

Abstracts of Papers

1. Optimum Stratification with Auxiliary Information for Scrambled Response

P.K. Mahajan and Y.S. Parmar

The paper considers the problem of optimum stratification when the information on the auxiliary variable x is used to estimate the population mean m of the sensitive study variable y ; the data on which are collected by scrambled randomized response technique. A rule for obtaining approximately optimum strata boundaries has been proposed. The limiting expression for the variance gives an insight into the manner in which the variance decreases with the increase in the number of strata.

University of Horticulture and Forestry, Solan

2. Performance of Machine Learning Techniques vis-à-vis Logistic Regression in Forewarning Incidence of Crop Diseases

Rajni Jain¹, Sonajharia Minz² and V. Ramasubramanian³

With advent of computers, the development of accurate forewarning systems for incidence of crop diseases has been increasingly emphasized. Timely forewarning of crop diseases will not only reduce yield losses but also alert the stakeholders to take effective preventive measures. Traditionally, logistic regression and discriminant analysis method have been used in forewarning systems. Recently several machine learning techniques such as decision tree (DT) induction, rough sets (RS), soft computing techniques, neural networks, genetic algorithms etc., are gaining popularity for predictive modeling. This paper presents the potential of three machine-learning techniques viz. DT induction using C4.5, RS and hybridized rough set based decision

tree induction (RDT) in comparison to standard LR method. RS offers mathematical tools to discover hidden patterns in data and therefore its application in forewarning models needs to be investigated. A DT is a classification scheme, which generates a tree and a set of rule representing the model of different classes from a given dataset. A Java implementation of C4.5 is referred as CJP in this paper. A variant of RDT called RJP, combines merits of both RS and DT induction algorithms. Powdery mildew of mango (PWM) is a devastating disease and has assumed a serious threat to mango production in India resulting in yield losses of 22.3% to 90.4%. As a case study, prediction models for forewarning PWM disease using variables viz. temperature viz. RS, CJP and RJP are compared with the prediction model developed using LR technique. The techniques RJP and CJP have shown better performance over LR approach.

1. NCAP, Pusa, New Delhi

2. Jawaharlal Nehru University, New Delhi

3. Indian Agricultural Statistics Research Institute, New Delhi

3. On Bayesian Estimation of Generalized Geometric Series Distribution under Different Priors and its Applications

Anwar Hassan¹ and Khurshid Ahmad Mir²

A Bayesian estimation of generalized geometric series distribution (GGSD) under different priors has been introduced. Comparisons are made of the Bayes estimate of $P [X=k]$ to the corresponding maximum likelihood (ML) estimate for any given sample for different values of k . Also some applications and closeness of sample relative frequency and Bayes relative frequency of GGSD are discussed through graph.

1. University of Kashmir, Srinagar

2. Amar Singh College, Srinagar

4. Adoption of Integrated Pest Management Practices in Crop Production - A Poisson Regression Approach

Alka Singh, A.K. Vasisht, Ranjeet Kumar,
D.K. Das and A.K. Mangal

Integrated pest management, which is essentially knowledge based technology, involves integration of different methods of disease and pest management. This technology has shown not only decreased pesticide applications and environmental risks but also raised yields and net returns. However, despite these favorable results, its adoption has remained restricted to hardly two per cent of total cropped area due to several constraints. Farmers' adoption of Integrated Pest Management (IPM) package depends on many factors, such as technical skill of the farmer, socio-economic conditions of the community and household as well as economic, psychological and cultural factors etc. Since farmers are the final decision makers for adoption of the developed technology, therefore, it is important for the technology development agency to identify how farmers react to the provided techniques and what about the adoption process of certain innovations.

The objectives of this paper are to examine the adoption of IPM practices as well as assessing the impact of key socio-economic and institutional factors on adoption of Integrated Pest Management practices in selected crops. The study uses Poisson Count Regression models to analyze technology adoption by using cross sectional data obtained from primary survey. In these models the dependent variable, i.e. adoption, is assumed to be an integer-value gradient. IPM adoption was measured by counting the number of practices adopted by farmer duly weighted by its importance.

The empirical model was estimated having dependent variables as weighted number of IPM practices adopted by each farmer. The explanatory variables include farmer's characteristics that condition adoption behavior such as farmer's age, education, farmers' knowledge regarding negative externalities of pesticide use; farmers' perception regarding expected yield losses due to pest if pesticide is not used; institutional factors such as membership in farmers' club/self help groups; farm size and frequency of meetings

with extension personals etc. The poisson regression model turned out significant, with chi-square values significant at 1 per cent level of significance. The study showed that technology awareness through formal crop specific IPM training provided by Farmers' Field Schools is extremely important for wider adoption of IPM in the study area. Hence, investment in IPM education through these programmes will have long-term beneficial impact. The effectiveness of extension services is an important and frequently debated issue in developing country like India, but study did not show (frequency of meeting extension personnel) statistically significant impact on adoption rates. The study finds mixed evidence about relationship between farm size and adoption of IPM practices. In case of paddy, negative relationship was observed while in case of cotton it shows positive relationship. Finally, the study concludes that a higher gross value of crop does not appear to have positive impact on IPM technology adoption in cotton.

Indian Agricultural Research Institute, New Delhi

5. An Information Theoretic Approach in Density Estimation

Parnil Kumar¹, Vikram Bansal², Pawan Kumar¹
and Bilal Ahmad Bhat³

In this paper we consider the problem of estimating the probability distribution function given a finite set of constraints in form of multivariate samples, using the maximum entropy approach. In this regard we have used Jaynes Maximum Entropy Principle. On this basis our formulation of the problem considers contributions only from the smoothness of the estimated distribution (as measured by its entropy) and the loss functional associated and in particular we have not make use of any additional constraints that cannot be justified from the sample data alone. By mapping the multivariate problem to a tractable univariate one, we have derived expressions for the goodness-of-fit of an arbitrary multivariate distribution to any given set of samples using both the traditional likelihood-based approach and information-theoretic approach.

1. *University of Jammu, Jammu*

2. *Govt. Post Graduate College, Sirsa*

3. *Sher-E-Kashmir University of Agricultural Sciences & Technology-J, Jammu*

6. Growth in Potato Production in India: A Non-parametric Analysis

K.P. Chandran, Arun Pandit and N.K. Pandey

The present study is carried out with an objective of modeling All-India area, production and yield of potato as well as measuring their rate of growth. For this purpose, Non-parametric Regression (NPR) approach, where no assumption on functional form is made, is employed. Further, it is compared with simple linear trend estimation procedures, which are constrained by the validity of assumptions on the functional form. The requisite data are taken for a period of 53 years (1951 to 2003) from Agriculture Statistics at a Glance, Directorate of Economics and Statistics. NPR models are found to be superior to the commonly used parametric models in explaining country's potato area, production and yield. Further, there was no evidence of a significance jump in productivity. The analysis has shown that the growth rate of area is declining over the years and that of yield is stabilized at around 2% in recent years leading to stagnation in potato production after reaching a peak during mid-seventies. It is suggested to take necessary steps to diffuse the potato production technology among the growers and to increase the potato area especially from the unconventional potato producing states to sustain the potato revolution in the country.

Central Potato Research Institute, Shimla

7. Sources of Production Variability in Oilseeds: A Statistical Component Analysis

Narayan Chandra Pradhan and Ramesh Golait

The objective of the statistical component is to separate the changes in the average production and variance of production between the first (1979-80 to 1990-91) and second (1991-92 to 2002-03) periods into constituent parts, which can be attributed separately to changes in the means, variances and co-variances of areas and yields. The methodology used here is able to identify the important components of increased instability in oilseeds production without going into any assumption about how real world works. So far as the all-India level of oilseeds production is concerned, both the changes in mean area and mean yield surprisingly occupy very large shares of the changes in the variance of production.

Sometimes, the behavior of farmers may be changed by increase in yield variability, which in turn can affect the mean or the variance of area shown with rainfed agricultural crop like oilseed. Most of the other factors are having stabilizing effect on the production variability in all-India as well as state level. This approach enables measurement of the contributions of different components of increased variability, whereas, it offers little formal insight into causation of the happenings. The simultaneous occurrence of some of the components is matter of speculation towards some of the policy intervention for reducing instability.

Reserve Bank of India, Mumbai

8. Study of Shifts in Cropping Pattern using Cluster Analysis

V.V. Narendra Nath and B.S. Kulkarni

Identification of shifts in cropped area is an important step in the assessment of technological impact on crops and cropping systems and useful for planners. Shifts of individual crops are generally measured on the basis of certain pre-defined periods of the data. To overcome this arbitrary selection of time periods, a procedure based on 'Cluster Analysis' approach using Ward's minimum variance method has been proposed. The application in the context of area under kharif and rabi seasons of important crops as a cropping system of Telangana region of Andhra Pradesh based on 40 years (1960-61 to 1999-2000) has been presented. The analysis revealed that the performance of the procedure in identifying the shifts (and hence the time periods) was satisfactory. The procedure identified existence of five different clusters of shifts in the cropped area during the two seasons data.

A.N.G. Ranga Agricultural University, Hyderabad

9. Minimum Variance Stratification for Ratio and Regression Methods of Estimation

M.R. Verma and K.K. Datta

The paper considers the problem of optimum stratification for two study variables when samples from different strata are collected by simple random sampling with replacement scheme and the information on the

auxiliary variable is used to estimate population mean using ratio and regression method of estimation. We have proposed a cumulative cube root rule for determination of optimum strata boundaries for ratio and regression method of estimation under compromise allocation. A limiting expression for the trace of variance covariance matrix also has been suggested.

ICAR Research Complex for NEH Region, Umiam

10. Small Sample Performance of One and Two Step Maximum Likelihood Estimators in Poisson Regression Model

A.R.S. Bhatta¹ and K. Aruna Rao²

Among the various methods of estimation, maximum likelihood estimation is widely used. In many applications closed form solution of maximum likelihood equations do not exist. Thus, the solutions require iterative procedure. In some situations the difficulty with this iterative procedure is the non-convergence. One-step estimator corresponds to the first iteration starting from an initial estimator and the two-step estimator corresponds to the iteration and these estimators are constructed using an \bar{O}_n consistent estimator and a least square estimator. The estimators are compared with respective bias of two-step estimator is less as compared to other estimator particularly maximum likelihood estimator. The relative mean square error of the entire estimator is almost the same. Based on the result we strongly recommend the use of two-step maximum likelihood estimator.

1. *University of Agricultural Sciences, Dharwad*
2. *Mangalore University, Mangalore*

11. Multivariate Analysis of Agricultural Data with R-Software

A.A. Khan and A.H. Mir

Multivariate analysis is one of the most common tools of statistics used by the agricultural scientists for data analysis. Its applicability was hampered due to non-availability of software packages. This impediment has been removed to some extent now. Statistical Software Packages like SAS, SPSS, S-PLUS are still costly and all the institutions cannot afford them. To avert this

problem, several softwares are made freely available on Internet. R-Software is one among them. This software has a close resemblance with S-PLUS software. A large number of functions are common between the two. These features attracted us to explore the applications of this software in multivariate analysis. In this paper, an attempt has been made to illustrate applications of R-software in the analysis of multivariate data generated from agricultural research. This includes numerical and graphic summaries, multivariate analysis of variance, discriminant analysis, principal component analysis, biplots and cluster analysis. Graphic functions of R are seen to be impressive.

Sher-E-Kashmir University of Agricultural Sciences & Technology-K, Srinagar

12. Partially Balanced Change-over Designs with First Order Residuals

V.K. Sharma and Sandipan Bhattacharya

Considering the presence of first order residual effects, Hedayat and Afsarinejad (1975) and Sharma *et al.* (2003) have studied a class of change-over designs that require $2t$ experimental units and $(t+1)/2$ periods for odd number of t treatments. These designs are basically partially balanced in terms of estimating contrasts in treatment effects (direct as well as residual). Here, a new class of partially balanced change-over designs using only t experimental units and any number of periods varying from 3 to t has been proposed for odd t . These designs are based on the circular association scheme. An outline of the method of analysis of these designs has been given along with an illustration. Besides, a modification of these designs, called repeated period partially balanced change-over designs has also been dealt with.

Indian Agricultural Statistics Research Institute, New Delhi

13. Estimation of Variance Components when Errors are Correlated by Autoregressive of Order One

N. Okendro Singh¹, V.K. Bhatia² and A.K. Paul²

In the present investigation, expressions for estimating variance components of one-way

classification random model are developed in case of correlated errors which follows autoregressive of order one [AR(1)]. These expressions are further used to see the influence of correlated errors on the estimate of heritability by half-sib method. The expected mean sum of squares due to error and due to sire are overestimated and underestimated respectively when errors are negatively correlated. The former increases and the later decreases as the degree of correlation increases. When the correlation is positive, just reverse results are obtained for both the expected mean sum of squares. The heritability values obtained by neglecting the correlation present in errors are underestimated when they are negatively correlated. In contrast, heritability values are overestimated if the correlation is positive. These results are found to be consistent for all the levels of heritability. Also, heritability increases from its minimum limit to nearly four times of its upper limit as the autoregressive coefficient increases from minus unity to approximately unity irrespective of the heritability values. Thus, when the coefficient of AR(1) is positive and very high, heritability value goes far beyond its actual upper limit (i.e. unity) but if it is negatively correlated, it will never cross the actual minimum limit of heritability even for minimum value of autoregression coefficient, and simply it matches to the minimum limit of heritability in such a situation.

1. National Research Centre on Coldwater Fisheries, Bhimtal
2. Indian Agricultural Statistics Research Institute, New Delhi

14. Statistical Package for Agricultural Research (SPAR 2.0)

Sangeeta Ahuja, P.K. Malhotra, V.K. Bhatia and Rajender Parsad

SPAR 2.0 has been primarily developed for the statistical analysis of experimental research data in Plant Breeding and Genetics. However, many of the programs can be used for the analysis of data coming from other disciplines of research, provided the data confirms to the method and design used in the program. SPAR 2.0 takes care of the problems of SPAR 1.0 as SPAR 2.0 is a Windows Version of SPAR 1.0 with some additional modules. This package has been developed in Microsoft Visual C++ 6.0 language. It is user friendly, interactive password protected, menu-driven package and can also be operated using the Toolbars. A Context-Sensitive Web

Help with Index, Contents, Search and Favorites facilities is available. This package consists of all the necessary details to use the software and also the basic definitions including mathematical formulae related to the methods used in package. Moreover, it includes sample inputs and outputs of all the modules. This is a helpful tool for quick understanding of this statistical software. This package is also useful for teaching the subject of genetical statistics to the post-graduate students and for the researchers in statistics with special interest in plant and animal sciences. The package consists of eight modules viz. Data Management, Descriptive Statistics, Estimation of Breeding Values, Correlation and Regression Analysis, Variance and Covariance Components Estimation, Stability Analysis, Multivariate Analysis and Mating Design Analysis. A system with minimum of 64 MB RAM and 2GB Hard Disk capacity is required to run this package and it will be compatible on Microsoft Windows 98, ME, 2000 and XP.

Indian Agricultural Statistics Research Institute, New Delhi

15. Statistical Assessment of Growth Trends of Peach Fruit

Arshad Mahmood¹ and S.E.H. Rizvi²

The world peach production is about 10 million tons, second only after apple (about 50 million tons) with a positive trend up to 1994. The highest concentration of peach production (orchards) is around the Mediterranean followed by the Far East and North America. While peach production is decreasing in U.S.A. and is stable in European Union, it is increasing in China and South America particularly in Chile. So, among the main producing countries, seven countries have a positive trend and three countries (Japan, U.S.A. and Argentina) have been diminishing their production in the last ten years. The main problem linked to the peach industry evidenced by most of the countries are low fruit quality and consequent consumption problems, high production cost, international competition, overproduction and the identification of peach as a minor fruit crop. Considering the commercial fruit categories in most of the countries the fresh market peaches are stable or decreasing and the nectarines are increasing.

1. J&K State of India
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16. Optimum Stratification for Two Characters with Ratio, Regression and Product Methods of Estimation

S.E.H. Rizvi

When information on an auxiliary variable is available, one may obtain more efficient estimators of population means/ totals than the usual simple random sampling estimators by making use of ratio, regression or product methods of estimation. The present investigation considers the problem of approximately optimum stratification for two study variables Y_i ($i = 1, 2$), by considering an auxiliary variable X , closely related with study variables as the basis of stratification, as proposed by Rizvi *et al.* (2000) to the case when information on the auxiliary variable is also used to estimate the population means \bar{Y}_i using ratio or regression or product methods of estimation. For the development of theoretical framework, the forms of regression of estimation variables Y_i on the auxiliary variable X as also the forms of conditional variance function $V(Y_i|X)$ are assumed to be known. Further, it is assumed that the regression of the estimation variable on the stratification variable is linear. In this paper, we have considered separate ratio and regression estimators and combined product estimators. By minimizing the generalized variance of the sample means of the study variables, minimal equations have been obtained under proportional method of allocations.

In the cases of ratio and regression methods of estimation, the minimal equations have been turned into identities indicating thereby that these identities are satisfied for any set $\{x_h\}$ of approximately optimum strata boundaries (AOSB) which is similar to the results obtained by Singh (1967) for the case of one study variable. Whereas, in case of product estimators a cumulative cube root method has been proposed for obtaining AOSB. Empirical investigations have also been made on certain density functions.

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17. Information Theoretic Procedure for Selection of Principal Variables in Multivariate Data Analysis

Komal Mishra and B.K. Hooda

Principal components are often used for reducing dimensions in multivariate data but they frequently fail to provide useful results and their interpretation is rather difficult. In the present paper we make use of entropy optimization principles for dimensional reduction in multivariate data. Under the assumptions of multivariate normality, a four-step procedure is developed for the selection of principal variables and hence discarding of redundant variables. The procedure has been illustrated using real data generated in the plant breeding experiment.

Chaudhary Charan Singh Haryana Agricultural University, Hisar

18. Demand Analysis for Fruits in Delhi State

L.N.T Lap and B.R. Atteri

Fruits are rich source of vitamins and minerals. These constitute an important component of diet among Delhi population. Because of its cosmopolitan nature, all kinds of fruits are consumed in Delhi and are demanded throughout the year. The efforts, in this paper, have been made to estimate the average consumption of various fruits and to estimate the price and income elasticities of demand for fruits in Delhi. The NSSO data for various rounds have been used in this study. A multistage budgeting framework was used for modeling and estimation of elasticities of demand for various fruits and income groups of households in Delhi. It was found that the annual consumption of fruits in Delhi varied from 10 kg per capita per year in poor households to 35 kg per capita per year on non-poor high income group of households during 1999-2000. Mango, banana, apple, grape, guava and orange are the major fruits that are consumed on a large scale in Delhi. NSSO 50th round data revealed that on an average the consumption of these fruits in Delhi was about 2.8, 11.0, 4.8, 0.6, 3.5 and 2.8 kg per capita per year, respectively. The share of expenditure on fruits in the total food expenditure ranged from 1.7 percent to 5.3 percent among various income groups of households in Delhi during 1999.

While price elasticity of demand for fruits varied from -1.24 to -2.76, the income elasticity varied from 0.58 to 3.31 percent among various income groups in Delhi during 1999. Also, there was high variation in demand elasticities for various fruits. Policy implication in view of magnitudes of the elasticities, increasing population and income in Delhi is that fruits demand will further increase faster and efforts are needed to increase the production and availability of fruits in Delhi.

Indian Agricultural Research Institute, New Delhi

19. Artificial Neural Network Modelling of Storage Data of UHT Milk for Shelf Life Prediction

D.K. Jain, A.P. Ruhil and R.R.B. Singh

Ultra-high-temperature processed milk is intended for long shelf life. During storage and marketing, the product undergoes variable temperature exposure making prediction of shelf life a difficult task. Artificial neural network (ANN) which has the ability to represent both linear and non-linear relationships, was therefore used for developing a shelf life prediction model. In the present investigation, an attempt was made to monitor deteriorative changes in UHT milk stored at various temperatures (9, 15, 25, 35 and 45°C) using quality indices like maillard browning, oxidative, lipolytic and proteolytic changes besides the change in colour and sensory properties of the stored product. A correlation matrix among various quality indices was generated and only those parameters, which showed higher correlation coefficients with sensory properties, were used for further analysis. Thus, the finally selected input parameters were represented by reflectance (instrumental measurement of colour), total hydroxy methyl furfural (measure of browning), thiobarbituric acid (measure of oxidative rancidity, free fatty acid (measure of lipolytic spoilage) and tri nitro benzene sulphonic acid (indicative of proteolytic degradation). The output parameters were sensorily evaluated for flavour and total sensory score which represented storage life of the product. A multilayer feed forward neural network model with back propagation algorithm was used for predicting shelf life of UHT milk employing MATLAB software. A number of ANN approaches like Bayesian regularization, gradient descent, resilient backpropagation, Levenberg-Marquardt, BFGS quasi-newton method etc. were used

to train the network out of which Bayesian regularization algorithm provided stable and consistent results for the given dataset. A total of 148 observations were used and the data set was divided into two subsets comprising of 112 observations (75% of total observations) for training of neurons and 36 observations (25% of total observations) for testing the model. Two network components namely number of layers (1 & 2) and number of neurons in each layer (3 to 25) were used. Relatively lower magnitude of per cent root mean square error (% RMS 5.85 for flavour and 4.20 for total sensory score) indicated an excellent fit which clearly showed ANN approach to be better suited as compared to kinetic modelling for accuracy of prediction of non-linear data. Thus, it was concluded that ANN could be suitably used as an effective tool for predicting the shelf life of long life dairy products for better quality control.

National Dairy Research Institute, Karnal

20. On Construction of Nested Resolvable Balanced Incomplete Block Designs

Gayatri Vishwakarma

The use of resolvable and α -resolvable designs in a statistical context was discussed by Fisher and Yates. An incomplete block design, which is resolvable, is more efficient than randomized complete block designs. The present paper, therefore, reviews and extends the knowledge of resolvability in Nested Balanced Incomplete Block (NBIB) designs.

Rani Durgawati Vishwavidyalaya, Jabalpur

21. Small Area Statistics for Agro-Climatic Regional Planning

B.V.S. Sisodia

Agro-Climatic Region Planning approach suggested by Alagh (1998) and initiated by Planning Commission, New Delhi is a button up planning process which revolves around sub-regionalization of districts based on resource endowment, climatic factors, rainfall, ecological parameters etc. This necessitated requirement of small area statistics for better planning of development projects in agriculture/ non-agriculture sectors in order

to increase the level of income of the people of the region and thereby improve the livelihood of the households.

In the present paper, some methodological issues for delineating small areas, i.e. sub-regions within blocks or districts through agro-climatic characterization by using computer based tools like Geographical information system/ Remote Sensing techniques are discussed, particularly for agro-climatic regional planning of hill regions. A brief review of estimation techniques for small area statistics is also presented in the paper. Finally, some suitable estimation strategies for estimating small area statistics, particularly, in context of agro-climatic-regional planning with special reference to hilly areas are suggested. Some important suggested estimation strategies are synthetic and composite estimators, some model-dependent techniques and strategies based on simulation techniques.

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22. Comparative Study on Effect of Different Fertilizers on Nutrient Release in Saline-Sodic Soil

P.B. Jagtap and C.A. Nimbalkar

The periodical release of nutrients in saline-sodic soil under integrated nutrient management was studied in incubation studies at ambient conditions in the laboratory. The soil used for incubation was Sawargaon soil series (*Vertic ustropepts*). The $\text{NH}_4^+ - \text{N}$ and $\text{NO}_3^- - \text{N}$ was released higher in urea treatment, however, superphosphate had positive influence on release of $\text{NH}_4^+ - \text{N}$ and $\text{NO}_3^- - \text{N}$. The application of $\text{FeSO}_4 + \text{ZnSO}_4$ along with FYM had beneficial effect on release of available phosphorus than urea application. Superphosphate application was found better for release of DTPA Zn and DTPA Fe compared with urea application. The $\text{NH}_4^+ - \text{N}$ was released significantly higher up to 10 days while $\text{NO}_3^- - \text{N}$ was up to 30 days of incubation. The available phosphorus was released significantly higher up to 30 days and DTPA Zn and DTPA Fe were higher upto 45 days of incubation. Interaction effects were significant for $\text{NH}_4^+ - \text{N}$, $\text{NO}_3^- - \text{N}$ and available phosphorus. In general, there was positive effect of applied fertilizers on release of nutrients. The FYM had additive effect on release of

nutrients. The application of FYM along with these fertilizers increased the efficiency of applied fertilizers.

NARP (Plain Zone), Pune

23. Comparative Economics of Bt and Non-Bt Cotton in Andhra Pradesh

V.T. Raju

In view of controversies involved in Bt Cotton cultivation, it was decided in the State Level Technical Committee Meeting of Agricultural Economists of ANGRAU to conduct studies on economics aspects of Bt Cotton in the cotton-growing regions of Andhra Pradesh. Accordingly, the studies were conducted from the year 2002-03 with main objective of studying the profitability and efficacy of Bt Cotton as compared to Non-Bt Cotton. The data were collected from 333 farmers growing Bt Cotton in different years and in different areas. The same number of farmers growing Non-Bt Cotton were selected for comparison. The results indicate that the cost of cultivation per hectare of Bt Cotton was one thousand rupees more compared to Non-Bt Cotton in 2002-03. But in 2003-04 and 2004-05 the cost of cultivation of Bt Cotton was less by around Rs. 1250/ha compared to Non-Bt Cotton. As regards yield, Bt Cotton yielded less (14 q/ha) compared to Non-Bt Cotton (18 q/ha) in 2002-03. In 2003-04 and 2004-05 the yield of Bt Cotton and Non-Bt Cotton have increased but the increase was more pronounced in case of Bt Cotton (25 q/ha) as compared to N-Bt Cotton (20 q/ha). There was no difference in the prices. The net returns of Bt Cotton were higher compared to Non-Bt Cotton. The benefit-cost ratios were also higher for Bt Cotton. The performance of Bt Hybrids in terms of productivity, profitability and low pesticide use was better over Non-Bt Hybrids. This suggests that cultivation of Bt Cotton should not be discouraged.

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24. Stability Analysis

C.A. Nimbalkar¹ and V.H. Bajaj²

Though, there are several stability measures available, however, the method suggested by Laxmi (1998) not only gives the birds eye view to determine

the stability of the genotypes across the different environments but also facilitate to classify genotypes as well as environments in favorable, non-favorable and average stability. Moreover, the method is very simple to analysis and interpretation. In the present investigation, sixteen genotypes of rajmash bean studied under four locations for their stability. Out of these genotypes seven genotypes exhibited high stability, while nine genotypes showed low stability. None of the genotypes has shown average stability.

1. NARP (Plain Zone), Pune

2. DBAM University, Aurangabad

25. Study of Multi-collinearity Problem with Generalized Stepwise Regression Procedure

K. Venkateswar Rao, Pochaiah Maratty and
C. Padma Veni

In most applications of regression analysis, especially with regard to Ordinary Least Squares estimation equal importance is given to all the explanatory variables under consideration and more stress is laid on unbiasedness at the cost of variance of relevant estimates. Here, generalization of T.D. Wallece's stepwise regression procedure to n-explanatory variables was derived and illustrated with an example.

The stepwise regression procedure of estimation, though leading to biased estimates, resulted in decrease in "Minimum Variance" of the corresponding Ordinary Least Squares (OLS) estimates. Keeping in view the above facts the evaluation data of training programme conducted at Extension Education Institute on "Monitoring and Evaluation", it was found that stepwise procedure for finding the variance of estimates was better than estimates of OLS procedure.

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26. Estimation of Production of Important Flowers on the Basis of Market Arrival in Delhi

A.K. Gupta, V.K. Jain, M.S. Narang, U.C. Sud
and K.K. Tyagi

At present, no scientific methodology for reporting of area and production under flowers is available.

Although National Horticulture Board (NHB) publishes area and production figures, these are not based on any statistical and scientific procedure. The already existing crop-cutting experiment approach being followed in case of other crops would be cost-prohibitive for developing estimates of area and production of flowers. This is due to multiple pickings involved in case of flowers. In this context, the National Statistical Commission has recommended the need to develop a suitable sampling methodology for estimation of area and production of flowers on the basis of market arrivals. Therefore, Indian Agricultural Statistics Research Institute conducted a study entitled "Pilot sample survey to develop sampling methodology for estimation of area, production and productivity of important flowers on the basis of market arrivals" with objective of developing precise estimates of production of important flowers on the basis of market arrival in Delhi. As a part of this study, a sample survey was carried out in the three flower mandis of Delhi namely, Khari Baoli mandi, Hanuman Mandir mandi and Mehrauli mandi during September 2003 to August 2004 to collect the data on market arrivals of important flowers in the flower mandis.

The sampling design for estimation of production on the basis of market arrivals was one of stratified random sampling in each flower mandi. The commission agents/ mashakhors in the mandis of Delhi comprise the first stratum while self-selling farmers the second stratum. Cut flowers of Rose, Gladiolus, Chrysanthemum, Tuberoses, Carnation and other seasonal flowers are mainly traded in the Hanuman Mandir mandi. In Khari Baoli and Mehrauli mandi, trading is done in loose flowers of Marigold, Rose, Margaret and Jaffrey etc. Keeping in view the trend of flower arrivals in the mandis, the entire survey period from September 2003 to August 2004 was divided into three periods viz. P-I: September-December 2003, P-II: January-April 2004 and P-III: May-August 2004.

Total market arrivals of loose flowers from Delhi as well as outside Delhi were found to be 14570.910 MT with 2.51% SE and 25829.580 MT with 1.50% SE respectively. The corresponding figures for cut flowers were 670.68820 lakh with 1.53% SE and 2380.80237 lakh with 0.74% S.E. The percentage of market arrival of loose flowers from Delhi and outside Delhi respectively was of the order of 36% and 64%. The corresponding figures in case of cut flowers were 22% and 78%. The percentage standard errors of the

estimates are within reasonable limits (to the tune of 5%), which are indicative of the fact that the estimated figures are reasonably precise.

Indian Agricultural Statistics Research Institute, New Delhi

27. Contract Farming: Suitable for Lac Cultivation in India

S.P. Bhardwaj

The contract farming (C.F.) is an understanding developed between farmers and processing units to satisfy their common interests. Basically, this is an agreement between two financially unequal partners. Farmer the weaker one, looks for resources at reducing level of risk and finally to increase his farm income. C.F. may be used as a tool to enhance income levels of rural agricultural poor as a part of poverty eradication programme in backward and tribal areas.

Benefits to Farmers: The main benefits for farmers are: ensured timely supply of inputs to enhance income levels of poor cultivators and availability of cheap credit for transfer of improved technological skills and guaranteed price of crop output.

Benefits of Processors: The main advantages for processors can be seen as ensured supply of lac for improvement of crop quality; and increase in total crop production in the area by promotion of farm inputs.

Expected Problems to Processors: The main problem may be faced by processors are farmer discontent; extra-contractual marketing; and input diversion.

Types of Contract Farming: There can be following five types of contract farming arrangements: Centralized model; Nucleus estate model; Multipartite model; Informal model; and Intermediary model.

Pricing Arrangements: Pricing and payment arrangements are the most discussed and challenging components of all farming contracts. The common pricing arrangements are Fixed prices; Flexible prices; Prices calculated on spot-market values; Prices on a consignment basis; and Split pricing.

Lac is an important cash crop of tribal poor and more than 5 million tribal cultivators are directly engaged in lac cultivation. Lac is also important from export point

of view, currently it fetches around Rs. 100 crores of foreign exchange. But the dark side is inspite of massive developmental efforts undertaken by State and Central agencies, the crop production could not rise to desired levels. Even the increasing crop price over the years fails to provide any ground for higher production. A vast untapped potential of lac production exist in our country. Even if we could achieve 1950's production level of 50,000 metric tons of lac, it will be a matter of great satisfaction. As discussed in the study lac cultivators are not able to mobilize necessary inputs for production. Contract farming may help to resolve this situation. Large number of unexploited host may be brought under cultivation and total crop output may be enhanced. The higher cash earnings of tribal poor will help them to improve their living conditions. Finally, more foreign exchange will be earned by the export of more lac. The lac farmers generally find it difficult to purchase brood lac with his limited financial resources. Contract farming will help in managing for brood lac in time. Time is a critical factor in lac cultivation and matter of limited hours. In most of the potential lac cultivating areas there is always shortage of brood lac. The introduction of contract farming will help in developing brood lac farms in those areas to increase the supply of brood lac. With the result a large number of un-utilized lac hosts holdings could be exploited for cultivation of lac. The increased crop production will provide opportunity to raise income levels. The existing status of extension of improved methods of lac cultivation practices is confined to a very limited area in Jharkhand state. The contract farming will help in mobilizing training camps on improved lac cultivation practices for farmers in their respective areas. The skill transfer to the farmer may help in the adoption of improved methods and efficient use of resources. The existing low yield levels of lac crop certainly affect the popularity of lac cultivation. The violent fluctuation in crop output affects the growth of lac industry and many processing units generally face closure due to less availability of crude lac. Contract farming may help in maintaining output levels and also to increase the total crop supply level in the long run. The ensured supply of crop output will attract fresh investment in this sector and lac processing will also be modernized. Contract farming as envisaged transferring skills to the cultivator; quality of lac crop will also be improved. The regulatory role of government envisages that under the regime of contract farming farmers are not being exploited particularly on pricing of the crop. The growth and

development of the crop depend upon its potential to attract cultivators as well as processors to invest more in this sector. Government action in the form of advertising crop price in primary markets may help in reducing disparity levels to some extent.

Indian Agricultural Statistics Research Institute, New Delhi

28. Shrinkage Testimators and Bayes Estimators for Shape Parameter of Pareto Distribution

B.N. Pandey and A.K. Srivastava

Pareto distribution is commonly used to study the higher-income distributions and the history and sociologically implications of this distribution was discussed in Arnold (1983) and Long (1978). If one make the logarithmic transformation $y = \log x$, the resulting distribution has the displaced exponential distribution with $(1/a)$ as the scale parameter and $\log s$ as the location parameter. For the ordered observations $x_{(1)} \leq x_{(2)} \leq \dots \leq x_{(n)}$ we have $y_{(1)}, y_{(2)}, \dots, y_{(n)}$ ordered observations. The maximum likelihood estimates for $\log s$ is $y_{(1)}$ and for a is

$$\hat{a} = \frac{1}{n} \sum_{(i=1, n)} (y_{(i)} - y_{(1)})$$

The estimation for the reciprocal of the shape parameter of the Pareto distribution $(1/a)$ has been considered. If a_0 be the prior guess value of a then shrunken estimator for $(1/a)$ has been proposed and studied the properties of the shrunken estimator. For socioeconomic data n is large, the normal approximation to test statistics can be applied (see Rahman *et al.* (1997)) which gives equal tail areas on either side of uniformly most powerful unbiased test. By taking normal approximations to test statistics a shrunken testimator for $(1/a)$ has been proposed and discussed its properties under squared error loss function. We have also proposed an improved estimator for $(1/a)$ and obtained the minimum risk of the existing estimator under Linex loss function. Lastly preliminary testimator for $(1/a)$ using normal approximations to test statistics has been considered and discussed the properties of this testimator using Linex loss function.

Banaras Hindu University, Varanasi

29. On Multivariate Analysis Techniques in Some Morphotypes of Mulberry (*Morus Spp*)

T.A. Raja, A.H. Mir, N.A. Munshi, S.E.H. Rizvi and Bilal Ahmad

The multivariate analysis of group distances based on eight different characters of fourteen morphotypes of mulberry was carried out using correlation matrix, cluster analysis and Mahalanobis D-square statistics. The analysis revealed genetic diversity among the morphotypes. These morphotypes were grouped into four clusters using Tocher's method. The clustering pattern indicated a mixed trend. The inter cluster distances ranged from 12.054 to 19.755 while as the intra cluster distances were 7.375, 6.575, 4.953 and 0.00 respectively in Clusters I, II, III and IV. The study revealed that fresh leaf weight (31.87%), moisture content (27.47%) and dry matter content (19.78%) contributed maximum towards divergence.

Sher-E-Kashmir University of Agricultural Sciences & Technology, Srinagar

30. On the Estimation of Regression Coefficient for Finite Population

Arti Rajyaguru and P.C. Gupta

In this paper, I propose to study the estimation of regression coefficient for finite population under stratified random sampling. The expression for the bias, upper limit of bias, estimate of variance will also be derived and the corresponding comparison will be made. Results will also be obtained under the assumption of bivariate normality.

South Gujarat University, Surat

31. Personal Probability Code in Useful Information

Abul Basar Khan¹, Parmil Kumar², Bilal Ahmad Bhat¹ and Anwar Hassan³

In this paper, we define a parametric mean length as the quality

$$\alpha L_u^\alpha = 1/t \log_D \left\{ \sum_{(i=1, N)} p_i^\alpha (u_i / (\sum u_i p_i)^{1+\alpha})^{D_{nit}} \right\},$$

$$\alpha \neq 1, \sum_{(i=1, N)} p_i = 1$$

is the useful mean length of the code words weighted with the function of utilities u_i – an addition parameter. Lower and upper bounds of the useful mean length of the code words, given above are derived in terms of useful information.

1. *Sher-E-Kashmir University of Agricultural Sciences Technology, Jammu*
2. *University of Jammu, Jammu*
3. *University of Kashmir, Srinagar*

32. Behavior of Arrivals and Prices of Vegetables

Y.N. Havaldar, K.R. Rajashekhar and Basavaraj Banakar

The vegetables are considered as highly perishable. However, the vegetables can be produced throughout the year in our country in one part or the other, there is a high fluctuation in arrivals and prices of vegetables. In order to plan or allocation of resources for production of vegetables to maximize the profits, there is a necessity to assess the behavior of arrivals and prices in which seasonal low and high were exists. The accurate analysis of seasonal periods, in most of the cases, use the monthly or yearly set of data through moving average method, which may not give true periods of high and low. Therefore, all the three sets of data that is weekly, monthly and yearly was considered to know the differences in the results through moving average method for eight years that is from 1996 to 2003. The results indicated that weekly set of data resulted in true and exact periods in which seasonal low and high exists as compared to other set of data. Hence, it is better to use weekly set of data to analyze the seasonal behavior of arrivals and prices of vegetables.

University of Agricultural Sciences, Dharwad

33. Genetic Diversity in Forage Maize (*Zea mays L.*)

J.S. Patel, S.K. Dixit, P.R. Vaishnav and Sneha Macwana

Maize is considered to be a valuable cereal forage crop. The possibilities of extending area under forage crop is very less looking to need of human foods. Therefore, there is need to increase the productivity of forage maize which can be achieved by crossing genetically diverse genotypes. Hence, the present investigation was to plan to analyze the extent of genetic divergence in forage maize.

An experiment consisting of 42 genotypes of forage maize was conducted in randomized block design with three replications. The data on days to tasseling, silking and milking, plant height (cm), number of leaves per plant, leaf length and leaf width (cm), and green forage yield (gram/plant) were recorded. The data were subjected to genetic diversity analysis (Mahalanobis (1936)). The results revealed considerable variability between the accessions. The genotypes were grouped into thirteen clusters. Maximum inter cluster distance ($D^2 = 118.06$) was observed between cluster V & VI followed by cluster VI & VII and VI & I. Green fodder yield followed by number of leaves per plant, height and leaf length and leaf width were found to be the important characters contributing to genetic diversity in order of their merit. A crossing programme involving genotypes belonging to cluster VI with clusters I, V or VII was suggested to develop high yielding varieties.

Anand Agricultural University, Anand

34. Effect of Weather Variables and Technological Advancement on Rice (*Oryza sativa L.*) Yield

P.R. Vaishnav, G.B. Patel, J.S. Patel and S.K. Dixit

Weather is a major factor, affecting crop production in advanced agricultural systems in our country. The major variation in yield is predominantly due to weather parameters. Rice is an important staple food for masses in the country. The present study has been taken up to identify the nature of the effect of weather parameters and technological advancement on rice crop for Kheda

district of Gujarat state. To estimate the effect of weather variables and technological advances, 33 years yield data from 1967-68 to 2001-02 were collected. The weekly averages of weather variables viz. bright sunshine hours, rainfall, maximum and minimum temperature and morning relative humidity from 23rd to 42nd standard meteorological week of the respective year were considered in the study. The week-wise and crop stage-wise approaches were used with original weather variables. Time trend was also included as independent variables in all the approaches.

The results revealed positive and significant effect of time trend in rice productivity. The effect of all the weather variables in relation to their quantum and direction differed over the approaches. The effect of weather variables also differed within the crop stage. Week-wise approach using original weather variables for 18 weeks period accounted higher variation ($R^2 = 0.89$) in rice yield.

Anand Agricultural University, Anand

35. Relation between Rainfall and Groundnut Productivity of Junagarh District in Gujarat State

R.S. Parmar, P.R. Vaishnav, S.K. Dixit and J.S. Patel

The district-wise average yield data of groundnut and daily rainfall data were used over a period of 33 years i.e. from 1970-2002. Five broad approaches were tried to investigate the relationship between rainfall and groundnut productivity. They were (1) aggregate rainfall (2) monthly rainfall (3) fortnightly rainfall (4) week-wise rainfall (5) crop phase-wise rainfall. Comparison of different regression equations with respect to the coefficient of determination (R^2) revealed that the equations, which considered weekly rainfall variables as a set of predictor variables exhibited the highest R^2 values. The regression equation, using crop phase-wise and week-wise rainfall approaches suggested that flowering and peg initiation and full pegging to pod development stages were the most critical phases with respect to moisture requirement of groundnut.

Anand Agricultural University, Anand

36. Pre-Harvest Forecasting of Rice (*Oryza sativa L.*) Yield Based on Weather Parameters

G.B. Patel, P.R. Vaishnav, J.S. Patel and S.K. Dixit

To develop the pre-harvest forecasting model of rice yield using weather variables and technological advances, 33 years yield data from 1967-68 to 2001-02 were collected. The weekly averages of weather variables viz. bright sunshine hours, rainfall, maximum and minimum temperature and morning relative humidity from 23rd to 42nd standard meteorological week of the respective year were considered in the study.

The week-wise, crop stage-wise and week number as weight using generated weather variable approaches were used. Time trend was also included as independent variable in all approaches. To provide early forecasts different (12 to 18) weeks intervals were considered. Three sets of multiple linear regression equations consisting of 27, 28 and 29 years data for each model were tried.

Week-wise approach using original weather variables was found superior over the other approaches. This approach provided suitable pre-harvest forecasting model of Kheda district, four week before expected harvest (i.e. 3rd week of September). The errors of simulated forecast were below 20 per cent for the selected model.

The pre-harvest proposed forecast model is

$$Y = 546.13 + 22.49 T - 35.64 X_1 w_{31} - 85.10 X_4 w_{28} + 10.53 X_5 w_{38} + 24.19 X_5 w_{32} - 44.33 X_1 w_{27} \quad (R^2 = 75.40\%)$$

Anand Agricultural University, Anand

37. Modification of Gamma Type Model for Lactation Curves of Dairy Animals

Shiv Prasad and Rajendra Singh

The gamma type function known as Wood model was modified for describing lactation curve of dairy animals. The model $Y_t = a t^b \exp(-ct + d/\bar{O}t)$ was proposed as modified form of Wood model. It was found

best among all the modified models considered in this study to estimate the lactation curve of crossbred cattle.

Indian Veterinary Research Institute, Izatnagar

38. Relative Efficiency of Different Experimental Designs and Effective Number of Replications in Tomato Yield Trials

C.M. Naliyadara, S.M. Upadhyay,
R.L. Kalawadia and C.V. Ramani

Uniformity trial on tomato (variety: Gujarat Tomato-1) was conducted during rabi season of the year 2003-04 at the Vegetable Research Station, Junagarh Agricultural University, Junagarh. The fruit yield data of 1296 plots (basic unit 1.20 m × 0.90 m) were recorded and analysed to work out the optimum size and shape of the plot using different approaches. The size and shape of the block was determined, the relative efficiency of different experimental designs was also compared and the effective number of replications for field experimentation was also worked out.

The results revealed that the Balanced Lattice Design was found to be comparatively more efficient than Randomized Block Design for field experiments on tomato followed by Simple Lattice Design.

Smaller plot was found more efficient in controlling soil variation. They required minimum of three replications to achieve 5 per cent accuracy in any of the block size. *But the total area required by smaller plots was much lower than that by bigger plots.* It is therefore, suggested that the smaller plots with more replications are desirable situation.

Junagarh Agricultural University, Junagarh

39. Growth Model of Weeds Grown with Soybean

T. Rai, Ranjana Agrawal and Madan Mohan

An attempt is made to study the growth behavior of weed variables grown with soybean during the kharif season for consequently three years from 1999-2000, 2000-01 and 2001-02. During the period of crop growth,

two types of weeds, i.e. broad leaves and gray leaves were identified for recording of observations on weed counts, dry matter accumulations and leaf area at weekly intervals starting from one week after emergence of weeds till a fortnight before the harvest. It was found that the growth of dry matter accumulation followed logistic pattern whereas that of leaf area was of quadratic type. Weed counts did not show much variability rather it was found to be almost static.

Indian Agricultural Statistics Research Institute, New Delhi

40. Comparative Efficiency of Least Squares Models for Evaluating Dairy Sires

H.R. Pandya¹ and S.K. Dixit²

The present investigation was aimed to compare the efficiency of sire evaluation methods with respect to six different traits viz. part lactation milk yield records of 150, 200, 250 days, standard lactation length and age at first calving of the progeny of dairy Gir cattle. Sire indices were constructed in two different conditions viz., with and without absorption of calving year and season effects. The two criteria employed to judge the efficiency of sire evaluation from different models were mean squared errors (MSE) and average standard errors (ASE) of sire indices. It was observed that absorption of year and season effect resulted in increased efficiency of sire evaluation for all traits barring age at first calving indicating thereby the impact of climatic factors on the efficiency of sire evaluation.

1. Junagarh Agricultural University, Junagarh

2. Anand Agricultural University, Anand

41. Optimization of Fertilizer Requirement of Maize Based on Farm Permanent Manorial Experiments under Dry-Sub Humid Inceptisols of Jammu

G.R. Maruthi Sankar¹, K.P.R. Vittal¹, Mahinder Singh², G. Ravindra Chary¹, Vikas Abrol², J.P. Singh² and Y.S. Ramakrishna¹

An attempt has been made in this paper to optimize fertilizer requirement of maize based on 9 field experiments conducted in the same site under a permanent manorial study at Rakh Dhiansar, Jammu

during kharif 1996 to 2004. The experiments were conducted with 10 fertilizer treatments with combinations of N, P, K, F, Y, M crop residue and zinc sulphate nutrients. The influence of rainfall and organic and inorganic fertilizers on maize yield has been assessed based on correlation and regression analysis of yield in terms of different variables. The location received a mean annual rainfall of 897 mm with a variation of 21%, while a mean treatment yield of 2329 kg/ha having a variation of 25% was attained during 9 seasons. A statistical assessment of treatments has been made based on sustainability yield index (Vittal *et al.* (2002)) measured for each treatment over 9 kharif seasons. Application of 100% recommended fertilizer NPK (60-40-20)+ZnSO₄ @20kg/ha was highly effective for maize which gave a maximum mean yield of 3172 kg/ha (120% increase over control) and a sustainability of 0.64, while application of 100% recommended NPK was the second best with a mean yield of 3051 kg/ha (116% increase over control) with a sustainability of 0.61 over seasons.

The correlation analysis of maize yield with organic and inorganic fertilizer combinations over seasons indicated that grain yield had a significant negative relation of -0.537^{**} with time indicating a degradation effect of soil on crop productivity. It had a positive relation of 0.456^* with rainfall indicating that the productivity was higher in some seasons due to a better distribution of rainfall. The relation of grain yields with fertilizer N (0.517^{**}), fertilizer P (0.523^{**}) and fertilizer K (0.545^{**}) were significant indicating an increase response due to fertilizer application. Among organic sources, FYM had a positive and significant correlation due to fertilizer application of 0.586%, while crop residue for giving 50% of N requirement of maize had a non-significant relation (-0.165) with yield. Zinc sulphate had a positive relation 0.367^* with yield indicating a crop response to zinc under inceptisols. Based on regression analysis of yield through rainfall, fertilizer NPK, FYM, crop residue and zinc over seasons, it is observed that there is a significant yield predictability of 0.696^{**} with a prediction error of 454 kg/ha. The optimal fertilizer doses for maximum productivity of maize were derived based on the calibrated model and are discussed in the paper.

1. CRIDA, Hyderabad

2. AICRDP Center, SKUAST, Jammu

42. A New Generalization of Gamma Distribution with an Application in Agricultural Data

Bilal Ahmad Bhat¹, Anwar Hassan², A.B. Khan¹, S.E.H. Rizvi¹ and T.A. Raja³

Gamma distribution is a natural extension of the exponential distribution and is one of the commonly used statistical distribution in reliability. Generally, bivariate distribution is produced by extending some special features of the univariate models. In the literature (Wicksell (1933), Kibble (1941), Coherian (1941), Moran (1969), Arnold and Strauss (1988) etc.), there exist a number of generalizations of bivariate gamma distribution. In this paper, an attempt has been made to propose a new generalization of bivariate gamma distribution. Finally, numerical illustrations in case of rainfall data has been given as in meteorology, the gamma function has been used extensively to fit rainfall data on fairly large space and time scales, ranging from individual storms up to monthly and yearly distributions (Thom (1958, 1968) and references therein).

1. Sher-E-Kashmir University of Agricultural Sciences & Technology, Jammu

2. University of Kashmir, Srinagar

3. Sher-E-Kashmir University of Agricultural Sciences & Technology-K, Mirgund

43. An Optimum Allocation with a Family of Estimators using Auxiliary Information in Sample Surveys

Gajendra K. Vishwakarma and Housila P. Singh

This paper considers the problem of obtaining optimum allocation using auxiliary information in stratified random sampling. An optimum allocation with a family of estimators is obtained and its efficiency is compared with that of Neyman allocation based on Srivastava (1971) class of estimators and the optimum allocation suggested by Zaidi *et al.* (1989). It is shown that the proposed allocation is better in the sense having smaller mean squared error compared to other optimum allocation.

Vikram University, Ujjain

44. Statistical Analysis of Adoption Pattern under New Extension System of India

Nafees Ahmad, G.R. Bhagat and S.K. Kher

Krishi Vigyan Kendras have grown in importance since the first KVK was established in 1973 at Pondicherry as per the recommendations of Mohan Singh Mehta Committee. The role and effectiveness of KVKs in affecting rural development by way of transfer of technology is still something that remains to be fully established. The present study focuses on the impact as reflected by the adoption pattern of the KVKs.

The study is confined to the state of Uttar Pradesh and recently carved out state of Uttaranchal from U.P. Five KVKs were selected purposively to represent across – section-two from the State Agricultural Universities, another two from non-governmental organizations and one from ICAR institutes. A sample of 70 beneficiaries from each KVK aggregating to 350 beneficiaries for all the five KVKs was randomly taken for the study. Data was collected by preparing interview schedule and pre-testing them.

It is evident from the overall findings of the KVKs that over half of the respondent farmers interviewed in the study have fully adopted the technological practices in agriculture and allied field. A considerable proportion of them did not at all adopt the technology professed by the KVK scientists. Full adoption of the technology was reported to be slightly better in case of KVKs from NGOs than those of Agriculture University system. Zero order correlation coefficient method was employed to test the relationship of socio-personal attributes of the farmers with their adoption patterns. The correlation values revealed negative and significant relation of such attributes as sex and age with adoption of farmers at 5% and 1% level of probability. Whereas, positive and significant relationships were observed for the level of education and size of holdings with respect to adoption of practices.

The KVKs need to strengthen infrastructure base – training facilities, demonstration units, transportation, residential and public utilities. The various positions especially the technical and scientific lying vacant should be immediately filled up.

Sher-E-Kashmir University of Agricultural Sciences & Technology, Jammu

45. Estimation at Small, Moderate and Large Area Level

Jagbir Singh

Usually Direct, Synthetic and Composite estimation procedures among the several small area estimation procedures are in common use and do not provide Minimum Variance Linear Unbiased Estimators (MVLUEs) for a population characteristic. In a sample survey each individual ultimate observational unit can be used to make an estimate, or these units can be combined in some desired manner to provide one or more estimates for a population characteristic. Multistage sampling design, now-a-days most commonly in use in sample surveys, is capable to provide estimate for a population characteristic at small area stage, moderate area stage and large area stage on the basis of the ultimate observational units. For instance the estimation of mean for a population characteristic in a crop/ livestock survey by three stage sampling design adopted in a district with sub-divisions/ blocks/ taluks as first stage units (FSUs), villages/ wards/ panchayats as second stage units (SSUs) within FSUs and cultivators/ households as third stage units (TSUs) within SSUs can be attempted at district level, sub-division level and at village level also even at cultivator level provided his fields/ livestock are taken as ultimate observational sampling units. With this in view MVLUEs have been developed of means for a population characteristics over two points of time of the survey, change therein over time and average/ total thereof over time for small, moderate and large area level under multistage sampling design and by making use of Projective Geometry Approach in this paper.

Indian Agricultural Statistics Research Institute, New Delhi

46. Correlates of Knowledge Gap in Paddy Cultivation

S.K. Kher¹, R.B. Patel², P.S. Slathia¹, and S.E.H. Rizvi¹

One hundred and two extension functionaries working in the chain of transfer of technology project under 'Training and visit' system in two agro-climatic zones of south Gujarat were interviewed personally for obtaining the data. It was observed that out of 11 selected

personal characteristics variables like family background, job factors, job activity preference, information input behavior and total service experience were found negatively significant with knowledge gap. The data was put on path analysis and revealed that major variable exerting highest negative direct effect on knowledge gap were job activity preference and job factors for Assistant Directors of Agriculture village level worker and agriculture extension officers respectively. Total highest negative indirect effect was produced by the variables job factors, information input behavior and information output behavior for all the three categories of extension personnel respectively. In case of first and second substantial effects it was having varied effects through different variables.

1. *Sher-E-Kashmir Univ. of Agril. Scis. & Tech., Jammu*

2. *NAU, Navsari*

47. Statistical Analysis of Growth of Teak as Influenced by Climatic Factors in Western Ghats of Karnataka

S.C. Madhu and P.A. Katarki

Five different forest ranges namely Dharwad, Haliyal, Sirsi, Banavasi and Dandeli have been considered. In this study two plantations each under five forests ranges were evaluated for various growth and yield parameters. Observations were recorded on the diameter at breast height (DBH), basal area, total height, and total volume of teak against other individuals within the quadrant. The data on each parameter were analyzed as two way ANOVA with forest ranges and plantations as two factors. The forest ranges have been grouped into two, based on the two-altitudinal area within each of the three rainfall areas. The analysis of variance revealed that forest ranges significantly differed with respect to their effect on the various growth and yield parameters of teak. Performance of teak for its various growth and yield measurements were found to be better in Dandeli forest range, which was characterized by higher altitude (> 609.89 m MSLm) and high rainfall (1690.71 mm). Generally trees under Banarasi range were found to possess more DBH (0.5613 m), however it was statistically on par with Sirsi (0.5538 m) and Dandeli (0.5525 m). Higher basal area (0.026 m²) was observed in trees located under Sirsi range. Nevertheless, performance of trees under Dandeli range was also found

better (0.0253 m²) and is on par with Sirsi range. Trees under Dandeli range as expected were found generally taller (14.062 m) when compared with trees of remaining forest ranges. Similarly, trees under Dandeli range were characteristically found to produce higher total volume (0.206 m³). Specific contrasts were constructed to test the effect of altitudinal zone alone on growth and yield parameters pooling over all the rainfall zones. Similarly pooling over all altitudinal zones tested effect of rainfall zones.

University of Agricultural Sciences, Dharwad

48. Models to Predict Rainfall within Seasons at Dharwad

Somappa N. Mergeri

The monthly rainfall (RF), maximum air temperature (Tmax) and relative humidity (RH) at Dharwad (15°26' N, 75°07' E 678m) for the period 1980 to 2004 was analyzed to predict within seasons rainfall. Southwest monsoon (SWM) consists of four months viz. June, July, August and September. We obtained modified geometric model was good fit for June RF (may Tmax as independent variable), 3rd degree polynomial fit for July RF (June RF as independent variable) sinusoidal fit for August RF (July RF as independent variable) and sinusoidal fit for September RF (August RF as independent variable). Northeast monsoon (NEM) consists of October and November months. For both the months sinusoidal fit was better with independent variable, September Tmax for October and October RH for November. To predict within SWM season rainfall previous month rainfall plays major role for July and August and previous month RH for June and September months. But for within NEM season rainfall prediction previous month Tmax for October and previous month RH for November plays a major role.

University of Agricultural Sciences, Dharwad

49. Rainfall Prediction Models at Shimoga

B.I. Halingali¹, S.N. Megeri² and
A.S.Kumarswamy¹

The rainfall at Shimoga (14°0' N, 75°40' E, 650 m) for the period 1980 to 2003 was analyzed to predict the

rainfall. Three years moving average and sinusoidal model techniques were used for the purpose. Three years moving average showed that the trend values and the actual rainfall coincides very well, whereas in case of sinusoidal model the observed and expected rainfall in all the years coincides, except in extremely dry years i.e. in 1988, 1989 and 1990.

1. College of Agriculture, Shimoga
2. University of Agricultural Sciences, Dharwad

50. Effect of Spacing on Yield of Groundnut and Intercrop under Dry Farming Condition

A.D. Kalola, D.N. Rathod, M.K. Khistaria and S.M. Upadhyay

A field experiment was conducted during kharif 1996, 1997, 1998, 2000 and 2001 to study the relationship of different spacing with yield of groundnut (*Arachis hypogaea*) and intercrop sesamum (*sesamum indicum*) pigeonpea (*Cajanus cajan*) on medium black soil at Main Dry Farming Research Station, Gujarat Agricultural University, Targhadia under rainfed condition. The result revealed that the sowing of groundnut at 30 cm spacing, being at par with 45 cm produced highest pod yield (1662 kg/ha) of groundnut. In intercropping with sesamum and pigeonpea the pod equivalent yield also remained lower than the yield of groundnut sole.

Junagarh Agricultural University, Junagarh

51. Non-linear Modelling of Banana Production of Different States in India

Sanjeev Panwar, N. Sivaramane and Anil Kumar

India accounts for nearly 10 per cent of world production of fruit crops with annual production of about 44 to 46 million tons. The major fruits accounting for bulk of the production are mango, banana, grape, citrus, apple, guava, papaya and pineapple. India ranks first in world production of both mango and banana, with a share of about 42 per cent and 26 per cent respectively. During 2001-02, India produced banana with production of 14209.9 (000' mts) from an area of 466.2 (000 ha). Productivity of grapes in India is the highest in the world.

Banana is a major fruit crop in India. It is mainly grown in states like Andhra Pradesh, Assam, Maharashtra, Tamil Nadu whereas the productivity was highest in Maharashtra (65.73 per 000' mt/ha). The non-linear models, viz. Logistic, Gompertz, Morgan-Mercer-Flodin (MMF), Richards, Weibull and Quadratic models were applied for banana production in India. Based on performance of best fit, one non-linear model was chosen for fitting the selected series. The banana series comprises of banana production for the year 1950-51 to 2001-02. The results show that Gompertz model is better than other models for predicting banana production data.

Indian Agricultural Statistics Research Institute, New Delhi

52. Growth Trends in Exports of Spices from India

N. Sivaramane and Sanjeev Panwar

This paper aims to examine the growth trends in spice exports by taking into account of structural break for different periods before liberalized and after the implementation of liberalized rules in world trade. Accordingly the realizations of spice exports (1964-65 to 2003-04) were grouped into two: Pre-liberalized (1964-65 to 1990-91) and liberalized periods (1991-92 to 2003-04). Also, this study attempted to forecast the time series for three periods in advance using Holt's exponential smoothing data, which has the capability to fit for most of the data types. Chow test is used to identify the year when the structural break is present. The growth rate is calculated by fitting the series to a log-linear regression and the variation of the data is studied using coefficient of variation after detrending the data wherever required.

There has been significant growth in the exports of all items of spices taken for the study during 1964-2003. The overall compound growth rate for spices is 12.49 per cent in quantity terms, 18.96 per cent in value terms and 10.03 per cent in unit rate terms. However, the growth is higher after the year 1990-91 when liberalized agreements came into implementation. The Chow test revealed that the growth pattern significantly changed for spices in quantity terms and value terms but there is no structural break in prices as there is a continuous increase in price trend. The presence of structural break necessitated to study the growth pattern separately for

the two periods (1964-65 to 1990-91 and 1991-92 to 2003-04). The growth rate is 2.93, 11.83 and 8.65 per cent for spices in quantity, value and unit rate terms for pre-liberalized periods whereas the same for post-liberalized period is 5.41, 16.68 and 10.69 per cent respectively. The coefficient of variation, which estimates the fluctuations or volatility in exports shows that it is lower for most of the spices during the pre-liberalized period compared to that of post-liberalized period. In summary, it is evident that the liberalized period has increased Indian spices export (in quantity and value terms) but with more volatility (as measured by the coefficient of variation) whereas in unit terms, there is a steady growth in both the periods. In this paper, Holt's method of exponential smoothing is used to forecast the spices export data. The Chow test was used here again to identify the range of dataset suitable for forecasting. The best fit for forecasting was selected based on the criteria such as MSE and MAPE.

Indian Agricultural Statistics Research Institute, New Delhi

53. Variability in Treatment Responses under Rice Wheat Sequence

Anil Kumar, Sanjeev Panwar,
Dharmendra Singh and Prawin Arya

Under All India Co-ordinated Research Project on Cropping Systems an experiment "Long range effect of continuous cropping and manuring on soil fertility and yield stability" was initiated during 1977 with the objective to study the long range effect of a crop sequence with high yielding varieties at graded fertilizer levels on yield stability and soil fertility. Being a compulsory experiment this was conducted at all the cropping systems research centers with the major prevailing cereal based cropping systems like rice-rice, rice-wheat, maize-wheat, sorghum-wheat and pearl millet-wheat.

Rice-wheat sequence at Rewa (lat 24.318N, long 81.158E) center was selected for the study. The climate of Rewa is characterized by mild to hot summers and fairly cool to cold winters. Eighteen fertility combinations, comprising three levels of N (40, 80 and 120 kg/ha) and P (0, 40 and 80 kg P_2O_5 /ha) and two levels of K (0 and 40 kg K_2O /ha) were evaluated in a $3^2 \times 2$ partially confounded factorial design in three replications with one control ($N_0P_0K_0$) in each replication.

In the present study, however, the fertilizers used were urea (46.4% N), single superphosphate (16% P_2O_5) and muriate of potash (60% KCl). Half of the N was applied as a basal dose in both crops and half was top-dressed at 30 days after transplanting in rice, and one day before the second irrigation in the wheat crop. The total P and K were applied as a basal dose. Zinc (Zn) was applied uniformly at 25 kg $ZnSO_4$ /ha in all plots of rice at transplanting. Each plot of the experiment received the same fertilizer treatment throughout the experiment and an annual rice-wheat double crop system was imposed during the 23 years period from 1978-79 to 2003-04. During kharif, treatment T_{18} i.e. NPK (120:80:40) was found to be most productive giving the mean grain yield of 41.23q/ha followed by T_{17} (120:80:0) (40.06q/ha) and treatment T_{19} i.e. control gave the lowest mean grain yield of 19.3q/ha. During rabi season, treatment T_{17} (120:80:0) gave maximum grain yield of 33.48q/ha followed by T_{18} (120:80:40) (30.06q/ha). In terms of gross return, T_{18} gave the maximum return of Rs.22781/ha followed by T_{17} (Rs.21389/ha).

Indian Agricultural Statistics Research Institute, New Delhi

54. Generalized Relative J-Divergence of Type S, Csiszar's F-Divergence and Information Inequalities

M.A.K Baig and R.A. Dar

In this paper, we have obtained bounds on Csiszar's F-divergence in terms of relative J-divergence of type S. The results obtained in particular lead to some known divergence measures such as relative J-divergence, chi-square divergence and triangular discrimination.

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55. Data Mining Techniques in Bio-informatics

K.N. Mathur

Data mining is the process of discovering meaningful new correlation, patterns and trends by shifting through large amount of data stored in repositories using pattern recognition technologies as well as statistical and mathematical techniques. It is multidisciplinary field, borrowing and enhancing ideas

from diverse areas such as statistics, signal and image processing, image understanding, mathematical optimization, computer vision and pattern recognition. Data doubles about every year, but useful information seems to be decreasing. The area of data mining has arisen over the last decade to address this problem. Mining scientific data sets is an area rich in challenging mathematical problems, where the complexity and size of the data, is matched only by the diversity of applications. One of the most exciting areas of modern biology is the application of data mining methods to biological databases. I have presented in the paper a summary of some techniques that have been applied in the field of bio-informatics. The list isn't comprehensive but will hopefully provide a starting point for learning about this growing area.

Indian Agricultural Research Institute, New Delhi

56. Trends of Soil Available Nutrients and their Prediction in Long-term Fertilizer Experiments

Ananta Sarkar, Rajender Parsad and D.K. Mehta

Long-term fertilizer experiments are generally conducted on a fixed crop sequence with treatments as graded levels of fertilizers. These experiments are generally conducted using a randomized complete block (RCB) design. Same design layout (including randomization) is followed over years. The observations are collected from same experimental plots over years. Major objective of these experiments is to monitor the changes in soil properties and crop productivity as a result of continuous application of treatments. Continuous application of same treatment combination to a plot may lead to build up or depletion of a nutrient in the soil. Therefore, change over time in either crop productivity or soil fertility is a critical parameter. The knowledge about the soil status of a particular field after application of a fertilizer treatment over a number of years, helps in taking remedial measures for maintaining the good soil health. Therefore, study on trends of soil status over years and development of models for prediction of soil status is of paramount importance. The observations in long-term fertilizer experiments are taken from the same plot over years, therefore, they may be

correlated. The trend behaviour of available soil nutrients may be non-linear. For studying the trend behaviour of available soil nutrients, the data from Ranchi Centre of All India Co-ordinated Research Project (AICRP) on Long Term Fertilizer Experiments (LTFE) are plotted. On the basis of shapes of plotted curves, different linear (Linear and Quadratic) and non-linear models (Exponential, Logistic, Gompertz, Monomolecular etc.) were fitted. Adjusted R^2 , root mean square error and percentage prediction error values are taken as model selection criterion. Partial data sets (excluding last five/six years) are used for model building and predictions of available soil nutrients are done for the last years. In most of the cases, the percentage prediction error is found to be less than 5%.

Indian Agricultural Statistics Research Institute, New Delhi

57. A Preliminary Test Estimator in Stratified Sampling

B.N. Mandal and Rajendra Singh

A separate regression estimator of population mean of the variable under study was developed using preliminary test to test the equality between the population mean of the auxiliary variable and estimate based on partial information. The estimator was developed under the assumption that population mean of the auxiliary variable is not known and we have two estimates: one from the double sampling and another from the partial information and the variance covariance matrix of the variables in each stratum are unknown. The preliminary test was used to decide which of the two estimates should be used to develop the estimator and then separate regression estimator subsequent to preliminary test estimator was developed. Its bias and mean square error were derived and their properties and behavior were studied under different conditions. The efficiency of this estimator with the usual separate regression estimator in case of stratified sampling was studied. The estimator will lead to higher efficiency provided there is high correlation between the variable under study and the auxiliary variable in each stratum.

Indian Veterinary Research Institute, Izatnagar

58. Estimation of Ordered Uniform Distributions with Known Ordering

B.K. Hooda and Deepak Grover

The problem of ordered parameters with known ordering often arises in agricultural and biological experiments when a researcher estimates the average yield of some character in the presence or absence of a treatment. In this paper, improved estimators of the parameters of two ordered uniform distributions have been proposed with known ordering. The proposed estimators have been compared with the maximum likelihood estimators under the squared error loss function. Best scale equivariant estimators are also proposed and compared with the usual estimators in terms of standardized bias and risk under squared-error loss.

CCS Haryana Agricultural University, Hisar

59. Decision Support System on Nutrient Management in Crops

Soumen Pal, I.C.Sethi and Alka Arora

Decision Support System on Nutrient Management in Crops (DSSNMC) is a web-based Decision Support System (DSS) to provide decision to farmers on nutrient management in crops. DSS has great importance in agriculture as experts are not always available to answer farmers' query. DSSNMC has three modules to provide decision support to farmers. First one is the subsystem based on soil test values. In this module, users provide soil test values along with desired crop to be grown, variety of that crop, season for that particular variety, soil type and targeted yield within a particular range. The system provides recommendation for application of chemical fertilizers for supplying the requirement of major nutrients such as nitrogen, phosphorus and potassium based on above data. The second module provides decision support on the basis of location such as district. If a farmer could not get the soil tested, the system will take input as the location of the farm in terms of district, targeted yield and rest other values of available nitrogen, phosphorus, potassium and the soil pH are taken from data base where standard values for particular district are stored and decision is provided in the same way as in the previous module. Another subsystem is

based upon nutrient deficiency symptom of crops. The basis here is the observation of the farmers which they compare with the images already stored in the system and can use the corrective measures provided by the system. 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 decision from the software. They can also ask questions regarding the software to the expert concerned by sending e-mail; this facility is included in the software itself. Users can also view some frequently asked questions (FAQs) regarding various queries of the farmers.

DSSNMC 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 Microsoft Access (MS Access). It is a kind of database widely used for its simplicity and ease to handle.

Indian Agricultural Statistics Research Institute, New Delhi

60. A Multivariate Approach to the Analysis of Growth Data on Pigs

Susheel Kumar Sarkar and Krishan Lal

Growth data are the longitudinal data in which the response of the each individual is observed over a period of time. Univariate and multivariate techniques for the analysis of growth data are available in the literature. In the present investigation, the method of profile analysis is used to analyze the growth (body weight) data on pigs. Profile analysis is the multivariate approach to analyze the growth data and this method provides the testing of three null hypotheses

1. Whether different factors (groups) significantly affect the growth of the animal.
2. Whether there is significant difference among the time points.
3. Whether there is any interaction between the factors and the time points.

The analysis of the data on the body weight maintained at different farms of pigs revealed that the interaction between the sex (male and female) and the time period is non-significant or we can say that the growth of both male and female pigs is parallel. This

means that the slope of growth is same over periods for both male and female pigs. The growth of pigs was maximum during the period of 20-24 weeks and 28-32 weeks of age.

Indian Agricultural Statistics Research Institute, New Delhi

61. A Pilot Study to Assess Production and Post-production Losses in Egg and Poultry Meat

Girish Kumar Jha, H.V.L. Bathla and R.P. Singh

Poultry production in India has emerged from a backyard activity to rapidly expanding commercial agri-business over the last three decades. The annual egg and broiler production has touched about 40 billion and 1.4 billion in the year 2003 from a meager figure of 5.3 billion and 4 million in 1971 respectively. However,

due to regional imbalance in production, both egg and live/ dressed chicken are transported from surplus production area to deficit regions of the country, resulting in appreciable losses due to egg shell damage, live weight shrinkage, mortality, downgrading of chicken carcasses resulting from bruises and injury as well as spoilage. This results not only in huge economic losses but also loss of valuable nutritious food. The magnitude of such losses in egg and poultry meat has been extensively studied in some industrialized countries but except a few limited studies, no systematic study has been carried out in India. The present paper discusses results of a pilot survey which was carried out in and around Bareilly district of Uttar Pradesh to assess the extent of losses of eggs and poultry meat at critical levels i.e. production, processing, market (wholesale/ retail) and household levels.

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