Examination for Improvement of Grade(s):

14.9.1 If a student wishes to improve her/his grade(s) in any course (s), s/he can re-appear in the End-Semester Examination in the subsequent odd/even semester(s), whenever the examination of the particular course(s) is held,

on payment of Rs. 2000/- (may be revised time to time by the University) per course in addition to the prescribed semester fee of the semester in which she/he has been promoted/provisionally promoted, if applicable, within the maximum permissible duration for the Programme of study of the student.

14.9.2 A student may improve her/his points/grade by reappearing in the End-Semester Examination of a course as per the provisions of reappearing mentioned above. In such cases points obtained by the student in the Continuous Internal Assessment of the particular course shall be carried forward to the subsequent End-Semester Examination of the course. However, in such case, the points/grades obtained on the basis of latest appeared End-Semester Examination shall be considered for calculation of final CGPA of the Programme.

14.9.3 The re-appear examination of a course for improvement of grade shall be based on the syllabi of the course in force at the time of initial registration to the course.

14.9.4 A student who has got the Migration/Transfer Certificate issued from the University shall not be allowed to re-appear in any examination for improvement of grade.

14.10 Repeating course(s):

14.10.1 A student having attendance shortage in any course may repeat the course by taking re-admission in that course in subsequent odd/even semester(s), whenever the course is being offered, within the maximum permissible duration of the Programme.

14.10.2 If a student repeats a course she/he has to fulfill all the desired requirements afresh including attendance, Continuous Internal Assessment and the End-Semester Examination. In such case the course content shall be based on the syllabi of the course in force at the time of repeat of the course. However, at the time of repeating, if the same course is not being offered by the Department due to any reason, the student may choose any other course of similar nature and credits from the available courses on recommendation of the Mentor and approval of the concerned Head of Department.

14.10.3 If a student repeats a course, she/he has to submit a fee of Rs. 3000/- (may be revised time to time by the University) per course in addition to the prescribed semester fee of the semester in which she/he has been promoted/provisionally promoted, if applicable.

14.11 Promotion Rules:

14.11.1 A student shall be declared as **'Promoted'** to the next semester when s/he earns 'P' Grade or above in the last concluded semester examination,

maintaining the spirit and pattern of semester system and covering the mandatory components, such as Continuous Internal Assessment and End-Semester Examinations in all the courses for which s/he was registered till date.

14.11.2 A student shall be **'Provisionally Promoted'** to the next semester if she/he secures less than 'P' grade in **maximum three courses** out of the total courses registered by her/him till date.

14.11.3 A student shall be deemed as **'Failed'** in a semester when she/he gets below 'P' Grade in **more than three courses** or does not appear in the End-Semester Examination of **more than three courses**, after fulfilling the attendance requirements as per this ordinance, out of the total courses registered by her/him till date. In such case(s), a student has to re-appear in the End-Semester Examination of the course(s) in subsequent odd/even semester(s) within the maximum permissible duration of the Programme on payment of Rs. 2000/- (may be revised time to time by the University) per course. Since, such student does not need to attend the classes of the course(s) again; the marks of Continuous Internal Assessment obtained by her/him in the course(s) earlier shall be carried forward to be added with the marks obtained by her/him in the latest End-Semester Examination of the respective course(s).

14.11.4 A student shall also be deemed as **'Failed'** in a semester when she/he failed to appear in the End-Semester Examinations of more than three courses due to the attendance criteria mentioned in 18.4 of this ordinance. Such student has to repeat the courses in the subsequent odd/even semester(s), whenever the courses are being offered, within the maximum permissible duration of the Programme, on payment of the prescribed fees as per the clause 14.10.3.

14.11.5 Under no circumstances, any student shall be permitted to register in a new course if she/he is having less than 'P' Grade in more than three courses.

14.11.6 A student shall be declared to have passed the Programme of study and award of the degree if she/he has secured the required credits with at least 'P' grade.

14.11.7 The re-examination of End-Semester Examination of the failed or provisionally promoted students shall be as per the clauses/sub-clauses under 14.8 above. However, only in a case where a student of final semester (within the minimum prescribed duration of the Programme) fails

to appear or to achieve 'P' grade in maximum three courses including all backlogs after the result declaration of final semester, the Department may ask the concerned course Teacher(s) to conduct re-examination of End-Semester Examinations of such course(s) within a month from commencement of the next semester relaxing the condition of odd/even semester as given in 14.8.3 the student shall have to pay a fee of Rs. 2000/- per course.

14.11.8 If a candidate is repeating a course in an academic session, whatever may be the reason, it shall not be counted in the total number of seats and shall not affect the fresh intake of the M.Sc. (Statistics). Programme in that academic session.

14.12 **Minimum Credit Requirements:**

For a two-year M.Sc. (Statistics). Degree Programme, the credit requirements shall be 96 credits, including core and elective courses as prescribed in the detailed syllabus attached with this ordinance and regulations. A minimum of 8 credits and maximum of 16 credits shall be in the form of elective courses from the core/elective courses offered by other Department(s).

15. Computation of SGPA and CGPA:

The University shall follow the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

15.1. The SGPA is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student in a particular semester and sum of the number of credits of all the courses undergone by a student in that semester, i.e.,

$$SGPA\ (Si) = \sum (Ci \times Gi)/\sum Ci$$

Where, Ci is the number of credits of the i^{th} course and Gi is the grade point scored by the student in the i^{th} course.

15.2. The CGPA is also calculated in the same manner taking into account all the considerable courses as per the provision laid down in this ordinance out of the total courses undergone by a student over all the semesters of a Programme, i.e.,

$$CGPA = \sum (Ci \times Gi)/\sum Ci$$

Where, Ci is the number of credits of the i^{th} course (which is to be considered for the award of the PG Degree) and Gi is the grade point

scored by the student in the i^{th} course.

15.3. The SGPA and CGPA shall be rounded off to 2 decimal points.

15.4 Since, the calculation of CGPA is not based on all the courses undergone by the student, rather it is governed by other provisions laid down in this ordinance like, clause 7.2.3, 13.5 etc., the CGPA may differ from the corresponding calculations based on SGPA only.

16. **Illustration of Computation of SGPA and CGPA:**

16.1. Illustration for computing SGPA:

Course	Credit	Grade Letter	Grade Point	Credit Point
Course I	3	A	8	3 x 8 = 24
Course II	4	B+	7	4 x 7 = 28
Course III	3	B	6	3 x 6 = 18
Course IV	3	O	10	3 x 10 =30
	Total credits for the semester = 13			Total Credit points Earned = 100

Thus, SGPA = 100/13 = 7.69

16.2 Illustrations for computing CGPA:

Courses Considered for the Award of the Degree	Completed in the month (Year)	Credit	Grade Letter	Grade Point	Credit Point
Course I	Dec 2018	4	A	8	4 x 8 = 32
Course II	Dec 2018	4	B+	7	4 x 7 = 28
Course III	June 2019	4	B	6	4 x 6 = 24
Course IV	June 2020	4	o	10	4 x 10 = 40
		Total credits for the semester =16			Total Credit points earned= 124

Thus, CGPA= 124/16= 7.75

Note: Formula to calculate percentage from CGPA/SGPA= CGPA or SGPA x 10; and formula to calculate percentage to CGPA or SGPA = Percentage/10,

e.g., In case of example mentioned in Table 16.2, the percentage of CGPA = 7.75 x 10 = 77.50%

16.3. **Transcript (Format):** Based on the above, letter grades, grade points, and the SGPA, the Transcripts/Detail Grades Certificates (DGCs) shall be issued to the candidates for each semester and a consolidated transcript on completion of the Programme indicating the performance in all the courses considered for calculating the CGPA. Along with the CGPA, the percentage of marks obtained in the Programme shall be reflected in this consolidated transcript on the basis of the CGPA. However, this system may be changed by the University at any point of time without prior notice to the stakeholders as per the need.

17. Removal of Student Name from the Programme:

The name of a student falling under any one of the following categories shall automatically stand removed from the rolls of the University:

(a) A student who has failed to fulfill the minimum grade point requirements prescribed for the Programme during the maximum duration of the Programme.

(b) A student who has already exhausted the maximum duration allowed for completion of the Programme and has not fulfilled the requirements for the award of the degree.

(c) A student who is found to be involved in misconduct, forgery, indiscipline or any other objectionable conduct, upon recommendation of the Disciplinary Committee/ Proctorial Board or any other procedure deemed fit by the University.

(d) A student who has failed to attend the classes as stipulated under the clause of attendance requirements in this ordinance.

18. Attendance Rules:

18.1 A student is required to attend 100% of the classes held in a course in the specific semester in order to be eligible to appear in the End-semester examination of that particular course.

18.2 Waiving of attendance-deficit up to a maximum of 25% is permissible to accommodate following situations:

(a) Representing the University in any inter-collegiate, inter-University, local, national or international events; (b) Participating in an activity of the University with prior permission of the Competent Authority; (c) Participation in NCC/NSC/NSS Camps duly supported by certificate. (d) Participation in Educational Excursions, which form a part of teaching in any subject, conducted on working days duly certified by the concern Course Teacher/ Head of Department /Dean; and (e) to cover all unforeseen reasons like illness, hospitalization, personal engagements elsewhere or other personal reasons which compel a student to absent herself/himself from attending the classes.

18.3 Hence, it shall be mandatory/compulsory to every student to have attendance in 75% classes held in particular course. No waiver, for whatsoever reason, shall be given. Accordingly, no application requesting waiver below 75% attendance shall be entertained by the University. However, a further relaxation up to 10% or the days spent (whichever is lesser) on the basis of situations mentioned under a, b, c, & d of Clause 18.2 above (not on the basis of e of Clause 18.2) may be considered by the Vice-Chancellor on the recommendation of the Head/In charge of the Department. In any other situation no appeal can be made for this purpose even to the Vice-Chancellor.

18.4 A student, however, shall not be allowed to appear in the End-Semester Examination of the courses which are not covered under above mentioned clauses 18.1, 18.2 and 18.3. Such a student shall be permitted to repeat the courses in the subsequent odd/even semester(s), whenever the courses are being offered, within the maximum permissible duration of the Programme, on payment of the prescribed fees as per the clause 14.10.3. However, in the first semester, for repeating the courses, it shall be mandatory for a student to have minimum 40% attendance in aggregate (taken together all the courses registered by her/him in the semester). If a student does not put in at least 40% of aggregate attendance in the first semester, she/he shall have to leave the Programme without claiming refund of any fees, and her/his admission shall be treated as cancelled.

18.5 The attendance of a newly admitted candidate shall be counted from the date of her/his admission/registration or date of beginning of classes, whichever is later. In the case of promoted candidates, attendance shall be counted from the date on which respective class begins. However, if a new student is admitted late after the commencement of the classes, s/he must get herself/himself registered in the desired courses following the due procedure within 5 working days after the admission failing which her/his attendance shall be counted after 5 working days from the date of admission.

18.6 In a case of changed registration as per the clause 13.3 of this ordinance the total classes held for calculating percentage of attendance in the newly registered course for a particular student shall be counted from the fresh registration in that particular course.

18.7 Monthly records of attendance of students in each of the courses taught by a teacher is to be prepared and submitted by the concerned teacher to the Office of the Head/In charge of the Department (HoD) and the Controller of Examinations' (CoE) office by the 10th day of the next month after displaying it to the students in the course and taking their signatures. The teacher will keep the original record of attendance with her/him and submit it finally to both the offices with her/his remarks regarding the eligibility of a student for appearing in the end semester examination within three working days after the last class or teaching day in the semester, whichever is later. Any failure in compliance in this matter must be informed by the concerned teacher to the Head of Department and the Controller of Examinations with justification.

x

18.8 There shall be an Attendance Monitoring Committee in the Department under the Chairmanship of the Head or her/his nominee for proper monitoring of attendance records and taking suitable action(s) as per the requirements.

19. Programme Structure:

The M.Sc.(Statistics). Programme shall be of two year duration divided into four semesters. A student is required to earn at least 96 credits within the stipulated time as per the details given in Annexure-1.

(ANNEXURE WILL CONTAIN THE FOLLOWING ALONG WITH THE DETAILED SYLLABUS)

The Courses and Credit Load (In the provided format along with specific scheme of examination, if any):

Semester-wise Distribution of Courses:

20. Power to Relax and Amendments

20.1 All the above clauses are subject to the amendments, as and when required, as per the decisions pertaining to rules, regulations and norms of the University Statutory Bodies and other Regulatory Bodies etc. (e.g., National Council for Teacher Education (NCTE)), from time to time.

20.1.1 Notwithstanding what is contained in the foregoing clauses of this ordinance, the Academic Council may, in exceptional circumstances consider at its discretion and for reasons to be recorded, relax any of the provisions except those prescribing CGPA requirements.

20.2 Notwithstanding anything stated in this ordinance, for any unforeseen issues arising, and not covered by this ordinance, or in the event of differences of interpretation, the Vice-Chancellor may take a decision, after obtaining the opinion/advice, if required, of UATEC. The decision of the Vice-Chancellor shall be final.

Annexure – I

CENTRAL UNIVERSITY OF SOUTH BIHAR

M.Sc. (Statistics) Programme Syllabus

(Effective from Academic Session 2018-2019)

Department of Statistics
SCHOOL OF MATHEMATICS, STATISTICS AND COMPUTER SCIENCE

10/07/18

दक्षिण बिहार केन्द्रीय विश्वविद्यालय

Central University of South Bihar

DEPARTMENT OF STATISTICS

School of Mathematics, Statistics and Computer Science

Syllabus of

M. Sc. (Statistics) Based on CBCS

2018

Proposed Course Structure for M. Sc. (Statistics) Based on CBCS: Effective from July 2018 onwards [96 credits]

Course Code	Course Title	Credits
	Semester-I	
MSSTS1001C04	Real Analysis and Linear Algebra	4
MSSTS1002C04	Distribution Theory and Nonparametric Statistics (**Open to other Depts. of the School of Mathematics, Statistics & Computer Sc.**)	4
MSSTS1003C04	Survey Sampling and National Development Statistics	4
MSSTS1004C04	Statistical Computing	4
MSSTS1005C04	Lab-I	4
MSCSC***/ MSMTH***	Elective –I (**from other Depts. of the School of Mathematics, Statistics & Computer Sc.**)	4
	Total Credits	**24**
	Semester-II	
MSSTS2001C04	Linear Models and Regression Analysis (**Open to other Depts. of the School of Mathematics, Statistics & Computer Sc.**)	4
MSSTS2002C04	Measure Theory and Probability	4
MSSTS2003C04	Statistical Inference	4
MSSTS2004C04	Lab-II	4
MSSTS2005E04/ MSSTS2006E04	Elective –II	4
MSCCS***/ MSMTH***	Elective-III (**from other Depts. of the School of Mathematics, Statistics & Computer Sc.**)	4
	Total Credits	**24**
	Semester-III	
MSSTS3001C04	Multivariate Analysis	4
MSSTS3002C04	Project[1] (Questionnaire Preparation and Data Collection)	4
MSSTS3003C04	Lab-III	4
MSSTS3004E04- MSSTS3008E04	Elective –IV	4
	Elective –V	4
	Elective –VI	4
	Total Credits	**24**
	Semester-IV	
MSSTS4001C04	Project[1] (Analysis and Report Writing)	4
MSSTS4002C04	Lab-IV	4
MSSTS4003E04- MSSTS4007E04	Elective-VII	4
	Elective-VIII	4
	Elective-IX	4
MSSTS4008E04- MSSTS4010E04-	Elective-X **(SWAYAM)**[2]	4
	Total Credits	**24**
	Grand Total	**96**

10/7/18

10/07/18

Semester-I Elective Basket Open to the Department of Statistics

Course Code	Course Title	Credits
	By the Dept. of Mathematics	
MSMTH***	Operations Research (OR)	4
	By the Dept. of Computer Science	
MSCSC***	Programming in C	4
MSCSC***	Introduction to IT	4
MSCSC***	Fundamentals of Computer	4
MSCSC***	Data Structure and Algorithm	4

Semester-II Elective Basket Open to the Department of Statistics

Course Code	Course Title	Credits
	By the Dept. of Statistics	
MSSTS2005E04	Business Analytics-I	4
MSSTS2006E04	Survival Analysis	4
	By the Dept. of Computer Science	
MSCSC***	Introduction to Database	4
MSCSC***	Image Processing	4
MSCSC***	Modelling and Simulation	4
MSCSC***	Artificial Intelligence	4
MSCSC***	Design and Analysis of Algorithm	4

Semester-III Elective Basket Open to the Department of Statistics

Course Code	Course Title	Credits
	By the Dept. of Statistics	
MSSTS3004E04	Stochastic Processes	4
MSSTS3005E04	Bayesian Inference	4
MSSTS3006E04	Business Analytics - II	4
MSSTS3007E04	Nonlinear Models	4
MSSTS3008E04	Spatial Data Analysis	4

Semester-IV-Elective Basket Open to the Department of Statistics

Course Code	Course Title	Credits
MSSTS4003E04	Design of Experiments	4
MSSTS4004E04	Categorical and Directional Data Analysis	4
MSSTS4005E04	Time Series and Forecasting	4
MSSTS4006E04	Statistical Processes and Quality Control	4
MSSTS4007E04	Demography	4

Semester-IV SWAYAM Courses[2]- Elective basket Open to the Department of Statistics

Course Code	Course Title	Credits
MSSTS4008E04	Distribution Free Methods	4
MSSTS4009E04	Econometric Analysis	4
MSSTS4010E04	Probability and Stochastic for Finance	4

10/7/18

10/7/18

Elective Basket Open to the Dept. of Mathematics and the Dept. of Computer Science

Course Code	Course Title	Credit
	Semester-I	
MSSTS1002C04	Distribution Theory and Nonparametric Statistics	4
MSSTS-***	Computer Intensive Statistical Methods-I*	4
	Semester-II	
MSSTS2001C04	Linear Models and Regression Analysis	4
MSSTS-***	Computer Intensive Statistical Methods-II*	4

Elective Basket Open to Other Schools

Course Code	Course Title	Credits
	Semester -IV	
MSSTS-***	Organizing and Visualizing Data*	4

* Open to all other departments.

List of Skill Based/Self Study Courses[3] (Non-Credit)

Course Code	Course Title	Credits
MSSTS-***	Latex	Non-credit
MSSTS-***	R-programming	Non-credit
MSSTS-***	Computer Based Data Graphing	Non-credit

[1] The filed survey under paper entitled Project in Semesters III & IV shall be conducted in villages.

[2]One of the SWAYAM courses (Statistics)- Distribution Free Methods, Econometric Analysis, and, Probability and Stochastic for Finance, may be opted by students as the Elective-X during Semester-IV

[3]The skill based /Self-study courses- Latex, R-programming and Computer Based Data Graphing have been designed to enhance students' skills in scientific typing and computer based statistical analysis and presentation.

10/07/18

10/7/18

Semester-I

Core Courses

Course Details			
Course Title: Real Analysis and Linear Algebra			
Course Code	MSSTS1001C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT- I:
Introduction to real numbers and set theory with related properties. Sequence and series of real numbers and their convergence. Functions of two or more variables. Maxima-minima of functions of two or more variables, constrained maxima – minima of functions.

UNIT-II
The Reimann and Reimann-Stieltjes Integrals: Existence and Properties. Multiple integrals, change of variables in multiple integration. Differentiation under the sign of integral – Leibnitz rule.

UNIT-III
Review of vector spaces and linear transformations, system of liner equations, characteristic roots and vectors, Cayley - Hamilton theorem, minimal polynomial, similar matrices, algebraic and geometric multiplicity of a characteristic root and spectral decomposition of a real symmetric matrix.

UNIT-IV
Gram-Schmidt orthogonalization process, orthonormal basis and orthogonal projection of a vector. Real quadratic forms, reduction and classification of quadratic forms. Partitioned matrices. Generalized inverse.

References

1. Apostol, T. M. (1985). Mathematical Analysis, Narosa Indian Ed.
2. Bartle, R, G. (1976).The Elements of Real Analysis, Second Edition, John Wiley & Sons, Inc., New York.
3. Bartle, R. G. and Sherbert, D. R. (2011). Introduction to Real Analysis, 4th Ed., John Wiley & Sons, Inc., New York.
4. Graybill, F. A. (2002). Matrices with Applications in Statistics, 2nd Ed. Wadsworth.

5. Malik S. C. and Arora, S (2017). Mathematical Analysis, 5th Ed. New Age International Publishers.
6. Miller, K. S. (1975). Advanced Real Calculus, Harper, New York.
7. Rudin, Walter (1976). Principles of mathematical analysis, 3rd Ed., McGraw-Hill, New York.
8. Searle, S. R. (1982): Matrix Algebra for Statistical Applications, John Wiley and Sons Inc.

Course Details			
Course Title: Distribution Theory and Nonparametric Statistics			
Course Code	MSSTS1002C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Brief review of basic distribution theory. Construction of Bivariate Distributions. Function of random variables and their distributions using Jacobian transformation and other tools. Compound, truncated and mixture distributions. Conditional expectation. Markov, Holder, Jensen inequalities and their applications, e.g. Liapounov's inequality. Entropy.

UNIT-II

Non-central distributions: Chi-square distribution, t-distribution, F-distribution and their properties.

UNIT-III

Order statistics, their distribution and properties. Joint and marginal distributions of order statistics. Distribution range, exact and asymptotic distribution of median. Empirical distribution function and its distributional properties, K-S goodness of fit.

UNIT-IV

Rank-test. One-sample location problem, sign test and signed-rank-test, two sample K-S test, two sample location & scale problems. Wilcoxon Mann-Whitney test.

References

1. Balakrishnan, N. and Lai, Cin-Diew (2009) Continuous Bivariate Distributions, 2nd ed. Springer.
2. Casella, G. and Berger, R. L. (2002). Statistical Inference, 2nd Ed. Duxbury Press.
3. Daniel, Wayne W. (2000). Applied Nonparametric Statistics, 2nd Ed. Cengage Learning.
4. Feller, W. (1968). An Introduction to Probability Theory and Its Applications, 3rd Ed. Wiley.

10/07/18

10/7/18

5. Gibbons, J. D. and Chakraborti, S (2010). Nonparametric Statistical Inference, 5th Ed. Chapman and Hall/CRC.
6. Hogg, R. V. and Craig, A. T. (2012). Introduction to Mathematical Statistics, 7th Ed. Pearson Edward (Indian Print).
7. Mood, A. M., Graybill, F. A. and Boes, D. C. (1974). Introduction to the Theory of Statistics (3rd edition), McGraw Hill.
8. Mukhopadhyay, P. (2015). Mathematical Statistics, Books & Allied (P) Ltd.
9. Parzen, E. (1992). Modern Probability Theory and Its Applications, Wiley Eastern.
10. Randles, R.H. and Wolfe, D.A. (1991). Introduction to the Theory of Nonparametric Statistics,
11. Rao, C. R. (2001). Linear Statistical Inference and its Applications, 2nd Ed. Wiley.
12. Rohatgi, V. K. and Saleh A. K. Md. E (2015). An Introduction to Probability and Statistics, 3rd Ed. Wiley, New York.

Course Details			
Course Title: Survey Sampling and National Development Statistics			
Course Code	MSSTS1003C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Review of basic finite population sampling techniques Simple random sampling (wr/ wor), Stratified. Systematic sampling and related results on estimation of population mean/total. Allocation problem in Stratified sampling.

UNIT-II

Unequal probability sampling: PPS wr/wor methods [including Lahiri's scheme] and related estimators of finite population mean, [Hansen-Hurwitz and Desraj estimators for a general sample size and Murthy's estimators for a sample of size 2]

UNIT-III

Ratio, product and regression estimators based on SRSWOR method of sampling. Two-stage sampling with equal number of second stage unit. Double sampling, Cluster sampling. Randomized response technique [Warner's model: related and unrelated questionnaire methods].

UNIT-IV

Human Development Index. Estimation of national income-product approach, income approach and expenditure approach. Measuring inequality in incomes, Gini's coefficient, Theil, Sen Poverty Indices, etc.

10/7/18 10/07/18

References

1. Chaubey, P. K. (1995). Poverty Measurement Issues, Approaches and Indices. New Age Publication, New Delhi.
2. Cochran, W. G. (1977). Sampling Techniques, 3rd Edition, Wiley.
3. Hedayat, A. S. and Sinha, B. K. (1991). Design and Inference in Finite Population Sampling, Wiley.
4. Mukhopadhyay, P. (2003). Inferential Problems in Survey Sampling .New Age International.
5. Murthy, M. N. (1967). Sampling Theory and Methods. Statistical Publishing Society, Kolkata.
6. Sen, Amatya. (1983). Poverty and Femine. Oxford University Press.
7. Singh, S. (2003). Advanced Sampling Theory with applications, Kulwer Academic Publishers, Netherlands.
8. Sukhatme, P. V., Sukhatme, B. V., Sukhatme, S. and Asok, C. (1984). Sampling Theory of Surveys with Applications, Iowa State University Press and Indian Society of Agricultural Statistics.

Course Details			
Course Title: Statistical Computing			
Course Code	MSSTS1004C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT I

Structure of a C Program, Writing C Programs, Data Types, Variable and Operators, Pre-processor Directives, Input and Output Operators, Control Statements: IF, IF-ELSE and IF-ELSIF-ELSE Statements, Nesting of IF-ELSE Statements, SWITCH, DO-WHILE, WHILE and FOR Statements.

UNIT II

One Dimensional, Two Dimensional and Multi-Dimensional Arrays, Strings, Understanding Pointers, Pointer expressions, Functions in C, Parameter passing: Call-by-value,Call-by-reference, Recursion, Variable Storage Classes, Input/Output operations on Files.

UNIT III

Solutions of statistical problems based on C, Calculation of Mean, Variance & Standard Deviation, Random number generation, Simulation techniques for various probability models.

UNIT-IV

MINITAB, R, Matlab, and SPSS for Graphics, Descriptive Statistics, Representation of Multivariate data, simple hypothesis tests, analysis of variance and linear regression.

References

1. Balagurusamy, E. (2017). Programming in ANSI C. (Seventh Edition) McGraw-Hill Deo, N. (2009). System simulations with Digital computers, PHI.
2. Devroye, L. (1986). Non-Uniform Random Variate Generation. Springer-Verlag NewYork Inc.
3. Hutchinson RC and Just R.B. (1998). Programming using the C Language. McGraw-Hill.
4. James, G. et al. (2014). An introduction to statistical learning with applications in R. Springer, New York.
5. Kanetkar, Y. (2016). Let Us C. (Fifteenth Edition), BPB Publications.
6. Pratap, Rudra (2010). Getting started with MATLAB. Oxford University Press
7. Ryan, B., Joiner, B. and Cryer, J. (2005). Minitab Handbook, 5th ed. Brooks/ Cole Cengage Learning.
8. Sheldon M. Ross. (2012). Simulation, 5th ed. Academic Press.
9. http://cran.r-project.org
10. www.mathworks.com

Course Details			
Course Title: Lab-I			
Course Code	MSSTS1005C04	**Credits**	4
L + T + P	1 + 0 + 3	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	15 (L) + 45 (P) Hours
Methods of Content Interaction	Lecture, demonstration, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 40% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination): 48% Written + 12% Viva-voce		

Note: Lab-I is based on the problems of the core papers of Semester-I

Semester-II

Core Courses

Course Details			
Course Title: Linear Models and Regression Analysis			
Course Code	MSSTS2001C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Gauss-Markov set-up, normal equations and least squares estimates, error and estimation spaces, variances and covariances of least squares estimates, estimation of error variance, estimation with correlated observations, least squares estimates with restriction on parameters.

UNIT-II

Simultaneous estimates of linear parametric functions, tests of hypothesis for one and more than one linear parametric functions, confidence intervals and regions.

UNIT-III

Simple linear regression, multiple and polynomial regressions, logistic regression, orthogonal polynomials.

UNIT-IV

Residuals and their plots as tests for departure from assumptions such as fitness of the model, normality, homogeneity of variances and detection of outliers, remedies. Introduction to non-linear models; least squares in non-linear case, estimating the parameters of a non-linear system, reparameterization of the models.

References

1. Cook, R. D. and Weisberg, S. (1982). Residuals and Inference in Regression, Chapman and Hall.
2. Draper, N. R. and Smith, H. (2012). Applied Regression Analysis, 3rd Ed. Wiley.
3. Graybill, I. A. (1961). An Introduction to Linear Statistical Models, Vol. 1, McGraw Hill Book Co. Inc.
4. Hosmer, D. and Lemeshow, S. (2000). Applied Logistic Regression, 2nd ed. Wiley.
5. Kutner, M., Nachtsheim, C., Neter, J. and Li, Willium (2004). Applied Linear Statistical Models, 5th ed. McGraw-Hill/Irwin.
6. Rao, C. R. (2001). Linear Statistical Inference and its Applications, 2nd ed., Wiley.
7. Ronald, C. (1997). Log-linear models and logistic regression. Springer.

8. Seber, G. A. F. and Wild, C. J. (2003). Non-linear Regression. Wiley.
9. Weisberg, S. (2013). Applied Linear Regression, 4th ed., Wiley.

Course Details			
Course Title: Measure Theory and Probability			
Course Code	MSSTS2002C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	EVEN	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Classes of sets, field, sigma field, minimal sigma field, Borel sigma field and induced sigma field, sequence of sets, lim sup, lim inf of a sequence of sets. measure, probability measure and induced probability measure, Cartherdory extension theorem (statement only), Lébesgue and Lébesgue-Stieltjes measures.

UNIT-II

Lebesgue measurable functions, Borel measurable functions, Random variables, Lebesgue Integration: Integration of non-negative measurable functions, Monotone convergence theorem and Fatou's lemma (statement only), Integrable functions and their properties, Dominated convergence theorem (statement only).

UNIT-III

Borel-Contelli lemma, various measures of convergence of sequence of random variables and their interrelationship. Convergence of rational functions of random variables.

UNIT-IV

Characteristic function, inversion theorem, uniqueness theorem, Levy-Cramer continuity theorem (statement only). Examples based on continuous and discrete distributions. Weak and strong law of large numbers and Central limit theorem (CLT) for iid sequences. Applications of CLT.

References

1. Ash, Robert. (1972). Real Analysis and Probability. Academic Press.
2. Barra, G. D. (1981). Measure Theory and Integration, New Age International (P) Ltd. Publisher, New Delhi.
3. Bhat, B. R. (2014). Modern Probability Theory, 4th ed. New Age International.
4. Bilingsley. P. (2012). Measure Theory and Probability. 4th ed. Wiley.
5. Rao, C. R. (2001). Linear Statistical Inference and its Applications, 2nd ed. Wiley Eastern.
6. Rohatgi, V. K. and Saleh, A. K. Md. E. (2015). An Introduction to Probability and Statistics, 3rd edn. Wiley.

Course Details			
Course Title: Statistical Inference			
Course Code	MSSTS2003C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	EVEN	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I:

Sufficiency, minimal sufficient statistics, completeness, exponential family of distributions. Rao-Blackwell theorem and Lehmann-Scheffe theorem, ancillary statistics, Basu's Theorem.

UNIT-II

CAN and BAN estimators. Method of Fisher-scoring for MLE.

UNIT-III

Most powerful tests, uniformly most powerful tests, uniformly most powerful unbiased tests, uniformly most powerful test for MLR family of distributions. LR test with its asymptotic distribution.

UNIT-IV

Sequential Probability Ratio Test (SPRT), Wald's fundamental Lemma, OC and ASN functions. General decision problem, loss function, risk function, squared error and absolute error loss function. Admissibility, minimaxity and Bayes procedures.

References

1. Berger, J. O. (1993). Statistical Decision Theory and Bayesian Analysis. Springer-Verlag.
2. Casella, G. and Berger, R. L. (2010). Statistical Inference, Wadsworth & Brooks/Cole, California, USA
3. Ferguson T. S. (1967). Mathematical Statistics, Academic Press.
4. Kale, B. K. (2005). A first course in Parametric Inference, 2nd Revised ed., Alpha Science International Ltd.
5. Lehman, E. L. and Casella, G. (2005). Theory of Point Estimation, 2nd ed. Springer.
6. Lehman, E. L. (2005). Testing Statistical Hypothesis, 3rd ed., Springer.
7. Mood, A. M., Graybill, F. A. and Boes, D. C. (1974). Introduction to the Theory of Statistics (3rd edition), McGraw Hill.
8. Rao, C. R. (2001). Linear Statistical Inference, 2nd ed., Wiley.
9. Rohtagi, V. K. and Saleh, A. K. Md. E. (2015). An introduction to probability and Statistics, 3rd ed. Wiley.

10/07/18 10/7/18

Course Details			
Course Title: Lab-II			
Course Code	MSSTS2004C04	**Credits**	4
L + T + P	1 + 0 + 3	**Course Duration**	One Semester
Semester	EVEN	**Contact Hours**	15 (L) + 45 (P) Hours
Methods of Content Interaction	Lecture, demonstrations, practicals, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 40% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 60% - End Term External Examination (University Examination) : 48% Written + 12% Viva-voce		

Lab-II is based on the problems of core and elective courses of Semester-II

Elective Courses

Course Details			
Course Title: Business Analytics-I (Predictive Modeling)			
Course Code	MSSTS2005E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	EVEN	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Introduction, Prediction Versus Interpretation, Key Ingredients of Predicting Models. Statistical Learning, Supervised Versus Unsupervised Learning, Regression Versus Classification Problem, Machine Learning, Assessing Model Accuracy, Basics of Decision Trees, Support Vector Machines, etc.

UNIT-II

Predictive Modeling Process, Data Pre-processing, Over Fitting, etc. Measuring Predictor Importance, Feature Selection, etc.

UNIT-III

Regression Models: Linear Regression, Nonlinear Regression Models. Regression Trees and Rule-Based Models.

UNIT-IV

Classification Models: Measuring Performance in Classification Models, Discriminant Analysis and Other Linear Classification Models, Nonlinear Classification Models. Classification Trees and Rule-based Models.

10/07/18. 10/7/18

References

1. Bishop, C. (2010). Pattern Recognition and Machine Learning. Springer.
2. Harrington, P. (2012). Machine Learning in Action. Dreamtech Press.
3. Hastie, T., Tibshirani, R., and Friedman, J. (2008). The Elements of Statistical Learning: Data Mining, Inference and Prediction. Springer, Second Edition.
4. Izenman, A. J. (2013). Modern Multivariate Statistical Techniques: Regression, Classification, and Manifold Learning, 2nd ed. Springer.
5. James, G., Witten, D., Hastie, T. and Tibshirani, R. (2013). An Introduction to Statistical Learning with Applications in R. Springer.
6. Kuhn, M. and Johnson, K. (2013). Applied Predictive Modeling. Springer.
7. Silver, N. (2012). The Signal and the Noise: The Art and Science of Prediction. Allen Lane, Penguin Books Ltd.

Course Details			
Course Title: Survival Analysis			
Course Code	MSSTS2006E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	EVEN	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Unit-I

Concept of time, order and random censoring, likelihood in the distributions-exponential, gamma, Weibull, lognormal, Pareto, Linear failure rate, inference for these distributions.

Unit-II

Life tables, failure rate, mean residual life and their elementary classes and their properties. Multiple decrement life tables.

Unit-III

Estimation of survival function- actuarial estimator, Kaplan-Meier estimator, estimation under the assumption of IFR/DFR, tests of exponentiality against non-parametric classes, total time on test. Two sample problem- Gehan test, log rank test.

Unit-IV

Semi-parametric regression for failure rate- Cox's proportional hazards model with one and several covariates. Rank test for the regression coefficient. Competing risk model, parametric and non-parametric inference for the model.

References

1. Cox, D. R. and Oakes, D.(1984). Analysis of survival data, Chapman and Hall, New York.
2. Gross, A. J. and Clark, V. A., (1975). Survival Distribution: Reliability applications in the Biomedical Sciences, John Wiley and Sons.
3. Elandt-Johnson, R. E. Johnson N.L., Survival Models and Data Analysis, John Wiley and Sons.
4. Miller, R. G.,(1981). Survival Analysis, John Wiley.
5. Kalbfleisch, J. D. and Prentice, R., The Statistical Analysis of Failure Time Data, John Wiley.

Core Courses

Course Details			
Course Title: Multivariate Analysis			
Course Code	MSSTS3001C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

Unit-I
Multivariate normal distribution and its properties. Maximum likelihood estimates of mean vector and dispersion matrix, distribution of sample mean vector.

Unit-II
Wishart matrix-its distribution and properties. Hotelling's T^2 statistic-its distribution and application in testing of mean vector for one and more multivariate normal populations. Mahalonobis D^2 statistic and its applications.

Unit-III
Multivariate linear regression model-estimation of parameters.

Unit-IV
Wilk's criteria and linear discriminant functions, Introduction to Principal Components. Concept of Factor Analysis. Cluster Analysis.

References

1. Anderson, T. W. (2003). An Introduction to Multivariate Statistical Analysis. 3rd ed.
2. Bhuyan, K. C. (2008). Multivariate Analysis and Its Applications. New Central Book Agency (P) Ltd. Kolkata, India.
3. Johnson, R. and Wichern, D. W. (2013). Applied Multivariate Statistical Analysis. 6th ed. Pearson.
4. Kotz, S., Balakrishnan, N. and Johnson, N. L. (2000). Continuous Multivariate Distributions, 2nd ed., Models and Applications, Vol. 1. Wiley.
5. Mardia, K. V., Kent, J. T. and Bibby, J. M. (2003). Multivariate Analysis. Academic Press, An Imprint of Elsevier Science.
6. Rencher, A. C. and Christensen, W. F. (2012). Methods of Multivariate Analysis, 3rd ed. Wiley
7. Siotani, M., Hayakawa, T. and Fujikoshi, Y. (1985). Modern Multivariate Statistical Analysis. American Sciences Press, Inc, USA.

8. Srivastava, M. S. and Khatri, C. G. (1979). An Introduction to Multivariate Statistics. North Holland.
9. Sharma, S. (1996). Applied Multivariate Techniques. *John Wiley & Sons, Inc. USA.*

Course Details			
Course Title:	**Project (Questionnaire Preparation and Data Collection)**		
Course Code	MSSTS3002C04	**Credits**	4
L + T + P	1 +1 + 2	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	15 (L) + 15 (T) +30 (P) Hours
Methods of Content Interaction	Lecture, tutorial, discussions, assignments, presentations, field survey, practical, etc.		
Assessment and Evaluation	• 40% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 60% - End Term External Examination (University Examination) : 40% Presentation + 20% Viva-Voce		

Selection of topic of the project, literature review, preparation of questionnaire, conduct of small scale survey (if needed).

Course Details			
Course Title:	**Lab-III**		
Course Code	MSSTS3003C04	**Credits**	4
L + T + P	1 +0 + 3	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	15 (L) + 45 (P) Hours
Methods of Content Interaction	Lecture, assignments, presentations, practical, etc.		
Assessment and Evaluation	• 40% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 60% - End Term External Examination (University Examination) : 48% Written + 12% Viva-voce		

Lab-III is based on the problems of elective and core courses of Semester-III

Course Details			
Course Title: Stochastic Processes			
Course Code	MSSTS3004E04	**Credits**	4
L + T + P	3 +1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorial, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination) : 40% Presentation + 20% Viva-Voce		

UNIT-I

Introduction to Stochastic Processes : Classification of general stochastic processes according to state space and time domain, countable state Markov chains, Chapman – Kolmogorov equations, calculation of n – step transition probabilities and its limit, stationary distribution, classification of states, transient Markov chain, random walk and gambler's ruin problem.

UNIT-II

Discrete state space and continuous time Markov chain: Kolmogorov – Feller differential equations, Poisson process and related inter – arrival time distributions, pure birth process, pure death process, birth and death process, Wiener process as a limit of random walk, first passage time and other problems.

UNIT-III

Renewal theory: Elementary renewal theorem and its applications, statement and uses of key renewal theorem, study of residual life time processes, stationary process, weakly stationary and strongly stationary processes.

UNIT-IV

Branching process: definition and examples of discrete time branching process, probability generating function, Galton – Watson branching process, probability of ultimate extinction, and distribution of population size.

References

1. Adke, S. R. and Manjunath, S. M. (1984). An Introduction to Finite Markov Processes, Wiley.
2. Cinlar, E. (2013). Introduction to Stochastic Processes, Prentice Hall.
3. Feller, W. (1968). Introduction to Probability and Applications, New Age India International.
4. Harris, T. E. (1963). The Theory of Branching Processes, Springer-Verlag.
5. Hoel, P. G., Port, S. C. and Stone, C. J. (1991). Introduction to Stochastic Processes, University Book Stall.
6. Karlin, S. and Taylor, H. M. (1995). A First Course in Stochastic Processes, Academic Press.
7. Medhi, J. (2009). Stochastic Processes, 3rd Ed. New Age India International.

8. Ross, S. M. (1996). Stochastic Processes, 2nd. Ed. Wiley.

Course Details			
Course Title: Bayesian Inference			
Course Code	MSSTS3005E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Subjective probability, its existence and interpretation. Prior distribution, Subjective determination of prior distribution. Subjective and objective priors. Improper priors, Non-informative (default) priors, Invariant priors. Conjugate prior families, Construction of conjugate families using sufficient statistics of fixed dimension, Mixtures of conjugate priors, Hierarchical priors. Maximum Entropy Prior.

UNIT-IV

Bayes Theorem for random variables. Posterior distribution and its calculation for discrete and continuous distributions.

UNIT-III

Point estimation, credible sets, testing of hypotheses and Predictive Inference. Comparison with classical procedures.

UNIT-IV

Asymptotic expansion for the posterior density. Bayesian calculation, Monte-Carlo Integration and Markov chain Monte Carlo techniques (without proof).

References

1. Berger, J. O. (1993). Statistical Decision Theory and Bayesian Analysis. Springer-Verlag.
2. Bernado, J. M. and Smith, A. F. M. (2000). Bayesian Theory. Wiley.
3. Box, G. P. and Tiao, G. C. (1992). Bayesian Inference in Statistical Analysis. Addison-Wesley.
4. Gelman, A., et al. (2004). Bayesian Data Analysis. Chapman Hall/CRC.
5. Gemerman, D., et al. (2006). Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference, 2nd ed. Chapman Hall.
6. Ghosh, J. K., Delampady, M. and Samanta, T. (2006). An Introduction to Bayesian Analysis, Theory and Methods. Springer.
7. Lee, P. M. (2012). Bayesian Statistics: An Introduction, 4th ed. John Wiley & Sons.

10/07/18 10/7/18

8. Leonard, T. and Hsu, J. S. J. (2001). Bayesian Methods. Cambridge University Press.
9. Robert, C. P. (2007). The Bayesian Choice: A Decision Theoretic Motivation, 2nd ed. Springer.
10. Robert, C. P. and Casella, G. (2010). Monte Carlo Statistical Methods. Springer.

Course Details			
Course Title: Business Analytics-II (Data Mining)			
Course Code	MSSTS3006E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Principles of Data Mining and basic concepts. Data Pre-processing and exploration.

UNIT-II

Basic and Other Techniques for Cluster Detection. Decision Tree Induction for Classification and other Classification Techniques.

UNIT-III

Techniques for Mining Boolean Association Rules. Mining Techniques for Other Types of Association.

UNIT-IV

Text Mining and Web mining. Applications of WEKA software and IBM SPSS Data Modeler software.

References

1. Du, H. (2010). Data Mining Techniques and Applications. Cenage Learning.
2. Han, J., Kamber, M. and Pei, J. (2012). Data Mining: Concepts and Techniques: An Introduction. Elsevier, The Morgan Kaufmann Series, Third Edition.
3. Nisbet, R., Elder, J. and Miner, G. (2009). Handbook of Statistical Analysis and Data Mining Applications. Elsevier.
4. Roiger, R. and Geatz, M. (2003). Data Mining: A Tutorial Based Primer. Pearson Education, Inc.
5. Witten, I. H., Frank, E. and Hall, M. A. (2011). Data Mining: Practical Machine Learning Tools and Techniques. Elsevier, The Morgan Kaufmann Publishers, Third Edition.

6. Rao, C.R., Wegman, E. G., and Solka, G. L. (2005). Data Mining and Data Visualisation. Handbook of Statistics, Vol. 24 (Edited by Rao, Wegman and Solka). Elsevier.
7. Govindaraju, V. and Rao, C.R. (2013). Machine Learning: Theory and Applications. Handbook of Statistics, Vol. 31(Edited by Govindaraju and Rao). Elsevier.
8. Izenman, A.J. (2008). Modern Multivariate Statistical Technique: Regression, Classification and Manifold Learning. Springer.

Course Details			
Course Title: Nonlinear Regression Models			
Course Code	MSSTS3007E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT I
Review of Simple Linear Regression, Multiple Regression and General Linear Regression Model. Regression Models for Quantitative and Qualitative Predictors.

UNIT II
Introduction to Nonlinear Regression, Least Squares Estimation in Nonlinear Regression, Introduction to Neural Network Modeling, Neural Network as Generalization of Linear Regression

UNIT III
Logistic Regression, Logistic Regression Diagnostics.

UNIT IV
Poisson Regression and Generalized Linear Models,

References

Bates, D. M., and Watts, D. G., *Nonlinear Regression Analysis and Its Applications*, Wiley, New York, 1988.

Gallant, A. R., *Nonlinear Statistical Models*, Wiley, New York, 1987.

Kutner, M. H., Nachtsheim, C. J. and Li, W., *Applied Linear Statistical Models,* fifth edition, McGraw Hill Education (India) Private Limited, New Delhi, 2013.

Ratkowsky, D. A., *Nonlinear Regression Modeling, Marcel Dekker,* New York, 1983.

Course Details			
Course Title: Spatial Data Analysis			
Course Code	MSSTS3008E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I
Geostatistical data, Lattice data, Point patterns.

UNIT-II
Ripley's & Cressie's approaches to analysis of spatial data. Basic stochastic processes. Spatial sampling.

UNIT-III
Autoregression and Autocorrelation. Point patterns – Distance methods, Nearest-neighbor methods. Variogram & Correlogram. Variogram model fitting.

UNIT-IV
Spatial Prediction and Kriging, Spatial models on Lattices for discrete and continuous data. GIS and its applications.

References

1. Cressie, N. A. (2015). Statistics for Spatial Data. Rev. ed. Wiley
2. Ripley, B. D. (2004). Spatial Statistics. Wiley.
3. Statistical Packages for Geological Data.

Semester-IV

Core Courses

Course Details			
Course Title: Project (Analysis and Report Writing)			
Course Code	MSSTS4001C04	**Credits**	4
L + T + P	1 + 1 + 2	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	15 (L)+15 (T)+30 (P) Hours
Methods of Content Interaction	Lecture, practical, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination) : 40% Report Writing + 30% Presentation		

Report writing and presentation of work.

Course Details			
Course Title: Lab-IV			
Course Code	MSSTS4002C04	**Credits**	4
L + T + P	1 + 0 + 3	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	15 (L) + 45 (P) Hours
Methods of Content Interaction	Lecture, practical, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 40% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 60% - End Term External Examination (University Examination) : 48% Written + 12% Viva-voce		

Lab-IV is based on the Elective papers of Semester-IV

Course Details			
Course Title: Design of Experiments			
Course Code	MSSTS4003E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Review of linear estimation and basic designs like CRD, RBD and LSD, missing plot technique – General theory and applications, analysis of covariance for CRD and RBD.

UNIT-II

Incomplete block design: Balanced Incomplete Block Design (BIBD) – recovery of interblock information. Simple lattice designs, two-associate partially balanced incomplete block designs: association scheme, group divisible designs.

UNIT-III

General factorial experiments, factorial effects, best estimates and testing the significance of factorial effects; study of 2^2 and 3^2 factorial experiments in randomized blocks, complete and partial confounding.

UNIT-IV

Split plot and strip – plot experiments. Introduction to response surface methodology.

References

1. Box, G. E. P. and Draper, N. R. (2007). Response Surfaces, Mixtures and Ridge Analyses, 2nd ed. Wiley.
2. Das, M. N. and Giri, N. (1986). Design and Analysis of Experiments. 2nd Ed. Wiley Eastern.
3. Dean, A. and Voss, D. (1999). Design and Analysis of Experiments. Springer.
4. Dey, A. (1986). Theory of Block Designs. Wiley Eastern.
5. Giri, N. (1986). Analysis of Variance. South Asian Publishers.
6. Joshi, D. D. (1987). Linear Estimation and Design of Experiments, Wiley Eastern.
7. Mathews, P. (2005). Design of Experiments with MINITAB, Pearson Education (Singapore) Pt. Ltd.
8. Montgomery, D. C. (2008). Design and Analysis of Experiments. 8th Ed. Wiley.

Course Details			
Course Title: Categorical and Directional Data Analysis			
Course Code	MSSTS4004E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Categorical Data analysis: Categorical data, measures of association and contingency tables.

UNIT-II

Estimation in complete and incomplete tables; missing data and E-M algorithm for contingency tables and goodness-of- fit tests.

UNIT-III

Generalized Linear Models for discrete data; Poisson and Logistic (Binary and Multinomial) Regression; Log-linear models.

UNIT-IV

Directional Data Analysis: Circular data, examples and differences with linear data; Data representations and Summary measures. Probability models on the circle- CN and Wrapped Stable distributions. Inference for the CN model- one, two and k-samples; Goodness-of-Fit tests. Tests for Isotropy; Predictive Inference. Circular-circular, Circular-linear, Linear-circular Regression.

References

1. Agresti, A. (2007). Introduction to Categorical Data Analysis. 2nd ed. Wiley
2. Fisher, N. I. (2001). Analysis of Circular Data, Cambridge University Press.
3. Jammalamadaka, S. R. and SenGupta, A. (2001). Topics in Circular Statistics, World Scientific.
4. Kendall, M. and Stuart, A. (1991). The Advanced Theory of Statistics, vol.2: Inference and Relationship, 5th ed. New York: Macmillan.
5. Little, R. J. and Rubin, D. B. (2002). Statistical Analysis with Missing Data. 2nd ed. Wiley.
6. Mardia, K.V. (1972). Statistics of Directional Data. Academic Press.
7. Rao, C. R. (1973). Linear Statistical Inference and its Applications, 2nd ed. Wiley.
8. SenGupta, A. (2005). DDSTAP 1.1 – Statistical Analysis Package for Directional Data, Indian Statistical Institute. Kolkata

10/02/18

10/2/18

Course Details			
Course Title: Time Series and Forecasting			
Course Code	MSSTS4005E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Time series as a stationary or nonstationary stochastic process, time domain analysis based on correlogram, sample autocovariance function (acvf), autocorrelation function (acf), Partial Autocorrelation Function.

UNIT-II

Exploratory time Series analysis, tests for trend and seasonality, exponential and moving average smoothing. Holt and Winters smoothing, forecasting based on smoothing.

UNIT-III

AR(p) process, MA(q) process, mixed ARMA(p,q) process, stationarity and invertibility conditions, random walk model, ARIMA(p,d,q) model, implications and tests for stationarity, unit root test, correlogram and role of acf and pacf in process identification, estimation of parameters of AR, MA, ARMA and ARIMA models, forecasting by Box-Jenkins procedures.

UNIT-IV

Frequency domain analysis based on the spectral density function, computations based on Fourier transform, spectra of AR (1) and MA (1) models, periodogram and its relationship with acvf.

References

1. Anderson, T. W. (1994). The Statistical Analysis of Time Series, Wiley, N.Y.
2. Bloomfield, P. (2013). Fourier analysis of Time Series—An Introduction, 2nd ed. Wiley.
3. Box, G. E. P. and G. M. Jenkins (2015). Time Series Analysis, Forecasting and Control 5th ed.
4. Brockwell, P. J. and Davis, R. A. (2009). Time Series: Theory and Methods (Second Edition), Springer-Verlag.
5. Chatfield, C. (2003). The Analysis of Time Series: An Introduction. 6th ed.
6. Findley, D. F. (Ed.) (1981). Applied Time Series Analysis II, Academic Press.
7. Fuller, W. A. (2008). Introduction to Statistical Time Series, 2nd. ed. John Wiley, N.Y.
8. Granger, C. W. J. and Hatanka, M. (1964). Spectral Analysis of Economic Time Series, Princeton Univ. Press, N.J.
9. Granger, C. W. J. and Newbold (1984). Forecasting Econometric Time Series, Third Edition, Academic Press.

10/07/18

10/7/18

10. Kendall, Sir Maurice and Ord, J. K. (1990). Time Series (Third Edition), Edward Arnold.
11. Kendall, M. G. and Stuart, A. (1966). The Advanced Theory of Statistics, Volume 3, Charles Griffin, London.
12. Koopmans, L. H. (1995). The spectral Analysis of Time Series, 2nd ed. Academic Press.
13. Montgomery, D. C. and Johnson, L. A. (1977). Forecasting and Time Series Analysis, McGraw Hill.
14. Nelson, C. R. (1973). Applied Time Series for Managerial Forecasting, Holden-Day.
15. Priestley, M. B. (1981). Spectral Analysis & Time Series, Griffin, London.

Course Details			
Course Title: Statistical Processes and Quality Control			
Course Code	MSSTS4006E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I
Basic concepts of quality, statistical process-monitoring and control. Tools of Continuous Quality Improvement.

UNIT-II
General theory and review of control charts for attribute and variable data, O.C. and A.R.L. of control charts; Moving average and exponentially weighted moving average charts: Cu-sum charts using V-masks and decision intervals, Multivariate statistical process control, Hotelling's T^2 control chart.

UNIT-III
Acceptance sampling plans for attribute inspection; single, double and sequential type sampling plans and their properties; Plans for inspection by variables for one-sided and two-sided specifications.

UNIT-IV
Capability indices Cp, Cpk and Cpm; estimation, confidence intervals and tests of hypotheses relating to capability indices for normally distributed characteristics, Quality in the service sector and TQM.

References

1. Mitra, A. (2014). Fundamentals of Quality Control and Improvement, 3rd ed. Wiley, India.
2. Montgomery, D. C. (2012). Statistical Quality Control: A Modern Introduction, 6th ed. Wiley, India.

3. Wetherill, G. B. and Brown, D.W (1991). Statistical Process Control: Theory and Practice. 3rd ed. Chapman and Hall, USA.

Course Details			
Course Title: Demography			
Course Code	MSSTS4007E04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Sources of demographic data; Evaluation and adjustment of age-sex data; Chandrasekhar-Deming method to check completeness of registration data.

UNIT-II

Measures of fertility, reproduction, mortality and migration. Direct and indirect standardization of rates; demographic transition theory.

UNIT-III

Complete and cohort life tables, construction of abridged life tables, age, period and cohort analyses, Lexis diagram; separating age, period and cohort effects. Stable, stationary and quasi-stable population models.

UNIT-IV

Methods of obtaining population estimates and projections – Mathematical methods, cohort component method of population projections.

References

1. Bhende, A, & Kanitkar, T. (2011). Principles of Population Studies. Himalaya Publishing House, Mumbai.
2. Cox, D. R. (1970). Demography, Cambridge University Press.
3. Henry, S. S, et al. (1980). The Methods and Materials of Demography, Vols. I & II, U.S. Department of Commerce, Bureau of the Census, Washington, D.C.
4. Keyfitz, Nathan. (1977). Introduction to the Mathematics of Population, Addision-Wesley Publishing Company, Massachusetts.
5. Pathak, K. B. and Ram, F. (2015). Techniques of Demographic Analysis, 2nd Revised ed. Himalaya Publishing House.
6. Preston, Samuel, H. and Coale, A. J. (1982). Age Structure, Growth, Attrition and Accession: A New Synthesis. Population Index, Vol. 50(2): 214-226.

10/07/18 10/07/18

7. Ramkumar, R. (2002). Technical Demography. The New Age International Publishers, New Delhi.
8. Spiegelman, M. (1969). Introduction to Demographic Analysis, Harvard University Press.

Elective Basket Open to the Dept. of Mathematics and the Dept. of Computer Science

Course Details			
Course Title: Distribution Theory and Nonparametric Statistics			
Course Code	MSSTS1002C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Brief review of basic distribution theory. Construction of Bivariate Distributions. Function of random variables and their distributions using Jacobian transformation and other tools. Compound, truncated and mixture distributions. Conditional expectation. Markov, Holder, Jensen inequalities and their applications, e.g. Liapounov's inequality. Entropy.

UNIT-II

Non-central distributions: Chi-square distribution, t-distribution, F-distribution and their properties.

UNIT-III

Order statistics, their distribution and properties. Joint and marginal distributions of order statistics. Distribution range, exact and asymptotic distribution of median. Empirical distribution function and its distributional properties, K-S goodness of fit.

UNIT-IV

Rank-test. One-sample location problem, sign test and signed-rank-test, two sample K-S test, two sample location & scale problems. Wilcoxon Mann-Whitney test.

References

13. Balakrishnan, N. and Lai, Cin-Diew (2009) Continuous Bivariate Distributions, 2nd ed. Springer.
14. Casella, G. and Berger, R. L. (2002). Statistical Inference, 2nd Ed. Duxbury Press.
15. Daniel, Wayne W. (2000). Applied Nonparametric Statistics, 2nd Ed. Cengage Learning.
16. Feller, W. (1968). An Introduction to Probability Theory and Its Applications, 3rd Ed. Wiley.
17. Gibbons, J. D. and Chakraborti, S (2010). Nonparametric Statistical Inference, 5th Ed. Chapman and Hall/CRC.
18. Hogg, R. V. and Craig, A. T. (2012). Introduction to Mathematical Statistics, 7th Ed. Pearson Edward (Indian Print).

10/7/18 10/07/18

19. Mood, A. M., Graybill, F. A. and Boes, D. C. (1974). Introduction to the Theory of Statistics (3rd edition), McGraw Hill.
20. Mukhopadhyay, P. (2015). Mathematical Statistics, Books & Allied (P) Ltd.
21. Parzen, E. (1992). Modern Probability Theory and Its Applications, Wiley Eastern.
22. Randles, R.H. and Wolfe, D.A. (1991). Introduction to the Theory of Nonparametric Statistics,
23. Rao, C. R. (2001). Linear Statistical Inference and its Applications, 2nd Ed. Wiley.
24. Rohatgi, V. K. and Saleh A. K. Md. E (2015). An Introduction to Probability and Statistics, 3rd Ed. Wiley, New York.

Course Details			
Course Title: Computer Intensive Statistical Methods-I			
Course Code	MSSTS***	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Odd	**Contact Hours**	45 (L) + 15 (P) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT I

Definitions and concepts of population, sample, parameters, statistics. Merits and demerits of statistics. Construction of frequency distributions, Graphical representations of a frequency distribution (histogram, frequency polygon, cumulative frequency distributions (Ogives),

UNIT II

Central Tendency and its measures, Dispersion and its measures, Moments, Skewness and Kurtosis and their measures.

UNIT III

Correlation, Product Moment Correlation Coefficient, Rank Correlation Coefficient, Multiple and Partial Correlation Coefficients. Concept and definitions of probability, addition and multiplication laws of probability. Probability distributions including binomial, Poisson and normal distributions.

UNIT VI

Concept and definition of simple random and stratified sampling. Methods of drawing simple random samples, Concepts of sampling and non-sampling errors, Nonprobability sampling methods.

References

Aczel, A. D. and Sounderpandian, J., *Complete Business Statistics*, sixth edition, Tata McGraw-Hill Publishing Company, New Deli,2006.

Gupta, S. C., *Fundamentals of Statistics*, Himalaya Publishing House, New Delhi, 2009.

Levin, R. I. and Rubin, D. S., *Statistics for Management*, seventh edition, Prentice Hall (An imprint of Pearson),New Delhi, 2009.

Levine, D. M.. Stephan, D. F. and Szabat, K. A., *Statistics for Managers, Using Microsoft Excel,* seventh edition, Pearson India Education Services Pvt. Ltd, Noida 201309, 2016.

Sharma, J.K., *Business Statistics*, second edition, Dorling Kindersley (India) Pvt. Ltd. Delhi, 110092, 2007.

Course Details			
Course Title: Linear Models and Regression Analysis			
Course Code	MSSTS2001C04	**Credits**	4
L + T + P	3 + 1 + 0	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (T) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT-I

Gauss-Markov set-up, normal equations and least squares estimates, error and estimation spaces, variances and covariances of least squares estimates, estimation of error variance, estimation with correlated observations, least squares estimates with restriction on parameters.

UNIT-II

Simultaneous estimates of linear parametric functions, tests of hypothesis for one and more than one linear parametric functions, confidence intervals and regions.

UNIT-III

Simple linear regression, multiple and polynomial regressions, logistic regression, orthogonal polynomials.

UNIT-IV

Residuals and their plots as tests for departure from assumptions such as fitness of the model, normality, homogeneity of variances and detection of outliers, remedies. Introduction to non-linear models; least squares in non-linear case, estimating the parameters of a non-linear system, reparameterization of the models.

References

10. Cook, R. D. and Weisberg, S. (1982). Residuals and Inference in Regression, Chapman and Hall.
11. Draper, N. R. and Smith, H. (2012). Applied Regression Analysis, 3rd Ed. Wiley.
12. Graybill, I. A. (1961). An Introduction to Linear Statistical Models, Vol. 1, McGraw Hill Book Co. Inc.

13. Hosmer, D. and Lemeshow, S. (2000). Applied Logistic Regression, 2nd ed. Wiley.
14. Kutner, M., Nachtsheim, C., Neter, J. and Li, Willium (2004). Applied Linear Statistical Models, 5th ed. McGraw-Hill/Irwin.
15. Rao, C. R. (2001). Linear Statistical Inference and its Applications, 2nd ed., Wiley.
16. Ronald, C. (1997). Log-linear models and logistic regression. Springer.
17. Seber, G. A. F. and Wild, C. J. (2003). Non-linear Regression. Wiley.
18. Weisberg, S. (2013). Applied Linear Regression, 4th ed., Wiley.

Course Details			
Course Title: Computer Intensive Statistical Methods-II			
Course Code	MSSTS***	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (P) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT I
Least square estimation, Linear regression and Multiple regression.

UNIT II
Standard normal variate, Types of error, Null and alternative hypothesis, Tests of significance for large samples, Tests based on Chi-square statistic, Student's t, Fisher's t and paired t test.

UNIT III
Analysis of variance and its assumptions; one-way and two-way classification of ANOVA

UNIT IV
Advantages and disadvantages of nonparameteric statistics, Sign test for one and two-sample, Wilcoxon signed rank test, One sample runs test for randomness, Mann Whitney-Wilcoxon test.

References

Aczel, A. D. and Sounderpandian, J., *Complete Business Statistics*, sixth edition, Tata McGraw-Hill Publishing Company, New Delhi, 2006.

Daniel, W. W., *Applied Nonparametric Statistics*, second edition, Duxbury, CA 93950, USA, 1990.

Gupta, S. C., *Fundamentals of Statistics*, Himalaya Publishing House, New Delhi, 2009.

Kanji, Gopal K., *100 Statistical Tests*, 3rd edition, Sage Publications, London in association with Vistaar Publicaion New Delhi, 2011.

Levin, R. I. and Rubin, D. S., *Statistics for Management*, seventh edition, Prentice Hall (An

imprint of Pearson),New Delhi, 2009.

Levine, D. M.. Stephan, D. F. and Szabat, K. A., *Statistics for Managers, Using Microsoft Excel,* seventh edition, Pearson India Education Services Pvt. Ltd, Noida 201309, 2016.

Sharma, J.K., *Business Statistics*, second edition, Dorling Kindersley (India) Pvt. Ltd. Delhi, 110092, 2007.

Elective Basket Open to Other Schools

Course Details			
Course Title: Organizing and Visualizing Data			
Course Code	MSSTS***	**Credits**	4
L + T + P	3 + 0 + 1	**Course Duration**	One Semester
Semester	Even	**Contact Hours**	45 (L) + 15 (P) Hours
Methods of Content Interaction	Lecture, tutorials, discussions, assignments, presentations, etc.		
Assessment and Evaluation	• 30% - Continuous Internal Assessment (Formative in nature but also contributing to the final grades) • 70% - End Term External Examination (University Examination)		

UNIT I
Data cleaning, data integration, data reduction, data transformation and data discretization; Measurement scales: nominal scale, ordinal scale, interval scale and ratio scale

UNIT II
Organizing categorical data includes the summary table and the contingency table. Visualizing categorical data includes Bar Chart, Side by Side-Bar Chart, Pie Chart, Pareto Chart

UNIT III
Organizing numerical data includes stacked and unstacked data, the ordered array, the frequency distribution, the cumulative frequency distribution

UNIT IV
Visualizing numerical data includes Stem and Leaf Display, Histogram, Polygon, Cumulative Percentage Polygon (Ogive), Boxplot, Interval Plot, Scatterplots, Time Series Plots, Area Graph, Three-dimensional Scatterplots and Surface Plots; Challenges in visualizing data.

References

Aczel, A. D. and Sounderpandian, J., *Complete Business Statistics*, sixth edition, Tata McGraw-Hill Publishing Company, New Delhi,2006.

Daniel, W. W., *Applied Nonparametric Statistics*, second edition, Duxbury, CA 93950, USA, 1990.

Han, J., Kamber, M. and Pie, J.. *Data Mining: Concepts and Techniques*, third edition, Morgan Kaufmann Publishers, An imprint of Elsevier, MA 02451, USA 2012.

Levine, D. M.. Stephan, D. F. and Szabat, K. A., *Statistics for Managers, Using Microsoft Excel,* seventh edition, Pearson India Education Services Pvt. Ltd, Noida 201309, 2016.

Sharma, J.K., *Business Statistics*, second edition, Dorling Kindersley (India) Pvt. Ltd. Delhi, 110092, 2007.