ABSTRACTS OF PAPERS PRESENTED AT THE 22ND ANNUAL GENERAL MEETING HELD AT PATNA IN DECEMBER, 1968

1. *Comparable Statistics of Area and Production in Different States* by Sharwan Kumar & N. C. Ahuja, Planning Commission, New Delhi.

Use of unreliable and incomparable statistics is like building a dam with defective material—there will always be seepage and holes in the structure it seeks to create. The Directorate of Economics and Statistics have been publishing agricultural statistics of area, production and yield per hectare since 1946. The data has, however, been changing both in its contents and coverage owing to a number of factors. The data has therefore lost comparability. The non-comparability of these statistics over time has rendered it unuseable for any time series analysis which has acted as a factor seriously limiting the efforts of an economic analyst, statistician or a researcher. Thus, a number of studies which could be based on a time series data could not just be taken up because of non-comparability.

Realising the inadequacy of statistics which they have been publishing, the Directorate of Economics and Statistics made a beginning in the direction of preparing a comparable series. They brought out the actual comparable series of area and production of major crops at All-India level for the time period 1950-51 to 1964-65. For the States, however, they have given only indices. The present study carries this work further and presents a comparable series of all the important crops in respect of area and production of States also, on the basis of methods of estimation and reporting area in 1963-64 for which fully revised estimates are available. For All-India, the present series is based on 1964-65 estimates as against 1960-61 adopted by the Directorate

Analysis of the differences between the actual and the revised series has produced some interesting results the most important of which relates to the under-estimation, hitherto, of yield per hectare figures in different States. At All-India level, however, the difference between the actual and revised series has been declining gradually except in the case of plantation crops.

The present study emphasizes the need for perfecting and standardising the techniques of estimation in different States. As it is, the present area and production statistics are not suitable for any time series analysis because of incomparability and wide variance. The revised series as presented now meets, in some measure, this requirement. Nevertheless further work on the subject is necessary.

2. *Plot size studies in Bajri—Pennisetum typhoides* (*S. & H.*) by N. M. Patel and Ramjibhai M. Patel, B.A. College of Agriculture, Anand.

The paper embodies the results of plot size study in Bajri—*Pennisetum typhoides* (S. & H.) at Anand, Gujarat State during two seasons of the year 1964-65. The main objective of this study was to find out an optimum size of plot for field experiments on Bajri. Uniformity data on grain yield and dry fodder yield were collected from 1024 units (2 metre—single row units, with row spacing of 0·45 m.).

Three approaches were considered to decide the optimum size of the plot.

viz., 1. Point of maximum curvature.

2. Mathematical approach using theory of maxima and minima.
3. Relative efficiency in land use.

It was observed in all the three cases that the optimum size varied about 8 units. Therefore, the optimum size of plots was considered 8 units. Among all combinations of 8 unit plot, a plot of 4 unit length × 2 rows (*i.e.*, 2 metres × 0 9 metre) had on an average minimum coefficient of variability per unit area. Therefore, 8 metres × 0·9 metre (*i.e.*, 8 units) is considered the best shape and size of the plot for field experimentation in Bajri.

3. *Study of Genetic and Phenotypic Parameters of different economic traits in various herds of Bihar* by J.N. Prasad & S.C. Biswas, Patna.

Bachhaur herd

A study on genetic and phenotypic parameters of milk yield, lactation length, age at first calving, calving interval, number

of services per conception, production life, sex ratio and correlation between age at first calving lactation yield was made. The genetic parameters which were studied included heritabilities of first lactation yield, age at first calving and re-eatability of milk yield.

Tharparkar herd:

Studies on lactation yield, lactation length, age at first calving, gestation period, calving interval, dry period, number of natural services per conception, postpartum heat, life time milk production, productive life in herd, longevity of cows in herd, no. of calving per cow in herd, percentage conception in first, second and third service, persistence of milk yield indices, occurrence of oestrus, secondary sex ratio and construction of selection indices were made.

Heritabilities of milk yield, age at first calving, calving interval, first gestation period, natural services per conception were estimated.

Repeatability estimates of the traits like calving interval, natural services per conception were made.

Hariana herd:

Genetic parameters like heritability and repeatability of milk yield, calving interval length, age at first calving, gestation period, postpartum interval to first service were studied. Genetic correlations were worked out between the milk yield of 305 days with age at first calving and the first calving interval as well as between lactation with age at first calving and interval.

Shahabadi Herd:

Phenotypic traits like milk yield, lactation length interval, age at first calving, gestation period, postpartum interval to first service, productive life in herd and sex ratio were studied.

Red Sindhi Herd:

Studies on lactation yield, lactation length, gestation period, calving interval, dry period were made.

Murrah buffalo herd:

The herd of Murrah buffalo at Government Cattle Farm, Dumraon was studied with the object to estimate lactation yield, lactation length, calving interval, age at first calving, gestation length, birth

weight, sex ratio and frequency of calving and oestrus. Further repeatability estimates of the above traits were also made.

Sheep :

Studies were made to know the variation in birth, weight of the Bihar, Bikaneri sheep and their crosses. Study was also made to compare growths.

4. *Application of Augmented Factorial Designs to Qualitative-cum-Quantitative Experiments* by Lalit Kishore, Rockefeller Foundation, Delhi and M. N. Das, I.A.R.S., New Delhi.

The use of augmented factorial designs is well known. Several new series of such designs have been developed by the authors (Kishore and Das 1968, Kishore 1968) recently. A simplified approach of analysing these designs has been also discussed therein.

In the present paper an application of these designs has been made to get designs for qualitative-cum-quantitative experiments, where there are two quantitative factors and one qualitative factor representing the qualities of one of the two quantitative factors It has been shown that the analysis of such experiments under additive model can be done easily using the analysis proposed by the authors for augmented factorial experiments treating the "dummies" as additional treatments. It has been further shown that these results can be generalized for any number of qualitative and quantitative factors.

5. *Transformations for mixtures of distributions* by G. Sadasivan, I.A.R.I., New Delhi.

In this paper the author is dealing with the methods of analysis to be followed when data obtained from some designs are mixtures of different distributions. Sometimes one portion of the experiment may be following one distribution and the other portion another. Sometimes each observation from the design will be the result of mixtures of the same or different kinds of distributions. The different kinds of mixtures possible and the transformations to be effected are detailed here. A practical example is also discussed.

6. *The study of Cotton Yields and Rainfall in Malwa and Nimar Tracts of Madhya Pradesh* by Chokhey Singh and Y.S. Kapse, College of Agriculture, Indore.

A study of the data on rainfall total and monthly distribution and cotton yields for 35 years at Indore and 43 years at Khandwa was made ; it indicates that there is no definite trend of rainfall received in the different years of study. The distribution of rainfall is also not uniform and varies much from year to year. The cotton yields too are not systematic during the different years of study and vary from year to year. At Khandwa (Nimar) though the cotton yields are higher than at Indore, they are more susceptible to rainfall variations, soil being lighter, than at Indore where the soils are heavy.

Significantly more rainfall is received at Indore than at Khandwa, but the average yields are higher at Khandwa than at Indore (Malwa).

Highest cotton yields are obtained at Khandwa when the rainfall is 679 mm with distribution of 91, 257, 119, 185, 27 mm during months of June, July, Aug., Sept., and October, respectively; at Indore too, the cotton yields are obtained highest with rainfall 679 mm, with distribution of 114, 205, 84, 177 and 35 mm respectively.

Low and medium rainfall years give more cotton yields while high rainfall years record low yields. Much high rainfall during July, Aug., and September affect the yield at both the places more adversely.

The agronomical practices in cotton cultivation are to be stabilised to get high yields of rainfed cotton under varying rainfall pattern of this type in this State.

7. *On use of Ratio and product method of estimation in stratification involving more than one character* by P.C. Gupta, Allahabad Agriculture Institute.

Ghosh (1963) has studied two-way stratification based on two-character under study and has discussed optimum boundary points which minimise the generalised variance of the unbiased linear estimates. Seth and Gupta (1968) have studied stratification based on auxiliary character for any number of characters under study. In the present note the use of product and Ratio method of estimation has been made and the optimum boundary points are obtained by minimising the generalised variance of the non-linear biased estimates. The knowledge of number of strata is assumed together with the nature of allocation of units among strata namely proportionate allocation.

8. *A new approach to the analysis of factorial experiments* by M. N. Das and S. Rawlo, I.A.R.S., New Delhi.

When an experiment is conducted over a number of years, the individual treatments can be assessed by working out a stability index, to indicate how the performances of any treatment over years change with the environments. Taking the average yields over all observation from the experiment in any year as the environment index for the year, the inverse of the regression coefficient of the average yield of a treatment on the environment index has been taken as the stability index. A treatment whose general performance is higher and has at the same time a higher stability index is considered to be better treatment. Again a value of the regression coefficient greater than unity indicates that the corresponding treatment responds better to better environment.

The data from a number of experiments including some simple fertiliser trials has been used to work out such indexes and the results indicate some promising results.

9. *Estimation of marketable surplus of wheat* by Padam Singh, I.A.R.S., New Delhi.

Though reliable estimate of food production helps in farming import-export policy of government, it is necessary to have the estimate of marketable surplus to form internal policy like distribution of food grains, control over price etc. Among the factors affecting the level of marketable surplus, the volume of output is the main.

Sukhatme and Kushal (1959) studied the double sampling ratio estimate in multistage design and Ray (1964) studied double sampling regression estimate for multistage design. In the present work some other but similar estimates are proposed which can be more applicable in the practical situations where knowledge of M_i the total number of secondary units of the primary unit of unselected units is lacking. The use of double sampling will be illustrated by a data on wheat of Pali District of Rajasthan.

10. *Effect of contour bunding on production and productivity of important cereals and cash crops in Maharashtra State* by G.A. Kulkarni, Ministry of Food and Agriculture, New Delhi.

To study the impact of measures like contour bunding and dry farming practices on the production and productivity of important cereals and non-cereals in Maharashtra State, data for the period

1950-51 to 1962-63 were studied. The crops studied were jowar, bajra, cotton and groundnut. Regions of the State as are important producers of these crops and where considerable area had been brought under contour bunding were chosen for the input-output analysis of data. Cobb-Douglas function was used to investigate whether contour bunding affected the agricultural production in the State significantly and if so to what extent.

In most of the areas where contour bunding had been done, there was evidence of improvement in the crop yields. The contribution of contour bunding to the increase in production of all crops studied was quite substantial.

It is also found that for obtaining best results from this measure, there should be a properly phased programme of bringing more and more area under contour bunding rather than undertaking this measure on a huge scale as a relief measure in some years when the rainfall is low since the benefits of contour bunding accrue only after a couple of years. Thus, dry farming areas in the country can also play a greater and more important part in boosting up agricultural production in the country.

11. *Plans for diallel crosses* by K.N. Ponnuswamy and M.N. Das. I.A.R.S., New Delhi.

Though methods of obtaining diallel cross plans are available, practical workers find it often times difficult to adopt such plans as they are not easily available. We have therefore prepared actual layout plans both for full and partial diallel crosses using blocking and presented them in form of tables. The expressions of estimates of general combining ability (g.c.a.) and their standard errors and expected values of the S S. due to g.c.a. have also been presented. Partial diallel cross plans have been given for 8 to 32 lines. There are about 100 plans in all.

12. *Efficiency of successive sampling with reference to collection of Agro-economic and Agronomic Data in the I.A.D.P. Districts* by Randhir Singh, I.A.R.S., New Delhi.

Jesson (1942) initiated the use of information obtained on a previous occasion for improving the estimates of mean for current occasion. Yates (1949) extended the above results to $b(b>2)$ occasions.

Singh (1968) has studied partial replacement on successive occasions with multistage designs.

In the present investigation, the efficiency of successive sampling on two occasions for two stage Designs where partial replacement is made only in P.S.U.'s, has been worked out with reference to the data collected from Agro-economic and Agronomic enquiry in the I.A.D.P. District, Aligarh.

13. *Ratio-type estimators for double sampling in two-stage designs* by R.C. Garg, Rockefellor Foundation, New Delhi and S S. Pillai, I.A R.S., New Delhi.

In the case of simple random sampling without replacement, unbiased ratio-type estimator was first developed by Hartley and Ross (1954). They assumed that the information on the auxiliary character in the population was completely available. But sometimes, it happens that this information is lacking. Under this situation, the problem was considered by Sukhatme (1962) who resorted to the technique of single stage, double sampling and presented several ratio-type estimators out of which one was an unbiased estimator of the population mean.

In the present paper, unbiased ratio-type estimators for two-stage sampling design have been presented when the population mean of the auxiliary variable is known or unknown. For obtaining unbiased ratio type estimators, a technique called "The extended method of symmetric means" to two-stage designs has been developed which is an extension to the technique developed by Tukey (1956) and generalized for the multi-variate case by Robson (1957). By using this extended method, variances of the several estimators considered, for the same order of approximation, have been worked out. While simplifying the expressions for variances, we have assumed that the number of primary units and secondary units in the population are large. The conditions under which unbiased ratio-type estimators were more efficient than the corresponding biased estimators for the two situations, *viz.*, when single phase sampling in two-stages and when two phase sampling in two-stages is adopted, have been obtained. The estimates of variance in double sampling for two-stage designs have been worked out. Using a cost function, the optimum variances for a fixed cost have also been obtained. The results obtained when double sampling is resorted to in two-stages, have been numerically illustrated.

14. *A Bradley-Terry Model for partial pairs* by S. C. Rai and G. Sadasivan I.A.R.I., New Delhi.

In this paper the authors have investigated the mathematical model of Bradley and Terry for paired comparisons and have extended it to the case of partial pairs. The maximum-likelihood estimates of treatment ranks have also been obtained under different situations. Investigations on combined analysis for different groups have also been made. The entire theory has been discussed by a practical example.

15. *Prediction of Coffee Production in India*" by V. Ramachandran, I.A.R.S., New Delhi.

For forecasting coffee production, a pilot survey was in operation for a period of three years (1964-65, 1965-66, 1966-67) in Coorg District of Mysore State. The object of the survey was to evolve a suitable technique for forecasting production of coffee during any season well in advance of the harvest with sufficient degree of accuracy for each of the district as well as for the whole of India. The list of all estates in the district is available from registration records. For the purpose of the study, a sample of 60 estates were selected at random during each year. The selected estates were divided into sections of approximately one acre each and two sections were selected at random from each of the selected estates. In each of the selected sections 3 groups of six hearing coffee plants were selected, the plant in each of the group being located at random. Measurements were made at three times during the growth of the coffee beans, x_1 on group 1 (observations 30-40 days after blossom showers), x_2 on group 2 (observations 90-100 days after blossom showers) and x_3 on group 3 (just before fly picking) as also the total yield of the section at the time of actual harvest (y).

In the present investigation, the ratio estimates both single and multivariate were used to forecast the coffee production based on data collected in 3 years, the multi-stage ratio estimates yielded better results. WALD'S and Bartlett's method of fitting the straight line was also examined.

16. *Modified Incomplete Block Bio-Assay Designs for Slope-Ratio Assays* by A. C. Kulshreshtha, I.A.R.S., New Delhi.

A new series of incomplete block designs for slope-ratio assays is presented. This series of designs enables the estimation of the

'intersection-contrast' and contrasts of types L_m' and L_{2m+1} (for all permissible values of m) with full accuracy. Further, the proposed designs provide full accuracy on one of the two degrees of freedom used in the estimation of potency. The proposed designs have been called as Modified Incomplete Block Bio-assay (MIBB) designs and compared with RBD, BIBD, and designs of Das and Kulkarni (1966). MIBB designs require fewer number of replications as compared to BIB designs and designs of Das and Kulkarni but exist only for an even number of doses in a preparation.

17. *Some Studies on the Relationship Between Weather and Yield of Crop* by B.P. Saha & J.C. Das (Meteorological Office, Poona).

Some studies were undertaken to correlate yield of some principal crops of some meteorological sub-divisions with weather elements like rainfall, temperature, etc., or parameters derived from these elements. The study presented in this paper relates to paddy yield of Madhya Maharashtra, Bihar Plains, Bihar Plateau. The study on the wheat yield of Punjab (India) and Bihar Plains is also presented.

18. *On a Relation Among Parameters of a BIBD* by D. K. Pandey, Patna University.

Yates (1936) suggested BIB Designs for producing the block size in field experiments. Fisher (1940) proved that $b \geqslant v$. Bose (1942) defined the property of resolvality of a BIBD and proved that for such designs,

$$b \geqslant v+r-1$$

which is obviously more stringent an inequality than Fisher's.

Recently M. Bhaskar Rao conjectured that for resolvable B.I.B.D. an inequality of the type,

$$\frac{r(r-1)}{\lambda} \geqslant b \geqslant v+r-1+\frac{K-1}{K}(r-K-\lambda)$$

should also hold.

The pourpose of this paper is to prove this proposed inequality.

19. *Rotatable Designs with Unequal Dose-Ranges* by A. Dey and M. N. Das, I.A.R.S., New Delhi.

Rotatable designs (Box and Hunter, 1957) available in literature suffer from one drawback that a design which is rotatable in

coded doses remains rotatable when changed to the actual doses with the origin shifted to the mid-dose only when the actual dose ranges for different factors are the same. But if the actual dose-ranges for different factors are unequal, as happens usually, different scale parameters are used for different factors for changing the design from the coded doses to the actual doses. As such the design in terms of the actual doses does not remain rotatable.

It was therefore thought worthwhile to search for designs which admit different actual dose-ranges for different sets of factors and are still rotatable. The purpose of the present paper is to discuss various designs having the above property.

20. *Study on plot sizes in yield surveys in India—A review in retrospect on methodology* by D.S. Ramaratnam, Directorate of N.S.S., Faridabad.

The object of this paper is to review the past studies on plot sizes imitiated by Indian Statistical Institute (ISI) and Indian Council of Agricultural Research (ICAR) and also to appraise the results published by them in comparison with the results of the joint crop cutting series and subsequent studies on circular cuts and square cuts by the Agricultural Statistics Division of the Directorate of National Sample Survey [NSS (AD)]. Accordingly, in Section 1 of the paper a brief summary of the important findings of earlier studies, in so far as it relates to food crops, will be given. It will be followed by an analytical problem in Section 2, on the methodological aspects in order to examine the plausible causes for the difference in the experience revealed by the recent studies carried out by NSS (AD).

The results on plotsize studies carried out by NSS (AD) subsequent to earlier studies by ISI and ICAR have brought out certain important findings in so far as locating bias in plot marking is concerned. The recent studies have led to the conclusion that there is sufficient evidence for further investigation on the need for application of a correction factor on yield estimates for removal of bias due to location of plots. It has also revealed an appreciable correlation between yield and relative position of cuts which have a direct influence on the nature of results for high yielding crops thickly grown under homogeneus conditions in smaller fields (as wheat) as also to low yielding thinly grown and heterogeneous crops in larger fields (like bajra). These studies, therefore, reopen the issue for further investigation on the estimation of unbiased yield rates by resorting to elimination of possible location bias in the marking of plots while

conducting crop cutting experiments in the state crop estimation surveys. Some suggestions for further detailed investigations to be carried out on a larger scale based on a suitable design are also given.

21. *Optimum Fertilization of Potato* by Pushkarnath, M.B. Jain and V. P. Malhotra, Central Potato Research Institute, Simla.

The paper describes the economics of the three main nutrients *ziz* , nitrogen, phosphorus and potash, based on the results of experiments conducted during the period 1964-67 at Jullundur (Punjab), Babugarh (Uttar Pradesh) and Patna (Bihar) trial centres of the Central Potato Research Institute. Optimum combinations of the three nutrients are determined by fitting a quadratic response surface to the data and considering a suitable profit-maximising function. For a reasonable range of price fluctuations of the produce, the limits and the corresponding net profits, which are economically optimum have been worked out.

22. *A note on changes in bovine milk production in the erstwhile Punjab state during the last decade* by V.V.R. Murty, B.B.P.S. Goel & K. B. Singh, I.A.R.S., New Delhi.

Sample surveys for estimation of milk production and study of bovine practices were conducted in Punjab by I.A.R.S. during 1956-57, 1961-62 and 1966-67. A study has been made on the changes of bovine milk production during the last decade.

It is estimated that during the period 1956-66, there is an increase of 10 per cent in plain areas of the erstwhile state. The productivity per buffalo in milk did not alter during the 10 years period but there was an increase of 13 per cent during 1956-61 and a fall of 7 per cent during 1961-66 in the case of cows. The per capita availability of milk in plain areas was 408 gms. during 1956-57 which reduced to 344 gms. in 1961-62 and 318 gms. in 1966-67.

23. *On analysis of confounded asymmetrical factorical designs* by S. Ray and M.N. Das, I.A.R.S , New Delhi.

An attempt is made to make the method of analysis of confounded asymmetrical factorial designs easier than the existing one. The method is very much like the method of analysis of symmetrical or asymmetrical designs by forming tables when there is no confounding. All that is done is to form suitable two way tables involving the affected interactions and obtain the adjusted cell totals. Sum of

squares of such totals are then obtained and these are then multiplied by suitable multipliers so as to get the required adjusted sum of squares.

24. *Stability of Performance of some Varieties and Hybrid Derivatives in Rice under High Yielding Varieties Programme* by J. Ram, O. P. Jain and B. R. Murty, I.A.R.I., New Delhi.

The stability of performance of some high yielding improved varieties and hybrid derivatives representing the *Indica* and *Japonica* races of rice was examined to detect the genetic differences among themselves for wide adaptability over a number of locations at two fertility levels during *Rabi* and *Kharif* seasons from 1965-67. The stability was measured in terms of three parameters, *viz.* regression coefficient (b_i) of the mean of genotype of environmental index (I_j), deviation from linearity ($\hat{\sigma}_{di}^2$) in addition to the mean value of the genotype over all environments (μ_i) on the following model proposed by Eberhart and Rusells (1966) :

$$y_{ij}=\mu_i+b_i=I_j+\hat{\sigma}d_{ij}$$

where $$I_j=(\sum_i y_{ij}/v)-\sum\sum y_{ij}/vn$$

With the restriction $\Sigma I_j=o$

A modification of the model with addition of an extra term phenotypic index is proposed.

The model suitable with a linear relationship of the genotypic response to environments has been found to be adequate in this case over both seasons and fertility levels. Substantial differences for stability among the dwarf *indicas* and *japonicas* were found indicating the influence of factors other than height on stability. In general, dwarf *indicas* like IR-18, IR-4 and IR-5 were more stable over a wide range of environments than *Japonicas*. The tall *indicas* exhibited above average stability but were low yielding. They have poor adaptability at both high and low fertility levels.

Differences in the stability of varieties over locations varied with the seasons indicating genotype X seasons interaction for stability. The regression coefficiets were larger in *kharif* than in *rabi* although the deviations from regression were of similar magnitute and the mean yields were lower. Among the varieties which are having higher mean yield than the experimental average, T(N)1, IR 9-60 and Tainan

3 were the best in 1965-66 when IR-8 was not included in the trials. When the fertility levels were similarly considered over seasons Tainan 3, T(N)1 and Dgwg were the best. Among thm Tainan 3 is a *japonica* type. The differences in the regression coefficient of dwarf *indicas* and *japonicas* were limited both under high and low fertility levels as for yields. When the data on seasons and fertility levels were pooled together T(N)1, T(N)1 x T65 and K-68 *japonica* combined high yield and high regression coefficients, indicating that seasonal fluctuations and fertility levels could alter the degree of adaptation.

The comparison of IR-8, IR-4 and IR-5 derivatives over 56 environments (pooled over locations and fertility levels) has shown, in general, the superiority of IR-8 followed by IR-5 and IR-4 derivatives both in mean and size of regression coefficients far exceeding T(N)1. IR-8 and IR-5 were suitable over both fertility levels with better response to favourable environments as compared to T(N)1.

Since the yields in *Rabi* were generally higher than *Kharif* probably due to more available sunlight, the performance of IR-8 and its derivatives in *Rabi* may be similar to that in *Kharif*.

The factors responsible for wide adaptation and choice of the area of adaptation have been discussed.

25. *Balanced Designs for switch over trials where Interest Centres on Periods into treatments interaction* by G. M. Saha, and M.N. Das, I A.R.S., New Delhi.

Recently, Baloam (1968) has presented a two-period design with t treatments in t^2 experimental units. For analysis of such designs, he has included in the model, periods into treatments interaction parameters instead of first residual effects. These designs are balanced for first residual effects and also interaction effects in the usual sense of constancy of the primary contrasts of the estimated effects.

In the present paper an improvement over Baloam's designs have been suggested. Designs for t treatments to be tried in any desired number of periods K ($K \leqslant t$) in $t(t-1)$ experimental units have been presented along with their analyses. Assuming the first residual effects also be present in the model, separate analyses are worked out.

26. *Analysis of crop rotation experiments in India* by T.P. Abraham & K.N. Agarwal, I.A.R.S., New Delhi.

In rotational experiments containing different crop rotations a completion of cycle of the experiment sometimes requires very many

years. The experimenter is therefore handicapped and wait for his comprehensive analysis till the completion of cycle. Recently Agarwal (1968) indicated how the method of analysis when the cycle is complete is modified when either cycle is in-complete or data of some of the years are not available. This method has been used in the present paper for analysing data of six crop rotational experiments obtained from Maharashtra and Mysore states in respect to (*a*) comparison of different crops included in the rotations (*b*) effects of different crops in the rotations on the yield rates and (*c*) economics of rotations.

27. *Some Designs for Qualitative-cum-Quantitative Experiments* by D.K. Joshi & M.G. Sardana, I.A.R.S., New Delhi.

Three alternative confounding schemes, for various qualitative-cum-quantitative experiments with factors N, quality of $N(Q)$, and P (qualitative or quantitative) have been considered and their analysis discussed, both under the additive and proportional models. The appropriate choice of the confounded designs in each case has been suggested. The designs considered are having either 4 or 5 levels of N, 3 or 4 levels of Q and 2, 3 or 4 levels of P.

28. *Genetic Variance and Negative Assortative Mating* by K.M. Reddy, I.A.R.S., New Delhi.

The population may deviate from random mating in two ways. One way is inbreeding. Other occurs when matings between either like or unlike phenotypes exceeds random expectation. In animals and insects this may occur because of individual preference for a mate of a particular phenotype by an individual of the same phenotype or different phenotype. The latter case is called negative assortative mating system.

Under this mating system genetic variance is calculated in the absence and presence of dominanee. Means decrease by

$$\left[\frac{1-3\,pq\,(1+pq)}{(2+pq)\,(1-2pq)}\right] da \text{ and } \left[\frac{q-2q^2\,(1+q)}{(1+q)}\right] da$$

in the absence and presenee of dominance respectively as compared to the means under random mating system, when one locus is segregating. The Variances decrease in both the cases compared to random mating system. The effect of linkage on genetic variance under negative assortative mating is being done.

29. *On the applicability of Midzuno-Sen Scheme in Sampling on successive occasions* by M.S. Avadhani and A.K. Srivastava I.A.R.S., New Delhi.

The variance of the ratio estimate under Midzuno-Sen sampling is not available in the literature in a form suited for further investigations. In this paper it has been shown that this variance, to the first approximation, is identical with the mean square error of the corresponding ratio estimate under simple random sampling without replacement. Applicability of the Midzuno-Sen sampling with ratio estimate to sampling on successive occasions has been studied.

30. *Genetic Divergence and Phenotypic Stability for some Characters in genus sorghum* by B.S. Rana, M.B.L. Saxena & J N. Govil, Division of Genetics, Indian Agricultural Research Institute, New Delhi.

Twenty improved varieties used as representative of the diversity in the genus *Sorghum* were grown over four successive years from 1965 to 1968 at Delhi. Six important characters contributing to fitness were recorded. Estimates of genetic divergence between them were computed each year by using D^2 statistic. Their stability over seasons was also assessed for each of the characters. Indian cultures showed close affinity for two years and Kafir, Feterita and Birdproof formed the independent groups. In the last two years some of the Indian cultures formed the separate groups and other varieties were included in the groups irrespective of their origin. Sudanense types formed a distinct independent cluster in all the seasons with the maximum genetic divergence from the rest of the varieties. The intra and inter groups divergence over different years were compared taking 1965 groups as the standard. The intra group divergence increased but inter groups divergence varied over seasons generally and was the least in 1967 and 1968 and maximum in 1965 and 1966 indicating that the stress environment in 1965 and 1966 increased the estimates of genetic divergence between varieties. Flowering time and panicle length contributed maximum to the total divergence.

The phenotypic stability of these varieties was also examined separately for each character. The varieties differed significantly in performance for all characters except early vigour. The linear component of environment was found significant for early vigour, flowering time and number of seeds per primary branch. Kafir,

Hegari, Birdproof and *C*-18 are some of the early stable varieties while Hegari, Zerazera and Nandyal has got above average stability for panicle length.

None of the populations was found consistent in stability for all the traits over years. Such interactions could be possible causes for the changes in the total genetic divergence between varieties over seasons. The varieties included in one cluster showed similar adoptation pattern.

31. *Studies on the Forecasting of Yield by Curvilinear technique I : Rabi Jowar (Sorghum) at Raichur* by P.S. Sreenivasan and J R. Banerjee (Agricultural Meteorology Division, Poona)

The response of any biological system to any given meteorological factor is invariably not according to a linear function but a curvilinear one with one maximum The response curve on either side of the maximum may decrease gradually or steeply and then may taper off between the limits of tolerance on either side. Making use of the data which are being collected under the auspices of Coordinated Crop-weather scheme for the last two decades, the curvilinear response of winter jowar grown at the Government Farm, Raichur to some of the more important meteorological factors was studied. In order to maximise the forcecasting value, the meteorological data extending upto barely eight weeks after sowing was made use of.

The study brought out that although none of the linear and partial regression coefficients between yield and the four meteorological factors namely (*a*) rainfall amount, (*b*) number of rainy days, (*c*) Maximum temperature and (*d*) Minimum temperature are significant, the index of curvilinear multiple correlation is of the order of 0 958 for the variety *M*-35-1 and 0·801 for the variety *PJ*-4*R*. Thus the curvilinear method accounts for 92% and 64% of the total variation for the varieties *M*-35-1 and *PJ*-4*R* respectively indicating thereby that this technique is a powerful tool in such biological studies.

ANNOUNCEMENT

In appreciation of the services rendered by Dr. V. G. Panse, a felicitation volume comprising articles contributed by noted Statisticians, Agricultural Economists, Agricultural Scientists and others has been published by the Indian Society of Agricultural Statistics. The Volume contains 33 articles along with a bibliography of the papers published by Dr. Panse. Other relevant information about the publication is given below :

Title of the publication :	Contributions in Statistics and Agricultural Sciences (1968).
Number of pages :	368 in addition to messages from eminent Persons and a complete list of scientific papers contributed by Dr. Panse.
Price :	For members of the Society : Rs.20 (in India) and $ 4 (foreign) For non-members : Rs. 25 (in India) and $ 4·5 (foreign).
Available with :	The Secretary, Indian Society of Agricultural Statistics C/o Institute of Agricultural Research Statistics, Library Avenue, New Delhi-12.

Those who are interested in purchasing the volume may please place their orders and remit the amount either in cash, M. O. or through cheque. The information may please be brought to the notice of those who are interested in the subject.