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UNIVERSITY OF MYSORE

Estd. 1916

VishwavidyanilayaKaryasoudha
Crawford Hall, Mysuru- 570 005

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

Dated:10.10.2022

Notification

Sub:- Syllabus and Examination Pattern of Statistics (UG) (III & IV Semester) with effective from the Academic year 2022-23 as per NEP-2020.

Ref:-
1. Decision of Board of Studies in of Statistics (UG) Meeting held on 01-08-2022.
2. Decision of the Faculty of Science & Technology Meeting held on 15-09-2022.
3. Decision of the Academic Council meeting held on 23-09-2022.

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The Board of Studies in Statistics (UG) which met on 01-08-2022 has recommended & approved the syllabus and pattern of Examination of Statistics Course (III & IV Semester) with effective from the Academic year 2022-23 as per NEP -2020.

The Faculty of Science & Technology and Academic Council at their meetings held on 15-09-2022 and 23-09-2022 respectively has also approved the above said syllabus and hence 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.

Draft Approved by the Registrar

10/10

DeputyRegistrar(Academic)

Deputy Registrar (Academic)
University of Mysore
Mysore-570 005

To:-

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
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 Earth Science, 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 Mysore, Mysuru.
10. Office Copy.

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

Syllabus for III and IV Semesters B.Sc. with subject Statistics as Major/Minor

AUGUST-2022

6. 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 Distributions-I	4
		Practicals based on A2/B2	2
III	A3/B3	Probability distributions-II	4
		Practicals based on DSC A3/B3	2
IV	A4/B4	Statistical Inference-I	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 Development.	3
		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 + ….TBD	
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	TBD	

	Project		
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 of Experiments	**3**
	A19	Limit Theorems in Probability	**3**
		Practicals based on A18	**2**
	Dissertation Work	TBD	**6**

Open Electives for III and IV Semesters

Sl.NO.	Titles of **Open Electives**
OE-5	Introduction Statistics with R
OE-6	Probability and mathematical Statistics
OE-7	Population Studies

Assessment for Discipline Specific Core(DSC)
Weightage for assessments (in percentage)

Type of Course	**Formative Assessment / IA**	**Summative Assessment**
Theory	40	60
Practical	25	25(20+5 for record book)
Projects	40	60
Experiential Learning (Internships, etc.)	40	60

Syllabus for III and IV Semesters B.Sc. with Statistics as Major/Minor

B.Sc. III Semester

Course Title: **Probabilityand Distributions-II**	
Total Contact Hours: 56	Course Credit : 04
Formative Assessment Marks: 40	Duration of ESA: 2 hours
Model Syllabus Authors: Statistics BoS Members ,UoM	Summative Assessment Marks: 60

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

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

Course Objectives:

1) To introduce the concept and various properties of joint distribution of bivariate random vector, marginal distribution, conditional expectations and correlation coefficient.
2) To introduce the various techniques of functions of random vector and their distributions
3) To introduce Weak law of large numbers(WLLN) and Central limit theorem (CLT)
4) To make students exercise the fundamentals of simulation techniques in R environment.

Course Outcomes: At the end of this course students are able to:

1) Understand the concept of joint distribution of bivariate random vector, able to find marginal, conditional expectations and correlation coefficient.
2) Understand in detail functions of random vector and their distributions
3) Able to find approximate distribution of statistic when is sample size is large
4) Generate random variables from various distributions using R-code.

Course Pedagogy :

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.

Title of the Course A3/B3: Probability and Distributions-II

Title of DSC A3/B3: Probability and Distributions-II

Theory Content of DSC A3/B3	**56hrs**
Unit 1: Two Dimensional Random Variables	
Notion of Bivariate random variables. Bivariate distribution functions: cumulative distribution function, joint density function for discrete and continuous random variables. Conditional distributions and stochastic independence: marginal and conditional distributions of discrete and continuous random variables, independence of random variables. Expectation: definition, covariance and correlation coefficient, conditional expectations, joint moment generating functions and moments, independence and expectation, Cauchy-Schwarz inequality.	16
Unit 2:Distributions of Functions of Random Variables	14
Distribution function technique: Description of technique, Distribution of sum and difference of tow random variables, distribution of product and quotient. Moment generating function technique: Description of technique: distribution of sums of independent random variables. Transformation of variable technique: Transformation of discrete and continuous random variables. Relationships among standard distributions. Expectations of functions of random variables: expectations of sums of random variables, expectations of product and quotient of random variables. Probability integral transformation. Concept of order statistics, Distribution of maximum and minimum order statistics (with proof) and r-th order statistic (without proof).	
Unit 3: Bivariate distributions, Weak law large numbers and Central limit Theorem.	10
Bivariate normal distribution: definition through probability density function, marginal and conditional distribution. Multinomial distributions. Definitions and concepts of convergence in probability, convergence in mean square and convergence in distribution . Weak law of large numbers and their applications(only statement), Statement of Central Limit Theorem (C.L.T.) for i.i.d. random variables, applications of CLT.	
Unit 4: **Sampling Distributions and Simulation**	16
Definitions of random sample, parameter and statistic, sampling distribution of sample mean, standard error of sample mean, sampling distribution of sample variance, standard error of sample variance. Sampling from the normal distributions: Role of normal distribution in statistics, The Chi-square distribution: mean, variance, moments, mode, additive property. The Student's and Fisher's t-distribution: mean, variance, moments and limiting form of t distribution. The F-distribution: mean, variance and mode. Relationship between t, F and Chi-square distributions. Introduction to simulation: Generation of random observations from Uniform, Exponential, Normal, Binomial, Poisson distributions using R-codes. Q-Q plots for continuous distributions. Plots of empirical distribution function versus population distribution function.	

References

1. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition.
2. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference,10th Edition, Pearson Education, New Delhi.
3. Jay Kerns, G. (2010). Introduction to Probability and Statistics using R. 1st Edition, Springer.
4.Mood,A.M,Grabill,F.A,Boes,D.C.(2001).Introduction to the Theory of Statistics.Tata McGraw Hill Edition.
5. Rohatgi, V.K. and A.K. Md. Ehsanes Saleh. (2002). An Introduction to Probability Theory and Mathematical Statistics, New York, John Wiley.
6. Ross, S. M. (2014). Introduction to Probability Models. 11th Edition, Elsevier science.
7. Ross, S. M. (2012). Simulation. Academic Press.
8. Verzani, J. (2002). Simple R - Using R for Introductory Statistics.

Course Title: **A3/B3:Probability and Distributions-II Practical 3/Lab 3**	
Total Contact Hours: 52	Course Credit :02
Formative Assessment Marks: 25	Duration of ESA: 2 hours
Model Syllabus Authors: Statistics BoS Members ,UoM	Summative Assessment Marks: **25(20+5(Practical record)**

Formative Assessment: Total 25 marks	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test 1	10
Internal Test 2	10
Records + Attendance	05
Total	25

List of Practical /Lab 3 based on A3/B3: Probability and Distributions-II

Note: A demonstration of R codes is the first practical task. All of the practical assignments from 7 to 12 must be manually solved using scientific calculators before being executed using R-codes.

Ins: Instructions on R-codes to execute practicals from 7 to 12.(may spend 2 sessions of practical hrs)

1. Bivariate Probability Distributions - Marginal and Conditional distributions,
2. Bivariate Probability Distributions - Conditional Mean, Conditional Variance, Correlation.
3. Applications of weak law of large numbers, convergence in distribution
4. Applications of central limit theorem.
5. Problems on Functions of random variables
6. Problems based sampling distributions of mean, variance and standard error
7. Application based problems on bivariate normal and multinomial distributions
8. Application based on Chi-square distributions.

9. Application based on t, and F distributions
10. Generating random sample from standard discrete distributions.
11. Generating random sample from standard continuous distributions
12. Problems based on Q-Q plots and plot of empirical distribution function.

B.Sc. IV Semester

Course Title: A4/B4 -**Statistical Inference-I**	
Total Contact Hours: 56	Course Credit :04
Formative Assessment Marks: 40	Duration of ESA: 02 hours
Model Syllabus Authors: Statistics BoS Members ,UoM	Summative Assessment Marks: 60

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

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

Course Objectives:

1) To introduce the estimation techniques and its theoretical properties
2) To introduce basic element of testing of statistical hypotheses.
3) To introduce how to construct confidence intervals and tests of hypotheses.

Course Outcomes: At the end of this course students are able to:

1. Obtain estimators and examine the properties of good estimators
2. Construct good test procedures and find size of errors and power of tests.
3. Employ suitable test procedure and construct Confidence interval for small as well as large sample sizes, respectively for a given data set.

Pedagogy:

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.

Title of the Course DSC: A4/B4: **Statistical Inference-I**

Theory of Content DSC A4/B4	**56hrs**
Unit 1: Point Estimation-I	
Point Estimation: Concepts of estimation, notions of mean square error, unbiasedness, best linear unbiased and minimum variance unbiased estimators. Necessary and sufficient condition for uniformly minimum variance unbiased estimators (UMVUE). Properties of UMVUE. Consistent estimators and asymptotic efficiency. Sufficiency, factorization theorem (discrete case only).	16
Unit 2:Point estimation-II	10
Fisher information. Cramer-Rao inequality and minimum variance bound (MVB) estimators, Rao- Blackwell theorem and its applications. Methods of Estimation: Method of Moments, Maximum likelihood estimation (MLE) and statements of their properties.	
Unit 3: Testing of Hypotheses	16
Theory of hypotheses testing: null and alternative, simple and composite hypotheses. Type-I and Type-II errors, test functions, non-randomized tests, size, level of significance, Power function, power of tests. Critical region, p- value and its interpretation. Most powerful (MP) test, uniformly most powerful (UMP) test (definition only). Neyman - Pearson lemma (statement and proof of sufficiency part only) and its applications to construct MP and UMP tests Likelihood ratio tests, properties of likelihood ratio tests (without proof).	
Unit 4: Exact tests and confidence intervals	14
Classical and p-value approaches of tests. Tests of significance related to Binomial proportion(s), Poisson mean(s), univariate Normal mean (s), standard deviation(s) and bivariate normal parameters. Confidence interval, confidence coefficient, shortest confidence interval. Methods of constructing confidence intervals using pivotal quantities. Construction of confidence intervals for mean, difference of two means, variance and ratio of variances, proportions, difference of two proportions.	

References:

1. Casella , G. and Berger R.L. (2002).: Statistical Inference, 2nd Edn. Thomson Learning.
2. Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley & Sons.
3. Hogg, R. V. McKean J. W. and Craig, A. T. (2012), Introduction to Mathematical Statistics, Pearson 7th Edition.
4. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009), Probability and Statistical Inference,10th Edition, Pearson Education, New Delhi.
5.Johnson, R.A. and Bhattacharyya, G.K. (2006), Statistics: Principles and methods. 5th Edition, John Wiley & Sons, New York.
6.Mood,A.M,Grabill,F.A,Boes,D.C.(2001).Introduction to the Theory of Statistics.Tata McGraw Hill Edition.
7. Rohatgi, V.K. and A.K. Md. Ehsanes Saleh. (2002). An Introduction to Probability and Statistics, New York, John Wiley.

8. Verzani, J. (2002). Simple R - Using R for Introductory Statistics

Course Title: **A4/B4 Statistical Inference-I Practical 3/Lab 3**	
Total Contact Hours: 52	Course Credit :02
Formative Assessment Marks: 25	Duration of ESA: 2 hours
Model Syllabus Authors: Statistics BoS Members ,UoM	Summative Assessment Marks: **25(20+5(Practical record)**

Formative Assessment: Total 25 marks	
Assessment Occasion/ type	**Weightage in Marks**
Internal Test 1	10
Internal Test 2	10
Attendance	05
Total	25

List of Practical 4 /Lab 4 based on A4/B4 Statistical Inference-I

Note: A demonstration of R codes is the first practical task. All of the practical assignments must be manually solved using scientific calculators before being executed using R-codes.

O: Demonstration on R-codes to execute following practical (may spend one session of practical hrs):

1. Likelihood function and its graph for some standard distributions: binomial, Poisson, normal, exponential.
2. Obtaining estimate of standard errors and mean square error of estimators
3. Computing maximum likelihood estimates.

4. Computing moment estimates.

5. Interval estimation: Construction of confidence interval (large and small samples)

6. Evaluation of Probabilities of Type – I and Type – II errors and power of tests.

7. Test of significance and confidence intervals for single proportion and difference of two proportions.
8. Test of significance for single Poisson mean and difference of two Poisson means.
9. Test of significance and confidence intervals for single mean and difference of two means.
10. Test of significance and confidence intervals for single variance and ratio of two variances.
11. Large sample tests: Tests for mean, equality of means when variance is (i) known (ii) unknown, under normality, variance and equality of two variances under normality. P-values for the above tests.

12. MP and UMP tests for parameters of binomial, Poisson distributions, normal and Exponential (scale parameter only) distributions and power curve.

OE-5. Introduction Statistics with R

Time: 3hrs /week Max.Marks:40+60

Course Objectives

Co-1: This soft core course is intended to introduce basic of Statistics with R language to students who do not study Statistics as part of their program.

Co-2: Introduce R codes to analyse data using standard statistical methods.

Course Outcomes (COs)

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

CO1. Install, Code and Use R Programming Language in R Studio IDE to perform basic tasks on Vectors, Matrices and Data frames.
CO2. Describe key terminologies, concepts and techniques employed in Statistical Analysis.

Pedagogy:

1. The course is taught using PPT, hands-on practice, and problem solving through examples and exercises.
2. Students are encouraged to use resources available on open sources.

Unit 1: 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., sine, cos, exp, log. The different types of numbers in R: Division by zero leading to Infor -Inf. NaN. NA. No need to go into details.

Unit 2: 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).

Unit 3: Matrix operations in R: Creation. Basic operations. Extracting submatrices.
Loading data from a file: read.table() and read.csv(). Mention of head=TRUE and head=FALSE.
Data frames. Mention that these are like matrices, except that different columns may be of different types.
Unit 4: Descriptive statistics, correlation and lines of regression. Basics of statistical inference in order to understand hypothesis testing and compute p-values and confidence intervals.

References:
1.Braun W J, Murdoch D J (2007): A First Course in Statistical Programming with R. Cambridge University Press. New
York
2.R for beginners by Emmanuel Paradis (freely available at **https://cran.r-project.org/doc/contrib/Paradisrdebuts_ en.pdf**)
3. Gardener, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.
4. Medhi, J. (2005). Statistical Methods, New Age International.

OE-6: Probability and Mathematical Statistics

Time: 3hrs /week Max.Marks:40+60

Course Objectives

Co-1: This soft core course is intended to introduce basic Mathematical Statistics to students who do not study Statistics as part of their program.

Co-2 Some advanced topics are also part of the course ,this course is suitable for students who studied Mathematics at 10+2 level.

Course Outcomes:

Some advanced topics are also part of the course and students finishing this course will have enough knowledge to explore further advanced topics in Probability and Statistics.

Pedagogy

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.

Unit 0: Review of set theory and calculus.

Unit 1: Probability: Axiomatic Probability, Random Variables and distributions. Expectations and moments.

Unit 2: Probability Distributions and sampling distributions: Standard discrete and continuous probability models. Sampling distributions. Modes of Convergence , WLLN, SLLN and CLT with applications (SLLN and CLT - statements only)

Unit 3: Descriptive Statistics: Measures of central tendency and dispersion. Correlation and regression - curve fitting.

Unit 4: Statistical Inference: Parameters and estimates. Methods of estimation - moment, maximum Likelihood Properties of estimators - Unbiasedness, MSE and consistency Interval. Estimation. **:** Testing of hypotheses - Basic concepts of testing, Neyman - Pearson lemma (Statement only) and examples Likelihood Ratio Tests - One sample and two sample problems.

Reference:

Hogg, R V. and Tanis, E.A.: Probability and Statistical Inference. McMillan, New York

Hogg, R. V. and Craig: Introduction to Mathematical Statistics, McMillan, New York.

Freund, J.E: Modern Elementary Statistics, Prentice Hall of India, New Delhi.

OE-7: Population Studies

Time: 3hrs /week Max.Marks:40+60

Course Objectives

Course Objectives :

1. This soft core course is intended to introduce to students who do not study Statistics as part of their program.
2. To enable the students to identify appropriate sources of data, perform basic demographic analysis using various techniques and ensure their comparability across populations.
3. To acquire knowledge about the construction of life table and its applications in demographic analysis.

Course Outcomes (CO)

Upon successful completion of this course the student will be able to

CO1. Study the concepts of Vital Statistics, sources of data, different measures of Fertility, Mortality and migration.

CO2. Understand the Growth rates- GRR and NRR and their interpretations.

Pedagogy

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.

Contents

Unit-1: Introduction and Sources of Population Data

Introduction: Sources of data on vital statistics, errors in census and registration data. salient features of Census, Civil Registration System, National Sample Surveys, Demographic Surveys, relative merits and demerits of these sources. Measurement of population, Ratesand ratios of vital events.

Unit2 : Measurements of Mortality

Crude Death Rate (CDR), Specific Death Rate (SDR), Standardized Death Rate, Cause of Death Rate, Case Fatality Rate, Infant Mortality Rate (IMR), Maternal Mortality Rate (MMR), Neonatal and Perinatal Mortality Rates.

Unit3: Life (Mortality) Tables

Assumption, descriptions of Complete and Abridged Life Tables, Cohort vs. Current Life Tables, Stationary and Stable population, Construction of Complete Life Table from population and death statistics, Central Mortality Rates and Force of Mortality, Uses of Life Tables.

Unit 4: Measurement of Population Growth:

Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR). *Population Estimation, Projection and Forecasting*: Use of A.P. and G.P. methods for population estimates, Use of component method for population projection, Fitting of Logistic curve for population forecasting using Rhode's method.

References

1. Barclay, G, W(1968). Techniques of Population Analysis, John Wiley and Sons, Incs. New York/London.

2. Keyfitz, H (1968). Introduction to the Mathematics of Population. Addison-Wesley Publishing Co.

3.Mishra B.D. (1980): An Introduction to the Study of Population, South Asian Pub.

4. Pathak, K.B and Ram, F (1991).Techniques of Demographic Analysis, Himalaya Publishing House.

5. Ramakumar. R (1986). Technical Demography, Wiley Eastern Ltd.

6. Srinivasan. K (1998). Basic Demographic Techniques and Applications, Sage Publication, New Delhi.

7. Wunsch G.J. & M.G. Tarmota(1978). Introduction to Demographic Analysis, Plenum