

Syllabus

for

B.Sc.(Honours) in Statistics

Sessions: 2013-2014, 2014-2015



Department of Statistics, University of Chittagong
Chittagong - 4331, Bangladesh
Email: stat_ctgu_bd@yahoo.com

Year of Examinations

First Year B.Sc. (Honours)	- 2014
Second Year B.Sc. (Honours)	- 2015
Third Year B.Sc. (Honours)	- 2016
Fourth Year B.Sc. (Honours)	- 2017

Contents

Subject	Page No.
1. Department of Statistics - An overview	03
2. Syllabus	08
3. Ordinance for Honours Course	54

Department of Statistics, University of Chittagong

– An overview

A. Beginning: The Department of Statistics is one of the oldest departments in Chittagong University. Courses on Statistics in Chittagong University were offered on November 1, 1968 with only two teachers, sixteen students in M.Sc. Preliminary and five Facit calculating machines under the department of Mathematics. The department of Statistics started functioning as an independent department on March 01, 1970. Dr. M.G. Mustafa was the founder Head of the department. The department of Statistics offers a full range of Statistical courses both in theoretical and applied statistics in under graduate as well as graduate levels (M.S.). Four year Honours programme were introduced in 1998-1999 session. There is a 'Committee of Courses and Studies' consisting of departmental faculties and three experts of Statistics from different public university that meet every two-year to revise and update the Syllabus/courses. The department celebrated the Silver Jubilee of its establishment on May 07, 1994, in a pomp and grandeur manner.

The key objectives of the department are to serve as a centre of excellence for statistical research and education, provide learning environments that produce well educated statisticians, play significant role in science and technology by probabilistic and statistical ideas and methods, and connect with others in making strengths of the statistical science to address societal needs.

We teach courses useful to those needing to apply Statistics to many fields, including medicine, social sciences, biology, business and finance. Statistics course curriculum is designed to train graduates for employment as professional statisticians to address the social needs.

Apart from the offering B.Sc. Honours and M.S degree in Statistics, faculties of the department conducts research and supervise a good number of M.Phil and Ph.D students regularly.

B. Students: In the first session of Honours course, 10 students were admitted into first year Honours in 1970. Large number of students could not be admitted due to the limitations of the laboratory and other logistic facilities. In mid 70's the number of seats were raised up to 45 in first year Honours course and 20 in M.Sc. Preliminary course. Currently 120 students have been getting admitted every year in B.Sc. Honours program. The present enrollment of the student in the department is around 600. M.Sc. Preliminary course has been turned off since 2000. Master's thesis programme was introduced in 1986. Since then more than 180 students completed their M.Sc. Programme with thesis works. The department had so far produced 15 M.Phil and 7 Ph.D degrees who are at present teaching in different universities and working in local job market efficiently and satisfactorily. Currently 5 and 3 researchers/teachers of other university are doing M.Phil and Ph.D. degrees respectively.

Since its commencement, the department has progressed gradually. It provides good teaching and research facilities. The graduates of the department are well as good as other graduates of different institution and are established by holding higher positions in various government, non-government organizations, and banks making significant contributions to the social and national development. Some of the students got higher degrees in reputed universities abroad and had been well-established over there.

C. Name of the Chairmen of the Department since its establishment:

Name of the Chairmen	From	To
Professor Dr. Golam Mostafa	01.03.1970	10.06.1973
Professor Dr. Sudhir Ranjan Paul	11.06.1973	31.08.1973
Professor Dr. Sultan Ahmad	01.09.1973	30.04.1977
Professor Dr. Shah Rafiqul Islam Chy.	01.05.1977	30.04.1980
Professor N.S.M. Yahya,	01.05.1980	30.04.1983
Professor Dr. Manindra Kumar Roy	01.05.1983	30.04.1986
Professor M. Mujibur Rahman	01.05.1986	30.04.1989
Professor Dr. Rabindra Nath Shil	01.05.1989	30.04.1992
Professor Dr. S.M. Shafiqul Islam	01.05.1992	30.04.1995
Professor Dr. Md. Shamsuddin,	01.05.1995	21.09.1997
Professor Dr. Manindra Kumar Roy (In Charge)	22.09.1997	12.10.1997
Professor Md. Aminur Rasul	13.10.1997	12.10.2000
Professor Dr. Jiban Chandra Paul	13.10.2000	26.01.2003
Professor Dr. Md. Abdul Karim	27.01.2003	26.01.2006
Professor Dr. Soma Chowdhury	27.01.2006	26.01.2009
Dr. Md. Abdul Maleque	27.01.2009	26.01.2012
Professor Md. Emdadul Haque	27.01.2012

D. Faculty Members

The regular faculty size is 20-25. Some junior faculty members are doing M.Phil and Ph.D abroad. The faculties are well-qualified and well-recognized in their own field of research. They have covered almost all areas of teaching and research in statistics. In addition to their teaching activities, the teachers of the department are involved in various researches in different areas of Statistics. There is a good number of research papers published in the national and international reputed journals, to the credit of all faculties. Some teachers of the department are the author of few good statistical books in Higher Secondary, Honours and Masters level. It is our pride that teachers of the department visited foreign reputed university in USA, Libya, Canada, Australia, India and Eretria, Africa as visiting associates/professors. Faculty members also participate in the national and international conferences and workshops from time to time.

Name of the existing teachers of the Department of Statistics, C.U. including those who are on leave along with their educational qualification:

Name and Position	Research Interest	Email
Professor		
Dr. Manindra Kumar Roy (P.R.L)	Probability Distribution and Statistical Inference	manindraroy@yahoo.com
Dr. Rabindra Nath Shil,	Design of Experiment and Basic Statistics	rnshil@yahoo.com
Md. Aminur Rasul, M. Phil.	Demography and Statistics	arcubd@yahoo.com
Dr. Jiban Chandra Paul	Econometrics and Economics	paulstatcu@yahoo.com
Dr. Md. Abdul Karim	Sample Survey & Demography	makstatcu@yahoo.com
Dr. Soma Chowdhury	Bio-statistics, Demography	soma_chow@hotmail.com

Name and Position	Research Interest	Email
-------------------	-------------------	-------

Professor

Md. Emdadul Haque, M.Sc. , J.U. Ph.D Fellow, C.U.	Modeling and Model determination, Econometrics, Data Mining	ehaque@cu.ac.bd m_ehaque@yahoo.com
Md. Imam Hussain, M.Sc. C.U.	Inference, Sample Survey & Non-parametric	ihstatcubd@yahoo.com

Associate Professor

Dr. Md. Abdul Maleque, C.U.	Population dynamics migration, Urbanization, Inference	maleque84cu@yahoo.com
Mr. Md. Monirul Islam, M.Sc. (CU)	Math. Statistics, Statistical Inference and Demography	monir_cu1966@yahoo.com
Mr. Chandan Kumer Podder, M.Sc. (CU)	Bayesian Statistics, Multivariate Analysis and Bio-statistics	podder_ck@yahoo.com
Mr. A. H. M. Rakibul Mawla, M.Sc. (CU)	Numerical Analysis, Probability Distribution	ahmrakib@yahoo.com
Mr. Md. Shakhawat Hossain, M.Sc. ,CU MS , Sweden	Sampling Distribution, Econom- etrics and Operations Research	mshcubd@yahoo.com
Mr. Md. Rokonzaman Azad, M.Sc. (CU), MS , Sweden	Econometrics, Probability, Distri- bution & Agricultural Statistics	mrzstat@yahoo.com

Assistant Professor

Mr. Md Moniruzzaman Bhuiyan, M.Sc. (CU)	Test of Hypothesis and Demography	bhuiyan_mz@yahoo.com
Mr. Md. Rahim Uddin Chy, Ph.D Fellow (On leave)	---	---
Mr. Mohammad Monjur Morshed, M.Sc. (CU)	Sample Survey & Sampling Distribution	morshed_mm@yahoo.com
Mr. Masud Hasan, Ph.D Fellow, (On leave)	---	---
Mr. Mohammad Salim Zahangir, M.Sc.,CU, M.S , Sweden	Demography	szstatcu@yahoo.com
Md. Shaha Alam Patwary, M.Sc. (CU)	Population Studies, Biostatistics and Distribution	sajin1982@yahoo.com

Lecturer

MS. Zamilun Nahar, M.Sc. (CU)	Demography and Economic Statistics	mznaharcubd@yahoo.com
Md. Shahidul Hoque, M.Sc. (CU)	Econometrics	shahidstatcu@yahoo.com
Mr. Kanak Choudhury, M.Sc. (JU)	Data Mining & Econometrics	kanak.stat.cu@gmail.com

E. Academic Activities/Facilities

i. Seminar / Lecture Series / Workshop

The Department organizes lectures, seminars/ conferences and workshop on different fields of statistics/popular talks regularly throughout the year. Faculties of the department are the regular contributors. The contributors also include distinguished Statisticians from home and abroad. A number of distinguished foreign Scholars visited our department and disseminate their ideas and knowledge regarding the latest developments in various fields of statistics among the teachers and students of the department during their visit over here.

Name of the some distinguished guests/Statisticians ever visited and presented paper(s) in the Department

1. Prof. Mir Masood Ali Dept. of Statistics, Western Ontario, Canada, in 1982.
2. Prof. Kazi Saleh Ahamed Department of Statistics, JU & Ex VC of Jahangir Nagar University, Savar, Dhaka, in 1986.
3. Prof. Ashraf Ali Bangladesh Agricultural University, Mymensingh, in 1987.
4. Prof. S. Huda Department of Statistics, King Saud University, Saudi Arabia, in 1993.
5. Prof. B. K. Sinha Stat and Math Division, ISI, Calcutta, India, in 1994.
6. Prof. S. B. Bagchi, Head, Department of Statistics, Burdwan University, West Bengal, India, in 1994.
7. Prof. Nurul Islam Department of Statistics, Dhaka University, and Ex-VC of Mawlana Bhasani University, Tangail in 1995 and 2007.
8. Dr. Alan Gray Department of Demography, Australian National University in 1995.
9. Dr. Shahjahan Khan Department of Mathematics and Computing, University of Southern Queensland, Australia, in 1999.
10. Prof. Dr. P. K. Sen Department of Bio-statistics and Statistics, University of North Carolina, USA, in 1999.
11. Prof. Dr. Sudhir Ranjan Paul Department of Mathematical Statistics, University of Windsor, 401, Sunset Avenue, Windsor, NSB3P4, Canada, in 2007.
12. Dr. Jaharlal Bhowmik Faculty member, Swinburne University of Technology, Australia, in 2008.
13. Prof. Dr. Atanu Biswas Indian Statistical Institute, Calcutta, ISI, India, 2010.
14. Dr. Manik Mukharjee Indian Statistical Institute, Calcutta, ISI, India, 2010
15. Prof. Dr. Mir Masoom Ali George and Frances Ball Distinguished Professor of Statistics and Professor Emeritus of Mathematical Sciences, Ball State University, USA in January, 2013.
15. Mr. Abud Darda Ph.D Fellow, Dept. of Statistical Sciences, University of Padua, Italy, Jan 2013.
16. Dr. Abul Kashem Majumder Australian Bureau of Statistics, Canberra, Australia in 2013.

ii. Seminar library

The department has a seminar library with a total of about 3000 textbooks, few journals, scientific literature and reference books on Statistics published by Bangladesh Bureau of Statistics (BBS), Bangladesh Institute of Development Studies (BIDS), Insurance Company and various Research organization that benefit students and faculties of the department a lot. Students seat and study in the seminar library during leisure period and borrow books for home.

iii. Computer facilities:

The department is well-equipped with computer facilities having a big state-of-the-art computer lab with more than fifty PCs. Teachers, both under graduate and graduate and students, M.Phil and Ph.D. researchers of the department avail these facilities. Currently, the department has been offering three courses in honours programme on computer language, programming and statistical package. We are expecting to start one more computer laboratory for M.S. thesis students in a very short time.

iv. Scholarships available in the department other than the University's regular scholarship:

- a) Education Board - Dhaka, Chittagong, Jessore, Rajshahi, Comilla, Barisal & Sylhet;
- b) UGC, Govt. of the Peoples' Republic of Bangladesh;
- c) Elite Paint Rabeya Siraj;
- d) Agrani Bank;
- e) Islami Bank Foundation;
- f) Islamic Foundation, Bangladesh;
- g) Different Zilla Parishad Scholarships;
- h) A.K.M. Shamsul Hoque Khan Education Trust, Habigonj;
- i) Jessore Education Trust;
- j) Statistical Association, Department of Statistics, C.U.
- k) Fatema Begum (in courtesy of the ex-professor of the department Dr. Sultan Ahamad, in memory of his mother).

(Note: a to i are subject to the circulation of the concerned authority).

v. Study tour

The department organizes study tour every year for the M.S. students with the co-operation of the University authority. Such study tour helps the students to enrich their theoretical as well as practical knowledge in Statistics.

F. Students' welfare Activities

There is a students' association named '**Parishankhyan Samity**' in Statistics department. The departmental Chairman is the president of the Samity as ex-officio. In addition to the core academic program, department organizes extra-curriculum activities such as indoor games competition, cultural activities, reception party for the fresh students, farewell party to the outgoing students, annual picnic, etc. in collaboration with the association recurrently. Three scholarships are awarded to the meritorious students of the department from the fund of association every year. The department has a plan to increase the present number of scholarships and the amount of the scholarship in near future.

Sd/-

(Professor Md. Emdadul Haque)

Chairman

Department of Statistics, CU

Faculty of Science
Syllabus for B. Sc. Honours in Statistics

Session: 2013-2014 & 2014- 2015

The B.Sc. Honours Courses in Statistics is an integrated program spread over four academic years. It shall be a terminal degree. The course is so designed that after successful completion, the graduates are well equipped to work efficiently in government and non-government organizations, research organization, banking sectors, service departments and other related fields. There would be four examinations at the end of each academic year-named First Year Honours Examination, Second Year Honours Examination, Third Year Honours Examination and Fourth Year Honours Examination. Each student has to take a total of 160 credits over four academic years. These include 96 Credits of theoretical courses, 40 credits of practical / computing courses, 12 credits of sessional/tutorial and 12 credits of viva-voce. For theoretical courses, 42 credits will be from courses of Mathematics, Economics & Banking and Computer Science.

First Year Honours Examination would consist of

- (i) Seven theory courses of which (five course each carrying 100 marks and two courses each carrying of 50 marks);
- (ii) Four practical courses of 24 hours duration carrying 50 marks each, 20% of the marks would be allotted for class performance;
- (iii) Viva-Voce Examination carrying 75 marks and
- (iv) Three sessional examinations carrying 75 marks on average, including maximum of 15 marks for class attendance.

** Student shall take a Non Credit Compulsory English course of 100 marks in the 1st year and s/he will be allowed to sit in the 1st year exam 2014 or/ in 2015.

Second Year Honours Examination would consists of

- (i) Nine theory courses of which (three course each carrying 100 marks and six courses each carrying of 50 marks);
- (ii) Four practical courses of 24 hours duration each carrying 50 marks, 20% of the marks would be allotted for class performance;
- (iii) Viva-Voce Examination carrying 75 marks and
- (iv) Three sessional examinations carrying 75 marks on average, including maximum of 15 marks for class attendance.

Third Year Honours Examination would consists of

- (i) Nine theory courses of which (Two course each carrying 100 marks and Seven courses each carrying 50 marks);
- (ii) Six practical courses of 36 hours duration each carrying 50 marks each , 20% of which would be allotted for class performance;
- (iii) Viva-Voce Examination carrying 75 marks and

- (iv) Three sessional examinations carrying 75 marks on average, including maximum of 15 marks for class attendance.

Fourth Year Honours Examination would consists of

- (i) Ten theory courses of which (three course carrying 100 marks each and seven courses carrying 50 marks each);
- (ii) Six practical courses of 36 hours duration carrying 50 marks each, 20% of which would be allotted for class performance;
- (iii) Viva-Voce Examination carrying 75 marks and
- (iv) Three sessional examinations carrying 75 marks on average, including maximum of 15 marks for class attendance.

The duration of examinations are 3 & 4 hours for each of 50 & 100 marks of theory courses respectively and 6 hours for each of 50 marks of Practical courses.

Marks Distributions for Faculty of Science, CU

Year	Major Theory + Practical	Related Theory + Practical	Sessional & Viva-Voce	Total Marks
1 st	450 (18)	350 (14)	150 (6)	950 (38)
2 nd	450 (18)	350 (14)	150 (6)	950 (38)
3 rd	850 (34)	-	150 (6)	1000 (40)
4 th	950 (38)	-	150 (6)	1100 (44)
Total	2700 (108)	700 (28)	600 (24)	4000(160)

Marks Distribution for different year of Examinations of Department of Statistics, CU

Year	Theory	Practical	Sessional & Viva-Voce	Total Marks
1 st	600 (24)	200 (08)	150 (6)	950 (38)
2 nd	600 (24)	200 (08)	150 (6)	950 (38)
3 rd	550 (22)	300 (12)	150 (6)	1000 (40)
4 th	650 (26)	300 (12)	150 (6)	1100 (44)
Total	2400 (96)	1000 (40)	600 (24)	4000 (160)

Note: Figures in parenthesis indicate the total credits

The year -wise structure for the B.Sc. (Honours) program in Statistics is given below:

First Year B. Sc. (Honours) 2014

Course No.	Course Title	Marks	Credit
Theoretical Courses			
Stat-101	Basic Statistics	100	4
Stat-102	Theory of Probability	100	4
Stat-103	Numerical Mathematics	50	2
Stat-104	Linear Algebra	50	2
Stat-105	Algebra, Geometry and Trigonometry	100	4
Stat-106	Calculus-I	100	4
Stat-107	Principles of Economics	100	4
Practical Courses			
Stat-108	Lab - I Basic Statistics	50 (40+10*)	2
Stat-109	Lab - II Numerical Mathematics	50 (40+10*)	2
Stat-110	Lab - III Linear Algebra	50 (40+10*)	2
Stat-111	Lab - IV Data Analysis - I	50 (40+10*)	2
-	Sessional Examination	75(60+15**)	3
-	Viva-Voce	75	3
-	Non Credit Compulsory English	100	0
Total		950	38

* Indicates class performance, ** indicates attendance in classes

Second Year B. Sc. (Honours), 2015

Course No.	Course Title	Marks	Credit
Theoretical Courses			
Stat-201	Probability Distribution	100	4
Stat-202	Sampling Distribution and Order Statistics	100	4
Stat-203	Calculus –II	75	3
Stat-204	Regression Analysis	50	2
Stat-205	Economic Statistics & Educational Statistics	50	2
Stat-206	Real Analysis and Complex Variables	75	3
Stat-207	Development Economics	50	2
Stat-208	Fundamentals of Banking & Management	50	2
Stat-209	Statistical Simulation and Data Processing	50	2
Practical Courses			
Stat-210	Lab - V Probability Distribution & Sampling Distribution	50 (40+10*)	2
Stat-211	Lab - VI Regression Analysis	50 (40+10*)	2
Stat-212	Lab - VII Economic Statistics and Educational Statistics	50 (40+10*)	2
Stat-213	Lab - VIII Data Analysis – II	50 (40+10*)	2
-	Sessional Examination	75(60+15**)	3
-	Viva-Voce	75	3
Total		950	38

* Indicates class performance, ** Indicates attendance in classes

Third Year B. Sc. (Honours), 2016

Course No.	Course Title	Marks	Credit	
Theoretical Courses				
Stat-301	Statistical Inference-I	100	4	
Stat-302	Time Series Analysis & Econometrics	100	4	
Stat-303	Stochastic Process	50	2	
Stat-304	Design and Analysis of Experiments	50	2	
Stat-305	Sample Survey	50	2	
Stat-306	Population Studies	50	2	
Stat-307	Industrial & Environmental Statistics	50	2	
Stat-308	Actuarial Statistics	50	2	
Stat-309	Data Analysis using S/R Language and MATLAB	50	2	
Practical Courses				
Stat-310	Lab -IX	Statistical Inference	50 (40+10*)	2
Stat-311	Lab -X	Time series Analysis & Econometrics	50 (40+10*)	2
Stat-312	Lab -XI	Population Studies	50 (40+10*)	2
Stat-313	Lab -XII	Design of Experiments & Sample Survey	50 (40+10*)	2
Stat-314	Lab -XIII	Industrial & Environmental Statistics	50 (40+10*)	2
Stat-315	Lab -XIV	Data Analysis – III	50 (40+10*)	2
--	Sessional Examination		75 (60+15**)	3
--	Viva-Voce		75	3
ToTal			1000	40

* Indicates class performance

** Indicates attendance in classes

Fourth Year B. Sc. (Honours), 2017

Course No.	Course Title	Marks	Credit	
Theoretical Courses				
Stat-401	Multivariate Analysis	75	3	
Stat-402	Design of Experiments	50	2	
Stat-403	Biostatistics and Epidemiology	75	3	
Stat-404	Applied Econometrics	50	2	
Stat-405	Mathematical Demography	50	2	
Stat- 406	Statistical Inference – II and Non-parametric Methods	100	4	
Stat- 407	Sampling Techniques & Research Methodology	100	4	
Stat- 408	Operations Research and Mathematical Programming	100	4	
Stat- 409	Statistical Data Mining for Bioinformatics	50	2	
Practical Courses				
Stat- 410	Lab - XV	Multivariate Analysis	50 (40+10*)	2
Stat- 411	Lab - XVI	Design of Experiments and Econometric Modeling	50 (40+10*)	2
Stat- 412	Lab - XVII	Sampling Techniques and Demography	50 (40+10*)	2
Stat- 413	Lab –XVIII	Statistical Inference & Non-parametric Methods	50 (40+10*)	2
Stat- 414	Lab -XIX	Mathematical Programming and Game theory	50 (40+10*)	2
Stat- 415	Lab - XX	Data Analysis - IV	50 (40+10*)	2
---	Sessional Examination		75(60*+15**)	3
---	Viva-Voce		75	3
	Total		1100	44
	Grand Total		4000	160

* Indicates class performance

** Indicates attendance in classes

First Year B. Sc. (Honours), 2014

Stat-101: Basic Statistics

Full Marks: 100 Credit 4 60 Class Hours

Group-A

Statistics- History and Scope: Origin, History and Development of statistics, Meaning of statistics, Definition, characteristics, functions Limitations, scope of Statistics, Statistics in different disciplines, Uses and abuses of Statistics, concepts of descriptive and Inferential statistics.

Statistical concepts and Data collection: Data, variable, different types of a variable, Population, Sample, random sample, parameter, statistic, Scale of measurements, classification of variables by scales of measurements. Primary data, secondary data, Methods of collection of primary data

Presentation and Classification of data: Classification and tabulation of data, frequency distribution, graphic presentation of qualitative and quantitative data, Exploratory data analysis, Stem and Leaf display, Dot plot, Time series plot

Measures of Central Tendency: Mean, median and mode; Different types of mean with their properties and their relationship, Quantiles with their Graphical presentation, Application of different measure of Central Tendency.

Measures of Dispersion of a Series of Data: Absolute and Relative Measures of Dispersion, Five Number Summary, box and Wishker's plot and their uses, Properties and applications of different measures of dispersion.

Moments and Shape Characteristics of Distribution: Moments and their interrelationship, Sheppard's Correction for Grouping Error, measures of Skewness, Kurtosis and their measures and interrelationship.

Group-B

Description and Relationship of bivariate data: Concept of Bi-variable data, construction of bi-variable frequency table, Scatter Diagram, Simple Correlation and its measure, properties of simple correlation coefficient, Spearman's Rank correlation, Kendall's Tau correlation and coefficient of concordance, Intra-class correlation, serial and biserial correlation, spurious correlation, Correlation ratio, Simple Regression and its measures, properties of simple regression coefficient, Lines of best fit, principle of least squares.

Concept of Partial and Multiple correlation and regression, Partial correlation coefficients, Relationship between simple, partial and multiple correlation coefficients, Coefficient of multiple determination.

Association of Attributes: Basic ideas, concept of independence, association, disassociation, data consistency, Measures of association, properties and interrelationship, Partial Association,

Contingency table: Analysis of rxc contingency table, derivation of 2x2 contingency table, degrees of freedom, Yate's correction: why and how is it done?

References:

1. Bhuyan, K.C.(2011) : Methods of Statistics, Sahitya Prokashani, Dhaka.
2. Gupta, S.P. & Kapoor, V.K (2009) : Fundamentals of Mathematical Statistics, 11th edition, Sultan Chand and Co., New Delhi
3. Islam M. N.(2004) : An Introduction to Statistics and Probability, 3rd edition, Mullick Brothers.
4. Kenney, J.F. & Keeping, E.S. : Mathematics of Statistics, 3rd Editon, Princeton, New Jersey.
5. Medhi, J. : Statistical Methods, An Introductory Text, Revised 2nd Ed, New Age International, New Delhi.
6. Moore P.G : Principles of Statistical Techniques, 3rd Ed, Cambridge University Press, London.
7. Mustafa, M.G. : Methods of Statistics.
8. Weatherburn, C.E. : A First Course in Mathematical Statistics.
9. Yule, G.U & Kendall, M.G. : An Introduction to the Theory of Statistics, (1999) Universal Book Stall, New Delhi

Stat-102: Theory of Probability

Full Marks: 100 Credit: 4 60 Class Hours

Group-A

Set theory: Set, subset, universal set, Venn diagram, Set operations, algebra of sets: Commutative laws, associative laws, complementary laws, difference laws and De-Morgan's law.

Combinatorial methods: Methods of counting sample points, Review of Permutations, Combinations, multiplication Principles and series.

Basic concepts of probability: History, meaning and Scope of probability, Approaches of defining probability: Classical, Empirical, Subjective and Axiomatic, axioms of probability, Experiment, random experiment, Sample Space, Event, different types of events, Odds and odd ratio, Event space and probability space, Union and Intersection of events, Difference between probability and possibility, Tree diagram, compound probability, Conditional probability and independence, some elementary theorems on probability, and conditional probability, Prior probability, Posterior probability, total probabilities & Bayes' theorem and their applications. Stochastic independence, some theorems related to independent events.

Group - B

Random variable: basic concepts, Discrete and continuous random variables, Probability mass function and density function, Distribution function and their properties with proofs.

Mathematical expectation and variance, Joint distribution functions, Marginal and conditional probability mass and density functions, Independent random variables, Conditional expectation and conditional variance, Cauchy-Schwarz inequality, Chebyshev's inequality, Jensen's inequality, Boole's inequality, Convergence of random variables, Convergence in

probability, Convergence in distribution, Law of large numbers (Weak law and Strong law), Central limit theorem

Generating function: Moment generating function, factorial function, cumulant generating function, relation between moments and cumulants, characteristic function and its properties, Probability generating functions, relationship between different types of generating functions, bi-variate probability generating function and its properties, Inversion theorem.

References:

1. Cramer, H. : The Elements of Probability Theory.
2. Feller, W. (1988). : Introduction to Probability Theory and its Applications, 3rd ed., Vol.I & II, Wiley Eastern, New Delhi
3. Gupta, S.P. and Kapoor, V.K : Fundamental of Mathematical Statistics, Sultan and Chand.
4. Islam, M.N., : Introduction to Statistics and Probability, 3rd Ed.
5. Lukacs, E. (1972) : Probability and Mathematical Statistics: An Introduction, Academic Press, N.Y.
6. Meyer, P.L. (1970) : Introductory Probability and Statistical Applications, 2nd edition, Addison Wesley, NY
7. Mosteller, F., Rourke, R.E. and Thomas, G.B (1970) : Probability with Statistical Applications, 2nd Edition, Addison- Wesley, London.
8. Rohatgi, V.K. & Saleh, A.K. Md. : An Introduction to Probability and Statistics, John Wiley and Sons, New York.
9. Ross S.M. (2009) : A First course in probability, 8th edition, Prentice Hall.
10. Roy M.K. (2008) : Fundamentals of Probability and Probability Distributions 8th edition.
11. Schaum's Outlines (2010) : Probability and Statistics, 3rd Ed., Tata McGraw Hill Education Pvt Ltd, New Delhi
12. Uspensky, J. V. : Introduction to Mathematical Probability

Stat-103: Numerical Mathematics

Marks: 50 Credit: 2 30 Class Hours

Different operators: Forward and backward difference operators, shift operator, inverse shift operator, differential and identify operators and divided difference operator, relationship among different operators, factorial notations.

Interpolation and extrapolation: Simple difference and divided difference table. Relationship between simple difference and divided difference table, Newton's forward and backward interpolation formula for equal interval of the argument.

Interpolation with unequal intervals of the argument: Properties of divided differences, Newton's general interpolation formula, Lagrange's interpolation formula for unequal intervals.

Central difference interpolation formulas : Central difference table, Gauss's forward and backward formulae, Stirling's interpolation formula and Bessel's interpolation formula.

Numerical differentiation: Detailed study of numerical differentiation.

Numerical integration: Difference between numerical differentiation and numerical integration, a general quadrature formula for equidistant ordinates, The Trapezoidal rule, Simpson's rules, Weddle's rule, Euler-Maclaurin's summation formula, Stirling's formula for approximation of factorials.

Inverse interpolation : Difference between direct interpolation and inverse interpolation, Lagrange's formula, method of successive approximation or iteration, and method of reversion of series.

Solution of algebraic and transcendental equations : Introduction, methods of finding the initial approximate value of the root; graphical method, Newton-Raphson method, method of false position, method of iteration, rate of convergence of Newton's method, geometric significance of Newton-Raphson method.

References:

1. Freeman, H. : Finite Differences for Actuarial Students.
2. Kuo, S. S. (1972) : Computer Applications of Numerical Methods
3. Mallick, S.A., Ahsanuddin : Numerical Mathematics: Theory and Application, (2008) 1st ed, Mullick & brothers.
4. Sastry, S (1997) : Introductory Methods of Numerical Analysis, 2nd Edition, Prentice Hall, New Delhi.
5. Scarborough, J.B. (1996) : Numerical Mathematical Analysis, 5th Edition, Oxford and IBH, New Delhi.
6. Scheld, F (1988). : Shaum's Outline of Theory of Problems of Numerical Analysis, McGraw Hill, Singapore.

Stat-104 Linear Algebra

Total Marks: 50 Credit: 2 30 Class Hours

Vector: Introduction, vectors and linear combinations, lengths, dot products, linear dependence and independence of set of Vectors, Vector space, sub-space, basis and dimension, orthogonality; orthogonalization of Vectors, Gram-Schmidt orthogonalization process.

Matrix: Definition, difference between matrix and determinant, basic operations and their properties, types of matrices, algebra of matrices: addition, subtraction and multiplication of matrices, orthogonal matrix, partitioned matrices, matrix product as linear combinations, transpose of matrix, trace of matrix, transformation of matrices (elementary, orthogonal transformation etc.)

Rank and Inverse of matrix : Definition, properties and related theorems of ranks with their proofs. Adjoins, inverse, Generalized inverse of matrix, properties of inverse of matrix, solution of equations with the help of inverse matrix, inverse by partitioning method. g-inverse.

Determinant: Definition, properties, Solution of equations with the help of determinant; Cramer's rule, sweep-out method etc

Eigenvalues and Eigenvectors: Introduction to Eigenvalues, diagonalizing a Matrix, Definition of characteristic roots and characteristics vectors of matrix, theorems of characteristic roots, Caley-Hamilton theorem and its applications, singular value decomposition.

System of linear equations

Quadratic forms: Various types of quadratic forms and related their theorems, reduction of quadratic forms and related theorems.

References:

1. Aitken, A.C. (1982) : Determinant and Matrices, Oliver & Boyd, London.
2. Ali, M.I. : Matrix Algebra.
3. Anton, H and Rorres, C. (2005) : Elementary Linear Algebra, 9th Edition, John Wiley & Sons, NY.
4. Ayres Frank (1982) : Theory and problems of Matrices, McGraw-Hill, New York.
5. Defranza, J., Gagliardi, D (2012) : Introduction to Linear Algebra with Applications, Tata McGraw Hill Education Pvt Ltd, New Delhi.
6. Lipschutz, S. (1981) : Schaum's Outline of Theory and Probability of Matrices, McGraw-Hill, Singapore.
7. Graybill, A. (1982) : Matrices with Application in Statistics, 2nd Edition, Wadsworth & Co, New York.
8. Gupta, S.S. (1987). : An Introduction to Matrices, Sultan Chand & Co., New Delhi.
9. Hadley, G. (1993) : Linear Algebra., 6th Rep, Narosa, New Delhi.
10. Narayan. S. (1985) : A Text Book of Matrices, 8th Edition, Sultan Chand & Co., New Delhi.
11. Searle, S.R. (1982) : Matrix Algebra Useful for Statistics, Wiley, NY.
12. Strang, G (2009) : Introduction to Linear Algebra, 4th (South Asian) edition, Cambridge University Press Ltd.

STAT-105 Algebra, Geometry and Trigonometry

Full Marks: 100 Credit: 4 60 Class Hours

Group- A: Algebra - 50 Marks

Theory of numbers; Residues and congruence's, Fermat's and Wilson's theorem; Theory of equations: relations between roots and coefficients, Newton's theorem on the sum of the powers of the roots of an equation. Descartes' rule of signs, Roots of symmetric functions, Solution of Cubic equations, Solution of bi-quadratic equations, Willi's Series, Inequalities, Summation of Series.

Convergence and divergence of a series, Different tests for convergence and divergence, Absolute convergence, Rearrangement of an alternating series and its sum, Partial fractions.

Group-B : Geometry and Trigonometry - 50 Marks

Co-ordinate Geometry of Two Dimensions: Transformation of axes; Equation of pair of straight lines, General equation of second degree; circle, parabola and hyperbola (tangents, normal chord of contact, pole), System of circles, Ellipse.

Geometry of Three Dimensions: Cartesian co-ordinate; Equation of plane, Straight line, Sphere, Hyperboloids and Paraboloids, General equation for second degree in three variables. Trigonometry: De-Moivre's Theorem and its elementary application: Gregory's series; Hyperbolic functions; Summation of Series (excluding hyperbolic series).

Spherical Trigonometry: Introductory concept of spherical Trigonometry, Cosine formula, Sine formula, Sine-Cosine formula.

References:

1. D.E. Litterwood : University Algebra.
2. Durall & Robson : Algebra Vol. I, II & III.
3. H. Rashid : Higher Algebra.
4. Mazumder, M.M. and Saifullah, K. : Elements of Higher Algebra
5. M. Shahidullah & P.K. Bhattacharjee. : Text Book on Algebra and Trigonometry.
6. R.A. Sardar, N.A. Khan & others : Text Book of Higher Trigonometry.

Stat-106: Calculus - I

Full Marks: 100 Credit: 4 60 Class Hours

Group-A: Differential Calculus - 50 Marks

Functions of a real variable, Domain, ranges and graphs of functions, Differentiation of functions; Successive differentiation; Leibnitz theorem, Partial differentiation; Statements of Rolle's theorem, Mean value theorem, Expansion of functions in power series. Indeterminate forms; Maxima and Minima: Tangents normal and pedal equation of plane curves; Curvature of plane curves; Asymptotes.

Curve Tracing: Inflexion Point, Convexity and concavity of curves,

Group-B: Integral Calculus - 50 Marks

Indefinite integrals; Integration by parts, Integration of rational fractions, Integration by reduction, definition of definite integral as the limit of a sum, Definite integrals, Elementary reduction formulae: Lengths of plane curves, plane areas and areas of surfaces of revolutions, Volumes of solids of revolution. Integral domain, Area of plane curves.

References:

1. Ayres, Franck : Theory and problems of Differential Equations.
2. Ayres, F and Meldelson, E. (1992) : Calculus, 3rd Edition, McGraw-Hill, NY.
3. Das & Mukherjee : Integral Calculus.
4. Edwards, J. : Calculus for Beginners.
5. Edwards, J. : Differential Calculus.
6. Edwards, J. : Integral Calculus.
7. Farid, S.M. : Differential Equation & tensor Analysis.
8. Granville : Calculus.
9. Jabber, M.A. : Differential Calculus.
10. Jabber, M.A. : Text Book on Integral Calculus.
11. K. Md and P.K Bhattacharjee : Text Book on Differential & Integral Calculus.
12. Lang, (1988) : First Course in Calculus, 5th Edition, Springer-Varlag, NY

Stat-107 Principles of Economics

Full Marks: 100 Credit: 4 60 Class Hours

Group A: Principles of Micro Economics

Preliminaries: Definition with criticism, scope of economic, positive and normative analysis, importance of studying microeconomics with examples, methodology of Economics, major economic problems.

Individual demand and supply : theory of demand and supply, laws of demand and supply, factors determining supply, demand schedule, supply schedule, equilibrium of demand and supply, elasticity of demand and supply, measurement of elasticity, price elasticity of demand and supply and their relationship.

Theory of consumer behavior: concept of utility, cardinal and ordinal utility, law of diminishing marginal utility, equi-marginal principle, Marshall's cardinal utility approach, Hicksian ordinal approach.

Indifference curve: Indifference curves and its characteristics, applications of indifference curves, Budget constraints- The budget line, substitutions effects, income effects and price effects, Slutsky equation, Giffen paradox, consumer's surplus, Consumers' equilibrium and corner solution, Engel's curves.

Market Structure:Theory of firm: meaning of market, perfect and imperfect competition; pricing under monopoly, oligopoly and monopolistic competition, short and long-run equilibrium analysis, concepts; revenue, marginal revenue, average revenue and, profit maximization, cost of production and cost curves, iso-cost line, theory of wages, rent and interest.

Theory of Production: production function, total, average and marginal production, law of diminishing returns, factors of production, pricing of factors of production under imperfect competition, least-cost combination of factors, division of labour, return to scale, laws of variable proportion, isoquants.

Group B: Principles of Macro Economics

Key concepts of macro economics: objectives, scope and instrument of macro economics, tools of macroeconomic policies

National Income: Measurement of national income. Two measures of national products as goods flow & as earnings flow-real vs. money national product, difficulties in the estimation of G.N.P. Theory of income and employment.

Elementary theory of income determination: The basic concepts of output-income, saving & investment-How income is determined at the level where saving & investment schedules interact.

Consumption: definition of consumption & income-aggregate consumption function-determinants of consumption function-how income increases through multiplier-importance of multiplier.

International Trade: Domestic Vs. International trade-the theory of comparative advantage, gains from trade- terms of trade. The demand for & supply of foreign exchange rates- flexible exchange rates.

Devaluation: its policy implications, inflation: Concepts, causes & effects of anti- inflationary measures, behaviors of national expenditure.

References:

1. Ahuja H L (2004) : Macroeconomics: Theory and Policy, Sultan Chand & Co., New Delhi.
- Ahuja H L (1977) : Principles of Microeconomics, 19th revised Ed., 2012.
2. Chiang, Alpha : Mathematical Economics.
- Dornbusch, R., Fischer S. (2005) : Macroeconomics, 6th Ed., McGraw Hill, New Delhi
3. Koutsoyiannis, A. (1985) : Modern microeconomics, 2nd edition, Macmillan, London.
4. Mankiw, N.G. (2004) : Macroeconomics, 5th Edition, Worth Publication.
5. Mankiw, N.G. (2001) : Principles of Economics, 2nd Edition, Worth Publication.
6. Parkin, M. (2003) : Microeconomics, 6th Edition, Pearson Education Inc, Australia.
7. Samuelson, P.A. & Nordhaus, W.D. (2004) : Economics, 16th Edition, McGraw-Hill, NY.
8. Shairo, E. : Macro Economics Analysis.

Course – Non Credit Eng (001): English Language

Marks: 100

Lectures: 60 Class Hour

Course Content

1. Reading and Comprehension of Prose Passage concerned with Different areas like Science, Linguistics etc. focusing on:
 - a) Vocabulary (Word class, Synonym, Antonym, Idioms and Phrasal Verbs, etc.)
 - b) Thematic Structures (Syntax)
 - c) Cohesion
 - d) Content Questions (Referential, Inferential, giving suitable title to the passage)
 - e) Summary/ Précis
2. Structures:
 - a) Tense, Modals and Conditionals, Determiners and Modifiers, Prepositional Phrases, Clauses.
 - b) Completion of Sentences.
 - c) Joining Sentences.

- d) Transformation of Sentences.
 - e) Framing Questions.
 - f) Correction of Sentences.
3. Writing free and guided Composition (within 150-220 words):
 - a) Narrative b) Descriptive c) Expository and d) Argumentative.
 4. Letter writing: a) Personal letters and b) formal letters (different kinds of official, business and public letters)
 5. Translate Bangla passage into English & from English into Bangla.
 6. Interpretation of charts, tables and diagrams in a concise and meaningful way.

References:

1. Houghton and Mifflin : Grammar and Composition
2. John Eastwood : Oxford Practice Grammar.
3. Maurise Imhoof & Hernan Hudson : From Paragraph to Essay.
4. R.C. Sharma and Krishna Mohan : Business correspondence and Report writing.
5. Q.M. Billah, G.S. Chy& M. Alam : Foundation English for undergraduates.
6. Stannard Allen : Living English Structure

Practical

Stat-108: Lab- I : Basic statistics

Marks : 50 (40+10*) Time : 6 Hours

Condensation and tabulation of data, Graphical presentation of a frequency distribution (histogram, different frequency curves, dot frequency diagram, frequency polygon, cumulative frequency curve, bar diagram, pie chart, time chart etc.), Calculation of various measures of locations by the usual formulas and graphical method and their comparison, Calculation of various measures of dispersion for grouped and ungrouped data, Combined mean and combined variance, skewness and kurtosis for grouped and ungrouped data.

Construction of a scatter diagram and bi-variable frequency distribution, Simple correlation coefficient, Simple regression coefficients, Intra-Class correlation coefficient, Correlation ratio, Rank correlation coefficient, Partial and Multiple correlation coefficients, Coefficient of multiple determination.

Association of Attributes, contingency table and Yates' correction, Association in contingency tables, Brandt and Snedecor formula for 2x2 contingency table, coefficient of concordance and Colligation, Yates' correction.

Stat- 109: Lab - II : Numerical Mathematics

Marks : 50 (40+10*) Credit-2 Time: 6 Hours

Use of different Interpolation Formulas : Newton's forward and backward interpolation formulas, Newton's general interpolation formula, Lagrange's interpolation formula, Central difference Interpolation formulas: Gauss's, Stirling's and Bessel's.

Inverse interpolation : By the method of successive and Lagrange's formulae.

Numerical integration: Trapezoidal rule, Simpson's rule, Weddle's rule, Euler-Maclaurin's formula.

Transcendental equations: Solution of equation by graphical Method, Newton-Raphson's method, Method of false position, Method of Iteration

Stat- 110: Lab- III : Matrix algebra

Marks : 50 (40+10*) Time : 6 Hours

Matrix inversion, Rank of a matrix, Vector space, Basis of vector space, Orthogonalization of vectors, Solution of homogeneous and non-homogeneous system of linear equations. Calculation of latent roots, and latent vectors, application of Caley- Hamilton theorem, Reduction to canonical form, Calculation of rank, signature and indices of matrices of different quadratic forms.

Stat- 111 : Lab - IV: Data Analysis - I

Marks: 50 (40+10*) Time: 6 Hours

Introduction: Briefly discuss about computer and its hardware; Processing Data: Presentation of Data by Computers, Bits and Bytes, Text Codes Data, Processing of Data by Computer, CPU-Control Unit, Arithmetic/Logic Unit and Registers, Factors Affecting the Processing Speed of Computer, Memory: Main and Auxiliary Memory, Storage Devices; Input and Output Devices; Operating System; Networking; Internet.

Task Oriented Software

Electronic Spreadsheet (MS Excel): Electronic spreadsheet (MS Excel): Meaning of spreadsheet software, The spreadsheet software's interface, Entering data in a worksheet, Editing and formatting a worksheet, build-in functions (Basic, Statistical, Math & Trigonometric), Add-in Options, Data Analysis ToolPak, Sort, Filter, Freeze Panel, PivotTable and PivotChart Report.

Word Processing: Word Processing Programs and their Uses, Word Processor's Interface, Entering and Editing Text, Formatting Text, Document Formats, Formula and Function Management, Creating Tables.

Power Point Presentation: Meaning and Use of Presentation Programs, Presentation Program's Interface, Creating Presentation, Formatting Slides.

Programming Language

Evaluation of Programming Language: Basic Concept, Types-machine Language, Assembly Language, High-level Language.

Fortran Language: Character Sets, Variable Names, Statements (Executable and Non-executable, Type Declaration, Assignment, FORMAT, OPEN, STOP, END), Operators (Arithmetic, Logical and Relational), Expressions, List-directed READ/WRITE Statements, FORMAT, Directed READ/WRITE Statements, Edit Descriptors, Vertical Control of Output, FORTRAN Built-in-Functions, Transfer (Unconditional and Conditional) Statement, Control Statements, One, Two and Higher Dimensional Arrays.

Subprogram: Statement-function, FUNCTION and SUBROUTINE Subprograms, RETURN, CALL, COMMON, CHARACTER, DATA PARAMETER, EQUIVALENCE Statements.

* Computing problems Using MS Excel and Fortran related to the courses STAT 101, STAT 102, STAT 103, STAT 104. In the practical examination students will have to solve practical problems using FORTRAN and MS EXCEL and will have to write a short report on the practical problems using MS WORD and finally have to make a POWER POINT SLIDE to present the report.

Second Year B. Sc. (Honours), 2015

Stat- 201 Probability Distribution

Full Marks: 100 Credit: 4 60 Class Hours

Group- A: Discrete Probability Distributions - 50 Marks

Univariate discrete probability distributions: Detailed study of bernoulli, binomial, Poisson, geometric, negative binomial, hyper geometric, logarithmic series, uniform, generalized negative binomial, generalized Poisson, generalized geometric etc., determination of moments by moment generating function, Probability generating function, cumulant generating function etc.

Bivariate probability distributions: Bivariate binomial, Poisson, Negative binomial, uniform, hyper geometric, Logarithmic etc.

Multinomial distribution, the continuity theorem, truncated distributions, truncated binomial & Poisson distributions.

Group- B : Continuous Probability Distributions - 50 Marks

Univariate continuous distributions: Detailed study of normal, Beta, Gamma, Exponential, Uniform, Lognormal, Cauchy, Laplace, Erlang, Maxwell, Weibull, Gumbel, Pareto, inverse Gaussian and other exponential family of distributions. Pearsonian system of curves, Determination of moments by moment generating function, cumulant generating function, Characteristics function, Laplace transform, Edgeworth Series, Gram-Charlier Series.

Bivariate probability distributions: Normal, Cauchy, Pareto, beta and gamma distributions.

Multinomial distribution: The continuity theorem, truncated distributions, Mixed Distributions.

References:

1. Feller, W. (1985) : Introduction to Probability Theory and Its Applications. 3rd edition, John Wiley & Sons, NY.
2. Gupta, S.P., Kapoor, V.K. : Fundamentals of Mathematical Statistics, Sultan & Chand Co/. New Delhi.
3. Hogg, R.V. and Craig, A.T. : Introduction to Mathematical Statistics, 6th Edition, Pearson Education Ltd, Singapore.
4. Johnson, N. & Kotz, S. and Kemp, A. (1994) : Univariate Discrete Distributions, 2nd Edition, John Wiley & Sons, New York.
5. Johnson, N and Balakrishnan, N. : Continuous Univariate Distributions, 2nd Edition, John Wiley & Sons, New York.
6. Kotz, S. Balakrishnan, N. and Johnson, N.L (2000) : Continuous Multivariate Distributions: Models and Applications, Vol.1, 2nd Edition, John Wiley
7. Mood, A.M., Graybill, P.A. and Boes, D.C. (1974) : Introduction to the Theory of Statistics, 3rd Edition, McGraw-Hill, NY.
8. Patel, J.K., : Handbook of Statistical Distributions.
9. Roy, M.K. (2008) : Fundamentals of Probability & Probability Distributions, 8th edition.
10. Islam, M.N. : An Introduction to Statistics and Probability

Stat- 202: Sampling Distribution & Order Statistics

Full Marks: 100 Credit: 4 60 Class Hours

Concepts of Probability and Sampling distributions, different methods of sampling distribution, methods of obtaining sampling distribution, distribution of sample mean, sample variance and their independence, sampling distributions of correlation and regression coefficients, standard error of statistics and their large sample approximation. Transformation of variables: square root, log, Sin inverse, Fisher's Z-transformation, laplace transformation, tan inverse, Hyperbolic inverse.

Standard errors of statistics: class frequencies, covariance of the frequencies in different classes, Standard errors in moments, Covariance of moments of different orders, Standard error of the variance and the standard deviation of a large sampl.

Detailed study of central and non-central chi-square, F, t and beta distributions.

Order Statistics: concepts of order statistics and their application; Distribution of single order statistics, joint distribution of two or more order statistics, Distributions of Sample median, range, maximum and minimum and other quantiles, moments of order statistics, estimation based on order statistics, Asymptotic distribution of order statistics, confidence interval estimates for population quantiles, Tolerance limits for distribution and coverages.

References:

1. Anderson and Bankraft : Statistical Theory in Research.
2. Ashraf Ali Vol. II : Theory of Statistics.
3. Balakrishnan, N. , Cohen, A. : Order Statistics and Inference Estimation Method, A.C. (1990) Academy Press, NY.
4. Cramer : Mathematical Method of Statistics.
5. David, H.A. (1980) : Order Statistics, 2nd Edition, John Wiley, NY.
6. Goulden : Methods of Statistics.
7. Gupta, S.P., Kapoor, V.K. : Fundamentals of Mathematical Statistics, Sultan & Chand Company, New Delhi.
8. Hoel, P.G. (1984) : Introduction to Mathematical Statistics, 5th Edition, Wiley, NY.
9. Islam, M.N. : An Introduction to Statistics and Probability.
10. Lindergreen, B.W. (1976) : Statistical Theory, 3rd Edition, MacMillan, UK.
11. Mathai, A.M. : Distribution of Test Statistics: Exact & Asymptotic, Null & Method.
12. Rao, C.R. (1962) : Advanced Statistical Methods in Biometric. Research, Wiley, NY.
13. Reiss, R.D : Approximate Distribution of Order Statistics.
14. Steel and Torrie : Principle and Procedure of Statistics.
15. Weatherburn, C.W. : A First Course in Mathematical Statistics. S. Chand & Company ltd.

Stat- 203: Calculus-II

Full Marks: 75 Credit: 3 60 Class Hours

Group – A: Advanced Calculus - 40 Marks

Function of several variables, Limit, Continuity and Differentiability of functions of several variables Taylor's series, Lagrange's method of undetermined multiplier. Jacobian transformations and their applications in statistics.

Double, triple and multiple integrations, Change of variables, Dirichlet's integral and its extension. Beta and Gamma functions and their properties. Incomplete Beta and Gamma functions. Fourier Series and Fourier Integrals, Transformation of Integrals, Change of the order of Integrations.

Group-B: Differential Equations - 35 Marks

Ordinary differential equation (ODE) of first order and first degree, variable separable, homogeneous and non-homogeneous equations, exact differential equations, Simple cases of differential equations of first order and of degree higher than one, Linear differential equations with constant co-efficient, ordinary simultaneous differential equations, Equations reducible to homogeneous forms, homogeneous linear equations, orthogonal trajectories. partial differential equations first order, second order (linear and non-linear) and their analysis in details.

References:

1. Buck, R.C., (1977) : Advanced Calculus, 3rd Edition, McGraw-Hill, NY.
2. Freeman, H. : Finite Difference for Actuarial Students.
3. Maxwell, E.H.G. : Analytical Calculus, Vol. II & III.
4. Muhammad & Bhattacharjee : Differential Calculus.
5. Santi Narayan : Mathematical Analysis.
6. Whittaka & Robinson : The Calculus of Observations.
7. Ayres, Franck : Theory and Problems of Differential Equations.
8. Farid, S.M. : Differential Equations and Tensor Analysis.

Stat- 204: Regression Analysis

Marks: 50 Credit: 2 30 Class Hours

Review of Simple Linear regression: Straight line relationship between two variables, linear regression, regression curve, formulation of the model and estimation of parameters, confidence intervals and test for intercept and regression co-efficients, F-test for overall significance of regression.

Multiple regression in matrix forms: Multiple regression models, regression model in matrix notation, Model assumptions, OLS estimation of regression parameters, properties of OLS estimators, properties of residuals, ML estimation, Partitioning of total sum of squares into components, co-efficient of multiple determination (R^2), Adjusted R^2 , Properties and sampling distribution of component SS, “Extra sum of squares” principle, Partial and Sequential F test.

Special topics on multiple regression; testing and inference about a general linear hypothesis, generalized least squares, weighted least squares, restricted least squares

Checking the straight line fit: lack of fit and pure error, basic plots for examining residuals, non-normality checks of residuals, checks for time effects, test for lack of fit, bias in regression estimates, Predictions (Individual and mean response).

Selecting the best regression equation: All possible regressions; “best subset” regression, stepwise regression, stage wise regression, Forward selection; Backward elimination; significance levels for selection procedures, Diagnostic criteria.

Generalizes linear models: Generalized linear models for binary data; Generalizes linear models for counts; exponential family of distribution.

Polynomial and Non-linear regression: Fitting polynomial regression model by the help of orthogonal polynomials, Different types of non-linear regression and their estimation process.

Outliers and Influential observations: Various residual plots, Cook’s statistics, detecting outliers using ordinary residuals, hat matrix and Studentized residuals,

References:

1. Chatterjee, S. Hadi, A.S. and Price, B. (2000) : Regression Analysis by examples, 3rd Edition, John Wiley & Sons Inc., USA.
2. Draper, N.R. and Smith, H (1999) : Applied Regression Analysis, 3rd Edition, Wiley, USA.
3. Gujarati , D.N. : Basic Econometrics, Fourth Edition.
4. Johnston, J. (1997) : Econometric Methods, 3rd Edition, McGraw-Hill, NY.
5. Kleinbaum, D.G., Kupper, A., Muller, K.E. (2009) : Applied Regression Analysis, Indian Ed., Cengage Learning India Pvt Ltd
6. Koutsoyiannis A. (1986) : Theory of Econometrics, 2nd Edition, MacMillan, USA.
7. Montgomery, D.C. Peck, E. (1992) : An Introduction to Regression Analysis, 2nd Edition, Wiley, NY.
8. Myers, R.H. : Classical and modern regression with applications.
9. Neter, J.B. and Wasserman, J.D. (1982) : Applied Statistical Linear Models, 2nd Edition, Wiley, NY.
10. Weisberg, S. (1985) : Applied Linear Regression, 2nd Edition, Wiley, N.Y.

Stat- 205: Economic Statistics & Educational Statistics

Marks: 50 Credit: 2 30 Class Hours

Index number : definition, steps involved in construction of index number, classification and calculation of index numbers, test of index numbers, cost of living index number.

Economic Statistics: Production function, productivity curves, returns to scale, Cobb-Douglas production function with properties, CES and CES types of production function with properties and estimation, Isoquants, Profit maximization, MRTS, Equilibrium condition, Euler's theorem.

Law of income and wealth Distribution: Parato's Law of Income Distribution, Log normal distribution with properties and estimation, Mandelbrot's Model, Lorenz curve, Gini's Concentration ratio, Income Inequality.

Input-output analysis, Leontief's Model: Open and closed models, Usefulness of Leontief model in economic planning.

Educational Statistics: Introduction, Scaling-Thronthike and Guttman Scales, intelligence and achievement tests, Test Scores, equivalence of scores, combination of Scores, intelligence quotient (I.Q.), reliability and validity to Tests, preliminary idea of environmental statistics and medical statistics.

Official Statistics of Bangladesh especially Related to Sectors of Economy and Population; BBS, BIDS, BANBEIS, Bangladesh Bank, Critical Evaluation of Sources and their limitations, other Publications related to BD data, Service Statistics and their role & importance in administration.

References:

1. Allen, R.G.D : Mathematical Analysis for Economists.
2. Chiang, Alpha : Mathematical Economics.
3. Duncan, A. J. (1970) : Quality Control and Industrial Statistics, 3rd Edition, Irwin, Illinois.
4. Fisher, R. A. : Economics.
5. Goon, A.M., Gupta, M.K. and Dasgupta, B. (1972) : Fundamentals of Statistics, Vol. II, The World Press Private Ltd, India.
6. Gupta, S.C. & Kapoor, : Fundamentals of Applied Statistics.
7. Klein, L. R. : Introduction to Econometrics.
8. Lange, O. : An Introduction to Econometrics.
9. Montgomery, D.C. (2002) : Introduction to Statistical Quality Control, 4th Edition, John Wiley, NY.
10. Mukhopodhaya, P. (1999) : Applied Statistics, Books & Allied Ltd, India.
11. Singh, S. P. : Econometrics and Mathematical Economics.

Stat- 206: Real Analysis & Complex Variable

Total Marks: 75 Credit: 3 60 Class Hours

Group - A : Real Analysis - 40 Marks

Classifications of numbers: Real numbers: Rational and irrational numbers, Dedekind section of numbers (No proof) Real line intervals : Open interval, Closed interval.

Definition of distance function and its properties; sequences and its classification and its limit.

Riemann-Stieltjes Integrals : Definitions and simple properties. Integrals of simple functions. Lebesgue measure and its properties. Distinction between probability measure and Lebesgue measure and Lebesgue integrals.

Improper integral: Different kinds of improper integrals and tests of convergency.

Group-B: Complex Variables - 35 Marks

Elements of complex variables: Complex numbers, Set of points in the argand diagram. Functions of complex variable : Analytic functions: Conjugate functions, Harmonic functions; Complex integration: Cauchy's theorems, Laurent's theorem, Zero's and Singularities, Cauchy's residue theorem and Contour integration

References:

1. Halmos, P.R. : Measure Theory.
2. Meanul, C. : Probability Measure.
3. P.N. Chatterjee : Real Analysis
4. Churchill, V.R. : Complex Variable
5. Chowdhury, B. : Elements of Complex Variable
6. Spiegel, R.M. : Complex Variable

Stat- 207: Development Economics

Total Marks: 50 Credit: 2 30 Class Hours

Overview of Economic development: Nature of economic development, Reasons for studying development economics, Importance and role of values in development economics, Traditional measures, Core values, Objectives.

Characteristics of Developing Nations: Defining the developing world, Structural diversity of developing economics, Common characteristics of developing nations.

Economic Growth and Development: Capital accumulation, Population size, Distribution and growth Kuznet's six characteristics of modern economic growth, limited value of historical growth experience.

Classic Theories of Development: Four approaches, Rostow's stages of growth, Harrod-Domar growth model, Neoclassical growth model, Romer model, Big push.

Poverty, Inequality and Development: Measuring inequality and poverty – size distribution, Lorenz curve, Gini-co-efficient, poverty gap, Foster-Greer-Thorbecke index, Ahliwalia-Chenery Welfare index.

Human Capital: Central role of Education and health, Educational system and development, health system and development.

Other elements of development: International trade, Finance, Investment, Foreign Aid and their Contributions, Balance of Payment.

Economy of Bangladesh: Structure, population growth and development, urbanization and rural-urban migration, growth and inequality, growth and poverty, unemployment, agricultural and rural development, development planning and fiscal policy in Bangladesh.

References:

1. Bangladesh Economic Review (2005) : Ministry of Finance Division, The People's Republic of Bangladesh.
2. Herrick B and Kindleberger, C. P. (1983) : Economic Development, McGraw- Hill, Singapore.
3. Hogendorn, J. S. (1996) : Economic Development, 3rd Edition, Harper Collins, NY, USA.
4. Khan A.R. and Hossain, M. (1989) : The Strategy of Development in Bangladesh, Macmillan, USA.
5. Meier, G. M. (1995) : Leading Issues in Economic Development, 6th Edition, Oxford University Press, USA.
6. Sobhan, R. (1991) : The Decade of Stagnation, University Press Limited, Dhaka.
7. Todaro, M. P. and Smith, S. C. (2007) : Economic Development, 8th Edition, Pearson Education, India, 2007.

Stat- 208: Fundamentals of Banking & Management

Marks: 50 Credit: 2 30 Class Hours

Commercial Banking: Definition & Functions- Commercial Bank and Economic Development – Commercial Bank Regulations: Banking Companies Act in Bangladesh. Types of Banks, Banker- Customer Relationship, Advances to Customers: Forms of Bank Credit - Secured and Unsecured Advances- Discounts and Advances-Overdrafts-Cash Credit-Term Lending-Steps Involved in the Appraisal of Credit Risk.

Central Banking: Nature and Functions of Central Bank in developed and Undeveloped Money Market- Bangladesh Bank: Organization, Management and Functions, Technique of Monetary Management.

Bank Fund Management: Sources and Use of Fund- Portfolio Management: Primary Reserve, Secondary Reserve, Loans & Investment- Capital Adequacy: BASEL I, II & other techniques.

Management: Meaning, Nature, Evaluation, Functions, Principles, Impact of Environment on Management.

Planning: Meaning; Importance; Types; Premises; Limitation of Planning.

Organization: Theory and Principle of Organizing, Division of Works, Decentralization, Span of Management, Delegation of Authority, Committee, Decentralization, Coordination, Controlling.

Personnel Management: Meaning, Importance, Scope, Functions of Personnel Management: Motivation, Participative Management, Selection, Promotion, Training, Wage & Incentives, Groups, Management of organizational change and Conflict, Leadership.

Principles of Accounting: Transactions, Ledger Books, Cash Book, Accounting Procedure, Trial Balance, Financial Statements, Company Final Accounts.

Cost & Financial Management: Elements of costs of products, Calculation of cost of production, Cost-volume-profit analysis, Relevant cost for Decision Making, Budget and Budgetary Control.

Marketing Management: Concept, Nature, Function, Marketing Mix Strategy.

Technology Management: Management of Innovation, Technology Life Cycle.

Industrial Law in Bangladesh: Factories Act, Industrial Relation Ordinance, Workmen Compensation Act.

References:

1. A. A. Khan : Bangladesh Labor and Industrial Law.
2. Edward W. Reed : Commercial Bank Management.
3. Griffin : Management.
4. Horengren : Cost accounting- a managerial emphasis.
5. Kerghose : Foreign Exchange & Financing of Foreign Trade.
6. Kotler : Marketing Management.
7. L. R. Chowdhury : Loans and Advances.
8. Md. Muinuddin Khan : Advanced Accounting.
9. Radhaswamy & Vasudvan : A Text Book of Banking.
10. Robbins : Management.
11. R. I. Robinson : The Management of Bank Fund.
12. R.S. Sayers : Modern Banking.
13. Shekhar : Banking Theory & Practice.

Stat- 209: Statistical Simulation and Data Processing

Marks: 50 Credit: 2 30 Class Hours

Simulation

Overview: Meaning, Motivational Example, Simulation Process, Verification, Validation, Synchronous and Asynchronous Discrete Event Simulation, Continuous Event Simulation, Hybrid Event Simulation, Monte Carlo: Hit or Miss Monte Carlo Method, Sample-Mean Monte Carlo Method.

Variance Reduction Technique: Stratified Sampling, Conditional Monte Carlo, Jackknifing, Antithetic Variates.

Generating Uniform Random Variable: Classes of Generators – Random Devices, Tables, Midsquare Method, Fibonacci and Additive Congruential Generators, Linear Congruential Generators, Linear Recursion Mod 2 Generator, Combinations of Generators, Choosing Good Generator Based on Theoretical Considerations, Serial Correlation, Cycle of Length, Spectral Test.

Empirical Testing of Uniform Random Number Generators: Chi-Square Test, Kolmogorov-Smirnov Test, Gap Test, Run Test, Poker Test, Test of Autocorrelation, Maximum Test.

Generating Non-Uniform Random Variables: Alias Method, Inverse Transformation Method, Acceptance-Rejection Method, Polar Method, Method of Generating Random Numbers from Normal, Exponential, Gamma, Beta, χ^2 , t , F , Cauchy, Binomial, Poisson, Geometric, Negative Binomial Distributions.

Statistical Analysis of Simulated Data: Checking Properties of BLUE, Estimating Parameters of Linear Regression and Non-linear Regression Model, Interval Estimates of Population Mean.

SPSS

Overview: Meaning of SPSS, Concepts of Commands, Syntax Diagram, Running Commands in Inter-Relative and Batch Mode, Sub-Commands, Keywords, Values in Command Specifications, String Values in Command Specifications, Delimiters Command Order.

Different Types of Files (Command, Journal, Data, Raw Data, SPSS-Format Data, SPSS Portable, Working Data, Files from other Software Applications), Variable, Variable Formats, Transformation Expressions, Functions, Numeric Functions, Random Variable of Distribution Functions, Missing Values in Numerical Expression.

Arithmetic, Relational and Logical Operators, Order of Evaluation, Missing Values Functions, Input Data Specification, Commands and Program States, File Definition Commands, Utility Commands, Input Program Command, Transformation Commands, Restricted Transformations, Procedures, Generating Random Data, Commonly Used Commands for Statistical Analysis.

SPSS for Windows: Basic Steps in Analysis, Windows and Menus, Dialog, Basic Structure of SPSS Data File, Entering Numerical, Non-Numeric Data, Defining Data, Defined Value Labels to Enter Data, Reading Spreadsheet Data, Database, Text Data, Transforming Data Values, Constructing Tables, Statistical Analysis with Dialogue Interface. Running SPSS using Production Facility.

References:

1. Afifi, A. A. and Azen, S. P. : A Computer Oriented Approach, 2nd edition, (1979): Academic Press, New York.
2. Bartley, P., Fox, B. L. and Schrage, L. E. (1987) A Guide to Simulation, 2nd edition, Springer-Verlag, New York.
3. Law, M. A. and Kellon, W. D. : Simulation Modeling and Analysis, 3rd edition, (2000) Tata McGraw-Hill, New Delhi.

- | | |
|-----------------------------|---|
| 4. Norusis, M. J. (1988) | A Guide SPSS/PC for Data Analysis, SPSS Inc., USA. |
| 5. Ross, B. M. (1997) | : Simulation, 2 nd edition, Academic Press, USA. |
| 6. Rubinstein, R. Y. (1981) | : Simulation and the Monte Carlo Method, John Wiley and Sons, New York. |

Practical

Stat- 210: Lab –V: Probability distributions & Sampling distributions

Marks : 50 (40+10*) Time : 6 Hours

Group-A: Probability Distributions

Drawing of commonly used curves: Binomial, Poisson, Negative binomial, Geometric, Hyper geometric, Normal, Exponential, Rectangular, Beta, Log normal, Pareto, Cauchy distributions etc.

Fitting of Binomial, Poisson, Normal, Negative binomial, Exponential, Rectangular, Geometric, Hyper geometric, Cauchy, Log normal distributions etc.

Group B: Sampling distributions

Drawing of curves of chi-square, F, t and beta distributions (central) , standard error of statistics and their large sample approximation, distributions of sample mean and sample variance, sampling distributions of correlation and regression coefficients.

Stat- 211: Lab - VI : Regression Analysis

Marks : 50 (40+10*) Time: 6 Hours

Fitting of multiple regression line, Tests associated with regression analysis and confidence interval and prediction intervals. Separation of sum of squares, Partial F-tests and Sequential F-tests, polynomial and orthogonal polynomial fittings, Various residual plots.

Stat- 212 Lab - VII: Economic Statistics & Educational Statistics

Marks : 50 (40+10*) Time : 6 Hours

Group-A: Economic Statistics

Production function, returns to scale, productivity curves. Cobb- Douglas production function with properties and estimation, CES and CES types of production function with properties and estimation, Isoquants, Profit maximization, MRTS, Equilibrium condition, Euler's theorem.

Calculation and Tests of Various index number, cost of living index number.

Distribution of income and wealth, Parato's distribution and Log normal distribution with properties and estimation, Mandelbrot's Model, Other size distributions, Lorenz curve, Concentration ratio.

Input-output analysis, Leontief's Model: Open and closed models, usefulness of Leontief model in economic planning.

Group - B: Educational Statistics

Educational Statistics : Introduction. Scaling-Throndike and Guttman Scales. Intelligence and Achievement Tests. Test Scores. Equivalence of scores. Combination of Scores. Intelligence Quotient (I.Q.). Reliability and Validity to Tests. Preliminary idea of environmental statistics and medical statistics.

Scaling individual test, Percentile scaling of scores on a test (Z or d score and Z scaling, Standard Scores, Normalized scores, T-Scores etc.), Scaling of ratings interms of normal curves, Construction of distribution for I.Q. Scaling of judgments of a number of products. Test reliability.

Stat- 213: Lab –VIII: Data Analysis - II

Marks : 50 (40+10*) 2 credit Time : 6 Hours

Simulation: Generating Random Number from Uniform, Binomial, Poisson, Normal, Exponential, and Gamma by Different Monte-Carlo Methods and Using Standard Softwares and Computer Program; Testing Uniform Random Numbers using chi-square Test, Kolmogorov-Smirnov Test and Graphical Methods, Assess Different Statistical Properties of Generated Data, Integration by Monte-Carlo Simulation.

Problem Solving Through SPSS and Mathematica: Solving Different Statistical Problems by SPSS and Mathematica (Measures of Central Tendency, Measures of Dispersion, Correlation and Regression), Graphical Presentation of Statistical Data by SPSS, Analysis of Data by SPSS, Writing and Running Syntax in SPSS and Mathematica to Solve Different Statistical Problems of all 3rd year courses.

Third Year B. Sc. (Honours), 2016

Stat- 301: Statistical Inference – I

Full Marks: 100 Credit: 4 60 Class Hours

Group- A: Estimation - 40 Marks

Basic concepts: Basic ideas of statistical inference, parametric and nonparametric inference, estimators, estimates, statistic, parameter, standard error, sampling distribution and uses in inference.

Estimation: point and interval estimation, estimation of parameters, different methods: method of moments, method of least squares, Method of minimum chi-square. method of modified chi-square, method of maximum likelihood- properties of MLE and LSE, Bayes estimator, criteria of a good point estimator, method of evaluating estimators: mean squared error, best unbiased estimator- efficiency, and Cramer- Rao lower bound, sufficiency- sufficient statistic, properties of a sufficient statistic, Rao-Cramer inequality, Rao-Blackwell theorem, MV and MVB estimators and their properties, minimal sufficient statistics, complete statistics.

Interval estimation : introduction, confidence interval, Central and non-central C.I., methods of finding confidence interval – pivotal quantity, exact and approximate confidence interval, large and small sample confidence intervals, method of evaluating interval estimators, simultaneous confidence region

Group- B: Test of Hypotheses - 60 Marks

Preliminary ideas of statistical hypothesis test, elements of test of hypothesis, errors in testing hypothesis, level of significance, one tailed and two tailed test, p-value, approaches to hypothesis testing: Neyman-Pearson approach, Fisher approach and Jeffrey's approach,

Usual tests based on normal distribution, t, χ^2 and F distribution, one sample settings- proportion, mean, variance, significance of correlation coefficient and regression coefficients, two sample (independent and paired) settings: equality of two proportions, means, variances and their confidence intervals, more than two sample settings: exact and large sample test, evaluating statistical test procedure- power of tests, optimal test, power of test, Neyman Pearson Lemma, MP, UMP, UMPU, LUMP tests, SPRT,

test of goodness of fit - probability plots, test for normality, Kolmogorov-Smirnov test, statistical test to categorical data problem, test of independence of attributes (2x2 and more than 2x2 contingency table), Fisher's exact test,

Similar regions, Similar region test and UMPSR test, unbiasedness and asymptotic relative efficiency of a test.

principles of likelihood ratio test and its applications, asymptotic distribution of LR statistic, LR test of goodness of fit problem.

References:

1. Anderson & Bancroft : Statistical Theory in Research.
2. Casella, G and Berger, RL (2002) : Statistical Inference, 2nd edition, Duxbury
3. Gupta, S.C., Kapoor, V.K : Fundamentals of Mathematical Statistics, Sultan & Chand, New Delhi
4. Hoel, P.G. : Introduction to Mathematical Statistics.
5. Hogg, R.H., McKean, J. and Craig, A.T. (2007) : Introduction to Mathematical Statistics, 6th Edition, Pearson Education Pvt. Ltd, Singapore.
6. Kendall, M.G. & Stuart, A. : Advanced Theory of Statistics Vol. II.
7. Kenney, J.F. & Keeping, E.S. : Mathematical Statistics Part-II.
8. Lehmann, E.L. : Testing Statistical Hypothesis.
9. Mood, A.M., Graybill, F.A and Bose, D.C. : Introduction to the Theory of Statistics, 3rd Edition, McGraw-Hill, NY.
10. Mostofa, M.G. : Methods of Statistics
11. Rao, C. R. (1962) : Advanced Statistical Method in Biometric Research, Wiley, USA
12. Rohatgi, V.K. (1993) : An Introduction to Probability Theory and Mathematical Statistics, Wiley Eastern, India.
13. Saxena, N.C. & Surendar, P.N : Statistical Inference.

Stat- 302 Time Series Analysis and Econometrics

Full Marks: 100 Credit: 4 60 Class Hours

Group- A: Time Series Analysis - 50 marks

Time Series Analysis: Types of data, Meaning and objectives of Time Series, different components of time series, Measurement of trend by different methods (Graphical method, method of semi average, method of least square, method of moving average), Measurements of seasonal variations (Method of simple average, ratio to trend method, ratio to moving average method, link relative method), Forecasting, objective, steps, exponential technique, MAD (mean absolute deviation), detrended and deseasonalized data

Stationary and non-stationary (evolutory) process, Properties of weakly and strictly stationary process Linear Process. Auto-Covariance function (ACVF), Auto correlation Function (ACF) from AR(I), AR(2), MA(I), MA (2), ARMA(I,I) models, correlogram Analysis.

Spectral and Periodogram analysis. Spectral density, periodogram, time invariant linear filters, spectral density of ARMA process problems.

Group- B: Econometrics - 50 marks

Preliminaries: Definition, economic and econometric models, types of Econometrics, nature Scope and division of Econometrics, aims and methodology of Econometric, Sources of Econometric data.

Classical linear regression model: Point estimation of parameters of two-variable linear regression model -OLS and ML method, Evaluation of forecasting power of the model, selection of regressors, desirable properties of an econometric model, Different model selection criteria, Restricted least square estimation.

Violations of assumptions: GLS and weighted least squares method, Multicollinearity, Heteroskedasticity, Autocorrelation, Specification error and all related matters.

Categorical variable techniques: Meaning and nature of dummy variables, testing structural stability of regression model using Chow test, dummy variable trap, method of avoiding dummy variable trap.

Dummy independent variable model, dependent variable model – log-linear, LPM, logit, probit, hazards model.

References:

1. Baumol, W. J. : Economic Theory and Operations Analysis.
2. Bowerman, B.L, O’Connell, R.T. and Koehler A. B. (2005) : Forecasting, Time Series & Regression, 4th Edition, Cengage Learning, USA.
3. Brockwell, P.J., Davis, R.A. (2002) : Introduction to Time Series and Forecasting, 2nd Edition, Springer-Verlag, NY. Inc.
4. Diebold, F.X. (2004) : Elements of Forecasting, 3rd Edition, Rahul Print O Pack, India.
Greene, W.H. ((2003) : Econometric Analysis, Pearson, 8th Impression in India, 2012
5. Gujarati D. : Basic econometrics.
6. Gujarati, D.N., Porter, D.C., Gunasekar, S. (2009) : Basic Econometrics, 5th Edition, Tata McGraw Hill, India, reprint in 2012.
7. Hamilton, J.D. (1994) : Time Series Analysis, Princeton University Press, New Jersey.
8. Harris, R. and Robert, S. (2003) : Applied Time Series: Modeling and Forecasting, Replika Press Pvt Ltd, India.
9. Harvey, Andrew C. (1993) : Time Series Models, 2nd Edition, Harvester Wheatsheaf, UK.
10. Intrilligator M D. : Econometric models, Techniques and Applications.
11. Johnston, J., Dinardo, J. (1997) : Econometric Methods, 4th Edition, McGraw-Hill Company, Inc, Singapore
12. Koutsiyannis, A. : Theory of Econometrics.
13. Maddala, G.S. and Lahiri, K : Introduction to Econometrics, 4th Ed., Wiley India.
14. Makridakis, S, Whellwright, S,C. & Hyndman, R.J. (1998) : Forecasting Methods and Applications, 3rd Edition, Wiley & Sons, NY.
15. Tsay, R.S. (2005) : Analysis of Financial Time Series, 2nd Ed., John Wiley & Sons, Inc, UK

Stat-303: Stochastic Process

Total Marks: 50 Credit: 2 30 Class Hours

Stochastic Processes: Introduction, stochastic process, characteristics of stochastic process, state space, classification of stochastic processes, markov process.

Markov Chains: introduction, concept, examples, conditional probability, transition probability function, one and n-step transition probabilities, higher transition probability, application of markov chains, Chapman Kolmogorov equations, limit theorems, classification of states and chains, properties of communication of states, Ergodic properties, Evaluation of P^n .

Counting process: Counting process, stationary and independent increment, interarrival and waiting time distribution, conditional distribution of inter-arrival time.

Random walk with ruin problem: theory of random walk with reflecting barriers, duality of random walks, the classical ruin problem, probability of ruin, affect of change of state, expected duration of game.

Homogenous Markov process: Poisson process, pure birth process, pure death process, birth and death process, concept of queue, characteristics of queuing system, steady state probability, single server queues, equilibrium theory, queues with many servers, Limiting properties of queue.

Renewal theory: renewal event, recurrent event, delayed recurrent event, delayed renewal processes, distribution of $N(t)$, limit theorems and its applications, renewal reward process, regenerative process, cyclic renewal, alternative renewal process, branching process.

References:

1. Bailey, N.T.J. : The Elements of Stochastic Processes. Wiley, N.Y.
2. Basu, A.K : An introduction to stochastic process, Narosa Publishers
3. Bhat, B.R.(2000) : Stochastic Models, New Age International Ltd Publishers, New Delhi.
4. Bhat, U.N. (1984) : Stochastic Process, 2nd Edition, John Wiley, NY.
5. Biswas, S. (2005) : Applied Stochastic Processes, New Central Book Agency, India, reprint in 2012.
6. Biswas, S., Sriwastav, G.L. (2006) : Stochastic Processes in Demography Applications, New Central Book Agency Pvt Ltd, Delhi, reprinted in 2011.
7. Chung, K.L. : Elementary Probability Theory with Stochastic Processes, 3rd Edition, Narosa Publishing, New Delhi.
8. Cox, D.R. and Miller, (1985) : The Theory of Stochastic Process, 2nd edition, Chapman and Hall, London.
9. Feller, W. (1988) : An Introduction to the Probability Theory and its Application. Vol. I & II, Wiley Eastern, New Delhi.

10. Grimmett, G and Stirzaker, D : Probability and Random Process, 3rd edition, (2001) Oxford University Press.
11. Karlin, S. (1975) : A First Course in Stochastic Process, 2nd Edition, Academic Press, NY.
12. Medhi, J. (1994) : Stochastic Processes, 3rd Edition, New Age International Publishers Ltd, New Delhi.
13. Minh, D.L. (2001) : Applied Probability Models, Thomsom Duxbury, California.
14. Ross, S.M. (2010) : Introduction to Probability Models, 10th Edition, reprint in 2012 in Delhi, John Wiley & Sons.
15. Srinivasan, S.K. and Mahata, K.M : Stochastic Process, 2nd Edition, Wiley Eastern, (1976) New Delhi.

Stat- 304 : Design and Analysis of Experiments

Marks: 50 Credit: 2 30 Class Hours

Agricultural statistics: definition, basic and current agricultural statistics, census of agriculture: objectives, scope.

Introduction to design of experiments: strategy of experimentation, difference between design of experiment and design of sample survey, Requirements of a good experiment, important steps to conduct design of experiments, applications of experimental design, basic principles of designs of experiments, experimental errors and interpretation of data, contrast, orthogonal contrasts, mutually orthogonal contrasts, analysis of variance with fixed effect, random effect and mixed effect models, model adequacy checking, efficiency of a design, relative efficiency of designs.

Analysis of variance: Fundamentals of analysis of variance, analysis of variance: one-way classification with equal and unequal observations, two-way (single and multiple equal no. of observation per cell) and three-way classification with equal number of observations per cell.

Detailed study of basic designs- estimation and analysis of Completely randomized designs (CRD), Randomized block design (RBD), Latin square design (LSD), RBD with multiple equal no. of observations per cell, Replicated Latin square design, Cross- over design, Missing plot techniques in RBD and LSD.

Multiple comparisons: Introduction, Tukey's W-test, Newman-Keuls several range test, Duncan multiple range test, Dunnett's test.

Factorial experiments: Introduction to factorial experiments, advantage of factorials, comparative study of factorial and non- factorial experiments. Construction and analysis of factorial experiments for two-level having upto ' n ' factors i.e., 2^2 , 2^3 , 2^4 , 2^n factorial experiments.

Blocking and Confounding: Introduction, blocking a replicated 2^n factorial design, confounding and data analysis in 2^3 , 2^4 factorial experiments in two blocks.

References:

1. Cochran, W.G. and Cox. G.M. : Experimental Design, 2nd Edition, John Wiley and Sons, New Delhi. (2000)
2. Das, M.M. & Giri, N.C. (1986) : Design and Analysis of Experiments, 2nd Edition, New Age International, New Delhi, printed in 2011.
3. Federer. W.T. : Experimental Design, Theory and Applications.
4. Fisher, R.A. : The Design of Experiments.
5. Joshi, D.D (1987) : Linear Estimation and Design of Experiments, Reprinted (2009), New Age International Publishers Ltd, New Delhi.
6. Jeff Wu, C.F., Hamada, M (2002) : Experiments: Planning, Analysis, and Parameter Design Optimization, John Wiley & Sons.
7. Kempthorne, O : Design of Experiments.
8. Montgomery, D.C. (2009) : Design and Analysis of Experiments, 7th Edition, John Wiley & Sons Inc, printed in India.
9. M.R.Bhuiya : Fundamentals of Experimental Design.
10. Steel, S.R. and Torrie, J.H. (1980) : Principles and Procedures of Statistics, 2nd Edition, McGraw-Hill, NY.

Stat- 305: Sample Survey

Marks: 50 Credit: 2 30 Class Hours

Introduction: Concept and scope of sampling, sample survey and complete enumeration, criteria of a good sampling design, unit, population, sampling frame, survey planning, steps in a sample survey, advantages of sample survey, basic principles of sample survey; steps in planning and problems arising in the execution and analysis of survey data.

Sampling preliminaries: probability and non-probability sampling, mixed sampling, drawing Samples from Finite population with and without replacement, sampling and non-sampling errors, bias, precision and accuracy of estimates, pilot survey.

Sources of Statistical Data: Primary and Secondary data; Methods of collecting data, Preparation of Questionnaire and Schedule, Pre-testing of Questionnaire, Data Coding and Code Plan.

Simple random sampling: Merits and demerits, drawing sample with and without replacement process estimates, standard errors and confidence interval, Simple random sampling for proportions and ratio estimate, standard error and confidence interval for specified precision.

Non-random sampling: purposive/judgment sampling, Quota sampling, convenience sampling, snowball sampling, merits, demerits and their applications.

Stratified random sampling: strata, stratification, principles of stratification; stratified random

sampling estimates, standard error and confidence interval, allocation of sample size in different strata by different methods, gain due to stratification, variance and cost function.

Systematic Sampling: linear and circular systematic sampling, use, limitations, estimation of mean, total and their variances, bias and efficiency, comparative study of simple random sampling, stratified random sampling and systematic sampling.

Study of National surveys in Bangladesh

References:

1. Cochran, W.G. (1977) : Sampling Techniques, 3rd edition, Wiley
2. Hansen, Hurwitz & Madow : Sample Survey Methods and Theory.
3. Kish, L. : Survey Sampling.
4. Kushawaha, K.S., Kumar, R. (2009) : The Theory of Sample Surveys & Statistical Decisions, 1st Ed., New India Publishing Agency
5. Lohr, SL (1998) : Sampling design and Analysis, Duxbury
6. Murthy, M.N. : Sampling Methods.
7. Snedecor, C.W. : Statistical Methods.
8. Sukhatme, P.V. and Ashok, C (1997) : Sampling Theory of Surveys with applications, 3rd ed., Indian Society of Agricultural Statistics
9. Mukhopadhaya (2000) : Theory and methods of Survey Sampling, Prentice -Hall, New Delhi
10. M.N. Islam (2005) : An Introduction to Sampling methods Theory and applications, Book World, Dhaka.

Stat- 306: Population Studies

Full Marks: 50 Credit : 2 30 Class hours

Demography: definition, nature and objectives, scope of demography.

Population studies: Definition, scope and importance of population studies, relationship of population studies with other disciplines.

Sources of demographic data: types of errors and deficiencies in data, population census, history, salient features, scope and uses of demographic data.

Registration of vital events: vital events, vital records, uses of registration of vital events.

Demographic surveys: the national sample survey, important demographic and family health survey.

Measures of mortality: Introduction, causes and uses of mortality, sources of mortality data, measures of mortality: crude death rate, Age-specific death rate, mortality rate, -- death rate, maternal mortality.

Measures of fertility: Introduction, sources of data for fertility analysis, importance of the study of fertility, some important fertility measures; crude birth rate, gross fertility rate, age-specific fertility rate, total fertility rate, gross reproduction rate, net reproduction rate.

Population Composition and Distribution: Rural and Urban Population, Urbanization, Age-Sex Composition and Structure, age sex population pyramid, age heaping, Myer's Index, Whipple's Index, United Nations Index, Causes of Errors in Age Data and their Detection.

Population growth, techniques of measuring population growth, doubling time concept in demography; population estimates.

Graduation of population data: meaning and its need, techniques of graduation, graduation of age distribution,

Migration: Introduction, some basic concepts, factors affecting migration, importance and consequences of migration.

World population growth: history, growth of population in different countries, demographic transition, human development index.

Reference Books

1. Barklay, J. : Techniques of Population Analysis., Wiley, NY
2. Biswas, S (1988) : Demography.
3. Cox, D. R. : Stochastic Process in Demography and Applications, Wiley Eastern, New Delhi.
4. Elandt ohnson : Survival Models and Data Analysis, John Wiley and Sons, NY.
5. Goon, A. M. & Gupta, M.N. : Fundamental of Statistics, Vol. II.
6. Gupta,S.C. & Kappor,V.K : Fundamental of Applied Statistics.
7. Lawless, J.F : Statistical Models and Method for Lifetime Data, John Wiley & Son.
8. Misra, B.D. : An Introduction to the Study of Population, South Asia, New Delhi
9. Shyrock, H.S., J.S. Siegel and Associates (2004) : The Methods and Materials of Demography, Latest edition, Academic Press, NY
10. Sinha, S. K. : Life Testing and Reliability, Wiley Eastern, New Delhi.
11. Spiegelman, M. : Introduction to Demography, Harvard University Press, USA
12. Swain, A.K.P.C (2005) : A text book of Population Studies, Kalyani Publishers, New Delhi.

Stat- 307: Industrial & Environmental Statistics

Total Marks: 50 Credit: 2 30 Class Hours

Industrial Statistics: Elementary concepts of industrial statistics and its objectives, industrial quality control, total quality control, statistical quality control, chance and assignable causes of variation, statistical process control.

Control chart: concept of control chart, Principles and statistical basis of control chart, types of control chart, Construction of control charts for mean (\bar{x}), Range (R), Standard deviation [s], proportion defectives [p], number of defectives [nP] and number of defects per unit [c]. Product control, Designing a single & double sampling plan.

Acceptance sampling: basic concepts, O.C. curves and its application, types & properties of OC curve, ASN, AOQ, AOQL, designing a variable sampling plan with a specified OC curve, sequential sampling and sequential probability ratio test (SPRT).

Environmental Statistics: Scope and Nature of Environmental Statistics: Stochastic process in-the environmental Probability Models and fitting of probability models to Environmental Data. Applications of Bernoulli and Poisson Processes to Environmental Problems, Normal process and its application to Environmental Problems, Environmental monitoring and Assessments, Ecological sampling.

Diffusion and Dispersion of Pollutants: Wedge Machine, Particle Frame Machine and Plume Model.

Dilution of Pollutants: deterministic dilution, stochastic dilution and the theory of successive random dilution (SRD), applications of SRD to Environmental Phenomena: air, quality, indoor quality, Water Quality, Concentrations in Soils, Plants and Animals and Concentrator's in foods and Human Tissue.

Statistical Theory of Rollback and its Application to Environmental Problems, Environmental Indicators: Definitions, Criteria for developing indices, Function of an indicator, II Computation of indices.

References:

1. Barnett, V. (2004) : Environmental Statistics and Data Analysis, John Wiley, NY.
2. Barnett, V. and Turkman, K.F (1993) : Statistics for the Environment, John Wiley and Sons, Chichester.
3. Duncan, A. J (1970) : Quality Control and Industrial Statistics, 3rd Edition, Irwin, Homewood, Illinois.
4. Gupta, S.C. & Kapoor, V.K : Fundamentals of Applied Statistics, Sultan & Chand, India.
5. Hill, M.K. : Understanding Environmental Pollutions, Cambridge University.
6. Millard, S.P. and Neerchal, N.K. : Environmental Statistics using S-Plus, CRC press.
7. Montgomery, D.C. (2002) : Introduction to Quality Control, 4th Edition. John Wiley & Sons, NY.
8. Wayner, R. Ott. (2002) : Environmental Statistics and Data Analysis, Lewis Publishers, England.

Stat- 308: Actuarial Statistics

Marks: 50 Credit: 2 30 Class Hours

Preliminaries:The meaning of Actuarial science, its relationship with Life Insurance, role of insurance in the economy, role of actuarial statistics especially in context of Bangladesh, Organization and Functions of Jiban Bima Corporation and Sadharan Bima Corporation - Role of Private Insurance Companies- Problems and Prospects of Insurance Business in Bangladesh.

Fundamentals of theory of Interest (In discrete time): definition of simple Interest and compound Interest and their comparisons; accumulated value factors and present value factors; effective and nominal rates of Interest and their interrelationship; effective and nominal rates of discount; relation between interest and discount. Equations of value and use of the time diagram in solutions of problems in Interest, Problems Involving unknown length of Investment and unknown rate of interest, Annuity; different types of annuities certain; present and accumulated values of immediate annuity and annuity due; present values of deferred annuities and variable annuities; analysis of annuities payable at a different frequency than interest is convertible, Perpetuity, capital redemption polities, amortization schedules and sinking funds, including the determination of outstanding principal, the split of payments into principal and Interest, and the determination of required periodic payments.

Economics of insurance, utility theory, application of probability to problems of life and death, determination of single premiums for insurances and annuities in both the discrete and continuous case.

Theory and practice of pension plan funding, assumptions, basic actuarial functions and population theory applied to private pensions.

Survival distributions and life tables, life Insurance, life annuities, net premium, premium series, multiple life functions, multiple decrement models, valuation theory for pension plans, expense function and dividends.

Construction of Actuarial tables: Introduction to the mortality table, principles of construction of mortality table, fundamental assumptions underlying exposure formulas and the implications of these assumptions; techniques of calculating exposures from individual records including considerations involving selection of studies.

Various observation periods and various methods of tabulating deaths, techniques of calculating exposures from valuation schedules including the general concept of fiscal year, the use of Interim schedules and variations in observations period or method of grouping deaths and practical aspects of construction of actuarial tables.

References:

1. Atkinson, M.E., Dickson, D.C.M. (2000) : An Introduction to Actuarial Studies, Edward Elgar Publishing Inc., UK.
2. Bather, R.W. (1978) : Mortality Table Construction, Prentice Hall, NJ.
3. Boland, P.J. (2007) : Statistical and Probabilistic Methods in Actuarial Science, Chapman & Hall, USA.
4. Dickson, David C.M. (2005) : Insurance Risk and Ruin, Cambridge University Press, UK.

5. Johnson, R.C.E. & Johnson N.L. : Survival models and data analysis, Wiley, NY (1980)
6. M. N. Mishra : Insurance- Principles and Practice.
7. Paramenter, M.M. (1988) : Theory of Interest and Life Contingencies with Pension Application, ACTEX Publication, CT, USA.
8. P. de Jong and Heller, G.Z. : Generalized Models for Insurance Data, (2008) Cambridge University Press, UK.
9. Shahiduddin Ahmed : Insurance Business in Bangladesh.
10. Sherris, M. (2009) : Principles of Actuarial Science, 1st Edition Cengage Learning, Australia.
11. Slud, Eric, V. (2001) : Actuarial Mathematics and Life Table Statistics, University of Maryland, USA.
12. Trowbridge, C.L. (1989) : Fundamental Concepts of Actuarial Science, Revised Edition, Actuarial Education of Research Fund (AERF).
13. Uddin, Mohammad Sohrab : An introduction to Actuarial and Financial Mathematics.
14. ---- : Publications of Jiban Bima, Corporation and Sadharan Bima Corporation.

Stat- 309: Data Analysis using S Language and MATLAB

Marks: 50 Credit: 2 30 Class Hours

R Programming

R Language Essentials: expressions and objects, functions and arguments, vectors, missing values, matrices and arrays, factors, lists, data frames, indexing, conditional selection, indexing of data frames, subset and transform, grouped data and data frames, sorting, implicit loops; The Graphics Subsystems: plot layout, building a plot from pieces, using par, combining plots; Session Management: the workspace, getting help, packages, built-in data, attach and detach; Data Entry: reading from a text file, the data editor, interfacing to other programs.

Probability and Distributions: random sampling, probability calculations and combinatorics, discrete and continuous distributions, densities, cumulative distribution functions, quantiles, random numbers.

Descriptive Statistics and Graphics: summary statistics for a single group, graphical display distributions -histograms, empirical cumulative distributions, Q-Q plots, boxplots, summary statistics by groups, graphics for grouped data, generating tables, graphical display of tables (barplot, dotplot, pie chart); One- and Two-Sample.

Tests: one-sample test, Wilcoxon signed-ranked test, two-sample t-test, comparison of variances, the paired t-test.

Regression and Correlation: simple and multiple linear regression, residuals and fitted values, prediction and confidence bands.

ANOVA and Kruskal-Wallis: one-way analysis of variance, pair wise comparisons and multiple testing, two-way analysis of variance.

MATLAB programming

Introduction of MATLAB: basic features, command window, script m-files; array operation; matrix operation; logical operation; function m-files; data analysis, interpolation, polynomials, roots, multiplication; addition, division, derivatives, numerical analysis: plotting, minimizing, zero finding, integration, differentiation, differential equation; two or three dimensional graphs: plot, line, styles, markers, color, grids, axes box, labels, legends, color maps, mesh, and surface plots.

MATLAB programming for statistical computing: Frequency table, measures of central tendency, measures of dispersions, graphical presentations of data, the probability density function, cumulative density function, the quantile function, simulating data from probability distributions, goodness of fit test, parametric and non-parametric test procedures for one sample and two sample data, p-value, contingency tables, fitting linear models, analysis of variance, estimation of parameters.

SAS

Input Statement: List Directed and Column Input, Pointers and Formats, Reading Structured and Unstructured Data Format List.

External File: Reading and Writing Raw and System Files, Reading and Writing Data from Program and ASCII Data from External File, File Options, Writing Data to External File, Creating and Reading Permanent SAS Data Set, Working with Large Data Sets Problems.

Importing and Exporting Data: Reading Data from Different Formatted Data Files, Converting Different Database Formatted Files to SAS System Files.

Arrays Used in SAS: Use of Array for Missing Values to Create New Variables, Transformation of Data Set, Temporary Arrays, Multidimensional Arrays.

Data Manipulation: Data Set Subsetting, Concatenating, Merging and Updating Subsetting, Combining Different Data from Multiple Files, Table Look Up, Updating Master File from Update File.

SAS Functions: Arithmetic and Mathematical, Random Number, Time Data, Input and Output, String and Lag Functions.

Use of SAS Program (Codes) and Functions for Descriptive Statistics, Correlation and Regression, Questionnaire Design and Analysis, Analysis of Variance, Multiple Regression.

Reference

1. Martinez, WL (2002). : Computational statistics handbook with MATLAB. Chapman & Hall.
2. Cody, R. P. and Smith, J. K. : Applied Statistics and the SAS Programming Language, 3rd edition, Prentice Hall, Inc., New Jersey. (1991)
3. R Core Team (2011). : Introduction to R (can be downloaded from <http://www.cran.r-project.org>).
4. Afifi, A. A. and Azen, S. P. : Statistical Analysis: A Computer Oriented Approach, 2nd edition, Academic Press, NY (1979)

Practical Courses

Stat- 310: Lab - IX : Statistical Inference

Marks: 50 (40+10*) Credit-2 Time : 6 Hours

Group- A : Estimation

Determining different point estimators, their variances, efficiencies and sufficiency. M.V. estimators, Application of the methods of least squares, Maximum likelihood, Minimum Chi-square and moments. Modified Chi- squares.

Group- B : Test of Hypotheses

Test and confidence interval for population: Proportion, mean and variance. Testing and confidence interval for equality of two proportions, means and variances, Paired t-test. Testing the homogeneity of several proportions, means and variances. Different tests on correlation and regression coefficients. Test of independence in a contingency table.

Stat- 311: Lab – X: Time Series Analysis & Econometrics

Marks: 50 (40+10*) Credit-2 Time : 6 Hours

Group-A: Time Series Analysis and Forecasting

Time Series Analysis: Measurement of trend by different methods (Graphical method, method of semi average, method of least square, method of moving average), Measurements of seasonal variations (Method of simple average, ratio to trend method, ratio to moving average method, link relative method). Elimination of trend and forecasting, Correlleogram and Periodigram Analysis.

Group-B: Econometric Methods

Formulation of economic models and their statistical measure, Estimation of model by OLS & GLS method. Econometric analysis of various functions; Demand, Cost and Production function. Tests related to regression co-efficients, Categorical variable techniques, Chow test, and Modified Chow test.

Stat-312: Lab - XI: Population Studies

Marks: 50 (40+10*) Credit-2 Time: 6 Hours

Calculation of various rates for demographic data, Standardization, Construction of life tables (Complete and abridged) relationship between different column of a life table, Stationary and stable population from a life table, Central mortality rate, Force of mortality, Different measurements of fertility and mortality (Crude death rate, maternal mortality rate, infant mortality rate etc.), Calculation of life expectancy at different ages.

Population estimates and projections: Inter censal and post censal estimates by mathematical method, Inter censal and post censal estimates by component method.

Fitting of logistic curves by different techniques.

Stat- 313: Lab – XII: Design of Experiments & Sampling methods

Marks: 50 Credit-2 Time: 6 Hours

Group-A: Design of Experiments

Analysis of variance of one, two and three-way classified data with reference to CRD, RBD (single and multiple but equal observations per cell), LSD and Replicated LSD. Relative efficiency, Missing plot techniques, Multiple comparison tests, Data analysis of 2^2 and 2^3 factorial experiments. Confounding and data analysis in 2^3 , 2^4 factorial analysis.

Group-B: Sampling Methods

Drawing of Samples by simple random sampling, stratified random sampling and systematic sampling. Estimation of mean, total, proportions and their variances. Determination of sample sizes. Calculation of precision and gain due to stratification and systematic sampling as compared to SRS.

Stat- 314: Lab – XIII: Industrial & Environmental Statistics

Marks : 50 Credit-2 Time : 6 Hours

Group-A: Industrial Statistics

Quality Control: Construction of Control charts (Mean, σ , R, P, NP and C charts etc.) and O.C. curves, Drawing of ATI, AOQ and AOQL curves, Simple, Double and Multiple sampling schemes, Determination of AOQL.

Group-B: Environmental Statistics

Scope and Nature of Environmental Statistics: Stochastic process in- the environmental Probability Models and fitting of probability models to Environmental Data. Applications of Bernoulli and Poisson Processes to Environmental Problems, Normal process and its application to Environmental Problems, Environmental monitoring and assessments, Ecological sampling.

Stat- 315: Lab – XIV: Statistical Computing

Marks: 50 Credit: 2 Time: 6 Hours

Computing problems related to all courses of third year using R language, MATLAB and SAS. Practically problems related to the course STAT 309

Fourth Year B. Sc. (Honours), 2017

Stat- 401: Multivariate Analysis

Marks: 75 Credit: 3 60 Class Hours

Preliminaries of multivariate analysis: Idea of Multivariate data, applications of multivariate techniques; the organization of data, datadisplay and pictorial representations

Multivariate normal distribution: Conditional and marginal density of MND and its properties.

Multivariate Methods: Hotelling's T^2 - statistics and its distribution; important properties and uses of Hotelling's T^2 and Mahalonibis D^2 statistics, Wishart distribution and its properties.

Discrimination and classification: Allocation rules, Fisher's linear discrimination function, classification into one of two and into one of more than two multivariate populations, quadratic discriminators,

Principal component analysis (PCA): Introduction to principal components in the population, principal components in practice, interpretation of the PCs, ML estimator of the principal components, Asymptotic properties of the principal components, Application of principal components in Regression Analysis.

Cluster analysis (CA): Introduction, the problem, proximity between objects, Hierarchical algorithms (agglomerative, splitting procedure), corresponding analysis; chi-square decomposition.

Factor analysis (FA): Introduction, orthogonal factor model, interpretation of factors, estimation of factor model: ML method, method of principal factor, testing the goodness of fit of the factor model, factor interpretation and transformation.

Canonical correlations analysis (CCA): Introduction, Canonical correlation and varieties in population, estimation & testing of canonical correlation.

Conjoint measurement analysis, Path analysis.

References:

1. Anderson, T.W. (2003) : An Introduction to Multivariate Statistical Analysis, 5th Edition, Wiley & Sons Inc., NY.
2. Argenti, A. (2002) : Categorical Data Analysis, John Wiley, NY.
3. Dillion, W.R. and Goldstein, M.(1984) : Multivariate Analysis: Methods and Application
4. George, H. D : Introduction to Multivariate Analysis.
5. Goldstein, M. D. : Multivariate Analysis: Methods and Applications.
6. Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., Tatham, R.L. (2006) : Multivariate Data Analysis, 6th Edition, Pearson Education Inc.
7. Hardle, W. & Simar, L(2007) : Applied Multivariate Statistical Analysis, 2nd ed., Springer-Verlag, Berlin.
8. Jolliffe, I.T. (2002) : Principal Component Analysis, 2nd ed., York, Springer
9. Johnson, R.A., Wichern, D.W. (2002) : Applied Multivariate Statistical Analysis, 5th Edition, Pearson Education, Asia.
10. Anderson, T.W. (2003) : An introduction to Multivariate Statistical Analysis, 5th Edition, Wiley & Sons Inc., NY.

11. Kendall, M.G. : Multivariate Analysis, New York.
12. Khirsager, A.M. : Multivariate Analysis, Marcell Dekkar Inc. NY.
13. Morrison, D.P. : Multivariate Statistical Methods, McGraw-Hill, Richard
14. Srivastava, M.S. (2002) : Methods of Multivariate statistics, Wiley.
15. Tong, Y.L (1990) : The Multivariate Normal Distributions, Springer-Verlag, NY

Stat- 402: Design of Experiments-II

Marks: 50 Credit: 2 30 Class Hours

Linear estimation: Estimable functions, parametric functions and conditions of estimability, Methods of estimation for analysis of variance models, optimality properties of least square estimators, relevant theorems, test of hypothesis involving several linear functions of parameters, Cochran's theorem and its application in design of experiments, Non-Orthogonal data , Analysis of Variance (ANOVA) of non- orthogonal two-way classified data.

Construction and analysis of 3^n factorial experiments,

Confounding: Concept of simultaneous confounded effects, Construction and analysis in 3^n factorial and in case of both total and partial confounded designs

Elementary concepts of asymmetrical factorial experiments with ANOVA, analysis of split plot design, strip plot design & nested design.

Analysis of covariance: ANCOVA with two or more concomitant variables in case of one and two-way classified data, covariance and analysis of experiments with missing observations

Galois field: Definition, application of Galois field in design of experiments, minimum function, technique of constructing minimum function.

Weighing design: Introduction, definition, method of estimation, incomplete block design as weighing design (Inter and intra block analysis), construction and analysis of BIB design, Orthogonal latin squares, Youden squares, Lattice designs, concept of partially balanced incomplete block design.

Fractional factorials: Introduction, regular fractional factorial; Resolution III, IV & V plans, construction of 2^{n-k} factorials.

Incomplete block design: Basic concepts, Construction & analysis of some incomplete block designs.

References:

1. Anderson, V.L. : Design of Experiments, A Realistic Approach.
2. Chakraborty, M. C. : Mathematics of Experimental Design.
3. Cochran, W.G., Cox, D.R. : Experimental Design, John Wiley and Sons, Inc.
4. Das, M.M. & Giri, N.C. : Design and Analysis of Experiments.
5. Gomez, K.A., Gomez, A.A. : Statistical procedures for Agricultural Research, 2nd edition.
6. John, P.W.M. : Statistical Design and Analysis of Experiments.

7. John & Quennoill : Design of Experiments.
8. K.C. Peng : Experimental Design.
9. Kempthorne, O. : The Design of Analysis of Experiments.
10. Montgomery, D. C. (2009) : Design and Analysis of Experiments, 7th Edition, John Wiley and Sons Inc.
11. Raghavarao, D. : Construction & Combinational Problems in Design of Experiments.
12. Raktde, B.L., : Factorial Design, Wiley, N.Y.
13. Scheffe, H : Analysis Variance.
14. Yates, F. : Design and Analysis of Factorial Experiments.

Stat- 403: Biostatistics and Epidemiology

Marks: 75 Credit: 3 60 Class Hours

Biostatistics: Introduction, some basic concepts; data, statistics, biostatistics, population, sample, quantitative and qualitative variable, Types of Data (Census/Survey, experimental, clinical), design, sources of data, main methods of data collection: Prospective, Retrospective, Cross-sectional study, Study of prevalence, incidence, applying statistical methods.

Censoring and truncation: Types of censoring, Type I censoring, Type II censoring, random censoring.

Survival function, hazard function, relative risk and odds ratio, conditional probability of failure, Central failure rate and their relationship. IFR , IFRA, DFR, DFRA and CFR.

Parametric models: Exponential, Weibull, Poisson, Uniform and extreme value distribution, Gamma distribution and log normal distribution, Rayleigh, Pareto.

Estimation : Maximum likelihood method, Newton-Raphson method and method of scoring, Delta method.

Logit Models for Multinomial responses: Nominal responses: Baseline-category Logit models, ordinal responses: cumulative logit models ordinal responses: cumulative link models.

Poisson regression: Methodology for Poisson regression; Simple Poisson counts example, Poisson regression for incidence densities, over dispersion in Lower Respiratory Infection example.

Analysis of categorical data: The goodness of fit, 2x2 contingency table, rxc contingency table, analysis of matched-pair studies.

Non-parametric methods: (One sample)- Life table (Reduced sample method, Actuarial method, Green-Wood formula, nonparametric test.

Product limit (Kaplan Meier) Method,: Hazard function estimator, Robust estimators.

Non-parametric methods : (Two samples and K samples) Kolmogorov - Smirnov test, Mental-Hanzal test, Gehan test, log-rank test,

Non-parametric methods : (Regression) Cox's proportional hazard model, Partial likelihood estimates, Score test statistic.

Concepts of epidemiology, strategy of epidemiology, disease, health and public health, history of disease, causal concepts, epidemiologic variables, epidemiological data,

Methods of epidemiologic research: epidemiologic and etiologic research, types of epidemiologic research, experiments, quasi-experiments, observational studies, validity of epidemiologic research: validity, internal validity, bias, direction of bias, classification of bias, selection bias, information of bias

Principles and procedures of epidemiologic research, logistic regression model for follow-up and control studies, MLE and inference.

References:

1. Armitage P. : Statistical Methods in Medical Research.
2. Armitage P. : Sequential Medical Trials.
3. Daniel, W.W (2010) : Biostatistics: Basic Concepts and Methodology for the Health Sciences, 9th Ed., Wiley & Sons Inc.
4. Forthofer, R.N., Lee, E.S., Hernandez, M. (2007) : Biostatistics: A Guide to Design, Analysis and Discovery, 2nd Ed., Elsevier Inc.
5. Joseph L. Fleiss : Statistical Methods for Rates of Proportions.
6. Hardle, W., Mori, Y.Z. (2007) : Statistical Methods for Biostatistics and Related fields, Springer, NY.
7. Kleinbaum, DG, Kupper, LL and Morgenstern, H (1982) : Epidemiologic Research, Van Nostrand Reinhold

Stat- 404: Applied Econometrics

Marks: 50 Credit: 2 30 Class Hours.

Lagged variable models: Role of lag and reasons for lag, Estimation of distributed lag models, Koyck's adaptive expectation and partial adjustment model and their combination. Causality in economics

Simultaneous Equation models: Concepts, the identification problem, test for simultaneity, tests of ergogeneity, idea of structural, reduced and recursive model, ILS, variance ratio, 2-SLS method of estimation.

Time series econometrics: Concepts – stochastic processes, stationary and non-stationary processes, tests for stationary, trend and difference stationary, co-integration, AR, MA and ARMA and ARIMA modeling of time series data, diagnostic checking and forecasting, concept of VAR, ARCH and GARCH modeling.

References:

1. Green, W.H. (2003) : Econometric Analysis, 5th Edition, Pearson Education, India.
2. Gujarati D. (2003) : Basic econometrics, 4th Edition, TATA McGraw-Hill
3. Intrilligator M D. : Econometric models, Techniques and Applications.
4. Johnston, J. and Dinardo, J. (1997) : Econometric Methods, 4th Edition, McGraw-Hill, NY.

5. Judge, G.G., Hill, R.C. : Introduction to the Theory and Practice of
Griffith, W.E. and Lee, T.C. (1988) Econometrics, 2nd Edition, John Wiley & Sons, NY
- . Kleim & Miller : An Introduction to Econometrics.
7. Koutsyiannis, A. (1977) : Theory of Econometrics, 2nd Edition, Palgrave
Macmillan Ltd, India.
8. Pankartz A. : Forecasting with univariate Box-Jenkins model.
9. Schumacker, R.E. and Lomax, : A beginner's Guide to Structural Equation
R.G (2010) Modeling, 3rd Edition, Routledge, NY.
10. Zellner : Bayesian Methods in Econometrics.

Stat-405: Mathematical Demography

Marks: 50 Credit: 2 30 Class Hours

Demography: Dual records system, Chandra Sekhar-Deming formula, Evaluation and adjustment of demographic data.

Fertility estimates (including indirect estimates) from survey and census data. Fertility models (Coale-Trussell. Gompertz relational). Davis-Blake framework of intermediate variables. Proximate determinants of fertility.

Life table: its concept, structure and calculation, complete life table and abridged life table, multiple decrement life table, different life table functions and interrelationships among them, use of life table migration, logistic curve, fitting of the curve by different methods,

Model life tables, Coale and Demeny regional model life tables.

Stable and stationary population: their characteristics and uses: Lotka and Dublin's model, Intrinsic age distribution, Lotka's integral equation and its real and complex roots, relationship between the mean length of generation and age of childbearing, Graduation of the net marternity function-lotka, Wicksell and Hadwiger, Interrelationship of demographic variables in stable population, quasi stable population, comparison of the age distribution of a stable population with that of Quasi stable population.

Microdemography: Fecundity, fecundability and sterility, Effective fecundability, Residual fecundability, Estimation of measures of fecundability, Pearl index, Effectiveness and efficiency of FP method.

Population Projection: concept and its necessity, different techniques of population projection- component method, linear/ arithmetic method, geometric, exponential method, matrix method (Lasli matrix), theory of demographic transition.

References:

1. Alho, J.M. and Spence, Bruce, : Statistical Demography and Forecasting,
D.(2005) Springer, USA.
2. Biswas, S (1988) : Stochastic processes to demography and
Application, Wiley Eastern Ltd. Delhi.

3. Bogue, D.J. (1969) : Principles of demography, Wiley & sons. NY.
4. Hooker, P.H. & Cook : : Life and other contingencies, Vol. 1 &2.
5. Johnson, R.C.E. & Johnson N.L. (1980) : Survival models and data analysis, Wiley, NY
6. Jordan, C.W. (1967) : Life contingencies, society of actuaries, Chicago.
7. Keyfiiz, N (1968) : Introduction to the mathematics of population, Addison Wesley Publication Company, California.
8. Do-- ----- (1977) : Applied Mathematical Demography, Wiley & Sons.
9. Rogers, A (1966) : Introduction to Multiregional Mathematical Demography, Wiley, NY.
10. Shyrock, H.S. & Siegel J.S. (1973) : The Methods and Materials of Demography. Vol. 1 & 2 : U.S. Bureau of Census, Washington

Stat- 406 Statistical Inference-II and Non-parametric Methods

Full Marks: 100 Credit: 4 60 (30+30) Class Hours

Group- A: Statistical Inference-II - 50 Marks

Statistical Inference: parametric, nonparametric and semiparametric inference; principles of data reduction: sufficiency principle, likelihood principle, equivalence principle;

Point Estimation : Sufficient statistic, exponential family, Complete sufficient statistic, Minimal sufficient statistic, Factorization theorem, Completeness theorem. Asymptotic

properties of ML estimators. Uniformly minimum variance unbiased estimator (UMVUE), Different methods of finding UMVUE, Lehmann-Scheffe's theorem, Loss function, Risk function. Location and scale invariance, Pitman estimator, Concepts of prior and posterior density functions, Posterior Baye's estimation, Admissible Baye's and minimax estimation.

Interval estimation : Central and non-central confidence interval, Shortest confidence interval, Bayesian interval.

Group- B: Non-parametric Inference - 50 Marks

Nonparametric inference: Introduction, inference concerning cumulative distribution function (cdf), quantiles and statistical functional, testing statistical hypothesis- one sample settings, two or more sample settings: Kendall's Tau, test of goodness of fit, the empirical distribution function, the Kolmogorov-Smirnov test, Glivenko-Cantelli theorem, the chi-square goodness of fit test, Comparison between Kolmogorov-Smirnov and chi-square goodness of fit. Rank orders statistics, Correlation between variate values and ranks, treatment of ties in rank tests, the sign test and Wilcoxon signed rank test, two sample problem: The Wald-Wolfowitz run test, the Komogorov-Smirnov two sample test, The median test, The Mann-Whitney U-test, Kruskal-Wallis test, Linear rank statistics. Linear rank tests for location problems: Wilcoxon tests, other location tests. Linear rank tests for the Scale problem: The

Mood test, Ansary-Bredlen test, The Sigel-Tukey test, the Klotz normal scores test, the Sukhathme test.

Test of the equality of K independent samples: Extension of the median test Kruskal-Wallis one way Anova test.

References:

1. Bolstad, W.M. (2007) : Introduction to Bayesian Statistics, 2nd Edition, John Wiley, New Jersey, USA.
2. Casella, G and Berger, RL(2002) : Statistical Inference, 2nd edition, Duxbury.
3. Conover, W.J.(1999) : Practical Non parametric Statistics, 3rd Edition, John Wiley & Sons, NY.
4. Gibbons, J.D. and Chakraborti, S (1992) : Non parametric Statistical Inference Marcell Dekker, Inc, USA.
5. Higgins, J.J. (2004) : An Introduction to Modern Nonparametric Statistics, Brooks/ Cole-Thomson Learning. ISA.
6. Hollander, M. : Non parametric Statistical Methods, Wiley, NY.
7. Kendall and Stuart : The Advanced Theory of Statistics, Vol. I, II & III, Charles Griffin Co. Ltd. London, 3rd Edition.
8. Krishnaith, R.R : Non parametric Methods.
9. Lehmann, E.L : Point Estimation.
10. Lehmann, E. L. : Testing Hypothesis.
11. Mood, A.M., Graybill, F.A. and Bose, D.C. (1974) : Introduction to the Theory of Statistics, 3rd Edition, McGraw-Hill NY
12. Wasserman L. (2006) : All of nonparametric statistics, Springer.
13. Wolfe, D.A : Introduction to the theory of Non parametric Statistics.
14. Zacks, S. : Theory of Statistical Inference.

Stat- 407: Sampling Techniques-II and Research Methodology

Full Marks: 100 Credit: 4 60 Class Hours

Group- A: Sampling Technique –II - 50 Marks

PPS and PPS Sampling procedure; Cluster sampling (with equal and unequal size of clusters), double sampling and inverse sampling, concept of multi stage and multi phase sampling: Estimation of population total, mean, proportion and their standard error.

Use of Auxiliary information: ratio estimator examples, necessity and limitations of ratio estimates, ratio estimates in stratified sampling, estimate bias, mean squared error,

approximate variance, requirements of unbiased ratio estimate, comparison of separate and combined estimates.

Regression estimates: examples, assumptions, properties and shortcomings, bias and approximate variance, estimate of variance, comparative advantages and disadvantages of ratio and regression estimates.

Group - B: Research Methodology - 50 Marks

Research Methods and Methodology: concept, aims and objectives, importance of research methodology, types of research, selection and formulation of research problems, case study, criteria of good research, research process.

Measurement and Scaling: rules of measurement, purpose of scaling, primary, comparative and non-comparative scaling techniques, criteria for good measurements:

Research Design: concepts of research design, types of research design, structured and unstructured design, steps involved in research design process.

dual record system, post enumeration survey, statistical methods to control the quality of data, basic considerations in preparing questionnaires, preparation of manual for interviewer, editing, Coding, recoding, code book and tabulation plans. SWOT analysis

Research Proposal: Purpose of Research proposal, Research benefits, Proposal development, types of research proposal, components of research proposal, evaluation of research proposal.

Report writing: types of report, general format of a report, analysis of data, presentation of the results, headings and subheadings, techniques of report writing with special reference to the discussions conclusions, policy recommendations, footnotes and bibliography, appendix etc.

Monitoring and Evaluation: concepts of monitoring and evaluation (M & E), objectives, process, designing a M & E program, writing an evaluation report, application of M & E.

References:

1. Blankenburg, F (1993) : Introduction into the planning, monitoring and evaluation system, April, Dhaka.
2. Chudhuri, A. and Stenger, H. (1992) : Survey Sampling Theory and Methods, Chapman and Hall, CRC.
3. Cochran, W.G. (1977) : Sampling Techniques, 3rd Edn, Wiley Eastern, India.
4. Dooley, D.R. (1995) : Social Research Methods, 4th Edition, Prentice Hall, India.
5. Hansen, M.H., Hurwitz, W.N. and Mado, W.G.(1953) : Sample Survey Methods and Theory, Vol. I and Vol. II, Wiley, NY.
6. Islam, M.N. : An Introduction to Sampling methods Theory and applications.
7. Islam, M.N. : An Introduction to Research Methods
8. Jessen, R.J. (1978) : Statistical Survey Technique, Willey, NY.

9. Kish, L. (1995) : Survey Sampling, Wiley, NY.
10. Kothari : Research Methodology. Methods and Techniques
11. Malhotra, N.K. (2006) : Marketing Research, 4th Edition, Pearson Education, Singapore.
12. Moser, S.C. : Survey Methods in Social Investigation.
13. Mukhupadhyay, P. (1998) : Theory and Methods of Survey Sampling, Prentice Hall, New Delhi.
14. Murthy, M. N. (1977) : Sampling Theory and Methods., Statistical Publishing, Calcutta.
15. Raj, D. and Chandhok, P. (1998) : Sample Survey Theory, Narosha Publishing House, New Delhi.
16. Sukhatme, P. V. and Sukhatme, B.V. : Sampling Theory of Sources with Applications, Indian
17. Bailey, K.D. (1987) : Methods of Social Research, 3rd. ed. The free Press, New York, London
18. Trochim, W.M.K. (2006) : Research Methods, 2nd Edition, Bizantra, New Delhi.

Stat- 408: Operations Research and Mathematical Programming

Full Marks: 100 Credit: 4 60 Class Hours

Group- A: Operations Research - 50 Marks

Definition, characteristics, scope and limitations of O.R. problem formulation and modeling in O.R. classification of O.R. models, characteristics of important O.R. techniques.

N-dimensional Euclidian space, convex set and convex function: hyper -plane, hyper sphere, open set, closed set, Convex sets, convex polyhedron, convex and concave functions, basic solution, basic feasible solution, non-degenerate and degenerate B.S., theorems related to the solutions.

Theory of Games: “two person zero sum” game, pure, mixed and optimal strategy, Graphical solution of 2x2 games, relationship between two person zero sum game and linear programming symmetric games, equivalence of two persons zero sum game and a linear programming problem, methods of solutions of the game problems.

Inventory models: deterministic model, single item static model, single item static model with price breaks, multiple item static model with storage limitations.

Group- B: Mathematical Programming - 50 Marks

Linear Programming: Introductions, concept of linear programming (L.P.), non linear programming, Fundamental theorem of linear programming problem, formulation of Linear programming problems, theorems of linear programming.

Methods of L.P.P: Graphical, Simplex method, revised simplex method, Dual simplex, big M-method, Two-phase method, primal and dual problems and their solutions, cyclical problems, sensitive analysis.

Integer linear programming; problem formulation, solution of mixed integer, inter programming problems by cutting plane algorithm, branch and bound algorithm.

Transportation and assignment problems: Basic solution of transportation problem, optimality test, degeneracy, variations and least time transportation problems, transshipment problems, industrial application like products mix problem, blending problem etc. discrete, dynamic & stochastic programming, assignment problems.

References:

1. Baumol, W. J. : Economic Theory and Operations Analysis.
2. Easty, T. L. : Mathematical Methods of Operations Research.
3. Gauss, S.I. : Linear Programming.
4. Hadley, G. (1990) : Linear Programming, Oxford and IBH, Narosa, New Delhi.
5. Karak P.M. : Linear Programming and Theory of Games.
6. Kothari, C.R. : Quantitative Techniques.
7. Mittal K.V. : Optimization Methods in O.R. and Systems Analysis.
8. Mon Mohan : Linear Programming and Theory of Games.
9. Swarp, K. Gupta, P.K. and Mohan, M. (2003) : Operations Research, 11th Edition, Sultan Chand & Sons, New Delhi.
10. Taha, H.A. (2003) : Operation Research: An Introduction, 7th edition, Prentice Hall, New Delhi.
11. Vajda : The Theory of Games and Linear Programming.

Stat-409: Statistical Data Mining for bioinformatics

Marks: 50 Credit: 2 30 Class Hours

Overview: Meaning of Data Mining and Knowledge Discovery, Basics, Data Mining Tasks, Classification, Regression, Time Series Analysis, Prediction, Clustering, Summarization, Association, Rules, Sequence Discovery, Development of Data Mining, Data Mining Issues and Mining Metrics, Social Implications of Data Mining.

Related Concepts of Data Mining: Fuzzy Sets: Introduction, Classical Set, Set Operation, Boolean Logic, Basic Concepts of Fuzzy Sets, Other Representations of Fuzzy Sets, Determination of Membership Functions, Fuzzy Sets Properties, Operations on Fuzzy Sets, Logic Operations, Algebraic Operations on Fuzzy Sets.

Fuzzy Relation: Classical Relations, Classical Reasoning, Fundamentals of Fuzzy Relations, Operations on Binary Fuzzy Relations, Types of Fuzzy Relations, Fuzzy Reasoning, Concluding Remarks, Bibliography, Web Resources.

Database/OLTP Systems, Logic, Information Retrieval, Decision Support Systems, Dimensional Modeling, Multidimensional Schemas, Indexing, Data Warehousing, OLAP, Web Search Engines, Statistics, Machine Learning, Pattern Matching.

Data Mining Techniques: Statistical Perspective on Data Mining: Point Estimation, Models based on Summarization, Bayes Theorem, Hypothesis Testing, Regression and Correlation. Similarity Measures, Decision Tree, Genetic Algorithms.

Neural Network: Background, Learning, Basic Neuron Model, Perception, Multiplayer Perception, Recurrent Network, Hopfield Network, Boltzmann Machine Network, Kohonen Self-Organizing Network, Background, Description, Determining the Winning Neuron, Learning Algorithm.

Classification: Issues in Classification, Statistical-based Algorithms, Regression, Bayesian Classification, Distance-based Algorithms, K-Nearest Neighbors, Decision Tree-based Algorithms, ID3, C4.5, C5.0, CART, Neural Network-based Algorithms, Propagation, NN, Supervised Learning, Radial Basis Function Network, Perceptrons, Rule-based Algorithms, Generating Rules from DT, Generating Rules from Neural Net.

Clustering: Similarity and Distance Measures, Outliers, Hierarchical Algorithms, Agglomerative Algorithms, Divisive Clustering, Partitional Algorithms, Minimum Spanning Tree, Squared Error Clustering Algorithm, K-Means Clustering, Nearest Neighbor Algorithm, PAM Algorithm, Bond Energy Algorithm, Clustering with Genetic Algorithms, Clustering with Neural Networks, Clustering Large Databases, Clustering with Categorical Attributes.

Association Rules: Meaning of Association, Large Item Sets, Basic Algorithms, Apriori Algorithm, Sampling Algorithm, Partitioning, Parallel and Distributed Algorithms, Data Parallelism, Task Parallelism, Advanced Association Rule/Technique, Quantitative Association Rules, Correlation Rules, Measuring Quality of Rules.

Web Mining: Web Content Mining, Crawlers, Harvest System, Virtual Web View, Personalization, Web Structure Mining, Page Rank, Clever, Web Usage Mining, Preprocessing, Data Structures, Pattern Discovery, Pattern Analysis.

References:

1. Dunham, M. H. (2003) : Data Mining, Pearson Education, Asia.
2. Ibrahim, A. M. (2004) : Fuzzy Logic for Embedded Systems Applications, Elsevier Science, USA.
3. Larose, D. T. (2006) : Data Mining: Methods and Models, Wiley-Interscience, India.
4. Schalkoff, R. (2005): : Pattern Recognition Statistical, Structural and Neural Approaches, John Wiley and Sons, New York.

Stat- 410: Lab – XV: Multivariate Analysis

Marks: 50 Credit-2 Time: 6 Hours

Linear model multivariate analysis and estimation of its parameters, Partial and multiple correlations and their allied tests, test about the correlation matrix, application of non- central chi-square, P and t distributions, simple cases of discriminant function, Hotelling's T^2 and Mahalanobis D^2 statistics, Principal component and canonical correlation, Problem of classification.

Stat- 411: Lab - XVI

Marks: 50 Credit-2 Time: 6 Hours

Group –A: Design of Experiments-II

Non-Orthogonal Data analysis, ANOVA of total and partial confounded 3^3 and 3^4 factorial experiments, Analysis of $p \times q$ and $p \times q \times s$ asymmetrical factorial experiments. Analysis of split plot designs, strip plot designs and nested designs, Multiple comparison tests, Analysis of co-variance (ANCOVA) in one and two-way classified data with one and two concomitant variables.

Group - B : Econometrics

Formulation of economic models and their statistical measure, Econometric analysis of various functions; Demand, Cost and Production function. Tests related to regression coefficients, Chow test, Modified Chow test. Simultaneous equation model, Time series analysis by spectral methods.

Dummy as independent variable, Forecasting using the models with dummy as dependent variable, Fitting of logit model, probit model, log-Linear model, lag model, AR model, MA model.

Stat- 412: Lab- XVII : Sampling Techniques -II and Demography

Marks : 50 Credit-2 Time : 6 Hours

Group - A : Sampling Techniques -II

Ratio method, Regression method and cluster sampling techniques, Estimation of mean, total and proportion and their variances, Comparison of efficiencies of different sampling techniques, Construction of a questionnaire, Statistical analysis of secondary data and report writing.

Group - B : Demography

Estimation of completeness of birth and death registration, Calculation of Whipple's index, Myers' index, UN Secretarial index, Smoothing of age data, Estimation of intrinsic birth rate, death rate, growth rate and stable age distribution, Construction of Brass's two parameter

model life table, Construction multiple decrement life table, Calculation of singulate mean age at marriage.

Stat- 413 Lab-XVIII: Non-parametric Tests & Drawing Power Curves

Marks: 50 Credit-2 Time : 6 Hours.

Group-A: Non parametric Tests

Sign test, Wilcoxon signed rank test, Median test, Binomial test, Quantile test, Determination of tolerance limits, Kolmogorov-Smirnov test, Tests based on two independent samples, Test based on several independent samples, Kolmogorov goodness of fit test. Measures of rank correlation, Tests based on Spearman's Rao and Kendall's Tau. Mann-Whitney test. Kruskal-Wallis test, Tests for equal variances based on ranks.

Group-B: Drawing of Power Curves

Estimation of parameters by using different methods, Drawing of power curves and finding unbiased critical regions, Drawing of samples from different populations (Cauchy, Log normal, Exponentials, Bivariate normal), Distribution of \bar{x} and s^2 .

Stat- 414 : Lab - XIX : Mathematical Programming & Game Theory

Marks: 50 Credit-2 Time: 6 Hours

Formulation of linear programming problem, Graphical solution, Simplex computational algorithm and solution of dual problems, Big-M method, Two phase method, Solution of transportations problems, Solution of game problems, graphical, Simplex, Algebraic etc.

Stat- 415: Statistical Data Analysis

Marks: 50 (SPSS -25 & R & S-Plus - 25) Credit-2 Time: 6 Hours

Data Mining

Determination of Partition of Set of Data by Sum of Squares of Errors, Clustering Criteria, Hierarchical Clustering by Nearest Neighbor, Further Neighbor, K-Means Method or Algorithm, Determination of Minimum Distance Decision Boundary, Performing K-NN Classification Using Euclidean and Statistical Matrix, Application of Different Rules of Data Mining, Classification by Regression Tree, Decision Tree, Bayesian Approach, Neural Network. Practically problems related to the course STA 409.

Generalized Linear Models and Categorical Data Analysis

Computing problems related to generalized linear models; Estimation, Fitting Generalized Linear Models, confidence intervals for model parameters, log-likelihood ratio statistic, assessing goodness of fit. Hypothesis testing using SAS / R or any other suitable computer software / language.

Computing problems related to Logit Models for Multinomial Responses; The 2x 2 Table; Sets of 2 x r and s x 2 Tables; The s x r Table; Sets of s x r Tables; Poisson Regression; Log-linear Models using SAS / R.

-- X --