ABSTRACTS OF PAPERS*

1. A GENERAL CLASS OF ESTIMATORS FOR ESTIMATING POPULATION MEAN USING AUXILIARY INFORMATION

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A general class of estimators for estimating the population mean of the character under study is propesed, which makes use of auxiliary information. Under the Simple Random Sampling Without Replacement (SRSWOR), the expressions of Bias and Mean Square Error (MSE), up to the first and the second degrees of approximation are derived. General conditions, up to the first order approximation, are also obtained under which any member of this class performs more efficiently than the mean per unit estimator, the ratio estimator and the product estimator. The class of estimators in its optimum case, under the first degree approximation, is discussed. It is shown that it is not possible to obtain the optimum values of parameters 'a', 'b', and 'p', which are independent of each other. However, the optimum relation among them is given by $(b - a) p = \rho C_y / C_x$. Under this condition, the expression of MSE of the class is same as that of the linear regression estimator.

2. A COMPARATIVE STUDY AMONG THE ESTIMATORS OBTAINED FROM WEIGHTED (ARITHMETIC, GEOMETRIC AND HARMONIC) MEANS OF MEAN PER UNIT ESTIMATOR AND RATIO/PRODUCT ESTIMATOR

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Apart from ratio and product estimators, for estimating population

mean or total, a number of estimators have been proposed which make use of auxlliary information. These estimators, however, need prior knowledge of one or more parameters of the population. Among these estimators are, the estimators due to Srivastava (1967), Walsh (1970), Gupta (1978), Vos (1980), Adhvaryu and Gupta (1983) etc. With proper choice of value of constant appearing in their functional form, they are known to be more useful than mean per unit estimator, ratio estimator and product estimator. However, it has been found rather difficult to make theoretical comparisions among these estimators.

   In the present paper comparisions among some estimators have been made. For that purpose the estimators are considered which can be constructed by working out weighted means (arithmetic, geometric and harmonic) of (i) mean per unit estimator and ratio estimator and (ii) mean per unit estimator and product estimator. It has been observed that all these estimators except the weighted harmonic mean of mean per unit estimator and product estimator, have been studied by different researchers. All these estimators have a common constant which determines weights. The weights have been assigned conveniently so as to facilitate some direct theoretical comparisions among them. It has been observed that when the value of weight determining constant is chosen around the value of '$\rho\, C_y/C_x$' these estimators perform quite efficiently. Comparisions upto first order approximations among these estimators in optimum case as well as in some different non-optimum cases, have been made using different live data and results have been discussed.

3. UNBIASED MULTIVARIATE ESTIMATOR FOR FINITE POPULATIONS

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   An unbiased multivariate estimator of the population mean $\bar{Y}$ has been proposed when information on more than one or two, auxiliary variables correlated with the main variate y, is available.

   Let y be a study variable and x_1, x_2 be two auxiliary variables. Suppose n-triplet $(y_i, x_{1i}, x_{2i})\, i = 1, 2, \ldots, n$ of observations are taken on n-units sampled from N population units using simple random sampling (SRS) design without replacement. Consider the following simple estimator for the population characteristic y as

$$\hat{\bar{Y}}_\psi = \bar{y} - w_1\, \frac{\bar{x}_1}{\bar{X}_1} - w_2\, \frac{\bar{x}_2}{\bar{X}_2} + 1$$

where w_1 and w_2 are the weights adding upto unity and $\bar{x}_1$, $\bar{x}_2$; X_1, $\bar{X}_2$ are respectively the sample and population means for the characteristics x_1 and x_2. Population means $\bar{X}_1$ and $\bar{X}_2$ are supposed to be known. Clearly the estimator is unbiased. Expression for the exact variance of the estimator $(\bar{Y}_w)$ has been obtained. The optimum variance of the weighted estimate $\hat{\bar{Y}}_w$ has also been worked out.

The precision of this unbiased estimator has been compared with the mean per unit, unbiased univariate estimator and Olkin's multivariate ratio estimator. It is observed that the present estimator is more precise than mean per unit estimator and better than the Olkin's estimator. This estimator is also preferable to mean per unit estimator for a more general class of populations compared to that for which Olkin's estimator is preferable to mean per unit. Also the lower and upper confidence limits for population mean have been found.

4. COMPOSITE ESTIMATORS IN PPS SAMPLING

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Two estimators viz. (i) combination of product and pps estimator and (ii) combination of ratio and product estimators in PPS sampling have been proposed. These estimators are found to be more efficient than usual pps, product and ratio estimators under PPS sampling. The optimum estimators have been obtained and if the difference between the weights taken and optimum weights is less than :

$$\left| 1 + \rho_{uv} \frac{C_u}{C_v} \right| \text{ and } \left| \rho_{uv} \frac{C_u}{C_v} \right|,$$

the first proposed estimator will be superior to product estimator under PPS sampling and usual pps estimators respectively and if less than

$$\frac{\left| 1 + \rho_{uv} \frac{C_u}{C_v} \right|}{2} \text{ and } \frac{\left| 1 - \rho_{uv} \frac{C_u}{C_v} \right|}{2},$$

the second proposed estimator will be superior to product and ratio estimators under PPS sampling.

5. CROSS-COUNT DATA ANALYSIS IN SOCIAL SURVEYS : AN INFORMATION THEORETIC APPROACH

JAGBIR SINGH*, NARENDRA CHAUDHARY* and RATNA R. LAXMI**

A simple and useful procedure for cross-count data analysis based on the information theoretic approach is presented in this paper. A consistent approach by the use of the principle of minimum discrimination information is made in developing test procedures. Beginning with tests of hypotheses of specified probabilities, various tests of independence, conditional independence, homogeneity of classifications, etc. are developed. Formulation of no-interaction hypotheses under different assumptions has been done upto fifth-order classification. Necessary illustrations are also presented by taking real set of data from social surveys.

6. METHODS OF COMBINING DATA BASED ON BLUP

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Henderson (1977) presented different methods for prediction of future records of animals based on different types of models using the concept of best linear unbiased predictions (BLUP). Keeping in view the same nature of data generated under the series of trials of germplasm evaluation in plant breeding and sire evaluation in animal breeding research, the three versions of BLUP are presented for finding the 'best' combined estimate of yield of different genotypes based on the data from series of trials. The versions of BLUP involved different estimates of entry and environmental variance components. The trial series included 20 different entries of rapeseed mustard these have been evaluated in 11 trials between 1986-87 to 1988-89. The method with smallest prediction error was judged best.

7. A TWO-TYPE BRANCHING PROCESS WITH MIGRATION

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A closed population may be regarded as a system where the development takes place according to probabilistic laws of branching process.

The population identifies two or more types of individuals and the process becomes a multi-type branching process (for example in human population for consideration of males and females, the process will be two-dimensional). A more general situation in population dynamics is the entry or exodus of individuals in the system simultaneously. Thus such a system can be studied by a multi-type branching process with immigration and emigration.

Gupta and Srivastava (1987) studied a branching process where a generation dependent emigration component is allowed. A generalised system where the offspring generating function is of the type $\sum_{i, j=0}^{\infty} p_{i j} s^i t^j$ has been considered. The expected population vector under different conditions of immigration and emigration has been obtained.

8. USE OF PRIOR INFORMATION ON THE PARAMETERS IN ESTIMATION OF LINEAR MODELS

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On the basis of sample observations one might expect to arrive at estimates which are unbiased and have minimum variance out of the class of linear estimators, if the assumptions of the least squares theory are met. However, in practice, the investigator comes across cases where though the assumptions are met, yet the estimates of the parameters are contrary to the expectations. In such cases information available from economic theory have been made use of in the estimation of the parameters for a linear consumption model. Relationship between macro time series parameters and micro cross-sectional parameters alongwith temporal interdependence of aggregate consumption among different time periods have been established for the individual consumption function.

$$C_{i t} = \beta_{0 i} + \beta_{1 i} P_t + \beta_{2 i} O_t \, \gamma_i I_{i t} + \epsilon_{i t}$$

$$i = 1, 2, \ldots, n$$

$$t = 1, 2, \ldots, T$$

and corresponding aggregate consumption function

$$C_t = \beta_0 + \beta_1 P_t + \beta_2 O_t + \gamma I_t + \epsilon_t \quad t = 1, 2, \ldots, T$$

through the use of extraneous information through permanent income hypothesis, partial adjustment income hypothesis, relative hypothesis and demonstration effect hypothesis.

9. MINIMUM DISCIMINATION INFORMATION STATISTICS AND CROSS CLASSIFIED DATA

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Karl Pearson (1900) introduced the X test of goodness of fit for the analysis of sequences of observed categorical data for certain properties, such as equi-distribution, independence, homogeneity and Markovity. Modification and extensions of this work followed, However the analysis part of several results of questionnaire on great many different topics simultaneously is based on X test which is restricted to two-dimensional ($m \times n$) contingency tables in most of the studies relating to social sciences. The limitation of X test for testing independence of multidimensional data simultaneously necessiates the need of statistical tools for testing different hypotheses. One of the method for analysing multi-dimensional contingency tables is log linear model and the another method is based on the application of Minimum Discrimination Information Statistics based on information theory approach and presentation of analysis of information table which has analogy with the analysis of variance. In this approach one is concerned with the MDIS and its various properties. In the present course of study authors have demonstrated conceptual simplicity of MDIS, its analogy with ANOVA and its computational convenience with an appropriate set of data. The application of log linear models is also demonstrated.

10. ON THE SOLUTION TO THE BEHRENS FISHER PROBLEM

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For comparing the means of two normal populations when variances are unequal, several solutions have been proposed in the literature. There have been some comparative studies also like Golhar (1964), Mehta and Srinivasan (1970) and latest by Zimmerman and Williams (1989) but no adequate guidelines have so far been established as to which one to follow in a given practical situation. Although t-test is known to be robust for all symmetrical populations (when variances are equal) but for $\sigma_1^2 \neq \sigma_2^2$, the test is far from satisfactory and the use of "t" test on the wrong

notions of $\sigma_1^2 = \sigma_2^2$ gives a low power. In this paper the "t" statistic is modified by using a jacknife estimate of $\sigma_1^2 + \sigma_2^2$ and approximating the numerator of the new statistic by Pearsonian Type III. It has been found that the new stastitic has a convenient form. It has been established that for various values of sample sizes and variances it behaves nicely.

11. ESTIMATION OF FRE'CHET DISTRIBUTION PARAMETERS FROM SAMPLES CENSORED AT MIDDLE

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Hooda *et al.* (1989) derived maximum likelihood estimates of the parameters of Type-II extreme value (Fre'chet) distribution from doubly censored samples. In the present study the maximum likelihood estimates of the scale parameter (b) and shape parameter (k) of Fre'chet distribution are derived from samples censored at middle. The elements of the information matrix are derived for proportions $Q_1 = 0.1 (0.1) 0.8$ and $Q_2 = 0.1 (0.1) (0.9 - Q_1)$ uncensored from below and above respectively of an ordered sample. Asymptotic variance-covariance matrices of the estimates are computed numerically for different uncensored proportions on both extremes. Asymptotic relative efficiencies of the estimates relative to the estimates derived under left, right and double censoring are presented for different censored and uncensored proportions for a comparative study.

12. FISH FARMING : A REMUNERATIVE ENTERPRISE

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The study is based on the data collected in a survey carried out by IASRI during 1985-86 in Cuttack district of Orissa State. The study revealed that crop farming with fish production was more remunerative than only crop farming. The net return over total input costs (Cost C) was about 27 percent in crop-fish farming as compared to 18 percent in crop farming. The output-input ratios for Cost A, Cost B and Cost C were 2.40, 1.33 and 1.27 respectively in crop-fish farming indicating net return of Rs. 140/-, Rs. 33/- and Rs. 27/- per hundred rupees investment in Cost A, Cost B and Cost C respectively. The output-input ratios for Cost A, Cost B and Cost C were 2.29, 1.28 and 1.18 respectively in only crop farming.

13. ON THE SAMPLING DISTRIBUTION OF AGE-SPECIFIC DEATH RATES AND BIRTH RATES FOR CATTLE

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A study on the sampling distribution of age-specific mortality and fertility rates for cattle was made at IASRI using the data available from a survey. Various samples of suitable size were developed through computer and, for each of 820 samples, estimates of the afore-said rates in respect of age groups at one-year interval as well as those at three-year interval were obtained. Mortality rates were estimated for male and female separately. In all, 432 distributions were formed out of which 235 were studied to identify suitable known type of statistical distributions. Stability of the distributions was examined by Kolmogrov-Smirnov test which indicated that the distributions tended to stabilize for about 600 samples or more.

A majority of the distributions were found to be suitable for study through negative Binomial distribution. The χ^2-test of goodness of fit, however, showed that only in six cases in the category of death rates by yearly age groups for female cattle, the fitting was satisfactory. Criteria for fitting Pearson's system of continuous distributions showed that, in majority of cases, type IX and type XI were indicated. However, the goodness of fit test did not provide confirmatory evidence for a good fit.

14. COMPARATIVE STUDY OF SOME METHODS FOR ESTIMATING MORTALITY RATES IN BOVINES

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A comparative study of alternative methods of estimating group-specific mortality rates for bovines under village conditions, viz. (i) Average population Method (Adjusted) (ii) Dandekar's Method and (iii) Life Table Method (Caughley, 1966) was made against Fractional Exposures Method (taken as standard) with a view to exploring if it was possible to obtain reasonably accurate estimates of the parameter in a simpler or cheaper way. The empirical results were obtained by demographic-cum-statistical analysis of sample survey data pertaining to about 2700 households from 90 villages of Amritsar district of Punjab; the sample having been drawn by stratified random sampling. The errors of apprex:mation due to various assumptions involved in the methods were investigated.

The Fractional Exposures Method, though accurate, involves accounting for the fractional period of exposure of every individual animal in the sample so as to obtain the 'risk population' and is thus laborious. The Average Population Method (Adjusted) is based on computations which are simple and time-saving. At the same time it could provide fairly accurate estimates of mortality rates. It might, therefore, be recommended when facilities for elaborate computations are lacking or when early reporting of results is a weighty consideration. The other two methods were found to suffer from limitations and inaccuracies.

15. ANALYSIS OF LIFE TABLE DATA FOR INSECTS

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The data of Age-specific life tables of *C. Gangis*, *S. Obliqua* and *S. Litura* constructed by Chaudhary and Bhattacharya (1986) has been used for analysis in this paper. Median life times are estimated alongwith their standard errors. Non-parameteric test also showed that the average survival times of the three species are the same. Gamma, Weibull, Rayleigh and log normal probability distributions have been fitted to the age at death for the three species separately. None of these fitted adequately to *C. gangis* and *S. Obliqua*. However, the deviations were observed to be the least for gamma. For *S. litura*, all the four distributions fitted adequately; the Weibull and Raleigh distributions having the better fit. Expectations of lifes, have been estimated as a function of x by using gamma type stochastic functions. The number of survivals at age x have been found to be adequately estimated by using a first order autoregressive model.

16. STUDIES ON MIXTURE OF CONTINUOUS AND DISCRETE DISTRIBUTED VARIABLES IN DAIRY CATTLE BREEDING-I (MEASURES OF ASSOCIATION)

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For formulating any programme for improvement in dairy cattle breeding it is important to know in advance the extent of association between different traits of interest. The variables of interest are not always continuously distributed but in practice we have mixture of continuously and discrete distributed variables. For this type of situations, the usual theory of correlation and regression for examining the relationship between

traits is not applicable. The present article deals with the study of associa-
tion between mixture of qualitative and quantitative traits by applying
the usual χ^2 tests of independence. These tests are applied for all two-
way classified tables when they are collapsed for one factor or two fac-
tors. When the tables are collapsed for one factor it is observed that
there is not much association between disposal and length as well as first
lactation milk yield for each of the breed. When the tables are collapsed
for two factors then all the other factor pairs are closely associated except
the factor pair breed-disposal. From these findings, it is concluded that
most of the important traits of interest in dairy cattle breeding are asso-
ciated among themselves.

17. STUDIES ON MIXTURE OF CONTINUOUS AND DISCRETE DISTRIBUTED VARIABLES IN DAIRY CATTLE BREEDING-II (FITTING OF LOG-LINEAR MODELS)

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In dairy cattle breeding, one generally comes across with the mixture
of continuous and discrete distributed variables. Although number of
methods exist for studying the relationship between these types of vari-
ables but in most of the methods the assumption of independence among
independent variables is always there. In the present paper an attempt
has been made to study the relationship through the log-linear models by
incorporating the dependence among variables. Firstly, the contribution
of different order interaction is studied by calculating the goodness of fit
tests as well as tests for partial association. Under the goodness of fit
tests, it is observed that models with two factor interaction are sufficient
to explain efficiently the cell frequency. It points out that models with
only main effects are not efficient to predict accurately expected cell fre-
quencies. This has arisen because of presence of strong association bet-
ween different traits. Further, to identify the contribution of a particular
type of effect (main-effect or interaction) the tests for partial association
are performed. From the results so obtained it is seen that leaving aside
the interaction DB, all main effects and two factor interactions have
significant contribution.

In the relationship studies, the model fitting approach is followed.
Different models are tried and the model, by employing the principle of
deleting terms, obtained is that of two factor interaction. It is seen that
the estimates of almost all main effects and two factor interaction exclud-
ing DB are significant. From the interaction estimates, certain type of

relationships between different factors are quite apparent. For instance, a relationship between breed of an animal, which is distributed discrete and a continuous distributed trait, first lactation milk yield, is clearly visible. Thus log-linear model help to examine the relationship between different traits which are either distributed continuously, discrete or mixture of both discrete and continuous.

18. ROLE OF BIOMETRICAL CHARACTERS IN ESTIMATION OF LAC YIELD

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Lac crop is mostly grown by the tribals in Bihar, Bengal, Madhya Pradesh, Orissa, Uttar Pradesh and in backward areas of some states. Lac is not only of economic importance to the country, its higher yield also helps in improving the economy of the weaker section eagaged in its cultivation. In this paper the study is carried out to streamline the effect of different factors on the production of lac. The data utilized for the study is taken from the "Pilot Sample Survey for the estimation of Production of lac," in Dudhi tehsil of Mirzapur district in U.P., for Baisakhi season for the year, 1984. The sampling design adopted was a stratified multistage random sampling design. Analysis of variance was carried out to see the effect of stratification. It is observed that 'between strata variation' was not significant at 5% indicating that stratification adopted under the survey could not bring out appreciable gain in efficiency of the estimates. Some variables are considered for increasing the efficiency of the estimates of the desired parameter by finding out correlation between the independent variables namely girth of shoot; number of shoots encurusted with lac, total length of encrustation and weight of shoot encrusted with lac, and the dependent variable viz. yield of lac per tree. It is observed that correlation between yield of lac and the characters considered are of the order varying from 0.3 to 0.8.

19. LOG LINEAR MODELS IN CROSS CLASSIFIED DATA ANALYSIS

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Critics of methods for cross classified data analysis have long maintained that most of the procedures used are only of a global chi-square test

nature. In recent years some authors have alluded to the analogy of such analysis with those used for quantitative data, in particular analysis of variance. In the present course of study we propose to illustrate through an example, the estimation and testing of parameters in the Log linear models which is for cross classified data.

20. WORK PRODUCTIVITY AMONG AGRICULTURAL SCIENTISTS

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It is well recognised that agricultural scientists in India have made a positive contribution to the significant increase in agricultural production in India during the last two decades. This could be attributed, among other factors, to the work environment prevalent in the ICAR institutions. With a view to exploring this phenomenon, a study has recently been undertaken to assess the quality of work environment of agricultural scientists, how they perceive it and what positive or negative impact it has on their mental health and functioning, particularly in the perspective of some personality characteristics.

In this study, some preliminary findings based on the Scientists' Perception of Work Environment Questionnaire are reported. These cover some important factors intrinsic to job—work over-or under-load; work conditions, relationships at work; role in the organisation—role ambiguity, role conflict; and organisational climate. The questionnaire is proposed to be administered to the cohort of agricultural scientists in some ICAR institutions. In due course, the role of personality factors vis-a-vis effective functioning is proposed to be studied intensively. The study is likely to have practical implications in terms of suggesting suitable interventions to promote agricultural research and optimal functioning of ICAR scientists.

21. SOME BALANCED n-ARY DESIGNS THROUGH INITIAL BLOCKS

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Generalising the concept of balanced binary designs, Tocher (1952) introduced balanced n-ary designs in the literature of balanced block designs. Later on, a good number of authors presented methods of construction of balanced n-ary designs using existing balanced incomplete

block designs as basic designs. However, very recently, the approaches made by Sujatha and Surendran (1987) and Malika and Surendran (1987) to evolve the said designs are quite different from those of earlier authors. Saha and Dey (1973) for the first time exploited the ingenious method of differences of Bose (1939) to construct these designs through suitably chosen initial blocks. In the present communication, two new techniques of obtaining balanced n-ary block designs through initial blocks have been suggested.

22. CONSTRUCTION OF VARIANCE BALANCED DESIGNS THROUGH GROUP DIVISIBLE DESIGNS

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Jhon (1964), and Hedayat and Federer (1974) developed methods of construction of Variance Balanced designs using Balanced Incomplete Block designs with unequal block sizes and unequal number of replications. Further other authors Tyagi (1979), Kageyama (1982), Khatri (1982), Ghosh and Divecha (1989) etc. gave several methods of construction of Variance Balanced designs. Recently Agarawal and Kumar (1985) have obtained some methods for the construction of Variance Balanced designs using group divisible designs. In the present investigation other methods for the construction of Variance Balanced designs with unequal block sizes and unequal replication sizes have carried out when the suitable BIB designs with appropriate parameters do not exist. The methods are further discussed with an example. It is seen here that over all efficiency of V B design is better than the respective BIB designs.

23. THE ROLE OF CHANGE-OVER DESIGNS IN ANIMAL EXPERIMENTATION

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An attempt has been made to classify the animal experiments broadly into three categories and the role played by Change-over designs in each category has been explained with illustrations. The amount of information and efficiencies are also worked out. Many draw-backs and other beneficial properties which have not been considered while making use of such designs, have been indicated.

24.   THE USE OF RANKS IN THE ANALYSIS OF LONGTERM EXPERIMENTS ON TEA IN NORTH EAST INDIA

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Analysis of long-term experimental data on tea by ANOVA of individual year is valid but not the combined analysis over years due to heterogeneity var-cov. matrix. This is due to successive years' plot yield correlation, the magnitude of which is generally dependent upon the time lag. Amongst the three methods of over years' analysis—Split block, Likelihood ratio and Rank, the latter was found to provide fairly accurate inference in testing the significance of treatment and treatment × year effects and also better practical interpretation of the results in conformity with results based on individual year's analysis.

25.   METHOD OF ADJUSTMENT OF PLOT YIELD BY NUMBER OF BUSHES IN EXPERIMENT WITH TEA IN NORTH-EAST INDIA

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In North-East India, plot yields of long-term experiments on mature tea are required to be adjusted due to varying degree of plant mortality over years. This increases the efficiency of experimentation and enable the experimenter to make valid treatment comparison. Of the two methods of adjustment—regression and ratio type, the former is found to be more efficient provided $\hat{\rho}$ is reasonably high (> 0.3). The choice of either of the methods does not depend on the extent of vacancy but on the value of $\hat{\rho}$ and K. the ratio between the c.v.'s of yields and number of bushes per plot,

26.   ANALYSIS OF A MATING DESIGN WITH ONE CROSS ENTIRELY MISSING

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Griffing (1956) presented the analysis of four diallel crossing schemes depending upon the inclusion of reciprocal crosses and/or parental lines using RBD. In this investigation, the analysis of a complete Diallel Cross

(CDC) design having $p(p+1)/2$ crosses and r blocks has been dealt with (Griffing Method-II, 1956) where one of the crosses is entirely missing. This situation may arise

    (a) when $(l \times l)$ th cross is missing.

and (b) when $(l \times l')$ th cross is missing.

The estimates of g_is are obtained in both the cases using the model :

$$Y_{ijk} = \mu + g_i + g_j + s_{ij} + \gamma_k + e_{ijk},$$
$$(i, j = 1, 2, \ldots p \text{ and } k = 1, 2, \ldots, r)$$

where the symbols used have their usual meanings. The expressions for variances of the typical elementary contrasts amongst g_is have also been obtained.

27. ON GROUP DIALLEL EXPERIMENTS

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Diallel experiments are most commonly used to gather genetic information on the parents (clones or inbred lines) and their progenies when the former are mated in different combinations. Such experiments yield maximum information, keep costs within the reasonable limits and help to choose a breeding programme most carefully. Hinkelmann (1974) discussed two level diallel experiments which furnished information on inter as well as intra population level using crosses between populations. Yadav and Arya (1986) modified these experiments to include parental lines in order to study the heterotic effects of the crosses. In the present study two level diallel experiments are considered where all possible crosses between population and one set of F_1s alongwith their parents within each population are discussed. The analysis has been presented for fixed and random effect models and illustrated with live data on rapeseed and mustard.

28. RELATIVE EFFICIENCY OF WILKINSON TECHNIQUE OVER RANDOMISED BLOCK DESIGNS FOR FIELD EXPERIMENTS WITH WHEAT ON SODIC SOILS

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Blocking has dominated field experiments for half a century but there are other methods for controlling error. Pearce and Moore (1976), Pearce

(1980) and Kempton and Howes (1981) have provided evidence of Popadakis's (1937) method of analysis for reducing error. Wilkinson *et al.* (1983) has introduced another neighbouring technique. Katyal, Sasmal and Pal (1988) studied the effect of Wilkinson technique in relation to the conduct of field experiments with Jute. It is absorved that for plot sizes 1×1 ($1.15m^2$), 2×1 ($2.30m^2$), 1×2 ($2.30m^2$) for uniformity trial with wheat, at CSSRI, Karnal relative efficiencies of Wilkinson technique over randomised block designs are 623%, 485%, 1169%, and 1682% respectively, C.V. (%) for above plot sizes after eliminating block effect are 44.9, 42.7, 39.7 and 50.4, whereas C.V. (%) by using Wilkinson technique for the same plot sizes are 18.0, 19.4, 11.6 and 12.3. Thus, the technique as neighbouring method is useful where the C.V. is very high. It can also be applied in semi-systematic designs as in agricultural engineering where the treatments happen to be systematic by necessity.

29. PARTICLE HETEROGENEITY IN COMPARTMENT MODELS

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It discusses a sequential irreversible two compartment model incorporating the particle heterogeneity arising due to different characteristics of feed such as age, size, chemical composition etc. Different rate constants, one for each characteristic feed, are considered for describing the flow of digesta through the gastro-intestinal tract of ruminants.

30. IMPACT OF SOIL CONDITION ON CROPPING PATTERN —A CASE STUDY OF HARYANA

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Cropping pattern in a region apart from other factors is largely influenced the characteristics of soil, water and weather condition. In Haryana about 5 lakh hectares land is affected by salanity/alkalinity conditions, developed due to saline ground water, seapage from Canal and erratic applications of irrigation water. The extent of salinity/alkalinity conditions can be traced by soil property indicators such as electrical conductivity, exchangeable sodium percentage, Socium absorption ratio and the pH. value of the soil. The crop management study suggest that the salt sensitive crops are Gram, lentil, Ground but and mustared, Semi-

tolerant to salt are Jowar, Bajra, Maize, Rice, Cotton, Raya, Taramira, Barseem, Oat and Wheat; and the sald tolerant crops are sugar cane, sugar beet, tobacco and Barley. The study showed that there has been a major shift in cropping pattern during the period of 1967-68 to 1985 to 86. The area under cereals has increased from 51 percent to 57 percent whereas declined in case of pulses from 26 percent to 15 percents. This shift has lead to imbalances in crop pattern and escalate in the price levels of some crops. The study also concludes that the imbalances in crop pattern can be checked by soil reclamation measures, proper use of ground water and the cultivation of salt tolerate crops.

31. MILK PRODUCTION FUNCTION AND RESOURCE PRODUCTIVITY IN BOVINES

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The present study was conducted in Jalandhar and Nakodar tehsils of Jalandhar District of Punjab state during 1986-87 using multi-stage stratified random sampling design for selection of households. Feed and milk data were collected by actual weighment from 200 households spread over 25 villages at monthly interval. In order to study the feed-milk relationship linear, Cobb-Douglas and quadratic regression models were fitted using physical quantities of fodders and feeds as explanatory variables. Though the quadratic regression model explained maximum variation compared to linear and log-linear, it could not be selected for further economic analysis due to perverse signs of regression coefficients of green fodder and concentrates. The linear was thus preferred over Cobb-Douglas for further economic analysis. Feeds and fodders alongwith order and stage of lactation together explained about 64 percent variation in milk yield for local cows, 44 percent for crossbred cows and 53 percent for buffaloes. The estimated regression equations were found statistically significant at 1 percent level of significance indicating the goodness of fit to the data. The production elasticities for inputs were generally higher for cows as compared to buffaloes. Further, the elasticities of production were higher for green fodder followed by dry fodder and concentrates in local cows. It was higher for greens followed by concentrates and dry fodder for cross bred cows and buffaloes. The marginal values of concentrate suggested that the milk producers can afford the expenditure upto Rs. 3.66, Rs. 3.68 and Rs. 3.86 for local cows, crossbred cows and buffaloes respectively to increase the productivity of bovines. Thus it was suggested that reallocation of feed resources can play a significant role in increasing the productivity of bovines.

32. RELATIONSHIP OF FAT CORRECTED MILK YIELD (FCM) AND ITS CALORIFIC VALUE WITH NUTRIENT INTAKE AND NUTRITIONAL EFFICIENCY IN CROSSBRED CATTLE

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The study was conducted to determine the relationship of fat corrected milk yield and its calorific value with nutrient intake and efficiency of energy and protein conversion and milk composition in crossbred Cattle. During the first phase, multiple Regression equations were fitted between FCM yield (Y_1), with independent variables X_1 = Total dry matter intake (kg), X_2 = Total crude protein intake (kg), X_3 = Net efficiency of protein conversion, X_4 = Gross efficiency of protein conversion, X_5 = Total digestible nutrient intake (kg), X_6 = Total metabolizable energy intake (Mcal), X_7 = Gross efficiency of energy utilization, X_8 = Net efficiency of energy utilization. During the second phase multiple regression equations were fitted between calorific value of 1 kg FCM (Kcal), Y_2 with independent variables, X_9 = milk fat percent, X_{10} = milk solids non fat percent, X_{11} = crude protein percent, X_{12} = Total solids percent. In the first phase, multiple correlation coefficient (R) was found highly significant ($P < 0.01$) which envisage that FCM yield in lactating cow is entirely dependent on the amount of total dry matter consumed, total crude protein intake, gross and net efficiency of energy utilization. Simultaneously in second phase study highly significant ($P < 0.01$) multiple correlation coefficient (R) pointed out that the calorific value of one kg FCM is dependent on milk fat percent, milk solids non fat percent, crude protein percent and total solids percent.

33. ON SOME ASPECTS IN PLANNING AND DESIGNING ANIMAL NUTRITION EXPERIMENTS

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In planning of any experiment, specially in the field of animal nutrition, decision about the number of replications is a ticklish job. In the present paper, attempts have been made to solve involving four characters namely growth, maintenance, milk production and wool production in the experiments. It was found that minimum number of replications should be between 4 and 6.

34. DISCRIMINATORY ANALYSES FOR STUDYING DIVERGENCE BETWEEN DIFFERENT GENETIC GROUPS OF CROSSBRED CATTLE

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Divergence among seven genetic groups of crossbred cattle—three groups of halfbreds of Hariana with Holstein Friesian, Brown Swiss and Jersey, (FH, BH and JH), and four of three-fourths with two exotic breeds (FBH, FJH, BFH and 3FH) has been studied using different appropriate discriminatory techniques on the data generated during 1976-82 under the All India Coordinated Research Project on Cattle at Haryana Agricultural University, Hisar. The characters considered were age at first calving, first lactation yield, fat percentage and first calving interval. The two sets of genetic groups with the same level of exotic inheritance irrespective of the exotic breed were found homogeneous in respect of their covariance structures. Significant differences were observed among half-breds with respect to their mean vectors and also among three-fourth genetic groups. From the overall D^2 values of discriminant functions fitted in pairs reportedly for halfbreds and three-fourths it was seen that the Friesian and Gersey half-breds were statistically divergent and so were FBH and JFH groups among the three-fourths. Fat percentage contributed maximum towards discrimination followed by age at first calving and first lactation yield. Genetic groups with 50% Jersey inheritance (JH and JFH) were found to form separate clusters among the groups of halfbreds and the three-fourths.

35. INTAKE OF FEED NUTRIENTS AND ITS REQUIREMENT IN BOVINES AT ORGANISED DAIRY FARM

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The present study was conducted at NDRI farm, Karnal during 1986-87 with the objective to estimate the intake of feed nutrients and its requirement in bovines. The data on daily milk yield of individual animal, intake of roughage and concentrates were collected every month by actual weighment. The samples of fodders and concentrates were analysed every month for determining composition of nutrients. In order to estimate the intake of feed nutrients and its requirement, the milking animals were grouped into nine categories according to their daily milk yield.

The average daily milk yield of cows was the highest (14.5 kg.) in February and the lowest (10.1 kg) in August. Among buffaloes it was

the highest (8.0 kg) in January and the lowest (6.0 kg) in June. The cows producing daily milk yield upto 17.0 kg received less quantity of D.M. and those producing above 17.0 kg received higher quantity of D.M. than the requirements. In case of buffaloes all the milking animals were given less quantity of D.M. than the requirement. The average daily intake of DCP on D.M. basis was more than the requirement in cows during Aug.-Feb. and in buffaloes it was more than the requirement almost in all the months except for January and May. The average daily intake of TDN on D.M. basis was less than the requirement during Sep.-Dec. in cows. Among buffaloes it was more than the requirement almost in all the months for all milking animals. It was concluded that the milk yield of bovines could be enhanced by judicious feeding of fodders and feeds.

36. DETERMINATION OF PLOT SIZE AND ESTIMATION OF OIL YIELD OF MENTHA THROUGH CROP CUTTING EXPERIMENT ON AN ORGANISED FARM

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The crop cutting experiment for the present study was conducted for estimating the oil yield of montha during rabi season of the year 1986-87 at the Central Institute of Medicinal and Aromatic Plants (CIMAP), Pantnagar. A stratified two stage random sampling design has been adopted and a sample of 9 out of 17 fields was selected for the survey with probability proportional to mentha area. Four plot sises viz., 5 m equilateral triangle, 5 m × 5 m, 10 m equilateral triangle and 10 m × 10 m were located in each selected field to determine the optimum plot size. A best fitted regression model was selected, using linear, Cobb-Douglas, square root and reciprocal regression models, to forecast the yield of mentha on the basis of first cutting. The average oil yield estimated for the centre, using 10 m × 10 m, 10 m equilateral triangle, 5 m × 5 m and 5 m equilateral triangle plot sizes, were obtained as 85.32, 86.96, 96.02 and 108.73 kg/ha. with their standard error 9.45, 9.48, 12-83 and 14.86 kg/ha. respectively. The percentage over estimation was minimum (9.5 per cent) in case of 10 m × 10 m plot with whole field harvest. While it was increasing as the plot area decreasing and it was maximum (39.56 per cent) in case of 5 m equilateral triangle plot with whole field harvest.

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The result showed that 10 m × 10 m plot was more appropriate to use as a sampling unit in estimating the oil yield of medicinal and aromatic crops. The correlation coefficient between oil yield of first cutting and total oil yield was 0.873 and found to be highly significant. The square root model ($Y = a + b \sqrt{X}$) was selected as best fit.

37. PROSPECTS OF RICE PRODUCTION IN INDIA AND ITS STATES

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The present study consists of the relative contribution of various input factors such as (area irrigated and unirrigated), area under high yielding variety, total fertiliser consumption ($N + P + K$) and rainfall on rice production in fifteen states of different agro-climatic conditions. The data on these characters are utilised to work out the linear growth rates during the period 1970-71 to 1984-85 for future projection. A multiple linear regression is best fitted for each state and All India to predict the future rice production keeping in view the availability of the resources.

38. FARM AREA CHARACTERISTICS LEADING TOWARDS HECTAREAGE ALLOCATION UNDER A CROP : A CASE STUDY OF WHEAT AND RICE IN ALLAHABAD DISTRICT OF UTTAR PRADESH

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The present paper attempts to identify various farm area characteristics like agroclimatic, economic, technology, risk and uncertaintity, leading towards hectareage allocation under a crop at tne farm level in Allahabad district of Uttar Pradesh with regard to wheat and rice through a sample enquiry of 90 farmers stratified over three categories S_1 (upto 2.00 ha), S_2 (above 2.00 and upto 4.00 ha) and S_3 (above 4.00 ha), respectively; for the agricultural year 1980-81. The empirical findings of the investigation reveal that (i) the farmers are responsive to prices, but their responsiveness is limited. Prices in general are found to influence the decision making of large farmers (S_2), rather than a general rule. (ii) In hectareage allocation under wheat/rice, family requirement is a main consideration for all the three categories of farmers in general and for small farmers (S_1) in particular. (iii) High cost of input (s) is a limiting factor in adoption

of wheat/rice particularly for small farmers and they in turn rather than to increase hectareage under wheat/rice, prefer to grow crops like gram, jowar, bajra, barley where so much cost (or restrain) in terms of chemical fertilizers etc. is not needed. (iv) As compared to other crops, relatively high per hectare yield of wheat/rice is a pro-adoption factor in its adoption; and (v) among other factors, soil complex and smaller risk, too find a place to influence the decision making of farmers in their hectareage allocation under wheat/rice.

39. CONSTRUCTION OF SERIES OF SEMI-REGULAR GROUP DIVISIBLE DESIGNS

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Clatworthy (1973) has prepared tables of two associate-class partially balanced designs which contains 110 Semi-Regular Group Divisible (SRGD) designs, out of which 5 SRGD designs are based on common parameters b ($=50$), r ($=10$), n ($=5$), λ_1 ($=0$), λ_2 ($=2$) and different parameters v, k, m, constituting a group. The present note on semi-regular group divisible partially balanced designs points out reproductive property of these designs. Thus, utilizing this property few series of SRGD designs are obtained. The general parameters of semi-regular group divisible designs are $v = Ls$, $b = 2s^2$, $r = 2s$, $k = L$, $\lambda_1 = 0$, $\lambda_2 = 2$, $m = L$ and $n = s$, where $L = 2, 3, \ldots, 2s + i$ and s is either an odd prime or power of the prime. In the present investigation, it has been shown that considering $s = 5$ and taking $L = 6, 7, 8$ and 9 new SRGD designs can be constructed. However, for same value of s with $L = (2, 3, 4, 5)$ and for $s = 3$ and 4 with different values of L, SRGD designs can also be constructed but all these are listed in Clatworthy (1973).

40. ROLE OF COMMERCIAL BANKS IN FINANCING IRDP—A STUDY IN BICHPURI BLOCK OF AGRA DISTRICT

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The present study was deliberately conducted in Bichpuri block of Agra district in Uttar Pradesh. C. D. Block Bichpuri has 43 villages and 13412 rural families. The weaker sections including small and marginal farmers and landless labourers, comprise 10219 or nearly 76 per cent of all rural families. The number of poor families below poverty line indentified by

1985 is 9443 which constitute nearly 70 per cent of the total rural famil-
ies and 92 per cent of the families in the weaker section. During the Sixth
plan period 3365 families were assisted under IRDP in the Block as
against the target of 3000 families per block. This indicates that the per-
formance of the IRDP has exceeded the physical targets in the block. Of
3365 families financed under IRDP the small farmers, marginal farmers
and landless labourers respectively constituted about 14, 29, 57 per cent.
The scheduled caste families financed under the programme constituted
about 48 per cent of the total financed families, thus crossing the stipul-
ated target of 30 per cent.

Of the total (3365) families financed under IRDP, 2085 or about 62
per cent have been financed by the commercial banks. Of the beneficiar-
ies, 1008 (48%) were scheduled caste. Of the total loan advances (Rs. 71
lakhs) by commercial banks, about Rs. 33 lakhs (about 46%) went to
scheduled caste families and about Rs. 38 lakhs (54%) to non scheduled
caste families. This indicates that the problem of rural poverty is not a
scheduled caste phenomenon because it is so widely spread among the
non-scheduled caste section of rural society. The poverty alleviation pro-
grammes with special emphasis on scheduled caste section of the society
may alienate a large section of rural society of rural poor from the scope
of such programmes.

Out of 2085 families financed by the banks, about 65 per cent were pro-
vided loans in primary sectors mainly for buffaloes (53%), and 19 per
cent in secondary sectors—mainly for shoe making (16%) and 16 per cent
in tertiary sector—mainly for small business/service. The proportion of
amount of loan advances by sectors is almost similar. The loan advances
in primary sector dominated in all the three economic categories and also
in both the social categories, but the extent of loan to non-agricultural
activities (secondary and tertiary sectors) was higher in case of scheduled
caste families among the social categories and in case of landless labour-
ers among the economic categories. This indicates that though commerc-
ial banks have been diversifying their lending by covering non agricultur-
al activities but the problem of rural poverty needs to be tackled through
an effective programme of diversification of rural economic activities in
the non traditional areas outside agriculture.

41. THE EFFECT OF MEASUREMENT ERRORS ON LEAST—
SQUARE ESTIMATORS OF THE REGRESSION COEFFICIENTS

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The measurement errors in the data may arise due to various causes,

For studying the effect of measurement errors on OLS estimators, a suitable linear model under some normality conditions has been assumed. The bias and m.s.e. of OLS estimators have been worked out by using confluent hypergeometric functions. Modifications have been suggested in order to work out the relative bias and relative m.s.e. of regression coefficients as given in tables by Richardson and Wu (1970).

42. GROWTH RATE OF AREA, PRODUCTION AND PRODUCTIVITY OF KHARIF JOWAR IN MAHARASHTRA STATE,

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Kharif jowar is the main crop (acreage of about 29 lakh hectare) in kharif season and it covers 15% of the total cropped area in Maharashtra State. Crop is mainly grown under rainfed condition in 22 out of 30 districts of the State. Of these, 11 districts are major in respect of production and area under the crop. Time series data of area, production and productivity of 11 districts of kharif jowar for the three different periods viz : 1960-61 to 1969-70; 1970-71 to 1987-88; and 1960-61 to 1987-88 was studied, taking 1960-61 as base year.

Exponential function taking years as independent variable and area, production and productivity as dependent variable was fitted.

State level results for the period of first ten years viz,, 1960-61 to 1969-70 indicated that there was not appreciable increase in growth rate of area, production or productivity. Amongst the three periods studied, the growth rate of area, production and productivity for next 18 years' period (i.e. 1970-71 to 1987-88) were highest. Production growth rate at State level was about 7% which was mainly due to higher growth rate of about 6% of productivity, while that of area was only 1%. District-wise results also confirmed the same findings. The overall growth rate of 28 years (1960-61 to 1987-88) at State level showed that production growth rate was 3.8%, again mainly due to productivity growth rate being about 3%. Same trend was observed in all the districts under study except Jalgaon and Osmanabad districts, where growth rate of area contributed more for high growth of production. There was no appreciable increase in growth rate of area in any of the three periods. This is because area under kharif jowar crop remains constant except for slight changes during unfavourable seasonal conditions, like draught or excessive rains.

43. SCREENING OF TOBACCO GERMPLASM USING MODIFIED AUGMENTED DESIGN

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When the seed material for the test lines in plant breeding evaluation programme is small a replicated trial may not be possible for comparing the yield potential of these lines with Standard Varieties Lin and Poushinsky (1983) has suggested a modified augmented design where in yield potential of Standard Varieties are compared with that of test lines. One hundred and twenty fcv tobacco germplasm lines selected from germplasm collection of Central Tobacco Research Institute, Rajahmundry were compared with four Standard Varieties Jayasri (MR), Godavari Special, CTRI Special (MR), and CTRI Special for their yield potential, using the modified augmented design. It was observed that nine of test lines were significantly superior in yield over most of the test lines and standard lines. Further the two test lines B. Gram Reditto and White Mammouth were observed to have a yield potential of 9006 and 8311 kg/ha.

44. ESTIMATION OF SEVERAL MISSING OBSERVATIONS IN GRAECO-LATIN SQUARES DESIGNS

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The present paper deals with estimation of several missing values in Graeco-Latin squares. When the missing observations are in a particular pattern, explicit and computable expressions are given for the estimators of the missing values. This procedure is illustrated by a numerical example.

45. ESTIMATION OF SEVERAL MISSING OBSERVATIONS IN CROSS-OVER DESIGNS

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In the present study an attempt has been made to estimate several missing values in cross-over desigus. When the observations are missing in a particular pattern, explicit expressions are given for the estimators of the mising values. This procedure is illustrated by a numerical example.