ABSTRACTS OF PAPERS

1. A Weighted Shrinkage Estimator for the Variance of a Normal Population

G. C. Mishra and B. N. Pandey
Banaras Hindu University, Varanasi

A weighted shrinkage estimator for the variance of a normal population in the presence of a guess value of the population variance is considered. In the proposed estimator, the degree of belief k $(0 \leq K \leq 1$) in the guess value is incorporated. If the value of k is near zero, the belief in the guess value is supposed to be strong enough. The expressions for the bias and mean square error of the estimator are derived. It is observed that the gain in relative efficiency of the proposed estimator with respect to the usual unbiased and consistent estimator is high when the guess value of the population variance is close to its true value and the sample size is small. Further, the relative efficiency is very much affected by the values of k and it increases as k decreases.

2. An Optional Randomized Response Sampling Technique Using Non-Stigmatized Attribute

N. S. Mangat
Punjab Agricultural University, Ludhiana

The randomized response (RR) data-gathering device to procure trustworthy data for estimation of proportion, of the human population belonging to sensitive attribute was first introduced by Warner (1965). Horvitz *et al.* (1967) and Greenberg *et al.* (1969) introduced a non-sensitive character in the RR procedure. Mangat (1991) has developed an optional RR strategy. His technique provides better estimates as compared to Warner's (1965) usual RR model in certain situations usually encountered in practice. In the present study, this idea is extended to Greenberg *et al.*'s (1969) RR model which assumes π_v proportion of non-sensitive characteristic, to be known. The situations where the suggested technique fares well as compared to Greenberg *et al.*'s (1969) usual model with known π_v have been identified.

3. Comparison of Powers of Two Solutions of Behrens-fisher Problem - a Monte Corlo Study

Pradeep Singh, K. K. Saxena and O. P. Srivastava
Haryana Agricultural University, Hisar

The relative marits of two solution of B-F problem have been discussed in respect of their powers. The solutions considered are-Cochran and Cox (1957) (t') and Saxena & Srivastava (1986) (t*). Powers have been calculated empirically using groups

having unequal means and variances. To achieve this, various normal populations were generated on a computer, the program based on Inverse Transform Method, for different combinations of μ and σ. Populations were paired in such a way as to get a difference of means m:$\mu_1 - \mu_2$ = [1.0 (1.0) 7.0] and ratio of standard deviations k: σ_1/σ_2 = [1.5 (0.5) 4.0]. From each pair of populations that is for each combination of m & k, 30 samples were randomly drawn thereby making 900 replicates of samples. This procedure of sampling was repeated for all combinations of m & k and combinations of n_1 & n_2 - the sample sizes. Approximately one lakh samples were analysed. For calculating the power of the test, the statistic and the corresponding critical values at 5% level of significance were calculated and the relative frequency with which the test statistic exceeded the critical value has been taken to be the estimate of power. It has been seen that for all the combinations of sample sizes the test t* maintained its superiority over the test t' in whole range of m & k. Particularly the percentage increase in power of t* over t' has been found to be the highest (88%) for n_1 = 8, n_2 = 10, k = 2.5 and m = 1.

4.   Sampling On Two Occasions with Two Correlated Characters

Jagbir Singh and O. P. Kathuria
IASRI, New Delhi

Projective Geometric Approach has been used to develop Minimum Variance Linear Unbiased Estimators (MVLUE's) of population parameters in sampling on two occasions for simultaneous estimation of two correlated characters. MVLUE's of the population parameters for levels, change over time and average over the entire time period for both the correlated characters have been obtained. Standard results with respect to estimation of mean on the second occasion, change and average over first and second occasion for two independent characters as a particular case have been studied.

5.   Effect of Non-normality on Non-negative Preliminary Test Estimator of Inter-group Variance Component

C. B. Tiwari* and R. A. Singhal
Project Directorate on Cattle, Meerut

A preliminary test estimator (PTE) of inter-group variance component (σ_a^2) associated with balanced one-way random model has been considered. The random effects are represented by the third approximation of Edgeworth series. The mathematical expressions for the bias and mean square error of the estimator ($\hat{\sigma}_a^2$) are derived and numerically evaluated for a priori para-metric values. The results reveal that the estimator is biased but efficient. Further, it is observed that the presence of skewness in group as well as error effects do not appreciably affect the PTE. The effect of kurtosis of error effects on the estimator is in general, marginal whereas for group effects it is remarkable.

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6. On the Estimation of Coefficient of Variation Using Auxiliary Characteristic in Sample Survey

Sarjinder Singh and N. S. Mangat
Punjab Agricultural University, Ludhiana

A class of estimators for estimating the coefficient of variation by using a prior knowledge of an auxiliary characteristic in sample surveys is suggested. The class of estimators defined here is an analogous to the class given by Srivastava and Jhajj (1981). Asymptotic bias and mean square error expressions are given. The proposed class of estimators is always more efficient as compared to the usual estimator.

7. Distribution of Variance Ratio in Unbalanced Random Model

B. Singh
IVRI, Izatnagar.

Expressions for distribution function and moments of variance ratio and the power of F-test are given in unbalanced one-way random model. The variance of the estimate of intraclass correlation is also deduced. The derived expressions are used to examine the effects of unbalancedness on the mean and variance of F-ratio and the power of F-test, numerically, for some apriori parametric values. The computed results reveal that the unbalancedness decreases the mean and variance of F as well as the power of F-test under non-null situations.

8. A Study of Politz-Simmon Estimator Under Non-cooperation

S. D. Sharma and Animesh Sil
R.A.U., Pusa (Bihar)

An attempt has been made to outline the impact of non-cooperation from the selected at-home-available respondents on the Politz- Simmon (P-S for Short) estimator which adjusts the non-responce bias by classifying the available responses into six at-home- availability classes and weighting each class mean by the inverse of probability of being at home. The P-S estimator assumes that all those individuals who are available at home, would necessarily cooperate with the investigator and there could by no further non-response. However, it is quite likely that an individual, even when available at home may not be willing to cooperate with the investigator due to his busy schedule at that very moment when the investigator calls on him. Obviously, in this case, the responses could be obtained with lower probability than the probability of being available at home. Further, nil response is also possible which was assumed to be absent in P-S estimator. The performance of P-S estimator under this situation of non-cooperation has been studied. It is found that the non- response bias increases due to non-cooperation. The algebraic comparison of mean square error was not possible. Consequently, an empirical study has been carried out to compare the mean square error under different situations. It is found that P-S estimator under the situation of non-cooperation has smaller mean square error than

the usual P-S estimator when the heterogeneous parent population is divided into distinct strata and strata size distribution is negatively skewed.

9.   Selection of Sampling Strategies For Estimation of Frequency Distributions of Cattle and Buffalo According to Type of Animals

Rajendra Singh, Krishan Lal, Shiv Prasad and Dinesh Kumar
IVRI, Izatnagar

Data on 317 livestock owners comprising 1025 bovine population from the four villages of Bhojipura block of Bareilly district were collected. Sampling schemes SRSwr, SRSwor and stratified sampling with proportional allocation were used for sample sizes 91 and 182 for cattle and 165 and 330 for buffaloes. The efficiency of sampling design in estimating frequency distribution was measured either by the measure $E(\alpha_1)$ or $E(\alpha_2)$. On the basis of two measures, it was observed that SRSwor is the overall acceptible sampling strategy, among the sampling strategies used, for estimating the frequency distributions of cattle and buffalo population according to type of animal.

10.   Optimal Estimators of a Finite Population Variance Under Superpopulation Models

D. N. Shah and Praful A. Patel
Sardar Patel University, Vallabh Vidyanagar (Gujarat)

Several authors have considered the problem of estimation of finite population mean under different superpopulation models. Most of these results find place in Cassel, Sarndal and Wretman (1977).

In this paper optimum estimation of variance function is considered under a modified general transformation model. The optimal variance estimators in a class Q_{p_ξ} of all quadratic p-unbiased predictors under general transformation model G_T and regression model G_A follow as special cases. Relaxing normality and quadraticity but imposing exchangeability condition, the variance estimator is shown to be optimal in the wider class A_ξ of all design unbiased predictors under an exchangeability model E_T. The result under random permutation model E_{RP} follow as a special case.

11.   Estimation of Quality of Work Environment in ICAR Institutes

S. D. Sharma, S. N. Deshpande, S. C. Rai and Neeru Bala
Krishi Anusandhan Bhavan (ICAR), Pusa, New Delhi

Quality of work environment as perceived by scientists working in ICAR institutes was studied in the present investigation. One thousand four hundred seventy two scientists from 12 ICAR institutes located in different parts of the country participated in the investigation. Data were collected from the scientists through the

administration of General Health Questionnaire (Goldberg, 1978) and Work Environment Questionnaire (especially prepared for the purpose). Composite index of work environment of different research institutes based on work environment satisfaction, subjective distress, workload, participation in decision making process, relationship, library facilities, and development of knowledge & skills, were worked out. The environmental distance between different institutes on the basis of above indicators were obtained. Model institutes were selected on the basis of composite index of work environment and environmental distance between institutes. The potential targets for different indicators for each institute were identified and suggestions were made to bring out improvement in the quality of work environment.

12.   Factors Influencing Poultry Farming: An Econometric Study

K. C. Chenna Raydu, P. Raghuram and P. B. Parthasarathy
College of Agriculture, Rajendranagar (AP)

Andhra Pradesh is one of the important states in India in poultry and egg production with an annual production of 70 millions S(17.5 percent) and 5000 millions (19.3 percent) respectively to the total production (1989). The specific objective of the present study is to analyse the factors influencing returns in poultry farming. Nellore in A.P. which is an important poultry and egg producing district has been selected for the study. 90 poultry farms were selected randomly representing small, medium and large farms. The path coefficient analysis and Linear regression analysis have been used to arrive at valid conclusions. Barring on Large farms, feeds exhibited significant contribution for higher returns in poultry farming. The results of path analysis also confirmed the same. On Large farms, the effect of feeds was not directly perceptible. Thus it can be inferred that on Small and Medium farms, the returns were feed-induced, while on large farms it was indirectly influenced by feeds.

13.   Forecasting the Effects of Input on Yield of Crops in Flood Affected & Unaffected Fields

Jagmohan Singh and B. H. Singh
IASRI, New Delhi

In order to forecast the effect of different inputs such as seed, fertilizer etc., on the yield of crops in the frequent flood affected fields, study of some flood parameters and inputs used is undertaken. The study was carried out taking into consideration the yield of paddy in flood affected and unaffected fields of sampled villages in Tanda Tehsil of U.P. utilising data under the project, "Pilot sample survey to study the impact of flood on agricultural production in a region of U.P." conducted by IASRI 1981-83.

The study revealed that during the year 1981, the contribution of seed towards yield of paddy was 85% & 90% in case of flood- affected and unaffected fields whereas the effect of fertilizer in yield of paddy was 81% and 64% in the flood affected and unaffected fields respectively. This indicates that the fertilizers boost the yield of paddy whereas not much loss of seeds was met in flood-affected fields.

14. Economic Return Through Intercropping in Chikoo Orchard.

T. Rai, M. S. Batra, Mohan Lal and G. M. Pathak
IASRI, New Delhi

Attempt is made to study the economics of inter-cropping in Chikoo orchard on the basis of data from a pilot sample survey conducted by IASRI, New Delhi-12 in Valsad district of Gujarat during the period 1982-83 to 1984-85. Cereal crops like paddy and wheat are commonly grown as intercrops in Chikoo orchards. The return through these crops varies from Rs. 1135 to Rs. 10,354 per hectare. However it is more from sugarcane and elephant food crops which are also intercropped with Chikoo. It is observed from the study that small farmers preferably go in for intercropping in young orchards and derive maximum benefit to the extent of Rs. 17,787 per hectare as compared to the medium and large ones.

15. Cost of Rearing a Nondescript Pig upto Different Ages

T. B. Jain
IASRI, New Delhi

The technology of pig rearing in our country has not been properly developed on economic and scientific lines. The study to find out the practices of rearing pigs in the rural area and the factors responsible for bringing out the economics in rearing cost upto different ages would help in further formulating the development programs for pig rearing on scientific lines. In the present study the costs of rearing pigs of either sex from creeper stage to adult stage at an interval of 2 months and the effect of flock size on cost under rural conditions were estimated utilizing the data collected from selected villages in Ranchi district of Bihar.

The average cost of rearing a male pig upto the age of 2 months, 4 months, 6 months and 8 months was Rs. 6.60, Rs. 23.40, Rs. 49.80 and Rs. 89.40 respectively while for a female pig upto these respective age groups it was Rs. 7.20, Rs. 27.00, Rs. 58.80 and Rs. 107.40. The rearing costs upto different ages were generally less in households rearing larger flocks than those rearing smaller flocks. In the rural conditions rearing a large number of pigs per household appears to be economical.

16. Adopted Doses of Fertiliser Nutrients for Optimum Wheat Production

Satyapal and T. Rai
IASRI, New Delhi

Attempt is made to find out the desirable combination of N, P and K doses for optimum production of wheat realised in the cultivator's field. The data collected under 'Sample Survey for methodological investigation into high yielding varieties programme' are utilised to fit a quadratic function separately for each of the states Haryana, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.

The doses of N,P and K obtained for optimum production of wheat varying as per the agro climatic condition are 70-110, 40- 60 and 20-40 kgs/ha respectively.

17.   Determining an Optimum Classification of Different
Districts of Orissa Through Hierarchical Clustering
Technique With Some Indicators of Development

P.K. Tripathy and P.N. Pradhan[*]
Utkal University, Bhubaneswar

The objective of this paper is to classify thirteen districts of Orissa on the basis of 'Similarities' and 'dissimilarities' found by utilising the indictors of development. Agglormerative methods for 'Heirarchical clustering procedure' has been used.

Fifteen indicators of development like agriculture, industry, infrastructure, communication, health, education, social and modernisation have been considered. The data for the variables have been taken from various census reports of Orissa (1981), vital statistics reports and other Govt. publications. Hierarchical clustering process has been done with the help of a dendrogram. All the thirteen districts of Orissa have been separated into well separated hierarchical structured clusters.

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*   OUAT, Bhubaneswar

18.   New Ratio Estimator

M.N. Patel
Bhavnagar University, Bhavnagar

The utilization of a prior value of coefficient of variation (C.V.) in the estimation purposes have been proposed with the work of Searls (1964). He considered an estimate which contained a prior value of C.V. of the character under study. Following Searls, Khan (1968) and Govindrajulu and Shahi (1972) utilized the knowledge of C.V. of the character under study to increase the efficiency of estimators. The knowledge of the C.V. of the character under study is seldom available. But the C.V. of an auxiliary variable can easily be obtained and it is used to improve the efficiency of estimators. Sosodia and Dwivedi (1981) suggested the modified ratio estimator of the type,

$$T_{SD} = \frac{\overline{y}(\overline{X} + C_x)}{(\overline{x} + C_x)}.$$

In this paper the estimator proposed is

$$T = \frac{\overline{y}\,\overline{X}}{\left[\alpha\,\overline{x}^* + (1-\alpha)\,\overline{X}\right]} \qquad \text{Where } \alpha \text{ is scalar and } \overline{x}^* = \frac{(N\overline{X} - \eta\overline{x})}{(N-\eta)} \qquad \text{Where}$$

$\overline{x}^*$ is unbiased for $\overline{X}$

If $\alpha = 0$, then $T = \overline{y} =$ Usual simple mean of $\overline{Y}$. And if $\alpha = 1$, then $T = \frac{\overline{y}\,\overline{x}}{\overline{x}^*}$.

Expressions for the Bias and mean squared error (MSE) of T can be obtained to the first order of approximation under simple random sampling without replacement (SRSWOR). Optimum estimator of T is also identified. Comparision is

also made with simple mean and ratio estimator. The results are indicated by simple numerical example.

19. Use of Eye Estimate and Weather Variables for Forecasting of Pearl Millet (Bajra) in Jodhpur District

B.S. Gupta, J.S. Rao, B.K. Mathur
Central Arid Zone Research Institute, Jodhpur

Various forecast models to study the effects of weather variables on Pearl millet bajra yield prediction in Jodhpur district were attempted employing step-wise regression technique. Value of coefficient of determination (R^2) was taken into account to identify the significant variables and "best fit" model. Linear regression model was found better as compared to other regression models. Further, the linear model, using eye estimated yield, crop season rainfall, maximum temperature, bright sunshine hours and weighted rainfall which explained 87.8 percent variation in bajra yield., with least error of forecast (32.34 percent) was considered to be appropriate for forecasting bajra yield.

20. On the Study of Linked Block Designs and R-type Group Testing Treatment Designs

D.K. Ghosh and Alex Thannippara
Saurashtra University, Rajkot (Gujarat)

The technique of group testing was originally proposed by Dorfman (1943) in the context of blood testing. The common assumption in the group testing problem is that there is no test error. The non-adaptive hypergeometric group testing problem was first introduced by Hwang and Sos (1981). In the present paper it is shown that non-adaptive hypergeometric group testing designs for $v^* \equiv 0 \pmod 6$ and $v^* \equiv 2 \pmod 6$ are singly linked block designs discussed by Bose (1975). It is pointed out that λ-linked block designs discussed in this paper are also block multigraph designs and geometry desigs. Here we introduced a new class of designs called Rectangular (R-) type group testing treatment designs (GTTD) from $v^* \equiv 0 \pmod 6$ and $v^* \equiv 2 \pmod 6$. It is shown that GTD with $v^* \equiv 0 \pmod 6$ and $v^* \equiv 2 \pmod 6$ are λ-singly linked block designs in the entire class of available non- adaptive hypergeometric group testing designs for identifying at most two defectives and such λ-linked block designs may yield GTTd.

21. Change - Over - Design

G.C. Chawla
IASRI, New Delhi

A change-over design has been constructed by associating the cyclic designs of John *et al.* (1972) with Williams Square. The analysis of this design has been worked out assuming the presence of first order residual effects. A homoscedastic fixed effects model $\underline{y} = \mathbf{T}\underline{\tau} + \mathbf{R}\underline{\rho} + \mu\underline{1} + \mathbf{P}\underline{\pi} + \mathbf{B}\underline{\beta} + \mathbf{S}\underline{\alpha} + \underline{\in}$ is followed and the joint information matrix $\mathbf{C}\theta_1/\theta_2$ (of direct and first residual effects) has been derived.

Following Patterson and Lucas (1962), the efficiency factors for a wide range of designs have been computed.

22.   Estimation of Two Missing Values in Strip Split Plot Design

J.S. Dhekale and P.A. Varade
Konkan Krishi Vidyapeeth, Dapoli

An attempt has been made to obtain formulae to estimate two missing values in strip split plot design. Fifteen different combinations of horizontal factors, vertical factors, sub sub plots and replications were considered. Out of fifteen cases, only three cases have different formulae and remaining of same type. The standard errors of difference between two single factor treatments were also obtained for all possible cases.

23.   Efficiency of Latin Square Design for Experimentation with Natural Grasses

P.R. Sreenath, D.P. Handa and S.K. Rajpali[*]
IASRI, New Delhi

Data from a uniformity trial were used for working out the relative efficiency of latin square design over complete randomized design. The relative efficieny (%) of 3 x 3, 4 x 4, and 6 x 6 latin square design for different plot sizes compared with complete randomised design ranged from 113 to 413, 166 to 461 and 189 to 345 whereas in comparison with randomised complete block design, using either row as blocks it ranged from 131 to 468,172 to 397 and 188 to 233, when rows are treated as blocks and 131 to 410, 149 to 477 and 160 to 373 when columns are treated as blocks. The number of units required in complete randomized design for getting the relative efficiency equivalent to that of 3 x 3, 4 x 4 6 x 6 Latin square design ranged from 3 to 10, 6 to 19 and 11 to 21 replications respectively, whereas in randomized complete block design, the number of units required, taking columns as blocks varied from 4 to 12, 6 to 12 and 10 to 22 while taking rows as blocks, ranged from 4 to 14, 7 to 16 and 11 to 14 replications. Latin square design was considered to be more efficient than complete randomized design for experimentation with natural grasses in the plains.

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24.   Correlated Response of the Physico-Chemical Traits on Sensory Characters of Chicken Gizzard Pickles

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Data based on 8 trials of oil based (OB) and vinegar based (VB) chicken gizzard pickles with varing number of observations in each trial were utilized to study the relationship among different physico-chemical and sensory traits. In fresh OB pickle,

pH was significantly correlated to tenderness. Whereas negative non- significant correlations of pH with shear force, juiciness and moisture content were observed. Moisture had significant correlations with flavour and acceptability of the pickle. Significant correlations of crude protein were found with juiciness and tenderness. Ether extract was highly correlated to flavor, juiciness, texture and acceptability. It also had significant correlations with moisture and crude protein. TBA (malanaldehyde, mg/kg.) was significantly associated with colour and pH.

In VB pickle, [H had significant correlations with colour and flavor. Negative but significant correlations of moisture were determined with colour, flavour, texture and pH. Highly negative significant correlation was seen between ether extract and juiciness. TBA had negative relation with acceptability of the product. Overall, moisture content and ether extract played important role in affecting acceptability of the pickles.

25.   Index Selection with Continuous and ALL-OR-NONE TRAITS

Amrit Pal Kaur and Prem Narain
IASRI, New Delhi

The use of selection index in Multiple-trait selection has long been a common practice in animal breeding. Theoretically the selection index has several advantageous features when true means and variances/covariances are known, or at least, appropriate estimates of these are available. In these circumstances the selection index approach minimizes the error when predicting breeding values and at the same time maximizes the correlation between true breeding value and prediction. When both phenotypic and genetic values are normally distributed, the use of a selection index also leads, from practical point of issue to other properties, namely the maximised probability of correctly ranking the individuals and to maximise the average true value of the selected group. The assumption of normality is fulfilled for many quantitatively inherited traits, though many other traits of economic importance follow different patterns of distribution, that is disease resistance, fitness, longevity etc. Often we may suppose that although observed as a discontinuous trait, the character has an underlying normal distribution with thresholds relating the underling and observed scale. In this investigation we have studied the efficiency of index selection including a continous trait and a binomial trait compared with index selection for two continuous traits.

26.   Empirical Comparison of Improved Regression Estimators of Heritability

Subhash Chander and U.C. Jaiswal
Haryana Agricultural University, Hisar.

Heritability is one of the important genetic parameters, which requires pre-requisite information to the planning of breeding programmes for animal and plant improvement. Intra-sire regression of daughter on dam is perhaps the most reliable method for estimation of heritability in farm animals. Quite often the estimates of heritability obtained by this procedure do not fall in the admissible range (o, 1). This creates a situation where it become difficult to attach a meaningful

interpretation to such estimates. Hence, there is a need to consider the improved regression estimators of heritability. In the present paper the four improved regression estimators of heritability viz., restricted regression estimator, modified range restricted regression estimator, minimum quadratic loss estimator and minimax linear restricted estimator have been illustrated and compared numerically. The results reveal that restricted regression method should be used for obtaining consistent and admissible estimates of heritability. However, when a prior information on the range of heritability is available, the modified range restricted regression method may be used.

27.   Non-allelic Interactions for Growth Traits in Crossbred Pigs

V.P.S. Chauhan
Project Directorate on Cattle, Meerut. (U.P.)

Additive-dominance and digenic models were fitted using weighted least squares methods to body weights of 8 generations of pigs comprising indigenous and Landrace purebreds, direct and reciprocal F1 and F2, and back-crosses. The data consisted of least squares means and variances of least squares means of live weights of 648 indigenous, 196 Landrace and 1210 crossbred pigs at birth, 4,8,16, 24 and 32 weeks of age. Least squares means and variances were estimated fitting a model with effects of year- season of birth, sex of piglet, sire and dam. In the additive dominance model the three parameters m, [d] and [h] were fitted, whereas in the digenic model the 6 parameters m, [d], [h], [i], [j] and [l] were fitted. The parameters denote the mean, additive, dominance, additive x additive, additive x dominance, and dominance x dominance effects of genes, respectively.

The additive-dominance model was found inadequate for all traits, indicating that the non-allelic interactions were present. The digenic model was found to be adequate for all traits, except the birth weight. The significance of both models was tested by Cavalli's joint scaling test. The significance of all parameters for each trait was also tested by student t-test. All parameters were by and large significant, except the (j) parameter which was significant for birth weight only. Since the (i) and (l) parameters were of opposite signs, the epistatic effects were apparently of duplicate type. From the (d) and (i) parameters it was also apparent that the genes for the above traits would respond to fixation through selection.

28.   Genetic Parameters of Growth Traits in Indigenous Chicken- Kadakanath

D.P. Singh, Ram Gopal and D.C. Johari
Central Avian Research Institute, Izatnagar

Inheritance of growth traits viz. Juvenile body weights, shank and keel lengths were studied in Kadakanath flock utilizing 270 male and 305 female progenies of 29 sire families. Least square means for day old, 4,8, 12,16,and 20 weeks body weights were 33.6 157.6,435.0, 775.4, 1064.7,and 1309.0 g respectively in males and the corresponding values for females were 33.3, 146.1, 374.2, 633.9, 853.9 and 1016.0 g. Low to moderate heritability estimates were found for various body weights ranging from .21 + .14 to .57 + .23 in males and .24 + .14 to .40 + .21 in females which

indicated scope for improvement through mass selection. Heritability estimates for shank length were moderate in magnitude and higher in males than females. For keel length reverse trend was noticed.

All phenotypic and genetic correlations among body weights (except with day old weight) were found to be high and positive (the values of r being .42 + .22 to 1.00 + .09 in males and 0.56 + .27 to 1.00 + .10 in females). Correlations of shank length with body weights were also high and positive in direction.

29.   Economics of Fertilizer Application to Wheat

C. H. Rao and K.C. Bhatnagar
IASRI, New Delhi

Utilizing the data on cultivators' field experiments under AICARP conducted in the main wheat growing states, an attempt has been made to examine the scope and extent of fertilizer application to wheat that would bring equitable profits to farmers. The economics of fertilizer application has been studied by working out cost benefit ratios. The fertilizer level studied were N_{60}, N_{120}, $N_{60}P_{30}$, $N_{120}P_{60}$, $N_{60}P_{30}K_{30}$, $N_{120}P_{60}K_{60}$. Additional yield as well as net return were highest at $N_{120}P_{60}K_{60}$ in most of the states. The cost benefit ratios were more than 2.50 for almost at all fertilizer levels in many states.

30.   Seasonal, Temporal and Spatial Variation in Milk and Milk Product Prices in A.P.

D. K. Jain and K. N. S. Sharma
National Dairy Research Institute, Karnal

The study was undertaken in five centres of A.P. viz., Visakhapatnam, Warangal, NSB, MRP and Rajahmundary for three items milk, curd and ghee. The monthly data on prices of these items from 1962-89 obtained from Directorate of Economics and Statistics, Hyderabad formed the basis of the study. The monthly prices indices were obtained by using method of link relatives. It was observed that the monthly price indices moved in a narrow range for all the items in all the centres. It ranged from 96 to 103 for milk; 97 to 102 for curd and 98 to 102 for ghee. The pattern of variation in monthly price indices differed significantly across different centres. All the centres showed highest prices of milk in July and August. In other months there was no systematic pattern. The prices of milk ruled high between November and February in Visakhapatnam; January and August in Warangal; April and November in NSB; March and July in MRP and May and November in Rajahmundary. Buffaloes are the major milk producing animals in A.P. and the milk prices reflect the breeding season of buffaloes. The variation in monthly price indices for curd showed almost similar pattern but the range of variation was lower than that for milk. The variation in monthly price indices for milk and curd were observed to be relatively more in NSB and Rajahmundary compared to other three centres. The monthly price indices of ghee was also observed to move within a narrow range, variation being less than that of milk and curd. This could be due to longer shelf-life of ghee. Generally, the ghee prices were observed to be higher between August and November which could be due to the observance of festivals in this period.

Deseasonalised prices were subjected to trend analysis using different growth

models. Exponential growth model was observed to be the best fit explaining more than 90 per cent of total variation for all the items in all the centres. The annual growth rate was observed to be the lowest for milk which ranged from 6.23 to 7.85 percent followed by curd (7.35 to 8.59%) and ghee (7.86 to 8.66%). The relative variation to growth of prices was more in milk followed by curd and ghee among different centres. Rajahmundary showed higher annual growth rate in prices for all the three products while it was lowest in Warangal for milk and in MRP for both curd and ghee.

31.   An Approach for Evaluation of Composite Yardsticks

C. H. Rao and K.C. Bhatnagar
IASRI, New Delhi

When a single input is applied, yardstick is defined as the average increase in output (additional response) per unit of input. When more than one input is applied together, the yardstick termed as composite yardstick is defined as the average additional response per unit of application of each of the input. Several methods have been adopted for obtaining the yardsticks for combined application e.g. i) by fitting a response curve for the sum of the levels of inputs, ii) by fitting a response curve for the averages over the levels of the second input etc.

In the present paper, a methodology developed for the evaluation of composite yardsticks by studying the behaviour of response surface. by which additional response is partitioned taking due consideration of the interaction present, is discussed.

32.   Trend and Inter-relationships : A case study of Price, Area and Production for Wheat and Rice in Allahabad District of Uttar Pradesh

Ashok Kumar
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The study undertaken for the period 1961-62 to 1977-78 to workout the role of farm harvest prices as affecting the crop hectareage and subsequently the production of two foodgrains i.e. Rice and Wheat. The empirical findings on the basis of analysis of time- series data of the district, through trend values and the Karl Pearson's zero order product-moment correlation coefficients, revealed that the prices showed rising trend both for wheat and rice crops; while area recorded a rising trend for wheat but no definite trend observed in case of rice. Production showed a continuous rising trend during the period 1968-69 to 1977-78 for wheat, while only a slight increasing trend in case of rice and that the extent of increase in production during the entire period of study was of the order of 274 percent in case of wheat and only 35 percent for rice. The correlation coefficients (r) between P_{t-1} (Price lagged one year) and X_t (area in current year), P_{t-1} and q_t (production in current year) and between (X_t, q_t) were significant for wheat while for rice the only significant coefficient was between X_t and q_t. Further, the correlation coefficients between (P_t, X_{t+1}), (P_t, X_{t+2}), (P_t, X_{t+3}) for wheat were significant while none of the coefficient for rice was significant. It is concluded that price affect the hectareage of wheat crop but not that of rice.

33. On the Trend of Milk Production in India and its Neighbouring Countries

Krishan Lal, Rajendra Singh and C. B. Tiwari
IVRI, Izatnagar

Analytical study of milk production (1975-85) in India and its neighbouring countries viz. Afganistan, Bangladesh, Bhutan, Burma, China, Nepal, Pakistan, Sri Lanka showed that India made a good progress in this field in comparison to others. India leads to its neighbouring countries with regard to both in compound growth rate of cow (8.55%) and buffalo milk milk production (3.53%). However, per capita availability of milk is still 148 gm. in India which is even much below the minimum nutritional requirement (210 gm.). On the other hand, the per capita per day production of all developed countries and all developing countries are 812 gm. and 83 gm. respectively. Bangladesh, Bhutan, Burma, China and Sri Lanka are having less than 100 gm. per capita milk available to their population.

34. Monetary Contribution of Meat in National Economy

Rajendra Singh, Krishan Lal and Dinesh Kumar
IVRI, Izatnagar

The output values from 1980-81 to 1985-86 on 1980-81 price for total meat and different kinds of meat were analysed. Total meat increased by 34.27% in 1985-86 as compared to 1980-81. The growth rate for the same period was observed to be 52.07% for poultry meat, 41.38% for pork, 22.39% for mutton and goat meat and 20.12% for beef and buffalo meat. The rate of growth in output values of poultry meat and pork was substantially higher than total meat during the period 1980-81 to 1985-86 while the share of mutton and goat meat and beef and buffalo reduced. Comprehensive review of results revealed that output values of poultry meat and pork gained outstanding growth than other types of meat.

35. Application of Analysis of Means in Agricultural Field Experiments

G. L. Khurana, K. C. Bhatnagar and P. N. Bhargava
IASRI, NEW DELHI

The Analysis of Means (ANOM) procedure is used for comparing a large number of treatments in field experiments with factors of fixed levels. Though both ANOM and ANOVA are equally powerful for small number of treatments, yet for large number of treatments, ANOM procedure gives decision lines similar to control charts so that the treatment differences and the statistical significance of the individual treatment may be assessed simultaneously. In this paper, a step by step introduction to the use of analysis of means in the Agricultural field experiments has been given. The procedure is applied in one-way and two-way factorial designs. An example of the application of the procedure to the data of production potential expts. conducted at Bichpuri (U.P.) under AICARP for Bajra-Wheat sequence is cited. In the expt., the treatments used as agro-nomic factors are. Date of sowing (D), Fertilizer application (F), Plant population (P), Irrigation (I) and weed control (W) at two levels each i.e. one recommended level and another reduced level.

36.   Livestock Epidemiology: Trends in Intensity of Diseases in Tamil Nadu

D. K. Bhatia, S. N. Arya and H. P. Singh
IASRI, NEW DELHI

Two parameters of interest in animal epidemiology, viz. Attack Rate and Case Fatality Rate, which measure the intensity of disease were worked out from published data on outbreaks, attacks and deaths due to various livestock diseases in Tamil Nadu. Yearly data available for the years 1972-73 to 1984-85 in respect of major cattle diseases (Rinderpest Haemorrhagic septicemia, Black quarter, Anthrax, surra and Foot-and-mouth disease) and ovine diseases (Enterotoxaemia, sheep pox and Anthrax were analysed. The rates were obtained for each year for every disease. Scatter diagrams indicated lot of fluctuation through the years. The highest value of the 'mean attack rate' pertained to rinderpest (30%) while the highest value of 'mean case fatality rate' was found in the case of anthrax which took a heavy toll of animals - over 80% in cattle and over 90% in ovines. The values of individual years were compared against the mean rates to know the extent of variation. Further, years favourable and unfavourable with respect to each disease were identified.

37.   Changes in The Structural Distribution of Land Holdings in The Mahatma Phule Agricultural University Region of Maharashtra.

S. M. Kareppa, S. V. Mahajan, and P. P. Pawar
Mahatma Phule Agricultural University, Rahuri - (M.S.)

As land is the important source of income and employment in rural community, an attempt has been made to study the changes in the structure and distribution of land holdings in the year 1985-86 over 1970-71 of nine districts included in Mahatma Phule Agricultural University (MPAU) Region. It is observed that there was increase in number of holdings and area in the marginal, small semi medium groups, whereas the trend was decreasing in the case of medium and large farmers group. The indicates that the number of holdings and area from medium and large group had been shifted to marginal, small and semi medium groups. The percentage of total number of holdings increased drastically and the total area remained more or less same which resulted in declining the average size of holdings. It is observed that nearly 80 percent of farmers having below 4 hectares land covered only 40 percent of total area. From Gini coefficient ratio it is noticed that there was uneven distribution of land for all districts both in 1970-71 and 1985-86.

38.   A Comparative Study of Growth Rates of Area, Production and Productivity Of Different Crops in Agro-ecological Regions (East and West Coastal Area)

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Recently, India has been delineated into 21 agro-ecological regions by Sehgal *et al.* (1990). Data for the period 65- 87 relating to area, production and productivity

of different crops were collected district - wise from statistical abstracts of different states published by economic and statistical organisations of various states and amalgamated to form agro- ecological regions 19 and 20. Where as region 19 consists of east coastal area, region 20 in west coastal area.

In region 19, growth rates of productivity were positive and highly significant for rice, G. nut and mustard while this was significant for wheat. For sugarcane it was negatively significant and non-significant in respect of tur crop. Growth rates of area were positively highly significant for all the above crops. For production growth rates were positively highly significant for all the above crops excepting sugarcane having non-significant growth rate. On the other hand, in agro-ecological reign 20 growth rate of productivity was positively highly significant for wheat and non-significant for rice, tur, G.nut, mustard and sugarcane crops. Growth rate of area was positive, highly significant for tur and negatively significant for G.nut whereas for rice, wheat and sugarcane these growth rates were non- significant. In case of production, growth rates were positively highly significant for wheat and tur crops, positively significant for sugarcane and non-significant for rice, G.nut and mustard crops.

39.   Studies on Variabilities in Agricultural Productivity in Chhattisgarh

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The present paper attempts to examine inter-district variation in agricultural productivity in Chhattisgarh region of Madhya Pradesh. Districtwise data of area, production and productivity of different crops for the period from 1982-83 to 1988-89 are analysed for Chhattisgarh alongwith its constituent districts and the State of M.P. as a whole using techniques of standard deviation, coefficient of variation, composite productivity index and the tabular analysis. The crops selected for the study were grouped into three categories viz. cereals, pulses and oil seeds. There was high degree of variation in productivity of crops between different districts.

40.   Statistical Study for Kharif Crops in Rajasthan

H. B. Choudhary
Retired Scientist, IASRI, New Delhi

In Rajasthan Kharif crops play an important role as 75% of the cultivated area is un-irrigated and the crops mostly depend on rains. Bajra, Jowar and Maize are the important kharif crops in this state and constitute more than 60 percent of the area under food crops. The secondary data were utilized for the years 1952-53 to 1986-87 both under irrigated and un-irrigated conditions to examine growth rates of area, production and productivity of crops; production potential and factors responsible for low productivity. Annual growth rates of these crops were estimated by taking time as independent variable. The average value for first three years of each variable was taken as base value and different production functions were fitted for these crops. The coefficient of variation for each variable was also estimated. The linear growth rate models for thirty years revealed:

(i) Growth rates pr annum in area, production and productivity for food crops under irrigated

conditions were, 4.8, 6.6, 20.9 respectively and under un-irrigated conditions these were 1.03, 1.37 and 0.22 respectively. (ii) The growth rates of area production and productivity for Bajra and Maize are +ve and in case of Jowar it is -ve. (iii) Analysing the data for 10 years seperately it was observed that the growth rates of area production and productivity under un- irrigated conditions for Maize gave +ve growth rates for all the three decades while that of Bajra gave +ve and significant growth rates for one decade only from 1962-63 to 1971-72.

41. Comparison of Sampling Methods for Estimating Lucern Yield

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The efficiency of three sampling methods, viz., stratified random sampling, double sampling and component sampling over simple random sampling was compared for estimating total green forage yield of lucern (Cv. Anand 2). The uniformity trial data of the years 1988-89 and 1989-90 were used for the purpose. In all, six cuts were obtained in each year. The results revealed that the stratified random sampling and component sampling were more efficient than the SRS. The component sampling was more efficient than stratified random sampling. The Double Sampling could not prove effective for this purpose.

42. Use of Mixed Model for Studying the Protein Levels and Litter- Floor Densities for Poultry Production

G.C. Chawla
IASRI, New Delhi

An attempt has been made to make use of mixed model taking simultaneously with two fixed and one random factors to study their effects on number of eggs per/100 hen-days. ANOVA with expected mean squares (EMS) for finding the significant differences among the main-effects and interaction has been given. For the purpose of comparison, a quadratic curve is also fitted to the average value of egg production under each density. It is found that there is maximum production at the density 1.6 sq. ft/bird when the birds are kept on litter-floor pens with 18% protein levels. But birds at density 0.8 sq. ft/bird occupying 50% less area will give about 8% fewer eggs. Never-theless the indications are that a man with a fixed amount of space of hens would be wise enough to use a density of 0.8 or even less.

43. Farming Efficiency in Crop-Dairy-Poultry-Fish Enterprises

R.L. Rustagi and Shivtar Singh
IASRI, New Delhi.

The ratios of output to cash and kind expenses (cost A) and output to total inputs (cost C) provide broad indications as to the general level of farming efficiency in different farming combinations. These ratios were worked out utilising the data

collected in a project undertaken by the IASRI.It was found that the farming efficiency of crop-poultry enterprise households was highest 3.56 for cost A and 1.28 for cost C.

44.   Small Area Estimation: Application to Milk Production

Shivtar Singh
IASRI, New Delhi

The growing awareness towards micro level planning has highlighted the need to obtain cost effective methodologies that will produce estimates of acceptable quality for subsets of the population. These subsets (domains) of the population may be geographic subdivisions, demographic groups, or other groupings. In this paper an attempt has been made to obtain seasonal estimates of production of cow milk at district level by suitable adaptation of the known techniques utilising (i) survey data collected during 1989-90 by the Department of Animal Husbandry for estimating the milk production in Himachal Pradesh and. (ii) 1982 Livestock Census. It has been found that for large sample sizes direct estimator is superior to synthetic estimator which is better in the case of small sample sizes. However, the composite estimator which is a linear combination of synthetic and direct estimator may be preferred. The breed of the animal was used as the criterion of grouping in synthetic method.

45.   Sample Survey for Estimation of Area Under Fish Ponds and Catch From Them

O.P. Kathuria, H.V.L. Bathla and K.K. Kher

A pilot sample survey was conducted in three districts of Orissa state viz. Cuttack, Sambalpur and Bolangir with a view to evolve a suitable sampling methodology for estimation of inland fishery resources and catch from them and to study the prevailing pisciculture practices. The sampling design followed in the survey was two stage stratified sampling, blocks and gram panchayats in a block constituted the first and second stage units respectively. The ponds and tanks in each of the gram panchayats were completely enumerated for estimating area. A further selection of four water units was made from each of the selected gram panchayats for estimating the fish catch.

The survey has provided estimate of the area under ponds and tanks and of catch from them with a reasonable degree of precision for the districts from which samples were selected. The study also throws light on the physical characteristics of ponds and tanks, methods of stocking and extent of their exploitation for fishing purpose.

46.   Multiplicity Sampling and Overlapping Clusters

A. K. Srivastava
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In multiplicity sampling, the individuals reported upon are linked to one or more than one enumeration units. The multiplicity rule for linking the individuals to enumeration units varies from survey to survey. For example, the rule may be based

on consanguinity or spatial relationships among individuals. The multiplicity estimators are particularly appropriate in study of rare populations where multiplicity helps in spreading the identification of individuals more broadly over the total population. In some situations, mobility of individuals lead to multiple links. When clusters are formed by associating units to the selected 'Key units' according to some pre-specified rule, the clusters are overlapping in nature and the multiplicity rule is based on spatial relationship. In the present paper, multiplicity estimators are considered for overlapping clusters and are compared with alternative varying probability estimators.

47.   Model Based Properties of Estimators in Two-Stage Sampling

Rakesh K. Rustagi
Northeastern Illinois University, Chicago, Illinois, USA

This paper concerns the application of the linear least-squares prediction approach to the problems of estimation in two-stage cluster sampling. The properties of some standard variance estimators for the ratio to size and the probability proportional to size estimators are studied under a general superpopulation model. Comparisons of the estimators are presented under the superpopulation models. One of the results obtained reveals a serious deficiency in a variance estimator often recommended for use with the ratio to size estimator.

48.   Contribution of India to World's Meat Production : An Analytical View

Shiv Prasad and Rajendra Singh
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The data on meat production (1975-85) revealed that the share of India to world's total meat production was in decreasing order in first five years whereas it was in increasing order during 1980- 85. The share of goat meat was the highest (13.58 to 16.34%) followed by buffalo meat (9.04 to 14.68%) in respective categories in the world. The contribution of total meat production to developing countries was also in decreasing order during first five years but was nearly at constant level (2.02%) during 1980-85. The share of goat meat was at top (14.77 to 17.98%) followed by buffalo meat (9.02 to 14.92%).

49.   Use of Coefficient of Variation in Ratio Estimation Procedure

V.K. Dwivedi
IVRI, Izatnagar (U.P)

A modified ratio estimator of $\bar{Y}_N$ using coefficient of variation of auxiliary variable X is proposed. Its bias and efficiency are compared with usual sample mean estimator $(\bar{Y}_n)$ and ratio estimator $(\bar{Y}_R)$. The proposed estimator is found to be more efficient than both the estimators when ρ lies between certain range.

50. Robustness of Non-normality of Conditionally Specified Estimator of Regression Coefficient in a Linear Regression Model

C.B. Tiwari
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Considering non-normal population (Edgeworth) estimation of regression coefficient in a linear regression model is proposed. Exact mathematical expressions for bias and MSE of the estimator are derived. Numerical results show that presence of skewness in the populations have little effect on these values. However, kurtosis in the populations have marginal effects. The bias of the estimator increases (decreases) for platykurtic (leptokurtic) first population in comparison to normal population for $\sigma^2 \leq 1$ otherwise this trend is reversed. The kurtosis in second population affects opposite to that of first population. Mean square error of the estimator decreases (increases) for platykurtic (Leptokurtic) population in comparison to normal population.

51. Use of Multivariate Auxiliary Information in Rotation Sampling

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Some composite estimators of population mean are developed using multivariate partial auxiliary information in rotation sampling. Properties of the proposed estimators are studied and their efficiency are compared with standard estimators available in literature.

52. Probability of Inadmissible Estimates of Heritability Defined as a Measure of Total Fixable Variation

Jogendra Singh
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A new and a more realistic definition of heritability as a measure of total fixable variation rather than additive genetic variation is mooted and its consequences studied. In addition, the probabilities of inadmissible estimates under the most general model of additive–dominance–epistasis gene action are obtained for both balanced and unbalanced situations.

53. Some Composite Estimators for Small Area Estimation

P.S. Pandey and O.P. Kathuria
IASRI, New Delhi

The demand for small area estimates has considerably increased in recent years, for micro level planning. The direct survey estimators, based only on the data from a given small area are likely to yield unacceptably large standard errors because

of small sample size in the small area. Therefore, the idea of composite estimator which is a weighted sum of two component estimators has generally been suggested to reduce the standard error of a small area estimator. In this paper, some composite estimators under different situations have been suggested and their efficiency comparisons have been made with the help of data of livestock survey.

54. An Evaluation of Modified Chi-square Test Statistics for Survey Data

Anil Rai and O.P. Kathuria
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The effect of complex sampling designs on the analysis of categorical data has received considerable attention in recent years. Complex designs seriously affect the Pearson or likelihood ratio chi-square tests for categorical models. A number of alternative tests have been proposed under various sets of assumptions about the nature of complex designs. Three alternatives represent general solutions : (i) the Wald Statistics (ii) adjustments to the original chi-square tests and (iii) Jackknifed chi-square test. In this paper, the various tests have been evaluated with respect to their actual size of critical region through an emperical investigation.

55. Use of n-Ary Design for Estimating the Combining Ability in Diallel Crosses

S.K. Dwivedi
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The analysis of diallel cross experiment laid out in two associate triangular PBIB design was given by Aggarwal (1974) making use of latent roots and latent vector of the C matrix of the design. The method of analysis given by him was very cumbersome and complex. In the present paper, the estimation of combining ability in diallel cross designs laid out in two associate triangular PBIB design have been given making use of property and analysis of n- ary block design. In the method, an estimate of g.c.a. (lines) and its sum of square was obtained as estimate of treatment effect and the sum of square is obtained for analysis of n-ary block design. The estimate of s.c.a. have been obtained by substracting the g.c.a. effects obtained in n-ary block design from the corresponding adjusted cross (treatment) effect obtained in two associate triangular PBIB design. Similarly, sum of square for the s.c.a. effect have been obtained by substracting the sum of square of g.c.a. effects obtained in n-ary block design from sum of square of treatment (cross) effects obtained in two associate triangular PBIB design. The present method of analysis has been applied in case of maize experiment taking 28 crosses (F1's) obtained from eight parents laid out in 2-associate triangular PBIB design at IARI Farm. A parallel experiment using same 28 crosses (F1's) was also laid out in RBD. The relative efficiency of 2-associate triangular PBIB design for various characters (traits) was also studied. It was found that the 2 associate triangular PBIB design was highly efficient for all the characters studied.

56. Use of Remote Sensing Data in Markov Chain Model for Crop Yield Modelling

Randhir Singh and Ai Abraham
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Matris (1985) suggested the use of Markov Chain Model in crop yield forecasting using biometrical characters. The spectral reflectance of a crop is a good manifestation of all the factors affecting the crop growth and crop conditions and hence is expected to have high relationship with the crop yield. The multi-date spectral data offers good advantages in crop identification and growth stage estimation. However, its implication in crop yield modelling have not been explored much. In the present study, it is proposed to make use of multi-date spectral data to develop a Markov Chain Model for a crop yield modelling.

57. Modelling Wheat Production in India

Prajneshu and P.K. Das
IASRI, New Delhi

Nonlinear statistical models are considered for describing wheat production in the country from 1950-91. Levenberg-Marquardt method is employed for estimation of parameters. Logistic, Gompertz, and Richards models are compared on the basis of a number of statistics. Three parameter logistics model is found appropriate for the present data. Examination of residuals showed that the errors are independent and normally distributed. Finally, the logistic model is used to forecast the future wheat production of the country.

58. Interactions at Reduced Levels of Agronomic Factors for Higher Productivity

G.L. Khurana, K.C. Bhatnagar and P.N. Bhargava
IASRI, New Delhi

A study was conducted to obtain interactions at reduced levels for higher productivity. The data of production potential experiments under resource constraints under AICARP (ICAR) for the years 1982-86 for Rice-Wheat sequence for different locations were utilised. The design adopted in these experiments was strip-plot with treatments: a combination of four agronomic factors (inputs) such as date of sowing (D1 & D2), fertiliser application (F1 & F2), plant population (P1 & P2) and weed control (W1 & W2) during Kharif. During rabi, the plant population was replaced by irrigation (I1 & I2). The suffices 1 & 2 denote the recommended and reduced levels respectively. The data were subjected to appropriate statistical analysis applying Multiple Regression and Analysis of Means (ANCM) techniques for arriving at meaningful conclusions.

The interactions that could possibly be useful for higher productivity at reduced levels for rice-wheat sequence for Masodha (U.P) were D1 x F1 with either level of P & W for kharif and D1 x F1 x I2 or D1 x F1 x I2 x W2 for rabi respectively. For Raipur and Kathulia Farm (M.P.), the useful interactions were D1 x F1 x P2 x W2 and D1 x F2 X P1 x W1 for kharif and D2 x I1 x F1 x W1 (W2) and D1 x F1 x I2 x W2 for rabi

respectively. Fór Rudrur (A.P.)., the important interactions (package of practices) that were found good at reduced levels, were D2 x F1 x P1 for kharif and D1 x I2 x W2 or D1 x I2 x F2 x W2 for rabi respectively.

59.   On A-Efficiency of Balanced Test Treatment Incomplete Block Designs

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It is proposed to study the problem of comparing $v(\geq 3)$ test treatments with a control with as high a precision as possible using A-optimality criterion when experimental units are arranged in 'b' blocks of size 'k', each such that k < v+1. Hedayat and Mazumdar (1984) obtained sufficient conditions for establishing the A-optimality of incomplete block designs for making test treatments control comparisons in the class D (v,b,k), where D (v,b,k) denotes the class of all connected designs with v test treatments and a control arranged in b blocks of size k each. It is difficult to give a general method of construction through which one can obtain an A-optimal design which satisfies these conditions. As such, three general methods of construction of Balanced Test Treatment Incomplete Block (BTIB) design (which estimate all the test treatment control contrasts with the same variance are given). In method 1, the union of two partially balanced incomplete block designs with same association scheme whose block sizes differ at most by one is used and the control treatment is added to their blocks such that final block size become k. In method 2, BTIB designs are obtained through the union of semi-regular or regular group divisible designs alongwith their association schemes treating groups as blocks. The absolute difference between the block size of the semi- regular or regular group divisible design and the block size of the design obtained from the association scheme should at most be one. Add the control treatment to the blocks so obtained in such a way that the final block size becomes k. The third method of obtaining BTIB designs is derived through cyclic designs. Take two cyclic designs such that their block sizes differ at most by one. Add the control treatment to the blocks of the designs such that final block size of design becomes k.

All the designs obtained through these methods of construction are tested for A-optimality using the conditions of theorem 2.1 of Hedayat and Mazumdar (1984). A-efficiencies (ratio of trace hypothetical A-optimal design for making test treatment control comparisons in a given class of designs to the trace of design whose efficiency is to be obtained in the same class of designs) for the designs obtained by method 1, 2 and 3 are computed. The designs with A-efficiency exactly equal to one are termed as A- optimal. The design obtained through different methods of construction are listed alongwith their A-efficiencies. It is observed that most of the designs have very high A-efficiencies. From these listed designs, those BTIB designs are excluded which satisfied the sufficient conditions for A-optimality of Stufken (1987), but can be obtained through these methods of construction.

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60. Construction of Complete Diallel Cross System III Using Balanced N-ary Designs

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There are several breeding experiments (more often in Animal breeding experiments) in which it is necessary to assume the presence of reciprocal effects among the inbred lines and to obtain their estimates. The estimation of reciprocal effect of lines can be had by conducting the experiments in complete diallel cross (CDC) system III of Griffing (1956). Agarwal and Das (1987) have constructed balanced n-ary design through BIB design and a two-associated PBIB triangular designs. In this paper application of so constructed balanced n-ary designs for the construction and analysis of CDC system III has been given. The evaluation of general combining ability (g.c.a.) effects and reciprocal cross effects of lines is considered.

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61. Some New Class of Variance Balanced Designs

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Several authors have discussed the method of construction of binary variance balanced designs. In the present investigation, various methods of constructing (i) Binary variance balanced design, (ii) Variance balanced ternary design with equireplicate and unequal replicate and (iii) Variance balanced n-ary design have been developed. A list of new variance balanced designs is prepared.

62. Balance Incomplete Block Design with Repeated Blocks

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Lint (1973) has pointed out that several BIB Designs obtained by Hanani (1961) have repeated blocks. Santon and Sprott (1964) discussed that s a blocks of BIB Designs are identical then b ≥ sv-(s-2). Mann (1969), sharpened this result and showed that b ≥ sv. Recently Lint & Ryser (1972) and Lint (1973-74) systematically studied the problem of construction of BIB designs with repeated blocks having parameters v, b, r, k, λ, such that b, r, λ., are relatively prime. Wynn (1975) and Foody and Hedayat (1977) constructed BIB Designs and discussed an applications of such designs in sampling. In the present investigation a large number of BIB Designs with repeated blocks are obtained by (i) Trial and error method and (ii) Systematic method. It is found that some of the BIB Designs with repeated blocks do not satisfy the condition b ≥ sv-(s-2) of Stanton and Sprott (1964) and b ≥ sv of Mann (1969).

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63.   Regression Modelling by Using Residual Analysis

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A PASCAL program has been developed for regression modelling of two, three and four independent variables on the basis of residual analysis. This program gives a regression equation that represents the closeness of the functional relationship and the necessary statistical information regarding the validity of the model. A few examples have been considered to test the validity of the program based on reported data and considerably good results have been obtained for all the cases.

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64.   Performance of Sunflower in India: A Quantitative Analysis

D.L. Sale, A.S. Kamble and Jg.R. Pawar
M.P.K.V., Rahuri

The index numbers of area and production of sunflower in India rose to 368.75 and 294.50, respectively, whereas the productivity decreased to 78.84 during the period 1970-71 to 1982-83. Index numbers of area, production and productivity rose in the States of Karnataka and Maharashtra, whereas in Tamil Nadu decrease in Index numbers of area, production and productivity rose to 118.43. Compound growth rates of area, production and productivity were positive in Karnataka and Maharashtra; whereas they were negative in Andhra Pradesh and Tamil Nadu. At all India level the area and production growth rates were positive to the tune of 4.70 and 2.30 per cent per annum, respectively. However, the growth rate of productivity was negative. In all the States and at national level productivity growth rates were lower as compared to production and area growth rates.