Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B060101T/MT230	**Title of the Course**	Theory of Estimation & Sampling Survey	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**4**	**0**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	To introduce the knowledge of estimating the unknown parameters of population and various sampling techniques for obtaining samples from the population						

Course Outcomes	
CO1	Knowledge of the concept of Sampling distributions.
CO2	Ability to understand the difference between parameter & statistic and standard error & standard deviation.
CO3	Knowledge of the sampling distribution of the sum and mean & the concept of Point and Interval Estimation and discuss characteristics of a good estimator. Ability to understand the t, F and chi-square distribution and to identify the main characteristics of these distributions.
CO4	Ability to understand and practice various methods of estimations of parameters & identify the situations where the various sampling techniques shall be used. Knowledge of various probability and non-probability sampling methods along with estimates of population parameters.
CO5	Knowledge of regression and ratio methods of estimation in simple random sampling.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Introduction to Sampling Distribution	Sampling Distributions: The concept of sampling distribution, Parameter, Statistic and Standard error. The sampling distribution for the sum of independent random variables of Binomial, Poisson and Normal distribution.	7	1
2	Some Sampling Distributions	Central limit theorem, sampling distribution of Z. Sampling distribution of t, F and chi-square without derivations, Simple properties of these distributions and their interrelationship	8	2
3	Point and Interval estimation	Point estimation: Characteristics of a good estimator: Unbiasedness, consistency, sufficiency and efficiency. Problems and examples, Interval estimation.	8	3
4	Estimation Methods	Method of Maximum Likelihood and properties of maximum likelihood estimators (without proof), Method of minimum Chi-square. Method of least squares and methods of moments for estimation of parameters	7	3
5	Introduction to Sampling techniques	Sampling vs. Complete enumeration: Sampling units and Sampling frame, Precision and efficiency of estimators, sampling and non sampling errors, Simple Random sampling with and without replacement, Estimation of population mean and proportion, Derivation of expression for variance of these estimators, Estimation of variances, Sample size determination.	6	4
6	Stratified random sampling	Stratified random sampling, Problem of allocation, proportional allocation, optimum allocation. Derivation of the expressions for the standard error of the usual estimators when these allocations are used, Gain in precision due to Stratification, Role of sampling cost in the sample allocation, Minimization of variance for fixed cost.	8	4
7	Systematic random sampling	Systematic Sampling: Estimation of Population mean and Population total, standard errors of these estimators. Two stage sampling with equal first stage units: Estimation of Population mean and its variance	8	4
8	Regression and ratio methods	Regression and ratio methods of estimation in simple random sampling, Cluster sampling with equal clusters, Estimators of population mean and their mean square errors.	8	5

Reference Books:

1. Ferund J.E (2001) : Mathematical Statistics, Prentice Hall of India.
2. Goon, A.M., Gupta, M.K. & Dasgupta, B.: Fundamentals of Statistics, Vol. I. ,Kolkata, The World Press.
3. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics (10^{th} ed.),Sultan Chand and Sons.
4. Hogg, R.V., McKean, J.W. & Craig, A.T: Introduction to Mathematical Statistics, Pearson.
5. Cochran, W.G.: Sampling Techniques. (Third Edition). John Wiley & Sons, New Delhi
6. DesRaj and Chandhok, P. (1998). Sample Survey Theory, Narosa Publishing house.
7. Mukhopadyay, P.: Survey Sampling. Narosa Publisher, New Delhi.
8. Singh, D. and Choudhary, F.S. (1977). Theory and Analysis of Sample Survey Designs.Wiley Eastern Ltd, New Delhi.

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS

www.simplilearn.com

www.qualtrics.com

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO4
CO1	3						3	3	2	3	2	3
CO2	3						1	3	3	2	2	3
CO3	3						3	3	3	3	2	2
CO4	3						1	3	2	2	3	3
CO5	3						1	3	3	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B030301T/ MT228	**Title of the Course**	Algebra & Mathematical Methods	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	**6**	**0**	**0**	**6**
Pre-Requisite	Knowledge of Sets, Relations and Integrations	**Co-requisite**	None				
Course Objectives	The objective of the course is to develop the skills to apply the basic knowledge of Abstract Algebra, Integral Transform and Fourier Series. The course will further develop understanding the concepts of Jacobians, Functionals and their applications. The topics introduced will serve as basic tools for specialized studies in science field. After successfully completion of course, the student will able to explore subject knowledge into their respective dimensions.						

Course Outcomes

CO1	Students will be able to explain the fundamental concept of Group and its well behaved subsets.
CO2	Students will be able to describe fundamental properties of Ring, Integral Domain and their properties.
CO3	Students will be able to learn function of two variables, Jacobians and their related properties which enable them to check the validity of different kind of transformation from one co-ordinate system to other.
CO4	Develop an understanding of Laplace Transforms, Fourier Series and its applications.
CO5	Students will be able to understand functional, strong and weak variations and their applications.

Unit No.	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
I	Equivalence relations and partitions, Congruence modulo n, Definition of a group with examples and simple properties, Subgroups, Generators of a group, Cyclic groups.	**12**	1
II	Permutation groups, Even and odd permutations, The alternating group, Cayley's theorem, Direct products, Coset decomposition, Lagrange's theorem and its consequences, Fermat and Euler theorems.	**11**	1
III	Normal subgroups, Quotient groups, Homomorphism and isomorphism, Fundamental theorem of group homomorphism, Theorems on isomorphism.	**11**	1
IV	Rings, Subrings, Integral domains and fields, Characteristic of a ring, Ideal and quotient rings, Ring homomorphism, Field of quotient of an integral domain.	**11**	2
V	Limit and Continuity of functions of two variables, Differentiation of function of two variables, Necessary and sufficient condition for differentiability of functions two variables, Schwarz's and Young theorem, Taylor's theorem for functions of two variables with examples, Maxima and minima for functions of two variables, Lagrange multiplier method, Jacobians.	**12**	3
VI	Existence theorems for Laplace transforms, Linearity of Laplace transform and their properties, Laplace transform of the derivatives and integrals of a function, Convolution theorem, inverse Laplace transforms, Solution of the differential equations using Laplace transforms.	**11**	4
VII	Fourier series, Fourier expansion of piecewise monotonic functions, Half and full range expansions, Fourier transforms (finite and infinite), Fourier integral.	**11**	4
VIII	Calculus of variations-Variational problems with fixed boundaries- Euler's equation for functionals containing first order derivative and one independent variable, Extremals, Functionals dependent on higher order derivatives, Functionals dependent on more than one independent variable, Variational problems in parametric form.	**11**	5

Reference Books: Part-A

1. J.B. Fraleigh, A first course in Abstract Algebra, Addison-weley.
2. I. N. Herstein, Topics in Algebra, John Wiley & Sons.
3. Suggested digital plateform: NPTEL/SWAYAM/MOOCS.

Reference Books: Part-B

1. T.M. Apostal, Mathematical Analysis, Person.
2. G.F. Simmons, Differential Equations with Application and Historical Notes, Tata -McGrawHill
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
4. Suggested digital plateform:NPTEL/SWAYAM/MOOCs

Course Articulation Matrix: (Mapping of COs with POs and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	1	1	-	1	1	2	3	2	3	2	3
CO2	1	-	-	-	-	1	3	2	1	1	2	2
CO3	2	-	1	1	-	-	2	1	3	2	3	1
CO4	2	-	-	-	-	-	1	2	1	1	1	1
CO5	3	1	1	1	-	2	3	2	2	2	1	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

IntegralUniversity,Lucknow

Effective from Session: 2023-24							
Course Code	I030302V/MT234	**Title of the Course**	Introduction to R	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Third	2	0	2	3
Pre-Requisite	Basic usage of a Windows PC or a Mac	**Co-requisite**					
Course Objectives	To make the students understand the basic concept and application of R software used for statistical analysis and better computing abilities.						

Course Outcomes	
CO1	Students will be able to understand the Introduction to R-language and using different operator in R.
CO2	Students will be able to understand the naming an object in R, creating and operating different functions in R
CO3	Students will be able to understand the character vectors, matrices, arrays, data frame and programming fundamentals in R
CO4	Students will be able to understand graphics in R
CO5	Students will be able to understand the descriptive statistics and summary of the data.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Introduction to R-Language, What is R?, Creating a Vector in R-c(), Arithmetic Operations on Vectors , Concept of Recycling	8	1
2	Data Entry	Naming an Object in R, The Functions; Seq() and Rep(),Logical Operators- TRUE(1), FALSE(0), Missing Values- NA	7	2
3	Character Vector	Character Vector- "," and Paste Function, Factor Vector and Ordering of Vectors, Matrices and Arrays.	7	3
4	Programming Fundamentals	Data Frame, Creating functions in R. Programming Fundamentals: Logical operators, conditional statements (if, else, else if statements in R), While loops, For loops, repeat loops.	8	3
5	Graphics	Graphics with R, Dot Chart, Pie Chart, Histogram (Hist()), Scatter Plot (Plot()) and Curve().	8	4
6	Descriptive Statistics	Obtaining Descriptive Statistics from R, Defining New Functions, Defining a Function for Standard Error of Mean, Descriptive Statistics of a Data Vector-describe(), Extension of describe() function for Data Frame	7	5

Reference Books:

1. Sandeep Rakshit, R for Beginner's, McGraw Hill Education-2017
2. Tilman M. Davies: The book of R, A first course in programming in Statistics, William Pollock, No starch Press, Inc
3. Gareth James, An Introduction to Statistical Learning with Application of R, Springer. 2022
4. Mark Gardener, Beginning R: The Statistical Programming Language, Wiley.
5. S. G. Purohit, Statistics Using R, Second Edition, Narosa.

e-Learning Source:

1. https://nptel.ac.in/courses/111104146
2. https://www.digimat.in/nptel/courses/video/111104100/L01.html
3. https://nptel.ac.in/courses/111104147
4. https://www.youtube.com/watch?v=nx-H2xog2d4
5. https://nptel.ac.in/courses/111104100

Course Articulation Matrix:(Mapping of Cos with Pos and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3					1	2	3	3	3	3	2
CO2	2					1	3	3	3	2	2	3
CO3	3					2	3	3	2	3	3	3
CO4	2					2	3	3	2	2	3	2
CO5	3					1	3	2	1	3	2	1

1- Low Correlation; 2-Moderate Correlation; 3-Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	B060101T/MT232	**Title of the Course**	Testing of Hypothesis & Applied Statistics	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	**4**	**0**	**0**	**4**
Pre-Requisite		**Co-requisite**					
Course Objectives	**To introduce the concepts of the parametric tests of various measures and interpret the result to predict the future events**						

Course Outcomes	
CO1	Knowledge of the terms like null and alternative hypotheses, two-tailed and one- tailed alternative hypotheses, significant and insignificant, level of significance and confidence, p value etc.
CO2	Ability to understand the concept of MP, UMP and UMPU tests
CO3	Ability to understand under what situations one would conduct the small sampleand large sample tests (in case of one sample and two sample tests) and familiarity with different aspects of Applied Statistics and their use in real lifesituations.
CO4	Ability to understand the concept of Time series along with its different component & the concept of Index numbers and their applications along with different types ofIndex numbers. Familiarity with various demographic methods and different measures of mortalityand fertility & understand the concept of life table and its construction.
CO5	Knowledge to understand the concept of statistical quality control and differentcontrol charts for variables and attributes.

Unit No.	Title of the Unit	Content of Unit	Contact Hrs.	Mapped CO
1	Statistical Hypothesis	Statistical Hypothesis (Simple and Composite), Testing of hypothesis. Type –I and Type – II errors, Significance level, p-values.	8	1
2	Tests for Statistical Hypothesis	Power of a test, Definitions of Most Powerful (MP), Uniformly Most Powerful (UMP) and Uniformly Most Powerful Unbiased (UMPU) tests.	8	2
3	Large Sample Tests	Test of significance: Large sample tests for (Attributes and Variables) proportions and means (i) for one sample (ii) for two samples Correlation coefficient in case of (a) p=p0 (b) p1=p2,	8	3
4	Small Sample Test	Small sample test based on t, f and chi-squaredistributions.	6	3
5	Time Series	Introduction & Definition of Time Series, its different components, illustrations, additive and multiplicative models. Determination of trend by free hand curve, semi average method, moving average method, method of least squares, Analysis of Seasonal Component by Simple average method, Ratio to moving Average Ratio to Trend, Link relative method.	8	4
6	Index Number	Index number: definition, application of index number, price relative and quantity or volume relatives, link and chain relative, problem involved in computation of index number, use of averages, simple aggregative and weighted average method. Laspeyre's, Paasche's and Fisher's index number, time and factor reversal tests of index numbers, consumer price index.	7	4
7	Vital Statistics	Vital Statistics: Measurement of Fertility– Crude birth rate, general fertility rate, age-specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate, standardized death rates Complete life table, its main features and construction.	8	4
8	Statistical Control Charts	Introduction to Statistical Quality Control, Process control, tools of statistical quality control, $+3\sigma$ control limits, Principle underlying the construction of control charts. Control charts for variables, 'X' and 'R' charts, construction and interpretation, Control charts for attributes 'p' and 'c' charts, construction and interpretation	7	5

Reference Books:

1. Ferund, J.E.: Mathematical Statistics, Prentice Hall of India.
2. Freedman, D., Pisani, R. and Purves, R. : Statistics. 4th Edition. Norton & Comp.
3. Goon, A.M., Gupta, M.K. & Dasgupta, B.: Fundamentals of Statistics, Vol. I,Kolkata, The World Press.
4. Gupta, S.C. and Kapoor, V. K.: Fundamentals of Mathematical Statistics, Sultan Chand and Sons.
5. Hogg, R.V., McKean, J.W. & Craig, A.T.; Introduction to Mathematical Statistics, Pearson.
6. Croxton F.E., Cowden D.J. and Klein, S.: Applied General Statistics, Prentice Hall of India Pvt. Ltd.
7. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics, SultanChand and Sons.
8. Montgomery D.C.: Introduction to Statistical Quality Control, Wiley IndiaPvt. Ltd.

e-Learning Source:

Suggestive digital platforms web link/platform: NPTEL/SWAYAM/MOOCS
www.ustat.toronto.edu
ecoursesonline.iaasri.res.in

	Course Articulation Matrix: (Mapping of COs with POs and PSOs)											
PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO4
CO1	3		1				3	3	2	3	2	3
CO2	3		1				1	3	3	2	2	3
CO3	3		3				3	3	3	3	2	2
CO4	3		3				1	3	2	2	3	3
CO5	3		1				1	3	3	3	3	2

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**

Integral University, Lucknow

Effective from Session: 2023-24							
Course Code	I030402V/MT235	**Title of the Course**	Introduction to SPSS	**L**	**T**	**P**	**C**
Year	Second	**Semester**	Fourth	2	0	2	3
Pre-Requisite	Basic usage of a Windows PC or a Mac	**Co-requisite**					
Course Objectives	To make the students understand the Statistical Package for Social Sciences (SPSS) software to perform statistics program gives a large amount of basic statistical functionality; some include frequencies, cross-tabulation, bivariate statistics, etc.						

Course Outcomes

CO1	Students will be able to understand the Basic Statistics: Meaning and Definition and Introduction of primary and secondary source of data and method of their collection.
CO2	Students will be able to understand the Basic of SPSS, entry data file, opening menu and dialogue boxes, creating data file and entering data.
CO3	Students will be able to understand the construction of different graphs in SPSS.
CO4	Students will be able to understand to find the descriptive measures (Univariate and Bivariate) by SPSS.
CO5	Students will be able to understand the hypothesis testing by SPSS.

Unit No.	**Title of the Unit**	**Content of Unit**	**Contact Hrs.**	**Mapped CO**
1	Introduction	Basic Statistics: Meaning and definitions of Statistics, data and variables, quantitative and qualitative variables, Scales of Measurements (Nominal, Ordinal, Interval & Ratio), primary and secondary sources of data, methods of data collection, classification of data.	7	1
2	Data Entry	Introduction to SPSS, working with data file, SPSS windows, Menu & Dialogue boxes, creating data file and entering data, defining the variables, modifying data file & import file.	8	2
3	Graphs	Construction of graphs by SPSS: Bar diagram, Histogram, frequency curve, Ogive curve, Pie chart and Box plot.	7	3
4	Univariate Measures	Descriptive (Univariate) measures by SPSS: Mean, Median, Mode & Partition values. Dispersion and its measures: Range, Quartiles deviation, Standard deviation & Variance. Measures of Skewness & Kurtosis	7	4
5	Bivariate Measures	Descriptive (Bivariate) measures by SPSS: Correlation & Scatter diagram, Karl Pearson's Coefficient of correlation, Spearman's Coefficient of Rank correlation, Regression equations and regression coefficients, Coefficient of determination.	8	4
6	Hypothesis Testing	Hypothesis testing by SPSS: Hypothesis, Null & Alternative hypothesis, Level of significance, Confidence level and Degrees of freedom, Normality test, testing of hypothesis based on t-test, Chi-square test, Analysis of variance (ANOVA), Reliability test (Cronbach's alpha), Non parametric test.	8	5

Reference Books:

1. John MacInnes, An Introduction to Secondary Data Analysis with IBM SPSS Statistics, Sage 2017
2. Marija Norusis, The SPSS Guide to Data Analysis, 1991.
3. Stephen A. Sweet, and Karen Grace-Martin, Data Analysis with SPSS: A First Course in Applied Statistics, 4th Edition, Pearson. 2012
4. Pallant, Julie SPSS Survival Manual, 4th Ed, McGraw-Hill, 2010.
5. Cronk, Brian, How to Use SPSS: A Step-By-Step Guide to Analysis and Interpretation, 5th Ed. 2008

e-Learning Source:

1. https://www.youtube.com/watch?v=ZpwZS3XnEZA
2. https://nptel.ac.in/courses/110107113
3. https://www.youtube.com/watch?v=_zFBUfZEBWQ
4. https://www.youtube.com/watch?v=-UF2k0PTw5w
5. https://www.youtube.com/watch?v=6rgwgwv8qdA

Course Articulation Matrix:(Mapping of COs with Pos and PSOs)

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3					1	2	3	3	3	3	2
CO2	2					1	3	3	3	2	2	3
CO3	3					2	3	3	2	3	3	3
CO4	2					1	3	3	2	2	3	2
CO5	3					2	3	2	1	3	2	1

1- Low Correlation; 2-Moderate Correlation; 3-Substantial Correlation

Name & Sign of Program Coordinator	**Sign & Seal of HoD**