BHARTI VISHWAVIDYALAYA DURG(C.G.)

Website-www.bhartiuniversity.org,

 Email–bhartiuniversity.in@gmail.com

BHARTI VISHWAVIDYALAYA

SCHEME OF EXAMINATION

&

SYLLABUS OF

BACHELOR OF STATISTICS SEMESTER EXAM

UNDER

FACULTY OF SCIENCE

(Approved by Board of Studies)

Effective form 2021-2022

BHARTI VISHWAVIDYALAYA, DURG

B. Statistics

Examination will be conducted in six semester

SEMESTER-I

THEORY

PAPER CODE	SUBJECT	CREDIT	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-101	Descriptive statistics	4	70	30	100
BSTAT-102	Statistical method	4	70	30	100
BSTAT-103	Computer fundamental	4	35	15	50
ECA	Tour, Industrial Training/ Field Visit, NSS/ Swachhta/ Sports/ others	2	35	15	50
AE	English Communication	2	35	15	50

PRACTICAL

PAPER CODE	SUBJECT	CREDIT	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-101	Descriptive statistics	2	35	15	50
BSTAT-102	Statistical method	2	35	15	50
BSTAT-103	Computer fundamental	2	35	15	50

BHARTI VISHWAVIDYALAYA, DURG

B. Statistics

SEMESTER–II

THEORY

PAPER CODE	SUBJECT	CREDIT	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-201	Probability and probability distribution	4	70	30	100
BSTAT-202	Introductory of probability	4	70	30	100
BSTAT-203	INTERNET& NETWORK,MS-EXCEL& ACCESS	4	35	15	50
ECA	Tour, Industrial Training/Field Visit, NSS/ Swachhta / Sports/ others	2	35	15	50
AECC	Environmental Science	2	35	15	50

PRACTICAL

PAPER CODE	SUBJECT	CREDIT	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-201	Probability and probability distribution	2	35	15	50
BSTAT-202	Introductory of probability	2	35	15	50
BSTAT-203	Office automation	2	35	15	50

BHARTI VISHWAVIDYALAYA, DURG

B. Statistics

SEMESTER–III

THEORY

PAPER CODE	SUBJECT	CREDIT	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-301	Sampling distribution	4	70	30	100
BSTAT-302	Survey sampling and Indian official statistics	4	70	30	100
BSTAT-303	Mathematical Analysis	4	70	30	100
BSTAT-304	Basics of statistical inference	4	35	15	50
BSTAT-305	Select one from the pool of sec courses offered by department	4	70	30	100

PRACTICAL

PAPER CODE	SUBJECT	CREDIT	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-301	Sampling distribution	2	35	15	50
BSTAT-302	Survey sampling and Indian official statistics	2	35	15	50
BSTAT-304	Basics of statistical inference	2	35	15	50

BHARTI VISHWAVIDYALAYA, DURG

B. Statistics

SEMESTER–IV

THEORY

PAPER CODE	SUBJECT	CREDIT	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-401	Statistical inference	4	70	30	100
BSTAT-402	Linear models	4	70	30	100
BSTAT-403	Statistical quality work	4	70	30	100
BSTAT-404	Applied statistics	4	35	15	50
BSTAT-405	Select one from the pool of sec courses offered by department	4	70	30	100

PRACTICAL

PAPER CODE	SUBJECT	CREDIT	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-401	Statistical inference	2	35	15	50
BSTAT-402	Statistical quality work	2	35	15	50
BSTAT-403	Applied statistics	2	35	15	50

BHARTI VISHWAVIDYALAYA, DURG

B. Statistics

SEMESTER–V

THEORY

PAPER CODE	SUBJECT	CREDIT	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-501	Stochastic processes And queuing theory	4	70	30	100
BSTAT-502	Statistical computing using C/C++	4	70	30	100
BSTAT-503	Elective paper-I	4	70	30	100
BSTAT-504	Elective paper-II	4	70	30	100

PRACTICAL

PAPER CODE	SUBJECT	CREDIT	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-501	Stochastic processes And queuing theory	2	35	15	50
BSTAT-502	Statistical computing using C/C++	2	35	15	50
BSTAT-503	Elective paper-I	2	35	15	50
BSTAT-504	Elective paper-II	2	35	15	50

BHARTI VISHWAVIDYALAYA, DURG

B. Statistics

SEMESTER–VI

THEORY

PAPER CODE	SUBJECT	CREDIT	THEORY MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-601	Design of experiment	4	70	30	100
BSTAT-602	Multivariate analysis and nonparametric method	4	70	30	100
BSTAT-603	Elective paper-III	4	70	30	100
BSTAT-604	Elective paper-IV	4	70	30	100

PAPER CODE	SUBJECT	CREDIT	PRACTICAL MARKS	TEACHER ASSESSMENT	TOTAL MARKS
BSTAT-601	Design of experiment	2	35	15	50
BSTAT-602	Multivariate analysis and nonparametric method	2	35	15	50
BSTAT-603	Elective paper-III	2	35	15	50
BSTAT-604	Elective paper-IV	2	35	15	50

* As per UGC CBCS guidelines, University / departments have liberty to offer courses offered by one department to students of other departments.

 [4 L or 2 L+ 2 P or l L+3 P or 3L+ l T] 1P = 2 hours.

*Credit= L+T+P/2

Where, **L-**Lecture**, T-**Tutorial and **P-** Practical

Total Credits=144

BHARTI VISHWAVIDYALAYA, DURG

SCHEME FOR PRACTICAL EXAMINATION

EXPERIMENT	MARKS
EXPERIMENT	25
VIVA-VOCE	10
TEACHER ASSESSMENT	15
TOTAL MARKS	50

Core Papers (14 papers)

BSTAT-101 Descriptive Statistics (Theory+ Practical)
BSTAT-102 Statistical methods
BSTAT-103-Computer fundamental (Theory+ Practical)

BSTAT-201 Probability and Probability Distributions

(Theory+ Practical)

BSTAT-202 Introductory probability
BSTAT-203-Office automation (Theory+ Practical)
BSTAT-301 Sampling Distributions (Theory+ Practical)
BSTAT-302 Survey Sampling and Indian Official Statistics (Theory+ Practical)
STAT C-303 Mathematical Analysis
BSTAT-304-Basics of Statistical Inference (Theory+ Practical)
BSTAT-401 Statistical Inference
 (Theory Practical)
BSTAT-402 Linear Models
(Theory Practical)
BSTAT-403 Statistical Quality Control (Theory+ Practical)
BSTAT-404-Applied Statistics (Theory+ Practical)

BSTAT-501 Stochastic Processes and Queuing Theory (Theory+ Practical)
BSTAT-502 Statistical Computing Using C/C++ Programming
 (Theory+ Practical)

STAT-601 Design of Experiments (Theory+ Practical)
BSTA-602 Multivariate Analysis and Nonparametric Methods (Theory+ Practical)

BSTAT-503,504 Elective Papers (2 papers to be selected)

1. Operations Research(Theory+ Practical)
2. Time Series Analysis(Theory+ Practical)
3. Econometrics(Theory+ Practical)
4. Demography and Vital Statistics (Theory+ Practical)

BSTAT-603,604 Elective Papers (2 papers to be selected)

1. Financial Statistics(Theory+ Practical)
2. Actuarial Statistics(Theory+ Practical)
3. Survival Analysis and Biostatistics(Theory+ Practical)
4. Project Work (Sixth Semester)

BSTAT-305 Elective Papers (1 Paper to be selected)

1. Statistical-Data Analysis Using Software Packages
2. Statistical Data Analysis Using R

BSTAT-405 Elective Papers (1 Paper to be selected)

1. Statistical Techniques for Research Methods
2. Data Base Management Systems

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B.STATISTICS SEMESTER-I

BSTAT-101

Descriptive Statistics

UNIT I
Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample.Data: quantitative and qualitative, attributes, variables, scales of measurement- nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives, consistency and independence of data with special reference to attributes.

UNIT II
Measures of Central Tendency: mathematical and positional. Measures of Dispersion: range,quartile deviation, mean deviation, standard deviation, coefficient of variation.

UNIT III
 Moments, absolute moments, factorial moments, skewness and kurtosis,
 Sheppard's corrections.

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

UNIT V
Index Numbers: Definition, construction of index numbers and problems thereof for weighted and unweighted index numbers including Laspeyre's, Paasche's, Edgeworth-Marshall and Fisher's. Chain index numbers, conversion of fixed based to chain based index numbers andvice-versa. Consumer price index numbers.

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 Statisticswith Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory ofStatistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

BHARTI VISHWAVIDYALAYA, DURG

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. Correlation coefficient for a bivariate frequency distribution.
9. Lines of regression, angle between lines and estimated values of variables.
10. Spearman rank correlation with and without ties.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-I

BSTAT-102

Statistical Methods

UNIT I
Introduction: Definition and scope of Statistics, concepts of statistical population and sample.Data: quantitative and qualitative, attributes, variables.

UNIT II
Scales of measurement - nominal, ordinal, interval and ratio. Presentation: tabular and graphic, including histogram and ogives.

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

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

UNIT V
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 Statisticswith Applications, (7th Edn.), Pearson Education, Asia.
3. Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory ofStatistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.

BHARTI VISHWAVIDYALAYA, DURG

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.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-I
BSTAT-103
COMPUTER FUNDAMENTALS

UNIT-1

Introduction to Computers: Definition of Computers, History and Generations of Computers, Characteristics of computer, Classification of Computers. Fundamental Block diagram of Computer: CPU, Input & Output Unit. Input devices, Output devices, Types of printer's, Memory, CD-ROM, Hard disk, Floppy disk.

UNIT-2

Software: Definition of Software, Types of Software-System software, Application software and Utility software. Computer Languages: Definition, types of Programming languages, Language Processors :Assemblers, Interpreters, Compiler and Editors. Introduction to Operating Systems: Types of Operating System, Functions of Operating System examples. MS-DOS Internal and External Commands.

UNIT-3

Windows: Introduction to Windows, Starting Windows, Desk Top, Task Bar, Start Up Menu Working with programs and icons-Adding, removing, starting and quitting programs and icon. Working with files and folders-creating, deleting, opening, finding, copying, moving and renaming files and folders. Control Panel, setting, My Computer, Recycle bin, My documents, drives. Windows notepad, Accessories and windows Explorer.

UNIT-4

MS-Word: Overview of Word Processing, Parts of word window, Types of Menus . Opening, creating saving, cut, copy and paste. print and print preview. Find and Replace, Header& Footer, save & save as, Borders and shading, Bullets & Numbering, spelling and Grammar, Word count, Mail Merge, Table handling and important shortcut keys, Macros.

UNIT-5

MS-PowerPoint: Overview of MS-PowerPoint, Slides, PowerPoint views, Auto content wizard, Custom Animation, Transition and build effects, Printing slides and important shortcut keys.

REFERENCES:
1. Microsoft Office 2007 Training Guide, BPB Publications-2010
2. Fundamentals of Computers,V Rajaraman 6th edition PHI Learning Private Limited 2014
3. Sanjay Saxena: A First Course in Computers. Vikas Publishing House.
4. Peter Norton: Computing Fundamentals. 6th Edition, McGraw Hill-Osborne,2007
5. Alexis Leon and Marthews Leon: Introduction to Computers, Leon Vikas,1999.

Practical hours: 2 hrs. twice/Week:

The students shall gain hands-on experience of using MS-Word and Presentation, MS-DOS commands

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-I
BSTAT-201

Probability and Probability Distributions

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

UNIT II
Random variables: discrete and continuous random variables, p.m.f., p.d.f. and c.d.f., illustrations and properties of random variables, univariate transformations with illustrations.

UNIT III
Two dimensional random variables: discrete and continuous type, joint, marginal and conditional p.m.f, p.d.f., and c.d.f., independence of variables, bivariate transformations withillustrations.

UNIT IV
Mathematical Expectation and Generating Functions: Expectation of single and bivariate random variables and its properties. Moments and Cumulants, moment generating function, cumulant generating function and characteristic function. Uniqueness and inversion theorems (without proof) along with applications. Conditional expectations.

UNIT V
Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hypergeometric, uniform, normal, exponential, Cauchy, beta and gamma along with their properties and limiting/approximation cases.

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, Mary lees (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

PRACTICAL / LAB. WORK:

List of Practical

1. Fitting of binomial distributions for n and $p = q = \frac{1}{2}$.
2. Fitting of binomial distributions for given n and p.
3. Fitting of binomial distributions after computing mean and variance.
4. Fitting of Poisson distributions for given value of lambda.
5. Fitting of Poisson distributions after computing mean.
6. Fitting of negative binomial.
7. Fitting of suitable distribution.
8. Application problems based on binomial distribution.
9. Application problems based on Poisson distribution.
10. Application problems based on negative binomial distribution.
11. Problems based on area property of normal distribution.
12. To find the ordinate for a given area for normal distribution.
13. Application based problems using normal distribution.
14. Fitting of normal distribution when parameters are given.
15. Fitting of normal distribution when parameters are not given.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-II

BSTAT-202

Introductory probability

UNIT I

Probability: Introduction, random experiments, sample space, events and algebra of events.

UNIT II

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.

UNIT III

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.

UNIT IV

Convergence in probability, almost sure convergence, Chebyshev's inequality, weak law of large numbers, De-Moivre Laplace and Lindeberg-Levy Central Limit Theorem (C.L.T.).

UNIT V

Standard probability distributions: Binomial, Poisson, geometric, negative binomial, hyper geometric, 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, Mary lees (2006): John E. Freund's Mathematical Statisticswith Applications, (7th Edn.), Pearson Education, Asia.
3. Myer, P.L. (1970): Introductory Probability and Statistical Applications, Oxford &IBH Publishing, New Delhi

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

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-II
BSTAT-203
INTERNET& NETWORK, MS-EXCEL& ACCESS

UNIT-1
Internet, World Wide Web: Introduction to Internet, Internet Access, Internet Basics, Protocols-TCP/IP,HTTP,FTP, Addressing, World Wide Web(WWW), Web Pages & HTML, Web browsers, Searching for information-search engines. Internet chat. Applications of Internet. Advantages and Disadvantages of Internet.

UNIT-2
E-mail: Introduction to e-mail, Mailing basics, e-mail ethics, creating an e-mail id, spanning, composing a mail, receiving and replying the mail, Advantages and Disadvantages of e-mail services, Mailing lists, News groups.

UNIT-3
Networking& web Designing: The need and use of Computer Networks. Concepts of Networking-LAN, WAN, MAN. ISP's in India and their responsibilities. Video Conference, downloading and uploading files. Introduction to HTML, Basic tags, Formatting tags, Style sheets, Table handling, Lists, Hyperlinks in HTML.

UNIT-4
MS-EXCEL: Overview of Spreadsheet, Opening, creating, saving work sheet and work book. Copy &paste, insert rows/columns, formatting, formula, print& print preview,. Functions: Types of functions, sort, filter and basic operations. Advanced features such as charts/graphs. Different formulae for calculations.

UNIT-5
MS-ACCESS: Overview of MS-Access, Main elements of Access, Table, Queries, creating Forms, entering and updating data using Forms, finding, editing and deleting data in a Form, Reports, Relationships.

REFERENCES:
1. Microsoft Office 2007 Training Guide, BPB Publications-2010
2. Fundamentals of Internet & WWW, Greenlaw & Hepp, Tata McGraw Hill 2002
3. Fundamentals of Computers,V Rajaraman 6th edition PHI Learning Private Limited 2014
4. Sanjay Saxena: A First Course in Computers. Vikas Publishing House.
5. HTML 4 for Dummies, Ed Tittel 5th edition

Practical hours: 2 hrs. Twice/Week
The students shall gain hands-on experience of using MS-Excel and MS-Access, HTML tags and Internet, email

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-III

BSTAT-301
Sampling Distributions

UNIT I

Limit laws: convergence in probability, almost sure convergence, convergence in mean square and convergence in distribution and their inter relations, Chebyshev's inequality, W.L.L.N., S.L.L.N. and their applications, De-Moivre Laplace theorem, Central Limit Theorem (C.L.T.) for i.i.d. variates, applications of C.L.T. and Liapunov Theorem (withoutproof).

UNIT II

Order Statistics: Introduction, distribution of the rth order statistic, smallest and largest order statistics. Joint distribution of rth and sth order statistics, distribution of sample median and sample range.

UNIT III

Definitions of random sample, parameter and statistic, sampling distribution of a statistic, sampling distribution of sample mean, standard errors of sample mean, sample variance and sample proportion. Null and alternative hypotheses, level of significance, Type I and Type II errors, their probabilities and critical region. Large sample tests, use of CLT for testing singleproportion, difference of two proportions.

UNIT IV

Exact sampling distribution: Definition and derivation of p.d.f. of χ2 with n degrees of freedom (d.f.) using m.g.f., nature of p.d.f. curve for different degrees of freedom, mean, variance, m.g.f., cumulant generating function, mode, additive property and limiting form ofχ2 distribution.

Tests of significance and confidence intervals based on χ^2 distribution.

UNIT V

Exact sampling distributions: Student's and Fishers t-distribution, Derivation of its p.d.f., nature of probability curve with different degrees of freedom, mean, variance, moments andlimiting form of t distribution.

Snedecore's F-distribution: Derivation of p.d.f., nature of p.d.f. curve with different degreesof freedom, mean, variance and mode.

Distribution of $1/F(n_1,n_2)$. Relationship between t, F and χ2 distributions. Test of significance and confidence Intervals based on t and F distributions.

SUGGESTED READING:

1. Goon, A.M., Gupta, M.K. and Dasgupta, B. (2003): *An Outline of Statistical Theory*,Vol. I, 4th Edn. World Press, Kolkata.

2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability andStatistics. 2^{nd}Edn. (Reprint) John Wiley and Sons.

3. Hogg, R.V. and Tanis, E.A. (2009): *A Brief Course in Mathematical Statistics*.Pearson Education.

4. Johnson, R.A. and Bhattacharya, G.K. (2001): *Statistics-Principles and Methods*, 4thEdn. John Wiley and Sons.

5. Mood, A.M., Graybill, F.A. and Boes, D.C. (2007): *Introduction to the Theory ofStatistics*, 3rd Edn. (Reprint).Tata McGraw-Hill Pub. Co. Ltd.

PRACTICAL/ LAB. WORK:

List of Practical

1. Testing of significance and confidence intervals for single proportion and differenceof two proportions

2. Testing of significance and confidence intervals for single mean and difference of twomeans and paired tests.

3. Testing of significance and confidence intervals for difference of two standarddeviations.

4. Exact Sample Tests based on Chi-Square Distribution.

5. Testing if the population variance has a specific value and its confidence intervals.

6. Testing of goodness of fit.

7. Testing of independence of attributes.

8. Testing based on 2 X 2 contingency table without and with Yates' corrections.

9. Testing of significance and confidence intervals of an observed sample correlationcoefficient.

10. Testing and confidence intervals of equality of two population variances

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-III

BSTAT-302
Survey Sampling and Indian Official Statistics

UNIT I

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, variances of these estimates, estimates of their variances and sample size determination.

UNIT II

Stratified random sampling: 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, post stratification andits performance.

UNIT III

Systematic Sampling: Technique, estimates of population mean and total, variances of these estimates (N=nxk). Comparison of systematic sampling with SRS and stratified sampling in the presence of linear trend and corrections.

UNIT IV

Introduction to Ratio and regression methods of estimation, first approximation to the population mean and total (for SRS of large size), variances of these estimates and estimates of these variances, variances in terms of correlation coefficient for regression method of estimation and their comparison with SRS. Cluster sampling (equal clusters only) estimationof population mean and its variance, comparison (with and without randomly formedclusters).

UNIT V

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 thetopics such as population, industry and finance.

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 ofAgricultural 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/

PRACTICAL/LAB. WORK:

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 andestablish 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 presenceof 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 regressionestimators 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.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-III
BSTAT-303
Mathematical Analysis

UNIT-I

Real Analysis: Representation of real numbers as points on the line and the set of real numbers as complete ordered field. Bounded and unbounded sets, neighborhoods and limit points, Superimum and infimum, derived sets, open and closed sets, sequences and their $r^n, \left(1+\frac{1}{n}\right)^n \text{ and } n^{\frac{1}{n}}$

convergence, limits of some special sequences such as and Cauchy's

general principle of convergence, Cauchy's first theorem on limits, monotonic sequences, limit superior and limit inferior of a bounded sequence.

UNIT-II

Infinite series, positive termed series and their convergence, Comparison test, D'Alembert's ratio test, Cauchy's n^{th} root test, Raabe's test. Gauss test, Cauchy's condensation test and integral test (Statements and Examples only). Absolute convergence of series, Leibnitz's test for the convergence of alternating series, Conditional convergence.

UNIT-III

Review of limit, continuity and differentiability, uniform Continuity and boundedness of a function. Rolle's and Lagrange's Mean Value theorems. Taylor's theorem with lagrange's and Cauchy's form of remainder(without proof). Taylor's and Maclaurin's series expansionsof sinx, cosx, $e^x, (1+x)^n, \log(1+x)$.

UNIT-IV

Numerical Analysis: Factorial, finite differences and interpolation. Operators, E and divided difference. Newton's forward, backward and divided differences interpolation formulae. Lagrange's interpolation formulae. Central differences, Gauss and Stirling interpolation formulae.

UNIT-V

Numerical integration. Trapezoidal rule, Simpson's one-third rule, three-eights rule, Weddle's rule with error terms. Stirling's approximation to factorial n. Solution of difference equations of first order.

SUGGESTED READINGS

1. Malik S.C. and Savita Arora: Mathematical Analysis, Second Edition, Wiley EasternLimited, New Age International Limited, New Delhi, 1994.
2. Somasundram D. and Chaudhary B.: A First Course in Mathematical Analysis,Narosa Publishing House, New Delhi, 1987.
3. Gupta S.L. and Nisha Rani: Principles of Real Analysis, Vikas Publ. House Pvt. Ltd.,New Delhi, 1995.
4. Appostol T.M.: Mathematical Analysis, Second Edition, Narosa Publishing House,NewDelhi, 1987.
5. Shanti Narayan: A course of Mathematical Analysis, 12th revised Edition, S. Chand &Co. (Pvt.) Ltd., New Delhi, 1987.
6. Singal M.K. and Singal A.R.: A First Course in Real Analysis, 24th Edition, R. Chand& Co., New Delhi, 2003.
7. Bartle, R. G. and Sherbert, D. R. (2002): Introduction to Real Analysis(3rd Edition), John Wiley and Sons (Asia) Pte. Ltd., Singapore.
8. Ghorpade, Sudhir R. and Limaye, Balmohan V. (2006): A Course in Calculus and Real Analysis,Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint.
9. Jain. K., Iyengar, S. R. K. and Jain, R. K. (2003): Numerical methods for scientificand engineering computation, New age International Publisher, India.
10. Mukherjee, Kr. Kalyan (1990): Numerical Analysis. New Central Book Agency.
11. Sastry, S.S. (2000): Introductory Methods of Numerical Analysis, 3rd edition,Prentice Hall of India Pvt. Ltd., New Del

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-III

BSTAT-304

Basics of Statistical Inference

UNIT I
Estimation of population mean, confidence intervals for the parameters of a normal distribution (one sample and two sample problems).

UNIT II
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 normaldistribution (one sample and two sample problems).

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

UNIT IV
Tests for the significance of correlation coefficient. Sign test for median, Sign test for symmetry, Wilcoxon two-sample test.

UNIT V
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) byJohn 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.

BHARTI VISHWAVIDYALAYA, DURG

PRACTICAL/LAB WORK

List of Practical

1. Estimators of population mean.
2. Confidence interval for the parameters of a normal distribution (one sample and twosample problems).
3. Tests of hypotheses for the parameters of a normal distribution (one sample and twosample problems).
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.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-IV
BSTAT- 401
Statistical Inference

UNIT I
Estimation: Concepts of estimation, unbiasedness, sufficiency, consistency and efficiency. Factorization theorem. Complete statistic, Minimum variance unbiased estimator (MVUE), Rao-Blackwell and Lehmann-Scheffe theorems and their applications.
Cramer-Rao inequality and MVB estimators (statement and applications).

UNIT II
Methods of Estimation: Method of moments, method of maximum likelihood estimation, method of minimum Chi-square, basic idea of Bayes estimators.

UNIT III
Principles of test of significance: Null and alternative hypotheses (simple and composite), Type-I and Type-II errors, critical region, level of significance, size and power, best critical region, most powerful test, uniformly most powerful test, Neyman Pearson Lemma (statement and applications to construct most powerful test).

UNIT IV
Likelihood ratio test, properties of likelihood ratio tests (without proof).Sequential Analysis: Sequential probability ratio test (SPRT) for simple vs simple hypotheses.

UNIT V
Fundamental relations among α, β, A and B, determination of A and B in practice. Wald's fundamental identity and the derivation of operating characteristics (OC) and average sample number (ASN) functions, examples based on normal, Poisson, binomial andexponential distributions.

SUGGESTED READINGS:

1. Goon A.M., Gupta M.K.: Das Gupta.B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta.
2. Rohatgi V. K. and Saleh, A.K. Md. E. (2009): An Introduction to Probability and Statistics. 2nd Edn. (Reprint) John Wiley and Sons.
3. Miller, I. and Miller, M. (2002) : John E. Freund's Mathematical Statistics (6th addition, low price edition), Prentice Hall of India.
4. Dudewicz, E. J., and Mishra, S. N. (1988): Modern Mathematical Statistics. John Wiley & Sons.
5. Mood A.M, Graybill F.A. and Boes D.C,: Introduction to the Theory of Statistics, McGraw Hill
6. Bhat B.R, Srivenkatramana T and Rao Madhava K.S. (1997) Statistics: A Beginner's Text, Vol. I, New Age International (P) Ltd.
7. Snedecor G.W and Cochran W.G.(1967) Statistical Methods. lowa State University Press.

PRACTICAL/LABWORK:

List of Practical

1. Unbiased estimators (including unbiased but absurd estimators)
2. Consistent estimators, efficient estimators and relative efficiency of estimators.
3. Cramer-Rao inequality and MVB estimators
4. Sufficient Estimators – Factorization Theorem, Rao-Blackwell theorem, Complete Sufficient estimators
5. Lehman-Scheffe theorem and UMVUE
6. Maximum Likelihood Estimation
7. Asymptotic distribution of maximum likelihood estimators
8. Estimation by the method of moments, minimum Chi-square
9. Type I and Type II errors
10. Most powerful critical region (NP Lemma)
11. Uniformly most powerful critical region
12. Unbiased critical region
13. Power curves
14. Likelihood ratio tests for simple null hypothesis against simple alternative hypothesis
15. Likelihood ratio tests for simple null hypothesis against composite alternative hypothesis
16. Asymptotic properties of LR tests
17. SPRT procedure
18. OC function and OC curve
19. ASN function and ASN curve

BHARTI VISHWAVIDYALAYA, DURG

B. STATISTICS SEMESTER-IV

BSTAT-402

Linear Models

UNIT I
Gauss-Markov set-up: Theory of linear estimation, Estimability of linear parametric functions, Method of least squares, Gauss-Markov theorem, Estimation of error variance.

UNIT II
Regression analysis: Simple regression analysis, Estimation and hypothesis testing in case of simple and multiple regression models, Concept of model matrix and its use in estimation.

UNIT III
Analysis of variance: Definitions of fixed, random and mixed effect models, analysis of variance and covariance in one-way classified data for fixed effect models.

UNIT IV
Analysis of variance and covariance in two-way classified data with one observation per cell for fixed effect models

UNIT V
Model checking: Prediction from a fitted model, Violation of usual assumptions concerning normality, Homoscedasticity and collinearity, Diagnostics using quantile-quantile plots

SUGGESTED READINGS:

1. Weisberg, S. (2005). Applied Linear Regression (Third edition). Wiley.
2. Wu, C. F. J. And Hamada, M. (2009). Experiments, Analysis, and Parameter DesignOptimization (Second edition), John Wiley.
3. Renchner, A. C. And Schaalje, G. B. (2008). Linear Models in Statistics (Secondedition), John Wiley and Sons.

BHARTI VISHWAVIDYALAYA, DURG

PRACTICAL/LAB. WORK:

List of Practical

1. Estimability when X is a full rank matrix and not a full rank matrix
2. Distribution of Quadratic forms
3. Simple Linear Regression
4. Multiple Regression
5. Tests for Linear Hypothesis
6. Bias in regression estimates
7. Lack of fit

8. Orthogonal Polynomials
9. Analysis of Variance of a one way classified data
10. Analysis of Variance of a two way classified data with one observation per cell
11. Analysis of Covariance of a one way classified data
12. Analysis of Covariance of a two way classified data

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-IV

BSTAT-403

Statistical Quality Control

UNIT I
Quality: Definition, dimensions of quality, historical perspective of quality control and improvements starting from World War II, historical perspective of Quality Gurus and Quality Hall of Fame. Quality system and standards: Introduction to ISO quality standards, Quality registration.

UNIT II
Statistical Process Control - Seven tools of SPC, chance and assignable Causes of quality variation. Statistical Control Charts- Construction and Statistical basis of 3-σ Control charts, Rational Sub-grouping.

UNIT III
Control charts for variables: X-bar & R-chart, X-bar & s-chart. Control charts for attributes:np-chart, p-chart, c-chart and u-chart. Comparison between control charts for variables and control charts for attributes. Analysis of patterns on control chart, estimation of process capability.

UNIT IV
Acceptance sampling plan: Principle of acceptance sampling plans. Single and Double sampling plan their OC, AQL, LTPD, AOQ, AOQL, ASN, ATI functions with graphical interpretation, use and interpretation of Dodge and Romig's sampling inspection plan tables.

UNIT V
Introduction to Six-Sigma: Overview of Six Sigma, Lean Manufacturing and Total Quality Management (TQM). Organizational Structure and Six Sigma training plans- Selection Criteria for Six-Sigma roles and training plans. Voice of customers (VOC): Importance and VOC data collection. Critical to Quality (CTQ).Introduction to DMAIC using one case study: Define Phase, Measure Phase, Analyse Phase, Improve Phase and Control Phase.

SUGGESTED READING:

1. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition, Wiley India Pvt. Ltd.
2. Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
3. Mukhopadhyay, P (2011):Applied Statistics, 2nd edition revised reprint, Books andAllied(P) Ltd.
4. Montogomery, D. C. and Runger, G.C. (2008): Applied Statistics and Probability forEngineers, 3rd Edition reprint, Wiley India Pvt. Ltd.
5. Ehrlich, B. Harris (2002): Transactional Six Sigma and Lean Servicing, 2nd Edition,St. Lucie Press.
6. Hoyle, David (1995): ISO Quality Systems Handbook, 2nd Edition, ButterworthHeinemann Publication.

PRACTICAL/LAB. WORK:

List of Practical

1. Construction and interpretation of statistical control charts
   - X-bar & R-chart
   - X-bar & s-chart
   - np-chart
   - p-chart
   - c-chart
   - u-chart
2. Single sample inspection plan: Construction and interpretation of OC, AQL, LTPD,ASN, ATI, AOQ, AOQL curves
3. Calculation of process capability and comparison of 3-sigma control limits withspecification limits.
4. Use a case study to apply the concept of six sigma application in DMAIC: practicalapplication.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-IV

BSTAT-404

Applied Statistics

UNIT I
Economic Time Series: Components of time series, Decomposition of time series-Additive and multiplicative model with their merits and demerits, Illustrations of time series.

UNIT II
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.

UNIT III
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.

UNIT IV
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

UNIT V
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 deathrates.
Life (mortality) tables: definition of its main functions and uses. Measurement of fertility andreproduction: CBR, GFR, and TFR. Measurement of population growth: GRR, NRR.

SUGGESTED READING:

1. Mukhopadhyay, P. (1999): Applied Statistics, New Central Book Agency, Calcutta.
2. Gun, A.M., Gupta, M.K. and Dasgupta, B. (2008): Fundamentals of Statistics, Vol. II,9th Edition World Press, Kolkata.
3. Gupta, S. C. and Kapoor, V.K. (2008): Fundamentals Of Applied Statistics, 4th Edition(Reprint), Sultan Chand & Sons
4. Montogomery, D. C. (2009): Introduction to Statistical Quality Control, 6th Edition,Wiley India Pvt. Ltd.

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

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-V

BSTAT-501

Stochastic Processes and Queuing Theory

UNIT I
Probability Distributions: Generating functions, Bivariate probability generating function. Stochastic Process: Introduction, Stationary Process.

UNIT II
Markov Chains: Definition of Markov Chain, transition probability matrix, order of Markovchain, Markov chain as graphs, higher transition probabilities.

UNIT III
Generalization of independent Bernoulli trials, classification of states and chains, stability of Markov system, graphtheoretic approach.

UNIT IV
Poisson Process: postulates of Poisson process, properties of Poisson process, inter-arrival time, pure birth process, Yule Furry process, birth and death process, pure death process.

UNIT V
Queuing System: General concept, steady state distribution, queuing model, M/M/1 with finite and infinite system capacity, waiting time distribution (without proof). Gambler's RuinProblem: Classical ruin problem, expected duration of the game.

SUGGESTED READING:

1. Medhi, J. (2009): Stochastic Processes, New Age International Publishers.
2. Basu, A.K. (2005): Introduction to Stochastic Processes, Narosa Publishing.
3. Bhat,B.R.(2000): Stochastic Models: Analysis and Applications, New AgeInternational Publishers.
4. Taha, H. (1995): Operations Research: An Introduction, Prentice- Hall India.
5. Feller, William (1968): Introduction to probability Theory and Its Applications, Vol I,3rd Edition, Wiley International.

BHARTI VISHWAVIDYALAYA, DURG

PRACTICAL/LAB. WORK

List of Practical

1. Calculation of transition probability matrix
2. Identification of characteristics of reducible and irreducible chains.
3. Identification of types of classes
4. Identification of ergodic transition probability matrix
5. Stationary of Markov chain and graphical representation of Markov chain
6. Computation of probabilities in case of generalizations of independent Bernoulli trials
7. Calculation of probabilities for given birth and death rates and vice versa
8. Calculation of probabilities for Birth and Death Process
9. Calculation of probabilities for Yule Furry Process
10. Computation of inter-arrival time for a Poisson process.
11. Calculation of Probability and parameters for (M/M/1) model and change in behaviorof queue as N tends to infinity.
12. Calculation of generating function and expected duration for different amounts ofstake.
13. Computation of probabilities and expected duration between players.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-V
BSTAT-C-502
Statistical Computing Using C/C++ Programming

UNIT I
History and importance of C/C++. Components, basic structure programming, character set, C/C++ tokens, Keywords and Identifiers and execution of a C/C++ program. Data types: Basic data types, Enumerated data types, derived data types. Constants and variables: declaration and assignment of variables, Symbolic Constants, overflow and underflow of data.

UNIT II
Operators and Expressions: Arithmetic, relational, logical, assignment, increment/decrement, operators, precedence of operators in arithmetic, relational and logical expression. Implicit and explicit type conversions in expressions, library functions. Managing input and output operations: reading and printing formatted and unformatted data

UNIT III
Decision making and branching - if…else, nesting of if…else, else if ladder, switch, conditional (?) operator. Looping in C/C++: for, nested for, while, do…while, jumps in andout of loops.
Arrays: Declaration and initialization of one-dim and two-dim arrays. Character arrays and strings: Declaring and initializing string variables, reading and writing strings from Terminal(using scan f and print f only).

UNIT IV
User- defined functions: A multi-function program using user-defined functions, definition of functions, return values and their types, function prototypes and calls. Category of Functions :no arguments and no return values, arguments but no return values , arguments with return values, no arguments but returns a value, functions that return multiple values.

UNIT V
Pointers: Declaration and initialization of pointer variables, accessing the address of a variable, accessing a variable through its pointer, pointer expressions, pointer increments/decrement and scale factor. Pointers and arrays, arrays of pointers, pointers as function arguments, functions returning pointers
Structure: Definition and declaring, initialization, accessing structure members, copying and comparison of structure variables, array of structures, structure pointers. Dynamic memory allocation functions :mall oc, call oc and free.

SUGGESTED READING:

1. Kernighan, B.W. and Ritchie, D. (1988): C Programming Language,2^{nd}Edition,Prentice Hall.
2. Balagurusamy, E. (2011): Programming in ANSI C, 6th Edition, Tata McGraw Hill.
3. Gottfried, B.S. (1998): Schaum's Outlines: Programming with C, 2nd Edition, TataMcGraw Hill

PRACTICAL/ LAB WORK
(Using C/C++ Programming Language)

List of Practical

1. Plot of a graph y = f(x)
2. Roots of a quadratic equation (with imaginary roots also)
3. Sorting of an array and hence finding median
4. Mean, Median and Mode of a Grouped Frequency Data
5. Variance and coefficient of variation of a Grouped Frequency Data
6. Preparing a frequency table
7. Value of n! using recursion
8. Random number generation from uniform, exponential, normal(using CLT) and gamma distribution, calculate sample mean and variance and compare with population parameters.
9. Matrix addition, subtraction, multiplication Transpose and Trace
10. Fitting of Binomial, Poisson distribution and apply Chi-square test for goodness of fit
11. Chi-square contingency table
12. t-test for difference of means
13. Paired t-test
14. F-ratio test
15. Multiple and Partial correlation.
16. Compute ranks and then calculate rank correlation(without tied ranks)
17. Fitting of lines of regression

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-VI

BSTAT- 601

Design of Experiments

UNIT I
Experimental designs: Role, historical perspective, terminology, experimental error, basic principles, uniformity trials, fertility contour maps, choice of size and shape of plots and blocks.

UNIT II
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.

UNIT III
Incomplete Block Designs: Balanced Incomplete Block Design (BIBD) – parameters, relationships among its parameters, incidence matrix and its properties, Symmetric BIBD, Resolvable BIBD, Affine Resolvable BIBD, Intra Block analysis, complimentary BIBD, Residual BIBD, Dual BIBD, Derived BIBD.

UNIT IV
Factorial experiments: advantages, notations and concepts, 2^2, $2^3 \ldots 2^n$ and 3^2 factorial experiments, design and analysis, Total and Partial confounding for 2^n ($n \leq 5$), 3^2 and 3^3. Factorial experiments in a single replicate.

UNIT V
Fractional factorial experiments: Construction of one-half and one-quarter fractions of 2^n ($n \leq 5$) factorial experiments, Alias structure, Resolution of a 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 EasternLtd.
3. Goon, A.M., Gupta, M.K. and Das gupta, B. (2005): Fundamentals of Statistics. Vol.II, 8[th]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.

BHARTI VISHWAVIDYALAYA, DURG

PRACTICAL/LAB. WORK:

List of Practical

1. Analysis of a CRD
2. Analysis of an RBD
3. Analysis of an LSD Analysis of an RBD with one missing observation
4. Analysis of an LSD with one missing observation
5. Intra Block analysis of a BIBD
6. Analysis of 2^2 and 2^3 factorial in CRD and RBD
7. Analysis of 2^2 and 2^3 factorial in LSD
8. Analysis of a completely confounded two level factorial design in 2 blocks
9. Analysis of a completely confounded two level factorial design in 4 blocks
10. Analysis of a partially confounded two level factorial design
11. Analysis of a single replicate of a 2^n design
12. Analysis of a fraction of 2^n factorial design

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-VI

BSTAT- 602

Multivariate Analysis and Nonparametric Methods

UNIT I

Bivariate Normal Distribution (BVN): p.d.f. of BVN, properties of BVN, marginal and conditional p.d.f. of BVN.

UNIT II

Multivariate Data: Random Vector: Probability mass/density functions, Distribution function, Mean vector & Dispersion matrix, Marginal & Conditional distributions.

UNIT III

Multivariate Normal distribution and its properties. Sampling distribution for mean vector and variance- covariance matrix. Multiple and partial correlation coefficient and their properties.

UNIT IV

Applications of Multivariate Analysis: Discriminant Analysis, Principal Components Analysis and Factor Analysis.

UNIT V

Nonparametric Tests: Introduction and Concept, Test for randomness based on total number of runs, Empirical distribution function, Kolmogrov Smirnov test for one sample, Sign tests- one sample and two samples, Wilcoxon-Mann-Whitney test, Kruskal-Wallistest.

SUGGESTED READING:

1. Anderson, T.W. (2003): An Introduction to Multivariate Statistical Analysis, 3rdEdn.,John Wiley
2. Muirhead, R.J. (1982): Aspects of Multivariate Statistical Theory, John Wiley.
3. Kshirsagar, A.M. (1972) :Multivariate Analysis, 1stEdn. Marcel Dekker.
4. Johnson, R.A. and Wichern, D.W. (2007): Applied Multivariate Analysis, 6thEdn.,Pearson & Prentice Hall
5. Mukhopadhyay, P. :Mathematical Statistics.
6. Gibbons, J. D. and Chakraborty, S (2003): Nonparametric Statistical Inference. 4thEdition. Marcel Dekker, CRC.

BHARTI VISHWAVIDYALAYA, DURG

PRACTICALS/ LAB WORK:

List of Practical

1. Multiple Correlation
2. Partial Correlation
3. Bivariate Normal Distribution,
4. Multivariate Normal Distribution
5. Discriminant Analysis

6. Principal Components Analysis
7. Factor Analysis
8. Test for randomness based on total number of runs,
9. Kolmogrov Smirnov test for one sample.
10. Sign test: one sample, two samples, large samples.
11. Wilcoxon-Mann-Whitney U-test
12. Kruskal-Wallis test

BHARTI VISHWAVIDYALAYA, DURG

Elective paper

B.STATISTICS SEMESTER-V

BSTAT-503

Operations Research

UNIT I
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. Charne's M-technique for solving

UNIT II
L.P.P. involving artificial variables. Special cases of L.P.P. Concept of Duality in L.P.P: Dualsimplex method. Post-optimality analysis

UNIT III
Transportation Problem: Initial solution by North West corner rule, Least cost method and Vogel's approximation method (VAM), MODI's method to find the optimal solution, specialcases of transportation problem.

UNIT IV
Game theory: Rectangular game, minimax-maximin principle, solution to rectangular game using graphical method, dominance and modified dominance property to reduce the game matrix.

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

SUGGESTED READING:

1. Taha, H. A. (2007): Operations Research: An Introduction, 8th Edition, PrenticeHall 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

PRACTICAL/ LAB WORK

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. Post-optimality
   a. Addition of constraint
   b. Change in requirement vector
   c. Addition of new activity
   d. Change in cost vector
4. Allocation problem using Transportation model
5. Allocation problem using Assignment model
6. Networking problem
   a. Minimal spanning tree problem
   b. Shortest route problem
7. Problems based on game matrix
   a. Graphical solution to mx2 / 2xn rectangular game
   b. Mixed strategy
8. To find optimal inventory policy for EOQ modelsand its variations
9. To solve all-units quantity discounts model

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER -V

BSTAT-503

Time Series Analysis

UNIT I
Introduction to times series data, application of time series from various fields, Componentsof a times series, Decomposition of time series.

UNIT II
Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves.

UNIT III
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,

UNIT IV
Seasonal Component cont: Ratio to Moving Averages and Link Relative method, Deseasonalization. Cyclic Component: Harmonic Analysis. Some Special Processes: Moving-average (MA) process and Autoregressive (AR) process of orders one and two, Estimation of the parameters of AR (1) and AR (2) – Yule-Walker equations.

UNIT V
Random Component: Variate component method. Forecasting: Exponential smoothing methods, Short term forecasting methods: Brown's discounted regression, Box-Jenkins method and Bayesian forecasting. Stationary Time series: Weak stationarity, autocorrelationfunction and correlogram of moving average.

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

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.

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER –V

BSTAT-504

Econo-metrics

UNIT I
Introduction: Objective behind building econometric models, nature of econometrics, model building, role of econometrics, structural and reduced forms. General linear model (GLM).Estimation under linear restrictions.

UNIT II
Multicollinearity: Introduction and concepts, detection of multicollinearity, consequences, tests and solutions of multicollinearity, specification error.

UNIT III
Generalized least squares estimation, Aitken estimators. Autocorrelation: concept, consequences of auto correlated disturbances, detection and solution of autocorrelation.

UNIT IV
Heteroscedastic disturbances: Concepts and efficiency of Aitken estimator with OLS estimator under heteroscedasticity.

UNIT V
Consequences of heteroscedasticity. Tests and solutions of heteroscedasticity. Autoregressive and Lag models, Dummy variables, Qualitative data.

SUGGESTED READING:

1. Gujarati, D. and Sangeetha, S. (2007): Basic Econometrics, 4th Edition, McGraw HillCompanies.
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.

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)
14. Problems on Autoregressive and Lag models.

BHARTI VISHWAVIDYALAYA, DURG

B.STASTISTICS SEMESTER-V

BSTAT-504

Demography and Vital Statistics

UNIT I

Population Theories: Coverage and content errors in demographic data, use of balancing equations and Chandrasekharan-Deming formula to check completeness of registration data. Adjustment of age data, use of Myer and UN indices, Population composition, dependency ratio.

UNIT II

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.

UNIT III

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

UNIT IV

Abridged Life Tables; Concept and construction of abridged life tables by Reed-Merrell method, Greville's method and King's Method. Measurements of Fertility: Crude Birth Rate(CBR), General Fertility Rate (GFR), Specific Fertility Rate (SFR) and Total Fertility Rate (TFR).

UNIT V

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, 9th Edition, World Press.
3. Biswas, S. (1988): Stochastic Processes in Demography & Application, Wiley Eastern Ltd.
4. Croxton, Fredrick E., Cowden, Dudley J. and Klein, S. (1973): Applied GeneralStatistics, 3rd Edition. Prentice Hall of India Pvt. Ltd.
5. Keyfitz N., Beckman John A.: Demogrphy through Problems S-Verlag New york.

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 lifetable using (i) Reed-Merrell Method, (ii) Greville's Method and (iii)
   King'sMethod
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 ofdata
8. Calculate GRR and NRR for a given set of data and compare them

BHARTI VISHWAVIDYALAYA, DURG

B.STASTISTICS SEMESTER-VI

BSTAT-603

Financial Statistics

UNIT I
Probability review: Real valued random variables, expectation and variance, skewsness and kurtosis, conditional probabilities and expectations. Discrete Stochastic Processes, Binomial processes, General random walks, Geometric random walks, Binomial models with state dependent increments.

UNIT II
Tools Needed For Option Pricing: Wiener process, stochastic integration, and stochastic differential equations. Introduction to derivatives: Forward contracts, spot price, forward price, future price. Call and put options, zero-coupon bonds and discount bonds

UNIT III
Pricing Derivatives: Arbitrage relations and perfect financial markets, pricing futures, put-call parity for European options, relationship between strike price and option price. Stochastic Models in Finance: Discrete time process- binomial model with period one.

UNIT IV
Stochastic Models in Finance: Continuous time process- geometric Brownian motion. Ito's lemma, Black-Scholes differential equation, Black-Scholes formula for European options.

UNIT V
Hedging portfolios: Delta, Gamma and Theta hedging. Binomial Model for European options: Cox-Ross-Rubinstein approach to option pricing. Discrete dividends

SUGGESTED READING:

1. Franke, J., Hardle, W.K. And Hafner, C.M. (2011): Statistics of Financial Markets: AnIntroduction, 3^{rd}Edition, Springer Publications.
2. Stanley L. S. (2012): A Course on Statistics for Finance, Chapman and Hall/CRC.

PRACTICAL / LAB WORK (Using spreadsheet/ R)

List of Practical

1. To verify "no arbitrage" principle
2. To verify relationship between spot price, forward price, future price
3. To price future contracts
4. To verify put-call parity for European options
5. To construct binomial trees and to evaluate options using these trees
6. To price options using black – Scholes formula

7. To hedge portfolios using delta and gamma hedging

8. To hedge portfolios theta hedging
9. Pricing of call options using binomial model
10. Computation of dividends on call options as a percentage of stock price.
11. Computation of dividends on call options as a fixed amount of money.
12. Pricing of put options using binomial model
13. Call-put parity for options following binomial models.
14. Effect of dividends on put options.

BHARTI VISHWAVIDYALAYA, DURG

B.STASTISTICS SEMESTER-VI

BSTAT-603

Actuarial Statistics

UNIT I
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.

UNIT II
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.

UNIT III
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, assumptions for fractional age, some analytical laws of mortality.

UNIT IV
Life Insurance: Models for insurance payable at the moment of death, insurance payable at the end of the year of death and their relationships.

UNIT V
Life annuities: continuous life annuities, discrete life annuities, life annuities with periodic payments. Premiums: continuous and discrete premiums.

SUGGESTED READING:

1. Dickson, C. M. D. (2005): Insurance Risk And Ruin (International Series OnActuarial 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.

BHARTI VISHWAVIDYALAYA, DURG

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

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B.STASTISTICS SEMESTER-VI

BSTAT-604

Survival Analysis and Biostatistics

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

UNIT II
Censoring Schemes: Type I, Type II and progressive or random censoring with biological examples. Estimation of mean survival time and variance of the estimator for Type I and Type II censored data with numerical examples. Non-parametric methods: Actuarial and Kaplan-Meier methods for estimating survival function and variance of the Estimator.

UNIT III
Competing Risk Theory: Indices for measurement of probability of death under competing risks and their inter-relations. Estimation of probabilities of death using maximum likelihood principle and modified minimum Chi-square methods. Theory of independent and dependentrisks. Bivariate normal dependent risk model.

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

UNIT V
Statistical Genetics: Introduction, concepts-Genotype, Phenotype, Dominance, Recessiveness, Linkage and Recombination, Coupling and Repulsion. Mendelian laws of Heredity, Random mating, Gametic Array .relation between genotypic array and gametic array under random mating. Distribution of genotypes under random mating. Clinical Trials:Planning and design of clinical trials, Phase I, II and III trials. Single Blinding

SUGGESTED READING:

1. Lee, E.T. and Wang, J.W. (2003): Statistical Methods for Survival data Analysis, 3rdEdition, John Wiley and Sons.
2. Biswas, S. (2007): Applied Stochastic Processes: A Biostatistical and PopulationOriented 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, JohnWiley and Sons.
5. Indrayan, A. (2008): Medical Biostatistics, 2nd Edition Chapman and Hall/CRC.

PRACTICAL / LAB WORK

List of Practical

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

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B.STASTISTICS SEMESTER-VI

BSTAT-604

Project Work

Objective: The aim of the course is to initiate students to write and present a statistical report, under the supervision of a faculty, on some area of human interest. The project work will provide hands on training to the students to deal with data emanating from some real life situation and propel them to dwell on some theory or relate it to some theoretical concepts.

BHARTI VISHWAVIDYALAYA, DURG

Elective paper
B.STATISTICS SEMESTER-III
BSTAT-305

Statistical-Data Analysis Using Software Packages

UNIT I
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, o gives with graphical summaries of data

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

UNIT III
Random number generation and sampling procedures. Fitting of polynomials and exponential curves.

UNIT IV
Application Problems based on fitting of suitable distribution, Normal probability plot.

UNIT V
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

BHARTI VISHWAVIDYALAYA, DURG

B.STATISTICS SEMESTER-III
BSTAT-305

Statistical Data Analysis Using R

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

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

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

UNIT IV
Simple analysis and create and manage statistical analysis projects, import data, code editing.

UNIT V
Basics of statistical inference in order to understand hypothesis testing and compute p-valuesand confidence intervals.

SUGGESTED READING:

1. Gardener, M (2012) Beginning R: The Statistical Programming Language, WileyPublications.
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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B.STATISTICS SEMESTER-IV

BSTAT-405

Statistical Techniques for Research Methods

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

UNIT II
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.

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

UNIT IV
Develop a questionnaire, collect survey data pertaining to a research problem (such as gender discriminations in private v/s government sector.

UNIT V
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 RevisedEdition reprint, New Age International Publishers.
2. Kumar, R (2011): Research Methodology: A Step - by - Step Guide for Beginners,SAGE publications.

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B.STATISTICS SEMESTER-IV

BSTAT-405

Data Base Management Systems

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

UNIT II
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)

UNIT III
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

UNIT IV
Database Structure: Introduction, Levels of abstraction in DBMS, View of data, Role of Database users and administrators, Database Structure: DDL, DML, Data Manager (DatabaseControl System).

UNIT V
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.