P.G. Diploma (Biostatistics)

DEPARTMENT OF EPIDEMIOLOGY AND BIOSTATISTICS
KAHER, BELAGAVI.

Contents

Mission

"To strengthen research in each and every KLE constituent units,
And
Sensitize faculty for Quality Research Culture of Internationally established standards"

Preamble

Biological sciences have very large variability, and it is difficult to understand completely all the parameters contributing for the event under study. In this situation applied statistics, as a science, has a great role to play for identifying the variables and their contributions in health and disease.

Statistics has been responsible for accelerating progress in all applied sciences by defining the correct methods of planning, collecting, analyzing and interpreting data for establishing cause and effect relationship.

No science can be learned or progress without continuous updates, hence collecting meaningful information, organizing information, and interpretation of the process and its outcome, is always the necessity of all applied sciences, so the applied statistics does not need introduction.

Department of Epidemiology and Biostatistics

The Department of Epidemiology and Biostatistics is aimed to help in meeting the mandatory need of teaching and research of applied statistics in various Graduate, Post Graduate, Post P.G. and Ph.D. Courses offered by KLEs J. N. Medical College, Belagavi, KLEs V.K. Institute of Dental Science, Belagavi, KLEs College of Pharmacy, Bangalore, KLEs College of Pharmacy, Belagavi, KLEs College of Pharmacy, Hubli, KLEs Institute of Physiotherapy, Belagavi, KLEs Institute of Nursing, Belagavi, and KLEs BMK Ayurveda College of Belagavi.

Department of Epidemiology and Biostatistics has been offering the following courses with required qualification from academic year 2014:

- ✓ B. Sc. Biostatistics & Population Sciences (3 Years) – 12th Standard (Pre-University) with Statistics or Mathematics, Biology alongwith Mathematics are also eligible.
- ✓ M.Sc. in Biostatistics (2 Years) – Three years graduate degree with statistics or mathematics,
- ✓ M. Sc. in Population Studies (2 Years) (Hybrid Mode – Offline & Online) - Three years graduate degree in any subject with Statistics/ Mathematics or graduates in Health Science subjects including Nursing and Pharmacy.
- ✓ Ph.D. in Biostatistics – Candidates with Post Graduation in Statistics or Mathematics from a recognised University.

Other Courses

- ✓ Certificate Course in Biostatistics (Hybrid Mode – Offline & Online) – designed to meet the research need of Research Scholars and faculty.
- ✓ P.G. Diploma in Biostatistics (Hybrid Mode – Offline & Online) - Medical and Allied subject graduates interested to pursue research career, with at list one paper in Statistics at Graduation level or Certificate in Biostatistics from any University.
- ✓ Intensive Course in Biostatistics & Research Methodology (Regular 4 Weeks/Part Time 6 Weeks, through contact teaching modules) – This is a skill enhancement course, and can be attended by any graduate desirous to develop research aptitude.

Its faculty with necessary knowledge and skills to deal with statistical analyses in applied research, and to train in quantitative analysis, along with risk managerial skills in their field of interest is well equipped. Substantial facilities are available for higher education.

P.G. Diploma (Biostatistics)

The syllabus of the P.G. Diploma (Biostatistics) course, besides compulsory background courses and courses of general interest, includes a variety of subjects in the field of statistics - theoretical and applied - as subjects of interest in Public Health, Medicine, Pharmacy and Physiotherapy. The P.G. Diploma (Biostatistics) course will provide trained manpower, for the sectors needing to churn data for decision making.

What will they learn

The students will gain specialized knowledge and skills required to teach subject matter, and design, monitor and manage research in medical and allied fields.

Careers in Health and Medicine's Teaching and Research

Internationally and nationally the demand for trained Biostatisticians far exceeds the availability. Furthermore, the course adds value to medical practice, healthcare and research.

Eligibility for P.G. Diploma (Biostatistics)

Graduates/ Interns / Post Graduates and PhD in Medical Health Sciences with minimum 50 percent marks for general category, and 45 percent for SC, ST and OBC will qualify for admission to P.G. Diploma (Biostatistics) course.

OR

Graduates in Pharmaceutical/ Pre & Paramedical/ Life sciences and Public Health /Interdisciplinary and Allied Health Sciences with a paper in Statistics/ Mathematics from any recognized University with minimum 50 percent marks for general category, and 45 percent for SC, ST and OBC will qualify for admission to P.G. Diploma (Biostatistics) course.

Total Intake – 20

Selection Procedure

The selection of students will be by: Personal interview

Evaluation and Teaching Schedule

The course will include theory classes followed by practical assignments comprised of two semesters of one-year duration for regular students (Hybrid Mode). The practical assignments will be evaluated for Internal Assessment marks. Average marks obtained in practical assignments, and an examination as replica of final examination before final examination, in each semester will be the Internal Assessment marks.

Students will also be the members of consultancy teams for data preparation for cleaning, analysis and interpretation of thesis/dissertation data of Research Scholars.

Attendance

Students are expected to have 80% of total attendance in theory and practical's. However, students will be expected to cover missed theory and practical classes, giving extra time after discussing with the concerned teacher.

Medium of instruction: English

Course Fees: As per University norms

Duration of course

One year of two Semesters comprising four papers each for regular students (Hybrid Mode – Offline and Online).

Mode of Online Teaching: Online teaching will be through

1) Live online classes and (Imparts)
2) Healthy group discussions and debates (LMS)

Mode of Offline Teaching: In each semester, Two-week offline teaching will be conducted in the department of Epidemiology and Biostatistics for exposure of contents, concept of subjects and hands on training. Student's attendance should not be less than 85% for each paper (subject), appearing for the University Examination. Failing to which student has to reappear for the same semester.

Examination pattern:

Theory				
Type of questions	**No. of questions**	**Questions to be answered**	**Marks per question**	**Total marks**
Long Essay	03	02	20	2 x 20=40
Short answer	07	05	08	5 x 08=40
Sub Total: 8 papers of 80 marks each (8 x 80=640)				640
Theory's Internal assessment (8 x 20=160)				160
Practical				
Details/ semester	1st		2nd	Total
Practical	50		50	160

Viva-voce	30	30	
Internal/ assessment	20	20	40
G. Total			**1000**

- In Internal assessment 35% marks are essential to appear for University Examinations
- For Practical one external and one internal examiner are essential.

Evaluation

- Minimum of 50% marks in theory, Oral examination and Internal Assessment put together shall qualify to pass the P.G. Diploma in Biostatistics.

Results

Candidate, who scores less than 50% of the total marks in an individual subject, has to reappear for the same subject, in subsequent examination conducted by the University.

Fifty percent clearing of papers for promotion to next semester is mandatory, however, in next semester all backlogs must be cleared (for distance education 4 semesters of two papers each).

- Class shall be awarded as per University rules

Class	**Percent marks**
A+	90% and above
A	75% and above but less than 90%
B	60% and above but less than 75%
C	50% and above but less than 60 %

<u>Year one</u>

Semester – I
(Regular Students), for distance learning (1st & 2nd Semesters-Two papers each)

Papers-(1-4): Basic Statistics, Probability Theory, Sampling Techniques and Methods in Statistical Inference.		
1	Basic Statistics	Students will gain sufficient knowledge in using these methods in Health and Disease, their necessity and interpretation using Computers/ Softwares, including concepts.
2	Probability theory	Students will gain sufficient knowledge in using Probability theory in health and disease, their necessity and interpretation using Computers/ Software.

3	Sampling techniques	Students will be equipped with sufficient knowledge and skills to plan appropriate sampling plan for different type of studies and to suggest necessary statistical methods for estimation of population parameters.
4	Methods in statistical Inference	Students will be equipped with sufficient knowledge and skills to suggest the path of causation and necessary modifications for further studies.

Paper 1: Basic Statistics		
1.1	**Types of Data** Concepts of a Statistical Population and Sample from a Population, Qualitative and Quantitative Data, Nominal and Ordinal Data, Cross Sectional and Time Series Data, Discrete and Continuous Data, Frequency and Non- Frequency Data. Different Types of Scales - Nominal, Ordinal, Ratio and Interval. **Collection and Scrutiny of Data** Primary data - Designing a Questionnaire and a Schedule, checking their Consistency. Secondary data - its major sources including some Government Publications. Complete Enumeration, Controlled Experiments, Observational Studies and Sample Surveys. Scrutiny of Data for Internal Consistency and Detection of Errors of Recording. Ideas of Cross-Validation, Logical Errors.	(12L+3P)
1.2	**Presentation of Data** Construction of tables with one or more factors of classification. Diagrammatic and Graphical Representation of grouped data. Frequency Distributions, Cumulative Frequency Distributions and their Graphical Representation, Histogram, Frequency Polygon, Frequency Curve, ogives, Box plot, and Population Pyramid.	(12L+3P)
1.3	**Analysis of Quantitative Data** Univariate data-Concepts of Central Tendency, Location. Dispersion and Relative Dispersion, Skewness and Kurtosis, and their Measures including those based on Quantiles and Moments.	(12L+3P)
1.4	**Analysis of Categorical Data** Consistency of categorical data. Independence and Association of attributes. Various measures of Association for two - three-way classified data. Odds ratio. Relative Risk	(12L+3P)

References

1. Bhat B.R, Srivenkatramana T and Rao Madhava K.S.(1996): Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
2. Croxton F.E, Cowden D.J and Kelin S (1973): Applied General Statistics, Prentice Hall of India.
3. Goon A.M., Gupta M.K., Das Gupta.B. (1991): Fundamentals of Statistics, Vol.I, World Press, Calcutta.
4. Medical Statistics: Principle and Methods, S. N. Dwivedi & V. Sreenivas K. R. Sundaram, Publisher: B.I. Publications Pvt. Limited, 2009, ISBN: 8172253192, 9788172253196
5. Introduction to Biostatistics and Research Methods, V Edition, By RAO, P. S. S. Sundar, Richard, J.PHI Learning Private Limited © 2011, Email: phi@phindia.com

Additional references

1. Anderson T.W and Sclove S.L (1978) An Introduction to the Statistical Analysis of Data, Houghton Miffin\Co.
2. Cooke, Cramer and Clarke (): Basic Statistical Computing, Chapman and Hall.
3. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
4. Snedecor G.W and Cochran W. G. (1967): Statistical Methods. Iowa State University Press.
5. Spiegel, M. R. (1967): Theory & Problems of Statistics, Schaum's Publishing Series.
6. A.P. Gore and S.A. Paranjpe (2000) : A Course in Mathematical & Statistical Ecology,

Suggested readings

1. Armitage, P., Statistical Methods in Medical Research, London, Blackwell Scientific Publications, 1989.
2. Hill, A.B., Principles of Medical Statistics, London, Edward Arnold, 1981.
3. Altman, D.G., Practical Statistics for Medical Research, London, Chapman and Hall, 1992.

Paper 2 - Probability Theory		
2.1	**Important Concepts in Probability** Definition of Probability - Classical and Relative Frequency Approach to Probability, Cramer and Kolmogorov's Approaches to Probability, Merits and Demerits of these Approaches (only general ideas to be given). **Random Experiment** Trial, Sample Point and Sample Space, Definition of an Event, Operation of Events, Mutually Exclusive and Exhaustive Events. Discrete Sample Space, Properties of Probability based on Axiomatic Approach, Conditional Probability, Independence of Events.	**12L+3P**

2.2	Bayes' Theorem and its Applications. Random Variables, Definition of Discrete Random Variables, Probability Mass Function, Idea of Continuous Random Variable, Probability Density Function, Illustrations of Random Variables and its Properties. Expectation of a Random Variable and its Properties - Moments, Measures Of Location, Dispersion, Skewness And Kurtosis, Probability Generating Function (if it exists), their Properties and Uses.	**12L+3P**
2.3	Standard Univariate Discrete Distributions and their properties: Discrete Uniform, Binomial, Poisson, Hypergeometric, and Negative Binomial Distributions.	**12L+3P**
2.4	Continuous Univariate Distributions-Normal, Exponential, Bivariate normal Distribution (Including Marginal and Conditional Distributions). Chebyshev's Inequality and Applications, Statements and Applications of Weak Law of Large Numbers and Central Limit Theorems.	**12L+3P**

References

1. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997): Statistics: A Beginner's Text, Vol. II, New Age International (P) Ltd.
2. Edward P.J., Ford J.S.and Lin (1974): Probability for Statistical Decision-Making, Prentice Hall.
3. Goon A.M., Gupta M.K., Das Gupta.B. (1999): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
4. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
5. R.C.Elandt Johnson (1975) : Probability Models & Statistical Methods in Genetics, Wiley, C.C.Li (1976)

Additional references

1. Cooke, Cramer and Clarke (): Basic Statistical Computing, Chapman and Hall.
2. David S (1996): Elementary Probability, Oxford Press.
3. Hoel P.G (1971): Introduction to Mathematical Statistics, Asia Publishing House.
4. Freund J.E (2001): Mathematical Statistics, Prentice Hall of India.
5. Hodges J.L and Lehman E.L (1964): Basic Concepts of Probability and Statistics, Holden Day.
6. Mood A.M, Graybill F.A and Boes D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
7. Berger, J. O. Statistical Decision Theory and Bayesian Analysis, Springer Verlag.
8. Robert C. P. and Casella, G. Monte Carlo Statistical Methods, Springer Verlag.
9. Leonard T. and Hsu, J. S. J. Bayesian Methods. Cambridge University Press.
10. DeGroot M. H. Optimal Statistical Decisions. McGraw Hill.
11. Bernando J. M. and Smith, A. F. M. Bayesian Theory, John Wiley and Sons.
12. Robert, C. P. The Bayesian Choice : A decision Theoretic Motivation, Springer.

Paper 3 - Sampling techniques		
3.1	**Sampling Techniques – Simple Random Sampling** Concepts of Sampling vs. Population, Simple Including Methods of Point and Interval Estimations.	**12L+3P**
3.2	Stratified and Cluster including Methods of Point and Interval Estimations.	**12L+3P**

3.3	Systematic, Multistage, Inverse, Interpenetrating, including Methods of Point and Interval Estimations.	**12L+3P**
3.4	Non-Probability (Quota, Purposive) Sampling Techniques, including Methods of Point and Interval Estimations.	**12L+3P**

References

1. Murthy M.N (1967): Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
2. Sampath S. (2000): Sampling Theory and Methods, Narosa Publishing House.
3. Sukhatme B.V(1984) : Sample Survey methods and Its Applications, Indian Society of Agricultural Statistics.
4. W.G. Cochran, Sampling Techniques, Wiley Eastern Limited, New Deli, Banglore.
5. Mukhopadhyay, Parimal (1996) : Mathematical Statistics. New Central Book Agency Pvt. Ltd., Calcutta.
6. Mukhopadhyay, Parimal (1998) : Theory and Methods of Survey Sampling. Prentice Hall.
7. Chatterjee, S. and Price, P. (1991) : Regression Analysis by example. Second edition. John Wiley & sons.
8. Guide to current Indian Official Statistics. Central Statistical Organisation, Govt. of India, New Delhi.

Paper 4 - Methods in Statistical Inference		
4.1	Sampling from a Distribution: Definition of a Random Sample - Simulating Random Sample from Standard Distributions, Concept of Derived Distributions of a Function of Random Variables, Concept of a Statistic and its Sampling Distribution, Point Estimate of a Parameter. Concept of Bias and Standard Error of an Estimate, Standard Errors of Sample Mean, Sample Proportion.	**12L+3P**
4.2	Sampling Means and Variance in Random Sampling from a Normal Distribution (without Derivation), Statistical Tests and Interval Estimation, Null and Alternative Hypotheses, Types of Errors, p-values, Statement of Chi-square, t, and F statistics. Testing for the Mean and Variance of Univariate Normal Distribution, Testing of Equality of two Means, Testing of Equality of two Variances of two Univariate Normal Distributions and related Confidence Intervals.	**20L+5P**
4.3	Sampling Distribution of Sum of Binomial, Poisson and Mean of Normal Distributions. Testing for the Significance of Sample Correlation Coefficient in Sampling from Bivariate Normal Distribution, Equality of Means and Equality of Variances in Sampling from Bivariate Normal Distributions.	**8L+2P**
4.4	**Large Sample Tests** Use of Central Limit Theorem for Testing and Interval Estimation of a Single Mean and a Single Proportion and Difference of two Means and two Proportions, Fisher's Z Transformation and its uses, Pearson's Chi-Square Test for Goodness of Fit and for Homogeneity for Standard Distributions, Contingency Table and test of Independence in a Contingency Table.	**8L+2P**

References

1. Cochran W.G and Cox G.M (1957): Experimental Designs, John Wiley and Sons.
2. Das M.N and Giri (1986): Design and Analysis of Experiments, Springer Verlag
3. Des Raj (2000): Sample Survey Theory, Narosa Publishing House.
4. Goon A.M.,Gupta M.K., Das Gupta.B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
5. Kempthorne O. (1965): The Design and Analysis of Experiments, Wiley Eastern.
6. N. Krishnan Nambudari, Lewis F. Carter, Hubert M. Blalock, Jr, Applied Multivariate analysis and Experimental and Desgins, McGRAW-HILL Book Company, New Delhi.
7. L. J. Bain and M. Englhardt: Statistical analysis of reliability and life testing models,
8. Marcel Dekker (1991). S. Zacks: Introduction to reliability analysis Probability models and statistical methods.

Semester – II

Papers (5-8): Statistical and Epidemiology Methods, and Demography		
5	Regression Analysis and Multivariate Analysis	Students will be equipped with the Methods for Smoothing, Standardization and Medicine etc. to Practice of Evidence Based Medicine (EBM)
6	Demography	Students will be equipped with sufficient knowledge and skills to plan population based studies and to provide needed information for community benefits and development.
7	Design of Experiments, Non-Parametric Statistics,	Students will be equipped with sufficient knowledge and skills to plan and analyze experimental studies and conclude from these studies. Students will be equipped with sufficient knowledge and skills to analyze and interpret data having small sample size, or not meeting assumptions of parametric tests.
8	Epidemiological Methods and Research Methodology	Students will be equipped with sufficient knowledge and skills to plan population based studies and to provide needed information for standardization of procedures and tools in health and disease.

Semester II

Paper 5 - Correlation, Regression and Multivariate analysis		
5.1	**Correlation and Regression analysis** Bivariate Data, Scatter Diagram, Product Moment Correlation Coefficient and its Properties, Coefficient of Determination, Correlation Ratio. Concepts of Error in Regression, Principle of Least Squares. Fitting of Linear Regression and related results, Fitting of Curves Reducible to Polynomials by Transformation, Rank Correlation — Spearman's and Kendall's Measures.	**10L+2P**
5.2	**Multivariate data** Multiple Regression, Multiple Correlation and Partial Correlation, their Measures and Related Results. **Multivariate analysis** Linear, Path Analysis, Multicollinearity and Homoscedasticity and adjusting for them in Regression Models, including their utility in Health and Disease.	**15L+3P**
5.3	Logistic Regression, Survival Analysis, including their utility in Health and Disease.	**10L+2P**
5.4	Discriminant Analysis, Cluster Analysis, Factor Analysis including their utility in Health and Disease.	**15L+3P**

References

1. Draper, N.R., and Smith, H., Applied Regression Analysis, New York, John Wiley & Sons, 1981.

2. Hand, D.J., and Taylor,C.C., Multivariate Analysis of Variance and Repeated Measures, London, Chapman and Hall, 1987.
3. Maxwell, A.E., Multivariate Analysis in Behavioural Research, London, Chapman and Hall, 1977.
4. McCullagh, P., and Nelder, T.A., Generalized Linear Models, London, Chapman and Hall, 1990.
5. Cochran, W.G., and Cox, G.M. Experimental Designs, Bombay; Asia Publishing House, 1962.
6. D.W.Hosmer & S.Lemeshaw (1989): Applied Logistic Regression Wiley.
7. Chatterjee, S. and Price, P. (1991): Regression Analysis by examples. Second edition. John Wiley & sons.

Paper 6 - Demography		
6.1	Population Censuses World and India, Concepts of Population Evolution, Population Change. Population Structure including Population Trends.	**12L+3P**
6.2	Methods in Population Projections and its utility in Health and Human Resource Management.	**10L+2P**
6.3	Fertility, Mortality.	**15L+3P**
6.4	Education and Occupation, Population Theories, Population Policies including their utility in Health, Human Resource Management.	**12L+3P**

References

1. Murdock S.R., Ellis D.R., Applied Demography: An Introduction for Basic Concepts Methods and Data, Bouldev, Co., West View Press, 1991.
2. United Nations Manual X, Indirect Techniques of Demography Estimation, New York, United Nations Population Division, 1983.
3. Keyfitz N, Applied Mathematical Demography, Second Edition, New York, Springer Verlag, 1985.
4. Brass W, The Relational Gompertz Model of Fertility by Age of Women. World Fertility Survey Data, London, World frtility Survey, 1980.
5. Bongaarts J, Population Policy Options in the Developing World, New York, Population Council, Research Division Working Paper No. 59, 1994.
6. Bongaarts J, Bulatao RA, Completing the Population Transition, New York, Population Council, Research Division Working Paper No. 125, 1999.
7. Singh S.N., M.K.Premi, P.S.Bhatia , Ashish Bose Population transition in India Vol.1 & 2, B.R. Publishing Corporation, Division of D.K Publishers. Distributors (P) Ltd , Delhi 110007,1989.
8. Henry S Shryock, Jacob S Siegel & Associates, The Methods & Material
9. of Demography, U.S. Bureau of the Census, U.S. Government Printing
10. Office, Washington D.C. - Vol I & II, 1980.

Paper 7 - Design of experiments and Non-parametric tests		
7.1	Analysis Of Variance (one/two way), Process of Randomization, Randomized Block Designs, Latin Square Designs including their utility in Health and Experimental Studies in Pharmacy, Physiotherapy etc. Factorial Designs, Incomplete Non-Factorial and Cross-Over Designs including their utility in Health and Experimental Studies in Pharmacy, Physiotherapy etc.	**20L+5P**
7.2	Analysis of Categorical Data, including their utility in Health and Experimental Studies in Pharmacy, Physiotherapy etc.	**8L+2P**
7.3	Non-Parametric Tests Definition of Order Statistics and their Distributions, Fisher's Exact Test, McNemar Test, Non-Parametric Tests, Chi-square (Test, Goodness of Fit, Independence), Power of the Tests. Sign Test for Univariate and Bivariate Distributions, Wilcoxon-Mann-Whitney Test, Run Test, Median Test. Spearman's Rank Correlation Test, Friedman's Two Way ANOVA and Concordance, Cochran Q Test.	**20L+5P**

Design of Experiments

References

1. Montgomery, D.C. (1991): Design and analysis of experiments. John Wiley.
2. Das, M.N. and Giri, N.C. (1979): Design and Analysis of Experiments. Wiley Eastern.
3. Aloke Dey (1986): Theory of Block Designs, Wiley Eastern.
4. Angela Dean and Daniel Voss (1999): Design and Analysis of Experiments, Springer.
5. Das, M.N. and Giri, N.(1979): Design and Analysis of Experiments, Wiley Eastern
6. Giri,N.(1986): Analysis of Variance, South Asian Publishers
7. John, P.W.M.(1971): Statistical Design and Analysis of Experiments, Macmillan
8. Joshi,D.D.(1987): Linear Estimation and Design of Experiments, Wiley Eastern
9. Montgomery,C.D.(1976): Design and Analysis of Experiments, Wiley, New York
10. Myers, R.H..(1971): Response Surface Methodology, Allyn & Bacon
11. Pearce,S.C.(1984): Design of Experiments, Wiley, New York
12. Rao,C.R..and Kleffe, J.(1988): Estimation of Variance Components and applications,North Holland.
13. Searle, S. R., Casella, G. and McCulloch, C. E.. (1992): Variance Components, Wiley.
14. Goon, A.M., Gupta, M.K. & Das Gupta, B. (1986) : Fundamentals of Statistics. Vol-II. World Press, Calcutta
15. Federer, W.T. (1975) : Experimental designs-theory and applications. Oxford & IBH.

None-parametric

References

1. Siegel, S., Non-Parametric Statistics for Behavioural Sciences, New York, McGraw-Hill,1988
2. D.J.Finney (1978) : Statistical Methods in Biological Assays, Charles Griffics & Co.

3. A.P. Gore and S.A. Paranjpe (2000) : A Course in Mathematical & Statistical Ecology,
4. Kluwer.
5. Z.Govindarajulu (2000) : Statistical Techniques in Bioassay, 2nd Edition, S.Karger.
6. D.W.Hosmer & S.Lemeshaw (1989) : Applied Logistic Regression Wiley.
7. R.C.Elandt Johnson (1975) : Probability Models & Statistical Methods in Genetics, Wiley, C.C.Li (1976) :
8. First Course in Population Genetics, Boxwood Press.
9. E.C.Pielou (1977) : An Introduction to Mathmatical Ecology, John Wiley.

Additional References

1. Davison, A.C. and Hinkley, D.V. (1997) : Bootstrap methods and their application, Cambridge University Press.
2. Gibbons, J.D. (1985): Nonparametric statistical inference, 2^{nd ed., Marcel Dekker, Inc.
3. Randles, R.H. and Wolfe, D.A. (1979): Introduction to the theory of nonparametric statistics, John Wiley & Sons, Inc.
4. Fraser, D.A.S. (1957): Nonparametric methods in statistics, John wiley & sons, Inc.
5. Hajek, J. and Sidak, Z. (1967): Theory of rank tests, Academic Press.
6. Puri, M.L. and Sen, P.K. (1971): Nonparametric methods in multivariate analysis, John Wiley & Sons, Inc.
7. Cox, D.R. and Oakes, D. (1983): Survival analysis, Chapman and Hall.

Paper 8 - a. Epidemiological methods and Research methodology		
8.1	Historical prospective of Epidemiology, General Epidemiology, Clinical epidemiology.	**10L+2P**
8.2	Statistical Methods in Epidemiology of Communicable and Non-Communicable Diseases.	**15L+3P**
b. Research methodology		
8.3	**Research Methodology** Concepts and definitions, Formulation of Objectives, Study Designs and including Basic Analytical Methods for their Analysis. Methods of Data Collection, Questionnaire Development and Pre-Testing of Questionnaire, Internal & External Validity of Questions, Study Designs.	**15L+3P**
8.4	Relevant Sampling Techniques, importance of Sample Size, Feasibility, Drawing Conclusions, Critical Appraisal of Published Articles.	**10L+2P**

References

1. Park K., Test Book of Preventive and Social Medicine, Edition 21, 2011.
2. Lilienfed, A.M. and D. Lilienfed, Foundation of epidemiology, 2nd Edition, New York, Oxford Publications, 1979.
3. K. J. Rothman and S. Geenland (ed.) (1998). Modern Epidemiology, Lippincott-Raven.
4. S. Selvin (1996). Statistical Analysis of Epidemiologic Data, Oxford University Press.

5. D. McNeil (1996). Epidemiological Research Methods. Wiley and Sons.
6. J. F. Jekel, J. G. Elmore, D.L. Katz (1996). Epidemiology, Biostatistics and Preventive Medicine. WB Saunders Co.
7. D.J.Finney (1978): Statistical Methods in Biological Assays, Charles Griffics & Co.
8. Kluwer. ,Z.Govindarajulu (2000): Statistical Techniques in Bioassay, 2nd Edition, S.Karger.
9. First Course in Population Genetics, Boxwood Press.
10. Indrayan A, Basic Methods of Medical Research, Third Edition, AITBS Publishers, J-5/6 Krishna Nagar, Delhi – 110051, India
11. Health Research Methodology , A guide for training in research methods,
12. WHO Regional Office for the Western Pacific Manila, 1992.