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

(FramedunderSection44(1)(c)oftheKSUAct2000)

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

CONTENTS

1. PreambleoftheProgramme

The BOS in Statistics of the Mangalore University has framed and proposed the syllabi for I and IIsemester 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 withMultiple Entry and Exit Options in the Undergraduate, and Postgraduate Degree Programmesunder the Faculty of Science from the academic year 2021-2022.The titles of the Corepapers and elective papers from semester III to semester X have been listed as per the Karnataka StateHigher Education Council (KHSC) Statistics model syllabus prepared by Statistics subject expertcommittee.

Statistics as the technology of data analysis and decision making under uncertainty has expanded vastly in the past few decades.It's 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 successfullycompletingtheB.Sc.(Honors)orB.Sc.andM.Sc.inStatisticsprogramwillh avegoodknowledge and expertise towork 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 academicinstitutions, Industry, Government and Research Institutions.

2. EligibilityforAdmissiontoB.Sc.Statistics(Basic/Hons) andM.Sc. (Statistics):

- Only those Candidates who have passed 10+2 level or equivalent with Mathematics as one ofthesubjects are eligible for admission to B.Sc. Statistics.
- Candidates must opt Mathematics as one of the majors along with Statistics during first twoyears(I toIV semestersof theundergraduate(UG)programme) are eligible for admission to M.Sc. Statistics

`ProgrammeOutcomes(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

Weightageforassessments(inpercentage)

TypeofCourse	FormativeAssessment/IA	SummativeAssessment
Theory	**40**	**60**
Practicals	**20**	**30(25+05(ForRecordbook))**
Projects	**40**	**60**
ExperimentalLearning (Internships,etc.)	**40**	**60**

4. ProgrammeStructureswithoptions

Theprogrammesareflexibleenoughtoallowlibertytostudentsindesigningthemaccordingtotheirrequirements.

- 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 (TwoSemesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year IntegratedMaster'sDegree Programme.
- **Exit with Diploma** upon the Successful Completion of the Second Year with 100 credits(FourSemesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year IntegratedMaster'sDegree Programme.
- **Exit with Basic Bachelor Degree** at the Successful Completion of the Third Year with 142-146credits(Six Semesters) of the multidisciplinary Four- year Undergraduate Programme/Five-yearIntegratedMaster's DegreeProgramme.
- **Exit with Bachelor Degree with Honours**in a Discipline at the Successful Completion of theFourthYearswith184-188credits(EightSemesters)ofthemultidisciplinaryFour-yearUndergraduate Programme/Five-yearIntegratedMaster'sDegree Programme.

ModelProgramStructuresfortheUnder-GraduateProgramsDepartments and Colleges affiliated to Mangalore University

BachelorofScience(Basic/Hons.)withStatistics as one of the major with practicals and with other subject as another majorsubject.

Semester	**Discipline Core(DSC) (Credits)(L+T+P)**	**DisciplineElective (DSE)/OpenElective(OE) (Credits)(L+T+P)**	**AbilityEnhancementCompulsoryCourses (AECC),Languages (Credits)(L+T+P)**		**SkillEnhancementCourses (SEC)**			**TotalCredits**
					Skill based(Credits)(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 &Wellness(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 hrseach)	EnvironmentalStudies(2)		Physical Education(1)(0+0+2)	NCC/NSS/R&R(S&G)/Cultural(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: ArtificialIntelligence(2) (1+0+2)	PhysicalEducation-Sports(1)(0+0+2)	NCC/NSS/R&R(S&G)/Cultural (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)	Constit utionof India(2)		PhysicalEd ucation - Games(1) (0+0+2)	NCC/NSS /R&R(S& G)/Cultur al (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 asCyberSec urity(2) (1+0+2)	PhysicalEd ucation - Games(1) (0+0+2)	NCC/NSS /R&R(S& G)/Cultur al (1) (0+0+2)	**24**
VI	**1.Sampling Techniques(3+2),** 2**. Statistical Inference II (3+2)** B7(3+2)DisciplineB 8(3+2) Internship(2)				SEC-4: Professional Communicati on (2)	PhysicalEd ucation - Games(1) (0+0+2	NCC/NSS /R&R(S& G)/Cultur al (1) (0+0+2)	**24**
Exitoption withBachelorofScience,B.Sc.BasicDegree(140credits)orChooseoneoftheDisciplinesasMajor								
VII	Real Analysis(3)Probabilit y Theory (3+2) Statistical Inference (3 +2)	DS- Elective-1(3) DS- Elective-2(3) Res.Methodology(3)						**22**
VIII	Linear Algebra(3)Multivaria te 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. CurriculumStructure-

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
	Internship	DataAnalysiswithR	2
VII	A9	RealAnalysis	3
	A10	ProbabilityTheory	3
	A11	StatisticalInference	3
		PracticalsbasedonA10,A11	4
	E-1andE-2	SelectTwoDSE coursesfromgroup–Ilistedbelow	3+3
	Research Methodology	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	StochasticProcesses	3
	A16	Time Series Analysis	3
	A17	DecisionTheoryandBayesianInference	3
		PracticalsbasedonA16andA17	2
	E-4,E-5	Select any twoDSE courses from the list below	3+3
X	A18	DesignandAnalysisofExperiments	3
	A19	LimitTheoremsinProbability	3
		Practicalsbasedon A18	2
	Dissertati onWork	Project Work	6

DisciplineSpecificElectives(DSE)forVIItoXSemesters

- ActuarialStatistics
- AdvancedStatisticalInference
- Categorical Data Analysis
- Analysis of Clinical Trials
- ReliabilityAnalysis
- OperationsResearch
- Econometrics
- Nonparametric Regression
- Nonparametric andSemiparametricMethods
- Bio-Statistics
- ComputationalStatistics
- Financial Time Series
- Machine Learning with R/Python
- Reliability and Statistical Quality Control
- Statistical Learning and Data Mining
- Survival Analysis

OpenElectives forItoIV Semesters

Sl.NO.	Titlesof**OpenElectives**
OE-1	StatisticalMethodsandApplications
OE-2	BusinessStatistics

OE-3	Appliedstatistics
OE-4	Biostatistics
OE-5	Introductionto StatisticswithR
OE-7	IntroductiontoTimeSeriesAnalysis
OE-8	MultivariateTechniqueswithR

6. CurriculumStructurefortheUndergraduateDegreeProgram B.Sc.

TotalCreditsfortheProgram: 184/188 Starting year of implementation: 2021-22Nameofthe DegreeProgram : B.Sc. Discipline/Subject:Statistics(Major)

ProgramArticulationMatrixforIandIISemester B.Sc.

This matrix lists only the core courses. Core courses are essential to earn the degree in thatdiscipline/subject.Theyincludecoursessuchastheory,laboratory,project,internshipsetc.

Semester	TitleoftheDSC	Programoutcomesthat thecourse addresses (not morethan 3per course)	Pre-requisite course(s)	Pedagogy	Assessments
I	DescriptiveStatistics	PO-1,PO-2,PO-3, PO-5, PO-08	10+2 levelorEquivalentMathematics	1.The course is taughtusingtraditionalchalkand talk method usingproblem solving throughexamples and exercises.2.Studentsareencouragedto use resources availableon opensources.	Theassessmentis doneusingcontinuousassessmenttthroughwritten testviva-voce,seminars,Data Analysis and peerdiscussions.
I	Practical	PO-2,PO-3,PO-4,PO-5, P-06, PO-08	10+2 levelorEquivalentMathematics	The course is taughtusing Excel software and/ormanually to carry outdescriptive statisticalanalysis.	AssessmentThroughpracticalexperiments

II	Probabilityand Distributions -I	PO-1,PO-2,PO-3, PO-12	10+2 levelorEquivalentMathematics	1. The course is taughtusing traditional chalkand talk method usingproblemsolving	Theassessmentis done using

				through examples andexercises. 2. Students areencouraged to useresources available onopensources	continuous assessmentt hroughwritt en test,viva-voce,semin ars,and peerdiscus sion s.
II	Practicals	PO-1,PO-2,PO-4,PO-5, PO-06, PO-07 and PO-08, PO-12	10+2 levelorEqu ivalentMat hematics	The course is taughtusing R programmingsoftwar e and/ormanuallyto carry out descriptivestat istical analysis	Assessme ntthrough experimen ts

CoursePre-requisite(s):10+2LevelMathematics

CourseOutcomes(COs)forIandIIsemesters

Attheend oftheIandIIsemesters coursesthe studentshould beable to:
CO-1.Acquireknowledgeof introductorystatistics,its scopeandimportanceinvariousareassuchas Medical, Engineering, Agriculturaland Social Sciencesetc.

CO -2.Learn various types of data, their organization and descriptive statistics such aspresentationsintabularformgraphsandsummarymeasuressuchasmeasuresofcentraltende ncyand dispersion etc.

CO-3.Learn correlation, curvefitting,regressionanalysis,regressiondiagnostics,partialandmultiplecorrelations.

CO-4.Learndifferentoftypesofdata reflectingindependenceandassociationbetweentwoormoreattributes.

CO-5.Conceptualizethe probabilitiesofeventsincludingfrequentistandaxiomaticapproach.Simultaneously, they will learn the notion of conditional probability including the concept ofBayes'Theorem and ablesolveproblems on thesetopics.

CO -6. Learn concept of discrete and continuous random variables and their probabilitydistributionsincluding expectation and moments.

CO-

7.LearnStandardunivariatediscreteandcontinuousdistributionsandtheirapplicationsdisciplineso
fscience. .

CO -8. Learn basics ofR-programming and able to write and execute R codes in descriptivestatistics,probabilitymodelsand fittingofsuitabledistributionstothegiven dataset,applicationsofnormaland otherstandarddistributions

CourseArticulationMatrix:MappingofCourseOutcomes(COs)withProgramOutcomes(POs 1-11)

CourseOutcomes(COs)/ ProgramOutcomes(POs)	1	2	3	4	5	6	7	8	9	10	11	12
CO-1. Acquire knowledge ofintroductory statistics, its scopeand importance in various areassuch as Medical, Engineering,AgriculturalandSocialSciencesetc.	x			x	x							
CO-2.Willlearnvarioustypesofdata, their organization anddescriptive statistics such aspresentations in tabular formgraphs andsummary measuressuch as measures of centraltendency anddispersion etc.		x	x	x	x							
CO-3:Learncorrelation,curvefitting , regression analysis,regressiondiagnostics,partialand multiplecorrelations.	x	x	x	x		x						x
CO-4.Learn differentoftypesofdata reflecting independence andassociation between two or moreattributes.	x	x	x	x	x							
CO -5. Conceptualize theprobabilities of events includingfrequentist and axiomaticapproach. Simultaneously, they will learnthe notion of conditionalprobability including the conceptofBayes'Theoremandable solve problemson thesetopics.	x	x	x	x								
CO -6. Will learn concept ofdiscreteandcontinuousrandomvariables and their probabilitydistributionsincluding expectationandmoments	x	x	x	x								x

CO -7. Learn Standardunivariate discrete andcontinuous distributions andtheirapplications in otherdisciplinesofscience	x	x	x	x	x					x		x

CO -8. Will learn basics ofR-programming andabletowriteandexecuteRcodesindescriptivestatistics,probability models ,Fittingofsuitabledistributionstothe given data set, applicationsnormaland otherdistributions.			x	x	x	x				x	x

DetailedSyllabusforSemestersI&IIB.Sc.,Statistics

Course Contentof Semester– I

DescriptiveStatistics

CourseTitle:**DescriptiveStatistics**	CourseCredits:4
Total ContactHours:56	DurationofESA:3hours
FormativeAssessmentMarks:40	Summative AssessmentMarks:60

TitleofDSC A1/B1:DescriptiveStatistics

NumberofTheoryCredits	Number of lecturehours/semester	Number of practicalCredits	Number of practicalhours/semester
04	**56**	**02**	**52**

TheoryContent of DSC A1/B1	**56hrs**
Unit–1:IntroductiontoStatistics	**13hrs**
Statistics: Definition and scope. Data: quantitative and qualitative, crosssectionalandtime-series,discrete andcontinuous. Scalesofmeasurement:nominal, ordinal,interval and ratio. Presentation of data: tabular and graphical. Frequency distributions, cumulative frequencydistributionsandtheirgraphical representations. Stemandleafdisplays. Concepts of population and sample. Methods of sampling- SRS, Stratified,Systematic and Cluster sampling methods:definitions only.	
Unit–2:UnivariateDataAnalysis	**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,relationbetweenthesemeasures.Range,Quartiledeviation,Meandeviation,Standarddeviation andtheirrelativemeasures.Gini'sCoefficient,LorenzCurve.Moments,Skewness andKurtosis. 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,measuresofassociation- oddsratio, Pearson'sand Yule'smeasure,MultivariateFrequencies,MultivariateDataVisualization,meanvectoranddispersionmatrix,Multiplelinearregression, multipleandpartialcorrelationcoefficients.Residualvariance.	

References

1. Agresti,A.(2010).AnalysisofOrdinalCategoricalData,2ndEdition,Wiley.
2. AndersonT.W.andJeremyD.Finn(1996).TheNewStatisticalAnalysisofData,Springer
3. Freedman,D.,Pisani,R.andPurves,R.(2014).Statistics,4th Edition,W.W.Norton&Company.
4. Gupta,S.C.(2018).FundamentalofStatistics, HimalayaPublishing House,7thEdition.
5. Gupta S.C. and V.K. Kapoor (2020). Fundamental of Mathematical Statistics, Sultan ChandandCo. 12thEdition.
6. Hogg, R. V. McKean J. W. and Craig, A. T. (2012). Introduction to MathematicalStatistics,Pearson 7thEdition.
7. JoaoMendesMoreira,AndreCPL FdeCarvalho,TomasHorvath(2018).GeneralIntroductionto Data Analytics, Wiley.
8. Johnson, R.A. and Bhattacharyya, G.K. (2006). Statistics: Principles and methods. 5thEdition,John Wiley & Sons, New York.
9. Medhi,J.(2005).StatisticalMethods,NewAge International.
10. Ross, S.M. (2014). Introduction to Probability and Statistics for Engineers and Scientists, 5thEdition,AcademicPress.
11. Tukey,J.W.(1977). ExploratoryData Analysis,Addison-WesleyPublishingCo.

Pedagogy

- The course is taught using traditional chalk and talk method using problem solvingthroughexamples andexercises.
- Studentsareencouragedtouseresources availableonopensources.

FormativeAssessment:Total30marks	
AssessmentOccasion/type	Marks
InternalTest1	15
InternalTest2	15
Assignment/Seminar/ Data Analysis(07 marks)+Attendance(3marks)	10
Total	40

PracticalContentbasedon DSCA1/B1

(Carrying-outallthepracticalsmanuallyaswellasusingExcelspread sheet)

1. Presentationofdataby frequencytables,diagramsandgraphs,stemand leaf,partitionvalues.
2. ArithmeticMean(AM),geometricmean,harmonicmean, weightedAM,trimmedmean,correctedmean.
3. Mode,median, partitionvalues.
4. Absoluteandrelative measures ofdispersion,Boxplots.
5. Problemsonmoments,skewnessandkurtosis.
6. Fittingofcurvesbyleastsquaresmethod.
7. Productmomentcorrelationcoefficientandrankcorrelation.
8. Fitting Simple Linear Regression
9. ,Partialand Multiple correlation.
10. ProblemsonAssociationofattributes.

CourseContentof Semester–II

ProbabilityandDistributions-I

CourseTitle:ProbabilityandDistributions-I	CourseCredits:4
Total ContactHours: 56	DurationofESA:3hours
FormativeAssessmentMarks:40	SummativeAssessmentMarks:60

Course Pre-requisite(s): 10+2 level or equivalent MathematicsTitleof theCourseA2/B2:Probability and Distributions-I

TitleofDSCA2/B2: ProbabilityandDistributions-I

Number of TheoryCredits	Number of lecturehours/semester	Number of practicalCredits	Number of practicalhours/semester
04	**56**	**02**	**52**

Theoryof ContentDSCA2/B2	**56hrs**
Unit–1 :Probability	**14hrs**
Probability: Introduction, random experiments, sample space, events and algebra of events.DefinitionsofProbability– classical,statistical,andaxiomatic.ConditionalProbability,lawsof addition and multiplication, independent events, theorem of total probability, Bayes'theorem and itsapplications.	
Unit–2:Randomvariables,MathematicalExpectationandGeneratingFunctions	**14hrs**
Randomvariables:discreteandcontinuousrandomvariables,p.m.f.,p.d.f.andc.d.f.,	

illustrations and properties of random variables, univariate transformations with illustrations.Mathematical Expectation and Generating Functions: Expectation of single random variablesanditsproperties.Momentsandcumulants,momentgeneratingfunction,cumulantgenerating function,probabilitygeneratingfunctions(p.g.f.).Probability inequalities(Markov'sand Chebychev's).	
Unit–3:StandardDiscreteandContinuousdistributions	**14hrs**
Standard discrete probability distributions: Bernolli, Poisson, geometric,discrete uniform negativebinomial,hypergeometric.Standardcontinuousprobabilitydistributions:uniform,Beta Type-I and Type-II, Gamma, normal,exponentialandapplications of discreteand continuous distributions.	
Unit –4:DataAnalysisUsingR	**14hrs**
IntroductiontoR: 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:, 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 avector using c (), reg() and Colon operator-Functions to summarize a vector sum mean, sd, median etc. Extrating a subset from the vectir (by index, by property) Introduction to plotting, plot(), lines(), Ablin(), 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.andMishra.S.N.(1998).ModernMathematicalStatistics.JohnWiley.
2. GoonA.M.,GuptaM.K.,DasGupta.B.(1991),FundamentalsofStatistics,Vol. I,WorldPress, Calcutta.
3. Hogg R,V.,Mckean J.W, and Craig,A.T(2019).Introduction to mathematical Statistics,8thEdition,Pearson Education, New Delhi.
4. Hogg,R.V.,Tanis,E.A.andRaoJ.M.(2009).ProbabilityandStatisticalInference,Sevent hEdition, Pearson Education, NewDelhi.
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6. Ross,S.(2002), AFirstCourseinProbability, PrenticeHall.
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8. Emmanuel Paradis(2005). R for Beginners (available athttps://cran.rproject.org/doc/contrib/Paradisrdebuts_en.pdf)

Pedagogy

- Thecourseistaught usingtraditional chalk andtalk methodusing problemsolvingthroughexamples andexercises.

- Studentsareencouragedtouseresourcesavailableonopensources.

FormativeAssessment:Total30marks	
AssessmentOccasion/type	Marks
InternalTest1	15
InternalTest2	15
Assignment/Seminar/ Data Analysis (7marks)+Attendance(3marks)	10
Total	40

ContentofPracticalCourse2:ListofExperimentstobeconducted

(Computingallthepracticalsmanuallyandusing Excel/R)

1. Descriptivestatistics-
1usingR(Presentations,Summarizations,Graphsusing R)
2. Descriptivestatistics-2usingR(Measuresofcentraltendencyanddispersions)
3. BivariateandMultivariateAnalysisusingR
4. Regression:SimpleandMultiple regressionanalysisusingR.
5. Computing probability: using addition and multiplication theorems. Conditional probabilityandBayes' theorem
6. Problems on pmf, CDF, expectation, variance, quantiles, skewness, kurtosis. Plots ofpmf,pdf,cdf,quantilesusing R
7. Fittingofbinomial,Poisson,distributions,Fittingofsuitablediscretedistributions
8. Applicationproblemsbased onnegativebinomialdistribution.
9. Fitting of normal distribution when parameters are given. Fitting of suitable continuousdistributions.
10. Applicationbasedproblems usingnormaldistribution.
11. Generation of Random samples (Binomial, Poisson, Normal)

DetailedSyllabus ofOpenElectiveCourses forIandII Semesters

OE-1:StatisticalMethods and Applications

CourseTitle:Statistical Methods and Applications	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

- Thisisanopenelective courseforotherthanstatisticsstudents.
- The students will learn the elements of descriptive statistics, probability, statisticalmethodssuch as tests of hypotheses, correlation and regression.

CourseOutcomes

Studentswill beable to
CO-1.Acquireknowledgeofstatisticalmethods.
CO-2. Identify types of data and visualization, analysis and interpretation.CO-3.Learnelementaryprobabilityand probability models.
CO-4.Learnto applytest proceduresforgivendataset.

Pedagogy

- The course is taught using traditional chalk and talk method using problem solvingthroughexamples andexercises.
- Studentsareencouragedtouseresources availableonopensources.

CourseContents

Unit1: Introduction 10Hours
Definition and scope of Statistics. Data: quantitative and qualitative, attributes, variables, scalesofmeasurement:nominal,ordinal,intervalandratio.Presentation:tabularandgraphic,including histogram and ogives. Concepts of population and sample. Sampling from finitepopulation .Simple random sampling, Stratified and systematic random sampling procedures(definitionsand methods only). Conceptsof sampling and non-sampling errors.

Unit2: Univariateand BivariateDataAnalysis 10 HoursMeasures 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 correlationcoefficient, Rank correlation. Simple linear regression, principle of least squares and fitting ofpolynomialsand exponential curves.

Unit3:ProbabilityandDistributions 12 Hours
Probability:Randomexperiment,trial,samplespace,events-mutuallyexclusiveandexhaustiveevents.Classical,statisticalandaxiomaticdefinitionsofprobability, additionandmultiplicationtheorems,Bayestheorem(onlystatements).Discreteandcontinuousrandomvariables,probability mass and density functions, distribution functions, expectation of a random variable.Standardunivariatedistributions:Binomial,PoissonandNormaldistributions(Elementarypropertiesandapplications only).

Unit4:SamplingDistributionsandTestingofHypothesis 10 Hours
Distribution of sample mean from a normal population, Chi-square, t and F distributions (Noderivations)andtheirapplications.StatisticalHypothesis:nullandalternativehypothesis,simplean

dcompositehypothesis.TypeIandTypeIIerrors,levelofsignificance,criticalregion,P-valueanditsinterpretation.Testforsinglemean,equalityoftwomeans,singlevariance,andequalityof two variancesfornormal populations.

References

1. Daniel,W.W.(2007Biostatistics-AFoundationforAnalysisintheHealthSciences,Wiley
2. T.W.Anderson andJeremyD.Finn(1996).TheNewStatisticalAnalysisofData,Springer.
3. MukhyopadyayaP(1999).AppliedStatistics,NewCentralbookAgency,Calcutta.
4. Ross,S.M.(2014)Introduction toProbabilityand StatisticsForEngineers andScientists.
5. Cochran,WG (1984):SamplingTechniques,WileyEastern,NewDelhi.

OE-2:BusinessStatistics

CourseTitle:B u s i n e s s 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

- Provideanintroductiontobasicsof statisticswithinafinancialcontext.
- Toenablestudentstousestatisticaltechniques foranalysisandinterpretationofbusinessdata.

CourseOutcomes(COs)

Uponthecompletionofthis coursestudents should beable to:
CO1.Frameandformulatemanagementdecisionproblems.
CO2.Understandthebasicconceptsunderlyingquantitativeanalysis.
CO3.Usesoundjudgmentintheapplications ofquantitativemethodstomanagementdecisions.

Pedagogy

- Thecourseistaught usingtraditional chalk andtalk methodusing problemsolvingthroughexamples andexercises.
- Studentsareencouragedtouseresourcesavailableonopensources.

CourseContents

Unit1:StatisticalDataandDescriptiveStatistics 12Hours
Nature and Classification of data: univariate, bivariate and multivariate data; time-series

andcross-sectionaldata.MeasuresofCentralTendency:mathematicalaverages includingarithmeticmean geometric mean and harmonic mean, properties and applications. Positional AveragesModeand Median (and otherpartition valuesincluding quartiles,deciles, andpercentiles).
MeasuresofVariation:absoluteandrelative.Range,quartiledeviation,meandeviation,standarddeviation, and their coefficients, Properties of standard deviation/variance Skewness: Meaning,Measurementusing Karl PearsonandBowley's measures;Conceptof Kurtosis.

Unit2:SimpleCorrelationandRegressionAnalysis 10Hours
Correlation Analysis: Meaning of Correlation: simple, multiple and partial; Correlation and Causation, Scatter diagram, Pearson's co-efficient of correlation; calculation andproperties (Proof not required). Correlation and Probable error; rank correlation.
RegressionAnalysis: Principle of least squares and simple linear regression(SLR).Fitting of Simple Linear Regression and interpretation. Propertiesofregressioncoefficients;Standard Errorof Estimateand its useininterpreting the results.

Unit3: IndexNumbers 10Hours
Definition, Problems involved in the construction ofindex numbers, methods of constructing indexnumbers of prices and quantities, simple aggregate and price relatives method, weighted aggregate andweighted average of relatives method, important types of weighted index numbers: Laspeyre's, Paasche's,Bowley's, Marshall- Edgeworth, Fisher's, method of obtaining price and quantity index numbers, testsconsistency of index numbers, time reversal test and factor reversal test for index numbers, Uses andlimitations of index numbers. Consumer price index number: Problems involved in the construction ofcost of living index number, advantages and disadvantages, Aggregative expenditure method and Familybudget method for the construction of consumer price index numbers. Applications of Cost of LivingIndexnumbers. Definitionand measurement of Inflationrate–CPIand GNPDeflator.

Unit4:TimeSeriesAnalysis10Hours
Introduction, definition and components of Time series, illustrations, Additive, Multiplicative and mixedmodels, analysisoftimeseries, methodsofstudying time series:Secular trend, method of movingaverages,leastsquaresmethod–linear,quadratic,exponentialtrendfittingstothedata.Seasonalvariation-definition,illustrations,measurements,simpleaveragemethod,ratiotomovingaveragemethod,Cyclicalvariation definition, distinction fromseasonalvariation, Irregular variation-definition,illustrations.

References

1. Levin, Richard, David S. Rubin, Sanjay Rastogi, and H M Siddiqui. Statistics forManagement.7th ed., Pearson Education.
2. DavidM.Levine,MarkL.Berenson,Timothy C.Krehbiel,P.K.Viswanathan,BusinessStatistics:A First Course, Pearson Education.
3. SiegelAndrew F.PracticalBusinessStatistics.McGrawHillEducation.
4. Gupta,S.P.,andArchanaAgarwal.BusinessStatistics,SultanChandandSons,NewDelhi.
5. VohraN.D.,Business Statistics,McGrawHillEducation.
6. MurrayRSpiegel,LarryJ.Stephens,NarinderKumar.Statistics(Schaum'sOutlineSeries),Mc-GrawHill Education.
7. Gupta,S.C.FundamentalsofStatistics.HimalayaPublishingHouse.
8. Anderson,Sweeney,andWilliams,StatisticsforStudentsofEconomicsandBusiness,CengageLearning.

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 andlimitationsofindexnumbers.Consumerpriceindexnumber:constructionofconsumerpriceindexnumbers. Applications of consumer priceindex numbers
Time Series Analysis: Components of time series, Decomposition of time series- Additive andmultiplicative model with their merits and demerits, Illustrations of time series. Measurement oftrendbymethodoffree-handcurve,methodofsemi-averagesandmethodofleastsquares(linear).Measurement ofseasonalvariations by method ofratio to trend.

Unit2: VitalStatistics 10Hours
Sources of demographic data, errors in data. Measurement of mortality: crude death rate, specificdeath rates, and standardized death rates, infant mortality rate, maternal mortality rate, neo natalmortality rates, merits and demerits and comparisons of various mortality rates. Measurement ofFertility and Reproduction: Fecundity, fertility, measurement of fertility, crude birth rate, generalfertilityrate,agespecificfertilityrateandtotalfertilityrates,meritsanddemeritsofeachmeasureoffertility,comparativestudyofthesemeasuresoffertility,Growthrates:Grossreproductionrate and Net reproduction rates.

Unit3:SamplingMethods 10Hours
Population and Sample. Need for sampling, Complete Enumeration versus Sample Surveys,Merits and Demerits, Non-Probability and Probability Sampling, Need and illustrations. Use ofrandomnumbers,principalstepsinsamplesurvey.Requisitesofagoodquestionnaire.Pilot surveys, Sampling and non – sampling errors, Description of simple random sampling withand without replacement procedures, Merits and demerits of Simple random sampling. Need forstratification, stratifying factors, Merits and demerits of stratified random sampling. Systematicrandom sampling procedure of obtaining sample, Merits and demerits of systematic randomsampling.

Unit4:StatisticalQualityControl 10Hours
Concept of quality and its management Causes of variations in quality: chance and assignable.General theory of control charts, Control charts for variables: X- bar and R-charts. Control chartsfor attributes: p and c-charts. Acceptance Sampling Plans (Product control): Basic terminologies:AQL,LTPD,AOQ,AOQL,ASN,OCcurve,producer'srisk,andconsumer'srisk.Single samplingplan, double sampling plan.

References

1. J.Medhi(1992)StatisticalMethods. NewAge International(P) Ltd.NewDelhi.
2. M.N.Das(1993)StatisticalMethodsand Concepts.Wiley EasternLtd.
3. Irwin Miller, John E Freund and Richard A Johnson (1992) Probability and Statistics forEngineers.PrenticeHallofIndia New Delhi.
4. D.C.Montgomery(1996)IntroductiontoStatisticalQualityControl.
5. Cochran,WG. (1984)SamplingTechniques,WileyEastern,NewDelhi.
6. MukhopadhayaP(1998)TheoryandMethodsofSurveySampling.PrenticeHallof India.

7. MukhopadhyayP.(2011):AppliedStatistics,2nded. Revisedreprint,BooksandAllied
8. KendallM.G.(1976): TimeSeries,CharlesGriffin.
9. ChatfieldC.(1980):TheAnalysisofTimeSeries–An Introduction,Chapman&Hall.

OE-4.Biostatistics

CourseTitle:Biostatistics	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

- To enable the students to identify the variables of biological studies and explore the toolsofclassification and presentation.
- Tostudytheprobabilitynotion,models andtheirapplicationsinthe studyof biologicalphenomenon.
- Toacquireknowledgeonsampling distributionandtesting ofhypotheses.

CourseLearningOutcomes

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

Pedagogy

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

CourseContents

Unit1:IntroductiontoBio-Statistics 10 hours

Definition and scope of Statistics. Scales of Measurement: nominal, ordinal, interval and ratio.Collection,classificationandtabulationofdata,constructionoffrequencytableforgroupedandun groupeddata,graphicalrepresentationofdatabyhistogram,polygon,ogivecurvesandPiediagram.

Unit2:DescriptiveStatistics 12hours

Measures of Central Tendency: Arithmetic mean, Median and Mode- definition, properties,merits and limitations. Measures of Dispersion: Range, Standard deviation and Coefficient ofVariation. Correlation and Regression Analysis: Bivariate Data ,Scater Diagram, definition ofcorrelation,typesofcorrelation,Karl-Pearson'scoefficientofcorrelationand its

properties, Spearman's Rank Correlation coefficient. Regression- Simple linearregression, fitting of regression equations by method of Least Squares, regressioncoefficientsand theirproperties and interpretation.

Unit3:ProbabilityandDistributions 10Hours
Probability:Randomexperiment,samplespace,events-
mutuallyexclusiveandexhaustiveevents.Classical,statisticalandaxiomaticdefinitionsofprobability, additionandmultiplicationtheorems,Bayes'theorem(onlystatements), application. Sensitivity, Specificity, positive predict value, negative predictive value, odds ratio.
Discreteandcontinuousrandomvariables,probability mass and density functions, distribution functions, expectation of a random variable.Standardunivariatedistributions:Bernoulli, Binomial,PoissonandNormaldistributions(Elementarypropertiesandapplications only).

Unit4:SamplingDistributionsand StatisticalInference10hours
Concepts of random sample and statistic, distribution of sample mean from a normal population,Chi-
square,tandFdistributions(Noderivations)andtheirapplications.Estimationofpopulationmean,populationstandarddeviationandpopulationproportion
fromthesamplecounterparts.Statisticalhypothesis:nullandalternativehypothesis,simpleandcompositehypothesis.TypeIandTypeIIerrors,size,levelofsignificance,powertest,criticalregion,P-value and its interpretation. Test for single mean, equality of two means, single variance, equalityoftwo variances for normal Populations, Test forproportions. Annova and Non parametric Tests.

References

1. Dutta,N.K.(2004),FundamentalsofBiostatistics,KanishkaPublishers.
2. GurumaniN.(2005),AnIntroductiontoBiostatistics,MJPPublishers.
3. Daniel,W.W. (2007), Biostatistics -AFoundationforAnalysisintheHealthSciences,Wiley
4. Rao, K. V. (2007), Biostatistics - A Manual of Statistical Methods for use in Health Nutrition andAnthropology
5. Pagano,M.and Gauvreau,K. (2007),Principles ofBiostatistics.
6. RosnerBernard(2010), FundamentalsofBiostatistics,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**.**