Darrang College (Autonomous), Tezpur-784001

Syllabus for FYUGP

Sub: STATISTICS

Approved by :

Board of Studies meeting held on 27-12-2025 &
Academic Council vide Resolution no. 2 dated-29-12-2025

DARRANG COLLEGE (AUTONOMOUS)
TEZPUR, ASSAM

FYUGP Structure as per UGC Credit Framework

DEPARTMENT OF STATISTICS

(Courses effective from Academic Year 2025-2026)

SYLLABUS OF COURSES OFFERED

(Minor)

AIMS OF FOUR-YEAR UNDER GRADUATE PROGRAMME (FYUGP) IN STATISTICS:

The aims of Four-Year under Graduate Programme (FYUGP) in Statistics are:

- The UG Programme in Statistics is structured to develop analytical, critical, and logical thinking skills in students.
- It emphasizes the application of mathematical reasoning in solving real-world problems.
- Students are introduced to diverse and practical statistical concepts throughout the course.
- The programme prepares students for roles like data scientist, statistician, strategic banker, researcher, and biostatistician.
- Graduates can pursue careers in industries, government agencies, public sector units, finance, business, and research.
- The curriculum includes both mathematical and applied statistics topics for well-rounded learning.
- Practical training is provided through hands-on sessions in the Computer Lab.
- Students gain experience using statistical software such as MS Excel, C/C++, R, and SPSS.
- Coding skills and software usage are integrated to deepen understanding of statistical methods.
- The programme aims to equip students with the necessary tools for success in research and industry.

Programme Outcome:

By the end of the programme a UG student of Statistics should be able to know about:

- **Statistical Knowledge**: Gain a strong foundation in theoretical and applied statistics to analyze and interpret data effectively.
- **Mathematical Reasoning**: Develop the ability to use mathematical tools and logical thinking for solving real-life and research-oriented problems.
- **Data Handling Skills**: Acquire skills in data collection, cleaning, visualization, and analysis using modern software and statistical techniques.

- **Computational Proficiency**: Learn to use programming languages and statistical software such as R, Python, SPSS, and C/C++ for data analysis and modeling.
- **Critical Thinking**: Enhance the ability to critically evaluate data sources, methods, and interpretations in a wide range of applications.
- **Research Competence**: Build capability to design and conduct statistical investigations and contribute to interdisciplinary research.
- **Problem Solving**: Apply statistical methods to solve practical problems in domains such as business, health, economics, environment, and public policy.
- **Communication Skills**: Develop effective written and verbal communication skills to present statistical findings clearly to both technical and non-technical audiences.
- **Ethics and Responsibility**: Understand the ethical issues in data handling, privacy, and responsible use of statistical results.
- **Career Readiness**: Prepare for careers in data science, analytics, government services, research institutions, finance, and further academic studies.

Teaching Learning Process:

The programme supports the application of multiple pedagogical approaches in both classroom and computer lab environments.

- Focus on learner-centric and outcome-based teaching methods.
- Use of both traditional lectures and digital tools for content delivery.
- Emphasis on conceptual clarity and practical application.
- Interactive sessions including discussions, quizzes, and problem-solving.
- Regular hands-on training using statistical software like R, SPSS, and Excel.
- Continuous internal assessment through tests, assignments, and presentations.
- Integration of project-based learning for real-life data analysis.
- Opportunities for internships and field work for practical exposure.
- Interdisciplinary approach connecting statistics with other domains.
- Inclusion of soft skill development and ethical value-based activities.

Teaching Learning Tools:

- Blackboard and Whiteboard Teaching – For explaining concepts, formulas, and derivations.

- Power Point Presentations – To visually present data, graphs, and theoretical concepts.
- Statistical Softwares – Tools like R, SPSS, Python, Excel for data analysis and practical's.
- ICT Tools – Projectors, Google Classroom
- Graphs and Charts – Manual and digital graph plotting for visualization.
- Problem-Solving Sessions – Interactive numerical sessions to enhance analytical skills.
- Case Studies – Real-life statistical data applications to encourage critical thinking.
- Group Discussions

Assessment/Evaluation Methods:

- A variety of subject-specific assessment procedures will be used to monitor student progress.
- Continuous evaluation will determine the final grade.
- Evaluation includes both In-semester assessment and End semester examination.
- In-semester evaluation methods include:
    - Class tests
    - In-semester Sessional exams
    - Home Assignments
    - Group Discussions
    - Attendance
- Assessment techniques include:
    - Tutorials
    - In-semester assessment
    - Problem-based assignments
    - Lab reports for practicals
    - Individual project reports
    - Oral presentations (including seminars)
    - Viva-voce
    - End Semester examinations (Theory and Practical)

Darrang College (Autonomous), Tezpur, Assam, 784001

FYUGP Structure as per UGC Credit Framework

Year	Semester	Course Code	Title of the Course	Total Credit
1st Year	**1st Semester**	STA-MJ-01014	Introductory Statistics and Probability	4
		STA-MN-01014	Introductory Statistics and Probability	4
		STA-SEC-01013	Statistical Data Analysis Using Excel	3
		VAC		4
		MDC		3
		AEC		2
	Total			**20**
	2nd Semester	STA-MJ-02014	Intermediate Probability Theory	4
		STA-MN-02014	Intermediate Probability Theory	4
		STA-SEC-02013	Statistical Data Analysis Using SPSS	3
		VAC		4
		MDC		3
		AEC		2
	Total			**20**
2nd Year	**3rd Semester**	STA-MJ-03014	Statistical Inference	4
		STA-MJ-03024	Mathematical Analysis	4
		STA-MN-03014	Basics of Statistical Inference	4
		STA-SEC-01013	Statistical Data Analysis Using R	3
		MDC		3
		AEC		2

	Total			**20**
	4th Semester	STA-MJ-04014	Linear Models & Probability Laws	4
		STA-MJ-04024	Linear Algebra	4
		STA-MJ-04034	Sampling Distributions	4
		STA-MJ-04044	Survey Sampling	4
		STA-MN-04014	Survey Sampling & Design of Experiments	4
		AEC		2
	Total			**22**
3rd Year	**5th Semester**	STA-MJ-05014	Applied Statistics	4
		STA-MJ-05024	Analysis of Variance and Design of Experiments	4
		STA-MJ-05014	Operations Research	4
		STA-INT-05014	Internship	4
		STA-MN-05014	Applied Statistics	4
	Total			**20**
	6th Semester	STA-MJ-06014	Stochastic Process and Queuing Theory	4
		STA-MJ-06024	Multivariate Analysis and Non-Parametric Inference	4
		STA-MJ-06034	Demography and Vital Statistics	4
		STA-MJ-06044	Project	4
		STA-MN-06014	Demography and Vital Statistics	4
	Total			**20**
4th Year	**7th Semester**	STA-MJ-07014	Advanced Mathematical Analysis	4
		STA-MJ-07024	Advanced Probability Theory	4
		STA-MJ-07034	Econometrics	4

		STA-MJ-07044	Research Methodology	4
		STA-MN-07014	Linear Models	4
	Total			**20**
	8th Semester	STA-MJ-08014	Time Series Analysis	4
		STA-MJ-08024	Bayesian Inference	4
		STA-MJ-08034	Queuing Theory	4
		STA-MJ-08044	Dissertation	4
		STA-MN-08014	Operations Research	4
	Total			**20**

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 1st SEMESTER

Title of the Course	Introductory Statistics and Probability
Course Code	STA-MN-01014
Nature of Course	Minor
Total Credit	4 (Theory -03 + Practical - 01)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	100-199

Course Objectives: The objective is to give students foundational ideas about the various statistical methods, measures of central tendency and basics of probability. The students are introduced to the methods of collecting data, their representational formats and basic statistical tools.

Learning Outcomes: At the end of the course, students will be able to analyse a data set, represent the data in tabular and diagrammatic form, prepare the frequency distribution, find the summary measures viz. the measures of central tendency, measure of dispersion, measures of skewness and kurtosis of a univariate data.

Course Outcomes:

CO1: Recall and define fundamental concepts in descriptive statistics and probability, such as mean, median, mode, variance, standard deviation, probability distributions, and basic rules of probability.

CO2: Interpret and explain the significance of descriptive statistical measures and probability concepts in real-world contexts. Describe the relationship between descriptive statistics and probability and how they are used to analyze and interpret data.

CO3: Apply descriptive statistical techniques to summarize and analyze data sets, including calculating measures of central tendency, dispersion, and constructing frequency distributions.

CO4: Analyze and interpret data using descriptive statistics and probability techniques, identifying patterns, trends, and relationships within datasets.

CO5: Assess the strengths and limitations of descriptive statistics and probability in

addressing real life questions and making informed decisions, and propose improvements or alternative approaches when necessary

Unit	Content	L	T	P	Total hrs
I	**Statistical Data and its representations:** Definition and scope of Statistics, concepts of statistical population and sample. Types of Data: quantitative and qualitative, primary and secondary data, attributes, variables, scales of measurement-nominal, ordinal, interval and ratio. Data visualization. Presentation & Classification of Data: tabular and frequency distribution, Collection and Scrutiny of Data: Primary data-designing a questionnaire and a schedule; Secondary data- their Major sources including some government publications. Idea of National Surveys (ASER, NFHS etc)	07	01	-	08
II	**Descriptive Statistics:** Mathematical measures of central tendency: Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean, Trimmed Mean, Winsorised Mean and their properties and applications. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Sheppard's corrections, skewness and kurtosis, Partition Values: Fractiles, Quartiles, Deciles, percentiles.	13	02	-	15
III	**Bivariate Data:** Representation of Bivariate Data, scatter diagram, simple, partial and multiple correlation (three variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curve	09	01	-	10

IV	**Introductory Probability**: Introduction, random experiments, sample space, events, algebra of events. Definitions of Probability: classical, statistical and axiomatic. Computational Probability: Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications. Idea of Quantum Probability	10	02	-	12
V	**Practical:** **Note**: Students can use calculators / Ms Excel programming as convenient**.** 1. Graphical representation of data. 2. Problems based on measures of central tendency & dispersion. 3. Problems based on measures of location. 4. Problems based on moments, skewness and kurtosis. 5. Karl Pearson correlation coefficient 6. Correlation coefficient for a bivariate frequency distribution 7. Lines of regression, angle between lines and estimated values of variables. 8. Estimation of parameters by Method of Least Square 9. Spearman rank correlation with and without ties. 10. Partial and multiple correlations.	-	-	15	30

SUGGESTED READING:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I &II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwinand Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A.and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co.Ltd.
4. Medhi, J. (2000): Statistical Methods: An Introductory text (New Age International (P) Ltd.
5. Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand & Sons. New Delhi. (12th Edition).

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 2nd SEMESTER

Title of the Course	Intermediate Probability Theory
Course Code	STA-MN-02014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	100-199

Course Objective: This course has the objective of providing exposure to random variable and large-scale properties of probability distributions. This is a fundamental course on probability theory, random variables and their distributions to make further progress on statistical analysis. This course also introduces the ideas of Statistical Inference and its importance in real world applications

Learning Outcomes: At the end of the course, students shall be able to appreciate the large sample implications of various statistical measures and also learn about a number of statistical distributions. They will be able to determine whether or not moments exist of any given random variable and if so, to determine them. They will also be able to use tools like Probability Generating function and Moment generating functions to study distributions in addition to learning several univariate discrete and continuous distributions and their characterizations.

Course outcomes:

CO1: Define the concepts of two dimensional random variables, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, bivariate transformations.

CO3: Define expectation of single and bivariate random variables and its properties, conditional expectations, conditional variance, moments, factorial moments.

CO3: Explain the properties of generating functions. cumulants, cumulant generating function, characteristic function

CO4: Illustrate the various probability distributions such as Discrete uniform, Bernoulli, Binomial, Poisson, geometric, negative binomial, hyper-geometric, Multinomial, Exponential, Cauchy, Beta and Gamma distributions, Lognormal, their properties and limiting cases and utilize these ideas to solve numerical problems.

Unit	Content	L	T	P	Total hrs
I	**Random variables:** Discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations. Two dimensional random variables: discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, transformation of random variables, Idea of discretisation of continuous random variable.	10	02	-	12
II	**Mathematical Expectation and Generating Functions:** Expectation of single and bivariate random variables and its properties, Computational Expectations of conditional, conditional variance. Generating Function, Moment generating function (mgf), cumulants, cumulant generating function (cgf) and characteristic function (cf), probability generating function (pgf) their properties and related problems. Distribution of CDF.	11	02	-	13
III	**Discrete Probability Distributions:** Discrete uniform, Bernoulli, Binomial, Poisson, geometric, negative binomial, hyper-geometric, logarithmic distribution along with their properties and limiting/approximation cases	09	01	-	10

IV	**Continuous Probability Distributions**: Uniform, normal, negative exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases, Log normal, Laplace, Weibull.	09	01	-	10
V	**Practical:** **Note**: Students can use calculators / Ms Excel/SPSS programming as convenient**.** 1. Fitting of binomial distributions for n and p = q = ½. 2. Fitting of binomial distributions for given n and p. 3. Fitting of binomial distributions after computing mean and variance. 4. Fitting of Poisson distributions for given value of lambda. 5. Fitting of Poisson distributions after computing mean. 6. Fitting of negative binomial. 7. Fitting of suitable distribution. 8. Application problems based on binomial distribution. 9. Application problems based on Poisson distribution. 10. Application problems based on negative binomial distribution. 11. Problems based on area property of normal distribution. 12. To find the ordinate for a given area for normal distribution. 13. Application based problems using normal distribution. 14. Fitting of normal distribution when parameters are given. 15. Fitting of normal distribution when parameters are not given. 16. Fitting of exponential distribution	-	-	15	30

SUGGESTED READING:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.

2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.

3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

4. Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand & Sons. New Delhi. (12^{th} Edition).

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 3rd SEMESTER

Title of the Course	Basics of Statistical Inference
Course Code	STA-MN-03014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	200-299

Course Objective: This course has the objective of exposing students to concepts of estimation and testing of hypothesis - its types, and desirable properties of an estimator and how to find a good estimate from a sample data and how to analyse categorical data.

Course Outcomes:

CO1: Describe the concepts of estimation, unbiasedness, sufficiency, consistency and efficiency, non-parametric tests and distribution free procedures.

CO2: Discuss factorization theorem. minimum variance unbiased estimator (MVUE), testing of hypothesis problems based on the traditional approach and p-value approach.

CO3: Illustrate different non-parametric tests such as Test for randomness based on total number of runs, Sign tests-one sample and two samples, Wilcoxon-Mann-Whitney test.

CO4: Learn the idea categorical data, tests related to categorical data and their applications.

Unit	Content	L	T	P	Total hrs
I	**Point Estimation:** Concepts of Estimation, Unbiasedness, Sufficiency, Consistency and Efficiency. Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE)	10	04	-	14
II	Tests of Hypothesis: Null and alternative hypothesis. Type I & Type II errors, level of significance, critical region, concept of p-value, The basic idea of significance test. Tests of hypotheses for the parameters of a normal distribution (one sample).	05	03		08
III	Categorical data analysis: Tests of proportions, tests of association and goodness-of-fit using Chi- square test, Yates' correction, Non-parametric tests: Test for median, Sign test for one sample and two sample, Wilcoxon one sample, two sample test, Mann Whitney test.	09	04	-	13
IV	**Large and small sample tests:** testing single proportion, difference of two proportions, single mean, difference of two means, standard deviation and difference of standard deviations by classical and p-value approaches. Concept of t-test and F ratio test.	06	04		10
V	**Practical:** **Note**: Students can use calculators / Ms Excel/SPSS programming as convenient**.** Based on Unit II, III & IV	-	-	15	30

SUGGESTED READING:

1. Gupta, S.C. and Kapoor, V.K. (2020). Fundamentals of Mathematical Statistics. Sultan Chand & Sons. New Delhi. (12th Edition).
2. Goon A.M., Gupta M.K.: Das Gupta. B. (2005): Fundamentals of Statistics, Vol. I, World Press, Calcutta.

3. Mood A.M, Graybill F.A. and Boes D.C: Introduction to the Theory of Statistics, McGraw Hill.
4. Rohatgi V. K. and Saleh, A.K. Md. E. (2015): An Introduction to Probability and Statistics. 2nd Edn. (Reprint) John Wiley and Sons.
5. Casella, George, and Roger Berger. *Statistical inference*. Chapman and Hall/CRC, 2024.
6. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
7. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
8. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 4th SEMESTER

Title of the Course	Survey Sampling and Design of Experiments
Course Code	STA-MN-04014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)

Course Objectives: The main objective of this course is to provide the basic knowledge of various probabilistic and non probabilistic sampling procedures to draw a random sample from a population. This course also has the objective of providing student the knowledge of art of analysis of field experiments.

Course Outcomes:

CO1: Learn the concept of population and sample, importance of sampling, principle underlying sampling and designing of large-scale survey; comparison between census and sample survey; SRSWR and SRSWOR.

CO2: Discuss the estimation procedure of sample size with different types of allocation in stratified random sampling.

CO3: Learn the technique of systematic sampling. Comparison between Systematic sampling, stratified, SRSWR and SRSWOR.

CO4: Learn fixed, random and mixed effect models, analysis of variance (one way and two way), principles of design of experiments, basic designs: CRD, RBD.

CO5: Discuss analysis of CRD and RBD with missing observations.

Unit	Content	L	T	P	Total hrs
I	Survey Sampling: Complete enumeration, controlled experiments, observational studies and sample surveys, Concept of population and sample, complete enumeration versus sampling, principal steps in a sample survey, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey.	10	02	-	12
II	Simple random sampling: Simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and mean square. Determination of sample size- preliminary formulas only.	09	02	-	11
	Stratified random sampling: Technique of stratified sampling, estimates of population mean and total, variances of these estimates (with derivation), proportional and optimum allocations and their comparison with SRS (with derivation), determination of sample size (in case of proportional allocation only). Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates (N=n x k). Comparison of systematic sampling with SRS (with derivation).	09	01	-	10
III	**Analysis of Variance:** Definitions of fixed, random and mixed effect models, analysis of variance in one-way classified data for fixed effect models, analysis of variance in two-way classified data with one observation per cell for fixed effect models.				

IV	**Design of Experiments:** Basic principles of Design, Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD)– layout, model and statistical analysis with derivations, analysis with missing observations. Concept of factorial experiments: 2^2 and 2^3	11	01	-	12
VI	Practical based on Unit II, III and IV	-	-	15	30

SUGGESTED READING:

1. 1. Cochran, W.G. (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.

2. Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. Asok,C.(1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics

3. Murthy, M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.

5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2001): Fundamentals of Statistics (Vol.2), World Press.

6. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House.

7. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd.

8. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8th Edn. World Press, Kolkata.

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 5th SEMESTER

Title of the Course	Applied Statistics
Course Code	STA-MN-05014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	300-399

Course Objective: This course has the objective of exposing students to the different domains of applied statistics.

Learning Outcomes: At the end of the course, students shall be able to understand how statistics is directly applied in economic analysis, govt. and society.

Course outcomes:

CO1: Define and construct index numbers of prices and quantities (Laspeyres' , Paasche's, Fisher's and Marshal-Edgeworth's).

CO2: Outline the organisations involved in official data collection in India along with major publications on such official statistics in India.

CO3: Explain the importance of statistical methods in industrial research and practice, how tolerance limits are determined, chance and assignable causes of variations in quality, various methods of fertility, mortality and reproduction, construction of life tables, concepts related to demand analysis and measures of inequality (Lorenz curve, Gini coefficient).

CO4: Prepare various control charts for process and product control.

CO5: Use various methods like method of free-hand curve, moving average method, method of semi-averages and method of least squares to measure trend and method of ratio to trend to measure seasonal variations.

Unit	Content	L	T	P	Total hrs
I	**Time Series:** Components of time series, Decomposition of time series: Additive and multiplicative model with their merits and demerits, Illustrations of time series. Measurement of trend by method of free-hand curve, moving average method, method of semi-averages and method of least squares (linear, quadratic and modified exponential), Detrending, Measurement of seasonal variations by method of ratio to trend. Effect of elimination of trend on other components of the time series. Measurement of cyclical fluctuations.	10	02	-	12
II	**Index Numbers:** Definition, Uses and limitations of index numbers. Criteria/tests for a good index number, different types of index numbers- price, quantity, value. Wholesale price index number, Index of Industrial Production. Construction of index numbers of prices and quantities – Laspeyres', Paasche's, Fisher's and Marshal-Edgeworth's Index numbers. Consumer price index number. Base shifting, splicing, and deflating of index numbers.	09	02	-	11
III	**Statistical Quality Control:** Importance of statistical methods in industrial research and practice. Rational subgroup., Determination of tolerance limits. Causes of variations in quality: chance and assignable. General theory of control charts, process & product control, Control charts for variables: X bar, R-charts and sigma chart. Control charts for attributes: np charts, p charts, c charts and u-charts. Comparison between control charts for variables and control charts for attributes. Product control – basic ideas of Single sampling and double sampling plans .	09	01	-	10

IV	**Demand Analysis:** Theory of consumption and demand, demand function, elasticity of demand, determination of elasticity of demand by family budget method, Lorentz curve and Gini's coefficient, Engel's law and Engel's curve, Pareto's law of income distribution.	11	01	-	12
V	**Practical:** Based on Unit I, II, III & IV			15	30

SUGGESTED READING:

1. Mukhopadhyay,P.(1999): Applied Statistics, New Central Book Agency, Calcutta.

2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II,9th Edition World Press, Kolkata.

3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4th Edition (Reprint), Sultan Chand & Sons.

4. Montogomery,D.C.(2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

5. Mukhopadhyay, P. (1999): Applied Statistics, Books and Allied(P)Ltd.

6. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9th Edition, World Press.

7. Croxton, Fredrick E., Cowden, Dudley J. and Klein, S. (1973): Applied General Statistics, 3rd Edition. Prentice Hall of India Pvt. Ltd.

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 6th SEMESTER

Title of the Course	Design of Experiments
Course Code	STA-MN-05014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	300-399

Course Objective: This course has the objective of providing student the knowledge of art of analysis of field experiments.

Learning Outcomes: At the end of the course, students shall be able to understand the different types of commonly used field experimental techniques.

Course Outcome:

CO1: Learn fixed, random and mixed effect models, analysis of variance (one way and two way), principles of design of experiments, basic designs: CRD, RBD.

CO2: Discuss analysis of covariance, RBD with more than one observation per cell, Latin Square Design (LSD), analysis with missing observations, Split Plot Design, Strip Plot Design.

CO3: Discuss 2^n and 3^n factorial experiments

CO4: Explain confounding technique to reduce block size in factorial experiment.

CO5: Discuss Split Plot Design, Strip Plot Design, Incomplete Block Designs, and balanced Incomplete Block Design (BIBD).

Unit	Content	L	T	P	Total hrs
I	Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, choice of size and shape of plots and blocks. Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – layout, model and statistical analysis, relative efficiency, analysis with one and two missing observations, Idea of Orthogonal Latin Square, Graeco Latin Square Design.	13	03		16
II	**Factorial experiments:** advantages, notations and concepts, 2^2, $2^3 \ldots 2^n$ and 3^2 factorial experiments, design and analysis, Total and Partial confounding for 2^n ($n \leq 5$), idea of 3^2 experiment.	09	04	-	13
III	**Analysis of Covariance**: one-way and two-way classified data with one concomitant variable. Variance Component Analysis: Introduction, analysis in a two-way classification.	04	04	-	08
IV	Split Plot Design, Strip Plot Design, Incomplete Block Designs, Introduction to Balanced Incomplete Block Design (BIBD).	04	04	-	08
V	**Practical/Lab** Based on Unit I, II, III & IV			15	30

SUGGESTED READING:

1. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House.

2. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd.

3. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8thEdn.

World Press, Kolkata.

4. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.

5. Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.

6. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4th Edition (Reprint), Sultan Chand & Sons.

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 7th SEMESTER

Title of the Course	Linear Models
Course Code	STA-MN-07014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	400-499

Course Objective:

The objective of the course is to give exposure to analysis of simple and multiple linear regression models.

Learning outcome:

Upon completion of the course, students will be able to apply simple and multiple regression analysis to analyse relationships between multiple variables, interpret regression coefficients, assess model fit, and make predictions based on the developed regression models.

Course outcomes:

CO1: Define multiple linear regression and its key components. Explain the assumptions underlying multiple linear regression, such as linearity, independence of errors, and homoscedasticity.

CO2: Identify the steps involved in building a linear regression model, from data preprocessing to model evaluation.

CO3: Explain the concept of multicollinearity, autocorrelation and their implications for simple and multiple linear regression models.

Unit	Content	L	T	P	Total hrs
I	**Gauss-Markov set-up:** Theory of linear estimation, Estimability of linear parametric functions, Method of least squares, Gauss-Markov theorem, Estimation of error variance. Simple Regression Model: Estimation of parameters and hypothesis testing in case of simple regression models, Classical/ matrix model.	10	02	-	12
II	**Multiple regression model:** Estimation of model parameters, Hypothesis Testing in multiple linear regression, Regression with and without intercept terms, standardized regression coefficients and interpretations, use of R^2 & adjusted R^2.	09	02	-	13
III	**Model checking:** Prediction from a fitted model, Violation of usual assumptions of ANOVA and their remedies by transformation. Diagnostics using probability plots & quantile-quantile plots.	09	01	-	10
IV	**Practical:** **Note**: Students can use calculators / Ms Excel/SPSS programming as convenient**.** Based on Unit I, II & III	-	-	15	30

SUGGESTED READING:

1. Weisberg, S. (2005). Applied Linear Regression (Third edition).Wiley.

2. Wu, C. F. J. And Hamada, M. (2009). Experiments, Analysis, and Parameter Design Optimization (Second edition), John Wiley.

3. Renchner, A. C. And Schaalje, G. B. (2008). Linear Models in Statistics(Second edition), John Wiley and Sons.

B.A./B.Sc. IN STATISTICS PROGRAMME (FYUGP)

DETAILED SYLLABUS OF FYUGP 8th SEMESTER

Title of the Course	Operations Research
Course Code	STA-MN-08014
Nature of Course	Minor
Total Credit	4 (Theory - 3 + Practical - 1)
Contact Hours	45 (Theory) + 30 (Practical)
Distribution of Marks	End Semester (45) + In Semester (30) + End sem Practical (25)
Course Level	400-499

Course Objective: This course has the objective of inculcating the skills of Operations Research.

Learning Outcomes: At the end of the course, students shall be able to use techniques of operations research to obtain optimization in field level problems.

Course Outcome:

CO1: Discuss optimization techniques using OR tools VIZ. LPP, Transportation problem, Replacement problem, Inventory Control and Network.

CO2: Distinguish use of different methods to various kinds of LPP on the basis of type of constraints and number of variables in real life problems.

CO3: Solve transportation problem using North West corner rule, Least cost method ad Vogel Approximation method.

CO4: Solve assignment problem using Hungarian method.

CO5: Determine different types of floats and slacks, determination of critical path in network problem.

Unit	Content	L	T	P	Total hrs
I	**Operations Research**: Introduction to Operations Research, Linear Programming Problem, Mathematical formulation of the L.P.P, basic geometry involving LPP, graphical solutions of a L.P.P. Simplex method for solving L.P.P, the artificial variable techniques - Charne's Big M-technique. Idea of Duality in linear programming, the symmetric and asymmetric duals.	10	03	-	13
II	**Transportation Problem:** Transportation Problem: Initial solution by North West corner rule, Least cost method and Vogel's approximation method (VAM), MODI's method to find the optimal solution, Idea of loop, special cases of transportation problem. Assignment problem: Hungarian method to find optimal assignment, special cases of assignment problem.	07	04	-	11
III	**Game theory:** Introduction, Two person Zero sum game, Dominance rule, The Minimax-Maximin Principle; saddle points; Game without saddle point; Pure and Mixed strategies; Solution procedure of 2x2 game; Graphical solution procedure; Equivalence of Rectangular game and linear programming.	08	04	-	12
IV	**Replacement model & Network Analysis:** Replacement problem, Different time estimates related to any project under CPM and PERT, Probability distribution associated with PERT, Probability of achieving completion date of	05	04	-	09

	project, Resource allocation – Resource Smoothing and Resource Levelling.				
V	**Practical/Lab** **List of Practical** Based on Unit I, II, III & IV			15	30

SUGGESTED READING:

1. Taha, H. A. (2007): Operations Research: An Introduction, 8th Edition, Prentice Hall of India.

2. Kanti Swarup, Gupta, P.K. and Manmohan (2007): Operations Research, 13th Edition, Sultan Chand and Sons.

3. Hadley, G: (2002) : Linear Programming, Narosa Publications

4. Hillier, F.A and Lieberman, G.J. (2010): Introduction to Operations Research- Concepts and cases, 9th Edition, Tata McGraw Hill.