Bangalore University
Department of Statistics
Jnanabharathi Campus
Bengaluru-560056

Syllabus for
V and VI Semester Discipline Core-Statistics
Under-Graduate (UG)Program

Members Present:

1. Dr. Parameshwar V Pandit, — Chairperson
    Professor and Chairperson, Department of Statistics
    Bangalore University, Bengaluru

2. Dr. Suresh, R. — Member
    Assistant Professor, Department of Statistics, BUB

3. Dr. Mallappa — Member
    Assistant Professor, Department of Statistics, BUB

4. Divya, V. R. — Member
    Assistant Professor, St. Clarat College, MES Ring Road,
    Jalahalli, Bengaluru

5. Kagendra — Member
    Assistant Professor, St. Clarat College, MES Ring Road,
    Jalahalli, Bengaluru

The following members have given approval by email.

6. Dr. S. B. Munoli — Member
    Professor, Department of Statistics
    Karnatak University, Dharwad

7. Dr. Sujatha Inginashetty -Member
    Professor and Chairman, Department of Statistics
    Gulbarga University, Kalaburagi

8. Dr. Kala Nayak — Member
    Registrar, Don Bosco College of Emgineering, Fatoda,
    Madagao, Goa

9. Dr. Satish Bhat — Member
    Associate Professor, Department of Statistics
    Yuvaraja College, Mysuru

The chairman welcomed the members to the meeting of Board of Studies in Statistics. The panel of examiners (UG and PG (both external and internal)) for examinations of 2023-24 are discussed. The members actively participated in the discussion of framing the syllabus for V and VI semester undergraduate programmes for Statistics as Major.

The board arrived at the following decisions:

1. The panel of Examiners for UG and PG (both external and Internal) examinations of 2023-24 are approved.

2. The members finalized the content of the syllabus for V and VI semesters of Statistics as major for undergraduate programme.

(DIVYA.V.R)   (J. Kagendra)   [Dr. Suresh.R]   (Dr. Mallappa)   (P V PANDI)

Program Outcomes

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

PO1: Acquire fundamental/systematic or coherent understanding of the academic field of Statistics and its different learning areas and applications.

PO2: Develop and demonstrate abilities to understand major concepts in various disciplines of Statistics.

PO3:Demonstrate the ability to use skills in Statistics and different practicing areas for formulating and tackling Statistics related problems and identifying and applying appropriate principles and methodologies to solve a wide range of problems associated with Statistics.

PO4: Understand procedural knowledge that creates different types of professionals related to the subject area of Statistics, including professionals engaged in government/public service and private sectors.

PO5: Plan and execute Statistical experiments or investigations, analyse and interpret data/information collected using appropriate methods, including the use of appropriate statistical software including programming languages, and report accurately the findings of the experiment/investigations.

PO6: Have a knowledge regarding use of data analytics tools like Excel and R-programming.

PO7: Developed ability to critically assess a standard report having graphics, and probability statements.

PO8: Analyze, interpret the data and hence help policy makers to take a proper decision.

PO9:Recognize the importance of statistical modelling and computing, and the role of approximation and mathematical approaches to analyse the real problems using various statistical tools.

PO10: Demonstrate relevant generic skills and global competencies such as

    i.   Problem-solving skills that are required to solve different types of Statistics related problems with well-defined solutions, and tackle open-ended problems, that belong to the disciplinary-area boundaries;

    ii.   Investigative skills, including skills of independent thinking of Statistics-related issues and problems;

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

    iv.   Analytical skills involving paying attention to details and ability to construct logical

    v.   Arguments using correct technical language related to Statistics and ability to translate them with popular language when needed;

    vi.   ICT skills;

    vii.   Personal skills such as the ability to work both independently and in a group.

PO11: Undertake research projects by using research skills- preparation of questionnaire, conducting national sample survey, research projects using sample survey, sampling techniques.

PO12: Understand and apply principles of least squares to fit a model to the given data, study the association between the variables, applications of Probability Theory and Probability Distributions.

Program Structure for the Under-Graduate Programs in Universities and Colleges in Bangalore University

Bachelor of Arts/Bachelor of Science with Statistics as Major with practicals

Sem.	Discipline Core(DSC) (Credits)(L+T+P)	DisciplineElective(DSE)/OpenElective(OE)(Credits)(L+T+P)	Ability Enhancement CompulsoryCourses(AECC),Languages(Credits)(L+T+P)		SkillEnhancementCourses(SEC)		TotalCredits
					Skillbased(Credits) (L+T+P)	Valuebased(Credits) (L+T+P)	
I	**Descriptive Statistics(4)+ Practical (2)** DisciplineB1(4+2)	OE-1(3)	L1-1(3),L2-1(3) (3+1+0each)		SEC-1:DigitalFluency (2)(1+0+2)		23
II	**Probability and Distributions (4) + Practical (2)** DisciplineB2(4+2)	OE-2(3)	L1-2(3),L2-2(3) (3+1+0each)	Environmental Studies (2)		HealthandWellness/ Social & EmotionalLearning(2)(1+0+2)	25
III	**Calculus and Probability Distributions(4) +Practical (2)** DisciplineB3(4+2)	OE-3(3)	L1-3(3),L2-3(3) (3+1+0each)		SEC-2:ArtificialIntelligence(2)(1+0+2)		23
IV	**Statistical Inference-I (4) + Practical (2)** DisciplineB4(4+2)	OE-4(3)	L1-4(3),L2-4(3) (3+1+0each)	Constitutionof India(2)		Sports/NCC/NSSetc. (2)(1+0+2)	25
V	**Sampling Theory and Regression Analysis (4)+Practical (2) Statistical Quality Control and Statistical Inference-II (4)+Practical (2)**				SEC-3: Employability skills/ Cyber Security(3)(2+0+2)	Ethics & Self Awareness (2) (1+0+2)?	20
VI	**Analysis of Variance and Designs of Experiments(4)+ Practical (2) Applied Statistics (4)+ Practical (2)**				Internship(2)		20

Program Name	**BSc in STATISTICS**		Semester	**V**
Course Title	**Sampling Theory and Regression analysis (Theory)**			
Course Code:	**STAC9-T**		No. of Credits	**04**
Contact hours	**60 Hours**		Duration of SEA/Exam	**2 hours 30 min**
Formative Assessment Marks	**40**		Summative Assessment Marks	**60**

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Understand the principles underlying sampling as a means of making inferences about a population.

CO2. Understand different sampling techniques.

CO3. To learn to estimate population parameters from a sample.

CO4. 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.

CO5. Apply regression analysis techniques to real world data sets.

Contents	**60 Hrs**
Unit 1: Introduction to sampling	15 Hrs
Objectives and principles of sampling theory; Concept of population and sample; complete enumeration versus sampling; Planning, execution, construction of questionnaire and analysis of a sample survey; basic principle of sample survey; sampling and non-sampling errors. Probability sampling and nonprobability sampling, Judgement sampling, quota sampling, snowball sampling, convenience sampling.	
Unit 2: Simple random sampling	15 Hrs
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.	
Unit 3: Stratified sampling and systematic sampling	15 Hrs
Stratification and its benefits; basis of stratification, Technique, estimates of population mean and total, variances of these estimates, proportional, idea of optimum allocations, Neyman's allocation, their comparison with SRS.	

Systematic Sampling: Linear systematic sampling Technique; estimates of population mean and total, variances of these estimates (N=n x k). Systematic sampling as a particular case of Stratified sampling.Comparison of systematic sampling with SRS in the presence of linear trend.	
Unit 4: Simple linear regression	15 Hrs
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.	

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.

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Internal Test 1	15
Internal Test 2	15
Assignment/Seminar (5 marks)+Attendance(5 marks)	10
Total	**40 Marks**
Formative Assessment as per NEP guidelines are compulsory	

Practical

Course Title	**Sampling theory and Regression analysis (Practical)**		Practical Credits	**2**
Course Code	**STAC10-P**		Contact Hours	**60 Hours**
Formative Assessment	**25 Marks**	Summative Assessment		**25 Marks**
Practical Content				

1. Drawing of random sample under SRSWOR from a given population and estimation of the mean and total and the standard error of the estimator.
2. Drawing of random sample under SRSWR from a given population and estimation of the mean and total and the standard error of the estimator.
3. Estimation of the proportion, total and the standard errors of the estimators based on a random sample under SRSWR.
4. Estimation of the proportion, total and the standard errors of the estimators based on a random sample under SRSWOR.
5. Construction of Confidence Intervals for mean and total for SRSWR and SRSWOR.
6. Estimation of the mean, total and the standard error of the estimator under stratified random sampling.
7. Exercise on allocation of samples in Stratified sampling. (Proportional Allocation)
8. Exercise on allocation of samples in Stratified sampling. (Neyman Allocation)
9. Systematic sampling
10. Simple Linear Regression

Pedagogy: Practical assignments 1 to 10 have to be first solved manually (using scientific calculators) and executed using R-programming.

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Internal Test 1	10
Internal Test 2	10
Attendance	5
Total	**25 Marks**
Formative Assessment as per NEP guidelines are compulsory	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs) /	Program Outcomes (POs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1.	2	1	2	3	-	-	-	-	2	3	-	-
CO2.	1	3	2	2	-	-	-	-	3	1	-	-
CO3.	2	3	2	1	-	-	-	-	3	2	-	-
CO4.	-	-	-	1	1	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-

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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	Mukhopadhyay, P. (1998): Theory and Methods of Survey Sampling. Prentice Hall
9	Singh, D. and Chaudhary, F. S. (1986): Theory and Analysis of Sample Survey Designs, Wiley Eastern Ltd., New Delhi.
10	Sukhatme, P.V., Sukhatme, B. V.(1984): Sampling theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
11	Sampath S. (2005): Sampling Theory and Methods, Second edition, Narosa, New Delhi.
12	Montgomery, D. C., Peck, E. A. and Vining, G. G. (2003). Introduction to Linear Regression Analysis, Wiley.
13	Weisberg, S. (2005). Applied Liner Regression, Wiley.
14	Yan, X. and Su, X. G. (2009). Linear Regression Analysis: Theory & Computing, World Scientific.

Program Name	**BSc in STATISTICS**		Semester	**V**
Course Title	**Statistical Quality Control and Statistical Inference -II (Theory)**			
Course Code:	**STAC11-T**		No. of Credits	**04**
Contact hours	**60 Hours**		Duration of SEA/Exam	**2 hours 30 min**
Formative Assessment Marks	**40**		Summative Assessment Marks	**60**

Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Learn about process control and product control, different limits and causes of variation.

CO2. Understand control chart for variables and process capability.

CO3. Understand lot acceptance sampling and sampling plans.

CO4: Learn about UMP test, MLR property and Likelihood ratio tests.

CO5: Learn about one sample and two sample nonparametric tests.

Contents	60 Hrs
Unit-1: Process Control	15 Hrs
Introduction – Statistical Quality Control (SQC) - Aims and objectives, Chance and assignable causes of variation, Process control and product control. Control charts and basis for its construction, Action, and warning limits. Various tools of SQC. Rational subgroups, Criteria for detecting lack of control. Control charts for variables: Derivation of control limits, basis, construction and interpretation of mean, range and standard deviation charts, np-chart, p-chart, stabilized p-chart c-chart and u-chart.	
Unit-2: Process Capability and Product control	15 Hrs
Process capability study: Natural tolerance limits and specification limits, process capability, PCR and interpretation. Lot Acceptance Sampling – Sampling Inspection,100 % inspection and rectifying inspection AQL, LTPD, Producer's Risk and Consumer's Risk. Acceptance sampling plans – single sampling plan by attributes. Derivation of OC, AOQ, ASN, and ATI functions for single sampling plan.	
Unit-3: Testing of Hypothesis-II	15 Hrs
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.	
Unit-4: Nonparametric tests	15 Hrs
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. (Based on large sample approximations).	

Pedagogy:

1. The course is taught using the traditional chalk and talk method using problem solving through examples and exercises.

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

Course Code	**STAC12-P**			Contact Hours	**60 Hours**
Formative Assessment	**25 Marks**		Summative Assessment		**25 Marks**

Practical Content

1. $\bar{x}$-R charts (Standard values known and unknown).

2. $\bar{x}$-S charts (Standard values known and unknown).

3. np and p charts (Standard values known and unknown).

4. C and u charts (Standard values known and unknown).

5. Drawing OC, AOQ, ASN, and ATI curves for single sampling plan.

6. UMP test based on sample from Bernoulli and Poisson distributions.

7. UMP test based on sample from Normal and exponential distributions.

8. UMP test based on sample from   exponential distributions.

9. One sample Nonparametric tests: Kolmogorov-Smirnov test, sign test, Wilcoxon signed rank test,

10. Two sample Nonparametric tests: Mann-Whitney (Wilcoxon rank sum test), Wald-Wolfowitz Run test,

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Internal Test 1	15
Internal Test 2	15
Assignment/Seminar (5 marks)+Attendance(5marks)	10
Total	**40 Marks**

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (Pos)

Course Outcomes (COs)	Program Outcomes (POs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1:.	1	3	2	2	-	-	-	-	2	3	-	-
CO2:	2	1	3	2	-	-	-	-	1	2	-	-
CO3:	3	2	1	2	-	-	-	-	2	1	-	-
CO4.	1	2	3	2	-	-	-	-	1	2	-	-
CO5	2	1	3	2	-	-	-	-	1	2	-	-

References	
1	George Casella, Roger L. Berger (2020): Statistical Inference, 2nd ed., Thomson Learning.
2	Rohatagi, V.K.: (2010): Statistical Inference, Wiley Eastern, New Delhi.
3	Hogg Mckean and Craig (2009): Introduction to Mathematical Statistics, 6th edition, Pearson Prentice Hall.
4	Goon, A. M. , Gupta, M. K. , Das Gupta, B. (1991). Fundamentals Of Statistics, Vol.I (World Press, Calcutta).
5	Grant, E. L. and Leavenworth, R. S. (1996): Statistical Quality Control. 7th Edition, Mc Grawhill, New York.
6	Mahajan, M. (2001): Statistical Quality Control, Dhanpat Rai & Co. (P) Ltd. New Delhi.
7	Gupta, R. C: Statistical Quality Control (Khanna Pub, Co.)
8	Montgomery, D .C (2013): Introduction to Statistical Quality Control (Wiley Int.Edn)
9	Gupta, R. C and V. K. Kapoor: Fundamentals of Applied Statistics, (Sultan Chand and Co.)

Program Name	**BSc in STATISTICS**		Semester	**VI**
Course Title	**Analysis of variance and Design of experiments (Theory)**			
Course Code:	**STAC13-T**		No. of Credits	**4**
Contact hours	**60 Hours**		Duration of SEA/Exam	**2 hours 30 min**
Formative Assessment Marks	**40**		Summative Assessment Marks	**60**

Course Outcomes (COs):

After the successful completion of the course, the student will be able to:

CO1. Learn fixed and random effect models and one-way and two-way classified data.

CO2.Understand different designs (CRD, RBD, LSD) and missing plot techniques.

CO3. Understand the different factorial experiments.

CO4. Develop complete and partial confounding for factorial experiments.

CO5: Understanding the practical applications of the above topics.

CONTENTS	60 Hrs
UNIT 1: ANALYSIS OF VARIANCE	15 Hrs
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.	
UNIT 2: EXPERIMENTAL DESIGNS	15 Hrs
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.	
UNIT 3: INCOMPLETE BLOCK DESIGNS AND FACTORIAL EXPERIMENTS	15 Hrs
Introduction to incomplete block designs, BIBD and its analysis, Yuden square designs, Basic concepts – main and interaction effects, and orthogonal contrasts in 2^2 and 2^3 factorial experiments. Yates' method of computing factorial effects total.	
UNIT 4: ANALYSIS OF FACTORIAL EXPERIMENTS AND CONFOUNDING	15 Hrs
Analysis of 2^2 and 2^3 factorial experiments in RBD, Need for confounding. Types of confounding - Complete and partial, Confounding in a 2^3 - factorial experiment in RBD and its analysis.	

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.

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Internal Test 1	15
Internal Test 2	15
Assignment/Seminar (5 marks)+Attendance(5marks)	10
Total	**40 Marks**

Course Title	**Analysis of variance and Design of experiments (Practicals)**		Practical Credits	**2**
Course Code	**STAC14-P**		Contact Hours	**60 Hours**
Formative Assessment	**25 Marks**	Summative Assessment		**25 Marks**
Practical Content				
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 2^2 factorial experiment usingRBD layout. 8. Analysis of 2^3 factorial experiment using RBD layout. 9. Analysis of 2^3 factorial experiment using RBD layout (Complete confounding). 10. Analysis of 2^3 factorial experiment using RBD layout (Partial confounding).				

Pedagogy: Practical assignments 1 to 10 have to be first solved manually (using scientific calculators) and executed using R-programming.

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Internal Test 1	10
Internal Test 2	10
Attendance	5
Total	**25 Marks**
Formative Assessment as per NEP guidelines are compulsory	

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs)	Program Outcomes (POs)											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1.	1	2	-	2	-	1	-	-	2	2	-	-
CO2.	2	1	-	-	-	3	-	-	3	3	-	-
CO3.	2	3	-	-	-	2	-	-	1	1	-	-
CO4.	3	2	-	3	-	1	-	-	2	2	-	-
CO5	2	1	-	-	-	3	-	-	3	3	-	-

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.

Program Name	BSc in STATISTICS		Semester	VI
Course Title	**Applied Statistics (Theory)**			
Course Code:	**STAC15-T**		No. of Credits	**04**
Contact hours	**60 Hours**		Duration of SEA/Exam	**2 hours 30 min**
Formative Assessment Marks	40	Summative Assessment Marks		**60**

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Course Outcomes (COs): After the successful completion of the course, the student will be able to:

CO1. Formulate a linear programming problem and solve it using graphical, simplex methods. Conceptualize the feasible region

CO2. find out feasible solution and transportation and assignment problems and give the optimal solution and solve game theory problems

CO3.Understand the Price and Quantity Index numbers and their different measures, understand the applicability of cost-of-living Index number.

CO4. Know the components and Need for Time series, understand the different methods of studying trend and Seasonal Index.

CO5.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.

Contents	60 Hrs
Unit 1: Introduction to operations research (OR) and Linear programming problem(LPP)	15 Hrs
Definition and scope of operations research (OR). Linear programming problem (LPP): Definition-standard forms. Formulation of LPP. Basic feasible solutions, degenerate and non-degenerate solutions. Graphical solution and simplex algorithm for solving an LPP., Criteria for unbounded, multiple, and infeasible solutions. Concept of duality.	
Unit -2: Transportation problem, Assignment Problem and Game theory	15 Hrs
Transportation problem: Mathematical formulation of transportation problem. Existence of feasible solution. Finding initial basic feasible solution: North - West corner rule and Vogel's method. Test for optimality. Transportation algorithm. Unbalanced transportation problem. Assignment problem: Mathematical formulation of assignment problem and Hungarian algorithm. Unbalanced assignment problems. Game theory: Basic concepts. Two – Person Zero Sum Game. Pure and Mixed Strategies. Maximin – Minimax principle, Games with saddle point. Principle of dominance. Games without saddle Point . Mixed Strategies. Solution for a (2*2) Game by algebraic method. Solution by graphical method for (2*n) and (m*2) games.	
Unit -3: Index numbers and Time series	15 Hrs
Index numbers: Introduction. Price and quantity index numbers. Construction of index numbers: Simple and weighted methods. Problems involved in the construction of general index numbers. Tests for consistency of index numbers, Consumer price index. Problems involved in the construction of Consumer price index numbers. Uses and limitations.	

Time series: Components of Time Series. Additive and multiplicative models. Measurement of trend by moving averages and by least squares. Construction of seasonal indices by simple averages and ratio to moving averages.	
Unit 4: Demography (Vital Statistics)	15 Hrs
Sources of demographic data. Measurement of Mortality: crude, specific and standardized death rates. Infant mortality rate, maternal mortality rate. Measurement of fertility: crude, age specific, general, and total fertility rates. Reproduction rates, Life table: Components of a life table, force of morality and expectation of life. Construction of a life table. Uses of a life table.	

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.

Formative Assessment for Theory	
Assessment Occasion/ type	**Marks**
Internal Test 1	15
Internal Test 2	15
Assignment/Seminar (5 marks)+Attendance(5marks)	10
Total	**40 Marks**

Course Title	**Applied Statistics(Practicals)**		Practical Credits	**2**
Course Code	**STAC16-P**		Contact Hours	**60 Hours**
Formative Assessment	**25 Marks**	Summative Assessment		**25 Marks**
Practical Content				

1. Formulation of Linear Programming Problem (L.P.P)-Graphical Solution.
2. Solution of L.P.P; Simplex Algorithm.
3. Transportation Problem
4. Assignment problem.
5. Game theory problems.
6. Construction of index numbers and consumer price index numbers, consistency of index numbers.
7. Time Series-1: Measurement of trend
8. Time Series-2: Measurement of seasonal variation
9. Vital Statistics -1: Computation of various morality rates and fertility rates.
10. Vital Statistics -2: Life table construction and computation of reproduction rates.

Pedagogy: Practical assignments 1 to 10 have to be first solved manually (using scientific calculators) and executed using R-programming.

Formative Assessment for Practical	
Assessment Occasion/ type	**Marks**
Internal Test 1	10
Internal Test 2	10
Attendance	5
Total	**25 Marks**

Course Articulation Matrix: Mapping of Course Outcomes (COs) with Program Outcomes (POs 1-12)

Course Outcomes (COs)	Program Outcomes (POs)											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1.	2	2	2	2	-	-	-	-	2	1	-	-
CO2.	1	3	3	2	-	-	-	-	2	3	-	-
CO3.	3	1	2	3	-	-	-	-	1	2	-	-
CO4.	3	2	1	1	-	-	-	-	3	1	-	-
CO5	2	3	3	3	-	-	-	-	1	3	-	-

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1	Churchman, C.W, Ackoff, R.L., and Arnoff, E.L. (1957). Introduction to Operations Research, John Wiley and Sons, New York.
2	Kanthi Swaroop, Manmohan, and P.K. Gupta (2012). Operations Research, Sultan Chand, New Delhi.

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3	Kalavathy, S. (2004). Operations Research, Vikas Publishing House Pvt. Ltd. New Delhi.
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5	Mustafi, C.K. (2006). Operations Research: Methods and Practice, 3/e, New Age International, New Delhi.
6	Mital, K.V. and Mohan, C. (2004). Optimization Methods, 3/e, New Age International, New Delhi.
7	Narag, A. S. (1970). Linear Programming and Decision Making, S. Chand, New Delhi.
8	Hillier, F.S. and Leiberman, G. J. (1962). Introduction to Operations Research, Holden Day, NewYork.
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