UNIVERSITY ✤ OF MYSORE
Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21

Dated: 26-10-2021

Notification

Sub:- Syllabus and Examination Pattern of Statistics (UG) with
effective from the Academic year 2021-22 as per NEP-2020.

Ref:- 1. Decision of Board of Studies in Statistics (UG) meeting
held on 29-09-2021.
2. Decision of the Faculty of Science & Technology Meeting
held on 16-10-2021.
3. Decision of the Academic Council meeting held on 22-10-2021.

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The Board of studies in Statistics (UG) which met on 29-09-2021 has recommended & approved the syllabus and pattern of Examination of Statistics Programme with effective from the Academic year 2021-22 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 16-10-2021 and 22-10-2021 respectively have also approved the above said proposal and it is hereby notified.

The syllabus and Examination pattern is annexed herewith and the contents may be downloaded from the University Website i.e., www.uni-mysore.ac.in.

Registrar
Registrar
University of Mysore
Mysore -

To:-

1. All the Principal of affiliated Colleges of University of Mysore, Mysore. Those who are running B.Sc Courses.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS, in Statistics, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DoS in Psychology, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangotri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council , Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of
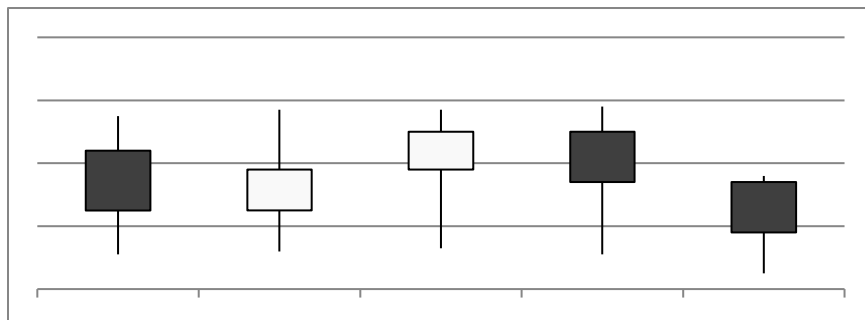
UNIVERSITY OF MYSORE, MYSURU
Regulations Governing the Choice Based Credit System Semester Scheme (CBCS) with Multiple Entry and Exit Options in the Undergraduate and Post-graduate Degree Programmes in the Faculties of Arts, Science as per NEP-2020

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

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

CONTENTS

1. Preamble of the Programme

The BoS in Statistics of the University of Mysore 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)/minor 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 in the Faculties of Arts, Science and Commerce from the academic year 2021-2022. The titles of the Core papers and elective papers from semester II 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 facilitates the decision making process by quantifying the element of chance or uncertainties. The descriptive and inferential statistics forms the basis for the growth of almost all the disciplines of the contemporary world. A person successfully completing the B.Sc (Honors) or B.Sc. and M.Sc. in Statistics program will have enough knowledge and expertise to statistically analyse all kinds of data sets, pursue advanced courses in Statistics or a Ph.D. in Statistics, work in software industry as domain expert, and independently consult for statistical data analysis and whatnot.

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.
- Candidates must opt Mathematics as one of the majors along with Statistics during first two years (I to IV semesters of the under graduate (UG) programme)

3. Programme Educational Objectives

- Graduates will demonstrate competence in respective domain as they apply skills to conduct scientific research and contribute to quality education.
- Graduates will be recognized as experts in educational and research institutes as well as industries in identifying and solving global challenges.
- Graduates will become leading researchers and professors who create and disseminate new knowledge in scientific and allied fields.

4. Programme Outcomes (POs)

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

PO-1.Discipline Knowledge: Use knowledge of science and apply to relevant areas.

PO-2. **Problem analysis:** Identify, formulate and analyze complex scientific problems using first principles of respective discipline.

PO-3. Problem solving: Execute a solution process using first principles of science to solve problems related to respective discipline.

PO-4. **Conduct investigations**: Conduct investigations of issues using research methods and research-based discipline knowledge including design of experiments, data collection, interpretation and analysis to arrive at valid conclusions.

PO-5. Modern tool usage: Identify, select and use modern scientific, Software/programming languages tool or technique for modeling, prediction, data analysis and solving problems in the areas of their discipline

PO-6.Environment and Society: Evaluate the impact of scientific solutions on society and environment and design sustainable solutions.

PO-7.Ethics: Demonstrate professional ethics, responsibilities and norms in respective profession.

PO-8.Individual and teamwork: Work effectively as an individual as a team member and as a leader in a multidisciplinary team.

PO-9.Communication: Communicate effectively with the stakeholders with emphasis on communicating with scientific community, comprehend scientific reports, write research papers and projects proposals and reports, deliver effective presentations, and give and receive clear instructions.

PO-10.Project Management and Finance: Apply the knowledge of scientific and technological principles to one's own work to manage projects in multidisciplinary settings.

PO-11.Lifelong Learning: Identify knowledge gaps and engage in lifelong learning in the context of changing trends in respective discipline.

5. 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**

6. Programme Structures with options

The programmes are flexible enough to allow liberty to students in designing them according to their requirements. Students may choose a single Major, Two majors and one Major with a Minor.

- One Major and one Minor subject/discipline along with Languages, Generic Electives, Ability Enhancement, Skill Development and Vocational courses including Extracurricular Activities
- 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 Years with 184-188 credits (Eight Semesters) of the multidisciplinary Four-year Undergraduate Programme/Five-year Integrated Master's Degree Programme.

IIA. Model Program Structures for the Under-Graduate Programs in Departments and Colleges affiliated to the University of Mysore
Bachelor of Science (Basic/ Hons.) with one major and one minor with practicals

Semester	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Discipline A1(4+2) Discipline B1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)		SEC-1: Digital Fluency (2)(1+0+2)	Physical Education for fitness(1) (0+0+2)	Health & Wellness (1) (0+0+2)	**25**
II	Discipline A2(4+2) Discipline B2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Environmental Studies (2)		Physical Education - Yoga(1) (0+0+2)	NCC/NSS/R&R(S&G)/ Cultural (1) (0+0+2)	**25**
Exit option with Certificate (50 credits)								
III	Discipline A3(4+2) Discipline B3(4+2)	OE-3 (3)	L1-3(3), L2-3(3) (4 hrs each)		SEC-2: Artificial Intelligence (2)(1+0+2)	Physical Education-Sports skills(1)(0+0+2)	NCC/NSS/R&R(S&G)/C ultural (1) (0+0+2)	**25**
IV	Discipline A4(4+2) Discipline B4(4+2)	OE-4 (3)	L1-4(3), L2-4(3) (4 hrs each)	Constitution of India(2)		Physical Education - Games (1) (0+0+2)	NCC/NSS/R&R(S&G)/C ultural (1) (0+0+2)	**25**
Exit option with Diploma (100 credits) OR Choose any one of the core subjects as Major and the other asMinor								
V	Discipline A5(3+2) Discipline A6(3+2) Discipline B5(3+2)	Vocational-1 (3)			SEC-3: SEC such as Cyber Security (2)			**20**

	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits

| VI | Discipline A7(3+2) Discipline A8(3+2) Discipline B6(3+2) | Vocational-2 (3) Internship (2) | | | (1+0+2) SEC-4: Professional Communication (2) | | | **22** |

| VII | Discipline A9(3+2) Discipline A10(3+2) Discipline A11(3) | Discipline A, E-1 (3) Discipline A, E-2 (3) Res.Methodology (3) | | | | | | **22** |
| VIII | Discipline A12(3+2) Discipline A13(3) Discipline A14(3) | Discipline A, E-3(3) Research Project (6)* | | | | | | **20** |

Award Bachelor of Science Honours, B.Sc. (Hons) degree in Statistics discipline (184 credits)

Master Degree with two Semesters

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

IIIA. Model Program Structures for the Under-Graduate Programs Departments and Colleges affiliated to the University of Mysore
Bachelor of Science (Basic/ Hons.) with both subjects as majors in 3rd Year

Semester	Discipline Core (DSC) (Credits) (L+T+P)	Discipline Elective(DSE) / Open Elective (OE) (Credits) (L+T+P)	Ability Enhancement Compulsory Courses (AECC), Languages (Credits) (L+T+P)		Skill Enhancement Courses (SEC)			Total Credits
					Skill based (Credits) (L+T+P)	Value based (Credits) (L+T+P)		
I	Discipline A1(4+2) Discipline B1(4+2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)		SEC-1: Digital Fluency (2)(1+0+2)	Physical Education for fitness(1) (0+0+2)	Health & Wellness (1) (0+0+2)	**25**
II	Discipline A2(4+2) Discipline B2(4+2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Environmental Studies (2)		Physical Education - Yoga(1) (0+0+2)	NCC/NSS /R&R(S&G)/ Cultural (1) (0+0+2)	**25**

| III | Discipline A3(4+2) Discipline B3(4+2) | OE-3 (3) | L1-3(3), L2-3(3) (4 hrs each) | | SEC-2: Artificial Intelligence (2)(1+0+2) | Physical Education-Sports skills(1)(0+0+2) | NCC/NSS /R&R(S&G)/Cultural (1) (0+0+2) | **25** |
| IV | Discipline A4(4+2) Discipline B4(4+2) | OE-4 (3) | L1-4(3), L2-4(3) (4 hrs each) | Constitution of India(2 | | Physical Education - Games (1) (0+0+2) | NCC/NSS /R&R(S&G)/Cultural (1) | **25** |

								(0+0+2)	
Exit option with Diploma (100 credits) or continue the third year with both the subjects as majors									
V	Discipline A5(3+2), Discipline A6(3+2) Discipline B5(3+2), Discipline B6(3+2)				SEC-3: SEC such as Cyber Security (2) (1+0+2)				**22**
VI	Discipline A7(3+2), Discipline A8(3+2) Discipline B7(3+2) Discipline B8(3+2) Internship (2)				SEC-4: Professional Communication (2)				**24**
Exit option with Bachelor of Science, B. Sc. Basic Degree (146 credits) or Choose one of the Disciplines as Major									
VII	Discipline A-9(3+2) Discipline A-10(3+2) Discipline A-11(3)	DS-A Elective-1(3) DS-A Elective-2(3) Res.Methodology(3)								**22**
VIII	Discipline A-12(3+2) Discipline A-13(3) Discipline A-14(3)	DS-A Elective 3(3) Research Project (6)*								**20**
Award Bachelor of Science Honours, B.Sc. (Hons) degree in Statistics discipline (188 credits)									
Master Degree with two Semesters									

*In lieu of the research Project, two additional elective papers/ Internship may be offered.

7. Curriculum Structure-Statistics

(Core courses)

Semesters- I to X

Semester	DSC	Core Courses	Credits
I	A1/B1	Descriptive Statistics	4
		Practicals based on A1 /B1	2
II	A2/B2	Probability and Distributions-I	4
		Practicals based on A2/B2	2
III	A3/B3	Probability and Distributions-II	4
		Practicals based on DSC A3/B3	2
IV	A4/B4	Sampling distributions, Estimation and Testing of Hypotheses	4
		Practicals based on DSC A4/B4	2
V	A5/B5	Matrix Algebra and Regression Analysis	3
		Practicals based on DSC A5/B5	2
	A6/B6	Analysis of Variance and Design of Experiments	3
		Practicals based on DSC A6/B6	2
VI	A7/B7	Sampling Techniques and Statistics for National	3

		Development.	
		Practicals based on DSC A7/B7	2
	A8/B8	Statistical Computing with R	3
		Practicals based on DSC A8/B8	2
	Internship	Data Analysis with R	2
VII	A9	Real Analysis	3
	A10	Probability Theory	3
	A11	Statistical Inference	3
		Practicals based on A10,A11	4
	E-1 and E-2	Select Two DSE courses from group –I listed below	3+3
	Research Methodology	Latex and use of Latex in report writing	3
VIII	A12	Linear Algebra	3
	A13	Multivariate Analysis	3
	A14	Linear Models and Regression Analysis	3
		Practicals based on A13 and A14	2
	E-3	Select one DSE courses from group –II listed below	3
	Research Project	TBD	6
IX	A15	Stochastic Processes	3
	A16	Multivariate Techniques	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 group –III listed below	3+3
X	A18	Design and Analysis of Experiments	3
	A19	Limit Theorems in Probability	3
		Practicals based on A18	2
	Dissertation Work	TBD	6

Discipline Specific Electives (DSE) for VII to X Semesters

	Group-I:VII Semester Electives (Select any Two)		Group-II:VIII Semester Electives (Select any One)	
E-1	Actuarial Statistics	E-6	Computational Statistics	
E-2	Bio-Statistics	E-7	Machine Learning with R	

E-3	Data Analytics with R	E-8	Nonparametric and Semiparametric Methods
E-4	Reliability Analysis	E-9	Time Series Analysis
E-5	Operations Research		
	Group-III:IX Sem Electives (Select any Two)		**Dissertation Work**
E-10	Advanced Probability Theory		Dissertation work based research papers suggested by guide
E-11	Extreme Value Theory		
E-12	Statistical Learning and Data Mining with R		
E-13	Advanced Statistical Inference		

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 Statistics with R
OE-6	Probability and mathematical Statistics
OE-7	Introduction to Time Series Analysis
OE-8	Multivariate Techniques with R

8.CurriculumStructure for the Undergraduate Degree Program
B.Sc.

Total Credits for the Program: 184/188   Starting year of implementation: 2021-22
Name of the Degree Program : B. Sc.   Discipline/Subject: Statistics(Major)

Program Articulation Matrix for I and II semesters

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, internships etc.

Semester	Title of the DSC	Program outcomes that the course addresses (not more than 3 per	Pre-requisite course(s)	Pedagogy	Assessments

			course)		
I	Descriptive Statistics	PO-1,PO-2,PO-3	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, and peer discussions.
I	Practical	PO-2,PO-3,PO-4,PO-5	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	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, and peer discussions.
II	Practicals	PO-1,PO-2,PO-4,PO-5	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 courses the student 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 of 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 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 distributions to the given data set, applications of normal and other standard distributions

<p style="text-align:center; color:red;">Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-11)</p>

Course Outcomes (COs) / Program Outcomes (POs)	1	2	3	4	5	6	7	8	9	10	11
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	x	x	x	x							

multiple correlations.												
CO -4. Learn different of 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 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								
CO -7. Learn Standard univariate discrete and continuous distributions and their applications in other disciplines of science	x	x	x	x	x						x	
CO -8. Will learn basics of R-programming and able to write and execute R codes in descriptive statistics, probability models ,Fitting of suitable distributions to the given data set, applications normal and other distributions.			x	x	x						x	

9. 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: 60
Model Syllabus Authors: Statistics BoS Members ,UoM	

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. Concepts of statistical population and sample (SRS, Stratified, Systematic and Cluster sampling methods Definitions only). 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.	
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. Quantiles and measures based on them. Box Plot. Outliers. Chebyshev's inequality, normal data sets.	
Unit – 3: Bivariate Data Analysis	**15 hrs**
Bivariate Data, Scatter plot, Correlation, Karl Pearson's correlation coefficient, Rank correlation: Spearman's and Kendall's measures. Concept of errors, Principle of least squares, fitting of polynomial and exponential curves. Simple linear regression and its properties. Fitting of linear regression line and coefficient of determination.	
Unit –4: Multivariate Data Analysis	**10hrs**
Analysis of Categorical Data: Contingency table, independence and association of attributes, measures of association - odds ratio, Pearson's and Yule's measure, Multivariate Frequencies, Multivariate Data Visualization, mean vector and dispersion matrix, Multiple linear regression, multiple and partial correlation coefficients. Residual error variance.	

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 C P L F de 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(7marks)+Attendance(3marks)	10
Total	40

Practical Content based on DSC A1/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. Regression of two variables.
9. Multivariate Descriptive statistics, mean Vector, dispersion matrix correlation matrix, 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 DSC A2/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 DSC A2/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	**14 hrs**
Standard discrete probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric. Standard continuous probability distributions: uniform, normal, exponential and applications of discrete and continuous distributions.	
Unit –4: Data Analysis Using R	**14 hrs**
Introduction to R: Installation, command line environment, overview of capabilities, brief mention of open source philosophy. R as a calculator: The four basic arithmetic operations. Use of parentheses nesting up to arbitrary level. The power operation. Evaluation of simple expressions. Quotient and remainder operations for integers. Standard functions, e.g., sin, cos, exp, log. The different types of numbers in R: Division by zero leading to Inf or -Inf. NaN. NA. No need to go into details. Variables. Creating a vector using c(), seq() and colon operator. How functions map over vectors. Functions to summarize a vector: sum, mean, sd, median etc. Extracting a subset from the vector (by index, by property). R as a graphing calculator: Introduction to plotting. Plot(), lines(), abline(). No details about the graphics parameters except colour and line width. Barplot, Pie chart and Histogram. Box plot. Scatter plot and simple linear regression using lm(y~x). Problems on discrete and continuous probability 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 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 (7marks)+Attendance(3marks)	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.

OE-1:Statistical Methods its Applications

Time: 3hrs /week   Max.Marks:40+60
Number of Credits:03

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 data set.

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 statistical 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. Mukhyopadyaya 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
Time: 3hrs /week   Max.Marks:40+60
Number of Credits:03

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; linear and non-linear, 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 regression lines, Regression equations and estimation; Properties of regression coefficients; Relationship between Correlation and 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: Laspeyre'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 fittings to the data. Seasonal variation - definition, illustrations, measurements, simple average method, ratio to moving average method, ratio of trend method, link relatives 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. Applied Statistics

Time: 3hrs /week   Max.Marks:40+60
Number of Credits:03

Course Objectives

- To enable the students to use statistical tools in finance, industries, population studies and health sciences.
- To acquire knowledge about sampling methods for surveys.

Course Outcomes (COs)

Upon successful completion of this course, the student will be able to:
CO1.Understand the Price and Quantity Index numbers and their different measures, understand the applicability of cost of living Index number.
CO2.Know the components and Need for Time series, understand the different methods of studying trend and Seasonal Index.
CO3. Study the concept of vital statistics, sources of data, different measures of Fertility and Mortality, Understand the Growth rates- GRR and NRR and their interpretations.
CO4. Know the concept of Population, Sample, Sampling unit, sampling design, sampling frame, sampling scheme, need for sampling, apply the different sampling methods for designing and selecting a sample from a population, explain sampling and non-sampling errors.
CO5. Describe the philosophy of statistical quality control tools as well as their usefulness in industry and hence develop quality control tools in a given situation.

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: Economic Statistics   12 Hours
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, neo natal 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 SRS, 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: 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. Mukhopadhaya 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
Time: 3hrs /week   Max.Marks:40+60

Number of Credits:03

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: Relation between two variables, definition of correlation, types of correlation, Scatter diagram, Karl-Pearson's coefficient of linear correlation and its properties, Spearman's Rank Correlation coefficient. Regression- Simple linear regression, fitting of regression equations by method of Least Squares, linear regression coefficients and their properties.

Unit 3: Probability and Distributions   10 Hours

Probability: Random experiment, 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 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 counter parts. 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.

References
1. Dutta, N. K. (2004), Fundamentals of Biostatistics, Kanishka Publishers.
2. Gurumani N. (2005), An Introduction to Biostatistics, MJP 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.