

DEPARTMENT OF AGRICULTURAL STATISTICS & COMPUTER APPLICATION

PG & PhD COURSES

SEMESTER – I

| Course No. | Course Title | Cr. Hrs |
|------------|--|---------|
| STAT-511 | Statistical Methods (Common for Ag., H.Sc. and Fisheries faculties) | 3(2+1) |
| STAT-512 | Statistical Methods In Engineering | 3(2+1) |
| STAT-611 | Sample Surveys | 3(2+1) |
| STAT-612 | Computer Applications In Agriculture | 3(2+1) |
| STAT-613 | Statistical Methods in Bioassay and Probit Analysis | 3(2+1) |

SEMESTER – II

| | | |
|----------|--|--------|
| STAT-501 | Elementary Statistics (Non credit for Home Science) | 3(2+1) |
| STAT-521 | Design of Experiments - I | 3(2+1) |
| STAT-522 | Economic Statistics | 3(2+1) |
| STAT-523 | Non-Parametric Statistics | 3(2+1) |
| STAT-621 | Research Methodology | 3(2+1) |
| STAT-622 | Design of Experiments - II | 3(2+1) |
| STAT-623 | Econometrics | 3(3+0) |
| STAT-624 | Psychometrics | 3(3+0) |

POSTGRADUATE COURSES

| | | |
|------------------|--|---------------|
| STAT- 511 | STATISTICAL METHODS (Common for Ag., H.Sc. and Fisheries) | 3(2+1) |
|------------------|--|---------------|

Theory:

Probability and Probability Distribution: Various definitions of probability, Addition and multiplication laws of probability and simple problems based on them. Expectation of a random variable, Moments, Skewness and Kurtosis.

Binomial and Poisson distribution, their fitting and simple problems based on them, Normal distribution, their properties and uses. Sampling: Sampling v/s Complete enumeration, Probability and non probability sampling, S.R.S. with and without replacement.

Test of significance: Hypothesis, null and Alternative hypothesis, type-I and type-II error, Level of significance, Critical region, one and two tailed tests, Procedure

for testing of hypotheses. Standard Normal deviate test for single mean, difference of two means. Proportion, difference of proportion and confidence interval, students 't' test, for comparison involving one and two sample means, paired 't' test, Confidence interval, Chi-square test for goodness of fit and independence of two attributes (2x2 and r x s contingency table) and Yate's correction for continuity, Correlation and Regression : Simple and partial correlation coefficients, Linear and multiple regressions. Partial regression coefficients, multiple correlation coefficients and their tests of significance.

Design of Experiments: Analysis of C.R.D., R.B.D. and L.S.D. with one observation per cell.

Practicals:

Simple problem based on probability, Simple problems based on Binomial, Poisson and Normal distribution. Problem based on area tables of Normal distribution. Draw simple random-sample of size 'n' from a given population of size 'N' with and without replacement scheme and obtain the estimate of (i) population mean (ii) population variance and (iii) standard error. Standard normal deviate tests for testing (i) $\mu = \mu_0$, (ii) $\mu_1 = \mu_2$, 't'-test for testing (i) $\mu = \mu_0$, (ii) $\mu_1 = \mu_2$, Confidence interval for means, for small and large samples. Chi-square test for goodness of fit. Chi-square test for independence of two attributes, 2x2, r x s contingency table and Yates' correction . Fitting of Regression line (i) $Y = a+bX$ and test for $\square_{yx} = 0$ (ii) $Y = a+b_1x_1 + b_2x_2$. Partial correlation coefficients and its tests of significance. Multiple correlation coefficient and its test by F-test

Suggested Readings:

1. V.G. Panse and P.V. Sukhatme (1985). Statistical Methods for Agricultural Workers. ICAR, New Delhi.
2. G.W. Snedecor and W.G. Cochran (1968). Statistical Methods. Oxford and IBH. New Delhi.
3. S.C. Gupta and V.K. Kapoor (2006). Fundamentals of Mathematical Statistics. Sultan Chand and Sons, New Delhi.
4. Sukthame and C. Ashok (1984). Sampling Theories and Surveys with Application. ICAR, New Delhi, 3rd ed.
5. G.N. Rao (2007). Statistics for Agricultural Science. Oxford and IBH, New Delhi.
6. S.C. Gupta (2006). Fundamentals of Statistics. Himalaya Publishing House. New Delhi

Theory:

Basic concepts, simple problems and applications of the topics such as- Probability, sample spaces, simple and compound events, mutually exclusive, equally likely and independent events, definition of probability, classical and axiomatic approach, addition and multiplication laws of probability, conditional probability. Bayes theorem and its application, Random variables, discrete and continuous, probability density function (pdf), cumulative distribution function (cdf), mathematical expectation, mean and variance of a random variable, joint pdf, cdf, marginal and conditional densities, independence of random variables.

Binomial, Poisson, Hypergeometric, Geometric, Multinomial distributions, their means and variances, Normal distribution its properties and simple problems, Lognormal, Exponential and Weibull distribution. Definitions and applications of t, F and χ^2 (Chi- square) distribution.

Statistical Inference: Estimation, confidence intervals. Testing of hypotheses regarding means and variances.

Regression and Correlation: Linear and curvilinear regression with one independent variable, linear correlation the test of significance of regression coefficient and correlation coefficient.

Practicals:

Inferences concerning means: one and two means cases, tests of significance. Inferences concerning variances: one and two variances, tests of significance. Testing of hypothesis in 2x2, and rxs contingency tables. Fitting of Binomial and Normal distributions. testing testing of correlation and regression coefficients.

Suggested Readings:

1. Miller Irwin and J.W. Frannd (1977). Probability and Statistics for Engineers. Prentice Hall of India Pvt. Ltd., New Delhi.
2. Statistics in Research (Indian ed. 1966). Bernard Ostle. Oxford and IBH Publication Co., New Delhi.
3. Johnsen, N.L. and Leone, F.C. John (1964). Statistics and Experimental Design In Engineering and Physical Sciences Vol. I. Wiley and Sons, New York.
4. S.C. Gupta and V.K. Kapoor (2006). Fundamentals of Mathematical Statistics. Sultan Chand and Sons, New Delhi.

PhD COURSES

STAT- 611 SAMPLE SURVEYS 3(2+1)

Theory:

Basic concepts in sampling, complete enumeration v/s sampling, field of enquiry, frames suitable for various types of surveys, elementary units, sample units of different types and sizes, selection of samples, bias in selection and estimation, sampling errors of estimates and their estimation. Simple random sampling, stratified sampling, ratio and regression estimates, systematic sampling, two stage and cluster sampling, preparation of schedule and questionnaire. Methods of enquiry, elementary idea about non-sampling errors.

Practicals:

Use of random number tables and selection of random samples by different methods, Estimation of mean, variance and standard error using SRSWR., Estimation of mean, variance and standard error using SRSWOR. Its efficiency over S.R.S.W.R. Stratified sampling, allocation of sample size to different strata under different allocation procedures. Estimation of mean and variance in case of stratified sampling (Proportionate allocation) its efficiency over S.R.S.W.O.R. Neyman allocation in stratified sampling and its efficiency over S.R.S.W.O.R. Systematic sampling, estimation of mean and variance. Circular systematic sampling, estimation of mean and variance. Cluster sampling, estimation of mean and variance. Ratio method of estimation, calculation of bias. MSE and efficiency compared to S.R.S.W.O.R. Two stage sampling with equal number of units in each P.S.U.

Suggested Readings:

1. P.V. Sukhatme, B.V. Sukhatme and C. Ashok (1984). Sampling Theory and Survey With Applications. IASRI, New Delhi.
2. W.G. Cochran (1953). Sampling Techniques. Asia Publishing House, New Delhi.
3. Des Raj (1968). Sampling Theory. Tata McGraw-Hill Publishing Company, Bombay.
4. M.N. Murthy (1967). Sampling Theory and Methods. Statistical Publishing Society, Calcutta.

**STAT- 612 COMPUTER APPLICATIONS IN 3(2+1)
AGRICULTURE**

Theory:

Introduction to Computers, Computer Generations, Input and Output Devices. Units of Memory, Hardware, Software and Classification of Computers. Personal Computers, Operating System – WINDOWS: GUI, Desktop and its elements, WINDOWS Explorer, working with files and folders, starting and shutting down of WINDOWS. Anatomy of a WINDOW, Title Bar, Minimum, Maximum and Close Buttons, Scroll Bars, Menus and Tool Bars. Applications – MSWORD: Word, processing and units of document, features of word-processing packages. Creating, Editing, Formatting and Saving a document in MSWORD; MSEXCEL: Electronic Spreadsheets, concept, Creating, Editing and Saving a spreadsheet with MSEXCEL. MS Power Point: Features of Power Point Package.

Practicals:

Study of Computer Components; Practicing WINDOWS Operating System, WINDOWS Explorer, Creating Folders, COPY and PASTE functions; MSWORD: Creating a Document, Saving and Editing; MSWORD, Use of options from Tool Bars, Format, Insert and Tools (Spelling & Grammar) Alignment of text; MSWORD, Creating a Table, MSEXCEL: Creating a Spreadsheet, Alignment of rows, columns and cells using Format tool bar. Editing and Saving a spreadsheet with MSEXCEL. Preparation of slides using Power Point Package.

Suggested Readings:

1. V. K. Kapoor (2005). Computers and Information Technology. Sultan Chand and Sons, New Delhi.
2. Microsoft Office (2000). BPB Publications, B-14, Caunnaut Place, New Delhi.

**STAT- 613 STATISTICAL METHODS IN BIOASSAY AND PROBIT
ANALYSIS 3(2+ 1)**

Theory:

Role of statistical science in biology, Purpose and structure of biological assay, Nature of direct assays, Precision of estimates, Fiducial limits in a direct assay, Utility of logarithmic transformation of doses, Indirect assays for quantitative responses, Dose response regression, Scedasticity transformation of response, Parallel line assay, Slope ratio assay, Designs suitable for bio-assay, Probit, log and angular transformations for percentage response, Other methods of estimation of median effective doses, Toxic action of mixtures.

Practicals:

Direct assay for relative potency and its precision with or without covariance, Linearizing Transformation of dose response relationship Scedasticity transformation, Probit Analysis, Parallel line assays.

Suggested Readings:

1. D. J. Finney. (1978). Statistical Methods in Biological Assay. Charles Griffin and Co. London 3rd Ed.
2. M. N. Das and N.C. Giri (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi.
3. D.J. Finney (1964). Probit Analysis. University Press, Cambridge.

basic designs. Factorial experiments: Symmetrical and Asymmetrical factorial experiments, 2^n factorial experiments, Yates method and general method of analysis of AxB and AxBxC factorial experiments.

Confounding in case of 2^n factorial experiments, Complete and partial confounding. Layout and analysis of Split and Strip plot design. Missing plot technique in R.B.D. and L.S.D. with one observation missing.

Progeny Row trial and compact family block design. Transformations: Square root, Logarithmic and Angular transformation. Analysis of Covariance.

Practicals:

Analysis of 2^2 and 2^3 experiments in R.B.D., Analysis of AxB factorial experiments. Analysis of AxBxC factorial experiments, Complete confounding in case of 2^3 experiments, Partial confounding in case of 2^3 experiments, Missing plot analysis in case of R.B.D. with one observation missing, Missing plot analysis in case of L.S.D. with one observation missing. Analysis of Split plot and Strip plot design, Analysis of Covariance in case of R.B.D. Use of transformations

Suggested Readings:

1. K.A. Gomez and A.A. Gomez (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons.
2. R.G.D. Steel and J.H. Torrie (1960). Principles and Procedures of Statistics. McGraw – Hill Book Co., New Delhi
3. V.G. Panse and P.V. Sukhtame (1985). Statistical Methods for Agricultural Workers. ICAR, New Delhi.
4. W.G.Cochran and G.M.Cox (1957). Experimental Designs. A Wiley International Edition. Canada.

STAT- 522

ECONOMIC STATISTICS

3(2+1)

Theory:

Interpolation and Extrapolation – Definition, Assumption, limitations. Methods of interpolation graphic method, Newton’s method of Advancing Difference, Newton Gauss Forward, Backward formula, Lagranges method, Newtons Divided Difference method.

Time Series Analysis- Meaning, importance and various components of time series, Trends: Straight line, Parabola, Exponential, Modified Exponential, Gompertz curve and Logistic curve, Measuring trend by graphic method, method of semi averages, method of moving average, Method of least squares. Measurement of seasonal variation: Method of Simple Average, Ratio to trend method, Ratio to moving average method, method of link relatives. Measurement of cyclic fluctuations by residue method and irregular movements.

Index number- Definitions, uses and limitations of Index Number, Types of Index Number, Problems in the construction of index number, Weighted and unweighted Index Number, (Index Numbers given by Laspeyres, Paache's Kelley, Marshall Edgeworth and Fisher's Ideal Index Number), Quantity Index Numbers, Chain base Index Number, Conversion of fixed base Index Numbers into Chain base Index Number and vice versa. Time Reversal, Factor Reversal and Circular Tests. Business Forecasting- Meaning and need of Business forecasting, Steps in forecasting, Methods of forecasting, Business Barometers, Theories of Business forecasting and utility of business forecasting, limitation of business forecasting and forecasting agencies.

Practicals:

Interpolation by advance difference formula, Interpolation by forward formula, Interpolation by backward formula, Interpolation by divided difference formula, Interpolation by Lagrange's formula, Measurement of trend: Method of semi average and moving average method, Measurement of trend and least square method by fitting (i) $Y = a+bt$, (ii) $Y = a+bt+ct^2$ and (iii) $Y = ab^t$ Seasonal variation through (i) Moving average, (ii) Ratio to moving average, (iii) Ratio to trend method, (iv) Link relative method. Calculation of price index number by various formulae viz., Laspeyres, Paasche's method, Fisher's Ideal Index Number, Marshall Edgeworth method. Calculation of quantity index number. Time Reversal, Factor Reversal and Circular test of Index Number.

Suggested Readings:

1. S.C. Gupta and V.K. Kapoor (2006). Fundamentals of Applied Statistics. Sultan Chand and Sons, New Delhi.
2. F.E. Croxton and D.J. Cowden (1988). Applied Statistics. Prentice Hall India.
3. V.K. Kapoor (2006). Fundamentals of Statistics for Business and Economics. Sultan Chand and Sons, New Delhi.

STAT- 523 NONPARAMETRIC STATISTICS 3(2+1)

Theory:

The use of non-parametric statistical test in research, the one sample case, binomial test. χ^2 - test, Kolmogorov Smirnov Test, run test, the case of two related samples. McNemar test, sign test, Wilcoxon's Matched pairs test signed rank test, randomization test for matched pairs, the case of two independent samples, Fisher's exact probability test, χ^2 - test, median test, Wilcoxon Mann- Whitney test, Kolmogorov Smirnov test, test for K related samples, the Cochran's Q- test and the Friedman two way analysis of variance for K samples. For K independent samples:

χ^2 - test, extension of median test, Kurskal-Wallis one way analysis of variance by ranks, measures of correlation, contingency coefficient, Spearman's and Kendall's Correlation Coefficient, Coefficient of Concordance.

Practicals:

Goodness of fit tests :

- (a) Chi-square test procedure (b) Kolmogorov –Smirnov Procedures.

Inferences concerning Location based on one sample or paired samples :

- (a) Sign test procedures, Binomial test
- (b) Wilcoxon signed rank test for location, Confidence intervals for the median or median difference.

Inferences concerning location based on two or more samples :

- (a) Mann-Whitney-Wilcoxon Procedures for two independent samples
- (b) Kruskal Wallis Procedures for K independent samples.

Inferences concerning Scale Parameters:

- (a) Siegel-Tukey test when medians equal or known,
- (b) Procedures when medians unequal and unknown.

General distribution tests for two or more independent samples:

- (a) Chi-square and Kolmogorov test procedures for two sample case.
- (b) Extension of Chi-square and Kolmogorov-Smirnov Procedures,
- (c) Test for equality of proportions.

Association analysis for two related or k related samples.

- (a) Rank correlation, Kendall Tau Statistic. Coefficient of Concordance.
- (b) Friedman Test, Measures of Association

Tests for randomness: run test, runs up and down procedures.

Suggested Readings:

1. Sidney Siegel, N. John Castellan, Jr. (1988). Nonparametric Statistics for the Behavioral Sciences. McGraw-Hill International Editions.
2. W.W. Daniel (1978). Applied Nonparametric Statistics. Houghton Mifflin Company, Boston.
3. J.D. Gibbons (1971). Nonparametric Statistics Inference. McGraw-Hill. Book Company, Kogacusha, Tokyo.

STAT- 621

**RESEARCH
METHODOLOGY**

3(2+1)

Theory:

Research Methodology: Meaning of research, Objectives of research, Types of research, Research approaches, Significance of research, Research and Scientific

method, Research process, Inductive and deductive methods, Criteria of good research.

Research Problem Formulation : Research reviews, hypothesis, synopsis and research methods. Collection of research data : Primary v/s secondary data, time series data, cross-sectional data and panel data, Various sources of Agricultural data, Census, schedules and questionnaire pre-tests, pilot study and inter disciplinary researches.

Scores and Scaling Techniques: Need for scaling, problems of scaling – continuum, reliability, validity and weighting methods of scaling.

Quantitative techniques: Growth rates, instability analysis, functional relationship-linear, quadratic, exponential and polynomial models.

Introduction to multivariate statistical methods, mean vectors, Variance-covariance matrix, discriminate function, factor analysis.

Sampling: Meaning and importance, Sampling techniques, determining size of the sample

Practicals:

Research problem formulation, Review of a research study, Formulation of a research topic, objectives, hypothesis and design of research for given research problem. Preparation of research project proposal, Collection of secondary data for a research topic. Analysis of secondary data for the above. Collection of primary data (survey data) for a research topic. Analysis of primary data for the above. Numerical application on scores and scaling techniques.

Suggesting Readings:

1. C.R. Kothari (2006). Research Methodology. Wiley Eastern Limited, Daryaganj, New Delhi
2. S.R. Bajpai (1984). Methods of Social Survey and Research. Kitab Ghar, Acharyanagar, Kanpur
3. S.P. Singh and S.P.S. Verma (1983).. Agricultural Statistics. Rana Publishing House, Baraut (Meerut).
4. S.S. Acharya and G.M.K. Madanani (1988). Applied Econometrics for Agricultural Economists. Himanshu Publications, Udaipur.

STAT- 622 DESIGN OF EXPERIMENTS- II 3(2+1)

Theory:

Confounding in 3^3 and 3^4 factorial experiment in 9 plot blocks; Confounding in asymmetrical factorial experiments e.g. $3 \times 2 \times 2$ and $3 \times 3 \times 2$ in six plot blocks; Fractional replication in factorial experiment e.g. 2^5 in $\frac{1}{2}$ replicate, 2^5 in $\frac{1}{4}$

replicate, 3^3 in $1/3$ replicate. Confounding in split plot design; Analysis of non-orthogonal data; Incomplete block designs; BIBD, simple lattice; Youden square design; Switch over designs with or without residual effect; Response surface study and first and second order designs; Central composite rotatable designs of second order; Method of determining optimum combination of factor levels; Group of experiments; Long term experiments; Rotational experiments.

Practicals:

Confounding in 3^3 in 9 plot blocks (Total and Partial), Confounding in $3 \times 2 \times 2$ or $3 \times 3 \times 2$ in 6 plot blocks, Fractional replication in 2^5 in $1/2$ replicate or 2^6 in $1/4$ replicate, Confounding in split plot design, Analysis of B.I.B.D, simple lattice Switch over trial, Response surface study for second order rotatable design, Groups of experiments, Long term experiments, Experiments on cultivator's field

Suggested Readings:

1. M.N. Das and N.C. Giri (1979). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi.
2. W.G., Cochran and G.M. Cox (1959). Experimental Design. Asia Publishing House, Bombay.
3. O.Kemphorne (1974). The Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi, 2nd. Ed.
4. B.J. Winer (1962). Experimental Design. McGraw-Hill Book Co., New York.
5. W.T. Federer (1962). Experimental Design. Oxford and IBH, New Delhi.
6. A. Dey (1986). Theory of Block Designs. Wiley Eastern Ltd., New Delhi.

STAT- 623

ECONOMETRICS

3(3+0)

Theory:

Concept of econometric model, mathematical model v/s econometric model, error term and its assumption. Concept of stochastic and deterministic models, Time series and cross section models, Study of linear regression model, Maximum likelihood and least square estimation, Bias and precision of the regression estimates, Specification problems, Serial correlation, Problems of multicollinearity, Heteroscedasticity, Lagged variables, Dummy variables, Use of instrumental variables, Input-Output models, Production functions.

Suggested Readings:

1. J. Johnston(1967). Econometric Methods. McGraw Hill Book Co., New York.
2. L.R. Klien.(1974). A Text Book of Econometrics. Prentice Hall, Englewood

cliffs.

3. P. Rao and R.L. Miller (1971). Applied Econometrics. Wadsworth Publishing Co. Belmont, Calif.
4. S.S. Acharya and G.M.K. Madanani (1988). Applied Econometrics for Agricultural Economists. Himanshu Publications, Udaipur.

COURSE NO. PSYCHOMETRICS Cr.Hrs. 3(3+0)
STAT- 624

Theory:

Psychological tests : Meaning of test and scale, Types of tests in social research, Projective and non projective tests, Procedures for developing a test, Item analysis : Item collection, discrimination and difficulty indices, Tests of item validation and final item selection, Types of scores and their standardization, Reliability and validity of tests and scales : meaning, kinds and techniques of measuring different kinds of reliability and validity in social research, Social distance scale, socio-economic status scale, Adoption quotient, Social participation scale, communication fidelity index, rationality quotient etc., Critical incident technique : meaning, its applicability and procedures involved, Q-sort technique : meaning, its applicability

Suggested Readings:

1. H.E. Garret (1966). Statistics in Psychology and Education. Vakils, Fetter and Simms Ltd.
2. C.A. Moser and G. Kalton (1979). Survey Methods in Social Investigation. The ELBS and Heinemann Educational Books.
3. F.N. Karlinger (1983). Foundation of Behavioral Research. S.S. Chhabra Publication. New Delhi.
4. A.M. Goon, M.K. Gupta and B. Dasgupta (1979). Fundamental of Statistics. The World Press, Calcutta.