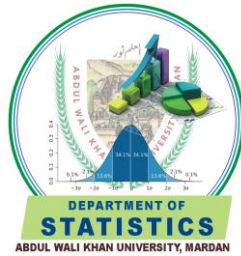


SCHEME OF STUDIES
FOR
BS (4-YEARS) DEGREE IN STATISTICS



Department of Statistics



Abdul Wali Khan University Mardan

2020

BS (4-YEARS) DEGREE PROGRAM IN STATISTICS
ABDUL WALI KHAN UNIVERSITY MARDAN
(SEMESTER-WISE SCHEME OF STUDIES)

Year 1		
Semester 1		
Course Code	Course Title	Credit hours
STAT-301	Introductory Statistics	3
EW-301	English composition and comprehension (English-I)	3
CV-301	Islamic Studies/Ethics	3
AH-308	A & H-I (History of Pakistan)	3
QR-301	Quantitative Reasoning-I (Basic Mathematics)	3
QR-302	Quantitative Reasoning-II (Introduction to information and communication Technology)	3
Total		18
Semester 2		
Course Code	Course Title	Credit hours
STAT-352	Introduction to Probability Distributions	3
EW-302	Communication & Presentation Skills (English-II)	3
CV-302	Pakistan Studies	3
SS-313	Social Science-I (Introduction to Economics)	3
NS-307	Natural Science-I (Fundamentals of Computer Programing)	3
STAT-307	Calculus-I	3
Total		18
Year 2		
Semester 3		
STAT-431	Basic Statistical Inference	3
STAT-452	Applied Statistics	3
EW-303	Technical report writing (English-III)	3
STAT-308	Calculus-II	3
AH-305	Arts & Humanities -II (Islamic History and Culture)	3
Total		15
Semester 4		
STAT-451	Introduction to Regression Analysis and Design of Experiment	3
STAT-457	Exploratory Data Analysis and Visualization	3
SS-306	Social Science-II (Principles of Management)	3
NS-303	Natural Science (Introduction to Physics)	3
STAT-458	Research Methods	3
Total		15
Semester 5		
STAT-501	Probability & Probability Distribution-I	3
STAT-502	Sampling Techniques-I	3
STAT-554	Population Studies (Demography)	3
STAT-629	Biostatistics	3

STAT-553	Statistical Methods	3
Total		15
Semester 6		
STAT-551	Probability and Probability Distribution-II	3
STAT-552	Sampling Techniques-II	3
STAT-503	Regression Analysis	3
STAT-553	Nonparametric Methods	3
STAT-504	Statistical Packages and Data Analysis	3
Total		15
Semester 7		
STAT-601	Statistical Inference-I	3
STAT-602	Design & Analysis of Experiments- I	3
STAT-555	Econometrics	3
STAT-630	Data Mining	3
STAT-653	Applied Multivariate Analysis	3
Total		15
Semester 8		
STAT-651	Statistical Inference-II	3
STAT-652	Design & Analysis of Experiments- II	3
STAT-604	Time Series Analysis & Forecasting	3
STAT-634	Categorical Data Analysis	3
STAT-699	Research Project	3
Total		15
Total Credit Hours in BS-4 years Degree Program		126

DETAILS OF THE COURSES

The proposed outlines of the BS Program in Statistics are as under:

STAT-301 Introductory Statistics

The Nature and Scope of Statistics. Organizing of Data, classification of data, Graphs and Charts: Stem-and leaf diagram, Box and Whisker plots and their interpretation. Measures of Central Tendency and Dispersion: Their properties, usage, limitations and comparison. Calculations for the ungrouped and grouped data. Measures of Skewness and Kurtosis and Distribution shapes.

Probability Concepts, Addition and Multiplication rules, Bivariate frequency tables, joint and marginal probabilities, Conditional probability and independence, Bayes' rule.

Books Recommended

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) "Probability and Statistics", 2nded. Schaums Outlines Series. McGraw Hill. NY.
2. Clark, G.M and Cooke, D. (1998), "A Basic Course in Statistics" 4th ed, Arnold, London.
- 3.* Walpole, R.E., Myers, R.H and Myers, S.L. (1998), "Probability and Statistics for Engineers and Scientist" 6th edition, Prentice Hall, NY.
4. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) "Statistics for Business & Economics" 9th ed. Prentice Hall, New Jersey.
5. Weiss,N.A.(1997),"Introductory Statistics"4thed.Addison-Wesley Pub. Company, Inc.
6. Chaudhry, S.M.and Kamal, S. (1996), "Introduction to Statistical Theory" Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.

* (Text Book)

STAT-352 Introduction to Probability Distributions

Discrete Random Variables, Probability Distribution, Mean and Variance of a discrete random variable. Bernoulli trials. Properties, applications and fitting of Binomial, Poisson, Hypergeometric, Negative Binomial and Geometric distributions.

Continuous Random Variable, probability density function and its properties. Normal Distribution and its properties, Standard Normal Curve, Normal approximation to Binomial and Poisson distributions. **Pre-requisite:** STAT-101

Books Recommended

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) “*Probability and Statistics*”, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.
2. Clark, G.M. and Cooke, D. (1998), “*A Basic Course in Statistics*” 4th ed, Arnold, London.
3. * Walpole, R.E., Myers, R.H and Myers, S.L. (1998), “*Probability and Statistics for Engineers and Scientist*” 6th edition, Prentice Hall, NY.
4. Mclave, J.T., Benson, P.G. and Snitch, T. (2005) “*Statistics for Business & Economics*” 9th ed. Prentice Hall, New Jersey.
5. Weiss,N.A.(1997),“*Introductory Statistics*”4thed.Addison-Wesley Pub. Company, Inc.
6. Chaudhry, S.M.and Kamal, S. (1996), “*Introduction to Statistical Theory*” Parts I & II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.
7. * **(Text Book)**

STAT-431 Basic Statistical Inference

Distribution of sample mean and central limit theorem. Estimation: Point Estimation. Desirable Properties of a Good Estimator. Interval Estimation. Interval Estimation of the population mean. Large and small sample confidence intervals for Population Mean.

Nature of Hypothesis Testing and Types of errors. Hypothesis Testing for Population Mean and variance. Inferences for Two Population Means. Large-sample inferences for Two Populations using Independent Samples. Inferences for the Mean of Two Normal Populations using Independent Samples (variances are assumed Equal/Not Equal). Inference for Two Populations Mean using Paired Samples.

Inferences for Population Proportions. Confidence Intervals and hypothesis testing for Population Proportion. Inferences for Two Populations Proportions using Independent Samples, Estimation of sample size.

Chi-Square Procedure. Chi-Square Goodness-of-fit Test. Chi-Square Independence Tests.

Pre-Requisite- STAT-102

Books Recommended

1. Spiegel, M.R., Schiller, J.L. and Sirinivasan, R.L. (2000) “*Probability and Statistics*”, 2nd ed. Schaums Outlines Series. McGraw Hill. NY.
2. Clark, G.M. and Cooke, D. (1998), “*A Basic Course in Statistics*” 4th ed, Arnold, London.
3. Mclave, J.T., Benson P.G. and Snitch, T. (2005) “*Statistics for Business & Economics*” 9th Prentice Hall New Jersey.
4. * Walpole, R.E., Myers, R.H. and Myers, S.L. (1998), “*Probability and Statistics for Engineers and Scientist*” 6th edition, Prentice Hall, NY.
5. Weiss, N.A. (1997), “*Introductory Statistics*” 4th ed. Addison- Wesley Pub. Company, Inc.
6. Chaudhry, S.M. and Kamal, S. (1996), “*Introduction to Statistical Theory*” Part I, II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.
7. * **(Text Book)**

STAT-451 Introduction to Regression Analysis and Experimental Design

Concepts of Regression and Correlation, Simple Linear regression, Inference regarding regression parameters, Linear correlation: simple, partial and multiple correlations. Inference regarding correlation coefficient. Coefficient of determination.

One-Way and Two-Way Analysis of Variance, Design of Experiments, Basic Principles of Design of Experiments, Description, Layout and Analysis of Completely Randomized Design, Randomized Complete Block Design and Latin Square Design. Multiple Comparisons (LSD and Duncan's test). Introduction to Non-Parametric Statistical Methods.

Pre-Requisite: STAT-101

Books Recommended

1. Clark, G. M. and Kempson, R. E. (1997), "Introduction to the Design & Analysis of Experiment" Arnold London.
2. * Walpole, P.E., Myers R.H., Myers S.L. (1998), "Probability and Statistics for Engineers and Scientists", 7th ed. Prentice Hall.
3. Weiss, N.A, (1997), "Introductory Statistics" 4th ed. Addison- Wesley Pub. Company, Inc.
4. Chaudhry, S.M., and Kamal, S., (1996), "Introduction to Statistical Theory" Part I, II, 6th ed, Ilmi Kitab Khana, Lahore, Pakistan.
5. * **(Text Book)**

STAT-452 Applied Statistics

Sampling: Need of sampling, Sample versus population, Random and non-random sampling, concepts of statistic and population parameter. Sampling techniques: Simple Random, Stratified and Systematic random sampling. Census and survey problem, framing of questionnaire. Sampling and Non-Sampling Errors.

Index numbers: construction and uses of index numbers, un-weighted index numbers (simple aggregative index, average of relative price index numbers). Weighted index numbers (Laspayers, Paaches and Fishers ideal index numbers). Consumer price index (CPI) and Sensitive Price Indicators.

Time Series Analysis: Components of time series and their isolation.

Vital Statistics: Meaning of vital statistics, registrations of Birth and death in Pakistan. Uses of vital statistics, shortcomings of vital statistics, rates and ratios (Sex ratio, child women ratio, birth and death ratio, population growth rate, classification of natal rates, death rates or mortality rates, crude death rate, specific death rate, infant mortality rate, case fatality rate, fertility rates, crude birth rate, specific birth rate, standardized death rate, reproduction rates, gross reproduction rate, net reproduction rate, morbidity or sickness rates, marriage rates, divorce rates etc. general; fertility rate, total fertility rate.)

Pre-Requisite: STAT-101

Books Recommended

1. Clark, G.M. and Cooke, D. (1998), “*A Basic Course in Statistics*” 4th ed, Arnold, London.
2. * Mclave, J.T. Benson, P.G. and Snitch, T. (2005) “*Statistics for Business & Economics*” 9th Prentice Hall New Jersey.
3. Walpole, P.E. Myers, R.H., Myers S.L. (1998), “*Probability and Statistics for Engineers and Scientists*”, Prentice Hall.
4. Chaudhry, S.M. and S. Kamal, (1996), “*Introduction to Statistical Theory*” Part I, II, 6th Ed, Ilmi Kitab Khana, Lahore, Pakistan.
5. * Cochran, W.G. “*Sampling Techniques*”.3rd Ed.
6. * Pollard, A.H.. Yousuf, F. and Pollard G.M. (1982), “*Demographic Techniques*”, Pergamon Press, Sydney.
7. * **(Text Book)**

STAT-504 Statistical Packages

Introduction to Minitab, data manipulation in Minitab, graphical representation in Minitab, Qualitatively and Quantitative data presentation and analysing data in Minitab, Programming in Minitab

Introduction of SPSS, data manipulation in SPSS, simple arithmetic in SPSS, SPSS function related to probability distributions, SPSS modules, simple graphing in SPSS.

Analysis using SPSS syntax programming. (Use of SPSS, Minitab, Matlab, Statistica is based upon the availability of Software)

Pre-Requisite: STAT-201

Books Recommended

1. Ryan, Barbara F.; Joiner, Brian L. and Cryer, Jonathan D.(2005) MINITAB Handbook, 5th Edition, Duxbury Press, California.
2. Delwiche, Lora D. and Slaughter Susan J. (1998) The Little SAS Book : A Primer, Second Edition, SAS institute, North Carolina.
3. Norusis, Marija(2006) SPSS 14.0 Guide to Data Analysis, Prentice Hall, New Jersey.
4. SPSS (2006) SPSS 14.0 Base User's Guide, , Prentice Hall, New Jersey.
5. Marques de Sá, Joaquim P.(2003) Applied **Statistics using SPSS, STATISTICA and MATLAB**

STAT-501 Probability and Probability Distributions-I

Probability as a set function. Conditional probability and Bayes' theorem. Random variables, Distribution function, Probability mass function and probability density function. Joint and conditional distributions for two and more random variables. Marginal and conditional distributions, stochastic independence. Mathematical expectation and its properties Conditional expectation, variance and moments. Probability generating function.

Moment generating and characteristic functions and their properties. Relation between moments and cumulants. Probability distributions: Hypergeometric, Binomial, Multinomial, Negative Binomial, Geometric, Poisson, Normal and Lognormal distributions with moments and cumulants.

Pre-Requisite: STAT-102

Books Recommended

1. Stirzaker, D. (1999). "Probability and Random Variables". Cambridge University Press, Cambridge.
2. Stuart, A. and Ord, J .K. *Kendall's* (1998), "Advanced Theory of Statistics", Vol. I, Charles Griffin, London.
3. Hirai, A.S. (1998), "A Course in Mathematical Statistics", Ilmi Kutab Khana, Lahore.
4. Fridett, B. & Gray, L. (1997). "A Modern Approach to Probability Theory" Birkhallser, Boston.
5. Freund, J. E. (1997). "Mathematical Statistics", Prentice Hall, New Jersey 6th edition.
6. * Mood, A.M, Graybill, F.A. and Boss, D.C. (1997), "Introduction to the Theory of Statistics", McGraw Hill, New York.
7. Khan, M. K., (1996). "Probability with Applications", Maktiba Ilmi, Lahore.
8. * Hogg, R.M. and Craig, A.T. (1995), "Introduction to Mathematical Statistics". Prentice Hall, Engle wood Cliffs, New Jersey.
9. Haq, M. (1984). *Foundation of Probability and Statistics*, Tahir sons, Urdu Bazar, Karachi.
10. * (Text Book)_{SEP}

STAT-502 Sampling Techniques-I

Basic concepts, advantages of sampling methods, requirements of a good sample, bias, sampling and non-sampling errors. Steps and problems involved in planning and conduct of census and sample surveys. Selection and estimation procedures. Description and properties of simple random sampling. Sampling for proportions and percentages. Estimation of variances, standard errors and confidence limits. Sample size determination under different conditions. Description and properties of stratified random sampling. Formation of strata, Different methods of allocation of sample size. Systematic sampling. Ratio and regression estimates in simple and stratified random sampling.

Note: Practical's of this course shall include visits of the students to various national statistical organizations and a report submitted to this effect.

Pre-Requisite: STAT-203

Books Recommended

1. Raj, D. & Chandhok, P. (1998), "Sample Survey Theory". Narosa Publishing House, New Delhi.
2. Ferguson, T.S. (1996), "A Course in large Sample Theory", Chapman & Hall, London.
3. Singh, R. and Singh N, (1996), "Elements of Survey Sampling", Kulwar Academic Publisher, Dodrecht.
4. Kish, L. (1992). "Survey Sampling", John Wiley, New York.
5. Sukhatme, P.V, Sukhatme, B., Sukhatme, S., and Asok, A. (1985), "Sampling Theory of Survey with Application". Iowa State University Press.
6. * Cochran, W.G. (1977), "Sampling Techniques", 3rd ed, John Wiley and Sons, New York.
7. Raj, D. (1971) "Design of Sample Survey". McGraw Hill, New York.
8. * (Text Book)

STAT-503 Regression Analysis

General linear model and its assumptions, Least-squares estimators, MLE, Least squares estimators, tests of hypothesis, tests of significance of a single and complete regression, tests of significance of subset of coefficients. Significance tests and confidence intervals. Test of linearity of regression. Use of extraneous information in linear regression model. Residual analysis, Detection and study of outliers. Polynomial regression, orthogonal polynomial, orthogonal regression analysis. Specification of models.

Pre-Requisite: STAT-203 Books Recommended

1. ***Draper**, N.R. and Smith, H. (2004).” *Applied Regression Analysis*”, John Wiley. New York.
2. Baltagi, B. H. (1999). “Econometrics”, 2nd Edition, Springer Varlog.
3. Gujrati, D. (1998). “Econometrics”, John Wiley, New York.
4. Wonnacott, T.H. and Wonnacott R.J. (1998). “Econometrics”, John Wiley, New -York.
5. Johnston, J. and Di. Nardo, J., (1997). “Econometric *Method*”, 4th Edition, McGraw Hill, New York.
6. Ryan, P. T. (1996) “*Modern Regression Methods*”, John Wiley and sons Inc. New York.
7. Montgomery, D.C., and Peck E.A. (1992).”*Introduction to linear Regression Analysis*”, 2nd Edition, John Wiley and sons Inc. New York.
8. Guttman, I, (1980); “*Linear Models: An Introduction*”, John Wiley, New York.
9. Koutsoyiannis, A. (1980), “*Theory of Econometrics*”, Macmillan. N.Y .
10. Maddala, G.S. (1977). “Econometrics”, McGraw Hill. New York.
11. Searle, S. R. (1971), “*Linear Models*”, John Wiley, New York.
12. * (**Text Book**)

STAT-602 Design and Analysis of Experiments-I

Principles of Design of Experiments. Analysis of variance and its assumptions. Cochran theorem. Fixed, random and mixed effect models. Effect of violation of assumptions and transformations.

Completely Randomized, Randomized Complete Block, Latin square, Graeco-Latin square and cross-over designs. Missing observations. Relative efficiency of designs. Estimation of mean squares and their expectations. Multiple Comparisons.

Analysis of covariance in CR, RCB designs. Estimation of missing values in analysis of covariance.

Pre-Requisite: STAT-202 Books Recommended

1. Montgomery, D.C. (2000). “*Design and Analysis of Experiments*”, John Wiley, New York.
2. Clarke, G.M., and Kempton, R.E. (1997), “*Introduction to the Design & Analysis of Experiments*”, Edward Arnold.
3. Steel, Robert, G. D., Terrie James H., and Dickey David A. (1997). “*Principles and Procedures of Statistics: A Biometrical Approach*” 3rd Edition, McGraw Hill, New York.
4. Boniface, D.R. (1995). “*Experiment Design & Statistical Methods*”, Chapman & Hall.
5. Myers, R.H. and Montgomery, D.C. (1995). “*Response Surface Methodology; Process & Product Optimization Using Design*”, John Wiley.
6. Clarke, G.M. (1994). “*Statistics & Experimental Design*”. Edward Arnold.
7. Harold, R. L (1992). “*Analysis of Variance in Experimental Design*”. Springer Verlag:
8. Maxwell, S.E. and Delaney, H.D. (1990). “*Designing Experiments and Analysis of Data*”. *A model comparison perspective*. Belmont and Wadeson.
9. Mead, R. (1988). “*The Design of Experiments*”. Cambridge University Press, Cambridge.
10. Das, M.N.and Geri, N.C, (1986). “*Design and Analysis of Experiments*”, John Wiley, New York.
11. Gomez, K.A., and Gomez, A.A. (1984).“*Statistical Procedures for Agricultural Research*”, 2nd Edition, John Wiley, New York.
12. Hicks, C.R. (1982). “*Fundamental Concepts in Design and Analysis of Experiments* Saunders
13. Cochran, W.G. and Cox, G.M. (1957). “*Experimental Design*”, John Wiley, New York.

STAT-553 Non-Parametric Methods

Location estimates for single samples: The sign test, modified sign test, Wilcoxon signed rank test, confidence interval based on these tests. Runs test for randomness.

Distribution tests and rank transformation. Kolmogorov's test, Lilliefors's test and Shapiro-Wilks test for normality. Tests and estimation for two independent samples; the median test, Wilcoxon Mann – Whitney test. The Siegel – Turkey test, the squared rank test for variance, Smirnov test. Tests for paired samples. Kruskal – Wallis test, Friedman test, multiple comparison with the Friedman test, Cochran's test for binary responses. Spearman's rank correlation coefficient, Kendall's rank correlation coefficient. Theil's regression method.

Pre-Requisite: STAT-202,301

Books Recommended

1. Conover, W.J. (1999), *Practical Nonparametric Statistics*, 3rd Edition, John Wiley and Sons, New York.
2. Maritz, J.S. (1995). *Distribution-Free Statistical Methods*. Chapman & Hall London.
3. Gibbons, J.D. and Chakraborti, S.(1992), *Nonparametric Statistical Inference*, Marcel Decker, New York.
4. Sprint, P. (1989). *Applied Nonparametric Statistical Methods*. Chapman & Hall London.
5. Lehman, E.L. (1973), *Nonparametric Statistical Methods, based on Ranks*, Holden-Day San Francisco.
6. * (Text Book)^[11]_[SEP]

STAT-551 Probability and Probability Distributions-II

Probability Distributions: Uniform, Exponential, Gamma, Laplace, Rayleigh with moments and cumulates Distributions of functions of random variables; Chi-square, t and F distributions, their derivations and properties. Central limit and Chebyshev's theorems and other inequalities. Weak and Strong Laws and their applications. Order statistics. Distributions of rth and sth order statistics. Bivariate Normal distribution.

Pre-Requisite: STAT-301

Books Recommended

1. Stirzaker, D. (1999). "*Probability and Random Variables*". Cambridge University Press, Cambridge.
2. Stuart, A. and Ord, J.K. *Kendall's* (1998), "*Advanced Theory of Statistics*", Vol. I, Charles Griffin, London.
3. Hirai, A.S. (1998), "*A Course in Mathematical Statistics*", Ilmi Kutab Khana, Lahore.
4. Fridett, B. & Gray, L. (1997). "*A Modern Approach to Probability Theory*" Birkhallser, Boston.
5. * Freund, J. E. (1997). "*Mathematical Statistics*", Prentice Hall, New Jersey.
6. * Mood, A.M, Graybill, F.A. and Boss, D.C. (1997), "*Introduction to the Theory of Statistics*", McGraw Hill, New York.
7. Hogg, R.M. and Craig, A.T. (1995), "*Introduction to Mathematical Statistics*". Prentice Hall, Engle wood Cliffs, New Jersey.
8. Khan, M. K., (1996). "*Probability with Applications*", Maktiba Ilmi, Lahore.
9. Haq, M. (1984). "*Foundation of Probability and Statistics*", Tahir sons, Urdu Bazar, Karachi.
10. * (Text Books)

STAT-552 Sampling Techniques-II

Cluster Sampling, Sub sampling, PPS-Sampling. Double Sampling, Multistage and Multiphase sampling. Thomson Hurwitz estimator. Comparison of different sample designs. Sampling and non-sampling errors and their sources. Non-response, their sources and bias. Randomized response. Critical study of National sample surveys conducted in Pakistan: Census of Agriculture, Household Income and Expenditure Survey (HIES), Pakistan Demographic Survey (PDS) and National Population and Housing Census and Surveys (NPHCS).

Pre-Requisite: STAT-303 Books Recommended

1. Des Raj & Chandhok, P. (1998), “*Sample Survey Theory*”. Narosa Publishing House, New Delhi.
2. Ferguson, T.S. (1996), “*A Course in Large Sample Theory*”, Chapman & Hall, London.
3. Singh, R. and Singh N, (1996), “*Elements of Survey Sampling*”, Kulwar, Dodrecht.
4. Kish, L. (1992), “*Survey Sampling*”, John Wiley, New York.
5. Sukhatme, P.V, Sukhatme, B., Sukhatme, S., and Asok, A. (1985), “*Sampling Theory of Survey with Application*”. Iowa State University Press.
6. * Cochran, W.G. (1977), “*Sampling Techniques*”, John Wiley and Sons, 3rd ed, New York.
7. Des Raj, (1971), *Design of Sample Survey*. McGraw Hill, New York.
8. Various publications of FBS, ACO and PCO.
9. * **(Text Book)**

STAT-555 Econometrics

Errors in Variables. Problems of autocorrelation, multicollinearity, heteroscedasticity and their solution. Ridge regression. Lagged variables. Dummy variables. System of simultaneous linear equations, Identification-Estimation method, indirect and two-stage least squares methods, restricted least squares. Test of identifying restrictions. Estimation with stochastic regressors, generalized least squares estimators.

Pre-Requisite: STAT-307

Books Recommended

1. Draper, N.R. and Smith, H. (2004). “*Applied Regression Analysis*”, John Wiley, New York.
2. Baltagi, B. H. (1999). “*Econometrics*”, 2nd Edition, Springer Verlag.
3. Gujarati, D. (1998). “*Econometrics*”, John Wiley, New York.
4. Wonnacot, T.H. and Wonnacot R.J. (1998). “*Econometrics*”, John Wiley, New York.
5. * Johnston, J. and Di. Nardo, J., (1997). “*Econometric Method*”, 4th Edition, McGraw Hill, New York.
6. Montgomery, D.C., and Peck E.A. (1992). “*Introduction to Linear Regression Analysis*”, 2nd Edition, John Wiley and sons Inc. New York.
7. Guttman, I. (1980); “*Linear Models: An Introduction*”, John Wiley, New York.
8. Koutsoyiannis, A. (1980), “*Theory of Econometrics*”, Macmillan.
9. Maddala, G.S. (1977). “*Econometrics*”, McGraw Hill. New York.
10. Searle, S. R. (1971), “*Linear Models*”, John Wiley, New York.
11. * **(Text Book)**

STAT-309: Statistical Methods

A brief introduction to basic statistical terminologies and sampling procedures. Sampling distribution of the sample mean (\bar{x}), sample proportion (\hat{P}), Difference of the two sample means ($\bar{x}_1 - \bar{x}_2$), difference of two sample proportion ($\hat{P}_1 - \hat{P}_2$) and their properties. Estimation of parameters, method of maximum likelihood estimation, method of moments estimation, unbiasedness, efficiency, sufficiency, consistency, testing of hypothesis, simple and composite hypothesis, construction of confidence interval, type-I and type-II errors, Power of a test, O.C. Curves, testing of Hypothesis and construction of confidence interval for means, proportions and variances in small and large samples, determination of the sample size. Analysis of categorical data, goodness of fit tests of commonly used distribution, testing of independence in contingency tables. Testing of homogeneity of several variances, Bartlett's test, and Fisher's exact test for 2x2 contingency table.

Books Recommended

- 1) S. M. Chaudhry and S. Kamal. "Introduction to Statistical Theory" (1996) Ilmi Kitab Khana Lahore
- 2) Walpole, R.E (1990) " Introduction to Statistics" 3rd edition, MacMillan Publishing Co. Inc. New York.
- 3) Snedecor, G. W. and Cochran W.G. (1997). Statistical Methods, IowaStateUniversity Press.
- 4) Daniels, H (1988). Applied Non-parametric Statistics, John Wiley, New York.
- 5) Steel, R.G.D., Torrie, J.H. and Dickey, D.A. (1996). Principles and Procedures of Statistics 3rd Edition, McGraw Hill, New York.
- 6) Mendenhall, W. and Beaver, R.J. (1994), "Introduction to Probability and Statistics" 9th edition, Duxbury press, Belmont, California.
- 7) Montgomery D.C and Peek, E.A.(1992). Introduction to Linear Regression analysis, John Wiley and Sons, Inc. New York.
- 8) Dixon, W.J. and Massey, F.J. (1983). Introduction to Statistical Analysis, McGraw Hill, New York.

STAT-652 Design and Analysis of Experiments-II

Factorial Experiments: 2k, 3k series and mixed level factorial experiments and their analyses. Confounding in factorial experiments, Complete and partial confounding, Confounding in Fractional replications, Quasi-Latin square designs. Split- plot, split block, split-split plot, strip plot and nested designs. Missing observations in Split plot design.

Incomplete block designs: BIBD - Lattice designs, lattice square and Youden squares, PBIBD with recovery of intra-block information. Introduction of response surface methods: First and Second order designs. Central composite designs. Fitting of response surface models and estimation of optimum/maximum response.

Pre-Requisite: STAT-305

Books Recommended

1. * Montgomery, D.C. (2000). “*Design and Analysis of Experiments*”, John Wiley, New York.
2. Clarke, G.M., and Kempton, R.E. (1997), “*Introduction to the Design & Analysis of Experiments*”, Edward Arnold.
3. Steel, G. D., Terrie, and Dickey A. (1997). “*Principles and Procedures of Statistics: A Biometrical Approach*” 3rd Edition, McGraw Hill, New York.
4. Boniface, D.R. (1995). *Experimental Design & Statistical Methods*, Chapman & Hall.
5. Myers, R.H. and Montgomery, D.C. (1995). “*Response Surface Methodology; Process & Product Optimization Using Design*”, John Wiley.
6. Clarke, G.M. (1994). “*Statistics & Experimental Design*”. Edward Arnold.
7. Harold, R. L (1992). “*Analysis of Variance in Experimental Design*”. Springer Verlag:
8. Maxwell, S.E. and Delaney, H.D. (1990). *Designing Experiments and Analysis of Data. A Model Comparison Perspective*. Belmont and Wadson.
9. Mead, R. (1988). “*The Design of Experiments*”. Cambridge University Press, Cambridge.
10. Das, M.N.and Giri, N.C, (1986). “*Design and Analysis of Experiments*”, John Wiley, New York.
11. Gomez, K.A., and Gomez, A.A. (1984). “*Statistical Procedures for Agricultural Research*”, 2nd Edition, John Wiley, New York.
12. Hicks, C.R. (1982). “*Fundamental Concepts in Design and Analysis of Experiments*”; Saunders
13. Cochran, W.G. and Cox, G.M. (1957). “*Experimental Design*”, John Wiley, New York.

STAT-554 Population Studies

The population and housing census Registration of vital events. Demographic surveys. Components of population growth, the composition of the population and vital events. Types and sources of errors. General testing procedures. Testing the accuracy of age and sex data. Fertility and mortality measures. Total and general fertility rates. Estimation from incomplete Data. Construction of complete and abridged life tables. Different types of life tables. Graphs of I_x , q_x and e_x . Description and uses of life table columns. Stationary population models. Population estimates and projections, Inter-censal estimates, Population projections through various methods. Theory of demographic transition. Stable and stationary population models, their applications and uses. Malthusian and post Malthusian theories of growth. Consequences of world population growth & population explosion. State of Population in Pakistan. Development of demographic profile in Pakistan. Recent demographic parameters. Current and future demographic activities in Pakistan.

Pre-Requisite: STAT-201 & 202

Books Recommended

1. Jay Weinstein, Vijayan, K. Pillai, (2001) "Demography: *The Science of Population*". Allyn & Bacon.
2. Hind, A., (1998). "Demographic *Method*", Arnold.
3. United Nations (1998), "*World Population Assessment*", UNFPA; New York.
4. Govt. of Pakistan (1998), *National, Provincial and District census reports and other supplementary reports with respect to 1998 census*; PCO, Islamabad.
5. United Nations (1996), "*Added years of Life in Asia*", ESCAP; U.N., Thailand.
6. Palmore, J.A; Gardner, R.W. (1994), "*Measuring Mortality Increase*"; East West Centre, Honolulu.
7. Bogue, D.J. Arriagu, E.E., Anderson, D.L. (1993), "*Readings in Population Research Methodology*", Vol. I-VIII, United Nations Fund; Social Development Centre, Chicago.
8. Impagliazo, J. (1993), *Deterministic Aspects of Mathematical Demography*, Springer Verlag New York.
9. United Nations (1990), "*World Population Monitoring 1989*", UNFPA.
10. Rukanuddin A.R. and Farooqi, M.N.I., (1988), "*The State of Population in Pakistan – 1987*", NIPS, Islamabad.
11. Keyfitz, N. (1983) "*Applied Mathematical Demography*", Springer Verlag N.Y.
12. * Pollard, A.H., Yousaf, F & Pollard, G.M. (1982), "*Demographic Techniques*", Pergamon Press, Sydney.
13. Pakistan Demographic Survey, Govt. of Pakistan, Federal Bureau of Statistics.
14. Publications of population census organizations.
15. * (Text Book)

STAT-601 Statistical Inference-I

Estimation of Parameters. Properties of Estimators: unbiasedness, consistency, sufficiency, efficiency, completeness. Cramer-Rao inequality, Rao-Blackwell and Lehmann-Scheffe Theorems. Methods of Estimation: Moments, Maximum likelihood, least-squares, minimum Chi-square and Bayes theorem.

Pre-Requisite: STAT-302 Books Recommended

1. Mood, A.M., Graybill, F.A. and Boss, D.C. (1997). "Introduction to the Theory of Statistics". McGraw Hill, New York.
2. * Hogg, R.V. and Craig, A.T. (1996). "Introduction to Mathematical Statistics". Prentice Hall, New Jersey.
3. Lindgren, B.W. (1998). "Statistical Theory". Chapman and Hall, New York.
4. Stuart, A. and Ord, J.K. (1998). *Kendall's "Advanced Theory of Statistics" Vol. II*. Charles Griffin, London.
5. Zacks, S. (1973), "Parametric Statistical Inference", John Wiley, New York.
6. Rao, C.R., (1973). "Linear Statistical Inference and its Applications", John Wiley, New York.
7. * Bickel, P.J., and Doksum, K.A. (2001), Mathematical Statistics, Vol I, Prentice Hall, N.J., 2nd ed.
8. * (Text Book)^[L]_{SEP}

STAT-653 Applied Multivariate Analysis

Introduction to Multivariate Normal Distribution. Estimation of the mean vector and covariance matrix. Multivariate analysis of variance (MANOVA). Principal components analysis, Factor analysis, discriminate analysis, Canonical Correlation Cluster analysis. Multidimensional scaling.

Pre-Requisite: STAT-302 Books Recommended

1. Anderson, T.W. (2003). “*An Introduction to Multivariate Statistical Analysis*”, John Wiley, New York.
2. Afifi, A. A. and Clark Virginia (2000). “*Computer Aided Multivariate Analysis*”, Lifetime learning publications, Belmont California.
3. Flurry B. (1997). “*A First Course in Multivariate Statistics*”, Springer Valerg, New York.
4. Manly, B.F.J. (1994). “*Multivariate Statistical Methods, A Primer*” 2nd Edition, Chapman and Hall, London.
5. * Johnson, R.A. and Wincher, D.W. (1992). “*Applied Multivariate Statistical Analysis*”. Prentice Hall. London.
6. * Morrison, F. (1990). “*Multivariate Statistical Methods*”, McGraw Hill, New York.
7. Chatfield, C. and Collins, A.J. (1980). “*Introduction to Multivariate Analysis*”, Chapman and Hall, London.
8. Mardia, K.V., Kent, J.T. and Bobby, J.M. (1979). “*Multivariate Analysis*”, Academic Press, London.
9. Everett, B.J. (1974). “*Cluster Analysis*”, McGraw Hill, New York.
10. * **(Text Book)**

STAT-603 Survey and Research Methods

Definition of Research, Types of Research, Selection of Problem, Search of References, Formation of Hypothesis and Procedure for its Testing, Research Methodology, Planning of Experiments to Test Hypothesis Objectivity, Principles of Experimental Design, Steps in Experimentation, Collection of Data, Data Analysis to Determine Functional Relationship Between Variables, Levels of Significance, Interpretation of Results, Components of Scientific Reports and Various Methods of Data Presentation, Preparation of Scientific Reports, Publication Procedures.

PRACTICAL:

Survey of Literature on a Given Topic, Collection of References from Various Sources Including SD-ROM Data Base. Collection of Primary and Secondary Data, Arrangement of Primary and Secondary Data, Preparation of Scientific Report for Publication, if Possible

Pre-Requisite: STAT-304 Books Recommended

1. Andrew, C.O. and P.E. Hildebrand. (1993) "Applied Agricultural Research", Foundations and Methodology, Western Press.
2. Hashmi, N. (1989) "Style Manual of Technical Writings", USAID/NARC, Islamabad.
3. Gimbaled, J. and W.S. Acuter (1988) "MLA handbook for Writers of Research Papers", McGraw The Modern Language Association of America.
4. Little, T.M. and F.J. Hills (1978) "Agricultural Experimentation", John Wiley & Sons.

STAT-651 Statistical Inference-II

Interval Estimation: Pivotal and other methods of finding confidence interval, confidence interval in large samples, shortest confidence interval, optimum confidence interval. Bayes' Interval estimation. Tests of Hypotheses: Simple and composite hypotheses, critical regions. Neyman-Pearson Lemma, power functions, uniformly most powerful tests. Deriving tests of Hypothesis concerning parameters in normal, exponential, gamma and uniform distributions. Randomized Tests. Unbiased tests, Likelihood ratio tests and their asymptotic properties. Sequential Tests: SPRT and its properties, A.S.N. and O.C. functions.

Pre-Requisite: STAT-401

Books Recommended

1. Stuart, A and Ord, J.K. (1998). *Kendall's 'Advanced Theory of Statistics' Vol. II*. Charles Griffin, London.
2. Lindgren, B.W. (1998). *Statistical Theory*. Chapman and Hall, New York.
3. * Mood, A.M. Gray Bill, F.A. and Boss, D.C. (1997). *Introduction to the Theory of Statistics*. McGraw Hill, New York.
4. Lehman, E.L. (1997). *Testing Statistical Hypotheses*. Springer - Volga, New York.
5. * Hogg, R.V. and Craig, A.T. (1996). *Introduction to Mathematical Statistics*. Prentice Hall, New Jersey.
6. Zacks, S. (1973), *Parametric Statistical Inference*, John Wiley, New York.
7. Rao, C.R., (1973). *Linear Statistical Inference and its Applications*, John Wiley, New York.
8. * **(Text Book)**

STAT- PROJECT ELECTIVE COURSES

STAT-621 Operations Research

History and definition of O.R. Introduction to linear programming. Formulation of LP model. Graphical solution of two variables. Standard Form. Simplex method. Duality theory; Sensitivity Analysis, Primal and dual form. Gaussian elimination. Transportation Problem, Assignment problem. Introduction to CPM and PERT techniques. Queuing Models, Inventory models, Dynamic programming and simulation models.

Books Recommended:

1. Taha, H.A. (1998). “*Operations Research*”. Macmillan. London.
2. Hillier, F.S. and Lieberman G. J. (1996). “*Introduction to Operations Research*”, Holden Day.
3. Gupta, P.K. & Hira, D.S. (1994). “*Operations Research*”. S. Chand & Co., New Delhi.
4. Bazarra, N.M., Jarvis J.J. and Sherali, H.D. (1990) “*Linear Programming and Network Flows*”, John Wiley & Sons, 2nd ed.
5. Ravindran, A., Philips, D.J and Sillerg, J.J. (1987). “*Operations Research: Principles and Practice*” John Wiley.
6. Bronson, R. (1983). “*Operations Research – Schaums’ Outline Series*” – McGraw Hill.
7. * (Text Book)

STAT-622 Stochastic Processes

Introduction. Generating Functions. Laplace Transforms. Difference Equations. Differential - Difference Equations. Introduction to Stochastic Processes. The Random Walk in one and two Dimensions. The Classical Gambler's Ruin Problem. Expected Duration of the Game.

Markov Chains: Definition. Higher Transition Probabilities. Classification of States and Chains. Markov processes with Discrete State Space. Poisson Process and its Generalization. Pure Birth and Death Processes. Markov Processes with Discrete State-Space (Continuous Time Markov Chains). Markov Processes with Continuous State Space. Introduction to Brownian motion. The Wiener Process. Diffusion Equations for the Wiener Process.

Books Recommended


1. Ross, S. (1996). "*Stochastic Process*", 2nd Edition, John Wiley, New York.
2. Feller, W. (1992). "*An Introduction to Probability Theory and its Applications*", John Wiley, New York.
3. Srinivasin, S.K. and Mehta, K.M. (1988). "*Stochastic Processes*". Tata McGraw Hill.
4. Karlin, S.A. and Taylor H.M. (1984). "*A first course in Stochastic Process*", Academic Press London.
5. Hole, P.G., Port, S. and Stone, C.L. (1984). "*An Introduction to Stochastic Process*", John Wiley, New York.
6. Cox, D.R. and Miller H.D. (1984). "*The Theory of Stochastic Processes*", Chapman and Hall, London.
7. Medhi, J. (1982), "*Stochastic Processes*", Wiley Eastern Ltd.
8. * (**Text Book**)

STAT-623 Reliability Analysis

Basic concepts of reliability. Structural reliability. Lifetime distributions (Failure models): Hazard rate; Gamma, Weibull, Gumball, Log-Normal and Inverse Gaussian Distribution. Stochastic fatigue-rate models. Point and interval estimation. Fatigue-life model.

Testing reliability hypothesis. Monte-Carlo, distribution-free and Bayes' methods in reliability. System reliability; series and parallel systems. Failure models, (k-out-of-m) New-better-than used models. Inferences for these models. Accelerated life testing.

Books Recommended

1. Achintya Haldar, Sankaran Mahadevan (2000). *Reliability Assessment Using Stochastic Finite Element Analysis*".
2. Crowder, M.J. (1994). "Statistical *Analysis of Reliability Data*".
3. Lee, J. Bain, Bain Bain, (1991). "Statistical *Analysis of Reliability and Life-Testing Models*".
4. Gertsbakh, I.B. (1989). "Statistical *Reliability Theory*". Marcel Decker. New York.
5. * Lawless, J.F. (1982). "Statistical *Model and Methods for Lifetime Data*".
6. Gertsbakh, I.B. (1988). "Statistical *Reliability Theory*".
7. Mann, N.R., Scheefer, R.E. and Singapoor wel, N.D. (1974).  *Methods for Statistical Analysis of Reliability*, John Wiley & Sons.
8. * **(Text Book)**

STAT-624 Time Series Analysis and Forecasting

Stochastic Process, Stationary Time-Series, Exponential smoothing techniques, auto-correlation and auto-covariance, estimates functions and standard error of the auto-correlation function (ACF) and PACF, Periodogram, spectral density functions, comparison with ACF, Linear stationary models: Auto regressive, Moving Average and mixed models, Non-stationary models, general ARIMA notation and models, minimum mean square forecasting. ARIMA Seasonal Models.

Books Recommended

1. Cox, D. R., Hinckley D.V. and Nielsen O.E.B. (1996). “*Time Series Models - In Econometrics, finances and other fields*”; Chapman & Hall, London.
2. * Chatfield, C. (1996). “*The Analysis of Time Series: An Introduction*”, Chapman and Hall, London.
3. Andy, P, West M. and Harrison, P. J. (1994). “*Applied Bayesian Forecasting and Time Series Analysis*”, Chapman & Hall New York.
4. Brock well P.J. and Davis R.A. (1991). “*Time Series Theory and Methods*”, Springer Verlag New York.
5. Harvey, A.C. (1990). “*Forecasting Structural Time Series Models and the Calamander*”, Cambridge University Press, Cambridge.
6. Dagle, P.J. (1990), “*Time Series: A Biostatistical Introduction*”, Clarendon Press, Oxford.
7. Bovas, A. and Johannes, L. (1983), “*Statistical Methods for Forecasting*”, John Wiley. New York.
8. Priestley, M.B. (1981), “*Spectral Analysis and Time Series*”, Academic Press, London.
9. * Box, G.E.P. and Jenkins, G.M. (1999). “*Time Series Analysis: Forecasting and Control*”, San Francisco.
10. * **(Text Book)**^[L]_[SEP]

STAT-625 Decision Theory

The nature and concept of loss functions, parameters, decisions and sample spaces. Risk and average loss. Admissibility and the class of admissible decisions. Minimax principle and its application to simple decision problems, linear and quadratic losses and their uses in problems of estimation and testing hypotheses. Asymptotically minimax procedure. A prior distributions and conjugate priors. Bayes' decision procedure, admissibility of Bayes' and minimax procedures.

Books Recommended

1. Berger, J. O. (1985). "Statistical *Decision Theory & Bayesian Analysis*", Springer Verlag.
2. * Lindgren, B.W. (1971). "Elements of *Decision Theory*, Macmillan", New York.
3. Blackwell, D. and Graphic, M.A. (1966). "Theory of *Games and Statistical Decision*", John Wiley, New York.
4. * **(Text Book)**

STAT-626 Robust Methods

Introduction to Robustness. Objective function. M-estimator of location. E-estimator, R-estimator and W-estimator, Redescending M-estimator's The Breakdown point of Robust estimator Influence function. M-estimator for scale. Outliers and influential observations. Outliers in Regression analysis.

Books Recommended

1. Rousseau, P.J. and Leroy, A.M. (1987). "*Robust Regression and outlier detection*", John Wiley. New York.
2. Hamper, T.R. Brochette, E.M. Rousseau, P.J. and Satchel, W.A. (1986). "*Robust Statistics*", "*The approach Based on Influence functions*", John Wiley New York.
3. * Huber, P.J. (1981). "*Robust Statistics*", John Wiley, New York.
4. * **(Text Book)**

STAT-627 Official Statistics

Design and planning of a Statistical Investigation. Data collection- approach and operation; Role of sampling in generation of Statistics, Sampling plans and survey Designs. Sources of Errors, Types of Errors, methods of their control. Data processing, presentation, and publication of Statistics. Different modes of Data Dissemination. Official Statistics, Statistical systems and standards, Sources of official statistics, their role, working and publication. Role of Official Statistics, Official Publications. Setup of official organizations in Pakistan their role, working & publication, Statistics Division, Federal Bureau of Statistics, Agricultural Census Organization, Population Census Organization, Ministry of Food, Agriculture and Livestock; National Data Base and Registration Authority (NADRA). Provincial Bureaus of Statistics. Financial Statistics: Ministry of Finance, State Bank of Pakistan-Department of Statistics, their working, publications and responsibilities. Other Organization's Statistical output, National and International series, classification and standards. Use of Statistics in administration and planning. Concepts and evaluation of GDP, GNP, NNP, Balance of Trade and payments. Measurement of Income Distribution, use of Index Numbers and time series. Deflation and Inflation of series. National sample surveys and censuses conducted in Pakistan.

Assignment: Visit of major Statistical Organizations will be a part of the course. An assignment will have to be submitted on any topic given by the course in charge.

Books Recommended:

1. Kish, L. (1992). "Survey *Sampling*", John Wiley, New York.
2. Statistics Division, "Activity Report" (1988-89). *Government of Pakistan*, Islamabad.
3. Statistical Institute for Asia & Pacific SIAP (1984). "Training of Trainers in Statistical Operations and Procedures" Part-I, II UNDP, ^[11]_{SEP} Tokyo.
4. Hansen M.H. (1980). "Progress and Problems in Survey Methods and Theory". *Illustrated by the work of U.S. Bureau of the Census, U.S. Department of Commerce; A Monograph*.
5. Murthy, M.N. (1979). "Quality of Data, Country Course on Sample Surveys", Karachi.
6. Statistics Division (1979). "Retrospect, Perspective and Prospect", Islamabad.
7. State Bank of Pakistan (1966). "Deptt. of Statistics-A Chronicle".
8. Zarkovich S.S. (1966) "Quality of Statistical Data, Food and Agricultural Organization", The U.N. Rome.
9. NIPA (1962) "Administrative uses of Statistics", NIPA Res. Sr.No.2 Karachi.
10. Yates F. (1960), "Sampling Methods for Census and Surveys", Charles Griffin. FAO Year Books.
11. Various Publications of FBS, PCO, ACO, "State bank of Pakistan, ^[11]_{SEP} Ministry of Finance" etc.

STAT-628 Survival Analysis

Special features of Survival data: Patient time and study time, Survival function and hazard function, Time-dependent and censored survival data. Nonparametric procedures: Estimation of Survival function, hazard function, median, and percentiles of Survival times. Confidence interval and comparison of group; stratified and log-rank tests for trend. Modeling of Survival data; hazard function modelling; its tests and confidence interval. The Waybill model for survival data. Exploratory data analysis and other models. Sample size requirement for survival study. Computer software for Survival analysis; any available software like SAS, BMDP, SPSS, GLIM, GENSTAT or S-plus.

Books Recommended

1. Lee, E.T. (1997). “*Applied Survival Analysis*”, John Wiley and Sons, New York.
2. Muller, R.G. and Xian Zhou (1996). “*Survival Analysis with long- term Survivors*”, John Wiley. New York.
3. Burkett, M. (1995). “*Analyzing Survival Data from Clinical Trials and Observational Studies*”; John Wiley New York.
4. Parmer M.K.B. & Macklin D. (1995). “*Survival Analysis: A Practical Approach*”; John Wiley New York.
5. Collett, D. (1994). “*Modeling Survival Data in Medical Research*”. Chapman & Hall, London.
6. Lee, E.T. (1992). “*Statistical Methods for Survival Data Analysis*”; John Wiley. N.Y.
7. Eland Johnson, R. C. and Johnson N. L. (1989), “*Survival Models & Data Analysis*”. John Wiley N.Y.
8. Turkey, J. (1987). “*Exploratory Data Analysis*”, John Wiley, New York.
9. Cox, DR. and Oakes, D. (1984). “*Analysis of Survival Data*”; Chapman & Hall London.
10. * (Text Book)

STAT-629 Biostatistics

Definition of Biostatistics, viz-a-viz the type of variables and observations in biological, health and medical sciences, Uniqueness in terms of behaviour of variables their domain, and units; Categorical, numerical and censored data. Populations, Target populations and samples; Role of sampling in biostatistics, Size of samples of various types of studies, Proportions, rates and ratios; incidence, prevalence and odds. Distributional behaviour of biological variables (Binomial, Poisson and Normal), Role of transformation for analysis of biological variables. Probit and Logit transformations and their analysis, p values, its importance and role. Confidence Interval in simple and composite hypothesis testing.

Books Recommended

1. Zar, J. (2000). "Biostatistical *Analysis*", 5th Edition, John Wiley and Sons.
2. Shoukri, M. M. & Pause, C. A. (1998). "Statistical *Methods for Health Sciences*". 2nd Edition, CRC Press, Florida.
3. * Daniel, W.W. (1996). "Biostatistics: *A Foundation for the Health Sciences*", 6th Edition, John Wiley, New York.
4. Diggle, J. P., Liang, Kung-Yee and Zeger, S. L. (1996). "Analysis of *Longitudinal Data*", Clarendon Press, Oxford.
5. Dunn, G. and Everit, B. (1995). "Clinical *Biostatistics*", Edward Arnold, London.
6. * Rosner, B. (1994). "Fundamentals of *Biostatistics*", 4th Edition, Duxbury Press.
7. Zolman, J.F. (1993). "Biostatistics: *Experimental Design and Statistical Inference*", Oxford University Press, New York.
8. Lee, E.T. (1992). "Statistical *Methods for Survival Data Analysis*", 2nd Edition, John Wiley, New York.
9. Harris, E. K. and Albert, A. (1991). "Survivorship *Analysis for Clinical*".
10. "Studies". Marcel Decker, New York.
11. Altman, G. (1991). "Practical *Statistics for Medical Research*". Chapman & Hall, London.
12. Lawless, J. F. (1982). *Statistical Models and Methods for Life Time Data*. John Wiley, New York.
13. * (Text Book)

STAT-630 Data Mining

Introduction to databases, including simple and relational databases; data warehouses. Review of classification methods from multivariate analysis; classification and decision trees. Clustering methods from both statistical and data mining viewpoints; vector quantization. Unsupervised learning from univariate and multivariate data; dimension reduction and feature selection. Supervised learning from moderate to high dimensional input spaces; artificial neural networks and extensions of regression models, regression trees. Association rules and prediction; applications to electronic commerce.

Books Recommended

1. Han, J. and Camber, M. (2000). Data Mining; “*Concepts and Techniques*”. Morgan Kaufmann.
2. Benson and Smith, S.J. (1997). “*Data Warehousing, Data Mining*”, and OLAP. McGraw-Hill.
3. Mitchell, T.M. (1997). “*Machine Learning*”. McGraw-Hill.
4. Ripley, B.D. (1996). “*Pattern Recognition and Neural Networks*”. Cambridge University Press.
5. Breiman, L. Friedman, J.H. Olshen, R.A. and Stone, C.J. (1984). “*Classification and Regression Trees*” Wadsworth and ^[L]_{SEP}Brooks/Cole.
6. * (Text Book)

STAT-631 Actuarial Statistics-I

Utility theory, insurance and utility theory, models for individual claims and their sums, survival function, curate future lifetime, force of mortality.

Life table and its relation with survival function, examples, assumptions for fractional ages, some analytical laws of mortality, select and ultimate tables.

Multiple life functions, joint life and last survivor status, insurance and annuity benefits through multiple life functions evaluation for special mortality laws.

Multiple decrement models, deterministic and random survivorship groups, associated single decrement tables, central rates of multiple decrement, net single premiums and their numerical evaluations.

Distribution of aggregate claims, compound Poisson distribution and its applications.

Books Recommended

1. Bowers, N.L. Gerber, H.U. Hickman, J.C. Jones, D.A. and Nesbitt, C.J. (1986). “Actuarial *Mathematics*”, Society of Actuarial, Ithaca, Illinois, U.S.A. Second Edition (1997).
2. Neill, A. (1977). “*Life Contingencies*”, Heineman.
3. Spurgeon, E.T. (1972), “*Life Contingencies*”, Cambridge University Press.

STAT-632 Actuarial Statistics-II

Principles of compound interest: Nominal and effective rates of interest and discount, force of interest and discount, compound interest, accumulation factor, continuous compounding.

Life insurance: Insurance payable at the moment of death and at the end of the year of death-level benefit insurance, endowment insurance, deferred insurance and varying benefit insurance, recursions, commutation functions.

Life annuities: Single payment, continuous life annuities, discrete life annuities, life annuities with monthly payments, commutation functions, varying annuities, recursions, complete annuities-immediate and apportionable annuities-due.

Net premiums: Continuous and discrete premiums, true monthly payment premiums, apportionable premiums, commutation functions, accumulation type benefits.

Payment premiums, apportionable premiums, commutation functions, accumulation type benefits.

Net premium reserves : Continuous and discrete net premium reserve, reserves on a semi-continuous basis, reserves based on true monthly premiums, reserves on an apportionable or discounted continuous basis, reserves at fractional durations, allocations of loss to policy years, recursive formulas and differential equations for reserves, commutation functions.

Some practical considerations: Premiums that include expenses-general expenses types of expenses, per policy expenses.

Claim amount distributions, approximating the individual model, stop-loss insurance.

Books Recommended

1. Bowers, N.L. Gerber, H.U. Hickman, J.C. Jones, D.A. and Nesbitt, C.J. (1986) “Actuarial *Mathematics*”, Society of Actuaries, Ithaca, Illinois, U.S.A. Second Edition (1997).
2. Spurgeon, E.T. (1972). “*Life Contingencies*”, Cambridge University Press.
3. Neill, A. (1977). “*Life Contingencies*”, Heinemann.

STAT-633 Mathematical Modelling and Simulation

Monte Carlo methods: Different methods of generating random variables, generation of random numbers, acceptance and rejection techniques from various distributions. Comparison of algorithms to generate random variables. Generating random variables from failure rates.

Generation from multinomial distribution / Monte Carlo integration. Gibbs sampling and other techniques. Variance reduction techniques: importance sampling for integration, control variates and antithetic variables.

Books Recommended:

1. Ross, S.M. (2002). "Simulation" (Third Edition) (Academic).
2. Fishman, G.S. (1996). Monte Carlo: "Concepts, Algorithms, and Applications", (Springer).
3. Rubinstein, R.Y. (1981). "Simulation and the Monte Carlo Method", (Wiley).
4. Ripley, B.D. (1987) "Stochastic Simulations" (Wiley)
5. * (Text Book)

STAT-634 Categorical Data Analysis

Introduction, describing two way contingency tables, inference for two way contingency tables, models for binary response variables, Log linear models, fitting Log linear and Logit models, building and applying Log linear models, Log linear Logit models for ordinal variables, multinomial response models for matched pairs, analyzing repeated categorical response data, logistic regression models and their analysis.

Books Recommended

1. Agresti, A. (1990), “*Categorical Data Analysis*”, John Wiley and Sons.
2. Bishop, Y.V.V., Fienberg, S.E. and Holland, P.W. (1975). “*Discrete Multivariate Analysis*”, MA: MIT Press Cambridge.
3. Cox, D.R. and Snell, E.J.(1989). “*The Analysis of Binary Data*”, Chapman and Hall, London.
4. David, W.H., Leweshow, S.L. (1989). “*Applied Logistic Regression*”.
5. Mc Gullah, P. and Nelder, J.A. (1989). “*Generalized Linear Models*”, 2nd ed. Chapman and Hall, London.

STAT-636 Bayesian Statistics

Prior information, Prior distributions, Methods of elicitation of prior distributions, Posterior distributions: The posterior means, medians (Bayes estimators under loss functions) and variances of univariate and bivariate posterior distributions, Non-informative priors: Methods of elicitation of non-informative priors, Bayesian Hypotheses Testing: Bayes factor; the highest density region; Posterior probability of the hypothesis.

Books Recommended

1. O'Hagan A. Kendall's Advanced Theory of Statistics (Vol.2B), Bayesian Inference, Cambridge, The University Press (1994).
2. Bernardo, J. M. & Smith, A.F.M., Bayesian Theory, John Wiley, New York (1994).
3. Lee, P.M. Bayesian Statistics, An Introduction, Oxford University Press, New York (1991).
4. Berger, J.O., Statistical Decision Theory and Bayesian Analysis (2nd Ed.), New York, Springer Verlag (1985).
5. Box, G.E. P & Tiao, G. C. Bayesian Inference in Statistical Analysis, Reading Addison-Wesley (1973).

STAT-637 Statistical Quality Management

Concept of quality control, total control and Total Quality Management (TQM) Statistical Methods in Quality Improvement. Statistical Process Control (SPC). Statistical Quality Control (SQC). Shewhart control charts: philosophy, construction, advantages. CUSUM and moving average control charts: Average Run Length (ARL); Fast Initial Response (FIR). ARL and FIR for X, R and S-charts.

Process capability analysis: Designed experiments. Process improvements using design of experiments. Taguchi Method. Orthogonal fractional factorial designs. Acceptance sampling for attributes and variables.

Acceptance sampling plans: Single, double, and multiple sampling plans with their O.C. curves, Military Standard 501 Sampling Plans. Introduction to ISO- 9000 and ISO-14000 series.

Pre-Requisite: STAT-301

Books Recommended

1. Montgomery, D.C. (2004). “*Introduction to Statistical Quality Control*”. McGraw Hill, New York.
2. Miltag H. J. and Rinne H. (1993). “*Statistical Methods of Quality Assurance*”, Chapman & Hall, London.
3. Nelson, W. (1990). “*Accelerated Testing*”. John Wiley, New York.
4. Banks, J. (1989). “*Principles of Quality Control*”. John Wiley, New York.
5. Ryan, T.P. (1989). “*Statistical Methods for Quality Improvement*”. John Wiley, New York.
6. Juran, J.M. and Guyana, F.K. (1988). “*Juan’s Quality Control Handbook*”. McGraw Hill New York.
7. Feigenbaum, A.V. (1986). “*Total Quality Control*”. McGraw Hill, New York.