UNIVERSITY OF KALYANI

4-YEAR UG COURSE STRUCTURE FOR STATISTICS

(AS PER NEP-2020)

WITH EFFECT FROM 2023-24

YEAR 1: SEMESTER I

Course Code	Course Title	Course Type	Credit	Class hour/ week	Marks				Total Marks
					Internal		End-Sem		
					Th	Pr	Th	Pr	
ST-M-1-T ST-M-1-P	Descriptive Statistics (Theo & Prac)	Major	4+2=6	6	10	5	40	20	75
ST-MI-1-T ST-MI-1-P	Statistical Methods (Theo & Prac)	Minor	3+1=4	4	7	3	28	12	50
ST-MU-1-T	Introductory Probability and Probability Distributions	Multi-disciplinary	3	3	10	-	35	-	45
ST-SEC-1-T	Mathematical Methods	Skill Enhancement	3	3	10	-	35	-	45
Total			16	16	45		170		215

YEAR 1: SEMESTER II

Course Code	Course Title	Course Type	Credit	Class hour/ week	Marks				Total Marks
					Internal		End-Sem		
					Th	Pr	Th	Pr	
ST-M-2-T ST-M-2-P	Probability and Probability Distributions (Theo & Prac)	Major	4+2=6	6	10	5	40	20	75
ST-MI-2-T ST-MI-2-P	Basic Probability and Probability Distributions (Theo & Prac)	Minor	3+1=4	4	7	3	28	12	50
ST-MU-2-T	Descriptive and Applied Statistics	Multi-disciplinary	3	3	10	-	35	-	45
AECC-1	Communicative English	Ability Enhancement	4	4	10		40		50
ST-SEC-2-P	C++ Programming (Prac)	Skill Enhancement	3	3	-	10	-	35	45
ST-SI-1	Summer Internship (Additional for Certificate/Diploma)	Internship	4	4					
Total			20(24)	20(24)	55		210		265

DETAILED SYLLABUS

YEAR 1: SEMESTER 1

Pape: ST-M-1-T Descriptive Statistics (Theoretical) Course Type: Major

Credit 4 Marks 50

Unit 1

1. Statistics: Definition and scope, concepts of statistical population and sample.

2. Data: quantitative and qualitative,

3. Scales of measurement: nominal, ordinal, interval and ratio. Frequency distribution.

4. Presentation: tabular and graphical, including histogram and ogives.

Unit 2

1. Measures of Central Tendency: Mean, Median, Mode.

2. Measures of Dispersion: range, mean deviation, standard deviation, coefficient of variation, Gini's Coefficient, Lorenz Curve. Moments, skewness and kurtosis, Quantiles and measures based on them. Box Plot. Outlier Detection. Quantile-Quantile Plot.

Unit 3

1. Bivariate data: Definition, scatter diagram, simple correlation, linear regression, principle of least squares. Intra-class correlation, correlation index and correlation ratio.

Unit 4

1. Analysis of Categorical Data: Contingency table, association of attributes, odds ratio, Pearson's measure, Goodman- Kruskal's γ. Binary response and logistic regression. Spearman's and Kendall's Rank correlation.

Paper: ST-M-1-P Descriptive Statistics (Practical) Course Type: Major

Credit 2 Marks 25

1. Graphical representation of data.
2. Problems based on measures of central tendency.
3. Problems based on measures of dispersion.
4. Problems based on combined mean and variance and coefficient of variation.
5. Problems based on moments, skewness and kurtosis.
6. Fitting of quadratic and exponential function.
7. Karl Pearson correlation coefficient.
8. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between lines and estimated values of variables.
10. Intra-class correlation.
11. Spearman's and Kendall's rank correlation.
12. Measures of association

Suggested Reading

• Goon, A.M., Gupta, M.K. and Dasgupta, B. (2002): Fundamentals of Statistics, Vol. I, 8th Edn. The World Press, Kolkata.
• Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
• Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
• Tukey, J.W. (1977): Exploratory Data Analysis, Addison-Wesley Publishing Co.
• Agresti, A. (2010): Analysis of Ordinal Categorical Data, 2nd Edition, Wiley.
• Freedman, D., Pisani, R. and Purves, R.(2014): Statistics, 4th Edition, W. W. Norton & Company.

Paper: ST-MI-1-T Statistical Methods (Theoretical) Course Type: Minor

Credit 3 Marks 35

Unit 1

Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Frequency distribution, Presentation**:** tabular and graphical including histogramand ogives.

Unit 2

Measures of Central Tendency: Mathematical and positional.

Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

Unit 3

Bivariate data: Definition, scatter diagram, simple correlation. Partial and multiple correlation (3 variables only), rank correlation (Spearman). Simple linear regression, principle of least squares and fittingof polynomials and exponential curves.

Unit 4

Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency.

Paper: ST-MI-1-P Statistical Methods (Practical) Course Type: Minor

Credit 1 Marks 15

1. Graphical representation of data

2. Problems based on measures of central tendency

3. Problems based on measures of dispersion

4. Problems based on combined mean and variance and coefficient of variation

5. Problems based on moments, skewness and kurtosis

6. Fitting of polynomials, exponential curves

7. Karl Pearson correlation coefficient

8. Partial and multiple correlations

9. Spearman rank correlation with and without ties.

10. Correlation coefficient for a bivariate frequency distribution

11. Lines of regression, angle between lines and estimated values of variables.

12. Checking consistency of data and finding association among attributes.

Suggested Reading:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8thEdn. The World Press, Kolkata.

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

3. Mood, A.M. Graybill, F.A. AndBoes, D.C. (2007): Introduction to the Theory of Statistics, 3rdEdn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

4. Goon A.M., Gupta M.K. and Dasgupta B. : Basic Statistics. The World Press, Kolkata.

5. Chakraborty, Arnab (2016) : Probability and Statistics. Sarat Book House

Paper: ST-MU-1-T Introductory Probability and probability distributions (Theoretical)
Course Type: Multidisciplinary Credit 3 Marks 45

Unit 1
Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of probability – classical, statistical and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit 2

Random Variables: Discrete and continuous random variables, p.m.f., p.d.f., c.d.f. Illustrations of random variables and its properties. Expectation, variance, moments and moment generating function.

Unit 3

Two dimensional random variables: discrete type, joint, marginal and conditional p.m.f and c.d.f., statement of properties of c.d.f, independence of variables, trinomial distribution.

Unit 4

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, beta, gamma.

Suggested Reading:

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

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

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

4. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8th Edn.The World Press, Kolkata.

5. Chakraborty, Arnab (2016): Probability and Statistics. Sarat Book House.

6. Ross, S. (2002): A First Course in Probability, Prentice Hall.

Paper: ST-SEC-1-T Mathematical Methods (Theoretical) Course Type: Skill Enhancement Credit 3 Marks 45

Unit 1

Representation of real numbers as points on a line. Algebraic, Order and Completeness properties of R (Concepts only). Bounded and unbounded sets, neighbourhood of a point, Supremum and infimum.

Functions, Countable, Uncountable sets and Uncountability of R. Sequences and their convergence,monotonic sequences, bounded sequences, squeeze theorem. Limits of some special sequences such as r^n, $(1 + 1/n)^n$ and $n^{1/n}$.

Infinite series, positive termed series and their convergence, comparison test, ratio test and root test. Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence.

Unit 2

Review of limit, continuity and differentiability. Indeterminate form, L' Hospital's rule. Rolle's and Lagrange's Mean Value theorems. Taylor's theorem with lagrange's form of remainder (without proof). Taylor's series expansions of sin x, cos x, e^x , $(1+x)^n$ and log $(1+x)$.
Maxima and Minima of Functions. Successive Differentiation.

Unit 3

Integral Calculus: definite integral (definition). Statements of properties, Fundamental Theorem of Integral Calculus.
Improper Integral, Beta and Gamma functions: properties and relationship between them.

Unit 4

Functions of two variables and Partial Derivatives. Maxima and Minima of such Functions. Constrained Maximization and minimization, use of Lagrange Multiplier. Double Integral (intuitive-graphical approach), change of order of integration, transformation of variables and Jacobians (statement of relevant theorems and their uses)

Suggested Reading:

1. Elements of Real Analysis, Shanti Narayan and Raisinghania, S. Chand
2. Introduction to Real Analysis, 9th Edition, S. K. Mapa, Levant.
3. Principles of Mathematical Analysis, Rudin, W, McGraw Hill
4. Differential Calculus, Das, B. C. and Mukherjee , B. N., U. N. Dhur and Sons Pvt. Ltd.
5. Integral Calculus, Das, B. C. and Mukherjee , B. N., U. N. Dhur and Sons Pvt. Ltd.

YEAR 1: SEMESTER 2

Paper: ST-M-2-T Probability and Probability Distributions (Theoretical) Course Type: Major Credit 4 Marks 50

Unit 1

Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Related problems. Geometric Probability.

Unit 2

Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit 3

Random variables: discrete and continuous random variables, p.m.f. , p.d.f. and c.d.f., statement of properties of c.d.f. , illustrations and properties of random variables.
Mathematical Expectation (discrete and continuous), Probability generating function. Moments. Moment generating function. Probability Inequalities**:** Markov & Chebyshev.

Unit 4

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, beta and gamma.

Unit 5

Two dimensional random variables: discrete type, joint, marginal and conditional p.m.f and c.d.f., statement of properties of c.d.f, independence of variables, Correlation coefficient, Conditional expectation and variance. Trinomial distribution.

Paper: ST-M-2-P Probability and Probability Distributions (Practical) Course Type: Major Credit 2 Marks 25

1. Application problems based on Classical Definition of Probability.
2. Application problems based on Bayes' Theorem.
3. Fitting of binomial distributions for n and p = q = ½.
4. Fitting of binomial distributions for given n and p.
5. Fitting of binomial distributions after computing mean and variance.
6. Fitting of Poisson distributions for given value of lambda.
7. Fitting of Poisson distributions after computing mean.
8. Fitting of negative binomial distribution.
9. Application problems based on binomial distribution.
10. Application problems based on Poisson distribution.
11. Application problems based on negative binomial distribution**.**
12. Problems based on area property of normal distribution.
13. To find the ordinate for a given area for normal distribution.
14. Application based problems using normal distribution.
15. Fitting of normal distribution when parameters are given.
16. Fitting of normal distribution when parameters are not given.

17. Problems similar to those in 1 to 5 in cases of other continuous distributions.

Suggested Reading:

1. Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa.
2. Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley.
3. Goon, A.M., Gupta, M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory (Vol-1), WorldPress.
4. Parzen, E. (1972): Modern Probability Theory and its Applications, John

   Wiley .

5. Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.

6. Cacoullos, T. (1973): Exercises in Probability. Narosa.

7. Rahman, N.A. (1983): Practical Exercises in Probability and Statistics, Griffen.

8. Ross, S. (2002): A First Course in Probability, Prentice Hall.

Paper: ST-MI-2-T Basic Probability and Probability Distributions (Theoretical) Course Type: Minor Credit 3 Marks 35

Unit 1
Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Related problems.

Unit 2
Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.

Unit 3
Random variables: discrete and continuous random variables, p.m.f. , p.d.f. and c.d.f., statement of properties of c.d.f. , illustrations and properties of random variables.
Mathematical Expectation (discrete and continuous), Probability generating function. Moments. Moment generating function. Probability Inequalities**:** Markov & Chebyshev.

Unit 4
Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, beta and gamma.

Unit 5
Two dimensional random variables: discrete type, joint, marginal and conditional p.m.f and c.d.f., statement of properties of c.d.f, independence of variables, Correlation coefficient, Conditional expectation and variance. Trinomial distribution.

Paper: ST-MI-2-P Basic Probability and Probability Distributions (Practical) Course Type: Minor Credit 1 Marks 15

1. Application problems based on Classical Definition of Probability.
2. Application problems based on Bayes' Theorem.
3. Fitting of binomial distributions for given n and p.
4. Fitting of binomial distributions after computing mean and variance.
5. Fitting of Poisson distributions after computing mean.
6. Application problems based on binomial distribution.
7. Application problems based on Poisson distribution.
8. Application problems based on negative binomial distribution.
9. Problems based on area property of normal distribution.
10. Application based problems using normal distribution.
11. Fitting of normal distribution when parameters are not given.

Suggested Reading:

1. Chung, K.L. (1983): Elementary Probability Theory with Stochastic Process, Springer / Narosa.
2. Feller, W. (1968): An Introduction to Probability Theory & its Applications, John Wiley.
3. Goon, A.M., Gupta, M.K. & Dasgupta, B. (1994): An Outline of Statistical Theory (Vol-1), WorldPress.
4. Parzen, E. (1972): Modern Probability Theory and its Applications, John

   Wiley .

5. Uspensky, J.V. (1937): Introduction to Mathematical Probability, McGraw Hill.

6. Cacoullos, T. (1973): Exercises in Probability. Narosa.

7. Rahman, N.A. (1983): Practical Exercises in Probability and Statistics, Griffen.

8. Ross, S. (2002): A First Course in Probability, Prentice Hall.

Paper: ST-MU-2-T Descriptive and Applied Statistics (Theoretical) Course Type: Multidisciplinary Credit 3 Marks 45

Unit 1
Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: quantitative and qualitative, attributes, variables. Frequency distribution, Presentation**:** tabular and graphical including histogramand ogives.

Unit 2
Measures of Central Tendency: Mathematical and positional.

Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, moments, skewness and kurtosis.

Unit 3

Bivariate data: Definition, scatter diagram, simple correlation. Rank correlation (Spearman). Simple linear regression, principle of least squares.

Theory of attributes, consistency of data, independence and association of attributes, measures of association and contingency.

Unit 4

Economic Time Series: Components of time series, Decomposition of time series- Additive and multiplicative model with their merits and demerits, Illustrations of time series. Measurement of trend by method of free-hand curve and method of least squares (linear and quadratic).Measurement of seasonal variationsby method of ratio to trend.

Unit 5

Index numbers: Definition, Criteria for a good index number, different types of index numbers. Construction of index numbers of prices and quantities, consumer price index number. Uses and limitations of index numbers.

Unit 6

Demographic Methods: Introduction, measurement of population, rates and ratios of vital events. Measurement of mortality: CDR, SDR (w.r.t. Age and sex), IMR, Standardized death rates. Life tables: definition of its main functions and uses. Measurement of population growth: GRR, NRR.

Suggested Reading:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I& II, 8thEdn. The World Press, Kolkata.

2. Goon A.M., Gupta M.K. and Dasgupta B. : Basic Statistics. The World Press, Kolkata
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn. (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
4. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
5. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4th Edition(Reprint), Sultan Chand & Sons

Paper: ST-SEC-2-P C++ Programming (Practical) Course Type: Skill Enhancement

Credit 3 Marks 45

Brief theoretical aspects, characteristics, functions etc. of C++ Programming followed by practical problems as given below:

1. Plot of a graph y = f(x).
2. Roots of a quadratic equation (with imaginary roots also).
3. Sorting of an array and hence finding median.
4. Mean, Median and Mode of a Grouped Frequency Data.
5. Preparing a frequency table.
6. Random number generation from uniform, exponential and normal distributions.

7. Compute ranks and then calculate rank correlation (without tied ranks).
8. Fitting of lines of regression.

Suggested Reading:

1. Balagurusamy, E. Object-Oriented Programming with C ++, McGraw Hill.
2. Kanetkar, Y. Let Us C++, BPB Publications.