ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Model Syllabus for 4-Year UG Honours in B.Sc. (Statistics) as Major in consonance with Curriculum framework w.e.f. AY 2025-26

Prepared by Yogi Vemana University, Kadapa

COURSE STRUCTURE (for Semester I to VI)

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
I	I	1	Descriptive Statistics	3	3
			Descriptive Statistics Practical Course	2	1
		2	Theory of Probability and Mathematical Expectations	3	3
			Theory of Probability and Mathematical Expectations Practical Course	2	1
	II	3	Theoretical Discrete Distributions	3	3
			Theoretical Discrete Distributions Practical Course	2	1
		4	Theoretical Continuous Distributions	3	3
			Theoretical Continuous Distributions Practical Course	2	1
II	III	5	Statistical Methods	3	3
			Statistical Methods Practical Course	2	1
		6	Inferential Statistics	3	3
			Inferential Statistics Practical Course	2	1
		7	Sampling Techniques	3	3
			Sampling Techniques Practical Course	2	1
	IV	8	Design and Analysis of Experiments	3	3
			Design and Analysis of Experiments Practical Course	2	1
		9	Applied Statistics	3	3
			Applied Statistics Practical Course	2	1
		10	Statistical data analysis using MS - excel	3	3
			Statistical data analysis using MS – excel practical course	2	1

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
III	V	11	Computational Statistics and R Programming	3	3
			Computational Statistics and R Programming Practical Course	2	1
		12 A	Operations Research	3	3
			Operations Research Practical Course	2	1
		OR			
		12 B	Actuarial Statistics	3	3
			Actuarial Statistics Practical Course	2	1
		13 A	Optimization Techniques	3	3
			Optimization Techniques Practical Course	2	1
		OR			
		13 B	Applied Statistics – II	3	3
			Applied Statistics – II Practical Course	2	1
	VI	14 A	Statistical Quality Control	3	3
			Statistical Quality Control Practical Course	2	1
		OR			
		14 B	Advanced Actuarial Statistics	3	3
			Advanced Actuarial Statistics Practical Course	2	1
		15 A	Statistical Techniques for Research Methodology	3	3
			Project work	2	1
		OR			
		15 B	Statistical Analysis for Clinical Trials	3	3
			Statistical Analysis for Clinical Trials Practical Course	2	1

Note: In the III Year (during the V and VI Semesters), students are required to select a pair of electives from one of the Two specified domains. For example: if set ‘A’ is chosen, courses 12 to 15 to be chosen as 12 A, 13 A, 14 A and 15 A or if set ‘B’ is chosen, It is to be chosen as 12 B, 13 B, 14 B and 15 B to ensure in-depth understanding and skill development in the chosen domain, students must continue with the same domain electives in both the V and VI Semesters.

SEMESTER - I

COURSE 1: DESCRIPTIVE STATISTICS

Theory **Credits: 3** **3 hrs/week**

Program Objectives

1. To build the basis for promoting various statistical methods theoretically and their applications in study of multidisciplinary sciences by emphasizing real life problems.
2. To inculcate statistical thinking and computer approach towards statistical methods, tools and techniques among the students.
3. To develop skills in handling complex problems in data analysis and research design.

Course Outcomes

After successful completion of the course students will be able to:

1. To acquaint with the role of statistics in different fields with special reference to business and economics.
2. To review good practice in presentation and the format most applicable to their own data.
3. To learn the measures of central tendency or averages reduce the data to a single value which is highly useful for making comparative studies.
4. To familiar with the measures of dispersion throw light on reliability of average and control of variability.

Unit – 1: Statistical Description of Data

Origin, history and definitions of Statistics. Importance, Scope and limitations Statistics. Function of Statistics – Collection, Presentation, Analysis and Interpretation. Collection of data – primary and secondary data and its methods. Classification of data – Quantitative, Qualitative, Temporal, Spatial. Presentation of data – Textual, Tabular – essential parts.

Unit – 2:

Measurement Scales – Nominal, Ordinal, Ratio and Interval. Frequency distribution and types of frequency distributions, forming a frequency distribution. Diagrammatic representation of data – Historiagram, Bar, Multiple bar and Pie with simple problems. Graphical representation of data: Histogram, frequency polygon and Ogives with simple problems.

Unit – 3: Measures of Central Tendency (MCT)

Arithmetic Mean – properties, methods. Median, Mode, Geometric Mean (GM), Harmonic Mean (HM). Calculation of mean, median, mode, GM and HM for grouped and ungrouped data. Median and Mode through graph. Empirical relation between mean, median and mode. Features of good average.

Unit – 4: Measures of Dispersion

Concept and problems – Range, Quartile Deviation, Mean Deviation and Standard Deviation and their coefficients, Variance and its applications viz. Business and Pharmacy etc.

Unit – 5:

Central and Non – Central moments and their interrelationship, Problems. Sheppard's correction for moments and problems. Skewness and its methods, kurtosis and related problems.

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedarnath Ramnath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts.
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - I

COURSE 1: DESCRIPTIVE STATISTICS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Writing a Questionnaire in different situations.
2. Forming a grouped and ungrouped frequency distribution table.
3. Diagrammatic presentation of data – Bar, multiple Bar and Pie.
4. Graphical presentation of data – Histogram, frequency polygon, Ogives.
5. Computation of measures of central tendency – Mean, Median and Mode.
6. Computation of measures of dispersion – Q.D., M.D and S.D.
7. Computation of non-central, central moments, β_1 and β_2 for ungrouped data.
8. Computation of non-central, central moments, β_1 and β_2 and Sheppard's corrections for grouped data.
9. Computation of Karl Pearson's and Bowley's Coefficients of Skewness.
10. Computation of Kurtosis.

SEMESTER - I

COURSE 2: THEORY OF PROBABILITY AND MATHEMATICAL EXPECTATIONS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To acquaint with the role of statistics in dealing with the univariate random variables.
2. To learn the extension of the univariate data to bivariate data.
3. To learn the measure of randomness mathematically by using expectations.
4. To get the familiarity about the generating functions, law of large numbers and central limit theorem, further to apply in research and allied fiends.

Unit – 1: Elementary Probability

Basic Concepts of Probability, random experiments, trial, outcome, sample space, event, mutually exclusive and exhaustive events, equally likely and favourable outcomes. Mathematical, Statistical, axiomatic definitions of probability. Conditional Probability and independence of events, Addition and multiplication theorems of probability for 2 and for n events and simple problems. Boole's inequality, Bayes theorem and its applications in real life problems.

Unit – 2: Univariate Random Variables

Definition of random variable (r.v.), discrete and continuous random variables, functions of random variable. Probability mass function, Probability density function, Distribution function and its properties. Calculation of moments, coefficient of skewness and kurtosis for a given pmf and pdf.

Unit – 3: Bivariate Random Variables

Bivariate random variable - meaning, joint, marginal and conditional Distributions, independence of random variables and simple problems.

Unit – 4: Mathematical Expectation

Mathematical expectation of function a random variable. Moments and covariance using mathematical expectation with examples. Addition and Multiplication theorems on expectation. Properties of expectations, variance, covariance. Chebyshev and Cauchy-Schwartz inequalities and their applications.

Unit – 5: Generating functions

Definitions of Moment Generating Function, Cumulant Generating Function, Characteristic Function and Probability Generating Function and their properties. Weak Law of Large Numbers (WLLN), Strong Law of Large Numbers (SLLN). Convergence in probability and convergence in distribution, concept of Central limit theorem.

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts.
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - I

COURSE 2: THEORY OF PROBABILITY AND MATHEMATICAL EXPECTATIONS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Calculation of moments of univariate random variable to the given pmf.
2. Calculation of coefficient of skewness and kurtosis of univariate random variable to the given pmf.
3. Calculation of moments of univariate random variable to the given pdf.
4. Calculation of coefficient of skewness and kurtosis of univariate random variable to the given pdf.
5. Problem related to jpmf, mpmf and conditional pmf and its independence.
6. Problem related to jpdf, mpdf and conditional pdf and its independence.
7. Chebyshev's inequality application oriented problems.

SEMESTER - II

COURSE 3: THEORETICAL DISCRETE DISTRIBUTIONS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To deal with the data by the basic discrete distributions such as Uniform and Binomial distributions.
2. To acquaint the Poisson distribution applications.
3. To learn about the Negative Binomial distribution and its applications towards the real life problems.
4. To familiar with dealing the data by Geometric and Hyper Geometric distributions.

Unit – 1: Uniform, Bernoulli and Binomial distributions

Discrete Uniform distribution – definitions, mean, variance. Bernoulli distribution – definitions, mean, variance and its mgf. Binomial distribution – Definition, moments, M.G.F, C.F, C.G.F, P.G.F, additive property if exists, skewness, kurtosis and problems. First two moments obtained through mgf, recurrence relation for probabilities, limiting case of Binomial Distribution to Normal distribution.

Unit – 2: Poisson Distribution

Poisson distribution - Definition, moments, M.G.F, C.F, C.G.F, P.G.F, additive property if exists, skewness, kurtosis and problems. First two moments obtained through mgf, recurrence relation for probabilities. Poisson distribution as a limiting case of Binomial distribution, limiting case of Poisson Distribution to Normal distribution.

Unit – 3: Negative Binomial Distribution

Negative Binomial Distribution - Definition, moments, M.G.F, C.F, C.G.F, P.G.F, additive property if exists, skewness, kurtosis and problems. First two moments obtained through mgf, recurrence relation for probabilities. Limiting case of Negative Binomial Distribution to Normal distribution.

Unit – 4: Geometric Distribution

Geometric Distribution – Definition, moments, M.G.F, C.F, C.G.F, P.G.F, additive property if exists, skewness, kurtosis and problems. First two moments obtained through mgf, Lack of memory property. Recurrence relation for probabilities.

Unit – 5: Hyper Geometric Distribution

Hyper Geometric Distribution – Definition, mean and variance, problems. Recurrence relation for probabilities. Limiting case of Hyper Geometric distribution to Binomial distribution.

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

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2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
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SEMESTER - II

COURSE 3: THEORETICAL DISCRETE DISTRIBUTIONS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Fitting of Binomial distribution – Direct method.
2. Fitting of Binomial distribution – Recurrence relation Method.
3. Fitting of Poisson distribution – Direct method.
4. Fitting of Poisson distribution – Recurrence relation Method.
5. Fitting of Negative Binomial distribution – Direct method.
6. Fitting of Negative Binomial distribution – Recurrence relation Method.
7. Fitting of Geometric distribution – Direct method.
8. Fitting of Geometric distribution – Recurrence relation Method.
9. Fitting of Hyper Geometric distribution.

SEMESTER - II

COURSE 4: THEORETICAL CONTINUOUS DISTRIBUTIONS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To deal with the data by the basic continuous distribution such as Uniform Binomial distribution.
2. To acquaint the Exponential distribution applications.
3. To learn about the Gamma and Beta distributions and their applications towards the real life problems.
4. To get familiarity of the most important distributions such as Normal and Standard Normal distribution and their applications in research and various fields.
5. To acquire the knowledge of exact sampling distributions.

Unit – 1: Continuous Uniform distribution

Uniform distribution – Definition, moments, M.G.F, C.F, C.G.F, skewness, kurtosis and Distribution function. Mean Deviation about mean.

Unit – 2: Exponential Distribution

Exponential distribution – Definition, moments, M.G.F, C.F, C.G.F, skewness, kurtosis and Distribution function. Memory less property.

Unit – 3: Gamma and Beta Distributions

Gamma Distribution - Definition, moments, M.G.F, C.F, C.G.F, skewness, kurtosis and additive property. Limiting form of gamma distribution.

Beta Distribution of first and second kind – Definition, mean, variance and harmonic mean.

Unit – 4: Normal Distribution

Normal Distribution – Definition, properties, importance, M.G.F, C.F, C.G.F, additive property, skewness, kurtosis and problems. Obtain mean, median and mode, Even and Odd order moments about mean, linear combination of normal variates, points of inflexion of normal probability curve.

Unit – 5: Standard Normal and Sampling Distributions

Standard Normal Distribution – Definition, mgf, mean and variance, Area property, problems. Concept of Population, Sample, Parameter, Statistic, Sampling Distribution. Student's t – distribution, F – Distribution, χ^2 – Distribution: Definitions, properties and their applications.

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

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2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
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SEMESTER - II

COURSE 4: THEORETICAL CONTINUOUS DISTRIBUTIONS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Calculation of moments of Uniform distribution.
2. Calculation of skewness and kurtosis of Uniform distribution.
3. Fitting of Exponential distribution.
4. Gamma distribution application-oriented problems.
5. Fitting of Normal distribution – Areas method.
6. Fitting of Normal distribution – Ordinates method.
7. Problems related to Standard Normal distribution.

SEMESTER - III

COURSE 5: STATISTICAL METHODS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To get the knowledge of estimating future values by using curve fitting.
2. To calculate the relationship between bivariate data.
3. To find the relationship about the multivariate data.
4. To acquaint about the forecasting of the data by using regression techniques.
5. To find the association of the categorical data by using attributes.

Unit – 1: Curve fitting

Bivariate data, Principle of least squares, fitting of k^{th} degree polynomial. Fitting of straight line, Fitting of Second degree polynomial, fitting of family of exponential curves and power curve.

Unit – 2: Correlation

Meaning, Types of Correlation, Measures of Correlation – Scatter diagram, Karl Pearson's Coefficient of Correlation, Rank Correlation Coefficient (with and without ties), Properties. Bivariate frequency distribution, correlation coefficient for bivariate data and problems.

Unit – 3:

Coefficient of concurrent deviation, probable error and its properties, coefficient of determination, Concept of multiple and partial correlation coefficients (three variables only), properties and problems, Intra-class correlation and correlation ratio.

Unit – 4: Regression

Concept of Regression, Linear and Non-Linear regression. Linear Regression – Regression lines, Regression coefficients and its properties, Angle between two lines of regression. Regressions lines for bivariate data and simple problems. Correlation vs regression. Explained and Unexplained variations.

Unit – 5: Attributes

Notations, Class, Order of class frequencies, Ultimate class frequencies, Consistency of data, Conditions for consistency of data for 2 and 3 attributes only, Independence of attributes, Association of attributes and its measures, Relationship between association and colligation of attributes.

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts.
2. Assignments including technical assignments if any.
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4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
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6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - III

COURSE 5: STATISTICAL METHODS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Fitting of straight line by the method of least squares.
2. Fitting of parabola by the method of least squares.
3. Fitting of exponential curve of two types by the method of least squares.
4. Fitting of power curve of the type by the method of least squares.
5. Computation of correlation coefficient and regression lines for ungrouped data.
6. Computation of correlation coefficient for bivariate frequency distribution.
7. Computation of correlation coefficient, forming regression lines for grouped data.
8. Computation of partial and multiple correlation coefficients.
9. Computation of Yule's coefficient of association and colligation.

SEMESTER - III

COURSE 6: INFERENTIAL STATISTICS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To acquaint with estimator, estimates, estimation techniques and its properties.
2. To acquire knowledge of testing the hypothesis of different distributions.
3. To learn about the large sample techniques by using various tools.
4. To learn about the small sample techniques by using various tools.
5. To deal with the situation where there are no parameters to the distributions.

Unit – 1: Theory of estimation

Estimation of a parameter, criteria of a good estimator – unbiasedness, consistency, efficiency, & sufficiency. Estimation of parameters by the method of moments and maximum likelihood (M.L), properties of MLE's. Rao – Cramer Inequality, properties. Binomial, Poisson & Normal Population parameters estimate by MLE method. Confidence Intervals.

Unit – 2: Testing of Hypothesis

Concepts of statistical hypotheses, null and alternative hypothesis, critical region, two types of errors, level of significance, concept of p value and power of a test. One and two tailed tests. Neyman -Pearson's lemma. Examples in case of Binomial, Poisson, Exponential and Normal distributions.

Unit – 3: Large sample Tests

Large sample test for single mean and difference of two means, confidence intervals for mean(s). Large sample test for single proportion, difference of proportions. Standard deviation(s) and correlation coefficient(s**).**

Unit – 4: Small Sample tests

Assumptions and t-test for single mean, difference of means and paired t-test. χ^2 test for goodness of fit and independence of attributes. χ^2 test for single variance, F-test for equality of variances.

Unit – 5: Non parametric tests

Advantages and disadvantages, comparison with parametric tests. One sample runs test, sign test and Wilcoxon – signed rank tests (single and paired samples). Two independent sample tests: Median test, Wilcoxon –Mann – Whitney U test, Wald Wolfowitz runs test**.**

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts.
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - III

COURSE 6: INFERENTIAL STATISTICS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Large sample test for mean and difference of means.
2. Large sample test for proportion and difference of proportions.
3. Large sample test for standard deviation and difference of standard deviations.
4. Large sample test for correlation coefficient.
5. Small sample test for mean and difference of means.
6. Small sample test for correlation coefficient.
7. Paired t - test (paired samples).
8. Small sample test for single variance (χ^2test) and difference of variances (F test).
9. χ^2 test for goodness of fit and independence of attributes.
10. Non parametric tests for single sample (run test, sign test and Wilcoxon signed rank test).
11. Non parametric tests for related samples (sign test and Wilcoxon signed rank test).
12. Non parametric tests for two independent samples (Median test, Wilcoxon –Mann – Whitney – U test, Wald–Wolfowitz's runs test).

Note: Conclusions of practical problems must be drawn based on p value as well as critical values.

SEMESTER - III

COURSE 7: SAMPLING TECHNIQUES

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To review about the population and its concepts also methods to collect data and errors to deal.
2. Introduced to various statistical sampling schemes such as simple, stratified and systematic sampling.
3. An idea of conducting the sample surveys and selecting appropriate sampling techniques.
4. Knowledge about comparing various sampling techniques.
5. To use appropriate factorial experimental to analyze the experimental data.

Unit – 1:

Brief review of parameter and statistic, sampling distribution. Principal steps and principles in a sample survey, sampling and non – sampling errors, advantages of sampling over census, limitations, types of sampling – concept of subjective, probability and mixed sampling.

Unit – 2: Simple Random Sampling (with and without replacement)

Notations and terminology, various probabilities of selection. Random numbers tables and its uses. Methods of selecting simple random sample, lottery method, method based on random numbers. Estimates of population total, mean and their variances and standard errors, determination of sample size, simple random sampling of attributes.

Unit – 3: Stratified random sampling

Stratified random sampling, Advantages and Disadvantages of Stratified Random sampling, Estimation of population mean, and its variance. Stratified random sampling with proportional and optimum allocations. Comparison between proportional and optimum allocations with SRSWOR.

Unit – 4: Systematic sampling

Systematic sampling definition when N = nk and merits and demerits of systematic sampling - estimate of mean and its variance. Comparison of systematic sampling with Stratified and SRSWOR. Comparison of variance of SRS, StRS and Sys for a linear trend. Concept of Cluster Sampling, Multistage Sampling and Quota Sampling.

Unit – 5: National Statistics Office

National Statistical Organization: vision and mission, National Statistics Office (NSSO and CSO), roles and responsibilities, important activities, publications etc.

National Statistical Commission: Need, Constitution, its role, functions, important acts.

Text Books

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi.
2. K. Rohatgi & Ehsanes Saleh: An Introduction to Probability and Statistics, John Wiley & Sons.

References

1. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
2. P. N. Arora & S. Arora: Quantitative Aptitude Statistics – Vol II, S. Chand & Company Ltd.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts.
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc. on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - III

COURSE 7: SAMPLING TECHNIQUES

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Show the sample mean is unbiased estimator of population mean in SRSWOR and also find variance of sample mean.
2. Show the sample mean square is unbiased estimator of population mean square in SRSWOR.
3. Show the sample mean is unbiased estimator of population mean in SRSWR and also find variance of sample mean.
4. Compare means and variances between SRSWR and SRSWOR.
5. Allocation of sample sizes to various strata in proportional and in optimum allocations to draw a Stratified random sample.
6. Compare precision in proportional and optimum allocations with SRSWOR and gain in efficiency due to proportional and optimum allocations.
7. Systematic sampling with N=nk and compare the precision of an estimate in systematic sampling with that of in Stratified and in SRSWOR.

SEMESTER - IV

COURSE 8: DESIGN AND ANALYSIS OF EXPERIMENTS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After successful completion of the course students will be able to:

1. To acquaint with the role of statistics indifferent fields with special reference to agriculture.
2. Learn to apply the one of the designs of experiment to agricultural fields.
3. Learn to apply the randomization to the blocks of various fields in agriculture.
4. To get the familiarity about applications of three principles.
5. Learn to deal the agricultural fields with different factors and levels.
6. To use appropriate experimental designs to analyze the experimental data.

Unit – 1: Analysis of variance (ANOVA)

Concept, Definition and assumptions. ANOVA one way classification – mathematical model, analysis – with equal and unequal classification. ANOVA two-way classification – mathematical model, analysis and problems.

Unit – 2: Completely Randomised Design (CRD)

Definition, terminology, Principles of design of experiments, CRD – Concept, advantages and disadvantages, applications, Layout, Statistical analysis. Critical Differences when hypothesis is significant.

Unit – 3: Randomised Block Design (RBD)

Concept, advantages and disadvantages, applications, Layout, Statistical analysis, problems and Critical Differences. RBD with one missing value and its analysis, problems.

Unit – 4: Latin Square Design (LSD)

Concept of LSD, its advantages and disadvantages, applications, Layout, Statistical analysis, problems and Critical Differences.

Unit – 5:

Estimation of one missing value in LSD and its analysis, problems. Efficiency of RBD relative to CRD. Efficiency of LSD over RBD and CRD and related problems.

Text Books / References

1. S. C. Gupta & V. K. Kapoor: Fundamentals of Applied Statistics, Sultan Chand & Sons, New Delhi.
2. K.V.S. Sarma: Statistics Made Simple: Do it yourself on PC. PHI.
3. M.R. Saluja: Indian Official Statistics. ISI publications.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts.
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - IV

COURSE 8: DESIGN AND ANALYSIS OF EXPERIMENTS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. ANOVA – one way classification with equal number of observations.
2. ANOVA – one way classification with unequal number of observations.
3. ANOVA – Two way classification.
4. Analysis of CRD and critical differences.
5. Analysis of RBD and critical differences. Relative efficiency of CRD with RBD.
6. Estimation of single missing observation in RBD and its analysis.
7. Analysis of LSD and efficiency of LSD over CRD and RBD.
8. Estimation of single missing observation in LSD and its analysis.

SEMESTER - IV

COURSE 9: APPLIED STATISTICS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able to know about

1. Forecasting Techniques and its applications.
2. Interpret and use a range of index numbers commonly used in the business sector.
3. Perform calculations involving simple and weighted index numbers.
4. Understand the basic structure of the Consumer price index and perform calculations involving its use.
5. Various data collection methods enabling to have a better insight in policy making, planning and systematic implementation.
6. Construction and implementation of life tables.
7. Population growth curves, population estimates and projections.
8. Real data implementation of various demographic concepts as outlined above through practical assignments.

Unit – 1: Time Series

Time Series and its components with illustrations, additive, multiplicative and mixed models. Trend – Estimation of trend by free hand curve method, method of Semi Averages. Determination of trend by Least squares (Linear trend, parabolic trend only), Moving averages method.

Unit – 2: Seasonal Component

Determination of seasonal indices by Simple Averages method, Ratio to Moving Average, Ratio to Trend and Link Relative methods, De-seasonalization.

Unit – 3: Index numbers

Concept, construction, problems involved in the construction of index numbers, uses and limitations. Simple and Weighted index numbers –Various Weighted Aggregate Index numbers, Criterion of a good index number, Fisher's ideal index number. Cost of living index number and Whole sale price index number.

Unit – 4: Vital Statistics

Introduction, definition, and uses of vital statistics, sources of vital statistics. Measures of Mortality Rates – Crude Death Rate, Specific Death Rate, Standardised Death Rate with different populations and problems.

Unit – 5:

Life table – Columns, Construction and Uses of Life table, Proofs of life table functions. Measures of Fertility Rates – Crude Birth Rate, General Fertility Rate, Specific Fertility Rate, Total Fertility Rate. Measures of population growth – Pearls, Gross Reproduction Rate, Net Reproduction Rate and its problems.

Text Books / References

1. Fundamentals of Applied Statistics: V. K. Kapoor & S. C. Gupta.
2. Mukopadhyay, P(2011): Applied Statistics,2nd ed. Revised reprint, Books and Allied Pvt. Ltd.
3. Brock well, P.J. and Devis, R.A. (2003): Introduction to Time Series Analysis. Springer.
4. Chatfield, C.(2001): Time Series Forecasting, Chapman & Hall.
5. Srinivasan, K.(1998): Demographic Techniques and Applications. Sage Publications.
6. Srivastava, O.S. (1983): A Text Book of Demography. Vikas Publishing House.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - IV

COURSE 9: APPLIED STATISTICS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Measurement of trend by method of moving averages (odd and even period).
2. Measurement of trend by method of Least squares (linear and parabola).
3. Determination of seasonal indices by method of simple averages.
4. Determination of seasonal indices by method of Ratio to Moving Averages.
5. Determination of seasonal indices by method of Ratio to Trend.
6. Determination of seasonal indices by method of Link relatives.
7. Computation of simple index numbers.
8. Computation of all weighted index numbers.
9. Computation of reversal tests.
10. Computation of various Mortality rates.
11. Computation of various Fertility rates.
12. Computation of various Reproduction rates.
13. Construction of Life Table.

SEMESTER - IV

COURSE 10: STATISTICAL DATA ANALYSIS USING MS - EXCEL

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After completing this course, students will be able to:

1. Understand data entry and formatting, manage worksheets, apply arithmetic and logical operations, perform data sorting, filtering, validation, and use Excel add-ins for analysis.
2. Create and interpret different types of charts and graphs, prepare frequency tables, and summarize data effectively using PivotTables and Pivot Charts.
3. Calculate and interpret measures of central tendency and dispersion, apply ranking and position measures, analyze skewness and kurtosis, and generate descriptive statistics reports.
4. Analyze relationships using correlation and regression techniques, interpret regression outputs, and apply forecasting methods to predict future trends.
5. Perform hypothesis tests such as Z-test, t-test, F-test, ANOVA, and chi-square test, interpret Excel outputs, and apply results in real-world decision-making.

Unit I – Excel Basics for Data Analysis

Data entry, formatting, worksheet management, Basic Excel Functions: *Arithmetic* → =SUM(), =PRODUCT(), =QUOTIENT(), =MOD(), Logical → =IF(), =AND(), =OR(), =IFERROR(), Lookup → =VLOOKUP(), =HLOOKUP(), =XLOOKUP(), =INDEX(), =MATCH(), Cell referencing: relative, absolute, mixed references, Data management: sorting, filtering, conditional formatting, Data validation (drop-down lists, input restrictions, error messages), Using Excel Add-Ins: Analysis ToolPak, Solver for advanced analysis

Unit II – Data Visualization and Frequency Analysis

Charts and Graphs: Bar, Column, Line, Pie, Area, Scatter, Histogram, Frequency tables: =COUNT(), =COUNTIF(), =COUNTIFS(), =FREQUENCY() for grouped data, PivotTables and PivotCharts for data summarization.

Unit III – Descriptive Statistics in Excel

Measures of Central Tendency: =AVERAGE(), =MEDIAN(), =MODE.SNGL(), =MODE.MULT(), =GEOMEAN(), =HARMEAN(), Measures of Dispersion:Range → =MAX()-MIN(). Variance → =VAR.S(), =VAR.P(), Standard Deviation → =STDEV.S(), =STDEV.P(), Coefficient of Variation (formula), Position & Ranking:=RANK.EQ(), =RANK.AVG(), =PERCENTRANK.INC(), =PERCENTRANK.EXC(), Shape of Distribution:Skewness → =SKEW(), Kurtosis → =KURT(), Descriptive Statistics report via Data Analysis ToolPak → Descriptive Statistics.

Unit IV – Correlation, Regression, and Forecasting

Correlation Analysis: Pearson → =CORREL(array1,array2), Covariance → =COVARIANCE.P(), =COVARIANCE.S(), Spearman Rank Correlation using =RANK.AVG() + =CORREL(), Regression Analysis: Simple Linear Regression via Data Analysis ToolPak → Regression, Extracting slope & intercept → =SLOPE(y_range,x_range), =INTERCEPT(y_range,x_range), Regression line → =FORECAST.LINEAR(x,known_y,known_x). Trend & Forecasting:=TREND() for future predictions

Unit V – Excel for Hypothesis Testing

Hypothesis Testing: Z-Test → =Z.TEST(), t-Test → Data Analysis ToolPak → t-Test (Paired, Two-Sample Equal/Unequal Variance), F-Test → Data Analysis ToolPak → F-Test Two-Sample Variance, ANOVA → Data Analysis ToolPak → ANOVA: Single Factor / Two Factor. Goodness of Fit & Association: Chi-Square Test → =CHISQ.TEST(). Real-world case studies: business, health sciences, social sciences applications, Interpreting Excel output for decision making.

Text Books / References

1. Statistics made simple: Do it yourself on PC Approach by K.V.S. Sharma.
2. N. Balakrishnan, K. Chandrasekaran & M. Saravanavel – Practical Statistics using Microsoft Excel – Sultan Chand & Sons.
3. Covers Excel functions, descriptive statistics, correlation, regression, and hypothesis testing.
4. S. P. Gupta & Archana Gupta – Statistical Methods – Sultan Chand & Sons.
5. Widely used in Indian universities; explains descriptive statistics, correlation, regression, and tests of significance.
6. J. K. Sharma – Business Statistics: Problems and Solutions using Excel – Vikas Publishing House.
7. Good for Excel-based applications of frequency analysis, regression, and hypothesis testing.
8. P. N. Arora & S. Arora – Statistics for Management with Excel Applications – S. Chand Publishing.
9. Focused on Excel tools for descriptive statistics, regression, and data visualization.
10. Vohra, N. D. – Business Statistics – McGraw Hill Education (India).
11. Explains correlation, regression, ANOVA, and hypothesis testing with practical orientation.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - IV

COURSE 10: STATISTICAL DATA ANALYSIS USING MS - EXCEL

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Central Tendency – Calculate mean, median, and mode for a given dataset.
2. Dispersion – Compute variance, standard deviation, and coefficient of variation.
3. Skewness and Kurtosis – Calculate skewness and kurtosis, and interpret the distribution shape.
4. Correlation Analysis – Determine simple correlation coefficient and prepare a correlation matrix for multiple variables (e.g., height, weight, age).
5. Simple Linear Regression – Fit a regression line and estimate the dependent variable.
6. Z and t-tests – Conduct one-sample and two-sample t-tests (for large and small samples).
7. Paired t-test – Compare before-and-after observations to test significance of difference.
8. F-test – Test equality of variances between two independent samples.
9. Chi-Square Test: Test the goodness of fit.
10. ANOVA – Perform one-way and two-way ANOVA to test differences among groups.

Note: MS - Excel Practical Problems must be done in Computer Lab at least 4 hours per month.

SEMESTER - V

COURSE 11: COMPUTATIONAL STATISTICS AND R PROGRAMMING

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course the student will be able

1. Students will be able to import and preprocess statistical datasets in R efficiently.
2. Students will demonstrate proficiency in basic data manipulation techniques for statistical preparation.
3. Students will apply R functions to handle real-world data issues like outliers and inconsistencies.
4. Students will compute and interpret descriptive statistics using R commands and packages.
5. Students will analyze data distributions and identify patterns or anomalies statistically.
6. Students will generate summary reports for datasets to support preliminary statistical insights.

Unit 1: Basics of R for Statistical Data Handling

R environment: Installation, command prompt, basic data types (vectors, matrices, data frames).
Data import/export: Reading from CSV, Excel, databases; handling missing values.
Basic operations: Subsetting, merging datasets, applying functions.

Unit 2: Descriptive Statistics and Data Summarization in R

Measures of central tendency (mean, median, mode) and variability (variance, standard deviation, range). Skewness, kurtosis, and quantiles; summary functions summary(), describe(). Handling categorical data: Frequency tables, cross-tabulations, and contingency tables.

Unit 3: Data Visualization for Statistical Insights in R

Base R graphics: Histograms, boxplots, scatter plots, bar charts, residual plots for assumption checking in statistics.

Unit 4: Inferential Statistics and Hypothesis Testing in R

Probability distributions in R: Normal, binomial, Poisson; random sampling (rnorm(), dbinom()). Hypothesis testing: t-tests, chi-square tests, ANOVA; p-values and confidence intervals. Non-parametric tests: Wilcoxon.

Unit 5: Regression Modeling in R

Karl Pearson correlation coefficient, Spearman Rank correlation coefficient and simple linear regression (lm()).

Text Books / References

1. Chambers, J. (2008): Software for Data Analysis: Programming with R, Springer.
2. Crawley, M.J. (2017): The R Book, John Wiley & Sons.
3. Matloff, N.(2011): The Art of R Programming, No Starch Press, Inc.
4. Dr. Mark Gardener (2012): Beginning R The statistical Programming Languages, John Wiley & Sons.
5. Sudha G. Purohit, Sharad D.Gore, and Shailaja R. Deshmukh (2008), Statistics Using R, Narosa Publishing House, India.
6. Mark Gardener: "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
7. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
8. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics", Wiley, 2011.
9. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
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7. Visits/field trips of firms, research organizations etc.

SEMESTER - V

COURSE 11: COMPUTATIONAL STATISTICS AND R PROGRAMMING

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Data Import and Preprocessing: Import a dataset (e.g., iris.csv), handle missing values, and perform basic sub setting.
2. Descriptive Statistics Computation: Calculate mean, variance, and skewness for a sample dataset and interpret results.
3. Frequency Analysis: Create contingency tables and chi-square tests on categorical data.
4. Basic Visualizations: Generate histograms and boxplots to assess data normality.
5. Hypothesis Testing: Conduct t-tests and ANOVA on experimental data, reporting p-values.
6. Non-Parametric Tests: Apply the Wilcoxon tests and compare with parametric alternatives.
7. Linear Regression Modeling: Fit a simple linear model, plot residuals, and predict new values.

Note 1: Use real datasets from sources like UCI Machine Learning Repository or built-in R datasets (e.g., mtcars, airquality).
Note 2: Practical Problems must be done in Computer Lab at least 4 hours per month by using R.

SEMESTER - V

COURSE 12 A: OPERATIONS RESEARCH

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To know the scope of Operations Research.
2. To link the OR techniques with business environment and life sciences.
3. To convert real life problems into mathematical models.
4. To find a solution to the problem in different cases.
5. To inculcate logical thinking to find a solution to the problem.

Unit – 1:

Introduction of OR – Origin and development of OR – Nature and features of OR –Scientific Method in OR – Modeling in OR – Advantages and limitations of Models – General Solution methods of OR models – Applications of Operation Research. Linear Programming problem (LPP) – Mathematical formulation of the problem - illustrations on Mathematical formulation of Linear Programming problem.

Unit – 2:

Graphical solution of linear Programming problems with maximizing and minimizing objective function up to 3 variables. Finding convex hull and non-convex hull of LPP. Some exceptional cases - Alternative solutions, Unbounded solutions, non-existing feasible solutions by Graphical method.

Unit – 3:

General linear Programming Problem(GLP) – Definition and Matrix form of GLP problem, Slack variable, Surplus variable, unrestricted Variable, Standard form of LPP and Canonical form of LPP. Definitions of Solution, Basic Solution, Degenerate Solution, Basic feasible Solution and Optimum Basic Feasible Solution. Introduction to Simplex method and Computational procedure of simplex algorithm. Solving LPP by Simplex method (Maximization case and Minimization case up to three variables only)

Unit – 4:

Artificial variable technique – Big – M method and Two-phase simplex method, Degeneracy in LPP and method to resolve degeneracy. Alternative solution, Unbounded solution, Non existing feasible solution and Solution of simultaneous equations by Simplex method.

Unit – 5:

Duality in Linear Programming – Concept of duality – Definition of Primal and Dual Problems, General rules for converting any primal into its Dual, Relation between the solution of Primal and Dual problem (statements only). Using duality to solve primal problem. Dual Simplex Method.

Text Books / References

1. S. D. Sharma: Operations Research, Kedar Nath Ram Nath & Co, Meerut.
2. Kanti Swarup, P. K. Gupta, Manmohn: Operations Research, Sultan Chand and sons, New Delhi.
3. J. K. Sharma: Operations Research and Application, Mc. Millan and Company, New Delhi.
4. Gass S. I: Linear Programming. Mc Graw Hill.
5. Hadly G: Linear Programming. Addison-Wesley.
6. Taha H.M: Operations Research: An Introduction: Mac Millan.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - V

COURSE 12 A: OPERATIONS RESEARCH

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Solution of Linear Programming Problem by using Graphical Method.
2. Solution of LPP with Simplex method.
3. Problem solving using Big M method.
4. Problem solving using Two Phase method.
5. Solution of special cases in LPP using Simplex method
    i. Unbounded solution
    ii. Alternative solutions.
6. Problems based on Principle of Duality.
7. Problems based on Dual simplex method.

SEMESTER - V

COURSE 12 B: ACTUARIAL STATISTICS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To define Insurance and acquainting its applications.
2. To aware of principles of premium calculations.
3. To know the survival rate and life tables.
4. To pave a path to life insurance industry to meet the standards.
5. To effectively understand the insurance annuities and premium plans.

UNIT I

Introductory Statistics and Insurance Applications: Discrete, continuous and mixed probability distributions. Insurance applications, sum of random variables. Utility theory: Utility functions, expected utility criterion, types of utility function, insurance and utility theory.

UNIT II

Principles of Premium Calculation: Properties of premium principles, examples of premium principles. Individual risk models: models for individual claims, the sum of independent claims, approximations and their applications.

UNIT III

Survival Distribution and Life Tables: Uncertainty of age at death, survival function, time until – death for a person, curate future lifetime, force of mortality, life tables with examples, deterministic survivorship group, life table characteristics, assumptions for fractional age, some analytical laws of mortality.

UNIT IV

Life Insurance: Models for insurance payable at the moment of death, insurance payable at the end of the year of death and their relationships.

UNIT V

Life annuities: continuous life annuities, discrete life annuities, life annuities with periodic payments. Premiums: continuous and discrete premiums.

Text Books / References

1. Dickson, C. M. D. (2005): Insurance Risk And Ruin (International Series On Actuarial Science), Cambridge University Press.
2. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A. And Nesbitt, C. J. (1997): Actuarial Mathematics, Society Of Actuaries, Itasca, Illinois, U.S.A.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - V

COURSE 12 B: ACTUARIAL STATISTICS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Risk computation for different utility models.
2. Discrete and continuous risk calculations.
3. Calculation of aggregate claims for collective risks.
4. Calculation of aggregate claim for individual risks.
5. Computing Ruin probabilities and aggregate losses.
6. Annuity and present value of contract.
7. Computing premium for different insurance schemes.
8. Practical based on life models and tables.

SEMESTER - V

COURSE 13 A: OPTIMIZATION TECHNIQUES

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To solve the problems in logistics.
2. To find a solution for the problems having space constraints.
3. To minimize the total elapsed time in industry by efficient allocation of jobs to the suitable persons.
4. To find a solution for an adequate usage of human resources.
5. To find the most plausible solutions in industries and agriculture when a random environment exists.

Unit – 1:

Transportation Problem – Introduction, Mathematical formulation of Transportation problem. Definition of Initial Basic feasible solution of Transportation problem – North – West corner rule, Lowest cost entry method, Vogel's approximation method. Method of finding optimal solution – MODI method. Degeneracy in transportation problem, Resolution of degeneracy, Unbalanced transportation problem. Maximization of TP.

Unit – 2:

Assignment Problem – Introduction, Mathematical formulation of Assignment problem, Hungarian Method for solving Assignment for both balanced and unbalanced Assignment Problems.

Unit – 3:

Sequencing problem: Introduction and assumptions of sequencing problem, Johnson's algorithm and problems for n jobs on two machines problem. Algorithm and problems for n jobs on three machines problem. Algorithm and problems for n jobs on m machines problem.

Unit – 4:

Game Theory: Two-person zero sum games. Pure and Mixed strategies. Maxmin and Minimax Principles, Saddle point and its existence. Games without Saddle point. Mixed strategies. Solution of 2 x 2 rectangular games. Graphical method of solving 2 x n and m x 2 games. Dominance Property.

Unit – 5:

Network Scheduling: Basic Components of a network, nodes and arcs, events and activities – Rules of Network construction – Time calculations in networks - Critical Path method (CPM) and PERT.

Text Books / References

1. S. D. Sharma: Operations Research, Kedar Nath Ram Nath & Co, Meerut.
2. Kanti Swarup, P. K. Gupta, Manmohn: Operations Research, Sultan Chand and sons, New Delhi.
3. J. K. Sharma: Operations Research and Application, Mc. Millan and Company, New Delhi.
4. Gass S. I: Linear Programming. Mc Graw Hill.
5. Hadly G: Linear Programming. Addison-Wesley.
6. Taha H.M: Operations Research: An Introduction: Mac Millan.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - V

COURSE 13 A: OPTIMIZATION TECHNIQUES

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. IBFS of transportation problem by using North West corner rule, LCEM and VAM.
2. Optimum solution to balanced and unbalanced transportation problems by MODI method (Minimization cases).
3. Solution of Assignment problem using Hungarian method (Minimization cases).
4. Solution of sequencing problem — processing of n jobs through two machines.
5. Solution of sequencing problem – processing of n jobs through three machines.
6. To perform Project scheduling of a given project (Deterministic case - CPM).
7. To perform Project scheduling of a given project (Probabilistic case - PERT).
8. Solution of m x n games by dominance rule.

SEMESTER - V

COURSE 13 B: APPLIED STATISTICS II

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able to know about

1. Different growth curves and its methods to construct, expertise with growth curves.
2. Interpret and use a range of index numbers methods commonly used in the business sector.
3. Understand the basic structure of the Demand analysis and perform calculations, involving its use.
4. Calculation of different scores specific to Psychological and Educational statistics.
5. Accustom various methods to calculation test reliability and test scores.

Unit – 1: Growth curves

Modified exponential curve, Logistic curve and Gompertz curve, fitting of growth curves by the method of three selected points and partial sums. Detrending. Effect of elimination of trend on other components of the time series.

Unit – 2: Index Numbers

Base shifting, calculation of index numbers with different bases – Fixed base and Chain base, splicing of index numbers series, Deflating the Index numbers. Index number of Industrial production, Interim Index number of Industrial production, Revised Index number of Industrial production.

Unit – 3: Demand Analysis

Introduction, price Elasticity of demand, partial Elasticities of demand, types of data required for estimating Elasticities, Leontief's method, Pigou's method (from time series data), Pigou's method (from family budget data), Engel's curve and Engel's law, Pareto's law of income distribution, Formulation of the problem, Curves of concentration.

Unit – 4: Psychological and Educational Statistics

Introduction, scaling individual test items in terms of difficulty (sigma scaling), scaling of scores on a test, Z score and Z scaling, standard scores, normalized scores, T-scores, percentile scores, scaling of rankings in terms of normal probability curve and scaling of ratings in terms of normal curve.

Unit – 5:

In Reliability of test scores, error variance or standard error of measurement, index of reliability, parallel tests, method of determining test reliability (the test – retest method, the Rulon method of estimating reliability, method of rational equivalence or Kuder – Richardson formula), validity of test scores, calculation of validity, validity and test length, comparison between reliability and validity, and intelligence quotient.

Text Books / References

1. Fundamentals of applied statistics: v k kapoor and s c gupta.
2. Mukopadhyay, P(2011): applied statistics, 2nd ed. Revised reprint, books and allied pvt. Ltd.
3. Brock well, P. J. and devis, R. A. (2003): Introduction to time series analysis, Springer.
4. Chatfield, C.(2001): Time series forecasting, Chapman & Hall.
5. Srinivasan, K.(1998): Demographic techniques and applications. Sage publications
6. Srivastavao. S.(1983): A text book of demography. Vikas publishing house.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - V

COURSE 13 B: APPLIED STATISTICS II

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Fitting of modified exponential curve (using method of three selected points)
2. Fitting of modified exponential curve (using method of partial sums)
3. Fitting of Gompertz curve (using method of three selected points)
4. Fitting of Gompertz curve (using method of partial sums)
5. Fitting of Logistic curve (using method of partial sums)
6. Finding index numbers by shifting the base.
7. Calculation of Fixed and Chain base index numbers.
8. Splicing two index number series.
9. Deflating index number.
10. Calculation of income and price elasticities.
11. Fitting of Pareto's curve to the given data.
12. Calculation of test reliability using the difficulty values of items and S.D of the total scores and mean and S.D of the total scores.

SEMESTER - VI

COURSE 14 A: STATISTICAL QUALITY CONTROL

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To define 'quality' in a scientific way.
2. To differentiate between process control and product control.
3. To speak about quality awareness in industry.
4. To pave a path to an industry to meet the standards.
5. To effectively implement various plans to control the quality standards at various stages of an industry.

Unit – 1:
Importance of SQC – 4 M's of SQC, causes of variation – Assignable and chance cause of variation, uses, process and product control, Control charts technique, Statistical basis of Shewhart control charts.

Unit – 2: Control charts for Variables
Introduction and Construction of Mean and Range chart; Mean and Standard Deviation Chart when standards are specified and unspecified.

Unit – 3: Control charts for Attributes
Introduction and Construction of fraction defective chart, number of defectives chart, no. of defects per unit Chart and U charts when standards are specified and unspecified.

Unit – 4:
Acceptance Sampling for Attributes: Introduction, Concept of sampling inspection plan, Comparison between 100% inspection and sampling inspection. Producer's risk and Consumer's risk, Operating characteristic (OC) curve, Acceptable Quality Level(AQL), Lot Tolerance Fraction Defective (LTFD) and Lot Tolerance percent Defective (LTPD), Average Outgoing Quality (AOQ) and Average Out going Quality Limit (AOQL), AOQ curve, Average Sample Number (ASN), Average Total Inspection(ATI).

Unit – 5:
Single Sampling Plan: Computation of probability of acceptance using Binomial and Poisson approximation of AOQ and ATI. Graphical determination of AOQL, Determination of a single sampling plan by: a) lot quality approach b) average quality approach.

Text Books / References

1. Montgomery, D. C. (2008): Statistical Quality Control, 6th Edn., John Wiley, New York.
2. Parimal Mukhopadhyay: Applied Statistics, New Central Book Agency.
3. Goon A.M., Gupta M.K. and Das Gupta B. (1986): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
4. S.C. Gupta and V.K. Kapoor: Fundamentals of Applied Statistics – Chand publications.
5. R.C. Gupta: Statistical Quality Control.
6. Duncan A.J.(1974): Quality Control and Industrial Statistics, fourth edition
7. D.B. Tarapore wala Sons and Co. Pvt. Ltd., Mumbai.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
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7. Visits/field trips of firms, research organizations etc.

SEMESTER - VI

COURSE 14 A: STATISTICAL QUALITY CONTROL

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Construction of Mean and R Charts.
2. Construction of Mean and Standard deviation charts.
3. Construction of p Chart for fixed sample size.
4. Construction of p Chart for variable sample size.
5. Construction of np Chart.
6. Construction of C chart.
7. Construction of U chart.
8. Single sampling plan for attributes (OC Curve, Producer's and Consumer's risks, AOQ, AOQL, ATI).
9. Determination of single sampling plan by: a) lot quality approach (b) average quality approach.

SEMESTER - VI

COURSE 14 B: ADVANCED ACTUARIAL STATISTICS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To define lite time r.vs and it distributions.
2. To aware of analytical laws.
3. To expertise in calculating actuarial present values.
4. To prepare the annuitys.
5. To perform the advanced actuarial statistical techniques.

UNIT I

Future life time random variable, its distribution function and density function, concept of force of mortality, curate future life time random variable its probability mass function, deferred probabilities, all these functions in terms of international actuarial notation.

UNIT II

Analytical laws of mortality such as Gompertz law and Makeham's law, Single decreament life table, select and ultimate life table.

Concept of compound interest rate, discount factor, present value of the money, nominal rate of interest, force of interest, Assurance contracts with level and varying benefits, such as whole life insurance, term insurance endowment insurance.

UNIT III

Means and variances of the present value random variables of the payments under these contracts under the assumption of constant force of interest, when the benefit payments are made at the end of year of death (discrete set up) or when it is paid at the epoch of death (continuous set up). Actuarial present value of the benefit, Net single premiums.

UNIT IV

Annuity contracts, annuity certain, discrete annuity, monthly annuity, continuous annuity, deferred annuity, present values and accumulated values of these annuities. Continuous life annuity, discrete life annuity, such as whole life annuity, temporary life annuity, n-year certain and life annuity, life annuities with mthly payments, Present value random variables for these annuity payments, their means and variances, Actuarial present value of the annuity

UNIT V

Loss at issue random variable, various principles to decide net premiums for insurance products and annuity schemes defined in unit II and III, fully continuous premiums and fully discrete premiums, True monthly payment premiums. Extended equivalence principle to decide gross premiums, Concept of reserve, prospective & retrospective approach, Fully continuous reserve, Fully discrete reserve.

Text Books / References

1. Deshmukh S.R. (2009). Actuarial Statistics: An Introduction Using R, Universities Press.
2. Harriett, E.J. and Dani, L. L.(1999). Principles of Insurance: Life, Health, and Annuities, 2nd Edn., Life Office Management Association.
3. Neill, Alistair (1977). Life Contingencies, The Institute of Actuaries.
4. Palande, P. S., Shah, R. S. and Lunawat, M. L. (2003). Insurance in India - Changing Policies and Emerging Opportunities, Response Books.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
4. Preparation of audio and videos on tools of diagrammatic and graphical representations.
5. Collection of material/figures/photos/author photoes of related topics.
6. Invited lectures and presentations of stalwarts to those topics.
7. Visits/field trips of firms, research organizations etc.

SEMESTER - VI

COURSE 14 B: ADVANCED ACTUARIAL STATISTICS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Computation of values of utility function.
2. Computation of various components of life tables.
3. Computation of compound interest (nominal and effective rate of interests).
4. Annuities and annuity dues.
5. Computation of premium for Term insurance and Whole life insurance.
6. Computation of premium for Endowment insurance.
7. Construction of multiple decrement table for deterministic survival group.
8. Determination of distribution function, survival function and force of mortality.

SEMESTER - VI

COURSE 15 A: STATISTICAL TECHNIQUES FOR RESEARCH METHODOLOGY

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To aware of the research and types of research.
2. To familiar with the real time data collection with surveys.
3. To understand the processing of data analysis.
4. To expertise in preparation of questionnaires and to draw inferences.
5. To perform the analysis and prepare report writing.

UNIT I
Introduction: Meaning, objection and motivation in research, types of research, research approach, significance of research. Research problems: definition, selection and necessity of research problems.

UNIT II
Survey Methodology and Data Collection, inference and error in surveys, the target populations, sampling frames and coverage error, methods of data collection, non-response, questions and answers in surveys.

UNIT III
Processing, Data Analysis and Interpretation: Review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation.

UNIT IV
Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector, unemployment rates, removal of subsidy, impact on service class v/s unorganized sectors), interpret the results and draw inferences.

UNIT V
Formats of Reports: introduction, parts of a report, cover and title page, introductory pages, text, reference section, typing instructions, copy reading, proof reading. Presentation of a report: introduction, communication dimensions, presentation package, audio-visual aids, presenter's poise.

Text Books / References

1. Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2nd Revised Edition reprint, New Age International Publishers.
2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.

Suggested Co-curricular Activities:

8. Training of students by related industrial experts
9. Assignments including technical assignments if any.
10. Seminars, Group Discussions, Quiz, Debates etc on related topics.
11. Preparation of audio and videos on tools of diagrammatic and graphical representations.
12. Collection of material/figures/photos/author photoes of related topics.
13. Invited lectures and presentations of stalwarts to those topics.
14. Visits/field trips of firms, research organizations etc.

SEMESTER - VI

COURSE 15 A: STATISTICAL TECHNIQUES FOR RESEARCH METHODOLOGY

Practical **Credits: 1** **2 hrs/week**

PROJECT WORK

Submit a Project Report based on empirical study on some real-life situation. It should be an original one and an indicative format for preparation is presented below:
Project report should be presented in the following sequence: i) Title page; ii) Student's declaration; iii) Supervisor's certificate; iv) Acknowledgements; v) Table of contents; vi) Abstract; vii) Literature Review; viii) Methodology; ix) Contents; x) major findings; xi) visualisations; xii) summary; xiii) Bibliography.

The student shall personally collect, analyse, interpret the data and prepare a report under the supervision of a mentor.

Note: The preparation of projects and it reports are suggest to encourage by mentor for publishing papers in reputed journals.

SEMESTER - VI

COURSE 15 B: STATISTICAL ANALYSIS OF CLINICAL TRIALS

Theory **Credits: 3** **3 hrs/week**

Course Outcomes

After learning this course, the student will be able

1. To Aquitaine with need and ethics of the clinical trials.
2. To aware of drawing the sample size for different population sizes.
3. To understand the dichotomous variables.
4. To expertise in performing the designs for various clinical trails.
5. To perform the analysis and report writing.

Unit I

Introduction to clinical trials: need and ethics of clinical trials, bias and random error in clinical studies, conduct of clinical trials, overview of Phase I-IV trials, multi-center trials. Data management: data definitions, case report forms, database design, data collection systems for good clinical practice.

Unit II

Determination of sample size: for two independent samples of Dichotomous Response variables, for two independent samples of Continuous Response variables and for repeated variables.

Unit III

Design of clinical trials: parallel vs. cross-over designs, cross-sectional vs. longitudinal designs, objectives and endpoints of clinical trials, design of Phase I trials, design of single-stage and multi-stage Phase II trials, design and monitoring of Phase III trials with sequential stopping, design of bioequivalence trials.

Unit IV

Reporting and analysis: analysis of categorical outcomes from Phase I - III trials, analysis of survival data from clinical trials.

Unit V

Surrogate end points: selection and design of trials with surrogate end points, analysis of surrogate end point data. Meta-analysis of clinical trials.

Text Books / References

1. S.Piantadosi(1997): Clinical Trials: A Methodological Perspective. Wiley and Sons.
2. C.Jennison and B.W.Turnbull(1999): Group Sequential Methods with Applications to Clinical Trials, CRC Press.
3. L.M.Friedman, C.Furburg,D.L. Demets(1998): Fundamentals of Clinical Trials, Springer Verlag.
4. J.L.Fleiss(1989): The Design and Analysis of Clinical Experiments. Wiley and Sons.
5. E.Marubeni and M.G.Valsecchi(1994): Analyzing Survival Data from Clinical Trials and Observational Studies, Wiley and Sons.
6. Chow S.C. and Liu J.P. (2004): Design and Analysis of Clinical Trials. 2nd Ed. Marcel Dekkar.
7. Fleiss J. L. (1989): The Design and Analysis of Clinical Experiments, Wiley.

Suggested Co-curricular Activities:

1. Training of students by related industrial experts
2. Assignments including technical assignments if any.
3. Seminars, Group Discussions, Quiz, Debates etc on related topics.
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SEMESTER - VI

COURSE 15 B: STATISTICAL ANALYSIS OF CLINICAL TRIALS

Practical **Credits: 1** **2 hrs/week**

List of Experiments:

1. Determination of Sample size.
2. Multiple Logistic Regression with two or Three variables.
3. Analysis of Clinical trial data using Crossover design.
4. Analysis of Clinical trial data using Parallel design.
5. Meta-analysis of Clinical trials.