

ABSTRACTS OF PAPERS

1. **Asymptotic Properties of a Generalized Regression Type Predictor of a Finite Population Variance in Probability Sampling**

D. N. Shah and P. A. Patel

Sardar Patel University, Vallabh Vidyanagar - 388 120

A system of predictors for estimating a finite population variance is defined and shown to be asymptotically design unbiased (ADU) and asymptotically design consistent (ADC) under probability sampling. An asymptotic mean square error (MSE) of a generalized regression type predictor, generated from the system, is obtained. The suggested predictor attains the minimum expected variance of any design unbiased estimator when the superpopulation model is correct. The generalized regression type predictor and the predictor suggested by Mukhopadhyay (1990) are compared.

2. **An Application of Generalised Stepwise Regression Procedure to a Multicollinearity Problem**

K. Venkateswar Rao, Y. Radha, K. C. Chenna Rayudu and
Y. Eswara Prasad

Regional Agril. Research Station (APAU), Jagtial-505327

The least squares estimation is one of the application procedures of regression analysis where equal importance is given to all the explanatory variables under consideration. Much of importance is laid on unbiasedness at the cost of variance of relevant estimates. Here, an application of generalisation of stepwise regression procedure to five dimensional space (Agriculture input costs) is attempted by partitioning the explanatory variables (viz : seed, fertilizer, plant protection, labour and others) into different steps depending on their relative importance to the analysis under consideration. The data used for the study were collected from 30 farmers of Karimnagar district of Andhra Pradesh. The expression for bias, Mean Square Error (MSE), Variance and comparison of MSE with variance of corresponding ordinary least square (OLS) estimates have been derived. This type of procedure of estimation though leading to biased estimates, resulted in less in "minimum variance" of corresponding OLS estimates.

annually for a fairly long time and forms the mainbase for land use planning and analysis.

However, This data does not give adequate information on many qualitative aspects of landuse which are relevant for landuse planning. Further, there are gaps in the data and also data is not available for few part of the country especially North-Eastern states.

Since 1972, remote sensing data on some aspects of landuse has become available for some points of time. Though not as comprehensive and detailed as the land revenue data, the remote sensing data is a useful supplement to official statistics on landuse.

Problems of Comparability

The availability of data from different sources has however, added to the problem of their comparability. Even at the aggregated level the differences in the estimates for different types of landuse are too large to be easily reconciled or ignored. For instance while according to official statistics area under forests is 75 million hac. NRSA data put area under forest at 46.3 million hac. and Forest Survey of India at 64 million hac.

A major deficiency of landuse statistics in India is the absence of information on the qualitative aspects of landuse. For effective landuse planning more and more data on these qualitative aspects is called for at the micro-level.

There is a need to collect the data on qualitative aspects of land along with non-agricultural uses of land. To improve the degraded land the data on the ownership as well as geographical spread of the land should be made available. Also, there is need to improve the system of data collection in use of official statistics.

3. Cross Checking in Frequency Table Preparation

R. C. Bharati, T. J. Khatri and R. K. Parikh
N. M. college of Agriculture, GAU, Navsari-396450

A simple method is provided for preparation of frequency distribution table for large observations. The existing method does not provide cross checks; as a result, it requires the repetition of whole process, when a mistake is detected. The proposed method reduces this problem to a considerable extent by facilitating the cross checks at several stages and checking only a concerned portion of data, if an error is detected. The method has been illustrated by suitable example.

4. Nonlinear Statistical Models for Describing State-wise Wheat Production Data in Post Green-revolution Era

Prajneshu and P. K. Das
IASRI, New Delhi-110012

Nonlinear statistical models viz. monomolecular, logistic, Gompertz, mixed influence and Richards are employed for describing state-wise wheat production data during the years 1966-67 to 1992-93. The six major wheat growing states considered are: Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Rajasthan, and Bihar. Parameters of these models are estimated using Levenberg-Marquardt procedure for nonlinear estimation. Adequacy of a model is judged by computing various measures like R^2 , RMSE, MAE, OSAF. The assumptions of randomness and normality of residuals are examined by using run test and Shapiro-wilk test respectively. It is found that, for each of the six major wheat growing states, logistic model describes quite well the wheat production data in the post green-revolution era. A comparative performance of various states in respect of wheat production is carried out on the basis of the magnitude of the estimates of parameters of the fitted models.

5. Estimation of Linear Regression Model under Linear & Ellipsoidal Apriori Restrictions

Anil K. Srivastava and Sanjay Rastogi*
Lucknow University, Lucknow

The paper deals with estimation of coefficient vector in a linear regression model subject to a set of given linear restrictions binding the coefficients and also inequality restrictions which are expressible in the form of ellipsoidal constraints. This is a kind of synthesis of minimax and restricted regression

techniques which has resulted in two proposed estimators. Assuming a normal probability law for the disturbances and assuming σ^2 to be known, the expressions for exact properties of the proposed estimators, have been derived.

* Banasthali Vidyapeeth, Rajasthan - 304022

6. Effect of Errors of Measurement of Estimates on Parameters of Forecast Model

Chandrabhas and T. Rai
IASRI, New Delhi - 110012

The paper deals with the possible effects of measurement errors on the parameters of the forecast model based on biometrical characters. For this purpose, an empirical investigation is made to study the effect of measurement errors on estimate of parameters of forecast model in which the concomitant variables are correlated among themselves and are measured with varying degree of reliability. It has been found that the coefficient of determination (R^2) increases when the measurement errors are taken into account while analysing the observed data. The relative sizes of the estimates of forecast model and hence its interpretation gets affected if the correction for measurement errors are carried out in the analysis.

7. An Extension of Balanced Repeated Replication (BRR) for Variance Estimation of Non-Linear Estimator

S. P. Verma, A. K. Srivastava and B. C. Saxena
IASRI, New Delhi-110012

Variance estimation is a major problem particularly in a complex survey. An alternative technique considered as 'Two unit reduced BRR', has been given in this paper which is simple and more flexible in approach for getting over this problem. Unlike the BRR method of variance estimation given by McCarthy (1966) which is applicable only when 2-units per stratum design is used, the proposed technique is an extension of BRR for general situation. The method consists in reducing the n_h unit stratified design to 2 unit stratified design, n_h being the number of selected units in h^{th} stratum, $h = 1$ to L (No. of strata) and then the combination by McCarthy (1966) has been applied to obtain the estimator of variance of non-linear estimator. The method has been illustrated by considering a small artificial population. It has been seen that the estimator is unbiased in linear estimator situation and it scores over the method suggested by Kish and Frankel (1870) and works satisfactorily in terms of precision in the case of unequal number of units selected from different strata.

8. Utilization of Auxiliary Character at Different Stages of Sampling

Anil Rai, T. Rai and Mohan Lal
IASRI, New Delhi-110012

Problems of estimating parametric functions in finite population, when auxiliary information regarding character under study is available at different stages of sampling are considered with the help of linear regression estimators. Seven different estimators are proposed as per the availability of auxiliary informations at various levels and their efficiencies compared empirically with the data collected during kharif 1977-78 for the rice crop in Ambala district of Haryana State. The estimator formulated by taking the regression at primary as well as secondary stage for each stratum is found to be superior to all the proposed estimators.

9. Estimation of Seemingly Unrelated Regression Equations when Explanatory Variables are Subject to Error

V. K. Sharma and Ashok Kumar
IASRI, New Delhi-110012

It has been shown in this paper that the usual generalized least-squares estimators of regression coefficients in a linear seemingly unrelated regression equations model are not consistent when the explanatory variables are subject to error. For such situations, consistent estimators have been proposed by using the instrumental variables technique. The method has been illustrated by estimating a two-equation acreage response model for wheat and sugarcane for Bulandshahar district of Uttar Pradesh.

10. Costs and Returns from Sheep Rearing Under Stationary Conditions

T. B. Jain, P. S. Rawat*, Riyazuddin* and S. C. Sharma*
IASRI, New Delhi-110012

Sheep rearing is an important activity in the rural economy of our country. A comprehensive study aiming to find out the rearing practices followed in a region, factors responsible for bringing about economy in rearing cost and the problems faced by shepherds in their profession will provide basis for formulating sheep development programmes on scientific lines. This in turn will help in improving the economic status of the rural folk.

In the present study the cost of maintenance of sheep upto assigned stages of growth, cost per kg. of wool and costs and returns from rearing sheep from lamb to adult stage under stationary conditions were estimated by utilizing the data collected during a study carried out in Tonk district of Rajasthan in 1991-92.

The average daily cost of maintenance of a lamb was of the order of 41 paise for male and 43 paise for female. In the case of young males, the daily cost per hogget ranged from 55 paise of 3 to 6 months age to 104 paise of 9 to 12 months age while in the case of young females it ranged from 57 paise to 101 paise over the animals of the same age groups. Average daily cost of an adult sheep was about Rs. 1.32 for male and 88 paise for female.

Average cost per kg. of wool including and excluding family labour was of the order of Rs. 20.15 and Rs. 10.20 respectively whereas the apportioned cost per kg. of mutton with and without inclusion of family labour was Rs. 15.10 and Rs. 7.20 respectively. It was found that ignoring family labour, the returns to a household from rearing sheep from birth to adult stage were about 3 times the investment in rural area.

* Central Sheep and Wool Research Institute, Avikanagar (Rajasthan) 304501

11. Estimating Seasonal Fluctuations

Jagbir Singh, H. C. Gupta and O. P. Kathuria
IASRI, New Delhi-110012

In many realistic problems prevailing in Agricultural Sector, the characteristics undergo changes over the years as well as seasonal changes within years. If there is a parameter Q_{ys} belonging to the s th season of y th year in a repeat survey spread over q seasons/occasions/levels of each of the p consecutive years, then the Minimum Variance Linear Unbiased Estimators (M V L U E's) for seasonal/ annual fluctuations and for the other related parameters have been developed as particular cases of MVLUE's for parametric functions $f(Q_{ys})$ by making use of Hilbert Space Method. These developments have also been demonstrated by presenting a methodology for the estimation of various seasonal/annual fluctuations in percentage losses of Post-harvest foodgrains in storage under a practical illustration.

12. Small Area Estimation of Egg Production in Kinnaur District, H.P.

D. K. Bhatia and S. C. Sethi
IASRI, New Delhi-110012

At present the estimates of egg production is being done at state level. But the growing demand of Small area statistics for formulating development programmes at grass root level and taking policy decision has made it necessary to develop small area estimates at district level. District Kinnaur in H. P. has been taken up to estimate egg production for summer season only by applying the synthetic method of estimation out of known techniques for the year 1989-90. The estimates of egg production per day was found to be 1089 ± 8.69 and through direct method the estimate was 1688 ± 17.33 .

13. Crop Weather Analysis for Preharvest Forecasting of Sorghum Yield in Surat District of Gujarat State

T. J. Khatri and R. K. Parikh
Gujarat Agricultural University, Navsari Campus, Gujarat-396450

Preharvest forecasting of the yield of sorghum (*sorghum bicolor* L.) in Surat District of Gujarat was attempted by selecting rainfall variables through step-wise regression analysis utilizing rainfall data of 22nd to 43rd Meteorological Standard weeks for the past 27 years from 1968 to 1994. Regression analysis helped in predicting sorghum yield by selecting six variables out of 22 rainfall variables during the crop growth, accounting 74% of the variation in yield. The selected variables also suggest that the premodia formation, flage leaf stage, flowering and milking stage are the critical stages of crop growth, when the sorghum crop requires irrigation for rabi cultivation as supplemental irrigation for getting higher yield.

14. Cause and Effect Analysis for Fruit Yield in Ber (*Zizyphus mauritiana*. Lamk)

B. H. Prajapati, D. G. Gauswami and J. K. Patel
Gujarat Agricultural University, Sardar Krushinagar-385506

The data on six biometrical characters collected from a physiological experiment on ber (Cv.Umran) conducted at the Arid Zone Research Station, Gujarat Agricultural University, S. K. Nagar during 1991-92 were subjected to correlation and path analysis. The results showed significant positive association between fruit yield and fruit set, pulp-stone ratio, whereas yield

had negative significant association with fruit drop and stone weight. The total variation accounted by all the characters was 86 per cent. Path analysis revealed positive direct contribution of fruit set and fruit length and negative contribution of fruit drop and stone weight. In breeding research programme for ber genotypes due weightage should be given to these four characters for evolving high yielding genotypes.

15. Pre-harvest Forecast Models for Prediction of Yield in Groundnut (Rabi)

Madan Mohan and B. H. Singh
IASRI, New Delhi-110012

To develop a suitable model for pre-harvest forecast of yield of groundnut, pilot survey was carried out in five taluks of Gujarat state during Rabi, 1985. A multi-stage stratified random sampling technique was used for selection of fields. Multiple regression technique of yield attributes to enter finally in the forecast model, the technique of stepwise regression was adopted. It was observed that biometrical characters (Plant population, number of branches, number of flowers, etc.) may be used to forecast the yield of groundnut about 6-8 weeks before the harvest.

16. A Study on Yield of Rabi Crops in Flood Prone Areas of U. P.

Jagmohan Singh and B. H. Singh
IASRI, New Delhi-110012

Frequent flood and drought conditions in one part or the other of the States of India, are the two major constraints which contribute extensively in one way or the other, towards production of kharif and rabi crops.

It is desirable to highlight the factors, such as, different depths of flood water in affected fields during kharif season for studying the effect on crops in the subsequent season.

With this objective, a study on wheat crop was carried out in the selected villages of Bansdhi tehsil of Ballia district in Uttar Pradesh utilising data collected under the project, 'Pilot sample survey to study the impact of flood on agricultural production', in a region of Uttar Pradesh.

The study revealed that the depth of flood water during kharif season in flood prone areas had varying effect on yield of wheat; e.g. the yield of wheat per acre in the fields with depth of flood water 0-30 cms, 31-60 cms, and

above 60 cms. during kharif season turned out to be 9.45 (± 0.53) quintals, 9.32 (± 0.17) qtls. and 7.85 (± 0.33) qtls and that of unaffected fields was 9.77 (± 0.22) qtls.

17. Models for Forecasting Aphid-Pest of Mustard Crop

Chandrabhas and G. N. Bahuguna
IASRI, New Delhi-110012

In this paper GMDH procedure originated by A. G. Ivakhneko is applied to develop models for forecasting aphid-pest population on the basis of meteorological data. The data pertains to weekly counts of aphid population for yellow seeded and brown seeded varieties of mustard crop and corresponding weekly records of meteorological variables like maximum temperature, minimum temperature and relative humidity. The study revealed that forecast of aphid population is generally possible eleven weeks after sowing of mustard crop on the basis of average maximum temperature at five week lag, average minimum temperature at seven week lag and average relative humidity at eight and nine week lag for yellow seeded variety; and average maximum temperature at four and five week lag, average minimum temperature at seven week lag and average relative humidity at nine week lag for brown seeded variety.

18. Measurement of Adoption Rate and Impact of Development Programmes

Jagmohan Singh, M. S. Narang and P. C. Mehrotra
IASRI, New Delhi-110012

Attempts have been made in the past to build up indices of adoption rate of technology as also to develop procedure (s) of measuring the impact of development programme. One of the main difficulty in constructing indices of adoption rate of a programme has been the choice of appropriate weights for the different components of the programme. In the absence of a prior knowledge of these weights generally the different components are assigned equal weights, which may not be desirable. In this paper attempts are made for building up suitable weights for the different components by making use of linear partial correlation coefficients between the dependent variable and the different components of the programme. Step-wise culling out of the insignificant type of indicators has also been attempted.

19. Behaviour of Yield During Different Years in Cultivation of Vegetable crops

D. C. Mathur and A. K. Gupta
IASRI, New Delhi-110012

An attempt has been made to study the behaviour of yield of Tomato and Brinjal crops obtained during different pickings. The data pertains to Pune district of Maharashtra state and was collected under the project, "Pilot sample survey for estimation of losses, price spread at various stages of marketing and cost of cultivation of vegetable crops, Pune, during 1986-88" conducted by IASRI, New Delhi.

The results revealed that number of pickings had significantly contributed towards the yield of Tomato and Brinjal. A quadratic fit was found to be the best fit for both vegetables. Multiple harvesting of vegetable crops can also be helpful in forecasting the yield of crops on the basis of observing few pickings. A positive response has indicated that an increase in the yield of crop is expected only when the number of pickings increases. Cultivation of Tomato was observed to be more profitable than Brinjal.

20. Role of Holding Size in Cultivation of Paddy Crop

S. C. Sethi and Jagmohan Singh
IASRI, New Delhi-110012

To investigate the efficient use of holding size, a study was carried out utilising the data collected by Haryana Govt. for conducting crop cutting experiments on major cereal crops. The present study is confined to paddy crop in Ambala district during 1986-87 of Haryana State considering four holding sizes. The inputs were fertilizers applied and the number of irrigations given.

The study revealed that the yield of paddy per acre was 1474 kg for holding size upto 5 acres, 1974 kg in 5-10 acres, 1892 kg. for 10-15 acres and 2128 kg for holding size more than 15 acres.

21. Minimal and Equineighbourd Repeated Measurements Designs

Jyoti Divecha and Pratima Patel
Sardar Patel University, Vallabh Vidyanagar-388120

Repeated Measurement (RM) designs provide arrangements for experiments in which experimental units are used repeatedly by exposing them to a sequence

of treatments over a span of time. Two natural requirements associated with the repeated measurements experiments are : (i) its size be minimal, and (ii) the observations assumed to be correlated.

In this paper, two aspects of Repeated Measurement designs balanced for residual effects of single preceding treatment are discussed. One aspect is to construct minimal such Repeated Measurement designs using the concept of m-terrace. Second aspect is to conjoin the concept of equineighbourhood with such Repeated Measurement designs to deal with the case of autocorrelated observations. Two examples giving construction procedures are described.

22. Robustness of Block Designs against the Exchange of a Treatment

P.K. Batra, P.R. Sreenath and Rajender Prasad
IASRI, New Delhi-110012

During the course of layout, due to constraints in experimental or due to accident it may happen that one or more experimental units may get the treatments which were not actually designated to them at planning stage. Such type of disturbance in the layout of agricultural experiments has been observed by Pearce (1948, 83) and Gomez and Gomez (1976). In the present investigation an attempt has been made to study the robustness of different classes of binary variance balanced block designs against the exchange of treatment using criterion of (i) connectedness (ii) efficiency of resulting design (d^*) relative to original design (d).

Using connectedness criterion, the variance balanced block design with non-zero eigen-value (μ) of its information matrix C satisfying $\mu > 1$ are found to be robust. Using efficiency criterion, the RCB designs are robust for v greater than 3 and having total number of experimental units greater than 20. The BIB designs are robust for $v \geq 13$. The non proper variance balanced block designs of Gupta and Jones (1983) and Kageyama (1974) are found to be robust for $v > 9$ and $v \geq 11$ respectively. In general it has been seen that the loss in efficiency decreases with increase in v or k (the size of affected block).

23. The Design and Analysis of Competition Experiments using Factorial Structure of Treatments

Vijayaraghava Kumar and P.R. Sreenath*
College of Agriculture, Vellayani, Trivandrum-695522

Interference or competition among neighbouring test treatments is a practically important problem occurring in various type of field and laboratory

experiments. Designs commonly designated as neighbour balanced designs or serial designs were made use of in such situations. In these designs the treatment appears in the form of an ordered triplet in which there will be a test treatment in the middle and two neighbour treatments on its both sides. The effect of a treatment applied to a plot is considered as the sum of a test treatment effect due to the treatment applied to the plot, as well as the left and right neighbour effects due to the treatments applied on its immediate left and right neighbour positions. In order to save resources sequences of these ordered triplets were developed whenever possible, such that each of the treatment is used for providing test treatment effect as well as neighbour effects.

The statistical concepts, assumptions and a model are presented regarding designs for such competition experiments. The design and analysis of experiments permitting comparison of competition effects and test treatment effects in a set of s competing treatments is attempted by establishing a correspondence between the set of s^3 treatment triplets and combinations of s^3 factorial experiment.

* Indian Agricultural Statistics Research Institute, New Delhi-12

24. Construction of a Composite Sow Index and Study of its Effects Due to Sire Parity and Season in Pigs

K.C. George and Cini Varghese

Kerala Agricultural University, Mannuthy, Trichur 680651

Pig breeding for meat, has become a very profitable profession for medium type families by feeding them their kitchen waste and other cheap edible materials. The growth rate of Yorkshire breed is much higher than the local breed. Age at farrowing, post weaning conception period, litter size at birth, average weight of a piglet at birth, litter size at weaning, average weight of a piglet at weaning can be considered as the six important independent contributing characters. So far very little study has been made to know the effects due to sire parity and season in pigs based on the above mentioned six characters. Hartwig, S. *et. al* (1990), Milkani, H. (1982), Sandhu, G. *et. al* (1983), Schadf, A. and Hammer, H. (1980), Sorensen, D.A. (1988) and Tomes, G.J. and Newman, R.B. (1982) were the few workers who did some studies in this direction. The present study was aimed at the construction of a composite sow-index and study its effects due to sire, parity and season in pigs. The data for this purpose has been collected from the KAU Pig Breeding Farm for the period 1978 to 1992 based on five parities. On the whole 255 animals of yorkshire breed were selected. The concept of the construction of the index is mainly based on; the age at first farrowing 12 months, litter size

at birth 8 numbers, litter weight at birth 10 Kg, litter size at weaning 8 numbers, litter weight at weaning 72 Kg and the post weaning conception period one fortnight under normal situation. Indices for different six characters x_1 , x_2 , x_3 , x_4 , x_5 and x_6 were constructed as $I_a = 1 + (12 - x_1) 0.2$, $I_b = 1 + (x_2 - 8) 0.2$, $I_c = 1 + (x_3 - 1.25) 0.2$, $I_d = 1 + (x_4 - 8) 0.2$, $I_e = 1 + (x_5 - 9) 0.2$ and $I_f = 1 + (0.5 - x_6) 0.2$. The composite sow index for every sow was constructed by adding the indices of the above six items in each sow's case and similarly for all the five parities. The table of best 25 sow-sire combinations were sorted out on the basis of the composite sow index for all the five parities. From this table the best sow-sire combinations were identified. In the same manner the selected best 25 animals were arranged in the three seasons viz; Winter, Summer and Rainy seasons and seasonal effect has been examined. The best performing 25 sows were sorted out under different parities. From this the best sow could be identified. Similarly by rearranging the best 25 animals and their sires were selected under each parity and the best performing sires were identified. In the same manner the best joint sow-sire pairs were also identified. The index of the 25 best animals were rearranged on the basis of the five parities and examined whether there is any parity effect existing or not. From the above study it was found that there is no effect due to season or parity in pigs as far as the six characters were considered.

25. Genotype \times Environment Interaction of Maize Varieties

G. Nageswara Rao and K. Alivelu

A. P. Agricultural University, Hyderabad-50030

A comparative study of three models namely Eberhart and Russel (1965), Perkins and Jinks (1968) and AMMI model was conducted for estimating Genotype \times Environment Interaction of maize varieties. AMMI model showed no significant Genotype \times Environment interaction in any of three kharif seasons of 1989, 1990 and 1991 whereas Eberhart and Russel model and Perkins and Jinks model showed significant Genotype \times Environment Interaction.

26. Estimation of Variance of Repeatability Estimators for Perennial Crops

S. D. Wahi

IASRI, New Delhi -110012

Wahi (1994) has proposed the new estimators of repeatability which are robust to bienniality and can be used for estimation of repeatability in perennial crops. The present paper is devoted to derive the formulae of variance for these

estimators and to compare them with the traditional ANOVA and Principal component (based on correlations) estimators.

The biennial data on orange and guava crops for 11 years and 5 years respectively were used to estimate the repeatability and their standard error by the four different methods (ANOVA, P. C. COR, Moving Average I and II). The results of present study were found in line with the results of simulation study conducted by Wahi (1994). The Moving Average estimators which are almost unbiased are found to have nearly the same standard error as that of ANOVA estimator for large values of k (i. e. the number of records per individual) and hence can be used in place of usual ANOVA estimator which is highly biased in presence of bienniality in data.

27. Growth Performance Index in Crossbred Goats

Lal Chand, S. D. Wahi and V. K. Bhatia
IASRI, New Delhi -110012

A procedure has been suggested for developing growth performance index in crossbred goats by combining body weight, pin-shoulder length, growth velocity and growth rate in an optimum manner. Records adjusted for various effects (fixed) like sex, season, period, type of birth, parity order etc. in respect of the four important Indian breeds namely, Jamana Pari, Beetal, Barbari and Black Bengal in 4x4 Diallel crossing alongwith their 3- and 4-breed crosses maintained at Udai Pratap college, Varanasi were utilised to develop a linear discriminant function by maximising the variation 'Between genetic groups' relative to 'Within genetic groups' for the composite character based on body weight, pin-shoulder length, growth velocity and growth rate (all traits upto one month of age) of the animals. It was observed that the variance ratio of the index increases by about 94 percent over the best component trait body weight. It was also noticed that the growth performance based on the composite character is maximum for Jamana Pari followed by Beetal x Jamana Pari and Jamana Pari x Beetal crosses.

28. Statistical Studies on Nitrogen Economy through Azolla in Rice

Madan Mohan
IASRI, New Delhi-110012

Biofertilizers namely Azotobacter, Azosopirillum and Azolla are sources of fertilizer. Azolla is fern capable of fixing nitrogen to the soil. In this paper, the effect of Azolla in rice growing areas were planned and the efficiency of

Azolla applied alone or in combination with a moderated dose of N as basal dressing against N applied through chemical fertilizers were studied. The study revealed that for kharif rice, application of N at 30 kg/ha or 60 kg/ha would be very well economised by application of Azolla at 5 tonnes/ha alone or in combination with 30 kg N/ha.

29. Some Equivalence in Cell Means Model and Weighted Squares of Means ANOVA Computations

S.C. Agarwal

Project Directorate On Cattle, Modipuram, Meerut-250110

This paper demonstrates for use in teaching applied statistics that the cell Means Model technique, a recent approach for analysing unbalanced (unequal subclass numbers) data, and the famous Yate's weighted squares of Means both having the same type of hypotheses are equivalent to compute sums of squares for main effects with an exception for interactions.

30. Study of Statistical Properties of Genetic Correlation

S.D. Wahi, V.K. Bhatia and Lal Chand

IASRI, New Delhi- 110012

The genetic correlation is an important genetic parameter and is being widely used by geneticists and breeders. One of the most commonly used method of estimation genetic correlation is based on half-sib family means. The formula of standard error of this estimate is highly approximate and uses the estimates of other genetic parameters. This results in incorrect estimation of the standard error of the genetic correlation. The present investigation is attempted to study the statistical properties of this important genetic parameter using bootstrap technique.

The results of this study showed that in 95% of cases the underlying distribution of the genetic correlation is non normal. The bootstrap estimates of genetic correlation are biased to extent of 5-10 per cent. The substantially higher bootstrap estimates of standard error has proved that standard error is highly underestimated by approximate formulae. As expected the confidence intervals obtained by the percentile method are shorter in majority of cases as compared to intervals obtained by normality assumption. The bias-corrected confidence intervals are also obtained but their behaviour is erratic and they increase the length of the confidence intervals instead of reducing it, in case of larger bias.

31. Identification of Significant Contribution of Inputs for Optimum Production of Total Foodgrain in India

T. Rai

IASRI, New Delhi-110012

The study is based on the time series data from 1971-72 to 1988- 89 to identify the significant contribution of the input variables such as area (unirrigated and irrigated), area under high yielding varieties (AHYV) Nitrogen and total fertiliser nutrients (N+P+K) which directly contribute to total foodgrain production. The contributions of area even if not irrigated and the Nitrogen, a fertiliser nutrient are found to be highly significant. These two input variables together explain 94% of the total variations in total foodgrain production in India. An increase of 13.91 kg. for an additional use of 1 kg. of Nitrogen is evident from the best predicted function. The productivity is observed to be about 1850 kg/ha.

32. A Linear Model Approach for Analysis of Two-way Classified Nominal Data

B. Singh

IVRI, Izatnagar (U. P.)-243122

A procedure for analysis of discrete data arranged in three- dimensional contingency table with one response and two factor variables is developed by using a linear model. The procedure is based on the conventional chi-square method. The expected and observed frequencies are estimated by using a linear model analogous to step down regression analysis for continuous data. In the presence of interaction between factor variables the method is developed by using weighted mean square approach for quantitative data. The procedure is illustrated numerically through a practical example in animal sciences.

33. Soil Compaction and its Effect on Crop Production

Satyendra Kumar

IARI, New Delhi-110012

Productivity of coarse textured loamy sand soil, is relatively low due to its excessive permeability which causes deep percolation of water and nutrients beyond root zone and this discourages the farmers to use high level of these costly inputs. These soils cover large areas in the states of Rajasthan & Haryana. A Compaction Technology which brings the soil particles near each other, has been developed to reduce deep percolation losses of water and nutrients,

evaporation losses of water and irrigation water requirement of crops grown on these soils. It involves making of 4- 20 passes of tractor or bullock driven roller (depending upon its weight), at optimum moisture or within 24 hours of irrigation/heavy rainfall. The data collected under the ICAR - All India Coordinated Research Project on "Improvement of Soil Physical Conditions to Increase Agricultural Production of Problematic Areas" at Jobner and Hissar centres is utilized for the present study.

The study revealed that the compaction of sandy or loamy sand soils have 30- 75% reduced infiltration rates, require 40% less water in each irrigation, retain moisture for a longer period, improve germination, provide anchorage to plant roots, reduce the attack of white ant and white grub and increase the uptake of nutrients, thereby enhancing the production potential of these soils.

The compaction of sandy and loamy sand soils to optimum level, increase significantly the yields of pearl millet (BJ-104) by 32% & wheat (Kalyan sona) by 17% over the yields of 10.6 and 23.2 q/ha, respectively, for uncompacted soil. The adoption of Compaction Technology in Farmer's Field Trials showed a net profit of Rs 2796/ha after deducting the additional cost of compaction of these soils.

34. **Season's Effect on Sex and Other Traits of
Sahiwal-Jersey Crossbred Cows- A Case Study of
Tarai Region of Uttar Pradesh**

V. K. Bharti and A. K. Shukla

*G. B. Pant University of Agriculture and Technology
Pantnagar-263145*

An attempt had been made to know the effect of different months of the year on sex of the calf and breeding season on first gestation period (FGP), second gestation period (SGP) and weight of first calf (WFC) on the basis of the data obtained from the Livestock Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar. The observations were screened depending on the available record from 171 Sahiwal- Jersey crossbred cows viz. 160 observations for the study of different month's effect on sex of new born calf and for the study of breeding season's effect; 140 observations for first gestation period, 142 observations for second gestation period and 120 observations for the weight of first calf. Chi-square test of goodness of fit was applied to test the hypotheses that proportion of female calf produced is same for all the months or there is no effect of season on the sex of the calf. It was concluded that there was no significant effect of calving season on the sex of calf. Completely Randomized Design was applied to know the effect of breeding season on first and second gestation periods and weight of first

calf. On the basis of the weather temperature a year is divided into four seasons : April, May, June (Season I); July, August, September (Season II); October, November, March (Season III); and December, January, February (Season IV).

The F-test revealed that there was no significant effect of breeding season on first gestation period ($F_{\text{cal}} = 1.742$), second gestation period ($F_{\text{cal}} = 1.294$) and weight of first calf ($F_{\text{cal}} = 2.641$).

35. Correlated Response of Physicochemical Characters on Sensory Attributes of Fried Gizzard and Fried Chicken Liver

A. K. Sachdev, Ram Gopal, T. K. Pangas and S. S. Verma
Central Avian Research Institute, Izatnagar-243 122

Quality based characterization of fried gizzard as well as fried chicken liver was done through two trials in each case. In addition to the determination of physicochemical properties viz. pH, Shear force value (SFV), thiobarbituric acid (TBA), moisture, crude protein (CP) and ether extract (EE) in triplicate samples in each trial, the observations on sensory traits including colour, flavour, juiciness, tenderness, texture and overall acceptability were also collected through minimum of 5 judges (each product and each trial) randomly selected from the professional staff of the institute. Correlations between these traits were estimated to identify the changes desired for further improvement in quality of these products. In case of fried gizzard, pH was highly correlated to SFV, TBA, and CP. Shear force value had significantly negative correlation with TBA, CP and colour. Similar effects of TBA were also evident on juiciness, tenderness and texture. Acceptability was negatively correlated to pH, SFV TBA, moisture and EE, but it had highly significant relationship with other sensory traits. In the event of fried liver, pH was negatively associated to all the parameters indicating significant impact on CP, colour, flavour, juiciness, tenderness, texture and acceptability. Whereas SFV evinced significant association with TBA, moisture, CP, flavour and texture. CP and EE were significantly correlated to all the sensory characters except colour. It was concluded from the studies that acidic, tougher fried gizzards with higher liquid and TBA contents resulted into poor acceptability. However, the crisper fried livers with higher SFV and fat contents received better acceptability.

36. **New Modified Product Estimator Using Coefficient of Variation of Auxiliary Variable**

V. P. Singh, M. L. Lakhera and H. P. Singh*
Gujarat Agricultural University, Anand- 388 110

A new product -type estimator is proposed for the population mean of study variable Y using knowledge of coefficient of variation of auxiliary variable X. Asymptotic properties of the proposed estimator are studied. To demonstrate the performance of the constructed estimator with various other estimators, an empirical study is carried out and shown that the proposed estimator is better than others.

* School of Studies in Statistics, Vikram University, Ujjain

37. **Markov Chain Model for Crop Yield Forecasting**

V. Ramasubramanian and R.C. Jain
IASRI, New Delhi -110012

In this study, models to forecast Sugarcane yield have been developed. Most of the earlier studies carried out for forecasting crop yields utilise regression models. An alternative approach to crop-yield forecasting is the probability model based on Markov Chain theory. This method overcomes some of the drawbacks of the regression model. So far one stage data at a time have been used by earlier workers in developing Markov Chain model for forecasting of crop yields. An attempt has been made to develop Markov Chain model that utilises two stages data at a time through growth indices of the explanatory variables. The results obtained were compared with those obtained from the existing methods. In most of the cases, Markov Chain approach that utilises two stages data at a time was found better in terms of forecasts and their standard errors over those of the existing methods. It was possible to forecast yield 4-5 months before harvest.

38. **Growth Rates, Trends, Fluctations and Variability in Area and Production of Pulses in India**

Kanwal Chugh, Satya Pal
IASRI, New Delhi-110012

Pulses are important constituent of human diet especially in India, where majority of the population is vegetarian. These are rich source of proteins, fats and vitamins so essential for growth and tissue repair. As per capita requirement, according to nutritional standards of 100gms. per day, the availability was estimated at 51.2 gms. at the beginning of the third plan period. By the end of

seventh plan, the availability has fallen to 41.1 gms. Unless serious efforts are made to increase the domestic production of pulses, this is going to cause a serious shortfall of this food group by 2000 A.D.

An attempt has been made to study the growth rates, trends and variability in area and production of pulses in India. For this study, time series data on area and production of pulses under third sub period of agricultural planning and growth in India i.e. from 1967-68 to 1989-90 (23 years) has been used. The data has been indexed on base year (triennial ending 1970-71). Exponential equation for growth rates and second degree polynomial for trends have been fitted over time. The study shows 1.5% growth rate in production of pulses even during this period of all round growth and agricultural development. On the basis of trend, the production of pulses is estimated at 16.25 million tonnes in the year 2000 A.D.

39. An Alternative Method of Construction of Triangular Design and its Comparison with Group Divisible Design in Terms of A- D- and E- Optimality Criterion

D.K. Ghosh and Naimesh R. Desai
Saurashtra University, Rajkot 360 005

A method for construction of triangular design with (i) block size three and $\lambda_1 = 1, \lambda_2 = 0$, (ii) block size $n - 1$ and $\lambda_1 = 1, \lambda_2 = 0$, (iii) block size six and $\lambda_2 = 1$ and (iv) block size ten and $\lambda_1 = (n - 3)(n - 4)/2$, has been carried out. These four methods yield the series of the Triangular type PBIB design, however all these designs are reported in Table of Clatworthy (1973). Some of the designs which are listed are also linked block design.

Further a comparison of A, D and E optimality criterion has been established between Triangular design and Group Divisible design which are having same parameters v, r, k and b . It is found that Triangular Designs and Group Divisible designs are equally better in terms of A optimality. However, some of the Triangular designs are better than Group Divisible designs in terms of D and E optimality.

40. Analysis of Trends in Area, Production and Productivity of Pulses in India

K.N. Mathur
Bio-Informatics Centre, IARI, New Delhi - 110012

Pulses form the most important source of protein to our majority of population in India. However, the per capita consumption of pulses is as low

as 40 gms per day. The total annual area under pulse crops in India is about 24 million hectares and the production is about 13- 14 million tonnes of grain. In the present paper trends in area, production and yield of major pulse crops and total pulses were estimated from the time series data (secondary) for the last 11 years (1980-81 to 1990-91). Simple linear regression equations were fitted by the least square method.

41. **An Application of Generalised Stepwise Regression Procedure to a Multicollinearity Problem**

K. Venkateswar Rao, Y. Radha, K.C. Chenna Rayudu
and Y. Eswara Prasad

Regional Agri. Res. Station (APAU) Gajjal - 505327

The least squares estimation is one of the application procedures of regression analysis where equal importance is given to all the explanatory variables under consideration. Much of importance is laid on unbiasedness at the cost of variance of relevant estimates. Here, an application of generalisation of Stepwise regression procedure to five dimensional space (Agriculture input costs) is attempted by partitioning the explanatory variables (viz: seed, fertilizer, plant protection, labour and others) into different steps depending on their relative importance to the analysis under consideration. The expression for bias, Mean Square Error (MSE), variance and comparison of the MSE with variance of corresponding ordinary least square (OLS) estimates have been derived. This type of procedure of estimation though leading to biased estimates, resulted in less in *minimum variance* of corresponding OLS estimates.

42. **Some Empirical Investigations on Non-Linear Genotype-Environment Interactions Applied to Vegetable Crops**

V.T. Prabhakaran and A.R. Rao

Indian Agricultural Statistics Research Institute, New Delhi

Most of the regression techniques currently employed in the analysis of genotype-environment interaction can adequately describe the behaviour of genotypes over different environments only when the genotypic response is, fairly linear, a situation characterised by the overwhelming contribution of linear regression component to the total genotype-environment interaction variation. In the event of remainder mean square (non-linear component) accounting for a large part of interaction variation the characterisation of genotypes based on the linear regression coefficients will be largely misleading. With this

background a critical assessment has been made on the existing procedures for studying the stability of different varieties of vegetable crops showing large non-linear interactions. A new procedure has also been given to overcome the defects in the two phase regression approach of Verma et.al. (1978).

43. Application of Trojan Squares for the Construction of Double Cross Mating Designs

K.N. Ponnuswamy and M. Dharmalingam*
University of Madras, Madras-600 005

Consider an $n \times n$ Latin Square in which each plot is divided into k subplots. In total there are n^2k subplots. Since each plot is composed of k treatments there are nk treatment allocated over these n^2k subplots. In this arrangement if the appearance of treatments in each plot is uniquely determined, then this arrangement is known as Trojan Square. Darby and Gilbert (1958) for the first time constructed Trojan Squares. The Double Cross Mating Designs (DCMD) were introduced by Rawlings and Cockerham (1962). The DCMD provide unbiased estimators for additive, dominance, additive \times additive, additive \times dominance and dominance \times dominance components of genetic variance. As the number of crosses $N = n(n-1)(n-2)(n-3)/8$ becomes too large, the need has arisen for the construction of Partial Double Cross Mating Design (PDCMD). Natarajan (1992) and Ponnuswamy, et al (1992, 1994) have considered certain method of construction of PDCMD.

An alternative method of construction of PDCMD is presented in this paper using Trojan Squares with $k = 4$.

* Salem Sowdeswari College, Salem-636 010

44. A study on Differential Effect of Sources of Phosphorus in Rice-Wheat Crop Sequence

Rajinder Kaur
Indian Agricultural Statistics Research Institute, New Delhi-110012

Fertilizer use efficiency of the various phosphatic fertilizers applied to rice-wheat crop sequence has been studied. Based on criteria of productivity, stability and relative agronomic effectiveness, promising phosphatic fertilizer source, identified for the sequence is Dia-ammonium-phosphate at all the centres under study.

45. Study of Effect of Weather on Response of Sorghum to Long-term Fertilizer Application through Cluster Analysis

Asha Saksena and Ajit Kaur Bhatia

Indian Agricultural Statistics Research Institute, New Delhi-110012

Response of sorghum to 18 fertilizer treatments applied over a period of 13 years from 1979-80 to 1991-92 was analysed to study the extent of variation due to weather. For this purpose years were classified into homogeneous groups using cluster analysis. Six weather variables at four stages of crop growth were used. Weights were applied to differences in variables according to their importance for calculating distances between years. Method of complete linkage was used to combine years. 13 years could be classified into 5 homogeneous clusters. Mean yields of these clusters were significantly different from each other for all treatments and control. Variation in responses due to cluster was examined by regressing responses over clusters. It was found that the quadratic equations were good fit and accounted for more than 80% variation in the responses. It was observed that the differences in responses of different treatments were not high in favourable weather years. P_2O_5 was found to be essential nutrient in the absence of which other nutrients N and K_2O failed to increase the response above control in both favourable and unfavourable years. Application of K_2O tend to increase the yield in unfavourable years whereas an additional dose of P_2O_5 instead of application of K_2O increased the response in favourable weather years.

46. Estimation of Harvest Index in Groundnut

S Chandra, S L Dwivedi, S N Nigam, and G Swaminathan

*International Crops Research Institute for the Semi-Arid Tropics,
Patancheru - 502 324*

Harvest Index (H) is computed as the ratio of podweight Y to biomass X by groundnut breeders and physiologists. The scatter plots of (Y,X) in an irrigated ICRISAT groundnut trial showed a linear relationship between Y and X. Also, fitting of the linear regression model $Y_i = A + HX_i + e_i$ consistently delivered a highly non-significant estimate of the intercept A for all genotypes. This was in conformity with the nature of the crop that the podweight Y must be 0 when the biomass X = 0. This suggested the possibility to get LS estimate of H from the no-intercept linear regression model $Y_i = HX_i + e_i$. The paper exemplifies and discusses this possibility using data of a genotype.

47

Adoption of HYVs of Maize in India

G.K.Jha and V.K. Sharma

Indian Agricultural Statistics Research Institute, New Delhi-12

On the basis of secondary data from 1966-67 to 1992-93 pattern of adoption of HYVs of maize in the major growing states has been analysed. The states were classified into four zones : (i) East Zone : Bihar and Orissa (ii) North Zone : Haryana, Himachal Pradesh, Jammu and Kashmir, Punjab, and Uttar Pradesh (iii) South Zone : Andhra Pradesh (iv) West Zone : Madhya Pradesh, Maharashtra, Gujarat, and Rajasthan. Resource availability, demonstration effect was found to play an important role in the adoption of HYVs. By and large, Bihar, Andhra Pradesh and Maharashtra were the leading states in their respective zones, however, in the north zone Punjab could emerge as a leading states in the adoption of HYVs only after seventies. Among all the states, Andhra Pradesh has been the leading state covering eighty-eight percent of its maize acreage with HYVs while Rajasthan remained the most backward state covering only three percent upto 1992-93. Adoption level remained below fifty percent in the major contributing states of Madhya Pradesh, Rajasthan and Uttar Pradesh. East and South zones exhibited better performance in adoption of HYVs as compared to the North and West zones. Since the former zones cover much less maize area in relation to the latter zones, emphasis has to be laid on the improvement of the infrastructure including extension services as also on the breeding of new location specific HYVs for the states in these zones in order to improve their productivity.

48. Population Dynamics, Health, Family Welfare and Related Measures in Rural Areas

K.C. Taneja

Former Member of the Indian Statistical Service

One of the most common characteristics of the developing countries, is that they are predominantly rural. India is no exception. About three-fourth of her population lives in the rural areas and almost the same proportion of this population is engaged in agriculture. Hence the importance of rural development in the overall programme of economic development hardly needs any emphasis. Accordingly, rural development has been an important component of the development strategy in the successive five year plans. The fabric of rural development is not unidimensional or uni-sectional in nature, rather it represents a rainbow of multi-sectoral dimensions. It is a balanced mix of activities to raise the agricultural production, create opportunities of employment, education

and extend health, family welfare and related facilities to ensure development of entire rural population and give India a new face.

With a view to attain this objective, it is not only necessary to increase agricultural output and develop the material resources which help in increasing it but also to ensure that we lay equal stress, if not more, on the development of human resources too and reduce the burden of a large number of developments on agriculture.

It has been observed that Agricultural Statisticians have been primarily laying the thrust on development of the material resources and other related factors which would help in increasing the agricultural output. Not much stress has been laid on examining the parameters relating to the development of the human resources and the factors which are hampering its growth. Accordingly, efforts have been made to examine the present scenario of human development efforts being made in the States on these crucial aspects- an essential ingredient of the rural development, and help the planners, policy makers to put the things in proper perspective and reframe their policies and plans to attain the objective.

It is felt that, there could be many factors responsible for development of human resources. These could be attributed to the growth of population, literacy, health, family welfare and related factors hampering it like high infant mortality rate, non-participation in family planning measures, desire to have more hands for help in the agriculture and domestic chores and for increasing the earnings of the family. Wide variations in the educational levels amongst men and women, both at the national and State levels could also be contributing significantly to this phenomenon. The study has made an attempt to examine these factors and elicit as to what extent these factors are responsible for this phenomenon.

The study has amply established that we have a long way to go for attainment of our ultimate objective of economic development and upliftment of the society. The dismal performance on all fronts whether it is the eradication of illiteracy, or providing health, family welfare and other developmental facilities in the rural areas have considerably defeated the attainment of the objective. The statistical appraisal amply indicates that even today, from the delivery in the world to the deliverance from the world, people in the rural area remain professionally unattended. Statistics speaks for itself and there is no logic stronger than the logic of facts.