1. **On some Generalised Ratio-Type Estimators**
By S.K. Srivastava and H.S. Jha ji
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For estimating the mean $\bar{Y}$ of a finite population using information on an auxiliary variable x, the following four generalised ratios-type of estimators suggested by Srivastava (1967), Chakrabarty (1968), Walsh (1970) and an analogus of Chakrabarty's estimator have been considered.

$$\hat{y}_S = \bar{y}(\bar{x}/\bar{X})^a$$
$$\bar{y}_C = (1-w)\bar{y} + w\bar{y}(\bar{X}/\bar{x})$$
$$\bar{y}_W = \bar{y}\bar{X}/A\bar{x} + (1-A)\bar{X}$$
$$\bar{y}_A = (1-a)\bar{y} + a\bar{y}(\bar{X}/\bar{x})$$

Here $\bar{y}$ and $\bar{x}$ denote the simple random sample means of the variables y and x respectively, and X denotes the known population mean of x. The constants a, w, A and a were determined so as to minimise the mean square errors up to terms of order n^{-1}, of the respectively estimators. The optimum values obtained were $\alpha = -C_v/C_x = -K$, say, $w = K$ and $a = -K$; and the minimum asymptotic mean square error of each of these estimators is equal to that of the linear regression estimator. Here C_y and C_x denote the coefficients of variation of the variables y and x respectively and ρ, the coefficient of correlation between them.

When the value of K is not known in advance it will be natural to estimate it by the corresponding sample value and substitute this estimated value of K in the optimum estimators described above. In this paper we have shown that each of the resulting estimators has asymptotic mean square error equal to that of the linear regression estimator: the asymptotic mean square does not increase if we replace the optimum value by the corresponding sample value. We have also obtained expressions for the mean square errors up to terms of order n^{-2}, of these four estimators and compared them with that of the linear regression estimator.

Since the mean square errors up to terms of order n^{-1}, do not change if we replace the optimum values of the constants by the

corresponding sample values in these estimators, the differences of these up to terms of order n^{-2} have been obtained. It is observed that up to this order of approximation the mean square errors of these estimators with optimum values of the constants are not necessarily smaller than those when the optimum values are replaced by the corresponding samples values in the estimators.

Numerical illustrations are given.

2. **Confidence Intervals for functions of components of variance in samples from moderate non-normal populations**
   By R.A. SINGHAL
   I.V.R.I., Izatnagar.

The study pertains to investigate the effects of moderate departures from normality in estimating confidence intervals for different functions of variance components in a balanced one-way Model II. It is found that the confidence intervals are fairly insensitive to the skewness in error effects but remarkably sensitive to the kurtosis in both the random effects. Computations reveal appreciably narrow or wide intervals for platykurtic or leptokurtic error effects than normal theory intervals. For the kurtosis in group effects the situation is just the reverse.

3. **Estimation of Cost of Cultivation of Inter-Crops in Apple Orchards in Uttar Pradesh**
   By JAGMOHAN SINGH AND S.D. BOKIL
   I.A.S.R.I., New Delhi-12

A pilot sample survey was conducted to study the cost of apple-production in four Himalayan districts of Uttar Pradesh in 1972-73 and 1973-74. Data on inputs and output of inter-crops were collected. These were analysed to provide estimates of cost of production of wheat, potato, Maize, and Vegetables (mixed). The results provide an idea of the return the apple growers are getting by cultivation of inter-crops. Not-with-standing the small sample size for individual crops, the estimates of cost of production (operational cost) came out to *be* reasonable.

4. **Factor Analysis of Family Expenditure of Farm Population in Punjab State.**
   By S.K. SINGLA AND RAKESH KUMAR
   Punjab Agricultural University, Ludhiana.

The State of Punjab has shown a sizeable growth in the per capita income as well as per capita expenditure due to increase in

Agricultural Production with the result that the Farm-Population has been recognised as a powerful lobby in deciding policy issues for the planners and administrators. This papers attempts to trace the factors responsible for variables in the inter farm family expenditure on various consumer goods using factor analysis technique and their respective share in explaining this variation.

Factor analysis using Principal axis method was employed using 22 variables related to three characters namely family composition and size, socio-economic variables and household expenditure under particular head for the year 1970-71, 1974-75 and 1978-79. The factor loadings so obtained were subjected to factor rotation in order to have a meaningful nominclature of the factors using normal, Varimax Criterion given by Kaiser (1958).

The analysis revealed that 4 factors namely Income, adult family, young family and essential goods (durables) are sufficient to explain between 60 per cent to 67 per cent of the inter farm variation in household expenditure for the three years selected. Income was the most important factor and it accounted for roughly 35 per cent to 40 per cent of the common variation in data.

From this analysis it was clear that farm families expenditure on various items can not be explained to a reasonable extent by income alone, but the efficiency of the Engel curve will increse if we include some variable, which is representative of family size and its composition. This can be further improved, if information related to variables like education age of head are included in the Analysis.

5. **Measurement of Instability in Production of Sugarcane and Sugar**
By Bhuwan Eshwar K. Gupta and S.D. Bokil
I.A.S.R.I., New Delhi.

The violent fluctuations in production of sugar have caused considerable hardship to the consumer. How far is the seasonal variation in production of sugarcane responsible for the situation? This can be tested by measuring variation around trend line for sugarcane and sugar. For this purpose exponential trend was fitted to data on production of and area under sugarcane and production of sugar for 14 years (1967-68 to 1980-81) for India as a whole as well as for 7 major sugar producing states.

In respect of growth rate at the all India level it is found that the growth rate of area was 1.66 per cent which is lesser than the

growth rate of production, viz. 2.75 per cent indicating that the pro-
ductivity has been increasing during the period. The growth rate of
sugar production was still higher, viz. 4.67 per cent.

In general sugar production is found to be more unstable than
sugarcane production for all-India as well as for various states.

6. Border Circulant Plans for Partial Diallel Crosses
By A.S. Arya
Haryana Agricultural University, Hissar

Partial diallel is a suitable mating design for testing the
general combining abilities of inbred lines or homozygous parents
in Hybrid combinations when under constraints of resources a
complete diallel is not feasible. Kempthorne and Curnow (1961)
introduced the circulant designs for this purpose. They imposed
the restrictions on n, the number of lines and s, the number of
times each line is involved into crosses with other lines, such that
if *n* is odd *s* should be even or vice versa. These plans had been
of great interest to the breeders in the past, but present investigation
revealed them to be least efficient among the possible alternatives
and hence their use is negated. Other plans, identified with partially
balanced incomplete two plot block designs, are also available, for
example. Fyfe and Gilbert (1963), Hrnkelmann and Kempthorne
(1963), Curnow (1963), Arya and Narain Arya (1977) and Narain &
Arya (1981).

The plans discussed in this presentation are more flexible and
efficiencies higher than those available elsewhere.

Let *n* lines under test be denoted by $i=1,2,...,n$. Every line
will be crossed with *s* other lines, *n* and *s* can not both be odd as
the number of crosses ($ns/2$) is integer. The border circulant plan
S(1,2,..., $s/2$) C for *s* even and any *n*) will stand for a design in which
line i has crosses with lines $(i+1)$, $(i+n-1)$; $(i+2)$,
$(1+n-2)$;...$(i+s$ 2), $(i+n-s/2)$ where all numbers greater than *n*
are reduced mod *n* and *o* is replaced by *n*. When *s* is odd and *n* is
even, the plan is S(i,2,...,$(s-1)/2$; $n/2$). Here i has a single cross
with line $i+n/2$.

The inversion of A, the matrix in the least squares equations,
is simplified on the following lines; A=(a_{ij}), where $a_{ii}=s$ (all i),
$a_{ij}=a_{ji}=1$ if the cross $i \times j$ is sampled or=0 otherwise. Let $\alpha'=$
$(a_1, a_2,.., a_n)$ and $\alpha^{*'}=(a^1, a^2,...,a^n)$ be the first rows of A and A^{-1}
respectively. Then we have

$$\theta = W\alpha \text{ and } \alpha^* = W\theta^*/n$$

where $W = (w_{ij})$, $w_{ij} = \text{Cos} \{(2\pi/n) i \times j\}$ $(i, j = 0, 1, ..., n-1)$, $\theta' = (\theta_1, \theta_2, ..., \theta_n)$ are the eigen values of A and $\theta^{*'} = (1/\theta_1, 1/\theta_2, ..., 1\theta_n)$. A^{-1} is generated from α^* and the analysis completed.

7. Statistical Methodologies Adopted in the Field of Dairying at N.D.R.I.—A Critical Review

BY K.C. BHATNAGAR, BHUPAL SINGH AND S.B. AGARWAL
N.D.R.I., Karnal

On the basis of recommendations during 5th conference of Agricultural Research Statisticians held at Lucknow in December, 1980 regarding Statistical Methodologies evolved in the field of animal sciences, a study has been undertaken at NDRI, Karnal. At the outset M.Sc. and Ph.D. dissertations to date were reviewed. In all 820 theses consisting of 673 M.Sc. and 147 Ph.D. have been evaluated. These were categorised according to three major disciplines of research at this Institute, *viz.*, processing, Production and Management. Processing consists of chemistry, Microbiology, Bacteriology, Biochemistry Engineering and Technology, Production includes Animal Nutrition Physiology, Forage production, Animal breeding and Genetics and Livestock Production. Dairy economics and Extension comprises Management. The distribution of theses according to major disciplines is 57,35 and 8 per cent in processing, Production and Management respectively. Out of these 80 percent are M.Sc. and 20 percent Ph D. under Processing, 84 percent M.Sc, and 16 percent Ph D. under Production and 91 percent M.Sc. and 9 percent are covered under Management.

Further critical evaluation of Statistical Methodologies adopted in various disciplines has been under taken on the following lines (*i*) Application of Statistical tools over years (*ii*) Statistical methodologies adopted in different disciplines (*iii*) Critical review of various statistical methods adopted. The study will be undertaken in the other research organisations and Institutes.

8. Bonded Labour : A Research Perspective

BY MARKANDEY RAI,
Patna University, Patna

The paper deals with statistical analysis of the data on Bonded labour based on two separate case studies conducted independently in Bhanderiya Block in Palamu district and Shankarpur village in Gaya district in year 1976. The first is a tribal belt and second is a non-tribal belt. Although the bonded labour are known by several

names due to regional and linguistic differences, the mode of torture and exploitation, their living conditions, educational standard and index of economic growth are almost the same. They are unaware of their rights and enactments, which the government has been legislating from time to time from their liberation from bondage.

The study will help in framing suitable policies to ensure freedom from bonded labour and pave path for further micro studies in this field.