Course Structure for B.Sc. in Statistics (General) under CBCS

May 2019

Semester	Type	Core	AECC	SEC	DSC
	Credits	12×6 = 72	2×4 = 8	2×4 = 8	4×6 = 24
I		STA –RC – 1016	ENG – AE – 1014		
		YYY –RC – 1016			
		ZZZ –RC – 1016			
II		STA – RC – 2016	ENV– AE – 2014		
		YYY – RC – 2016			
		ZZZ– RC – 2016			
III		STA – RC – 3016		STA - SE – 3XX4	
		YYY – RC – 3016			
		ZZZ – RC – 3016			
IV		STA – RC – 4016		STA - SE – 4XX4	
		YYY – RC – 4016			
		ZZZ – RC – 4016			
V				STA - SE – 4XX4	STA - RE – 5016
					YYY - RE – 5026
					ZZZ - RE – 5036
VI				STA - SE – 5XX4	STA - RE – 6016
					YYY - RE – 6026
					ZZZ - RE – 6036

Total Credit: 110

Legends

RC : Core Papers **from Three Disciplines** **SE :** Skill Enhancement Papers

RE : Discipline Specific Elective Papers **AE :** Ability Enhancement Compulsory Course

X : Semester : Numerical digit for Semester. One of **1**, **2**, **3**, **4**, **5**, or **6**

YY : Serial No of Paper : Two-digit numerical number (within the semester)

XXX : Subject 1 (Core / Primary for Honours / Regular)

YYY : Subject 2

ZZZ : Subject 3

Core Course (12 Papers): 4 Courses from each of the 3 disciplines of choice up to 4th Semester.

DSC (6 Papers): Two papers from each discipline of choice including paper of interdisciplinary nature.

Contents

STA-RC- 1016

Statistical Methods

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

1.1 Theory

1.1.1 Unit 1: *Statistical Data*: (Lectures: 12)

Introduction: Definition and scope of Statistics, concepts of statistical population and sample. Data: Univariate Data: quantitative and qualitative, attributes, variables, scales of measurement - nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives.

1.1.2 Unit 2: *Measures of Central Tendency*: (Lectures: 12)

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

1.1.3 Unit 3: *Calculus of Finite Difference*: (Lectures: 12)

Finite Difference: Definition, Operators Δ & E, their properties, Difference table, missing terms, Interpolation: Definition, Newton's Forward and Backward interpolation formula. Divided Difference (DD): Definition, DD table, Newton's DD formula. Lagrange's interpolation formula. Numerical Integration: Introduction, General quadrature formula, Trapezoidal, Simpson's 1/3rd & 3/8th rules, Newton-Raphson method.

1.1.4 Unit 4: *Bivariate Data*: (Lectures: 12)

Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares.

1.1.5 Unit 5: *Theory of Attributes*: (Lectures: 12)

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

SUGGESTED READING:

1. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co.Ltd.

1.2 PRACTICAL/ LAB WORK

List of Practical

1. Graphical representation of data
2. Problems based on measures of central tendency
3. Problems based on measures of dispersion
4. Problems based on combined mean and variance and coefficient of variation
5. Problems based on moments, skewness and kurtosis
6. Fitting of polynomials, exponential curves
7. Karl Pearson correlation coefficient
8. Partial and multiple correlations
9. Spearman rank correlation with and without ties.
10. Correlation coefficient for a bivariate frequency distribution
11. Lines of regression, angle between lines and estimated values of variables.
12. Checking consistency of data and finding association among attributes.

STA-RC- 2016

Introductory Probability

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

2.1 Theory

2.1.1 Unit 1: *Probability*: (Lectures: 15)

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

2.1.2 Unit 2: *Random Variables*: (Lectures: 15)

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

2.1.3 Unit 3: *Convergence in Probability*: (Lectures: 12)

Idea of convergence in probability, Chebyshev's inequality, weak law of large numbers, De-Moivre Laplace and Lindeberg-Levy Central Limit Theorem (C.L.T.) (statement only without proof).

2.1.4 Unit 4: *Standard Distributions*: (Lectures: 18)

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

SUGGESTED READING:

1. Hogg, R.V., Tanis, E.A. and Rao J.M. (2009): Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
2. Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford & IBH Publishing, New Delhi

2.2 PRACTICAL/LAB. WORK:

List of Practical

1. Fitting of binomial distributions for n and p = q = ½ given
2. Fitting of binomial distributions for n and p given
3. Fitting of binomial distributions computing mean and variance

4. Fitting of Poisson distributions for given value of lambda
5. Fitting of Poisson distributions after computing mean
6. Application problems based on binomial distribution
7. Application problems based on Poisson distribution
8. Problems based on area property of normal distribution
9. To find the ordinate for a given area for normal distribution
10. Application based problems using normal distribution
11. Fitting of normal distribution when parameters are given
12. Fitting of normal distribution when parameters are not given.

STA-RC- 3016

Basics of Statistical Inference

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

3.1 Theory

3.1.1 Unit 1: *Tests of Hypothesis*: (Lectures: 20)

Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample).

The basic idea of significance test. Null and alternative hypothesis. Type I & Type II errors, level of significance, concept of p-value. Tests of hypotheses for the parameters of a normal distribution (one sample), Non-parametric tests: Sign test for median, Sign test for symmetry, Wilcoxon two-sample test.

3.1.2 Unit 2: *Categorical Data Analysis*: (Lectures: 18)

Categorical data: Tests of proportions, tests of association and goodness-of-fit using Chi- square test, Yates' correction.

3.1.3 Unit 3: *Analysis of Variance*: (Lectures: 22)

Analysis of variance, one-way and two-way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block. Analysis of completely randomized design, randomized complete block design. Bioassay.

SUGGESTED READING:

1. Daniel, Wayne W., Bio-statistics: A Foundation for Analysis in the Health Sciences. John Wiley (2005).
2. Goon, A.M., Gupta M.K. & Das Gupta, Fundamentals of statistics, Vol.-I & II (2005).
3. Dass, M. N. & Giri, N. C.: Design and analysis of experiments. John Wiley.
4. Dunn, O.J Basic Statistics: A primer for the Biomedical Sciences. (1964, 1977) by John Wiley.
5. Bancroft, Holdon Introduction to Bio-Statistics (1962) P.B. Hoebar New York.
6. Goldstein, A Biostatistics-An introductory text (1971). The Macmillion New York.

3.2 PRACTICAL/LAB WORK

List of Practical

1. Estimators of population mean.
2. Confidence interval for the parameters of a normal distribution (one sample).
3. Tests of hypotheses for the parameters of a normal distribution (one sample).
4. Chi-square test of proportions.

5. Chi-square tests of association.
6. Chi-square test of goodness-of-fit.
7. Test for correlation coefficient.
8. Sign test for median.
9. Sign test for symmetry.
10. Wilcoxon two-sample test.
11. Analysis of Variance of a one way classified data
12. Analysis of Variance of a two way classified data.
13. Analysis of a CRD.
14. Analysis of an RBD.

STA-RC- 4016

Applied Statistics

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

4.1 Theory

4.1.1 Unit 1: *Time Series*: (Lectures: 12)

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

4.1.2 Unit 2: *Index Numbers*: (Lectures: 12)

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

4.1.3 Unit 3: *Statistical Quality Control*: (Lectures: 12)

Statistical Quality Control: Importance of statistical methods in industrial research and practice. Determination of tolerance limits. Causes of variations in quality: chance and assignable. General theory of control charts, process & product control, Control charts for variables: X- bar and R-charts. Control charts for attributes: p and c-charts

4.1.4 Unit 4: *Demography*: (Lectures: 12)

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

4.1.5 Unit 5: *Demand Analysis*: (Lectures: 12)

Demand Analysis: Theory of consumption and demand, demand function, elasticity of demand, determination of elasticity of demand by family budget method, Lorentz curve and Gini's coefficient, Engel's law and Engel's curve, Pareto's law of income distribution.

SUGGESTED READING:

1 Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.

1 Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9th Edition World Press, Kolkata.

2 Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals of Applied Statistics, 4th Edition (Reprint), Sultan Chand & Sons

3 Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.

4.2 PRACTICAL/LAB WORK

List of Practical

1. Measurement of trend: Fitting of linear, quadratic trend, exponential curve and plotting of trend values and comparing with given data graphically.
2. Measurement of seasonal indices by Ratio-to-trend method and plotting of trend values and comparing with given data graphically.
3. Construction of price and quantity index numbers by Laspeyre's formula, Paasche's formula, Marshall-Edgeworth's formula, Fisher's Formula. Comparison and interpretation.
4. Construction of wholesale price index number, fixed base index number and consumer price index number with interpretation
5. Construction and interpretation of X bar & R-chart
6. Construction and interpretation p-chart (fixed sample size) and c-chart
7. Computation of measures of mortality
8. Completion of life table
9. Computation of measures of fertility and population growth

STA-RE- 5016

Operations Research

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

5.1 Theory

5.1.1 Unit 1: *Operations Research*: (Lectures: 20)

Introduction to Operations Research, phases of O.R., model building, various types of O.R. problems. Linear Programming Problem, Mathematical formulation of the L.P.P, graphical solutions of a L.P.P. Simplex method for solving L.P.P.

5.1.2 Unit 2: *Transportation Problem*: (Lectures: 15)

Transportation Problem: Initial solution by North West corner rule, Least cost method and Vogel's approximation method (VAM).

5.1.3 Unit 3: *Game theory*: (Lectures: 10)

Game theory: Rectangular game, minimax-maximax principle.

5.1.4 Unit 4: *Inventory Management*: (Lectures: 15)

Inventory Management: ABC inventory system, characteristics of inventory system. EOQ Model and its variations, with and without shortages, Quantity Discount Model with price breaks.

5.2 Practical/Lab **(Using TORA/WINQSB/LINGO)**

List of Practical

1. Mathematical formulation of L.P.P and solving the problem using graphical method, Simplex technique and Charne's Big M method involving artificial variables.
2. Identifying Special cases by Graphical and Simplex method and interpretation
   a. Degenerate solution
   b. Unbounded solution
   c. Alternate solution
   d. Infeasible solution
3. Allocation problem using Transportation model
4. Networking problem
   a. Minimal spanning tree problem
   b. Shortest route problem
5. Problems based on game matrix
   a. Graphical solution to mx 2 / 2xn rectangular game
   b. Mixed strategy
6. Mathematical formulation of L.P.P and solving the problem using graphical method, Simplex technique and Charne's Big M method involving artificial variables.
7. Networking problem
   a. minimal spanning tree problem
   b. Shortest route problem
8. Problems based on game matrix
   a. Graphical solution to mx2 / 2xn rectangular game
   b. Mixed strategy

9. To find optimal inventory policy for EOQ models and its variations
10. To solve all-units quantity discounts model

SUGGESTED READING:

1. Taha, H. A. (2007): Operations Research: An Introduction, 8th Edition, Prentice Hall of India.
2. KantiSwarup, Gupta, P.K. and Manmohan (2007): Operations Research, 13th Edition, Sultan Chand and Sons.
3. Hadley, G: (2002) : Linear Programming, Narosa Publications
4. Hillier, F.A and Lieberman, G.J. (2010): Introduction to Operations Research- Concepts and cases, 9th Edition, Tata McGraw Hill.

STA-RE- 5026

Time Series Analysis

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

6.1 Theory

6.1.1 Unit 1: *Introduction to Time Series*: (Lectures: 15)

Introduction to times series data, application of time series from various fields, Components of a times series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves.

6.1.2 Unit 2: *Introduction to Time Series*: (Lectures: 18)

Trend Cont.: Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend.

6.1.3 Unit 3: *Moving averages*: (Lectures: 15)

Seasonal Component continued: Ratio to Moving Averages and Link Relative method, Deseasonalization.

6.1.4 Unit 4: *Forecasting and smoothing to Time Series*: (Lectures: 12)

Random Component: Variate component method. Forecasting: Exponential smoothing methods.

SUGGESTED READING:

1. Kendall M.G. (1976): Time Series, Charles Griffin.
2. Chatfield C. (1980): The Analysis of Time Series –An Introduction, Chapman & Hall.
3. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied

6.2 PRACTICAL / LAB WORK

List of Practical

1. Fitting and plotting of modified exponential curve
2. Fitting and plotting of Gompertz curve
3. Fitting and plotting of logistic curve
4. Fitting of trend by Moving Average Method
5. Measurement of Seasonal indices Ratio-to-Trend method
6. Measurement of Seasonal indices Ratio-to-Moving Average method
7. Measurement of seasonal indices Link Relative method
8. Calculation of variance of random component by variate difference method
9. Forecasting by exponential smoothing
10. Forecasting by short term forecasting methods.

STA-RE- 5036

Survival Analysis and Biostatistics

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

7.1 Theory

7.1.1 Unit 1: *Survival Analysis*: (Lectures: 18)

Survival Analysis: Functions of survival times, survival distributions and their applications-exponential, gamma, Weibull, Rayleigh, lognormal, death density function for a distribution having bath-tub shaped hazard function.

Censoring Schemes: Type I, Type II and progressive or random censoring with biological examples.

7.1.2 Unit 2: *Independent and dependent Risk*: (Lectures: 12)

Theory of independent and dependent risks. Bivariate normal dependent risk model.

7.1.3 Unit 3: *Epidemic Model*: (Lectures: 15)

Stochastic Epidemic Models: Simple epidemic models, general epidemic model definition and concept (without derivation). Duration of an epidemic.

7.1.4 Unit 4: *Statistical Genetics*: (Lectures: 15)

Statistical Genetics: Introduction, concepts-Genotype, Phenotype, Dominance, Recessiveness, Linkage and Recombination, Introduction to Clinical Trials.

SUGGESTED READING:

1. Lee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival data Analysis, 3rd Edition, John Wiley and Sons.
2. Biswas, S. (2007): Applied Stochastic Processes: A Biostatistical and Population Oriented Approach, Reprinted 2ndCentral Edition, New Central Book Agency.
3. Kleinbaum, D.G. (1996): Survival Analysis, Springer.
4. Chiang, C.L. (1968): Introduction to Stochastic Processes in Bio Statistics, John Wiley and Sons.
5. Indrayan, A. (2008): Medical Biostatistics, 2nd Edition Chapman and Hall/CRC.

7.2 PRACTICAL / LAB WORK

List of Practical

1. To estimate survival function
2. To determine death density function and hazard function
3. To identify type of censoring and to estimate survival time for type I censored data
4. To identify type of censoring and to estimate survival time for type II censored data

5. To identify type of censoring and to estimate survival time for progressively type I censored data
6. Estimation of mean survival time and variance of the estimator for type I censored data
7. Estimation of mean survival time and variance of the estimator for type II censored data
8. Estimation of mean survival time and variance of the estimator for progressively type I censored data
9. To estimate the survival function and variance of the estimator using Non-parametric methods with Actuarial methods
10. To estimate the survival function and variance of the estimator using Non-parametric methods with Kaplan-Meier method
11. To estimate Crude probability of death
12. To estimate Net-type I probability of death
13. To estimate Net-type II probability of death
14. To estimate partially crude probability of death
15. To estimate gene frequencies

STA-RE-5046

Survey Sampling and Indian Official Statistics

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

8.1 Theory

8.1.1 Unit 1: *Survey Sampling*: (Lectures: 8)

Concept of population and sample, complete enumeration versus sampling, sampling and non-sampling errors. Types of sampling: non-probability and probability sampling, basic principle of sample survey, simple random sampling with and without replacement, definition and procedure of selecting a sample, estimates of: population mean, total and proportion.

8.1.2 Unit 2: *Stratified random sampling*: (Lectures: 26)

Technique, estimates of population mean and total, variances of these estimates, proportional and optimum allocations and their comparison with SRS. Practical difficulties in allocation, estimation of gain in precision. Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates ($N=n \times k$). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections, introduction to PPS sampling and two stage sampling.

8.1.3 Unit 3: *Ratio and Regression Method of Sampling*: (Lectures: 20)

Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size). Cluster sampling (equal clusters only) estimation of population mean and its variance, Concept of sub sampling.

8.1.4 Unit 4: *Official Statistics*: (Lectures: 6)

Present official statistical system in India, Methods of collection of official statistics, their reliability and limitations. Role of Ministry of Statistics & Program Implementation (MoSPI), Central Statistical Office (CSO), National Sample Survey Office (NSSO), and National Statistical Commission. Government of India's Principal publications containing data on the topics such as population, industry and finance.

8.2 Practical/Lab

List of Practical

1. To select a SRS with and without replacement.
2. For a population of size 5, estimate population mean, population mean square and population variance. Enumerate all possible samples of size 2 by WR and WOR and establish all properties relative to SRS.
3. For SRSWOR, estimate mean, standard error, the sample size
4. Stratified Sampling: allocation of sample to strata by proportional and Neyman's methods Compare the efficiencies of above two methods relative to SRS
5. Estimation of gain in precision in stratified sampling.

6. Comparison of systematic sampling with stratified sampling and SRS in the presence of a linear trend.
7. Ratio and Regression estimation: Calculate the population mean or total of the population. Calculate mean squares. Compare the efficiencies of ratio and regression estimators relative to SRS.
8. Cluster sampling: estimation of mean or total, variance of the estimate, estimate of intra-class correlation coefficient, efficiency as compared to SRS.

SUGGESTED READING

1. Cochran, W.G. (1984): Sampling Techniques (3rd Ed.), Wiley Eastern.
2. Sukhatme, P.V., Sukhatme, B.V. Sukhatme, S. Asok,C.(1984). Sampling Theories of Survey With Application, IOWA State University Press and Indian Society of Agricultural Statistics
3. Murthy, M.N. (1977): Sampling Theory & Statistical Methods, Statistical Pub. Society, Calcutta.
4. Des Raj and Chandhok, P. (1998): Sample Survey Theory, Narosa Publishing House.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2001): Fundamentals of Statistics (Vol.2), World Press.
6. Guide to current Indian Official Statistics, Central Statistical Office, GOI, New Delhi.
7. http://mospi.nic.in/

STA-RE- 6016

Econometrics

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

9.1 Theory

9.1.1 Unit 1: *Economic Models*: (Lectures: 15)

Introduction: Objective behind building econometric models, nature of econometrics, model building, role of econometrics, linear models: two or more variables.

9.1.2 Unit 2: *Estimation*: (Lectures: 18)

Least square assumptions, estimation of regression parameters, tests of significance and confidence intervals.

9.1.3 Unit 3: *Regression*: (Lectures: 15)

Multiple Regression analysis, estimation and inference.

9.1.4 Unit 4: *Collinearity*: (Lectures: 12)

Violations of Least Square assumptions: multicollinearity, autocorrelation and heteroscedasticity.

SUGGESTED READING:

1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition, McGraw Hill Companies.
2. Johnston, J. (1972): Econometric Methods, 2nd Edition, McGraw Hill International.
3. Koutsoyiannis, A. (2004): Theory of Econometrics, 2nd Edition, Palgrave Macmillan Limited,
4. Maddala, G.S. and Lahiri, K. (2009): Introduction to Econometrics, 4th Edition, John Wiley & Sons.

9.2 PRACTICAL /LAB WORK

List of Practical

1. Problems based on estimation of General linear model
2. Testing of parameters of General linear model
3. Forecasting of General linear model
4. Problems concerning specification errors
5. Problems related to consequences of Multicollinearity
6. Diagnostics of Multicollinearity
7. Problems related to consequences of Autocorrelation (AR(I))
8. Diagnostics of Autocorrelation
9. Estimation of problems of General linear model under Autocorrelation
10. Problems related to consequences Heteroscedasticity
11. Diagnostics of Heteroscedasticity
12. Estimation of problems of General linear model under Heteroscedastic distance terms
13. Problems related to General linear model under (Aitken Estimation).

STA-RE- 6026

Demography and Vital Statistics

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

10.1 Theory

10.1.1 Unit 1: *Population Theory*: (Lectures: 10)

Population Theories: Coverage and content errors in demographic data, use of balancing equations, Population composition, dependency ratio.

10.1.2 Unit 2: *Measurement of Mortality*: (Lectures: 15)

Introduction and sources of collecting data on vital statistics, errors in census and registration data. Measurement of population, rate and ratio of vital events. Measurements of Mortality: Crude Death Rate (CDR), Specific Death Rate (SDR), Infant Mortality, Rate (IMR) and Standardized Death Rates.

10.1.3 Unit 3: *Life Table*: (Lectures: 18)

Stationary and Stable population, Central Mortality Rates and Force of Mortality. Life (Mortality) Tables: Assumption, description.

10.1.4 Unit 4: *Measurement of Fertility*: (Lectures: 17)

Measurements of Fertility: Crude Birth Rate (CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR) and Total Fertility Rate (TFR). Measurement of Population Growth: Crude rates of natural increase, Pearl's Vital Index, Gross Reproduction Rate (GRR) and Net Reproduction Rate (NRR).

SUGGESTED READING:

1. Mukhopadhyay, P. (1999): Applied Statistics, Books and Allied (P) Ltd.
2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II, 9 th
3. Edition, World Press.
4. Biswas, S. (1988): Stochastic Processes in Demography & Application, Wiley Eastern Ltd.
5. Croxton, Fredrick E., Cowden, Dudley J. and Klein, S. (1973): Applied General Statistics, 3rd Edition. Prentice Hall of India Pvt. Ltd.
6. Keyfitz N., Beckman John A.: Demography through Problems S-Verlag New York.

10.2 PRACTICAL/LAB. WORK:

List of Practical

1. To calculate CDR and Age Specific death rate for a given set of data
2. To find Standardized death rate by:- (i) Direct method (ii) Indirect method
3. To construct a complete life table

4. To fill in the missing entries in a life table
5. To calculate probabilities of death at pivotal ages and use it construct abridged life table using (i) Reed-Merrell Method, (ii) Greville's Method and (iii) King's Method
6. To calculate CBR, GFR, SFR, TFR for a given set of data
7. To calculate Crude rate of Natural Increase and Pearle's Vital Index for a given set of data
8. Calculate GRR and NRR for a given set of data and compare them

STA-RE- 6036

Design of Experiments

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

11.1 Theory

11.1.1 Unit 1: *Design of Experiments*: (Lectures: 25)

Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, choice of size and shape of plots and blocks.

Basic designs: Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD) – layout, model and statistical analysis, relative efficiency, analysis with missing observations, Greaco Latin Square Design.

11.1.2 Unit 2: *Design of Experiments*: (Lectures: 15)

Split Plot Design, Strip Plot Design, Incomplete Block Designs, Introduction to Balanced Incomplete Block Design (BIBD).

11.1.3 Unit 3: *Factorial Experiments*: (Lectures: 20)

Factorial experiments: advantages, notations and concepts, 2^2, 2^3…2^n and 3^2 factorial experiments, design and analysis, Total and Partial confounding for 2^n ($n \leq 5$), idea of 3^2 experiment.

11.2 Practical/Lab

List of Practical

1. Analysis of a CRD
2. Analysis of an RBD
3. Analysis of an LSD
4. Analysis of an RBD with one missing observation
5. Analysis of an LSD with one missing observation
6. Analysis of 2^2 and 2^3 factorial in CRD and RBD
7. Analysis of a completely confounded two level factorial design in 2 blocks
8. Analysis of a completely confounded two level factorial design in 4 blocks
9. Analysis of a partially confounded two level factorial design.

SUGGESTED READINGS:

1. Cochran, W.G. and Cox, G.M. (1959): Experimental Design. Asia Publishing House.
2. Das, M.N. and Giri, N.C. (1986): Design and Analysis of Experiments. Wiley Eastern Ltd.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2005): Fundamentals of Statistics. Vol. II, 8th Edn. World Press, Kolkata.
4. Kempthorne, O. (1965): The Design and Analysis of Experiments. John Wiley.
5. Montgomery, D. C. (2008): Design and Analysis of Experiments, John Wiley.

STA-RE- 6046

Actuarial Statistics

Total Lectures: 60 Credits: 6 (Theory: 04, Practical/Lab: 02)

12.1 Theory

12.1.1 Unit 1: *Probability Distributions*: (Lectures: 15)

Introductory Statistics and Insurance Applications: Discrete, continuous and mixed probability distributions. Insurance applications, sum of random variables. Utility theory: Utility functions, expected utility criterion, types of utility function, insurance and utility theory.

12.1.2 Unit 2: *Premium Calculation*: (Lectures: 15)

Principles of Premium Calculation: Properties of premium principles, examples of premium principles. Individual risk models: models for individual claims, the sum of independent claims, approximations and their applications.

12.1.3 Unit 3: *Survival Distribution*: (Lectures: 18)

Survival Distribution and Life Tables: Uncertainty of age at death, survival function, time- until-death for a person, curate future lifetime, force of mortality, life tables with examples, deterministic survivorship group, life table characteristics.

12.1.4 Unit 4: *Life Insurance*: (Lectures: 12)

Life Insurance: Models for insurance payable at the moment of death, insurance payable at the end of the year of death.

SUGGESTED READING:

1. Dickson, C. M. D. (2005): Insurance Risk And Ruin (International Series On Actuarial Science), Cambridge University Press.
2. Bowers, N. L., Gerber, H. U., Hickman, J. C., Jones, D. A. And Nesbitt, C. J. (1997): Actuarial Mathematics, Society of Actuaries, Itasca, Illinois, U.S.A.

12.2 PRACTICAL / LAB WORK (Using Spreadsheet/R)

List of Practical

1 Risk computation for different utility models
2. Discrete and continuous risk calculations
3. Calculation of aggregate claims for collective risks
4. Calculation of aggregate claim for individual risks
5. Computing Ruin probabilities and aggregate losses
6. Annuity and present value of contract
7. Computing premium for different insurance schemes
8. Practical based on life models and tables

STA – SE - 3014

Statistical Data Analysis Using Software Packages

Total Lectures: 30 Credits: 4 (Theory: 02, Practical/Lab: 02)

13.1 Theory/Practical/Lab

This course will review and expand upon core topics in statistics and probability, particularly by initiating the beneficiaries of the course to at least one of the software packages viz., Microsoft Excel, SPSS, Minitab, Matlab, for statistical computing.

13.1.1 Unit 1: *Graphical Representation*: (Lectures: 8)

Learn how to load data, plot a graph viz. histograms (equal class intervals and unequal class intervals), box plot, stem-leaf, frequency polygon, pie chart, ogives with graphical summaries of data

13.1.2 Unit 2: *Report Generation*: (Lectures: 6)

Generate automated reports giving detailed descriptive statistics, correlation and lines of regression.

13.1.3 Unit 3: *Fitting Curves*: (Lectures: 8)

Random number generation and sampling procedures. Fitting of polynomials and exponential curves. Application Problems based on fitting of suitable distribution, Normal probability plot.

13.1.4 Unit 4: *Analysis*: (Lectures: 8)

Simple analysis and create and manage statistical analysis projects, import data, code editing, Basics of statistical inference in order to understand hypothesis testing and compute p-values and confidence intervals.

SUGGESTED READING:

1. Moore, D.S. and McCabe, G.P. and Craig, B.A. (2014): Introduction to the Practice of Statistics, W.H. Freeman
2. Cunningham, B.J (2012): Using SPSS: An Interactive Hands-on approach
3. Cho, M,J., Martinez, W.L. (2014) Statistics in MATLAB: A Primer, Chapman and Hall/CRC

STA – SE - 4014

Data Base Management Systems

Total Lectures: 20 Credits: 4 (Theory: 02, Practical/Lab: 02)

14.1 Theory/Practical/Lab

This skill based course is structured to enhance database handling, data manipulation and data processing skills through SQL. The course will enable its beneficiaries develop data centric computer applications.

14.1.1 Unit 1: *Overview of DBMS*: (Lectures: 8)

Introduction: Overview of Database Management System, Introduction to Database Languages, advantages of DBMS over file processing systems.

14.1.2 Unit 2: *RDBMS*: (Lectures: 8)

Relational Database Management System: The Relational Model, Introduction to SQL: Basic Data Types, Working with relations of RDBMS: Creating relations e.g. Bank, College Database (create table statement)

14.1.3 Unit 3: *RDBMS Continued*: (Lectures: 6)

Modifying relations (alter table statement), Integrity constraints over the relation like Primary Key, Foreign key, NOT NULL to the tables, advantages and disadvantages of relational Database System

14.1.4 Unit 4: *Data Base Structure*: (Lectures: 8)

Database Structure: Introduction, Levels of abstraction in DBMS, View of data, Role of Database users and administrators, Database Structure: DDL, DML, Data Manager (Database Control System).Types of Data Models Hierarchical databases, Network databases, Relational databases, Object oriented databases

SUGGESTED READING:

1. Gruber, M. (1990): Understanding SQL, BPB publication
2. Silberschatz, A, Korth, H and Sudarshan, S (2011) "Database System and Concepts", 6th Edition McGraw-Hill.
3. Desai, B. (1991): Introduction to Database Management system, Galgotia Publications.

STA-SE-5014

Statistical Data Analysis using R

Total Lectures: 20 Credits: 4 (Theory: 02, Practical/Lab: 02)

15.1 Theory/Practical/Lab

This course will review and expand upon core topics in probability and statistics through the study and practice of data analysis and graphical interpretation using 'R'.

15.1.1 Unit 1: *Plotting Graphs*: (Lectures: 8)

Learn how to load data, plot a graph viz. histograms (equal class intervals and unequal class intervals), box plot, stem-leaf, frequency polygon, pie chart, ogives with graphical summaries of data

15.1.2 Unit 2: *Report Generation*: (Lectures: 6)

Generate automated reports giving detailed descriptive statistics, correlation and lines of regression.

15.1.3 Unit 3: *Generation of Random Numbers*: (Lectures: 8)

Random number generation and sampling procedures. Fitting of polynomials and exponential curves. Application Problems based on fitting of suitable distribution, Normal probability plot.

15.1.4 Unit 4: *Statistical Analysis*: (Lectures: 8)

Simple analysis and create and manage statistical analysis projects, import data, code editing, Basics of statistical inference in order to understand hypothesis testing and compute p-values and confidence intervals.

SUGGESTED READING:

1. Gardener, M (2012) Beginning R: The Statistical Programming Language, Wiley Publications.
2. Braun W J, Murdoch D J (2007): A First Course in Statistical Programming with R. Cambridge University Press. New York

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Statistical Techniques for Research Methods

Total Lectures: 20 Credits: 4 (Theory: 02, Practical/Lab: 02)

16.1 Theory/Practical/Lab

Statistical Techniques provide scientific approaches to develop the domain of human knowledge largely through empirical studies. The course aims at enabling students understand basic concepts and aspects related to research, data collection, analyses and interpretation.

16.1.1 Unit 1: *Research problems*: (Lectures: 7)

Introduction: Meaning, objection and motivation in research, types of research, research approach, significance of research. Research problems: definition, selection and necessity of research problems.

16.1.2 Unit 2: *Survey Methodology*: (Lectures: 7)

Survey Methodology and Data Collection, inference and error in surveys, the target populations, sampling frames and coverage error, methods of data collection, non-response, questions and answers in surveys.

16.1.3 Unit 3: *Data Analysis and Interpretation*: (Lectures: 7)

Processing, Data Analysis and Interpretation: Review of various techniques for data analysis covered in core statistics papers, techniques of interpretation, precaution in interpretation.

16.1.4 Unit 4: *Questionnaire Preparation*: (Lectures: 9)

Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector, unemployment rates, removal of subsidy, impact on service class v/s unorganized sectors), interpret the results and draw inferences.

SUGGESTED READING:

1. Kothari, C.R. (2009): Research Methodology: Methods and Techniques, 2nd Revised Edition reprint, New Age International Publishers.
2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners, SAGE publications.