

ABSTRACTS OF PAPERS

1. Statistical Investigation on the Fertilizer Use Efficiency in Relation to Cultural Practices

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Several cultural cum manurial experiments are conducted at various research stations on different crops in National Agricultural Research System. Most of these experiments have factorial set up of treatments. In these experiments, one factor is cultural treatment and other is fertilizer. It will be of great interest to contribute meaningful suggestions on fertilizer use efficiency in relation to cultural practices. A study of interaction between different levels of cultural treatments with different levels of fertilizers is essential. Optimum doses of various fertilizers and corresponding yield were worked out at various levels of cultural practices for various crops by using complete quadratic response surface model. It is observed that at optimum dose of fertilizer changes with respect to various levels of cultural treatment. Responses of fertilizer also change as per various levels of cultural treatment for getting optimum yield of various crops, much variation in optimum doses of fertilizers and corresponding yield of various crops at various levels of cultural treatments. In most of the cases, optimum doses of fertilizer and cultural practices are found within range of doses, which were taken in the treatments of the experiments. Linear effects of both fertilizer and cultural practices are observed positive but quadratic effects in both the cases are found negative. Interaction effects are found positive in 50% cases and negative in 50% cases in complete quadratic response surface model is found suitable for cultural cum manurial experiments.

2. SPFE 1.0: Statistical Package for Factorial Experiments

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The SPFE gives the designs for symmetrical and asymmetrical factorial experiments and also analysis of the data generated. It has the capability to generate the randomized layout of the design for factorial experiments with or without confounding. The design is generated once the independent interactions to be confounded are listed. Different number of interactions may be confounded in different replications. It also generates regular fractional factorial plans for symmetrical factorial experiments. It analyzes the data generated from the experiments using these designs. The data generated are analyzed as per procedure of blocked/unblocked designs for single factor experiments. Contrast analysis is carried out to obtain the sum of squares of main effects and interactions. A null hypothesis on any other contrast of interest can also be tested. The package is also useful for illustration purposes in the classroom teaching as well as for the researchers in statistics with interest in experimental designs particularly in factorial experiments. The package has been developed using Microsoft Visual C++6.0, Microsoft Visual Basic 6.0 and Microsoft Access 2000.

3. Plot Size Study from Uniformity Trial Data of Clusterbean

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Optimum plot size for rainfed clusterbean crop experimentation was worked out using uniformity trial data. The trial was carried out at Main Pulses Research Station, Gujarat Agricultural University, Sardar Krushinagar during Kharif 2001. Three methods viz., (1) Maximum curvature method (2) Fair-field Smith's variance law and (3) Comparable variance method were used for the purpose. A plot of 10.8 m² size having shape of 4 m length and 2.7 m cross width (6 rows in N-S) is optimum size (net) and shape for rainfed clusterbean crop experiment. The minimum number of replications were 9 at 5% SE_m and 3 at 8% SE_m for the same.

4. Analysis of Variance Method For Rank Data From Balanced Incomplete Block Designs

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The statistical methods for analysis of rank data are available only for two or several independent samples and no method is available for analysis of rank data from other commonly used designs. In this study the ANOVA method is developed for analysis of rank data from balanced incomplete block design. The model, assumptions, null hypotheses and sums of squares are presented analogous to ANOVA method for quantitative data. The asymptotic distributions of sums of squares are derived. The test statistics are defined and their reference distributions are obtained.

5. AGRIDESIGNER 1.0 – A Computer Software for PBIB(3) Designs and Partial Diallel Crosses

Anu Sharma, Cini Varghese, Seema Jaggi and V.K. Sharma

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Designing the experiment is an important part of any scientific experimentation. Block designs, complete or incomplete, are the most popular designs for agricultural field experiments. The purpose of this paper is to describe a PC-based software, named as AGRIDESIGNER 1.0, developed for cataloguing, generating and analyzing three-associate class partially balanced incomplete block designs. The software also generates efficient cost effective plans for partial diallel crosses obtained through three-class association schemes and carries out analysis in complete or incomplete block settings. Proper software engineering practices, the standard architecture and design are adopted for the development and implementation of the software. AGRIDESIGNER 1.0 runs using 5MB of memory space, under Window 95, 98 or XP and offers user-friendly screens organized to simplify and reduce the number of entries. The software is designed for multipurpose use, to meet the needs of students and teachers for demonstration of methods and concepts in experimental designs. The software is also useful for agronomists and breeders engaged in agricultural and allied sciences.

6. Application of Three-Associate Class Partially Balanced Incomplete Block Designs in Partial Diallel Crosses

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Mating designs are being used in plant and animal breeding trials to investigate the genetic properties of inbred lines or individuals. These consist of all possible single crosses (complete diallel) or a subset of all crosses (partial diallel), among a set of inbred lines. The association schemes of partially balanced incomplete block (PBIB) designs can be used to sample the crosses for a partial diallel cross (PDC) plan. A lot of work has been done in sampling the diallel crosses by utilizing two-associate class association schemes of PBIB designs. The total number of crosses involved in a PDC using a two-associate class association scheme is likely to be large resulting in difficulty to handle all of them effectively. But for the same v (number of lines), if there is a design with higher associate class, the number of crosses are likely to be small and there is more flexibility in the choice of associate classes. In this study, PDC plans based on various 3-associate class association schemes have been given. The efficient plan has been obtained based on the information per cross as compared to a complete diallel cross plan. Parameters of various PDC plans along with their efficiencies have been tabulated for number of lines less than or equal to 30. The method of analysis using the most efficient PDC plan in a suitable environmental design has also been indicated.

7. Statistical Assessment of Diversified Rice Based Crop Sequences

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Experiment was conducted to test the performance of 16 crop sequences at R.S. Pura (J & K) during kharif, rabi & summer season of 2001-2002. The experiment was laid out in group balanced block design with six replications. Design consists of 4 groups each having 4 crop sequences adjusted in 4 blocks in each replication. Groups were based on 4 varieties i.e. IET, 1410 PC - 19, Jaya and Scented Basmati of rice crop sown during kharif. Analysis based on monetary returns exhibited significant differences among 4 groups and also

among 4 crop sequences within each group. Maximum returns were observed from the group with the sequences, Rice (PC-19)-wheat-fodder, Rice (PC-19)-mustard-greengram, Rice (PC-19) – potato-rajmash and Rice (PC-19)-peas-maize (cob) and among these 4 crop sequences the last sequence gave the highest returns.

8. Size and Shape of Plots and Blocks for Experiments with Safflower

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Uniformity trial was undertaken on safflower during winter (Rabi) season in 2002. The optimum plot size varied between 18.9 m² and 24.6 m², depending on the per cent cost per unit area with an approximate rectangularity of 2.66. The value of Smith's coefficient of heterogeneity (b) was 0.819.

9. Assessment of Different Crop Rotations

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The experiments are being conducted at cropping system research centres under All India Co-ordinated Research Project on Cropping Systems to assess the relative performance of rotations of different durations in terms of crop productivity, yield stability and soil health. In these experiments, one, two, three or four years rotations have to be evaluated. To study the analytical technique of this type of experiments, the data of the experiment conducted at Akola using Balanced Incomplete Block Design with parameters (7, 7, 4, 4, 2) with two years rotation and two sets of rotations from 1997-98 to 1998-99 and 1999-2000 to 2000-01 were utilized for the study. Seven crop sequences as treatments were taken in such a way that in the first year some treatments were reported but after two years of rotation, all the seven treatments were distinct including the residual effect of previous experimentation. The same treatment structure was repeated in the second set.

As the crop rotations include a number of crops whose productivity cannot be aggregated as such for comparison of different rotations, the analysis of variance was carried out after converting the grain, straw and grain+straw data in terms of gross returns using the prices (year-wise) as provided by the centre, calories and proteins for each set of rotations and then over the complete cycle of rotations. The data were analysed using the procedure of general block designs in PROC GLM of SAS. To monitor the changes in soil fertility status after different cropping sequences, covariance analysis was performed on different soil parameters viz., N, P, K and O.C taking initial soil status (Kh. 1997-98) as the co-variate.

The results revealed that on the basis of gross returns obtained from grain yield only, grain+straw and calories, sorghum-wheat; maize-wheat at rotation was judged to be the best. From the point of view of proteins, sorghum-gram; soybean-wheat rotation was significantly superior from all the rotations. Contribution of sorghum-gram; soybean-wheat rotation in improving the soil fertility of nitrogen and phosphorus was significantly higher whereas fertility of K and Organic Carbon was enhanced by the rotations sorghum-gram; soybean-sunflower and sorghum-sunflower; soybean-wheat respectively.

10. On Totally Balanced Block Designs for Competition Effects

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Field experiments are usually performed to assess the effect of several management factors or genetic factors, or both, on crop performance. The experimental plots allocated to different treatments and subjected to different production techniques are commonly placed side by side. As a consequence, the response from a given plot may be affected by the treatments applied to its neighbouring plots besides the treatment applied to the plot itself. Interdependence of adjacent plots because of their common needs is referred to as competition effect. Competition between neighbouring units in field experiments is a serious source of bias. The study of a competing situation needs construction of an environment in which it can happen and the competing units have to appear in a predetermined pattern. This paper describes methods of constructing incomplete block designs balanced for neighbouring competition effects. The designs obtained are totally balanced in the sense that all the effects, direct and neighbours, are estimated with the same variance. The efficiency of these designs has been computed as compared to a complete block design balanced for neighbours and a catalogue has also been prepared.

11. Analytical Techniques of Experimental Data from On-Farm Trials

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A large number of on-farm trials are being conducted in different agro-climatic zones of the country. These trials are being conducted under the aegis of Project Directorate of Cropping Systems Research, Modipuram. The main objective of these on-farm trials is to develop/refine/identify the components of technology that can help to increase the farm income separately for each of these development zones. For a given agro-climatic zone, a random sample of few development blocks, out of the totality of blocks in the zone constituting the jurisdiction of researcher, is selected at the first stage. From the selected development block a random sample of few villages is selected in the second stage. In the third stage a cultivator is selected at random from the cultivators in the selected village. The field of the selected cultivator is then divided into as many plots as there are treatments. The treatments are allocated to these plots randomly so that each treatment is allocated to one experimental unit. In other words, the cultivator or village forms one complete replication of a randomized complete block (RCB) design and the villages within development blocks are the replications for a given block of RCB design. A critical look reveals that this structure is that of nested block design, where the villages are nested within development blocks. As the developmental blocks are different locations or environments, therefore, the interaction between development blocks and treatments may also exist. For the analysis of experimental data from these experiments, it is generally assumed that the development block effects, villages (blocks) and development block \times treatment effects are fixed. However, in these trials, the development blocks and villages are a random sample from a large number of development blocks and villages. Therefore, these are random effects. Therefore, we should not use the fixed effect model to analyze the data. An analytical procedure by taking the treatment effects as fixed and the development blocks, villages within blocks and block \times treatment interaction effects as random has been developed. The method is based on a linear mixed effect model. The method is capable of identifying specific blocks that seem to favour one treatment over the other. This shall be useful for making recommendations for smaller areas. The method has been illustrated with the help of data obtained from the on-farm trials conducted under the said project. Based on this analysis, we suggest the following

- If development block by treatment interaction or the variance component due to block*treatment is significant, then we must identify the specific development blocks that seemed to favour one treatment

over the other. This may help in identification of different recommendation zones that is not possible through comparing the treatment averaged over all the development blocks alone.

- Besides the data on production technology, the data on full description of the climate, soil, farm, and the management practices of the trial site should be collected. This will enable us to analyze and correlate the information for arriving at appropriate recommendations.

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12. Influence of Assumptions Underlying Analysis of Variance on Precision (C.V. %) of Field Experiments

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Coefficient of variation (C.V.%) is a good index of reliability of results of field experiments. The C.V.% of 906 experiments conducted in randomized complete block design at 25 research stations of Gujarat Agricultural University on six pulse crops indicated that out of 906 experiments, 20.86%, 24.06% and 5.19% of the experiments did not satisfy basic assumptions underlying analysis of variance viz. normality, additivity and both respectively. The results obtained in the present study revealed that the basic assumptions viz. normality and additivity significantly influenced C.V.% (precision) of the field experiments. The C.V.% was reduced by about 44.96 per cent, when experimental data satisfied both the assumptions (15.36%) compared to the experimental data did not satisfy these assumptions (27.89%). Therefore, in order to improve the precision of experimental results (or to reduce C.V.%), it is advisable to test, normality and additivity of data and use an approximate transformation (if necessary) before applying analysis of variance technique.

13. Comparison of Different Bootstrap Strategies on the Estimate of Standard Error of Heritability by Half-sib Method

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The bootstrap estimates of standard error of heritability using half-sib model are obtained by drawing independent master samples for optimum family size by three different bootstrap strategies. In strategy I, the bootstrapping was done both at sire level as well as at progeny level whereas in strategy II bootstrapping was done at the sire level alone. The strategy III involves bootstrapping at progeny level alone. The strategy II has performed better than the strategies I and III. The estimate of standard error by strategy II is always lower than the strategies I and III except in the later when the number of sire is extremely greater as compared to the number of progenies per sire. The performance of the strategies I and II when the number of sire is large enough as compared to the number of progenies per sire for the given structure. The bias in the estimates of heritability in strategy II is also least that is around 10% for low heritability and is around 1-3% for both moderate and high heritability values in case of large samples. These results clearly show that the superiority of bootstrap strategy II to the strategies I and III for estimating the precision of heritability as well as for the parameter estimation.

14. Empirical Investigations on the Estimation of Heritability in Presence of Non-Genetic Fixed Effects

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The estimates of heritability based on sire and sire plus dam components of variance are found heavily biased in presence of non-genetic fixed effects in the data. The method of fitting constants commonly used for estimation and adjustment of all the fixed effects prior to estimation of heritability based on sire component has been found comparable to mixed model technique for samples from populations with moderate and high heritability. In case of samples from low population heritability the bias in the estimates of heritability from data adjusted for all the fixed effects is slightly higher as compared to estimates

based on mixed model technique. The estimates of heritability based on sire plus dam components are found to be heavily biased in both unadjusted as well as adjusted data for all levels of heritability. The heritability estimates obtained by mixed model technique are also biased but are comparatively less biased. The sample size and family structure do play some role in reducing the bias in the estimates of heritability by all methods but could not eliminate it.

15. GIS Based System for Comparing Soil Fertility Changes and Prescribing Optimum Dose of Nutrients for Targeted Yield through Soil Fertility Maps in Andhra Pradesh

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Fertilizer prescription, that integrates the soil fertility and crop requirement information, is globally proven technology for efficient resource utilization. A fertilizer use programme tuned to soil fertility levels and crop requirements ensures that the benefits of fertilizer use are delivered on the farm. Use of soil fertility maps for recommending fertilizer is very useful. An attempt is made here to create spatial fertilizer recommendation maps using available validated fertilizer adjustment equations (STCR's generated) and Geographic Information System (GIS). District wise soil fertility maps for different years have been prepared using index values for Nitrogen (N), Phosphorus (P) & Potassium (K). Corresponding equivalent soil nutrient values in respect of N, P & K have been calculated from the index values. Reasonable limits for targeted yields have also been defined. Using the above information soil fertility maps for Andhra Pradesh has been prepared for the years 1995 and 2001. It is seen from the maps that changes in nitrogen are more dynamic as compared to P and K. It is also seen that the fertility of the district Khammam was stable at medium level for all the nutrient for all the reported years. In totality fertility status for K was high in 1995 but after span of 6 years there was decline towards medium fertility. The use of the recommendation system suggests for varied applications for targeted yield in different districts of A.P.

16. Prediction of Optimal Nitrogen Rate of Rice in Southern, Western and Eastern India

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This study evaluated the quadratic response plateau and quadratic models for 3-5 years, two crops sequence data set with 4, 3 and 5 nitrogen fertilizer rates in southern, western and eastern India. The quadratic response model predicted a maximum grain yield of 2 to 13% larger and an optimal nitrogen fertilizer rate 2 to 73% larger than predicted by the quadratic response plateau model. These analyses indicate that the quadratic response plateau model is preferable to the quadratic model for predicting nitrogen fertilizer requirements of rice. Economic analyses also indicates that the benefits of using quadratic response plateau can be more than by using quadratic model. Site or season specific knowledge of crop nutrient requirements and indigenous nutrient supply will be required in order to achieve maximum yields.

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17. Relational Database Package for the Institute's Data Management

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In the old days, information was limited to crude tables without any graphs or charts. Standardized reports were spit out of huge printers every month and fed to employees who were on the designated recipient limits. Now we have become a data rich society in many aspects of our lives, both at work and at home. It appears that much information are incoherent and missing opportunities because the information need or could use is jumbled cluttered. Getting a grip on the information around is a great way to do. The architect of any new information system must decide how much responsibility for data management, the new custom software should take and how much should be left to packaged software and the operating system. The principles of Relational database management system have been implemented in development of the package for efficient management, storage and retrieval of data. This package has three modules viz., personal management system, professional management system

and research information system, which has been developed for the Institute's data management. Reports can be generated as per the need of the user. This customized package is user friendly and helpful for efficient decision-making and resource utilization for administrators.

18. Voice Activated Learning System for Children Education

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Most of today's teaching methodologies of imparting education are intended to improve the knowledge of learning process. Investigations are being made on innovative applications of technology for education. In current scenario, the use of Information Technology is growing to enhance student's skill for reading, writing and studying. The present work is devoted to develop a voice based learning system and its features are summarized as follows

- System is menu driven
- System is reliable and understandable
- This system makes the child education much more easier and enjoyable
- It helps in removing confusions
- It improves their logical ability

It improves the pronunciation capabilities of children, as bookish knowledge is not enough to improve this.

19. Use of AMMI in Simultaneous Selection of Genotypes for Yield and Stability

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Multi-environmental trials (MET), generally, have significant main effects and significant multiplicative genotype \times equivalent interaction effect. AMMI

offers a more appropriate statistical analysis to deal with such situations, as compared to traditional methods like ANOVA, PCA and linear regression. In this paper, a family of simultaneous selection indices is proposed, which selects genotypes for both high yield and stability in MET using AMMI model. A comparison between proposed indices and existing simultaneous selection indices is also made. To assist agronomists and plant breeders, a user-friendly computer programme is proposed and demonstrated with real data.

20. Model for Forewarning Mustard Aphid

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Aphid is considered as important constraint in mustard production and is reported to cause up to 83% losses (Mandal *et al.* 1994). Efficient control of aphid may be obtained if prior knowledge is available regarding its timing of attack and severity before the pest actually occurs. Weather plays an important role in influencing the pest. Therefore, weather based forewarning models were developed for three parameters namely, time of first appearance of aphid, time of peak aphid population and maximum aphid population. These models have been developed for various centres using historical data on pest status and weekly weather variables from standard week of sowing to 50th standard meteorological week (maximum minimum temperature, maximum minimum relative humidity, bright sunshine hours). Using the data on weather parameter, weather indices were developed which were used as independent variables in regression model. Important weather indices were selected through stepwise regression technique. Validation of models on data for subsequent years (not included in model development) revealed that forecasts obtained through the models were very close to the observed ones.

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21. A Study on the Classification of Different Regions on the Basis of Area, Production and Productivity of Ginger (*Zingiber Officinale*) Crop

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The story of Indian spices dates back to 7000 years into the past. Within the past one decade the international trade in spices has grown by leaps and bounds. An estimated 500,000 tones of spices and herbs valued at 1500 million US dollars are now imported globally every year. An impressive 46 per cent of this supply comes from India. The Indian export of spices has crossed the 450 million US dollar mark during 1999-2000 and has reached 468 million US dollar. Ginger has been cultivated in India both as a fresh vegetable and marketed as a dried spice since time immemorial. Ginger, being a major spice, is used in food, flavouring and medicinal products.

World over, about 2.5 lakh hectares area (excluding China) is under this crop, with the production of about 6 lakhs tones. Nigeria has maximum area under this crop. India is the largest producer of ginger in the world with 263170 tonnes during 1999-2000 and occupies an area of about 77610 hectares of land. Though it is produced in almost all the states, the major producers of ginger are Kerala, Orissa, Meghalaya and West Bengal. In this study, state-wise (22 states) data of area, production and productivity of ginger for the period 1991-92 to 1999-2000 were used. Kerala (cluster-1, area) state has the maximum share in both area (18.8 per cent) and production (19 per cent) in the country and West Bengal, Meghalaya (cluster-2, area) and rest of 18 states (A.P., U.P., H.P., M.P., Arunachal Pradesh, Bihar, Gujarat, Haryana, Karnataka, Maharashtra, Manipur, Mizoram, Rajasthan, Sikkim, Tamil Nadu, Tripura, Nagaland, Andaman & Nicobar Islands) in (cluster-3, area). Meghalaya (cluster-1, production) with only 8.4 per cent of the total area under ginger produces 18.6 per cent of the total production, Kerala (cluster-1, production) and Orissa (cluster-2, production) and rest of 19 states (cluster-3, production). However, the maximum yields per unit achieved by Tamil Nadu (cluster-1, productivity) and Arunachal Pradesh, U.P., Meghalaya, Mizoram, Nagaland in (cluster-2, productivity) and rest of 16 states in (cluster-3, productivity). There is a steady increase in production in the country over the years. During the thirty years period, i.e., between 1970 and 2000 the area under the crop, has been more than trebled, while the production has increased nine times. The estimated area and production at present is 77610 hectares and 263170 tonnes respectively.

22. A Branching Process in Varying Environments – A Mixed Model

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Considering the importance of mixed mating system over the single mating system in genetic improvement programmes, a model of branching process in varying environment is developed. The model has been applied to a system where genotypic assortative and random matings operate alternately and where complete selection against homozygote recessives plus partial selection against heterozygotes is allowed. The ultimate genetic structure of the population in terms of superior genotype leaving aside the inferior ones has been studied.

23. Non-Linear Growth Modelling of Apple Productivity of Different States in India

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India has a varied climate and soils because of which a large number of horticulture crops such as fruits, vegetables, flowers, nuts, coconut, cashewnut, arecanut, tropical tuber crops, spices, mushroom, medicinal and aromatic plants etc. are produced. India has made a fairly good progress on the horticulture map of the world with a total annual production touching over 152.5 million tones (29.7 per cent) during 2000-2001. Today, India is the second largest producer of the fruits (45.4 million tones). Our share in the world production is 9.7 per cent in fruits. The overall productivity of fruits is 111.7 tonnes per hectare. India produces about 122.27 lakh tones of apple annually, apart from India, the other major producers of apple in world are China, USA, France, Italy, Turkey, Russia, Iran and Poland. Apple is a major fruit crop in India, it is mainly grown in states like J & K, Arunachal Pradesh, U.P. Hills, Nagaland and Himachal Pradesh in the country whereas, the highest productivity (8.5 mt/ha) was J & K in the country.

Non-linear growth models, viz. logistic, gompertz, monomolecular, Morgan-Mercer-Flodin (MMF), Richards and Weibull models were used for describing state-wise yield data of apple during 1991-92 to 2000-2001. The parameters of these models were estimated using Levenberg-Marquardt

producers for non-linear estimation. The five major apple-growing states considered J & K, Arunachal Pradesh, U.P. Hills (now renamed as Uttaranchal), Nagaland and Himachal Pradesh. For each of these states, logistic model described quite well the apple productivity data. In Uttaranchal state, parameters estimates for each model is negative may be of decreasing productivity. A comparative performance of various states for apple productivity showed that Nagaland (carrying capacity achieved by 2000-2001) performance is good as reflected by its intrinsic growth rate, which is likely to continue in near future.

24. Some Considerations for Improvement of Agricultural Human Resource Development Programmes (AHRD) in India

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G.B. Pant University of Agriculture & Technology is the first agricultural university established in India. Since then there has been a steady growth in respect of agricultural universities and colleges in the country imparting education and conducting research in agricultural and allied sciences. Today we have about 30 State Agricultural Universities, 4 Deemed Universities and one Central Agricultural University with a total of more than 200 colleges of Agriculture, Veterinary and other allied sciences. These colleges offer under graduate and postgraduate programmes in different disciplines of agriculture and allied sciences. Nearly 10,000 students are admitted in under graduate programmes and more than 6500 students in M.Sc. and Ph.D. programmes each year in State Agricultural Universities. The human resources developed by these universities have played a key role in ushering green revolution in the country by not only developing new technologies, assessments and refining of technology but also by dissemination of high production technology to the farmers. In recent years, there has been a decline in the standard of agricultural education due to factors like lack of infrastructure development, lack of firm policies for faculty competence improvement, lack of access to new information and libraries. There is a need for improvement in the quality of agricultural education through modernization of laboratory, library strengthening, better environment for continuous learning, computerization and computer training to faculty and students, course curriculum revision, faculty competence improvement, instructional material development, management training for managers, manpower planning and assessment, faculty awards etc. To bring

such improvements, efforts have been made at IASRI, New Delhi and National Information System on Agricultural Education has been developed. This information system is capable of maintaining an up-to-date data bank and provides answers to assessment of agricultural related queries covering all above aspects. Further efforts are being made to implement the system on Internet for which the cooperation and participation of all state agricultural universities in providing the necessary information is essential.

25. Web Based Online Examination and Evaluation System

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Today's students are generally computer literate and have high expectations of university information technology resources. Most of the universities now provide networked computers for learning, research, communication and accessing the worldwide web. Now-a-days, web based examination system is becoming popular and an effective solution for mass education and evaluation. Online examination system, which is simple and flexible, can be an effective substitute, replacing the traditional paper based examination system. The present attempt is a web based testing interface for students, which include client side control, time control, security control and auto grading. It has been developed in Java Server Page (JSP) and has a three-layered architecture. Client Side Interface Layer is implemented in Hypertext Markup Language (HTML) and JavaScript. Server Side Application Layer is implemented in Java Server Pages and Java Database Connectivity. Database Layer is implemented in Microsoft Access 2000. This system would allow students to familiarize themselves with common practical procedures. The development of Web Based Examination and Evaluation System would result in substantially less administration and bureaucracy for course organizers and proved to be a valuable research tool.

26. Incomplete Block Designs for Circulant Partial Diallel Crosses

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Generally the parents are included in the experimental material for combining ability analysis for comparing the performance of crosses with parents and for calculation of heterosis. Because of non-availability of analysis procedure, parents are ignored for combining ability analysis in partial diallel crosses (PDC). In the present paper, plans for the construction and analysis of PDC's corresponding to method-2 of Griffing (1956), have been provided through symmetrical circular designs with block size two. The efficiency of proposed designs has been compared with the Mating-Environment designs of Singh and Hinkelmann (1995) and Sharma (1998).

27. Information Technology in Precision Agriculture under Indian Scenario

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The recent advances in Information Technology have affected the entire societies of the world. Powerful new technologies such as internet, ATM, wireless communication, and satellite applications have entirely reshaped the whole world. Societies in general and agriculture in particular are becoming keenly aware of the need to manage information using these new tools. Precision agriculture is based on the philosophy of heterogeneity within homogeneity and requires precise information on the degree of variability for within field management. So it depends on the precise monitoring of the process (inputs and practices), estimate the end result (Biological production) and finally computational tools to simulate and evaluate different scenario seeking a decision or a control estimate that will maximize efficiency or profit. In order to apply precision agriculture it is necessary to depend strongly on Information Technology and Communications. The advent of remote sensing, GIS, GPS and crop simulation models having the edge in precision agriculture with the capability to automate data collection, documentation and the utilization of these information for strategic farm management with the field operation through

spatial analysis. Use of increasing inexpensive powerful computers and Geo spatial information technology has reached to a level where a farmer can have access to information and tools to manage his field operations. In such a situation this paper is aimed at finding out the feasibility related to information technology aspects in precision agriculture under Indian conditions.

28. Knowledge Discovery in Cropping Systems Database

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Large investments in technology and data collection are being made in the area of agriculture. Relatively little analysis on the utility of data is currently being performed. The key issue in *Knowledge Discovery in Databases* (KDD) is to realize that there is more information hidden in the data than what one can be able to distinguish at first sight.

Cropping systems is one of the vital concepts in cultivating profitable and sustainable agriculture. In every season, large volumes of data related to cropping systems is being collected, which contains a lot of hidden knowledge. Advanced data mining techniques are required to extract knowledge from the huge database.

This paper deals with knowledge discovery from cropping systems database using different methods viz., query languages (SQL, PL/SQL, MDX), OLAP, pattern recognition algorithms, association rules, statistical methods, decision trees and neural networks.

29. Comparisons of Three Product-type of Estimators in Small Sample

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In this paper, we have proposed a class of unbiased product type of estimators for estimating the population mean \bar{Y} of the study variate y using

auxiliary variate x in single phase sampling. Expressions for bias and mean square error of the proposed class has been derived in small sample assuming a linear model, and its exact efficiency is compared with the usual unbiased estimator \bar{y} , conventional product estimator \bar{y}_p and unbiased jackknife product estimator \bar{y}_{pj} . Minimum mean square error of the proposed class of estimators has been derived. Here, to simplify our discussion, we confine ourselves to simple random sampling and assume the population size to be infinite.

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30. Trend of South West Monsoon Rainfall at Dharwad

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The southwest monsoon rainfall at Dharwad ($15^{\circ} 26'N$, $75^{\circ} 07'E$, 678m) during the period of 1950 to 2002 was analyzed to study the trend of rainfall. The 12 year moving average technique was used for this purpose. The trend was shown in a graph. The rainfall was nearly constant with around 500 mm in the period 1955 to 1964. Then the trend became mild oscillatory until 1982. The trend became gradual negative from the year 1983 to 1997 with the rainfall changing from 494 mm to 378 mm respectively.

31. Estimating the Parameters of Log-zero Poisson Distribution – A Spatial Distribution for Larval Population

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Errors in observing and reporting sample data often complicate the problem of estimating parameters of the distribution being sampled. If neglected, such errors may lead to seriously biased estimates. There exist large

general classes of such estimation problems involving numerous different distributions, different types of varying degrees of observational errors.

The purpose of the present paper is to bring to the notice of entomologists about the existence of the 'Log-zero Poisson' modified distribution, which is very versatile discrete distribution for larval population. Log-zero Poisson distribution is often used to describe plant distribution especially when reproduction of the species produces, clusters. In this paper, Log-zero Poisson distribution is modified at the k^{th} probability and estimators are derived both from method of moment and maximum likelihood estimation method. Asymptotic variance and covariance are also derived and an illustrative example is included.

32. Nonlinear Models to Describe Growth Pattern of Indian Native Chickens

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Aseel is famous bird of Indian native chicken and is well known for its high stamina, majestic gait and dogged fighting qualities. In addition, it has plenty delicious flavoured meat due to its biggest body size among the Indian native breeds of chickens accompanied by broader breast. About 13 varieties of Aseel are found in the country out of which Kagar and Peela are being maintained at Central Avian Research Institute, Izatnagar. The average body weights at 0, 8, 20, 30 and 40 weeks of age for male and female chickens were 36.18 ± 0.56 g, 35.89 ± 0.53 g; 402.00 ± 12.84 g, 385.37 ± 11.20 g, 1550.38 ± 34.72 g, 1479.63 ± 43.66 g, 2246.25 ± 57.54 g, 2097.96 ± 71.51 g, 2627.62 ± 71.94 g and 2449.07 ± 103.72 g respectively. The male birds grew faster than female birds but both followed the same growth trend. On the average basis they attained the maximum weights gain at 15th week of age. Seven nonlinear functions were fitted to average weekly body weights of male and female birds. Gompertz function was found the best function to describe their growth pattern.

33. Statistical Models to Predict Seasonal Rainfall at Dharwad

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The seasonal rainfall monthly maximum air temperature and relative humidity (RH) at Dharwad (15°26'N, 75°07'E, 678m) for the period 1980 to 2002 was analysed to predict the seasonal rainfall. We obtained three models for the SW monsoon. They are third degree polynomial, Hoerl and the saturation growth rate models, when we considered the independent variables namely May RH, premonsoon rainfall and May maximum temperature respectively. Four suitable models for the NE monsoon were obtained. They are sinusoidal, quadratic fit, Hoerl and sinusoidal fit models, with the independent variables namely, premonsoon rainfall, September RH, SW monsoon rainfall and September maximum temperature respectively. To predict the SW monsoon rainfall May RH and maximum temperature play major role as indicated by the above model. For the prediction of NE monsoon rainfall September maximum temperature, RH and the premonsoon rainfall are important.

34. Agricultural Development and Disparities in Various Districts of Karnataka

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The development of agriculture and the factors affecting regional disparity with respect to agricultural development was studied in detail using nine important agricultural development indicators. The study pertains to Karnataka state and its component districts. The secondary data was collected for period of 6 years depending on the availability of the data starting from 1992-93 to 1997-98, pertaining to nine important agricultural development indicators like per cent net area irrigated, per cent net area sown, productivity, per cent net area under high yielding varieties, number of irrigation pumpsets, fertilizer consumption, agricultural production, regulated markets and rainfall.

The Mahalanobis D^2 analysis (distance statistic) and Tocher's method of clustering was employed to know the extent of regional disparity, factors affecting regional disparity and to classify the districts based on agricultural development. The results revealed that districts were highly despair with respect

to agricultural development and the per cent net irrigated area, number of regulated markets and agricultural production were the major factors affecting regional disparity followed by number of irrigation pumpsets, productivity of important food grains, rainfall, per cent area under high yielding varieties, per cent area sown and fertilizer consumption. All the 20 districts were grouped into 10 clusters and then ten clusters were categorized into three groups as highly developed, moderately developed and low developed using the agricultural development index formed. In highly developed group five districts were included viz., Bangalore (Rural), Kolar, Shimoga, Bangalore and Dakshina Kannada, in moderately developed group 12 districts were included viz., Mandya, Mysore, Chitradurga, Hassan, Bellary, Raichur, Tumkur, Chikmagalore, Gulbarga, Uttar Kannada, Belgaum and Kodagu and in low developed group remaining 3 districts were included viz., Bijapur, Bidar and Dharwad.

35. The Canonical Correlation Analysis Approach for Forecasting of Rainfall

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Rainfall forecasts are generally made through the Multiple Regression Approach "independently" for each period of the season, ignoring the interrelation that exists between them. The present study examines the suitability of Canonical Correlation Analysis Approach by using the lagged rainfall variables. Through this approach, forecasts for a vector of dependent variables (instead of a single dependent variable) can be obtained. The approach was applied for forecasting the rainfall of South West monsoon corresponding to the four districts of Rayalseema region of Andhra Pradesh State. The analysis was based on 35 years of monthly rainfall data covering the years 1961 to 1995. It was found that the efficiency of the forecasts depend on the "dominance" of the dependent variables in the canonical vectors, in addition to the first canonical correlation coefficient ρ_1 . The forecasts for June rainfall were found to be, in general, relatively more efficient than the other months.

36. Bias and Sample Size in Count Regression Models

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In regular models with p dimensional parameter θ , the commonly used estimators, namely, maximum likelihood estimator, moment estimator and minimum distance estimator are usually biased. The asymptotic bias of these estimators are normally to the order of $O(1/n)$, which vanishes as the sample size increases. However, for moderate sample sizes, when the covariates are large, the magnitude of the bias may be substantial. This has led many researchers to seek bias corrected estimators. Two of the commonly used approaches are using Taylor series expansion and Jackknife estimation. However, in practice, neither of these approaches is used. Many of the packages do not normally incorporate these and an inference is obtained by the use of uncorrected estimators. This has motivated us to investigate the sample size required for the estimation to be nearly unbiased. This is achieved through the numerical computation of bias for simulated data sets. Two count regression models were tried. A sample size of 10 is sufficient to achieve minimum bias in the case of truncated Poisson regression as against the 30 to 40 in the case of Poisson regression model. The asymptotic relative bias was very small for truncated Poisson regression model as compared to Poisson regression model.

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37. Modelling and Forecasting of Monthly Frozen Shrimp Exports Values – An Application of Holt-Winters Exponential Smoothing Approach

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Seafood exports have gained increasing prominence in the basket of commodities that are exported from India. In 2001-2002 cultured shrimp contributed nearly 85 per cent of the export value of seafood. Since there has been a widening international market base for frozen shrimps, the trends in unit value of frozen shrimp is a clear indicator of gains from trade and terms of trade. Shrimp farmers, shrimp hatcheries, processors and exporters keep a close watch

on the returns per kilogram of frozen shrimp in order to time their respective operations and maximize their returns on investment. An attempt has been made in the present study. This helps to give an insight into the month-to-month fluctuations of price realization which thereby helps in decision making. Monthly unit value realization of frozen shrimp exports for the period 1990-91 to 2001-02 exhibited trend and seasonality. Accordingly, Holt-Winters trend and seasonal triple exponential smoothing model was chosen for the analysis. This method has two versions additive and multiplicative and the same were applied to the frozen shrimp export values data. The performance of the two models were compared with various goodness of fit statistics viz., Root mean square error (RMSE), mean absolute error (MAE), mean absolute percentage error (MAPE), Theil inequality coefficient. RMSE and MAE are lower for Holt-Winters multiplicative model when compared to Holt-Winters (HW) additive model. This implies that HW Multiplicative model yielded better fit when compared to HW additive. However, MAPE, and Theil Inequality Coefficient yielded similar results, implying both the versions of Holt-Winters model perform similarly for forecasting.

38. Some Aspects of Environmental Pollution in Kymore Plateau (M.P.): A Statistical Analysis

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In this paper, an attempt has been made to study the environmental pollution with reference to the cement dust pollution at Kymore plateau of Madhya Pradesh. The effects of cement dust pollution on biotic and biotic components of the ecosystem were combined into an index of penalization measuring the net damage caused to the total system at any given place along with the penalization gradient. This methodology was found to be convenient to measure penalization of environment from various pollution sources.

39. Comparison of Different Statistical Techniques using Simulated Data on Milk Yield

Satya Pal

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In this study, the data pertaining to the project "Development of a suitable methodology to study the effect of housing conditions and other related factors on milk production under village conditions" is utilized. The data is generated by using mean and variance covariance values of different characters affecting the milk yield. For the purpose of generating the data Max-Muller transformation is used. The generated data is analysed through the statistical techniques Path coefficient analysis, Regression analysis and Principal Component analysis. The variation explained by different factors in the three techniques are 44%, 44.75% and 80.9% respectively.

40. A Modified Ratio-type Estimator

B.V.S. Sisodia, Anupam Singh and Sunil Kumar

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The usual ratio estimator of finite population mean (\bar{Y}) is modified using linear transformation of an auxiliary variable x related to study variate y when information on x is known for all units in the population. Sisodia & Dwivedi (1981) used known c.v. of x to modify the ratio estimator. However, if x_i ($i = 1, 2, \dots, N$) is known for all i , then coefficient of skewness and kurtosis of the distribution of x can easily be computed. These descriptive statistics including c.v. of x are used to modify the usual ratio estimator through a linear transformation of x . Accordingly, we get a set of three modified ratio estimators. The properties of these modified ratio estimators are studied. These modified ratio estimators are compared with usual ratio estimator, estimator due to Sisodia & Dwivedi (1981) and such other estimators. The proposed estimators were found to be more efficient than other usual ratio type estimators in many of the real world situations.

41. Modelling of Time Series Data for Describing Oilseed Production in Uttar Pradesh

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Oilseeds is one of the important crops in Uttar Pradesh. It has received a lot of attention of State as well as Central Governments because of continuous shortfall in oilseed production in the country, and as a result, the country has to import edible oil to meet the domestic requirement. In the present paper, an attempt has been made to model the time series data on oilseed production in Uttar Pradesh in order to describe its growth trend and future carrying capacity to enhance the oilseeds production. The data on total oilseed production and rapeseed & mustard were considered for the period 1961-62 to 2001-02. Six models, viz., gompertz, exponential, compound growth, logistic and sigmoid models were fitted to the data. In both the cases, sigmoid (4p) was found to be best fitted in view of less RMSE. However, the carrying capacity achieved in case of rapeseed & mustard was only 63.7 per cent which indicates that there is still a lot of scope to increase the rapeseed & mustard production in the State.

42. Path Analysis – Its Application in Social Sciences

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Path analysis is one of the important biometric techniques to determine the influence of cause variables on effect variable. In recent days, the use of path analysis has become inevitable in social sciences also. Path analysis further partitions the Correlation Coefficient value into estimates of direct effects and indirect effects.

43. A Comparative Study of the Snow Profiles of Pir Panjal and Great Himalayan Ranges

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Natural snow after deposition on the ground undergoes through the process of settlement. This process is very rapid in the first few hours as the snow crystals, which are branched initially, undergo equi-temperature metamorphism and tends to get rounded. Later on this deposited snow undergoes through various other types of metamorphism to form different types of snow grains. Different types of layer formed after metamorphism have its own characteristics and a weak layer formation causes a serious avalanche threat. Buried weak layers in the snow cover can be detected by stratigraphy and the snow profile data can give an idea about the microstructure of the snow pack.

In the present study, past years snow profile and meteorological data were analyzed to draw some trends in the Pir Panjal and Great Himalayan Ranges.

Meteorological parameters snowfall, ambient temperature and fresh snow density analyzed while the snow pack parameter standing snow, variation of standing snow with temperature, density of snow pack, natural and modified layers, height of equi-temperature, temperature gradient and melt freeze layers of two ranges Pir Panjal and Great Himalayan Ranges have been compared with the help of graphs and some trends found in both the ranges were found. On the basis of these trends in two ranges the cause of avalanche activity in these two ranges were inferred.

44. Avalanche Forecasting for Chowkibal Tangdhar – Axis using Nearest Neighbour Model

Dan Singh, J.B. Singh and Bhan Singh
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Avalanche forecasting is cheapest short-term control method used for avalanche hazard. Avoiding human exposure during period of potential avalanche activity can reduce avalanche hazard. Evaluation depends on reliable avalanche forecast. There are many methods for avalanche forecasting.

The present study is concerned with nearest neighbour model. The nearest neighbour model considers each past avalanche or non-avalanche activity as a

case. The most similar situation like a day to be forecasted is calculated from the past database on the basis of some metric. The model developed takes snow and meteorological parameters as input parameters and gives probability of avalanche occurrence on the basis of the ten nearest neighbours. The model developed gives high prediction accuracy for non-avalanche day and good accuracy for prediction of avalanche day. The excessive prediction of model is very high for entire season. The side-by-side prediction of model is high and probability of avalanche occurrence on sidewise analysis lies in high range avalanche forecast with respect to model prediction probability.

45. Characters Associated with Grain Yield of Rice in Tarai Region of Uttaranchal – A Path Analysis

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A sample survey was conducted at Pantnagar University Farm, using two stage stratified random sampling technique. The correlation coefficients and path analysis for eight characters were studied. The characters dry matter accumulation per hill and length of flag leaf showed significant and positive correlation with grain yield at first growth stage (10-12 weeks after sowing) and third growth stage (14-16 weeks after sowing) while the number of green leaf per main tiller was significant and positively associated with grain yield only at third growth stage. In path analysis, the characters dry matter accumulation per hill and number of green leaf per main tiller were direct components that influenced yield at third growth stage. It was concluded that direct selection for these characters would be effective to increase the grain yield of rice.

46. Significance of Snow and Meteorological Variables Towards Avalanching : Chowkibal-Tangdhar Axis (J & K)

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Individual snow and meteorological variables have been analyzed as a function of probability of avalanching for data from the snow and

meteorological observatory-Stage II on C-T axis in Jammu & Kashmir. Snow and meteorological data of past 10 winters (Oct. to April, 1992-2001) have been analyzed. Variables showing strong significance towards avalanching are : Fresh snow of 24 hours, 48 hours and 72 hours, Fresh snow water equivalent, minimum temperature and standing snow. Variables having moderate significance include maximum temperature and average wind direction and the variables showing less significance on C-T axis area are : average wind speed, relative humidity and sunshine hours.

47. Economics of Migratory Sheep Rearing in Backward Areas of Rajasthan

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Rearing of sheep is an important activity for the poor section of the society in the backward areas. Sheep are traditionally raised under mixed grazing system and several times the stocking density on range land far exceeds its carrying capacity leading to gradual degradation of land. Due to nonavailability of fodder and water during summer months, farmers are forced to migrate with their stock to neighbouring states. This practice has been going on since very long. Sheep farmers of Rajasthan migrate to Uttar Pradesh, Madhya Pradesh, Gujarat, Haryana and Punjab during critical seasons and return to their native place with onset of monsoon. The present study has been conducted in Ajmer district of Rajasthan and primary data from six villages have been collected from the migratory sheep farmers. The objectives of the present investigation are to study the socio-economic conditions of the migratory sheep farmers, wool yield, cost and income as well as employment from this vocation. The study revealed that the average family size of these farmers was about 13 and had a land area of 3.5 ha. The average numbers of sheep maintained on the selected farms were 173. Yield of wool per adult sheep was 1.8 kg. The average inputs cost of migratory sheep rearing was about Rs. 442 and gross income realization was Rs. 460 per animal per annum. The average return over input cost was very low (Rs. 18.00) in this region and it turned out to be negative for small flock size. This enterprise has a good employment potential, as it generated an average employment of 1158 man-days per farm per annum for these migratory sheep farmers.

48. Stochastic Model in Two Graded Manpower Planning

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Planning is a natural and inevitable phenomenon in every day life for optimum utilization of resources. One of the major resources is human resources. The planning of personnel in an organization is often referred as Manpower planning of the organization. Manpower planning is the integration of manpower policies, practices and procedures in order to achieve the right people in the right jobs at the right time. It is often defined as the attempt to match the supply of people with the jobs available for them. The growth and development of a company is dependent largely on the proper planning of their personnel. Since, the human behaviour is random in nature, stochastic models provide the basic framework for efficient analysis and design of a Manpower systems.

The two graded manpower planning model is much useful in predicting the manpower/labour stocks and flows and hence to have efficient operational strategies for manpower systems. Using cumulant generating function of grade size distribution, the model behaviour is analyzed under both transient and equilibrium conditions. The average number of employees in each grade and variance of the grade size distribution and the covariance of the grade sizes have studied in this model. The model is very realistic in nature and useful in different Agricultural Extension trainings, Government and Private organizations.

49. Generalization of Roychoudhury Method

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When information about auxiliary variable is available unequal probability sampling is used. The estimator based on it is expected to be better than that based on equal probability sampling if there is near proportionality between study and auxiliary variables. Roychoudhury (1957) has given an estimator based on unequal probability sampling which performs better even when the intercept of the regression line is nonzero. In this paper, Roychoudhury estimation procedure is generalized. From empirical investigation it is observed

that the generalized estimator is even better than regression estimator, the efficiency increasing with increase in relative intercept.

50. Resource Use Efficiencies under Hi-Tech and Field Rose Cultivation : An Application of Data Envelopment Analysis

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Rose is the largest traded flowers internationally with a turnover of more than 1000 million dollars per year in Holland Auction Market alone. In India, rose is grown under open field condition since time immemorial whereas controlled environmental cultivation is of recent origin. Rose is cultivated in these controlled conditions using polyhouses and adopting advanced technology. Because of this technological dualism, there exists wide difference in resource use pattern. Even within the hi-tech farms, there exists considerable difference in the level of technology adoption, which is reflected by the resource use efficiency. Conventionally, comparison of resource use efficiency or technology dualism is done by comparing the coefficients of regression using Chow test. However, this test cannot be used when the sample size is very small. Hence, Data Envelopment Analysis (DEA) is used in this study. The area near Bangalore comprising of two districts – Bangalore Rural district and Dharmapuri district of Tamil Nadu were selected purposively for survey. A random sample of 44 farms growing rose under open field condition and a population of eleven farms growing rose under greenhouse were selected (leaving units which are under establishment stage and which are using soil-less, fully computerized management system of cultivation). The DEA involves the use of Linear Programming methods to construct a non-parametric piecewise surface (or frontier) over the data, so as to able to calculate efficiencies relative to this surface. The results of DEA show that, among the open field rose cultivation farms, the average technical efficiency (TE) were higher at 86.1 per cent whereas the allocative efficiency (AE) is very low, i.e., 16.1 per cent. On the other hand, among hi-tech farms, both the TE and AE were higher at 90.7 per cent and 76.3 per cent respectively. When the samples were pooled and analyzed, the frontier, as expected, was a hi-tech farm. It is found that the overall economic efficiency of open field farms is very low (0.4 per cent) as compared to hi-tech farms (69.6 per cent). It is concluded that hi-tech cultivation practices are more efficient in resource utilization compared to open field

cultivation and there exists ample scope for increasing efficiency in open field rose cultivation through optimal input mix and better management practices.

51. Efficient Generalizations of Product Estimator using Principle of Limited Invariance

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Singh and Upadhy (1986) proposed a product type estimator, assuming the knowledge of coefficient of variation. In the present paper, the principle of limited invariance is discussed. Following Vos (1980), efficient generalizations of product estimators are proposed. The proposed estimators are compared with conventional estimators. Comparisons are based on computer aided empirical studies, with Monte-Carlo simulation sampling from hypothetical bivariate normal populations.

52. Regression Vector Comparison through Pitman Closeness Measure

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For the purpose of comparing estimators of a parameter or a parametric function, Mean Square Error (MSE) is most commonly used measure in applied statistics. However, its usefulness based on small samples is doubtful for comparison purposes. Another measure, introduced by Pitman (1937) known as Pitman Nearness (PN) measure can be used with advantage. An attempt has been made to introduce a method for the evaluation of PN in the Univariate case following Rao, Keating and Mason (1986). PN measure for the multivariate case is proposed while two estimators of the regression vector are compared employing Pitman Nearness Criterion.

53. On Temporal and Spatial Aspects of Groundwater Monitoring Network

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As ground water is the most endangered natural resource due to unethical exploitation for drinking and agricultural purposes, its monitoring network should be scientifically planned with cost effectiveness in mind. Groundwater monitoring is a surveillance system of the storage and water quality status of the ground water reservoirs, generally executed by central ground water boards and state government departments in India. The monitoring wells are excavated for this depending on the aquifer characteristics and supposed to capture the diversity of ground water system for studying the defined objective of the network precisely. But, groundwater dynamics is influenced by a variety of meteorological parameters like rainfall, evaporation etc., and human interventions for agricultural and self-consumption besides other static geological factors. For these reasons, the temporal monitoring of observation wells is carried out which on many occasions shows constant trend without delineating the real underground phenomenon. Consequently, excess withdrawal of ground water for agricultural and allied purposes exhaust the resource to its unsafe level without being detected by the monitoring wells.

Here, the time series data of existing monitoring wells in three blocks of Balasore district of Orissa are analyzed to study whether the existing network captures the real ground water dynamics where its exploitation is highest for agricultural purposes. The fall in acreage of cultivation due to depletion of ground water level has been investigated. Again, the spatial analysis of existing bore well depths have been carried out to find the gap between the monitoring network has been suggested taking the auxiliary characteristic into consideration.

54. Wool Productivity in the Surveyed Area – A Comparison of Estimators

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A multistage stratified random sampling design based survey was conducted to assess the wool productivity of Kolar district of Karnataka. The

productivity figures for few categories of animals were not available due to natural and statistical reasons. But still estimation of productivity and production was carried out by adopting two sizes of p.s.us and the estimated figures and their standard errors were compared with the sample data set imputed with the breeding centre values of the locale surveyed as well as the one wherein the stochastically simulated data have been used for imputation purposes. A classified summary is being presented to study the impact of various common sampling and non-sampling aberrations in the estimator.

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55. Estimation of Sensitivity in Surveys

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Often in surveys respondents are reluctant to part with the information pertaining to sensitive characteristics. For example, one may not tell about the income from one's resources had but an easy access to the insurance coverage information about related characteristics is possible. With this view Minimum Variance Linear Unbiased Estimators have been developed for both the sensitive and related characteristics' parameters, deviancy therein and average thereof over two points of time of the survey by making use of Projective Geometry Approach in this paper.

56. On Sample Selection Criterion in Large-scale Sample Survey on Studies Relating to Accidents due to Farm Mechanisation

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Farm mechanization along with increased application of the agricultural inputs has enhanced the productivity and production on farms. But, inadvertent

neglect of agronomical aspects in design and operation of various tools and machinery had laid to many casualties and injuries due to accidents while carrying out different agricultural activities. Though, there are some case studies, no comprehensive data on agricultural accidents in the country is available. Therefore, to have an idea about the extent and severity of this problem in quantitative terms, a survey on accidents in agriculture was initiated in four states namely, Madhya Pradesh (MP), Orissa, Tamil Nadu and Punjab by AICRP on Human Engineering and Safety in Agriculture (HESA) through its Centres located in these states. Information on accidents occurred in agriculture during the five years period i.e. 1995-99 was collected. Here only the accidents causing loss of more than two days of working time were included in the survey so as to maintain the similarity with the industrial accidents data. The results presented during AICRP's Workshop being alarming and unacceptable were highly criticized. One of the recommendation in the Workshop was that expertise of survey statisticians available at IASRI, New Delhi may be utilised and as such a collaborative project on "Survey of agricultural accidents for the year 2003-04 in a large sample of villages selected on the basis of statistical consideration", is being planned.

While planning a sample survey, determination of sample size is an important decision, which a survey statistician has to take while deciding the sampling plan. In most of the large scale surveys, the sampling design adopted is stratified multi-stage random sampling. In such situations, determination of adequate sample sizes at different stages of sampling is of immense importance.

The sampling design proposed to be adopted is stratified multi-stage random sampling, the strata being States, districts being psu's, villages within districts being ssu's, accident victims within a village being the tsu's. It is proposed to select randomly 20% of the districts within each stratum, keeping in view their mechanisation indices. From each selected district, a random sample of 40 villages will be selected. Within each selected village, accident victims will be completely enumerated and data on different aspects will be collected. Out of 122 districts in the four States (strata), at psu level, a sample of 25 districts is to be selected randomly with due consideration to mechanisation levels following proportional allocation. The total sample size has been allocated to different strata (in MP State, 9 districts have been allocated, the total number of districts in MP being 45), the districts within each stratum have been arranged in ascending order of magnitude of mechanisation indices and homogenous groups of 10 or more districts have been prepared and from each group, at least 2 districts have been selected randomly (1 district out of 5 districts). The sample size has been determined on the criterion of desired level of efficiency (95%) at a tolerable margin of error (5% for characters having 40 to 50% coefficient of variation. From each selected district, at the secondary stage, out of total number of villages, a random sample of 40 villages has been selected. Accordingly, the total number of selected villages in MP state is 360. It is proposed to develop estimates at the district as well as State-level.

57. Use of Satellite Data for Small Area Estimations of Crop Yield

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General crop estimation surveys (GCES) are conducted throughout the country for estimation of crop yield of all major crops at district level. With the advent of remote sensing technology satellite data has been widely used for obtaining various crop statistics. In India several studies have been conducted during the past decade by Department of Space under the CAPE project for crop acreage and production estimation for various major crops using the satellite spectral data. Singh *et al.* (1992) and Singh *et al.* (2002) used the satellite spectral data along with the survey data on crop yield based on crop cutting experiments to develop more efficient post stratified estimators of crop yield at district level.

In the present study district level improved estimates of wheat crop yield and small area estimates at block level for district Rohtak, Haryana for the years 1997-98 have been developed. Crop yield data from general crop estimation surveys and satellite spectral data from the Indian Remote Sensing Satellite IRS-1D-LISS-III of Feb.4, 1998 have been used.

58. Trends in Area, Production and Productivity of Wheat in India

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In terms of production, wheat (*Triticum* spp.) occupies the prime position among the food crops in the world. In India, it is the second important food crop being next to rice and contributes to the total food grains production of the country to the extent of about 34 per cent. The production of wheat increased from 11 million tonnes in 1966-67 to about 70 million tonnes in 2000-01 registered a growth rate of 4.59 per cent. Area under wheat increased at a compound growth rate of 1.59 per cent whereas productivity increased at the rate of 1.56 per cent. Compound growth rates of area, production and productivity during the high yielding variety (HYV) period (1966-67 to 2000-2001) were computed by the least square technique of fitting the exponential

function $Y = a(b)^{t}$. The growth rates were computed for major wheat growing states viz. Punjab, Haryana, Uttar Pradesh, Rajasthan and Bihar as well as All India.

59. Studies on Zero Inflated Data¹

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Data with excess zeros are commonly seen in many fields. In recent years, there has been considerable interest in models for count data that allow for excess zeros. In the present study, excess zeros in the Poisson distribution is considered. Maximum likelihood estimate is compared with least square estimate, one step estimate and two-step estimate. Likelihood ratio test, Score test and Wald test were used to know whether the excess zeros in the model follows Poisson distribution or modified form of Poisson distribution. Similarly these tests were used to know the effect of co-variate on the distribution. Tests were compared by computing size and power of the tests.

¹ Presented in the 56th Annual Conference of ISAS at UAS, Dharwad

² University of Agricultural Sciences, Dharwad

60. To Assess Value of Product Characteristics and their Contribution to the Price of Teak (*Tectona grandis* Linn.) – Application of Hedonic Price Analysis¹

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The objective of Hedonic price analysis model was to determine factors influencing the price. The contribution due to different characteristics on the

price of teak was studied using regression analysis. Three models were fitted namely, Logarithmic, Semi-logarithmic and Linear. Among these three models logarithmic model shows the best fit model.

¹ Presented in the 56th Annual Conference of ISAS at UAS, Dharwad

61. Forecasting of Price of Different Classes of Teak (*Tectona grandis* Linn.) – by using Exponential Smoothing Model¹

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An exponential smoothing model is preferred to the multiplicative time series model for forecasting purposes. The exponential smoothing model is best for short term forecasting than regression and moving average. In present study dingle parameter exponential smoothing model was used for forecasting purpose. Therefore prediction of prices of different classes of teak were made by exponential smoothing model, so that the predicted values are more closer to the actual values. Kirby (1966) noted that in terms of month to month forecasting accuracy, exponential smoothing model did best with smoothing averages and exponential smoothing giving similar results when the forecasting horizon was increased by six months.

¹ Presented in the 56th Annual Conference of ISAS at UAS, Dharwad

62. Estimation of Body Weight in UAS Improved Sheep¹

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Biometrical observations were recorded on UAS crossbred sheep maintained at department of Livestock Production and Management of this institute. The measurements (cm.) were recorded on body length (point of shoulder to pin bone), chest girth (circumference immediately behind the

forelegs) and height (ground level to wither). Actual body weight (kg.) was also recorded on adult normal sheep. The correlation coefficients between various biometrical measures were highly significant ($P \leq 0.01$). Out of the various equations tried, the better-fit equations for estimating the body weight are given below:

$$Y = 0.5764 \times L^{0.4164} \times G^{0.4597} \times H^{0.0332}$$

After the technique of testing of hypothesis, the equations are

$$Y = 0.6149 \times L^{0.4174} \times G^{0.4692}$$

and $Y = 0.6306 (L \times G)^{0.4435}$

where

Y = Estimated weight (kg.), L = Body length (cm.),

G = Chest girth (cm.), H = Height (cm.)

The Chi-square values did not reveal any significant difference for all estimated equations.

¹ Presented in the 56th Annual Conference of ISAS at UAS, Dharwad