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Education and Training

DEGREE COURSES

The Institute continued to conduct the following degree courses in collaboration with the Post Graduate School of Indian Agricultural Research Institute (IARI) which has the status of a Deemed University:

(i) Ph.D. (Agricultural Statistics)

(ii) M.Sc. (Agricultural Statistics)

(iii) M.Sc. (Computer Application)

Both Ph.D. and M.Sc. students are required to study courses not only in Agricultural Statistics but also in Agricultural Sciences like Genetics, Agronomy, Agricultural Economics, etc. The courses in Mathematics, Agricultural Statistics and Computer Application are offered at this Institute while the courses in Agricultural Sciences are offered at IARI.

The eligibility qualification for admission to Master's degree in Agricultural Statistics is a Bachelor's degree with atleast 60% marks or its equivalent overall grade point average (OGPA) in Agriculture/Horticulture/ Forestry/Agroforestry/Sericulture/Agricultural Marketing/B.Sc. (10+2+3 System). For admission to Master's degree in Computer Application, the eligibility qualification is a Bachelor's degree with atleast 60% marks or its equivalent overall grade point average (OGPA) in Agriculture/Computer Science/Agricultural Engineering/B.Sc. (Horticulture), Veterinary Science, Home Science, B.Sc. (Forestry)/B.Sc. with Maths./ Statistics/Physics/Biology/B.Sc. (10+2+3 System).

Further for, admission to Doctor's degree in Agricultural Statistics the eligibility qualification is a Master's degree with atleast 60% marks or its equivalent overall grade point average (OGPA) in Agricultural Statistics/Statistics/ Mathematical Statistics/Bio-Statistics of IVRI/ Professional Statisticians' Certificate Course (PSCC) from IASRI.

Number of students admitted/completed various courses are:

(a) **Ph.D. (Agricultural Statistics)**

Three students were admitted and 7 students completed the Ph.D. (Agricultural Statistics) degree.

(b) **M.Sc. (Agricultural Statistics)**

Five students were admitted and five students completed the M.Sc. (Agricultural Statistics) degree.

(c) **M.Sc. (Computer Application)**

Four students were admitted and seven students completed the M.Sc. (Computer Application) degree.

Details of students completed various courses during 2007-08 is as follows:

Ph.D. (Agricultural Statistics)

i) Pardip Kumar Nandi

Design and analysis for multi-response experiments

Experiments in which data on several responses are measured from an experimental unit corresponding to the application of a treatment are known as multi-response experiments. Multi-response experiments are of two types viz. complete multi-response experiments (all the response variables are recorded from each experimental unit) and incomplete multi-response experiments (recording of all the responses variables from each experimental unit is not feasible). A stepwise procedure of performing multivariate analysis of variance (MANOVA) of data from complete multi-response experiments conducted in block designs has been developed. If the treatments are found to be significantly different through MANOVA, then the experimenter is interested in testing the hypothesis regarding some treatment contrasts, particularly making all the possible pair wise treatment comparisons. To answer this question, the procedure of carrying out multivariate treatment contrast analysis has been developed. A method based on Euclidean distance from null vector and J-plot based on the singular value decomposition (SVD) of the treatment effects matrix (treatment means/ adjusted treatment means for all the response variables) have been recommended for identification of best treatment.

In a designed experiment, when one experimental plot is heavily infested with pests, disease and/or weeds, the response observed from this plot would be markedly different from the response from all other plots. This response may be abnormally high or abnormally low. Such responses are termed as outlier(s). To tackle the problem of outlier(s) in multi-response experiments, a test statistic has been developed for detection of a single outlier vector in complete multi-response experiments run in a block design. Proposed test statistic has been illustrated with the help of an example.

Besides the analysis of data, the designing of multi-response experiments is also of paramount importance. It has been shown that designs efficient for single response experiments are also efficient for complete multi-response experiments. The only requirement is that the number of response variables should be less than the error degrees of freedom. A method of construction of designs for incomplete multi-response experiments is also obtained using a combination of Randomized Complete Block (RCB) designs and Balanced Incomplete Block (BIB) designs. To accommodate more number of response variables, one can use singular group divisible design as response-wise design instead of a BIB design. The designs obtainable from this method are economical from resource point of view.

The above relates to the discussion on the problems associated with comparative experiments. A large number of experiments are conducted for establishing a relationship between the levels of input factors and several response variables. These experiments are usually conducted in response surface designs to perform simultaneous optimization of several responses. Simultaneous optimization procedures of several responses for both complete and incomplete multi-response experiments have been considered. Two situations of incomplete multi-response experiments are considered. The procedure of estimation of parameters from linear multi-response models for incomplete multi-response experiments has been developed for both the situations. It has been shown that the parameter estimates are consistent and asymptotically unbiased. Using these parameter estimates, simultaneous optimization of incomplete multi-response experiments is attempted following the generalized distance criterion.

Guide: Dr. Rajender Parsad

ii) Kankure Ajay Krishanrao

On some aspects of spatial ranked set sampling

Ranked Set Sampling (RSS) as suggested by McIntyre (1952) when applied to spatially-correlated areal population fails to take into account the spatial correlation. Arbia (1990) suggested Dependent Unit Sequential Technique (DUST), a sample selection procedure for selection of areal units from spatially correlated population in which spatial correlation among the population units has been incorporated into sample selection procedure. In this thesis attempt has been made to propose a sample selection technique named as Spatial Ranked Set Sampling (SRSS) in which desirable features of both RSS and DUST have been incorporated. SRSS has characteristics of RSS such as randomization technique for better representation of population and additional information about ranking of units within a set in the sample selection process. Also, the proposed SRSS incorporated spatial correlation as in case of DUST in the sample selection process. Four strategies of sample selection are proposed viz. (1) Ranked set sampling based on Spatial Clusters formed by DUST (RSCD), (2) Ranked set sampling based on Spatial Clusters formed by SRS (RSCS), (3) Ranked set sampling based on Spatial Sets formed by DUST (RSSD) and (4) Ranked set sampling based on Spatial Sets formed by SRS (RSSS). A spatial simulation study was carried out to empirically test the performance of SRSS with respect to the traditional sampling techniques. It has been found that SRSS always performs better in terms of efficiency with respect to SRS and there is sufficient gain in efficiency with respect to RSS in case of smaller set size which is generally recommended to avoid ranking errors. Among the four strategies of sample selection by SRSS, it has been observed that RSSD was the most efficient strategy as it had the lowest sampling variance. The availability of cheap and reliable data on a highly correlated auxiliary variable (NDVI) was put to use to carry out ratio estimation in all the four estimators. As expected, ratio estimator showed more gain than the corresponding estimator used earlier. Maximum gain was found for the ratio estimator of RSCS among all four ratio estimators considered. The results of the study point out that, in spatial surveys, a considerable gain in efficiency of the estimators could be achieved by using distance based sample selection strategies even when applying these for complex sampling schemes such as Ranked Set Sampling. The complex algorithms involved in the selection procedure of distance based sampling strategies could be solved with the use of advanced computing and software.

Guide: Dr. Anil Rai

iii) Jitender Singh Tomar

Design and analysis of agricultural experiments under interference and dependent observations

In agricultural field experiments, blocks are often formed using adjacent plots within a field. The experimental plots occurring close together within blocks may, therefore, be correlated. Further, the treatment applied to one plot in a block may affect the response on the neighbouring plots. As a result, the estimates of treatment differences may deviate because of interference from neighbouring units and correlated or dependent observations. Neighbour balanced designs have been developed in the literature to deal with the interference effects, while spatial designs are used to deal with the dependent observations. Considerable amount of work has been done separately on these two aspects. The present work deals with the situation when both these effects are present in the same trial. Two types of models (non-directional and directional) have been considered based on how the neighbour effects of treatments are taken into account under different error correlation structures. Some definitions and properties of block designs with neighbour effects and dependent observations have been given. Series of strongly neighbour balanced/ neighbour balanced complete/ incomplete block designs, permitting the estimation of direct and neighbour effects, under non-directional and directional neighbour effects model and dependent observations have been obtained. The optimality aspects of these designs have been studied, and A- and D- efficiencies for direct and neighbour effects have been worked out. The designs constructed have also been compared with the existing neighbour balanced block designs under uncorrelated structure. The performance of some series of existing neighbour balanced designs has also been studied under the situation of correlated error structure. A catalogue of all the designs giving parameters and efficiencies for direct as well neighbour effects under NN and AR(1) error structures has been prepared for different values of correlation coefficient. Further, the model

incorporating the effect of interference from adjacent neighbouring units and dependent observations from an experiment conducted in randomized complete block design has been defined. Semi-variograms have been used to visualize the nature of spatial correlation and the average location effects of a particular plot are predicted. The procedure is illustrated through a data from an agricultural field experiment.

Guide: Dr. Seema Jaggi

iv) Rama Krishna Singh

Study of fuzzy and artificial neural network methodologies in agriculture

Theory of fuzzy sets and Possibilistic regression analysis is discussed. Three methods, viz. Minimization, Maximization, and Conjunction are considered. The methodology is applied to employ farmers' estimates at block level for modeling cotton crop yield at block levels of Sirsa district, Haryana. It is found that Conjunction method performed the best. Possibility and Necessity measures for obtaining reliable fuzzy estimates of crop yield are thoroughly studied. Estimation of parameters is carried out using "Fuzzy least-squares" procedure. As an illustration, the methodology is applied to pearl millet crop yield data in order to build block level estimates for Bhiwani district, Haryana based on farmers' estimates. A modified fuzzy least-squares approach for estimation of parameters is thoroughly studied. Relevant computer program is developed in SAS/IML software package. Performance evaluation criterion based on "Difference in membership functions" is adopted for computation of error in estimation. As an illustration, the methodology is applied for Pearl Millet crop yield estimation at Block level. Superiority of present approach over Possibility fuzzy least-squares approach is demonstrated for data under consideration. Fitting of fuzzy von Bertalanffy growth model is carried out when response variable is reported in intervals corresponding to various values of explanatory variable. An efficient two-stage procedure based on fuzzy least squares is employed. The methodology is thoroughly discussed and, for its application, relevant computer programs are developed in "Nonlinear programming solver LINGO, Version 8" software package. Finally, an illustration to pearl oyster age-length data is discussed.

Multilayered feedforward artificial neural network (MLFANN) is thoroughly studied. In order to train such a network, two types of learning algorithms, namely Gradient descent algorithm and Conjugate gradient descent algorithm, are described. The methodology is illustrated by considering maize crop yield data as response variable and total human labour, farm power, Fertilizer consumption, and pesticide consumption as predictors. The data is taken from Division of Agricultural Economics, IARI., New Delhi. To train the neural network, relevant computer programs are written in MATLAB software package using Neural network toolbox. An important model from this class, viz. Adaptive Neuro-fuzzy inference system is implemented on Fuzzy Logic Toolbox of MATLAB. As an illustration, the methodology is applied for development of a forecasting model for secondary data of yield of 100 banana plants on the basis of data at six different stages of growth using several biometrical characters, like plant height, plant girth, and leaf length as predictors.

Guide: Dr. Prajneshu

v) Mir Asif Iquebal

A study of some nonlinear time-series models in agriculture

Basic concepts of various statistical modeling techniques are described. Gaussian mixture transition distribution, Mixture autoregressive (MAR), and MAR-Autoregressive conditional heteroscedastic (MAR-ARCH) models are thoroughly studied and applied to weekly wholesale onion price data. Estimation of parameters is carried out using Expectation-Maximization algorithm. It is concluded that a two-component MAR-ARCH is best for modeling as well as forecasting purposes.

Threshold Autoregressive (TAR) family of models for describing cyclical fluctuations in time-series data are also investigated. Two-regime Self-exciting TAR (SETAR) models are studied and applied to country's lac export data. Three-regime SETAR models are applied to describe country's Shellac production data. Fitting of the models is carried out using Genetic algorithm (GA) technique. Finally, forecasts for out-of-sample data are made.

Methodology for estimation of parameters using GA is developed for Nonlinear Richards growth model. As an illustration, the same is applied for modeling and forecasting of country's foodgrain production data. As the conventional estimators for ordinary least squares

variance-covariance matrix estimation in respect of linear regression models under heteroscedasticity are biased and inconsistent, GA-based estimators are proposed. Their properties are thoroughly studied by Monte Carlo methods for various sample sizes. It is shown that GA-versions of estimators are superior to corresponding non-GA versions as there are significant reductions in total relative bias as well as total root mean square error.

Guide: Dr. Prajneshu

vi) Sarika

Some investigations on response surface designs

Response surface methodology explores the relationship between response variable and several explanatory variables with the motive to obtain an optimal response using a set of designed points. In response surface analysis, it is generally assumed that the observations are independent and there is no effect of neighbouring units. But under certain situations, the experimental units may experience neighbour or overlap effects from adjacent units. Hence, it is important to include the neighbour effects in the model to have the proper specification. First and second order response surface models with neighbour effects from immediate left and right neighbouring units have been considered and the conditions for the estimation and rotatability of these models have been derived. The variance of estimated response has also been obtained. Method of constructing designs for fitting response surfaces in the presence of neighbour effects has been developed. The response surface analysis, incorporating the neighbour effects from adjacent units, has been illustrated through constructed/ real data sets and the competition coefficient from neighbours is estimated such that the residual sum of squares is minimum. The results have shown substantial reduction in residual sum of squares and increase in precision of estimates of the parameters of the model. Further, in many experimental situations, particularly in field experiments, the observations are correlated through some systematic pattern of environmental variations. Some methods of constructing designs for fitting first order and second order response models with correlated errors (equi-correlation and autocorrelation structure) have been obtained. Also the performance of some existing second order response surface designs viz. central composite and Box-Behnken, that are efficient for fitting response surfaces under uncorrelated situation, have been studied under correlated error structure. Response surface methodology in the presence of neighbour effects as well as correlated error structure has been developed. Some aspects of designs for fitting response surface models with quantitative-cum-qualitative factors have been studied under neighbour effects/correlated error structure. Various SAS codes under different experimental situations for studying response surfaces have been developed.

Guide: Dr. Seema Jaggi

vii) Baidya Nath Mandal

Combinatorics and its applications with special reference to sample surveys

Balanced sampling plans excluding adjacent units {BSA (m) plans} are useful for sampling from populations in which the nearer units provide similar observations due to natural ordering of the units in time or space. For BSA (m) plans, first order inclusion probabilities of all units are same and second order inclusion probabilities for pairs of adjacent units are zero and constant for other pairs of units. BSA (m) plan can be obtained by assigning equal probability of selection to the blocks. A computer algorithm has been developed and a computer aided search of polygonal designs using this algorithm gave all the existent polygonal designs in the literature in the parametric range of $v \le 40, b \le 400, k \le 7$ and $m \le 4$ along with 75 new designs. The algorithm developed has also been modified to generate BSA (m) plans directly comparatively in a short time. The linear programming has also been exploited to obtain both circular and linear BSA (m) plans by minimizing the probabilities of selection of samples containing adjacent units. This method is quite useful for obtaining smaller sampling plans and takes very less time.

BSA (m) plans suffer from the drawback that the unbiased estimation of variance of Horvitz-Thompson estimator of population mean is not possible. To tackle this problem, a family of distance balanced sampling plans (DBSP) with the property that the second order inclusion probabilities are non-decreasing function of distance between the two concerned units is developed. Unbiased estimation of variance of Horvitz-Thompson estimator of population mean for DBSP is considered. The conditions for DBSP to be more

efficient than simple random sampling without replacement (SRSWOR) and BSA (m) plans have been obtained. It has been shown that if the assumption of decreasing correlation between the units as the distance between the units increases holds then the proposed plans are more efficient than other alternative sampling plans such as SRSWOR and BSA (m) plans. A class of incomplete block designs, called as distance balanced incomplete block (DSBIB) designs is introduced, whose blocks can act as a support of the DBSP. Existence and construction of DSBIB designs has also been given.

IPPS plans excluding adjacent (IPPSEA plans) units have been developed by making use of binary, proper and unequireplicated block designs and linear programming approach. It has been shown that proposed IPPSEA plans perform better than alternative sampling plans such as SRSWOR, BSA (m) plans, probability proportional to size with replacement, Hartley and Rao' strategy, Rao, Hartley and Cochran's strategy and Sampfords' IPPS plan using a real life population.

Stratified sampling is often used to draw a representative sample from a population. Stratification based on geographical contiguity may yield strata which are heterogeneous due to some other factors affecting characteristic under study. To deal with this, nested stratified sampling in which there are secondary strata within each primary stratum has been developed for the estimation of finite population total and its variance. Optimum allocation of sample size in a particular primary stratum to secondary strata within that primary stratum and optimum allocation of total sample size to primary strata in the population was discussed in detail. A condition for nested stratified sampling with arbitrary allocation to be more efficient than usual stratified sampling with arbitrary allocation was obtained. Feasibility of application of doubly nested incomplete block designs to nested stratified sampling was discussed in this context. Application of doubly nested block designs was also shown to obtain designs for tetrallel crosses.

Guide: Dr. Rajender Parsad

M.Sc. (Agricultural Statistics)

i) Vinayanand Kandala

A study of forecast models using resampling methods

The study deals with comparing the performance of resampling based methods with conventional methods for estimation of nonlinear models. For this, productivity of wheat and proportional area under HYVs of maize over time were studied by fitting non-linear growth models viz. Logistic and Gompertz at various locations by employing two estimation procedures; the first one being the conventional Marquardt's nonlinear estimation procedure and the other one is the resampling based Jackknife estimation procedure. A simulation study has also been done to compute the variances of the parameter estimates. The fitted models have been utilized for forecasting the crop statistics considered for subsequent periods not included in model fitting. The parameter estimates obtained by employing the resampling based method have consistently lesser biases than those obtained using the conventional method without increase in their corresponding estimated variances. When the goodness of fit and forecast performance measures of these models were compared, the models using resampling based method came out to be either at par or slightly better with those using conventional method for most of the locations in case of both the crop statistics considered. In the light of these results, Marquardt's estimation procedure can be recommended for the estimation of Logistic and Gompertz models.

Guide: Dr. Ranjana Agrawal

ii) Sonawane Maheshkumar Namdevrao

A study on experimental designs for bioequivalence trials

Bioequivalence is the degree to which clinically important outcomes after receiving a new formulation resembles a well established formulation. Evaluation of veterinary medicinal products is one of the important areas where bioequivalence trials are conducted. In bioequivalence trials, the main interest of the experimenter lies in making test vs. reference formulation comparisons with as much precision as possible and comparisons within test formulations are not of much interest. Hence, designs that give estimates of test vs. reference formulations comparisons with maximum precision are a smart choice for bioequivalence trials.

Some series of balanced/partially balanced designs for bioequivalence trials in incomplete sequences have been presented for experimental situations in which

the experiment can not be continued for more number of periods. Further, some series of balanced/partially balanced designs for bioequivalence trials in complete/ incomplete sequences assuming the presence of residual effects have also been proposed. In experimental situations where a set of test formulations are to be compared with another set of reference formulations, two classes of designs for bioequivalence trials have been constructed assuming residual effects of formulations to be present. Variance of the estimates of contrasts pertaining to test vs. reference formulations have been calculated using SAS programs developed . All the proposed designs give better estimates for comparisons between test vs. reference formulation comparisons and hence can be recommended for their application in bioequivalence trials. Lists of all proposed designs have been prepared for a practical range of parameter values.

Guide: Dr. Cini Varghese

iii) Lokesh Dwivedi

Some investigations on change over designs

Designs in which each experimental unit receives some or all of the treatments, one at a time, in successive periods are known as change over designs (CODs). The distinguishing feature of these designs is that the treatments applied in a particular period influence the responses of the experimental units not only in that period but also leaves residual effects in the succeeding periods. These designs are of special importance when the experimenter finds it difficult to obtain homogeneous experimental units or when the experimental units are expensive. These designs have been advantageously used in animal nutrition experiments, clinical trials in medical research, long-term fertilizer experiments in agriculture, educational studies, bioequivalence trials, etc.

In many experimental situations, it is often required to measure the effect of response from two unrelated factors in the presence of first order residual effects of both the factors. Three series of CODs with two non-interacting factors out of which two are symmetric factorial and one is asymmetric have been proposed. The symmetric factorial designs are partially variance balanced for levels of each factor based on circular association scheme and the levels of first factor in the asymmetric factorial CODs follows Group Divisible association scheme. To meet experimental situations involving simultaneous application of levels of two factors when one of the factors exhibits residual effects while the other does not, two classes of uniform strongly balanced CODs with two factors balanced for residual effects of levels of one factor have been obtained. These designs are variance balanced in the sense that the contrasts pertaining to direct effects of treatment combinations consisting of various levels of both the factors are always estimated with a constant variance. SAS programs have been developed to calculate variances of estimates of contrasts pertaining to direct effects of various treatment combinations of levels of two interacting as well as non-interacting factors.

Guide: Dr. Cini Varghese

iv) Subrat Keshori Behera

Study of heritability of threshold character

There are many characters of economic importance in animal & plant breeding which are polygenic in inheritance but their phenotypic expressions show discontinuties. The characters whose inheritance is multifactorial but exhibit all-or-none or one-or-the-other kind phenotypic expression are called threshold characters. Intraclass correlation coefficient r provides a quantitative measure of similarity between individuals within groups.

Mastitis or inflammation of the mammary gland, is one of the most common disease of dairy cattle throughout the world which causes heavy economic loss to the farmers. Here we have studied the heritability of mastitis disease in sahiwal breed of cows by estimating its heritability through estimation of intraclass correlation based on different methods. SAS programs have been developed for estimating intraclass correlation and for estimation of heritability. Also heritability of mastitis disease is estimated following beta-binomial method. Comparison of the methods developed using intraclass correlation and beta-binomial method done on the basis of standard errors as well as on the basis of estimate values. The estimates of heritability based on ρ_{AOV}, ρ^{*}_{AOV}, ρ_{FC}, ρ_{KPR}, ρ^{*}_{KPR}, ρ_{PPR} estimators and beta-binomial heritability estimate $\hat{h}^2_f(beta)$ showed similar performance as reported in literature. These heritability estimates have less standard error as compared to other estimates. On the other hand, beta-binomial family heritability estimates $\hat{h}^2_f(beta)$, $\hat{h}^2_f(\Delta p|beta)$ are

found to be greater than and other estimates based on intraclass correlation coefficient.

Guide: Dr. A.K. Paul

v) Yogita Gharde

A Study on cross-over designs in the presence of first order residual effects

In cross-over designs (CODs) each experimental unit receives a sequence of several treatments, one treatment at a time over successive periods and observations are recorded in each period. These designs have been advantageously used in several fields of research, notably in nutrition experiments with dairy cattle, clinical trials in medical research, psychological experiments, long-term agricultural field experiments, bioequivalence trials and bio-assays.

In the present study, two new classes of minimal strongly balanced CODs have been developed assuming the presence of first order residual effects. Designs in the first class are minimal strongly balanced circular CODs for v treatments using v/2 experimental units for 2v periods. The second class of designs deals with minimal strongly balanced CODs for v treatments using 2v experimental units for v/2 periods. Both the classes of designs are partially variance balanced with m-associate classes based on a circular association scheme. These designs are useful for the situations where experimental units or periods are scarce or expensive.

Moreover, a class of two-period totally balanced trend-free CODs considering presence of first order residual effects has been developed. Conditions for a variance balanced cross-over design to be trend-free have been obtained. A method of construction and analysis of these designs have been given along with an illustration. Universal optimality of these two-period totally balanced trend-free designs have been established for the estimation of contrasts among direct effects and among first order residual effects.

Guide: Dr. V.K. Sharma

M.Sc. (Computer Application)

i) Sumit Sharma

Information system for dissemination of ready to adopt agriculture technologies

ISDAT (Information System for Dissemination of Ready to Adopt Agricultural Technologies) is a web based user-friendly, information system for ready to adopt agricultural technologies of ICAR. It is developed as comprehensive information system for ready to adopt agricultural technologies. ISDAT acts as a transfer agent for dissemination of ready to adopt technologies. The information, which is available in the form of books, journals, popular magazines, etc., is beyond the reach to each and every person across the world. Therefore, in the electronic era the ISDAT may help progressive farmers, industrialists, researchers, students and extension workers for rapid dissemination of knowledge and benefit humankind.

It has a three-layered architecture. Client Side Interface Layer is implemented in HTML and JavaScript. Server Side Application Layer is implemented in Java Server Pages and Java Database Connectivity. Database Layer is implemented in Microsoft SQL Server (MSSQL). ISDAT can be implemented as a network-based system so that information is available on-line. The software has one level of authentication i.e. Administrator; which has the privilege to add, modify or delete the information from the database.

Guide: Dr. S.D. Sharma

ii) Iti Jha

Software for stability analysis using AMMI and SREG models

Yield stability as a selection trait in plant breeding programmes and evaluation trials is constantly gaining importance over yielding ability. Some of the common techniques as an alternative to additive ANOVA model are Additive Main effects and Multiplicative Interaction (AMMI), Sites Regression (SREG), Factorial regression, Joint regression etc. Biometricians that are interested in stability analysis are aware of the specialized software packages like SAS, SPAR 2.0 etc. that can handle this analysis. Though SAS is a statistical software package, it requires programming knowledge for writing the program syntax codes to analyze data for analysis purposes. SPAR 2.0 (developed at IASRI) has a module on stability analysis, in which stability analysis can be performed using the three models, Eberhart and Russell (1966), Perkins and Jinks (1968) and Freeman and Perkins (1971). However, it cannot perform stability analysis using AMMI and SREG Models.

Keeping in view the above problems, software package for stability analysis is developed using AMMI and SREG models and integrated with SPAR2.0. It has been developed using VC++ and VB, which is more flexible, user-friendly and economic. Data files can be ASCII file and Excel file as well. There is no restriction on the number of response variables and observations. This module of SPAR2.0 calculates environment-wise ANOVAs, pooled ANOVA, percentage explained by each Principal Component Analysis (PCA), Gollob test for AMMI analysis and also the biplots of Mean vs. First PCA and First PCA vs. Second PCA. It has been provided with an extensive Help document, regarding statistical concepts involved, how to use the software, example data file, example of input files and output files. It has also the options like favorites and search through contents and index. Thus SPAR2.0 has been further strengthened for stability analysis by the inclusion of two more modules on AMMI and SREG.

Guide: Dr. P.K. Malhotra

iii) Nongmaithem Uttam Singh

Some statistical modules for analysis of breeding data

With the introduction of programmable computers, several tailor made programs for statistical analysis were written. They were modified to statistical packages by integrating the tailor made programs as mankind progressed in Information Technology. It is difficult to find, which the first statistical package is but first version of SPSS was released in 1968 by Norman H. Nie, C. Hadlai (Tex) Hull and Dale H. Bent and after this, many packages were developed. Besides these, there are statistical packages like GENUP, Pedigree, SPAB 1.0 etc. for animal breeding data analysis. There is always a scope to improve the packages by making them more user friendly, better architectured with more programs as no software is ever complete.

Keeping in view of the above mentioned requirements and to fulfill some needs in breeding data analysis, the present software for analysis of breeding data has been developed. The programs of the package are also integrated with SPAB 2.0, a package existing in IASRI. Present package has the programs for analysis, namely, Homogeneity testing of variance-covariance matrices by likelihood ratio test, Mahalanobis D^2 analysis, Distance analysis by Iterative Minimax and Oblique Axes procedures. Further, two programs viz., calculation of expected responses to recurrent and reciprocal recurrent selections are also included. The package is built using Java Swing to create window based editor and Core Java to develop the statistical modules.

The user is also provided with the information needed to make data and parameter files. This information is available in the help as well as the module's window. Data files can be text or notepad or Excel file. There is no restriction on the number of variables and observations. However, it should be text tab delimited ASCII file. Outputs can be displayed, saved and printed using appropriate menus. The help document is extensive and also contains relevant statistical formula and references. Further, the way of using the software is provided with processed examples.

The overall architecture of this windows based software can be regarded as two tier with Java Swing as front end and Core Java as back end.

Guide: Dr. I.C. Sethi

iv) Sandip Shil

Critical evaluations of Indian web-portals on agriculture

Like other fields, web portals have also a major role to play in agricultural field. Agricultural web portals are expected to make farm families more productive, keep farmlands fertile, strengthen rural infrastructure support and help promote a healthy business and social environment through providing the agricultural communities timely and updated information/services. There are many web portals addressing different sectors of agriculture such as research, development, input supply, protection against pests and diseases, weather, prices and marketing, export/import, farmer associations, government policies, taxation *etc*, but there are no evaluating tools that could help evaluate the existing agricultural web-portals, guiding the farmers/ users in selecting appropriate web portal in their domain of interest and also to suggest for better designing of web portals in agriculture which are farmers / end users oriented. This research work has been carried out with the objective to study and review some popular web portals, followed by identification of the indicators for discrimination among the web portals using Delphi technique and lastly the development of an online evaluation system for evaluating all Indian agro-web portals. Finally, the online evaluation system, named

Evaluation System for Agricultural Web Portals (ESAP), that evaluates agricultural web portals and generates automated evaluation reports with proper charts after an interval of seven days, has been implemented using HTML, Java, JSP, PL/SQL and Oracle 9i technologies.

Guide: Dr. S.D. Sharma

v) Dibyendu Deb

Software for stability analysis using factorial regression

Yield stability as a selection trait in plant breeding programmes and evaluation trials is constantly gaining importance over yielding ability. Some of the common techniques as an alternative to additive ANOVA model are Additive Main effects and Multiplicative Interaction (AMMI), Sites Regression (SREG), Factorial regression, Joint regression etc. Whenever the information on external environmental characteristics such as weather parameters and soil characteristics is available, it may be accommodated in the basic ANOVA model mentioned above in an attempt to interpret the interaction using the technique called Factorial Regression. Biometricians that are interested in stability analysis are aware of the specialized software packages like SAS, SPAR 2.0 etc. that can handle this analysis. Though SAS is a statistical software package, it requires programming knowledge for writing the program syntax codes to analyze data for analysis purposes. SPAR 2.0 (developed at IASRI) has a module on stability analysis, in which stability analysis can be performed using three models, Eberhart and Russell (1966), Perkins and Jinks (1968) and Freeman and Perkins (1971). However, it cannot perform stability analysis using Factorial regression.

Keeping in view the above problem, the software for stability analysis using Factorial regression has been developed and integrated with SPAR 2.0. It has been built using Visual C++ 6.0 and Visual Basic 6.0 which is more flexible, user-friendly and economic. Data files can be text or notepad or Excel files. There is no restriction on the number of response variables and observations. It has been provided with an extensive Help document, regarding statistical concepts involved, how to use the software, example data file, example of input files and output files. It has also the options like favorites and search through contents and index. Thus SPAR2.0 has been further strengthened for stability analysis by the inclusion of one more module on factorial regression.

Guide: Dr. P.K. Malhotra

vi) Chayana Jana

Information system on herbicide use in field crop

The present era has seen an exponential growth and diversification in all forms of information, sometimes called, an information explosion. It has been made possible due to the impact of computer technology on the modern society. Computerized information systems have influenced nearly all domains. The domain of agriculture is no exception.

Now, the country has made impressive progress in the field of agriculture but, it is one enterprise that faces uncertainty at every stage. In the field of agriculture, crops must be protected from different enemies such as weeds, insects & pests etc. Regarding weeds, it is becoming a major problem day by day. Every crop is exposed to severe competition from weeds. So, proper weed management is a pre-requisite for obtaining higher input efficiency. Weed management is done through the mechanical, cultural and chemical means i.e. herbicides. Use of herbicides is an important method in the modern concept of weed management-technology. Farmers, of course, are using herbicides for controlling the growth of weeds but their use is limited to few crops and few regions. The lack of awareness, information about the availability and the application of herbicides is one of the main reasons for their limited use. Sometimes, the farmers may not know the right dose, time of application and the procedures for the application of herbicide. Because of this, farmer doesn't get expected results inspite of its use. Hence, proper selection of the herbicides and its right dose and time of application are very important for good weed control and for preventing crop damage.

Information System on Herbicide use in Field Crops (ISHUFC) is a Web-based Information System to provide information to extension personnel, farmers, students, researchers etc. for proper herbicide recommendations in field crops. CIS (Computer based Information System) has great importance in agriculture as experts are not always available to answer farmers' query. ISHUFC has a simple query and report generation module to provide the information about crops, weeds, herbicides, herbicide recommendations etc. even in the printable formats.

The software has one level of authentication i.e. Administrator. Administrator has the privilege to add, modify or delete information from the database. Users are free to get information from the software. They can also ask questions regarding any information or about the software to the concerned experts by sending an e-mail; this facility is included in the software itself. Users can also view some frequently asked questions (FAQs).

ISHUFC is developed using ASP.NET. It is a new web-based technology in the scenario. It is an easy and effective tool to develop web based applications. Database part is developed using SQL Server 2000. It is the database widely used for its simplicity and ease in operation.

Guide: Dr. V.K. Mahajan

vii) Mukesh Kumar Vishal

Web based decision support system for watershed management

Web based decision support system for watershed management is web-enabled information system to provide information to farmers, NGO's, teaching community on watershed management. CIS (Computer based Information System) has great importance in agriculture as experts are not always available to answer farmers query. In this regard, this DSS is very meaningful to provide the alternate decision scenarios for watershed management. It has five modules for making decision on Soil and Water Conservation Measure, Land based Activities, Solution to Specific Watershed Problems, Crop Selection and Potential Employment Information. The design consideration of Engineering (Structural) and Vegetative (Agronomical) measure are also considered in the DSS.

This software has one level of authentication i.e. Administrator. Administrator has the privilege to "Add", "Modify" or "Delete" the information or records from database. Other features such as "Ask Us", "FAQ", "Contact Us", " Useful Links", are available as modules of the of the DSS which makes this software more flexible and interactive. Users can also ask questions regarding the software to the concerned experts by sending an e-mail and can view some important questions in FAQ (Frequently Asked Questions).

This DSSWM has been developed using recent technologies *viz.* ASP.NET, SQL Server 2000, HTML, XHTML and Java Script. The developed DSSWM has been successfully validated for the different watersheds such as Datia, Kheda, and Saliyur and other regions in India. Nonetheless, the developed DSS is flexible enough to incorporate activities of other region in India.

Guide: Dr. R.C. Goyal

NATIONAL/INTERNATIONAL TRAINING PROGRAMME

Senior Certificate Course in Agricultural Statistics and Computing

Senior Certificate Course in Agricultural Statistics and Computing was organised for the benefit of research workers engaged in handling statistical data collection, processing, interpretation and employed in Research Institutes of the Council, State Agricultural Universities and State Government Departments, etc. and foreign countries including SAARC countries. The main objective of the course was to train the participants in the use of latest statistical techniques as well as use of computers and software packages.

The course was organised during the period 03 July 2007 to 29 December 2007. The course comprised of two independent modules of three months duration each. Eight participants including one departmental and two foreign nationals from Afghanistan participated in both the Modules. Module-I was organized during 03 July 2007 to 29 September 2007. Two participants including one departmental participated in Module–I only.

A participant receiving the certificate after completing 'Senior Certificate Course in Agricultural Statistics and Computing'

Module-II was organised during 09 Oct 2007 to 29 December 2007. The course covered under both the modules included Statistical Methods and Official Agricultural Statistics, Use of Computers in Agricultural Research, Sampling Techniques, Econometrics and Forecasting Techniques, Design of Experiments and Statistical Genetics.

The Valedictory Function for the course was held on 29 December 2007 in which Dr. SD Sharma, Director, IASRI distributed the certificates to successful participants.

Programme under Centre of Advanced Studies

- A 21 days training programme on **"Spatial and Non-Spatial Information Management and Mining in Agriculture"** was organized during 13 November 2007 to 3 December 2007 under aegis of Centre of Advanced Studies in Agricultural Statistics and Computer Applications. Dr. Anil Rai was the Course Director for the training programme.

  The training programme was aimed at familiarizing the participants with the concepts of spatial and non-spatial information management and mining in context of agriculture. It acquainted the participants with the technologies and tools of spatial and non-spatial information management and mining in reference to agriculture and gave exposure to applications of tools and techniques of spatial and non-spatial information management in the field of agriculture. The training programme was attended by 8 participants from various ICAR Institutes (5) and State Agricultural Universities (3). The entire course for this programme was structured in a series of four modules namely (i) Data Base Management System (ii) Remote Sensing and GIS (iii) Data Warehousing System and (iv) Data Analysis and Mining.

  The Cousre material was distributed to the participants in the form of Reference Manual and CD. The course contents were completed in 48 lectures, and 15 practicals. 23 faculty members from the Institute and 7 guest speakers (Dr. A.K. Choubey, Senior Technical Director, Prof. Navneet Goyal, Department of Computer Science & Information systems, Shri. Ramesh Singh, Senior Technical Director, Dr. Sesha Sai MVR, National Remote Sensing Agency (NRSA), Dr. Girish K. Jha, IARI, Dr. R.P. Sahoo, IARI, Sh. Vipin Dubey, IBM) delivered the lectures.

- A 21 days training programme on **"Advances in Quantitative Techniques for Policy Analysis in Agricultural Economics"** was organized during 06 to 26 December 2007 under aegis of Centre of Advanced Studies in Agricultural Statistics and Computer Applications. Dr. Ashok Kumar was the Course Director and Dr. Prawin Arya, Dr. D.R. Singh were course Coordinators for the training programme.

  The training programme was aimed at familiarizing the participants with the concepts of advances in the field of econometric tools in agriculture and to acquaint the participants with advanced techniques in econometrics for policy analysis enhancing research, teaching and training skills of the participants.

  The training programme was attended by 12 participants from various ICAR Institutes (5) and State Agricultural Universities (7). The entire course for this programme was structured in a series of three modules namely (i) Orientation to Statistical Packages for Econometrics Research, (ii) Analytical Econometric Techniques and (iii) Policy Analysis.

  The Course material was distributed to the participants in the form of Reference Manual in two volumes. The course contents were completed in 55 lectures, and 7 practicals. 21 faculty members from the Institute and 14 guest speakers (Dr. N.P. Singh, IARI, Dr. R.N. Padaria, IARI, Dr. Alka Singh, IARI, Dr. B.R. Atteri, IARI, Dr. Bal Raj Singh, IARI, Dr. G.K. Jha, IARI, Dr. Shiv Kumar, IARI, Dr. S. Mauriya, ICAR, Dr. Seema Bathla, JNU, Dr. Pratap S. Birthal, NCAP,

Inauguration of training programme of 'Advances in Quantitative Techniques for Policy Analysis in Agricultural Economics'

Dr. Shinoj, NCAP, Dr. Suresh Pal, NCAP, Prof. P. Kumar, NCAP, Prof. Ramesh Chand, NCAP delivered the lectures.

- A 21 days training programme on **"Advances in Biometrical Techniques"** was organized during 08 to 28 February 2008 under aegis of Centre of Advanced Studies in Agricultural Statistics and Computer Applications Dr. Amrit Kumar Paul was the Course Director and Shri S. D. Wahi was Associate Course Director for the training programme.

  The training programme was aimed with the objective to familiarize the participants with the recent advances in the field of Biometrics and other useful statistical and computational tools applied in the areas like Plant/Animal Breeding, Genomics and Bioinformatics, to acquaint the participants with the statistical software packages used in the analysis of data, to help upgrade the research and teaching skills of the participants. The training programme was attended by 19 participants from various ICAR Institute and State Agricultural Universities.

Inauguration of training programme on 'Advances in Biometrical Techniques'

The training was structured under five modules (i) Some Preliminaries, (ii) Introduction to Computers and Use of Statistical Software Packages for Data Analysis, (iii) Advanced Statistical Methods in Breeding and Genetics, (iv) Advanced Statistical and Computational Techniques in Genomics and Bioinformatics and (v) Statistical Modeling in Biological Phenomena.

The Course material was distributed to the participants in the form of Reference Manual and CD. The course contents were completed in 65 lectures, and 23 practicals. 22 faculty members from the Institute and 12 guest speakers delivered the lectures.

- A 21 days training programme on **"Development of Web Applications for Knowledge Dissemination in Agriculture"** was organized during 04 - 24 March 2008 under aegis of Centre of Advanced Studies in Agricultural Statistics and Computer Applications. Mohammad Samir Farooqi was the Course Director for the training programme.

  This training programme offered sufficient practical knowledge to design, develop and host a web application using Microsoft .NET technology on IIS web server with MS-SQL server as database. The training programme was attended by 16 participants from various ICAR Institutes (3) and State Agricultural Universities (13). In brief the practical was divided into five modules (i) Hypertext Mark-Up Language (HTML), (ii) Internet Information Server, (iii) SQL Server, (iv) Asp.NET and (v) Knowledge Dissemination. Major areas covered were Web applications for knowledge dissemination, Role of information communication technology in taking scientific knowledge/technologies to the end users, Data warehouse and its applications in agriculture, On line library information system, web application architecture, Introduction to .NET framework, Working with HTML (Structure, Formatting, Tables and Images), Demo of training site for HTML controls, VB.NET language concepts, OOPS concepts using VB.NET, Introduction to Web Web Server (IIS), Configuration & development of web application, Concepts of RDBMS, Structured query language, Overview of SQL server, Creation of tables, Views using SQL server enterprise manager, Introduction to Visual Studio.NET, Introduction to ASP.NET, ASP.NET Web application, Web controls, Accessing database with ADO.NET, Manuplating data with ADO.NET, Securing ASP.NET Web application etc.

  Guest lectures on topics of interest were also organised. The Course material was distributed to the participants in the form of Reference Manual and CD. The course contents were completed in 39 lectures and 19 practicals. 18 faculty members from the Institute and 4 guest speakers (Mr. Vipin Kumar, IBM, Mr. Tarun Sharma, IBM, Mr. Rajat Nayyar, TCS, Mr. Anil Kumar Jha, NIC) delivered the lectures.

A participant receiving the certificate after completing training programme on 'Development of Web Applications for Knowledge Dissemination in Agriculture'

Inauguration of training programme on 'Research Methodology for scientists of ICFRE'

OTHER TRAINING PROGRAMMES

Organized and conducted a two weeks training programme on **Research Methodology** for scientists of Indian Council of Forestry Research and Education (ICFRE) from 07 to 18 January 2008. Dr. Seema Jaggi was the Course Director.

This training programme was specially designed for scientists of ICFRE undertaking forestry research to equip them with the art of collection, analysis of data and drawing valid interpretation of their results.

There were in all 19 scientists from various disciplines of forestry and representing nine different Institutes of ICFRE who attended this training.

All the topics useful for forestry research starting with basics to some advanced topics covering Statistical methods, Experimental designs, Sample surveys, Biometrics and Spatial statistics were covered. The practicals were done using statistical software, mainly SPSS.

Concepts were explained largely without using much of mathematics using computer software and the course emphasized on understanding which analysis is appropriate to use and correct interpretation of the results.

Course material in the form of Reference Manual and Electronic Manual was provided to all the participants.

A **"study tour for the two participants of Senior Certificate Course from Afghanistan"** was conducted which comprised visit to CSWRI, Avikanagar, Jaipur and National Research Centre on Seed Spices (NRCSS), Ajmer during 19-24 November 2007 and visit to CIRG, Makhdum, Mathura, and State Department of Agriculture, Anga during 10-12 December 2007.

A FAO sponsored **"study visit of participants from Afghanistan"** was organised during 10-29 December, 2007. The participants were very senior people from Afghanistan. The participants were taken to almost all the offices related to Indian Statistical System for acquiring them the details of the Indian Statistical System.

The detailed discussions on the subject were held with the Experts in India. The topics covered were Statistical system in India; Area, yield and production statistics; Horticulture statistics; Market information system; Role of Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India in Planning; Livestock statistics; Livestock census; Land utilisation statistics; Agricultural census; Cost of cultivation; Official crop forecasting; GDP estimation for agriculture and allied activities; Management and organization of agricultural data base, Role of NSSO in agricultural statistics system. As a part of the Study Visit the participants were also demonstrated the Indian Agricultural Statistical System in two States, one having land records and the second not having land records. For the purpose, participants were taken to Kerala State during 16-19 December 2007 where land records are not available and a complete demonstration was given to them by Director,

Directorate of Economics and Statistics, Kerala State regarding the statistics being generated in that State. Regarding States having land record system, the participants were taken to Directorate of Economics and Statistics, Hyderabad (A.P.) during 25-27 December, 2007.

A participant from Afghanistan receiving the certificate after completing 'Senior Certificate Course'

A complete demonstration of the agricultural statistical system covering all the relevant aspects was given to them. To know, how the research institutions like Indian Agricultural Statistics Research Institute help in further development of the statistical system in the country, the topics of current interest on which the Institute has undertaken projects on the request of different organizations were explained to them. One more topic on 'Vital statistics' was added and an expert from Registrar General of India was invited to explain them the system. The participants have been provided printed material for all the topics covered.

A winter school on **Sample Survey Techniques in Agricultural Research** was organised at the Institute during 16 January to 05 February 2008. The participants were Assistant/Associate Professors from State Agricultural Universities (SAUs) and Scientists from ICAR Institutes. Dr KK Tyagi was the Course Director. The broader objective was to provide exposure to the participants about the different sample survey techniques in agricultural research as well as to help to upgrade their capabilities in research, teaching and training. A total of 21 participants participated in the winter school. The main topics covered were overview of survey sampling in relation to agricultural research, various concepts in sample survey, different procedures of sample selection, simple random sampling, stratified sampling, cluster sampling, sampling on successive occasions, multi-stage sampling, multi-phase sampling, systematic sampling, use of auxiliary information in sample surveys, determination of sample size, non-sampling errors and quality of data, role of models in survey sampling, regression analysis from survey data, variance estimation techniques, small area estimation techniques in relation to national agricultural insurance scheme, use of remotely sensed data and GIS in survey sampling, simulation techniques, survey data analysis packages, planning and organisational aspects related to conduct of sample surveys, some recent agricultural surveys related to crops, livestock, farm mechanization etc. In addition, participants were exposed to various divisional activities including the types of surveys conducted by the Institute. Participants were also given a practical demonstration of how to conduct crop cutting experiments, in a village Mitraun in Najafgarh Community Development Block of Delhi State. A number of lectures/practicals on different topics relating to the broader objectives of the Winter School were delivered. The resource persons were from among the Institute Faculty as well as senior level Officers from other Organizations. The participants were very much satisfied with the course content, the material prepared in the lecture notes and the presentations made by the faculty in the lectures. The course was relevant to their needs. Fairly good number of participants indicated that the

A participant receiving the certificate after completing the winter school on 'Sample Survey Techniques in Agricultural Research'

material covered was worth while and the expectation out of the course was fully met. The participants were of the view that practical session should be lengthier so that they themselves could do the practical exercises. The training material supplied during the course was quite useful. The participants interacted with the faculty, however they suggested keeping a lecture per week free for the purpose. Overall, the feedback of participants was worth appreciating.

An International Training Programme on "**Biometrics in Agricultural Research"** was organized during 3 October – 01 December 2007 for one trainee of NARC, Nepal under ICAR – NARC, Work Plan for the year 2006-07. Dr. Prajneshu was the Course Director and Shri Pal Singh was Associate Course Director.

The training programme was conducted with the following objectives: (i) to familiarize NARC participant with Biometrical techniques in the field of agricultural research, (ii) to acquaint participant with statistical software packages used in analysis of data, (iii) to help upgrade research skills of the participant.

This training course was structured in a series of seven modules with class room lectures and practicals on computers, including demonstration of software packages. The modules were : (1) Some preliminaries in Biometrics, (2) Statistical software packages for data analysis, (3) Statistical methods in breeding and genetics, (4) Statistical modelling of biological phenomena (5) Statistical planning of agricultural field experiments, (6) Analysis of sample survey data and (7) Field visits.

A participant receiving the certificate after completing the training programme on 'Biometrics in Agricultural Research'

There were 70 theory classes and 25 practical classes, taught by 30 IASRI faculty. This training also included several study tour and visits to National Agricultural Science Museum, National Gene Bank, National Phytotron Facility, NCMRWF, and NIC, etc.

A 10 days winter school on **"Agri-business and Market Intelligence"** was organised during 06-15 October 2007. Dr S.P. Bhardwaj was the Course Director. This training provided knowledge about supply and demand analysis for agribusiness, sampling and forecasting techniques as well as other econometric/statistical techniques applied in agribusiness with the objectives, i) to familiarize the participants with the latest developments in agribusiness in the country, ii) to acquaint the participants with advanced techniques used in market intelligence, and iii) application of computer software in agribusiness and market Intelligence studies.

The training had been designed in a series of three modules, namely; Agribusiness, Market Intelligence and Computer Software in Agribusiness & Market Intelligence, having classroom lectures on agribusiness and market intelligence with practical application of software on computers. Module-I(Agribusiness) covered Concepts, scope, nature and significance of agribusiness; Supply and demand analysis in agribusiness; Sampling and forecasting techniques for agribusiness; Trade related issues in agriculture and Contract farming-theories and related issues. Module-II (Market Intelligence) covered Terminology, role and importance of agricultural marketing: Marketing functions, market margins and its measurement techniques etc; Marketing intelligence concepts, functions and needs of marketing integration and Role of marketing intelligence and dissemination of information. Under Module-III (Computer Software in Agribusiness & Market Intelligence), Use and application of Minitab, R software, SAS and SPSS were covered.

This training programme made the participants aware of the recent trends in agribusiness and marketing and equipped them to assess the impact of prevailing marketing strategies as well as to suggest new policy measures based on inferences drawn from empirical data using sophisticated econometric/statistical technique.

Research Fellowship

During 2007–08, 8 Ph.D. and 22 M.Sc. students received research fellowship. 7 Ph.D. students received IARI Scholarship at the rate of Rs. 7,000 p.m. in addition to Rs.10,000 per annum as the contingent grant. 01 Ph.D. student received CSIR Scholarship at the rate of Rs. 8,000 p.m. in addition to Rs.15,000 per annum as the contingent grant.14 M.Sc. students received ICAR Junior Research Fellowship at the rate of Rs. 5,760 p.m. besides Rs. 6,000 per annum as the contingent grant and 8 M.Sc. students received IARI Scholarship at the rate of Rs. 5,040 p.m. besides Rs. 6,000 per annum as the contingent grant.

FACULTY MEMBERS OF P.G. SCHOOL, IARI IN AGRICULTURAL STATISTICS

S. No.	Name	Year of induction
1.	Dr. VK Gupta, National Professor	1984
2.	Dr. Prajneshu, Principal Scientist	1984
3.	Dr. VK Bhatia, Professor (Agricultural Statistics)	1987
4.	Dr. VT Prabhakaran, Principal Scientist	1987
5.	Sh. SD Wahi, Principal Scientist	1987
6.	Dr. Ranjana Agrawal, Principal Scientist	1988
7.	Dr. HVL Bathla, Principal Scientist	1991
8.	Dr. UC Sud, Principal Scientist	1995
9.	Dr. KK Tyagi, Principal Scientist	1995
10.	Dr. Rajender Parsad, National Fellow	1995
11.	Dr. Anil Rai, Senior Scientist	1995
12.	Dr. Seema Jaggi, Senior Scientist	1995
13.	Dr. Chandrahas, Principal Scientist	1996
14.	Dr. PK Batra, Principal Scientist	1996
15.	Dr. Jagbir Singh, Principal Scientist	1996
16.	Mrs. Asha Saksena, Principal Scientist	1998
17.	Dr. Aloke Lahiri, Senior Scientist	1998
18.	Dr. Amit Kumar Vasisht, Principal Scientist	1998
19.	Dr. Lal Mohan Bhar, Senior Scientist	1998
20.	Dr. Amrit Kumar Paul, Senior Scientist	1998
21.	Dr. Tauqueer Ahmad, Senior Scientist	1998
22.	Dr. AR Rao, Senior Scientist	1998
23.	Dr. Ramasubramanian V, Senior Scientist	1999
24.	Dr. Girish Kumar Jha, Senior Scientist (at IARI)	1999
25.	Dr. Cini Varghese, Senior Scientist	2000
26.	Dr. Prachi Misra Sahoo, Scientist (Sr. Scale)	2002
27.	Dr. RL Sapra, Principal Scientist (at IARI)	2002
28.	Dr. Krishan Lal, Senior Scientist	2003
29.	Sh. Hukum Chandra, Scientist (Sr. Scale)	2003
30.	Sh. Amrender Kumar, Scientist (Sr. Scale)	2003
31.	Md. Wasi Alam, Scientist (Sr. Scale)	2003
32.	Dr. Prawin Arya, Scientist (Sr. Scale)	2003
33.	Dr. Himadri Ghosh, Senior Scientist	2004

FACULTY MEMBERS OF P.G. SCHOOL, IARI IN COMPUTER APPLICATION

S. No.	Name	Year of induction
1.	Dr. SD Sharma, Director	1996
2.	Dr. PK Malhotra, Professor (Computer Application)	1991
3.	Dr. RC Goyal, Principal Scientist	1995
4.	Dr. IC Sethi, Principal Scientist	1995
5.	Dr. VK Mahajan, Principal Scientist	1996
6.	Dr. DK Agarwal, Principal Scientist	1999
7.	Sh. Harnam Singh Sikarwar, Scientist (SG)	1997
8.	Md. Samir Farooqi, Scientist (Sr. Scale)	2001
9.	Ms. Alka Arora, Scientist (Sr. Scale)	2001
10.	Ms. Shashi Dahiya, Scientist (Sr. Scale)	2001
11.	Ms. Sangeeta Ahuja, Scientist	2002
12.	Sh. Sudeep, Scientist (Sr. Scale)	2002
13.	Sh. KK Chaturvedi, Scientist (Sr. Scale)	2002
14.	Sh. SN Islam, Scientist (Sr. Scale)	2004
15.	Sh. SB Lal, Scientist (Sr. Scale)	2004
16.	Ms. Anshu Dixit, Scientist (Sr. Scale)	2004
17.	Ms. Anu Sharma, Scientist (Sr. Scale)	2004
18.	Ms. Rajni Jain, Sr. Scientist (at NCAP)	2007

COURSES TAUGHT DURING THE ACADEMIC YEAR 2006–07

Code	Title	Course Instructors
	Trimester – III	
	Agricultural Statistics	
AS-103	Elementary Sampling & Non-parametric Methods (2+1)	Asha Saxena & Prachi Misra
AS-163	Statistical Inference (4+1)	Rajender Parsad & L.M. Bhar
AS-164	Design of Experiments-I (3+1)	Seema Jaggi & V.K. Gupta
AS-166	Statistical Genetics-I (3+1)	V.T. Prabharkran & A.K. Paul
AS-302	Advanced Design of Experiments-II (2+1)	R. Srivastava & P.K. Batra
AS-306	Advanced Statistical Genetics-II (2+1)	A.K. Paul
AS-307	Forecasting Techniques (1+1)	Chandrahas & Ramasubramanian V.
AS-370	Recent Advanced in the Field of Specialisation	V.K. Gupta
AS-299	Seminar (1+0)	Seema Jaggi
	Computer Application	
CA-131	Data Base Management System (2+2)	R.C. Goyal, Anu Sharma & KK Chaturvedi
CA-132	Data Structures and Algorithms (2+1)	Shashi Dahiya & K.K. Chaturvedi
CA-134	Modeling and Simulation (2+1)	P.K. Malhotra & Samir Farooqi
CA-135	Computer Networks (2+1)	S.N. Islam
CA-299	Seminar (1+0)	S.N. Islam

COURSES TAUGHT DURING THE ACADEMIC YEAR 2007–08

Code	Title	Course Instructors
	Agricultural Statistics	
	Trimester – I	
AS-101	Elementary Statistical Method (2+1)	K.K.Tyagi & G.K. jha
AS-150	Mathematical Methods (4+0)	Cini Varghese & Himadri Ghosh
AS-160	Probability Theory (2+0)	P.K. Batra
AS-161	Statistical Methods-I (2+1)	V.T. Prabhakaran & Seema Jaggi
AS-167	Applied Multivariate Analysis (2+1)	Ranjana Agrawal & A.R. Rao
As-168	Econometrics (2+1)	V.K. Sharma & A.K. Vasisht
AS-169	Planning of Surveys/Experiments (2+1)	R.S. Khatri & Aloke Lahiri
AS-200	Design of Experiments-II (1+1)	Rajender Parsad & Cini Varghese
AS-201	Sampling Techniques-II (1+1)	K.K. Tyagi & Prachi Mishra
AS-202	Statistical Genetics-II (1+1)	A.K. Paul & S.D. Wahi
AS-203	Regression Analysis (1+1)	L.M. Bhar & Ramasubramanian V.
AS-204	Linear Models (2+0)	V.K. Sharma & Krishan Lal
AS-206	Optimization Techniques (1+1)	Prajneshu & U.C. Sud
AS-370	Recent Advances in the Field of Specialisation (1+0)	V.K. Bhatia
AS-299	Seminar (1+0)	Seema Jaggi
	Trimester – II	
AS-102	Elementary Design of Experiments (2+1)	P.K. Batra & Krishan Lal
AS-151	Mathematical Methods in Statistics-II (4+0)	N.K. Sharma & Cini Varghese
AS-162	Statistical Methods-II (2+1)	V.T. Prabhakaran & G.K. Jha
AS-165	Sampling Techniques-I (3+1)	Tauqueer Ahmad & Anil Rai
AS-170	Statistical Modeling (2+1)	Prajneshu
AS-205	Advanced Statistical Inference (1+1)	Krishan Lal & U.C. Sud
AS-207	Stochastic Processes (3+0)	Himadri Ghosh
AS-301	Advanced Design of Experiments-I (2+1)	L.M. Bhar & V.K. Gupta
AS-303	Advanced Sample Survey-I (2+1)	H.V.L. Bathla & Jagbir Singh
AS-299	Seminar (1+0)	Seema Jaggi
	Computer Application	
	Trimester – I	
CA-100	Introduction to Computer Application (1+1)	V.H. Gupta & Balbir Singh
CA-111	Computer Organization and Architecture (3+0)	Anil Rai & Shashi Dahiya
CA-112	Fundamentals of Computer Programming in C (2+1)	K.K. Chaturvedi & Pal Singh
CA-114	Mathematical Foundations in Computer Application (4+0)	P.K. Batra, N.K. Sharma & H.S. Sikarwar
CA-211	Compiler Construction (2+1)	S.B. Lal
CA-212	Computer Graphics (2+1)	Pal Singh & H.S. Sikarwar
CA-213	Artificial Intelligence (2+1)	Rajni Jain & Anshu Dixit
CA-214	Internet Technologies & Applications (2+1)	Alka Arora & S.N. Islam
CA-215	Software Engineering (1+0)	Anu Sharma
CA-299	Seminar (1+0)	S.N. Islam
	Trimester – II	
CA-101	Computer Fundamentals & Programming (3+1)	S.N. Islam & Pal Singh
CA-121	Object Oriented Programming & Design (2+1)	S.B. Lal
CA-122	Operating System (2+1)	H.O. Agarwal
CA-124	System Analysis & Design (2+1)	I.C. Sethi & M.S. Farooqi
CA-221	Data Warehousing and Data Mining (2+1)	Anil Rai, K.K. Chaturvedi & Rajni Jain
CA-222	Multimedia and Applications (1+1)	Shashi Dahiya
CA-224	GIS and Remote Sensing Techniques (1+0)	Prachi Mishra & M.S. Farooqi
CA-225	Data Analysis in Agriculture (1+2)	V.K. Mahajan & M.S. Farooqi
CA-299	Seminar (1+0)	S.N. Islam

Note: Figures in the parentheses indicate the number of credits (Lectures + Practicals)