GOVERNMENT ARTS COLLEGE (AUTONOMOUS)
COIMBATORE 641 018

Learning Outcomes based Curriculum Framework (LOCF) for

B. Sc STATISTICS
(With effect from 2021 – 2022 onwards)

POST GRADUATE AND RESEARCH DEPARTMENT OF STATISTICS

MAY-2021

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Preamble:

Over the past decades the higher education system of our country has undergone substantial structural and functional changes resulting in both quantitative and qualitative development of the beneficiaries. Such changes have gained momentum with the introduction of Choice Based Credit System (CBCS) which further expects learning outcome-based curriculum in order to maximize the benefits of the newly designed curriculum. The learning outcome-based curriculum will definitely help the teachers of the discipline to visualize the curriculum more specifically in terms of the learning outcomes expected from the students at the end of the instructional process. It is pertinent to mention here that the purpose of education is to develop an integrated personality of the individual and the educational system provides all knowledge and skills to the learner for this.

Tamil Nadu State Council for Higher Education (TANSCHE) has formed the State Integrated Boards of Studies, which, with great diligence and expertise has devised the mandatory areas that have to be covered for three-year undergraduation and two-year postgraduation courses to realize the facilitation of the mobility of faculty and students from one university to another and to easily solve the problem of equivalence among courses. Great care has been taken so that these areas would take 75% of the course content and the remaining 25% can be decided by the individual institutions. The areas that must be covered by the student that are mandatory for earning the degree to have due value has been worked out so that the student will gain enough depth of knowledge in the subject concerned. 25% percent of the syllabus should be designed by the institutions, and the areas covered under this also must have a weightage of 25%. This gives the autonomous institution seamless liberty on every Board of Studies (BOS) to innovate and experiment, and more importantly, it is here that the institution devises appropriate strategies by which (i) to make creative and critical applications of what has been learnt in the mandatory components, and (ii) to meaningfully connect the learners to the career demands and expectations. It is essential that the theoretical subject knowledge of the students must be translated into practical hands-on experience.

One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the country which will help the

students to ensure similar quality of education irrespective of the institute and location. With initiatives of University Grants Commission (UGC) for nation-wide adoption and implementation of the LOCF for bachelor's programmes in colleges, universities and HEIs in general. A Core Expert Committee (CEC) was constituted to formulate the modalities for developing the LOCF in various subjects being taught in the undergraduate courses in sciences, humanities, commerce and professional courses. The CEC also constituted the Subject Expert Committees (SEC) in various subjects to prepare detailed guidelines for the LOCF in subjects concerned.

The key components of the planning and development of LOCF are given in terms of clear and unambiguous description of the Graduate Attributes (GA), Qualification Descriptors (QD), Program Learning Outcomes (PLO) and Course Learning Outcomes (CLO) to be achieved at the end of the successful completion of each undergraduate program to be offered by HEIs. In undergraduate education in Information Technology, the programme of study leading to the degree of B.Sc. in Information Technology is discussed herewith.

The Qualification Descriptors (QD), Program Learning Outcomes (PLO) and the Course Learning Outcomes (CLO) were also finalized keeping the broad requirement of the programme in view. The LOCF also gives general guidelines for the Teaching Learning Process (TLP) corresponding to each component of theory, experiment, tutorials, projects and industrial / field visits to be followed in order to achieve the stated outcomes for each component. Finally, some suggestions for using various methods in the assessment and evaluation of learning levels of students are also made. It is a student centric framework where they are expected to learn fundamentals of Information Technology along with the latest trends and techniques like Artificial Intelligence, Internet of Things, Machine Intelligence along with advanced skillsets that include Mobile Application Development, Object Oriented Programming among many other courses.

1. Introduction

Statistics is used in different ways in different contexts. For a cricket fan, Statistics is the information about runs scored or wickets taken by a player. For the manager of a manufacturing unit, Statistics may be the information about the process control. For a medical researcher investigating the effects of a new drug, Statistics is the evidence of research efforts. For a college student, Statistics shows the grades or marks scored in a course. Thus, in all these illustrations, Statistics refers to quantitative data in the area under study.

Statistics as a subject is an important branch of knowledge and is devoted to various techniques of collection, presentation, analysis and interpretation of data. It is a science of learning from data. The subject provides tools for making decisions when conditions of uncertainty prevail. Hence Statistical tools and techniques are used in almost all fields which are indispensable for people working in fields like agriculture, business, management, economics, finance, insurance, education, biotechnology and medical science, etc. For the last two decades, large amount of data has been handled with the help of computers and more sophisticated statistical techniques can be used in an effective manner to draw valid conclusions. Knowledge of different aspects of Statistics has become crucial in the present scenario. There is a continuous demand for statisticians in fields of education, industry, software and research.

The syllabi of three-year B.Sc. degree course in Statistics are framed in such a way that the students at the end of the course, can be thorough in statistical techniques for pursuing higher studies and simultaneously can apply statistical tools judiciously to a variety of data sets to arrive at some valid conclusions.

B.Sc. Statistics programme consists of 140 credits spread over six semesters. This programme emphasizes both theory and applications of statistics and is structured to provide knowledge and skills in depth necessary for the employability of students in industry, other organizations, as well as in academics.

1.1 Course Structure – Types of Courses.

The following types of courses are offered under CBCS-LOCF:

a) **Core Courses (CC).** A core course is a compulsory discipline specific course. A student of Statistics has to take 15 such Statistics courses including practical over six semesters.

b) Elective Courses (EC). An elective course is a course that is to be chosen from a specified set of courses. These courses are of two types. Which may be very specific or specialized or advanced or supportive to the discipline/subject of study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course.

i. **Discipline Specific Electives (DSE).** These are elective courses that provide advanced undergraduate training in specialised areas of Statistics. A set of six semester-specific, courses of this kind are offered in the First through fourth semester of the Undergraduate programme, Statistics.

ii. **Project.** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a teacher/faculty member is called dissertation/project. Such a course is compulsory in sixth semester.

iii. **Generic Electives (GE).** These courses, in disciplines other than Statistics, are intended to broaden the training of a student in the Statistics Undergraduate programme. A student of Statistics will take one such course, offered by another department, in each of Semester V and VI.

c) **Ability Enhancement Compulsory Course (AECC).** Two such courses are to be taken, one in Semester I (Environmental Studies) and one in Semester II (Value Education– Gandhian Thoughts).

d) **Skill Enhancement Course (SEC).** A student is to take one such course each in Semester III through Semester VI.

2. Learning Outcomes Based Approach to Curriculum Planning

2.1 Nature and Extent of the B.Sc. Statistics Programme

The B.Sc. Statistics Programme has some unique features such as independent projects, a number of elective courses including practical training on realistic problems, and extensive insight into statistical computations using standard statistical packages. Standard statistical package, namely, SPSS used in practical courses and project work. The course has been designed in such a way that besides the core courses, a student can opt for outcome based elective courses from the streams such as *Indian Official Statistics, Actuarial Statistics, Educational and Psychological Statistics and Demographic Methods.*

The independent project work is one of the important components of this programme which will focus on one of the streams opted by the candidate. B.Sc. Statistics programme is of three years duration, with semester pattern.

- During first two semesters, students will be given the basic information that includes methods of data representation and summarization. Further, they will be introduced to probability and random variables along with applications.
- During third and fourth semesters**,** students are expected to study probability distribution, C programming, sampling theory and numerical analysis.
- During fifth and sixth semesters, some theory papers and practicals deal with theoretical as well as applied aspects of statistics. Besides, they are supposed to take up a Project Work preferably on a problem related to industries.

2.2 Aims of Bachelor's degree Programme in Statistics

- To prepare graduates who are not only statistically sound but also capable of using their appropriate statistical skills in interdisciplinary areas such as finance, health, agriculture, government, business, industry, telecommunication and biostatistics. As a result, they can pursue their future career either in the core field or in the applied field of Statistics.

- To familiarize students with computational techniques and software used in the statistical arena.
- To provide a solid ground in the best practices of collating and disseminating information.
- To prepare students for undertaking further study.
- To teach students to construct practical statistical models for several processes in the real-world.

3. Graduate Attributes in Statistics

- **Disciplinary Knowledge**: The proposed curriculum is expected to provide the students a sound knowledge of Statistics covering various aspects. As a result, they will not only appear appropriate for pursuing higher studies in the subject but also develop skill to apply the statistical knowhow to a variety of real life problems.

- **Critical Thinking**: The proposed course is designed to enrich the students with ability to examine the various statistical issues in a more logical and methodical manner. It is expected that the students will strengthen themselves both computationally and analytically.

- **Problem Solving**: The students will be able to critically examine various hypotheses and research queries, and will be able to identify and consult relevant resources to find their rational answers.

- **Analytical Reasoning**: The students are expected to develop capability to identify logical flaws and loopholes in the arguments of practicing Statisticians, analyse and synthesise data from a variety of sources and accordingly draw conclusions.

- **Research Related Skills**:The students should be able to develop original thinking for formulating new problems and providing their solutions. As a result, they will be able to develop research related skills for their own subject as well as for those who are practicing Statistics
- **Communication Skills and Team Work:** The students are expected to develop effective and confident Communication skill after completion of the course. They will have an ability to work in a team as well as in isolation.

- **Moral and Ethical Awareness**: After completion of the course, the students are expected to develop ethical and social responsibility as well. As a result, the students will be able to identify ethical issues, avoid unethical behaviour such as fabrication, falsification or misrepresentation and misinterpretation of data.

- **Scientific Reasoning:** The students will be able to analyse, interpret and draw appropriate conclusions from both quantitative and qualitative data and critically evaluate ideas, evidence and experiences with an unbiased and consistent approach.

- **Reflective thinking:** The students should be sensitive to real experiences with respect to self, society and nation.

- **Information/Digital literacy:** The proposed course is expected to develop digital literacy among the students for using ICT in different learning situations. The students should be able to equip themselves with in depth programming and simultaneously use appropriate Statistical software for advanced Statistical computing with high level graphical interface.

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

- **Multicultural Competence:** The students are expected to be aware of values and beliefs of different cultures and have a global perspective by examining various forms of primary and secondary data resources.

- **Leadership Readiness/Qualities:** The students will be capable of mapping out the tasks of a team or an organization, formulating an inspiring vision, building a team for achieving the desired objectives, motivating and inspiring team members accordingly, and using management skills to guide people in the right direction smoothly and efficiently.

- **Lifelong Learning:** The proposed course is designed to develop independent, coherent and decisive thoughts among the students that will ultimately develop

4. Qualification Descriptors for B.Sc. Statistics

Qualification descriptors for a Bachelor's Degree in Statistics: The qualification descriptors for a Bachelor's degree in Statistics will

- demonstrate (i) a systematic, extensive, coherent knowledge of an academic field of study and its applications, links to interdisciplinary areas of study with a critical knowledge of the subject and a number of emerging issues, (ii) procedural knowledge that creates professionals in the field of Statistics including research and development, teaching, government and public services, (iii) skills in areas related to specialization and current developments in Statistics.
- demonstrate skills in collection of relevant quantitative and/or qualitative data, analysis and interpretation of data using appropriate statistical methodologies.
- use knowledge, understanding and skills for critical assessment of a wide range of ideas and complex problems and issues relating to the chosen field of study.
- communicate the results of studies undertaken in statistics in a range of different contexts using the main concepts, constructs and techniques of the subject.
- address one's learning needs relating to current and emerging areas of study, making use of research, development and professional materials as appropriate, including those related to new frontiers of knowledge.
- apply one's statistical knowledge and skills to new contexts and to identify and analyse problems and issues and seek solutions to real-life problems.
- demonstrate subject-related skills that are relevant to some of the job trades and employment opportunities.

5. Programme Learning Outcomes in B.Sc. Statistics

The student graduating with the Degree B.Sc. Statistics should be able to

1. Demonstrate the ability to use skills in Statistics and its related areas of technology for formulating and tackling Statistical related problems and identifying and applying appropriate principles and methodologies to solve a wide range of problems associated with Statistics.

2. Acquire

(i) a fundamental/systematic or coherent understanding of the academic field of Statistics, its different learning areas and applications in Medical Statistics, Actuarial Statistics, Psychological Statistics, Agricultural Statistics, Industrial Quality control, Econometrics, etc.,

(ii) procedural knowledge that creates different types of professionals related to the disciplinary/subject area of Statistics, including professionals engaged in research and development, teaching and government/public service;

(iii) skills in areas related to one's specialization area within the disciplinary/subject area of Statistics and current and emerging developments in the field of Statistics.

3. Recognize the importance of statistical modelling simulation and computing, and the role of approximation and mathematical approaches to analyze the real world problems.

4. Plan and execute Statistical related experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate software such as programming languages and purpose-written packages, and report accurately the findings of the experiment/investigations while relating the conclusions/findings to relevant theories of Statistics.

5. Demonstrate relevant generic skills and global competencies such as

(i) problem-solving skills that are required to solve different types of Statistics-related problems with well-defined solutions, and tackle open-ended problems that belong to the disciplinary-area boundaries;

(ii) investigative skills, including skills of independent investigation of Statistics-related issues and problems;

(iii) communication skills involving the ability to listen carefully, to read texts and research papers analytically and to present complex information in a concise manner to different groups/audiences of technical or popular nature;

(iv) analytical skills involving paying attention to detail and ability to construct logical arguments using correct technical language related to Statistics and ability to translate them with popular language when needed;

(v) ICT skills;

(vi) personal skills such as the ability to work both independently and in a group.

6. Demonstrate professional behavior such as

(i) being objective, unbiased and truthful in all aspects of work and avoiding unethical, irrational behavior such as fabricating, falsifying or misrepresenting data or committing plagiarism;

(ii) the ability to identify the potential ethical issues in work-related situations;

(iii) appreciation of intellectual property, environmental and sustainability issues; and

(iv) promoting safe learning and working environment.

6. Structure of B.Sc. Statistics Programme

Scheme of Examination

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
Semester – I									
I	**21TAM11L**	**Part–I :** Language: Tamil I	6	50	50	100	20	40	3
II	**21ENG12L**	**Part–II:** English I	6	50	50	100	20	40	3
III	**21BST13C**	**Core I :** Descriptive Statistics	5	50	50	100	20	40	4
III		**Core Practical – I:** Statistics Practical – I (Using MS Excel)	3	50	50				
III	**21BST14A**	**Allied – I :** Mathematics for Statistics – I	8	50	50	100	20	40	5
IV	**21ENV1GE**	**Value Education –** Environmental Studies	2	50	50	100	20	40	2
Semester – II									
I	**21TAM21L**	**Part–I:** Language: Tamil II	6	50	50	100	20	40	3
II	**21ENG22L**	**Part–II:** English II	6	50	50	100	20	40	3
III	**21BST23C**	**Core II:** Probability and Random variables	5	50	50	100	20	40	4

III	**21BST24P**	**Core Practical – I:** Statistics Practical – I (Using MS Excel)	3	50	50	100	20	40	4
III	**21BST25A**	**Allied – II:** Mathematics for Statistics – II	8	50	50	100	20	40	5
IV	**21VAL2GE**	**Value Education –** Gandhian Thoughts	2	50	50	100	20	40	2

Part	**Sub Code**	**Title of the Paper**	**Hrs (wk)**	**Internal (CA) Marks**	**External Marks**	**Total Marks**	**Ext– Min.**	**Total Pass Mark**	**Credits**
Semester – III									
***I**	**21TAM31L**	***Part–I:** Language: Tamil III	6	50	50	100	20	40	3
II	**21ENG32L**	***Part–II:** English III	6	50	50	100	20	40	3
III	**21BST33C**	**Core III:** Probability Distributions	6	50	50	100	20	40	4
III	**21BST34A**	**Allied – III:** Programming in 'C'	5	50	50	100	20	40	5
III		**Core Practical – II:** Statistics Practical – II (Using C Language)	3						
IV	**21BST35S**	**Skill Based Subject–I:** Indian Official Statistics	4	50	50	100	20	40	3

Semester – IV									
I*	**21TAM41L**	***Part–I:** Language: Tamil IV	6	50	50	100	20	40	3
II	**21ENG42L**	***Part–II:** English IV	6	50	50	100	20	40	3
III	**21BST43C**	**Core IV:** Basic Sampling Theory	5	50	50	100	20	40	4
III	**21BST44P**	**Core Practical – II:** Statistics Practical – II (Using C Language)	3	50	50	100	20	40	4
III	**21BST45A**	**Allied – IV:** Numerical Analysis	6	50	50	100	20	40	5
IV	**21BST46S**	**Skill Based Subject – II:** Elements of Actuarial Statistics	4	50	50	100	20	40	3
V	**21EXA4GE**	**@Extension Activities: NCC/NSS/SPORTS/YRC**	-	-	-	-	-	-	1

Part	**Sub Code**	**Title of the Paper**	**Hrs (wk)**	**Internal (CA) Marks**	**External Marks**	**Total Marks**	**Ext– Min.**	**Total Pass Mark**	**Credits**
Semester – V									
III	**21BST51C**	**Core V :** Statistical Estimation Theory	5	50	50	100	20	40	4
III	**21BST52C**	**Core VI:**Statistical Quality Control	5	50	50	100	20	40	4
III	**21BST53C**	**Core VII:** Elements of Econometrics	5	50	50	100	20	40	4

III	**21BST54C**	**Core VIII: AOS:** Elements of Operations Research	5	50	50	100	20	40	4
III		**Core Practical – III:** Statistics Practical – III (Using Scientific Calculator)	3						
IV	**21BST55S**	**Skill Based Subject – III:** Educational and Psychological Statistics	4	50	50	100	20	40	3
IV	**21BST5EL**	**Non-Major Elective Paper – I:**	3	50	50	100	20	40	2
Semester – VI									
III	**21BST61C**	**Core IX:** Testing Statistical Hypothesis	5	50	50	100	20	40	4
III	**21BST62C**	**Core X:** Design of Experiments	5	50	50	100	20	40	4
III	**21BST63C**	**Core XI:AOS:** Applied Statistics	5	50	50	100	20	40	4
III	**21BST64P**	**Core Practical – III:** Statistics Practical – III (Using Scientific Calculator)	3	50	50	100	20	40	4
III	**21BST65P**	**Core Practical – IV:** Statistics Practical – IV (Using SPSS)	3	50	50	100	20	40	4
III	**21BST66V**	**Project & Viva – Voce**	2	50	50	100	20	40	15
IV	**21BST67S**	**Skill Based Subject – IV:** Demographic Methods	4	50	50	100	20	40	3
IV	**21BST6EL**	**Non-Major Elective Paper – II:**	3	50	50	100	20	40	2
		Total/Credits	**180**			**3600**			**140**

***Courses offered with four semester Language Papers**

@ No External Examinations. Only Continuous Internal Assessment (CIA)

Includes 50/50 continuous internal assessment marks for theory and practical papers respectively

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**I**	**21BST13C**	**CORE PAPER I – DESCRIPTIVE STATISTICS**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Design the basics of data collection and organization of data
2	Apply the theory and applications of statistics
3	Present the data through diagrams and graphs
4	Explain the statistical concepts of Measures of central tendency, Dispersion, Skewness and Kurtosis
5	Calculate and interpret the various Measures of central tendency, Measures of dispersion and Measures of skewness
6	Analyze and interpret the relationship between variables using correlation
7	Estimate the values using regression analysis

Unit - I

Statistics – Definition – Origin - Scope and Limitations – Collection of data - Primary and Secondary data – Classification and Tabulation of Statistical Data - Formulation of Frequency Distributions - Diagrammatic Representation - One Dimensional and Two Dimensional Diagrams – Box plots - Graphical Representation – Histogram - Frequency Polygon - Frequency Curve and Ogives.

Unit - II

Measures of Central Tendency - Characteristics of a Good Average - Arithmetic Mean, Median, Mode - Geometric Mean and Harmonic Mean - Weighted Arithmetic Mean – Merits and Demerits - Trimmed mean.

Unit – III

Absolute and Relative Measures of Dispersion – Range - Quartile Deviation - Mean Deviation - Standard Deviation and Co-efficient of Variation - Merits and Demerits .

Measures of Skewness - Karl-Pearson's Co-efficient of Skewness - Bowley's Co-efficient of Skewness.

Kurtosis (concept only)

Unit – IV

Correlation - Types of Correlation - Uses - Properties - Scatter Diagram – Karl Pearson's co-efficient of Correlation - Spearman's Rank Correlation - Concurrent Deviation Method of Correlation – Properties of Correlation coefficient.

Unit - V

Regression Analysis - Regression Equations – Properties of Regression Co-efficients - Simple problems – comparison of correlation and regression.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta and V.K. Kapoor (2002).Fundamentals of Mathematical Statistics, 11th thoroughly Revised Edition, Reprint 2013, Sultan Chand & Sons Publishers, New Delhi.
2	S.P.Gupta (2012). Statistical Methods, 42nd Revised Edition, Sultan Chand & Sons Publishers, New Delhi.

FURTHER READING:

1	B.L. Agarwal (2009). Programmed Statistics, 2nd Edition, New Age International Publishers, New Delhi.
2	Goon, A.M., Gupta, M. K., Dasgupta, B. (2016). Fundamentals of Statistics, Vol. I, World Press, Kolkata, India
3	R.S.N. Pillai and V. Bagavathi (1984). Statistics – Theory and Practice, Reprint 1999, S. Chand & Sons Company Ltd, New Delhi.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.investopedia.com/terms/d/descriptive_statistics.asp
2	https://youtu.be/mk8tOD0t8M0
3	https://youtu.be/MXaJ7sa7q-8

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge		✓	✓	✓	✓	✓	✓
	2	Communication Skills		✓		✓	✓	✓	✓
	3	Critical Thinking	✓			✓	✓	✓	✓
	4	Research related Skills			✓		✓	✓	✓
	5	Analytical Reasoning		✓			✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work			✓	✓	✓		
	8	Moral and Ethical Awareness	✓			✓	✓		
	9	Multi Cultural Competence	✓			✓	✓		

AECC-1 @ SEMESTER I

Year	Sem.	Subject Code	Title of the paper	Hours/Week
2021 -2022 onwards	**I**	**21ENV1GE**	**ENVIRONMENTAL STUDIES (For all UG courses)**	**2**

COURSE LEARNING OUTCOMES:

On the successful completion of the course, students will be able to:

1. Recognize the role of the environment and the need to conserve it for sustaining life.
2. Enumerate the natural resources
3. Explores the adverse effects of deforestation and over exploitation of natural resources
4. Associate the components of the ecosystem and need for biodiversity conservation.
5. Evaluate the environmental pollution hazards and their effects on the living system.
6. Interpret the different disaster management procedures.
7. Analyse the climatic change and global effects
8. Infer the need for environmental laws in the constitution of India.
9. Relate the growth of the human population and its impact on the environment.

UNIT I:

Environment – Introduction – Nature - Scope – Content – Need for study. Natural resources- Forest and energy resources- Use and overexploitation - deforestation. Energy resources- renewable and non-renewable energy resources.

UNIT II:

Ecosystem – concept – types- Forest, Grassland, Desert and Aquatic (Pond)- Structure and function of an ecosystem – Producers- consumers and decomposers – Food chain – food web- ecological pyramids- energy flow. Biodiversity and its conservation- *in situ* and *ex situ* conservation- Mega biodiversity centres and hotspots.

UNIT III:

Environmental pollution- definition- causes-effects and control measures of air, water, soil, thermal and nuclear pollution. Waste management- Industrial and solid waste. Disaster management – earthquake, cyclone, flood and landslides.

UNIT IV:

Social Issues and the environment-Urbanization-Urban problems related to energy and watershed management. Environmental Ethics- Issues and possible solutions- Wasteland reclamation- Climate change - causes and effects. Global warming- Acid rain- Ozone layer depletion- Public awareness. Environmental laws- Environment Protection Act, Wildlife Protection Act, Forest Conservation Act.

UNIT V:

Human population and its impact on environment- Population growth- Resettlement and Rehabilitation of project affected persons- Case studies – Sardar Sarovar Project, Maharashtra and Bandipur National Park- Project Tiger, Karnataka, NTPC, India. Role of Indian and Global religions and Cultures in environmental conservation- Case study:

sacred groves in Western Ghats (kavu) & Chinese culture. Human and Wildlife Conflict.

PEDAGOGY STRATEGIES

- ❖ Board and Chalk lectures
- ❖ PowerPoint slide presentations
- ❖ Assignments

Textbooks:

1. Sharma, P. D. 2000. Ecology & Environment. Rastogi Publications, Meerut, India.
2. Bharucha, E. 2003. Text book of Environmental Studies. UGC, New Delhi & Bharati Vidyapeeth Institute of Environmental Education and Research, Pune.
3. Arumugam, M. and Kumaresan, V. 2016. Environmental Studies (Tamil version). Saras Publications, Nagerkoil.

Online/E-Resources:

https://www.edx.org/course/subject/environmental-studies
https://www.coursera.org/courses?_facet_changed_=true&domains=life-sciences%2Cphysical- science-and-engineering%2Csocial-sciences&query=environmental%20science%20and%20sustainability&userQuery=environmental% 20science%20and%20sustainability
https://www.open.edu/openlearn/nature-environment/free-courses

COURSE LEVEL MAPPING OF PROGRAMME LEVEL OUTCOME:

Program Level Outcomes (PLO)	**Course Level Outcome (CLO)**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Disciplinary Knowledge		√	√		√	√			
Communication Skills		√		√				√	√
Critical Thinking	√		√		√		√		
Research related skills	√		√			√		√	
Analytical reasoning	√			√		√		√	
Problem Solving		√	√			√			√
Team Work				√	√		√		√
Moral and ethical awareness		√		√		√		√	√

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**II**	**21BST23C**	**CORE PAPER II: PROBABILITY AND RANDOM VARIABLES**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the concept of probability, basic terminologies and the application of addition and multiplication theorems.
2	Analyze the basics of conditional probability and the related theorems
3	Summarize the concept of random variables and its related terminologies. Evaluate various measures of central tendency
4	Explain mathematical expectation and its properties related to variance, covariance and linear combination of random variables.
5	Calculate moment generating function and explain its limitations along with properties. Discuss the cumulants, characteristic functions and its properties.
6	Demonstrate the concept of convergence in probability, bivariate distributions, marginal and conditional distributions.
7	Analyze the independence of random variables, deriving moments, marginal and conditional expectations

Unit - I

Probability - Basic terminology - Sample space - Classification of events - Mathematical, Statistical and Axiomatic definition of probability - Theorems on Probability -Addition and Multiplication theorems for two events - Conditional Probability - Baye's theorem - Boole's inequality - Simple problems.

Unit - II

Random variables - Distribution function - Properties (without proof) - Discrete and Continuous Random Variables - Probability Mass function - Probability density function - Measures of central tendency for continuous random variable - Mean, Median, Mode, Dispersion and moments - simple problems.

Unit – III

Mathematical Expectation - Expected value of function of a random variable - Properties of Expectations - Properties of variance - covariance - Linear combination of Random Variables - simple problems.

Unit – IV

Moment Generating Function and Cumulants - Limitations - Properties of MGF - Uniqueness theorem (statement only) - Cumulants – Properties (without proof) .

Characteristics Function - Properties (without proof) - T Chebychev's inequality - Convergence in probability - Weak law of large number - Concept of Central limit theorem - De Moivre's Theorem (Statement only).

Unit - V

Bivariate Distributions - Concept of Bivariate Distributions - Marginal and Conditional Distributions - Independence of Random Variables - Moments of Bivariate probability distributions - Marginal and Conditional expectations - Conditional variance.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	R.V. Hogg and A.H. Craig (2012). Introduction to Mathematical Statistics, Seventh Edition, Pearson Education.
2	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.

FURTHER READING:

1	J.N. Kapoor and H.C. Saxena (2011). Mathematical Statistics, Sultan Chand & Sons, New Delhi.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/102/111102111/
2	https://nptel.ac.in/courses/111/104/111104146/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓		
	2	Communication Skills	✓	✓	✓				✓
	3	Critical Thinking	✓	✓	✓				
	4	Research related Skills		✓	✓	✓		✓	
	5	Analytical Reasoning			✓	✓	✓		
	6	Problem Solving	✓	✓	✓	✓	✓		
	7	Team Work	✓	✓	✓				✓
	8	Moral and Ethical Awareness	✓	✓	✓				
	9	Multicultural Competence		✓	✓	✓		✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**II**	**21BST24P**	**CORE PRACTICAL – I: STATISTICS PRACTICAL – I (Using MS Excel)**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the theory through practical oriented training
2	Perform the basic operations of Excel software
3	Apply the software for various applications
4	Compute statistical measures using software
5	Perform statistical data analysis
6	Compute probability, conditional probability and probabilities using Baye's theorem
7	Compute Expectation, mean and variance

1. Formation of Frequency Distribution.
2. Formation of Diagrams - Bar Diagrams, Pie Diagram
3. Formation of Graphs - Frequency Polygon, Frequency Curve and Ogive Curves.
4. Calculation of Measures of Central Tendency - Mean, Median, Mode, Geometric Mean, and Harmonic Mean
5. Calculation of Quartiles and Percentiles
6. Calculation of Measures of Dispersion- Range, Quartiles Deviation, Mean Deviation, Standard Deviation and Variance.
7. Calculation of Coefficient of Skewness and Kurtosis.
8. Correlation - Scatter Diagram - Calculation of Correlation Coefficients
9. Regression - Finding Regression Coefficients and Formation of Regression Lines.
10. Calculation Probability
11. Calculation of Conditional probability
12. Solve problems under Bayes' theorem
13. Expectation - mean and variance

PEDAGOGY STRATEGIES

- Lecturing and Hands-on training
- Lab Experiments
- Questioning
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:	
1	S.P. Gupta (2012). Statistical Methods, 42nd Revised Edition, Sultan Chand & Sons Publishers, New Delhi.
2	R.V. Hogg and A.H. Craig (2012). Introduction to Mathematical Statistics, Seventh Edition, Pearson Education.
FURTHER READING:	
1	Brian W. Sloboda (2020) - EXCEL for Statistical Analysis, University of Phoenix, Arizona, USA.
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udemy.com/basic-excel/promo
2	https://www.linkedin.com/learning/**excel**
3	https://www.udemy.com/course/statistics-using-excel

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	✓	✓	✓	✓	✓		
	2	**Communication Skills**	✓	✓	✓				✓
	3	**Critical Thinking**	✓	✓	✓		✓		✓
	4	**Research related Skills**		✓	✓	✓		✓	
	5	**Analytical Reasoning**			✓	✓	✓	✓	✓
	6	**Problem Solving**	✓	✓	✓	✓	✓		
	7	**Team Work**	✓	✓	✓				✓
	8	**Moral and Ethical Awareness**							
	9	**Multicultural Competence**							

AECC-2 @ SEMESTER II

Year	Subject Title	Semester	Sub Code
2021 -22 Onwards	**VALUE EDUCATION – GANDHIAN THOUGHTS (For all UG courses)**	**II**	**21VAL2GE**

COURSE LEVEL OUTCOMES:

On successful completion of the course, the student will be able to:

1. Interpret Gandhiji's experiments to his spiritual pursuits and search for purity, political activities through fasting protests, and even his role as an educator using diet and meals as teaching exercises.
2. Lead a life marked with humility and truthfulness and subsequent realization of the Truth as the purpose of human life.
3. Infer **lessons that are fundamental to living in harmony and social progress such as respect, empathy, equality, solidarity and** critical thinking**.**
4. Promote tolerance and understanding above and beyond our political, cultural and religious differences.
5. Create special emphasis on the defense of human rights, the protection of ethnic minorities
6. Emerge as responsible citizens with clear conviction to practice values and ethics in life.
7. Transform themselves to become good leaders.
8. Realize their role and contribution to the nation building.

UNIT I: Birth and Parentage - Childhood - At the High school - Stealing and Atonement - Glimpses of Religion - Gandhi's choice - Experiments in Dietetics - Acquaintance with Religions - The Great Exhibition.

UNIT II: The first case - Preparing for South Africa - same experiences - on the way to Pretoria – Coolie - Natal Indian Congress - Education of Children - Brahmacharya.

UNIT III: Simple life - The Boer war - Sanitary Reform and Famine Relief - Lord Curzon's Darbar - A month with Gokhale - Experiments in Earth and water treatment - Indian opinion - Coolie Locations or Ghettoes - The Black plague.

UNIT IV: The Magic spell of a Book - The Zulu Rebellion - The Birth of Satyagraha - More experiments in Dietetics - Kasturbai's Courage - Domestic Satyagraha- Fasting - Shanti Niketan - Woes of Third-Class passengers.

UNIT V: Kumbha mela - Lakshman Jhula - Founding of the Ashram - Abolition of Indentured Emigration - The Kheda Satyagraha - The Rowlatt Bills - Navajivan and young India - Congress Initiation - The Birth of Khadi.

TEXT BOOKS

1. M.K. GANDHI, “The Story of My Experiments with Truth”, An Autobiography Apple publishing International(P) Ltd, Chennai.

. மகாத்மா காந்தியின் சுயசரிதை - சத்தியசோதனை தமிழாக்கம் - -ரா.வேங்கடராஜுலு, நவஜீவன் பரசுராலயம், அகமதாபாத

2.

PEDAGOGY STRATEGIES

- Board and Chalk lecture
- Powerpoint slide presentations
- Seminar

- Assignments
- Quizes
- Group discussion

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES.

			Course Level Outcomes (CLO)							
			1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Program Level Outcomes (PLO)	**1**	**Reflective thinking**	✓	✓			✓		✓	✓
	2	**Communication skills**		✓		✓	✓	✓	✓	✓
	3	**Critical thinking**	✓			✓		✓	✓	✓
	4	**Multicultural competence**				✓	✓	✓	✓	✓
	5	**Analytical reasoning**		✓	✓	✓		✓		
	6	**Problem solving**		✓	✓	✓		✓	✓	✓
	7	**Team work**	✓		✓		✓	✓	✓	
	8	**Leadership readiness/qualities**			✓		✓	✓		✓
	9	**Moral and ethical awareness**	✓		✓		✓	✓		✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**III**	**21BST33C**	**CORE PAPER III – PROBABILITY DISTRIBUTIONS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the concept of Bernoulli, Binomial, Hypergeometric distribution and discuss its properties, uses and moments. Deduce the cumulants and characteristic function
2	Estimate the Poisson distribution, Negative Binomial and its related constants
3	Identify the limiting cases of the distributions. Examine the lack of memory of Geometric distribution
4	Define and discuss Normal distribution - mean, median, mode, M.G.F, Cumulants, Mean deviation, Characteristic function
5	Write the Rectangular distribution and its moments
6	Outline the Exponential, Beta and Gamma distribution and Analyze the property of lack of memory
7	Summarize the concept of sampling distributions such as t, F and Chi-square. Determine the density functions and analyzing their relationships

Unit - I

Discrete Distributions - Concept of theoretical probability distributions - Discrete distributions - Bernoulli, Binomial - Properties and uses - Moments - Recurrence relation for moments - Mode - MGF - Additive property - Characteristic function - Cumulants - Fitting of Binomial distribution.

Unit - II

Discrete Distributions - Poisson distribution - Properties - Moments - Mode - Recurrence relation for moments - MGF - Characteristic function - Cumulants - Additive property- Fitting of Poisson distribution. Hypergeometric distribution - Mean and variance - Factorial moments - Approximation to Binomial distribution. Negative Binomial Distribution - Deductions - MGF - Cumulants - Poisson as limiting case of the Negative binomial distribution - Geometric distribution - Lack of Memory - Moments - MGF.

Unit – III

Continuous Distributions - Rectangular distribution - Moments - MGF - Characteristic Function - Normal distribution - Chief Characteristics - Mode - Median - MGF - Cumulants - Moments - Linear combination of independent Normal variate - Area property - Simple problems.

Unit – IV

Continuous Distributions - Exponential Distribution - MGF- Moments - Lack of memory. Gamma distribution - MGF - Cumulants - Additive property. Beta distribution (first kind and

second kind) - Moments.

Unit - V

Sampling Distributions - Population – Sample - Concept of sampling distribution - Chi-square - Derivation of density - Additive property - Definition – Student's t - Derivation of density – Definition of F variate – Derivation of density – Relationship between t, F and Chi-square Distributions.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta and V.K.Kapoor (2012). Fundamentals Of Mathematical Statistics, 11 th edition, Sultan Chand & Sons, New Delhi.
2	R.V. Hogg and A.H. Craig (2012). Introduction to Mathematical Statistics, Fifth Edition, Pearson Education .

FURTHER READING:

1	J.N. Kapoor and H.C. Saxena (2011). Mathematical Statistics, Sultan Chand & Sons, New Delhi,.
2	V.K. Rohatgi and A.K.M.E Saleh. An Introduction to Probability and Statistics, Third Edition, John Wiley & Sons, NewYork.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayamprabha.gov.in/index.php/Syllabus/detail/10774
2	https://nptel.ac.in/courses/111/105/111105041/
3	https://nptel.ac.in/courses/111/104/111104146/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓		✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓		✓		✓
	3	Critical Thinking	✓	✓		✓	✓	✓	✓
	4	Research related Skills	✓	✓	✓		✓	✓	✓
	5	Analytical Reasoning	✓	✓	✓	✓		✓	✓
	6	Problem Solving	✓	✓		✓	✓	✓	✓
	7	Team Work	✓		✓	✓	✓	✓	✓
	8	Moral and Ethical Awareness							
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**III**	**21BST34A**	**ALLIED PAPER III - PROGRAMMING IN 'C'**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the basic concepts and Structure of C Language
2	Discuss the concept of Looping
3	Apply decision making statements
4	Describe the concept of arrays and its applications in Statistics
5	Point out the Parameters, functions and Pointers in Data Analytics
6	Describe Cyber Crime and Cyber Threat.
7	Develop computing skills for Statistics and Data Analytics

Unit - I

Introduction To C - Overview of C - Importance of C-Structure Of C Program-Programming Style – Process of Executing a C Program- Constants - Variables - Data Types - Character Set - C Tokens - Keywords – Identifiers - Declaration of Variables - Assigning Values to Variables - Symbolic Constants.

Unit - II

Operators and Expression - Arithmetic Operator-Relational Operator - Logical Operators-Assignment Operators - Conditional Operators-Increment and Decrement Operators - Library Function - Managing Input and Output Statements: Single Character Input- getchar() Function-putchar() function- scanf() function - Output functions - printf() function - gets() and puts() function.

Unit – III

Decision Making and Branching - Decision Making with if Statement – if – else Statement - Nesting if-else Statement – Switch Statemen t - Break - Continue Statement - Looping and Branching Using While Statement - Do-While Statement - For Loop Statement - Syntax and Simple Examples.

Unit – IV

Arrays - One Dimensional Arrays -Declaration - Initialization - Two Dimensional Arrays - Syntax - Initialization (Concepts only) Simple Programs - Mean – Median - Standard Deviation – Correlation.

Unit - V

User Defined Functions - Need – Multi-Function Program - Elements Of User Defined Functions - Definition Of Functions - Function Calls - Return Types – Declaration - Category Of Functions -

Function Program To Sort An Array Of Integers.
Cyber Crime – Definition – Characteristics of Cyber Crime – Tools of Cyber Crime – Identity Theft – International convention on Cyber Crime – Cyber Security (Theory Only)

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	E. Balagurusamy (2009). Programming in ANSI C, Tata McGraw-Hill, New Delhi.
2	Clay Wilson (2020). https://ndupress.ndu.edu/ - CHAPTER 18 - Cyber Crime

FURTHER READING:

1	Herbert Scheldt (2012). The C Complete Reference.
2	https://ndupress.ndu.edu/ -

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/106/105/106105171/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	✓
	3	Critical Thinking	✓	✓	✓	✓	✓	✓	✓
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work	✓	✓	✓	✓	✓	✓	✓
	8	Moral and Ethical Awareness							
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 Onwards	**III**	**21BST35S**	**Skill Based Subject – I: INDIAN OFFICIAL STATISTICS**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to

1	Describe the Statistical System in India
2	Apply the fundamentals of measurement in official statistics
3	Apply appropriate methods for presenting and preparing commentaries on official statistics
4	Evaluate the methods for data collection, analysis and interpretation of health, social and economic problems
5	Recognize the limitations that arise from measurement and processes of statistical production
6	Execute the tasks in agricultural and economic statistics
7	Evaluate the Official Index Numbers

UNIT-I

Statistical System in India - Central and State Government Organizations - Functions of Central Statistical Organization (CSO) - National Sample Survey Organization (NSSO) - Organization of large scale sample surveys - General and special data dissemination systems.

UNIT –II

Official Statistics – Meaning - Present official statistical system in India- methods of collection – limitations - reliability Principal publications containing data on the topics such as population – agriculture - industry – trade – prices – labour – employment - transport and communications - Banking and finance.

UNIT –III

National Income – Measures of national income - Income expenditure and production approaches - Applications in various sectors in India - Measurement of income inequality - Gini's coefficient - Lorenz curves - Application of Pareto - Lognormal as income distribution.

UNIT – IV

Agricultural and Social Statistics - System of Collection of Agricultural Statistics - Crop forecasting and estimation **–** Productivity - fragmentation of holdings - Support prices - Buffer stocks - Impact of irrigation projects**.**

Statistics related to industries - foreign trade - Balance of payment - Inflation - Social statistics.

UNIT – V

Official Index Numbers - Price Index Numbers- Construction – Uses – Limitations - Tests for index numbers - Chain base Index Number - Consumer Price Index - Index of Industrial Production – Construction of index numbers - uses.

PEDAGOGY STRATERGIES:

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing Feedback

REFERENCES:

1	Allen R. G. D. (1975). Index Numbers in Theory and Practice, Macmillan.
2	C. S. O. (1990). Basic Statistics Relating to the Indian Economy.
3	C.S.O. (1995). Statistical System in India.
4	C. S. O. (1999). Guide to Official Statistics.
5	Mukhopadhyay, P. (2011). Applied Statistics, Second Edition, Books & Allied Ltd, India.

FURTHER READING:

1	Bhaduri, A. (1990). Macroeconomics: The Dynamics of Commodity Production, Macmillan India Limited, New Delhi.
2	Branson, W. H. (1992). Macroeconomic Theory and Policy, Third Edition, Harper Collins Publishers India (P) Ltd., New Delhi.
3	Goon A. M., Gupta M. K., and Dasgupta. B. (2001). Fundamentals of Statistics, Vol. 2, World Press, India.
4	Panse, V. G. (1964). Estimation of Crop Yields (FAO), Food and Agriculture Organization of the United Nations.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

- https://www.classcentral.com/course/swayam-macro-economics-19942
- https://www.classcentral.com/course/swayam-economics-of-health-and-health-care-14023

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning		✓	✓	✓		✓	✓
	3	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	4	Scientific Reasoning			✓	✓		✓	✓
	5	Information/Digital Literacy		✓	✓	✓		✓	✓
	6	Problem Solving		✓	✓	✓	✓	✓	✓
	7	Cooperation/ Team Work			✓	✓		✓	✓
	8	Moral and Ethical Awareness			✓		✓	✓	
	9	Self-Directed Learning			✓		✓	✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**IV**	**21BST43C**	**CORE PAPER IV – BASIC SAMPLING THEORY**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the method of designing, organizing and executing a sample survey.
2	Summarize the various types of Simple random sampling and its practical usage.
3	Explain Stratified random sampling and its applications.
4	Describe the method of selecting a Systematic sample and its efficiency.
5	Summarize the Cluster sampling in detail.
6	Explain the significance of Two stage sampling method and its uses.
7	Discuss the significance of the Sample survey and its applications in real life situations.

Unit - I

Sample Survey - Concept of Population and Sample – Census and Sample surveys – Merits and Limitations of Sampling technique – Design, Organization and Execution of Sample Survey – Principal Steps in Sample Surveys – Principles of Sample survey - Preparation of Questionnaire and Schedules – Pilot Survey – Sampling and Non-Sampling Errors

Unit - II

Simple Random Sampling - Selection of Simple Random Sample – Merits and Drawbacks of Simple Random Sampling – Simple Random Sampling With and Without Replacement – Unbiased Estimate of Mean and Variance – Simple Random Sampling of Attributes – Estimation of mean and variance - Determination of sample size.

Unit – III

Stratified Random Sampling - Concept and Advantages of Stratification – Principal advantages of Stratified Random Sampling - Unbiased Estimate of the Mean and Variance – Proportional and Optimum Allocation – Neyman's Allocation - Comparison of Stratified and Simple Random Sampling.

Unit – IV

Systematic Random Sampling - Concept, Merits and Demerits of Systematic Sampling - Estimation of the Mean and Variance – Comparison of Simple, Stratified and Systematic Sampling – Population with Linear Trend - Circular Systematic sampling.

Unit - V

Cluster Sampling - Introduction – Equal Cluster Sampling – Estimation of mean and its variance – Relative efficiency of Cluster sampling.

Two-stage Sampling - Introduction – Two-stage sampling with equal First-stage units with

respect to Simple Random Sampling –Estimation of the Mean and its Variance.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Daroga Singh, F.S. Chaudhary (2018) – Theory and Analysis of Sample Survey Designs, New Age International (P) Limited, Publishers, New Delhi.
2	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.

FURTHER READING:

1	William. G. Cochran (2011). Sampling Techniques, Wiley India (P) Limited, New Delhi.
2	Des Raj (1978). Sampling Theory, Tata-McGraw Hill, New Delhi.
3	Sukhatme, P.V., and Sukhatme, B.V. (1970). Sampling Theory of Surveys with Applications, 1970, Asia Publishing House, New Delhi.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/104/111104073/
2	https://nptel.ac.in/content/storage2/courses/111104073/Module14/Lecture42.pdf
3	https://www.mooc-list.com/tags/sampling-methods

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓		✓		
	3	Critical Thinking	✓		✓		✓	✓	
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning				✓	✓	✓	✓
	6	Problem Solving			✓	✓	✓	✓	
	7	Team Work	✓	✓	✓	✓		✓	
	8	Moral and Ethical Awareness	✓	✓			✓	✓	
	9	Multicultural Competence					✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**IV**	**21BST44P**	**CORE PRACTICAL -II – STATISTICS PRACTICAL –II (Using 'C' Language)**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the theory through practical oriented training
2	Perform the basic operations of C Language
3	Apply the C Language for Data Analytics
4	Access the data through Arrays
5	Compute Model fitting by developing programs
6	Perform Computations for Index numbers
7	Develop computation skills for Statistics and Data Analytics

LIST OF EXPERIMENTS

1. C Program to find factorial of n numbers.
2. C program to find Binomial Coefficient nc_x.
3. C program to Arrange Data in Ascending and Descending order Using Bubble Sort.
4. C program to find the Value of Mean and Standard Deviation for raw data.
5. C Program to find the Coefficient of Variations for two groups.
6. C Program to determine Median and Mode for raw data.
7. C Program to find Skewness and Kurtosis.
8. C program to Calculate Correlation Coefficient.
9. C program to determine the regression equations.
10. C program to Calculate Cumulative Probabilities of Binomial Distribution.
11. C program to Calculate Cumulative Probabilities of Poisson Distribution.
12. C program to solve the simultaneous equations by Gauss Jacobi Methods.
13. C program to find the roots of equation by Newton Raphson Method.
14. C program to fit a Linear Trend by the Method of Least Squares.
15. C program to find the sum of the series $1 + ½ + 1/3 + ¼ \ldots\ldots\ldots + 1/n$.
16. C program for Fitting Exponential Curve $Y = ab^x$
17. C program for Fitting Exponential Curve $y = ax^b$
18. C Program to determine the roots of the quadratic equation of the form $ax^2 + bx + c = 0$.

19. C Program to Interpolate using Trapezoidal rule.
20. C Program to Interpolate using Simpson's $1/3^{rd}$ rule.
PEDAGOGY STRATEGIES • Lecturing and Hands-on training • Lab Experiments • Questioning • Class Test • Quiz & Drill Practice Providing feedback

REFERENCES:	
1	E. Balagurusamy (2009). Programming in ANSI C, Tata McGraw-Hill, New Delhi.
2	Clay Wilson (2020). https://ndupress.ndu.edu/ - CHAPTER 18 - Cyber Crime
FURTHER READING:	
1	Herbert Scheldt (2012). The C Complete Reference.
2	https://ndupress.ndu.edu/ -
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105171/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	✓
	3	Critical Thinking	✓	✓	✓	✓	✓	✓	✓
	4	Research related Skills							
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work	✓	✓	✓	✓	✓	✓	✓
	8	Moral and Ethical Awareness							
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**IV**	**21BST45A**	**ALLIED PAPER IV – NUMERICAL ANALYSIS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Analyze the data and predict the future values using curve fitting.
2	Summarize the finite differences and explain the operators and its relationships
3	Interpolate the missing values using Newton's Forward and Backward difference formula.
4	Interpolate the central difference using Gauss Forward, Backward, Stirling's and Bessel`s formula.
5	Apply interpolation for unequal intervals by Newton's divided difference formula, Lagrange`s and Inverse interpolation formula
6	Compute the numerical differentiation using Newton's Forward and Newton's Backward
7	Compute the Derivative using Stirling's Formula - using Trapezoidal, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule computing integration.

Unit - I

Curve Fitting - Principle of least squares - fitting the curves of the form $Y = a + bx$, $Y = a + bx + cx^2$ and curves transformable to the above form. Fitting an exponential curve $Y = ax^b$, $Y = ab^x$

Unit - II

Interpolation with Equal Intervals - Finite Differences - Operators – Forward and Backward Difference Operators – Operator E and their basic Properties (without proof) - Interpolation with Equal Intervals - Newton's Forward and Backward Difference Formulae – Simple Problems – Equidistant Terms with One or More Missing Values .

Unit – III

Central Difference Interpolation - Central Difference Interpolation Formula – Gauss Forward Interpolation Formula – Gauss Backward Interpolation Formula – Stirling's Formula – Bessel's formula – Simple problems

Unit – IV

Interpolation with Unequal intervals – Divided Difference and their properties (without proof) – Newton Divided Difference Formula – Lagrange's Formula – simple problems – Inverse Interpolation using Lagrange's formula.

Unit - V

Numerical Differentiation - Newton's Forward and Newton's Backward difference formula to compute the derivative – Derivative using Stirling's formula (Upto Second order only).
Numerical Integration - Trapezoidal Rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules, Weddle's Rule

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	P. Kandasamy, K.Thilagavathy and K.Gunavathi (2016)- Numerical Methods, S.Chand Company Ltd, New Delhi.
2	S.S. Sastry (2012). Introductory Methods of Numerical Analysis, PHI Learning Pvt Ltd

FURTHER READING:

1	G. Shanker Rao. Numerical Analysis, New Age International (P) Ltd, Publishers, New Delhi
2	V. Rajaraman (2018). Computer Oriented Numerical Methods, PHI Learning Pvt. Ltd.
3	M. Shanthakumar (1987). Computer based Numerical analysis, Khanna Publishers, New Delhi.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/127/106/127106019/
2	https://nptel.ac.in/courses/111/106/111106101/
3	https://nptel.ac.in/courses/111/107/111107062/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	
	3	Critical Thinking	✓	✓	✓	✓	✓	✓	✓
	4	Research related Skills							
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work							
	8	Moral and Ethical Awareness							
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 Onwards	**IV**	**21BST46S**	**SKILL BASED ELECTIVE PAPER II - ELEMENTS OF ACTUARIAL STATISTICS**	**4**

Course Level Outcomes:

On the successful completion of the course, student will be able to:

1	Describe and analyze the impact of Finance events on Simple Interest, Compound interest
2	Explain the Present value concept
3	Calculate Annuities and identify its types. Explain Financial interest, social and financial issues of Actuarial Statistics
4	Demonstrate the procedures of developing and implementing of Redemption of loan – Sinking fund – Lender's sinking fund in Actuarial Statistics
5	Describe the principle of Life assurance and premium relate to types of endowments
6	Explain the procedures in Financial Sectors
7	Compute the interests involved in Actuarial Statistics

Unit:1

Mathematic Finance - Simple Interest - Compound interest - nominal and effective rate of interest - Definition – Simple problem

Unit:2

Present Value - accumulated value of a single payment with fixed rate or varying rate of interest during certain period – Varying payments during certain period with fixed or varying rate of interest – Simple problems.

Unit:3

Annuities – types – Present and accumulated value of an Immediate Annuity and with different period value of an Annuity due and with different periods – Simple problems.

Unit:4

Redemption of loan – Sinking fund – Lender's sinking fund – Simple problems- Probabilities survival and death p_x, q_x, ${}_np_x$, , ${}_{m\backslash}q_x$ and ${}_{m\backslash n}q_x$ – Simple problems.

Unit:5

Principle of Life assurance – Premium and its types (single, annual, half yearly, quarterly) – Four basic types of assurance – Temporary, Whole life, Endowment and Pure Endowment.

- **PEDAGOGY STRATERGIES:**
- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing Feedback

REFERENCES:	
1	Mathematical Basis of Life Assurance (2015). Published by Insurance Institute of India, Bombay.
2	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
FURTHER READINGS:	
1	PA. Navaneetham (2014) - Business Mathematics and Statistics, Jai Publishers, Trichy.
2	CT- 5 Indian institute of Actuarial Statistics.
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	**https://www.edx.org/course/introduction-to-actuarial-science**
2	**https://www.iiap.res.in/astrostat/School08/PennStateSchool08_LecNotes.pdf**
3	**https://www.annuityfyi.com/types-of-annuities/**
4	**http://www.math.utk.edu/~kbonee/123/2.3-2.4-problems-sol.pdf**
5	**https://www.ifs.org.mo/Document/Insurrance%20Manual/English/Life%20Ins.%20Examination.pdf**

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning	✓	✓	✓	✓			✓
	3	Research related Skills							
	4	Scientific Reasoning							
	5	Information/Digital Literacy	✓	✓		✓		✓	✓
	6	Problem Solving	✓	✓	✓		✓		✓
	7	Cooperation/ Team Work	✓	✓		✓		✓	
	8	Moral and Ethical Awareness	✓	✓		✓		✓	
	9	Self-Directed Learning	✓	✓	✓	✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**V**	**21BST51C**	**CORE PAPER V – STATISTICAL ESTIMATION THEORY**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Point out the basic concepts of Population, Sample and explain the Characteristics of estimators
2	Analyze the concept of unbiasedness and consistency with examples
3	Compute the efficiency of estimators and describe its essential concepts
4	Identify the minimum variance estimators with its examples
5	Discuss the sufficiency with its related theorems
6	Identify the methods of estimations
7	Identify the possible intervals of the estimators with examples

Unit - I

Statistical Inference - Basic Concepts - Population, Sample, Statistic, Parameter, Parameter Space

Point estimation - Meaning – Characteristics of estimators – Unbiasedness – Simple problems - Consistency – Invariance Property of consistent estimator – Sufficient condition for consistency - Simple problems.

Unit - II

Efficiency - Efficient Estimators - Simple problems - Most Efficient Estimator - Simple problems - Minimum Variance Unbiased Estimators - Uniqueness of MVUE - Theorems on MVUE.

Unit – III

Sufficiency – Neymann Factorization theorem – Cramer-Rao Inequality – Assumptions - Conditions for equality - Minimum Variance Bound Estimator – Simple problems based on Normal, Exponential and Cauchy distributions - Rao-Blackwell Theorem.

Unit – IV

Methods of Estimation - Method of Maximum Likelihood - Properties of MLE (Without Proof)- Simple theorems - Methods of Minimum variance -Method of moments - Simple Examples.

Unit - V

Interval Estimation - Confidence interval and Confidence limits - Simple problems based on Normal distribution and Uniform distribution - Confidence intervals for Large samples - Simple problems based on Poisson distribution and Exponential distributions.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.
2	A.M. Goon, M.K. Gupta, B. Dasgupta - An Outline of Statistical Theory Vol. II, World Press.

FURTHER READING:

1	C.W. Snedecor, and W.G.Cochran (1991) - Statistical Methods, Eight reprint, Wiley International.
2	P.G. Hoel (2012). Introduction to Mathematical Statistics, Wiley International.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://swayamprabha.gov.in/index.php/Syllabus/detail/1077
2	https://nptel.ac.in/courses/111/105/111105041/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓		✓		✓	
	3	Critical Thinking	✓	✓		✓		✓	
	4	Research related Skills							
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work	✓	✓	✓			✓	
	8	Moral and Ethical Awareness							
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**V**	**21BST52C**	**CORE PAPER VI – STATISTICAL QUALITY CONTROL**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	List out the basis of control charts and Construct control charts for attributes and variables
2	Interpret the results from the control charts
3	Explain the basic concepts of acceptance sampling plans
4	Describe the role of Acceptance Sampling in modern quality control systems
5	Discuss the advantages and disadvantages of Acceptance Sampling
6	Point out the major types of Acceptance sampling procedures and explain the uses of Single, Double and Sequential sampling plans
7	Determine the Operating Characteristic (OC), AOQ, ATI and ASN curves for Single, Double and Sequential sampling plans for Attribute
8	Discuss the effects of sampling plan parameters on sampling plan performance

Unit - I

Quality – meaning - concepts – Quality of design – Quality of conformance – Quality of performance

Statistical Quality Control – Meaning – Basic concepts of SQC – Uses – Causes of variation – Process Control – Basis of Control Charts – Uses of control charts - 3 sigma control limits.

Unit - II

Control Charts - Criteria for deducting lack of control - Control Charts for Variables – $\bar{x}$ and R Charts - Control Chart for attributes - p and np charts - Control Charts for number of defects - c Charts (for fixed and varying sample size) – Comparison of attribute and variable control charts.

Unit – III

Product Control - Acceptance Sampling – Meaning – Applications in Industry - Producer's Risk and Consumer's Risk - Definitions of AQL, IQL, LQL - Measures of performance - Concept of OC Function - Type A and Type B OC curves – OC Functions Based on Hyper-geometric, Binomial and Poisson distributions - Attribute Sampling Plans – Designing a Sampling Plan.

Unit – IV

Single Sampling Plans - Designing a Sampling Plan - Determination of the parameters in Single Sampling Plans - OC, AOQ, ASN and ATI functions of SSP.

Double Sampling Plans for attributes - Operating Procedures - Conditions of Applications - OC, AOQ, ASN and ATI functions – Advantages – Disadvantages.

Unit - V	
Sequential Sampling Plan for Attributes – Wald's Sequential Probability Ratio Test – Operating Procedure - OC Curve – ASN Function – Five Points on OC Curve –Five Points on ASN. **INDUSTRIAL VISIT**	
PEDAGOGY STRATEGIES • Lecturing • Assignment • Classroom Discussion • Questioning • Seminar • Class Test • Quiz & Drill Practice • Providing feedback	
REFERENCES:	
1	S.C. Gupta and V.K. Kapoor- Fundamentals of Applied Statistics, 4th Edition 2015, Sultan Chand & Sons, New Delhi.
2	M. Mahajan - Statistical Quality Control, 2009, Dhanpat Rai & Co (P) Ltd, Delhi, 2009.
FURTHER READING:	
1	E.L.Grant and R.S. LeavenWorth. Statistical Quality Control, McGraw Hill.
2	Duncan, A. J. (2003). Quality Control and Industrial Statistics, Irwin-Illinois, US.
3	Montgomery, D. C. (2009). Introduction to Statistical Quality Control, Sixth Edition, Wiley India, New Delhi
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://bmepedia.weebly.com/uploads/2/6/6/8/26683759/unit_4_quality_control.pdf
2	https://nptel.ac.in/courses/116/102/116102019/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	
	3	Critical Thinking	✓	✓	✓		✓	✓	
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning	✓	✓					✓
	6	Problem Solving	✓	✓					✓
	7	Team Work	✓			✓	✓	✓	✓
	8	Moral and Ethical Awareness	✓			✓	✓	✓	✓
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**V**	**21BST53C**	**CORE PAPER VII – ELEMENTS OF ECONOMETRICS**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the need and assumptions of Econometric models
2	Discuss the Linear regression model and the significance of Least square estimation
3	Analyze the Multiple regression model and the practical applications of the model in real life situations
4	Summarize the methods of detecting Multicollinearity and remove it from the model
5	Explain Auto correlation and to analyze the problems related to Auto correlated variables
6	Describe the techniques of fitting and computing the Econometric models
7	Illustrate the uses of Econometric models in predicting the future values

Unit - I

Econometrics – Nature, Definition and Scope of Econometrics – Relationship between economic theory, Mathematics and Statistics – Model building in Econometrics – Goals of Econometrics – Limitations and Divisions of Econometrics.

Unit - II

Simple Linear Regression Model – Error Term in Econometric Models – Reasons for introducing error term in the econometric model - Statistical Assumptions in Linear Model - Least Square Estimation- Gauss-Markov theorem - Properties of Least Square Estimation - Testing of Parameters of the Model - Estimation of Error Variance - Simple Problems.

Unit – III

Multiple Regression Model – Model with two explanatory variables – Derivation of normal equations - Measure of goodness of fit –Adjusted co-efficient of multiple determinations – Testing of significance of individual regression co-efficients.

Unit – IV

Multicollinearity – Consequences of perfect and imperfect Multicollinearity - Detection of Multicollinearity – Auxiliary regressions - Variance Inflation Factor and its relation – Solution to the problem of Multicollinearity.

Unit - V

Autocorrelation - Pure and Impure serial correlation – Autocorrelation by omitted variable and incorrect functional form – Visual inspection – Positive and Negative Autocorrelation – Consequences and sources of Autocorrelation - Durbin-Watson Test.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	K. Dhanasekaran (2011). Econometrics, 2nd Edition, Vrinda Publications (P) Ltd, Delhi -110 091
2	A. Koutsoyiannis (2004). Theory of Econometrics, 2nd Edition, Palgrave Publishers Limited, Replica Press Private Limited, India.

FURTHER READING:

1	S.P. Singh, Anil. K Parshar and H.P. Singh (1999). Econometrics and Mathematical Economics, 7th Edition, S.Chand & Company Ltd, New Delhi – 110 055.
2	Johnston. J. (1997). Econometric Methods, McGraw-Hill International Editions.
3	Dawn C. Porter, Sangeetha Gunasekar, and Damodar N. Gujarati (2004). Basic Econometrics, 5th Edition, McGraw-Hill Inc.,

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.youtube.com/watch?v=6I1WPKkNgoQ
2	https://cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ECO/1.pdf
3	https://sites.google.com/site/econometricsacademy/masters-econometrics/simple-regression-model

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	✓
	3	Critical Thinking	✓	✓				✓	✓
	4	Research related Skills	✓		✓	✓		✓	✓
	5	Analytical Reasoning	✓	✓			✓		✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work			✓		✓	✓	✓
	8	Moral and Ethical Awareness	✓	✓			✓	✓	✓
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**V**	**21BST54C**	**CORE PAPER VIII – AOS – ELEMENTS OF OPERATIONS RESEARCH**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Point out the Definition, Scope, Uses and Limitations of Operations Research and solve Linear Programming Problem by Graphical and Simplex methods
2	Find the Optimum Solution in Transportation problem by using NWC, LCM, VAM and MODI method
3	Solve the Assignment problems by Hungarian method
4	Solve problems on Inventory Control in Purchasing and Manufacturing Models with No Shortages
5	Explain the Replacement problems arises in different situations
6	Solve the Sequencing problems in industries
7	Explain the theory of Games and solve it

Unit - I

Operations Research - Definition – Scope – Uses – Linear Programming Problem – Formulation of LPP – Solution by Graphical Method - Canonical and Standard Form of LPP – Maximization and Minimization Problems – Simplex Method.

Unit - II

Transportation Problem – Definition - Balanced and Unbalanced Transportation Problem – Initial Basic Feasible Solution – North West Corner Rule, Least Cost Method and Vogel's Approximation Method – Optimum solution by MODI method

Unit – III

Assignment Problem – Definition - Balanced and Unbalanced Assignment Problem – Maximization and Minimization Problems – Hungarian Method – Difference between Transportation and Assignment problems.

Inventory Control – Introduction –Types of Inventory – Reasons for maintaining inventory – Costs associated with Inventories - Factors affecting Inventory control – Purchasing and Manufacturing models with no Shortages.

Unit – IV

Replacement Problems – Introduction – Replacement of items that deteriorates gradually - Replacement policy when Value of Money does not Change with Time.

Sequencing Problem – Introduction – Basic terms - Problems with n-jobs through Two Machines – Problems with n- jobs on Three Machines.

Unit - V

Game Theory – Introduction – Two-Person Zero-Sum Games – Concept of Pure and Mixed Strategies – Games With and Without Saddle Points – Solving 2 x 2 Games – Graphic Solution of m x 2 and 2 x n Games.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Kanti Swarup, P.K. Gupta and Manmohan (2009). Operations Research, Fourteenth Thoroughly Revised Edition, Sultan Chand & Sons, New Delhi.
2	Prof. V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan (2000). Resource Management Techniques, A.R. Publications, Tamil Nadu, New Revised Edition.

FURTHER READING:

1	Hamdy A. Taha. (2017). Operations Research - An Introduction, 10th Edition, Prentice Hall of India.
2	J.K. Sharma (2007). Operations Research - Theory & Applications, Macmillan India Ltd, Third Edition.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/107/111107128/
2	https://nptel.ac.in/courses/112/106/112106134/
3	https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	3	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	4	Scientific Reasoning	✓	✓	✓	✓	✓	✓	✓
	5	Information/Digital Literacy					✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Cooperation/ Team Work							
	8	Moral and Ethical Awareness	✓	✓	✓				
	9	Self-Directed Learning							

Year	Sem.	Subject Code	Title of the Paper	Hours/Week
2021-2022 onwards	**V**	**21BST55S**	**SKILL BASED SUBJECT III - EDUCATIONAL AND PSYCHOLOGICAL STATISTICS**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Discuss the various concepts of Correlation (Biserial, Point biserial, Tetrachoric r, Phi coefficient and contingency coefficient) with the corresponding computations
2	Compute Z-score, Standard score, Normalized and T-scores for ungrouped and grouped data
3	Explain scaling of rankings and scaling of ratings with examples
4	Explain the basics of reliability and different methods of determining test reliability
5	Identify the effect of test length and effect of different ranges on testing reliability of a test
6	Explain the basics, types, estimation of validity and also the effect on validity by lengthening a test
7	Discuss the concepts Mental Age and Intelligent Quotient (IQ) with simple calculation

Unit - I

Correlation - Biserial correlation - Standard deviation of Biserial Correlation – Point Biserial correlation – Comparison of Biserial and Point Biserial correlation – Tetrachoric r – Calculation. The Phi (Φ) co-efficient – Significance of Phi ((Φ) – Comparison of Phi and Tetrachoric r. The contingency coefficient (c) - Simple Problems - Curvilinear or Non-Linear relationship.

Unit - II

Partial and Multiple Correlation - Correlation ratio - Intra-class correlation - Partial and Multiple correlation - Definition- Formula for three variables - Simple problems - Properties of multiple correlation co-efficient – Limitations to the use of partial and multiple correlation.

Unit – III

Scaling of Scores on a Test - Scaling procedures - Introduction - Scaling individual test item in terms of difficulty – Scaling of scores on a test - Z or σ scores -Standard scores - Normalized scores - T-scores for ungrouped and grouped data - Percentile score - Scaling of rankings in terms of Normal Probability curve - scaling of ratings in terms of Normal Probability curve.

Unit – IV

Reliability - Reliability of test scores - Definition of Reliability - Index of Reliability - Methods for determining test reliability - Test-Retest Method - Alternate or Parallel Forms Method - Split Half method - Effect of test length on the reliability of the test - Effect of different ranges on the reliability of the test.

Unit - V

Validity - Validity of test scores - Estimation of Validity - Types of Validity - Validity and Test Length - Comparison between Reliability and Validity.

Intelligence Tests - Mental Age - Intelligence Quotient.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Assignment
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Gupta, S.C. and Kapoor, V.K. (2019). Fundamentals of Applied Statistics, Sultan Chand and Sons, 4th thoroughly revised edition, New Delhi.
2	Henry. E. Garrett (2014). Statistics in Psychology and Education, Surjeet Publications, Fourth Indian Reprint.

FURTHER READING:

1	Gupta, S.C. and Kapoor, V.K (2017). Fundamentals of Mathematical Statistics, Sultan Chand and Sons, 11th Revised Edition.
2	Guilford, J.P. (1986). Fundamental Statistics in Psychology and Education, Mc Graw Hill

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/noc/courses/noc21/SEM1/noc21-hs49/
2	https://labs.la.utexas.edu/gilden/files/2016/05/Statistics-Text.pdf
3	https://www.youtube.com/watch?v=W9yiUlBlRjg
4	https://www.youtube.com/watch?v=jgzph9118vk

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning	✓	✓			✓	✓	✓
	3	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	4	Scientific Reasoning	✓	✓	✓	✓	✓	✓	✓
	5	Information/Digital Literacy							
	6	Problem Solving	✓	✓			✓	✓	✓
	7	Cooperation/ Team Work	✓	✓			✓	✓	✓
	8	Moral and Ethical Awareness	✓		✓	✓			✓
	9	Self-Directed Learning	✓	✓		✓	✓	✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**V**	**21BST5EL**	**NON MAJOR ELECTIVE - I BASIC STATISTICS – I**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the basic concepts in Statistics and develop the skills in collection and presentation of data
2	Calculate various Measures of Statistics
3	Compute various problems through Statistical Methods
4	Apply the concept of Spread and Dispersion Measures
5	Differentiate the concept of Symmetry and Skewness
6	Outline the concept of Peakedness and Kurtosis
7	Explain the application of Statistics in Various fields

Unit – I

Basic Statistics – Introduction – Definition - Functions of Statistics – Scope - Uses - Limitations of Statistics – Collection of data – Primary and Secondary data – Methods of collecting Primary data – Classification of data - Tabulation of data - Formation of Frequency Distribution.

Unit - II

Diagrams and Graphs – Bar diagrams – Multiple Bar diagram – Box Plot - Pie diagram – Graphs of frequency distribution – Histogram - Frequency polygon - Frequency curve - Ogive curves - Merits - Demerits.

Unit – III

Measures of Central Tendency - Requisites of a good average – Raw Data – Frequency Data – Continuous Data - Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean – Merits and Demerits.

Unit – IV

Measures of Dispersion - Absolute and Relative Measures – Range, Quartile Deviation, Mean Deviation, Median Deviation, Standard Deviation and Co-efficient of Variation – Simple problems.

Unit - V

Skewness - Definition - Characteristics of Skewness - Measures of Skewness – Types - Karl-Pearson's Co-efficient of Skewness - Bowley's Co-efficient of Skewness - Simple Problems.
Kurtosis – Types of Kurtosis – Characteristics of Kurtosis (Concept only)

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Navanitham, P.A. (2008). Business Mathematics and Statistics, Jai Publishers, Trichy.
2	Pillai, R.S.N and V. Bagavathi (1999). Statistics – Theory and Practice, S.Chand & Sons Company Ltd, New Delhi.

FURTHER READING:

1	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.
2	Vittal P.R. - Business Statistics, Margham Publications, Chennai.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107114/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning		✓	✓	✓	✓	✓	
	3	Self-directed Learning	✓	✓	✓	✓	✓	✓	
	4	Reflective Thinking	✓	✓	✓	✓	✓	✓	✓
	5	Information/Digital Literacy		✓	✓		✓	✓	
	6	Problem Solving	✓	✓	✓	✓	✓	✓	
	7	Cooperation/Team Work	✓	✓	✓	✓	✓	✓	
	8	Moral and Ethical Awareness			✓	✓	✓	✓	
	9	Lifelong learning	✓	✓	✓	✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/Week
2021-2022 Onwards	**VI**	**21BST61C**	**CORE PAPER IX - TESTING STATISTICAL HYPOTHESIS**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1	Discuss testing of statistical hypothesis
2	Explain the procedures for Likelihood Ratio Test and tests based on normal Population
3	Discuss the test of significance for Large and small sample tests
4	Explain the procedures of F-test and Chi-Square Test
5	Describe Non-Parametric Tests on one Sample and Two Sample Problems
6	Apply Mann-Whitney 'U' Test, Kolmogorov's Smirnov One Sample Test and Kruskal Wallis Test
7	Apply testing of hypothesis to different distributions

UNIT - I

Testing of Hypothesis - Statistical Hypothesis - Simple and Composite Hypothesis, Null and Alternative Hypothesis - Two Types of Errors - Critical Region - Level of significance and Power of a Test - Most Powerful Test - Uniformly Most Powerful Tests - Neyman-Pearson Lemma.

UNIT - II

Tests Based on NP lemma - Likelihood Ratio test – Definition - Test for Single Mean, Two Means, Single Variance and Two Variance for normal population.

UNIT - III

Tests of Significance - Large Sample Tests - Mean, difference of two Means, Single proportion, difference of Two proportions. Small Sample Tests - t-test for single Mean, difference of two Means, Paired t-test – Test of Correlation Co-efficient

UNIT - IV

F-test for variances - Contingency Tables - Yate's correction – Chi-Square Test - Test for Goodness of Fit and Independence of Attributes.

UNIT - V

Non-Parametric Tests – Introduction - Advantages and Disadvantages - Sign test, Run test, Median test and Mann-Whitney 'U' test (One Sample and Two Sample Problems) - Kolmogorov's Smirnov One Sample Test - Kruskal Wallis Test.

PEDAGOGY STRATERGIES:

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing Feedback

REFERENCES:

1	S.C. Gupta, and V.K. Kapoor (2012). Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11th Revised Edition.
2	Hogg R.V and Craig A.G. Introduction to Mathematical Statistics

FURTHER READING:

1	Snedecor, G.W and Cochran W. G . Statistical Methods (Oxford and IBH)
2	Lehmann, E.L. (1986). Testing Statistical Hypothesis (2nd Edition), Springer New York.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://math.ucdenver.edu/~ssantori/MATH2830SP13/Math2830-Chapter-08
2	https://www.cse.iitk.ac.in/users/nsrivast/HCC/lec07-09.pdf
3	http://www2.univet.hu/users/jfodor/biomath/Biomath12

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓			
	3	Critical Thinking	✓	✓	✓	✓			
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work	✓	✓	✓				✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**VI**	**21BST62C**	**CORE PAPER X – DESIGN OF EXPERIMENTS**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the theoretical aspects of Linear models, Analysis of Variance and Design of Experiments
2	Discuss the fundamental principles of experimentation
3	Analyze and interpret one-way and two – way ANOVA
4	Outline the type of Design of experiments with its advantages and disadvantages
5	Analyze and interpret Completely Randomized Design, Randomized Block Design and Latin Square Design
6	Discuss the basics of Factorial experiments with its design
7	Analyze and apply Factorial experiments
8	Explain the need of concept of confounding

Unit - I

ANOVA - Definition – Assumptions – Importance – Linear Models – Fixed Effect Model – Random Effect Model – One-way ANOVA for Fixed Effect Model – Least Square Estimates of Parameters and the Variances - Sum of squares – Two-way ANOVA for Fixed Effect Model - Least Square Estimates of Parameters and the Variances – Sum of squares.

Unit - II

Design of Experiments - Fundamentals – Terminology in design of Experimental design – Experimental Error –Principles of Experimental Design – Size and Shape of the Plots.
Completely Randomized Design (CRD) - Concept - Layout - Statistical Analysis - Advantages and Disadvantages.

Unit – III

Randomized Block Design (RBD) – Application of RBD - Layout – Statistical Analysis of RBD for observation per experimental unit– Advantages and Disadvantages – Efficiency of RBD over CRD – Estimation of one Missing value and its ANOVA in RBD – Estimation of Two missing values in RBD

Unit – IV

Latin Square Design (LSD) – Layout of LSD – Standard Latin Square - Statistical Analysis of LSD for one observation per experimental unit.– Advantages and Disadvantages – Least Square Estimates – Estimation of one Missing Value in LSD - Efficiency of LSD over CRD and RBD.

Unit - V

Factorial Experiments – Advantages and Limitations – 2^2 Factorial Design – Statistical Analysis of 2^2 Design – Yates method of Computing Factorial Totals – 2^3 Factorial Design - Statistical Analysis of 2^3 Design – Confounding - Partial and Complete Confounding .

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.
2	R. Pannerselvam (2012). Design and Analysis of Experiments, Prentice Hall of India, New Delhi.

FURTHER READING:

1	Montgomery. Design and Analysis of Experiments, Wiley India Pvt. Ltd, 5th Edition,
2	Das M.N. and Giri N.C. (2011). Design and Analysis of Experiments, New Age International Private Ltd., New Delhi
3	Cochran W.G. and Cox G.M. (1992). Experimental Designs, Second Edition, John Wiley & Sons, New York.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/105/110105087/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	✓
	3	Critical Thinking				✓	✓	✓	✓
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning				✓	✓	✓	✓
	6	Problem Solving				✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**VI**	**21BST63C**	**CORE PAPER XI – AOS – APPLIED STATISTICS**	**5**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Discuss the concept of Time series and its components
2	Analyze and interpret the Trend values
3	Forecast the values using trend analysis
4	Differentiate the concepts of ARMA and ARIMA models
5	Explain the concept and uses of Index Numbers
6	Analyze and interpret the Weighted index numbers
7	Discuss the various measurements and scaling techniques

UNIT - I

Time Series - Definition- Components of Time Series - Uses - Measurement of Trend: Graphical Method - Semi-Average Method - Method of Moving Averages - Merits and Demerits - Method of Least Squares in fitting a linear trend.

UNIT - II

Seasonal Variation – Measurement of Seasonal Variations - Method of Simple Averages, Ratio-to-Trend Method, Ratio-to-Moving Average Method and Link Relative Method – Cyclical Variations and Random Variations (Concepts only) - Concept of ARMA and ARIMA models.

UNIT – III

Index numbers - Meaning - Definition - Uses and Types – Price Index numbers – Un-weighted Index Numbers – Simple aggregative method – Simple average of Price relative method - Weighted Index Numbers – Weighted Aggregative Price Index - Laspeyre's Price Index, Paasche's Price Index, Dorbish & Bowley's Price Index, Marshall Edgeworth Price Index and Fisher's Index Number - Weighted Average of Price Relatives Method.

UNIT – IV

Criteria of a Good Index Number : Unit Test, Time Reversal Test, Factor Reversal Test and Circular Test – Construction of Fixed Base and Chain Base Index Numbers - Cost of Living Index Numbers – Uses – Construction - Aggregate Expenditure and Family Budget Methods

UNIT – V

Measurement and Scaling techniques - Categorical variables - Data types - Metric, Interval and Ratio data. Non-Metric data – Nominal and Ordinal data. Scales of measurement - Comparative scale, Paired comparison scale, Rank order scale, Constant sum scale, Non-comparative scale - Continuous rating scale, Itemized rating scale - Likert scale and Guttmann scale

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.
2	S.P.Gupta (2012). Statistical Methods, Sultan Chand & Sons, New Delhi, 42nd revised Edition.
3	S.K. Mangal (2009). Statistics in Psychology and Education, Second Edition, PHI Learning Private Limited, New Delhi.

FURTHER READING:

1	Croxton and Cowden - Applied General Statistics, Prentice - Hall of India (Private) Ltd, New Delhi.
2	B.L. Agarwal – Programmed Statistics, New Age International, Chennai

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.slideshare.net/ujjmishra1/measurement-and-scaling-techniques
2	https://www.stat.berkeley.edu/~bartlett/courses/153-fall2010/lectures/1.pdf

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓			
	3	Critical Thinking	✓	✓	✓	✓	✓		
	4	Research related Skills	✓	✓	✓	✓			
	5	Analytical Reasoning	✓	✓	✓	✓			
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work	✓	✓			✓	✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**VI**	**21BST64P**	**CORE PRACTICAL III – STATISTICS PRACTICAL – III (Using Scientific Calculator)**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Estimate the parameters using method of moments and MLE. Analyze the data using appropriate Large and small sample test. Ensuring the Goodness of fit and Independence of attributes using Chi – Square Test. Verify the data using Non – Parametric Tests.
2	Ensure the Goodness of fit and Independence of attributes using Chi – Square Test. Verify the data using Non – Parametric Tests
3	Analyze the data using CRD, RBD and LSD. Estimate the missing values in RBD and LSD.
4	Frame the control charts using p, np, c, $\bar{x}$ and R charts. Verify the process is under control practically Draw the OC , ASN, ATI, AOQ curves and analyze the data using Single sampling plan and measuring the performances
5.	Frame the LPP and solving them. Identify the transportation cost using various methods and analyze the optimal solution. Determine the optimal assignment using Hungarian method.
6	Identify the duration to replace the parts. Identify the optimal strategies in Game theory.
7	Measure the trend and identify the seasonal variations. Calculate the index number using various methods.

Statistical Inference

1. Estimation of Parameters of Distribution by the Method of Moments
2. Estimation of Parameters by the Method of Maximum Likelihood
3. Testing of hypothesis- Large Sample Tests- Test for Mean – Difference of Mean. Proportion - Difference of proportion. Small sample tests - Test for mean - Difference of mean – Paired t-test -Test for variance ratio
4. Chi – Square Test - Test for Goodness of Fit and Independence of Attributes.
5. Non – Parametric Tests – Sign test - Run Test - Median Test - Mann-Whitney 'U' Test - Kolmogorov's Smirnov One Sample Test - Kruskal Wallis Test

Design of Experiments

6. Analysis of CRD
7. Analysis of RBD
8. Analysis of LSD Layouts
9. Missing Plot Techniques in RBD
10. Missing Plot Techniques in LSD

Statistical Quality Control

11. Control Charts for Attributes - p, np and c charts
12. Control Charts for Variables - $\overline{X}$ and R charts
13. Single Sampling Plan for attributes - OC, ASN, ATI and AOQ Curves.

Operations Research

14. Linear Programming Problem –Formation of LPP- Graphical Method – Simplex Method
15. Transportation Problem – North West Corner Rule – Least Cost Method – VAM Method
16. Optimal Solution by MODI Method
17. Assignment Problem – Hungarian Algorithm
18. Replacement Problems
19. Sequencing problems - Problems with n jobs on three machines
20. Game theory - Games without saddle point - Solving 2x2 games - Graphic Solution of 2 x n and m x 2 Games.

Time Series

21. Measurement of Trend - Graphical Method - Semi-Average Method - Method of Moving Averages
22. Measurement of Seasonal Variations - Method of Simple Averages, Ratio-to-Trend Method, Ratio-to-Moving Average Method and Link Relative Method
23. Index numbers - Un-weighted Index Numbers – Simple aggregative method – Simple average of Price relative method
24. Weighted Index Numbers - – Laspeyre's Price Index – Paasche's Price Index – Dorbish & Bowley's Price Index – Marshall Edgeworth Price Index - Fisher's Index Number.
25. Time Reversal Test and Factor Reversal Test

PEDAGOGY STRATEGIES

- Lecturing and Hands-on training
- Lab Experiments
- Questioning
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta, and V.K. Kapoor (2012). Fundamentals of Mathematical Statistics, 11th Revised Edition, Sultan Chand & Sons, New Delhi.
2	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, 4th Edition, Sultan Chand & Sons, New Delhi.
3	P.K. Kanti Swarup, Gupta and Manmohan (1980). Operations Research, Sultan Chand & Sons, New Delhi.

4	S.P.Gupta (2012). Statistical Methods, 42nd revised Edition, Sultan Chand & Sons, New Delhi.
5	M. Mahajan (2009) - Statistical Quality Control , Dhanpat Rai & Co (P) Ltd, New Delhi.
6	A.M. Goon, M.K.Gupta and B. Dasgupta (1989). An Outline of Statistical Theory-Vol.II, World Press, Calcutta.
FURTHER READING:	
1	P.A. Navanitham (2008) - Business Mathematics and Statistics, Jai Publishers, Trichy.
2	Prof. V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan (2000). Resource Management Techniques, New Revised Edition, A.R. Publications, Tamil Nadu.
3	P. K. Gupta and Manmohan - Problems in Operations Research, Sultan Chand & Sons, New Delhi.
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/102/111102111/
2	https://nptel.ac.in/courses/111/104/111104032/
3	https://nptel.ac.in/courses/111/105/111105043/
4	https://epgp.inflibnet.ac.in/Home/ViewSubject?catid=34
5	https://nptel.ac.in/courses/110/105/110105087/
6	https://nptel.ac.in/courses/112/106/112106134/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	
	3	Critical Thinking							
	4	Research related Skills							
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work			✓	✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**VI**	**21BST65P**	**CORE PRACTICAL IV – STATISTICS PRACTICAL – IV (Using SPSS)**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Design a questionnaire and collect the data
2	Demonstrate the method of creating and formatting a data file in SPSS.
3	Handle and transform the data in SPSS
4	Draw various diagrams for the created data set using SPSS.
5	Analyze the Univariate and Bivariate data set
6	Analyze Parametric and Non parametric statistical tests
7	Analyze a big data set and solve the complicated problems using various statistical concepts

1. Creating, Editing and Managing Data Files
2. Diagrammatic Representation – Simple, Multiple, Sub-divided and Percentage bar diagrams
3. Pie diagram, Scatter diagram, Box plots, Histogram and Frequency table
4. Descriptive Statistics – Mean, Median, Mode and S.D
5. Skewness and Kurtosis
6. Correlation – Karl Pearson's and Spearman's Rank correlation
7. Regression – Simple Regression analysis
8. Testing of Hypothesis – Parametric tests – One sample 't' test – Two sample 't' test – Paired 't' Test
9. Non- Parametric tests – One sample K-S test - Mann-Whitney U test – Wilcoxon Signed Rank test – Kruskal Wallis test
10. Chi-square test – Test for independence of attributes – Test for goodness of fit
11. Analysis of Variance – One way ANOVA – Two way ANOVA

PEDAGOGY STRATEGIES

- Lecturing and Hands-on training
- Lab Experiments
- Questioning
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Jeremy J. Foster (2001). Data analysis using SPSS for windows - New edition, Versions 8-10 Sage publications, London

2	Darren George and Paul Mallery. SPSS for Windows Step by Step, Eigth Edition – Dorling Kindersely (India) Pvt. Limited (Pearson Education), New Delhi.
FURTHER READING:	
1	Clifford E. Lunneborg (2000) - Data analysis by resampling: concepts and applications - Dusbury Thompson learning, Australia.
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/110/107/110107113/
2	https://nptel.ac.in/courses/110/105/110105060/
3	https://nptel.ac.in/courses/111/104/111104098/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	✓	✓	✓	✓	✓	✓	✓
	2	**Communication Skills**	✓	✓	✓	✓	✓	✓	✓
	3	**Critical Thinking**	✓	✓	✓	✓	✓	✓	✓
	4	**Research related Skills**	✓	✓	✓	✓	✓	✓	✓
	5	**Analytical Reasoning**	✓	✓	✓	✓	✓	✓	✓
	6	**Problem Solving**	✓	✓	✓	✓	✓	✓	✓
	7	**Team Work**	✓	✓	✓	✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**VI**	**21BST67S**	**SKILL BASED SUBJECT IV - DEMOGRAPHIC METHODS**	**4**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the basics of demography and the sources of demographic data
2	Discuss the uses and applications of demography in various fields
3	Explain the concept fertility and calculate its measures CBR, GFR, TFR, ASFR, GRR and NRR
4	Summarize the concept mortality and calculate its measures CDR, ASDR, SDR and IMR.
5	Calculate and construct the life table and discuss its uses and functions
6	Discuss about migration and its types in real life situations
7	Describe various types, importance and methods for estimation of population projection.

Unit - I

Demography - Definition - Importance of Demographic data – Sources of Demographic data - Population Census – Uses - Registration method - Vital Registration - Population Register - Records - Sample surveys - International publications - Demography in Sociology, Economics and Health planning.

Unit - II

Fertility measurements - Rates and Ratios – Fertility – Factors affecting Fertility – Fertility Measures - Crude Birth Rate (CBR), General, Specific and Total Fertility Rates – Growth Rates - Gross Reproduction Rate (GRR) - Net Reproduction Rate (NRR) - Simple Problems.

Unit – III

Mortality Measurements - Mortality – Mortality Measures - Crude Death Rate (CDR), Age, Sex and Cause Specific Death Rates - Standardized Death Rate - Infant Mortality Rate - Simple Problems.

Unit – IV

Life Table – Assumptions - Description of various columns of a Life table –Relationship between life table functions - Construction of a Life table - Uses of a Life table - Simple Problems.
Migration - Definition – Types of Migration - Effects of Migration.

Unit - V

Population Projection – Types - Methods of population projection – Importance - limitations – Population estimates and projection – Mathematical Method – Arithmetic Method and Geometric Method - Growth Component Method – Logistic curve – Basic ideas of Stationary and Stable population.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Jhingan M.L, Bhatt B.K and Desai J.N. (2003). Demography, Vrinda Publications (P) Ltd, Delhi, 2nd Revised Edition.
2	Gupta S.C. and Kapoor V.K. (2019). Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi, 4th thoroughly revised edition.

FURTHER READING:

1	Mishra D.E (2001). An Introduction to the Study of Population, South India publishers, Madras.
2	Goon, A.M, Gupta, M.K and Das Gupta (2009). Fundamentals of Statistics, Vol II (World Press).

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/109/104/109104045/
2	https://swayam.gov.in/nd1_noc19_hs39/preview
3	https://nptel.ac.in/courses/109/104/109104150/
4	http://www.ru.ac.bd/wp-ontent/uploads/sites/25/2019/03/402_10_00_Lundquist_Demography.pdf
5	https://www.youtube.com/watch?v=51eqdcSg0Pw

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	3	Research related Skills					✓	✓	✓
	4	Scientific Reasoning					✓	✓	✓
	5	Information/Digital Literacy	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving			✓	✓	✓	✓	✓
	7	Cooperation/ Team Work	✓	✓	✓	✓	✓	✓	✓
	8	Moral and Ethical Awareness	✓	✓			✓	✓	✓
	9	Self-Directed Learning	✓	✓				✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**VI**	**21BST6EL**	**NON MAJOR ELECTIVE II - BASIC STATISTICS – II**	**3**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the study of relationship between two variables
2	Convert qualitative data into ranks and calculate the rank correlation.
3	Discuss the applications of Time Series and its Components
4	Compute Index numbers
5	Discuss the concept of cost of living index
6	Apply index numbers in real life situations
7	Demonstrate the applications of Time Series in Forecasting

Unit - I

Correlation – Meaning – Scatter diagram – Karl Pearson's Correlation Coefficient – Merits and Demerits - Rank Correlation – Spearman's Rank Correlation Coefficient – Merits and Demerits – Concurrent Deviation Method – Simple Problems.

Unit - II

Regression – Meaning - Uses – Applications - Regression Equation Y on X – Regression Equation X on Y – Properties – Determination of Correlation using Regression Coefficients – Forecasting - Simple Problems.

Unit – III

Time Series – Uses – Components of Time Series – Measurement of Trend –Graphical method- Semi Average Method - Moving Average Method - Method of Least Squares – Simple Problems.

Unit – IV

Index Numbers – Uses – Characteristics – Price Index Numbers - Construction of Weighted Index Numbers – Laspeyre's, Paasches and Fisher's Index Numbers – Cost of Living Index - Simple Problems.

Unit - V

Sampling Techniques – Census Survey – Merits and Demerits - Sample Survey – Merits and Demerits – Principles of Sampling – Methods of Sampling – Simple Random Sampling – Non-Random Sampling Methods – Snow Ball Sampling – Quota Sampling - Merits and Demerits – Sampling Error (Concepts Only).

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Navanitham, P.A. (2008). Business Mathematics and Statistics, Jai Publishers, Trichy.
2	S.C. Gupta and V.K. Kapoor (2015). Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.

FURTHER READING:

1	Pillai, R.S.N and V. Bagavathi (1999). Statistics – Theory and Practice, S.Chand & Sons Company Ltd, New Delhi.
2	Vittal P.R. Business Statistics, Margham Publications, Chennai.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/107/110107114/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	3	Self-directed Learning	✓	✓			✓	✓	✓
	4	Reflective Thinking	✓	✓		✓		✓	✓
	5	Information/Digital Literacy	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Cooperation/Team Work	✓	✓	✓	✓	✓	✓	✓
	8	Moral and Ethical Awareness		✓	✓	✓			
	9	Lifelong learning			✓	✓	✓	✓	

ALLIED PAPERS
(Offered to other Departments)

GOVERNMENT ARTS COLLEGE, COIMBATORE 641 018

B. Sc. STATISTICS (OBE PATTERN)

(For the students admitted from the academic year **2020-2021** and onwards)

Scheme of Examination for Allied Papers offered to Other Departments

Part	Sub Code	Title of the Paper	Hrs (wk)	Internal (CA) Marks	External Marks	Total Marks	Ext– Min.	Total Pass Mark	Credits
Semester – 1									
III	**21BGE14A**	Statistics – I	8	25	75	100	30	40	
III	**21BCS14A**	Statistics and Numerical Methods	6	25	75	100	30	40	
III	**21BCA14A**	Business Mathematics	6	25	75	100	30	40	
III	**21BBA14A**	Statistics for Management – I	6	25	75	100	30	40	
Semester – II									
III	**21BGE24A**	Statistics – II	8	25	75	100	30	40	
III	**21BIT24A**	Computer Oriented Numerical and Statistics Methods	6	25	75	100	30	40	
III	**21BBA24A**	Statistics for Management – II	6	25	75	100	30	40	
Semester – III									
III	**21BPS34A**	Statistics – I	6	25	75	100	30	40	
III	**21BCA34A**	Statistics for Business	6	25	75	100	30	40	
Semester – IV									
III	**21BPS44A**	Statistics – II	6	25	75	100	30	40	
III	**21BCO44A /21BIB44A**	Business Statistics	6	25	75	100	30	40	

Year	Sem.	Subject Code	Title of the Paper	Hours / Week
2021-22 onwards	**I**	**21BGE14A**	**I B.Sc., GEOGRAPHY – Allied – I: STATISTICS – I**	**8**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1.	Discuss the scope and necessity of Statistics
2.	Tabulate and represent the data in diagrams and graphs
3.	Identify the nature of data
4.	Choose the suitable measure according to the nature of the observed data
5.	Apply the formula and calculate statistical measures for the observed data in their field
6.	Check the relevance of the measures calculated
7.	Interpret the results of the statistical measures used

Unit – I

Statistics - Definition, Scope and Limitations – Types and Sources of Data – Methods of Collecting Primary Data – Tools for Data Collection - Sources of Secondary Data – Classification and Tabulation of Data.

Unit – II

Frequency Distribution - Formation of Frequency Distribution - Presentation of Data. **Diagrams:** Bar Diagrams and Pie Diagram. **Graphs –** Histogram - Frequency Polygon - Frequency Curve and Ogives – Finding Median and Mode graphically.

Unit – III

Measures of Central Tendency – Meaning - Objectives - Mean, Median, Mode, Geometric Mean and Harmonic Mean – Merits and Demerits – Properties of a Good Measure – The Best Measure among Measures of Central Tendency.

Unit – IV

Measures of Dispersion – Meaning - Objectives - Range, Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Variation. The Best Measure among Measures of Dispersion.
Skewness and Kurtosis - Definition – Concept of Symmetry and Skewness - Measures of Skewness – Karl Pearson's Co-efficient of Skewness and Bowley's Co-efficient of Skewness - Measures of Kurtosis.

Unit – V

Probability - Concept – Basic Concepts – Types of Events – Mathematical and Statistical Definitions of Probability – Conditional Probability – Addition and Multiplication Theorems (Without Proof) – Problems based on these theorems.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

References:

1.	S.P.Gupta (2012). Statistical Methods, Sultan Chand & Sons, New Delhi, 42nd revised Edition.
2.	Gupta, S C. and Kapoor V. K. (2018) - Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand & Sons, New Delhi.

Further Reading:

1.	P. R. Vittal - Business Statistics, Margham Publications, Chennai.
2.	P.A. Navneetham (2008). Business Mathematics & Statistics, Jai Publishers, Trichy.
3.	Goon A.M., Gupta M.K., and Das Gupta B. (2013). Fundamentals of Statistics, Vol.1, World Press Private Ltd, Calcutta.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1.	https://nptel.ac.in/courses/111/105/111105041/
2.	https://nptel.ac.in/courses/111/106/111106112/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓			✓	✓	✓	
	2	Communication Skills		✓	✓	✓	✓	✓	
	3	Critical Thinking	✓	✓	✓	✓	✓		✓
	4	Research related Skills			✓	✓		✓	✓
	5	Analytical Reasoning		✓		✓	✓		✓
	6	Problem Solving							
	7	Team Work							
	8	Moral and Ethical Awareness	✓		✓			✓	
	9	Multicultural Competence	✓		✓			✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**I**	**21BCS14A**	**I BSc., (CS) - Allied I: STATISTICS & NUMERICAL METHODS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Calculate and apply measures of central tendency and measures of dispersion – grouped data cases.
2	Calculate and apply measures of central tendency and measures of dispersion –ungrouped data cases.
3	Compute and interpret the results of Skewness and Correlation Analysis.
4	Demonstrates and understands Linear Regression and Curve fitting.
5	Apply numerical methods to solve system of simultaneous equations and analyze and evaluate the accuracy of common numerical methods.
6	Solve Numerical Differentiation and Central difference problems using Newton Forward Difference and Backward Difference.
7	Solve Numerical Integration problems using Newton Forward Difference and Backward Difference, Trapezoidal Rule, Simpson Rule 1/3 rd , 3/8 th and Weddle's rules.

Unit - I

Measures of Central Tendency – Mean - Median and Mode - Relationship among Mean, Median and Mode – Uses - Merits and Demerits

Measures of Dispersion - Range - Quartile Deviation - Mean Deviation - Standard Deviation and Coefficient of Variation.

Unit - II

Skewness and Kurtosis - Definition - Bowley's and Karl Pearson's Coefficient of Skewness. Concept of Kurtosis.

Correlation - Definition - Scatter Diagram - Types of Correlation - Karl Pearson Correlation Coefficient – Spearman's Rank Correlation Coefficient.

Unit – III

Regression Analysis -Definition - Regression Equations for Two Variables - Regression Coefficients - Properties - Curve Fitting - Linear - Simple Problems.

Unit – IV

Numerical Methods - System of Simultaneous Equations - Gauss Elimination- Gauss Seidal Methods – Interpolation - Newton's Forward and Backward Interpolation Formula - Lagrange's Interpolation - Central difference interpolation formulae - Gauss forward and backward formula - (No Derivations) Simple Problems Only.

Unit - V

Numerical Differentiation - Newton Forward Difference - Newton Backward Difference. Numerical Integration - Trapezoidal Rule - Simpson's 1/3 rd Rule - Simpson's 3/8 th Rule and Weddle's Rule (No Derivations) Simple Problems Only.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	S.C. Gupta and V.K. Kapoor (2012). Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11th revised Edition.
2	P. Kandasamy, K. Thilagavathy and K. Gunavathi. Numerical Methods, S. Chand & Company Ltd, New Delhi.

FURTHER READING:

1	S.P. Gupta (2012). Statistical Methods, Sultan Chand & Sons, New Delhi, 42nd revised Edition.
2	R.S.N. Pillai and V. Bagavathi (1999). Statistics – Theory and Practice, S. Chand & Sons Company Ltd, New Delhi.
3	E. Balagurusamy - Numerical Methods, Tata MC grew hill Pvt ltd.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	**https://nptel.ac.in/courses/111/105/111105041/**
2	**https://nptel.ac.in/courses/111/106/111106112/**
3	**https://www.classcentral.com/course/intro-to-numerical-analysis-13684**

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge							
	2	Communication Skills							
	3	Critical Thinking							
	4	Research related Skills							
	5	Analytical Reasoning							
	6	Problem Solving							
	7	Team Work							
	8	Moral and Ethical Awareness							
	9	Multicultural Competence							

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**I**	**21BCA14A**	**I BCom (CA) -Allied I: BUSINESS MATHEMATICS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Explain the concepts and uses of series.
2	Discuss the nature of business problems
3	Apply the knowledge of mathematics (algebra, matrices, calculus) in solving business problems.
4	Solve the business problems using Basic Mathematics
5	Analyze and take decisions in day to day business transactions
6	Solve the Transportation problem
7	Discuss Assignment problem and solve it

Unit - I

Mathematics of Finance - Arithmetic and Geometric Series - Simple interest - Compound interest - Annuity - Concept of present value and amount of sum types of annuities - Present value and amount of an annuity including the cases of continuous compounding - Problems relating to sinking fund.

Unit - II

Matrices - Definition of a matrix - types of matrices- Properties of determinants - Calculations of values of determinants up to third order – Adjoint of a matrix – Elementary row and column operations - Inverse of a Matrix (up to 3 x 3) - Solution of a system of linear equations having unique solution and involving not more than three variables - Rank of a Matrix (up to 3 x 3).

Unit – III

Numerical Differentiation - Variables - Constants and Functions - Differentiation - Meaning of Derivative – First and Second Order Derivatives - Maxima and Minima; cases of one variable involving second or higher order derivatives - Marginal Revenue and Marginal Cost - Simple Problems.

Unit – IV

Numerical Integration - Integration as anti-derivative process - Standard forms - Meaning - Basic Integral Formulas - Methods of Integration - By substitution - By parts - By use of partial functions – Simple Problems.

Unit - V

Transportation and Assignment Problems - Transportation Problem - Introduction - Balanced

and Unbalanced Problems – Initial Basic Feasible Solution – North-West Corner Rule, Least Cost Method and Vogel's Approximation Method (VAM) - Assignment Problem – Hungarian Method - Simple Problems.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Vittal P.R. (2012). Business Mathematics and Statistics: Margham Publications, Chennai.
2	Eugene Don and Joel J. Lerner, (2009). Basic Business Mathematics: McGraw-Hill Education, New Delhi.

FURTHER READING:

1	Navneetham P.A. (2008). Business Mathematics & Statistics: Jai Publishers, Trichy.
2	Kanti Swarup, Gupta P.K and Manmohan (1980). Operations Research: Sultan Chand & Sons, New Delhi.

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.notesformba.com/subject/business-mathematics
2	https://www.mheducation.com/highered/explore/business-math.html

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills		✓			✓	✓	✓
	3	Critical Thinking	✓	✓		✓		✓	✓
	4	Research related Skills							
	5	Analytical Reasoning		✓		✓			
	6	Problem Solving					✓	✓	✓
	7	Team Work							
	8	Moral and Ethical Awareness						✓	✓
	9	Multicultural Competence						✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours / Week
2021-22 onwards	**I**	**21BBA14A**	**I BBA – Allied I: STATISTICS FOR MANAGEMENT- I**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1.	Discuss the scope and necessity of Statistics
2.	Tabulate and represent the data in Diagrams and Graphs
3.	Identify the nature of data
4.	Choose the suitable measure according to the nature of the observed data
5.	Apply the formula and calculate statistical measures for the observed data in their field
6.	Check the relevance of the measures calculated
7.	Interpret the results of the statistical measures used

Unit – I

Statistics – Definition - Scope and Limitations – Types and Sources of Data – Methods of Collecting Primary Data – Tools for Data Collection - Sources of Secondary Data – Classification and Tabulation of Data. **Graphs -** Histogram - Frequency Curve and Ogives – Finding Median and Mode graphically. **Measures of Central Tendency -** Mean, Median, Mode.

Unit – II

Measures of Dispersion - Meaning - Objectives - Range, Quartile Deviation, Mean Deviation, Standard Deviation and Co-efficient of Variation. The Best Measure among Measures of Dispersion. **Skewness -** Definition – Concept of Symmetry and Skewness - Measures of Skewness – Karl Pearson's Co-efficient of Skewness and Bowley's Co-efficient of Skewness.

Unit – III

Correlation - Definition - Types and Methods of measuring of Correlation - Scatter Diagram - Karl Pearson's Method - Spearman's Rank Method. **Regression -** Definition and Types – Simple Regression only – Construction of Regression Equations – Difference between Correlation and Regression.

Unit – IV

Index Numbers - Definition - types and uses - Weighted and Un-weighted Methods of constructing Price index Numbers – Time Reversal and Factor Reversal Tests. Cost of Living Index Number – Uses - Construction by Family Budget Method – Aggregate Expenditure Method.

Unit – V

Time Series - Concept and Components - Estimation of Trend – Method of Moving Averages - Method of Least squares (Linear only). Estimation of Seasonal Variation – Method of Simple Averages – Ratio-to-Moving Averages Method.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

References:

1.	S.P. Gupta (2012). Statistical Methods, Sultan Chand & Sons, New Delhi, 42nd revised Edition.
2.	Gupta S.C. and Kapoor V.K. (2018). Fundamentals of Mathematical Statistics, Eleventh Edition, Sultan Chand & Sons, New Delhi.

Further Reading:

1.	P. R. Vittal - Business Statistics, Margham Publications, Chennai.
2.	P.A. Navneetham (2008) - Business Mathematics & Statistics, Jai Publishers, Trichy.
3.	Goon A.M., Gupta, M.K. and Das Gupta B. (2013). Fundamentals of Statistics, Vol.1, World Press Private Ltd, Calcutta.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1.	https://nptel.ac.in/courses/111/105/111105041/
2.	https://nptel.ac.in/courses/111/106/111106112

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓			✓	✓	✓	
	2	Communication Skills		✓	✓	✓	✓	✓	
	3	Critical Thinking	✓	✓	✓	✓	✓		✓
	4	Research related Skills			✓	✓		✓	✓
	5	Analytical Reasoning		✓		✓	✓		✓
	6	Problem Solving							
	7	Team Work							
	8	Moral and Ethical Awareness	✓		✓			✓	
	9	Multicultural Competence	✓		✓			✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**II**	**21BGE24A**	**II B.Sc., GEOGRAPHY – Allied II: STATISTICS – II**	**8**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Evaluate the correlation and constructing regression equations by various methods
2	Explain the applications of random and non-random sampling methods
3	Analyze and test the means, proportions using large sample procedure
4	Identify and apply small sample test problems for testing means and variances
5	Evaluate the various applications of Chi square test with relevant examples
6	Demonstrate layout and application of one-way and two-way classifications
7	Identify and apply CRD and RBD with appropriate real-life problems

Unit - I

Correlation – Meaning - Scatter Diagram - Karl Pearson's Co-efficient of Correlation - Spearman's Rank Correlation – Coefficient of Concurrent Deviation - Simple Problems.
Regression – Meaning - Construction of regression equations - Difference between Correlation and Regression – Properties of Regression coefficients - Simple Problems.

Unit - II

Sampling Methods – Advantages and Limitations – Sampling and Non-Sampling Errors – Random Sampling Methods - Simple Random Sampling - Systematic Sampling - Stratified Sampling – Non-Random Sampling Methods (No Derivations, Only Concepts).

Unit – III

Testing of Hypothesis - Sampling Distribution – Standard Error – Tests of Significance – Null and Alternative Hypotheses – Type I and Type II Errors.
Large Sample Tests – Test for Single Mean, Difference of Means, Single Proportion and Difference of Proportions – Simple Problems.

Unit – IV

Small Sample Tests - Student's 't' test – Test for Single Mean - Difference of Means (independent and paired samples) – Chi-Square Test –Test for Independence of Attributes and Goodness of Fit – F- test for Equality of Two Variances.

Unit - V

ANOVA, CRD AND RBD – Assumptions – Layout and analysis of One way and Two way Classifications (No Derivations) – Layout and analysis of Completely Randomized Design (CRD) - Randomized Block Design (RBD) - Simple Problems.

PEDAGOGY STRATEGIES

- Lecturing
- Classroom Discussion
- Questioning
- Seminar
- Assignment
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Gupta, S.C. and Kapoor, V.K. (2017). Fundamentals of Mathematical Statistics, Sultan Chand &Sons, New Delhi, 11th revised Edition.
2	Pannerselvam R (2012). Design and Analysis of Experiments – Prentice Hall of India.

FURTHER READING:

1	Gupta, S.P. (2014). Statistical Methods, Sultan Chand & Sons, New Delhi, 44th Thoroughly Revised Edition.
2	Gupta S.C. and Kapoor V.K. (2019). Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi 4th Thoroughly Revised Edition.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/110/105/110105087/
2	https://nptel.ac.in/courses/102/106/102106051/
3	https://nptel.ac.in/courses/102/101/102101056/
4	https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-mg23/

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓		✓	✓	✓	✓	✓
	3	Critical Thinking	✓	✓	✓	✓	✓	✓	✓
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning	✓		✓	✓	✓	✓	✓
	6	Problem Solving	✓		✓	✓	✓	✓	✓
	7	Team Work	✓		✓	✓	✓	✓	
	8	Moral and Ethical Awareness	✓		✓	✓	✓	✓	✓
	9	Multicultural Competence	✓		✓	✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**II**	**21BIT24A**	**II BSc., (IT) - Allied II: COMPUTER ORIENTED NUMERICAL & STATISTICAL METHODS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Apply numerical methods to solve system of simultaneous equations and analyze and evaluate the accuracy of common numerical methods
2	Solve Numerical Differentiation and Central difference problems using Newton Forward Difference and Backward Difference
3	Solve Numerical Integration and differentiation problems using Newton Forward Difference and Backward Difference, Trapezoidal Rule, Simpson Rule 1/3 rd , 3/8 th rules and Weddle's rule
4	Calculate and apply measures of central tendency and measures of dispersion – grouped data cases
5	Calculate and apply measures of central tendency and measures of dispersion –ungrouped data cases
6	Compute and interpret the results of Skewness and Correlation Analysis
7	Demonstrates and understands Linear Regression and Curve fitting

Unit - I

Numerical Methods - System of Simultaneous Equations - Gauss Elimination- Gauss Seidal Methods – Interpolation - Newton's Forward and Backward Interpolation Formula - Lagrange's Interpolation - Central difference interpolation formulae: Gauss forward and backward formula - (No Derivations) Simple Problems Only.

Unit - II

Numerical Differentiation - Newton Forward Difference - Newton Backward Difference - Numerical Integration - Trapezoidal Rule - Simpson's 1/3 rd Rule - Simpson's 3/8 th Rule and Weddle's Rule (No Derivations) - Simple Problems Only.

Unit – III

Measures of Central Tendency – Mean -Median and Mode - Relationship among Mean, Median and Mode – Uses - Merits and Demerits

Measures of Dispersion - Range - Quartile Deviation - Mean Deviation - Standard Deviation and Coefficient of Variation.

Unit – IV

Skewness and Kurtosis - Meaning - Bowley's and Karl Pearson's Coefficient of Skewness -

Concept of Kurtosis.
Correlation - Definition - Scatter Diagram - Types of Correlation - Karl Pearson Correlation Coefficient – Spearman's Rank Correlation Coefficient.

Unit - V

Regression Analysis - Definition - Regression Equations for Two Variables - Regression Coefficients - Properties - Curve Fitting - Linear - Simple Problems.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	P. Kandasamy, K. Thilagavathy and K. Gunavathi - Numerical Methods, S. Chand & Company Ltd, New Delhi.
2	S.C. Gupta and V.K. Kapoor (2012). Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 11th revised Edition.

FURTHER READING:

1	E. Balagurusamy - Numerical Methods, Tata MC Grawhill Pvt ltd.
2	S.P. Gupta (2012). Statistical Methods, Sultan Chand & Sons, New Delhi, 42nd revised Edition.
3	R.S.N. Pillai and V. Bagavathi (1999). Statistics – Theory and Practice, S. Chand & Sons Company Ltd, New Delhi.

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1	**https://www.classcentral.com/course/intro-to-numerical-analysis-13684**
2	**https://nptel.ac.in/courses/111/105/111105041/**
3	**https://nptel.ac.in/courses/111/106/111106112/**

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓			✓		✓	✓
	3	Critical Thinking	✓			✓		✓	
	4	Research related Skills				✓	✓	✓	✓
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work	✓	✓	✓			✓	✓
	8	Moral and Ethical Awareness		✓	✓	✓	✓	✓	
	9	Multicultural Competence				✓	✓	✓	

Year	Sem.	Subject Code	Title of the Paper	Hours / Week
2021-22 onwards	**II**	**21BBA24A**	**II BBA – Allied II: STATISTICS FOR MANAGEMENT- II**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1.	Explain the scope and necessity of Operations Research
2.	Identify the nature of data observed
3.	Discuss the various techniques available in OR
4.	Choose the suitable Technique according to the nature of the observed data
5.	Apply the formula and arrive the relevant results related to the observed data in their field
6.	Validate the relevance of the technique applied
7.	Interpret the results arrived using the OR techniques

Unit – I

Operations Research – Introduction – Meaning – Scope**. Linear Programming Problem** – Definition – Assumptions – General Form – Advantages and Limitations of LPP – Mathematical Formulation – Graphical Method.

Unit – II

Transportation Problem – Definition – Balanced and Unbalanced Problems – Initial Basic Feasible Solution (IBFS) – Methods of Finding IBFS – North-West Corner Rule – Least Cost Method and Vogel's Approximation Method (VAM).

Assignment Problem – Definition – Hungarian Method of Solving – Simple Problems.

Unit – III

Game Theory – Concept and Definition of a Game – Pure and Mixed Strategies – Saddle Point – Value of a Game – Algebraic Method – Dominance Rule.

Queuing Theory – Concept – Uses – Queuing System – Characteristics of a Queuing System – (M/M/1):(∞/FIFO) Model – Simple Problems.

Unit – IV

Network Analysis – Basic Concepts – Rules of Network Construction – Types of Floats – Earliest Start Time – Earliest Finish Time – Latest Start Time – Latest Finish Time – Duration of Critical Path – Critical Path Method – PERT Method – Probability Considerations.

Unit – V

Replacement Problem – Definition – Concept and Types of Replacement – Replacement of items that Deteriorates Gradually – Replacement of items that Fails Suddenly – Simple Problems.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

References:

1.	Kanti Swarup, Gupta P.K. and Man Mohan. (2017). Operations Research, Nineteenth Edition, Sultan Chand & Sons, New Delhi.
2.	V. Sundaresan, K.S. Ganapathy Subramanian and K. Ganesan (2000). Resource Management Techniques, A.R. Publications, Tamil Nadu.

Further Reading:

1.	J.K. Sharma (2007). Operations Research -Theory & Applications, Macmillan India Ltd, Third Edition.
2.	Sharma S. D. (2017). Operations Research: Theory, Methods and Applications, Kedar Nath, Ram Nath and Co, Meerut.
3.	Taha H. A. (1982). Operations Research: An Introduction, Third Edition, McMillan Publishing Co., Inc., London.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1.	https://nptel.ac.in/courses/111/107/111107128/
2.	https://nptel.ac.in/courses/112/106/112106134/
3.	https://onlinecourses.swayam2.ac.in/cec20_ma10/preview

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	
	2	Communication Skills	✓	✓	✓	✓	✓	✓	
	3	Critical Thinking			✓	✓	✓	✓	
	4	Research related Skills	✓	✓				✓	✓
	5	Analytical Reasoning			✓	✓	✓	✓	✓
	6	Problem Solving			✓	✓	✓	✓	✓
	7	Team Work	✓	✓		✓	✓	✓	✓
	8	Moral and Ethical Awareness	✓	✓				✓	✓
	9	Multicultural Competence	✓	✓				✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 Onwards	**III**	**21BPS34A**	**II B.Sc., Psychology –Allied III: STATISTICS – I**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1	Discuss the importance of Statistics and Scope in Psychology
2	Draw Diagrams, Graphs and compute averages for the collected data
3	Calculate the Measures of Dispersion and Skewness
4	Explain the concept of Correlation and its practical applications
5	Describe the theorems in probability, compute and solve the problems in probability
6	Analyze the nature of data and interpret the measures
7	Describe the concepts of probability and find solutions in real life situations

UNIT - I

Statistics - Definition - Scope – limitations - uses - Importance of Statistics in Psychology - Collection of Data - Primary and Secondary - Classification and Tabulation - Formation of Frequency Distribution.

UNIT - II

Diagrammatic and Graphical Representation - Simple, Multiple, Sub-Divided, Percentage Bar Diagrams and Pie Diagram - Histogram, Frequency Polygon, Frequency Curve and Ogives.
Measures of Central Tendency - Mean, Median, Mode, Geometric Mean and Harmonic Mean.

UNIT - III

Measures of Dispersion – Range, Quartile Deviation, Mean Deviation (about Mean), Standard Deviation and Co-efficient of Variation – Concept of Skewness – Karl Pearson's and Bowley's Coefficient of Skewness – Simple Problems

UNIT - IV

Correlation – Definition, Types of correlation, Scatter Diagram –Measures of Correlations Karl-Pearson's Coefficient of Correlation – Spearman's Rank Correlation.
Regression Analysis - Definition – Properties of Regression Coefficients – Simple Problems.

UNIT - V

Probability - Concept of Probability – Basic Definitions – Mathematical and Statistical Approach – Addition and Multiplication Theorems of Probability (Without Proof) – Simple Problems.

- **PEDAGOGY STRATERGIES:**
- Lecturing
- Assignment
- Classroom Discussion

• Questioning • Seminar • Class Test • Quiz & Drill Practice • Providing Feedback	
REFERENCES:	
1	R.S.N. Pillai and V. Bagavathi (1999). Statistics – Sultan Chand & Sons Company Ltd, New Delhi.
2	S.P. Gupta (2012). Statistical Methods, Sultan Chand & Sons, New Delhi, 42nd revised Edition.
3	J.P. Verma and Mohammed Ghufran. Statistics for Psychology, Tata Mcgraw Hill Education (P) Ltd. New Delhi.
FURTHER READING:	
1	Henry E. Garrett (2007). Statistics in Psychology and Education, Paragon International Publishers, Twelfth Indian Reprint.
RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	http://cs.ioc.ee/ITKStat/files/1_intro.
2	https://labs.la.utexas.edu/gilden/files/2016/05/Statistics
3	https://numerons.files.wordpress.com/2012/04/research-methods-and-statistics-in-psychology

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	**2**	**3**	**4**	**5**	**6**	**7**
Program Level Outcomes (PLO)	**1**	**Disciplinary Knowledge**	✓	✓	✓	✓	✓	✓	✓
	2	**Communication Skills**	✓	✓	✓	✓	✓	✓	✓
	3	**Critical Thinking**				✓	✓	✓	✓
	4	**Research related Skills**	✓	✓	✓	✓	✓	✓	✓
	5	**Analytical Reasoning**	✓	✓	✓	✓	✓	✓	✓
	6	**Problem Solving**	✓	✓	✓	✓	✓	✓	✓
	7	**Team Work**			✓	✓	✓	✓	✓
	8	**Moral and Ethical Awareness**			✓	✓	✓	✓	
	9	**Multicultural Competence**			✓	✓	✓	✓	

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**III**	**21BCA34A**	**II BCom (CA) - Allied III : STATISTICS FOR BUSINESS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Deal with numerical and quantitative issues in business
2	Enable the use of statistical, graphical and algebraic techniques wherever relevant
3	Produce numerical descriptive statistics for different types of data
4	Use simple correlation and simple regression models to analyse the underlying relationships between the variables
5	Apply index number rules and construct index number relating to Weighted and Un-weighted Methods answer questions within a business context
6	Demonstrate knowledge of the importance of the tests of index number and its applications
7	Conduct and interpret a variety time series method to aid decision making in a business context

Unit - I

Introduction to Statistics: Meaning and Definition - Importance / Scope of Statistics / Application of Statistics in various fields In States of Statistics – Functions and Limitations of Statistics - Primary and Secondary Data - Sources of Data – Methods of Collecting Data – Sampling methods - Classification and Tabulation of Data – Diagrammatic Representation - Bar Diagrams – Pie Diagram – Graphical Representation - Histogram – Frequency Curve and Ogives.

Unit - II

Measures of Central Tendency: Meaning – Definition - Merits and Demerits of Mean – Median - Mode - Geometric Mean - Harmonic Mean – Its Measures – Simple Problems..

Measures of Dispersion: Meaning - Definition - Merits and Demerits of Range- Quartile Deviation- Mean Deviation- Standard Deviation – Its measures and their coefficients – Simple Problems.

Unit – III

Correlation and Regression: Meaning – Definition - Types and uses of Correlation – Scatter diagram –Method of Studying correlation - Karl Pearson's Co-efficient of Correlation - Spearman's Rank Correlation – Meaning and uses of Regression – Construction of Regression Equations – Difference between Correlation and Regression – Simple Problems.

Unit – IV

Index Numbers: Concept – Definition - Uses and Characteristic of Index Numbers – Methods of

construction of Index number– Weighted and Un-weighted Methods –Time Reversal and Factor Reversal Tests - Cost of Living Index Number - Construction using Family Budget Method – Aggregate Expenditure Method.

Unit - V

Time Series Analysis: Time Series – Concept and Components – Estimation of Trend: Methods of Moving Averages - Method of Least squares (Linear only). Measurement of Seasonal Variation: Method of Simple Averages – Ratio-to-Moving Averages Method.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing feedback

REFERENCES:

1	Gupta S.P. (2012). Statistical Methods, Sultan Chand & Sons, New Delhi.
2	Goon A.M., Gupta M.K., and Das Gupta B. (2013). Fundamentals of Statistics, Vol.1, World Press Private Ltd, Calcutta.

FURTHER READING:

1	Vittal P.R. (2012). Business Mathematics and Statistics, Margham Publications, Chennai.
2	Navneetham P.A, (2008). Business Mathematics & Statistics, Jai Publishers, Trichy.
3	Aczel A.D. et al., (2012). Complete Business Statistics, Tata McGraw Hill Education Private Limited, New Delhi.

RELATED ONLINE CONTENTS

1	https://nptel.ac.in/courses/111/105/111105041/
2	https://nptel.ac.in/courses/111/106/111106112/
3	www.edx.org › learn › statistics

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
			1	2	3	4	5	6	7
Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓		✓		✓	✓
	3	Critical Thinking			✓	✓	✓		✓
	4	Research related Skills			✓	✓	✓	✓	✓
	5	Analytical Reasoning	✓	✓	✓	✓	✓	✓	✓
	6	Problem Solving	✓	✓	✓	✓	✓	✓	✓
	7	Team Work		✓	✓		✓		✓
	8	Moral and Ethical Awareness			✓	✓	✓		✓
	9	Multicultural Competence			✓	✓	✓		✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021 – 2022 Onwards	**IV**	**21BPS44A**	**II B.Sc., Psychology – Allied IV : STATISTICS – II**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, student will be able to:

1	Discuss the importance of Discrete and Continuous distributions
2	Explain the methods of sampling with its Advantages and Disadvantages
3	Apply the Small sample tests, Chi-Square test and Association of Attributes in Psychological testing problems
4	Explain the types of Measurement and scaling techniques
5	Describe Non-Parametric tests based on one sample and two sample tests
6	Compute the parameters of Discrete and Continuous distributions
7	Analyze the different types of data in Statistical Inference

UNIT - I

Probability Distribution – Binomial, Poisson and Normal Distributions – Definitions, Properties and Applications (without Proof) – Simple Problems.

UNIT - II

Sampling Methods – Advantages and Disadvantages – Simple Random Sampling – Stratified Random Sampling – Systematic Sampling – (Concept Only) – Sampling Distribution – Standard Error.

Tests of Significance – Types of Errors - LOS – Large Sample Tests for Single Mean and Two Means. Tests for single proportion and difference of two proportions.

UNIT - III

Small Sample Tests – Test for Single Mean and Two Means – Paired 't' Test. Chi-Square Test - Independence of Attributes- Goodness of fit – Contingency Tables – Theory of Association of Attributes – Yule's Coefficient of Association

UNIT - IV

Measurement and Scaling techniques- Categorical Variables - Data Types - Metric, Interval and Ratio data. Non-Metric data- Nominal, ordinal data. Scales of measurement -Comparative scale, paired Comparison scale, rank order scale, constant sum scale, Non-comparative scale- continuous rating scale, Itemized rating scale - Likert scale, Guttmann scale

UNIT - V

Non – Parametric Tests– Introduction, Definition, advantages and disadvantages. Run test, Sign test, Median test, Mann-Whitney U test (one sample only) Kolmogorov - Smirnov test (two samples).

PEDAGOGY STRATERGIES:

- Lecturing
- Assignment
- Classroom Discussion
- Questioning
- Seminar
- Class Test
- Quiz & Drill Practice
- Providing Feedback

REFERENCES:

1	R.S.N. Pillai and V. Bagavathi (1999). Statistics – Theory and Practice, S. Chand & Sons Company Ltd, New Delhi.
2	S.C. Gupta and V.K. Kapoor(2012). Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi, 11th revised Edition.
3	J.P Verma and Mohammed Ghufran. Statistics for Psychology, Tata Mcgraw Hill Education (P)Ltd. New Delhi.

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1	Henry E. Garrett (2007). Statistics in Psychology and Education, Paragon International Publishers, Twelfth Indian Reprint.
2	Hogg, R.V and Craig, A.G. Introduction to Mathematical Statistics

RELATED ONLINE CONTENTS [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.google.com/search?q=probability+distribution+ppt&rlz
2	https://math.ucdenver.edu/~ssantori/MATH2830SP13/Math2830-Chapter-08
3	https://www.cse.iitk.ac.in/users/nsrivast/HCC/lec07-09.pdf
4	http://www2.univet.hu/users/jfodor/biomath/Biomath12

COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

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Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓	✓	✓	✓
	3	Critical Thinking	✓		✓	✓	✓		
	4	Research related Skills	✓	✓	✓	✓	✓	✓	✓
	5	Analytical Reasoning	✓		✓	✓		✓	✓
	6	Problem Solving	✓		✓	✓	✓	✓	✓
	7	Team Work	✓		✓	✓	✓		
	8	Moral and Ethical Awareness					✓	✓	✓
	9	Multicultural Competence				✓	✓	✓	✓

Year	Sem.	Subject Code	Title of the Paper	Hours/ Week
2021-2022 onwards	**IV**	**21BCO44A/ 21BIB44A**	**II BCOM & II BCOM (IB) - Allied IV: BUSINESS STATISTICS**	**6**

COURSE LEVEL OUTCOMES:

On the successful completion of the course, students will be able to:

1	Differentiate numerical and quantitative issues in business
2	Use the statistical, graphical and algebraic techniques wherever relevant
3	Create numerical descriptive statistics for different types of data
4	Use simple correlation and regression to analyse the relationships between the variables
5	Apply index number rules and construct index number relating to Weighted and Un-weighted methods
6	Demonstrate the importance and applications of the tests of index numbers
7	Conduct and interpret the variety of time series methods in decision making problems

Unit - I

Introduction to Statistics: Meaning and Definition - Importance / Scope of Statistics / Application of Statistics in various fields In States of Statistics – Functions and Limitations of Statistics - Primary and Secondary Data - Sources of Data – Methods of Collecting Data – Sampling methods - Classification and Tabulation of Data – Diagrammatic Representation - Bar Diagrams – Pie Diagram – Graphical Representation - Histogram – Fequency Curve and Ogives.

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Unit – III

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Unit – IV

Index Numbers: Concept – Definition - Uses and Characteristic of Index Numbers – Methods of construction of Index number– Weighted and Un-weighted Methods –Time Reversal and Factor Reversal Tests - Cost of Living Index Number - Construction using Family Budget Method – Aggregate Expenditure Method.

Unit - V

Time Series Analysis: Time Series – Concept and Components – Estimation of Trend: Methods of Moving Averages - Method of Least squares (Linear only). Measurement of Seasonal Variation: Method of Simple Averages – Ratio-to-Moving Averages Method.

PEDAGOGY STRATEGIES

- Lecturing
- Assignment
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COURSE LEVEL MAPPING OF PROGRAM LEVEL OUTCOMES

			Course Level Outcomes (CLO)						
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Program Level Outcomes (PLO)	1	Disciplinary Knowledge	✓	✓	✓	✓	✓	✓	✓
	2	Communication Skills	✓	✓	✓	✓			✓
	3	Critical Thinking			✓	✓	✓		
	4	Research related Skills			✓	✓	✓	✓	✓
	5	Analytical Reasoning			✓	✓	✓	✓	✓
	6	Problem Solving			✓	✓	✓	✓	✓
	7	Team Work			✓	✓	✓	✓	✓
	8	Moral and Ethical Awareness					✓	✓	✓
	9	Multicultural Competence			✓	✓	✓		

7. Teaching Learning Processes

The teaching learning processes play the most important role in achieving the desired aims and objectives of the undergraduate programs in Statistics as elaborated in detail in the Learning Based Curriculum Framework (LOCF). Statistics is the science which deals with data collection, analysis and interpretation of numerical data. While such ideas and concepts originate in the minds of the genius, anywhere and anytime in the universe, their verifications and confirmations have to be done in the data analysis. To achieve this goal, the appropriate training of young individuals to become competent statisticians in future has to be accomplished. For this purpose, a very good undergraduate program in Statistics is the first step. We should therefore have an excellent teaching-learning procedural protocol for all the colleges, universities and other Higher Education Institutions (HEI). To be specific, it is desirable to have:

- Necessary and sufficient infrastructural facilities for the class rooms, laboratories and libraries equipped with adequate modern and modular furniture and other requirements.
- Modern and updated computer laboratory equipment are needed for the undergraduate programme.
- Recent reference and text books for the libraries are to be updated
- Sufficient infrastructure for ICT and other facilities needed for technology-enabled learning like computer facilities, PCs, laptops, Wi-Fi and internet facilities with all the necessary software.
- Sufficient number of teachers in permanent position to do all the class room teaching and perform and supervise the computer laboratory experiments to be done by the students.
- All the teachers should be qualified as per the UGC norms and should have good communication skills.
- Sufficient number of technical and other support staff to run the laboratories, libraries, equipment and maintain the infrastructural facilities like buildings, electricity, sanitation, cleanliness etc.
- Teachers should make use of all the approaches for an efficient teaching-learning process i.e.,

(i) Class room teachings with lectures using traditional as well as electronic boards,

ii) Use of smart class rooms for simulation and demonstration for conveying the difficult concepts and tools of Statistics in class room teaching and laboratories,

(iii) Tutorials must be an integral part of all the theory and laboratory courses. Theory courses should have 1-2 tutorials every week depending upon the nature of the course,

(iv) Teaching should be complimented with student's seminar to be organized very frequently,

(v) Guest lectures and seminars/workshops should be arranged by eminent teachers to be invited by the concerned college/university/HEI,

vi) Open-ended project work should be given to all students individually or in group to 2-3 students depending upon the nature of the course,

(vii) Special attempts should be made by the institution to develop problem-solving skills and design of Statistics projects for demonstration at the UG level. For this purpose, a mentor system may be evolved where 3-4 students may be assigned to each faculty member,

(viii) Teaching load should be managed such that the teacher has enough time to interact with the students to encourage an interactive/participative learning.

8. Assessment Methods

In the undergraduate education of Statistics leading to the B.Sc. Statistics degree, the assessment and evaluation methods focus on testing the conceptual understanding of the basic ideas, development of mathematical skills and experimental techniques retention and ability to apply the knowledge acquired to explain with analysis and reason what has been learnt and to solve new problems and communicate the results and findings effectively. Since the learning objectives are defined clearly for each course in detail, it is easier to design methods to monitor the progress in achieving the learning objectives during the course and test the level of achievement at the end of the course.

- The courses offered in the undergraduate Statistics are the first courses at the college/university level, the priority should be given to Formative Assessment for monitoring the progress towards achieving the Learning Objectives while keeping its weightages lower than Summative Assessments. This is to assure that the students know their strengths and weaknesses periodically through the results of Formative Assessments and make amends for the gaps in their knowledge without affecting their final grades in any significant way. In this context it is suggested that 25-30% weightage be given Formative Assessments in case of theory components while 30-40% weightage be given to the Laboratory/Field work/Projects/Case Study/Dissertation components of the various courses. Moreover, use of more than one method of Assessment in each course is highly recommended.
- Some of the methods suggested for Theory Component with regard to Formative Assessment are i) Regular Tutorial assignments ii) Seminar presentations
  iii) Performance in group discussions iv) Problem based longer assignments (other than tutorials) v) True/False Tests vi) Multiple Choice Tests vii) Short Answer Tests
  viii) viva-voce tests ix) Any other innovative tests in the context of the course.
- In the case of substantive Summative Assessment for the theory papers, can be a combination of the following i) Mid-Semester test ii) Seminar Report iii) Individual /Team Project report iv) Oral Presentations of Seminar/Projects v) Viva -Voce Examination on the above reports.

- End Semester closed book examination in the pattern of a) Multiple Choice b) Short Answer c) Long Answer. End Semester Open Book Examination in the form of a) Peer review by a group of experts by written and oral examinations, b) Any other innovative method depending upon the nature of the course.
- B. Laboratory Experiments / Field work / Projects / Case Study / Dissertation can be assessed for Formative Assessment through i) Regular evaluation of Lab. experiments regarding written report of each experiment and Viva-Voce on each experiment, ii) Mid semester examination.
- At the end, the main purpose of Statistics teaching should be to impart objective knowledge to students in concrete, comprehensive and effective way. Here, effectiveness implies gaining knowledge and skill which can be applied to solve practical problems as well as attaining capability of logical thinking and imagination which are conducive to new knowledge and new discoveries. The student shall embrace the curriculum in a way which would incite imagination and imbibe a spirit of enquiry in them, so that in future they will opt for further investigations or research. Needless to say, there should be a continuous evaluation system for the students. This will enable the teachers not only to ascertain the overall progress of learning by the students, but also to identify the students who are slow learner and for whom special care should be taken. An appropriate grading system is the 'relative grading system' can also be envisaged for certain papers, introducing a competitive element among the students. All in all, the teacher should act as a facilitator and guide and not as a guardian of curriculum.
- HEIs can design their own ways and methods to quantify the assessment and evaluation based on the above methods. It would then be converted to the letter grades by the procedure described by the template given by the UGC.
- Once the letter grade for a course is obtained for a course, it should be done for all the courses offered by the student. Once the letter grades for all the courses are accumulated, then a CGPA should be calculated by quantifying the letter grades as described by the template provided by the UGC.

MODEL QUESTION PAPER

GOVERNMENT ARTS COLLEGE (AUTONOMOUS) COIMBATORE -18.

End Semester Examination November - 2021
I Semester - I B.Sc., Statistics: DESCRIPTIVE STATISTICS

Duration : 3hours Max. Marks:50

PART – A
Answer All the Questions

I Choose the best answer **(5x1 =5 Marks)**

1. The process of arranging data into rows and columns is called
   (a) Frequency distribution
   (b) Classification
   (c) Tabulation
   (d) Array
2. Find the median of the following data: 180,160,300,400,200,320,280
   (a) 160
   (b) 300
   (c) 180
   (d) 280
3. What is the range of the following data set?
   14, 23, 9, 12, 21, 18, 8
   (a) 9 to 21
   (b) 10.5
   (c) 15
   (d) 14
4. A correlation coefficient of 1 indicates
   (a) The absence of any correlation
   (b) A perfect correlation
   (c) A relatively small degree of correlation
   (d) A relatively high degree of correlation
5. In the regression equation Y=21-3X, the slope is

(a) 21

(b) -21

(c) 3

(d) -3

II Answer any Three questions (3x2=6 Marks)

6. What is meant by Primary data?

7. Write any two relative measures of Skewness.

8. What is Dispersion?

9. List of different types of correlation.

10. Define Regression

PART - B (5 x 3 =15 Marks)

Answer All the Questions

11(a) Write short notes on secondary data.

(or)

(b) Explain the methods of classification of data.

12. (a) Discuss the merits and demerits of mode.

(or)

(b) A contractor employs 20 males, 15 females and 3 children. He pays to a male worker Rs.40 per day, to a female worker Rs.32 per day and to a child worker Rs 15 per day. What is the average wage per day paid by the contractor.

13. (a) What are the measures of dispersion? Explain.

(or)

(b) From a moderately skewed distribution of retail prices for men's shoes, it is found that the mean price is Rs.20 and the median price is Rs.17. If the co-efficient of variation is 20%, find the Pearson's co-efficient of Skewness.

14. (a) Draw a scatter diagram for

(i) No correlation

(ii) Perfect positive correlation

(iii) Perfect Negative correlation

(or)

(b) If the co-variance between X and Y variables is 10 and the variance of X and the variance of Y are 16 and 9 respectively, find the co-efficient of correlation.

15.(a) Mention the properties of regression co-efficients.

(or)

(b) Comment on the following

(i) $b_{xy} = 2.8$ and $b_{yx} = -0.3$

(ii) $b_{xy} = -0.8$, $b_{yx} = -1.2$ and $r_{xy} = 0.92$

PART C (3 x 8 = 24 Marks)

Answer Any Three Questions

16. Explain in detail about the various parts of table.

17. Solve the following problem to find mean, median and mode

Class Interval :	10-20	20-30	30-40	40-50	50-60
Frequency :	4	6	10	7	3

18. The scores of two batsmen A and B in six innings during a certain season are

A :	32	28	47	63	71	39
B:	19	31	48	53	67	90

Find which of the two batsmen A or B is more consistent in scoring.

19. Evaluate the rank correlation co-efficient of X and Y from the following data

X:	50	55	65	50	55	60	50	65	70	75
Y:	110	110	115	125	140	115	130	120	115	160

20. Distinguish between correlation and regression.

END