# MAR IVANIOS COLLEGE
# (AUTONOMOUS)

**Affiliated to the**

**University of Kerala**
**Thiruvananthapuram**

**Kerala**

## SCHEME AND SYLLABUS FOR THE

## FOUR YEAR UNDERGRADUATE PROGRAMME

## (FYUGP)

# MAJOR DISCIPLINE STATISTICS (SF)

(With effect from 2024 Admissions)

Approved by the Board of Studies in

Mathematics and Statistics

# CONTENTS

## PREAMBLE

National Education Policy (NEP 2020) envisions 'higher education as playing an extremely important role in promoting human as well as societal wellbeing and in developing India as envisioned in its Constitution - a democratic, just, socially conscious, cultured, and humane nation upholding liberty, equality, fraternity, and justice for all' (Section 9.1). NEP also expects higher education 'to develop good, thoughtful, well-rounded, and creative individuals, enabling an individual to study one or more specialized areas of interest at a deep level, and also develop character, ethical and Constitutional values, intellectual curiosity, scientific temper, creativity, spirit of service, and 21st century capabilities across a range of disciplines including sciences, social sciences, arts, humanities, languages, as well as professional, technical, and vocational subjects' (Section 9.1.1). Hence, more than the creation of greater opportunities for individual employment, higher education represents the key to more vibrant, socially engaged, cooperative communities and a happier, cohesive, cultured, productive, innovative, progressive, and prosperous nation. (Section 9.1.3). NEP also identifies some of the major problems currently faced by the higher education system in India (Section 9.2) and envisions a complete overhaul and re-energizing of the higher education system to overcome these challenges and thereby deliver high-quality higher education, with equity and inclusion (Section 9.3). One of the major changes which the policy proposes is moving towards a more multidisciplinary undergraduate education (Section 9.3(b)) which develops all capacities of human beings -intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner (Section 11.3). In order to achieve this in its full potential, NEP visions the adjusting of the structure and lengths of degree programmes accordingly. "The undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a certificate after completing 1 year in a discipline or field including vocational and professional areas, or a diploma after 2 years of study, or a Bachelor 's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student." (Section 11.9)

In accordance with the NEP 2020, the UGC formulated a new student-centric "Curriculum and Credit Framework for Undergraduate Programmes (CCFUP)" incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options and establishing three Broad Pathways,

(a) 3-year UG Degree,

(b) 4-year UG Degree (Honours), and

(c) 4-year UG Degree (Honours with Research)

Accordingly, the Kerala Higher Education Reforms Commission 2022, headed by Prof. Shyam B. Menon, has recommended a comprehensive reform in the undergraduate curriculum with the adoption of the 4-year undergraduate Programmes, which will bring undergraduate education in Kerala at par with the universities abroad. Consequently, Kerala State Curriculum

Committee for Higher Education 2023 has been constituted, with Dr. Suresh Das as Chairman, and they have proposed a model Kerala State Higher Education Curriculum framework for undergraduate education.

The University of Kerala has decided to introduce the Four Year Under Graduate Programmes (FYUGP) from the academic year 2024-2025 onwards in its teaching departments and all affiliated colleges, and has issued many draft documents and conducted college level awareness programmes about the same.

Mar Ivanios College, by virtue of its autonomy status, conferred in 2014 and extended in 2022, vide University Grants Commission (Conferment of Autonomous Status Upon Colleges and Measures for Maintenance of Standards in Autonomous Colleges) Regulations, 2023, has the power to review existing courses/programmes and, restructure, redesign and prescribe its own courses/programmes of study and syllabi and to formulate new courses/programmes within the nomenclature specified by UGC as per the Specification of Degrees 2014 as amended from time to time. Accordingly, the Board of Studies in Statistics (SF) of Mar Ivanios College (Autonomous) proposed the implementation of the FYUGP scheme with effect from 2024 admission onwards and prepared the scheme and syllabi through many of the meetings and discussions. The Academic Council of the college which met on 30$^{th}$ April gave discussed the proposal and syllabi in detail and approved the same to be implemented from 2024 admission onwards, subject to the final directions of the University of Kerala.

The salient features of the syllabus prepared and presented by the Board of Studies include the following:

- The curriculum is designed based on Outcome Based Education (OBE) approach.
- The curriculum follows Choice-Based Credit System (CBCS): This system allows students to select courses from a prescribed list. A specified number of credits must be earned to award the degree
- The curriculum follows the basic framework, course wise/programme-wise minimum/maximum credits set by the University of Kerala for FYUGP and abides by the basic mandatory principles of **Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024.**
- The course provides a comprehensive exploration of statistical methods and data analysis techniques essential for understanding and interpreting complex datasets across various disciplines.
- Adequate Discipline Specific Elective (DSE) specialization courses has provided in Data Analytics and hence the students are able to acquire 3 Year / 4 Year (Honours) UG degree majoring in **Statistics with Specialization in Data Analytics.**
- Starting with foundational concepts such as descriptive statistics and basic probability theory, students progress through advanced topics including correlation and regression analysis, time series analysis, and statistical inference.
- Specialized modules cover areas such as geostatistics, statistical quality control, hypothesis testing, and experimental design, offering practical skills for making data-driven decisions.

- Students also gain proficiency in statistical programming using Python and R, as well as exploring advanced technologies like machine learning for predictive modeling and optimization problems.
- By the course's end, students emerge equipped with a diverse toolkit for tackling complex statistical problems across various domains, from inventory management to multivariate analysis and survival modeling, empowering them to drive data-driven insights and innovations in research and industry.

**Graduate Attributes and Programme Outcomes (POs):**

The National Higher Education Qualification Framework (NHEQF) envisages that students on completion of a programme of study must possess and demonstrate the expected graduate profile/attributes acquired through one or more modes of learning. The graduate profile/attributes indicate the quality and feature or characteristics of the graduate of a programme of study, including learning outcomes relating to the disciplinary area(s) relating to the chosen field(s) of learning and generic learning outcomes that are expected to be acquired by a graduate on completion of the programme(s) of study. The graduate profile/attributes include capabilities that help widen the current knowledge base and skills, gain and apply new knowledge and skills, undertake future studies independently, perform well in a chosen career, and play a constructive role as a responsible citizen in the society. The graduate profile/attributes are acquired incrementally and describe a set of competencies that are transferable beyond the study of a particular subject/disciplinary area and programme contexts in which they have been developed. Graduate profile/attributes are fostered through meaningful learning experiences made available through the curriculum and learning experience, the total college/university experience, and a process of critical and reflective thinking. Mar Ivanios College (Autonomous) is fully committed to ensuring the attainment of the necessary graduation attributes by the students. The college has clearly defined its raison de'tre, the philosophy of its existence, through the Motto "Truth Shall Liberate You" (Veritas Vos Liberabit) which refers to the ultimate enlightenment which can emerge only at the intersection of sharp intellect, sound physique, strong mind, staunch ethics, and profound spirituality. This is further made explicit through its Vision, Mission and Goals and the same expect all students who graduate from the college to:

- Have inculcated "the values of truth and charity for the protection and promotion of human dignity and of a cultural heritage, through teaching, research, and extension activities dedicated to society";
- Be co-creators of a vibrant academic community known for its innovation, intellectual rigour and social commitment;
- Be "intellectually trained, morally upright, socially committed, spiritually inspired and ecologically conscious young men and women who would be dedicated to working for the good of society, the nation and the world";
- Have acquired "global competencies and skills";
- Have inculcated a sense of harmony, equality and fraternity among youth, transcending religious, linguistic, regional or sectional diversities; and
- Have developed "scientific temper, humanism and the spirit of inquiry and reform".

Programme Outcomes are the expected student attributes achieved by a student after the student completes the FYUGP from any of the streams/pathways.

The Programme Outcomes (POs) for the FYUGP programmes across all streams and pathways, based on the above core philosophy, and in consonance with the National Higher Education Qualifications Framework (NHEQF) are given below:

**By the end of the Four-Year Under-Graduate Programme, students will:**

| | |
|---|---|
| PO 1 | **Demonstrate the acquisition of all necessary knowledge and skills within their disciplinary/ multi-disciplinary areas of learning.** These include the acquisition of:<br>• comprehensive knowledge and coherent understanding of their chosen disciplinary/ interdisciplinary areas of study, their linkages with related fields, and the awareness of current trends in their chosen area of study;<br>• essential knowledge for skilled work in chosen field(s), including self-employment and entrepreneurship skills;<br>• proficiency in specialized areas within chosen fields of study, encompassing diverse practical skills applicable to different situations within those fields;<br>• the ability to apply learned knowledge to novel situations, solve problems, and relate concepts to real-world scenarios rather than just memorizing curriculum content. |
| PO 2 | **Acquire problem-solving, critical thinking, analytical reasoning skills and demonstrate creativity in their thought processes** by demonstrating the ability to:<br>• solve different kinds of problems in familiar and non-familiar contexts both within and outside their disciplinary/ multidisciplinary areas of learning;<br>• apply analytic thought to a body of knowledge, including the analysis and evaluation of policies, and practices, as well as evidence, arguments, claims, and beliefs;<br>• analyse and synthesize data from a variety of sources and draw valid conclusions and support them with evidence and examples.<br>• the ability to plan, execute and report the results of an experiment or investigation;<br>• adhere to scientific temper and ethics in their thought process;<br>• adopt innovative, imaginative, lateral thinking, interpersonal skills and emotional intelligence; and<br>• incubate entrepreneurial and start-up ideas. |
| PO 3 | **Develop a profound environmental dedication by fostering ecological awareness and engaging in actions that promote sustainable development** by achieving the ability to<br>• recognize environmental and sustainability issues, and participate in actions to promote sustainable development as well as mitigate the effects of environmental degradation, climate change, and pollution;<br>• contribute to effective waste management, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, sustainable development and living, and the preservation of life in all forms.<br>• participate in community-engaged services/ developmental activities and thus exemplify the ideals of community engagement and service learning and deep social commitment. |
| PO 4 | **Accomplish perfect communication, teamwork, and leadership skills, particularly in academic and professional settings, while demonstrating** |

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|---|---|
| | **nuance and attention to etiquette in all communicative contexts.** This will enable them to:<br>• listen carefully, and read texts and research documents, and present complex information with clarity and precision to different audiences;<br>• express thoughts and ideas and communicate effectively through speech and writing using appropriate media;<br>• communicate using language which is respectful of gender and minority orientations;<br>• act together as a group or a team in the interests of a common cause and working efficiently as a member of a team;<br>• inspire the team with a vision to achieve a stated goal, and use management skills to guide the team in the right direction. |
| PO5 | **Acquire the necessary skills, including 'learning to learn' skills, and foster innovative ideas to improve competence and employability, keeping pace with the evolving global landscape and technological advancements** by demonstrating the ability to:<br>• pursue learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social, and cultural objectives, and adapting to changing trades and demands of the workplace, including adapting to the changes in work processes in the context of the fourth industrial revolution, through knowledge/ skill development/reskilling;<br>• work independently, identify appropriate resources required for further learning;<br>• acquire organizational and time management skills to set self-defined goals and targets with timelines;<br>• be a proactive life-long learner;<br>• use ICT in a variety of learning and work situations;<br>• access, evaluate, and use a variety of relevant information sources, and use appropriate software for analysis of data;<br>• navigate cyberspaces by following appropriate ethical principles and cyber etiquette;<br>• use cutting edge AI tools with equal commitment to efficiency and ethics;<br>• think 'out of the box' and generate solutions to complex problems in unfamiliar contexts. |
| PO6 | **Develop research-related skills including the ability to conceptualize research hypotheses/projects and adopt suitable tools and methodologies for analysis** with:<br>• a keen sense of observation, inquiry, and capability for asking relevant/ appropriate research questions;<br>• the ability to problematize, synthesize, and articulate issues and design research proposals;<br>• the ability to define problems, formulate appropriate and relevant research questions, formulate hypotheses, test hypotheses using quantitative and qualitative data, establish hypotheses, make inferences based on the analysis and interpretation of data, and predict cause-and effect |

| | |
|---|---|
| | relationships;<br>• the capacity to develop appropriate methodology and tools for data collection;<br>• the appropriate use of statistical and other analytical tools and techniques;<br>• the ability to plan, execute and report the results of an experiment or investigation;<br>• the ability to acquire the understanding of basic research ethics and skills; in practicing/doing ethics in the field/ in personal research work, regardless of the funding authority or the field of study. |
| PO7 | **Assimilate a sound value system, a sense of autonomy, multicultural competence, social commitment, and the spirit of inclusivity and empathy by imbibing the spirit and the holistic ethos of the 'Multi-Dimensional Ivanian' (MDI) approach.** This will enable them to:<br>• embrace and practice constitutional, humanistic, ethical, and moral values in life, including universal human values of integrity, truth, righteous conduct, peace, love, nonviolence, scientific temper, citizenship values;<br>• identify ethical issues related to work, follow ethical practices and be objective, unbiased, and truthful actions in all aspects of work, including avoiding unethical behaviour such as fabrication, falsification or misrepresentation of data, or committing plagiarism, and adhering to intellectual property rights;<br>• exercise responsibility and demonstrate accountability in applying knowledge and/or skills in work and/or learning contexts appropriate for the level of the qualification, including ensuring safety and security at workplaces;<br>• practice responsible global citizenship required for responding to contemporary global challenges, enabling learners to become aware of and understand global issues and to become active promoters of more peaceful, tolerant, inclusive, secure, and sustainable societies;<br>• effectively engage in a multicultural group/society and interact respectfully with diverse groups;<br>• identify with or understand the perspective, experiences, or points of view and emotions of another individual or group;<br>• demonstrate gender sensitivity and adopt a gender-neutral approach, as also empathy for the less advantaged and the differently-abled including those with learning disabilities;<br>• demonstrate proficiency in arts/ sports/ games, physical, mental and emotional fitness, entrepreneurial / organizational /public speaking/ environmental / community-oriented areas by actively participating in the wide range of co-curricular activities that are available to the students of Mar Ivanios College. |

**Programme Specific Outcomes (PSOs)**

In conformity with the POs, the Programme Specific Outcomes (PSOs) of the Major in STATISTICS are drafted as given below:

| | |
|---|---|
| 1 | Understand the foundational principles of Statistics in order to analyse, interpret and draw inferences from statistical statements and data using the principles of statistical logic and effectively communicate statistical ideas through various means. |
| 2 | Apply various statistical principles and methods to develop proficiency in problem-solving skills with regard to real-world situations in diverse fields and build critical and analytical thinking capacity and skills through statistical inquiry and exploration. |
| 3 | Engage with current trends and developments in diverse research and applications in statistics in order to acquire the capacity for independent learning and research and acquire skills for ongoing self-directed study and professional development in statistics, and embrace opportunities for intellectual growth and exploration beyond the classroom. |
| 4 | Identify the diverse cultural perspectives and experiences within the statistical community and society and improve collaboration and teamwork skills through group exercises, discussions, problem-solving activities, lab works, projects, statistical outreach activities, etc. |
| 5 | Develop expertise and skills in the use of various statistical software and computational tools and applying them in different fields and disciplines of knowledge. |
| 6 | Formulate ethical awareness and responsibility in the use and application of statistical knowledge for sustainable development and proficiency in analysing environmental data using statistical modelling and statistical techniques. |

**Course and Credit Structure of FYUGP**

The pathway preferably followed by the department will be Major with Minor or Major with multiple disciplines of study.

**The Course and Credit Structure of FYUGP is given below**:

| Sem | DSC (4 Cr) | DSE (4 Cr) | AEC (3 Cr) | SEC (3 Cr) | MDC (3 Cr) | VAC (3Cr) | Internship (credit-2)/ Project/ Additional Courses (credit-12) | Total courses | Total credits |
|---|---|---|---|---|---|---|---|---|---|
| I | A-1<br>B-1<br>C-1 | | AEC (Eng)-1<br>AEC(OL)-2 | | MDC-1 | | | 6 | 21 |
| II | A-2<br>B-2<br>C-2 | | AEC (Eng)-3<br>AEC(OL)-4 | | MDC-2 | | | 6 | 21 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| III | A-2<br>B-2<br>C-2 | DSE A -1 | | | MDC (Kerala Studies)-3 | VAC-1 | | 6 | 22 |
| IV | A-4<br>A-5 | DSE A-2 | | SEC-1 | | VAC-2<br>VAC-3 | Internship | 6 | 21 |
| V | A-6<br>A-7<br>A-8 | DSE - 3<br>DSE - 4 | | SEC-2 | | | | 6 | 23 |
| VI | A-9<br>A-10<br>A-11 | DSE - 5<br>DSE - 6 | | SEC-3 | | | | 6 | 23 |
| Total | A (11)<br>B (3)<br>C (3) | 6 | 4 | 3 | 3 | 3 | 1* | 36 | 133 |
| **EXIT OPTION AVAILABLE AND STUDENTS WILL BE AWARDED UG DEGREE WITH MAJOR IN A** | | | | | | | | | |
| VII | A-12<br>A-13<br>B/C-4<br>B/C-5<br>B/C-6 | DSE - 7 | | | | | | 6 | 24 |
| VIII | MOOC courses<br>A -14,<br>A -15 | | | | | | Research Project/ Internship /Project or 03 courses -12Cr | 2+1**/ 3*** | 20 |
| Total | A (15)<br>B(3)<br>C (3)<br>B/C(3) | 7 | 4 | 3 | 3 | 3 | 1*+1**/ 3*** | 44+1* + 1**/3*** | 177 |

A – Major Discipline
B/C-Minor/Multiple discipline
* - Mandatory Internship at the end of Semester 4

** - Research Project/ Internship /Project as part of Honours with Research
*** - Additional courses of 4 credits each.
Cr - Credits

- **Research group project for students exiting after UG 3 years:** Students who propose to exit after 3 Year UG programme can do a group project with an extra two credits to

obtain research experience in discipline-specific areas of the program. The BoS can decide the number of students for the group and the evaluation criteria.

- Students will be able to take other pathways permissible under **University of Kerala Four Year Under Graduate Programmes (UoK-FYUGP) Regulations, 2024,** subject to the availability of courses/ faculty/infrastructure of the college.

- The Board of Studies shall prepare and publish a list of online courses at different levels before the commencement of classes in the respective semester offered in various online educational platforms recognised by the academic council of the college, which can be opted by the students for acquiring additional credits.

**Course Participation/Attendance-**

1. A student shall be permitted to register for the end-semester evaluation of a specific course to acquire the credits only if the student has completed 75% of the prescribed classroom activities in physical, online, or blended modes, as stipulated by the BoS, including any makeup activities as specified by the faculty of that particular course.
2. The reasons/cases of permissible authorised leave shall be specified by the college, with the approval of the Academic Council, ratified by the Governing Body.
3. The condonation facility shall be availed as per the existing University/college norms.

**Assessment and Evaluation**

1. The assessment of a course shall combine a Continuous Comprehensive Assessment (CCA) and an End Semester Evaluation (ESE).
2. For courses without practical/lab modules, 30% weightage shall be given for CCA and the remaining 70% of the weight shall be for the ESE.
3. CCA will have two sub-components: Formative Assessment (FA) and Summative Assessment (SA).
4. The CCA subcomponents will be given marks as per the following proportions:

   Discipline specific summative assessment - 15% of the total
   Course attendance (Formative) - 5 % of the total.
   Discipline specific formative assessment - 10% of the total.
5. The details of summative and formative assessment criteria, including that of attendance, will be specified by each course coordinator at the beginning of the semester, with the approval of the respective Head of the Department/BoS Chairperson and the Principal, and will be published on the college website.
6. For courses with practical/lab modules, 40% weightage shall be given for CCA and the remaining 60% of the weight shall be for the ESE.
7. In such cases specified in the item above, the CCA subcomponents will be given marks as per the following proportions:
   - Discipline specific summative assessment - 10% of the total
   - Course attendance (Formative) - 5 % of the total
   - Discipline specific formative assessment - 15% of the total.
   - Summative Assessment (Practical Record, Practical test, skill, etc). - 10% of the total.

**The above is given in detailed tabular form as follows:**

| Sl. No. | Activity | Percentage (%) of the total | |
|---|---|---|---|
| | | Theory courses | Courses with practical |
| 1. | Summative Assessment (written Test or any other discipline specific assessment tools like Open book test, Lab reports, problem-based assignments, individual or team project report, case study report, literature survey, book reviews, video/film/documentary productions, etc) | 15 | 10 |
| 2. | Summative Assessment (Practical Record, Practical test, skill, etc.) | ---------- | 10 |
| 3. | Formative Assessment (Attendance) | 5 | 5 |
| 4. | Formative Assessment (Class room activities, observation of skills, viva voce, quiz, interview, oral presentations, in class discussions, computerized adaptive testing, group tutorial work, reflection writing assignments, field study reports, self and peer assessments, service-learning activities, etc.) | 10 | 15 |
| | Total | 30 | 40 |

8. The Course Coordinator shall be responsible for evaluating all the components of CCA for the course in question. Any grievances regarding the same shall be submitted to the Course Coordinator within 5 days of the publication of the same on the department notice board or official class group. If the grievance is not settled at the Course Coordinator level, the student is free to appeal to the Head of the Department, within the next 3 days, who will discuss the same in the Department Level Monitoring Committee (DLMC). If still needed, students can further appeal to the College Level Monitoring Committee (CLMC) or in essential situations the University Level Monitoring Committee (ULMC) in a time period as specified by these bodies.
9. Regarding evaluation, one credit will be evaluated for 20 marks in a semester; thus, a 4-credit course will be evaluated for 80 marks, and 3-credit courses for 60 marks. However, any changes to this if brought by the University will be followed.
10. The duration of the end semester examination of a course with 4 credits will be 2 hours and the same for a course with 3 credits may be 1.5 hours/2 hours.

**Mark Distribution Table**

| Course | Credit | | Marks | | Lecture | | | Practical | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Lecture | Practical | Lecture | Practical | CCA (30%) | | ESE (70 %) | CCA (40%) | | ESE (60 %) |
| | | | | | SA (50 %) | FA (50 %) | | SA (50 %) | FA (50 %) | |
| 4 credit courses | 4 | 0 | 80 | 0 | 12 | 12 | 56 | 0 | 0 | 0 |
| | 3 | 1 | 60 | 20 | 9 | 9 | 42 | 4 | 4 | 12 |
| | 2 | 2 | 40 | 40 | 6 | 6 | 28 | 8 | 8 | 24 |
| | 1 | 3 | 20 | 60 | 3 | 3 | 14 | 12 | 12 | 36 |
| | 0 | 4 | 0 | 80 | 0 | 0 | 0 | 16 | 16 | 48 |
| | **Credits** | | **Marks** | | **Lecture** | | | **Practical** | | |
| | **Lecture** | **Practical** | **Lecture** | **Practical** | **CCA (30%)** | | **ESE (70 %)** | **CCA (40%)** | | **ESE (60 %)** |
| 3 credit courses | | | | | **SA (50 %)** | **FA (50 %)** | | **SA (50 %)** | **FA (50 %)** | |
| | 3 | 0 | 60 | 0 | 9 | 9 | 42 | 0 | 0 | 0 |
| | 2 | 1 | 40 | 20 | 6 | 6 | 28 | 4 | 4 | 12 |
| | 1 | 2 | 20 | 40 | 3 | 3 | 14 | 8 | 8 | 24 |
| | 0 | 3 | 0 | 60 | 0 | 0 | 0 | 12 | 12 | 36 |

**Letter Grades and Grade Point**

1. A mark system is followed to evaluate each question. For each course in the semester, letter grades and grade points are introduced in a 10-point indirect grading system as per the guidelines given below.
2. The Semester Grade Point Average (SGPA) is computed from the grades to measure the student's performance in a given semester. The SGPA is based on the current term's grades, while the Cumulative Grade Point Average (CGPA) is based on the grades in all courses taken after joining the programme of study.
3. The weighted grade point will be mentioned in the student's final grade cards, issued by the college, based on the marks obtained.

4. **The grades and grade points will be given as per the following format:**

| Letter Grade | Grade Point | Percentage of marks (X) (CCA + ESE together) | Class |
|---|---|---|---|
| O (Outstanding) | 10 | $X \geq 95\%$ | FIRST CLASS WITH DISTINCTION |
| A+ (Excellent) | 9 | $85\% \leq X < 95\%$ | |
| A (Very Good) | 8 | $75\% \leq X < 85\%$ | |
| B+ (Good) | 7 | $65\% \leq X < 75\%$ | FIRST CLASS |
| B (Above Average) | 6 | $55\% \leq X < 65\%$ | |
| C (Average) | 5 | $45\% \leq X < 55\%$ | SECOND CLASS |
| $P\ (Pass)^*$ | 4 | $35\% \leq X < 45\%$ | THIRD CLASS |
| F (Fail) | 0 | X< 35% | FAIL |
| Ab (Absent) | 0 | | FAIL |

- For a course PASS, separate minimum of 35% is needed for CCA and ESE.
- Less than 35% in either ESE or CCA is FAIL.

**Computation of SGPA and CGPA**

SGPA (Semester Grade Point Average) and CGPA (cumulative Grade Point Average) will be computed as follows:

1. The SGPA is the ratio of the 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 and the sum of the number of credits of all the courses undergone by a student in the semester. That is,

$$S_j = \frac{\sum(C_{ij} \times G_{ij})}{\sum C_{ij}}$$

where $S_j$ is the SGPA in the j$^{th}$ semester,
$C_{ij}$ is the number of credits for the i$^{th}$ course in the $j^{th}$ semester
and $G_{ij}$ is the the grade point scored by the student in the i$^{th}$ course in the $j^{th}$ semester.

2. The CGPA is also calculated in the same manner considering all the courses undergone by a student over all the semesters of a programme. That is,

$$CGPA = \frac{\sum(C_i \times S_i)}{\sum C_i}$$

where $S_i$ is the SGPA in the i$^{th}$ semester and
$\sum C_i$ is the total number of credits in the i$^{th}$ semester.

3. The SGPA and CGPA shall be rounded to 2 decimal points and reported in the transcripts.

4. **Requirement for the successful completion of a Semester**:
SGPA of 4 or above and a PASS in all the courses, that is, minimum total of 35% mark in each course (CCA + ESE), with a separate minimum of 35% mark for both CCA and ESE. Appropriate and permissible rules of rounding off numbers may be adopted as per decisions of the Academic Council.

5. **Minimum Eligibility Criteria for 4 Year UG (Honours with Research):**
    - Students satisfactorily finishing all courses up to the 6th semester in the Department, with a CGPA of 7.5/10 or equivalent to 75% marks and above, will qualify to select the Honours programme with a Research Degree during the upcoming 7th and 8th semesters.
    - A relaxation of 0.5 score, i.e., CGPA of 7/10 or an equivalent relaxation of grade, will be allowed for those who belong to SC/ST/OBC (non-creamy layer)/Differently Abled, Economically Weaker Section (EWS) and other categories as per the UGC norms from time to time.

Mr. Sumesh S. S.
Chairman BoS
HOD, Department of Mathematics and Statistics,
Mar Ivanios College (Autonomous),
Thiruvananthapuram

Thiruvananthapuram

20-05-2024

**FYUGP Syllabus Summary:**

| Course Code | Course Title | Course Category | Credits | Hour distribution per week | | |
|---|---|---|---|---|---|---|
| | | | | L | T | P |
| **SEMESTER I \| Academic Level 100-199** | | | | | | |
| **MIUK1DSCSTA100.1** | Statistical Methods-I | DSC | 4 | 4 | | |
| **MIUK1DSCSTA101.1** | Descriptive Statistics | DSC | 4 | 4 | | |
| **MIUK1DSCSTA102.1** | Statistics for Data Analysis | DSC | 4 | 4 | | |
| **MIUK1DSCSTA103.1** | Basic Probability Theory | DSC | 4 | 4 | | |
| **MIUK1MDCSTA104.1** | Basics of Statistics - I | MDC | 3 | 3 | | |
| **MIUK1MDCSTA105.1** | Business Statistics and Logical Reasoning - I | MDC | 3 | 3 | | |
| **MIUK1MDCSTA106.1** | Introduction to Statistical Quality Control | MDC | 3 | 3 | | |
| **MIUK1MDCSTA107.1** | Basics of Testing of Hypothesis | MDC | 3 | 3 | | |
| **SEMESTER II \| Academic Level 100-199** | | | | | | |
| **MIUK2DSCSTA150.1** | Probability Theory - I | DSC | 4 | 4 | | |
| **MIUK2DSCSTA151.1** | Random Variables and Distribution Theory | DSC | 4 | 4 | | |
| **MIUK2DSCSTA152.1** | Correlation and Regression Analysis | DSC | 4 | 4 | | |
| **MIUK2DSCSTA153.1** | Geostatistics | DSC | 4 | 4 | | |
| **MIUK2MDCSTA154.1** | Basics of Statistics - II | MDC | 3 | 3 | | |
| **MIUK2MDCSTA155.1** | Business Statistics and Logical Reasoning - II | MDC | 3 | 3 | | |
| **MIUK2MDCSTA156.1** | Statistics and Research Methodology | MDC | 3 | 3 | | |
| **MIUK2MDCSTA157.1** | Introduction to Design of Experiments | MDC | 3 | 3 | | |
| **SEMESTER III \| Academic Level 200-299** | | | | | | |
| **MIUK3DSESTA200.1** | Time Series Analysis | DSE | 4 | 4 | | |
| **MIUK3DSCSTA201.1** | Statistical Methods - II | DSC | 4 | 4 | | |
| **MIUK3DSCSTA202.1** | Statistical Inference | DSC | 4 | 4 | | |
| **MIUK3DSCSTA203.1** | Introduction to Index Numbers and Time Series Analysis | DSC | 4 | 4 | | |
| **SEMESTER IV \| Academic Level 200-299** | | | | | | |
| **MIUK4DSCSTA250.1** | Distribution Theory -I | DSC | 4 | 4 | | |
| **MIUK4DSCSTA251.1** | Estimation | DSC | 4 | 4 | | |
| **MIUK4DSESTA252.1** | Machine Learning | DSE | 4 | 4 | | |
| **MIUK4DSESTA253.1** | Introduction to Data Analysis Softwares | DSE | 4 | 4 | | |
| **MIUK4SECSTA254.1** | Advanced Technologies in Statistical Analysis | SEC | 3 | 3 | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **MIUK4VACSTA254.1** | | VAC | 3 | 3 | | |
| **MIUK4VACSTA255.1** | | VAC | 3 | 3 | | |
| **SEMESTER V \| Academic Level 300-399** | | | | | | |
| **MIUK5DSCSTA300.1** | Limit Theorems and Sampling Distributions | DSC | 4 | 4 | | |
| **MIUK5DSCSTA301.1** | Applied Statistics | DSC | 4 | 4 | | |
| **MIUK5DSCSTA302.1** | Testing of Hypothesis | DSC | 4 | 4 | | |
| **MIUK5DSESTA303.1** | Sample Survey Methods | DSE | 4 | 4 | | |
| **MIUK5DSESTA304.1** | Data Analysis using R | DSE | 4 | 4 | | |
| **MIUK5DSESTA305.1** | Design of Experiments | DSE | 4 | 4 | | |
| **MIUK5SECSTA306.1** | Statistical Programming using R | SEC | 3 | 3 | | |
| **SEMESTER VI \| Academic Level 300-399** | | | | | | |
| **MIUK6DSCSTA350.1** | Distribution Theory - II | DSC | 4 | 4 | | |
| **MIUK6DSCSTA351.1** | Introduction to Operation Research | DSC | 4 | 4 | | |
| **MIUK6DSCSTA352.1** | Probability Theory -II | DSC | 4 | 4 | | |
| **MIUK6DSESTA353.1** | Multivariate Analysis | DSE | 4 | 4 | | |
| **MIUK6DSESTA354.1** | Inventory Control & Queuing Theory | DSE | 4 | 4 | | |
| **MIUK6SECSTA355.1** | Statistical Programming Using Python | SEC | 3 | 3 | | |
| **SEMESTER VII \| Academic Level 400-499** | | | | | | |
| **MIUK7DSCSTA400.1** | Statistical Quality Control | DSC | 4 | 4 | | |
| **MIUK7DSCSTA401.1** | Advanced Sampling Theory and Design of Experiments | DSC | 4 | 4 | | |
| **MIUK7DSCSTA402.1** | Analytic Tools for Statistics | DSC | 4 | 4 | | |
| **MIUK7DSESTA403.1** | Big Data Analytics and Artificial Intelligence | DSE | 4 | 4 | | |
| **MIUK7DSESTA404.1** | Reliability and Survival Analysis | DSE | 4 | 4 | | |
| **SEMESTER VIII \| Academic Level 400-499** | | | | | | |
| **MIUK8DSESTA450.1** | Stochastic Process and Advanced Time Series | DSE | 4 | 4 | | |
| **MIUK8DSESTA451.1** | Applied Regression Modeling | DSE | 4 | 4 | | |

**Mar Ivanios College (Autonomous)**

## COURSES OFFERING – SEMESTER I

| COURSE TYPE | MAJOR (STUDENTS) | COURSE TITLE | CREDITS |
|---|---|---|---|
| DSC | STATISTICS | Statistical Methods-I | 4 |
| DSC | ALL SCIENCES (PHYSICS, CHEMISTRY, ZOOLOGY, BOTANY, BIO-TECHNOLOGY AND CS) | Descriptive Statistics | 4 |
| DSC | HUMANITIES AND COMMERCE | Statistics for Data Analysis | 4 |
| DSC | ALL SCIENCES (PHYSICS, CHEMISTRY, ZOOLOGY, BOTANY, BIO-TECHNOLOGY AND CS), HUMANITIES AND COMMERCE | Basic Probability Theory | 4 |
| MDC | ALL SUBJECTS OTHER THAN STATISTICS | Basics of Statistics - I | 3 |
| MDC | COMMERCE | Business Statistics and Logical Reasoning - I | 3 |
| MDC | ALL SUBJECTS OTHER THAN STATISTICS | Introduction to Statistical Quality Control | 3 |
| MDC | ALL SUBJECTS OTHER THAN STATISTICS | Basics of Testing of Hypothesis | 3 |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK1DSCSTA100.1</td></tr>
<tr><td>Course Title</td><td colspan="5">STATISTICAL METHODS-I</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td>-</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Arithmetical Operations</td></tr>
<tr><td></td><td colspan="5">Texts:<br>1. Saxena, H.C. (1983). Elementary Statistics. S. Chand & Co., New Delhi.<br>2. Mukhopadhyay, P. (1996). Mathematical Statistics. New Central Book Agency (P) Ltd,Calcutta.<br>3. Gupta, S. P (2011). Statistical Methods. Sultan Chand & Sons, New Delhi.<br>References:<br>1. Anderson, T.W. and Sclove, S. L. (1978). An Introduction to Statistical Analysis of Data. Houghton Miffin/co, USA.<br>2. Anderson, T.W. and Finn, J.D. (2012). The New Statistical Analys of Data. SpringerScience & Business Media, New York.</td></tr>
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| | |
|---|---|
| | 3. Croxton, F.E. and Cowden, D.J. (1973). *Applied General Statistics*. Prentice Hall ofIndia, New Delhi.<br>4. Gupta S.C. and Kapoor, V.K. (1984). *Fundamentals of Mathematical Statistics*.Sultan Chand & Co., 3rd Edn, New Delhi.<br>5. Kendall, M.G. (1943). *Advanced Theory of Statistics Vol-I*. Charles Griffin: London. |
| Course Summary | Statistics is a branch of mathematics that deals with collecting, organizing, analysing, interpreting, and presenting data. It involves techniques for gathering data, summarizing data using numerical and graphical methods, making predictions or inferences about populations based on sample data, and testing hypotheses.<br>Measures of central tendency are statistical measures used to describe the center or average of a data set. Measures of dispersion quantify the spread or variability of data points in a data set.<br>Moments, skewness, and kurtosis are statistical measures that help us understand the shape and distribution of data. These measures are essential in statistical analysis as they provide insights into the nature of the data distribution, helping analysts make informed decisions about the characteristics and behavior of the data set. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Statistics** | | **15** |
| | 1 | Definition and scope of Statistics | 2 |
| | 2 | Merits and demerits of Statistics | 1 |
| | 3 | Uses of Statistics | 1 |
| | 4 | Designing of questionnaire and schedule | 1 |
| | 5 | Data – primary and secondary data | 1 |
| | 6 | Sources of collecting secondary data | 1 |
| | 7 | Editing of data | 1 |
| | 8 | Classification and tabulation of data | 2 |

| | | | |
|---|---|---|---|
| | 9 | Diagrammatic representation- Bar diagram (Sub-divided, Multiple), Pie diagram, Histogram, Frequency polygon, Frequency curve and Ogives | 2 |
| **II** | **Measures of Central Tendency** | | **15** |
| | 10 | Definition of central tendency and its properties | 3 |
| | 11 | Measures of central tendency - arithmetic mean, weighted arithmetic mean, median, mode, geometric mean, harmonic mean | 4 |
| | 12 | Properties of these averages | 4 |
| | 13 | Positional averages – quartiles, deciles and percentiles | 4 |
| **III** | **Measures of Dispersion** | | **15** |
| | 14 | Definition of dispersion and its properties | 3 |
| | 15 | Measures of dispersion - range, quartile deviation, mean deviation, standard deviation | 4 |
| | 16 | Properties of these measures | 4 |
| | 17 | Relative measures of dispersion | 4 |
| **IV** | **Moments, Skewness, Kurtosis** | | **15** |
| | 18 | Moments - raw and central moments and their interrelationships | 4 |
| | 19 | Sheppard's corrections for moments for grouped data | 3 |
| | 20 | Definition and measures of skewness | 4 |
| | 21 | Definition and measures of kurtosis | 4 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand the definitions of Statistics and draw diagrammatic representation of Data. | U, An, Ap | PSO - 1,3 |
| CO-2 | Compute the measures of central tendency. | U, R, Ap | PSO - 1,2,3,4,6 |
| CO-3 | Compute the measures of dispersion | U, R, Ap | PSO – |

| | | | |
|---|---|---|---|
| | | | 1,2,3,4 |
| CO-4 | Compute moments, skewness and kurtosis. | U, R, Ap | PSO – 1,2,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistical Methods-I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/ PSO | Cognitive Level | Knowledge Category | Lecture (L)/ Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Understand the definitions of Statistics and draw diagrammatic representation of Data. | PSO - 1,3 | U, An, Ap | F, C, P | Lecture | ✓ |
| 2 | Compute the measures of central tendency. | PSO - 1,2,3,4,6 | U, R, Ap | F, C, P | Lecture | ✓ |
| 3 | Compute the measures of dispersion. | PSO – 1,2,3,4 | U, R, Ap | F, C, P | Lecture | ✓ |
| 4 | Compute moments, skewness and kurtosis. | PSO – 1,2,6 | U, R, Ap | F, C, P | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 1 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK1DSCSTA101.1** | | | | |
| Course Title | **DESCRIPTIVE STATISTICS** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **I** | | | | |
| Academic Level | 100 - 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | - | 4 |
| Pre-requisites | Basic Arithmetical Operations | | | | |
| | Basic Statistics | | | | |
| | **Texts:**<br>1. Saxena, H.C. (1983). *Elementary Statistics*. S. Chand & Co., New Delhi.<br>2. Gupta S.C. and Kapoor, V.K. (1984). *Fundamentals of Mathematical Statistics*.Sultan Chand & Co., 3rd Edn, New Delhi.<br>3. Gupta, S. P (2011). *Statistical Methods*. Sultan Chand & Sons, New Delhi.<br>4. Agarwal, B.L. (2006). *Basic Statistics*. 4th Edition, New Age international (P) Ltd., NewDelhi.<br>5. Mukhopadhyay, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd,Calcutta<br>6. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Applied Statistics*, SultanChand & Co. New Delhi.<br>7. Parimal Mukhopadyay. (2009). *Theory and Methods of Survey Sampling*, PHILearning Pvt Ltd. New Delhi. | | | | |

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|---|---|
| | **References:**<br>1. Cochran, W.G. (1977). *Sampling Techniques*. Wiley Eastern Ltd., New Delhi.<br>2. Sambath. (2001). *Sampling Theory and Methods*. Narosa Publishing House. NewDelhi, Chennai, Mumbai, Calcutta.<br>3. Murthy, M.N. (1967). *Sampling theory and Methods*. Statistical Publishing Society,Calcutta.<br>4. Sukhatme, P.V. and Sukhatme, B.V. (1970). *Sampling Theory of Surveys with Applications*. Indian Society of Agricultural Statistics.<br>5. Anderson, T.W. and Sclove, S. L. (1978). *An Introduction to Statistical Analysis ofData*. Houghton Miffin/co, USA.<br>6. Anderson, T.W. and Finn, J.D. (2012). *The New Statistical Analysis of Data*. SpringerScience & Business Media, New York.<br>7. Croxton, F.E. and Cowden, D.J. (1973). *Applied General Statistics*. Prentice Hall ofIndia, New Delhi. |
| Course Summary | Statistics is a branch of mathematics that deals with collecting, organizing, analysing, interpreting, and presenting data. It involves techniques for gathering data, summarizing data using numerical and graphical methods, making predictions or inferences about populations based on sample data, and testing hypotheses. Census aims to collect data from every member of a population, while sample surveys collect data from a subset (sample) of the population to make inferences about the entire population. Each method has its advantages and disadvantages, and the choice between a census and a sample survey depends on factors such as the research objectives, available resources, and feasibility.<br><br>Measures of central tendency are statistical measures used to describe the center or average of a data set. Measures of dispersion quantify the spread or variability of data points in a data set. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **I** | **Introduction to Statistics** | | **15** |
| | 1 | Definition and scope of Statistics | 2 |
| | 2 | Designing of questionnaire and schedule | 2 |
| | 3 | Data- primary and secondary | 2 |
| | 4 | Editing of data | 3 |
| | 5 | Classification and tabulation of data | 3 |
| | 6 | Diagrammatic representation- Pictogram, Cartogram, Bar diagram (Sub-divided, Multiple), Pie diagram, Histogram, Frequency polygon, Frequency curve and ogives. | 3 |
| **II** | **Sample Survey Methods** | | **15** |
| | 7 | Census and Sample Surveys | 3 |
| | 8 | Methods of sampling: Probability and non-probability sampling, simple random sampling with replacement (SRSWR) & simple random sampling without replacement (SRSWOR) | 4 |
| | 9 | Systematic sampling and Stratified sampling | 4 |
| | 10 | Sampling and non- sampling errors | 4 |
| **III** | **Measures of Central Tendency** | | **15** |
| | 11 | Measures of central tendency - arithmetic mean, weighted arithmetic mean, median, mode, geometric mean, harmonic mean | 5 |
| | 12 | Properties of these averages | 5 |
| | 13 | Positional averages – quartiles, deciles and percentiles | 5 |
| **IV** | **Measures of Dispersion** | | **15** |
| | 14 | Measures of dispersion - range, quartile deviation, mean deviation, standard deviation | 5 |
| | 15 | Properties of these measures | 5 |
| | 16 | Relative measures of dispersion | 5 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand the definitions of Statistics. | U, Ap, An | PSO – 1, 6 |
| CO-2 | Understand the various sampling techniques. | U, R | PSO – 1, 6 |
| CO-3 | Compute the measures of central tendency. | R, U, Ap | PSO – 1,2,3,4 |
| CO-4 | Compute the measures of dispersion. | R, U, Ap | PSO – 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Descriptive Statistics**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Understand the definitions of Statistics. | PSO – 1, 6 | U, Ap, An | F, C, P | Lecture | |
| 2 | Understand the various sampling techniques. | PSO – 1, 6 | U, R | F, C | Lecture | |
| 3 | Compute the measures of central tendency. | PSO – 1,2,3,4 | R, U, Ap | F, C, P | Lecture | ✓ |
| 4 | Compute the measures of dispersion. | PSO – 1,2 | R, U, Ap | F, C, P | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | - | 1 | 1 | - | 3 | 3 | 1 | 1 | 2 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

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<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK1DSCSTA102.1</td></tr>
<tr><td>Course Title</td><td colspan="5">STATISTICS FOR DATA ANALYSIS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td>-</td><td>4</td></tr>
<tr><td rowspan="2">Pre-requisites</td><td colspan="5">Basic Arithmetical Operations</td></tr>
<tr><td colspan="5">Basic Statistics</td></tr>
<tr><td></td><td colspan="5">Texts:<br>1. Gupta S.C. and Kapoor, V.K. (1984). Fundamentals of Mathematical Statistics.Sultan Chand & Co., 3rd Edn, New Delhi.<br>2. Kendall, M.G. (1943). Advanced Theory of Statistics Vol-I. Charles Griffin: London.<br>3. Saxena, H.C. (1983). Elementary Statistics. S. Chand & Co., New Delhi.<br>4. Snedecor, G.W. and Cochran, W.G. (1967). Statistical methods. Iowa State UniversityPress, United States.<br>5. Agarwal, B.L. (1988). Basic Statistics. Wiley Eastern Ltd. New Delhi Basic Statistics Relating to the Indian Economy (CSO) 1990.<br>6. Guide to Official Statistics (CSO) 1995.<br>7. Statistical System in India (CSO) 1995.<br><br>References:<br>1. Agarwal, B.L. (2006). Basic Statistics. 4th Edition, New Age international (P) Ltd., NewDelhi.<br>2. Mukhopadhyay, P. (1996). Mathematical Statistics. New Central</td></tr>
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| | |
|---|---|
| | Book Agency (P) Ltd,Calcutta.<br>3. Gupta, S. P (2011). *Statistical Methods.* Sultan Chand & Sons, New Delhi.<br>4. Anderson, T.W. and Sclove, S. L. (1978). *An Introduction to Statistical Analysis ofData*. Houghton Miffin/co, USA.<br>5. Anderson, T.W. and Finn, J.D. (2012). *The New Statistical Analysis of Data*. SpringerScience & Business Media, New York.<br>6. Kapur J.N., and Saxena H.C. (1970), *Mathematical Statistics*, Sultan Chand & Sons, New Delhi. |
| Course Summary | Statistics is a branch of mathematics that deals with collecting, organizing, analysing, interpreting, and presenting data. It plays a crucial role in various fields such as science, economics, business, social sciences, and more. It provides powerful tools and techniques for analysing data, drawing meaningful insights, and making informed decisions in various fields of study and practice.<br><br>Indian Official Statistics provide a comprehensive and systematic framework for collecting, analysing, and disseminating data on various aspects of the country's economy, society, and demographics. They are essential tools for evidence-based policymaking, planning, and development initiatives in India.<br><br>Measures of central tendency are statistical measures used to describe the center or average of a data set. Measures of dispersion quantify the spread or variability of data points in a data set. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Statistics** | | **15** |
| | 1 | Definition and scope of Statistics | 2 |
| | 2 | Designing of questionnaire and schedule | 2 |
| | 3 | Sources of collecting secondary data | 2 |
| | 4 | Editing of data | 3 |
| | 5 | Classification and tabulation of data | 3 |
| | 6 | Diagrammatic representation- Pictogram, Cartogram, Bar diagram (Sub-divided, Multiple), Pie diagram, Histogram, Frequency polygon, Frequency curve and ogives | 3 |
| **II** | **Indian Official Statistics** | | **15** |

| | | | |
|---|---|---|---|
| | 7 | National Statistical Office (NSO) | 2 |
| | 8 | MOSPI | 1 |
| | 9 | population census - De Facto and De Jure method | 2 |
| | 10 | economic census | 1 |
| | 11 | Agricultural statistics-world agricultural census | 1 |
| | 12 | livestock and poultry statistics | 1 |
| | 13 | forest statistics | 1 |
| | 14 | fisheries statistics | 1 |
| | 15 | mining and quarrying statistics | 1 |
| | 16 | labour statistics | 1 |
| | 17 | national income statistics | 1 |
| | 18 | methods of national income estimation | 1 |
| | 19 | financial statistics | 1 |
| **III** | **Measures of Central Tendency** | | **15** |
| | 20 | arithmetic mean | 2 |
| | 21 | weighted arithmetic mean | 2 |
| | 22 | Median | 2 |
| | 23 | Mode | 2 |
| | 24 | geometric mean | 2 |
| | 25 | harmonic mean | 2 |
| | 26 | Properties of these averages | 2 |
| | 27 | Positional averages – quartiles, deciles and percentiles | 3 |
| **IV** | **Measures of Dispersion** | | **15** |
| | 28 | range | 2 |
| | 29 | quartile deviation | 2 |
| | 30 | mean deviation | 2 |

| | | | |
|---|---|---|---|
| | 31 | standard deviation | 3 |
| | 32 | Properties of these measures | 3 |
| | 33 | Relative measures of dispersion | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand the definitions of Statistics. | U, Ap | PSO – 1,6 |
| CO-2 | Understand Indian Official Statistics. | U | - |
| CO-3 | Compute the measures of central tendency. | R, U, Ap | PSO – 1,2,3,4,5 |
| CO-4 | Compute the measures of dispersion. | R, U, Ap | PSO – 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistics for Data Analysis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Understand the definitions of Statistics. | PSO – 1,6 | U, Ap | F, C, P | Lecture | |
| 2 | Understand Indian Official Statistics. | - | U | F, C | Lecture | |
| 3 | Compute the measures of central tendency. | PSO – 1,2,3,4,5 | R, U, Ap | F, C, P | Lecture | ✓ |
| 4 | Compute the measures of dispersion. | PSO – 1,2 | R, U, Ap | F, C, P | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 2 | 1 | 2 | 3 |
| **CO 2** | 2 | - | - | - | - | 1 | 3 | - | 2 | 3 | 3 | - | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | 3 | 3 | 2 | 1 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment / Seminar Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK1DSCSTA103.1** | | | | |
| Course Title | **BASIC PROBABILITY THEORY** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **I** | | | | |
| Academic Level | 100 -199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | - | 4 |
| Pre-requisites | Sample Space and Events | | | | |

**References:**


1. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). *Statistics: A Beginners Text Vol- 2*, New Age International (P) Ltd., New Delhi.

2. F. M. Dekkingetal. (2005). *A Modern Introduction to Probability and Statistics*.Springer Verlag, New York.

3. Goon A. M., Gupta N.K., Das Gupta B. (1999). *Fundamentals of Statistics. Vol. 2*, World Press, Kolkatta.

4. Mukhopadhaya, P. (1996). *Mathematical Statistics.* New Central Book Agency (P)Ltd., Calcutta.

5. Rohatgi,V.K. *An Introduction To Probability Theory and Mathematical Statistics, Wiley Eastern Limited.*

6. Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability andStatistics*. 2nd edition. John Wiley & Sons.

| | |
|---|---|
| Course Summary | Basic Probability theory would cover concepts like sample spaces, events, probability distributions, conditional probability, independence, and basic laws like the law of total probability and Bayes' theorem. It also includes understanding random variables, expected value, variance, and common distributions like the binomial, Poisson, and normal distributions. Additionally, basic combinatorial principles such as permutations and combinations are often covered. Understanding these concepts forms the foundation for more advanced topics in probability and statistics. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Random Experiment, Sample Space, Events** | | **15** |
| | 1 | Random Experiment | 4 |
| | 2 | Sample Space | 3 |
| | 3 | Events and types of events | 4 |
| | 4 | Laws of Algebra of events | 4 |
| **II** | **Statistical Regularity and Probability** | | **15** |
| | 5 | Statistical Regularity | 7 |
| | 6 | Frequency definition of Probability – Properties - Advantages and Disadvantages | 8 |
| **III** | **Probability Measure** | | **15** |
| | 7 | Probability Measure (Definition only) | 4 |
| | 8 | Axiomatic definition of Probability and its properties | 4 |
| | 9 | Conditional Probability and Multiplication theorem | 4 |
| | 10 | Independence of events | 3 |
| **IV** | **Bayes Theorem** | | **15** |
| | 11 | Classical definition of Probability – Advantages and Disadvantages | 8 |
| | 12 | Bayes theorem | 7 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand different types of Events. | U, An | PSO – 2,4 |
| CO-2 | Understand the various definitions of probability. | U | PSO – 2,3,4 |
| CO-3 | Know Probability Measure. | U, An, Ap | PSO – 1,2,4 |
| CO-4 | Understand Bayes' Theorem. | U, Ap | PSO – 2,3,4 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Basic Probability Theory**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Understand different types of Events. | PSO – 2,4 | U, An | F, C | Lecture | |
| 2 | Understand the various definitions of probability. | PSO – 2,3,4 | U | F, C, P | Lecture | |
| 3 | Know Probability Measure. | PSO – 1,2,4 | U, An, Ap | F, C, P | Lecture | |
| 4 | Understand Bayes' Theorem. | PSO – 2,3,4 | U, Ap | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 3 | 2 | 3 | 1 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |
| **CO 2** | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| **CO 4** | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK1MDCSTA104.1</td></tr>
<tr><td>Course Title</td><td colspan="5">BASICS OF STATISTICS - I</td></tr>
<tr><td>Type of Course</td><td colspan="5">MDC</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 hours</td><td>-</td><td>-</td><td>3</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Arithmetical Operations</td></tr>
<tr><td></td><td colspan="5">Texts:<br>1. Gupta, S. P (2011). Statistical Methods. Sultan Chand & Sons, New Delhi.<br>2. Agarwal, B.L. (2006). Basic Statistics. 4th Edition, New Age international (P) Ltd., NewDelhi.<br>3. Mukhopadhyay, P. (1996). Mathematical Statistics. New Central Book Agency (P) Ltd,Calcutta.<br>4. Saxena, H.C. (1983). Elementary Statistics. S. Chand & Co., New Delhi.<br>5. Snedecor, G.W. and Cochran, W.G. (1967). Statistical methods. Iowa State UniversityPress, United States.<br>6. Gupta S.C. and Kapoor, V.K. (1984). Fundamentals of Mathematical Statistics.Sultan Chand & Co., 3rd Edn, New Delhi.</td></tr>
</table>

| | |
|---|---|
| | **References:**<br>1. Anderson, T.W. and Sclove, S. L. (1978). *An Introduction to Statistical Analysis ofData*. Houghton Miffin/co, USA.<br>2. Anderson, T.W. and Finn, J.D. (2012). *The New Statistical Analysis of Data*. SpringerScience & Business Media, New York.<br>3. Croxton, F.E. and Cowden, D.J. (1973). *Applied General Statistics*. Prentice Hall ofIndia, New Delhi.<br>4. Spiegel, M. R. (1961). *Theory and Problems of Statistics*. Schaum's outline series,New York. |
| Course Summary | Statistics encompasses a broad range of methods and techniques for dealing with data. It involves both descriptive statistics, which focus on summarizing and describing data through measures like the mean, median, mode, range, variance, and standard deviation, and inferential statistics, which are used to make predictions or inferences about populations based on sample data. Central to statistics is the concept of probability, which quantifies the likelihood of events occurring. Measures of dispersion quantify the spread or variability of data points in a data set. |

**Detailed syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Introduction to Statistics** | **11** |
| | 1 | Definition and scope of Statistics | 2 |
| | 2 | Application of Statistics in various fields of science | 2 |
| | 3 | Preliminaries of data collection | 2 |
| | 4 | Graphical representation of categorical data | 3 |
| | 5 | Frequency distribution of data | 2 |
| **II** | | **Descriptive Statistics** | **11** |
| | 6 | Average measures - mean, median, mode, GM and HM (for raw data only) | 5 |

| | | | |
|---|---|---|---|
| | 7 | Positional averages – quartiles, percentiles and deciles | 6 |
| **III** | **Measures of Dispersion** | | **12** |
| | 8 | Concept of dispersion | 2 |
| | 9 | Range | 2 |
| | 10 | Quartile Deviation | 2 |
| | 11 | Mean deviation | 2 |
| | 12 | Standard deviation (for raw data only) | 2 |
| | 13 | Skewness and kurtosis | 2 |
| **IV** | **Random Experiment, Sample Space, Events** | | **11** |
| | 14 | Random Experiment | 3 |
| | 15 | Sample Space | 2 |
| | 16 | Events and types of Events | 3 |
| | 17 | Classical Definition of Probability | 3 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe definition, scope of statistics, graphical representation of categorical data and frequency distribution of data. | U, Ap | PSO – 1,6 |
| CO-2 | Learn average measures – mean, median, mode, GM and HM (for raw data only) | U, Ap | PSO – 1,2,3,4,6 |
| CO-3 | Understand the concepts of Dispersion – Range, QD, Mean Deviation and Standard Deviation, Skewness and Kurtosis. | U | PSO – 1,2,3,4,6 |
| CO-4 | Describe random experiments, sample space, events, types of events, various definitions of Probability and | U, Ap | PSO – 3,4,6 |

| | | | |
|---|---|---|---|
| | their applications in simple problem solving. | | |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Basics of Statistics - I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Describe definition, scope of statistics, graphical representation of categorical data and frequency distribution of data. | PSO – 1,6 | U, Ap | F, C, P | Lecture | |
| 2 | Learn average measures – mean, median, mode, GM and HM (for raw data only) | PSO – 1,2,3,4, 6 | U, Ap | F, C, P | Lecture | |
| 3 | Understand the concepts of Dispersion – Range, QD, Mean Deviation and Standard Deviation, Skewness and Kurtosis. | PSO – 1,2,3,4, 6 | U | F, C, P | Lecture | |
| 4 | Describe random experiments, | PSO – 3,4,6 | U, Ap | F, C | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | sample space, events, types of events, various definitions of probability and their applications in simple problem solving. | | | | | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 2 | 1 | 3 | 3 | 1 | 2 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 2 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment / Seminar Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK1MDCSTA105.1** | | | | |
| Course Title | **BUSINESS STATISTICS AND LOGICAL REASONING - I** | | | | |
| Type of Course | **MDC** | | | | |
| Semester | **I** | | | | |
| Academic Level | 100 - 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | - | 3 |
| Pre-requisites | NIL | | | | |

**Texts:**


1. Elhance.D.L, *Fundamentals of Statistics*, KitabMahal, Allahabad.
2. Gupta.B.N. *Statistics - Theory and Practice*, SahityaBhawan Publications, Agra.
3. Gupta.S.P. *Statistical Methods*, Himalaya Publishing House, Mumbai.
4. Nabendu Pal and Haded Sarkar S.A. *Statistics - Concept and Application*, PHI,NewDelhi.
5. Richard I.Levin and David S. Rubin, *Statistics for Management*, Prentice Hall ofIndia, latest edition


**References:**


1. Agarwal, B.L. (1988). *Basic Statistics*. Wiley Eastern Ltd. New Delhi.
2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of*

| | |
|---|---|
| | *Mathematical Statistics.*Sultan Chand & Sons, New Delhi.<br>3. Anderson, T.W. and Sclove, S. L. (1978). *An Introduction to Statistical Analysis of Data*. Houghton Miffin/co, USA.<br>4. Anderson, T.W. and Finn, J.D. (2012). *The New Statistical Analysis of Data.* Springer Science & Business Media, New York.<br>5. Croxton, F.E. and Cowden, D.J. (1973). *Applied General Statistics.* Prentice Hall of India, New Delhi.<br>6. Gupta S.C. and Kapoor, V.K. (1984). *Fundamentals of Mathematical Statistics*. Sultan Chand & Co., 3rd Edn, New Delhi.<br>7. David W. Hosmer and Stanley Lemeshow (2000). *Applied Logistic Regression*. 2nd edition. Wiley series in probability and statistics, New York. |
| Course Summary | Business statistics involves the application of statistical techniques to solve business problems and make informed decisions. In this paper, Indian Official Statistics refer to the data and statistical information collected, compiled and disseminated by various government agencies and departments in India. These statistics play a crucial role in monitoring and evaluating the economic, social and demographic aspects of the country.<br><br>Measures of central tendency are statistical measures used to describe the center or average of a data set. Measures of dispersion quantify the spread or variability of data points in a data set.<br><br>Correlation measures the strength and direction of linear association between variables, while regression analyses the relationship between variables and helps make predictions based on that relationship. They are both essential tools in statistical analysis. Index Numbers are statistical measures used to represent changes in a set of related variables over time or across different groups. They are widely used in economics, finance and various other fields to track trends, monitor changes, and compare relative magnitude. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Indian official statistics** | **11** |
| | 1 | Introduction to statistics | 1 |
| | 2 | Indian official statistics: National Statistical Office (NSO), MOSPI | 1 |

| | | | |
|---|---|---|---|
| | 3 | population census- De Facto and De Jure method | 1 |
| | 4 | economic census | 1 |
| | 5 | agricultural statistics-world agricultural census | 1 |
| | 6 | livestock and poultry statistics | 1 |
| | 7 | forest statistics | 1 |
| | 8 | fisheries statistics | |
| | 9 | mining and quarrying statistics | 1 |
| | 10 | labour statistics | |
| | 11 | national income statistics | 1 |
| | 12 | methods of national income estimation | 1 |
| | 13 | financial statistics | 1 |
| **II** | **Measures of Central Tendency and Dispersion** | | **12** |
| | 14 | Measures of Central Tendency- Mean, Median, Mode, Quartiles | 3 |
| | 15 | Measures of Dispersion: Range, Quartile Deviation, Standard Deviation. | 3 |
| | 16 | Coefficient of variation | 3 |
| | 17 | Coefficient of Quartile Deviation. | 3 |
| **III** | **Correlation and Regression** | | **11** |
| | 18 | Bivariate data - Meaning and definition | 1 |
| | 19 | Scatter diagram | 1 |
| | 20 | Karl Pearson's Coefficient of Correlation | 1 |
| | 21 | Rank Correlation | 2 |
| | 22 | Regression lines | 2 |
| | 23 | Regression equations | 2 |
| | 24 | Regression coefficients | 2 |
| **IV** | **Index Numbers** | | **11** |

| | | | |
|---|---|---|---|
| | 25 | Index numbers -Meaning and importance | 2 |
| | 26 | Problems in construction of index numbers | 3 |
| | 25 | Method of construction of index numbers – Simple aggregative, Average of Price relatives, Laspeyre's, Paasche's and Fisher's Ideal Index numbers. | 3 |
| | 26 | Test of Consistency: Time Reversal Test and Factor Reversal Test | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand Indian Official Statistics. | U | - |
| CO-2 | Learn about measures of Central Tendency and Dispersion. | U, Ap | PSO – 1,2,3,4,6 |
| CO-3 | Know about Correlation and Regression. | U, Ap | PSO – 1,2,3,4,6 |
| CO-4 | Describe Index Numbers. | U, Ap | PSO – 1,2,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Business Statistics and Logical Reasoning - I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Understand Indian Official Statistics | - | U | F, C | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Learn about measures of Central Tendency and Dispersion | PSO – 1,2,3,4,6 | U, Ap | F, C, P | | |
| 3 | Know about Correlation and Regression | PSO – 1,2,3,4,6 | U, Ap | F, C, P | | |
| 4 | Describe Index Numbers | PSO – 1,2,4,6 | U, Ap | F, C, P | | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 1 | - | 1 | - | - | 1 | 3 | - | 3 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment / Seminar Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK1MDCSTA106.1</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTION TO STATISTICAL QUALITY CONTROL</td></tr>
<tr><td>Type of Course</td><td colspan="5">MDC</td></tr>
<tr><td>Semester</td><td colspan="5">I</td></tr>
<tr><td>Academic Level</td><td colspan="5">100 - 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 hours</td><td>-</td><td></td><td>3</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">NIL</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Ekambaram, S. K. (1963). Statistical basis of Acceptance Sampling. Asia Publishing House.<br><br>2. Gupta, R. C. (1974). Statistical Quality Control. Khanna Publishers, Delhi.<br><br>3. Kanti Swarup, Gupta, P. K and Manmohan. (1993). Operations Research. Sultan Chand Publishers, New Delhi.<br><br>4.Goel and Mittal (1982). Operations Research. Pragathi Prakashan, Meerut.<br><br>5. Kapoor, V. K and Gupta, S. P. (1978). Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.<br><br>6. Grant, E.L. and Laven Worth, R.S. (1996). Statistical Quality Control. McGraw Hill.</td></tr>
</table>

| | |
|---|---|
| | 7. Montgomery, D.C. (1983). Introduction to Statistical Quality Control. John Wiley & Sons. |
| Course Summary | Statistical quality control (SQC) is a set of tools and techniques used to monitor, control, and improve the quality of products and processes. SQC involves the application of statistical methods to analyse process data, identify sources of variation, and make data-driven decisions to maintain or enhance quality standards. Key SQC tools include control charts, which monitor process performance over time and detect deviations from expected behaviour, helping to identify and correct issues before they result in defects. Additionally, techniques such as process capability analysis assess whether a process meets predefined quality specifications, while sampling plans and acceptance sampling determine the acceptability of batches or lots based on sample inspections. SQC plays a critical role in industries such as manufacturing, healthcare, and service sectors, where consistent quality is essential for customer satisfaction, compliance with regulations, and overall business success. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Introduction to Statistical Quality Control (SQC)** | **11** |
| | 1 | Basic terminologies in SQC | 2 |
| | 2 | Need for SQC techniques in industry | 2 |
| | 3 | Control charts | 3 |
| | 4 | Specification and tolerance limits- 3 sigma limits, warning limits | 4 |
| **II** | | **Control charts for variables** | **11** |
| | 5 | $\bar{X}$ chart and R chart | 11 |
| | | Purpose of the charts | |
| | | Plotting $\bar{X}$ and R results | |
| | | Determining the trial control limits | |
| | | Interpretation of control charts | |
| | | Criterion for detecting lack of control in $\bar{X}$ and R Chart | |

| | | | |
|---|---|---|---|
| **III** | **Control chart for attributes** | | **12** |
| | 6 | Purpose of the charts | |
| | 7 | Construction of p - chart | |
| | 8 | Construction of np - chart | |
| | 9 | Construction of c - chart | |
| | 10 | Construction of u - chart | |
| **IV** | **Acceptance sampling plans** | | **11** |
| | 11 | Producer's risk | 1 |
| | 12 | Consumer's risk | 1 |
| | 13 | Single and Double sampling plans | 9 |
| | | AQL | |
| | | LTPD | |
| | | AOQ | |
| | | AOQL | |
| | | ATI | |
| | | ASN | |
| | | OC Curves | |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe SQC and its applications. | U | PSO-1,2 |
| CO-2 | Sketch control chart for variables. | U, Ap | PSO- 1,2,5 |
| CO-3 | Sketch control chart for attributes. | U, Ap | PSO-1,2,5 |

| | | | |
|---|---|---|---|
| CO-4 | Describe acceptance sampling plans. | U, Ap, An | PSO-1,3 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Introduction to Statistical Quality Control**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe SQC and its applications. | PSO-1,2 | U | F, C | Lecture | |
| CO-2 | Sketch control chart for variables. | PSO-1,2,5 | U, Ap | C, P | Lecture | |
| CO-3 | Sketch control chart for attributes. | PSO-1,2,5 | U, Ap | C, P | Lecture | |
| CO-4 | Describe acceptance sampling plans. | PSO-1,3 | U, Ap, An | C | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | - | - | 1 | 1 | 3 | 1 | 3 | 2 | - | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 2 |
| **CO 3** | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 1 | 2 | 2 |
| **CO 4** | 3 | - | 3 | - | - | 2 | 3 | 1 | 2 | - | 2 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK1MDCSTA107.1** | | | | |
| Course Title | **BASICS OF TESTING OF HYPOTHESIS** | | | | |
| Type of Course | **MDC** | | | | |
| Semester | **I** | | | | |
| Academic Level | 100 - 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| Pre-requisites | Probability | | | | |
| | Distributions | | | | |

**References:**


1. Aron A, Aron R & Coups E J (2006). *Statistics for Psychology* (4thed), Pearson Education,New Delhi.

2. Garret E Henry (2004). *Statistics in Psychology and Education* (11thed), ParagonInternational Publishers, New Delhi.

3. Gravetter, F J & Wallnau L B (2000). *Statistics for Behavioral Science* (5thed),Wadsworth-Thomson learning Singapore

4. Heiman W Carry (2000). *Basic Statistics for Behavioral Science* (3rd ed.), HoughtonMifflin Company, New York

5. Mangal S K (2000). *Statistics in Psychology and Education* (2nd ed.), Prentice_Hall ofIndia Private Limited, New Delhi

6. Minium W Edward, King M Bruce & Bear Gardon (2001). *Statistical Reasoning inPsychology and Education* (3rded), John Wiley & Sons, New York

| | |
|---|---|
| | 7. Yule Undy G & Kendal M G (1991). *An Introduction to Theory of Statistics* (14th ed.)Universal Book Stall, New Delhi. |
| Course Summary | Hypothesis testing is a fundamental concept in statistics used to make decisions or draw conclusions about population parameters based on sample data. It involves setting up hypotheses, collecting data, and using statistical methods to determine whether there is enough evidence to reject or fail to reject the null hypothesis.<br><br>This paper covers a range of hypothesis testing methods, including small and large sample tests and tests for proportions and variances, providing tools for statistical analysis and decision-making based on data. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Theory of Estimation** | | **11** |
| | 1 | Basic Terminologies | 2 |
| | 2 | Sampling distributions and their inter relationships | 3 |
| | 3 | Sampling distribution of sample mean | 2 |
| | 4 | Point Estimation | 2 |
| | 5 | Interval Estimation | 2 |
| **II** | **Introduction to Testing of Hypothesis** | | **11** |
| | 6 | Simple and composite | 1 |
| | 7 | Null and alternative hypothesis | 1 |
| | 8 | Procedure for testing of hypothesis | 2 |
| | 9 | Two types of errors | 1 |
| | 10 | Level of significance | 2 |
| | 11 | Power of a test | 2 |
| | 12 | p - value | 1 |
| | 13 | Two tailed and one tailed tests of significance | 1 |
| **III** | **Large sample tests** | | **12** |

| | | | |
|---|---|---|---|
| | 14 | Testing the significance of a mean. | 2 |
| | 15 | Testing the significance of difference between two means. | 2 |
| | 16 | Testing the significance of a proportion | 2 |
| | 17 | Testing the significance of difference between two proportions. | 2 |
| | 18 | Tests based on chi– square distribution | 2 |
| | | Testing the goodness of fit | |
| | | Testing the independence of attributes | |
| | 19 | Coefficient of Contingency | 2 |
| **IV** | **Small sample tests** | | **11** |
| | 20 | Test of significance of mean from a normal population | 2 |
| | 21 | Testing the significance of difference between means of two normal population | 3 |
| | 22 | Paired-t test | 3 |
| | 23 | Testing the significance of correlation coefficient | 3 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe the basic concepts in Theory of Estimation. | R, U | PSO-1 |
| CO-2 | Describe the basic concepts in Testing of Hypothesis. | R, U | PSO-1,3,5 |
| CO-3 | Describe Large sample tests and their practical problems based on statistical tables. | U, Ap | PSO-1,2,3,5 |
| CO-4 | Explain Small sample tests and their practical problems based on statistical tables | U, Ap | PSO-1,2,3,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Basics of Testing of Hypothesis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe the basic concepts in Theory of Estimation. | PSO-1 | R, U | F, C | Lecture | |
| CO-2 | Describe the basic concepts in Testing of Hypothesis. | PSO-1,3,5 | R, U | C, P | Lecture | |
| CO-3 | Describe Large sample tests and their practical problems based on statistical tables. | PSO-1,2,3,5 | U, Ap | F, C, P | Lecture | |
| CO-4 | Explain Small sample tests and their practical problems based on statistical tables | PSO-1,2,3,5 | U, Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | - | 1 | 1 | - | 1 | 3 | 2 | - | 2 | 2 | 2 | 2 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 2** | 3 | 2 | 3 | 1 | 3 | - | 3 | 3 | 2 | 1 | 2 | 2 | 2 |
| **CO 3** | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 1 | 3 | 1 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 2 | 3 | 1 | 3 | 3 | 2 | 3 | 1 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

**COURSES OFFERING – SEMESTER II**

| COURSE TYPE | MAJOR (STUDENTS) | COURSE TITLE | CREDITS |
|---|---|---|---|
| DSC | STATISTICS | Probability Theory - I | 4 |
| DSC | ALL SCIENCES (PHYSICS, CHEMISTRY, ZOOLOGY, BOTANY, BIO-TECHNOLOGY AND CS), HUMANITIES AND COMMERCE | Random Variables and Distribution Theory | 4 |
| DSC | ALL SCIENCES (PHYSICS, CHEMISTRY, ZOOLOGY, BOTANY, BIO-TECHNOLOGY AND CS), HUMANITIES AND COMMERCE | Correlation and Regression Analysis | 4 |
| DSC | ALL SCIENCES (PHYSICS, CHEMISTRY, ZOOLOGY, BOTANY, BIO-TECHNOLOGY AND CS), HUMANITIES AND COMMERCE | Geostatistics | 4 |
| MDC | ALL SUBJECTS OTHER THAN STATISTICS | Basics of Statistics - II | 3 |
| MDC | COMMERCE | Business Statistics and Logical Reasoning - II | 3 |
| MDC | ALL SUBJECTS OTHER THAN STATISTICS | Statistics and Research Methodology | 3 |
| MDC | ALL SUBJECTS OTHER THAN STATISTICS | Introduction to Design of Experiments | 3 |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK2DSCSTA150.1** | | | | |
| Course Title | **PROBABILITY THEORY - I** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **II** | | | | |
| Academic Level | 100- 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic Mathematics | | | | |

**References:**


1. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). *Statistics: A Beginners Text Vol- 2*, New Age International (P) Ltd., New Delhi.

2. F. M. Dekkingetal. (2005). *A Modern Introduction to Probability and Statistics*. Springer Verlag, New York. 9

3. Goon A. M., Gupta N.K., Das Gupta B. (1999). *Fundamentals of Statistics. Vol. 2* World Press, Kolkatta.

4. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*, Sulthan Chand, New Delhi

5. Mukhopadhaya, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd., Calcutta.

6. Rohatgi, V.K. *An Introduction to Probability Theory and Mathematical Statistics*.Wiley eastern Limited

| | |
|---|---|
| Course Summary | Probability theory is the branch of mathematics that deals with quantifying uncertainty. It provides a framework for understanding the likelihood of events occurring. In probability theory, events are assigned probabilities between 0 and 1, where 0 indicates impossibility and 1 indicates certainty. The sum of probabilities of all possible outcomes in an event space is always 1. Probability theory encompasses concepts such as random variables, probability distributions. These concepts are fundamental in probability theory and statistical analysis, providing a framework for understanding and analysing the behaviour of random phenomena and variables. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Axiomatic Approach to Probability** | **15** |
| | 1 | Random experiment | 2 |
| | 2 | Sample space | 2 |
| | 3 | Events and types of events | 2 |
| | 4 | Various definitions of probability, and its properties | 3 |
| | 5 | Probability Space | 2 |
| | 6 | Conditional probability | 2 |
| | 7 | Bayes theorem and its application | 2 |
| **II** | | **Distribution Function** | **15** |
| | 8 | Random variables | 2 |
| | 9 | Distribution functions and it's properties | 3 |
| | 10 | Discrete random variables | 2 |
| | 11 | Continuous random variables | 2 |
| | 12 | Probability mass function | 2 |
| | 13 | Probability density function | 2 |

| | | | |
|---|---|---|---|
| | 14 | Function of Random variables | 2 |
| **III** | **Bivariate Random Function** | | **15** |
| | 15 | Bivariate random variable | 3 |
| | 16 | Joint distribution functions and properties | 3 |
| | 17 | Joint probability mass function and joint probability distribution function and it's properties. | 3 |
| | 18 | Marginal and conditional distribution | 3 |
| | 19 | Independence of random variable | 3 |
| **IV** | **Mathematical Expectations** | | **15** |
| | 20 | Mathematical expectation and it's properties | 3 |
| | 21 | Expectation of function of random variable | 3 |
| | 22 | Moments- univariate and bivariate | 3 |
| | 23 | Cauchy-Schwatz inequality | 3 |
| | 24 | Conditional Expectation and conditional variance | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe random experiment, sample space, events, type of events, and definitions of probability. | U, Ap | PSO - 1,2,4,6 |
| CO-2 | Explain random variables, distribution functions, probability density function and probability mass function. | U, Ap | PSO – 1,2,4,6 |
| CO-3 | Describe standard distributions- Binomial, Poisson and Normal: definition, mean, variance and numerical problems. | U, Ap | PSO – 1,2,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Probability Theory - I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe random experiment, sample space, events, type of events, and definitions of probability. | PSO - 1,2,4,6 | U, Ap | F, C, P | Lecture | |
| CO-2 | Explain random variables, distribution functions, probability density function and probability mass function. | PSO – 1,2,4,6 | U, Ap | F, C, P | Lecture | |
| CO-3 | Describe standard distributions- Binomial, Poisson and Normal: definition, mean, variance and numerical problems. | PSO – 1,2,4,6 | U, Ap | F, C, P | Lecture | ✓ |
| CO-4 | Describe various sampling distributions- normal, chi-square, t, F | PSO – 1,2,3,4, 6 | U, An, Ap | F, C, P | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | - | 3 | 2 | 3 | 3 |
| **CO 3** | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | 3 | 1 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK2DSCSTA151.1</td></tr>
<tr><td>Course Title</td><td colspan="5">RANDOM VARIABLES AND DISTRIBUTION THEORY</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Academic Level</td><td colspan="5">100- 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic concepts of probability</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). Statistics: A Beginners Text Vol- 2, New Age International (P) Ltd., New Delhi.<br><br>2. Goon A. M., Gupta N.K., Das Gupta B. (1999). Fundamentals of Statistics. Vol. 2 World Press, Kolkatta.<br><br>3. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sulthan Chand, New Delhi.<br><br>4. Hogg, R.V. and Craig, A.T. (1970). Introduction to Mathematical Statistics. Pearson Education Pvt. Ltd, UK.<br><br>5. Mukhopadhaya, P. (1996). Mathematical Statistics. New Central Book Agency (P) Ltd., Calcutta.<br><br>6. Rohatgi, V. K. An Introduction to Probability Theory and Mathematical Statistics.Wiley eastern Limited</td></tr>
</table>

| | |
|---|---|
| | 7. Wilks, S.S. (1964). *Mathematical Statistics*, John Wiley, New York. |
| Course Summary | Random variables are numerical quantities whose values are determined by the outcome of a random phenomenon. They can take on different values with certain probabilities associated with each value. Random variables can be discrete, where they can only take on distinct, separate values, or continuous, where they can take on any value within a certain range. A probability distribution describes the probabilities of all possible outcomes of a random variable. For discrete random variables, the probability distribution is represented by a probability mass function (pmf), while for continuous random variables, it is represented by a probability density function (pdf). Common probability distributions include the normal distribution, binomial distribution, Poisson distribution, and exponential distribution, each with its own characteristics and applications in various fields such as finance, engineering, and biology. Understanding random variables and distribution theory is essential for statistical analysis and inference. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Mathematical Definition of Probability** | | **15** |
| | 1 | Random experiment | 2 |
| | 2 | Sample space | 2 |
| | 3 | Events and types of events | 2 |
| | 4 | Mathematical definition of probability | 3 |
| | 5 | Addition theorem and conditional probability | 3 |
| | 6 | Multiplication Theorem | 3 |
| **II** | **Mathematical Expectation** | | **15** |
| | 7 | Random variables and it's various types | 3 |
| | 8 | Probability mass function and probability density function | 3 |
| | 9 | Distribution function | 3 |
| | 10 | Mathematical expectation of random variables | 3 |

| | | | |
|---|---|---|---|
| | 11 | Moment generating functions and characteristics function | 3 |
| **III** | **Standard Distributions** | | **15** |
| | 12 | Binomial distribution – mean and variance | 5 |
| | 13 | Poisson distribution – mean and variance | 5 |
| | 14 | Normal distribution – mean and variance | 5 |
| **IV** | **Sampling Distributions** | | **15** |
| | 15 | Concepts of parameter and statistics | 5 |
| | 16 | Standard normal distribution | 5 |
| | 17 | Various sampling distributions | 5 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe random experiment, sample space, events, type of events and definition of probability. | U | PSO - 1,2,3,4 |
| CO-2 | Describe types of Random Variables, probability density function, probability mass function and distribution function. | R, U | PSO – 1,2,3,4,6 |
| CO-3 | Describe Standard distributions- Binomial, Poisson, Normal and compute mean and variance | U, Ap | PSO – 2,3,4,5,6 |
| CO-4 | Describe various Sampling distributions- standard normal, chi-square, t and F. Comput the numerical problems associated. | U, Ap | PSO – 1,2,3,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Random Variables and Distribution Theory**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe random experiment, sample space, events, type of events and definition of probability. | PSO - 1,2,3,4 | U | F, C, P | Lecture | |
| CO-2 | Describe types of Random Variables, probability density function, probability mass function and distribution function. | PSO – 1,2,3,4, 6 | R, U | F, C, P | Lecture | |
| CO-3 | Describe Standard distributions- Binomial, Poisson, Normal and compute mean and variance. | PSO – 2,3,4,5, 6 | U, Ap | F, C, P | Lecture | ✓ |
| CO-4 | Describe various Sampling distributions- standard normal, chi-square, t and F. Compute the numerical problems associated. | PSO – 1,2,3,4, 5,6 | U, Ap | F, C, P, M | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | - | 3 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | - | 3 | 2 | 3 | 3 |
| **CO 3** | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK2DSCSTA152.1</td></tr>
<tr><td>Course Title</td><td colspan="5">CORRELATION AND REGRESSION ANALYSIS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">II</td></tr>
<tr><td>Academic Level</td><td colspan="5">100- 199</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td>-</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Mathematics</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Agarwal, B.L. (1988). Basic Statistics. Wiley Eastern Ltd. New Delhi.<br><br>2. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.<br><br>3. Gupta, S. P (2011). Statistical Methods. Sultan Chand & Sons, New Delhi.<br><br>4. Kapur, J. N and Saxena, H. C. (1970). Mathematical Statistics. Sultan Chand & Sons, New Delhi.<br><br>5. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). Statistics: A Beginners Text Vol- 2, New Age International (P) Ltd., New Delhi.<br><br>6. F. M. Dekkingetal. (2005). A Modern Introduction to Probability and Statistics. Springer Verlag, New York.<br><br>7. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sulthan Chand, New Delhi.</td></tr>
</table>

| | |
|---|---|
| | 8. Rohatgi,V.K., *An Introduction to Probability Theory and Mathematical Statistics*, Wiley eastern Limited.<br><br>9. David W. Hosmer and Stanley Lemeshow (2000). *Applied Logistic Regression*. 2nd edition. Wiley series in probability and statistics, New York. |
| Course Summary | Correlation and regression analysis are statistical techniques used to understand the relationship between variables. correlation analysis quantifies the strength and direction of the relationship between two variables, while regression analysis models the relationship between a dependent variable and one or more independent variables, providing insights into how changes in the independent variables affect the dependent variable. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Random Variables** | | **15** |
| | 1 | Types of random variables - Discrete and continuous | 3 |
| | 2 | Probability mass function and Probability density function | 3 |
| | 3 | Distribution function | 3 |
| | 4 | Bivariate data | 3 |
| | 5 | Correlation | 3 |
| **II** | **Correlation** | | **15** |
| | 6 | Coefficient of correlation | 5 |
| | 7 | Rank correlation coefficient | 5 |
| | 8 | Uses of correlation | 5 |
| **III** | **Fitting of Curves** | | **15** |
| | 9 | Curve fitting -Fitting of first-degree curves | 3 |
| | 10 | Fitting of second-degree curves | 3 |
| | 11 | Fitting of power curves | 3 |

| | | | |
|---|---|---|---|
| | 12 | Fitting of exponential curves | 3 |
| | 13 | Method of least squares | 3 |
| **IV** | **Regression Analysis** | | **15** |
| | 14 | Regression analysis | 5 |
| | 15 | Determination of Regression lines | 5 |
| | 16 | Simple linear regression- Regression equations and their applications | 5 |

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe types of random variables, probability density function, probability mass function and distribution function. | U, Ap | PSO – 1,2,3,4 |
| CO-2 | Calculate Karl Pearson's coefficient of correlation and Spearman's rank correlation. | R, U, Ap | PSO – 1,2,3,4,5,6 |
| CO-3 | Describe Curve fitting and method of Least Squares. | R, U, Ap | PSO – 1,2,4,6 |
| CO-4 | Describe Regression Analysis. | R, U, Ap | PSO – 1,2,3,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Correlation and Regression Analysis**

**Credits: 4:0:0 (Lecture: Tutorial: Practical)**

| **CO No.** | **CO** | **PO/PSO** | **Cognitive Level** | **Knowledge Category** | **Lecture (L)/Tutorial (T)** | **Practical (P)** |
|---|---|---|---|---|---|---|
| 1 | Describe types of random variables, | PSO – 1,2,3,4 | U, Ap | F, C | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | probability density function, probability mass function and distribution function. | | | | | |
| 2 | Calculate Karl Pearson's coefficient of correlation and Spearman's rank correlation. | PSO – 1,2,3,4,5, 6 | R, U, Ap | F, C, P | Lecture | |
| 3 | Describe Curve fitting and method of Least Squares | PSO – 1,2,4,6 | R, U, Ap | F, C, P | Lecture | |
| 4 | Describe Regression Analysis | PSO – 1,2,3,4,5, 6 | R, U, Ap | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | - | 1 | 3 | 3 | 1 | 3 | 2 | 2 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |

| | |
|---|---|
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment / Seminar Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK2DSCSTA153.1** | | | | |
| Course Title | **GEOSTATISTICS** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **II** | | | | |
| Academic Level | 100- 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic probability | | | | |
| | **References:**<br>1. Cheeney, R. F (1983). *Statistical Methods in Geology*.<br>2. Davis, J. C. (2002). *Statistics and Data Analysis in Geology*. 3rd Ed. John Wiley (Chapters 2, 4 & 6).<br>3. Miller, R. L. and Khan, T. S. (1962). *Statistical Analysis in the Geological Analysis*. Wiley.<br>4. Nebendu Pal and Sahadeb Saikar (2008). *Statistics Concepts and Applications*. Prentice Hall of India. Chapters (1, 2, 3, 4, 5).<br>5. Montgomery, C.J. (1976). *Design and Analysis of Experiments*, Wiley Eastern.<br>6. Joshi, D.D. (1987). *Linear Estimation and Design and Analysis of Experiments*, Wiley Eastern. | | | | |
| Course Summary | Geostatistics is a branch of statistics focused on analysing spatial or geographic data. It integrates statistical techniques with principles from geology and geography to characterize spatial variability, model spatial relationships, and make predictions at unsampled locations. | | | | |

| | |
|---|---|
| | Standard distributions in Statistics refer to common probability distributions that have well-defined mathematical properties and are frequently encountered in statistical analyses. These distributions play a fundamental role in statistical modeling, hypothesis testing and probability theory. Testing is a fundamental aspect of statistical analysis that helps researchers draw conclusions, make decisions, and infer population characteristics based on sample data. Understanding the principles and methods of hypothesis testing is crucial for conducting meaningful and valid statistical research.<br><br>ANOVA or Analysis of Variance is a statistical technique used to analyse the difference between means of three or more groups. It extends the concept of t-tests for comparing means between two groups to situations where there are multiple groups involved. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Introduction to Geostatistics** | **15** |
| | 1 | Geostatistics – introduction, importance and scope | 4 |
| | 2 | Correlation | 4 |
| | 3 | Least square methods | 4 |
| | 4 | Construct regression lines for data set | 3 |
| **II** | | **Standard Distributions** | **15** |
| | 5 | Random variable. | 5 |
| | 6 | Mathematical expectation of a random variable. | 5 |
| | 7 | Binomial, Poisson and Normal distributions. | 5 |
| **III** | | **Introduction to Testing of Hypothesis** | **15** |
| | 8 | Basic concepts of testing | 5 |
| | 9 | Large sample test | 5 |
| | 10 | Small sample test | 5 |
| **IV** | | **Analysis of Variance** | **15** |

| | | | |
|---|---|---|---|
| | 11 | ANOVA for One- way Classification. | 3 |
| | 12 | ANOVA for Two- way Classification. | 3 |
| | 13 | Discriminant analysis | 3 |
| | 14 | Cluster analysis | 3 |
| | 15 | Factor Analysis. | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Explain Correlation, least square method and Regression Analysis. | U, Ap | PSO – 1,2,3,4,5,6 |
| CO-2 | Identify statistical methods generally used in Earth Sciences. | U, Ap | PSO – 1,2,3,4,5,6 |
| CO-3 | Use statistical tools for analysis of data from different areas of geosciences. | U, Ap | PSO – 1,2,3,6 |
| CO-4 | Carry out test of hypothesis. | U, An, Ap | PSO – 1,2,3,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Geostatistics**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | Cos | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Explain Correlation, least square method and Regression | PSO – 1,2,3, 4,5,6 | U, An, Ap | F, C, P | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Analysis. | | | | | |
| CO-2 | Identify statistical methods generally used in Earth Sciences. | PSO – 1,2,3, 4,5,6 | An. R | F, C, P | Lecture | ✓ |
| CO-3 | Use statistical tools for analysis of data from different areas of geosciences. | PSO – 1,2,3, 6 | Ap | F, C, P, M | Lecture | ✓ |
| CO-4 | Carry out test of hypothesis. | PSO – 1,2,3, 4,5,6 | U, An, Ap | F, C, P, M | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 2 | 1 |
| **CO 3** | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |

| | |
|---|---|
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK2MDCSTA154.1** | | | | |
| Course Title | **BASICS OF STATISTICS –II** | | | | |
| Type of Course | **MDC** | | | | |
| Semester | **II** | | | | |
| Academic Level | 100- 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| Pre-requisites | Basic probability | | | | |

**References:**


1. Agarwal, B.L. (1988). *Basic Statistics*. Wiley Eastern Ltd. New Delhi.
2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*, Sultan Chand & Sons, New Delhi.
3. Gupta, S. P (2011). *Statistical Methods*. Sultan Chand & Sons, New Delhi.
4. Kapur, J. N and Saxena, H. C. (1970). *Mathematical Statistics*. Sultan Chand & Sons, New Delhi.
5. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). *Statistics: A Beginners Text Vol- 2*, New Age International (P) Ltd., New Delhi.
6. F. M. Dekkingetal. (2005). *A Modern Introduction to Probability and Statistics*. Springer Verlag, New York. 9
7. Rohatgi,V.K., *An Introduction to Probability Theory and Mathematical Statistics*, Wiley eastern Limited
8. David W. Hosmer and Stanley Lemeshow (2000). *Applied Logistic Regression*. 2nd edition. Wiley series in probability and statistics, New York.

| | |
|---|---|
| Course Summary | Random variables are numerical quantities whose values are determined by the outcome of a random phenomenon. They can take on different values with certain probabilities associated with each value. Random variables can be discrete, where they can only take on distinct, separate values, or continuous, where they can take on any value within a certain range. A probability distribution describes the probabilities of all possible outcomes of a random variable.<br><br>Standard distributions in Statistics refer to common probability distributions that have well-defined mathematical properties and are frequently encountered in statistical analyses. These distributions play a fundamental role in statistical modeling, hypothesis testing and probability theory. Correlation analysis quantifies the strength and direction of the relationship between two variables, while regression analysis models the relationship between a dependent variable and one or more independent variables, providing insights into how changes in the independent variables affect the dependent variable. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Random Experiment** | **11** |
| | 1 | Random experiment | 2 |
| | 2 | Sample space | 2 |
| | 3 | Events and types of events | 2 |
| | 4 | Various definitions of probability, and its properties. | 3 |
| | 5 | Addition theorem of two and three events | 2 |
| **II** | | **Probability Models for Univariate Data** | **12** |
| | 6 | Binomial distribution - mean and variance | 4 |
| | 7 | Poisson distribution - mean and variance | 4 |
| | 8 | Normal distribution - mean and variance | 4 |
| **III** | | **Bivariate Data** | **11** |
| | 8 | Correlation | 2 |
| | 9 | Correlation coefficient | 3 |

| | | | |
|---|---|---|---|
| | 10 | Rank correlation coefficient | 3 |
| | 11 | Coefficient of determination | 3 |
| **IV** | **Regression** | | **11** |
| | 11 | Regression | 8 |
| | 12 | Relationship among correlation coefficient and regression coefficient | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe random experiments and definitions of probability with examples and addition theorem of two and three events. | U, Ap | PSO – 1,2,3 |
| CO-2 | Describe probability model for univariate data and examples based on its applications. | R, U, Ap | PSO – 2,3,5,6 |
| CO-3 | Describe bivariate data- scatter diagram, describe correlation- meaning, types of correlation. Determination of Karl-Pearson's correlation coefficient and coefficient of determination. | U, Ap | PSO – 1,2,3,4,5,6 |
| CO-4 | Analysis of bivariate data- simple linear regression. | U, Ap, An | PSO – 1,2,3,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Basics of Statistics - II**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe random | PSO – | U, Ap | F, C | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | experiments and definitions of probability with examples and addition theorem of two and three events | 1,2,3 | | | | |
| CO-2 | Describe probability model for univariate data and examples based on its applications. | PSO – 2,3,5, 6 | R, U, Ap | F, C, P | Lecture | |
| CO-3 | Describe bivariate data- scatter diagram, describe correlation- meaning, types of correlation. Determination of Karl-Pearson's correlation coefficient and coefficient of determination. | PSO – 1,2,3, 4,5,6 | U, Ap | F, C, P | Lecture | |
| CO-4 | Analysis of bivariate data- simple linear regression. | PSO – 1,2,3, 4,6 | U, Ap, An | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 1 | - | 1 | 3 | 3 | - | 2 | 2 | 3 | 3 |
| **CO 2** | 2 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK2MDCSTA155.2** | | | | |
| Course Title | **BUSINESS STATISTICS AND LOGICAL REASONING - II** | | | | |
| Type of Course | **MDC** | | | | |
| Semester | **II** | | | | |
| Academic Level | 100- 199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| Pre-requisites | Basics of sketching graphs | | | | |
| | Basic probability | | | | |

**Texts:**


1. Elhance. D. L. *Fundamentals of Statistics*, KitabMahal, Allahabad.
2. Gupta. B. N. *Statistics - Theory and Practice*, SahityaBhawan Publications, Agra.
3. Gupta. S.P. *Statistical Methods*, Himalaya Publishing House, Mumbai.
4. Nabendu Pal and Haded Sarkar S.A. *Statistics - Concept and Application*, PHI,New Delhi.
5. Richard I. Levin and David S. Rubin, *Statistics for Management*, Prentice Hall ofIndia, latest edition
6. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics.* Sultan Chand & Sons, New Delhi.


**References:**


1. Agarwal, B.L. (1988). *Basic Statistics*. Wiley Eastern Ltd. New

| | |
|---|---|
| | Delhi.<br>2. Gupta, S. P (2011). *Statistical Methods.* Sultan Chand & Sons, New Delhi.<br>3. Kapur, J. N and Saxena, H. C. (1970). *Mathematical Statistics.* Sultan Chand & Sons, New Delhi.<br>4. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). *Statistics: A Beginners Text Vol- 2*, New Age International (P) Ltd., New Delhi.<br>5. F. M. Dekkingetal. (2005). *A Modern Introduction to Probability and Statistics*. Springer Verlag, New York.<br>6. Rohatgi, V. K. *An Introduction to Probability Theory and Mathematical Statistics*. Wiley eastern Limited.<br>7. Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability and Statistics*. 2nd edition. John Wiley & Sons, Inc., New York. |
| Course Summary | Business statistics involves the application of statistical techniques to solve business problems and make informed decisions. It includes collecting, analysing, and interpreting data related to various aspects of business operations, such as sales, marketing, finance, and operations.<br><br>This paper includes the concept of random variable which is a mathematical concept used in probability theory and statistics to represent numerical outcomes of random experiments or processes. The probability distribution of a random variable specifies the probabilities associated with each possible value that the random variable can take.<br><br>Standard distributions in statistics refer to common probability distributions that have well-defined mathematical properties and are frequently encountered in statistical analyses. These distributions play a fundamental role in statistical modeling, hypothesis testing, and probability theory. Time series analysis involves studying and analysing patterns, trends, and behaviours within the data to make forecasts or derive insights. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Time Series** | | **11** |
| | 1 | Concepts of time series | 3 |
| | 2 | Components of time series | 3 |
| | 3 | Measurement of trends | 5 |
| **II** | **Probability Theory** | | **11** |
| | 4 | Random variable – continuous, discrete | 2 |
| | 5 | Probability mass function and probability distribution function | 3 |
| | 6 | Distribution function | 3 |
| | 7 | Expectation of Random Variables. | 3 |
| **III** | **Standard Distributions** | | **12** |
| | 8 | Binomial distribution - mean and variance | 4 |
| | 9 | Poisson distribution - mean and variance | 4 |
| | 10 | Normal distribution - mean and variance | 4 |
| **IV** | **Logical Reasoning** | | **11** |
| | 11 | Number series | 2 |
| | 12 | Seating arrangements | 3 |
| | 13 | Direction tests | 3 |
| | 14 | Blood relations | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe different components of Time Series. | U, Ap | PSO – 1,2,4,5,6 |

| | | | |
|---|---|---|---|
| CO-2 | Describe basic Probability Theory | R, U, Ap | PSO – 1,2,4 |
| CO-3 | Understand some Standard distributions. | R, U, Ap | PSO – 1,2,3,4,5,6 |
| CO-4 | Understand the concept of Logical Reasoning. | Ap | PSO – 1,2,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Business Statistics and Logical Reasoning - II**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe different components of Time Series. | PSO – 1,2,4,5,6 | U, Ap | F, C | Lecture | |
| CO-2 | Describe basic Probability Theory | PSO – 1,2,4 | R, U, Ap | F, C, P | Lecture | |
| CO-3 | Understand some Standard distributions. | PSO – 1,2,3,4,5,6 | R, U, Ap | F, C, P | Lecture | |
| CO-4 | Understand the concept of Logical Reasoning. | PSO – 1,2,4,5,6 | Ap | C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 3 | 2 | 3 | - | 2 | 3 | 3 | - | 1 | 1 | 1 | - |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 2 | 3 | - | - | - |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| **Discipline** | **STATISTICS** | | | | |
| **Course Code** | **MIUK2MDCSTA156.1** | | | | |
| **Course Title** | **STATISTICS AND RESEARCH METHODOLOGY** | | | | |
| **Type of Course** | **MDC** | | | | |
| **Semester** | **II** | | | | |
| **Academic Level** | 100-199 | | | | |
| **Course Details** | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| **Pre-requisites** | Distribution theory | | | | |
| | **References:**<br>1. Bhattacharya and Sreenivas (1972), *Psychometrics and Behavioural Research*. SterlingPublishers, P. Ltd.<br>2. Gopal, M. H. (1964), *An Introduction to Research Procedure in Social Sciences*. AsiaPublishing House, Mumbai.<br>3. Kothari, C. R. (2001). *Research Methodology-Methods and Techniques*, 2nd Ed. ViswaPrakashan, New Delhi.<br>4. Torgerson, W. (1958). *Theory and methods of Scaling*. John Wiley and Sons, New York. | | | | |
| **Course Summary** | This course provides an introduction to statistical methods and research methodology, focusing on both theoretical foundations and practical applications. Students will learn essential statistical techniques for data analysis and interpretation, as well as key principles and procedures for conducting research in various fields. Students will gain a solid foundation in statistics and research methodology, which enables them to critically | | | | |

| | |
|---|---|
| | evaluate research literature, design their own studies, and conduct data analysis effectively in various fields of study. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Research Methodology** | | **11** |
| | 1 | Objectives of Research | 1 |
| | 2 | Types of Research | 2 |
| | 3 | Steps involved in Scientific Research | 2 |
| | 4 | Formulation of research problems | 2 |
| | 5 | Preparation of research design/research plan | 2 |
| | 6 | Types of Variables | 2 |
| **II** | **Role of Statistics in Research** | | **11** |
| | 7 | Measurement and Scaling | 1 |
| | 8 | Different types of Scaling | 2 |
| | 9 | Scaling of rates and ranks | 1 |
| | 10 | Scaling of judgements | 1 |
| | 11 | Types of Data | 1 |
| | 12 | Definition of statistics | 1 |
| | 13 | Primary and Secondary data | 1 |
| | 14 | Population and Sample | 1 |
| | 15 | Sampling frame | 1 |
| | 16 | Census and Sampling surveys | 1 |
| **III** | **Sampling Design** | | **11** |
| | 17 | Methods of collecting primary data | 1 |
| | 18 | Designing a questionnaire and schedule | 2 |
| | 19 | Collection of Secondary data | 2 |

| | | | |
|---|---|---|---|
| | 20 | Sampling design | 1 |
| | 21 | Sampling and non-sampling errors | 1 |
| | 22 | Selection of sample size | 1 |
| | 23 | steps in sampling design | 1 |
| | 24 | Collection of data | 1 |
| | 25 | Scrutiny of data | 1 |
| **IV** | **Research Report Writing** | | **12** |
| | 26 | Representation of data | 1 |
| | 27 | Classification and Tabulation | 1 |
| | 28 | Descriptive measures | 1 |
| | 29 | Testing of Hypothesis | 2 |
| | 30 | Types of Errors | 2 |
| | 31 | p- value | 2 |
| | 32 | One tailed and two tailed test | 2 |
| | 33 | Interpretation of results and report writing | 1 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Explain the concepts & objectives of research and formulation of research process. | R, U | PSO-1,2 |
| CO-2 | Describe the role of statistics in research. | R, U | PSO-1,2,3 |
| CO-3 | Design a questionnaire & conduct sample survey. | R, U | PSO-1,2,3,4 |
| CO-4 | Explain basic concepts of testing of hypothesis. | R, U, Ap | PSO-1,2,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistics and Research Methodology**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Explain the concepts & objectives of research and formulation of research process. | PSO-1,2 | R, U | F, C | Lecture | |
| CO-2 | Describe the role of statistics in research. | PSO-1,2,3 | R, U | F, C | Lecture | |
| CO-3 | Design a questionnaire & conduct sample survey. | PSO-1,2,3,4 | R, U | F, C | Lecture | |
| CO-4 | Explain basic concepts of testing of hypothesis. | PSO-1,2,5 | R, U, Ap | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 2 | 1 | - | 1 | 3 | 3 | 1 | 1 | 2 | 2 | 2 |
| CO 2 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 2 | 2 | 3 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 4 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 2 | 3 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | | ✓ |
| **CO 2** | ✓ | | | ✓ |
| **CO 3** | ✓ | | | ✓ |
| **CO 4** | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK2MDCSTA157.1** | | | | |
| Course Title | **INTRODUCTION TO DESIGN OF EXPERIMENTS** | | | | |
| Type of Course | **MDC** | | | | |
| Semester | **II** | | | | |
| Academic Level | 100-199 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| Pre-requisites | F - Distribution | | | | |

**References:**


1. Benjamin, B (1960). *Elements of Vital Statistics*. G. Allen & Unwin.
2. S. C. Gupta and V. K. Kapoor (2002)- *Fundamentals of Applied Statistics*. Sultan Chand & Co. New Delhi.
3. Parimal Mukhopadyay. (2005). *Applied Statistics*. Arunabha Sen Books and Allied Ltd. Kolkata.
4. Cochran, W.G and Cox, G.M. (1992). *Experimental Designs*. John Wiley, New York.
5. Das, M.N. and Giri, N. C. (1979). *Design and Analysis of Experiments*. Wiley- Eastern Ltd., New Delhi.
6. Joshi, D. D. (1987). *Linear Estimation and Design of Experiment*. Wiley-Eastern Ltd., New Delhi.
7. Kemthorne, O. (2005) *Design and Analysis of Experiments*. Wiley, New York.

| | |
|---|---|
| Course Summary | Design of experiments (DOE) is a systematic approach to planning, conducting, and analysing experiments to optimize processes, products, or systems. It involves carefully selecting experimental factors and levels, determining the appropriate experimental design (e.g., factorial design, response surface methodology), and allocating resources efficiently to achieve the desired objectives. By varying factors systematically and controlling for potential sources of variability, DOE allows researchers to identify significant factors, interactions, and optimal settings for maximizing desirable outcomes or minimizing variability. Analysis of the experimental data using statistical techniques such as analysis of variance (ANOVA) or regression enables researchers to draw conclusions and make informed decisions based on empirical evidence. DOE is widely used across various industries, including manufacturing, engineering, healthcare, and agriculture, to improve quality, efficiency, and performance while reducing costs and time. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **ANOVA** | **11** |
| | 1 | Basic concepts | 1 |
| | 2 | ANOVA for one way and two-way classification | 4 |
| | 3 | Layout and analysis | 4 |
| | 4 | Principles of experimentation | 2 |
| **II** | | **Basic Designs** | **12** |
| | 5 | Completely Randomised Design-layout and analysis | 2 |
| | 6 | Randomised Block Design -layout and analysis | 2 |
| | 7 | Latin Square Design-layout and analysis | 2 |
| | 8 | Missing plot technique for one or two missing observations | 2 |
| | 9 | Efficiency of RBD over CRD | 2 |
| | 10 | Efficiency of LSD over RBD and LSD over CRD | 2 |
| **III** | | **Factorial Experiments - I** | **11** |

| | | | |
|---|---|---|---|
| | 11 | Basic concepts $2^2$ and $2^n$ factorial experiments. | 3 |
| | 12 | Main effects and interaction effect | 3 |
| | 13 | Confounding | 2 |
| | 14 | Yate's method of analysis | 3 |
| **IV** | **Factorial Experiments - II** | | **11** |
| | 15 | Basic concepts of $3^2$ and $3^n$ factorial experiments | 3 |
| | 16 | Main effects and interaction effects | 3 |
| | 17 | Confounding | 2 |
| | 18 | Yates method of analysis | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Explain the basic concepts, principles of experimental design and ANOVA for One – way and Two – way classification. | R, U, Ap | PSO-1,2,4,5,6 |
| CO-2 | Explain basic designs of experiments. | U, Ap | PSO-1,2 |
| CO-3 | Describe $2^2$ and $2^n$ factorial experiments. | U, Ap | PSO-1,2,3,5 |
| CO-4 | Describe $3^2$ and $3^n$ factorial experiments. | U, Ap | PSO-1,2,3,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Introduction to Design of Experiments**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial | Practical (P) |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | **(T)** | |
| CO-1 | Explain the basic concepts, principles of experimental design and ANOVA for One – way and Two – way classification. | PSO-1,2,4, 5,6 | R, U, Ap | F, C, P | Lecture | |
| CO-2 | Explain basic designs of experiments. | PSO-1,2 | U, Ap | F, C, P | Lecture | |
| CO-3 | Describe $2^2$ and $2^n$ factorial experiments. | PSO-1,2,3, 5 | U, Ap | F, C, P, M | Lecture | |
| CO-4 | Describe $3^2$ and $3^n$ factorial experiments. | PSO-1,2,3, 5 | U, Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO4** | **PSO5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO5** | **PO6** | **PO7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 1 |
| CO 2 | 3 | 3 | 2 | 1 | 2 | 1 | 3 | 3 | 1 | 2 | 2 | 2 | 1 |
| CO 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 2 |
| CO 4 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 2 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|

| | |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

**COURSES OFFERING – SEMESTER III**

| COURSE TYPE | MAJOR (STUDENTS) | COURSE TITLE | CREDITS |
|---|---|---|---|
| DSE | STATISTICS | Time Series Analysis | 4 |
| DSC | STATISTICS | Statistical Methods - II | 4 |
| DSC | SCIENCES (PHYSICS, CHEMISTRY, ZOOLOGY, BOTANY, BIO-TECHNOLOGY AND CS) | Statistical Inference | 4 |
| DSC | HUMANITIES AND COMMERCE | Introduction to Index Numbers and Time Series Analysis | 4 |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK3DSESTA200.1</td></tr>
<tr><td>Course Title</td><td colspan="5">TIME SERIES ANALYSIS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 – 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basics of sketching graphs</td></tr>
<tr><td></td><td colspan="5">References:<br>1. Agarwal, B.L. (1988). Basic Statistics. Wiley Eastern Ltd. New Delhi.<br>2. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.<br>3. Gupta, S. P (2011). Statistical Methods. Sultan Chand & Sons, New Delhi.<br>4. Kapur, J. N and Saxena, H. C. (1970). Mathematical Statistics. Sultan Chand & Sons, New Delhi.</td></tr>
<tr><td>Course Summary</td><td colspan="5">Time series analysis is a statistical technique used to analyse sequential data points collected over time. It involves identifying patterns, trends, and relationships within the data to make predictions or understand underlying dynamics. Key components include data visualization, trend analysis, seasonality detection, and forecasting methods. It's widely used in economics, finance, weather forecasting, and many other fields where understanding and predicting trends over time is crucial.</td></tr>
</table>

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Time Series** | | **15** |
| | 1 | Concepts of time series | 7 |
| | 2 | Components of Time series | 8 |
| **II** | **Concepts of Trend in Time Series** | | **15** |
| | 3 | Measurement of trend using graphical method | 3 |
| | 4 | Measurement of trend using semi-average method | 4 |
| | 5 | Measurement of trend using moving average methods | 4 |
| | 6 | Measurement of trend using method of least squares | 4 |
| **III** | **Concepts of Seasonal Variation** | | **15** |
| | 7 | Seasonal variation | 3 |
| | 8 | Measurement of seasonal variation using method of simple averages. | 6 |
| | 9 | Measurement of seasonal variation using ratio to trend method. | 6 |
| **IV** | **Measurement of Seasonal Variation** | | **15** |
| | 10 | Measurement of seasonal variation using ratio to moving average method. | 7 |
| | 11 | Measurement of seasonal variation using method of link relatives. | 8 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand the concepts time series | R, U | PSO - 1 |
| CO-2 | Evaluate the components of time series. | U, Ap | PSO - 1,2 |

| | | | |
|---|---|---|---|
| CO-3 | Understand and apply different forecasting methods to estimate trend and seasonal effect. | U, Ap | PSO - 1,2 |
| CO-4 | Understand and apply different forecasting methods to estimate seasonal effect. | U, Ap | PSO - 1,2,4 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Time Series Analysis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Understand the concepts time series | PSO - 1 | R, U | C | Lecture | |
| CO-2 | Evaluate the components of time series. | PSO - 1,2 | U, Ap | C, P | Lecture | |
| CO-3 | Understand and apply different forecasting methods to estimate trend. | PSO - 1,2 | U, Ap | F, C, P | Lecture | |
| CO-4 | Understand and apply different forecasting methods to estimate seasonal effect. | PSO - 1,2,4 | U, Ap | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | - | - | 1 | 3 | 2 | - | 1 | - | 1 | - |
| **CO 2** | 3 | 3 | 1 | - | 2 | - | 3 | 3 | - | 1 | 2 | 2 | - |
| **CO 3** | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 3 | 1 | - | 2 | 2 | 1 |
| **CO 4** | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 3 | 1 | - | 1 | 2 | 1 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK3DSCSTA201.1</td></tr>
<tr><td>Course Title</td><td colspan="5">STATISTICAL METHODS-II</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 – 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Concepts of random variables</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). Statistics: A Beginners Text Vol- 2, New Age International (P) Ltd., New Delhi and Statistics. Springer Verlag, New York.<br><br>2. Goon A. M., Gupta N.K., Das Gupta B. (1999). Fundamentals of Statistics. Vol. 2, World Press, Kolkatta.<br><br>3. Hogg, R.V. and Craig, A.T. (1970). Introduction to Mathematical Statistics. Pearson Education Pvt. Ltd, UK.<br><br>4. Mukhopadhaya, P. (1996). Mathematical Statistics. New Central Book Agency (P) Ltd., Calcutta.<br><br>5. Rohatgi, V.K. An Introduction to Probability Theory and Mathematical Statistics.Wiley eastern Limited.<br><br>6. Rohatgi, V. K and Saleh, A.K.MD. (2001). An Introduction to Probability and Statistics. 2nd edition. John</td></tr>
</table>

| | |
|---|---|
| | Wiley & Sons, Inc., New York<br><br>7. David W. Hosmer and Stanley Lemeshow (2000) *Applied Logistic Regression*. 2nd edition. Wiley series in probability and statistics, New York<br><br>8. Gupta S. C. and Kapoor, V. K. (1984). *Fundamentals of Mathematical Statistics*, Sulthan Chand & Co. 3rd edition. New Delhi<br><br>9. Saxena H.C. (1983). *Elementary Statistics*. S. Chand & Co., New Delhi. ISBN- 9788121909259 |
| Course Summary | Generating functions are mathematical tools used in combinatorics and probability theory to represent sequences of numbers or coefficients. They can help in solving problems related to counting, probability distributions, and recurrence relations.<br><br>Correlation measures the strength and direction of the linear relationship between two variables. It quantifies how change in one variable are associated with changes in another variable.<br><br>Curve fitting involves finding a mathematical function (curve) that best represents a set of data points. It aims to approximate the relationship between variables and minimize the error between observed and predicted values.<br><br>Regression analysis is a statistical method used to model and analyse the relationship between a dependant variable (response variable) and one or more independent variables (predictor variables).<br><br>These topics are interconnected and form the basis of data analysis, modeling, and inference in various scientific, engineering, and statistical applications. Understanding these concepts helps in making informed decisions, deriving meaningful insights from data, and building predictive models. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Generating Functions** | **15** |
| | 1 | Probability generating function | 3 |

| | | | |
|---|---|---|---|
| | 2 | Moment generating function | 3 |
| | 3 | Characteristic function | 3 |
| | 4 | Cumulant generating function | 3 |
| | 5 | Bivariate moment generating function | 3 |
| **II** | | **Concept of Correlation** | **15** |
| | 6 | Concept of Correlation | 3 |
| | 7 | Coefficient of Correlation | 4 |
| | 8 | Rank Correlation Coefficient | 4 |
| | 9 | Tied Ranks | 4 |
| **III** | | **Curve Fitting** | **15** |
| | 10 | Association of attributes | 3 |
| | 11 | Partial and multiple correlation for three variables. | 4 |
| | 12 | Concepts of curve fitting | 4 |
| | 13 | Principle of Least Squares | 4 |
| **IV** | | **Regression Analysis** | **15** |
| | 14 | Regression equations by Method of Least Squares | 4 |
| | 15 | Linear Regression Coefficient | 4 |
| | 16 | Angle between regression lines | 3 |
| | 17 | Coefficient of determination | 4 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Understand various generating functions and its properties. | U, Ap, An | PSO - 1 |

| | | | |
|---|---|---|---|
| CO-2 | Understand the concept of correlation and compute Karl Pearson's correlation coefficient and Spearman Rank correlation coefficient. | U, Ap | PSO - 1,2 |
| CO-3 | Understand the concept of curve fitting. | U. Ap | PSO - 1,2 |
| CO-4 | Fit the regression equations using the method of least squares | U, Ap | PSO - 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistical Methods - II**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Understand various generating functions and its properties. | PSO - 1 | U, Ap, An | F, C, P | Lecture | |
| CO-2 | Understand the concept of correlation and compute Karl Pearson's correlation coefficient and Spearman Rank correlation coefficient. | PSO - 1,2 | U, Ap | F, C, P | Lecture | |
| CO-3 | Understand the concept of curve fitting. | PSO - 1,2 | U. Ap | F, C, P | Lecture | |
| CO-4 | Fit the regression equations using the method of least | PSO - 1,2 | U, Ap | F, C, P, M | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | squares | | | | | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | - | 1 | - | 2 | 1 | 3 | - | 3 | 1 | 2 | 2 | - |
| **CO 2** | 3 | 3 | 2 | 2 | 1 | - | 3 | 3 | 1 | - | 2 | 3 | 1 |
| **CO 3** | 3 | 3 | 2 | 1 | 3 | 1 | 3 | 3 | 1 | 3 | 2 | 1 | - |
| **CO 4** | 3 | 3 | 1 | 2 | 2 | 1 | 3 | 3 | - | 3 | 3 | 3 | 1 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK3DSCSTA202.1** | | | | |
| Course Title | **STATISTICAL INFERENCE** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **III** | | | | |
| Academic Level | 200 - 299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic distribution theory | | | | |

**References:**


1. Goon, A.M, Gupta, M.K and Das Gupta (1994), *An outline of statistical theory Vol-I*, World Press Calcutta.
2. Gupta, S.C and Kapoor, V.K (2002). *Fundamentals of Mathematical Statistics*, Sultan Chands.
3. Hogg, R.V., Craig, A.J. (2011). *Introduction to Mathematical Statistics*, 4th edition, Collier McMillan.
4. Mood, A.M, Graybill, F.A. and Bose, D.P. (1972). *Introduction to theory of statistics*, 3rd edition–Mc Graw Hill.
5. Rohatgi, V.K. (1984). *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern, New York.
6. Rohatgi, V.K and Saleh, A.K. MD. (2001). *An Introduction to Probability and Statistics*, II edition. John Wiley & Sons, Inc., New York.
7. Wilks, S.S(1962). *Mathematical Statistics*, John Wiley, New York.

| | |
|---|---|
| Course Summary | Statistical inference is a crucial aspect of data analysis, allowing researchers to draw conclusions about populations based on sample data. It involves using probability theory to make inferences about parameters or hypotheses. Hypothesis testing is a common technique in statistical inference, where researchers test hypotheses about population parameters, such as means or proportions, using sample data. ANOVA extends the concept of t-tests for comparing means between two groups to situations where there are multiple groups involved. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Fundamental Concepts of Testing** | **15** |
| | 1 | Introduction to testing of hypotheses. | 3 |
| | 2 | Types of hypotheses | 3 |
| | 3 | Types of errors | 3 |
| | 4 | Level of significance | 3 |
| | 5 | Power of a test | 3 |
| **II** | | **Large Sample Test** | **15** |
| | 6 | Testing the significance of mean of a population | 3 |
| | 7 | Testing the significance of difference between two means | 3 |
| | 8 | Testing the significance of proportion of a population | 3 |
| | 9 | Testing the significance of difference between two proportions | 3 |
| | 10 | Tests based on chi-square distribution – testing of goodness of fit, testing the independence of attributes | 3 |
| **III** | | **Small Sample Test** | **15** |
| | 11 | Test for mean – one sample and two sample cases | 5 |
| | 12 | Paired - t test. | 5 |
| | 13 | Testing Correlation Coefficient | 5 |

| | | | |
|---|---|---|---|
| **IV** | **ANOVA** | | **15** |
| | 14 | Testing of equality of multiple means | 5 |
| | 16 | ANOVA-One way | 5 |
| | 17 | ANOVA-Two way | 5 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe the fundamental concept of testing. | U, Ap | PSO - 1 |
| CO-2 | Apply large sample tests. | Ap, An | PSO - 1,2 |
| CO-3 | Apply small sample tests. | Ap, An | PSO - 1,2 |
| CO-4 | Explain the concept of ANOVA for One - way and Two - way classified data. | U, Ap | PSO - 1,2,4,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistical Inference**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| **CO No.** | **CO** | **PSO** | **Cognitive Level** | **Knowledge Category** | **Lecture (L)/Tutorial (T)** | **Practical (P)** |
|---|---|---|---|---|---|---|
| CO-1 | Describe the fundamental concept of testing. | PSO - 1 | U, Ap | F, C | Lecture | ✓ |
| CO-2 | Apply large sample tests. | PSO - 1,2 | Ap, An | F, C, P, M | Lecture | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO-3 | Apply small sample tests. | PSO - 1,2 | Ap, An | F, C, P, M | Lecture | ✓ |
| CO-4 | Explain the concept of ANOVA for One - way and Two - way classified data. | PSO - 1,2,4, 5 | U, Ap | F, C, P, M | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | - | 2 | 1 | 3 | 2 | 1 | - | 2 | - | - |
| **CO 2** | 3 | 3 | 1 | 1 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 3 | 1 |
| **CO 3** | 3 | 3 | 1 | 1 | 2 | 1 | 3 | 3 | 2 | 2 | 2 | 3 | 1 |
| **CO 4** | 3 | 3 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 2 | 2 | 3 | 1 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar

- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK3DSCSTA203.1</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTION TO INDEX NUMBERS AND TIME SERIES ANALYSIS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">III</td></tr>
<tr><td>Academic Level</td><td colspan="5">200 – 299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td rowspan="2">Pre-requisites</td><td colspan="5">Basic Arithmetical Operations</td></tr>
<tr><td colspan="5">Basics of Sketching graphs</td></tr>
<tr><td></td><td colspan="5">References:<br>1. Agarwal, B.L. (1988). Basic Statistics. Wiley Eastern Ltd. New Delhi.<br>2. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.<br>3. Gupta, S. P (2011). Statistical Methods. Sultan Chand & Sons, New Delhi.<br>4. Kapur, J. N and Saxena, H. C. (1970), Mathematical Statistics, Sultan Chand & Sons, New Delhi.</td></tr>
<tr><td>Course Summary</td><td colspan="5">Index numbers and time series analysis are fundamental tools in statistics and economics, serving to quantify and analyse trends and changes over time. Index numbers provide a standardized way to measure changes in variables such as prices, quantities, or economic indicators relative to a base period. They are</td></tr>
</table>

| | |
|---|---|
| | crucial for monitoring inflation, assessing economic performance, and comparing trends across different time periods or regions. Time series analysis, on the other hand, focuses on analysing sequential data points collected over time to identify patterns, trends, and relationships. It involves techniques such as data visualization, trend analysis, seasonality detection, and forecasting methods. Time series analysis is widely used in forecasting future values, understanding economic fluctuations, and making informed decisions in finance, economics, and various other fields where understanding and predicting trends over time is essential. Together, index numbers and time series analysis provide powerful tools for understanding and interpreting data in a dynamic and evolving world. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Index Numbers** | | **15** |
| | 1 | Introduction to Index Numbers | 3 |
| | 2 | Types of Index Numbers | 4 |
| | 3 | Methods of construction of Index Numbers | 4 |
| | 4 | Various tests on index numbers | 4 |
| **II** | **Time Series Analysis** | | **15** |
| | 5 | Concept of Time series | 5 |
| | 6 | Components of Time series. | 10 |
| **III** | **Concepts of Trend in Time Series** | | **15** |
| | 7 | Measurement of trend using graphical method | 3 |
| | 8 | Measurement of trend using semi-average method | 4 |
| | 9 | Measurement of trend using moving average method | 4 |
| | 10 | Measurement of trend using method of least squares | 4 |
| **IV** | **Concepts of Seasonal Variation** | | **15** |
| | 11 | Measurement of seasonal variation using method of simple averages. | 3 |
| | 12 | Measurement of seasonal variation using ratio to trend method. | 4 |

| | | | |
|---|---|---|---|
| | 13 | Measurement of seasonal variation using ratio to moving average method. | 4 |
| | 14 | Measurement of seasonal variation using method of link relatives. | 4 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Identify the various index numbers and compute them for datasets. | U, Ap, E | PSO - 1,2 |
| CO-2 | Understand the concepts of time series. | R, U | PSO - 1 |
| CO-3 | Understand and apply different forecasting methods to estimate trends. | U, Ap, An | PSO - 1,2 |
| CO-4 | Understand and apply different forecasting methods to estimate seasonal effect. | U, Ap, An | PSO - 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Introduction to Index Numbers and Time Series Analysis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Identify the various index numbers and compute them for datasets. | PSO - 1,2 | U, Ap, E | F, C, P | Lecture | |
| CO-2 | Understand the | PSO - | R, U | F, C | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | concepts of time series. | 1 | | | | |
| CO-3 | Understand and apply different forecasting methods to estimate trends. | PSO - 1,2 | U, Ap, An | F, C, P | Lecture | |
| CO-4 | Understand and apply different forecasting methods to estimate seasonal effect. | PSO - 1,2 | U, Ap, An | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | - | - | 2 | 2 | 3 | 3 | 2 | 1 | 1 | 1 | - |
| **CO 2** | 3 | - | 1 | 1 | 2 | 1 | 3 | - | - | 2 | 2 | - | - |
| **CO 3** | 3 | 3 | - | 2 | 2 | 1 | 2 | 3 | - | - | 2 | 2 | 1 |
| **CO 4** | 3 | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 1 | 1 | 2 | 2 | 1 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

**COURSES OFFERING – SEMESTER IV**

| COURSE TYPE | MAJOR (STUDENTS) | COURSE TITLE | CREDITS |
|---|---|---|---|
| DSC | STATISTICS | Distribution Theory -I | 4 |
| DSC | STATISTICS | Estimation | 4 |
| DSE | STATISTICS | Machine Learning | 4 |
| DSE | STATISTICS | Introduction to Data Analysis Softwares | 4 |
| SEC | STATISTICS AND OTHER SUBJECTS | Advanced Technologies in Statistical Analysis | 3 |
| VAC | ALL SUBJECTS | | 3 |
| VAC | ALL SUBJECTS | | 3 |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK4DSCSTA250.1</td></tr>
<tr><td>Course Title</td><td colspan="5">DISTRIBUTION THEORY – I</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSC</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Academic Level</td><td colspan="5">200-299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td rowspan="2">Pre-requisites</td><td colspan="5">Probability</td></tr>
<tr><td colspan="5">Mathematical Expectation</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Bhat, B. R., Sri. Venkata Ramana T and Rao Madhava K. S. (1977). Statistics: A Beginners Text Vol- 2, New Age International (P) Ltd., New Delhi.<br><br>2. F. M. Dekkingetal. (2005). A Modern Introduction to Probability and Statistics. Springer Verlag, New York. 9<br><br>3. Goon A. M., Gupta N.K., Das Gupta B. (1999). Fundamentals of Statistics. Vol. 2 World Press, Kolkatta.<br><br>4. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Mathematical Statistics, Sulthan Chand, New Delhi.<br><br>5. Hogg, R.V. and Craig, A.T. (1970). Introduction to Mathematical Statistics. Pearson Education Pvt. Ltd, UK.<br><br>6. Mukhopadhaya, P. (1996). Mathematical Statistics. New Central Book Agency (P) Ltd., Calcutta.<br><br>7. Rohatgi, V. K. An Introduction to Probability Theory and Mathematical Statistics. Wiley eastern Limited.</td></tr>
</table>

| | |
|---|---|
| | 8. Rohatgi, V. K and Saleh, A.K.MD. (2001). An *Introduction to Probability and Statistics*. 2nd edition. John Wiley & Sons, Inc., New York.<br><br>9. Wilks, S.S. (1964*). Mathematical Statistics*, John Wiley, New York. |
| Course Summary | Distribution theory is a fundamental aspect of statistics, providing the foundation for understanding the behaviour of random variables and the probability distributions they follow. It encompasses various probability distributions, including the normal distribution, binomial distribution, Poisson distribution, and many others, each with its own characteristics and applications. Distribution theory enables statisticians to model and analyse real-world phenomena, make probabilistic statements about outcomes, and perform statistical inference. Understanding distribution theory is essential for effectively applying statistical methods, interpreting results, and drawing meaningful conclusions from data in fields ranging from finance and economics to biology and engineering. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Discrete Probability Distributions-I** | | **15** |
| | 1 | Degenerate distribution | 2 |
| | 2 | Bernoulli distribution | 2 |
| | 3 | Binomial distribution | 3 |
| | 4 | Poisson distribution | 2 |
| | 5 | Recurrence relations for binomial and Poisson. | 2 |
| | 6 | Fitting of binomial and Poisson. | 4 |
| **II** | **Discrete Probability Distributions-II** | | **15** |
| | 7 | Negative Binomial Distribution | 5 |
| | 8 | Geometric Distribution | 5 |
| | 9 | Hyper geometric Distribution | 5 |
| **III** | **Continuous Probability Distributions-I** | | **15** |
| | 10 | Uniform Distribution | 3 |
| | 11 | Triangular Distribution | 3 |
| | 12 | Exponential Distribution | 3 |

| | | | |
|---|---|---|---|
| | 13 | Beta Distributions | 3 |
| | 14 | Gamma Distributions | 3 |
| **IV** | **Continuous Probability Distributions-II** | | **15** |
| | 15 | Normal distribution- Mean and Variance | 3 |
| | 16 | Median and Mode of Normal Distribution | 2 |
| | 17 | Moment generating function of normal distribution | 2 |
| | 18 | Linear combinations of independent normal variates | 2 |
| | 19 | Standard normal distributions | 3 |
| | 20 | Fitting of normal distributions | 3 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe and analyse the univariate discrete distributions-Degenerate, Bernoulli, Binomial, Poisson | An. R | PSO - 1,2 |
| CO-2 | Describe and analyse the univariate discrete distributions- Geometric, Negative binomial and Hyper Geometric. | An. R | PSO - 1,2 |
| CO-3 | Describe the univariate continuous distributions- Uniform, Triangular, Exponential, Beta – I & II kind, Gamma. | An, Ap, R | PSO - 1,2,4 |
| CO-4 | Describe the normal distribution-Calculate raw moments and central moments, including their special case, the mean and variance. Calculate the moment generating function and appreciate its link to moments. | An, Ap, U | PSO - 1,2,3,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Distribution Theory -I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| **CO No.** | **CO** | **PSO** | **Cognitive Level** | **Knowledge Category** | **Lecture (L)/Tutorial** | **Practical (P)** |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | **(T)** | |
| CO-1 | Describe and analyse the univariate discrete distributions- Degenerate, Bernoulli, Binomial, Poisson | PSO - 1,2 | An. R | F, C, P | Lecture | ✓ |
| CO-2 | Describe and analyse the univariate discrete distributions- Geometric, Negative binomial and Hyper Geometric. | PSO - 1,2 | An. R | F, C, P | Lecture | |
| CO-3 | Describe the univariate continuous distributions- Uniform, Triangular, Exponential, Beta – I & II kind, Gamma. | PSO - 1,2,4 | An, Ap, R | F, C, P | Lecture | |
| CO-4 | Describe the normal distribution- Calculate raw moments and central moments, including their special case, the mean and variance. Calculate the moment generating function and | PSO - 1,2,3,6 | An, Ap, U | F, C, P, M | Lecture | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | appreciate its link to moments. | | | | | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 2 | - | - | 3 | 3 | - | 1 | 1 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 1 | 2 | 1 | 3 | - | 3 | 2 | 2 | 2 | 1 |
| **CO 3** | 3 | 3 | - | 3 | - | 2 | 3 | 3 | 1 | 2 | 2 | 2 | - |
| **CO 4** | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 3 | - | 2 | 2 | 3 | 1 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK4DSCSTA251.1** | | | | |
| Course Title | **ESTIMATION** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **IV** | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Distributions | | | | |
| | **References**<br><br>1. Gupta,S. C and Kapoor, V.K (2002), *Fundamentals of Mathematical Statistics*, Amerind Publishing Co. Pvt. Ltd.<br><br>2.Hogg, R. V and Craig, A. T (1970). *Introduction to Mathematical Statistics*, Amerind Publishing Co. Pvt. Ltd.<br><br>3.Joshi, D.D. (1987). *Linear Estimation and Design of Experiments*. Wiley Eastern Ltd., New Delhi.<br><br>4.Mukhopadhaya. P. (1996). *Mathematical Statistics*, New Central Book Agency (P) Ltd., Calcutta.<br><br>5.Rohatgi, V.K. *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd.<br><br>6.Rohatgi, V. K and Saleh, A.K.MD. (2001). *An Introduction to Probability and Statistics*, 2ndedition. John Wiley & Sons, Inc, New York. | | | | |
| Course Summary | Estimation of statistics involves methods for estimating unknown parameters or characteristics of populations based on sample data. Point estimation aims to provide a single value as an estimate of the parameter, such as the sample mean or proportion. Interval estimation, on the other hand, provides a range of plausible values for the parameter, typically | | | | |

| | |
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| | accompanied by a confidence level. Common estimation techniques include maximum likelihood estimation, method of moments, and Bayesian estimation. These methods are essential for making informed decisions, drawing conclusions about populations, and quantifying uncertainty in statistical analysis. Estimation statistics plays a central role in various fields, including science, engineering, finance, and social sciences, where accurate estimation of parameters is crucial for decision-making. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Point Estimation** | **15** |
| | 1 | Problem of point estimation | 3 |
| | 2 | Estimator and estimate | 3 |
| | 3 | Unbiasedness | 3 |
| | 4 | Consistency | 3 |
| | 5 | Sufficient condition for consistency and its use | 3 |
| **II** | | **Sufficiency** | **15** |
| | 6 | Factorization theorem and its application | 4 |
| | 7 | Efficiency | 2 |
| | 8 | Minimum variance unbiased estimator | 3 |
| | 9 | Cramer-Rao inequality and its application | 3 |
| | 10 | Minimum variance bound estimator | 3 |
| **III** | | **Interval Estimation** | **15** |
| | 11 | Confidence interval | 4 |
| | 12 | Confidence coefficient | 3 |
| | 13 | Constructing confidence intervals for each of the mean | 4 |
| | 14 | Variance and proportion of a population | 4 |
| **IV** | | **Methods of Estimation** | **15** |
| | 15 | Methods of moments | 2 |
| | 16 | Properties of moment estimator | 3 |

| | | | |
|---|---|---|---|
| | 17 | Method of maximum likelihood | 5 |
| | 18 | Properties of likelihood estimator | 3 |
| | 19 | Methods of least squares | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Define the concept of Estimation. | R | PSO - 1,2 |
| CO-2 | Define the desirable properties of a good estimator and explain whether an estimator satisfy any of the desirable properties or not. | Ap, R | PSO - 1,2,4 |
| CO-3 | Construct confidence intervals for mean, variance, proportion in population, difference between means and difference between proportions in two populations. | Ap | PSO - 1,2 |
| CO-4 | Study different methods of Estimation and their properties. | An, Ap, R | PSO - 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Estimation**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Define the concept of Estimation. | PSO - 1,2 | R | F, C, P | Lecture | ✓ |
| CO-2 | Define the desirable properties of a good estimator and explain whether an estimator satisfy any of the desirable properties or not. | PSO - 1,2,4 | Ap, R | F, C, P, M | Lecture | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO-3 | Construct confidence intervals for mean, variance, proportion in population, difference between means and difference between proportions in two populations. | PSO - 1,2 | Ap | F, C, P | Lecture | ✓ |
| CO-4 | Study different methods of Estimation and their properties. | PSO - 1,2 | An, Ap, R | F, C, P, M | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 1 | 2 | | 3 | 3 | - | - | 2 | 2 | - |
| **CO 2** | 3 | 3 | 2 | 3 | 2 | 1 | 2 | 3 | - | - | 2 | 2 | 1 |
| **CO 3** | 3 | 3 | 2 | 2 | - | - | 3 | 3 | 1 | 2 | 2 | 2 | 1 |
| **CO 4** | 3 | 3 | 1 | - | - | 1 | 3 | 3 | 2 | 1 | 1 | 1 | - |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam

- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK4DSESTA252.1** | | | | |
| Course Title | **MACHINE LEARNING** | | | | |
| Type of Course | **DSE** | | | | |
| Semester | **IV** | | | | |
| Academic Level | 200-299 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | NIL | | | | |

**Texts:**


1. Alpaydin, E. (2009). *Introduction to machine learning*. MIT press.
2. Trevor, H., Robert, T., & JH, F. (2009). *The elements of statistical learning: data mining, inference, and prediction.*
3. Gupta, G.K. (2008): *Introduction to Data Mining with case studies*, Prentice – Hall of India Pvt. Ltd.


**References:**


1. Bhat, B. R. (1985). *Modern Probability Theory: An Introductory Text Book*, 2nd Edition, Wiley Eastern.
2. Brian Coffo. *Statistical Inference for Data Science.*
3. Tan, T., Steinbach, M. and Kumar, V. (2006): *Introduction to Data Mining*, Pearson Education.

| | |
|---|---|
| | 4. Daniel T. Larose (2006): *Data Mining: Methods and Models*, John Wiley and sons. (relevant portions of Chapter 4). |
| Course Summary | Machine learning is a branch of artificial intelligence that focuses on developing algorithms and models that enable computers to learn from and make predictions or decisions based on data. It encompasses a wide range of techniques, including supervised learning, unsupervised learning, and reinforcement learning. In supervised learning, algorithms are trained on labelled data to make predictions or classify new data points. Unsupervised learning involves extracting patterns and structures from unlabelled data, while reinforcement learning involves training agents to make sequential decisions through trial and error. Machine learning algorithms adapt and improve their performance over time as they are exposed to more data, enabling them to tackle complex problems such as image recognition, natural language processing, recommendation systems, and autonomous driving. With its ability to uncover insights and patterns from vast amounts of data, machine learning has become a transformative technology with applications across industries, driving innovation, efficiency, and decision-making processes. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Machine Learning** | | **15** |
| | 1 | Machine learning | 2 |
| | 2 | Supervised learning | 3 |
| | 3 | Unsupervised learning | 3 |
| | 4 | Semi supervised learning | 2 |
| | 5 | Vapnik- Chervomenkis (VC) dimension | 2 |
| | 6 | Probably Approximately Correct (PAC) learning | 3 |
| **II** | **Bayesian Estimation** | | **15** |
| | 7 | Model selection and Generalization | 1 |
| | 8 | Bayesian Decision Theory | 2 |
| | 9 | Utility Theory | 1 |

| | | | |
|---|---|---|---|
| | 10 | Association Rules | 2 |
| | 11 | Parametric methods-Maximum Likelihood Estimation, | 2 |
| | 12 | Evaluating an estimator- Bias and variance | 2 |
| | 13 | The Bayes' estimator | 1 |
| | 14 | Parametric classification | 1 |
| | 15 | Regression | 2 |
| | 16 | Tuning Model complexity | 1 |
| **III** | **Introduction to Data Mining** | | **15** |
| | 17 | Data reduction and classification | 1 |
| | 18 | Introduction to data mining | 2 |
| | 19 | Clustering | 6 |
| | 20 | k-means clustering | |
| | 21 | Nearest neighbour method | |
| | 22 | Supervised learning after Clustering | |
| | 23 | Hierarchical Clustering | |
| | 24 | Decision trees | 2 |
| | 25 | Neural Network | 2 |
| | 26 | Random forests | 2 |
| **IV** | **Data Analytics** | | **15** |
| | 27 | Support vector machine | 1 |
| | 28 | Naïve Bayes Classifier | 2 |
| | 29 | Components of Data Architecture | 1 |
| | 30 | Data Warehouse | 1 |
| | 31 | Column oriented data structure | 2 |
| | 32 | Parallel v/s Distributed Computing | 2 |
| | 33 | Data validation | 1 |

| | | | |
|---|---|---|---|
| | 34 | Model Building | 1 |
| | 35 | Transduction | 1 |
| | 36 | Reinforcement learning | 1 |
| | 37 | Training Data | 1 |
| | 38 | Use of regression and classification methods for implementation. | 1 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Understand the various applications of Machine Learning and the different types of Learning Algorithms. | U | PSO - 1,2 |
| CO-2 | Apply various Machine Learning techniques as per the requirements. | U, Ap | PSO - 1 |
| CO-3 | Describe data and calculate the number of clusters based on the various clustering algorithms. | U, Ap | PSO - 1,3 |
| CO-4 | Have a better understanding of SVM and analyse data using data validation techniques. | U, Ap, E | PSO - 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Machine Learning**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Understand the various applications of Machine Learning | PSO - 1,2 | U | F, C | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | and the different types of Learning Algorithms. | | | | | |
| CO-2 | Apply various Machine Learning techniques as per the requirements. | PSO - 1 | U, Ap | F, C, P | Lecture | |
| CO-3 | Describe data and calculate the number of clusters based on the various clustering algorithms. | PSO - 1,3 | U, Ap | F, C | Lecture | |
| CO-4 | Have a better understanding of SVM and analyse data using data validation techniques. | PSO - 1,2 | U, Ap, E | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | - | - | 1 | 3 | 3 | 1 | - | 2 | 2 | 1 |
| **CO 2** | 3 | 2 | 1 | - | 2 | 1 | 3 | 3 | - | 2 | 2 | 2 | 1 |
| **CO 3** | 3 | 1 | 3 | 2 | 2 | - | 3 | 3 | 1 | 1 | 2 | 2 | 1 |
| **CO 4** | 3 | 3 | 1 | 2 | 1 | 2 | 3 | 3 | 1 | 2 | 1 | 2 | - |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK4SECSTA253.1</td></tr>
<tr><td>Course Title</td><td colspan="5">INTRODUCTION TO DATA ANALYSIS SOFTWARES</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Academic Level</td><td colspan="5">200-299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Computer Knowledge</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Brace, Nicola, (2006) SPSS for psychologists 5th ed, BF39.B73 2013.<br>2. Argyrous, D. G. (2011), Statistics for Research: With a Guide to SPSS, UnitedKingdom: SAGE Publications.<br>3. Remenyi D., English J., Onofrei G. (2022), An Introduction to Statistics using Microsoft Excel, South Africa: University Press of University of Johannesburg.<br>4. Bennett K., Heritage B., Allen P. (2022), SPSS Statistics: A Practical Guide_ Fifth Edition. Australia: Cengage Learning Australia.<br>5. Cody R, (2021), A Gentle Introduction to Statistics Using SAS Studio in theCloud, United States: SAS Institute.<br>6. https://www.ibm.com/docs/SSLVMB_29.0.0/pdf/IBM_SPSS_Statistics_Core_Syste m_User_Guide.pdf<br>7. https://cedar.princeton.edu/sites/g/files/toruqf1076/files/media/introduction_to_tablea u_training_0.pdf</td></tr>
<tr><td>Course Summary</td><td colspan="5">The first module provides a comprehensive understanding of fundamental spreadsheet operations. Students learn various selection techniques and shortcut keys for mathematical functions like Sum, Average, Max, Min, Count, Counta, SumIf, and CountIf. Formatting techniques including Currency, Number, Font, Alignment, and Borders are covered, alongside</td></tr>
</table>

| | |
|---|---|
| | text functions such as Upper, Lower, Proper, Left, Mid, Right, Trim, Len, and Exact. Additionally, the course introduces Tableau, exploring its interface, connecting to data sources including Excel and Text Files, creating folders, sorting data, and generating visualizations like charts and graphs. Furthermore, students delve into SPSS, gaining insights into importing data, coding and decoding variables, scaling variables, visualizing data, and conducting descriptive statistics. Lastly, the course offers an introduction to the Statistical Analysis System (SAS), covering its environment, data step programming for reading, manipulating, and combining data, data management techniques like sorting and merging, formatting data, and basic statistical analysis focusing on descriptive statistics. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Advanced Excel** | | **15** |
| | 1 | An Overview of basic Spread sheet Concepts | 3 |
| | 2 | Various Selection Techniques | 3 |
| | 3 | Shortcut Keys for Mathematical Functions- Sum, Average, Max, Min, Count, Counta, SumIf, CountIf. | 3 |
| | 4 | Format - Currency, Number, Font, Alignment and Borders | 3 |
| | 5 | Text Function- Upper, Lower, Proper, Left, Mid, Right, Trim, Len, Exact | 3 |
| **II** | **Tableau** | | **15** |
| | 6 | Introduction to Tableau interface | 1 |
| | 7 | Connecting to data sources | 2 |
| | 8 | Excel Files | 2 |
| | 9 | TextFiles | 2 |
| | 10 | Data Labels | 2 |
| | 11 | Create Folder | 2 |
| | 12 | Sorting Data | 2 |
| | 13 | Visualizations: charts and graphs | 2 |
| **III** | **SPSS** | | **15** |
| | 14 | Introduction | 2 |

| | | | |
|---|---|---|---|
| | 15 | Import Data- Data View and Variable View | 2 |
| | 16 | Coding and Decoding of variable | 3 |
| | 17 | Scaling of Variable | 3 |
| | 18 | Visualisation of Data | 3 |
| | 19 | Descriptive Statistics | 2 |
| **IV** | **Statistical Analysis System (SAS)** | | **15** |
| | 20 | Introduction to SAS environment | 3 |
| | 21 | Data step programming: reading, manipulating, and combining data | 4 |
| | 22 | Data management techniques: sorting, merging, and formatting data | 4 |
| | 23 | Basic statistical analysis: descriptive statistics | 4 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Explain Excel features and functions for dataanalysis and manipulation. | R, U | PSO - 1 |
| CO-2 | Describe effective visualizations using Tableau for presenting data insights and trends. | R, U, C | PSO-1,2,3,4,5 |
| CO-3 | Explain the features in SPSS for importing, coding, decoding, scaling, and visualizing data, as well as performing descriptive statistics. | R, U, Ap | PSO-1,2,4,5 |
| CO-4 | Describe the features of SAS for data management, including reading, manipulating, combining, sorting, merging, formatting, and conducting basic statistical analyses. | R, U, Ap | PSO-1,2,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Distribution Theory -I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Explain Excel features and functions for data analysis and manipulation. | PSO - 1 | R, U | F, C | Lecture | |
| CO-2 | Describe effective visualizations using Tableau for presenting data insights andtrends. | PSO-1,2,3, 4,5 | R, U, C | P | Lecture | |
| CO-3 | Explain the features in SPSS for importing, coding, decoding, scaling, and visualizing data, as well as performing descriptive statistics. | PSO-1,2,4, 5 | R, U, Ap | C, P | Lecture | |
| CO-4 | Describe the features of SAS for data management, including reading, manipulating, combining, sorting, merging, formatting, and conducting basic statistical analyses. | PSO-1,2,4, 5,6 | R, U, Ap | C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 2 | 1 | 2 | 3 | 3 | - | 2 | 2 | 1 | - |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | 2 | - | 2 | 1 |
| **CO 3** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 1 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 | 3 | - |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK4SECSTA254.1</td></tr>
<tr><td>Course Title</td><td colspan="5">ADVANCED TECHNOLOGY IN STATISTICAL ANALYSIS</td></tr>
<tr><td>Type of Course</td><td colspan="5">SEC</td></tr>
<tr><td>Semester</td><td colspan="5">IV</td></tr>
<tr><td>Academic Level</td><td colspan="5">200-299</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>3</td><td>3 hours</td><td>-</td><td></td><td>3</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Statistics</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Andrew S. Tanenbaum (1996). Computer Networks. 3rd edition, Bratislava. ISBN-10.<br><br>2. David W. Hosmer and Stanley Lemeshow (2000). Applied Logistic Regression. 2nd edition. Wiley series in probability and statistics, New York.<br>3. Eibe Frank and Mark Hall (2011). Data mining; practical machine learning tools and techniques. 3rd Edition. Elsevier India.<br><br>4. Gupta, G. K. (2011). Introduction to Data mining with case studies. PHI. New Delhi.<br><br>5. Michael J. Craley (2013). The R Book, second edition, Wiley, New York.<br><br>6. Purohit, S. G., Deshmukh, S.R., & Gore, S. D. (2008). Statistics using R. Alpha Science International, United Kingdom.<br>7. Alpaydin, E. (2009). Introduction to Machine Learning. MIT press.</td></tr>
<tr><td>Course Summary</td><td colspan="5">This course provides a comprehensive overview of statistical applications essential for practitioners in machine learning, data mining, and R programming. Through a combination of theoretical foundations and</td></tr>
</table>

| | |
|---|---|
| | practical implementation, students will gain proficiency in utilizing statistical methods to extract insights from data and build predictive models. Emphasis is placed on hands-on experience with R programming language to perform data analysis, visualization, and model evaluation. By the end of the course, students will be equipped with the knowledge and skills necessary to apply statistical techniques effectively in real-world scenarios, enabling them to tackle complex data-driven problems with confidence. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Machine Learning** | | **10** |
| | 1 | Introduction | 2 |
| | 2 | Basic concept of supervised learning | 2 |
| | 3 | Unsupervised learning and Reinforcement learning | 2 |
| | 4 | Dimension of supervised learning | 2 |
| | 5 | VC dimension | 2 |
| **II** | **Data mining and Data warehousing** | | **10** |
| | 6 | Introduction | 1 |
| | 7 | Data mining and OLAP | 1 |
| | 8 | Data description for data mining | 1 |
| | 9 | Predictive data mining | 1 |
| | 10 | Type of predictions | 1 |
| | 11 | Networks | 1 |
| | 12 | Decision trees | 1 |
| | 13 | Logistic regression | 1 |
| | 14 | Discriminant analysis | 1 |
| | 15 | Nearest neighbourhood techniques | 1 |
| **III** | **R for Data Science** | | **15** |
| | 16 | Basic concepts in R language | 2 |
| | 17 | Logical operators | 2 |
| | 18 | Comparison operators | 2 |

| | | | |
|---|---|---|---|
| | 19 | Methods of Data input | 2 |
| | 20 | Functions (combine, scan, rep, data.frame, matrix, list, resident data set) | 3 |
| | 21 | R programming codes for measures of central tendency and measures of dispersion | 4 |
| **IV** | **Data visualization and Modelling** | | **10** |
| | 22 | Bar graph using R | 2 |
| | 23 | Histogram using R | 2 |
| | 24 | Pie diagram using R | 2 |
| | 25 | Line chart using R | 2 |
| | 26 | Basics of data visualization using ggplot2 | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Analyse the data and understand insights from it and a clear understanding of machine learning algorithms and its applications. | U | PSO - 1,2,6 |
| CO-2 | Describe data mining and data warehousing. | U | PSO - 1,4 |
| CO-3 | Write programs for statistical applications and data analysis using R | An | PSO - 1,2,4,5 |
| CO-4 | Visualize data using R | An, Ap | PSO - 1,2,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Advanced Technologies in Statistical Analysis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| CO-1 | Analyse the data and understand insights from it and a clear understanding of machine learning algorithms and its applications. | PSO - 1,2,6 | U | F, C | Lecture | |
| CO-2 | Describe data mining and data warehousing. | PSO - 1,4 | U | F, C | Lecture | |
| CO-3 | Write programs for statistical applications and data analysis using R. | PSO - 1,2,4,5 | An | F, C | Lecture | ✓ |
| CO-4 | Visualize data using R. | PSO - 1,2,6 | An, Ap | F, C, P | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | - |
| **CO 2** | 3 | 2 | 2 | 3 | - | 2 | 2 | 3 | 2 | 2 | 3 | 3 | 1 |
| **CO 3** | 3 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | - | 1 | - | 2 | 1 |
| **CO 4** | 3 | 3 | - | 2 | 2 | 3 | 3 | 2 | 2 | - | 1 | 1 | - |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

**COURSES OFFERING – SEMESTER V**

| COURSE TYPE | MAJOR (STUDENTS) | COURSE TITLE | CREDITS |
|---|---|---|---|
| DSC | STATISTICS | Limit Theorems and Sampling Distributions | 4 |
| DSC | STATISTICS | Applied Statistics | 4 |
| DSC | STATISTICS | Testing of Hypothesis | 4 |
| DSE | STATISTICS | Sample Survey Methods | 4 |
| DSE | STATISTICS | Data Analysis using R | 4 |
| DSE | STATISTICS | Design of Experiments | 4 |
| SEC | STATISTICS | Statistical Programming using R | 3 |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK5DSCSTA300.1** | | | | |
| Course Title | **LIMIT THEOREMS AND SAMPLING DISTRIBUTIONS** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **V** | | | | |
| Academic Level | 300 – 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Normal distribution | | | | |
| | **References:**<br>1. Bhat, B. R. (2007). *Modern Probability Theory - An Introductory Text Book*, New Age International Publishers, New Delhi.<br>2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*, Amerind Publishing Co. Pvt. Ltd., New Delhi.<br>3. Rohatgi, V.K. and Saleh A.M.E. (2001). *An Introduction to Probability and Statistics*. 2nd edition, John Wiley and Sons Inc., New York.<br>4. Rohatgi, V. K. (1976). *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern Ltd. | | | | |
| Course Summary | The limit theorem and sampling distribution are foundational concepts in statistics that underpin much of statistical inference. The limit theorem, particularly the central limit theorem, states that as the sample size increases, the sampling distribution of sample means approaches a normal distribution regardless of the shape of the population distribution. This theorem is crucial because it allows statisticians to make probabilistic statements about population parameters based on sample statistics. The sampling distribution, on the other hand, refers to the distribution of a | | | | |

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| | sample statistic (such as the sample mean or proportion) across all possible samples of a given size from a population. Understanding the sampling distribution is essential for conducting hypothesis tests, constructing confidence intervals, and making inferences about population parameters. Together, the limit theorem and sampling distribution provide the theoretical foundation for statistical inference and play a central role in data analysis and decision-making in various fields. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Introduction to measure theoretic probability** | **10** |
| | 1 | Sequence of events, Limit of events | 2 |
| | 2 | Limit supremum, Limit infimum | 2 |
| | 3 | monotone and continuity property of probability measure | 2 |
| | 4 | independence of finite number and sequence of events | 2 |
| | 5 | Borel- Cantelli lemma | 2 |
| **II** | | **Chebychev's inequality** | **15** |
| | 6 | Convergence in probability | 2 |
| | 7 | Convergence in law | 2 |
| | 8 | Bernoulli's Law of large numbers | 2 |
| | 9 | Chebychev's weak law of large numbers | 2 |
| | 10 | Central limit theorem | 3 |
| | 11 | Lindberg-Levy Central Limit theorem | 2 |
| | 12 | Applications of central limit theorem. | 2 |
| **III** | | **Sampling distributions** | **20** |
| | 13 | Concept of random sample and statistic | 3 |
| | 14 | Definition of sampling distribution | 3 |
| | 15 | Sampling distribution of the mean and variance of a sample arising from a normal distribution | 3 |

| | | | |
|---|---|---|---|
| | 16 | $\chi^2$ distribution-mean and variance | 4 |
| | 17 | M.g.f., Additive property and use of $\chi^2$ tables | 3 |
| | 18 | Student's t distribution- mean and variance | 4 |
| **IV** | **F-distribution** | | **15** |
| | 19 | F-distribution - Mean and variance | 5 |
| | 20 | Inter-relationships between the standard normal, $\chi^2$, t and F distributions | 5 |
| | 21 | Non–central distributions and its properties - $\chi^2$, t and F | 5 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Learn measure probability. | U, Ap | PSO-1,3,4 |
| CO-2 | Get familiarised with laws of large numbers and their practical problems based on statistical tables. | R, U, Ap | PSO-1,3 |
| CO-3 | Understand sampling distributions and their practical problems based on statistical tables. | Ap | PSO-1,2,3,5 |
| CO-4 | Explain Non – central distributions. | An, Ap | PSO-1,2,3,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Limit Theorems and Sampling Distributions**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/ Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Learn measure probability. | PSO - | U, Ap | C, P | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | 1,3,4 | | | | |
| CO-2 | Get familiarised with laws of large numbers and their practical problems based on statistical tables. | PSO -1,3 | R, U, Ap | C, P | Lecture | |
| CO-3 | Understand sampling distributions and their practical problems based on statistical tables. | PSO - 1,2,3 ,5 | Ap | C, P | Lecture | |
| CO-4 | Explain Non – central distributions. | PSO - 1,2,3 ,5 | An, Ap | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | - | 3 | 3 | - | - | 3 | - | - | 3 | 2 | 3 | 2 |
| **CO 2** | 3 | - | 3 | 2 | - | - | 3 | - | - | 3 | - | 3 | 2 |
| **CO 3** | 3 | 3 | 3 | 1 | 3 | - | 3 | 3 | - | 2 | 1 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 1 | 3 | 2 | 3 | 3 | 1 | 3 | - | 3 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK5DSCSTA301.1** | | | | |
| Course Title | **APPLIED STATISTICS** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **V** | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic Statistics | | | | |
| | **References:**<br>1. Agarwal, B.L. (1988). *Basic Statistics*. Wiley Eastern Ltd. New Delhi.<br>2. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics,* Sultan Chand & Sons, New Delhi.<br>3. Gupta, S. P (2011). *Statistical Methods.* Sultan Chand & Sons, New Delhi.<br>4. Kapur, J. N and Saxena, H. C. (1970). *Mathematical Statistics.* Sultan Chand & Sons, New Delhi.<br>5. Srivastva, O. S (1983). *A Text Book of Demography*. Stosius Inc/Advent Books Division | | | | |
| Course Summary | Applied statistics involves the practical application of statistical methods and techniques to real-world problems and data. It encompasses a wide range of areas, including business, economics, healthcare, social sciences, engineering, and more. Applied statisticians use tools such as regression analysis, hypothesis testing, time series analysis, and experimental design to analyse data, make predictions, and draw conclusions. They play a critical role in decision-making processes by providing insights into trends, relationships, and patterns within datasets. Whether it's analyzing consumer behaviour, optimizing manufacturing processes, designing clinical trials, or predicting market trends, applied statistics enables | | | | |

| | |
|---|---|
| | professionals to extract valuable insights from data, inform decision-making, and drive innovation across various domains. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Index Numbers** | | **15** |
| | 1 | Meaning, classification, construction of index numbers | 2 |
| | 2 | Weighted and Unweighted index numbers | 3 |
| | 3 | Laspeyre's and Fisher's index numbers | 3 |
| | 4 | Dorbish-Bowley's index numbers | 2 |
| | 5 | Marshall-Edgeworth's index numbers | 2 |
| | 6 | Kelly's Method- Quantity index numbers | 3 |
| **II** | **Linear Test on Index Numbers** | | **15** |
| | 7 | Factor and time reversal test | 3 |
| | 8 | Circular test | 3 |
| | 9 | Chain index numbers | 3 |
| | 10 | Shifting, splicing and deflating of index numbers | 3 |
| | 11 | Consumer price index numbers | 3 |
| **III** | **Demography** | | **15** |
| | 12 | Vital statistics –census registration | 2 |
| | 13 | Adhoc surveys | 1 |
| | 14 | Hospital records | 1 |
| | 15 | Life tales | 2 |
| | 16 | Measurement of mortality | 1 |
| | 17 | Crude death rate | 1 |
| | 18 | Age specific death rate | 2 |
| | 19 | Infant mortality rate | 1 |
| | 20 | Standardized death rate | 1 |

| | | | |
|---|---|---|---|
| | 21 | Complete life table | 2 |
| | 22 | Mortality rate and probability of dying | 1 |
| **IV** | **Measurement of fertility** | | **15** |
| | 23 | Crude birth rate | 2 |
| | 24 | General fertility rate | 2 |
| | 25 | Age specific birth rate | 3 |
| | 26 | Total Fertility rate | 2 |
| | 27 | Gross reproduction rate | 3 |
| | 28 | Net reproduction rate | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Identify the various index numbers and compute them for datasets. | Ap, U | PSO - 1,2 |
| CO-2 | Explain the concepts of base shifting, splicing and deflation of index numbers. | Ap, R | PSO - 1,2 |
| CO-3 | Understand the concept of consumer price index. | Ap, R | PSO - 1 |
| CO-4 | Compute various measures of fertility, mortality and population growth and then construct life tables. | Ap, U | PSO - 1,2,4 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Applied Statistics**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Identify the various index numbers and | PSO - 1,2 | Ap, U | F, C, P | Lecture | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | compute them for datasets. | | | | | |
| CO-2 | Explain the concepts of base shifting, splicing and deflation of index numbers. | PSO - 1,2 | Ap, R | F, C, P | Lecture | ✓ |
| CO-3 | Understand the concept of consumer price index. | PSO - 1 | Ap, R | F, C, P | Lecture | ✓ |
| CO-4 | Compute various measures of fertility, mortality and population growth and then construct life tables. | PSO - 1,2,4 | Ap, U | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 1 | 1 | 2 | 1 | 3 | 3 | 1 | 2 | - | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 3 | - | 1 | 2 | 2 | - |
| **CO 3** | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 3 | - | 2 | 3 | 2 | 2 |
| **CO 4** | 3 | 3 | 2 | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |

| | |
|---|---|
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK5DSCSTA302.1** | | | | |
| Course Title | **TESTING OF HYPOTHESIS** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **V** | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Probability | | | | |
| | Distributions | | | | |

**Reference Books**


1. Goon, A.M, Gupta, M.K and Das Gupta (1994). *An outline of statistical theory Vol-I*, World Press Calcutta.
2. Gupta, S.C and Kapoor, V.K (2002). *Fundamentals of Mathematical Statistics*, Sultan Chands.
3. Hogg, R.V., Craig, A.J. (2011). *Introduction to Mathematical Statistics*, 4th edition, Collier McMillan.
4. Mood, A.M, Graybill, F.A. and Bose, D.P. (1972). *Introduction to theory of statistics*, 3rd edition–Mc Graw Hill.
5. Rohatgi, V.K. (1984). *An Introduction to Probability Theory and Mathematical Statistics*, Wiley Eastern, New York.
6. Rohatgi, V.K and Saleh, A.K. MD. (2001). *An Introduction to Probability and Statistics*, 2nd edition. John Wiley & Sons, Inc., New York.

| | |
|---|---|
| | 7. Wilks, S.S(1962). *Mathematical Statistics*, John Wiley, New York. |
| Course Summary | Hypothesis testing is a fundamental concept in statistics used to make decisions or draw conclusions about population parameters based on sample data. It involves setting up hypotheses, collecting data, and using statistical methods to determine whether there is enough evidence to reject or fail to reject the null hypothesis.<br><br>This paper covers a range of hypothesis testing methods, including small and large sample tests and tests for proportions and variances, providing tools for statistical analysis and decision-making based on data. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Statistical hypothesis** | | **15** |
| | 1 | Simple and composite | 1 |
| | 2 | Null and alternative hypothesis | 1 |
| | 3 | Test of hypothesis | 2 |
| | 4 | Two types of errors | 2 |
| | 5 | Level of significance | 2 |
| | 6 | Size and power of a test | 3 |
| | 7 | Critical region | 2 |
| | 8 | Power curve and power function | 2 |
| **II** | **Neymann – Pearson's Approach** | | **15** |
| | 9 | Neymann Pearson's approach for testing of hypothesis | 2 |
| | 10 | Neymann– Pearson's lemma | 2 |
| | 11 | Most powerful test | 2 |
| | 12 | Uniformly most powerful test | 2 |
| | 13 | Derivation of test using Neyman-Pearson's lemma for mean and variance of a normal population | 2 |

| | | | |
|---|---|---|---|
| | 14 | The mean of binomial and Poisson distribution | 2 |
| | 15 | Likelihood ratio test and its properties | 3 |
| **III** | **Test of significance** | | **15** |
| | 16 | Large sample tests-testing the significance of a proportion, testing the equality of two proportions | 2 |
| | 17 | Testing the significance of a mean. | 2 |
| | 18 | Testing the equality of two means, testing the significance of correlation coefficient | 2 |
| | 19 | Testing the significance of difference between two correlation coefficients. | 2 |
| | 20 | Tests based on chi– square distribution- testing the goodness of fit | 3 |
| | 21 | Testing the independence of attributes | 2 |
| | 22 | Testing the significance of standard deviation of a normal population | 2 |
| **IV** | **Small sample tests** | | **15** |
| | 23 | Test based on Students' t distribution | 3 |
| | 24 | Test of significance of means from a normal population | 2 |
| | 25 | Testing the equality of means of two normal population | 2 |
| | 26 | Testing the significance of correlation coefficient | 2 |
| | 27 | Paired-t test | 2 |
| | 28 | Test based on F distribution | 2 |
| | 29 | Testing the equality of variances of two normal populations. | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive | PSO addressed |
|---|---|---|---|

| | | Level | |
|---|---|---|---|
| CO-1 | Describe the basic concepts in Testing of Hypothesis. | U | PSO – 1,2 |
| CO-2 | Explain Neymann – Pearson's lemma. | Ap | PSO – 1,2,3,4,6 |
| CO-3 | Describe Large sample tests and their practical problems based on statistical tables. | U, Ap | PSO – 1,2,3,4,5,6 |
| CO-4 | Explain Small sample tests and their practical problems based on statistical tables | U, Ap | PSO – 1,2,3,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Testing of Hypothesis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe the basic concepts in Testing of Hypothesis. | PSO – 1,2 | U | C | Lecture | ✓ |
| CO-2 | Explain Neymann – Pearson's lemma. | PSO – 1,2,3,4, 6 | Ap | C, P | Lecture | |
| CO-3 | Describe Large sample tests and their practical problems based on statistical tables. | PSO – 1,2,3,4, 5,6 | U, Ap | F, C, P | Lecture | ✓ |
| CO-4 | Explain Small sample tests and their practical problems based on statistical tables | PSO – 1,2,3,4, 5,6 | U, Ap | F, C, P, M | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | 2 | - | - | 3 | 2 | 3 | 3 | 3 | 2 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK5DSESTA303.1</td></tr>
<tr><td>Course Title</td><td colspan="5">SAMPLE SURVEY METHODS</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">V</td></tr>
<tr><td>Academic Level</td><td colspan="5">300 - 399</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td></td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic Sampling concepts</td></tr>
<tr><td></td><td colspan="5">References:<br><br>1. Cochran, W.G. (1977). Sampling Techniques. Wiley Eastern Ltd., New Delhi.<br><br>2. Gupta, S.C. and Kapoor, V.K. (2002). Fundamentals of Applied Statistics, Sultan Chand & Co. New Delhi.<br><br>3. Parimal Mukhopadyay. (2009). Theory and Methods of Survey Sampling. PHI Learning Pvt Ltd. New Delhi.<br><br>4. Sambath. (2001). Sampling Theory and Methods. Narosa Publishing House. New Delhi, Chennai, Mumbai, Calcutta.<br><br>5. Murthy, M.N. (1967). Sampling theory and Methods. Statistical Publishing Society, Calcutta.</td></tr>
</table>

| | |
|---|---|
| | 6. Sukhatme, P.V. and Sukhatme, B.V. (1970). *Sampling Theory of Surveys with Applications. Indian Society of Agricultural Statistics.* |
| Course Summary | Sample survey methods are crucial techniques used to gather information about populations by collecting data from a subset, or sample of the population. These methods involve selecting a representative sample through various sampling techniques such as simple random sampling, stratified sampling, cluster sampling, or systematic sampling. Once the sample is selected, data is collected using surveys, interviews, questionnaires, or other data collection instruments. Careful design and implementation of sample survey methods are essential to ensure the reliability and validity of the results. Sample survey methods are widely used in market research, social sciences, public opinion polling, and official statistics to obtain information about populations efficiently and cost-effectively. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Concepts of Population and Sample** | **15** |
| | 1 | Sampling frame | 1 |
| | 2 | Sampling design | 1 |
| | 3 | Need for sampling | 1 |
| | 4 | Principle steps in sample survey | 1 |
| | 5 | Advantages of sample survey over census survey | 1 |
| | 6 | Probability sampling and non-probability sampling | 2 |
| | 7 | Mixed sampling | 1 |
| | 8 | basic concepts in sampling | 1 |
| | 9 | Organizational aspects of survey sampling | 2 |
| | 10 | sampling and non – sampling errors | 2 |
| | 11 | sample selection and sample size | 2 |
| **II** | | **Simple Random Sampling** | **15** |
| | 12 | Simple random sampling with and without replacement | 2 |

| | | | |
|---|---|---|---|
| | 13 | Estimation of population mean and variance | 1 |
| | 14 | Expectation and variance of estimators | 2 |
| | 15 | Unbiased estimators of variances of these estimators | 2 |
| | 16 | Determination of sample size for SRS | 2 |
| | 17 | Confidence interval for population mean | 2 |
| | 18 | SRS for attributes | 2 |
| | 19 | Estimation of sample size based on desired accuracy for variables and attributes | 2 |
| **III** | **Stratified Sampling** | | **15** |
| | 20 | Concepts of stratified population and stratified sample | 2 |
| | 21 | Estimation of population mean and population total | 2 |
| | 22 | Mean and variance of estimator of population mean assuming SRSWOR within strata | 3 |
| | 23 | Proportional allocation | 3 |
| | 24 | Optimum allocation with and without varying costs | 2 |
| | 25 | Comparison of simple random sampling with proportional and optimum allocation | 3 |
| **IV** | **Systematic Sampling** | | **15** |
| | 26 | Concepts of systematic population and systematic sample | 2 |
| | 27 | Estimation of population mean and population total | 3 |
| | 28 | Expectation and variance of estimators | 3 |
| | 29 | Circular systematic sampling | 2 |
| | 30 | Comparison with stratified sampling | 3 |
| | 31 | Population with linear trend | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be | Cognitive | PSO |
|---|---|---|---|

| | able to: | Level | addressed |
|---|---|---|---|
| CO-1 | Learn basic concepts in theory of sampling. | U | PSO – 1,2 |
| CO-2 | Explain Simple Random Sampling and its properties. | U, Ap | PSO – 1,2,4,5,6 |
| CO-3 | Describe Stratified Sampling and its properties. | U, Ap | PSO – 1,2,4,5,6 |
| CO-4 | Explain Systematic Sampling and its properties. | U, Ap | PSO – 1,2,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Sample Survey Methods**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Learn basic concepts in theory of sampling. | PSO – 1,2 | U | C | Lecture | |
| CO-2 | Explain Simple Random Sampling and its properties. | PSO – 1,2,4,5, 6 | U, Ap | F, C, P, M | Lecture | |
| CO-3 | Describe Stratified Sampling and its properties. | PSO – 1,2,4,5, 6 | U, Ap | F, C, P, M | Lecture | |
| CO-4 | Explain Systematic Sampling and its properties. | PSO – 1,2,4,5, 6 | U, Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 1 | - | - | - | 3 | - | 2 | 1 | 1 | 1 | 2 |
| **CO 2** | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK4DSESTA304.1** | | | | |
| Course Title | **DATA ANALYSIS USING R** | | | | |
| Type of Course | **DSE** | | | | |
| Semester | **V** | | | | |
| Academ icLevel | **300-399** | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic Mathematics | | | | |

**References:**


1. Dalgaard P. (2008). Introductory Statistics with R, Second Edition, Springer, New York.
2. Gupta, S. C., & Kapoor, V. K. (2020). Fundamentals of mathematical statistics. Sultan Chand & Sons.
3. Purohit, S. G., Deshmukh, S.R., & Gore, S. D. (2008). Statistics using R. Alpha Science International, United Kingdom.
4. Gardener M (2023). An Introduction to R: Data Analysis and Visualization, Pelagic Publishing, UK.
5. Heumann C., Schomaker M. and Shalabh (2022). Introduction to Statistics and Data Analysis With Exercises, Solutions and Applications in R, Second Edition, Springer Nature Switzerland
6. Jones E., Harden S., Crawley M.J., (2023). The R Book, Third Edition, John Wiley & Sons Ltd.
7. Taylor R. Brown (2023). An Introduction to R and Python for Data Analysis: A Side-By-Side Approach, CRC Press/Chapman & Hall.
8. Kloke J., McKean J.W., (2015). Nonparametric Statistical Methods Using R, CRC press.
9. Thomas W.M, Yates J.M. (2016). Introduction to Nonparametric Statistics for the Biological Sciences Using R, Springer.

| | |
|---|---|
| | **Web Resources:**<br><br>1. https://cran.r-project.org<br>2. https://cran.r-project.org/manuals.html<br>3. https://www.r-project.org/other-docs.html<br>4. https://journal.r-project.org/<br>5. https://www.r-bloggers.com |
| Course Summary | Statistical Hypotheses are statements about population parameters, such as means or proportions. Simple hypotheses propose a specific value for a parameter, while composite hypotheses propose a range of values. Type I error occurs when we reject a true null hypothesis, while Type II error occurs when we fail to reject a false null hypothesis. Significance Level is denoted by α, it determines the threshold for rejecting the null hypothesis. p-value is the probability of observing the data, or more extreme results, given that the null hypothesis is true. Power of a Test is probability of correctly rejecting the null hypothesis when it's false. One-sample and two-sample cases for independent and paired samples involve comparing means or proportions using tests like z.test(), t.test(), and prop.test() in R. Chi-square Test for Variance evaluates if a population's variance equals a specified value, using var.test() in R. F-Test for Equality of Variances compares variances of two populations with var.test() in R. Analysis of Variance (ANOVA) tests equality of means across groups, using aov() and summary() in R for one-way and two-way ANOVA. Non-parametric Tests make fewer assumptions about data distribution. Examples include Wilcoxon Signed Rank Test, Mann-Whitney U Test, and Kruskal-Wallis H-Test, performed using wilcox.test(), kruskal.test(), binom.test(), and chisq.test() in R, respectively. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Testing of Hypothesis** | **15** |
| | 1. | Statistical hypotheses | 2 |
| | 2. | Simple and Composite hypotheses | 2 |
| | 3. | Two types of error | 2 |
| | 4. | Significance level, p-value, power of the test | 2 |
| | 5. | Testing mean and proportion- one and two sample cases | 2 |
| | 6. | Independent and paired samples (no mathematical derivations are required) | 2 |

| | | | |
|---|---|---|---|
| | 7. | Uses of R functions-z.test(), t.test() and prop.test() to perform the test. | 3 |
| **II** | **Chi-Square Test** | | **15** |
| | 8. | Chi-Square test for variance | 5 |
| | 9. | F-test for equality of variance (no mathematical derivations are required) | 5 |
| | 10. | Uses of R functions- chisq.test(), var.test() to perform | 5 |
| **III** | **Analysis of Variance** | | **15** |
| | 11. | Testing of equality of several means | 5 |
| | 12. | Analysis of variances (ANOVA) of one way and two way classified data without replication (no mathematical derivations are required) | 5 |
| | 13. | Uses of R functions- aov(), summary() to perform the tests | 5 |
| **IV** | **Non-parametric Test** | | **15** |
| | 14. | Wilcox Signed rank test | 2 |
| | 15. | Mann-Whiteny U test | 2 |
| | 16. | Chi-square test of goodness of fit | 2 |
| | 17. | Independence and homogeneity | 3 |
| | 18. | Kruskal Wallis H-test for one way analysis of variances (ANOVA) by Ranks( no mathematical derivations are required) | 3 |
| | 19. | Uses of R functions-binom.test(), Wilcox.test() and kruskal.test() to perform the tests | 3 |

**Course Outcomes**

| No. | Upon Completion of the course, students will beable to: | Cognitive level | PSO addressed |
|---|---|---|---|
| CO1 | Explain the concept of testing statistical hypotheses. | U | PSO-1,2,3 |
| CO2 | Illustrate Chi-square tests using R | An | PSO-2,3,4 |

| | | | |
|---|---|---|---|
| CO3 | Illustrate various Parametric tests using R | An | PSO-1,2,3,4,5 |
| CO4 | Illustrate various non-parametric tests using R | An | PSO-1,2,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Data Analysis using R-I**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/ PSO | Cognitive Level | Knowledge Category | Lecture (L)/ Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Explain the concept of testing statistical hypotheses. | PSO-1,2,3 | U | C | Lecture | ✓ |
| 2 | Illustrate Chi-square tests using R | PSO-2,3,4 | An | P, M | Lecture | ✓ |
| 3 | Illustrate various Parametric tests using R | PSO-1,2,3, 4,5 | An | P, M | Lecture | ✓ |
| 4 | Illustrate various non-parametric tests using R | PSO-1,2,5 | An | P,M | Lecture | ✓ |

**F-Factual, C- Conceptual, P-Procedural, M- Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 2 |
| **CO2** | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 1 | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 1 | 2 | 3 | 1 | 2 | 1 | 3 | 2 |
| **CO4** | 3 | 3 | 1 | 2 | 3 | 2 | 3 | 3 | 1 | 2 | 3 | 3 | 1 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment/ Discussion / Seminar
- Midterm Exam
- Practical Evaluation
- Final Exam

**Mapping of Cos to Assesment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK5DSESTA305.1** | | | | |
| Course Title | **DESIGN OF EXPERIMENTS** | | | | |
| Type of Course | **DSE** | | | | |
| Semester | **V** | | | | |
| Academic Level | 300 - 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | NIL | | | | |

**References**


1. Benjamin, B (1960). *Elements of Vital Statistics*. G. Allen & Unwin.
2. S. C. Gupta and V. K. Kapoor (2002)- *Fundamentals of Applied Statistics*. Sultan Chand & Co. New Delhi.
3. Parimal Mukhopadyay. (2005). *Applied Statistics*. Arunabha Sen Books and Allied Ltd. Kolkata.
4. Cochran, W.G and Cox, G.M. (1992). *Experimental Designs*. John Wiley, New York.
5. Das, M.N. and Giri, N. C. (1979). *Design and Analysis of Experiments*. Wiley- Eastern Ltd., New Delhi.
6. Joshi, D. D. (1987). *Linear Estimation and Design of Experiment*. Wiley-Eastern Ltd., New Delhi.
7. Kemthorne, O. (2005) *Design and Analysis of Experiments*. Wiley, New York.

| | |
|---|---|
| Course Summary | Design of experiments (DOE) is a systematic approach to planning, conducting, and analysing experiments to optimize processes, products, or systems. It involves carefully selecting experimental factors and levels, determining the appropriate experimental design (e.g., factorial design, response surface methodology), and allocating resources efficiently to achieve the desired objectives. By varying factors systematically and controlling for potential sources of variability, DOE allows researchers to identify significant factors, interactions, and optimal settings for maximizing desirable outcomes or minimizing variability. Analysis of the experimental data using statistical techniques such as analysis of variance (ANOVA) or regression enables researchers to draw conclusions and make informed decisions based on empirical evidence. DOE is widely used across various industries, including manufacturing, engineering, healthcare, and agriculture, to improve quality, efficiency, and performance while reducing costs and time. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **ANOVA** | **15** |
| | 1 | Basic concepts | 3 |
| | 2 | ANOVA for one way and two-way classification | 4 |
| | 3 | Layout and analysis | 4 |
| | 4 | Principles of experimentation | 4 |
| **II** | | **Basic Designs** | **20** |
| | 5 | Completely Randomised Design | 6 |
| | 6 | Randomised Block Design | 7 |
| | 7 | Latin Square Design-layout and analysis | 7 |
| **III** | | **Efficiency Of Designs and Comparisons** | **15** |
| | 8 | Efficiency of RBD over CRD | 4 |
| | 9 | LSD over RBD and LSD over CRD. | 5 |
| | 10 | Missing plot analysis | 2 |

| | | | |
|---|---|---|---|
| | 11 | Missing plot technique for one or two missing observations. | 4 |
| **IV** | **Factorial Experiments** | | **10** |
| | 12 | Basic concepts of $2^n$ factorial experiments | 3 |
| | 13 | Main effects and interaction | 2 |
| | 14 | Confounding | 2 |
| | 15 | Yate's method of analysis | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe ANOVA. | U | PSO – 1,2,4,5,6 |
| CO-2 | Explain basic designs of experiments. | U | PSO – 1,2,3,4,5,6 |
| CO-3 | Familiarise with efficiency of designs and missing plot analysis. | U, Ap | PSO – 1,2,3,4,5,6 |
| CO-4 | Describe Factorial experiments. | U, Ap | PSO – 1,2,3,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Design of Experiments**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe ANOVA. | PSO – 1,2,4, 5,6 | U | F, C, P | Lecture | ✓ |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO-2 | Explain basic designs of experiments. | PSO – 1,2,3, 4,5,6 | U | F, C, P, M | Lecture | ✓ |
| CO-3 | Familiarise with efficiency of designs and missing plot analysis. | PSO – 1,2,3, 4,5,6 | U, Ap | F, C, P, M | Lecture | |
| CO-4 | Describe Factorial experiments. | PSO – 1,2,3, 4,5,6 | U, Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 2 | 3 | 2 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |

| | |
|---|---|
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK5SECSTA306.1** | | | | |
| Course Title | **STATISTICAL PROGRAMMING USING R** | | | | |
| Type of Course | **SEC** | | | | |
| Semester | **V** | | | | |
| Academic Level | 300 – 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| Pre-requisites | NIL | | | | |

**Texts:**

1. Wickham, H. & Grolemund, G. (2018). R for Data Science. O'Reilly: New York. Available for free at http://r4ds.had.co.nz

2. Adler, J. (2010). *R in a nutshell: A desktop quick reference*. " O'Reilly Media, Inc.".

**References:**


1. Braun, W. J., & Murdoch, D. J. (2016). *A first course in statistical programming with R*. Cambridge University Press.

2. Bloomfield, V. A. (2018). *Using R for numerical analysis in science and engineering*. CRC Press.

3. Everitt, B.S. and Hothorn T. (2010) *A Handbook of Statistical Analysis Using R*, Second Edition, CRC Press.

4. Fonseca i Casas, P., & Tormos, R. (2018). *Using the R language to manage and show statistical information in the cloud. Technologies*, *6*(4), 113.

| | |
|---|---|
| | 5. Michael J. Crawley (2013) *The R book*, Second Edition, John Wiley & Sons Ltd.<br>6. Rubinstein, R.Y. (1981) *Simulation and Monte Carlo Methods*, Wiley. |
| Course Summary | Statistical programming involves using programming languages to perform data analysis, statistical modelling, visualization, and other statistical computations. R is a powerful and widely used programming language and environment specifically designed for statistical computing and data analysis. R is an open-source programming language and environment for statistical computing and graphics. It provides a wide range of statistical and graphical techniques and is supported by a vast collection of packages contributed by the R community. R provides various data structures such as vectors, matrices, data frames, lists, and factors, which are essential for organizing and manipulating data. R has a rich ecosystem of packages covering a wide range of statistical techniques, machine learning algorithms, data manipulation functions, and visualization tools. R has powerful visualization libraries such as ggplot2, lattice, and base graphics, allowing users to create customized and publication-quality plots and charts. R can be seamlessly integrated with other programming languages, databases, and tools for data import/export, data cleaning, and collaboration. R supports a variety of statistical modelling techniques, including linear regression, logistic regression, time series analysis, clustering, and more advanced methods. Thus, R is a versatile and powerful tool for statistical programming, data analysis, and visualization. Its extensive capabilities, rich libraries, and active community make it a preferred choice for statisticians, data scientists, researchers, and analysts working with complex datasets and statistical models. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Installing R Software** | **11** |
| | 1 | Installing R | 2 |
| | 2 | Exploring R package repositories | 2 |
| | 3 | Basic Terminologies in R. | 2 |
| | 4 | R syntax | 3 |
| | 5 | R objects | 2 |
| **II** | | **Functions in R** | **12** |

| | | | |
|---|---|---|---|
| | 5 | Functions in R | 2 |
| | 6 | Reading Data into R | 2 |
| | 7 | Manipulating Data | 3 |
| | 8 | Manipulating Strings | 3 |
| | 9 | Writing functions in R | 2 |
| **III** | **R-Graphics** | | **11** |
| | 10 | An Introduction to R Graphics | 3 |
| | 11 | Drawing various mathematical functions | 2 |
| | 12 | Usage of ggplot2 package | 3 |
| | 13 | Building data graphics for dynamic reporting | 3 |
| **IV** | **Big Data Analysis** | | **11** |
| | 14 | Complex data transformations | 1 |
| | 15 | Introduction to Non-tabular data types | 1 |
| | 16 | Big data problems | 1 |
| | 17 | Data transformations | 2 |
| | 18 | Dirty data problems | 2 |
| | 19 | Introduction to Bioconductor | 2 |
| | 20 | Introduction to R and Hadoop | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Write programs for statistical applications and data analysis. | An, Ap, U | PSO - 1,3 |
| CO-2 | Develop R packages for statistical applications. | Ap, U | PSO - 1,3 |
| CO-3 | Use built-in R packages. | An, Ap | PSO - 1,3 |

| | | | |
|---|---|---|---|
| CO-4 | Modify built- in R packages. | An, Ap | PSO - 1 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistical Programming using R**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Write programs for statistical applications and data analysis. | PSO - 1,3 | An, Ap, U | F, C | Lecture | |
| CO-2 | Develop R packages for statistical applications. | PSO - 1,3 | Ap, U | C, P | Lecture | |
| CO-3 | Use built-in R packages. | PSO - 1,3 | An, Ap | F, C, P | Lecture | |
| CO-4 | Modify built- in R packages. | PSO - 1 | An, Ap | C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 3 | - | - | 2 | 3 | 3 | 1 | 2 | 2 | 2 | 1 |
| **CO 2** | 3 | 2 | 3 | - | 2 | 2 | 2 | 3 | - | 2 | 2 | 3 | 1 |
| **CO 3** | 3 | 3 | 2 | - | 2 | 1 | 3 | 3 | 1 | 2 | 1 | 1 | - |
| **CO 4** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 1 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

**COURSES OFFERING – SEMESTER VI**

| COURSE TYPE | MAJOR (STUDENT) | COURSE TITLE | CREDITS |
|---|---|---|---|
| **DSC** | STATISTICS | Distribution Theory -II | 4 |
| **DSC** | STATISTICS | Introduction to Operation Research | 4 |
| **DSC** | STATISTICS | Probability Theory -II | 4 |
| **DSE** | STATISTICS | Multivariate Analysis | 4 |
| **DSE** | STATISTICS | Inventory Control & Queuing Theory | 4 |
| **SEC** | STATISTICS | Statistical Programming Using Python | 3 |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK6DSCSTA350.1** | | | | |
| Course Title | **DISTRIBUTION THEORY - II** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **VI** | | | | |
| Academic Level | 300 – 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Standard distributions | | | | |

**References:**


1. Bhat, B. R., Sri. Venkata Ramana, T. and Rao Madhava, K.S. (1977). *Statistics: A Beginners Text* Vol- 2, New Age International (P) Ltd., New Delhi.

2. Dekking, F. M. (2005). *A Modern Introduction to Probability and Statistics: Understanding Why and How*. Springer Science & Business Media, New York.

3. Goon, A. M., Gupta, N.K., Das Gupta, B. (1999). *Fundamentals of Statistics*- Vol.2. World Press, Kolkatta.

4. Gupta, S.C. and Kapoor, V.K. (2002). *Fundamentals of Mathematical Statistics*. Sulthan Chand, New Delhi.

5. Hogg, R.V. and Craig, A.T. (1970). Introduction *to Mathematical Statistics*, Pearson Education. Pvt. Ltd. UK.

| | |
|---|---|
| | 6. Mukhopadhaya, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd., Calcutta.<br><br>7. Rohatgi, V.K. and Saleh, A.M.E. (2001). *An Introduction to Probability and Statistics*, 2 nd edition, John Wiley & Sons, Inc, New York.<br><br>8. Rohatgi, V. K. *An Introduction to Probability Theory and Mathematical Statistics*, Wiley eastern Limited.<br><br>9. Wilks S.S. (1964). *Mathematical Statistics*, John Wiley, New York. |
| Course Summary | Distribution theory is a fundamental aspect of statistics, providing the foundation for understanding the behaviour of random variables and the probability distributions they follow. Distribution theory enables statisticians to model and analyse real-world phenomena, make probabilistic statements about outcomes, and perform statistical inference. Distribution theory is essential for effectively applying statistical methods, interpreting results, and drawing meaningful conclusions from data in fields ranging from finance and economics to biology and engineering. Understanding order statistics provides insights into the characteristics and distributional properties of data, allowing statisticians and researchers to make informed decisions, perform robust statistical tests, and analyse survival and reliability data effectively. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Multinomial distribution** | **15** |
| | 1 | Multinomial distribution - mean, variance, covariances and mgf. | 4 |
| | 2 | Multinomial distribution – mgf and conditional distributions. | 5 |
| | 3 | Cauchy distribution and its standard form | 3 |
| | 4 | Lognormal distribution - mean, variance, | 3 |
| **II** | | **Log-Normal** | **15** |

| | | | |
|---|---|---|---|
| | 5 | Log-Normal, Pareto, Weibull, Laplace, Logistic, Log-logistic. | 5 |
| | 6 | Rayleigh and Generalized Exponential distributions and their properties. | 4 |
| | 7 | Functions of random variables and their distributions using transformation of variable technique. | 3 |
| | 8 | Distributions of sum, product and ratios of random variables. | 3 |
| **III** | **Introduction to order statistics** | | **15** |
| | 9 | Empirical distribution function | 2 |
| | 10 | Order statistic | 3 |
| | 11 | Probability distribution of $r^{th}$ order statistic | 3 |
| | 12 | Moments of $r^{th}$ order statistic | 3 |
| | 13 | Probability distribution of $1^{st}$ and $n^{th}$ order statistics from U(0, θ) distribution and exponential distribution. | 4 |
| **IV** | **Joint Distribution** | | **15** |
| | 14 | Joint distribution of two or more order statistics. | 5 |
| | 15 | Distribution of functions of two order statistics – median, range and mid-ranges. | 5 |
| | 16 | Probability mass function of order statistics arising from discrete distributions. | 5 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Explain multivariate distribution and its properties | U | PSO – 2,3,6 |

| | | | |
|---|---|---|---|
| CO-2 | Understand some continuous distributions and its properties. | U | PSO – 1,2,3.4.6 |
| CO-3 | Describe order Statistics. | U | PSO – 1,2,3,4,6 |
| CO-4 | Get familiarised with distribution of functions of two order Statistics. | Ap | PSO – 1,2,3,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Distribution Theory -II**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Explain multivariate distribution and its properties | PSO – 2,3,6 | U | F, C, P | Lecture | |
| CO-2 | Understand some continuous distributions and its properties. | PSO – 1,2,3 .4.6 | U | F, C, P | Lecture | |
| CO-3 | Describe order Statistics. | PSO – 1,2,3 ,4,6 | U | F, C, P, M | Lecture | |
| CO-4 | Get familiarised with distribution of functions of two order Statistics. | PSO – 1,2,3 ,4,6 | Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 2 | 3 | 3 | 2 | - | 3 | 3 | 3 | 1 | 2 | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 1 | 2 | 2 |
| **CO 3** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 | 1 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK6DSCSTA351.1** | | | | |
| Course Title | **INTRODUCTION TO OPERATIONS RESEARCH** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **VI** | | | | |
| Academic Level | 300 – 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic Mathematics | | | | |
| | **References**<br><br>1. Frederick, S. Hiller and Gerald, J. Lieberman. (1987). Operations Research. CBS Publishers &Distributors, Delhi.<br><br>2. Kanti Swarup, Gupta, P. K and Manmohan. (1993). Operations Research. Sultan Chand Publishers, New Delhi.<br><br>3. Goel and Mittal (1982). Operations Research. Pragathi Prakashan, Meerut.<br><br>4. Schaum's outline series (1997): Operation Research.<br><br>5. Bronson, R. and Naadimuthu, G. (1997). Schaum's Outline of Operations Research. McGraw Hill Professional, US.<br><br>6. Gupta, R.K. (1985). Operations Research. Krishna Prakashan, Mandir Meerut.<br><br>7. Hamdy, A. Taha. (1996). Operation Research, 6th Ed. Prentice Hall of India, New Delhi. | | | | |
| Course Summary | Introduction to operations research (OR) provides a framework for applying mathematical and analytical methods to decision-making and problem-solving in complex systems. OR encompasses a wide range of techniques, including | | | | |

| | |
|---|---|
| | optimization, simulation, queuing theory, and decision analysis, to address problems related to resource allocation, process improvement, and strategic planning. By systematically modelling and analysing systems, OR aims to identify optimal solutions, improve efficiency, and minimize costs or risks. Applications of OR span various domains, including logistics, supply chain management, transportation, finance, healthcare, and telecommunications, where it plays a crucial role in optimizing operations, enhancing productivity, and supporting informed decision-making at both strategic and tactical levels. Through its interdisciplinary approach and emphasis on quantitative analysis, OR offers valuable insights and tools for tackling challenging problems and improving organizational performance in a dynamic and competitive environment. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Operations Research** | | **15** |
| | 1 | Formulation of Linear programming problem (LPP) | 7 |
| | 2 | Solving LPP by graphical method, basic solution, optimum solution | 8 |
| **II** | **Simplex Method** | | **15** |
| | 3 | Solving LPP by simplex method-various cases-unbounded solution | 5 |
| | 4 | Infeasible solution | 5 |
| | 5 | Alternative optimum, need for artificial variables | 5 |
| **III** | **Advanced Techniques of Simplex Method** | | **15** |
| | 6 | Two phase method | 4 |
| | 7 | Big-M method | 4 |
| | 8 | Primal-dual relationship | 4 |
| | 9 | Dual simplex method | 3 |
| **IV** | **Transportation Problems** | | **15** |
| | 10 | North West Corner rule | 2 |
| | 11 | Least Cost Method | 2 |

| | | | |
|---|---|---|---|
| | 12 | Vogel's Approximation Method | 2 |
| | 13 | Degeneracy problems | 2 |
| | 14 | Optimality test- MODI Method | 3 |
| | 15 | Transportation problem | 2 |
| | 16 | Assignment problem | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Explain the evolution and significance of OR. | U | PSO - 1 |
| CO-2 | Solve LPP using Graphical method and Simplex method | Ap, U | PSO - 1,2,4 |
| CO-3 | Solve LPP using Big- M method and Two-phase method | Ap, U | PSO - 1,2 |
| CO-4 | Solve transportation problem and assignment problem | Ap | PSO - 1,2 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Introduction to Operation Research**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Explain the evolution and significance of OR. | PSO - 1 | U | F, C, P | Lecture | |
| CO-2 | Solve LPP using Graphical method | PSO - 1,2,4 | Ap, U | F, C, P | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | and Simplex method. | | | | | |
| CO-3 | Solve LPP using Big-M method and Two-phase method. | PSO - 1,2 | Ap, U | F, C, P, M | Lecture | |
| CO-4 | Solve transportation problem and assignment problem. | PSO - 1,2 | Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | - | 1 | 1 | - | 2 | 3 | 3 | - | - | 1 | 2 | - |
| **CO 2** | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 3 | - | 2 | 2 | 2 | 1 |
| **CO 3** | 3 | 3 | 2 | 1 | 2 | 2 | 3 | 3 | - | - | 2 | 2 | - |
| **CO 4** | 3 | 3 | - | 1 | 2 | 2 | 3 | 3 | 1 | - | 2 | 2 | - |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment

- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK6DSCSTA352.1** | | | | |
| Course Title | **PROBABILITY THEORY - II** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **VI** | | | | |
| Academic Level | 300 – 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | Basic probability | | | | |

**Texts:**

1. Kingman, J.F.C. and Taylor, S.J. (1977). A text book of Introduction to Measure Theory and Probability, 3rd Edn., Cambridge University Press, London.

2. Laha, R.G. and Rohatgi, V.K. (1979). Probability Theory, John Wiley, New York.

3. Rohatgi, V.K. and Saleh, Ehsanes (2014). An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern Ltd.

4. Bhat, B.R. (1991). Modern Probability Theory, 2nd Edn., Wiley Eastern Ltd., New Delhi.

**References:**

1. Cacoullos, T. (1989). Exercise in Probability, Springer-Verlag, New-York.

| | |
|---|---|
| | 2. Feller W. (1968) Introduction to Probability Theory and Its Applications Vol. 1 and 2, John Wiley, New York.<br>3. Loeve, M (1968). Probability Theory Allied East-West Press.<br>4. Roussas, G.G. (2014). An Introduction to Measure-Theoretic Probability, Academic Press, USA. |
| Course Summary | Probability theory is the mathematical framework for quantifying uncertainty and randomness, providing tools to analyse and model uncertain events. It encompasses concepts such as random variables, probability distributions, and stochastic processes, which form the basis for probabilistic reasoning and decision-making. Key principles include the law of large numbers, which describes the convergence of sample averages to population means as sample size increases, and the central limit theorem, which states that the distribution of sample means approaches a normal distribution regardless of the population distribution. Probability theory enables the calculation of probabilities for various outcomes, facilitating predictions, risk assessment, and inference in diverse fields such as statistics, finance, engineering, and machine learning. By understanding and applying probability theory, practitioners can make informed decisions, assess uncertainty, and derive insights from data to address real-world challenges effectively. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Definition of Probability** | **15** |
| | 1 | Sequence of sets, limit supremum, limit infimum and limit of sequence of sets, Monotone sequence of sets | 3 |
| | 2 | Class of sets- Semi ring, ring, sigma ring, field and sigma field | 2 |
| | 3 | Borel sigma field and monotone class, probability space | 3 |
| | 4 | Probability measure, Limit of sequence of events, monotone and continuity properties of probability measure | 2 |

| | | | |
|---|---|---|---|
| | 5 | Independence of sequence of events, conditional probability and Bayes theorem | 2 |
| | 6 | Borel- Cantelli lemma and Borel zero-one law | 3 |
| **II** | **Linear Equations** | | **15** |
| | 7 | Expectation of random variables and its properties | 2 |
| | 8 | Probability generating function, moment generating function and cumulant generating function | 2 |
| | 9 | Characteristic function (c.f.) and their elementary properties, uniform continuity and non-negative definiteness of characteristic function | 2 |
| | 10 | Uniqueness theorem | 1 |
| | 11 | Inversion thoerem | 2 |
| | 12 | Fourier inversion theorem | 2 |
| | 13 | Convolution theorem | 2 |
| | 14 | Levy's continuity theorem and Bochner's theorem | 2 |
| **III** | **Various Inequalities in Probability** | | **15** |
| | 15 | Inequalities-Markov, Tchebychev's, Lyapunov, and Jensen's | 5 |
| | 16 | Stochastic convergence of sequence of random variables: convergence in probability, almost sure convergence, convergence in $p^{th}$ mean, weak and complete convergence of distribution functions and their interrelations. | 5 |
| | 17 | Slutsky's theorem and its applications | 5 |
| **IV** | **Stochastic Series of Sequence of Random Variables** | | **15** |
| | 18 | Law of large numbers, weak law of large numbers due to Bernoulli, Tchebyshev and Khintchine | 4 |
| | 19 | Strong law of large numbers- Kolmogorov's strong law of large numbers for independent and identically distributed random variables and for independent random variables | 4 |
| | 20 | Central limit theorem: Classical, De-Moivre-Laplace, Lyapunov, and Lindberg-Feller | 4 |

| | | | |
|---|---|---|---|
| | 21 | Applications of various central limit theorems. | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Identify a probability measure and explain its properties. | U | PSO - 1 |
| CO-2 | Calculate expectation and moments of a random variables. | Ap, U | PSO - 1,2,6 |
| CO-3 | Describe various inequalities in probability and its applications. | U | PSO - 1,2,6 |
| CO-4 | Describe various laws to sequences of random variables. | U | PSO - 1,4 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Probability Theory -II**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Identify a probability measure and explain its properties. | PSO - 1 | U | F, C | Lecture | |
| CO-2 | Calculate expectation and moments of a random variables. | PSO - 1,2,6 | Ap, U | C, P | Lecture | |
| CO-3 | Describe various inequalities in probability and its | PSO - | U | F, C, P, M | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | applications. | 1,2,6 | | | | |
| CO-4 | Describe various laws to sequences of random variables. | PSO - 1,4 | U | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 1 | 2 | - | 3 | 3 | 1 | - | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 2 | - | 3 | 3 | 3 | 3 | 1 | - | 2 | 2 |
| **CO 3** | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | - | 2 | 2 | 2 |
| **CO 4** | 3 | 2 | 1 | 3 | 2 | 1 | 3 | 3 | 1 | - | 2 | 1 | - |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| **Discipline** | **STATISTICS** | | | | |
| **Course Code** | **MIUK6DSESTA353.1** | | | | |
| **Course Title** | **MULTIVARIATE ANALYSIS** | | | | |
| **Type of Course** | **DSE** | | | | |
| **Semester** | **VI** | | | | |
| **Academic Level** | 300-399 | | | | |
| **Course Details** | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| **Pre-requisites** | Distribution theory | | | | |
| | **Texts:**<br>1. Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis, John Wiley, New York.<br>2. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, John Wiley & Sons New York<br>3. Johnson, R and Wychern (1992): Applied Multivariate Statistical Analysis, Prentice Hall, London.<br>**References:**<br>1. Kendall, M. G. (1958): A Course in Multivariate Analysis, Griffin, London.<br>2. Khatri, C.G. and Srivastava (1979): An Introduction to Multivariate Statistics, North Holland, New York. | | | | |

| | |
|---|---|
| | 3. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, John Wiley & Sons New York. |
| **Course Summary** | Multivariate analysis is a statistical method used to analyse relationships among multiple variables simultaneously. Unlike univariate analysis (which focuses on a single variable) or bivariate analysis (which deals with two variables), multivariate analysis deals with three or more variables. Multivariate analysis helps in understanding how variables are related to each other and identifying patterns or structures in the data. It is used to build predictive models that can estimate or forecast outcomes based on multiple predictors. The Wishart distribution is used to model the distribution of sample covariance matrices or precision matrices (inverse covariance matrices) in multivariate normal distributions. Techniques such as principal component analysis (PCA) and factor analysis are used to reduce the dimensionality of data while retaining important information. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Multivariate Normal Distribution** | | **15** |
| | 1 | Properties | 2 |
| | 2 | Characteristic function | 2 |
| | 3 | Marginal and conditional distributions | 2 |
| | 4 | Distribution of Linear combinations of normal variates | 2 |
| | 5 | Distribution of quadratic forms in normal variables | 2 |
| | 6 | Distribution of sums and quotient of independent quadratic forms | 3 |
| | 7 | Cochran's theorem | 2 |
| **II** | **Properties of Multivariate Normal Distribution** | | **15** |
| | 8 | Samples of multivariate normal distribution | 1 |
| | 9 | M.L.E of mean vector and dispersion matrix | 2 |
| | 10 | Distribution of sample mean vector | 2 |

| | | | |
|---|---|---|---|
| | 11 | Wishart distribution: Definition | 1 |
| | 12 | Analogy with chi-square distribution | 1 |
| | 13 | Characteristic Function | 1 |
| | 14 | Additive property | 1 |
| | 15 | Generalized variance | 2 |
| | 16 | Partitioned Wishart matrix | 2 |
| | 17 | Distribution of sample dispersion matrix | 2 |
| **III** | **Correlation Coefficients of Multivariate Normal Distribution** | | **15** |
| | 18 | Sampling distribution of correlation matrix and simple correlation coefficient | 3 |
| | 19 | Multiple correlation coefficient | 3 |
| | 20 | Partial correlation coefficient | 3 |
| | 21 | Distribution of the sample multiple correlation and partial correlation under null case | 3 |
| | 22 | Tests of significance | 3 |
| **IV** | **Tests of Hypothesis** | | **15** |
| | 23 | Tests of hypothesis about mean vector of a multivariate normal distribution | 1 |
| | 24 | Equality of means of two multivariate normal distributions | 2 |
| | 25 | Hotelling's $T^2$ and Mahalanobis' $D^2$ statistic | 2 |
| | 26 | Classification problem | 2 |
| | 27 | Bayes solution | 2 |
| | 28 | Fisher's discriminant function | 2 |
| | 29 | Principal component analysis | 2 |
| | 30 | Canonical variables and Canonical correlations | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe multivariate normal distribution and its properties | Ap, U | PSO – 1,2,3 |
| CO-2 | Describe Wishart distribution and its properties | Ap, R | PSO – 1,2,3,4.6 |
| CO-3 | Describe multiple and partial correlation coefficients | Ap | PSO – 1,2,3,4,6 |
| CO-4 | Use Hotelling's $T^2$ and Mahalanobis $D^2$ statistics for testing hypothesis | Ap, U | PSO – 1,2,3,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Multivariate Analysis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe multivariate normal distribution and its properties | PSO – 1,2,3 | Ap, U | F, C, P | Lecture | |
| CO-2 | Describe Wishart distribution and its properties | PSO – 1,2,3,4. 6 | Ap, R | F, C, P, M | Lecture | |
| CO-3 | Describe multiple and partial correlation coefficients | PSO – 1,2,3,4, 6 | Ap | F, C, P, M | Lecture | |
| CO-4 | Use Hotelling's $T^2$ and Mahalanobis | PSO – 1,2,3,4, | Ap, U | F, C, P, M | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | $D^2$ statistics for testing hypothesis. | 6 | | | | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 1 | - | 1 | 3 | 2 | - | - | 1 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 2 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 3 | 3 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | | ✓ |
| **CO 2** | ✓ | | | ✓ |
| **CO 3** | ✓ | | | ✓ |
| **CO 4** | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

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|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK6DSESTA354.1** | | | | |
| Course Title | **INVENTORY CONTROL AND QUEUING THEORY** | | | | |
| Type of Course | **DSE** | | | | |
| Semester | **VI** | | | | |
| Academic Level | 300 – 399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | NIL | | | | |

**References:**


1. Gross, D. and Hariss, C.M. (2009). *Fundamentals of Queueing Theory*, John Wiley & Sons.
2. Kanthi Swarup, Gupta, P.K, and Man Mohan (2012). *Operations Research*, Sulthan Chand & Sons.
3. Sharma, J.K. (2009). *Operations Research Theory and Applications*, Macmillan India Limited.
4. Medhi J (2014) *Introduction to Queueing Systems and Applications*, New Age International Publishers.
5. Mittal, K.V. and Mohan, C. (1996). *Optimization Methods in Operations Research and System Analysis*, New Age Publishers.
6. Paneerselvam, R. (2006). *Operations Research*, Prentice Hall of India.

| | |
|---|---|
| | 7. Rao S S. (1984), *Optimization Theory and Applications*, New Age Publishers, Wiley Eastern. |
| Course Summary | Inventory control involves managing and controlling the levels of inventory (stock) within an organization to ensure efficient operations while minimizing costs. The primary goal is to strike a balance between meeting customer demand and avoiding excessive inventory holding costs. Queuing theory is a mathematical approach used to analyse waiting lines or queues and optimize the design and operation of systems where customers or entities wait for service. Queues are prevalent in various settings, such as service centers, transportation systems, manufacturing processes, and telecommunications. Both inventory control and queuing theory play crucial roles in optimizing resource utilization, improving customer service, reducing costs, and enhancing overall operational efficiency in organizations. By applying principles and techniques from these areas, businesses can better manage their resources, streamline processes, and meet customer demands effectively. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Introduction to Inventory Control** | **15** |
| | 1 | Introduction | 3 |
| | 2 | Terminologies associated with inventories | 3 |
| | 3 | Cost associated with inventories | 3 |
| | 4 | Factors affecting inventory control<br><br>Economic order quantity (EOQ) | 3 |
| | 5 | Classical EOQ Model | 3 |
| **II** | | **Various Techniques of Inventory Control** | **15** |
| | 4 | Deterministic Inventory problem with no shortages | 3 |
| | 5 | Deterministic inventory problem with shortages | 3 |
| | 6 | EOQ problem with price breaks | 3 |
| | 7 | Inventory problem with uncertain demand | 2 |
| | 8 | Probabilistic inventory Control | 1 |
| | 9 | Newspaper boy problem | 3 |

| | | | |
|---|---|---|---|
| **III** | **Introduction to Queuing Theory** | | **15** |
| | 8 | Queuing system | 2 |
| | 9 | Elements of a queuing system | 2 |
| | 10 | Operating characteristics | 2 |
| | 11 | Pure birth and death model | 2 |
| | 12 | Classification of queuing models | 2 |
| | 13 | Transient and steady state | 2 |
| | 14 | Kolmogorov differential equations | 3 |
| **IV** | **Various Queueing Models** | | **15** |
| | 15 | Poisson queues M\|M\|1 with infinite channel capacity | 5 |
| | 16 | Poisson queues M\|M\|1 with limited channel capacity | 5 |
| | 17 | Non-Poisson queuing system - M/$E_k$/1 queue | 3 |
| | 18 | Cost models in queuing | 2 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Describe inventory control and cost associated with inventories. | U, R | PSO - 1,6 |
| CO-2 | Describe Economic Order Quantity. | U, Ap, E | PSO - 1,2 |
| CO-3 | Describe the basic concepts of queuing theory. | R, U | PSO - 1,3 |
| CO-4 | Derive the steady state solution of M/M/1 queue model. | U, Ap | PSO - 1,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Inventory Control & Queuing Theory**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe inventory control and cost associated with inventories | PSO - 1,6 | U, R | F, C | Lecture | |
| CO-2 | Describe Economic Order Quantity | PSO - 1,2 | U, Ap, E | F, C, P | Lecture | |
| CO-3 | Describe the basic concepts of queuing theory | PSO - 1,3 | R, U | F, C | Lecture | |
| CO-4 | Derive the steady state solution of M/M/1 queue model. | PSO - 1,5 | U, Ap | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | - | 2 | 3 | 3 | 3 | 1 | 2 | 2 | 1 | 1 |
| **CO 2** | 3 | 3 | - | 2 | 2 | 2 | 3 | 2 | - | - | 3 | 2 | - |
| **CO 3** | 3 | - | 3 | 2 | 1 | 1 | 3 | 3 | - | 1 | 2 | 2 | 2 |
| **CO 4** | 3 | 2 | 2 | - | 3 | 1 | 3 | 3 | 1 | 2 | - | - | 1 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

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|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK6SECSTA355.1** | | | | |
| Course Title | **STATISTICAL PROGRAMMING USING PYTHON** | | | | |
| Type of Course | **SEC** | | | | |
| Semester | **VI** | | | | |
| Academic Level | 300-399 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 3 | 3 hours | - | | 3 |
| Pre-requisites | NIL | | | | |

**Texts:**


1. Chun, W. (2006) *Core python programming*. Prentice Hall Professional.
2. Embarak, O. (2018). *Data Analysis and Visualization Using Python*: Analyze Data to Create Visualizations for BI Systems, Apress.
3. Lambert, K. A. (2011). *Fundamentals of Python: First Programs*. Cengage Learning


**References:**


1. Thereja, R. (2019). *Python Programming Using Problem Solving Approach*. Oxford University Press.
2. Kurniawan, A (2019). *Python and SQL Server Development*. PE press.
3. Jackson, C. (2018). *Learn Programming in Python with Cody Jackson*, Packt Publishing.
4. Balagurusamy, E. (2017). *Introduction to Computing & Problem-Solving using Python*, McGraw Hill Education (India) Private

| | |
|---|---|
| | Limited.<br><br>5. Boschetti, A. Massaron, L. (2015) - Python Data Science Essentials - Learn the fundamentals of Data Science with Python. Packt Publishing. |
| Course Summary | Statistical programming using Python involves leveraging the extensive libraries and tools available in Python to perform data analysis, visualization, and statistical modeling. Key libraries such as NumPy, pandas, and SciPy provide powerful data structures and functions for data manipulation, cleaning, and exploration. Matplotlib, Seaborn, and Plotly enable the creation of insightful visualizations to understand data distributions, relationships, and trends. Additionally, Python offers powerful statistical modeling capabilities through libraries like StatsModels and scikit-learn, allowing users to fit regression models, conduct hypothesis tests, and perform machine learning tasks. Jupyter Notebooks provide an interactive environment for conducting analyses, documenting code, and sharing insights. With its versatility, ease of use, and extensive community support, Python has become a popular choice for statistical programming across academia, industry, and research domains. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction & Basics of Python Programming** | | **11** |
| | 1 | Introduction to Python Programming – Installation & setup | 1 |
| | 2 | Basic terminologies in Python | 2 |
| | 3 | Types of Expressions | 2 |
| | 4 | Types of Operators | 2 |
| | 5 | Conditional statements in Python | 3 |
| | | if - statement | |
| | | if-elif-else statement | |
| | | for and while statements | |
| | | Exception handling | 1 |
| **II** | **Data Structures** | | **11** |

| | | | |
|---|---|---|---|
| | 6 | Types of Data Structures and various built – in methods | 10 |
| | | Lists | |
| | | Tuples | |
| | | Sets | |
| | | Dictionaries | |
| | 7 | Mutable and Immutable Objects | 2 |
| **III** | **Functions** | | **12** |
| | 8 | Types of functions | 5 |
| | 9 | Global and local variables | 2 |
| | 10 | Introduction to modules | 3 |
| | 11 | Python packages via pip | 2 |
| **IV** | **Files** | | **11** |
| | 12 | File Operations | 7 |
| | | Creating a file | |
| | | Reading from a file | |
| | | Writing file | |
| | 13 | Introduction to Databases | 6 |
| | | Working with Databases | |
| | | Using SQL, Python, SQLite and MYSQL | |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Basic concepts in Python programming. | R, U | PSO – 2,4,5,6 |
| CO-2 | Familiarise with Data structures. | R, U, Ap | PSO – 1,5 |

| | | | |
|---|---|---|---|
| CO-3 | Describe Functions, types of variables, modules and packages in Python. | U, Ap, An, C | PSO – 1,5 |
| CO-4 | Write codes in SQL. | U, Ap, C | PSO – 1,2,3,4,5,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistical Programming Using Python**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Basic concepts in Python programming. | PSO – 2,4,5, 6 | R, U | F, C | Lecture | |
| CO-2 | Familiarise with Data structures. | PSO – 1,5 | R, U, Ap | C, P | Lecture | |
| CO-3 | Describe Functions, types of variables, modules and packages in Python. | PSO – 1,5 | U, Ap, An, C | F, C, P | Lecture | |
| CO-4 | Write codes in SQL. | PSO – 1,2,3, 4,5,6 | U, Ap, C | P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 1 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | - | - | 3 | 2 | 3 |
| **CO 2** | 3 | - | 1 | - | 3 | 1 | 3 | 3 | - | - | 3 | 3 | 3 |
| **CO 3** | 3 | - | 1 | - | 3 | 2 | 3 | 3 | - | - | 3 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |

| | | | | |
|---|---|---|---|---|
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

## COURSES OFFERING – SEMESTER VII

| COURSE TYPE | MAJOR (STUDENT) | COURSE TITLE | CREDITS |
|---|---|---|---|
| **DSC** | STATISTICS | Statistical Quality Control | 4 |
| **DSC** | STATISTICS | Advanced Sampling Theory and Design of Experiments | 4 |
| **DSC** | STATISTICS | Analytic Tools for Statistics | 4 |
| **DSE** | STATISTICS | Big Data Analytics and Artificial Intelligence | 4 |
| **DSE** | STATISTICS | Reliability and Survival Analysis | 4 |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK7DSCSTA400.1** | | | | |
| Course Title | **STATISTICAL QUALITY CONTROL** | | | | |
| Type of Course | **DSC** | | | | |
| Semester | **VII** | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| Pre-requisites | NIL | | | | |
| | **References**<br><br>1. Ekambaram, S. K. (1963). Statistical basis of Acceptance Sampling. Asia Publishing House.<br><br>2. Gupta, R. C. (1974). Statistical Quality Control. Khanna Publishers, Delhi.<br><br>3. Kanti Swarup, Gupta, P. K and Manmohan. (1993). Operations Research. Sultan Chand Publishers, New Delhi.<br><br>4.Goel and Mittal (1982). Operations Research. Pragathi Prakashan, Meerut.<br><br>5. Kapoor, V. K and Gupta, S. P. (1978). Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.<br><br>6. Grant, E.L. and Laven Worth, R.S. (1996). Statistical Quality Control. McGraw Hill. | | | | |

| | |
|---|---|
| | 7. Montgomery, D.C. (1983). Introduction to Statistical Quality Control. John Wiley & Sons. |
| Course Summary | Statistical quality control (SQC) is a set of tools and techniques used to monitor, control, and improve the quality of products and processes. SQC involves the application of statistical methods to analyse process data, identify sources of variation, and make data-driven decisions to maintain or enhance quality standards. Key SQC tools include control charts, which monitor process performance over time and detect deviations from expected behaviour, helping to identify and correct issues before they result in defects. Additionally, techniques such as process capability analysis assess whether a process meets predefined quality specifications, while sampling plans and acceptance sampling determine the acceptability of batches or lots based on sample inspections. SQC plays a critical role in industries such as manufacturing, healthcare, and service sectors, where consistent quality is essential for customer satisfaction, compliance with regulations, and overall business success. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Statistical Quality Control (SQC)** | | **15** |
| | 1 | Definition, quality, quality control and statistical quality control | 4 |
| | 2 | Need for SQC techniques in industry-causes of quality variation | 4 |
| | 3 | Control chart-uses of control chart | 4 |
| | 4 | specification and tolerance limits- 3 sigma limits, warning limits | 3 |
| **II** | **Control Charts** | | **15** |
| | 5 | Control chart for variables- $\bar{x}$ chart and R chart | 1 |
| | 6 | Purpose of chart | 1 |
| | 7 | Plotting - $\bar{x}$ and R results | 2 |
| | 8 | Determining the trial control limits | 1 |
| | 9 | Interpretation of control charts | 1 |
| | 10 | Control chart for attributes | 2 |

| | | | |
|---|---|---|---|
| | 11 | purpose of the chart | 2 |
| | 12 | construction of p chart, np chart, c-chart, and u-charts. | 5 |
| **III** | **Terms in SQC** | | **15** |
| | 13 | Acceptance sampling plans for attributes and variables, producer's risk and consumer's risk | 5 |
| | 14 | Concepts of AQL, LTPD, AOQ, AOQL, ATI, ASN, and OC Curves. | 5 |
| | 15 | ARL & process capability of control charts, CUSUM charts | 5 |
| **IV** | **Sampling Inspection Techniques** | | **15** |
| | 16 | Single, double and multistage sampling plans and their properties | 2 |
| | 17 | Chain sampling | 2 |
| | 18 | Continuous sampling | 2 |
| | 19 | Taguchi method | 2 |
| | 20 | Total quality management | 2 |
| | 21 | ISO Standardization | 1 |
| | 22 | ISO 9001 | 2 |
| | 23 | Six sigma concepts | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe SQC and its applications. | U | PSO - 1 |
| CO-2 | Sketch control chart for variables and attributes. | Ap, U | PSO - 1,2,4 |
| CO-3 | Describe acceptance sampling plans. | U | PSO - 1,2,4 |

| | | | |
|---|---|---|---|
| CO-4 | Describe various sampling inspection techniques. | U | PSO - 1,2,3 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Statistical Quality Control**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe SQC and its applications. | PSO - 1 | U | F, C | Lecture | |
| CO-2 | Sketch control chart for variables and attributes. | PSO - 1,2,4 | Ap, U | F, C, P | Lecture | ✓ |
| CO-3 | Describe acceptance sampling plans. | PSO - 1,2,4 | U | F, C | Lecture | |
| CO-4 | Describe various sampling inspection techniques. | PSO - 1,2,3 | U | F, C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 2 | - | - | 1 | 2 | 3 | - | - | 2 | 2 | 1 |
| **CO 2** | 3 | 3 | 2 | 3 | 2 | 1 | 3 | 3 | - | - | 2 | 2 | 1 |
| **CO 3** | 3 | 3 | 1 | 2 | 2 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| **CO 4** | 3 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | - | 1 | 2 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | ✓ | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

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|---|---|---|---|---|---|
| **Discipline** | **STATISTICS** | | | | |
| **Course Code** | **MIUK7DSCSTA401.1** | | | | |
| **Course Title** | **ADVANCED SAMPLING THEORY AND DESIGN OF EXPERIMENTS** | | | | |
| **Type of Course** | **DSC** | | | | |
| **Semester** | **VI** | | | | |
| **Academic Level** | 400-499 | | | | |
| **Course Details** | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| **Pre-requisites** | Basics of sampling theory | | | | |
| | **Texts:**<br>1. Chakrabarti, M.C. (1962): *Mathematics of Design and Analysis of Experiments*, Asia Publishing House, Bombay.<br>2. Das, M. N. And Giri, N. (1979). *Design and Analysis of Experiments*. Wiley Eastern Limited, New Delhi.<br>3. Montgomery, C.D. (1976): *Design and Analysis of Experiments*, John Wiley, New York. 4. Cochran, W.G. (1997): Sampling Techniques. John Wiley and Sons, New York, ISBN -13:978-0471162384<br>5. Mukhopadhyay, P. (2008): *Theory and Methods of Survey Sampling*. Prentice Hall of India, ISBN:97881 20336766<br>**References:**<br>1. Sukhatme, P. V., Sukhatme, B. V. And Ashok, C. (1970): *Theory of Sample Surveys with Applications*. Asia Publishing House, Delhi. ISBN-13 :978-02 10225196 | | | | |

| | |
|---|---|
| | 2. Rao, P.S.R.S. (2000): *Sampling Methodologies with Applications*, Chapman and Hall/CRC. ISBN-13:978-1584882 145<br><br>3. Govindarajulu, Z. (1999). *Elements of Sampling Theory and Methods*. Printice Hall of India ISBN-13 :978-0137435760<br><br>4. Aloke Day (1986). *Theory of Block Designs*, Wiley Eastern, New Delhi.<br><br>5. John, P.W.M. (1971). Statistical Design and Analysis of Experiments, Macmillan.<br><br>6. Joshi,D. D. (1987): *Linear Estimation and Design of Experiments*, Wiley Eastern, Wiley Eastern Limited, New Delhi.<br><br>7. http:/mospi.nic. in/ |
| **Course Summary** | Cluster sampling and PPS sampling are valuable tools in data analysis and sampling methodology. Cluster sampling helps in identifying natural groupings or patterns in data, while PPS sampling ensures proportional representation of larger units in the sample, enhancing the accuracy of estimates in survey sampling and research studies. Both cluster sampling and PPS sampling are valuable techniques in survey research and statistical analysis, offering practical solutions for sampling from large and diverse populations while ensuring representativeness and efficiency in data collection.<br><br>Nested designs and split-plot designs are advanced experimental design techniques that address specific experimental considerations, such as hierarchical structures, nesting of factors, and efficiency in resource utilization. This course provides a comprehensive understanding of advanced sampling theory, including various sampling techniques, sampling distributions, errors, and bias. It also covers the principles and techniques of experimental design, ANOVA, and their applications in research, quality improvement, and statistical analysis. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Methods of Estimation** | **15** |
| | 1 | Ratio, product and regression methods of estimation | 1 |
| | 2 | Estimation of population mean | 1 |

| | | | |
|---|---|---|---|
| | 3 | Evaluation of bias and variance to the first order of approximation | 2 |
| | 4 | Comparison with simple random sampling | 1 |
| | 5 | Equal size cluster sampling | 1 |
| | 6 | Estimators of population mean and total and their standard errors | 2 |
| | 7 | Comparison of cluster sampling with SRS | 1 |
| | 8 | Concept of multistage sampling and its application | 2 |
| | 9 | Two-stage sampling with equal number of second stage units | 2 |
| | 10 | Estimation of population mean and total | 2 |
| **II** | **Sampling with Probability Proportional to Size** | | **15** |
| | 11 | Sampling with probability proportional to size (with and without replacement method) | 3 |
| | 12 | Des Raj and Das estimators for n=2 | 3 |
| | 13 | Horvitz-Thomson's estimator | 3 |
| | 14 | Midzuno-Sen method | 3 |
| | 15 | Murthy's unordered estimator | 3 |
| **III** | **Design of Experiment** | | **15** |
| | 16 | Block designs- information matrix of block designs | 2 |
| | 17 | Criteria for connectedness | 2 |
| | 18 | Balance and orthogonality | 2 |
| | 19 | Analysis of covariance technique in standard designs | 2 |
| | 20 | Factorial designs: Statistical analysis of symmetrical factorial designs | 3 |
| | 21 | Total and partial confounding in $3^n$ experiments | 2 |
| | 22 | Concepts of fractional replication | 2 |
| **IV** | **Analysis of Experimental Data and Adopting Available Designs** | | **15** |
| | 23 | Incomplete block design | 2 |
| | 24 | BIBD | 3 |

| | | | |
|---|---|---|---|
| | 25 | Analysis with recovery of inter block information and intra block information | 3 |
| | 26 | PBIBD and analysis of PBIBD with only two associate classes | 3 |
| | 27 | Nested designs | 2 |
| | 28 | Basic concepts (only) of split plot and strip plot designs – analysis | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Apply concepts and techniques in sampling methods. | Ap, U | PSO – 1,2,3,4 |
| CO-2 | Describe various estimators used in sampling theory. | Ap, R | PSO – 1,2,4,6 |
| CO-3 | Apply various designs in suitable situations. | Ap | PSO – 1,2,3,4,6 |
| CO-4 | Perform the analysis of data coming out of experiments conducted adopting available designs. | Ap, U | PSO – 1,2,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Advanced Sampling Theory and Design of Experiments**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Apply concepts and techniques in sampling methods. | PSO – 1,2,3,4 | Ap, U | F, C, P | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| CO-2 | Describe various estimators used in sampling theory | PSO – 1,2,4,6 | Ap, R | F, C, P | Lecture | |
| CO-3 | Apply various designs in suitable situations. | PSO – 1,2,3,4, 6 | Ap | C, P, M | Lecture | |
| CO-4 | Perform the analysis of data coming out of experiments conducted adopting available designs. | PSO – 1,2,4,6 | Ap, U | C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | - | 1 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 1 | 3 | - | 3 | 3 | 3 | - | 1 | 2 | 3 | 1 |
| **CO 3** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 | 1 | 3 | 3 | 2 |
| **CO 4** | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |

| | |
|---|---|
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | **Internal Exam** | **Assignment** | **Seminar** | **End Semester Examinations** |
|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | | ✓ |
| **CO 2** | ✓ | | | ✓ |
| **CO 3** | ✓ | | | ✓ |
| **CO 4** | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

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|---|---|---|---|---|---|
| **Discipline** | **STATISTICS** | | | | |
| **Course Code** | **MIUK7DSCSTA402.1** | | | | |
| **Course Title** | **ANALYTIC TOOLS FOR STATISTICS** | | | | |
| **Type of Course** | **DSC** | | | | |
| **Semester** | **VII** | | | | |
| **Academic Level** | 400-499 | | | | |
| **Course Details** | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| **Pre-requisites** | NIL | | | | |
| | **Texts:**<br>1. Apostol T. M. (1974): *Mathematical Analysis*, Narosa Publishing House, New Delhi.<br>2. Malik, S.C., Arora, S. (2012): *Mathematical Analysis*, New Age International, New Delhi<br>3. Biswas, S. (2012). *Textbook of Matrix Algebra*, Third edition, PHI Learning Pvt Ltd, New Delhi.<br>4. Graybill,A and Belmont, C.A.(1983): *Matrices with Applications in Statistics*, II Edition, John Wiley, New York.<br>5. Mathai, A.M. (1999). *Linear Algebra (Part I, II & II)*, Centre for Mathematical Sciences, Trivandrum.<br><br>**References:** | | | | |

| | |
|---|---|
| | 1. Pringle, R.M. and Rayner,A. (1971): *Generalized Inverse of Matrices with Application to Statistics*, Griffin, London.<br><br>2 Rao,C.R (1973): *Linear Statistical Inference and its Applications*, Wiley Eastern, NewYork.<br><br>3. Roydon, H. L. (1968): *Real Analysis*, Macmillan, New York. |
| **Course Summary** | This course provides a comprehensive foundation in real and linear algebra, covering fundamental concepts, techniques, and applications in mathematics, science, engineering, and computational fields. Students gain proficiency in solving linear equations, manipulating matrices, understanding vector spaces and transformations, and applying linear algebra tools in diverse areas of study and research. The course emphasizes both theoretical understanding and practical problem-solving skills, preparing students for advanced studies and real-world applications in linear algebra and related disciplines. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Classes of Open and Closed Sets** | **15** |
| | 1 | Euclidean space $R^n$ | ½ |
| | 2 | Open balls | ½ |
| | 3 | Interior point | ½ |
| | 4 | Open sets | 1 |
| | 5 | Limit points | 1 |
| | 6 | Adherent points | 1 |
| | 7 | Closed sets | 1 |
| | 8 | Bolzano – Weierstrass theorem | 1 |
| | 9 | Cantor intersection theorem | 1 |
| | 10 | Compactness in $R^n$ | ½ |
| | 11 | Heine-Borel theorem | 1 |

| | | | |
|---|---|---|---|
| | 12 | Metric space | ½ |
| | 13 | Compact subsets of a metric space | 1 |
| | 14 | Sequence in metric space | ½ |
| | 15 | Convergent sequence | ½ |
| | 16 | Cauchy Sequence (definition and concept) | ½ |
| | 17 | Completeness of metric space | ½ |
| | 18 | Limit of real valued functions | ½ |
| | 19 | Continuous functions | ½ |
| | 20 | Continuity and inverse images of open and closed sets | ½ |
| | 21 | Connected sets | ½ |
| | 22 | Uniform continuity and monotone functions (definition, examples and applications only) | ½ |
| **II** | **Cauchy Sequence, Completeness, Compactness and Connectedness** | | **15** |
| | 23 | Definition and existence of Riemann integral (concepts only) | 1 |
| | 24 | Riemann-Stieltjes integral | 2 |
| | 25 | Reduction to Riemann integral, | 1 |
| | 26 | Properties of Riemann-Stieltjes integrals (viz. linearity, product quotient and modulus of integrals). | 1 |
| | 27 | Fundamental theorem of integral calculus, mean value theorem (statement only), Functions of bounded variation, properties, total variation and additive property, continuous functions of bounded variation. | 2 |
| | 28 | Mean value theorem (statement only) | 2 |
| | 29 | Functions of bounded variation | 2 |
| | 30 | Properties | 2 |
| | 31 | Total variation and additive property | 1 |
| | 32 | Continuous functions of bounded variation | 1 |

| | | | |
|---|---|---|---|
| **III** | **Linear Transformations** | | **15** |
| | 33 | Vector space and subspaces | 3 |
| | 34 | Independence of vectors, basis and dimensions | 2 |
| | 35 | Matrices and determinants | 2 |
| | 36 | Rank of a matrix | 2 |
| | 37 | Null space and nullity | 2 |
| | 38 | Partitioned matrices | 1 |
| | 39 | Linear transformations | 1 |
| | 40 | Matrix representation of linear transforms | 1 |
| | 41 | Solution of system of linear equations (problems only) | 1 |
| **IV** | **Concept of Eigen Values, Eigen Vectors and Related Results in Linear Algebra** | | **15** |
| | 43 | Eigen values and eigen vectors | 1 |
| | 44 | Algebraic and geometric multiplicity of eigen values | 1 |
| | 45 | Cayley- Hamilton theorem | 1 |
| | 46 | Spectral decomposition of Matrices | 1 |
| | 47 | Canonical forms | 1 |
| | 48 | Diagonal form | 1 |
| | 49 | Triangular form | 1 |
| | 50 | Jordan form | 1 |
| | 51 | Quadratic form | 1 |
| | 52 | Reduction of quadratic forms | 1 |
| | 53 | Generalized inverse | 1 |
| | 54 | Moore-Penrose inverse | 1 |
| | 55 | Jacobian of transformation | 1 |
| | 56 | Derivative of a function with respect to a vector | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe classes of open and closed sets. | Ap, U | PSO – 1 |
| CO-2 | Use the concept of Cauchy sequence, completeness, compactness and connectedness to solve problems. | An. R | PSO – 1,2,4 |
| CO-3 | Apply linear transformation in Statistics. | Ap | PSO – 1,2,4 |
| CO-4 | Apply concept of Eigen values, Eigen vectors and related results in Statistics. | An, Ap | PSO – 1,2,4 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Analytic Tools for Statistics**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Describe classes of open and closed sets | PSO – 1 | Ap, U | F, C | Lecture | |
| CO-2 | Use the concept of Cauchy sequence, completeness, compactness and connectedness to solve problems. | PSO – 1,2,4 | An. R | F, C | Lecture | |
| CO-3 | Apply linear transformation in Statistics. | PSO – 1,2,4 | Ap | F, C, P | Lecture | |
| CO-4 | Apply concept of | PSO – | An, Ap | F, C, P | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Eigen values, Eigen vectors and related results in Statistics. | 1,2,4 | | | | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | - | 2 | - | - | 3 | 3 | - | 2 | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | - | 3 | - | - | 3 | 3 | - | 2 | 3 | 3 | 3 |
| **CO 3** | 3 | 3 | - | 3 | - | - | 3 | 3 | 3 | 3 | 2 | 3 | 2 |
| **CO 4** | 3 | 3 | - | 3 | - | - | 3 | 3 | - | 2 | 3 | 3 | 3 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | | ✓ |
| **CO 2** | ✓ | | | ✓ |
| **CO 3** | ✓ | | | ✓ |
| **CO 4** | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

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|---|---|---|---|---|---|
| **Discipline** | **STATISTICS** | | | | |
| **Course Code** | **MIUK7DSESTA403.1** | | | | |
| **Course Title** | **BIG DATA ANALYTICS AND ARTIFICIAL INTELLIGENCE** | | | | |
| **Type of Course** | **DSE** | | | | |
| **Semester** | **VII** | | | | |
| **Academic Level** | 400-499 | | | | |
| **Course Details** | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| **Pre-requisites** | NIL | | | | |

**Texts:**

1. Berson, A. and Smith, S.J. (1997): Data Warehousing, Data Mining, and OLAP, McGraw- Hill.
2. Breiman, L. Friedman, J.H. Olshen, R.A. and Stone, C.J. (1984): Classification and Regression Trees, Wadsworth and Brooks/Cole.
3. Han, J. and Kamber, M. (2000): Data Mining; Concepts and Techniques, Morgan Kaufmann.
4. Acharjya, D.P., Sachidananda, D. And Sugata, S (2016): Computational Intelligence for Big Data Analysis: Frontier Advances and Applications. Springer
5. DT Editorial Services, Big Data Black Book.

**References:**

1. D. Cielen, Arno D. B. Meysman and M. Ali (2016): Introducing Data Science, Dreamtech

2. F. Flach (2015): Machine Learning. Cambridge University Press.

| | |
|---|---|
| | 3. J. Kumar and N. S. Gill (2020): Artificial Intelligence and Deep Learning for Decision Makers, BPB Publications**.** |
| **Course Summary** | The course on Big Data provides a comprehensive overview of key concepts and technologies essential for handling large volumes of data. The module delves into the fundamentals of Big Data, including its structure, elements, analytics, and various applications within business contexts and later the focus shifts to technologies tailored for managing Big Data, such as distributed and parallel computing, data models, and an introduction to Hadoop, emphasizing its components like HDFS and MapReduce. It expands to analytics and Big Data, the Hadoop ecosystem, including HDFS architecture, MapReduce, Hadoop YARN, and tools like HBase, Hive, and Pig. Finally, the last module gives idea on the MapReduce framework, optimization techniques, and the role of HBase in data processing, culminating in practical exercises in developing MapReduce applications. Through these modules, students gain a comprehensive understanding of Big Data principles and the practical skills necessary for effective data management and analysis. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Introduction to Big Data Analytics** | **15** |
| | 1 | Introduction to Big Data | 2 |
| | 2 | Structuring Big Data | 3 |
| | 3 | Elements of Big data | 3 |
| | 4 | Big data analytics | 2 |
| | 5 | Big data applications | 2 |
| | 6 | Big Data in business context | 3 |
| **II** | | **Introduction to Technologies for Handling Big Data** | **15** |
| | 7 | Technologies for handling big data | 3 |
| | 8 | Distributed and Parallel computing for Big Data | 3 |
| | 9 | Data Models | 3 |
| | 10 | Computing Models | 3 |

| | | | |
|---|---|---|---|
| | 11 | Introducing Hadoop – HDFS and MapReduce | 3 |
| **III** | **Hadoop Ecosystem** | | **15** |
| | 12 | Understanding Analytics and Big data | 1 |
| | 13 | Comparison of Reporting and Analysis | 1 |
| | 14 | Types of Analytics | 1 |
| | 15 | Analytical approaches | 1 |
| | 16 | Hadoop Ecosystem | 2 |
| | 17 | Hadoop Distributed file system | 2 |
| | 18 | HDFS architecture | 2 |
| | 19 | MapReduce | 2 |
| | 20 | Hadoop YARN | 2 |
| | 21 | Introducing HBase, Hive and Pig | 1 |
| **IV** | **MapReduce Fundamentals** | | **15** |
| | 22 | MapReduce framework | 2 |
| | 23 | Techniques to Optimize MapReduce | 2 |
| | 24 | Uses of MapReduce | 1 |
| | 25 | Role of HBase in Big data processing | 2 |
| | 26 | Processing Data with MapReduce – Framework | 2 |
| | 27 | Developing simple MapReduce Application | 2 |
| | 28 | MapReduce execution and Implementing MapReduce Programs | 2 |
| | 29 | Limitations of MapReduce | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive | PSO addressed |
|---|---|---|---|

| | | Level | |
|---|---|---|---|
| CO-1 | Understand when a data becomes Big Data. | R, U | PSO-1,4 |
| CO-2 | Choose appropriate technology for processing Big Data problems. | R, U, Ap | PSO-1,2,4,5 |
| CO-3 | Get good understanding of Hadoop and HDFS Ecosystem. | R, U | PSO-1,2,4 |
| CO-4 | Explore MapReduce configuration. | R, U | PSO-1,2,5 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Big Data Analytics and Artificial Intelligence**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Understand when a data becomes Big Data. | PSO-1,4 | R, U | F, C | Lecture | |
| CO-2 | Choose appropriate technology for processing Big Data problems. | PSO-1,2,4,5 | R, U, Ap | F, C, P | Lecture | |
| CO-3 | Get good understanding of Hadoop and HDFS Ecosystem. | PSO-1,2,4 | R, U | F, C, P | Lecture | |
| CO-4 | Explore MapReduce configuration. | PSO-1,2,5 | R, U | F, C, P | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 1 | 2 | 3 | 2 | 2 | 3 | 2 | 2 | 3 | 1 | 2 | 2 |
| **CO 2** | 3 | 3 | 2 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 2 | 3 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 3 | 1 |
| **CO 4** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 3 | 2 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | | ✓ |
| **CO 2** | ✓ | | | ✓ |

| | | | | |
|---|---|---|---|---|
| **CO 3** | ✓ | | | ✓ |
| **CO 4** | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

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|---|---|---|---|---|---|
| **Discipline** | **STATISTICS** | | | | |
| **Course Code** | **MIUK7DSESTA404.1** | | | | |
| **Course Title** | **RELIABILITY AND SURVIVAL ANALYSIS** | | | | |
| **Type of Course** | **DSE** | | | | |
| **Semester** | **VII** | | | | |
| **Academic Level** | 400-499 | | | | |
| **Course Details** | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | | 4 |
| **Pre-requisites** | Basic Distributions | | | | |
| | **Texts:**<br>1. Barlow, R.E. and Proschan, F. (1985): *Statistical Theory of Reliability and Life Testing*, Holt, Rinehart and Winston.<br>2. Cox, D.R. and Oakes, D. (1984): *Analysis of Survival Data*, Chappman Hall.<br>3. Md. Rezaul Karim and M. Ataharul Islam(2019). *Reliability and Survival Analysis*,Springer,New York.<br>4. Barlow, R. E. and Proschan, F. (1975): *Statistical theory of reliability and life testing*.Holt, Reinhart and Winston.<br>5. Lawless, J. F. (2003). *Statistical models and methods for lifetime data*. John Wiley &Sons.<br>**References:** | | | | |

| | |
|---|---|
| | 1. Smith, P.J. (2002): *Analysis of Failure and Survival Data*. CRC.<br>2. Kleinbaum, D. G. and Klein, M. (2012). *Survival Analysis: A Self-Learning Text*, 3rdEd, Springer, New York.<br>3. Galambos, J. and Kotz, S. (1978) *Characterization of Probability Distributions.*<br>4. Klefjo, B. (1982) *The HNBUE and HNWUE Classes of Life distributions*, Naval Research Logistic Quarterly, 29, 331-344.<br>5. Lawless, J. F. (2003): *Statistical Models and Methods for Lifetime Data*, John Wiley.<br>6. Nelson, W. (1982): *Applied life data analysis*, Wiley.<br>7. Sinha, S. K. (1986) *Reliability and Life Testing*, Wiley. |
| **Course Summary** | This course provides a comprehensive foundation in real and linear algebra, covering fundamental concepts, techniques, and applications in mathematics, science, engineering, and computational fields. Students gain proficiency in solving linear equations, manipulating matrices, understanding vector spaces and transformations, and applying linear algebra tools in diverse areas of study and research. Students learn to analyse time-to-event data, estimate survival probabilities, model survival distributions, perform hypothesis tests, and conduct regression analyses for survival outcomes. The course emphasizes practical skills in using statistical software tools and interpreting results for decision-making in reliability engineering, medical research, and related fields. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | | **Reliability -Types and Assessment** | **15** |
| | 1 | Basic reliability concepts: Reliability concepts and measures | ½ |

| | | | |
|---|---|---|---|
| | 2 | Components and systems | ½ |
| | 3 | Coherent systems | 1 |
| | 4 | Reliability of coherent systems | 1 |
| | 5 | Cuts and paths | 1 |
| | 6 | Series and parallel system | 1 |
| | 7 | k-out-of-n systems | 1 |
| | 8 | Bounds on System Reliability | 1 |
| | 9 | Failure rate | 1 |
| | 10 | Mean residual life | 1 |
| | 11 | Mean time to failure in the univariate cases | 4 |
| | 12 | Exponential | |
| | 13 | Weibull | |
| | 14 | Pareto | |
| | 15 | Inverse Gaussian and Gamma as life distribution models | 1 |
| | 16 | Characterization of life distribution based on failure rate and mean residual life function | 1 |
| **II** | **Validity And Precision of Statistical Analysis** | | **15** |
| | 17 | Reliability concepts in discrete set up | 2 |
| | 18 | Notion of ageing based on failure rate and mean residual life | 2 |
| | 19 | NBU | 2 |
| | 20 | NBUE | 2 |
| | 21 | HNBUE | 2 |
| | 22 | Classes and their duals | 3 |
| | 23 | Interrelationships | 2 |
| **III** | **Reliability in Discrete Setup** | | **15** |
| | 24 | Inference in reliability models: Estimation of parameters based on complete and censored samples in exponential. | 5 |

| | | | |
|---|---|---|---|
| | 25 | Weibull and Gamma models. | 5 |
| | 26 | Non-parametric estimation of failure rate and reliability function. | 5 |
| **IV** | **Inference in Reliability Model** | | **15** |
| | 27 | Likelihood Inference with Censored Data | 1 |
| | 28 | Single sample methods | 1 |
| | 29 | Life tables | 2 |
| | 30 | Kaplan-Meier Estimator | 1 |
| | 31 | Parametric models | 1 |
| | 32 | Two sample methods | 2 |
| | 33 | Log-rank test | 2 |
| | 34 | Parametric comparisons | 2 |
| | 35 | Regression models: covariates and their uses | 1 |
| | 36 | Definition and interpretation of Cox's proportional hazard model and additive hazard model | 2 |

**Course Outcomes**

| **No.** | **Upon completion of the course the graduate will be able to:** | **Cognitive Level** | **PSO addressed** |
|---|---|---|---|
| CO-1 | Define reliability including different types and how they are assessed. | U | PSO – 1 |
| CO-2 | Summarize the validity and precision of statistical analysis. | Ap, R | PSO – 1,2,4,6 |
| CO-3 | Explain reliability in discrete setup. | Ap | PSO – 1,2,4,6 |
| CO-4 | Interpret inference in reliability model. | Ap, U | PSO – 1,2,3,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Reliability and Survival Analysis**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PSO | Cognitive Level | Knowledge Category | Lecture (L)/Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| CO-1 | Define reliability including different types and how they are assessed. | PSO – 1 | U | F, C, P | Lecture | |
| CO-2 | Summarize the validity and precision of statistical analysis. | PSO – 1,2,4,6 | Ap, R | C, P | Lecture | |
| CO-3 | Explain reliability in discrete setup. | PSO – 1,2,4,6 | Ap | C, P | Lecture | |
| CO-4 | Interpret inference in reliability model. | PSO – 1,2,3,4, 6 | Ap, U | C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 2 | 1 | 2 | - | 1 | 3 | 2 | - | - | 2 | 2 | 2 |
| **CO 2** | 3 | 3 | 1 | 3 | - | 3 | 3 | 3 | - | - | 2 | 1 | 1 |
| **CO 3** | 3 | 3 | 1 | 3 | - | 3 | 3 | 1 | - | - | 1 | 2 | 1 |
| **CO 4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | - | 2 | 2 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Assignment
- Seminar
- Midterm Exam
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Seminar | End Semester Examinations |
|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | | ✓ |
| **CO 2** | ✓ | | | ✓ |
| **CO 3** | ✓ | | | ✓ |
| **CO 4** | | ✓ | ✓ | ✓ |

**Mar Ivanios College (Autonomous)**

**COURSES OFFERING – SEMESTER VIII**

| COURSE TYPE | MAJOR (STUDENTS) | COURSE TITLE | CREDITS |
|---|---|---|---|
| **DSE** | STATISTICS | Stochastic Process and Advanced Time Series | 4 |
| **DSE** | STATISTICS | Applied Regression Modeling | 4 |

**Mar Ivanios College (Autonomous)**

| | | | | | |
|---|---|---|---|---|---|
| Discipline | **STATISTICS** | | | | |
| Course Code | **MIUK8DSESTA450.1** | | | | |
| Course Title | **STOCHASTIC PROCESS AND ADVANCED TIME SERIES** | | | | |
| Type of Course | **DSE** | | | | |
| Semester | **VIII** | | | | |
| Academic Level | 400-499 | | | | |
| Course Details | Credit | Lecture per week | Tutorial per week | Practical per week | Total Hours/Week |
| | 4 | 4 hours | - | - | 4 |
| Pre-requisites | Basic Time Series Analysis | | | | |

**Texts:**


1. Karlin, S. and Taylor, H.M. (1975). A First Course in Stochastic Processes, Academic Press.
2. Medhi, J. (2009). Stochastic Processes, New Age International Publishers, New Delhi.
3. Box, G.E.P., Jenkins G.M. and Reinsel, G.C. (2007) Time Series Analysis, Forecasting andControl, Pearson Education.
4. Brockwell,P J. and David R. A. (2002). Introduction to time series and forecasting, 2ndedition, Springer.


**References:**


1. Bhat, U.N. (1972). Elements of Applied Stochastic Processes, John Wiley, New York.

| | |
|---|---|
| | 2. Cinlar, E. (1975). Introduction to Stochastic Processes, Prentice Hall, Inc, New York.<br>3. Makridakis, S and Wheelwright, S C. Forecasting methods and applications, John Wiley andSons.<br>4. Feller, W. (1968). Introduction to Probability Theory and Applications, Vol. I, John Wiley,New York.<br>5. Feller, W. (1971). Introduction to Probability Theory and Applications, Vol. II, John Wiley,New York. |
| Course Summary | . This course provides a comprehensive understanding of stochastic processes, including Markov chains, Brownian motion, and diffusion processes, along with practical skills in time series analysis. Students learn to model and analyse random processes over time, forecast future behaviour, identify trends and seasonal patterns, and apply advanced techniques for modeling and inference in time series data. The course emphasizes both theoretical concepts and hands-on applications using statistical software tools and programming languages like R, Python etc. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction To Stochastic Processes** | | **15** |
| | 1 | Basic Terminologies in Stochastic Processes | 2 |
| | 2 | Classification of stochastic processes | 1 |
| | 3 | Markov process | 2 |
| | 4 | Random Walk and Wiener process | 2 |
| | 5 | Transition probabilities and Transition probability matrix | 2 |
| | 6 | Chapman - Kolmogorov equation | 2 |
| | 7 | Ergodic theorem | 2 |
| | 8 | Gambler's ruin problem | 2 |
| **II** | **Poisson Process** | | **15** |
| | 9 | Poisson process | 3 |
| | 10 | Compound Poisson process | 2 |

| | | | |
|---|---|---|---|
| | 11 | Pure Birth process | 3 |
| | 12 | Birth Immigration process | 2 |
| | 13 | Pure Death process | 2 |
| | 14 | Birth and Death process | 3 |
| **III** | **Renewal Process** | | **15** |
| | 15 | Renewal process | 1 |
| | 16 | Renewal function and Renewal density | 1 |
| | 17 | Renewal theorems | 2 |
| | 18 | Wald's equation | 2 |
| | 19 | Backward and Forward recurrence times | 1 |
| | 20 | Branching process | 2 |
| | 21 | Galton – Watson branching process | 2 |
| | 22 | Probability of ultimate extinction | 2 |
| | 23 | Distribution of total number of progeny | 2 |
| **IV** | **Advanced Time Series Analysis** | | **15** |
| | 24 | Stationary time series | 3 |
| | 25 | Autocorrelation | 3 |
| | 26 | Linear stationary Models | 3 |
| | 27 | Linear non-stationary models | 3 |
| | 28 | Forecasting using ARMA and ARIMA models | 3 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe and exemplify concepts of Stochastic processes, time space and state space, classification of stochastic processes based on the nature of time space and state | U, Ap | PSO - 1,2,3,4 |

| | | | |
|---|---|---|---|
| | space,Classical stochastic processes like processes with stationary independent increments, Markov process, martingales, Wiener process, Gaussian process. | | |
| CO-2 | Describe Poisson process – pure birth and death process. | U, E | PSO - 1,2,3,4,6 |
| CO-3 | Explain and exemplify renewal processes, renewal equation. Describe and apply renewal theorem. Describe Branching processes, offspring distribution, extinction probabilities. | U, E | PSO -1,2,3 |
| CO-4 | Stationary time series, Autocorrelation, partial auto correlation function, linear stationary Models. | U, Ap, C | PSO - 1,2,3,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Stochastic Process and Advanced Time Series**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/ PSO | Cognitive Level | Knowledge Category | Lecture (L)/ Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Describe and exemplify concepts of Stochastic processes, time space and state space, classification of stochastic processes based on the nature of time space and state space,Classical stochastic processes like processes with stationary independent increments, Markov process, martingales, Wiener process, Gaussian process. | PSO - 1,2,3,4 | U, Ap | F, C, P | Lecture | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | Describe Poisson process – pure birth and death process. | PSO - 1,2,3,4,6 | U, E | F, C, P, M | Lecture | |
| 3 | Explain and exemplify renewal processes, renewal equation. Describe and apply renewal theorem. Describe Branching processes, offspring distribution, extinction probabilities. | PSO - 1,2,3 | U, E | C, P, M | Lecture | |
| 4 | Stationary time series, Autocorrelation, partial auto correlation function, linear stationary Models. | PSO - 1,2,3,4,6 | U, Ap, C | C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | **PSO 1** | **PSO 2** | **PSO 3** | **PSO 4** | **PSO 5** | **PSO 6** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | - | 1 | 3 | 3 | 1 | 2 | 2 | 3 | 2 |
| **CO 2** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 2 | 3 | 2 | 3 | 3 |
| **CO 3** | 3 | 3 | 3 | 2 | - | 2 | 3 | 3 | 2 | 1 | 1 | 3 | 2 |
| **CO 4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 2 | 3 | 2 |

**Correlation Levels:**

| **Level** | **Correlation** |
|---|---|
| - | Nil |

| | |
|---|---|
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**Mar Ivanios College (Autonomous)**

<table>
<tr><td>Discipline</td><td colspan="5">STATISTICS</td></tr>
<tr><td>Course Code</td><td colspan="5">MIUK8DSESTA451.1</td></tr>
<tr><td>Course Title</td><td colspan="5">APPLIED REGRESSION MODELING</td></tr>
<tr><td>Type of Course</td><td colspan="5">DSE</td></tr>
<tr><td>Semester</td><td colspan="5">VIII</td></tr>
<tr><td>Academic Level</td><td colspan="5">400-499</td></tr>
<tr><td rowspan="2">Course Details</td><td>Credit</td><td>Lecture per week</td><td>Tutorial per week</td><td>Practical per week</td><td>Total Hours/Week</td></tr>
<tr><td>4</td><td>4 hours</td><td>-</td><td>-</td><td>4</td></tr>
<tr><td>Pre-requisites</td><td colspan="5">Basic concepts of Regression</td></tr>
<tr><td></td><td colspan="5">Texts:<br><br>1. Montgomery, D.C., Peck, E.A. and Vining, G.G. (2003). Introduction to Linear Regression Analysis, John Wiley & Sons, Asia.<br>2. Rao, C, R. and Tutenburg, H. (1995). Linear Models, Springer Series in Statistics, New York.<br>3. Dobson, A.J. (2002) An Introduction to Generalized Linear models, Second edition, CRCPress.<br><br>References:<br><br>1. Mc Cullagh, P. and Nelder, J.A. (1989). Generalized Linear Models, Chapman and Hall.<br>2. Neter, J. and Wasserman, D.W. (1983). Applied Linear Statistical Models, Richard, D. Irwin,Inc., Illinois.<br>3. Rao, C.R. (1973). Linear Statistical Inference and its Applications, Wiley, New York.<br>4. Draper, N.R. and Smith, R. (2003). Applied Regression Analysis, John Wiley and Sons inc.,New York.<br>5. Seber, G.A.F. (1977). Linear Regression Analysis, John Wiley and Sons, New York.</td></tr>
</table>

| | |
|---|---|
| Course Summary | Applied regression modeling is a powerful statistical technique for understanding and predicting relationships in data. It involves a systematic process of model building, validation, and interpretation to derive insights and make informed decisions in various domains. In regression analysis, hypothesis testing is used to assess the significance of regression coefficients (parameters) and overall model fit.<br>Aitken estimator is a method used in numerical analysis and iterative processes to improve the convergence rate of estimators or algorithms.<br><br>Residual plots are graphical tools used in regression analysis to assess the goodness of fit of a regression model and to check for violations of assumptions.<br><br>The various regression models and techniques offer a diverse toolkit for modeling various types of data and relationships in statistical analysis, predictive modeling, and hypothesis testing. Each model has its assumptions, strengths, and applications, making them valuable tools in different contexts of data analysis and inference. |

**Detailed Syllabus:**

| Module | Unit | Content | Hrs |
|---|---|---|---|
| **I** | **Introduction to Statistical Modeling** | | **15** |
| | 1 | Statistical Models | 2 |
| | 2 | Principles of statistical modeling | 2 |
| | 3 | Regression models | 2 |
| | 4 | Fitting of models | 3 |
| | 5 | Principle of Least squares | 2 |
| | 6 | Significance test and confidence intervals | 2 |
| | 7 | Coefficient of determination | 2 |
| **II** | **Multiple linear regression** | | **15** |
| | 8 | Multiple linear regression models | 1 |
| | 9 | Least square estimation | 2 |
| | 10 | Hypothesis testing on regression parameters | 2 |
| | 11 | ANOVA | 2 |
| | 12 | Generalized Linear Regression model | 2 |

| | | | |
|---|---|---|---|
| | 13 | The Aitken estimator | 2 |
| | 14 | Heteroscedastic disturbances | 2 |
| | 15 | Autocorrelation | 2 |
| **III** | **Residual analysis** | | **15** |
| | 16 | Methods of scaling residuals | 3 |
| | 17 | Residual plots | 3 |
| | 18 | Partial residual plots | 3 |
| | 19 | PRESS Statistic | 3 |
| | 20 | Detection and treatments of outliers | 3 |
| **IV** | **Polynomial regression** | | **15** |
| | 21 | Polynomial regression | 1 |
| | 22 | Indicator variables | 1 |
| | 23 | Stepwise regression | 1 |
| | 24 | Multicollinearity | 2 |
| | 25 | Generalized Linear models | 2 |
| | 26 | Logit models | 2 |
| | 27 | Log linear models | 2 |
| | 28 | Logistic regression | 2 |
| | 29 | Poisson regression | 2 |

**Course Outcomes**

| No. | Upon completion of the course the graduate will be able to: | Cognitive Level | PSO addressed |
|---|---|---|---|
| CO-1 | Describe simple and multiple linear regression models and its properties. | U, Ap | PSO - 1,2,3,4,6 |

| | | | |
|---|---|---|---|
| CO-2 | Describe Aitken estimator and generalized least square method of estimation. | U, R, Ap | PSO - 1,2,4,6 |
| CO-3 | Understand Residual Analysis and residual plots. | U, R, Ap | PSO - 1,2,4,6 |
| CO-4 | Explain Generalized Linear models and inference on models with binary response. | U, R, Ap | PSO - 1,2,3,4,6 |

**R-Remember, U-Understand, Ap-Apply, An-Analyse, E-Evaluate, C-Create**

**Name of the Course: Applied Regression Modeling**

**Credits: 4:0:0 (Lecture:Tutorial:Practical)**

| CO No. | CO | PO/ PSO | Cognitive Level | Knowledge Category | Lecture (L)/ Tutorial (T) | Practical (P) |
|---|---|---|---|---|---|---|
| 1 | Describe simple and multiple linear regression models and its properties. | PSO - 1,2,3,4,6 | U, Ap | F, C | Lecture | |
| 2 | Describe Aitken estimator and generalized least square method of estimation. | PSO - 1,2,4,6 | U, R, Ap | C, P | Lecture | |
| 3 | Understand Residual Analysis and residual plots. | PSO - 1,2,4,6 | U, R, Ap | C, P, M | Lecture | |
| 4 | Explain Generalized Linear models and inference on models with binary response. | PSO - 1,2,3,4,6 | U, R, Ap | C, P, M | Lecture | |

**F-Factual, C- Conceptual, P-Procedural, M-Metacognitive**

**Mapping of COs with PSOs and POs:**

| | PSO 1 | PSO 2 | PSO 3 | PSO 4 | PSO 5 | PSO 6 | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | - | 2 | 2 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 2 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |
| **CO 3** | 3 | 3 | 2 | 3 | - | 3 | 3 | 3 | 1 | 2 | 2 | 3 | 3 |
| **CO 4** | 3 | 3 | 3 | 3 | - | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 2 |

**Correlation Levels:**

| Level | Correlation |
|---|---|
| - | Nil |
| 1 | Slightly / Low |
| 2 | Moderate / Medium |
| 3 | Substantial / High |

**Assessment Rubrics:**

- Quiz / Assignment/ Quiz/ Discussion / Seminar
- Midterm Exam
- Programming Assignments
- Final Exam

**Mapping of COs to Assessment Rubrics:**

| | Internal Exam | Assignment | Project Evaluation | End Semester Examinations |
|---|---|---|---|---|
| CO 1 | ✓ | | | ✓ |
| CO 2 | ✓ | | | ✓ |
| CO 3 | ✓ | | | ✓ |
| CO 4 | | ✓ | | ✓ |

**MAR IVANIOS COLLEGE (AUTONOMOUS), THIRUVANANTHAPURAM**
**BOARD OF STUDIES IN MATHEMATICS AND STATISTICS, 2023 – 2026**

| No | Name | Designation |
|---|---|---|
| **1.** | Mr. Sumesh S S<br>(Chairman) | Assistant Professor and Head, Dept. of Mathematics, Mar Ivanios College |
| **2.** | Dr. Manoj Changat<br>(University Nominee) | Professor,<br>Department of Futures Studies,<br>University of Kerala |
| **3.** | Fr Dr Gigi Thomas | Dean,<br>Mar Ivanios College |
| **4.** | Ms Tiji Thomas | Faculty member of the Department |
| **5.** | Dr. Jill K Mathew | Faculty member of the Department |
| **6.** | Dr. Linda J P | Faculty member of the Department |
| **7.** | Dr. Neeradha C K | Faculty member of the Department |
| **8.** | Dr. Anusha Edwin | Faculty member of the Department |
| **9.** | Dr. Raju K George | Outstanding Professor of Mathematics,<br>Dean (R&D, IPR),<br>IIST Trivandrum |
| **10.** | Dr Subrahamanian Moosath K. S. | Professor,<br>Department of Mathematics,<br>IIST Trivandrum |
| **11.** | Dr Viji Z. Thomas | Associate Professor,<br>Department of Mathematics,<br>IISER Trivandrum |
| **12.** | Mr Deepak Negi | Head,<br>Applied Mathematics Division,<br>VSSC, Thiruvananthapuram |
| **13.** | Ms Jyothi Ramaswamy | Tata Consultancy Services (TCS),<br>Technopark Campus,<br>Karyavattom, Trivandrum |
| **14.** | Ms. Indu L | Assistant Professor,<br>Department of Mathematics,<br>College of Engineering Trivandrum,<br>Thiruvananthapuram |
| **15.** | Dr. C. Satheesh Kumar | Professor of Statistics,<br>Director School of Physical and Mathematical Sciences,<br>University of Kerala |
| **16.** | Dr. A. Riyaz | Assistant Professor, |

| | | |
|---|---|---|
| | | Department of Statistics,<br>University of Kerala |
| **17.** | Dr. Subha R. Nair | Associate Professor,<br>Department of Statistics,<br>HHMSPB NSS College for Women,<br>Thiruvananthapuram |