# ABSTRACTS OF PAPERS¤

## 1. A General Class of Chain Estimators for Finite Population Mean in Two Phase Sampling

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A general class of chain estimators for estimation of finite population mean has been defined. Asymptotic expression for mean square error (MSE) of the proposed class has been derived. A subclass of optimum estimators has been identified from the proposed class. The estimators belonging to this class have been shown to be more efficient than Chand (1975). Srivastava et al (1990) and Prasad et al (1992) estimators. An empirical study is included.

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## 2. The Effect of Response Errors and Non-response Errors on Variance Estimation

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The study aims to estimate the variance when data contains response errors as well as non-response errors. In situation when data is subject to large response errors and non-response errors, the contribution towards total variance due to these non-sampling errors components may be quite significant and even more important than the sampling variance. Taking this as background, a theoretical model has been developed and variance is obtained using this model. Two variance estimators are proposed. Firstly the design unbiased variance estimator gives bias independent of sampling errors. Secondly the random group variance estimator gives bias independent of non- sampling errors, which may be made bias corrected variance estimator.

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## 3. On Linear Combination of Ratio Estimator and Its Dual

Thomas Varghese and S.G. Prabhu Ajgaonkar
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A linear combination of ratio estimator and its dual is considered. Expressions for bias and mean square error are derived. The optimum estimator is determined and the mean square error of the optimum estimator is obtained. The conditions under which the proposed estimator is better than separate ratio estimator and also its dual are obtained. Further, an empirical study is presented.

## 4. A Class of Modified Chain Type Estimators Using the Known Coefficient of Variation of Second Auxiliary Character in Two Phase Sampling

G.N. Singh and L.N. Upadhyaya
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A class of modified chain-type estimators is proposed by making use of a known coefficient of variation of second auxiliary character in two-phase sampling. The bias and mean squared error of proposed estimator are obtained upto the first order of approximation. It has been compared with various estimators including those derived from the proposed one. The performance has been supported by a numerical example.

## 5. The Stepwise Approach for Clustering under Multi-Sample Situation

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Clustering methods are basically developed for single data situation– i.e., single observation (vector) per object. However, when these methods are extended to multi-sample situation, the crucial assumption of homogeneity of covariance matrices of the objects has to be satisfied. In the context of climatic classification of centres on the basis of rainfall, clustering under multi-sample situation is preferable to the single sample situation which is based on the mean values of the rainfall variates. A step-wise procedure is proposed to tackle the assumption of homogeneity of covariance matrices. The approach is illustrated

with the clustering of the districts of Andhra Pradesh State on the basis of monthly rainfall data of South-West monsoon season covering 30 years (1961-62 to 1990-91). The MANOVA approach (that leads to canonical analysis) which duly considers the year-to-year variations in the rainfall within the districts, has been applied for clustering. The stepwise procedure led to clusterings within the 3 groups of districts that exhibited three different levels of variability. These results were also compared with the clusterings obtained with the conventional method (i.e., without verifying the assumption of homogeneity) and those under single data situation where mean values of the rainfall variates were considered for analysis. The study indicated that clustering under multisample situation can be preferred for the classification studies based on rainfall and for the application of clustering methods, the proposed stepwise procedure may provide a useful solution to tackle the crucial assumption.

# 6.      On Outliers in Linear Regression Analysis

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An outlier is an extreme observation. Residuals that are considerably larger in absolute value than others say three or four times the standard deviations from the mean are potential outliers and these should be carefully investigated to see if a reason for their unusual behaviour can be found. Various tests have been proposed for detecting and rejecting outliers by many research workers. In the present study the performance of usual regression analysis and adaptive regression procedures are investigated when the outliers are present in the data.

# 7.      On the Pearson Criteria of Frequency Curves

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The object has been to fit suitable probability distributions to the given agricultural data. The Pearson criteria for frequency curves were determined. In majority of cases these criteria suggested Type-I curves. The $\chi^2$ test showed that the fits were not good at 5% level of significance. The graphs for these data suggested fitting of normal distribution. The values of $\beta_1$ and $\beta_2$ were calculated, which were significantly different from those of the normal curve.

In spite of this, the normal curves were fitted and in majority of cases the fits were good. In the present cases the Pearson criteria were not of much help.

## 8. Comparative Study of Farmer's Eye Estimate and Crop Cut Estimate by Fitting Models

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Different types of linear models have been fitted in the case of farmer's eye estimate as well as crop-cut estimate separately to estimate average yield at block level. The data on wheat crop in Aligarh and Ghaziabad districts of U.P. and Patiala district of Punjab are used for the study. It is observed that the heteroscedastic linear model with intercept term is the best fitted model. These is no significant difference between farmer's eye estimate and crop-cut estimate at block level provided the farmer's eye estimate is obtained about a week before the harvest.

## 9. Utilization of Research Data for Gap Analysis Study of Major Cereals in Latur Division of Maharashtra State

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An attempt has been made to examine the gap in yield of major cereal crops grown in Latur division of Maharashtra State. Three years data (1989-90 to 1991-92) about research yield, National Demonstration Scheme (NDS) yield and farmer level's yield for Hy. jowar, pady and wheat crops were obtained from research reports and epitome of agriculture, Maharashtra State. The yield gap between research yield and farmer level's yield was more than 72 per cent in all the cereals under study. There was only 28 per cent achievement of yield in cereal crops at farmer level when compared with research yield. More than 68 per cent yield gap in between NDS yield and farmer level yield was noticed. There was a yield gap of 10-15 per cent between research yield and NDS yield level.

## 10.    An Appropriate Forecast Model for Production of Stick Lac in Major Lac Growing States of India

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Lac is a very important cash crop mainly cultivated by tribals living in relatively backward areas in the states of Bihar, M.P., Orissa, West Bengal, U.P. and Maharashtra. So it is very essential to know in advance its production for the policy makers to decide its import export policy and price fixation. In this paper an attempt has been made to develop appropriate forecast model for each state as well as for All India utilising data for 27 years taken from the publications of the Directorate of Eco. & Statistics. Six models were developed using the methods.

(i)   Simple moving average

(ii)  Double moving average

(iii) Fundamental Exponential Smoothing

(iv)  Double Exponential Smoothing

(v)   Triple Exponential Smoothing

(vi)  Winter's Method

For each of the states under study, the mean square errors were obtained by varying different values of smoothing constant. The appropriate model and appropriate values of smoothing constants were chosen. It was inferred from the analysis that for three out of five states the appropriate model was Single moving average, but for all India, Double moving average was most appropriate. It was found that for Bihar which is the most important state for production of lac the most appropriate model was Double moving average.

## 11.    On Some Useful Interrelationships Among Common Stability Parameters

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A few interrelationships among common stability parameters which are useful from the computational point of view are established. Theoretical basis

of the observed similarity in the behaviour of some of these parameters is explained in the light of these relationships.

## 12. Growth and Instability of Rice in Coastal Andhra Region of Andhra Pradesh

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An attempt has been made to study growth and instability in rice, in Coastal Andhra region. The study period 1955-56 to 1989-90 has been divided into sub-periods with a view to examine the situation during Pre-Green Revolution, Green Revolution and Post-Green Revolution and overall periods. Trend analysis was used for finding growth rates and convergence/divergence as a measure of instability. Hazell's decomposition model has been used to measure the components of change in production.

The production growth rates were positive and significant in all the three periods, but highest growth (4.33 %) being recorded in period I. In the overall period Andhra pradesh has recorded significant positive growth rate (1.44%). The trend line was divergent both in state and region showing year to year fluctuation. With regards to change in components, maximum increase is seen in area-yield covariance between period I and period II (106.41%) and between periods II and III (501.68%). It is observed that increase in area and yield components increased the production of rice in majority of the districts. Change in covariance of area and yield component was most dominant in the region and State.

## 13. Trends in Onion Production

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Onion (Allium cepa) is an important vegetable crop. India ranks second in onion production in the world next to China. During the year 1989-90 the onion production in the country was estimated at 3.02 million tonnes. In a developing country like India, study of trends in area and production of different crops can be very useful in planning its production. Fitting of regression models and time series analysis are the chief and simplest methods for studying the trends in production. Various models have been fitted to the available time

series data for the states of Maharashtra, Karnataka and Orissa which account for more than 50% of the area under onion in the country.

The study shows slightly negative growth rate of production in the chief Onion growing state of Maharashtra. Linear regression model was found to be a fairly good fit to the data of area and production at all India level. The area under onion was estimated at 329.23 thousand hectares during 1993-94 with corresponding production of 3320 thousand tonnes. The employment potential of the crop during the same period was estimated at 109.03 million man days.

## 14.    Use of Resurvey Data for Gap Analysis in Cotton under Jayakwadi Command Area of Marathwada Region in Maharashtra State

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A study was undertaken with specific objectives (i) to know the changes in input utilization of cotton crop (ii) to work out the input gap with recommended level and (iii) to know the impact of different inputs on production of cotton. The groupwise information about utilization of various inputs in cotton crop was collected by survey method. The data of present survey (1990-91) was estimated and compared with the data estimates of previous survey (1976-79). The percentage changes, gap and functional analysis was carried out. There was considerable increase in the utilization of different inputs in hybrid cotton over previous survey. The increase in utilization of nitrogenous fertilizer was the highest (59.2%) followed by male labour (42.6%). The increase in the bullock labour was minimum (4.7%). There was gap to the extent of more than 26% in the utilization of various inputs with the recommended levels. The area exhibited the significant impact in increasing the output of the drop. The rest of the independent variables were observed to be not significant.

## 15.    Agromet Yield Model for Rice Crop in Pantnagar

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A pilot study was conducted to develop an Agromet yield model for rice crop at Pantnagar. Weather data on different characters were obtained from the Agrometeorological observatory situated at the crop research centre of the

G.B. Pant University of Ag. & Tech. Pantnagar. The 25 years weekly averages of eight weather variables were obtained. Rice yield data for the same period were collected from Pantnagar University farm. Pantnagar farm is well irrigated· fully mechanized and well managed, having about eleven thousand acres of cultivable land.

Five regression models using week-number or correlation co-efficient between yield and weather variables in a particular week as weight and by dropping quadratic terms of weather variables or correlation coefficient or by including only linear terms of weather variables and correlation co-efficients, were studied. The Agromet model was developed by considering all the weather variables simultaneously using partial crop season weather data. Stepwise regression technique was applied for selecting significant generated variables in the selected linear model. Considering the earliness in time of forecast and other factors, the 3rd week of August, was considered to be appropriate for the forecast purpose. The significant variables included in the models were relative humidity at 14 hours, number of rainy days, number of bright sunshine hours and daily pan evaporation. In order to study the stability of the Agromet yield model simulated yield forecasts for the subsequent years which were not included in the model were worked out and compaired with the actual yield. The deviation from actual yield was upto 10%.

## 16. Impact of Occurrence of Flood on Yield of Paddy at Various Stages of Crop Growth

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Occurrence of flood during Kharif season at various stages of crop-growth is a common phenomenon in most parts of Northern India. While high intensity of flood generally destroys crops, flood at low intensity may be beneficial for some crops as floods increase moisture contents in the soil alongwith fertility, etc. Crop-stage at the time of occurence of flood is one of the factors for studying the effect of flood parameters on yield of paddy in flood affected fields. With this objective, a study on paddy crops was carried out in the selected villages of Faizabad district of Uttar Pradesh based on data. collected under the project, "Pilot sample survey to study the impact of flood on agricultural production in a region of Uttar Pradesh".

The study revealed that the occurence of flood at the tillering and. post-flowering stages of paddy growth reduces the yield of paddy significantly

as compared to the flood-occurence at other stages of crop growth. The yield of paddy in Akbarpur tehsil, where the fields were affected by flood at tillering and post- flowering stages of paddy growth, was 20.28 Qtls/ha. as compared to 56.07 Qtls/ha. in unaffected paddy growing fields (loss 63.83%). But in case of Faizabad tehsil, where flood occured at tillering and preflowering stages of crop growth, the yield of paddy was 31.64 Qtls/ha. as compared to that of 44.24 Qtls/ha in unaffected fields (loss 28.48%). However in case of Tanda tehsil, the yield of paddy crop, affected by flood at growth and preflowering stages, was 17.20 Qtls/ha as compared to 34.24 Qtls/ha in fields not affected by flood (loss 49.76%).

## 17. Factor Use Efficiency of Income under IRDP — An Application of Multivariate Techniques

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An attempt has been made to analyse the factors influencing the per capita income of the beneficiaries and non beneficiaries of Integrated Rural Development Programme (IRDP), living below the poverty line in two blocks (DPAP and CADA) of Anantapur, which is a drought prone district of Andhra Pradesh by employing log linear multiplicative regression function considering land with and without dummy and decomposition model. The respondent were drawn using two stage random sampling, first stage being block and second stage beneficiaries (60) non-beneficiary (60) from each block. The results revealed that the working labour force, per capita employment and total productive expenditure significantly influenced the per capita income of both beneficiaries and non beneficiaries. The contribution of IRDP ( time) effect to incremental per capita income was around 5 per cent in case of CADA beneficiaries and 11 per cent for DPAP beneficiaries. Similarly, the number of days of employment per unit emerged as the major contributory factor to the growth in income. Thus the most important, indeed the central one, has to be the creation of massive wage employment opportunities, both on private and public account, in rural areas.

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## 18. Instability in Turmeric Production in India

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India is the largest producer and principal exporter of turmeric in the world. Among the producing States Andhra Pradesh, Tamil Nadu, Orissa, Maharashtra, Kerala and Assam account for more than 80% of total production. Though the production of turmeric has grown over the years, it has varied much from year to year. This instability in production tends to be transmitted to market and may cause wide fluctuation in the price of the crop. An attempt has been made to find out the factor responsible for instability of production, using an index called Mac bear index which is based on moving averages.

In general, the production instability increased in the second period (1980-81 to 1989-90) as compared to the first period (1970-71 to 1979-80), which was due to increase in both yield and area instability. The yield instability was higher in the second period suggesting that the introduction of high yielding varieties had a negative impact on yield stability. Decomposition analysis showed that the yield instability was the dominant factor affecting the production instability.

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## 19. Some Combinatorial Properties of Designs for Neighbour Effects and Correspondence of these Designs to Directed Graphs

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Interference between neighbouring test units is a common dazing problem in many field and laboratory experiments. If the treatments applied to one plot affect the response of the treatments in the neighbouring plots, it may cause bias in estimation. Designs commonly designated as neighbour balanced designs or serial designs were made use of in such situations. Here the treatment appears in the form of a triplet with a test treatment in the middle and two neighbour treatments on its both sides. For s test treatments one can form $s^3$ such triplets. In order to save resources, sequences of the triplets were constructed such that each of the treatment is used for estimating test treatment effect as well as

for providing neighbour effects. To reduce the length (or size) or these sequences workers used to take a subset of the $s^3$ triplets with suitable assumptions so that the contrasts of interest are estimable.

Selecting a subset of the triplets will make a sequence not existent in some cases, and for randomization, often one has to use computer programmes. In the present work an attempt is made to group the treatment triplets into distinct classes which will provide a basis for selecting a subset of the triplets. The correspondence of these sequences to completely symmetric directed graphs is illustrated which will provide a basis for the construction as well as within block randomisation of sequences, to develop suitable designs.

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# 20.　　Accounting for Interference among Treatments in Adjacent Plots in Field Trials

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Application of a technique due to. Draper & Guttman (1980) is illustrated on a tomato field trial to show how to account for interference among treatments in adjacent plots in field trials. The tomato trial, having $p = 8$ treatments with treatment p as a control, was laid out in RCBD with $r = 4$ replications. The RCBD model

$$Y = ( \; 1 \; : \; T \; : \; B \; ) \; (m \; : \; t' \; : \; b')' + e$$
$$n \times 1 \quad n \times 1 \quad n \times p \quad n \times r \qquad 1 \times p \quad 1 \times r \qquad n \times 1$$

was first formulated in terms of contrasts of interest as

$$Y = ( \; 1 \; : \; X \; : \; Z \; )$$
$$n \times 1 \quad n \times 1 \quad n \times (p-1) \quad n \times (r-1)$$

$$(\theta_o \; : \; \theta' \; : \; \phi' \; )' + e \qquad\qquad (1)$$
$$1 \times (p-1) \quad 1 \times (r-1) \qquad n \times 1$$

where $n = pr$; T and X are treatment design matrices; B and Z are block design matrices; $\theta_o = m + t_p + b_r$; $t = (t_1, \ldots, t_p)'$; $b = (b_1, \ldots, b_r)'$; $\theta = (\theta_1, \ldots, \theta_{p-1})'$ with $\theta_i = t_i - t_p$, $i = 1, \ldots, p{-}1$; $\phi = (\phi_1, \ldots, \phi_{r-1})'$ with $\phi_j = b_j - b_r$, $j = 1, \ldots, r{-}1$; and $e \sim N(o, \sigma_e^2 I_n)$. To account for the effect of interference, model (l), following Draper & Guttman, was extended to

$$Y = G \ (\ 1 \ : \ X \ : \ Z \ )$$
$$n \times 1 \quad n \times n \quad n \times 1 \quad n \times (p-1) \quad n \times (r-1)$$

$$(\theta_o \ : \ \theta' \ : \ \phi')' \ + \ e \qquad\qquad (2)$$
$$1 \times (p-1) \quad 1 \times (r-1) \quad n \times 1$$

where G is symmetric with elements $g_{kk} = 1$, $g_{ks} = |\alpha| < 1$ $(k \neq s)$ if plots k and s are adjacent and 0 otherwise ; k, s = 1, . . . n; $\alpha$ being coefficient of interference. Model (2) was fitted to four plot – adjacency patterns and results compared with those from model (1). Under three adjacency patterns with significent $\hat{\alpha}$ (p < 0.05), the residual SS and CV decreased considerably with substantial increase in $R^2$ value; $\hat{\theta}$, non-significant under model (1), became significant (P < 0.05 ). Interference appeared to be most dominant in E–W direction.

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## 21.   Estimation of Combining Ability of Parents through Augmented Partial Diallel Cross Design

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The Augmented Partial Diallel Cross (APDC) represents an intermediate position between the Complete Diallel Cross (CDC) and the Partial Diallel Cross in which some lines are primary lines that are crossed with all the other lines and the remaining lines are secondary lines that form a PDC system. The method of sampling adopted for crosses of secondary lines is from arrangement of secondary lines on circumference of a circle. The mathematics for analysis of such APDC has been given systematically. The analysis so developed has been applied to the data collected from a designed experiment on maize by taking two primary lines and seven secondary lines. The nine lines constituting 36 CDC's were also sown in a similar experiment. The efficiency of estimates of general combining ability (g.c.a) effects obtained from APDC has been compared with that of CDC. It is observed that there are four types of variances of g.c.a effects where as for comparing specific combining ability (s.c.a) effects there are large number of variances indicating that the design is totally unbalanced for s.c.a. comparisons. The results obtained by analysing CDC and APDC indicate that APDC can replace CDC without much loss in efficiency and with less number of crosses.

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## 22. Relationship Between Various Traits of Sahiwal-Jersey Crossbred Cows in Terai Region of Uttar Pradesh

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The present paper provides relationship between productive reproductive and growth traits of sahiwal-Jersey crossbred cows. Six pairs of traits namely first lactation milk yield and first lactation period, weight of first calf and first gestation period, interval between first and second calving and number of services required for second calving, were studied to know the relationship existing between them. It was found that the relationship between first lactation milk yield and first lactation period was highly positive and significant. The regression equation showed that for the increase of one day within 246 to 358 days in first lactation period, the first lactation milk yield on an average would increase by 8.15 ± 1.85 kg. The relationship between weight of first calf and first gestation period is also highly positive and significant. Their regression equation showed that for increase of one day in first gestation period, weight of first calf would increase by 266 ± 0.071 gms. The relationship between interval between first and second calving and number of services required for second calving found to be highly positive and significant. When an additional breeding service would be required for the second conception, the interval between first and second calving would increase by 49±7 days. The relationship of the rest three pairs of the variables was not significant.

## 23. Yield Gap Analysis in Buffalo Milk in a Rural Area

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An attempt was made to identify the factors responsible for milk production through path analysis utilising data collected under the project "Development of a suitable methodology to study the effects of housing conditions and other related factors on milk production under village conditions". The area of study was Gurgaon district of Haryana comprising four tehsils viz Gurgaon, Sohna, Nuh and Taoru. Linear, Cobb-Doughals and Quadratic models fitted to study the input-output relationship explained 32%, 33% and 36% variations respectively. The quadratic function which explained more variations was used for further analysis of data. The direct effect of D.C.P. on milk yield was 0.70 and total effect 0.92 and that of TDN 0.25 and 0.90 and labour –0.31 and –0.29.

## 24.    Average Farm Size for Agricultural Graduates in Gujarat

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Unemployment is a serious problem for agril. graduates in Gujarat. As an alternative they need to be motivated for accepting agriculture as profession. For this purpose a survey was carried out to study the average farm size (in ha), expected income and other facilities required by the agril. graduates. Information was collected from 133 graduates spread over entire state. The analysis showed that year of graduation, own profession and location of farm were the influencing variables in deciding farm size and expected income by agril. graduates. The average farm size varied from 2.0 ha in Valsad taluka to 30 ha in Bhiloda taluka of Gujarat state, the average being 10 ha on state basis. Limiting factors coming in the way of agril. graduates for accepting farming as profession are discussed.


## 25.    Models for Assessing the Effect of Weeds on Wheat Yield

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It is a well established fact that weeds cause substantial loss in crop yield. Gambhir (1985) has mentioned that India loses Rs. 1980 crores annually due to weed infestation. This paper deals with development of statistical model for estimating the loss in wheat crop due to non-graminaceous weeds as wheat crop is mostly infested with broad leaved weeds. The data for two rabi seasons viz. 1984-85 and 1985-86 collected earlier through field experiments planned in the research farm of Indian Agricultural Research Institute (IARI) are utilized for developing models using step-wise regression of crop yield on weed characters recorded at three stages of crop growth viz. 60, 75 and 90 days after sowing.

This study reveals the possibility of using dry matter weight of weeds recorded 60 days after sowing of the crop as regressor variable in the models for obtaining crop loss estimates. The fitted model explained 63% and 57% variation in crop yield during 1984-85 and 1985-86 with respective crop loss estimates as 23.73% and 15.13%. The avoidable loss is obtained as 1031 and 474 kg/ha. for 1984-85 and 1985-86 repectively.

## 26.    Incomplete Block Designs through Omission of One Treatment from Singular Group Divisible Designs

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Several authors have discussed missing plot technique for complete block design and incomplete block design when one or more than one treatments are missing. In the present investigation, a systematic method of Analysis of variance of an incomplete block design has been developed through omission of a particular treatment from each of the block of a Singular Group Divisible design.

## 27.    Analysis of Variability in Districts of Andhra Pradesh with Respect to Certain Crops

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The extent of variation in area, production and productivity of rice, jowar and maize crops between and within agro-climatic zones of Andhra Pradesh over years were estimated using mixed model of analysis of variance technique.

The area and production of rice were largely varied among *zones* than *year* and *year × zone* interaction. However yield of rice was varying more over *years* compared to *zones* and *year × zone*.

In jowar, there was more variation among *zones* followed by *year* in area and production and very low variation in *year × zone* interaction. In productivity, the variability was almost same among *years, zones* and *year × zone* interaction. In maize, the variation of productivity was almost same with respect to *year*, *district* and *year × zone* revealing that yields were highly vulnerable to seasonal fluctuations. Trends on area, production and productivity of the said crops were fitted using 2nd degree polynomial, multiple regression equation and exponential function with *time* as independent variable. The function with high $R^2$ value was considered as the best function.

With respect to Trend analysis, all the districts showed positive trend in rice production. The increasing trends in rice yields were observed in the districts of *Delta* and south coastal districts. Area, production and productivity of jowar showed declining trend in most of the districts. But Nellore and Khamman districts in production, Kurnool and Anathapur districts in yield showed positive

trend. Nizamabad and Medak districts had shown declining trend in area of maize and Warangal district had shown declining trend in both area and production.

## 28.    The Differential Response in Regression Analysis

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The possibility of a differential response of the dependent variable when it is influenced by the different situations of an attribute, which is otherwise not accounted by the well known Dummy variables approach is examined in the context of crop yield-weather relationships. The hypothesis is examined in respect of the yields of three crops : Paddy, Groundnut (both from Chittor district, A.P.) and Sorghum (Khammam district, A.P), based on 31 years of data (1956-57 to 1986-87). The analysis revealed existence of an independent response of the crop yields under the different sub-periods, which correspond to the *levels* of qualitative variable, *Technology*, such as *the Old Technology* and the *new Technology*. The relationships estimated for each of the sub-periods were logical in explaining the crop yield behavior. Estimation of the relationship based on the overall data by combining the sub-periods led to the identification of irrelevant variables and the relationship was not meaningful. The study clearly demonstrated the possible error in assuming the same set of independent variables common for all the sub-sets, as is normally done in the dummy variables approach.

## 29.    A New Method of Construction of Second Order Slope Rotatable Designs using Symmetrical Unequal Block Arrangements with Two Unequal Block Sizes

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A new method of construction of Second Order Slope Rotatable Designs (SOSRD) using Symmetrical Unequal Block Arrangements (SUBA) with two unequal block sizes is introduced. These new designs are called Type-II SOSRDs to distinguish them from the existing similar designs which may be referred as Type-I SOSRDs. In this method the number of design points required is in some cases less than the number required in the method of construction

of SOSRD using BIB design. The design parameters are tabulated for $6 \le v \le 16$ ('V' stands for the number of factors) for the new designs. Some illustrative examples are also included for the new designs.

# 30.    An Alternative Approach for the Analysis of Data of Long Term Experiments

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A new method was suggested for the analysis of data from repeated trials with dependent sets of observations. The method consists in extracting the first Principal component from the original Nr x p matrix of observations where N is the number of treatments r is the number of replication and p the number of years. As the principal component is the best linear combination of the 'p' yearly responses the assumption of independence of error terms seems to be logically sound. In situations where two or more components have to be retained multivariate analyses of variance of the transformed component scores may be attempted, the transformation being the division of the scores by the square root of the respective eigen values. The method was applied to the data generated from the permanent manurial trial on rice at Pattambi and the results indicated that it was slightly more efficient than the usual split-plot analysis and the analysis of groups of experiments.

# 31.    Probability of Obtaining Negative Estimates of Heritability from Full-Sib Analysis

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Inadmissible estimates of heritability cause problem in their interpretation and the experiment is rendered useless. Sampling fluctuation is the major contributor to inadmissible estimates. The expressions for the probabilities of negative estimates from full-sib analysis have been derived. The evaluation of these probabilities has been undertaken for different combinations of sires(s), dams(d) and non-aditivity coefficient assuming different full-sib family sizes (3, 4 and 5) for different levels of heritability.

It is observed that a large number of observations are required to minimise the frequency of negative estimates of heritability given value of lowly heritable traits ($h^2 < 0.25$). Further for a given value of true heritability, many more

observations are required to minimise the same from dam component or the combined estimate. When heritability is estimated from sire component, there is some advantage in using more information per sire, till the optimum family size $(4/h^2)$ is reached. As for the dam component and combined estimates, no such advantage is discernible by having more information per sire. This has revealed that such an advantage is only for lowly heritable traits $(h^2 < 0.25)$ and for cases with full-sib family size not more than 3.

It is concluded that the sire component estimate of heritability is more precise than the combined estimate for low heritabilities $(h^2 < 0.25)$ and vice-versa. At $h^2 = 0.25$ the two methods are equally precise. The estimate based on dam component is the least reliable in all situations.

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## 32.    Structure of Ovine Population in a district of Tamil Nadu

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This paper gives the detailed structure of ovines in the 105 villages of Tiruchirapalli district of Tamil Nadu which were randomly selected and surveyed under a project of IASRI. The ovines numbering about 65,000 comprised of sheep and goats in the ratio of 42:58 per cent. These animals were being maintained by about 11,000 householders of which 82% were keeping only goats.

The ovines had a sex-ratio of 82 females against 18 males; there being no sighificant difference between the two species.Whereas all the goats in the sample were of non-descript type, there were several distinct breeds in the sheep population. The breed with the maximum frequency was Madras Red (48%) followed by Mechere (24%) and Tiruchi Black (20%). Crossbreds accounted for 3% of the sheep. As regards the age structure, most of the animals in each species were under 4 years in age. In the population of males, over 50% of the animals were under 1 year in age. In the case of famales, the percentages of lambs and kids were 17 and 27 respectively.

## 33.     Estimation of Crop Yield at Block Level

Tauqueer Ahmad and O.P. Kathura
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For estimating the average crop yield at block level alterative estimators have been tried using simple random sampling, double sampling ratio, double sampling regression, multivariate ratio and regression methods of estimation in case of double sampling with farmer's eye estimate and area of the fields as auxiliary variables. The yield of the chosen crop is estimated by the farmer's eye appraisal from a larger sample while from a sub- sample of the fields the yield is estimated physically by method of crop-cutting. Farmer's eye estimates were taken one week prior to the harvest of the crop. The efficiencies of these estimators have been compared to each other. It has been observed that among all the estimators, multivariate regression estimator using double sampling is the most efficient estimator.

## 34.    Estimation of Annual Broiler Meat Production in an Area : Methodology and Results

K. P. S. Nirman, S. N. Arya and Shivtar Singh
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The paper deals with the extent of mortality and culling of broilers prevalent in commercial poultry farms and using the same, inter alia, for estimation of broiler meat production in an area. The requisite data were collected through a survey of the farms (1985-87) in the then Union Territory of Delhi adopting stratified random sampling. The method of 'Fractional exposure' was used to work out; age-specific rates of mortality and culling for starters (0-3 weeks), growers (3-6 weeks) and finishers (6-9 weeks). The rate of morality in an age group had the maximum value of 1% in the starter age group. Each rate was estimated with high precision. The age-specific rate of depletion was then obtained by combinig the two. The rate varied from 2 to 4 per cent. It generally decreased with increase in age and also with increase in the scale of farming. The total broiler meat production in the Union Territory of Delhi during 1986-87 was estimated to be 1630 tonnes. Of this, nearly 50% was produced in winter while summer and rainy seasons contributed about 25% each.

## 35. A Study of Measurement Errors Due to Enumerators and Respondents Simultaneously

K. N. Singh

*C. P. R. S. Modipuram, Meerut-250 100*

A more general model than that of Cochran's (1968) has been developed under assumption of the existence of homogeneous groups. From each group, samples are selected in the form of interpenetrating subsamling and enumerators are employed for survey in each group. For simple random sampling the enumerator effect, respondent-effect and effect introduced due to interaction caused by enumerators and respondents have been estimated seperately using the proposed model. Further the problem of testing the significance of contribution towards variance due to these factors has been tackled so that appropirate measures can be adopted to control or minimise the variance.

## 36. A Dual to Chain Ratio Estimator in Survey Sampling

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A new chain product-type estimator is proposed which is complementary in certain sense to the chain ratio estimator given by Chand (1975). Asymptotic formulae for the bias and mean squared error have been derived. It is shown that the proposed estimetor is always more efficient than Chand's estimator.

## 37. Restricted Shrinkage Estimation of an Updated Regression Model

Anil K. Srivastava and Sanjay Rastogi

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Estimation of coefficient of an updated linear regression model has been considered subject to a set of exact linear restriction binding the coefficients of the original model. This situation arises when a practitioner dealing with a given model, observes that over the passage of time, some more variables have become relevant and so they need to be included in the model. For this setup, shrinkage restricted regression estimators suggested by Srivastava and Srivastava (1984) have been considered and small disturbance asymptotic approximations for the properties of these estimators under a quadratic loss framework have

been derived. Performance of these estimators vis-a-vis that of restricted regression estimators have been studied wherefrom dominance condition for the superiority of these estimators are derived.

## 38. Estimation of Bias and Standard Error for an Improved Estimator of Normal Mean

Shalabh

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An improved estimator of normal mean which is obtained by considering a feasible version of minimum mean squared error estimator has been worked out. The exact expression for the bias and mean squared error are fairly complicated and do not provide any guidelines as how to estimate the standard error of the improved estimator. An unbiased estimator is derived for the bias and mean squared error of the improved estimator. Incidently, they turn out to be minimum variance unbiased estimators. Further, this exercise yields a simple formula for estimating the standard error. Based on the criterion of estimated standared error, the efficiency of improved estimator with respect to the traditional unbiased estimator (i. e., sample mean) is examined numerically. The relationship with asymptotic standard error is also studied.

## 39. Impact of Farmer Contact Programme on Yield of Wheat in Haryana

S. C. Sethi. Jagmohan Singh and D. K. Bhatia

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After sixties, the production of cereal crops showed increasing trend due to the application of modem technology and better inputs. For optimum use of modem technology and inputs guidance to the farmer at field level was given by initiating a field level contact programme. To evaluate the effect of contact programme on wheat crop, a field level contact programme was intiated in 1987-88 in Karnal district of Haryana. The effect of the farmer contact programme on the yield of wheat was studied utilising data on inputs used, date of sowing, number of irrigations etc. collected under the project "Crop estimation surveys in Haryana (1987-88)".

The study showed that the yield of wheat per acre was 1303 kg. in case of contacted farmer where as it was 1516 kg. in case of the sampled cultivator.

## 40. Estimation of Fodder and Feeds Availability and Requirement for Bovine Feeding in India

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The study is based on the data on bovine population in different age groups for different states obtained from quinquennial livestock Census reports (1966 to 1987). Various mathematical models were fitted to estimate the growth rate in bovine population in different age groups which were later used to project the bovine population. These population figures were later multiplied by the requirement scaler provided by Animal Nutritionists to estimate the nutrient requirement of cattle and buffalo separately. Time series data on area under fodder crops, permanent pastures and grazing lands, forests, area and production of various food and non-food crops, vegetables and fruits etc, was used to estimate the availability of green fodder, crop residues, oilseed cakes, vegetable and fruit wastes in different states. Information on availability of non-conventional feeds, fishery wastes and other agro-industrial byproducts was also collected. The availability of nutrients (DCP and TDN) among various feeds and fodder was estimated and projected using nutritive value figures on dry matter basis in consultation with Animal Nutritionists.

Total DCP requirement for cattle and buffalo for India was estimated to be 38.9 million tonnes in 1993 and is expected to go up to 42.4 million tonnes by 2000 A. D. The TDN requirement for the corresponding two years will be 436.3 and 469.3 million tonnes respectively. The DCP and TDN requirement was maximum in U. P. followed by M. P., West Bengal, Bihar and minimum in H. P. obviously due to differences in bovine population. Total availability of DCP from various sources was estimated to be 17.0 million tonnes in 1993 and is likely to go up to 19.0 million tonnes in 1997. The corresponding figures for TDN availability were 213.4 and 237.6 million tonnes in the two years respectively. The availability of DCP was observed to be maximum in M. P. followed by Rajasthan, U. P., Maharashtra etc. whereas TDN availability was observed to be maximum in U. P. followed by M. P., Maharashtra, Rajasthan etc.

The gap between the availability and requirement of DCP was of the order of 51.5 per cent in 1993 and is expected to gradually decrease to 48.9 percent in 1997. The gap beteen TDN requirement and availability was 48.7 per cent in 1993 and is likely to come down to 45.5 per cent in 1997. Across states, the estimated gap between DCP availability and requirement in 1997 is expected to be maximum in West Bengal (90.6%) followed by Bihar, Kerala and U.P.

and minimum in H.P. (9.3%). On the other hand, the gap between TDN availability and requirement was observed to be highest in Kerala (77.0%) and lowest in H.P. (3.7%).

## 41.   Application of Markov Chain Analysis to an Analysts of Major Non-Traditional Silk Export Markets of India in the Global Silk Trade

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Silk is produced in over 30 countries of the world of which 14 are situated in the Asian region. The Asian countries produce about 90% of the total silk in the world. Out of the 14 countries, significant contributions are from India, China, Japan, Korea and Thailand. India is the second largest producer of silk in the world, after China. The study was undertaken with the objective to analyse the growth and the structural changes of Indian silk exports to the non-traditional markets. Growth rates were worked out for the silk goods exported from India to major non-traditional markets for the period 1974 - 75, to 1991-92 through linear functions.The structural changes in the export trade was analysed in the Markov chain framework.

The results of the growth rate on quantity of silk goods exported to the major non-traditional market indicates that there is an encouraging growth to the majority of the market. USA showed a positive growth of 6% of their import of silk goods from India. In the case of Germany a positive growth rate of 5% was observed. India is making a headway in becoming a major supplier of silk garments, (mainly women dresses) and furnishing fabrics to European countries. Export of Indian silk goods to *Italy* registered only 1% growth for the span of years (1974 - 75 to 1991 - 92). *Canada* registered the highest growth rate over all the countries included in the study with 11% growth rate. *France* registered a negative growth rate of -2%. Exports of Indian silk goods to United Kingdom reveal 4% growth rate.

In summary it can be concluded that Indian silk goods have got the potential in the non-traditional market considering that majority of the market has got a positive growth rate.

## 42. PGAN's Formula for Production Productivity or Growth Component Analysis

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A simple algebraic formula has been derived to estimate precisely the influence of area and productivity on the production trend of a crop over a period of time. This will help to estimate correctly the possibilities of extending the area and boosting productivity to achieve targetted production. The new formula is :

$$Y_2 - Y_1 = (A + \hat{a})\hat{p} + P\hat{a}$$

(Total increase/decrease in production) = (contribution due to productivity) + (contribution due to area) where A, P denote area and productivity respectively; $\hat{a}$ and $\hat{p}$ denote corresponding increments which can be either positive or negative.

## 43. Construction of Resolvable Semiregular Group Divisible Design Through Association of Sets of Equal Sizes

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A method of construction of resolvable PBIB design derived from association scheme is discussed. Here using the Kronecker product of same set with equal cardinality, resolvable two associate PBIB designs are obtained.

Associations of Kronecker product gives a semi regular group divisible designs. However it is found that this SRGD is resolvable also. This method can be extened to get some more SRGD designs.

## 44. Plant Survival Evaluation Sampling Plan

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This plan is discussed here to take decision regarding the introduction of a particular plant for a specific campaign using general Markov-chain Theory.

From this survival evaluation sampling plan it is possible to know (i) whether the plantation of a particular kind is suitable in a specific area (ii) the expected number of observations which should be considered before taking a decision and (iii) the chances of survival of a plant at different stages of observation.

## 45.   Analysis of Covariance of Non-orthogonal Data in Three-ways Classification with Two Ancillary Variables

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Federer (1957) developed method of analysis of covariance for three-way classified unbalanced data. In the present investigation, a systemetic method of analysis of covariance for a three way classified non-orthogonal data is discussed and different effects estimated. In general it is not so easy to obtain the variance of treatment contrast of $a_i$ and $a_m$ in case of three way classified data having unequal number of observations in subclasses as computation is very rigorous which is claimed by Federer (1957). However a simple technique has been developed here to estimate the variance of the difference of two treatment effects and then to obtain the test of significance. Again for this model algebra is very complicated to obtain the adjusted error sum of square. However it can be made easier using a lemma which has been developed in the present investigation.

## 46.     Flexible Partial Diallel Cross

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The work refers to where information on combinig abilities is sought on the available stuff under resource constraints to be more important than others in some respect. Augmented PDC of Pearson (1980) is an endeavor in this direction wherein a combination of CDC for Primary lines and a PDC of secondary lines is raised. Herein all primary lines are given equal importance and same being true for secondary lines. Venkatesan (1985) discussed flexible PDC where lines could be assigned varying importance. He suggested a systematic method of construction using 'Priority' criterion and outlined its analysis. In this case also, the experimenter has little choice regarding the

definite importance of different lines except assigning them relative priority. Observe that we are concerned neither with parental lines nor the reciprocals.

In this paper a systematic design is presented where the experimenter may assign any priority to every or several lines as he wishes. Technically speaking, the N parental lines may be divided in to M groups, ith group containig $N_i$ lines (i=1,...,M., $\Sigma N_i$=N). Of the two groups containing $N_i$ and $N_j$ lines, each line from ith group ($N_i < N_j$) is crossed with $S_{ij}$ lines of jth group thus raising a partial set of $N_i \times S_{ij}$ crosses. Note that $N_i S_{ij} \neq N_j S_{ij}$. The total number of crosses thus sampled will be $\underset{i<j}{\Sigma\Sigma} N_i S_{ij}$. The construction and analysis of designs proposed here are achieved through partial circulant schemes.

## 47. Plot Technique Study for Water Management Experiment on Summer Groundnut

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An experiment was conducted to study the efficacy of two methods of irrigation, viz., sprinkler and surface for summer groundnut (Cv. GG-2). Three levels of irrigation (0.75, 0.60 and 0.45 IW/CPE ratios each at 4 cm depth of irrigation were tried only in sprinkler irrigation. Four blocks of each of 48 m × 33 m of crop raised under irrigation treatments were used as uniformity trials. The pod and haulam Yield data were collected from each block, using basic unit size of 4 rows (spaced 30 cm apart) each of 1 m length.

The fuiduigs were:

(i) Surface irrigation showed larger variation in pod yield than sprinkler irrigation.

(ii) The C. V. % and relative land use efficiency decreased with the increase in plot size in all the uniformity trials.

(iii) On an average 10 units size (12.0 sq.m=20 rows each of 2 m length) was found as optimum plot size under both the methods of irrigation for summer groundnut under middle Gujarat conditions.

## 48.   Studies on Genetic Gain on Deleting Various Traits in Different Selection Strategies

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In selection experiments based on multiple traits, the contribution of individual character on genetic gain plays a very useful role for formulating future breeding plans. Following cunningham (1969), the theory of reduced indices in the case of phenotypic index has been developed. For illustration purpose the breeding data of Sahiwal breed of cattle belonging to different Military Dairy Farms have been used.

The percentage reduction in efficiency of the reduced index on dropping a trait in comparison to original index for all the characters has been worked out and the maximum value is due to the character weight at calving with the value as 17.48%. The percentage reduction in efficiency for dropping two or three traits at a time have also been obtained. In the case of phenothpic index the reduction in efficiency by various auxiliary traits have been worked out.

## 49.      Assessment of Human Energy Consumption and Labour Cost in Wheat Production - A Case Study of Hill Region of U. P.

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To assess the human energy consumption and labour cost in various agricultural operations particularly land preparation, sowing, fertilizer application and irrigation, village Igyardevi representing the Pithoragarh district was selected purposively. The farmers of the village were divided in two categories as per their land holdings - marginal farmers with land holdings less than one hectare and small farmers with land holdings of one to two hectares. The village was having only these two categories of farmers. Labour wages in the village were 30 to 35 rupees for one day (8 hours). Z-test was applied to test the significance of mean difference between marginal and small categories of farmers considering human energy and labour cost involved. Significant difference was found for the operations of land preparation, sowing and fertilizer application, whereas it was non-sighificant for the operation of irrigation in both the cases.