GULBARGA UNIVERSITY, GULBARGA
SYLLABUS FOR B.A. STATISTICS
(SEMESTER SCHEME)

Semester- I

Theory Paper – I (Descriptive Statistics and Mathematics)
Practical – I (Based on paper-I)

Semester - II

Theory Paper – II (Probability Theory, Distributions and Descriptive Statistics)
Practical – II (Based on paper-II)

Semester - III

Theory Paper – III (Descriptive Statistics, Distribution Theory & Theory of Estimation)
Practical – III (Based on paper-III)

Semester - IV

Theory Paper – IV (Testing of Hypotheses)
Practical – IV (Based on paper- IV)

Semester- V

Theory Paper – V (Sampling Theory & Demand Analysis)
Theory Paper – VI (Statistical Quality Control & Vital Statistics)
Practical – V (Based on paper-V)
Practical – VI (Based on paper-VI)

Semester - VI

Theory Paper – VII (Designs of Experiments & Numerical Methods)
Theory Paper – VIII (Index Numbers, Time Series Analysis & Computing)
Practical – VII (Based on paper - VII)
Practical – VIII (Based on paper-VIII)

GULBARGA UNIVERSITY, GULBARGA
DEPARTMENT OF STUDIES AND RESEARCH IN STATISTICS

APPLIED STATISTICS

B.A. Syllabus (Semester)

SEMESTER – I

Paper I: Descriptive Statistics and Mathematics

A. BASIC STATISTICS

Introduction, definition, functions, scope and limitations of statistics.

COLLECTION OF DATA

Primary data and secondary data and their sources. Classification and tabulation of data. Diagrammatic and graphical representation of data. Frequency distribution (for discrete and continuous variable).

MEASURE OF CENTRAL TENDENCY

Arithmetic mean, Geometric mean, Median, Mode and Hormonic mean, Weighted arithmetic mean, their merits and demerits. Partition values (Quartiles, Deciles and Percentiles).

MEASURES OF DISPERSION

Range, Mean deviation, Quartile deviation and Standard deviation (with properties). Coefficient of variation. Moments: Relation between moments about the origin and moments about Arithmetic mean, different measures of Skewness and Kurtosis and their properties. (50h)

B. MATHEMATICS

Theory of Indices, use of Logarithm, Binomial theorem. Introduction to matrix and determinants. Basic idea of differentiation and integration. Maxima and Minima for functions of one variable. (10h)

Practical-I

1) Tabulation of data – One, two and three factors of classification.

2) Preparation of univariate and bivariate frequency distribution and diagrammatic and graphical representation.

3-4)Computation of measures of central tendency – Arithmetic mean, Geometric mean, Median, Mode, Quartiles, Deciles and Percentiles. Weighted Arithmetic mean.

5) Computation of measures of dispersion – Mean Deviation and Quartile Deviation.

6) Computation of measures of dispersion – Standard Deviation and Coefficient of Variation.

7) Skewness and Kurtosis – Their measures.

References

1) Dixon & Massey : "Introduction to Statistical Analysis".
2) Fruend J. E. : "Modern Elementary Statistics".
3) Gupta S.P. : "Elementary Statistical Methods".
4) Gupta C.B. : "Fundamentals of Statistics".
5) Magi S.S. : "Sankhyasastra" (Kannada).
6) Siddanagouda : "Sankhyasastra" (Kannada).
7) Gupta S.P. : "Practical Statistics".
8) Basco series : P.U.C. Mathematics.
9) Experts series : P.U.C. Mathematics.
10) S.C.Gupta & V. K. Kapoor : "Fundamentals of Mathematical Statistics", Vol – I.

SEMESTER – II

Paper II: Probability Theory, Distribution & Descriptive Statistics

A. PROBABILITY THEORY

Concepts of probability, sample space (finite only). Events, Algebra of events, addition theorem (for any two events and two mutually exclusive events). Independence of events, conditional probability. Multiplication theorem of probability.

RANDOM VARIABLES

Discrete and continuous variables. Mathematical expectation. Theorems on expectation, probability mass function (pmf) and probability density function (pdf).(20h)

B. STANDARD DISTRIBUTIONS

Discrete distributions: Bernoulli, binomial and Poisson distributions – definition, examples, mean and variance.

Continuous distributions: Normal, exponential, rectangular distributions – their properties and applications. (20h)

C. DESCRIPTIVE STATISTICS

Fitting of curves: Fitting of linear, quadratic and exponential distribution by using method of least squares. (20h)

Practical-II

1) Fitting of first and second degree curves by method of least squares.

2) Fitting of exponential curves.

3) Computation Q and χ^2 - measure of association.

4) Computation of probability – based on addition and multiplication theorems.

5) Fitting of binomial distribution.

6) Fitting of Poisson distribution.

7) Fitting of normal distribution.

References

1) S.C.Gupta : "Fundamentals of Statistics".
2) C.B.Gupta : "An Introduction to Statistical Methods".
3) S.C.Gupta & V.K.Kapoor : "Fundamentals of Mathematical Statistics", Vol.-II.
4) Umraj R.R. : "Probability and Statistical Methods".
5) Freund J. E. : "Modern Elementary Statistics".
6) Steel & Torrie : "Introduction to Statistics".

SEMESTER – III

Paper III: Descriptive Statistics, Distribution Theory & Theory of Estimation

A. DESCRIPTIVE STATISTICS

Bivariate data; scatter diagram, Karl Pearson's coefficient of correlation and its properties, Rank correlation. Lines of regression, properties of lines of regression and regression coefficients.

Partial and multiple correlation. Multiple regression equations. (20h)

B. DISTRIBUTION THEORY

Bivariate p.m.f's and p.d.f's., marginal and conditional probability functions. Independence of random variables. Expectation of sum and product of two random variables.

Sampling distributions of sample mean and sample variance. Chi-square, t and F distributions and their applications. (20h)

C. THEORY OF ESTIMATION

Point estimation: Concepts of parameter, estimator and estimate. Standard error of an estimator. Properties of an ideal estimator i.e. consistency, unbiasedness, efficiency and sufficiency. M.L.E. and its properties (without proof).

Interval estimation: Confidence intervals for mean, difference of means, large sample intervals for proportion and difference of proportions. (20h)

Practical-III

1) Computation – correlation coefficient for ungrouped data.

2) Computation – correlation coefficient for grouped data.

3) Computation – rank correlation coefficient (including repeated ranks).

4) Finding of regression lines for ungrouped data.

5) Finding multiple regression equations.

6) Partial and multiple correlation coefficients.

7) Estimation of parameters by MLE for binomial and Poisson distributions.

8) Construction of confidence intervals for mean, difference of means, proportion and difference of proportions.

References

1) C.B.Gupta : "An Introduction to Statistics".
2) S.C.Gupta : "Fundamentals of Statistics".
3) Dixon & Massey : "Introduction to Statistical Analysis".
4) S.P.Gupta : "Statistical Methods".
5) S.C.Gupta & V.K.Kapoor : "Fundamentals of Mathematical Statistics", Vol.-I.

SEMESTER – IV

Paper IV: Testing of hypotheses

TESTING OF HYPOTHESES

Statistical hypotheses, null and alternative hypotheses, simple and composite hypotheses. Concepts of type-I and type-II errors and their probabilities. Critical region, best critical region and Most Powerful tests. Statement of Neyman-Pearson lemma and its uses.

Tests of significance for mean, equality of means, variance and equality of variances under normality. Large sample tests for single proportion and difference of proportions. Chi-square test for equality of population variance, goodness of fit and independence of attributes in contingency table. Case of (2 x 2) contingency table. Student's t-test for single mean, equality of means and for paired observations. F-test for equality of variances, Fisher's Z-transformation.

Non parametric tests: Concepts, advantages, sign test, median test and run test. (60h)

Practical-IV

1) Tests for single mean and equality of means under normality when (a) variance is known (b) variance is unknown.

2) Tests for single proportion and equality of proportions.

3) Tests for single variance and equality of variances under normality.

4) Test for correlation coefficient Z – transformation.

5) Chi-square tests for population variance and goodness of fit for binomial, Poisson distributions and for specified probabilities.

6) Tests for independence of attributes in contingency tables.

7) Tests for single mean and equality of means for small samples.

8) Tests for equality of variances in small samples.

9) Non parametric tests.

References

1) S.C.Gupta : "Fundamentals of Statistics".
2) S.P.Gupta : "Statistical Methods".
3) C.B.Gupta : "An Introduction to Statistics".
4) S.C. Gupta & V.K.Kapoor: "Fundamentals of Mathematical Statistics", Vol.-I.

SEMESTER – V

Paper V: Sampling Theory and Demand Analysis

SAMPLING THEORY

Concepts of population and sample, need of sampling, complete enumeration and sample survey with their relative merits and demerits. Organizational aspects of a sample survey. Sampling and non sampling errors.

Some basic sampling designs: Simple Random Sampling, SRSWOR and SRSWR – their properties. Estimation of population mean S.E. of sample mean.

Stratified Random Sampling: Estimate of population mean and its S.E., allocation of sample size to different strata. Proportional allocation and optimal allocation.

Linear Systematic Sampling: Estimation of population mean and S.E. of the estimate comparison of systematic sampling with stratified random sampling and also with SRSWOR.

Acquaintance with working of N.S.S. and C.S.O. (50h)

DEMAND ANALYSIS

Definition of demand and supply. Drawing equilibrium curves of demand and supply. Elasticity of demand and supply. Parato's curve and Lorenz's curve. (10h)

Practical-V

1) Listing of all possible SRSWR samples from a given population and verification of the facts that the usual estimates of mean (total) and sampling variance of the estimator are unbiased.

2) Listing all possible SRSWOR samples from a given population and verification of the facts that usual estimate of the mean and the sampling variance of the estimator are unbiased.

3) Drawing random samples under SRSWR design from a given population and estimation of the mean and S.E. of the estimator.

4) Drawing a random sample under SRSWOR design from a given population and estimation of the mean and S.E. of the estimator.

5) Estimation of mean and S.E. of the estimator under stratified random sampling.

6-7) Allocation problem under stratified sampling comparison of the precision of the estimators under stratified random sampling with proportional allocation and optimum allocation and that under unstratified random sampling.

8) Systematic random sampling – estimation of population mean and its S.E.

9) Calculation of equilibrium price and quantity exchanged

References

1) S.C.Gupta & V.K.Kapoor : "Fundamentals of Applied Statistics", Vol.-II.
2) Chocran : "Sampling Technique".
3) Desraj : "Sampling Theory".
4) S. G. Gani : "Anvayaka Sankhyasastra" (Kannada).

Paper VI: Statistical Quality Control & Vital Statistics

STATISTICAL QUALITY CONTROL

Introduction, meaning of variability, quality control, process control and product control. Importance of SQC in industries.

Control charts for variables, construction and interpretation of $\overline{X}$ and R - charts. Control charts for attributes, construction of p, np and c – charts. Advantages of control charts. Natural tolerance limits, specification limits and modified control charts.

Acceptance sampling, explanation of various terms. Single sampling plan, Double sampling plan by attributes. (40h)

VITAL STATISTICS

Definition, uses, sources of vital statistics. Measurement of population.

Measurement of mortality: C.D.R., A.S.D.R., I.M.R. and S.T.D.R. with their relative merits and demerits.

Measurement of fertility: C.B.R., G.F.R., A.S.F.R., T.F.R., G.R.R. and N.R.R. with their relative merits and demerits. (20h)

Practical-VI

1) Construction and interpretation of $\overline{X}$ and R - charts.
2) Construction and interpretation of p – charts.
3) Construction and interpretation of np – charts.
4) Construction and interpretation of c – charts.
5) Plotting O.C. and A.S.N. functions in case of single sampling plans.
6) Computation of C.D.R. and A.S.D.R's
7) Computation of S.T.D.R. by direct and indirect methods.
8) Computation of C.B.R., G.F.R. and A.S.F.R.
9) Computation of T.F.R., G.R.R. and N.R.R.

References

1) S.C.Gupta & V.K.Kapoor : Fundamentals of Applied Statistics, Vol-II.
2) C.B. Gupta : Statistical Methods
3) S.C Gupta : Fundamentals of Statistics
4) S. P. Gupta : Statistical Methods
5) Kepthorn : Design of Experiments
6) S.C. Gani : "Anwayika Sankhyashastra" (Kannada).
7) Mahagav. B.K. : Statistical Quality Control.
8) S.P.Gupta : Practical Statistics.

SEMESTER – VI

Paper VII: Designs of experiments & Numerical Methods

A. ANALYSIS OF VARIANCE (Fixed effect model)

Analysis of one-way, two–way classification.

Designs of experiments: Principles of experimentation, Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD).

Missing plot technique: Single observation missing in RBD and LSD. (40h)

B. NUMERICALO METHODS

Definition of interpolation and extrapolation and its uses.

Estimation of missing values by using:
1) Binomial expansion method.
2) Lagrange's method for unequal interval.
3) Newton's-gregary method of forward and backward formula.
4) Newton's method.

Introduction to linear programming, formulation and solving l.p.p by graphical Method. Transportation problem and its optimal solution. (20h)

Practical-VII

1) Analysis of One – way classification.

2) Analysis of Two – way classification.

3-5) Analysis of CRD, RBD and LSD.

6-7) Missing plot technique in RBD and LSD.

8-11) Estimation of Intermediate and Extrapolation by using
(i) Binomial expansion.
(ii) Lagrange's method.
(iii) Newton's formula.
12. Formulation of l.p.p.
13. Solution of l.p.p by graphical method.
14. Solving a transportation problem.

References

1)	S.C.Gupta & V.K.Kapoor	:	Fundamentals of Applied Statistics Vol.II.
2)	S.P.Gupta	:	Statistical Methods.
3)	S.C.Gupta	:	Fundamentals of Statistics.
4)	Elhance	:	Fundamentals of Statistics.
5)	Goon, Gupta & Das Gupta	:	Fundamentals of Statistics Vo.II.
6)	S.S.Mogi	:	"Sankhyasastra" (Kannada).
7)	Siddanagouda	:	"Sankhyasastra" (Kannada).
8)	C.K. Mustafi	:	Operations Research Methods and Pracatice.
9)	A. Taha	:	Operations Research- An Illustation, 6th edition, Macmillan Co., New York.

Paper VIII: Index Numbers, Time Series Analysis & Computing

INDEX NUMBERS

Meaning of index numbers, problems in the construction of index numbers of prices and quantities. Paasche's, Laspeyre's, Marshall-Edgeworth and Fisher's formulae. Criteria of a good index number – time reversal test, factor reversal test and circular test. Cost of living index numbers, construction of consumer price index numbers, uses and limitations of index numbers. (20h)

TIME SERIES ANALYSIS

Definition and uses of time series. Components of a time series: secular trend, seasonal variations, cyclic variations and irregular variations.

Measurement of trend: Free hand curve, semi-averages method, moving averages method and method of least squares. Linear, quadratic and exponential curves. Merits and demerits of these methods.

Measurement of seasonal variations: Simple averages, ratio to trend, ratio to moving average and link relatives methods; with their relative merits and demerits. (20h)

COMPUTING

Introduction to computers, Flow-chart & Algorithms (simple problems), use of MS Excel in data analysis. (20h)

Practical-VIII

1) Computation of index numbers by simple aggregate, weighted aggregate methods and using price relative.

2) Computation of index numbers using Paasche's, Laspeyre's, Marshall-Edgeworth and Fisher's formulae.

3) Computation of cost of living index number.

4) Measurement of trend by the methods of semi-averages and moving averages.

5 & 6)Measurement of trend by least squares method. Fitting of linear, quadratic and exponential trend equations, finding trend values and plotting of original values and trend values.

7) Computation of seasonal indices by simple averages method & ratio to trend method.

08) Computation of seasonal indices by ratio to moving average method.

9) Computation of seasonal indices by link relatives method.
10) Flow chart & Algorithms for simple problems.

References

1) S.C.Gupta & V.K.Kapoor : Fundamentals of Applied Statistics Vo.II.
2) S.P.Gupta : Statistical Methods.
3) S.S.Mogi : "Sankhyasastra" (Kannada).
4) Siddanagouda : "Sankhyasastra" (Kannada).
5) Sanjay Saxena : MSOFFICE 2000 for everyone Vikas Publication(2001)
6) Balaguruswamy : Programming in Basic.

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GULBARGA UNIVERSITY, GULBARGA
SYLLABUS FOR B.A./ B.Sc. MATHEMATICAL STATISTICS
(SEMESTER SCHEME)

Semester- I

Theory Paper – I (Descriptive Statistics and Mathematics)
Practical – I (Based on paper-I)

Semester - II

Theory Paper – II (Probability, Distributions and Descriptive Statistics)
Practical – II (Based on paper-II)

Semester - III

Theory Paper – III (Statistical Quality Control and Demographic Methods)
Practical – III (Based on paper-III)

Semester - IV

Theory Paper – IV (Distribution theory and Fortran Language)
Practical – IV (Based on paper- IV)

Semester- V

Theory Paper – V (Theory of Estimation and 'C' Language)
Theory Paper – VI (Testing of Hypotheses)
Practical – V (Based on paper-V)
Practical – VI (Based on paper-VI)

Semester - VI

Theory Paper – VII (Sampling Techniques & Design of Experiments)
Theory Paper – VIII (Applied Statistics and Operations Research)
Practical – VII (Based on paper - VII)
Practical – VIII (Based on paper-VIII)

GULBARGA UNIVERSITY, GULBARGA
SYLLABUS FOR B.A. / B.Sc. MATHEMATICAL STATISTICS
(SEMESTER SCHEME)

Semester - I

Theory Paper I : **Descriptive Statistics and Mathematics.**

Basic Statistics

Meaning, definition, functions and limitations of Satistics.

Primary and Secondary data: Methods of collecting primary data, sources of secondary data

Presentatioin of data : Classification- rules and methods of classification (univariate and bivariate).
Tabulation- rules, types and methods of tabulation.
Diagrams-Bar diagram and Pie chart.
Graphs- Histogram, frequency polygon, frequency curves and ogives.

Measures of Central tendancy: Arithmetic mean, Weighted arithmetic mean, Median , Mode, Geometric mean and Harmonic mean.Partition values- Derivation of median and mode formula for continuous frequency distributiuon.

Measures of Dispersion: Range, Quartile deviation, Mean deviation and standard deviation (with properties), Coefficient of variation, moments about origin and arithmetic mean and relation between them.Measures of Skewness and Kurtosis. (45h)

Mathematics

Differential Calculus: Functions of one variable, various types of functions like e^x , log (x), sin(x), cos(x), tan(x), sec(x), cosec(x), cot(x), hyperbolic functions, continuity, differentiability, derivatives of standard functions, derivatives of product & quotient of functions, derivative of a function of a function, chain rule. Functions of two variables. Partial derivatives.

Integral Calculus: Integration as inverse process of differentiation, Integrals of standard functions. Standard methods of integration, definite integrals. (15h)

Practical - I (2 practicals on each of the following topics)

1) Tabulation of data – one, two and three factors of classification.
2) Preparation of univariate and bivariate frequency distribution and graphical representation.
3) Computation of measures of central tendency – arithmetic mean, geometric mean, harmonic mean and weighted arithmetic mean.
4) Computation of measures of central tendency – median, mode, quartiles, deciles and percentiles.
5) Computation of measures of dispersion – mean deviation and quartile deviation.
6) Computation of measures of dispersion – standard deviation and coefficient of variation.
7) Skew-ness and kurtosis – various measures.

References

01.Anderson, T.W. and Selove, S.L.(1978): "An introduction to the statistical analysis of data".Houghton Miffin and Co.
02.Freund J.E. and Ronald E.Walpole (1987): "Mathematical Statistics". Fourth edition. Prentice Hall of India, New Delhi.
03.Goon A.M., Gupta M.K. and Dasgupta, Vol.1 (1991) & Vol.2(2001): "Fundamentals of Statistics". World press, Calcutta.
04.Lapin L.(1978): "Statistics for business decisions". Harcourt Brace Jovansvick.
05.Spiegal M.R.(1967): "Theory and problems of Statistics". Schaum publishing Co.
06.S.C.Gupta & V.K.Kapur: "Fundamentals of Mathematical Statistics". S.Chand & Co., Delhi.
07.Hogg R.V. and Craig A.I.(1971): "Introduction to Mathematical Statistics". Mc.Millan.
08.Croxton F.E., Cowdin D.J. & Klein S.(1973): "Applied General Statistics". Prentice Hall of India, New Delhi.
09.Snedecor G.W. & Cochran W.G.(1967): "Statistical Methods". Lowa State University Press.
10.Murray R.Spiecel: "Advanced Calculus". Schaum Series.
11.S.Shanti Narayan: "Differential Calculus". S.Chand.
12.'''''''''''''''''''''' "Integral Calculus" S. Chand.
13.S.C.Malik: "Mathematical Analysis". Wiley Eastern.

Semester - II

Theory Paper II : **Probability Theory, Distributions & Descriptive Statistics.**

A : Probability Theory

Random experiment: Trial, sample space (both discrete and continuous), events, algebra of events, mutually exclusive events, exhaustive events.

Concepts of probability: Classical and axiomatic approach to probability (as in K.L.Chung), properties of probability involving only finite number of events – proofs based on axiomatic approach. Independence of events, conditional probability, multiplication theorem, Bayes' theorem and its application. (15h)

B: Distributions

Random variables and distributions: Random variable (as in K.L.chung), distribution function (univariate only), probability mass function (pmf), probability density function (pdf), expectation of a random variable, median, moments, skewness and kurtosis, moment generating function (mgf) and uses.

Study of standard discrete distributions: (definition through pmf, computation of moments and mgf): bernoulli, discrete uniform, binomial, hyper-geometric, Poisson, geometric, negative binomial (application of these distributions in real life).

Study of standard continuous distributions: (definition through pdf, computation of moments and mgf wherever they exist): rectangular (uniform), exponential, gamma, normal, Laplace & Cauchy distributions. (25h)

C: Descriptive Statistics

Bivariate data : Scatter diagram, regression curve between two variables and concepts of error in regression, principle of least squares and fitting of first, second and third degree polynomials and exponential curves. Fitting of Gompertz and logistic curve by the method of partial totals. Product moment correlation and regression coefficients and their properties, coefficient of determination. Spearman's rank correlation coefficient, intra-class correlation coefficient.

Trivariate data: Multiple regression, multiple correlation and partial correlation coefficients – their properties. (20h)

Practical – II

01.Fitting of first and second degree curves by the method of least squares.
02.Fitting a polynomial of degree three by the method of least squares.
03.Fitting exponential curves $y = ab^x$ and $y = ax^b$ by the method of least squares.
04.Computation of correlation coefficient and regression lines for ungrouped data.
05.Computation of correlation coefficient and regression lines for grouped data.
06.Spearman's rank correlation coefficient.
07.Computation of intra-class correlation coefficient.
08.Computation of multiple and partial correlation coefficients.
09.Computation of the equation of regression plane.
10.Computation of probabilities using combinatorial methods and Bayes theorem.
11.Generating random observations from binomial and Poisson distributions.
12.Generating random observations from a negative binomial distribution.
13.Generating random observations from exponential and normal distributions.
14.Fitting of binomial distribution (computation of expected frequencies). Poisson distribution and plotting their probability mass functions.
15.Fitting of negative binomial distribution and plotting the probability mass function.
16. Fitting of normal distribution by area method and plotting the probability density function.
17. Fitting of exponential distribution and plotting the probability density function.

References

01.Anderson, T.W. and Selove, S.L.(1978): "An introduction to the statistical analysis of data". Houghton Miffin and Co.
02.Freund J.E. and Ronald E.Walpole (1987): "Mathematical Statistics". Fourth edition. Prentice Hall of India, New Delhi.
03.Goon A.M., Gupta M.K. and Dasgupta, Vol.1 (1991): "Fundamentals of Statistics". World press, Calcutta.
04.Lapin L.(1978): "Statistics for business decisions". Harcourt Brace Jovansvick.
05.Spiegal M.R.(1967): "Theory and problems of Statistics". Schaum publishing Co.
06.Chung K.L.(1985): "Elementary probability theory with stochastic processes". Third edition. Narosa publishing house, New Delhi.
07.Feller W.(1985): "An introduction to probability theory and its applications". Vol.1, third ed. Wiley Eastern, Bangalore.
08.Parzen E.(1972): "Modern probability theory and its applications". Wiley Eastern, N'Delhi.
09.S.C.Gupta & V.K.Kapur: "Fundamentals of Mathematical Statistics". S.Chand & Co., Delhi.
10.Hogg R.V. and Craig A.T.(1978): "Introduction to Mathematical Statistics". Mc.Millan.
11.Croxton F.E., Cowdin D.J. & Klein S.(1973): "Applied General Statistics". Prentice Hall of India, New Delhi.
12.Snedecor G.W. & Cochran W.A.(1967): "Statistical Methods". Lowa State University Press.

Semester - III

Theory Paper III : **Statistical Quality Control and Demographic Methods.**

A: Statistical Quality Control

Variation: Chance and assignable causes of variation. Statistical Quality Control, process control and product control. Importance of Statistical Quality Control in industry.

Process Control: Theoretical basis and practical background of control charts for variables. 3-σ (sigma) limits, 2-σ limits and probability limits. Criteria for detecting lack of control. $\bar{X}$ – R charts and $\bar{X}$ - chart. Construction of $\bar{X}$ – R and s charts and interpretations. Natural tolerance limits and specification limits. Study of process capabilities. Control charts for attributes – np- chart, p-chart, c-chart and u-chart.

Product Control: Sampling inspection and 100 percent inspection. AQL, LTPD, producer's risk, consumer's risk. Acceptance sampling plans – single and double sampling plans by attributes. Derivation of O.C., A.T.I., A.O.Q., A.S.N. functions. Constructions of single sampling plans by attributes given (i) AQL, LTPD, producer's risk, consumer's risk (ii) a point on the O.C.curve and either sample size or acceptance number. (40h)

B. Demographic methods

Sources of demographic data: census, registration, special demographic surveys, institutional data collection, limitations and use in demographic studies.
Measurement of Mortality: Crude, Specific and Standardized death rates, infant mortality rates. Fecundity and fertility. Measurement of fertility: Crude birth rate, age specific, general and total fertility rates.
Life table: Components of a life table, forces of mortality & expectation of life. Uses of life tables.
Population growth: Growth and rate of growth of population based on births, deaths and cross migrations, population projection using logistic curve. (20)

Practical - III (2 practicals on each of the following topics)

01. X bar and R- charts (standard values known and standard values unknown).
02. X bar and s – charts (standard values known and standard values unknown).
03. np and p – charts (standard value known and standard value unknown).
04. c and u charts (standard value known and standard value unknown).
05. Construction of single sampling plans by attributes.

06. Drawing O.C., A.S.N., A.T.I., and A.O.Q. curves for single sampling plan by attributes.
07. Drawing O.C., A.S.N., A.T.I. and A.O.Q. curves for double sampling plan by attributes.
08.Computation of various rates of mortality, and various rates of fertility.
09.Population projection using logistic curve.

References

01.Cowden, D.J.(1960): "Statistical Methods in Quality Control", Asia Publishing House.
02.Duncan, A.J.(1974): "Quality Control and Industrial Statistics", fourth edition. Taraporowala and Sons.
03.Grant, E.L. and R.S.Leaverworth (1988): "Statistical Quality Control", 6th edition. McGraw-Hill.
04.Guttman, I, Wilks, S.S. and Hunter, J.S.(1982): "Introductory Engineering Statistics", Third Edition, John Wiley.
05.Srivastava, O.S. (1983): "A Textbook of Demography", Vikas Publications.

Semester - IV

Theory Paper – IV **Distribution Theory & Fortran Language.**

A: Distribution Theory

Bivariate pmf and pdf. Marginal and conditional pmf and pdf. Examples including trinomial and bivariate normal distributions. Moments, covariance, correlation coefficient and conditional expectation with special reference to trinomial and bivariate normal distributions. Independence of random variables (r.v.s.). Expectation of sum and product of r.v.s. Mean and variance of linear combination of r.v.s.

Distributions of functions of r.v.s. Transformation of r.v.s and use of Jacobian of transformations. Beta, Chi-square, t and F distributions. Sampling distributions of sample mean, sample variance, students-t and F-Statistics under normality assumption and the inter relationships among these distributions.

Tchebycheff's inequality, Convergence in probability of a sequencer of r.v's, statements of weak law of large numbers and central limit theorem for independent identically distributed r.v.s – their applications. (40h)

B: Computer Programming-I

Computers – types & classification, input devices, output devices, programming languages – flow charts.

Programming in FORTRAN: Elements of the language, coding FORTRAN statements, constants, variables, arrays, expressions, arithmetic and logical assignment statements, control

statements, Do loops, input statements, format statements, data initialization statements, specification statements, sub-programs & sub-routine sub-programs (examples for programming should be considered mainly from Statistics, such as averages, measures of dispersion, correlation and regression etc.). (20h)

Practical – IV

01-02.Generating random samples from bivariate normal and trinomial distributions and preparation of bivariate frequency tables.

Algorithms, Flow charts & programs for the following:

03.Using input output statements.
04.Using GOTO, IF… THEN and FOR….NEXT.
05.Using subscripted variables.
06.Finding Max., Min. and ordering of a given sequence of numbers.
07.Discrete frequency distribution tables.
08.Continuous frequency distribution tables.
09.Computing Average, S.D. and Variance for ungrouped data.
10.Computing Average, S.D. and Variance for grouped data.

11.Computing median for ungrouped data.
12.Computing Correlation coefficient for bivariate data.
13.Computation of binomial and Poisson probabilities.

References

01.Goon A.M., Gupta M.K. and Dasgupta, Vol.1 (1991): "Fundamentals of Statistics". World press, Calcutta.
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06.Freund, J.E. (1977): "Modern Elementary Statistics", 4th Edition, Prentic-Hall, New Delhi.
07.Rajaraman: "Principles of Computer Programming".
08.Sharma: "FORTRAN IV Programming"

Semester - V

Theory Paper – V: **Theory of Estimation & 'C' language**

A: Theory of Estimation

Point Estimation: Concepts of parameter, estimator, estimate and standard error of an estimator. Standard errors of sample mean and sample proportion. Unbiasedness and Consistency of estimators, sufficient conditions for consistency. Sufficiency and Fisher information function. Statement of Fisher-Neyman criterion and its use in finding sufficient statistics. Statement of Cramer-Rao inequality and its application in the construction of minimum variance unbiased estimators.

Methods of estimation – maximum likelihood and moment methods. Properties of these estimators (without proof).

Confidence Intervals: Confidence coefficient. Confidence intervals for mean, difference between means, variance and ratio of variances under normality. Large sample confidence intervals for proportion and for difference between proportions. (40h)

B: Computer Programming-II

Programming in 'C': Constants, variables, data types, operators – arithmetic, relational, logical, assignment, increment, decrement operators, hierarchy of operators, arithmetic and logical expressions – Input Output functions – Control statements – if – else, while, do – while, for, switch, go to – Nesting of control statements – arrays – user defined functions. (20h)

Practical – V (programs 10-18 are to be written in 'C' language)

01-02.Generating r.v.s from binomial, uniform & exponential distributions given sufficient statistic.
03-06.Estimating parameters of binomial, Poisson, uniform, exponential, normal, bivariate normal and trinomial distributions by the maximum likelihood method and the method of moments.
07-09.Construction of confidence intervals for mean, difference between means (variance known and unknown cases), variance, ratio of variances, proportion and difference between proportions.
Algorithms, Flow charts and Programs for the following:
10.Using subscripted variables.
11.Finding Max., Min. and ordering of a given sequence of numbers.
12.Discrete frequency distribution tables.

13.Continuous frequency distribution tables.
14.Computing Average, S.D. and Variance for ungrouped data.
15.Computing Average, S.D. and Variance for grouped data.
16.Computing median for ungrouped data.
17.Computing Correlation coefficient for bivariate data.
18.Computation of binomial and Poisson probabilities.

References

01.Goon A.M., Gupta M.K. and Dasgupta, Vol.1 (1991): "Fundamentals of Statistics". World press, Calcutta.
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06.Freund, J.E. (1977): "Modern Elementary Statistics", 4th Edition, Prentic-Hall, New Delhi.
07.C.R.Rao (1973): "Linear Statistical Inference and Its Applications", Revised Edition. Wiley Eastern.
08.Bhattacharya G.K. and Johnson R.A. (1977): "Statistical Concepts and Methods", John Wiley and Sons.
09.E.Balaguraswamy: "Programming in ANSI C", 2nd Edition, Tata McGraw-Hill.
10.Byron Gottfried: "Programming with C", 2nd Edition, Tata McGraw-Hill.
11.Yashwant Kanetkar: "Let us C", BPB Publications.

Theory Paper – VI: **Testing of Hypotheses**

Testing of Hypotheses: Statistical hypotheses. Null and alternative, simple and composite hypotheses. Critical region and critical function. Concepts of Type-I and Type-II errors, level of significance; size and power of a test. Most Powerful (MP) tests. Statement of Neymann-Pearson lemma and its use in the construction of MP tests. Uniformly Most Powerful (UMP) tests. Monotone Likelihood Ratio (MLR) property. Statement of the theorem which gives UMP tests for testing one sided hypotheses for distributions with MLR property. Likelihood Ratio Tests for one parameter distributions. Large sample approximation to the distributions of the likelihood ratio statistics (without proof).

Tests of significance: Tests for the mean, the equality of means, variance and equality of variances under normality. Large sample tests for proportions. Chi-square test of goodness of fit and for independence of attributes in contingency tables.

Sequential Analysis: Need for sequential tests. Wald's SPRT. Sequential tests for the mean of normal distribution (variance known) and for the binomial proportion. Approximate expressions for O.C. and A.S.N. functions (without derivation).

Non-parametric Tests: Advantages. Sign test for one sample problem and for a paired observations. Median test and Mann-Whitney – U test for two sample problems. Runs test for randomness. Test for independence based on Spearman's rank correlation coefficient (large sample approximation to the null distribution of the statistic is to be used in all cases). (60h)

Practical – VI

01-02.Evaluation probabilities of Type-I & Type-II errors, power of tests. Power curve for testing the mean of normal distribution (variance known).
03-05.Construction of MP tests and computation of powers. Discrete and continuous distributions.
06. Tests for single mean, equality of means under normality when (a) variance is known (b) variance is unknown.
07. Tests for single proportion and equality of two binomial proportions.
08. Tests for single variance and equality of variances under normality.
09. Tests for correlation coefficient – Z transformation.
10-12.Tests for goodness of fit (a) for specified probabilities (b) for uniform, binomial, Poisson and normal distributions.
13. Tests for independence of attributes in contingency tables.
14-16.SPRT for proportion. O.C. and A.S.N. curves. SPRT for the mean of normal distribution. OC and ASN curves.
17-19.Non-parametric tests – one sample problems, two sample problems, runs test for randomness, test of independence based on Spearman's rank correlation coefficient.

References

01.Rohatgi, V.K.(1986): "An Introduction to Probability Theory and Mathematical Statistics". Wiley Eastern, New Delhi.
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Semester - VI

Theory Paper – VII: **Sampling Techniques & Design of Experiments**

A. Sampling Techniques

Concepts of population and sample, need for sampling. Complete enumeration and sample survey. Organizational aspects of sample survey. Sampling and non-sampling errors.
Some basic sampling designs: Simple Random Sampling with replacement (SRSWR) and Simple Random Sampling without replacement (SRSWOR). Methods of selecting a random sample using SRSWR and SRSWOR designs. Estimation of population mean (total) by sample mean. Standard error (S.E.) of the sample mean and estimation of the S.E. showing that the sample mean is the Best Linear Unbiased Estimator (BLUE). Confidence limits for population mean (total). Estimation of sample size. Estimation of population proportion by sample proportion. S.E. of sample proportion and estimation of the S.E.

Stratified Random Sampling with SRSWR and SRSWOR designs. Estimation of the population mean, S.E. of the estimator and estimation of the S.E. Allocation of sample size to different strata - proportional allocation, Neyman allocation, optimum allocations for fixed cost and fixed precision. Comparison between stratified sampling and SRSWOR in terms of precision and in terms of cost. Practical difficulties in adopting optimum allocation. Estimation of the gain in precision due to stratification.

Linear systematic sampling – estimation of the population mean, S.E. of the estimator and estimation of the S.E. Comparison of systematic sampling with SRSWOR and stratified sampling for general population and for population with linear trend. (35h)

B. Design of Experiments

Gauss Markov model and Gauss Markov theorem (statement only).
Analysis of Variance (fixed effects model) – Analysis of one-way, two-way and three-way classified data.
Need for design of experiments. Three fundamental principles of design of experiments.
Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – models for the data, least squares estimates of parameters. Best estimates of contrasts. Hypotheses and test procedures. Anova tables.
Missing plot technique: Single observation missing in RBD and LSD. Substitution for the missing value by minimizing error sum of squares. Iterative procedure when two observations are missing – Analysis. (25h)

Practical – VII

01. Listing all possible SRSWR samples from a given population and verification of the facts that the usual estimators of the mean (total) and the sampling variance of the estimator are unbiased.
02. Listing all possible SRSWOR samples from a given population and verification of the facts

that the usual estimators of the mean (total) and the sampling variance of the estimator are unbiased.

03. Drawing a random sample under SRSWR design from a given population and estimation of the mean (total) and the standard error of the estimator.
04. Drawing a random sample under SRSWOR design from a given population and estimation of the mean (total) and standard error of the estimator.
05. Estimation of the proportion and the standard error of the estimator based on a random sample under SRSWR and SRSWOR designs.
06. Estimation of the mean (total) and the standard error of the estimator under stratified random sampling.
07-08. Allocation problems under stratified random sampling comparison of the precisions of the estimators under stratified random sampling with proportional allocation and optimum allocation and that under unstratified random sampling
09. Estimation of the gain in precision due to stratification.
10-11. Listing all possible linear systematic samples from a given population and computation of the intra-class correlation coefficient. Comparison of the precisions of the estimators under systematic sampling with those under SRSWOR. Drawing a systematic sampling and estimation of the mean and standard error of the estimator.
12-13. Analysis of one-way and two-way classified data.
14. Analysis of three-way classified data.
15-17. Analysis of CRD, RBD and LSD.
18-19. Missing plot technique: RBD and LSD – single value missing and two values missing.

References

01. Murthy, M.N. (1967): "Sampling Theory and Methods", Statistical Publishing Society, Calcutta.
02. Sukhatme (1984): "Sampling Theory of Surveys with Applications", Indian Society of Agricultural Statistics, New Delhi.
03. Cochran, W.G. (1984): "Sampling Techniques", 3rd Edition, Wiley Eastern.
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05. Singh, D and Chaudhary, F.S. (1986): "Theory and Analysis of Sample Survey Designs". Wiley Eastern.
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09. Goon, A.K., Gupta, M.K. and Dasgupta, B.(1986): "Fundamentals of Statistics", Vol – II, World Press, Calcutta.
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11. Das, M.N. and Giri, N.C.(1979): "Design and Analysis of Experiments", Wiley Eastern.

Theory Paper – VIII **Applied Statistics & Operations Research**

A: Applied Statistics

Economic Statistics: Index numbers, meaning and uses, selection of items to be included, choice of the base, mathematical formulae for computation of index numbers – based on arithmetic mean, Laspeyres , Paasche, Marshall-Edgeworth, Fisher's ideal index number, Weighted group index number. Time reversal, Factor reversal and circular tests, cost of living (consumer price) index numbers.

Time Series Analysis: Components of time series, measurement of trend, seasonal variation and cyclical variation. (20h)

B: Operations Research

Operations Research: Nature, scope and models.

Linear Programming Problems (LPP): Formulation of problems . Solution – graphical method, simplex algorithm (without proof) and Charne's method (without proof). Balanced Transportation Problems – starting solution, North-West corner rule and Vogel's method. Stepping stone algorithm using U-V method (no proof) – non-degenerate case only. Assignment problems – Hungarian algorithm (no proof).

Inventory Models: Basis concepts, economic lot size model for the case of known uniform demand and instantaneous procurement – extension to the case of shortages allowed (proof under continuity assumptions only).

Network models: PERT and CPM.
Game Theory: Zero-sum-two-person games, games with saddle points, mixed strategy, solution by graphical method for 2Xn and nX2 games.
Sequencing models. (40h)

Practical – VIII

01.Computation of index numbers using Laspeyre's, Paasche's, Marshall-Edgeworth and Fisher's formulae.
02.Computation of weighted index numbers, cost of living index numbers.
03.Determination of trend by moving average method and seasonal variation by ratio to moving average method.
04.Graphical representation of a L.P.P. with two variables – Maximization and Minimization Problems.
05.Graphical representation of a L.P.P. with two variables – problem with many optimal solutions, problem with unbounded solutions, problem with no feasible solution.
06.Solution of L.P.P. involving slack variables only – Simplex algorithm.
07.Charne's Big M-method – solution of a maximization problem.
08.(i) Charne's Big M-method – problem with no feasible solution.
(ii)Simples algorithm – problem with unbounded solution.

09.Solving Transportation problem by choosing initial solution by North-West corner rule.
10.Solving Transportation problem by choosing initial solution by Vogel's method.
11.Solving Assignment problems.
12. PERT and CPM.
13. Problems on Game Theory.
14. Sequencing problems.

References

01.S.C.Gupta and V.K.Kapoor (1976): "Fundamental of Applied Statistics", Sultan Chand and Sons, New Delhi.
02.R.R.Umarji (1962): "Probability and Statistical methods", 2nd Edition, Asia Publishing House. Bombay.
03.Kantiswarup, P.K., Gupta and Manmohan (1990): "Operations Research", 5th Edition, Sultan Chand and Sons, New Delhi.
04.A.Taha (1999): "Operations Research – An Illustration",6th Edition, Macmillan Co., New York.
05.M.Sasieni, A.Yaspan and L.Friedman (1959): "Operations Research – Methods & Problems", Wiley, New York.
06.F.S.Hillier and G.J.Libermann: "Introduction to Operations Research", 5th Edition, Sultan Chand and Sons, New Delhi.

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