



MANGALORE

UNIVERSITY

**Regulations Governing the Choice Based Credit System Semester
Scheme(CBCS) with Multiple Entry and Exit Options in the Undergraduate
and Post-graduate Degree Programmes under the Faculty of Science as per
NEP-2020**

(Framed under Section 44(1)(c) of the KSU Act 2000)

**B.Sc.STATISTICS (Basic/Hons.)/
M.Sc. Statistics Syllabus
September-2021**

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1. Preamble of the Programme

The BOS in Statistics of the Mangalore University has framed and proposed the syllabi for I and II semester B.Sc.(Basic/Hons) and M.Sc(Statistics) with Statistics subject as one of the major(s) as per the Regulations Governing the Choice Based Credit System (CBCS) Semester Scheme with Multiple Entry and Exit Options in the Undergraduate, and Postgraduate Degree Programmes under the Faculty of Science from the academic year 2021-2022. The titles of the Core papers and elective papers from semester III to semester X have been listed as per the Karnataka State Higher Education Council (KHSC) Statistics model syllabus prepared by Statistics subject expert committee.

Statistics as the technology of data analysis and decision making under uncertainty has expanded vastly in the past few decades. Its descriptive and inferential roles not only formulate the basis of growth of almost all the disciplines of the contemporary world but also provide an array of employment avenues in industry, academia, computer software companies, government and R&D organizations. Candidates

successfully completing the B.Sc.(Honors) or B.Sc. and M.Sc. in Statistics program will have good knowledge and expertise to work as statistical consultant for the analysis of all kinds of data, pursue Ph.D. in Statistics, work in software industry as domain experts and use the Statistical Knowledge effectively in academic institutions, Industry, Government and Research Institutions.

2. Eligibility for Admission to B.Sc. Statistics (Basic/Hons) and M.Sc. (Statistics):

- Only those Candidates who have passed 10+2 level or equivalent with Mathematics as one of the subjects are eligible for admission to B.Sc. Statistics.
- Candidates must opt Mathematics as one of the majors along with Statistics during first two years (I to IV semesters of the undergraduate (UG) programme) are eligible for admission to M.Sc. Statistics

Programme Outcomes (POs)

By the end of the program the students will be able to:

1. Acquire fundamental/systematic or coherent understanding of the academic field of Statistics and its different learning areas and applications.
2. Develop and demonstrate an ability to understand major concepts in various disciplines of Statistics.
3. Demonstrate the ability to use skills in Statistics and different practicing areas for formulating and tackling Statistics related problems and identifying and applying appropriate principles and methodologies to solve a wide range of problems associated with Statistics.
4. Understand procedural knowledge that creates different types of professionals related to subject area

of Statistics, including professionals engaged in government/public service and private sectors.

5. Plan and execute Statistical experiments or investigations, analyze and interpret data/information collected using appropriate methods, including the use of appropriate statistical software including programming languages, and report accurately the findings of the experiment/investigations.

6. Have a knowledge regarding use of data analytics tools like Excel and R-programming.

7. Developed ability to critically assess a standard report having graphics, probability statements.

8. Analyze, interpret the data and hence help policy makers to take a proper decision.

9. Recognize the importance of statistical modeling and computing to analyze the real problems using various statistical tools.

10. 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 thinking of Statistics-related issues and problems;

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

(iv) Analytical skills involving paying attention to details 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.

11. Undertake research projects by using research skills- preparation of questionnaire, conducting sample survey, research projects using sample survey, sampling techniques.

12. Understand and apply principles of least squares to fit a regression model to the given data, study the association between the variables, applications of Probability Theory and Probability Distributions.

3. Assessment

Weightage for assessments (in percentage)		
Type of Course	Formative Assessment/IA	Summative Assessment
Theory	40	60
Practicals	20	30(25+05(For Record book))
Projects	40	60
Experimental Learning (Internships, etc.)	40	60

4. Programme Structures with options

The programmes are flexible enough to allow liberty to students in designing them according to their requirements.

- Students choose Two Major subject/disciplines along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses, including Extracurricular Activities.
- **Exit with Certificate** upon the Successful Completion of the First Year with 50 credits (Two Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme.
- **Exit with Diploma** upon the Successful Completion of the Second Year with 100 credits (Four Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme.
- **Exit with Basic Bachelor Degree** at the Successful Completion of the Third Year with 142-146 credits (Six Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme.
- **Exit with Bachelor Degree with Honours** in a Discipline at the Successful Completion of the Fourth Year with 184-188 credits (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme.

Model Program Structures for the Under-Graduate Programs Departments and Colleges affiliated to Mangalore University

Bachelor of Science (Basic/Hons.) with Statistics as one of the major with practicals and with other subject as another major subject.

Semester	Discipline Core(DSC) (Credits)(L+T+P)	Disciplin eElective (DSE)/O penElecti ve(OE) (Credit s)(L+T +P)	AbilityEnhanceme ntCompulsoryCou rses (AECC),Languages (Credits)(L+T+P)		SkillEnhancementCourses (SEC)			Tota lCre dits
					Skill based(Cre dits)(L+T +P)	Value based(Credits)(L+ T+P)		
I	Descriptive Statistics (4+2) DisciplineB1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs. each)		SEC-1: (2)(1+0+2)	Yoga (1)(0+0+2)	Health & Wellne ss(1) (0+0+2)	25
II	Probability and Probability Distributions-I(4+2)DisciplineB2(4 +2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrseac h)	Environ mentalS tudies(2)		Physical Education(1)(0+0 +2)	NCC/NSS /R&R(S& G)/Cultur al(1) (0+0+2)	25
ExitoptionwithCertificate (48credits)								
III	Probability and Probability Distributions-II(4+2) DisciplineB3(4+2)	OE-3 (3)	L1-3(3), L2-3(3)(4 hrseach)		SEC-2: ArtificialInt elligence(2) (1+0+2)	PhysicalEd ucation-Sports(1)(0 +0+2)	NCC/NSS /R&R(S& G)/Cultur al(1) (0+0+2)	25

IV	Statistical Inference I (4+2)DisciplineB4 (4+2)	OE-4 (3)	L1-4(3), L2-4(3)(4 hrseach)	Constitution of India(2)		Physical Education - Games(1) (0+0+2)	NCC/NSS /R&R(S&G)/Cultural (1) (0+0+2)	25
ExitoptionwithDiploma(96 credits)orcontinuethethirdyear withboththesubjectsasmajors								
V	1.Matrix Algebra and Regression Analysis(3+2). 2.Analysis of Variance and Design of Experiments (3+2) Discipline B5(3+2),Discipline B6(3+2)				SEC-3:SEC such asCyberSecurity(2) (1+0+2)	Physical Education - Games(1) (0+0+2)	NCC/NSS /R&R(S&G)/Cultural (1) (0+0+2)	24
VI	1.Sampling Techniques(3+2), 2. Statistical Inference II (3+2) B7(3+2)DisciplineB8(3+2) Internship(2)				SEC-4: Professional Communication (2)	Physical Education - Games(1) (0+0+2)	NCC/NSS /R&R(S&G)/Cultural (1) (0+0+2)	24
Exitoption withBachelorofScience,B.Sc.BasicDegree(140credits)orChooseoneoftheDisciplinesasMajor								
VII	Real Analysis(3)Probability Theory (3+2) Statistical Inference (3 +2)	DS- Elective-1(3) DS- Elective-2(3) Res.Methodology(3)						22
VIII	Linear Algebra(3)Multivariate Analysis (3) Linear Models and Regression Analysis (3) Practical based on all theory papers (2)	DS- Elective 3(3)Research Project(6)*						20
AwardBachelorofScienceHonours,B.Sc.(Hons)degreeinStatisticsdiscipline(188credits)								
MasterDegreewithtwoSemesters								

*InlieuoftheresearchProject,two additionalelectivepapers/Internshipmaybeoffered.

5. Curriculum Structure-

Statistics(Corecourses)

Semesters-ItoX

Semester	DSC	CoreCourses	Credits
I	A1/B1	DescriptiveStatistics	4
		PracticalsbasedonA1/B1	2
II	A2/B2	ProbabilityandP r o b a b i l i t y Distributions-I	4
		Practicalsbasedon A2/B2	2
III	A3/B3	ProbabilityandDistributions-II	4
		PracticalsbasedonDSCA3/B3	2
IV	A4/B4	Statistical Inference-I	4
		PracticalsbasedonDSCA4/B4	2
V	A5/B5	MatrixAlgebraandRegressionAnalysis	3
		PracticalsbasedonDSCA5/B5	2
	A6/B6	AnalysisofVariance and DesignofExperiments	3
		PracticalsbasedonDSCA6/B6	2
VI	A7/B7	Sampling Techniques	3
		PracticalsbasedonDSCA7/B7	2
	A8/B8	StatisticalInference-II	3
		PracticalsbasedonDSCA8/B8	2
	Internshi p	DataAnalysiswithR	2
VII	A9	RealAnalysis	3
	A10	ProbabilityTheory	3
	A11	StatisticalInference	3
		PracticalsbasedonA10,A11	4
	E- 1andE- 2	SelectTwoDSE coursesfromgroup–Ilistedbelow	3+3
	Research Methodol ogy	Latexand useof Latexin reportwriting	3
VIII	A12	LinearAlgebra	3
	A13	MultivariateAnalysis	3
	A14	LinearModelsandRegressionAnalysis	3
		PracticalsbasedonA13 andA14	2
	E-3	Selectone DSEcourses fromlistbelow	3
	Research	Research Project	6

	Project		
IX	A15	Stochastic Processes	3
	A16	Time Series Analysis	3
	A17	Decision Theory and Bayesian Inference	3
		Practicals based on A16 and A17	2
	E-4, E-5	Select any two DSE courses from the list below	3+3
X	A18	Design and Analysis of Experiments	3
	A19	Limit Theorems in Probability	3
		Practicals based on A18	2
	Dissertation Work	Project Work	6

Discipline Specific Electives (DSE) for VII to X Semesters

- Actuarial Statistics
- Advanced Statistical Inference
- Categorical Data Analysis
- Analysis of Clinical Trials
- Reliability Analysis
- Operations Research
- Econometrics
- Nonparametric Regression
- Nonparametric and Semiparametric Methods
- Bio-Statistics
- Computational Statistics
- Financial Time Series
- Machine Learning with R/Python
- Reliability and Statistical Quality Control
- Statistical Learning and Data Mining
- Survival Analysis

Open Electives for I to IV Semesters

Sl.NO.	Titles of Open Electives
OE-1	Statistical Methods and Applications
OE-2	Business Statistics

OE-3	Applied statistics
OE-4	Biostatistics
OE-5	Introduction to Statistics with R
OE-7	Introduction to Time Series Analysis
OE-8	Multivariate Techniques with R

6. Curriculum Structure for the Undergraduate Degree Program B.Sc.

Total Credits for the Program: 184/188
22 Name of the Degree Program : B.Sc.

Starting year of implementation: 2021-
Discipline/Subject: Statistics (Major)

Program Articulation Matrix for I and II Semester B.Sc.

This matrix lists only the core courses. Core courses are essential to earn the degree in that discipline/subject. They include courses such as theory, laboratory, project, internship etc.

Semester	Title of the DSC	Program outcome that the course addresses (not more than 3 per course)	Pre-requisite course(s)	Pedagogy	Assessments
I	Descriptive Statistics	PO-1, PO-2, PO-3, PO-5, PO-08	10+2 level or Equivalent Mathematics	1. The course is taught using traditional chalk and talk method using problem solving through examples and exercises. 2. Students are encouraged to use resources available on open sources.	The assessment is done using continuous assessment through written test, viva-voce, seminars, Data Analysis and peer discussions.
I	Practical	PO-2, PO-3, PO-4, PO-5, PO-06, PO-08	10+2 level or Equivalent Mathematics	The course is taught using Excel software and/or manually to carry out descriptive statistical analysis.	Assessment Through practical experiments

II	Probability and Distributions-I	PO-1, PO-2, PO-3, PO-12	10+2 level or Equivalent Mathematics	1. The course is taught using traditional chalk and talk method using problem solving	The assessment is done using
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				through examples and exercises. 2. Students are encouraged to use resources available on open sources	continuous assessment through written test, viva-voce, seminars, and peer discussions.
II	Practicals	PO-1, PO-2, PO-4, PO-5, PO-06, PO-07 and PO-08, PO-12	10+2 level or Equivalent Mathematics	The course is taught using R programming software and/or manually to carry out descriptive statistical analysis	Assessment through experiments

Course Pre-requisite(s): 10+2 Level Mathematics

Course Outcomes (COs) for I and II Semesters

At the end of the I and II semesters course, the students should be able to:

CO-1. Acquire knowledge of introductory statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences etc.

CO -2. Learn various types of data, their organization and descriptive statistics such as presentations in tabular form, graphs and summary measures such as measures of central tendency and dispersion etc.

CO-3. Learn correlation, curve fitting, regression analysis, regression diagnostics, partial and multiple correlations.

CO-4. Learn different types of data reflecting independence and association between two or more attributes.

CO-5. Conceptualize the probabilities of events including frequentist and axiomatic approach. Simultaneously, they will learn the notion of conditional probability including the concept of Bayes' Theorem and able to solve problems on these topics.

CO -6. Learn concept of discrete and continuous random variables and their probability distributions including expectation and moments.

CO-

7. Learn Standard univariate discrete and continuous distributions and their applications disciplines of science.

CO -8. Learn basics of R-programming and able to write and execute R codes in descriptive statistics, probability models and fitting of suitable distribution to the given dataset, applications of normal and other standard distributions

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-11)

Course Outcomes (COs)/ Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11	12
CO-1. Acquire knowledge of introductory statistics, its scope and importance in various areas such as Medical, Engineering, Agricultural and Social Sciences etc.	x			x	x							
CO-2. Will learn various types of data, their organization and descriptive statistics such as presentations in tabular form graphs and summary measures such as measures of central tendency and dispersion etc.		x	x	x	x							
CO-3: Learn correlation, curve fitting, regression analysis, regression diagnostics, partial and multiple correlations.	x	x	x	x		x						x
CO-4. Learn different types of data reflecting independence and association between two or more attributes.	x	x	x	x	x							
CO -5. Conceptualize the probabilities of events including frequentist and axiomatic approach. Simultaneously, they will learn the notion of conditional probability including the concept of Bayes' Theorem and able to solve problems on these topics.	x	x	x	x								
CO -6. Will learn concept of discrete and continuous random variables and their probability distributions including expectation and moments	x	x	x	x								x

CO -7. Learn Standard univariate discrete and continuous distributions and their applications in other disciplines of science	X	X	X	X	X					X		X
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CO -8. Will learn basics of R-programming and able to write and execute R codes and descriptive statistics, probability models, Fitting of suitable distribution to the given data set, applications normal and other distributions.			X	X	X	X					X	X
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Detailed Syllabus for Semesters I & II B.Sc., Statistics

Course Content of Semester – I

Descriptive Statistics

Course Title: Descriptive Statistics	Course Credits: 4
Total Contact Hours: 56	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 16

Title of DSC A1/B1: Descriptive Statistics

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
04	56	02	52

Theory Content of DSC A1/B1	56hrs
Unit-1: Introduction to Statistics	13hrs
Statistics: Definition and scope. Data: quantitative and qualitative, cross sectional and time-series, discrete and continuous. Scales of measurement: nominal, ordinal, interval and ratio. Presentation of data: tabular and graphical. Frequency distributions, cumulative frequency distributions and their graphical representations. Stem and leaf displays. Concepts of population and sample. Methods of sampling- SRS, Stratified, Systematic and Cluster sampling methods: definitions only.	
Unit-2: Univariate Data Analysis	18hrs
Concept of measures of central tendency and measures of dispersion. Mean, weighted mean, trimmed mean, Median, Mode, Geometric and harmonic means, properties, merits and limitations, relation between these measures. Range, Quartile deviation, Mean deviation, Standard deviation and their relative measures. Gini's Coefficient, Lorenz Curve. Moments, Skewness and Kurtosis. Portion Values and measures based on them. Box Plot. Outliers, normal datasets.	

Unit –3:BivariateDataAnalysis	15 hrs
BivariateData,Scatterplot,Correlation,KarlPearson’scorrelationcoefficient,Rankcorrelation: Spearman’sandKendall’smeasures. Functional relation between the variables, conceptoferrors,principleofleastsquares,Simple linear regressionand itsproperties.Fitting oflinear regression lineand coefficientof determination their interpretation. Fitting of polynomial and exponential curves.	
Unit –4:MultivariateDataAnalysis	10hrs
AnalysisofCategoricalData:Contingencytable,independenceandassociationofattributes,measuresofas sociation- oddsratio, Pearson’sand Yule’smeasure,MultivariateFrequencies,MultivariateDataVisualization,meanvectoranddispersionma trix,Multiplelinearregression, multipleandpartialcorrelationcoefficients.Residualvariance.	

References

1. Agresti, A. (2010). Analysis of Ordinal Categorical Data, 2nd Edition, Wiley.
2. Anderson T. W. and Jeremy D. Finn (1996). The New Statistical Analysis of Data, Springer
3. Freedman, D., Pisani, R. and Purves, R. (2014). Statistics, 4th Edition, W. W. Norton & Company.
4. Gupta, S. C. (2018). Fundamental of Statistics, Himalaya Publishing House, 7th Edition.
5. Gupta S. C. and V. K. Kapoor (2020). Fundamental of Mathematical Statistics, Sultan Chand and Co. 12th Edition.
6. Hogg, R. V. McKean J. W. and Craig, A. T. (2012). Introduction to Mathematical Statistics, Pearson 7th Edition.
7. Joao Mendes Moreira, Andre CPL Fde Carvalho, Tomas Horvath (2018). General Introduction to Data Analytics, Wiley.
8. Johnson, R. A. and Bhattacharyya, G. K. (2006). Statistics: Principles and methods. 5th Edition, John Wiley & Sons, New York.
9. Medhi, J. (2005). Statistical Methods, New Age International.
10. Ross, S. M. (2014). Introduction to Probability and Statistics for Engineers and Scientists, 5th Edition, Academic Press.
11. Tukey, J. W. (1977). Exploratory Data Analysis, Addison-Wesley Publishing Co.

Pedagogy

- The course is taught using traditional chalk and talk method using problem solving through examples and exercises.
- Students are encouraged to use resources available on open sources.

Formative Assessment: Total 30 marks	
Assessment Occasion/type	Marks
Internal Test 1	15
Internal Test 2	15
Assignment/Seminar/ Data Analysis (07 marks)+Attendance (3 marks)	10
Total	40

Practical Content based on DSCA1/B1

(Carrying-out all the practicals manually as well as using Excel spread sheet)

1. Presentation of data by frequency tables, diagrams and graphs, stem and leaf, partition values.
2. Arithmetic Mean (AM), geometric mean, harmonic mean, weighted AM, trimmed mean, corrected mean.
3. Mode, median, partition values.
4. Absolute and relative measures of dispersion, Box plots.
5. Problems on moments, skewness and kurtosis.
6. Fitting of curves by least squares method.
7. Product moment correlation coefficient and rank correlation.
8. Fitting Simple Linear Regression
9. Partial and Multiple correlation.
10. Problems on Association of attributes.

Course Content of Semester-II

Probability and Distributions-I

Course Title: Probability and Distributions-I	Course Credits: 4
Total Contact Hours: 56	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Course Pre-requisite(s): 10+2 level or equivalent

Mathematics Title of the Course A2/B2: **Probability and Distributions-I**

Title of DSCA2/B2: Probability and Distributions-I

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
04	56	02	52

Theory of Content DSCA2/B2		56hrs
Unit-1 : Probability		14hrs
Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.		
Unit-2: Random variables, Mathematical Expectation and Generating Functions		14hrs
Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f.,		

illustrations and properties of random variables, univariate transformations with illustrations. Mathematical Expectation and Generating Functions: Expectation of single random variables and its properties. Moments and cumulants, moment generating function, cumulant generating function, probability generating functions (p.g.f.). Probability inequalities (Markov's and Chebychev's).	
Unit-3: Standard Discrete and Continuous distributions	14hrs
Standard discrete probability distributions: Bernolli, Poisson, geometric, discrete uniform negative binomial, hypergeometric. Standard continuous probability distributions: uniform, Beta Type-I and Type-II, Gamma, normal, exponential and applications of discrete and continuous distributions.	
Unit -4: Data Analysis Using R	14hrs
Introduction to R: R as a calculator, statistical software and a programming language, R preliminaries, getting help, data inputting methods (direct and importing from other spreadsheet applications like Excel), data accessing, and indexing, packages, Graphics in R, built in functions, saving, storing and retrieving work. Descriptive statistics: measures of central tendency (mean, median and mode), partition values, measures of dispersion (range, standard deviation, mean deviation and inter quartile range), summaries of a numerical data, skewness and kurtosis. Creating a vector using c (), reg() and Colon operator- Functions to summarize a vector sum mean, sd, median etc. Extracting a subset from the vector (by index, by property) Introduction to plotting, plot(), lines(), Abin(), Barplot, Pie chart and Histogram-Box plot, Scatter Plot and fitting simple linear regression. Probability Distributions: R as a set of statistical tables- cumulative distribution, probability density function, quantile function, and simulate from the distribution, plotting probability curves for standard distributions.	

References

1. Dudewitz, E.J. and Mishra, S.N. (1998). Modern Mathematical Statistics. John Wiley.
2. Goon A.M., Gupta M.K., Das Gupta, B. (1991), Fundamentals of Statistics, Vol. I, World Press, Calcutta.
3. Hogg R, V., McKean J.W, and Craig, A.T (2019). Introduction to mathematical Statistics, 8th Edition, Pearson Education, New Delhi.
4. Hogg, R. V., Tanis, E.A. and Rao J.M. (2009). Probability and Statistical Inference, Seventh Edition, Pearson Education, New Delhi.
5. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007). Introduction to the Theory of Statistics, 3rd Edition. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
6. Ross, S. (2002), A First Course in Probability, Prentice Hall.
7. Sudha G. Purohit, Sharad D. Gore, Shailaja R Deshmukh, (2009). Statistics Using R, Narosa Publishing House.
8. Emmanuel Paradis (2005). R for Beginners (available at https://cran.rproject.org/doc/contrib/Paradisrdebuts_en.pdf)

Pedagogy

- The course is taught using traditional chalk and talk method using problems solving through examples and exercises.

- Students are encouraged to use resources available on open sources.

Formative Assessment: Total 30 marks	
Assessment Occasion/type	Marks
Internal Test 1	15
Internal Test 2	15
Assignment/Seminar/ Data Analysis (7 marks)+ Attendance (3 marks)	10
Total	40

Content of Practical Course 2: List of Experiments to be conducted (Computing all the practicals manually and using Excel/R)

1. Descriptive statistics-
1 using R (Presentations, Summarizations, Graphs using R)
2. Descriptive statistics-2 using R (Measures of central tendency and dispersions)
3. Bivariate and Multivariate Analysis using R
4. Regression: Simple and Multiple regression analysis using R.
5. Computing probability: using addition and multiplication theorems. Conditional probability and Bayes' theorem
6. Problems on pmf, CDF, expectation, variance, quantiles, skewness, kurtosis. Plots of pmf, pdf, cdf, quantiles using R
7. Fitting of binomial, Poisson, distributions, Fitting of suitable discrete distributions
8. Application problems based on negative binomial distribution.
9. Fitting of normal distribution when parameters are given. Fitting of suitable continuous distributions.
10. Application based problems using normal distribution.
11. Generation of Random samples (Binomial, Poisson, Normal)

Detailed Syllabus of Open Elective Courses for I and II Semesters

OE-1: Statistical Methods and Applications

Course Title: Statistical Methods and Applications	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
03	42	-	-

Course Objectives

- ☐ This is an open elective course for other than statistics students.
- ☐ The students will learn the elements of descriptive statistics, probability, statistical methods such as tests of hypotheses, correlation and regression.

Course Outcomes

Students will be able to

CO-1. Acquire knowledge of statistical methods.

CO-2. Identify types of data and visualization, analysis and

interpretation. CO-3. Learn elementary probability and probability models.

CO-4. Learn to apply test procedures for given dataset.

Pedagogy

- ☐ The course is taught using traditional chalk and talk method using problem solving through examples and exercises.
- ☐ Students are encouraged to use resources available on open sources.

Course Contents

Unit 1: Introduction

10 Hours

Definition and scope of Statistics. Data: quantitative and qualitative, attributes, variables, scales of measurement: nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives. Concepts of population and sample. Sampling from finite population. Simple random sampling, Stratified and systematic random sampling procedures (definitions and methods only). Concepts of sampling and non-sampling errors.

Unit 2: Univariate and Bivariate Data Analysis

10

Hours Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis. Bivariate data, scatter diagram, Correlation, Karl-Pearson's correlation coefficient, Rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves.

Unit 3: Probability and Distributions

12 Hours

Probability: Random experiment, trial, sample space, events - mutually exclusive and exhaustive events. Classical, statistical and axiomatic definitions of probability, addition and multiplication theorems, Bayes theorem (only statements). Discrete and continuous random variables, probability mass and density functions, distribution functions, expectation of a random variable. Standard univariate distributions: Binomial, Poisson and Normal distributions (Elementary properties and applications only).

Unit 4: Sampling Distributions and Testing of Hypothesis

10 Hours

Distribution of sample mean from a normal population, Chi-square, t and F distributions (No derivations) and their applications. Statistical Hypothesis: null and alternative hypothesis, simple and

composite hypothesis. Type I and Type II errors, level of significance, critical region, P-value and its interpretation. Test for single mean, equality of two means, single variance, and equality of two variances for normal populations.

References

1. Daniel, W. W. (2007) Biostatistics - A Foundation for Analysis in the Health Sciences, Wiley
2. T. W. Anderson and Jeremy D. Finn (1996). The New Statistical Analysis of Data, Springer.
3. Mukhyopadhyaya P (1999). Applied Statistics, New Central book Agency, Calcutta.
4. Ross, S. M. (2014) Introduction to Probability and Statistics For Engineers and Scientists.
5. Cochran, W. G. (1984): Sampling Techniques, Wiley Eastern, New Delhi.

OE-2: Business Statistics

Course Title: Business Statistics	Course Credits: 3
Total Contact Hours: 42	Duration of ESA: 3 hours
Formative Assessment Marks: 40	Summative Assessment Marks: 60

Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
03	42		

Course Objectives

- ☐ Provide an introduction to basics of statistics within a financial context.
- ☐ To enable students to use statistical techniques for analysis and interpretation of business data.

Course Outcomes (COs)

Upon the completion of this course students should be able to:

CO1. Frame and formulate management decision problems.

CO2. Understand the basic concepts underlying quantitative analysis.

CO3. Use sound judgment in the applications of quantitative methods to management decisions.

Pedagogy

- ☐ The course is taught using traditional chalk and talk method using problem solving through examples and exercises.
- ☐ Students are encouraged to use resources available on open sources.

Course Contents

Unit 1: Statistical Data and Descriptive Statistics

12 Hours

Nature and Classification of data: univariate, bivariate and multivariate data; time-series

and cross-sectional data. Measures of Central Tendency: mathematical averages including arithmetic mean, geometric mean and harmonic mean, properties and applications. Positional Averages Mode and Median (and other partition values including quartiles, deciles, and percentiles).

Measures of Variation: absolute and relative. Range, quartile deviation, mean deviation, standard deviation, and their coefficients, Properties of standard deviation/variance Skewness:

Meaning, Measurement using Karl Pearson and Bowley's measures; Concept of Kurtosis.

Unit 2: Simple Correlation and Regression Analysis

10 Hours

Correlation Analysis: Meaning of Correlation: simple, multiple and partial; Correlation and Causation, Scatter diagram, Pearson's co-efficient of correlation; calculation and properties (Proof not required). Correlation and Probable error; rank correlation.

Regression Analysis: Principle of least squares and simple linear regression (SLR). Fitting of Simple Linear Regression and interpretation. Properties of regression coefficients; Standard Error of Estimate and its use in interpreting the results.

Unit 3: Index Numbers

10 Hours

Definition, Problems involved in the construction of index numbers, methods of constructing index numbers of prices and quantities, simple aggregate and price relatives method, weighted aggregate and weighted average of relatives method, important types of weighted index numbers: Laspeyres's, Paasche's, Bowley's, Marshall-Edgeworth, Fisher's, method of obtaining price and quantity index numbers, tests consistency of index numbers, time reversal test and factor reversal test for index numbers, Uses and limitations of index numbers. Consumer price index number: Problems involved in the construction of cost of living index number, advantages and disadvantages, Aggregative expenditure method and Family budget method for the construction of consumer price index numbers. Applications of Cost of Living Index numbers. Definition and measurement of Inflation rate—CPI and GNP Deflator.

Unit 4: Time Series Analysis

10 Hours

Introduction, definition and components of Time series, illustrations, Additive, Multiplicative and mixed models, analysis of time series, methods of studying time series: Secular trend, method of moving averages, least squares method—linear, quadratic, exponential trend fitting to the data. Seasonal variation—definition, illustrations, measurements, simple average method, ratio to moving average method, Cyclical variation—definition, distinction from seasonal variation, Irregular variation—definition, illustrations.

References

1. Levin, Richard, David S. Rubin, Sanjay Rastogi, and H M Siddiqui. Statistics for Management. 7th ed., Pearson Education.
2. David M. Levine, Mark L. Berenson, Timothy C. Krehbiel, P. K. Viswanathan, Business Statistics: A First Course, Pearson Education.
3. Siegel Andrew F. Practical Business Statistics. McGraw Hill Education.
4. Gupta, S. P., and Archana Agarwal. Business Statistics, Sultan Chand and Sons, New Delhi.
5. Vohra N. D., Business Statistics, McGraw Hill Education.
6. Murray R Spiegel, Larry J. Stephens, Narinder Kumar. Statistics (Schaum's Outline Series), Mc-Graw Hill Education.
7. Gupta, S. C. Fundamentals of Statistics. Himalaya Publishing House.
8. Anderson, Sweeney, and Williams, Statistics for Students of Economics and Business, Cengage Learning.

OE-3.AppliedStatistics

Course Title: Applied Statistics	CourseCredits:3
Total ContactHours: 42	DurationofESA:3hours
FormativeAssessmentMarks:40	SummativeAssessmentMarks:60

Number of TheoryCredits	Number of lecturehours/semester	Number of practicalCredits	Number of practicalhours/semester
03	42		

CourseObjectives

- ☐ Toenablethestudentstousestatisticaltoolsinfinance,industries,populationstudiesandhealthsciences.
- ☐ Toacquireknowledge about sampling methodsforsurveys.

CourseOutcomes(COs)

Uponsuccessful completionofthiscourse,thestudentwillbeableto:

CO1.UnderstandthePriceandQuantityIndexnumbersandtheirdifferentmeasures,understandtheapplicability of cost of living Index number.

CO2.KnowthecomponentsandNeed forTimeseries,understand thedifferentmethodsofstudyingtrend and Seasonal Index.

CO3.Studytheconceptofvitalstatistics,sourcesofdata,differentmeasuresofFertilityandMortality,Understand theGrowthrates-GRR andNRR and theirinterpretations.

CO4.KnowtheconceptofPopulation,Sample,Samplingunit,samplingdesign,samplingframe,sampling scheme, need for sampling, apply the different sampling methods for designing andselectingasamplefrom apopulation, explain sampling and non-samplingerrors.

CO5.Describethephilosophyofstatisticalqualitycontrol toolsaswellastheirusefulnessinindustryand hencedevelop quality control tools in agiven situation.

Pedagogy

- ☐ The course is taught using traditional chalk and talk method using problem solvingthroughexamples andexercises.
- ☐ Studentsareencouragedtouseresourcesavailableonopensources.

CourseContents

Unit1:EconomicStatistics

12Hours

Index numbers: Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number. Uses

and limitations of index numbers. Consumer price index number: construction of consumer price index numbers. Applications of consumer price index numbers

Time Series Analysis: Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series. Measurement of trend by method of free-hand curve, method of semi-averages and method of least squares (linear). Measurement of seasonal variations by method of ratio to trend.

Unit 2: Vital Statistics

10 Hours

Sources of demographic data, errors in data. Measurement of mortality: crude death rate, specific death rates, and standardized death rates, infant mortality rate, maternal mortality rate, neonatal mortality rates, merits and demerits and comparisons of various mortality rates. Measurement of Fertility and Reproduction: Fecundity, fertility, measurement of fertility, crude birth rate, general fertility rate, age specific fertility rate and total fertility rates, merits and demerits of each measure of fertility, comparative study of these measures of fertility, Growth rates: Gross reproduction rate and Net reproduction rates.

Unit 3: Sampling Methods

10 Hours

Population and Sample. Need for sampling, Complete Enumeration versus Sample Surveys, Merits and Demerits, Non-Probability and Probability Sampling, Need and illustrations. Use of random numbers, principal steps in sample survey. Requisites of a good questionnaire. Pilot surveys, Sampling and non-sampling errors, Description of simple random sampling with and without replacement procedures, Merits and demerits of Simple random sampling. Need for stratification, stratifying factors, Merits and demerits of stratified random sampling. Systematic random sampling procedure of obtaining sample, Merits and demerits of systematic random sampling.

Unit 4: Statistical Quality Control

10 Hours

Concept of quality and its management Causes of variations in quality: chance and assignable. General theory of control charts, Control charts for variables: $\bar{X}$ -bar and R-charts. Control charts for attributes: p and c-charts. Acceptance Sampling Plans (Product control): Basic terminologies: AQL, LTPD, AOQ, AOQL, ASN, OC curve, producer's risk, and consumer's risk. Single sampling plan, double sampling plan.

References

1. J. Medhi (1992) Statistical Methods. New Age International (P) Ltd. New Delhi.
2. M.N. Das (1993) Statistical Methods and Concepts. Wiley Eastern Ltd.
3. Irwin Miller, John E Freund and Richard A Johnson (1992) Probability and Statistics for Engineers. Prentice Hall of India New Delhi.
4. D.C. Montgomery (1996) Introduction to Statistical Quality Control.
5. Cochran, W.G. (1984) Sampling Techniques, Wiley Eastern, New Delhi.
6. Mukhopadhyaya P (1998) Theory and Methods of Survey Sampling. Prentice Hall of India.

7. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied
8. Kendall M. G. (1976): Time Series, Charles Griffin.
9. Chatfield C. (1980): The Analysis of Time Series—An Introduction, Chapman & Hall.

OE-4. Biostatistics

Course Title: Biostatistics		Course Credits: 3	
Total Contact Hours: 42		Duration of ESA: 3 hours	
Formative Assessment Marks: 40		Summative Assessment Marks: 60	
Number of Theory Credits	Number of lecture hours/semester	Number of practical Credits	Number of practical hours/semester
03	42		

Course Objectives

- To enable the students to identify the variables of biological studies and explore the tools of classification and presentation.
- To study the probability notion, models and their applications in the study of biological phenomenon.
- To acquire knowledge on sampling distribution and testing of hypotheses.

Course Learning Outcomes

After studying the course, the student will be able to apply statistical tools and techniques in data analysis of biological sciences.

Pedagogy

- The course is taught using traditional chalk and talk method using problem solving through examples and exercises.
- Students are encouraged to use resources available on open sources.

Course Contents

Unit 1: Introduction to Bio-Statistics

10 hours

Definition and scope of Statistics. Scales of Measurement: nominal, ordinal, interval and ratio. Collection, classification and tabulation of data, construction of frequency table for grouped and ungrouped data, graphical representation of data by histogram, polygon, ogive curves and Pie diagram.

Unit 2: Descriptive Statistics

12 hours

Measures of Central Tendency: Arithmetic mean, Median and Mode- definition, properties, merits and limitations. Measures of Dispersion: Range, Standard deviation and Coefficient of Variation. Correlation and Regression Analysis: Bivariate Data, Scatter Diagram, definition of correlation, types of correlation, Karl-Pearson's coefficient of correlation and its

properties, Spearman's Rank Correlation coefficient. Regression- Simple linear regression, fitting of regression equations by method of Least Squares, regression coefficients and their properties and interpretation.

Unit 3: Probability and Distributions

10 Hours

Probability: Random experiment, sample space, events -

mutually exclusive and exhaustive events. Classical, statistical and axiomatic definition of probability, addition and multiplication theorems, Bayes' theorem (only statements), application. Sensitivity, Specificity, positive predict value, negative predictive value, odds ratio.

Discrete and continuous random variables, probability mass and density functions, distribution functions, expectation of a random variable. Standard univariate distributions: Bernoulli, Binomial, Poisson and Normal distributions (Elementary properties and applications only).

Unit 4: Sampling Distributions and Statistical Inference 10 hours

Concepts of random sample and statistic, distribution of sample mean from a normal population, Chi-

square, t and F distributions (No derivations) and their applications. Estimation of population mean, population standard deviation and population proportion

from the sample counterparts. Statistical hypothesis: null and alternative hypothesis, simple and composite hypothesis. Type I and Type II errors, size, level of significance, power test, critical region, P-value and its interpretation. Test for single mean, equality of two means, single variance, equality of two variances for normal Populations, Test for proportions. Anova and Non parametric Tests.

References

1. Dutta, N. K. (2004), Fundamentals of Biostatistics, Kanishka Publishers.
2. Gurumani N. (2005), An Introduction to Biostatistics, MJ Publishers.
3. Daniel, W. W. (2007), Biostatistics - A Foundation for Analysis in the Health Sciences, Wiley
4. Rao, K. V. (2007), Biostatistics - A Manual of Statistical Methods for use in Health Nutrition and Anthropology
5. Pagano, M. and Gauvreau, K. (2007), Principles of Biostatistics.
6. Rosner Bernard (2010), Fundamentals of Biostatistics, 6th Edition, Duxbury.

UNIT V - Statistical computing (R software) (10L)

Introduction to R, R as a calculator, statistical software and a programming language, R preliminaries, getting help, data inputting methods (direct and importing from other spread sheet applications like Excel), data accessing, and indexing, packages, Graphics in R, built in functions, saving, storing and retrieving work. Descriptive statistics: diagrammatic representation of univariate and bivariate data (box plots, stem and leaf diagrams, bar plots, pie diagram), measures of central tendency (mean, median and mode), partition values, measures of dispersion (range, standard deviation, mean deviation and inter quartile range), summaries of a numerical data, skewness and kurtosis,

Probability Distributions: R as a set of statistical tables - cumulative distribution, probability density function, quantile function, and simulate from the distribution, plotting probability curves for standard distributions.