

# ABSTRACTS OF PAPERS\*

## 1. Multiphase Sampling on two Occasions with a Two Stage Design

By

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Mostly, in large-scale surveys, the information is required on a set of characters, among them many are highly correlated with each other, and a two stage sampling design is used. If the survey is planned taking into account the inherent correlations between (and/or within) first stage units (fsu's) between different characters on the different occasions, we may reduce the cost, time and labour to a considerable extent. The first attempt in this direction seems to have been made by Tikkiwal (1954, 55, 67) for uni-stage sampling designs. Agarwal (1977) has extended the theory for two stage designs in a simple situation where fsu's are of equal sizes and simple random sampling without replacement (SRSWOR) is used at all the occasions and both the stages.

In practice, very often, the fsu's are not of equal sizes. Kathuria (1978) has developed the theory for such situations by using a PPSWR sampling scheme at the first stage and SRSWOR at the second, under some different replacement pattern. In this paper, the theory is developed when fsu's are of unequal sizes and SRSWOR is used at both the stages. Three replacement patterns are considered for the purpose.

## 2. On the variance function of the mean of a stationary Stochastic Process

By

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It is often observed that the daily  $N$  balance of an adult individual maintaining body weight on fixed  $N$  intake follows a stationary stochastic process such as (i) autoregressive process (ii) Moving average process or (iii) autoregressive-cum-Moving average process. The behaviour of the variance function of the mean taken over  $n$

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\*For 35th Annual Conference of the Society, December, 1981 at IASRI, New Delhi-110 012.

days of each of these three stationary stochastic processes is examined. It is observed that the variance, in each case, can be written in the form  $\frac{\sigma^2}{n} \cdot \lambda$  where  $\sigma^2$  is the variance of the process and  $\lambda$  is a function of  $n$  and the parameters of the process. It has also been found that  $\lambda$  increases monotonically and approaches a finite limit as the sample size gets larger and hence  $\frac{\sigma^2}{n} \cdot \lambda$  decreases to zero in the limit. Relevance of this result is explained in examining whether the influence of variation in daily requirement can be reduced by averaging intake over a number of days as necessary to provide that is called a habitual requirement.

**3. A Class of Estimators For Coefficient of Variation Using Knowledge on the C.V. of an Auxiliary Character.**

By

AJIT KUMAR DAS AND T.P. TRIPATHI

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In this paper we present a class of estimators, based on simple random sampling without replacement (SRSWOR), for  $C_y$ , the coefficient of variation (C.V.) of a character  $y$  in the finite populations, utilizing the knowledge of  $C_x$ , the C.V. of an auxiliary character  $x$ . We have studied the properties of the proposed class of estimates, in case of large samples, to the terms of order  $(1/n)$ . It is found that under some moderate conditions a number of estimators better than the usual estimator for  $C_y$  may be generated from the proposed class. In case the populations are bivariate normal, these conditions depend merely on the knowledge of the quantities such as  $p_{(1)}$  and  $C_{(1)y}$  defined by  $0 < p_{(1)} \leq p$  and  $0 < C_{(1)y} \leq C_y$ . An empirical study is made and a number of estimators have been identified which have both mean square error and absolute bias smaller than those of usual estimator for  $C_y$ .

**4. Estimation of Population Ratio on two Occasions Using Multivariate Auxiliary Information**

By

D.K. CHATURVEDI AND T.P. TRIPATHI

*Indian Statistical Institute, Calcutta*

The problem of estimating population ratio  $R_2 = \bar{Y}_2 / \bar{X}_2 = Y_2 / X_2$  of two population means (totals) using multivariate auxiliary information and the scheme of partial replacement has been considered

on two occasions. The general properties of the proposed sampling strategy are studied and comparison with other known strategies has been made through an empirical study. The proposed strategy is found to be better than those by Rao (1957), Rao and Pereira (1968), Tripathi and Sinha (1976) and Das (1976, 80).

## 5. Efficiency of Double Sampling in Two Stage Designs

By

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Most of the large scale household surveys adopt a multistage design. In most of the cases the villages or cluster of villages are the first stage sampling units and house holds are the second stage units. In many situations the information on one or more auxiliary variables pertaining to the whole village can be obtained easily; similarly information on some other auxiliary characters can be collected easily for a large sample of households for the selected villages. Therefore in the present investigation the efficiency of the following four different sampling schemes under fixed cost have been obtained.

(i) A two stage sampling design.

(ii) Double sampling for study of an auxiliary character for first stage units only.

(iii) Double sampling for study of an auxiliary character for second stage units only.

(iv) Double sampling for one auxiliary character for first stage units and double sampling for another auxiliary character for the second stage units.

## 6. On Families of Ratio and Product-Type Estimators

By

L.N. UPADHYAYA AND H.P. SINGH

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In sample survey an auxiliary information is used for improving the precision of an estimator. When the correlation between the variable of interest  $y$  and a concomitant variable  $x$  is high positive, the ratio method of estimation is quite effective for this purpose. On the other hand, if the correlation is high but negative the product method of estimation can be employed. In this paper we have

proposed two parameter families of ratio and product type estimators for a finite population mean  $\bar{Y}$  based on simple random samples of observations on the variable of interest  $y$  and an auxiliary variable  $x$ . The biases and mean squared error (MSES) of the proposed estimators are obtained, under the large sample approximation. The efficiencies of the estimators are compared with the usual unbiased estimator  $y$ , traditional ratio (product) estimator  $\bar{y}_R$  ( $\bar{y}_P$ ) and that of Ray and Sahai (1980). For illustration a numerical example is given for the case of positive correlation. Here we confine ourselves to sampling scheme SRSWOR.

### 7. Adjustments for Nonresponse using Auxiliary Character

By

K.K. SINGH AND A.K. SRIVASTAVA

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Non-response, though undesirable, is a practical reality in most of the surveys. However, its magnitude depends upon the type of the survey, the interviewer's ability to conduct an interview, and respondents motivation to respond to survey questions. Some methods of Compensation for non-response, given by Chapman (1976), are (a) Zero substitution (b) Duplication (c) Balancing areas and weighing classes (d) historical data substitution and (e) hot and cold deck procedures.

Platek, Singh and Trembley (1977) considered the concept of response probability on the assumption that each population unit if selected responds with certain probability. In the proposed study we consider some of the adjustment procedures (imputation) using auxiliary information under the assumption that it is available for all the units of the population whether they are responding or non-responding. Also, biases and Mean sum of squares has been calculated for the proposed imputation procedures.

### 8. Use of Supplementary Information in Quantitative Randomized Response Model

By

RAJENDRA SINGH AND O.P. KATHURIA

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Moors (1971) has discussed the optimization of unrelated question randomized response model and suggested to employ the second sample solely to estimate the proportion of people showing

neutral characteristic. The same result was observed by Greenberg *et al.* (1971) and Horvitz *et al.* (1975) in case of quantitative response. In the present paper, methods of estimation using supplementary information have been discussed which under certain conditions, give more reliable estimates of population means of sensitive and neutral characters for the quantitative randomized response model. The efficiency and mean square error of these estimators have been compared with estimator under Moor's optimized version model.

### 9. Sampling without Replacement in Qualitative Randomized Response Models

BY

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In many survey situations, the population size is moderately small. Sampling with replacement, that has generally been proposed by many research workers in the field of randomized response, may not yield good estimate of proportion of individuals possessing a sensitive character. In the present paper, a general result is proved that the probability of 'Yes' response is the same both in sampling with replacement as well as sampling without replacement. With sampling without replacement some estimators have been described and their variances obtained for using unrelated randomized response model for binary and discrete data. The efficiencies of these estimators have been compared with estimators under the same models in sampling with replacement. The mean square errors of these estimators were worked out to see the effect of false reporting. This approach is better than Eriksson (1973) in the sense that Winkler and Franklin (1979) method can be applied to modify the estimate in case it does not fall in the prescribed range.

### 10. Estimation based on Auxiliary Characteristic

BY

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In many situations, observations on the characteristic under study are not available and the estimation is to be done on the basis of values of the auxiliary characteristic alone. In such cases, three methods of estimation, namely, (i) regression, (ii) ratio, (iii) standard

have been suggested. These methods respectively make use of the relationship of the stability, wherever existing, over periods of (i) co-efficient of regression of the two characteristics, (ii) ratio of the means of values of the two characteristics and (iii) ratio of the standard deviations of the two characteristics. Efficiencies of the estimators suggested in the three cases have also been obtained and compared. It has been found that approximately the ratio method is more efficient than the regression method if the coefficient of regression is greater than the ratio, and in case of normal population the standard method is more efficient than the ratio method if the co-efficient of variation is greater than one.

#### 11. A Survey Design to Estimate Enumerator Bias

By

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Errors arising due to sources other than sampling are known as non-sampling errors. While population census data are subject to non-sampling errors only, sample survey data are subject to both sampling and non-sampling errors. Enumerator effect is one of the sources of non-sampling errors. Mahalanobis (1946) was the first to develop the technique of interpenetrating sub-sampling for comparing the variability of enumerators with the help of analysis of variance. Many authors do not advocate the use of the technique on the ground that it involves higher cost. But without use of interpenetrating sub-sampling techniques there is no other means to have estimates of enumerator effect. In the paper a survey design is being suggested wherein stratification has been adopted at the first instance and the techniques of interpenetrating sub-sampling has been applied within each stratum. In allotting the enumerators to different sub-samples of the strata, care has been taken such that the area to be travelled by an enumerator is kept at minimum, which results in reduced cost of the survey. In the suggested design an enumerator is to visit more than one sub-sample distributed over different strata. The design enables numerical estimation of enumerator bias and at the same time cost of the survey is minimized in comparison to the conventional types of interpenetrating sub-sampling.

**12. Multi-Sample Sequential Estimation**

By

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AND

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Recently some authors have given an approach to defining both parameter and estimator in the concept of probability measure. Singh (1977) has applied the concept with some modifications to sequential sampling and a class of acceptable estimators has been discussed. This study is also an extension of this idea and a new sampling technique has been developed—a technique of selecting a group of units in each draw. An estimator has been derived and unbiasedness has been shown.

**13. On ratio estimate used in cost of production studies**

By

H.C. GUPTA AND U.G. NADKARNI

In the study of cost of production of a commodity, the cost per unit is obtained by taking the ratio of total cost of all units to the number of units produced. Numerator in this is generally a product of two random variables. In the present study formulae have been obtained for relative bias and variance of estimate of  $(R_n)$  by considering the variable occurring in the numerator as (i) a single variate (ii) product of two independent variates and (iii) product of two dependent variates. For the latter two cases expression for variance for using approximate and exact formulae given by Goodman have been obtained.

**14. A General Class of Unequal Probabilities without Replacement Sampling Schemes for two Units**

PRANESH KUMAR AND S.K. AGARWAL

*I.A.S.R.I., New Delhi-12.**University of Jodhpur, Jodhpur.*

A general class of unequal probabilities sampling schemes for selecting two units without replacement is given. The inclusion probabilities proportional to sizes ( $\pi$ PS) sampling scheme due to Singh (1978) is shown to be member of the class. A necessary and sufficient condition for the  $\pi$ PS sampling scheme of the class to be more efficient than the probabilities proportional to sizes with replacement (PPSWR) sampling scheme is obtained. The sufficient condition for non-negative unbiased variance estimator for proposed scheme is worked out.

**15. Some Properties of Padam Singh's Sampling method**

By

M.N. DESHPANDE

*Institute of Science, Aurangabad*

In this paper the sampling method proposed by Padam Singh 1978 is studied further. Second order inclusion probabilities for the method are evaluated and various relationship between  $\pi_i$ 's and  $\pi_{ij}$ 's are established.

**16. Precision of Double Sampling Scheme in Estimating Fibre Yield on a Jute Field**

By

B.C. SASMAL AND V. KATYAL

*Jute Agricultural Research Institute, Barrackpore, West Bengal.*

It is well known that by utilising the information on an auxiliary character which is highly related with the character under study, precision of the auxiliary character of all the sampling units in the estimator can be increased to a large extent. Whenever the information on the population is not available or when the cost is prohibitive to obtain such information, double sampling techniques can be adopted for estimating the character.

JRC 212 was grown in 1978 at Jute Agricultural Research Institute, Barrackpore in a field of 720 m<sup>2</sup> divided into 150 sampling units of 8m × 0.6m. Uniform treatment was applied to all the units. Data on dry fibre weight and green weight was recorded for each sampling unit at the harvest stage. As green weight was highly correlated with dry weight, it was used as an auxiliary variable for the estimation purpose. It was observed that irrespective of with or without replacement, the variance for double sampling was less than that for single simple random sampling, and was more than that for ratio method of estimation and linear regression method of estimation used in single phase sampling.

**17. Sequential Estimation of Biological Population in the field**

F.S. CHAUDHARY AND R.P. GOSWAMI

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In this paper it is proposed to devise a sequential method of estimation of a biological population which is alive and freely moving. Assuming that the probability is proportional to the size of a sub-region a well-defined region of a biological population of a given



class, an estimator has been derived on the basis of observed distances between individuals and their nearest neighbours. A comparative study has been made with the classical and maximum likelihood estimators and to test the veracity of the method, an empirical study has been made.

**18. Sequential Estimation of Population Size**

By

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*HAU, Hissar*

AND

RANDHIR S. KHATRI

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Some authors have worked out methods suggesting new approaches to estimation of population size. Chaudhary & Khatri (1980) have discussed sequential estimation of population size for proportion values between 0.1 to 1.0 but they have not discussed for proportion values between 0 and 0.1. In this study, it has been worked out and curves showing relationship between (i) proportion and difference; (ii) proportion and relative precision and (iii) difference and relative precision are drawn. Both with and without replacement procedures have been considered.

**19. A Dual to Multivariate Ratio Method of Estimation in Finite Population**

By

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A dual to multivariate ratio estimator for the population mean, analogous to Olkin's multivariate ratio estimator has been proposed. The exact expression for bias and mean square error are derived and the comparison with simple unbiased and multivariate ratio estimator have been given for any sampling design. The specific situation has been mentioned when either of them may be efficiently utilized. For the case of two auxiliary variables, the derivation for bias and mean square error have been given and also the generalization to multi-auxiliary variables.

**20. Parameters Estimation of Multiple Logistic Growth Model**

By

A.S. SETHI

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This paper aims at developing a methodology for estimating parameters of a multiple interactive logistic type of growth model.

Such a model is likely to be fitted in the situations where growth of a character is influenced simultaneously by a number of  $\times$  variables each individually having simple logistic relationship with the character. An iterative procedure has been developed for equally spaced  $\times$  variables with  $p=2$  and 3 (and can be extended for any general value of  $p$ ) following Nair's (1954) new method of fitting growth curves. The procedure is free from arbitrary assignment to starting values of any of the parameters which, in fact, are provided by the technique itself. Consequently, the proposed methodology is likely to furnish a convergent solution for the parameters with small number of iterations.

**21. Estimation of Cotton Yield in Vidarbha Region Using Double Sampling and Component Sampling Approaches**

BY

D.K. WANKHADE AND MRS. N.A. CHAUBE

*Punjabrao Krishi Vidyapeeth, Akola*

During 1970's Indian Agricultural Statistics Research Institute conducted pilot surveys on vegetables and on the basis of data of crop cutting experiments has developed methodologies for estimation of average yield, production etc. of vegetables involving multiple pickings. Recently Kaishta, A.C. and Goel, B.B.P.S. (1981) advocated the use of partial harvest data adopting double sampling as well as component sampling approaches for the estimation of vegetable production. Like vegetables, cotton also involves large number of pickings and use of entire harvest data for estimation purpose for this crop would entail exorbitant cost of data collection and so also the operational difficulties. The object of the present study is to examine the suitability of double sampling as well as component sampling approaches with use of partial harvest data for estimation of yield of cotton in Vidarbha region of Maharashtra State. An attempt has been made to identify the suitable picking or group of pickings on which major stress need to be given for data collection of double sampling and also to work out appropriate sample sizes.

The study revealed that the estimates based on double sampling approach with different large samples were not as efficient as that of the component sampling approach. Thus for estimating the cotton yield in Vidarbha region, the method of component sampling with use of partial harvest data is quite appropriate.

**22. On Heteroscedastic Disturbances and Growth Curves**

BY

N.S. GANDHI PRASHAD AND B.G. SAPATE

*Punjabrao Krishi Vidyapeeth, Akola*

Linear growth curves or experimental growth curves are very commonly used to assess the magnitude and direction of the growth and to forecast the future. The unknown parameters are usually estimated by the method of ordinary least squares. The suitability of the growth curves are decided on the basis of  $R^2$  and standard errors. At times some of the research workers even indicate the presence of auto-correlation by giving Durbin-Watson statistic. The purpose of this paper is to demonstrate, with the help of some empirical data, that even for fitting of the growth curves; the data has to be examined for the presence of heteroscedasticity. In this, exercise, Spearman Rank correlation test and Glejser's tests are applied for the detection of the heteroscedasticity in a time series data pertaining to the Area under Kh. Jowar grown in Maharashtra, during the period 1960-61 to 1977-78. Both the criterion, have confirmed the presence of heteroscedasticity. The efficient estimators, in case of linear regression, have been obtained after making necessary transformation as indicated by the Glejser's test.

**23. On Stability of Ridge Estimates and their Summary Statistics**

BY

N.S. GANDHI PRASAD, B.G. SAPATE AND S.W. JAHAGIRDAR

*Punjabrao, Krishi Vidyapeeth, Akola*

The Resource productivities of crop production are usually studied with the help of Cobb-Douglas production function. The elasticities of this function are normally estimated by the method of ordinary least squares. But in this method strong inter correlations among the independent variables lead to a problem of multicollinearity and affects the standard errors of the estimates. Ridge estimation technique is often advocated as a solution for the problem of multicollinearity. Input-output relationship studies many times come across with such problems of multicollinearity. Therefore, the present study is undertaken to examine the stability in production elasticities and their summary statistics with reference to production of cotton, a major crop grown in Vidarbha region by the method of ridge regression.

The study reveals that though the ridge estimation technique provides stable estimators, the summary statistics may not be stabilized at the same value of scalars and thus it is left to the Research workers for the selection of 'k' value which is common for all the regression coefficients (*i.e.* all the estimators may not be equally stable at the chosen values of 'k') as well as for summary statistics.

**24. On Semi-Markov-Analogue of Random Walk with Absorbing Barriers**

By

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Department of Agriculture, Faridabad (Haryana)*

This paper deals with some problems pertaining to a random walk with absorbing barriers, the time between any two transitions *i.e.* between a shift in position, being a random variable whose distribution depends on the direction of the movement. Probability of position at time  $t$  before absorption, probability of ultimate absorption at a barrier conditioned on the starting position are obtained explicitly. The probability distribution of the duration of the walk have also been studied. The problem is motivated by questions pertaining to growth of a cancer tumor and multigene evolution.

**25. Response Functions for Selected Cereals In Himachal Pradesh**

By

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An attempt was made to study the price responsiveness in selected cereal crops (rice, wheat, maize and barley) and to estimate the the short-run and long-run price elasticities. Supply response functions using Nerlovian type adjustment model were fitted for these four cereal crops. The current area planted under the crop was taken as dependent variable. The independent variables with one year lag were area, actual price variability and yield variability of that crop. The time trend was also included in each function as one of the independent variables. Thus Cobb-Douglas functions were used. This study was based on the time series data covering a period of 25 years from 1951-52 for the whole of Himachal Pradesh.

From the analysis of regression equations it was found that the coefficients of multiple determination ( $R^2$ ) were high in all the equations ranging from 0.60 in rice equation to 0.97 in maize equation. In all the equations the variable denoting the trend was not found significant thereby, indicating that the technology had no influence on the allocation of the area under these crops. In the case of wheat the regression equation showed that one per cent increase in lagged area and lagged price would increase the current area of the crop by about 0.57 per cent and 0.098 per cent respectively. For barley, lagged areas, yield variability and the time trend were found to have significant effect on the allocation of the area.

The long-run elasticities were computed as 0.1445, -0.0713, 0.2267 and 0.03360 for maize, rice, wheat and barley respectively. The coefficient of area adjustment (1-coefficient of lagged area) obtained from the equations were 0.3403, 0.7576, 0.4322 and 0.5766 for maize, rice, wheat and barley respectively. The estimated number of years required for complete adjustment to within 5 per cent of one were found to be 7.21 for maize, 2.11 for rice, 5.34 for wheat and 3.49 for barley. Thus the inelasticity of farm supply responses to prices indicated that there would be very limited scope for the feasibility of formulating price policies to bring about desired changes in the output-mix crop-mix in Himachal Pradesh, which is barley self-sufficient in food-grain production.

## 26. Growth Rates of Area, Production and Yield of Major Food grains A case study of Uttar Pradesh

By

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The nature and extent of growth rates of five major food crops (wheat, rice, gram, barley and bajra) for the state of Uttar Pradesh, during the period 1950-51 to 1977-78 have been attempted. The linear growth models have been used and the various findings reveal that (i) yields of wheat and rice have increased relatively at a faster rate as compared to those of gram, barley and bajra, (ii) for wheat and rice the aggregate production increased at a faster rate as compared to area and yield, (iii) the production of gram increased at a slower rate as compared to its yield, (iv) barley and bajra both recorded a negative rate of increase in their area and production, and (v) the per annum rates of increase of area, production and yield are observed to be 3.67 per cent, 10.19 per cent and 2.23 per cent for

wheat; 0.43 per cent, 4.31 per cent and 2.69 per cent for rice;— 1.49 per cent, 0.75 per cent and 1.57 per cent for gram; —2.07 per cent —2.08 per cent and 1.22 per cent for barley;—0.39 per cent, —0.19 per cent and 1.27 per cent for bajra, as compared to those of 0.49 per cent, 2.11 per cent and 2.02 per cent for the total food grains as a whole.

**27. A Study of Stability in yield Performance of Improved Varieties and F-1 Hybrids of American Cotton under Vidarbha Conditions**

By

B.G. SAPATE, N.S. GANDHI PRASAD AND M.A. TAYYAB  
*Punjabrao Krishi Vidyapeeth, Akola*

The object of the study was to assess the stability in yield performance of improved varieties and F-1 hybrids of American cotton under Vidarbha conditions. The data of final varietal trials (large plot, replicated, multilocational trials repeated over years) conducted by 'All India Coordinated Cotton Improvement Project, Punjabrao Krishi Vidyapeeth, Akola' has been adapted for the study.

The trials for varieties were taken under rainfed conditions for the years 1978-79 and 1979-80 at 8 locations in Maharashtra. The trials for hybrids were for the years 1977-78 to 1979-80 under rainfed conditions at above mentioned 8 locations while under irrigated conditions at 3 locations. The stability performance of F-1 hybrids was studied for 3 types of environmental conditions, namely, rainfed, irrigated and irrigation ignored.

The stability of genotype performance was studied using Freeman And Perkins (1971) model and that of phenotype performance was assessed using Eberhartt and Russel (1966) model. In both these models, relationship between genotype/phenotype performance and environment is assumed to be linear.

The study revealed that though genotype and phenotype differences were observed between F-1 hybrids, they were not fully explained by the linear relationship as assumed in the stability models. Thus stability models are not applicable under the situations as revealed by the study and hybrids can not be ranked with regard to genotype or phenotype stability. This may be attributed to high degree of scatter or non-linear relationship between performance and environment or rather to heterogeneity of interaction between performance and environment. As such adaptation of any hybrid over complete tract of environments may be according to its yield

performance only and in case of presence of heterogeneity of interaction, better adaptable hybrid may differ according to its performance over groups of homogeneous environments. Genotype as well as phenotype differences were not observed between varieties.

**28. An Interstate Growth Analysis of Groundnut in India**  
By

P.R. WAGHMARE AND J.H. GARULE

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The time series data regarding area, production and yield of the groundnut crop for the period (1969-70 to 1977-78) were studied. The states Gujrat, Andhra Pradesh, Tamilnadu, Karnataka, Maharashtra, Madhya Pradesh and Uttar Pradesh contributed to the extent of 92 per cent in area to the total. The contribution of the states in production was with the same tune that of area. The area and yield fluctuations measured in terms of C.V. were low as compared to the production. The C.V. for production and yield were the highest (45.59 per cent) and (43.96 per cent) respectively for the state Gujarat which contributed to the highest (24.17 per cent) in area to the total. The significant positive compound growth rates were observed in area for the states Bihar (10.39 per cent), Kerala (6.55 per cent), Orissa (5.44 per cent), and it was negative and significant for Andhra Pradesh (3.64 per cent), and Punjab (1.61 per cent). Production significantly increased at the linear average rate of (12.54 per cent) and at the compound rate of (13.65 per cent) of the state Bihar. The yield significantly increased in Haryana and Pondicherry with the compound rate of (4.84 per cent) and (6.70 per cent) respectively. The positive and higher compound growth rates were obtained by Gujarat (4.02 per cent), Maharashtra (2.95 per cent), Rajasthan (2.69 per cent) and Bihar (2.95 per cent) respectively for yield which were statistically not significant.

**29. Analysis of Marketable Surplus of wheat in Operational Research Project Area, Chittorgarh (Rajasthan)**

By

H.B. CHOUDHRY AND R.K. PANDEY

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The main objective of this paper is to study the factor affecting marketed surplus of wheat in the operational research project area Chittorgarh. The data for the study was obtained from a household

survey of farmers during the year 1978-79. The study covers small medium and large farmers growing wheat. In all 168 cultivators were selected for detailed analysis.

It was observed that the marketable surplus was mainly concentrated in the hands of big cultivators. It varied from 41 to 82 percent in different panchayat samitees. The main variables affecting the marketable surplus are total output, area under the crop and family size. Linear and log-linear models have been estimated to examine the impact of the above mentioned variables on marketed surplus.

### 30. Joint Effects of Weather Variables on rice yield

By

RANJANA AGRAWAL, R.C. JAIN AND M.P. JHA

*I. A. S. R. I., New Delhi*

An attempt has been made to study the joint effects of climatic variables on rice yield at different stages of crop growth. The weekly weather parameters viz. maximum temperature, relative humidity (14 hrs) and total rainfall were considered. Results on joint effects of maximum temperature and relative humidity revealed that beneficial effects of above average maximum temperature on yield increased with rise in humidity during active vegetative phase while detrimental effects decreased in other phases of crop growth. The adverse effect was pronounced during flowering stage of the crop. The rise in humidity had small beneficial effects in general throughout the crop season. Beneficial effect was pronounced at the time of flowering. The effects increased with increase in temperature. Joint effects of maximum temperature and rainfall revealed that rise in temperature associated with high rainfall had beneficial effects during growth phase of the crop. The increase in rainfall with sufficient temperature was beneficial except towards the end of initial growth and ripening phases of the crop.

### 31. The New Approach for solving a L.P. problem.

By

M.T. BHARAMBE

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In this paper the new approach (in simplex method) is suggested for solving a LP problem which have variables and 2 constraints. In usual simplex method, we move from the given basic feasible



solution to an optimal basic feasible solution by changing a single variable in the basis at a time. In the suggested method, we move from given basic feasible solution to an optimal basic feasible solution by changing one or two variables at a time.

### 32. Effect of Intermating in Early Segregating Generations on Character Association in Bread Wheat

By

SUBEDAR SINGH AND G.C. MISRA

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Character associations among BIP, BIP-selfs and  $F_3$  progenies were studied for six characters, namely, plant height, spike length, grains/spike, grain yield of 3 spikes, test weight and yield/plant. Usually, yield was significantly positively associated with plant height, spike length, grains/spike, grain yield of 3 spikes and test weight. Intermating in early segregating generations affected the character associations. Therefore, it is suggested that biparental matings result in accumulation of favourable genes, change in direction and magnitude of character associations and maintenance of genetic variability in subsequent generations for selection to be effective. The environment suppressed the expression of the actual correlation among the characters.

### 33. Generalized N-Ary Partially Balanced Block Designs

By

V.S. SOUNDARA PANDIAN.

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Madurai*

Tocher (1952) introduced and defined Balanced n-Ary Block (BNB) designs. Following Tocher's definition, Murthy and Das (1967), Das and Rao (1968), Dey (1970), Saha and Dey (1973), Nigam (1974), Saha (1975), Morgan (1977) and others have constructed BNB designs through various methods. Later Mehta, Agarwal and Nigam (1975), seeing the definition of Partially Balanced n-Ary Block (PBNB) design given by Paik and Federer (1973), have constructed some PBNB designs as a generalization of PBIB designs. Utilizing the definition of PBNB design, Soundara Pandian (1980) has generalized the binary General Module Theorem of Sprott (1955) and extended it to General n-Ary Module Theorem for constructing a new series of PBNB designs from initial blocks

or a set of initial blocks. Kageyama's (1980) work on characterization of BNB design when  $RK = \Delta V$  and Soundara Pandian's (1981) work on some properties of  $n$ -ary designs may also be noted. But so far no generalization or general work on PBNB design itself is available except the generalization of Das and Murthy (1967) and Shafiq and Federer (1979) on BNB designs. Present paper extends the generalization work of Shafiq and Federer for BNB designs to PBNB designs of two associate classes.

The concept of  $N$ -ary partially balanced incomplete block designs developed from any binary partially balanced scheme, where the incidence matrix  $n$  contains the  $N$  values  $0, 1, \dots, N-1$ , is extended to Generalized  $N$ -Ary Partially Balanced Block (GNPBB) designs, where the new incidence matrix  $n^*$  contains the  $N$  values  $m_a$ , for  $a=0, 1, \dots, N-1$ , for  $m_a = am_1(a-1)m_0$ , and for any  $m_0$  and  $m_1$  satisfying  $0 \leq m_0 < m_1$ . Definition, parameters, fundamental identities, association matrices and necessary conditions for  $n^*$  are presented. For different set of  $m_a$ ; ( $a=0, 1, \dots, N-1$ ) values, a new class of  $N$ -ary partially balanced block designs are constructed by fixing the number of treatments ( $v$ ) and total number ( $N^*$ ) of experimental units, where the original association scheme is maintained throughout. Criteria are developed to select the two associate scheme partially balanced  $n$ -ary design (s) in the class with smallest variance of a contrast. Consideration of special type of partially balanced  $n$ -ary block designs and efficiency factor for generalized two associate  $n$ -ary designs are also presented.

#### 34. A Construction of Balanced Arrays of Strength $t$ and Some Related Incomplete Block Designs

By

G. M. SAHA AND B. K. SAMANTA

*Indian Statistical Institute, Calcutta*

*Jute Agricultural Research Institute, Barrackpore*

Saha (1975) has shown the equivalence between a 'tactical system' (or  $t$ -design, as they are now called) and a two-symbol balanced array (BA) of strength  $t$ . The implicit method of construction of BA in that paper has been generalised herein to that of an  $s$ -symbol BA of strength  $t$ . Some BIB and PBIB designs are also constructed from these arrays. Majinder (1978), Vanstone (1974) and Saha (1978) have all shown that the existence of a symmetrical BIBD for  $V$  treatment implies the existence of six more BIBD's for  $V$  treatment in  $(V_2)$  blocks. An analogue of this result has been obtained for a large class of PBIB designs in this paper.

## 35. A Note on the Analysis of Balanced Incomplete Multiresponse Designs

BY

R. K. MITRA AND G. M. SAHA

*M. J. College, Jalgaon**Indian Statistical Institute, Calcutta*

The analysis of balanced incomplete multiresponse designs on the decomposition of the matrix  $\underline{C}_i$  of  $D_{2i}$ ,  $i=1, 2, \dots, u$  (for notations and terminology a reference may be made to the book by Roy *et al.* (1971) in the form

$$\underline{C}_i = \alpha_{i1}F_1 + \alpha_{i2}F_2 + \dots + \alpha_{im}F_m \text{ such that}$$

$$\sum_{q=1}^m F_q = J; \alpha_{iq}'s \text{ are known scalars and the choice of}$$

$\theta_i$  to make  $\underline{LL}'$  non-singular.

It is observed in this note, however, that for any given response-wise design  $D_1$  (not necessarily balanced) and for balanced connected (BC) block designs  $D_{2i}$ 's ( $D_{2i}$ 's may be same or different BC designs in the  $u$  sets)  $i=1, 2, \dots, u$ , the analysis can be carried out much more easily without involving the  $\theta_i$ 's. Further, we show that, for efficiency balanced designs used in different sets, similar simpler analysis can also be achieved.

## 36. On Resolvable P.B.I.B. Designs

BY

KISHORE SINHA AND ALOKE DEY

*Birsa Agricultural University, Ranchi &**I.A.S.R.I., New Delhi.*

Resolvable solutions for some two associate PBIB designs obtained by duplicating some non-resolvable designs are given. For the same designs 2-, 3- and 5- resolvable solutions are reported by clatworthy (1973). A method of construction and some new resolvable PBIB designs obtained through this are given.

## 37. Combined Analysis of a Group of Split-Plot Design

BY

K. C. BHUYAN AND T. K. GUPTA

*Bidhan Chandra Krishi Viswa Vidyalaya, Kalyani (W.B.)*

If a group of split-plot design is conducted in different places under homogeneous agro-climatic conditions to recommend a group

of treatments which are best over all places, homogeneous error variance is very much likely. But if the experiments are conducted in different agro-climatic conditions or if the individual experiments are conducted by different experiments using different procedures, heterogeneity in the error variances is very much likely.

In this paper combined analysis both for homogeneous and heterogeneous error variances are provided. Usual least squares procedure are applied in combined analysis with homoscedastic model. Exact test statistic is suggested for testing the insignificance of the difference between two sub-plot treatment means at different levels of whole-plot factor. Assuming error variances of different experiments to be known, the combined estimate of treatment effects in heterocedastic model are obtained and the corresponding analysis is provided with the help of weighted generalized least squares. For unknown error variances, an adjustment of the estimators and other statistics using estimated weights is suggested for removing much of the resulting bias. The adjustment stems from a theorem due to Meier (1953).

The weights used are the reciprocals of the estimated error variances from each individual experiment. During whole-plot comparison the reciprocals of whole-plot mean sum of squares from individual experiment are used as estimated weights and the reciprocals of sub-plot error mean sum of squares are used as weights in sub-plot comparison.

### 38. On Cox's Mixture Polynomial

BY

M. S. RAMACHANDRA MURTHY,  
*Osmnania University, Hyderabad*

Experiments for the study of response surfaces in a multi-component system in which the response depends only on the proportions of the components present are termed as experiments with mixtures. The factor space in such  $n$  component systems is a regular  $(n-1)$  dimensional simplex. Scheffe (1958, 1963) introduced designs and their associated canonical polynomial models for the study of response surfaces. Methods of construction of experimental designs for mixture experiments in  $n$ -components using factorial designs in  $(n-1)$  factors have been developed using orthogonal transformations (Murthy 1966, Thompson and Myers 1968). While fitting response surface models in  $n$  components, it is convenient to first fit the models in  $(n-1)$  independent factors and then transform them to the corresponding models of

Scheffe. In such cases Ramachandra Murthy (1980) derived relationship between the estimates of the parameters of the resulting models.

Cornell (1975) obtained a relationship between the estimates of the parameters of Scheffe's canonical polynomial models and those of the corresponding models suggested by Cox (1971). In this paper, a relationship between the estimates of the parameters of linear and Quadratic models in  $(n-1)$  independent factors and those of corresponding models of Cox are presented.

**39. A Note on Uses of Argumented Balanced Incomplete Block Design**

BY

S. MOHANTY

*O.U.A.T., Bhubaneswar*

A special family of bib design with parameter  $v=2(t+1)$ ,  $b=2(2t+1)$ ,  $r=(2t+1)$ ,  $k=t+1$  and  $\lambda=1$ , has been used for construction of irregular fractional plans of  ${}_2V$  factorials by using the incidence matrix of the design alongwith two more additional points (000...00) and (111...11) to form treatment combinations. These plans are (i) Orthogonal Resolution III type plans when  $t$  is even and (ii) Orthogonal Resolution IV plan when  $t$  is odd.

**40. A General Algorithm for the Analysis of Incomplete Block Designs**

BY

NGUYEN KY NAM

*I.A.S.R.I., New Delhi-110 012.*

A general algorithm for intra-block, inter-block and combined analysis of BIBD, PBIBD (with any number of associate classes) on computers is described. The algorithm utilises the general theory of incomplete block designs and two special matrix operators of Beaton (1964) : the SCP operator (sum of cross product operator) and SWP operator (sweep operator).

**41. A Note on Orthogonal Main Effect Plans for Asymmetrical Factorials**

BY

VEENA AGRAWAL

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AND

A. DEY

*I.A.S.R.I., New Delhi-110 012.*

Fractional factorial plans of resolution III permit the estimation of mean and all main effects when all interactions are assumed

zero. If the plan permits orthogonal estimation of mean and all main effects, the plan is called an orthogonal main effect plan.

Orthogonal main effect plans have been studied and tabulated extensively by Addelman (1962) and Addelman and Kempthorne (1961). Additional plans have been reported by Starks (1964), Margolin (1968), Dey and Ramakrishna (1977), Chacko, Dey and Ramakrishna (1979), Chacko and Dey (1980) and Gupta, Nigam and Dey (1981).

This communication presents two new series of orthogonal main effect plans, viz.,

- (i)  $n \cdot 4^r \cdot 3^s \cdot 2^{3n-9-3(r+s)}$  in  $4n$  runs,  $2 \leq (r+s) \leq 3$ ,  $(r, s) \neq (0, 0)$  and
- (ii)  $t \cdot 4 \cdot 2^{n-1}$  in  $2n$  runs, where  $n$  is a multiple of four and  $t=n/2$ .

#### 42<sub>2</sub> Optimum Plot Size for Field Experiments on Brinjal

By

K.C. GEORGE AND V. HARIHARAN

*Kerala Agricultural University, Trichur.*

The variability of plot size and shape was determined by calculating the coefficient of variation. It was observed that an increase in the plot size in either direction decreased the C.V. The decrease was more rapid along N-S direction. Long and narrow plots yielded lower CV than approximately square plots.

The observed relation between plot size and variance was in conformity with the Fairfield Smith's variance law. The optimum plot size observed through Smith's method and maximum curvature method was almost the same. From the above considerations, a plot size of  $8.64\text{m}^2$  ( $9.6\text{m} \times 0.9\text{m}$ ) was found to be most advisable for conducting most of the field experiments in brinjal.

The efficiency of the plot decreased as the size of the plot increased there is a general decrease of block efficiency with increasing block size. More compact blocks of the same size show a higher efficiency.

#### 43. The Design and Analysis of Intercropping water Assessment Experiments

By

B. GILLIVER

*International Crops Research Institute for the Semi-Arid Tropics, Patancheru (A.P.)*

In the semi-arid regions of the world one of the most important environmental constraints confronting farmers is the dread of insufficient rainfall to maintain his crop through to the seed producing

stage. Agricultural research workers have recognized the priority of gearing their work to this possible drought situation. At the present time, the majority of farmers in the semi-arid regions practise inter-cropping farming methods and coupled with the drought problem there is the need by statisticians to assist biologists in devising experimental designs and methods of processing results for investigating such systems.

In this paper I outline possible approaches to deal with the assessment of breeding material for two crops grown in conjunction with one another and also an approach taken by physiologists to assess the impact of drought stress in the intercrop situation.

**44. A Note on the Comparison of the Efficiencies of Different Regression Models for Processing Fertilizer Trials**

BY

G.R. MARUTHI SANKAR, M. VELAYUTHAM AND K.C.K. REDDY  
*All India Co-ordinated Soil Test Crop Response Correlation Project (ICAR), Amberpet, Hyderabad.*

Six different regression models have been investigated to study the asymptotic efficiencies of the estimators of the regression coefficients by using the test and efficiency criteria proposed by Cox (1961, 1962) and Pereira (1977). The frequency preferences of a model to the alternative models have been estimated by considering the response data of a soil test crop response field experiment. The consequences of using a true model or a false model when the given model is false or true have been examined. The optimum nutrient requirements have been derived from the different models wherever possible for the significant nutrients which followed the law of diminishing returns. The results suggest that the Orthogonal Polynomials (OP) are more efficient and are preferred to the other regression models studied for the example.

**45. Combining Ability Analysis in a  $8 \times 8$  diallel Involving Semidwarf Cultivars of *Triticum aestivum* L. em Thell**

BY

R.P. SINGH, R.B. SINGH, SUBEDAR SINGH, B.D. SINGH AND R.M. SINGH

*Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.*

Eight diverse and elite wheat cultivars were ordered into a non-reciprocal diallel cross to study combining ability variances and

estimates in  $F_1$  and  $F_2$  populations. Data were recorded on days to 50 per cent heading, number of grains/spike, grain yield of 3 spikes, yield/plant and 100 grain weight. GCA and SCA variances were significant for all the characters both in  $F_1$  and  $F_2$  populations, except to SCA variance for yield/plant. The GCA/SCA variance ratio showed that additive genetic variances were higher than the non-additive variances for all the characters in both the generations. The GCA/SCA variance ratio was relatively higher in  $F_2$  as compared to that in  $F_1$  for most of characters due to a decline in the magnitude of SCA variances in  $F_2$ . In general, *per se* performance of the parents were with their GCA effects, but the superior  $F_1$ 's were not necessarily the crosses whose parents had high GCA effects. Most of the crosses showing higher or significant positive SCA effects involved one good and one poor or even negative general combiners. High estimates of SCA effects were usually recorded in those crosses which involved diverse interacting parents.

#### 46. Grouping of Ordered Observations in Split-Plot Designs

By

S.C. RAI AND P.P. RAO

*I.A.S.R.I., New Delhi.*

In order to find out the treatments (say varieties or doses of fertilizers etc.) suitable for a particular tract it is necessary that the trials may be conducted at a number of locations in the region during different years. For drawing valid conclusions from such trials, it becomes necessary to make the joint statistical analysis of data by combining the results of individual trials. Trials in splitplot Designs are very convenient and popular in field experimentations. Statistical analysis of the data from a series of Split-plot experiments presents special problems when error variances are heterogeneous for error (*a*) or error (*b*) or both. The usual technique of analysis of variance is not valid in such cases. In the present paper we have developed a method of analysis of data from group of split-plot Designs.

The procedure involves first ranking the observations for each treatment in a replication and then calculating the test statistic suitable for comparing main plot treatments, Sub-plot treatments and interaction of mainplot and sub-plot treatments. The probability distributions for various test-statistics have been worked out for testing the null hypothesis.

against 
$$H_0 : T_i = T_j \quad \text{for all } i \text{ and } j, i \neq j$$

$$H_1 : T_i \neq T_j \quad \text{for some } i \text{ and } j.$$



Test statistics for combining the results from various split-plot experiments have been developed. Procedures for testing the treatment  $\times$  place or year interactions have been evolved. Entire procedures have been explained by a numerical illustrative example.

**47. A Non-Iterative Approach For Least Square Estimates Under a Singular Pattern of Missing Observations**

BY

S.P. SINGH AND M. PRATAP

*J.V. College, Baraut (U.P.)*

If for one or the other reasons  $m$  observations in a planned experiment are missing, the least square estimate of these observations are obtained by solving a set of  $m$  simultaneous linear equations. If these equations are not independent, such a pattern of missing observations is called singular. Searle (1971), John and Prescott (1975), Rubin (1972) and others have shown that only the iterative procedure can be gainfully used to obtain the estimates in the case of singular pattern of missing observations. Some of them, however, stressed the need of exploiting the noniterative procedure under such circumstances.

In the present investigation the non-iterative procedure of finding the least square estimates in the case of singular pattern of missing observations has been discussed. A Latin square design, when one treatment has completely failed, has been considered for analysis. It has been found that any solution of the simultaneous equations obtained by imposing a linear restriction on the missing observations will yield an unique of the error sum of squares. This property enables us to proceed for the non-iterative estimation.

**48. A Note on the Application of Analysis of Covariance**

BY

MUKTI NATH

*D.A.V. College, Dehradun (U.P.)*

An easy approach for the application of Analysis of Covariance technique is presented with four models based on the Completely Randomised Design, Completely Randomised Block Design, Latin Square Design, and Factorial Design respectively.

49. Size and shape of plots and blocks for field experiments in natural grasslands in hills and ravines of India

BY

RAM BABU AND M.C. AGARWAL

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A two year uniformity trial on natural grasslands of outer Himalayas at various hill slopes, lower Ambala Siwalik hills, Nilgiri hills and on ravines (top, slope and bottom) revealed that the coefficient of variation decreased with the increase in plot size upto  $12m^2$  at various slopes of outer Himalayas,  $8m^2$  at Siwalik hills and Nilgiri hills and  $12m^2$  at ravines (top, slope and bottom). The equation  $y=ax^{-b}$  gave a good fit to the relationship between coefficient of variation and plot size at various slope ranges of outer Himalayas, Siwalik hills, Nilgiri hills and ravines (top and bottom). The fit was not good for few cases of ravine slope. For a fixed size of plot, the shape of plot did not indicate any consistent effect on CV. However, the plots elongated along the slope on all the slopes of outer Himalayas, compact plots on Siwalik hills, plots elongated along the slope on Nilgiri hills and plots elongated perpendicular to the slope at ravine top and ravine bottom and along the slope on ravine slope showed smaller CV. with the fixed experimental resources or cost, small plots were more efficient. For outer Himalaya hill slopes, Ambala Siwalik hills and Nilgiri hills, the plot size of 8 to  $12m^2$  appeared to be optimum and practicable for all the locations. However, in the case of ravine top, ravine bottom and ravine slopes, the plot size of 12 to  $24m^2$  appears to be most suitable for all the locations. The average number of replications and experimental area were higher with larger blocks. efficiency decreased with an increase in block size. The shape of block had no consistent effect on block efficiency, but block across the slope at all the outer Himalayas hill slopes, across the slope or compact at Siwalik hills, across the slope at Nilgiri hills and along the slope or compact at ravine top and bottom and across the slope or compact on ravine slope were more efficient. The relationship  $y=ax^b$  between coefficient of variation ( $y$ ) and block size ( $x$ ) was fitted to block size ranging from 2 to 24 at all locations. The equation gave a good fit except for few cases at each locations. Confounding proved more efficient at each locations,

50. **Dynamics of Acreage Allocation a case study for cotton in Akola district (Maharashtra)**

BY

MRS. N.A. CHAUBE AND S.W. JAHAGIRDAR

*Punjabrao Krishi Vidyapeeth, Akola*

The object of study was to explore economic and non-economic factors which effect the decision making of farmers of Akola district with regard to acreage allocation to Cotton. The study covered time series data for the period 1967-68 to 1978-79. The Nerlovian 'adjustment lag' model was utilised for the study.

The elasticities were estimated by OLS method and the elasticity of adjustment is then worked out as,  $\lambda=(1-b_1)$ . The estimating models initially included different sets of 7 explanatory variables and on the basis of information provided by summary statistics, models were modified step by step by deleting one or other variables to identify a few appropriate models showing high explanatory powers and containing significantly influential characters.

This study revealed, that lagged area under competing crop, the risk involved in the yield of competing crop are only the influential variables and influences the rational behaviour of the farmers. The variables lagged area and yield under Cotton, its yield risk, its price, price and price risk of competant crops have little effect on the dynamics of the rational behaviour of the farming community. It was further observed that farmers' adjustment for climatic and other eventualities were quite rapid and perfect.

51. **Economics of Fertilizer use under dryland farming conditions**

By

N.Y. PALIMKAR S.V. RAIKHELKAR AND ABDUL QUDEER.

*Marathwada Agriculture University, Parbhani*

Fertilizer is one of the major inputs for increasing agricultural production even under dryland farming conditions if it is managed efficiently in relation to availability of soil moisture and with its economic consideration. The efficiency of fertilizer use depends on better agronomic management of crop and crop sequences and economic considerations of prevailing price of fertilizer and products at that particular seasons and market. The factor production ratio of prices should be smaller as far as possible to enhance high profits. This will help farmers in exploiting production potential of the crops. With this object in view an economic optima for sorghum CSH-5

was found to be 79.305 kg N/ha and for pearl millet 80 kg N/ha was most economical dose, for cotton H-4 it was 75.502 kg N/ha for Godavari hybrid rainfed cotton it was 60.66 kg N/ha for pulses it was 50 kg  $P_2O_5$  per hectare with seed treatment of rizobium culture. Regarding groundnut crop the application of 30 kg N, 60 kg  $P_2O_5$  and 40 kg  $K_2O$  per ha, gave net returns ranging from 3.2 to 8.73 per rupee invested on fertilizer. Whereas in rainfed paddy the optimum dose of nitrogen for Tuljapur-1 was found to be ranging from 40 to 50 kg N and 25 kg  $P_2O_5$ /hectare.

## 52. An Evaluation of Response Models

By

RAJENDRA SINGH AND F.S. CHAUDHARY

*Hisar Agricultural University, Hisar*

In developing countries, recommended optimal doses of chemical fertilizers are generally not acceptable to the farmers and as such they hesitate to use them in toto. Estimates of optimal fertilizer rates for developed countries are readily available in Myers (1971) but for many crop-soil conditions like India, these response model need a careful study especially when fertilizer has become a very scare and costly input. To evaluate the merits of response models a study has been made and modified quadratic model has been proposed. The Proposed model has the desired merit of examining declining yield at higher rates of applications. The upward bias in estimating optimal rates is completely removed and reasonable values of optimal rates are obtained for single nutrient experiment. The proposed model can be accepted as an appropriate model for describing and interpreting fertilizer response in field trials.

## 53. Use of yield prediction model in locating critical stages of growth in groundnut.

By

T.J. KHATRI, R.M. PATEL AND P.D. MISTRY

*Gujarat Agricultural University, Anand*

Step-wise regression analysis of groundnut yield and rainfall data of the past 24 years for the district of Ahmedabad in Gujarat State was primarily used to develop a yield prediction model. An attempt has been made to utilize this model for locating critical stages of crop growth. The critical stage for this purpose is the stage, when the occurrence or otherwise of rainfall has significant influence on groundnut yield. Ascertaining the critical stages in this way will serve as guidelines in scheduling irrigation for cultivation of irrigated groundnut crop in the district.

#### 54. Comparison of Resource Productivities of Irrigated and Unirrigated Holdings in Arid Region of Rajasthan

By

A. P. GAUR

*Agricultural Research Station, Durgapura, Jaipur.*

The resource productivities of different inputs utilized in agricultural production process is of much importance to find the extent to which the output could be increased from the given resources. A sizeable portion of cropped area remains rainfed and assured irrigational facilities are inadequate. Keeping in view, these points, this research study has been conducted. Ninetyfive holdings constitute the total sample size for which the data pertaining to various inputs and output have been collected during 1978-1979. The samples have been selected from Jodhpur, Barmer, Bikaner and Jaisalmer tehsils situated in arid tract of Rajasthan. Sixty holdings pertain to unirrigated while remaining are classified as irrigated holdings.

The conclusions derived from the study are :

Gross cropped area is being utilized at optimum level on both types of holdings. Additional human labour input would be more profitable on irrigated farms compared to unirrigated ones. There is potentiality to increase human labour resource more than double to its existing use on irrigated holdings. The bullock labour is being utilized at present in excess, but its shifting to other resources will be profitable only when the cost of transfer does not exceed the benefit. Tractor utilization could be increased on unirrigated holdings profitably, as the farmers have to utilize the available moisture of soil in a short period for sowing operation due to low and erratic rainfall. For irrigated farm, the elasticity coefficient for tractor labour is negative showing its excessive use, although the coefficient is not significant. The oilengine/electric motor coefficient is positive, depicting that further use of this input will result in profitable gains on both types of holdings.

#### 55. A Study of Economic Loss Associated with Calf Mortality

By

B. V. S. SISODIA, V. K. DWIVEDI AND SATISH KUMAR

*I.V.R.I., Izatnagar (U.P.)*

In the present study an attempt was made to determine the economic loss associated with the mortality of Holstein-Friesian

calves raised at Indian Veterinary Research Institute, Izatnagar (U.P) and how it could be averted by introducing a calf insurance scheme from individual level to some organised body. It was shown that the total economic loss due to 19.21% overall calf mortality from 1976 to 1980 was Rs. 6,340.37 and it could be diverted to Rs. 3,954.84 after introducing a calf insurance scheme. Calf mortality rates of 13.45, 25.0, 21.21, 12.50 and 26.32 percent during the years 1976 to 1980, respectively, led to a loss of 40.80, 96.60, 57.13, 48.70 and 64.06 percent in respective years. When the calves were assumed to be insured it was observed that there could be a reduction in loss by 16.42, 48.44, 20.48, 23.57 and 18.72 percent in respective years.

**56. Prediction of Slaughter Weights of Pigs on the Basis of a Few Initial Weighings**

By

L. B. S. SOMAYAZULU AND S. C. AGARWAL

*I.A.S.R.I, New Delhi-110012*

Prediction of weights of pigs at slaughter helps to know well in advance the profits that can be anticipated. The problem is a kin to that of predicting the lactation yield of a cow or buffalo and it is quiet useful for a farm owner.

From the weightment records of 10 experimental pigs from Vateriaary College farm, Tirupati, different curves were fitted on the records of weekly weights of different periods starting from the first week. It was observed that the curves fitted on the weekly records ranging from 1 to 20 weeks, the value of  $R^2$  was highest for a quadratic curve. Taking these curves, weights at slaughter were predicted with 95% confidence interval and it was observed that the actual and the predicted weights were quite close and well within the confidence limits.

A  $\chi^2$  test was performed to test the significance of difference between the actual and expected weights at slaughter and it was found that in case of prediction from the curves based on records of 1 to 20 weeks and over the  $\chi^2$  was not significant while in other cases it was highly significant.

In a bid to choose a single regression curve for all the pigs, a curve on the combined data of average weekly weights was fitted and these regression equations were tested for slopes. It was found that the curve fitted with average weekly weights was satisfactory

for all the individual equations as a representative as no significance of deviation from the hypothesis of the equal slopes was observed.

From this study it was concluded that the weekly records from 1—20 weeks could be used for a satisfactory prediction of the slaughter weights the other conditions of management remaining the same.

### 57. Study of Growth of Large-White Yorkshire and Land Race Breeds of Pigs

By

L. B. S. SOMAYAZULU AND S. C. AGARWAL

*I.A.S.R.I. New Delhi-110 012*

Data obtained from a nutritional experiment conducted by the Allahabad Agricultural University has been analysed to see whether there are really significant differences between breeds between sexes or between treatments after accounting for the initial differences in their body weights.

Linear and logistic curves are fitted and the growth rates are compared. It is observed that growth rates obtained from logistic curve are higher than those obtained from the linear. It is also observed that, while treatments overall did not show significance within the separate age and sex groups, the treatments are found to be highly significant as judged from the body weights record of pigs. However, when the initial body weights are taken as a concomitant variable and analysis of covariance is performed, no effect is found to be significant indicating that the differences shown were due to the differences in the initial body weights and not due to the treatment or any other factor.

### 58. Statistical Studies on the Mortality Patterns of Selected Broiler Breeds

By

K. V. DEVAPPA, S. RAMACHANDRA, N. SUNDARA RAJ, B. S. RAMAPPA AND R. N. SRINIVAS GOWDA

*University of Agril. Sciences, G.K.V.K. Campus, Bangalore.*

The mortality patterns among Poultry birds, as a result of a few important Poultry diseases viz Coccidiosis, Marek's disease and Lymphoid Leucosis, have been studied. The data of 3591 White

rock strain birds pertaining to the period April 1973 to March 1979 complete in respect of information for the first 40 weeks of birds' life constitute the data-base for this study.

Three different approaches for the comparison of mortality experiences are presented. These are (1) Survivorship curves and their comparisons (2) Sex-ratio and survivorship patterns (3) Age-specific percentage distribution of deaths and mortality patterns.

The analysis reveals that (a) during the early part-up to the first 10 weeks from hatching time—the survivor rates are lower for female birds than for the male birds with the reversion of its direction, this time in favour of female birds (b) the sex-ratio index—measured in terms of number of male birds surviving for every 1000 female birds at each age-interval (weeks)—showed a survivorship rate of 355 male birds to 1000 female birds during the first week of life reducing to 322 male birds per 1000 female birds by 40th week demonstrating a higher intensity of mortality experience among male birds.

The other approaches revealed roughly the same mortality pattern.

#### **59. Floor Area and Transactions in Birds in Poultry**

By

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An earlier study made by Agarwal (1980) showed that the egg production in commercial poultry farms was affected more by the frequent changes in the stock of birds at the farm than by either feed or labour. Similar, results were obtained by Ravindran (1980) for the floor area when it was included as an input factor.

In the present study, different production functions were fitted to the same data taking egg production as a dependent variable and number of standard birds maintained, feed cost, labour cost, floor area and transaction factor as dependent variables. The statistical analysis of the data showed that the relative contribution to egg production due to transaction factor and floor area when studied jointly were again larger than those due to feed and labour. Using quadratic equation, optimum floor areas are obtained for fixed levels of flock strength and transaction factor and the floor areas per bird are compared over the changes in transaction factor.



**60. Business Analysis of Broiler Production—A Case Study**

BY

S.W. JAHAGIRDAR

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The net profit per unit of broiler meat depends upon the costs towards purchasing price of day old chicks, feed, maintenance, medicine, etc. and cost associated with mortality of the birds. All India Coordinated Research Project on Poultry Breeding (Meat) P.K.V. Akola and University Poultry Farm, P.K.V., Akola examined the growth potentials of different competing test crosses under the local conditions to identify and recommend the strains for broiler production. Each strain has its own costs and benefits depending upon growth potentials, susceptibility of environments, mortality etc.

The optimum sizes of the poultry worked out under different strategies revealed that out of the four strains the birds of Izatnagar and Bhubaneswar centres are not beneficial under local conditions for commercial purpose. Only the birds of Bangalore and Pune centres are quite suitable for broiler production on commercial basis under local conditions and at varying proportions of expenditure on management. The study further revealed that the enterprise with these two strains has capabilities of higher returns by way of reduction in the expenditure on the items of management.

**61. Life time economics of Crossbred and non-descript cows in a rural area**

BY

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Studies made at experimental stations and in a few rural areas have shown that crossbred cows are superior to non-descript cows in production and some other traits. Crossbreds are, however, inferior to non-descripts in respect of mortality and fat content in milk. In this investigation an attempt has been made to compare the life time production, costs and returns from crossbred and non-descript cows utilising the data collected in a large scale survey carried out by IASRI in rural areas of West Bengal during 1977-80.

The average age at first calving was 43 months for a crossbred and 56 months for a non-descript cow. The average number of lactations completed by crossbred cow during the lifetime was 5.6 as compared to 4.7 for a non-descript one. Of the 100 normal

calvings among crossbreds, about 34 females would be available for further production and reproduction, when sex ratio and mortality were taken into account. In case of non-descript animals there would be 41 females. During the life time, these crossbreds would give about 180 tonnes and non-descripts 62 tonnes of milk, the average lactation yield worked out to be about 950 kg for crossbred and 320 kg for non-descript. The available data were also utilised for working out different costs (actual as well as imputed) and returns. It was observed that when actual paid-in-cost was considered, return-cost ratio was 1.67 for crossbreds and 1.08 for non-descripts. In all other cases the return was less than the cost, although the crossbred performed better.

**62. On a Method of Construction and Analysis of Confounded Asymmetrical Factorial Design**

BY

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A method of construction and analysis of confounded designs for asymmetrical factorials is developed. This method is quite general and is applicable to the symmetrical factorials as well. For the construction of a design for asymmetrical factorial firstly a suitable confounded design for  $2^n$  experiment is obtained, where  $n$  denotes the number of pseudo factors in the two level experiment and depends on the number of factors in the given asymmetrical design. Next the design for the symmetrical factorial is converted into the required design by means of suitable linear transformation.

A method of detecting interaction confounded in the desired asymmetrical design as a consequence of interaction confounded due to blocking in the corresponding  $2^n$  design of pseudo-factors has been given. An appropriate method of analysis of such designs is also discussed. The entire procedure of construction and analysis has been illustrated through a  $4 \times 3 \times 2$  asymmetrical design in blocks of size 8. The technique can easily be extended to confounded asymmetrical factorial designs involving any type of levels.

**63. Problems and Defects in the Estimation of Rural Income and Wealth for Tax Assessment in Uganda**

BY

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Most of the people who are liable to pay graduated tax in Uganda especially those in rural areas, do not keep records of their

incomes or production. These have to be estimated in order to determine their tax liability. The method used to estimate the income and wealth of people in the rural areas in Uganda is explained. The major problems encountered in this regard are : (i) The lists of tax-payers (or Tax Registers) are incomplete, *i.e.* some people are not registered as taxpayers ; (ii) The information used in the estimation of income is usually incomplete and inaccurate; and (iii) The values used in the imputation of value to various property is uncomparable between districts.

These problems and defects and others are discussed and numerically illustrated using data from 14 of the 32 rural districts of Uganda.

Recommendations are made for the improvement of the estimation exercise, in order first of all, to increase tax revenue to the various districts administrations, but, even more, important, so that it can be used as an alternative source of data in the rural areas. For example, a suggested expanded Tax Assessment Form could provide data wanted by National Accounts, Agricultural Statistics ; etc. Also, the recommended periodical surveys and studies to determine imputation values could provide data needed for compilation of National Accounts and Agricultural Statistics. In the light of the present serious problems facing the Statistics industry in Uganda, the estimation of rural income and wealth for tax assessment, if properly done, could provide an extra and relatively cheap source of data on the rural areas in general and on agricultural statistics in particular.

64. Study on use of successive sampling technique in surveys for estimation of crop yields

By

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The paper deals with the use of successive sampling technique in the analysis of data of crop cutting experiments collected in the survey "Methodological investigations into HYVP programme" conducted by IASRI during the 5th Plan. The sampling design adopted was stratified four stage random sampling with strata as blocks and villages, cultivators, fields growing HYV of the crop and a plot of specific size and shape as the sampling units at the four stage respectively. Although under the survey two independent

samples of fields were taken viz. one in which crop cutting experiments were conducted by Statistical Inspectors and other in which this work was entrusted to VLW's, data collected in the former series were studied in this paper as the successive sampling technique for the selection of units was used in this series only. In a year, 50 per cent of the villages selected in a stratum during the corresponding season of the previous year were retained and the remaining 50 per cent were selected a fresh and in the following the retained villages were replaced by fresh villages but those selected fresh were retained. Further, in retained villages, cultivators and fields were also retained as far as possible. The objective of the study was to investigate the extent of gain in precision of the estimated yield as also the number of years for which data may be collected for the purpose.

Three different types of estimates viz. one based on utilizing all the previous years information, the season based on previous one year information and the last, without using successive sampling technique were obtained. The district level estimates were arrived at by pooling the block level estimates with weights as the ratio of the number of villages in the sample from a particular stratum to the total number of villages in the sample taken in the district.

The comparison of the percentage S.E. of the three estimates revealed that the estimate based on successive sampling technique using either the entire previous years information or only the last one year information were more precise than the simple estimate, the corresponding S.E. being around 5 and 7.4 per cent respectively. However, the differences in two estimates are based on data of one previous year and the other using data of two previous years was negligible, the S.E. being 5.10 and 4.99 per cent respectively.

**65. Some aspects of storage and disposal of foodgrains in Delhi State**

By

S.K. RAHEJA, P.C. MEHROTRA AND K.K. TYAGI

*I.A.S.R.I., New Delhi*

The paper deals with farm level storage and disposal of foodgrains in Delhi State. It was observed that a majority of the cultivators (72%) continued to store the foodgrains by the conventional method (packing in guny bags/theekka and keeping in the open in the living rooms) which are not safe from moisture effect and rodents attack etc. The average amount spent on construction

purchase of storage structure in terms of per quintal of capacity was around Rs. 19 for pukka room store, Rs. 10 for metallic container and Rs. 2.50 for non-mettalic container. The average life of the respective stores was 66, 20 and 2 years. The main problems reported in the existing storage facilities were (i) rodent attack, (ii) weather (moisture) effect and (iii) short life. The main constraints in acquiring improved storage facilities were lack of funds and non-availability of the desired type of storage facility. Nearly three-fourths of the holdings adopted protective measures during storage. Those not adopting protective measures were not convinced about the benefits accruing from such measures. Nearly 7 per cent of the holdings reported foodgrain losses of varying intensity in storage. The loss worked out to nearly 50% of foodgrains per holding. For the main crop of the area *viz.* wheat, nearly 27 per cent of the farmers had no surplus, 23 per cent sold out the surplus immediately after harvest, 27 per cent partly sold out the surplus and partly retained it for later disposal and the remaining 23 per cent retained the entire surplus for later disposal.

#### 66. Role of credit in adoption of improved agricultural technology

By

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The paper deals with the study of the extent and intensity of utilization of credit facilities available and their effect on the adoption of modern technology by cultivators growing hybrid varieties of jowar in Akola district of Maharashtra State during 1977-78. It was observed that nearly one third of the farmers availed of credit facilities and the average amount borrowed per borrowing cultivator was around Rs. 1400. Both the proportion of borrowing cultivators and the amount borrowed per borrowing cultivator increased with increase in the size of holding. On the other hand the average amount borrowed per hectare per borrowing cultivator declined with increase in the size of holding being Rs. 420, Rs. 320 and Rs. 250 in small, medium and large holdings respectively. The adoption rate of most of the components of new technology studied like fertilizer levels, use of improved implements, plant protection measures etc. was of a higher order in the credit availing class of farmers compared to that in the non-credit availing class. However, all the farmers in credit availing class could not adopt the various components of new technology and bring the entire area sown with jowar under hybrids on account of lack of funds. Accordingly there is an acute need

for not only providing credit facilities to the farmers but also to ensure that the quantum of financial assistance is adequate to meet the requirements of crucial inputs.

**67. A scheme for construction of index of adoption rate of improved agricultural technology**

By

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The new agricultural strategy involves the adoption of the various recommended improved practices for optimizing the yield levels. However, in actual practices, the extent and intensity of adoption of different components of the new technology by the cultivators very widely over different regions, categories of farmers, etc. even for the same crop variety.

For a study of the rate of adoption of new technology as also of its variation over the different categories of farmers, regions etc. it is necessary to have a measure of the aggregate rate of adoption of new technology representing the sum total of the different components, since a componentwise comparison is neither feasible nor meaningful. It is, therefore, desirable to develop a suitable scheme of combining the adoption rates of these components so as to arrive at an overall index of adoption of the new technology by farmers in a defined class. In this paper an attempt has been made to develop suitable indices of adoption rate of new technology.