Syllabus for Undergraguate Programme

B.A. / B. Sc. In Statistics

Manipur University, Canchipur

Imphal-795003

Manipur University

B.A/B.Sc.-I
Semester-1
Statistics
Paper-I (Theory)/STA: 101

Full Marks-75
Pass Marks: 25
Approximate lectures: 90

Unit-1   Descriptive Statistics   12 marks   (15 lectures)

1.1   Meaning of Statistics and its definition.
1.2   Importance of Statistics.
1.3   Scope of Statistics: In the areas of Industry, Biological Sciences, Medical Sciences, Economics Sciences, Social Sciences, Management Sciences, Agriculture, Insurance, Information Technology, Education and Psychology.
1.4   Types of characteristics:-
       Attributes: Nominal scale, ordinal scale, Variables: Interval scale, ratio scale; discrete and continuous variables, difference between linear scale and circular scale.
1.5   Types of data: (a) Primary data, Secondary data (b) Cross-sectional data, time series data.
1.6   Statistical population: Finite population, infinite population, homogeneous population and heterogeneous population, notion of sample.
1.7   Graphical presentation of data: Bar diagram (simple, multiple, sub-divided, percentage), pie diagram, pictogram, cartogram, stem and leaf chart.
1.8   Classification: Raw data and its classification, discrete frequency distribution, continuous frequency distribution, inclusive and exclusive method of classification, open-end classes, cumulative frequency distribution.
1.9   Graphical presentation of frequency distribution: Histogram, frequency curve, frequency polygon, Ogive curves.

Unit-2   Measures of Central Tendency   13 marks   (15 lectures)

2.1   Notion of Central Tendency: Average, characteristics of an ideal average.

2.2   Arithmetic Mean (A.M): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, its applications.

2.3 Mode: Definition, formula for computation (with deviation), graphical method of determination of mode, merits and demerits, its applications

2.4 Median: Definition, formula for computation (with derivation), graphical method of determination of median, merits and demerits, its applications.

2.5 Empirical relation between mean and median and mode.

2.6 Partition Values: Quantiles, Deciles and Percentiles, their applications.

2.7 Geometric Mean (G.M): Definition, merits and demerits, its applications

2.8 Harmonic Mean (H.M): Definition, merits and demerits, its applications

2.9 Relation between A.M., G.M., and H.M.

2.10 Weighted Mean: Weighted A.M., G.M. and H.M.

Unit-3 Measures of Dispersion   13 marks   (15 lectures)

3.1 Concept of dispersion, characteristics of an ideal measure of dispersion.

3.2 Range: Definition, merits and demerits.

3.3 Semi-interquartile range (Quartile deviation).

3.4 Mean deviation: Definition, minimality property (without proof).

3.5 Mean square deviation: Definition, minimality property of mean square deviation (with proof), Variance and standard deviation – definition, merits and demerits, effect of change of origin and scale

3.6 Determination of variance of a combine series

3.7 Measures of dispersion for comparison: coefficient of range, coefficient of quartile deviation and coefficient of mean deviation, coefficient of variation (C.V)

Unit-4   Moments   12 marks   (15 lectures)

4.1 Raw moments for grouped and ungrouped data.

4.2 Moments about an arbitrary constant for grouped and ungrouped data.

4.3 Central moments for grouped and ungrouped data, Effect of change of origin and scale, Sheppard's correction for moments up to fourth order (without proof).

4.4 Relations between central moments and raw moments (up to fourth order)

Unit-5   Skewness and Kurtosis: 12 marks   (15 lectures)

5.1   Concept of skewness of frequency distribution, positive skewness, negative skewness, symmetric frequency distribution.

5.2   Bowley's coefficient of skewness.

5.3   Karl Pearson's coefficient of skewness

5.4   Measures of skewness based on moments

5.5   Concept of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions.

5.6   Measures of kurtosis based on moments

Unit-6   Probability   13 marks   (15 lectures)

6.1   Random experiment, sample space (for finite), events, algebra of events with illustration by using Venn diagram.

6.2   Definition of probability- classical, statistical (their criticism) and axiomatic, Probability space

6.3   Elementary properties of probability:

i) $P(\emptyset) = 0$ ii) $P(A) = 1 - P(A^c)$ iii) If $A \subset B$, then $P(A) \leq P(B)$

iv) $P(A^c \cap B) = (B) - P(A \cap B)$

6.4   Conditional probability.

6.5   Addition and Multiplication theorems of probability for two events.

6.6   Boole's inequality.

6.7   Bayes' Theorem and its application

Practical

Paper-I

STA: 101(P)

Full Marks: 25

Pass Marks: 10

Sl.No.	Topic	No. of experiments
1.	Diagrammatic representation of statistical data	3
2.	Construction of frequency distribution and its graphical representation.	3
3.	Measures of Central Tendency, partition values	3
4.	Measures of dispersion, coefficient of variation	2
5.	Calculation of Moments	2
6.	Measures of skewness and kurtosis	2
	Total	**15**

Instructions:

i)   To solve 2 experiments out of 3 experiments.
ii)   Each experiment caries 9 marks
iii)   Note Book carries 4 marks Viva voce carries 3 marks

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1, The World Press Pvt. Ltd., Kolkata.
2. Goon, Gupta and Dasgupta: Basic Statistics, The World Press Pvt. Ltd., Kolkata.
3. S.R. Chakravarti & N. Giri: Basic Statistics, South Asian Publishers, New Delhi
4. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
5. J. Medhi: Statistical Methods, Wiley Eastern
6. Miller and Fruend: Modern Elementary Statistics.
7. Snedecor and Cochran: Statistical Methods, Oxford and IBH Publishers.

Manipur University

B.A/B.Sc.-I

Semester-2

Statistics
Paper-II (Theory)/STA: 202

Full Marks-75
Pass Marks: 25
Approximate lectures: 90

Unit-1   Random variables, Mathematical Expectations and Generating functions-I

13 marks   (15 lectures)

1.1   Definition of random variable.

1.2   Types of random variables- discrete and continuous

1.3   Probability Density Function (pdf) and Probability Mass Function (pmf) and its properties

1.4   Distribution function (df) of a r.v. and its properties

1.5   Joint distribution, marginal and conditional distribution and its properties (without proof)

1.6   Independent r.v.'s, pair-wise independence and mutual independence for 3 events.

1.7   Relation between pdf and distribution function (df)

1.8   Transformation of r.v.'s (up to 2 r.v.'s), Jacobian of a transformation.

Unit-2   Random variables, Mathematical Expectations and Generating functions-II

13 marks   (15 lectures)

2.1   Moments generating function (mgf) and its properties-

i) $M_{cx}(t)=M(ct)$ ii) $M_{X_1+X_2+...X_n}=M_{X_1}(t).M_{X_2}(t) \dots \dots M_{X_n}(t)$

iii) Effect of change of origin and scale   iv) Uniqueness theorem

2.2   Cumulating generating function and its properties-

i) Additive property of cumulants ii) Effect of change of origin on cumulants

2.3   Probability generating function (for discrete r.v) and convolution

2.4   Moments from mgf using: i) Expansion method ii) Differentiation method,

2.5   Relation between moments and cumulants (without proof) upto fourth order

2.6   Characteristic function and its properties (without proof).

2.7   Mathematical expectation of a r.v. and its properties

i) $E(a)=a$ ii) $E(aX)= a E(X)$

2.8   Addition and Multiplication theorems of expectation

2.9   Variance and covariance of r.v.'s of linear forms-

i) $Cov (aX, bY)=ab Cov(X,Y)$ ii) $Cov (X+a, Y+b)=Cov(X,Y)$

iii) $Cov[(X-\bar{x}/\sigma_x, (Y-\bar{y}/\sigma_y]= [1/(\sigma_x\sigma_y)] Cov (X,Y)$

iv) $Var (aX)=a^2 Var(X)$ v) Variance of the sum and variance of the difference of two random variables vi) Standardised random variable

Unit-3   Correlation   12 marks   (15 lectures)

3.1   Bivariate distribution, bivariate frequency distribution, bivariate frequency table, correlation table and contingency table.

3.2   Correlation, scatter diagram and its merits and demerits

3.3   Karl Pearson's correlation coefficient: derivation of limits of correlation coefficient and effect of change of origin and scale, assumptions underlying Karl Pearson correlation coefficient.

3.4   Rank correlation coefficient, derivation of Spearman's rank correlation coefficient (untied and tied cases), limits of rank correlation coefficient.

Unit-4   Curve fitting and Regression Analysis   12 marks   (15 lectures)

4.1   Concept of curve fitting

4.2   Method of least square, most plausible values

4.3   Fitting of polynomials (1st and 2nd degree)

4.4   Regression: Linear and curvilinear

4.5   Lines of regression (for two variables), interpretation of slope and intercept, and their uses.

4.6   Regression coefficient and its properties.

Unit-5   Limit Theorems   12 marks   (15 lectures)

5.1   Cauchy-Schwartz and Chebyshev's inequalities and their applications.

5.2   Convergence in probability, almost sure convergence

5.3   Weak law of large number (Bernoulli and Khinchin) and their applications, Strong Law of Large Number (Statement only)

5.4   Convergence in distribution, convergence of mean square

5.5   Central limit theorem (iid case) – (De-Moivre- Laplace, Lindeberg-Levy) with illustration and their application to standard distributions.

Unit-6   Finite difference and numerical analysis-I   13marks (15 lectures)

6.1   Basic concept of finite difference theory

6.2   Operators Δ and E and their relations, construction of diagonal and horizontal difference tables, determination of the values of nth and $(n+1)^{th}$ degree difference of the polynomial of degree n (Theorem with proof).

6.3   Concept of interpolation and extrapolation and their importance, derivation of Newton's forward and backward interpolation formula (without remainder terms),

6.4   Construction of divided difference table and its properties, Newton's divided difference interpolation formula and Lagrange's interpolation formula for unequal intervals (without remainder terms)

6.5   Numerical integration, derivation of general quadrature formula.

6.6   Deduction of Trapezoidal, Simpson's $1/3^{rd}$ and $3/8^{th}$ rules of numerical integration from general quadrature formula.

Practical
Paper-II
STA: 202 (P)

Full Mark: 25

Pass Mark: 10

Sl.No.	Topic	No. of experiments
1.	Karl Pearson's Correlation coefficient	2
2.	Spearman's rank correlation coefficient	2
3.	Fitting of 1st and 2nd degree polynomial	2
4.	Fitting regression line (for 2 variables)	2
5.	Interpolation	4
6.	Numerical integration	3
	Total	**15**

Instructions:

i)   *To solve 2 experiments out of 3 experiments.*
ii) *Each experiment carries 9 marks*
iii) *Note Book carries 4 marks*
iv) *Viva voce carries 3 marks*

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1&II, The World Press Pvt. Ltd., Kolkata.
2. Goon, Gupta and Dasgupta: Basic Statistics, The World Press Pvt. Ltd., Kolkata.
3. S.R. Chakravarti & N. Giri: Basic Statistics, South Asian Publishers, New Delhi
4. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
5. J. Medhi: Statistical Methods, Wiley Eastern
6. Snedecor and Cochran: Statistical Methods, Oxford and IBH Publishers.
7. Mukhopadhyay, P.: Mathematical Statistics, New Central Book Agency, Calcutta,
8. S.C. Gupta and V.K.Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
9. Hogg, R.V. and Craig R.G.: Introduction to Mathematical Statistics, MacMillan Publishing Co., New York.
10. Mood, A. M. and Graybill, F.A. and Boes D.C.E.: Introduction to Theory of Statistics, McGraw Hill and Kagakusha Ltd. London.

Full Marks-75
Pass Marks: 25
Approximate lectures: 90

Unit-1   Discrete Probability Distributions   13 marks   (15 lectures)

1.1   Bernoulli trial, Binomial distribution: derivation, properties and practical applications

1.2   Poisson distribution (as a limiting case of binomial), properties and practical applications.

1.3   Rectangular, Multinomial, Geometric, Hypergeometric, Negative binomial; derivation of means, variance and mgf of these distributions.

Unit-2   Continuous Probability Distributions   13 marks   (15 lectures)

2.1   Distributions: Uniform, Laplace, Exponential, Cauchy, Beta (both first and second), Gamma, Weibul; derivation of first two moments and mgf of these distributions.

2.2   Normal distribution: definition, mean, median, mode, quartiles, mean deviation, variance, moments, points of inflexion of normal curve, mgf and characteristic function of standard normal variate, importance and properties. (Without proof/derivation).

Unit-3   Theory of estimation-I   12 marks   (15 lectures)

3.1   Concept of parameter and statistic, parametric space, problem of estimation.

3.2   Types of estimation: Point and interval estimations

3.3   Criteria of a good estimator- unbiasedness, consistency, sufficiency and efficiency, with simple examples.

3.4   Methods of point estimation- Maximum likelihood estimation (mle), least square, moments

3.5   Properties of m.l.e. (without proof), application of the method of m.l.e. and method of moments- for obtaining estimates of the parameters of binomial, Poisson and Normal distributions.

Unit-4   Sample Survey-I   13 marks   (15 lectures)

4.1   Introduction, concept of statistical population and sample.

4.2   Difference between census and sample survey, advantages of sample survey over census and vice versa.

4.3   Principles of sampling theory – validity, regularity and optimization.

4.4   Principle steps involved in a large scale sample survey, preparation of questionnaire and schedule, sampling and non-sampling errors.

4.5   Some sampling techniques: purposive, quota, snowball, volunteer; simple random sampling, stratified random sampling, systematic sampling, cluster sampling, multistage sampling, multiphase sampling (no theorems)

4.6   Simple random sampling (with and without replacement): techniques of selecting a random sample – lottery method & use of Random Number Tables, estimation of population total and mean, variance and S.E. of the estimates, unbiasedness of sample mean for the population mean, merits and demerits, comparison of simple random sampling with and without replacement.

Unit-5   Theory of Attributes   12 marks   (15 lectures)

5.1   Attributes: classification, notion of manifold classification, dichotomy, class-frequency, order of class, positive class-frequency, negative class frequency, quanta class frequencies, ultimate class frequency, relationship among different class frequencies (up to three attributes), dot operator to find the relation between frequencies, fundamental set of class frequencies.

5.2   Consistency of data (up to 3 attributes), condition for consistency of data.

5.3   Concept of independence and association of two attributes.

5.4.1   Yule's coefficient of association (Q)

Unit-6   Demography   12 marks   (15 lectures)

6.1   Introduction to demography- source of vital statistics, deficiencies of census and registration system data.

6.2   Measurement of Mortality rates- CDR, ASDR, STDR

6.3   Complete Life Table- assumptions, description and construction

6.4   Stationary and stable population (concept only)

6.5   Measurement of Fertility rates- GFR, ASFR, TFR

6.6   Measurement of reproduction rate- GRR, NRR

6.7   Logistic curve- derivation and its fitting by using Pearl and Reed method and its uses in population projection.

Practical

Paper-III

STA: 303 (P)

Full Mark: 25

Pass Mark: 10

Sl.No.	Topic	No. of experiments
1.	Consistency of qualitative data and coefficient of Association, independence of attributes	2
2.	Mortality and fertility Life table	4
3.	Construction of complete Life table	2
4.	Population growth and projection (including logistic curve)	2
5.	Selection of simple random sample by using Random Number Table and estimation of population total, variance and S.E of the estimates	3
6.	Fitting of Binomial and Poisson distributions	2
	Total	**15**

Instructions:

  v)   *To solve 2 experiments out of 3 experiments.*
  vi)   *Each experiment carries 9 marks*
  vii)   *Note Book carries 4 marks*
  viii) *Viva voce carries 3 marks*

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1&II, The World Press Pvt. Ltd., Kolkata.
2. Goon, Gupta and Dasgupta: Basic Statistics, The World Press Pvt. Ltd., Kolkata.
3. S.R. Chakravarti & N. Giri: Basic Statistics, South Asian Publishers, New Delhi
4. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
5. J. Medhi: Statistical Methods, Wiley Eastern
6. S.C. Gupta and V.K.Kapoor: Fundamentals of Mthematical Statistics, Sultan Chand and Sons, New Delhi.
7. S.C. Gupta and V.K.Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.

Manipur University

B.A/B.Sc.-II

Semester-4

Statistics
Paper-IV (Theory)/STA: 404

Full Marks-75
Pass Marks: 25
Approximate lectures: 90

Unit-1   Sampling distribution-I   12 marks   (15 lectures)

1.1   Concept of sampling distribution and standard error (SE), SE of mean and variance of normal distribution (with derivation)

1.2   Distribution of a random sample from a continuous distribution of i.i.d. random variables $X_1, X_2, \ldots X_n$.

1.3   Distribution of $ns^2 = \sum_{i=1}^{n}(x_i - \bar{x})^2$ for a random sample from normal population using orthogonal transformation, independence of x and s^2.

1.4   Sampling distributions: t, F, X^2 distributions (without derivation) and Fisher's Z-transformation (statement only) and its applications.

Unit-2   Testing of hypotheses-I   13 marks   (15 lectures)

2.1   Statistical hypothesis- simple and composite, null and alternative hypothesis, one and two-tailed test, non-critical and critical region (acceptance and rejection region), level of significance.

2.2   Test of a statistical hypothesis, Type I and II errors, p-value, size of a test, power and power function of a test.

2.3   Concept of test of significance, assumptions and their validity.

2.4   Large sample test for

i) test of single proportion ii) test for difference of two proportions

iii) test for single mean   iv) test for difference of two means

Unit-3   Testing of hypotheses – II   13 marks   (15 lectures)

3.1   Application of t-distribution:

        i) test for single mean

        ii) test for difference of two means (independent and not independent samples)

        test for sample correlation coefficient

3.2   Application of F-distribution:

        i) test for the quality of two population variances

3.3   Application of X^2 distribution:

        i) test for population variance $H_o: \sigma^2 = \sigma_0^2$.

        ii) test of goodness of fit (1st and 2nd degree equations, Binomial, Poisson and Normal   distributions)

        iii) test of independence of attributes

3.4   Application of Fisher's Z-distribution: To test i) $H_0: \xi = \xi_0$

Unit-4   Time Series-I   12 marks   (15 lectures)

4.1   Introduction and importance of time series analysis, components of time series.

4.2   Additive and multiplicative models of time series.

4.3   Objective of measuring trend, measurement of trend by the methods of graphical, semi-averages, principle of least square and moving averages (for linear cases only)

Unit-5   ANOVA & Design of Experiments-I   13 marks   (15 lectures)

5.1   Analysis of variance, fixed effect model, estimation of parameters by the method of least square with special reference to one and two way classified data (one observation per cell)

5.2   Design of experiments, principles of design of experiment- randomization, replication and local control.

5.3   CRD, RBD (one observation per cell) and its statistical analysis.

Unit-6   Index Numbers   12 marks   (15 lectures)

6.1   Introduction, problems involved in the construction of index numbers.

6.2   Laspeyre's, Paasche's, Fisher's, Marshall-Edgeworth, Dorbish-Bowley index numbers.

6.3   Requirements of a good index number – time reversal test, factor reversal test and circular test, Fisher's index number's reversibility.

6.4   Construction of wholesale and cost of living index number

Practical

BA/B.Sc.-II

Paper-IV

STA: 404 (P)

Full Mark: 25

Pass Mark: 10

Sl.No.	Topic	No. of experiments
1.	Determination of trend by moving average method	2
2.	Construction of index numbers and reversibility test (Fisher's Index Number), cost of living index number	3
3.	Analysis of CRD, RBD	2
4.	Large sample tests	4
5.	Small sample tests	4
	Total	**15**

Instructions:

ix)   *To solve 2 experiments out of 3 experiments.*
x)   *Each experiment carries 9 marks*
xi)   *Note Book carries 4 marks*
xii)   *Viva voce carries 3 marks*

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1&II, The World Press Pvt. Ltd., Kolkata.
2. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
3. J. Medhi: Statistical Methods, Wiley Eastern
4. S.C. Gupta and V.K.Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
5. Snedecor and Cochran: Statistical Methods, Oxford and IBH Publishers.

Manipur University
B.A/B.Sc.-III
Semester-5
Statistics (Honours)
Paper-V (Theory)/STA: H 501

Full Marks-100
Pass Marks: 36
Approximate lectures: 100

Unit-1   Set theory and Measure   18 marks   (18 lectures)

1.1   Set, types of set, operations on sets and their properties (with proof)
1.2   Intervals- open, closed, half-open, half-closed
1.3   Countable and uncountable sets, open and closed sets, compact set and their elementary properties.
1.4   Definition of field of sets, sigma-field and their elementary properties.
1.5   Measure, measure space, elementary properties of measure.

Unit-2   Basic Mathematics   22 marks   (18 lectures)

2.1   Convergence of sequence, Cauchy criterion

2.2   Infinite series: Cauchy criterion for convergence, geometric series, convergence test of positive term series by (i) comparison test (ii) Cauchy's root test (iii) D'Alembert's ratio test (iv) Raabe's test (application only for the above tests)

2.3   Alternating series: test of convergence (Leibnitz test), concept of absolute convergence, conditional convergence.

2.4   Lagrange's method of determining multiplier

2.5   Mean Value Theorem of differential calculus.

2.6   Riemann integrability

2.7   Infinite and improper integral (concept only), Gamma and Beta function and their elementary properties (with proof)

Unit-3   Determinant and Matrices   20 marks   (18 lectures)

3.1   Determinants: definition as a function of its element, addition and subtraction, properties (without proof)

3.2   Minors and co-factors

3.3   Matrices- definition, type, addition and multiplication.

3.4   Adjoint, transpose, determinant of a square matrix.

3.5   Inverse, rank of a square matrix.

Unit-4   Computer Programming-I   20 marks   (18 lectures)

4.1   Introduction to computer, computer generations, classification of computer- (i) All-purpose and specific purpose (ii) Digital, Analog and Hybrid (iii) Notebook, personal, workstations, mainframe system, super computers.

4.2   Basic computer organization; Input unit and its devices, output unit and its devices, CPU, storage unit, Arithmetic Logic Unit (ALU), control unit, system board. Primary memory- RAM, ROM; secondary memory

4.3   Software: introduction, system software, application software.

4.4   Computer language: machine language, high level language, compiler, interpreter, assembler.

4.5   Binary numbers: binary number system, conversion of decimal to binary and vice-versa, binary arithmetic- addition, subtraction and complement.

4.6   Internet: Introduction, Internet Service Provider (ISP), WWW, webpage, HTML, web browser, search engine, web browsing/net surfing, IP address, domain name.

4.7   Concept of: Windows, desktop, toolbar, taskbar, folder, icon, creation of files and folder, My computer.

4.8   Use of MSEXCEL for: drawing charts, calculation of sum, product, quotient

Unit-5   Computer Programming-II   20 marks   (18 lectures)

5.1   Programming with FORTRAN 77: Algorithm, Flowchart, Source program, Object program, steps of compilation of FORTRAN Program.

5.2   General appearance of a FORTRAN program, Executable and Non-Executable statements, FORTRAN Character set.

5.3   Data type: Numeric-Integer and Real constants, character constant, Logical constant

5.4   FORTRAN variables: Naming of a variable- Integer and Real variables, Implicit type, Explicit type (or Type Declaration), character variable, logical variable

5.5   Expressions: Arithmetic operators, Arithmetic expressions, Rules for forming arithmetic expression, Arithmetic assignment statement, Library function, Relational operators, Logical operators, Truth tables of .AND., .OR. and .NOT. operators.

5.6   Statements: Unformatted input/ output statement- READ and WRTE, Idea of format, STOP and END statements.

5.7   Control statement: GO TO statement – unconditional GO TO statement, IF statement- Arithmetic IF statement, Logical IF statement, simple and nested blocks: IF- THEN-ELSE-ENDIF, and IF-THEN-ELSEIF-THEN-ENDIF; WHILE-DO statement; DO statement, Nested Do statement.

5.8   Arrays: subscript expressions, DIMENSION statement, Input of one and two dimensional arrays by using Do loops.

5.9   Statement function, Sub-routine, Sub-program, parameter passing and data sharing.

5.10   Writing statistical program in FROTRAN:

(i) Mean (ii) variance (iii) Karl Pearson's correlation coefficient (for ungrouped data) (iv) linear regression (for 2 variables) (iv) Newton's forward interpolation formula.

Books recommended:

1. V. Rajaraman: Programming in Fortran 77, Prentice Hall of India, New Delhi
2. C. Xavier: Numerical Methods in Fortran 77, Wiley Eastern, New Delhi
3. SC Malik: Mathematical Analysis, Wiley eastern, New Delhi
4. HL Royden: Real Analysis, Prentice Hall of India, New Delhi
5. W. Rudin: Principles of Mathematical Analysis, McGraw Hill
6. BS Vatsam: Theory of Matrices, Wiley Eastern, New Delhi
7. B.M. Singh: Measure, Probability and Stochastic Processes, South Asian Publishers, New Delhi

Manipur University
B.A/B.Sc.-III
Semester-5

Statistics (Honours)
Paper-IV (Theory)/STA: 502

Full Marks-100
Pass Marks: 36
Approximate lectures: 100

Unit-1   Normal and Bivariate Probability Distributions   20marks (20 lectures)

1.1   Normal distribution: definition, derivation as a limiting case of binomial distribution, mean, median, mode, quartiles, mean deviation, variance, moments, points of inflexion of normal curve, mgf and characteristic function of standard normal variate, importance and discussion of properties (with proof).

1.2   Bivariate random variable or vector (X,Y) – discrete and continuous

1.3   Joint probability functions-mass function and density function,

1.4   Joint probability functions- its properties (without proof)

1.5   Marginal and conditional distributions

1.6   Conditional expectations and conditional variance

1.7   mgf of bivariate random vector and its properties

1.8   mgf of marginal distributions

1.9   Independence of random variables

1.10   Bivariate normal distribution and finding of marginal and conditional mean and variance.

Unite-2   Theory of Estimation-II   18 marks   (18 lectures)

2.1   Minimum Variance Estimator (MVE), Rao-Blackwell theorem (Statement only), MVUE and its uniqueness, (with proof), Cramer-Rao Inequality (special case of i.i.d. r.v.'s) (with proof)

2.2   Interval estimation, confidence interval, confidence coefficient (one method of obtaining confidence limits), confidence interval for mean and variance of normal distribution.

Unit-3   Design of Experiment-II   22 marks   (22 lectures)

3.1   LSD-its statistical analysis, advantages and disadvantages, critical difference for comparing treatment means.

3.2   Missing plot technique, one missing observation for CRD, RBD, LSD.

3.3   Factorial experiments, their advantage and comparison with simple experiments.

3.4   Analysis of 2^2, 2^3, and 2^4 factorial experiments applied in RBD.

3.5   Concept of 3^2 and 3^3 factorial experiment (without analysis);

3.6   Confounding in factorial experiments (Total and partial confounding in 2^2, 2^3 & 2^4)

3.7   Concept of confounding in 3^2 and 3^3 factorial experiment (layout only)

3.8   Split plot technique applied in RBD (without analysis)

3.9   Description of strip plot arrangement in RBD (without analysis)

3.10 Series of experiment (without analysis)

Unit-4   Correlation and Curve fitting   20 marks   (20 lectures)

4.1   Multiple and partial correlation (for three variables), their coefficient and properties, residual and its properties, variance of residuals.

4.2   Multiple and partial correlation coefficient in terms of total correlation coefficients for 3 variables.

4.3   Explained and unexplained variation, coefficient of determination.

4.4   Intra class correlation coefficient (derivation) and its limits.

4.5   Correlation ratio (derivation) and its properties.

4.6   Pearsonian system of curve- Pearsonian general differential equation and derivation of Pearsonian curves of Type- I, II and III

4.7   Orthogonal polynomial – its importance and derivation of orthogonal polynomials.

Unit-5   Sampling Distribution-II   20 marks   (20 lectures)

5.1   Derivation of t, F, X^2 distributions, shape of its curves and its properties

5.2   Theorems of X^2 distribution

5.3   Relation between t, F and X^2

5.4   Derivation of sampling distribution of sample total correlation coefficient and sample range.

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1 & II, The World Press Pvt. Ltd., Kolkata.
2. Bertrand L. Hausen & Prabhakar M. Ghare, Quality Control and Application, Prentice Hall of India, New Delhi
3. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
4. S.C. Gupta and V.K.Kapoor: Fundamentals of Mthematical Statistics, Sultan Chand and Sons, New Delhi.
5. S.C. Gupta and V.K.Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
6. DD Joshi, Linear Estimation and Design of Experiments, New Age International Publisher, New Delhi
7. Cox & Cochran: Experimental Design, Asia Publishing House, New Delhi
8. Das & Giri: Design and Analysis of Experiments, Wiley eastern, New Delhi

B.A/B.Sc.-III

Statistics (Honours)

Paper-VII (Practical)

STA: H 503 (P)

Full Marks-100

Pass Marks: 40

Sl.No.	Topic	No. of experiments

Group A

1.	Fitting of Normal Distribution and test of goodness of fit	1
2.	Multiple and partial correlation	2
3.	Fitting of Pearsonian curves	3
4.	Fitting of curves using orthogonal polynomial (1st & 2nd degree)	2
5.	Intraclass correlation coefficient and correlation ratio	2

Group B

1.	LSD	1
2.	One Missing plot analysis of RBD and LSD	2
3.	Factorial experiment (2^2, 2^3 and 2^4)	3
4.	Partial and total confounding (2^3 and 2^4)	3

Group C

1.	Writing and running FORTRAN program for mean, variance, correlation, linear regression, interpolation formula in computer	5
2.	Drawing of charts, Calculation of sum, product, quotient in MSEXCEL	1
	Total	**25**

Manipur University
B.A/B.Sc.-III
Semester-6
Statistics (Honours)
Paper-VIII (Theory)/STA: 601

Full Marks-100
Pass Marks: 36
Approximate lectures: 100

Unit-1	**Statistical Inference-II**	**20 marks**	**(20 lectures)**

1.1 Most powerful critical region (MPCR), Neyman- Pearson lemma and its application in construction of MPCR for testing simple hypothesis against simple alternative for binomial, Poisson and normal distributions.

1.2 UMPCR, unbiased test, UMPUCR

1.3 Definition of order statistics- derivation of the distribution of rth sample order statistic and joint distribution of rth and s^{th} sample order statistics.

1.4 Non-parametric tests: Sign test for univariate distribution, Run test, median test, Wilcoxon signed rank test and Mann-Whitney U-test

Unit-2	**Statistical Quality Control**	**20 marks**	**(20 lectures)**

2.1 Introduction, meaning and purpose of SQC, tools of SQC, 3-sigma control limits, advantages of SQC

2.2 Process control: construction, use and interpretation of control charts for – mean, range, fraction defective, number of defectives and number of defects per unit (fixed & variable sample size)

2.3 Product control: Description of Rectifying Sampling Inspection Plan, consumer and producer's risk, explanation of the terms – AQL, LTPD, ASN, ATI, OC, AOQ, AOQL (interpretation only)

2.4 Operation of single and double sampling inspection plan, determination of n and c for single sampling plan, comparison of single and double sampling plans (including flow charts).

Unit-3   **Time Series-II**   **18 marks**   **(18 lectures)**

3.1   Objective of measuring seasonal variation and measurement of seasonal variation by the methods of simple averages, ratio to trend, ratio to moving averages and link relatives.

3.2   Objective and Measurement of cyclic movements by the method of residual approach.

3.3   Spencer's 15-point and 21-point formulae and their importance in determining trend and their deviation.

Unit-4   **Sample survey-II**   **22 marks**   **(22 lectures)**

4.1   Simple random sampling: determination of sample size for (i) specified coefficient of dispersion (ii) given margin of error in estimate and the confidence coefficient.

4.2   Stratified random sampling: definition of strata, advantage of stratification, principles of stratification, estimation of population total and mean, variance and SE of its estimates, allocation of samples: (i) equal (ii) proportional (iii) Neyman (optimum), derivation of the variances for proportional and optimum allocation.

4.3   Gain in precision due to stratification: proportional and optimum in comparison with SRS.

4.4   Systematic sampling (linear): techniques of selecting systematic sample, merits and demerits, estimation of population total and population mean and its sampling variance, comparison of systematic sampling with simple random sampling and stratified sampling.

4.5   Techniques of : Cluster sampling, multi-stage sampling, multiphase sampling, double sampling

4.6   Comparison of multistage and multiphase sampling

4.7   Ratio estimation (in SRS): estimation of the population mean and population total, bias of ratio estimators, approximate variance of ratio estimator, advantages and applications of ratio estimators, product estimator (concept only)

4.8   Regression estimators (in SRS): bias of regression estimator, sampling variance of regression estimator.

4.9   Non-sampling errors: Source and type

4.10   Non-sampling bias, non-response errors.

Unit-5   National Income & Demand and Supply Analysis   20marks   (20 lectures)

5.1   Definition of national income by (i) Marshall (ii) Pigou (iii) Fisher

5.2   Different concept of national income (a) gross national product (GNP) (b) net national product (NNP)

5.3   Methods of estimation of national and the difficulties in methods (a) output method (b) income method (c) expenditure method

5.4   Importance of national income

5.5   Supply and demand function – introduction, demand and supply law, demand and supply curve, demand and supply function with constant price elasticity.

5.6   Types of data required for estimation of elasticity- family budget and time series.

5.7   Method of estimating demand functions- Leontiff's method (from time series data) Pigou's method (from family budget data)

5.8   Engel's law and Engel's curve, Pareto's law and Pareto's curve, curves of concentration, indifference curve, properties of the above curves.

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1&II, The World Press Pvt. Ltd., Kolkata.
2. Hogg, R.V. and Craig R.G.: Introduction to Mathematical Statistics, MacMillan Publishing Co., New York.
3. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
4. Miller and Fruend: Modern Elementary Statistics.
5. Snedecor and Cochran: Statistical Methods, Oxford and IBH Publishers.
6. S.C. Gupta and V.K.Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
7. S.C. Gupta and V.K.Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
8. W. Cochran: Sampling Technique, Wiley Eastern, New Delhi
9. Sukhatme, PV: Sample Survey: Methods and Its Applications, ISAS, New Delhi
10. Daroga Singh & FS Chaudhury: Theory and Analysis of Sample Survey Design, Wiley Eastern, New Delhi

Manipur University
B.A/B.Sc.-III
Semester-6
Statistics (Honours)
Paper-IX (Theory)/STA: 602

Full Marks-100
Pass Marks: 36
Approximate lectures: 100

Unit-1   Finite difference and Numerical Analysis-II   20 marks   (20 lectures)

1.1   Inverse interpolation formula, method of approximation, reversion of series method (derivation)
1.2   Weddle's rule (derivation)
1.3   Central difference formula, Gauss formulae, Sterling's and Bessel's formulae (derivations)
1.4   Sterling's bivariate interpolation.

Unit-2   Finite difference and Numerical Analysis-III   20marks   (20 lectures)

2.1   Laplace-Everett formula (derivation)

2.2   Newton-Cots formula (derivation)

2.3   Euler-Maclaurin's summation formula (derivation)

2.4   Sterling's formula for factorial n (derivation)

2.5   Difference equation with constant coefficient (homogeneous, non-homogeneous equations only)

Unit-3   Operation Research   22 marks   (22 lectures)

3.1   Origin and development of OR, importance and scope of OR

3.2   Models of OR-iconic, analogue and mathematical models

3.3   Elements of LPP, formulation of LPP

3.4   Solution of LPP by graphical method (for 2 variables)

3.5   Solution of LPP by simplex method

3.6   Artificial variable, solution of LPP by Big-M method

3.7   Concept and formulation of dual problem

3.8   Dual simplex method

Unit-4   Psychological and Educational Statistics   18 marks (18 lectures)

4.1   Introduction, comparison and combination of exams and ranks
4.2   Normalised scale
4.3   Mental measurements-IC (construction and standardization of test), Simon-Bunet scale.
4.4   Methods for the estimation of test, reliability and validity, Spearman's two factor theory

Unit-5   Indian Official Statistics   20 marks   (20 lectures)

5.1   Statistical system in India, CSO, NSSO, Office of the Registrar General, Directorate- General of Commercial Intelligence and Statistics, Directorate of Economics and Statistics, Labour Bureau, Army Statistical Organisation (features of the organisations and name of their publications only).

5.2   Discussion on the official statistics of India related to census, agriculture and industries,

    5.2.1   Census- type of census and type adopted by India, organization of census, type of data included in the schedule of last census.

    5.2.2   Agricultural Statistics- Land utilization statistics, total area, classification of area, area under crop, area irrigated, and crops irrigated, crop production statistics- forecast crops, non-forecast and plantation crops

    5.2.3   Industrial statistics- Statistics relating to organized and unorganized sectors.

5.3   Study of official publications and journals of North Eastern Council (NEC) and Basic Statistics of NEC.

Books recommended:

1. Goon, Gupta and Dasgupta: Fundamentals of Statistics, Vol.1&II, The World Press Pvt. Ltd., Kolkata.
2. J.N. Kapur & H.C. Saxena: Mathematical Statistics, S. Chand & Co., New Delhi
3. S.C. Gupta and V.K.Kapoor: Fundamentals of Applied Statistics, Sultan Chand and Sons, New Delhi.
4. S.C. Gupta and V.K.Kapoor: Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
5. Scarborough, J.B: Numerical Mathematical Analysis, Oxford and IBH
6. Gupta & Malik: Calculus of Finite Differences and Numerical Analysis, Krishna Prakashan Mandir, Meerut.

7. Havey M. Wagner, Principles of Operations Research, Prentice Hall of India, New Delhi
8. Kanti Swarup, PK Gupta, Man Mohan, Operations Research, Sultan Chand and Sons, New Delhi.
9. VK Kappor, Operation Research, Sultan Chand and Sons, New Delhi.
10. Kalyan Kr. Mukherjee, Numerical Analysis, New Central Book Agency, Kolkata
11. JP Guilford & B.Fruchter: Fundamentals of Statistics in Psychology and Education, McGraw Hill
12. H.A. Taha: Operation Research An Introduction, Prentice Hall of India,

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B.A/B.Sc.-III

Statistics (Honours)

Paper-X (Practical)
STA: H 603 (P)

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Full Marks-100
Pass Marks: 40

Sl.No.	Topic	No. of experiments

Group A

1.	Stratified random sampling (including proportional and optimum allocation and comparison of efficiencies)	3
2.	Systematic sampling	2
3.	Trend values by Spencer's formulae	2
4.	Constitution of control charts	5

Group B

5.	Finite difference	4
6.	Numerical analysis	3
7.	Scale (T-score and P. C. Graph)	2
8.	LPP by Simplex method	2
	Total	**23**