



KARNATAK UNIVERSITY, DHARWAD  
ACADEMIC (S&T) SECTION

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ  
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ



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'A' Grade 2014

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No. KU/Aca(S&T)/JS/MGJ(Gen)/2023-24/59

Date: 04/09/2023

ಅಧಿಸೂಚನೆ

ವಿಷಯ: 2023-24ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಎಲ್ಲ ಸ್ನಾತಕ ಪದವಿಗಳಿಗೆ 5 ಮತ್ತು 6ನೇ ಸೆಮಿಸ್ಟರ್  
NEP-2020 ಪಠ್ಯಕ್ರಮವನ್ನು ಅಳವಡಿಸಿರುವ ಕುರಿತು.

- ಉಲ್ಲೇಖ: 1. ಸರ್ಕಾರದ ಅಧೀನ ಕಾರ್ಯದರ್ಶಿಗಳು(ವಿಶ್ವವಿದ್ಯಾಲಯ 1) ಉನ್ನತ ಶಿಕ್ಷಣ ಇಲಾಖೆ ಇವರ  
ಆದೇಶ ಸಂಖ್ಯೆ: ಇಡಿ 104 ಯುಎನ್‌ಇ 2023, ದಿ: 20.07.2023.  
2. ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ ಸಂಖ್ಯೆ: 2 ರಿಂದ 7, ದಿ: 31.08.2023.  
3. ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶ ದಿನಾಂಕ: 04/09/2023

ಮೇಲ್ಕಾಣಿಸಿದ ವಿಷಯ ಹಾಗೂ ಉಲ್ಲೇಖಗಳನ್ವಯ ಮಾನ್ಯ ಕುಲಪತಿಗಳ ಆದೇಶದ ಮೇರೆಗೆ, 2023-24ನೇ  
ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಅನ್ವಯವಾಗುವಂತೆ, ಎಲ್ಲ B.A./ BPA (Music) /BVA / BTTM / BSW/ B.Sc./B.Sc. Pulp &  
Paper Science/ B.Sc. (H.M)/ BCA/ B.A.S.L.P./ B.Com/ B.Com (CS) / BBA & BA ILRD ಸ್ನಾತಕ ಪದವಿಗಳ 5  
ಮತ್ತು 6ನೇ ಸೆಮಿಸ್ಟರ್‌ಗಳಿಗೆ NEP-2020ರ ಮುಂದುವರಿದ ಭಾಗವಾಗಿ ವಿದ್ಯಾವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ಅನುಮೋದಿತ  
ಕೋರ್ಸಿನ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ [www.kud.ac.in](http://www.kud.ac.in) ದಲ್ಲಿ ಭಿತ್ತರಿಸಲಾಗಿದೆ. ಸದರ ಪಠ್ಯಕ್ರಮಗಳನ್ನು ಕ.ವಿ.ವಿ.  
ಅಂತರ್ಜಾಲದಿಂದ ಡೌನ್‌ಲೋಡ್ ಮಾಡಿಕೊಳ್ಳಲು ಸೂಚಿಸುತ್ತ ವಿದ್ಯಾರ್ಥಿಗಳ ಹಾಗೂ ಸಂಬಂಧಿಸಿದ ಎಲ್ಲ ಬೋಧಕರ ಗಮನಕ್ಕೆ  
ತಂದು ಅದರಂತೆ ಕಾರ್ಯಪ್ರವೃತ್ತರಾಗಲು ಕವಿವಿ ಅಧೀನದ/ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ  
ಸೂಚಿಸಲಾಗಿದೆ.

ಅಡಕ: ಮೇಲಿನಂತೆ

  
ಕುಲಸಚಿವರು.

ಗೆ,

ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯದ ವ್ಯಾಪ್ತಿಯಲ್ಲಿ ಬರುವ ಎಲ್ಲ ಅಧೀನ ಹಾಗೂ ಸಂಲಗ್ನ ಮಹಾವಿದ್ಯಾಲಯಗಳ  
ಪ್ರಾಚಾರ್ಯರುಗಳಿಗೆ. (ಕ.ವಿ.ವಿ. ಅಂತರ್ಜಾಲ ಹಾಗೂ ಮಿಂಚಂಚೆ ಮೂಲಕ ಬಿತ್ತರಿಸಲಾಗುವುದು)

ಪ್ರತಿ:

1. ಕುಲಪತಿಗಳ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
2. ಕುಲಸಚಿವರ ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
3. ಕುಲಸಚಿವರು (ಮೌಲ್ಯಮಾಪನ) ಆಪ್ತ ಕಾರ್ಯದರ್ಶಿಗಳು, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
4. ಅಧೀಕ್ಷಕರು, ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ / ಗೌಪ್ಯ / ಜಿ.ಎ.ಡಿ. / ವಿದ್ಯಾಂಡಳ (ಪಿ.ಜಿ.ಪಿ.ಎಚ್.ಡಿ) ವಿಭಾಗ, ಸಂಬಂಧಿಸಿದ  
ಕೋರ್ಸುಗಳ ವಿಭಾಗಗಳು ಪರೀಕ್ಷಾ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.
5. ನಿರ್ದೇಶಕರು, ಕಾಲೇಜು ಅಭಿವೃದ್ಧಿ / ವಿದ್ಯಾರ್ಥಿ ಕಲ್ಯಾಣ ವಿಭಾಗ, ಕ.ವಿ.ವಿ. ಧಾರವಾಡ.



**KARNATAK UNIVERSITY, DHARWAD**

# **B.Sc. in Statistics**

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**SYLLABUS**

**With Effect from 2023-24**

**DISCIPLINE SPECIFIC CORE COURSE (DSCC) FOR SEM V & VI**

**AS PER N E P - 2020**

**Karnatak University, Dharwad**  
B.Sc. in Statistics  
Effective from 2023-24

Sem.	Type of Course	Theory/ Practical	Course Code	CourseTitle	Instructi onhour/ week	Total hours / sem	Duration of Exam	Marks			Credits
								Formati ve	Summa tive	Total	
V	DSCC-9	Theory	035 STA 011	Matrix algebra and Regression analysis	04hrs	56	02 hrs	40	60	100	04
	DSCC-10	Practical	035 STA 012	Matrix algebra and Regression analysis	04 hrs	56	03 hrs	25	25	50	02
	DSCC-11	Theory	035 STA 013	Analysis of variance and Design of experiments	04hrs	56	02 hrs	40	60	100	04
	DSCC-12	Practical	035 STA 014	Analysis of variance and Design of experiments	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										04
	Other subject										04
	SEC-3	Practical	035 STA 061	Machine Learning with R-programming	04hrs	56	03 hrs	25	25	50	02
<b>Total</b>								<b>275</b>	<b>375</b>	<b>650</b>	<b>26</b>
VI	DSCC-13	Theory	036 STA 011	Statistical Inference-II	04hrs	56	02 hrs	40	60	100	04
	DSCC-14	Practical	036 STA 012	Statistical Inference-II	04 hrs	56	03 hrs	25	25	50	02
	DSCC-15	Theory	036 STA 013	Sampling Methods, Official Statistics and Econometrics	04hrs	56	02 hrs	40	60	100	04
	DSCC-16	Practical	036 STA 014	Sampling Methods, Official Statistics and Econometrics	04 hrs	56	03 hrs	25	25	50	02
	Other subject										04
	Other subject										04
	Other subject										04
	Internship-1	Practical	036 STA 091	Data Science Internship/Mini Project				50	0	50	02
<b>Total</b>								<b>300</b>	<b>350</b>	<b>650</b>	<b>26</b>

## B.Sc. Semester – V

### Discipline Specific Course (DSC)-9

**Course Title: Matrix algebra and regression analysis**

Course Code: 035 STA 011

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
<b>DSCC-9</b>	<b>Theory</b>	<b>04</b>	<b>04</b>	<b>56 hrs.</b>	<b>2hrs.</b>	<b>40</b>	<b>60</b>	<b>100</b>

**Course Outcomes (COs): At the end of the course students will be able to:**

- CO1 : Demonstrate and understanding of basic concepts of matrix algebra, including determinants, inverse and properties of various types of matrices.
- CO2 : Apply matrix algebra and linear algebra techniques to solve systems of linear equations, determine the rank of matrix, understanding quadratic forms and their applications in statistics, characteristic roots and vectors.
- CO3 : Develop and understanding of simple and multiple regression models, including the assumptions underlying these models, techniques for inference and hypothesis testing and diagnostics checks and corrections.
- CO4 : Apply regression analysis techniques to real world data sets.

Unit	Title:	56. hrs/sem
<b>Unit I</b>	<p><b>Algebra of matrices and determinants :</b></p> <p>A review of matrix algebra, theorems related to triangular, symmetric and skew symmetric matrices, idempotent matrices, orthogonal matrices, singular and non-singular matrices and their properties. Trace of a matrix, unitary matrices. Adjoint and inverse of a matrix and related properties. Determinants of Matrices: Definition, properties and applications of determinants for 3rd and higher orders, evaluation of determinants of order 3 and more using transformations. Symmetric and Skew symmetric determinants. Jacobi's Theorem, product of determinants.</p>	14 hrs
<b>Unit II</b>	<p><b>Linear Algebra :</b></p> <p>Linear algebra: Use of determinants in solution to the system of linear equations, row reduction and echelon forms, the matrix equations <math>AX=B</math>, solution sets of linear equations, linear independence, Applications of linear equations. inverse of a matrix. Rank of a matrix, row-rank, column-rank, standard theorems on ranks, rank of the sum and the product of two matrices.</p>	14 hrs

<b>Unit III</b>	<b>Simple linear regression :</b>  Assumptions, inference related to regression parameters, standard error of prediction, tests on intercepts and slopes, extrapolation, diagnostic checks and correction: graphical techniques, tests for normality, uncorrelatedness, homoscedasticity, lack-of-fit testing, transformations on Y or X (Box-Cox, square root, log etc.), method of weighted least squares, inverse regression.	14 hrs
<b>Unit IV</b>	<b>Multiple linear regression :</b>  Standard Gauss Markov setup, Gauss-Markov theorem (without proof), least squares (LS) estimation, variance-covariance of LS estimators, estimation of error variance, LS estimation with restriction on parameters. Simultaneous estimation of linear parametric functions. Tests of hypotheses for one and more than one linear parametric functions, confidence intervals, Variable selection problems.	14 hrs

**References:**

1. Ramachandra Rao, A. and Bhimasankaram, P. (2000). Linear Algebra.Hindustan Book Agency
2. Searle, S. R. (1982). Matrix Algebra Useful for Statistics, John Wiley, New York.
3. Kumaresan, S. (2000). Linear Algebra: A Geometric Approach, Prentice Hall
4. Gilbert strang (2016) Linear Algebra and its Applications, 5<sup>th</sup> edition Cengage Learning.
5. Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003). Introduction to Linear Regression Analysis, Wiley.
6. Weisberg, S. (2005). Applied Liner Regression, Wiley.
7. Yan, X. and Su, X. G. (2009). Linear Regression Analysis: Theory & Computing, World Scientific.

<b>Formative Assessment for Theory</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines.</i>	

## B.Sc. Semester – V

### Discipline Specific Course (DSC)-10

**Course Title: Matrix algebra and Regression analysis**

Course Code: 035 STA 012

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
<b>DSCC-10</b>	<b>Practical</b>	<b>02</b>	<b>04</b>	<b>56 hrs.</b>	<b>3hrs.</b>	<b>25</b>	<b>25</b>	<b>50</b>

**Course Outcomes (COs): At the end of the course, students will be able to:**

- CO 1: Computation of rank, inverse, and Eigen values of higher order matrix
- CO 2 : Express Linear Regression models in Matrix form and model evaluation with software.
- CO 3: Identify situation where linear regression is appropriate.
- CO 4: Build and fit linear regression models with software.
- CO 5: Interpret estimates and diagnostic statistics.
- CO 6: Produce exploratory graphs.

Expt. No,	Title:	56.hrs/ sem
1	Calculation of determinant of higher order	
2	Calculation of rank of a matrix	
3	Calculation of equivalent canonical form by using elementary row and column operations	
4	Calculation of inverses of symmetric matrices of higher order by partitioning method	
5	Calculation of inverse of matrices of higher order	
6	Calculation of eigen values and eigen vectors	
7	Solution of simultaneous equations	
8	Simple Linear Regression	
9	Multiple Regression-I	
10	Multiple Regression-II	

Instruction to the Examiners

- In case the University question papers are not available the external examiner shall prepare question papers for all the experiments, in consultation with the internal examiner.
- No students shall be allowed for the examination without their Journal / Practical records, certified by the Staff in-charge and Head / Principal. If the Journal/ Practical record is not presented by the student, the Head/Principal shall issue a certificate stating that he/she has attended the regular practical's and his/her attendance is satisfactory (not less than 75% including 10% of extracurricular activities if applicable) and the candidate shall then be allowed to appear for examination. In such

cases the marks reserved, for the journal shall be deducted.

3. Candidates having an attendance record of less than 75 % (including 10% of extracurricular activities, if applicable) in that practical paper shall not be allowed to take the practical examination.
4. The Principal shall permit the students to take the examination as out of turn in any other batches only on technical reasons like overlapping of the timings with other subjects but not for any other personal reasons of the candidate including medical grounds.
5. No practical examination shall be conducted in the absence of an external examiner. Absence of external examiner if any is to be brought to the notice of the principal by the internal examiner to enable alternative arrangements to be made. The Principal shall appoint external examiners as per the instruction already given. If the internal examiner remains absent, the principal shall appoint another internal / external examiner. Under any circumstances, there shall not be two internal examiners for a given batch but two external examiners shall be allowed.

<b>Formative Assessment for Practical</b>	
<b>Assessment</b>	<b>Distribution of Marks</b>
Solve any two questions out of given three questions manually and execute the problems in R software, each question carries 10 marks. For each question following is division of marks.	<b>2 X 10</b>
1. Identifying problem and methodology	2
2. Manual calculations	3
3. Execution in R	3
4. Conclusions	2
Viva Voce	<b>2</b>
Journal	<b>3</b>
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per UNIVERSITY guidelines are compulsory</i>	

The same shall be used for semester end Examination

## B.Sc. Semester – V

### Discipline Specific Course (DSC)-11

**Course Title: Analysis of variance and Design of experiments**

Course Code: 035 STA 013

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
<b>DSCC-11</b>	<b>Theory</b>	<b>04</b>	<b>04</b>	<b>56 hrs.</b>	<b>2hrs.</b>	<b>40</b>	<b>60</b>	<b>100</b>

**Course Outcomes (COs): At the end of the course, students will be able to:**

- CO1 : Can learn Exploratory Data Analysis (EDA) basics for ANOVA appropriate data.
- CO2 : Learn fixed and random effect models and one-way and two-way classified data
- CO3 : Understand different designs (CRD, RBD, LSD) and missing plot techniques.
- CO4 : Understand the different factorial experiments.
- CO5 : Develop complete and partial confounding for factorial experiments.

Unit	Title:	56.Hrs/sem
Unit I	<b>ANALYSIS OF VARIANCE:</b> Meaning and assumptions. Fixed and random effect models. Analysis of One - way and two way classified data with and without interaction effects. Multiple comparison tests: Tukey's method, Critical difference.	14 hrs
Unit II	<b>EXPERIMENTAL DESIGNS :</b> Principles of design of experiments. Completely randomized, randomized block and Latin square designs (CRD, RBD, LSD) – layout formation and the analysis using fixed effect models. Comparison of efficiencies of CRD, RBD and LSD. Estimation of one and two missing observations in RBD and LSD and analysis.	14 hrs
Unit III	<b>FACTORIAL EXPERIMENT :</b> Basic concepts – main and interaction effects, and orthogonal contrasts in 2 <sub>2</sub> and 2 <sub>3</sub> factorial experiments. Yates' method of computing factorial effects total. Analysis of 2 <sub>2</sub> and 2 <sub>3</sub> factorial experiments in RBD.	14 hrs
Unit IV	<b>CONFOUNDING :</b> Need for confounding. Types of confounding - Complete and partial, Confounding in a 2 <sub>3</sub> - factorial experiment in RBD and its analysis.	14 hrs



**References:**

1. Goon, A. M., Gupta, M. K., Das Gupta, B.(1991). Fundamentals of Statistics, Vol-I, World Press, Calcutta.
2. Montgomery. D. C. (2014): Design and Analysis of Experiments, Wiley. New York.
3. Joshi. D. D. (1987): Linear Estimation and Design of Experiments, New Age International (P) Limited, New Delhi.
4. Cochran. G and G. M. Cox, G. M. (1992): Experimental Designs, John Wiley and Sons, New York.
5. Mukhopadhyay. P (2015): Applied Statistics, Books and Allied (P) Ltd., Kolkata.

<b>Formative Assessment for Theory</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines.</i>	

## B.Sc. Semester – V

### Discipline Specific Course (DSC)-12

**Course Title: Analysis of variance and Design of experiments**

Course Code: 035 STA 014

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
<b>DSCC-12</b>	<b>Practical</b>	<b>02</b>	<b>04</b>	<b>56 hrs.</b>	<b>3hrs.</b>	<b>25</b>	<b>25</b>	<b>50</b>

**Course Outcomes (COs): At the end of the course, students will be able to:**

- CO1 : Learn Perform basic computations of ANOVA with R-programming and interpret the results.
- CO2 : Carry out the Tukey pairwise mean comparison method and Learn about other pairwise mean comparison methods with R-programming.
- CO3 : Construct and evaluate an appropriate statistical model (CRD, RBD, LSD, etc.) in order to answer important scientific or business-related questions with R programming.
- CO4 : Sketch and interpret bar graphs and line graphs showing the results of studies with simple factorial designs with Statistical software's.
- CO5 : Perform analysis to distinguish between main effects and simple effects with Statistical software's and recognize when an analysis of simple effects is required.
- CO6 : Analyses Confounding, Partial and Total confounding in factorial experiment with Statistical software's.

Expt. No,	Title:	56.hrs/ sem
1	ANOVA for one-way classified data.	
2	ANOVA for two-way classified data.	
3	Analysis of CRD.	
4	Analysis of RBD.	
5	Analysis of LSD.	
6	Missing plot techniques in RBD and LSD.	
7	Analysis of 2 <sup>2</sup> factorial experiment using RBD layout.	
8	Analysis of 2 <sup>3</sup> factorial experiment using RBD layout.	
9	Analysis of 2 <sup>3</sup> factorial experiment using RBD layout (Complete confounding).	
10	Analysis of 2 <sup>3</sup> factorial experiment using RBD layout (Partial confounding).	

Instruction to the Examiners

- In case the University question papers are not available the external examiner shall prepare question papers for all the experiments, in consultation with the internal examiner.
- No students shall be allowed for the examination without their Journal / Practical records, certified by the Staff in-charge and Head / Principal. If the Journal/ Practical record is not presented by the student, the

Head/Principal shall issue a certificate stating that he/she has attended the regular practical's and his/her attendance is satisfactory (not less than 75% including 10% of extracurricular activities if applicable) and the candidate shall then be allowed to appear for examination. In such cases the marks reserved, for the journal shall be deducted.

3. Candidates having an attendance record of less than 75 % (including 10% of extracurricular activities, if applicable) in that practical paper shall not be allowed to take the practical examination.
4. The Principal shall permit the students to take the examination as out of turn in any other batches only on technical reasons like overlapping of the timings with other subjects but not for any other personal reasons of the candidate including medical grounds.
5. No practical examination shall be conducted in the absence of an external examiner. Absence of external examiner if any is to be brought to the notice of the principal by the internal examiner to enable alternative arrangements to be made. The Principal shall appoint external examiners as per the instruction already given. If the internal examiner remains absent, the principal shall appoint another internal / external examiner. Under any circumstances, there shall not be two internal examiners for a given batch but two external examiners shall be allowed.

<b>Formative Assessment for Practical</b>	
<b>Assessment</b>	<b>Distribution of Marks</b>
Solve any two questions out of given three questions manually and execute the problems in R software, each question carries 10 marks. For each question following is division of marks.	<b>2 X 10</b>
1. Identifying problem and methodology	2
2. Manual calculations	3
3. Execution in R	3
4. Conclusions	2
Viva Voce	<b>2</b>
Journal	<b>3</b>
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per UNIVERSITY guidelines are compulsory</i>	

The same shall be used for semester end Examination

# B.Sc. Semester – V

## Skill Enhancement Course: SEC-3

**Course Title: Machine Learning with R-programming**

**Course Code: 035 STA 061**

Type of Course	Theory / Practical	Credits	Instruction hour/ week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
SEC-3	Practical	02	04	56 hrs.	3hrs.	25	25	50

**Course Outcomes (COs): At the end of the course, students will be able to:**

- CO1 : Develop an appreciation for what is involved in Learning models from data
- CO2 : Understand a wide variety of learning algorithms
- CO3 : Understand how to evaluate models generated from data
- CO4 : Apply the algorithms to a real problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Expt. No,	Title:	56.hrs/sem
1	Machine Learning Algorithms using Simple Linear Regression Model (Problem 1)	
2	Machine Learning Algorithms using Simple Linear Regression Model (Problem 2)	
3	Machine Learning Algorithms using Multiple Linear Regression Model (Problem 1)	
4	Machine Learning Algorithms using Multiple Linear Regression Model (Problem 2)	
5	Machine Learning Algorithms using Polynomial Regression Model (Problem 1)	
6	Machine Learning Algorithms using Polynomial Regression Model (Problem 2)	
7	Machine Learning Algorithms using Logistic Regression Model (Problem 1)	
8	Machine Learning Algorithms using Logistic Regression Model (Problem 2)	
9	Machine Learning Algorithms using Logit Transformation Model	
10	Machine Learning Algorithms using Decision Tree Learning Methods	

### References:

1.	Andreas M and Guido S (O'Reilly) (2016). Introduction to machine learning with Python.
2.	Deborah Nolan and Duncan Temple Lang (2015). Data Science in R- A case studies approach to computational reasoning and problem solving, CRC Press.
3.	Gareth J, Daniel W, Trevor, H and Tibshirani, R (2013). An Introduction to Statistical Learning with Application in R.
4.	Zelterman , D. (2015). Applied Multivariate Statistics with R, Springer.
5.	Nina Zumel and John Mount (2020), Practical Data Science With R, Second Edition, Manning Shelter Island.

Instruction to the Examiners

1. Students have to explain in brief problem and model to be used with machine learning algorithm.
2. Out of the above TEN Machine learning algorithms students has to pick any one and answer it.
3. Execute R code of problem and write the report.

<b>Formative Assessment for Practical</b>	
<b>Assessment</b>	<b>Distribution of Marks</b>
Problem and model adequacy description	4 Marks
R-Code writing	4 Marks
R-Code execution	8 Marks
Report Writing	4 Marks
Certified Journal Submission	2 Marks
Viva-Voce	3 Marks
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per guidelines.</i>	

The same shall be used for semester end examination

**B.Sc. in Statistics**

**VI Semester**

**W. e. f.: 2023-24**

## B.Sc. Semester – VI

### Discipline Specific Course (DSC)-13

**Course Title: Statistical Inference-II**

Course Code: 036 STA 011

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-13	Theory	04	04	56 hrs.	2hrs.	40	60	100

Course Outcomes (COs): **At the end of the course, students will be able to:**

- CO1 : Understand expected loss, decision rules, decision principles and Bayes and minimax decision rule.
- CO2 : Learn about UMP test, MLR property and Likelihood ratio tests.
- CO3 : Learn about UMP test, MLR property and Likelihood ratio tests.
- CO4 : Explore about sequential inference.
- CO5 : Learn about one sample and two sample nonparametric tests.

Unit	Title:	56.hrs/sem
Unit I	<b>Statistical Decision Theory :</b> Basic elements of Statistical Decision Problem. Expected loss, decision rules (nonrandomized and randomized), decision principles (conditional Bayes, frequentist), inference as decision problem, Loss function, squared error loss, Bayes and minimax decision rule.	14 hrs
Unit II	<b>Testing of Hypothesis-II :</b> Definition of UMP test, monotone likelihood ratio (MLR) property, Examples of distributions having MLR property, Construction of UMP test using MLR property. UMP test for single parameter exponential family of distributions. Likelihood ratio (LR)tests, LR test for normal, exponential.	14 hrs
Unit III	<b>Sequential Inference :</b> Need for sequential analysis, Wald's SPRT, ASN, OC Functions, examples based on Bernoulli, Poisson, Normal and exponential distributions.	14 hrs
Unit IV	<b>Nonparametric tests :</b> Nonparametric and distribution-free tests, one sample problems: Sign test, Wilcoxon signed rank test, Kolmogorov-Smirnov test. Test of randomness using run test. General two sample problems: Wolfowitz runs test, Kolmogorov Smirnov two sample test (for sample of equal size), Median test, Wilcoxon-Mann-Whitney U-test. Several sample problems: Friedman's test, Kruskal Wallis test	14 hrs

<b>References :</b>	
1	Berger, J. O. (1985): Statistical Decision Theory and Bayesian Analysis, 2 <sup>nd</sup> Edition, Springer Verlag.
2	Bernando, J. M. And Smith, A. F. M. (1993): Bayesian Theory, John Wiley and Sons.
3	Robert, C. P. (2007): The Bayesian Choice : A Decision Theoretic Motivation, Springer.
4	George Casella, Roger L. Berger (2020): Statistical Inference, 2 <sup>nd</sup> ed., Thomson Learning.
5	Rohatagi, V. K. : (2010): Statistical Inference, Wiley Eastern, New Delhi.
6	Rohatagi V. K. and A.K.Md.E Saleh(2008) An Introduction to Probability and statistics, 2 <sup>nd</sup> Ed. Wiley .
7	Hogg Mckean and Craig (2009) : Introduction to Mathematical Statistics, 6 <sup>th</sup> Edition, Pearson Prentce Hall.

<b>Formative Assessment for Theory</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines.</i>	



# B.Sc. Semester – VI

## Discipline Specific Course (DSC)-14

**Course Title: Statistical Inference-II**

Course Code: 036 STA 012

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-14	Practical	02	04	56 hrs.	3hrs.	25	25	50

**Course Outcomes (COs): At the end of the course, students will be able to:**

CO 1: construct UMP tests for some discrete and continuous distributions.

CO 2: construct sequential probability ratio tests for some discrete and continuous distributions.

CO 3: draw OC and ASN curves

CO 4: know some important non-parametric tests

Expt. No,	Title:	56.hrs/sem
1	Problems on Bayes and minimax estimation.	
2	UMP test based on sample from Bernoulli and Poisson distributions.	
3	UMP test based on sample from Normal and exponential distributions.	
4	Construction of SPRT for Bernoulli and Poisson distributions.	
5	Construction of SPRT for Normal and Exponential distributions	
6	Evaluation of SPRT for Bernoulli and Poisson distributions using OC and ASN function.	
7	Evaluation of SPRT for Normal and Exponential distributions using OC and ASN function.	
8	One sample Nonparametric tests: Kolmogorov-Smirnov test, sign test, Wilcoxon signed rank test,	
9	Two sample Nonparametric tests: Mann-Whitney (Wilcoxon rank sum test), Wald-Wolfowitz Run test,	
10	Several sample Nonparametric tests: Kruskal -Wallis test, Friedman's test.	

### Instruction to the Examiners

1. In case the University question papers are not available the external examiner shall prepare question papers for all the experiments, in consultation with the internal examiner.
2. No students shall be allowed for the examination without their Journal / Practical records, certified by the Staff in-charge and Head / Principal. If the Journal/ Practical record is not presented by the student, the Head/Principal shall issue a certificate stating that he/she has attended the regular practical's and his/her attendance is satisfactory (not less than 75% including 10% of extracurricular activities if applicable) and the candidate shall then be allowed to appear for examination. In such cases the marks reserved, for the journal shall be deducted.

3. Candidates having an attendance record of less than 75 % (including 10% of extracurricular activities, if applicable) in that practical paper shall not be allowed to take the practical examination.
4. The Principal shall permit the students to take the examination as out of turn in any other batches only on technical reasons like overlapping of the timings with other subjects but not for any other personal reasons of the candidate including medical grounds.
5. No practical examination shall be conducted in the absence of an external examiner. Absence of external examiner if any is to be brought to the notice of the principal by the internal examiner to enable alternative arrangements to be made. The Principal shall appoint external examiners as per the instruction already given. If the internal examiner remains absent, the principal shall appoint another internal / external examiner. Under any circumstances, there shall not be two internal examiners for a given batch but two external examiners shall be allowed.

<b>Formative Assessment for Practical</b>	
<b>Assessment</b>	<b>Distribution of Marks</b>
Solve any two questions out of given three questions manually and execute the problems in R software, each question carries 10 marks. For each question following is division of marks.	<b>2 X 10</b>
1. Identifying problem and methodology	2
2. Manual calculations	3
3. Execution in R	3
4. Conclusions	2
Viva Voce	<b>2</b>
Journal	<b>3</b>
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per UNIVERSITY guidelines are compulsory</i>	

The same shall be used for semester end Examination

# B.Sc. Semester – VI

## Discipline Specific Course (DSC)-15

**Course Title: Sampling Methods, Official Statistics and Econometrics.**

Course Code: 036 STA 013

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
<b>DSCC-15</b>	<b>Theory</b>	<b>04</b>	<b>04</b>	<b>56 hrs.</b>	<b>2hrs.</b>	<b>40</b>	<b>60</b>	<b>100</b>

**Course Outcomes (COs): At the end of the course, students will be able to:**

- CO1 : Understand the principles underlying sampling as a means of making inferences about a population.
- CO2 : Understand the difference between probability and nonprobability sampling.
- CO3 : Understand different sampling techniques.
- CO4 : To learn to estimate population parameters from a sample.
- CO5 : Understand official statistical system in India and their functions.
- CO6 : Understand the role statistics in national development.

Unit	Title:	56.hrs/ Sem
Unit I	<p><b>Introduction to sampling theory :</b> Objectives and principles of sampling theory; Concept of population and sample; complete enumeration versus sampling; Planning, execution and analysis of a sample survey; practical problems at each of these stages; basic principle of sample survey; sampling and non-sampling errors; Types of sampling: non-probability and probability sampling, pilot survey.</p> <p><b>Simple random sampling :</b> Simple random sampling with and without replacement, definition, and procedure of selecting a sample, estimates of population mean, total and proportion, variances and SE of these estimates, estimates of their variances related proofs, sample size determination.</p>	14 hrs
Unit II	<p><b>Stratified sampling and systematic sampling :</b></p> <p>Stratification and its benefits; basis of stratification, Technique, estimates of population mean and total, variances of these estimates, proportional, optimum allocations, Neyman's allocation, allocation with cost functions and their comparison with SRS. Practical difficulties in allocation, derivation of the expressions for the standard errors of the above estimators when these allocations are used, estimation of gain in precision, post stratification and its performance.</p> <p>Systematic Sampling: Linear systematic sampling Technique; estimates of population</p>	14 hrs

	<p>mean and total, variances of these estimates (<math>N=n \times k</math>).</p> <p>Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections.</p>	
Unit III	<p><b>National Development:</b> An outline of present official statistical system in India, Role, function, and activities of Central and State Statistical organizations. Methods of collection of official statistics, their reliability and limitations. Central Statistical Office (CSO), National Sample Survey Office (NSO), Registrar General Office and National Statistical Commission. Scope and content of Population census of India. Population census methods, economic census. Methods of national income estimation, problems in the estimation of national income. System of collection of Agricultural Statistics. Crop yield, Production Statistics, Crop estimation and forecasting. Statistics related to industries, foreign trade, balance of payment, cost of living, inflation, educational and other social statistics.</p>	14 hrs
Unit IV	<p><b>Introduction to Econometrics :</b></p> <p>Origin, definition, methodology, scope and limitations of econometrics. Simple Econometrics models : assumptions and analysis.</p> <p><b>Analysis of Residuals :</b> Presence of outliers omitted variables, nonlinear relationship, correlated disturbances, heteroscedasticity, Generalized Least Squares.</p> <p>Multicollinearity: The plausibility of the assumption of non-multicollinear regressors, consequences of multicollinearity, tests for detecting multicollinearity, solutions for multicollinearity.</p>	14 hrs

References	
1.	Cochran, W. G. (2007): Sampling Techniques, Third Edition, Wiley India Pvt. Ltd., New Delhi.
2.	Changbao Wu and Mary E. Thompson (2020): Sampling Theory and Practice, Springer Nature Switzerland.
3.	Raghunath Arnab (2017): Survey Sampling Theory and applications (2017), Elsevier
4	Des Raj and Chandhok P. (1998): Sample Survey Theory, Narosa Publishing House.
5	Goon A.M., Gupta M.K. and Dasgupta B. (2001): Fundamentals of Statistics (Vol.2), World Press
6	Murthy, M. N. (1967): Sampling Theory and Methods, Statistical Publishing Society, Kolkata.
7	Mukhopadhyay P (2008): Theory and methods of survey sampling. Prentice-Hall of India, New Delhi
8	Singh, D. and Chaudhary, F. S. (1986): Theory and Analysis of Sample Survey Designs, Wiley Eastern Ltd., New Delhi.
9	Sukhatme, P.V., Sukhatme, B. V.(1984): Sampling theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
10	Sampath S. (2005): Sampling Theory and Methods, Second edition, Narosa, New Delhi.
11	Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi. <a href="http://mospi.nic.in/">http://mospi.nic.in/</a>
12	Baltagi B.H. (2000) Econometrics, Springer.

13	Gujarati D.N. (2003) Basic Conometrics, McGraw-Hill.
14	Maddala G.S. (2002) Introduction to Econometrics, John Wiley.

<b>Formative Assessment for Theory</b>	
<b>Assessment Occasion/ type</b>	<b>Marks</b>
Internal Assessment Test 1	10
Internal Assessment Test 2	10
Quiz/ Assignment/ Small Project	10
Seminar	10
<b>Total</b>	<b>40 Marks</b>
<i>Formative Assessment as per guidelines.</i>	

# B.Sc. Semester – VI

## Discipline Specific Course (DSC)-16

**Course Title: Sampling Methods, Official Statistics and Econometrics.**

**Course Code: 036 STA 014**

Type of Course	Theory / Practical	Credits	Instruction hour per week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
DSCC-16	Practical	02	04	56 hrs.	3hrs.	25	25	50

**Course Outcomes (COs): At the end of the course, students will be able to:**

- CO 1: To select a Simple random sample with and without replacement from a finite population and estimation of the mean and total and the standard error of the estimator.
- CO 2: To select a Stratified random sampling and Systematic Sampling from a finite population and estimation of the mean and total and the standard error of the estimator.
- CO 3: Estimation of the proportion, total and the standard errors of the estimators based on a random sample under SRSWR and SRSWOR.
- CO 4: Compute and analyze Multiple linear regression models with R-codes by addressing the consequences of Multicollinearity and Diagnostics of Multicollinearity.
- CO 5: Compute and analyze Multiple linear regression models with R-codes by addressing the consequences of autocorrelation and heteroscedasticity.

Expt. No,	Title:	56.hrs/sem
1.	Drawing of random sample under SRSWOR and SRSWR from a given population and estimation of the mean and total and the standard error of the estimator.	
2.	Construction of Confidence Intervals for mean and total for SRSWR and SRSWOR.	
3.	Estimation of the proportion, total and the standard errors of the estimators based on a random sample under SRSWR and SRSWOR.	
4.	Estimation of the mean, total and the standard error of the estimator under stratified random sampling.	
5.	Exercise on allocation of samples in Stratified sampling. (Proportional Allocation and Neyman Allocation)	
6.	Estimation of the mean, total and the standard error of the estimator under Systematic sampling.	
7.	Estimation techniques in official statistics.	
8.	Fitting of simple and multiple regression model	
9.	Multiple regression model : detecting autocorrelation	
10.	Multiple regression model : detecting multicollinearity	

### Instruction to the Examiners

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2. No students shall be allowed for the examination without their Journal / Practical records, certified by the Staff in-charge and Head / Principal. If the Journal/ Practical record is not presented by the student, the Head/Principal shall issue a certificate stating that he/she has attended the regular practical's and his/her attendance is satisfactory (not less than 75% including 10% of extracurricular activities if applicable) and the candidate shall then be allowed to appear for examination. In such cases the marks reserved, for the journal shall be deducted.
3. Candidates having an attendance record of less than 75 % (including 10% of extracurricular activities, if applicable) in that practical paper shall not be allowed to take the practical examination.
4. The Principal shall permit the students to take the examination as out of turn in any other batches only on technical reasons like overlapping of the timings with other subjects but not for any other personal reasons of the candidate including medical grounds.
5. No practical examination shall be conducted in the absence of an external examiner. Absence of external examiner if any is to be brought to the notice of the principal by the internal examiner to enable alternative arrangements to be made. The Principal shall appoint external examiners as per the instruction already given. If the internal examiner remains absent, the principal shall appoint another internal / external examiner. Under any circumstances, there shall not be two internal examiners for a given batch but two external examiners shall be allowed.

<b>Formative Assessment for Practical</b>	
<b>Assessment</b>	<b>Distribution of Marks</b>
Solve any two questions out of given three questions manually and execute the problems in R software, each question carries 10 marks. For each question following is division of marks. 1. Identifying problem and methodology 2. Manual calculations 3. Execution in R 4. Conclusions	<b>2 X 10</b>  2 3 3 2
Viva Voce	<b>2</b>
Journal	<b>3</b>
<b>Total</b>	<b>25 Marks</b>
<i>Formative Assessment as per UNIVERSITY guidelines are compulsory</i>	

The same shall be used for semester end Examination

## B.Sc. Semester – VI

### INTERNSHIP/MINOR PROJECT\*

**Course Title:** Data Science Internship

**Course Code:** 036STA091

- If Internship is not feasible, Mini Project is to be carried out.

Type of Course	Theory / Practical	Credits	Instruction hour/ week	Total No. of Lectures/Hours / Semester	Duration of Exam	Formative Assessment Marks	Summative assessment Marks	Total Marks
<b>INTERN SHIP/MINOR PROJECT</b>	<b>Practical</b>	<b>02</b>	<b>04</b>	<b>56 hrs.</b>	<b>3hrs.</b>	<b>50</b>	<b>0</b>	<b>50</b>

**Course Outcomes (COs): At the end of the course students will be able to:**

CO 1: Accountable for individual and team responsibilities and deliverables.

CO 2: Exercise the ability to compromise and problem solve with involved parties.

CO 3: Apply computing theory, languages, and algorithms, as well as mathematical and statistical models, and the principles of optimization to appropriately formulate and use data analyses

CO 4: Formulate and use appropriate models of data analysis tools to solve hidden solutions to business-related challenges

CO 5: Interpret data findings effectively to any audience, orally, visually, and in written formats.

Expt. No	Title:	56.hrs/sem
1	Identifying key areas of statistics useful to internship	
2	Develop and deliver engaging training sessions on various data science topics, including statistical analysis, machine learning, and data visualization	
3	Create comprehensive training materials, such as presentations and hands-on exercises, to facilitate effective learning for our students	
4	Provide guidance and support to students, helping them solve complex data science problems and reinforcing their understanding of key concept	
5	Collaborate to enhance and update curriculum, ensuring that it remains current and aligned with industry trends	
6	Conduct assessments and evaluations to measure student progress and identify areas for improvement, adapting teaching strategies accordingly	
7	Stay up-to-date with the latest developments in data science and technology	
8	Contribute to the growth and success of our education programs	
9	Writing visit reports, filing and collecting trial documentation	
10	Report writing	



<b>Formative Assessment for Practical</b>	
<b>Assessment</b>	<b>Distribution of Marks</b>
Analyze data using models and descriptive statistics	10
Participate in project planning	10
Contribute to project report	10
Collection of raw data	10
Produce tables/ figures/ interpretation	10
<b>Total</b>	<b>50 Marks</b>
<i>Formative Assessment as per guidelines.</i>	

# UG Programme: 2023-24

## GENERAL PATTERN OF THEORY QUESTION COURSE FOR DSCC/ OEC

**(60 marks for semester end Examination with 2 hrs duration)**

### **Part-A**

1. Question number 1-06 carries 2 marks each. Answer any 05 questions : 10 marks

### **Part-B**

2. Question number 07- 11 carries 05Marks each. Answer any 04 questions : 20 marks

### **Part-C**

3. Question number 12-15 carries 10 Marks each. Answer any 03 questions : 30 marks  
(Minimum 1 question from each unit and 10 marks question may have sub questions for 7+3 or 6+4 or 5+5 if necessary)

**Total: 60 Marks**

**Note: Proportionate weightage shall be given to each unit based on number of hours prescribed**