ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION

Model Syllabus for Statistics (Minor) in consonance with Curriculum framework w.e.f. AY 2025-26

Prepared by Yogi Vemana University, Kadapa

COURSE STRUCTURE

Year	Semester	Course	Title of the Course	No. of Hrs /Week	No. of Credits
II	III	1	Descriptive Statistics	3	3
			Descriptive Statistics Practical Course	2	1
	IV	2	Theory of Probability and Mathematical Expectations	3	3
			Theory of Probability and Mathematical Expectations Practical Course	2	1
III	V	3	Theoretical Distributions	3	3
			Theoretical Distributions Practical Course	2	1
		4	Statistical Methods	3	3
			Statistical Methods Practical Course	2	1
	VI	5	Inferential Statistics	3	3
			Inferential Statistics Practical Course	2	1
		6	Sampling Techniques and Design of Experiments	3	3
			Sampling Techniques and Design of Experiments Practical Course	2	1

SEMESTER-III

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-III

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.

Note: List of experiments are suggested to do in MS – Excel also.

SEMESTER-IV

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 deal with the situation where there is uncertainty and to measure that uncertainty by using the probability, which is essential in all research areas.

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-IV

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.

Note: List of experiments are suggested to do in MS – Excel also.

SEMESTER-V

COURSE 3: THEORETICAL 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.
2. To deal with the data by the basic continuous distribution.
3. To get familiarity of the most important distributions such as Normal and Standard Normal distribution and their applications in research and various fields.
4.

Unit – 1: Binomial distribution and Poisson Distribution

Binomial distribution – Definition, moments, M.G.F, C.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. Poisson distribution - Definition, moments, M.G.F, C.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 – 2: Negative Binomial, Geometric and Hyper Geometric Distribution

Mean, Variance and Mgf of NBD, GD and HGD.

Unit – 3: Continuous distributions

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

Unit – 4: Gamma and Beta Distributions

Gamma Distribution - Definition, moments, M.G.F, C.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 – 5: Normal Distribution

Normal Distribution – Definition, properties, M.G.F, C.F, additive property, skewness, kurtosis and problems. Obtain mean, median and mode, Even and Odd order moments about mean. Standard Normal Distribution – Definition, mgf, mean and variance, Area property, problems.

Text Books / References

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.
3. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
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SEMESTER-V

COURSE 3: THEORETICAL 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 Exponential distribution.
6. Fitting of Normal distribution – Areas method.
7. Fitting of Normal distribution – Ordinates method.

Note: List of experiments are suggested to do in MS – Excel also.

SEMESTER-V

COURSE 4: 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: 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 – 4: 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.

Unit – 5: Exact Sampling Distributions

Concept of Population, Sample, Parameter, Statistic, Sampling Distribution. Student's t – distribution, F – Distribution, χ^2 – Distribution: Definitions, properties and their applications.

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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.
3. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
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SEMESTER-V

COURSE 4: 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 Yule's coefficient of association and colligation.

Note: List of experiments are suggested to do in MS – Excel also.

SEMESTER-VI

COURSE 5: 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 / References

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.
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SEMESTER-VI

COURSE 5: 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).

Note1: Conclusions of practical problems must be drawn based on p value as well as critical values.
Note2: List of experiments are suggested to do in MS – Excel also.

SEMESTER-VI

COURSE 6: SAMPLING TECHNIQUES AND DESIGN OF EXPERIMENTS

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, types of sampling – concept of subjective, probability and mixed sampling. **Simple Random Sampling** (with and without replacement), Methods of selecting simple random sample, lottery method, method based on random numbers. Estimates of population total, mean and their variances and standard errors.

Unit – 2: 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. Systematic sampling definition when N = nk and merits and demerits of systematic sampling - estimate of mean and its variance. Comparison of variance of SRS, StRS and Sys for a linear trend.

Unit – 3: 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 – 4: Completely Randomised Design (CRD)

Definition, terminology, Principles of design of experiments, CRD – Concept, advantages and disadvantages, applications, Layout, Statistical analysis, problems.

Unit – 5: Randomised Block Design (RBD) and Latin Square Design

RBD and LSD – Concept, advantages and disadvantages, applications, Layout, Statistical analysis, problems.

Text Books / References

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.
3. O. P. Gupta: Mathematical Statistics, Kedar nath Ram nath & Co.
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SEMESTER-VI

COURSE 6: SAMPLING TECHNIQUES AND DESIGN OF EXPERIMENTS

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

List of Experiments:

1. Compare means and variances between SRSWR and SRSWOR.
2. Systematic sampling with N=nk and compare the precision of an estimate in systematic sampling with that of in Stratified and in SRSWOR.
3. ANOVA – one way classification with equal number of observations.
4. ANOVA – Two way classification.
5. Analysis of CRD.
6. Analysis of RBD.
7. Analysis of LSD.

Note: List of experiments are suggested to do in MS – Excel also.