FIRST DEGREE PROGRAMME UNDER CBCSS
SCHEME AND SYLLABI OF COMPLEMENTARY STATISTICS
FOR B. Sc. MATHEMATICS CORE w.e.f. 2018 Admission.

The goal of the syllabus is to equip the students with the concepts, principles and methods of Statistics. It is aimed that students be acquainted with the applications of statistical methods to analyze data and draw inferences wherever the statistical decisions are meaningful. Emphasis is given to understand the basic concepts and data analysis tools. There are practical sessions in each semester. Numerical problems solving using scientific calculators is also included in the End Semester Examination (ESE) of Courses in the semesters I, II, III & IV. There is one course in practical using Excel in Semester IV. ESE of courses in semesters I, II, III, & IV will be of 3 hours duration and have questions from all modules in the respective semester.

Courses in semesters I & II will be of 2 credits each and in semesters III & IV, 3 credits each. The ESE of Practical course in semester IV will be of 2 hours duration with credit 4.

It is mandatory to submit a fair record of practical done (module V of courses in semesters I, II, III and IV) and print-out of the output of the same duly certified at the time of ESE of practical course. ESE of the practical course will be held under the supervision of external examiners duly appointed by the University.

Semester	Title of the course	Hours/ week		No. of credits	Total Hrs/ week	ESE Duration	Weightage	
		L	P				CE	ESE
I	ST 1131.1: Descriptive Statistics	2	2	2	72	3 hrs	20	80
II	ST 1231.1: Probability and Random Variables	2	2	2	72	3 hrs	20	80
III	ST 1331.1: Statistical Distributions	3	2	3	90	3 hrs	20	80
IV	ST 1431.1: Statistical Inference	3	2	3	90	3 hrs	20	80
	ST 1432.1: Practical using EXCEL			4		2 hrs	20	80

Hours/week: 4

ST 1131.1: Descriptive Statistics

The course aims that students will learn to understand the characteristics of data and will get acquainted with describing data through illustrating examples and exercises. They will also learn to collect, organize and summarize data, create and interpret simple graphs and compute appropriate summary statistics.

Module I: Part A: Introduction (Not for Examination Purpose): Significance of Statistics, Limitations and misuse of Statistics, Official Statistical system of India. Types of Data: Concepts of primary data and secondary data, population and sample; Classification of data based on geographic, chronological, qualitative and quantitative characteristics.

Part B: Collection and Presentation of Data: Scales of data-Nominal, Ordinal, Ratio and Interval. Methods of collection of primary data–Preparation of questionnaires / schedules. Secondary data –major sources and limitations; Census and Sample Surveys; Methods of sampling: Probability and non-probability sampling, simple random sampling with replacement (SRSWR) & simple random sampling without replacement (SRSWOR), Systematic sampling and Stratified sampling (concepts only); sampling and non-sampling errors; Presentation of raw data: Classification and tabulation - Construction of Tables with one or more factors of classification, frequency distributions, relative and cumulative frequency distributions, their graphical representations.

Module II: Summarization of Data: Central tendency- mean, median, mode, geometric mean, harmonic mean; properties of Arithmetic Mean and Median; Relationship between AM, GM and HM; Absolute and relative measures of dispersion: Range, quartile deviation, mean deviation and standard deviation; Properties of mean deviation, standard deviation, combined mean and combined standard deviation; coefficient of variation; Moments- Raw and central moments; relationship between raw and central moments; effect of change of origin and scale; Skewness, Kurtosis and their measures.

Module III: **Bivariate data**: Scatter diagram, Fitting of curves- Principle of least squares, fitting of straight line, fitting parabola, curves $y=ab^x$, $y=ax^b$, $y=ae^{bx}$, and $y=ax^{-1}+b$.

Module IV: Regression lines and prediction, Karl Pearson's coefficient of correlation, Spearman's rank correlation.

Module V: Practical based on Modules I, II, III, & IV – Data analysis: presentation of data –Charts and Diagrams, Frequency table, Frequency graphs, calculation of descriptive statistics, curve fitting, correlation and regression.

References

1. Gupta S.C. and Kapoor V.K. (1980). *Fundamentals of Mathematical Statistics*. Sultan Chand and Sons, New Delhi.

2. Gupta, S. C., and Kapoor, V. K. (1994). *Fundamental of Mathematical Statistics*. Sultan Chand & Sons, New Delhi.

3. Gupta S. P. (2004). *Statistical Methods*. Sultan Chand & Sons, New Delhi.

4. Kenny J. F & Keeping E. S (1964). *Mathematics of Statistics –Part Two*. 2nd Edition, D. Van Nostard Company, New Delhi-1.

5. Kenny J. F (1947). *Mathematics of Statistics Part One*. 2nd Edition, D. Van Nostard Company, New Delhi-1. **ASIN: B0013G0LYA.**

6. Mukhopadhyay, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd, Calcutta.

7. Agarwal, B.L. (2006). *Basic Statistics*. 4th Edition New Age international(P) Ltd., New Delhi. **ISBN: 8122418147, 9788122418149.**

8. Agarwal, B.L.(2013). *Basic Statistics*. Anshan, Uk. **ISBN-13: 978-1848290679; ISBN-10: 1848290675.**

SEMESTER II

Hours/week: 4

ST 1231.1: Probability and Random variables

This course will introduce the elementary ideas of probability and random variables.

Module I: Random experiments- sample point and sample space- Events, algebra of events, concepts of equally likely, mutually exclusive and exhaustive events; Probability: Statistical regularity, relative frequency and classical approaches, Axiomatic approach, theorems in probability, probability space.

Module II: Conditional probability, multiplication theorem, independence of two and three events, compound probability, Bayes' theorem and its applications.

Module III: Random variables- discrete and continuous, probability mass function and probability density function, distribution function, joint distribution of two random variables, marginal and conditional distributions, independence, transformation of variables- one-to-one transformation-univariate.

Module IV: Expectation of random variables and its properties, theorems on expectation of sums and product of independent random variables, conditional expectation, moments, moment generating function, characteristic function, their properties and uses; Bivariate moments, Cauchy- Schwartz inequality and correlation coefficient.

Module V: Practical (Numerical Problems) based on Modules I, II, III, & IV - random variables (univariate and bivariate), expectations and moments.

References

1. Bhat B.R. (1985). *Modern Probability Theory*. New Age International (P) Ltd, New Delhi.
2. Dudewicz E.J and Mishra S.N (1988). *Modern Mathematical Statistics*. John Wiley & Sons, New York.
3. Gupta, S. C., and Kapoor, V. K. (1994). *Fundamental of Mathematical Statistics*. Sultan Chand & Sons. New Delhi.
4. Pitman, J. (1993). *Probability*. Narosa Publishing House, New Delhi
5. Mukhopadhyay, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd, Calcutta.
6. Rohatgi V. K.(1993). *An Introduction to Probability Theory and Mathematical Statistics*. Wiley Eastern, New Delhi.
7. Rao C.R (1973). *Linear Statistical Inference and its Applications*. 2/e, Wiley, New York.

SEMESTER III

Hours/week: 5

ST 1331.1: Statistical Distributions

This course introduces standard probability distributions, limit theorems and sampling distributions.

Module I: Standard Distributions(Discrete)- Uniform, binomial, Poisson and geometric- moments, moment generating function, characteristic function, problems, additive property (binomial and Poisson), recurrence relation (binomial and Poisson), Poisson as a limiting form of binomial, memory less property of geometric distribution; Fitting of binomial and Poisson distributions; hypergeometric distribution(definition, mean and variance only).

Module II: Standard Distributions (Continuous)– Uniform, exponential, and gamma - moment generating function, characteristic function, problems; memory less property of exponential distribution; additive property of gamma distribution; beta distribution (I and II)- moments, Normal distribution- moments, moment generating function, characteristic function, problems, recurrence relation of central moments; convergence of binomial and Poisson to normal.

Module III: Chebychev's inequality; Law of large numbers-BLLN, convergence in probability (definition only), WLLN; central limit theorem for iid random variables- statement and applications.

Module IV: Sampling distributions -Parameter and statistic, Sampling distributions- Distribution of mean of a sample taken from a normal population, Chi-square(χ^2)- definition and properties, t and F distributions (definitions only) and statistics following these distributions, relation between normal, χ^2, t and F distributions.

Module V: Practical based on Modules I, II, III, & IV – Discrete and continuous probability distributions and applications, law of large numbers and CLT.

References

1. Medhi J.(2005). *Statistical Methods-An Introductory Text*. New Age International (P) Ltd, New Delhi.
2. Gupta S.C. and Kapoor V.K. (1980). *Fundamentals of Mathematical Statistics*. Sultan Chand and Sons, New Delhi.
3. John E. Freund(1980). *Mathematical Statistics*. Prentice Hall of India, New Delhi.
4. Mukhopadhyay, P. (1996). *Mathematical Statistics*. New Central Book Agency (P) Ltd, Calcutta.
5. Rohatgi V. K.(1993). *An Introduction to Probability Theory & Mathematical Statistics*. Wiley-Eastern, New Delhi.

SEMESTER IV

Hours/week: 5

ST 1431.1: Statistical Inference

This course enables the students to understand the methods of Statistical Inference.

Module I: Point estimation, Properties of estimators – unbiasedness, consistency, efficiency and sufficiency; Methods of estimation - Maximum likelihood method, method of moments; Interval estimation of mean, variance and proportion (single unknown parameter only).

Module II: Testing of Hypothesis- statistical hypotheses, simple and composite hypotheses, two types of errors, significance level, p-value, power of a test, Neyman-Pearson lemma (without proof) .

Module III: Large sample tests- testing mean and proportion (one and two sample cases), Chi-square (χ^2) test of goodness of fit, independence and homogeneity.

Small sample tests- Z-test for means; One sample test for mean of a normal population, Equality of means of two independent normal populations, Paired samples t-test, Chi-square test for variance, F-test for equality of variances.

Module IV: Design of Experiments- assumptions, principles, models and ANOVA tables of one way and two way classified data (Derivation of two – way model is not included).

Module V: Practical based on Modules I, II , III & IV.

References

1. Das M. N., Giri N. C.(2003). *Design and analysis of experiments*. New Age International (P) Ltd, New Delhi.

2. John E. Freund(1980). *Mathematical Statistics*. Prentice Hall of India, New Delhi.

3. Medhi J. (2005). *Statistical Methods-An Introductory Text*, New Age International(P) Ltd.. New Delhi.

4. Paul G. Hoel, Sidney C. Port, Charles J. Stone (1971). *Introduction to Statistical Theory*. Universal Book stall, New Delhi.

Course V - ST 1432.1: Practical using Excel

The students will learn to use statistical tools available in Excel and have hands on training in data analysis.

This course covers topics of courses I, II, III & IV.

Use of Excel in statistics (Charts, functions and data analysis),

Practical covering Semesters I, II, III, & IV

Section I: Charts- Bar chart, Pie chart & scatter diagram

Functions- Evaluation of numerical problems using the following functions

AVEDEV	AVERAGE	BINORMDIST	CHIDIST	CHINV	CHITEST
CONFIDENCE	CORREL	COVAR	DEVSQ	FDIST	FINV
FREQUENCY	FTEST	GEOMEAN	HARMEAN	INTERCEPT	KURT
MEDIAN	MODE	LINEST	LOGEST	NORMDIST	NORMINV
NORMSDIST	PEARSON	POISSON	PROB	SKEW	SLOPE
STANDARDIZE	STDEVP	TDIST	TINV	TREND	TTEST

Section II: Data analysis

Histogram, Descriptive Statistics, Covariance, Correlation, Regression, Random Number Generation, Sampling, t-tests for means: Paired t-test, Equality of means of two normal populations, z-test: Two Sample test for Means, F-test for Variances, ANOVA- Single Factor and Two Factor without Replication.

References

1. Dan Remenyi, George Onofrei, Joe English (2010). *An Introduction to Statistics Using Microsoft Excel*. Academic Publishing Ltd., UK

2. Neil J Salkind (2010). *Excel Statistics, A Quick Guide*. SAGE Publication Inc. New Delhi

3.Vijai Gupta (2002). *Statistical Analysis with Excel*. VJ Books Inc. Canada

Record of Practical

Duly certified record of practical sessions is mandatory to appear for the practical examination. Five questions are to be worked out in each sheet based on the topics given below:

<u>Sheets</u>

1. Diagrams and Graphs
2. Measures of Central Tendency and Dispersion
3. Moments, Skewness and Kurtosis
4. Fitting of Curves
5. Correlation and Regression
6. Probability
7. Univariate Random Variables
8. Bivariate Random Variables
9. Mathematical Expectation
10. Bivariate Moments
11. Standard Distributions- Discrete
12. Standard Distributions- Continuous
13. Law of Large Numbers
14. Sampling Distributions
15. Point Estimation
16. Interval Estimation
17. Large Sample Tests
18. Small Sample Tests
19. Analysis of Variance
20. Charts in Excel
21. Functions in Excel
22. Analysis Tools in Excel

Print-out of output of practical sheets 20, 21 and 22 are to be attached. CE and ESE marks are to be awarded and consolidated as per regulations of the FDP in affiliated Colleges, 2013.