Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Name of the Faculty: Science & Technology

CHOICE BASED CREDIT SYSTEM

Syllabus: BIOSTATISTICS

Name of the Course: M.Sc. I (Sem.– I & II)
(Syllabus to be implemented from w.e.f. June 2019)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

Syllabus of M.Sc. I (Biostatistics)

1) **Title of the course:** M.Sc. (Biostatistics).
2) **Duration of course**: Two years.
3) **Pattern:** Semester and Credit system.
4) **Eligibility:**

Any Science graduate/ B.E./B.Tech. / BCA / BCS having Mathematics at HSC level.

5) Strength of the Students: 20

M. Sc. program in Biostatistics consists of 100 credits. Credits of a course are specified against the title of the course.

A Four Semester M.Sc. Biostatistics Course

Semester	No. of Papers/ Practicals / Seminar	Marks	Credits
Semester I			
• Theory Papers	04	400	16
• Practical Paper	04	200	08
• Seminar/Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester II			
• Theory Papers	04	400	16
• Practical Paper	04	200	08
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester III			
• Theory papers	04	400	16
• Practical Paper	04	200	08
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Semester IV			
• Theory papers	04	400	16
• Practical Paper	04	200	08
• Seminar/ Tutorial/Home Assignment /Field Tour/ Industrial Visit	01	25	01
Total marks and credits for M.Sc. Course		**2500**	**100**

Semester	Code	Title of the Paper	Semester Examination			L	T	P	Credits
			Theory	IA	Total				
Sem-I		**Hard Core**							
	HCT1.1	Introduction to Biostatistics	70	30	100	4	--	--	4
	HCT1.2	Design of Sample Surveys	70	30	100	4	--	--	4
	HCT1.3	Probability and distributions	70	30	100	4	--	--	4
		Soft Core (Any one)							
	SCT1.1	Data Analysis using Software	70	30	100	4	--	--	4
	SCT1.2	Introduction to Ecology	70	30	100	4	--	--	4
		Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
	HCP1.1	Statistical Data Analysis Using MS-Excel	35	15	50	--	--	03	2
	HCP1.2	Statistical Data Analysis Using SPSS	35	15	50	--	--	03	2
	HCP1.3	Statistical Data Analysis Using R	35	15	50	--	--	03	2
	HCP1.4	Statistical Data Analysis Using Minitab/Matlab	35	15	50	--	--	03	2
		Total for Semester-I	**420**	**205**	**625**	--	--	--	**25**
Sem-II		**Hard Core**							
	HCT2.1	Introduction to Basic Epidemiology	70	30	100	4	--	--	4
	HCT2.2	Statistical Inference-I	70	30	100	4	--	--	4
		Soft Core (Any one)							
	SCT2.1	Linear Algebra and Regression Techniques	70	30	100	4	--	--	4
	SCT2.2	Introduction to Statistical Genetics	70	30	100	4	--	--	4
		Open Elective(Any one)							
	OET2.1	Vital Statistics	70	30	100	4	--	--	4
	OET2.2	Statistical Methods	70	30	100	4	--	--	4
	HCT2.3	Communicate in English Confidently	55	20	75	3	-	1	3
		Seminar/Tutorial/ Industrial Visit/ Field Tour	---	25	25	--	1	--	1
	HCP2.1	Statistical Data Analysis Using MS-Excel/ SPSS	35	15	50	--	--	03	2
	HCP2.2	Statistical Data Analysis Using R	35	15	50	--	--	03	2
	HCP2.3	Statistical Data Analysis Using Minitab/Matlab	35	15	50	--	--	03	2
	OEP2.1	Practicals based on OET	35	15	50	--	--	03	2
		Total for Semester-II	**420**	**205**	**625**	--	--	--	**25**

HCT=Hard Core Theory   HCP=Hard Core Practical   SCT=Soft Core Theory
OET=Open Elective Theory   IA=Internal Assessment
L=Lecture   T=Tutorials   P=Practical

Evaluation Scheme:

Each theory paper will have 100 marks out of which 70 marks will be for Term End examination and 30 marks for Internal Assessment. The candidate has to appear for internal evaluation of 30 marks and external evaluation (University Examination) of 70 marks for each theory paper.

Each practical paper will have 50 marks out of which 35 marks will be for Term End examination and 15 marks for Internal Assessment. The candidate has to appear for internal evaluation of 15 marks and external evaluation (University Examination) of 35 marks for each practical paper.

Internal Evaluation:

- In case of theory papers internal examinations will be conducted by department / school.

- In case of practical papers, 5 marks shall be for day-to-day journal and 10 marks shall be for internal test, which will be conducted by the department / school.

External Evaluation (End of Term University Examination):

I) Nature of Theory question paper:

    1) Each Theory paper is of 70 marks.

    2) Each Theory paper will be of 2 hours and 30 minutes duration

    3) There shall be 5 questions each carrying 14 marks.

    4) Students have to attempt all the questions.

II) Nature of Practical question paper: (End of Term Examination)

Practical examination will be conducted for 30 marks and is of two hours duration. There shall be 05 questions each of 10 marks, of which student has to attempt any 03 questions. VIVA will be for 5 marks.

Semester I

HCT1.1

Introduction to Biostatistics

Unit I: Data Sources, Types of data: Quantitative and qualitative. Scales of measurement. Data classification: Individual data, grouped and ungrouped data Presentation of data: Tabular and graphical. Pie chart, Histogram, frequency curve, bar diagram, multiple bar diagram, stem and leaf chart, pictogram. **(15 L)**

Unit II: Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode for. Examples and problems.

Measures of dispersion: range, quartile deviation, variance, standard deviation, coefficient of variation, skewness and kurtosis. Examples and problems. **(15 L)**

Unit III: Scatter diagram, Idea of correlation, types of correlation, Spearman's rank correlation coefficient: with and without ties. Regression, Lines of regression, regression coefficients, relation between regression coefficients and correlation coefficient. **(15 L)**

Unit IV: Concepts of attributes, Notation, Classification dichotomy, class frequency, order of classes, positive and negative class frequencies, ultimate class frequencies, relation between class frequencies, consistency of attributes, (three attributes) Independence and association of two attributes, Yule's coefficient of association Q. Coefficient of colligation Y. Relation between them and problems. **(15 L)**

References
1. Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publications, New Delhi : Gupta S.C. and Kapoor
2. Fundamentals of Biostatistics, Kanishka Publishers: Dutta, N. K.
3. Statistical Methods: Gupta S. P
4. Fundamentals of Statistics Vol. I and II, World Press, Calcutta: Goon, Gupta and Dasgupta

HCT1.2
Design of Sample Surveys

Unit I: . Concepts of population and sample, need for sampling, census and sample surveys, designing of a questionnaire, sampling and non-sampling errors.   **(15 L)**

Unit II: Types of sampling: Probability and non-probability sampling. Simple random sampling with and without replacement, stratified sampling, systematic sampling, cluster sampling, two-stage sampling, multistage sampling, multiphase sampling. Examples based on biostatistical experiments.   **(15 L)**

Unit III: Non-probability sampling: Incidental sampling, quota sampling, purposive sampling, snowball sampling, convenience sampling, consecutive sampling. Examples based on biostatistical experiments.   **(15 L)**

Unit IV: Sample size determination, estimation of mean, proportion. Comparison of two sample means and two proportions. Estimation of correlation coefficient.

(15 L)

References
1. Fundamentals of Applied Statistics: Gupta and Kapoor
2. Theory and Methods of Survey Sampling 2nd Edition.: Parimal Mukhopadhyay
3. Sampling Techniques. Wiley : Cochran, W.G. (2002).
4. Sampling Theory of Surveys with Applications, Indian Society Agricultural Statistics, New Delhi : Sukhatme, P.V. and Sukhatme, B.V.

HCT1.3

Probability and Probability Distributions

Unit-I: Probability theory: Sample space, Axioms of probability theory. Conditional probability, independent events. Baye's theorem, Examples. **(15 L)**

Unit-II: Discrete Probability Distributions: Definition of a discrete random variable, Probability mass functions and probability distribution functions, Bernoulli trials and related distributions, Poisson distribution, Discrete Uniform distribution, geometric distribution, Expectation and moments and their evaluation, Examples. **(15 L)**

Unit-III: Continuous Probability Distributions: Definition of a continuous random variable, Probability density function. Expectation and moments and their evaluation, uniform, exponential and gamma distributions, normal distribution. Distribution of functions of a continuous random variable, Examples. **(15 L)**

Unit-IV: Bivariate distributions: Discrete bivariate distributions, continuous bivariate distributions. Covariance and correlation. Conditional distribution and conditional mean, Bivariate normal distribution, Examples. **(15 L)**

References
1. An Introduction to Probability and Statistics, John Wiley & Sons. Rohatgi, V.K.& Saleh, A.K.Md.
2. Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publications, New Delhi : Gupta S.C. and Kapoor
3. Schaum's Outlines-Statistics, 4th edition : Murray R Spiegel & Larry J Stephens.
4. Mathematical Statistics: Parimal Mukhopadhyay
5. A First Course in Probability , 9th edition : Sheldon M Ross

SCT1.1

Data Analysis using Software

Unit I: Basics of computer. Need of statistical software for data analysis. Types of software.

Introduction to MS-Excel: Data entry using MS-Excel. Graphical and statistical analysis of data. Identifying relevant outcomes from the output generated by the software. Interpretation of results. Merits and demerits of software. **(15 L)**

Unit II: Introduction to SPSS: Data entry using SPSS. Graphical and statistical analysis of data. Import and export of data. Identifying relevant outcomes from the output generated by the software. Interpretation of results. Merits and demerits of software. **(15 L)**

Unit III: Introduction to R-Programming: Data entry using R. Graphical and statistical analysis of data. Import and export of data. Identifying relevant outcomes from the output generated by the software. Interpretation of results. Merits and demerits of software. **(15 L)**

Unit IV: Introduction to Minitab: Data entry using Minitab. Graphical and statistical analysis of data. Identifying relevant outcomes from the output generated by the software. Interpretation of results. Merits and demerits of software. Introduction to Matlab. **(15 L)**

References
1. Microsoft Excel 2019 Data Analysis and Business Modeling (6th Edition) by Wayne Winston (Author)
2. Computer Systems and Applications, Himalaya Publishing House: Rustum Sroff
3. SPSS for windows step by step: Darren George Paul Mallery
4. SPSS for Beginners : Vijay Gupta
5. Minitab Guide McGraw Hill Higher Education : Kilman Shin
6. Statistics and Probability with R CRC Press : Ugarte and Militino

SCT1.2

Introduction to Ecology

Unit I: Introduction to ecology and evolution, population dynamics: single species Exponential, Logistic and Gompertz models, Leslie matrix model for age and stage Structured population, survivorship curves-Constant, monotone and bath tub shaped hazard rates. **(15 L)**

Unit II: Two Species: Lotka-Volterra equations, isoclines. Abundance estimation: Capture –recapture, Nearest Neighbor, line transect sampling, indirect methods. Ecological Diversity: Species abundance curve, indices of diversity (Simpson's index, Shannon Wiener index). **(15 L)**

Unit III: Game Theory in Ecology - Evolutionarily stable strategy, its properties, simple games such as Hawk-Dove game, Prisoner's dilemma, etc. Preservation of ecology and biodiversity. **(15 L)**

Unit IV: Statistics for Ecology- Analysis of variance: basic assumptions and its violations, one and two way classified data. Multivariate analysis: discriminant analysis, hypothesis testing. **(15 L)**

References
1. A Course in Mathematical And Statistical Ecology: Anil Gore & Sharayu Paranjpe (2001), Kluwer academic Publishers.

Practical Papers

HCP1.1: At least ten practicals based on papers HCT1.1, HCT1.2, HCT 1.3. Practicals should be carried out manually or using MS-Excel.

HCP1.2 : At least ten practicals based on papers HCT1.1, HCT1.2, HCT 1.3. Practicals should be carried out using SPSS.

HCP1.3 : At least ten practicals based on papers HCT1.1, HCT1.2, HCT 1.3. Practicals should be carried out using R-programming.

HCP1.4: At least ten practicals based on papers HCT1.1, HCT1.2, HCT 1.3. Practicals should be carried out using Minitab/Matlab.

Semester-II

HCT2.1

Introduction to Basic Epidemiology

Unit I: Basic concepts and ethics of epidemiology, Measures of exposure and outcome: History of Epidemiology, Emergence of modern epidemiology, Measures of Exposures, Types of exposures, Sources of exposures, Measures of outcome. Measures of exposure effect, relative and absolute measures of effect. Communicable and non-communicable diseases. **(15 L)**

Unit II: Disease registries, International classification of diseases. Measures of disease frequency: Prevalence, Incidence, Risk, Odds of disease, Incidence time, Relationship between prevalence, rate and risk, measures of disease occurrence, direct and indirect method of standardization, cumulative rate, cumulative risk, proportional incidence. Confidence intervals and significance tests for measures of occurrence and effect **(15 L)**

Unit III: Type of study design: Observational study, Intervention studies, Cohort studies, case-control studies, cross-sectional studies, ecological studies, Prospective and retrospective study. **(15 L)**

Unit IV: Validity and reliability of measures of exposure and outcome: Sensitivity, Specificity, positive predictive value and negative predictive value, Intra and Inter-observer reliability, Kappa statistic. **(15 L)**

References
1. Fundamentals of Epodemology and Biostatistics: Deepti Shyam Sunder (2019), CBS Publishers & Distributors.
2. Epidemiological Studies: Alan J. Silman, Cambridge University Press

HCT2.2

Statistical Inference-I

Unit I: Basic concepts and properties of estimators: Parametric models, parameters, random sample and its likelihood, statistic and its sampling distribution, problem of inference, estimator and estimate, mean square error (MSE).   **(15 L)**

Unit II: Properties of estimators : unbiasedness, consistency, efficiency. Methods of estimation: Fisher information, complete and sufficient statistic, Basics of MLE, MVUE.   **(15 L)**

Unit III: Interval estimation: concepts of confidence interval, confidence coefficient, confidence interval for the parameters of univariate normal, proportion, mean, difference of means. Small sample and large sample confidence intervals. Large sample confidence intervals for binomial and Poisson parameters, bootstrap methods.

(15 L)

Unit IV: Concept of testing of hypothesis, simple hypothesis, composite hypothesis, null and alternative hypothesis, test statistics, level of significance, critical region, type-I error, type-II error, power of test, power function. Examples.   **(15 L)**

References
1. An Introduction to Probability and Statistics, John Wiley & Sons : Rohatgi, V.K.& Saleh, A.K.Md.
2. Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publications, New Delhi : Gupta S.C. and Kapoor
3. Statistical Inference : Theory of estimation: Shrivastav, Khan & Srivastav
4. Statistical Inference : Testing of Hypothesis: Shrivastav & Srivastav

SCT2.1

Linear Algebra and Regression Techniques

Unit I: Linear Algebra: Set operations, vectors and matrices, matrix operations, determinants, inverse of a square matrix; Applications, Linear independence and rank of a matrix. Linear equations. **(15 L)**

Unit II: Analysis of Bivariate data: Scatter diagram, Principle of least squares; Karl Pearson's correlation coefficient; coefficient of determination; correlation ratio; rank correlation; partial and multiple correlations, Linear regression, Simple linear regression, multiple regression, fit of polynomials and use of orthogonal polynomials. Residuals and their plots, tests for departure from assumptions such as fitness of the model, normality. **(15 L)**

Unit III: Generalized linear models, analysis of binary and grouped data by using logistic models, large sample tests about parameters, goodness of fit, analysis of deviance, variable selection. **(15 L)**

Unit IV: Introduction to Poisson regression, log-linear models, Random and mixed effect models, Nonparametric regression and generalized linear models. **(15 L)**

References
1. Schaum's Outline: Linear Algebra, 3rd edition:Seymour Lipschutz & Marc Lipson
2. Introduction to Linear Regression Analysis: Douglas C. Montogomery.
3. Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publications, New Delhi : Gupta S.C. and Kapoor
4. Regression Analysis by Examples: Samprit Chatterjee & Hadi

SCT2.2

Introduction to Statistical Genetics

Unit I: Basic biological concepts in genetics, Mendel's law, Hardy Weinberg equilibrium, estimation of allele frequency (dominant/co-dominant cases), Approach to equilibrium for X-linked gene. The law of natural selection, mutation, genetic drift.

(15 L)

Unit II: Non-random mating ,inbreeding, phenotypic assortative mating. I ,T,O matrices, identity by descent. **(15 L)**

Unit III: Family data-estimation of segregation ratio under ascertainment bias, pedigree data : Elston - Stewart algorithm for calculation of likelihoods. Linkage, estimation of re-combination fraction, inheritance of quantitative traits. **(15 L)**

Unit IV: Population Genetics: Random mating, genetical variance and correlations, multiple alleles and blood types, maximum likelihood method of estimation, Sex linked genes, Autopolyploid. **(15 L)**

References
1. Preventive Genetics: Sharad Gogate, JAYPEE Publishers.
2. Statistical Analysis of Quantitative Genetics: B. L. Agarwal and S.P.Agarwal, New Age International Publishers

OET2.1

Vital Statistics

Unit-I: Sources of demographic data, census, registration, ad—hoc surveys, Hospital records, Demographic profiles of the Indian Census. **(15 L)**

Unit-II: Complete life table and its main features, Uses of life table. Population pyramid. Makehams and Gompertz curves. National life tables. UIT model life tables. Abridged life tables. **(15 L)**

Unit-III: Stable and stationary populations. Measurement of Fertility: Crude birth rate, General fertility rate, Age specific birth rate, Total fertility rate, Gross reproduction rate, Net reproduction rate. Measurement of Mortality Crude death rate. Standardized death rates, Age—specific death rates. Infant Mortality rate, Death rate by cause. **(15 L)**

Unit-IV: Internal migration and its measurement, migration models, concept of international migration. Net migration. International and postcensal estimates. Projection method including logistic curve fitting. Decennial population census in India.. **(15 L)**

References
1. Fundamentals of Applied Statistics: Gupta & Kapoor.
2. Demographic Analysis : Pressat R. & Atherton A. (1972).

OET2.2
Statistical Methods

Unit-I: Descriptive Statistics: Measures of central tendency, arithmetic mean, geometric mean, harmonic mean, median and mode for grouped and ungrouped data with examples. Measures of dispersion, range, quartile deviation, variance, standard deviation, coefficient of variation, skewness and kurtosis. Examples and problems.

(15 L)

Unit-II: Correlation and regression: Scatter diagram, Karl Pearson's coefficient of correlation, rank correlation, regression, lines of regression, regression coefficients, fitting of regression lines. Examples and problems. **(15 L)**

Unit-III: Probability and Probability distributions: Random experiment, Trial, Sample space, Sample point and different types of events. Classical definition of Probability, addition and multiplication rules. Random variable (discrete and continuous) and its probability distribution. Probability mass function and Probability density function. Bernoulli, Binomial, Poisson, Uniform, Exponential and Normal distributions, their means and variances.

(15 L)

Unit-IV: Testing of hypothesis: Notion of hypothesis, null and alternative hypothesis, simple and composite hypothesis, test statistic, critical region, idea of one and two tailed test, type-I and type-II errors, level of significance, Hypothesis testing for mean and proportion. Hypothesis testing for difference of two means and two proportions. chi-square test for independence of attributes, Nonparametric run test, sign test and signed-rank test.

(15 L)

References
1. Gupta S.C. and Kapoor V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & Sons Publications, New Delhi.
2. Kapoor J.N and Saxana H.C : Mathematical Statistics, Sultan Chand & sons Publications, New Delhi
3. Kulkarni M.B., Gore A.P. and Ghatpande S.B.: Statistical Tests, Satyajeet Prakashan, Pune.

Practical Papers

HCP2.1: At least ten practicals based on papers HCT2.1, HCT2.2, SCT2.1/SCT2.2. Practicals should be carried out manually or using MS-Excel/ SPSS.

HCP2.2 : At least ten practicals based on papers HCT2.1, HCT2.2, SCT2.1/SCT2.2.. Practicals should be carried out using R-programming.

HCP2.3 : At least ten practicals based on papers HCT2.1, HCT2.2, SCT2.1/SCT2.2.. Practicals should be carried out using Minitab/Matlab.

OEP2.1: At least ten practicals based on papers OET2.1/OET2.2.