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ABSTRACTS OF PAPERS

1. Two-Sided Neighbours for Block Designs with Neighbouring Effects

RR Laxmi and Parmita
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A method for finding left-neighbours and right-neighbours of a treatment in a Balanced Incomplete Block Design incompletely balanced for neighbour competition effects has been suggested in this paper. It is found that these left-neighbours and right-neighbours form common series for a treatment and has circular property.

2. Doubly Linked Block Association Schemes

KK Singh Meitei
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The inception of the Singly Linked Block (SLB) association scheme was known due to Shrikhande (1950), defining the association relationship of two blocks based on their intersection number of treatment which must be either 0 or 1. In the present work, starting from a given block design in which any two blocks intersect at either 1 or 2 treatment(s), a new 2-class association scheme to be named "Doubly Linked Block Association Scheme" is introduced and also some combinatorial approaches to its existence are laid down.

3. Algorithmic Construction of Efficient Multi level *k*-circulant Supersaturated Designs

BN Mandal, VK Gupta and Rajender Parsad
Indian Agricultural Statistics Research Institute, New Delhi

A supersaturated design (SSD) is a fractional factorial design whose run size is insufficient for estimating all the main effects represented by the design matrix. SSDs can be very cost-effective under the effect sparsity assumption. SSDs have received considerable attention in literature because of potential application in factor screening experiments, computer experiments, software testing, medical, industrial, engineering and biometrical experiments. In this article, some results related to upper bound on number of factors in a balanced multi-level SSD such that no two columns are fully aliased is presented. An algorithm to construct efficient balanced multi-level *k*-circulant supersaturated designs with *m* factors and *n* runs is proposed. Efficient balanced multi-level *k*-circulant supersaturated designs can be generated using the proposed algorithm. The algorithm is utilized to construct many balanced multi-level supersaturated designs. A list of many optimal and near optimal, multi-level supersaturated designs is also prepared for number of factors (m) ≤ 60 and number of levels (q) ≤ 10. Two-level *k*-circulant supersaturated designs can also be prepared using the proposed algorithm and some large optimal two-level supersaturated designs are presented. The algorithm was implemented in R software and an R package called *mkssd* has been developed and is available on http://cran.r-project.org/web/packages/mkssd/.

4. Effect of Non-normality on Selection Intensity of some Traits of Rice Crop

Karnail Singh, Pritpal Singh, Rupinder Kaur, TS Bharaj and Naveen Singh
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Twelve characters viz; days to maturity, leaf length, leaf width, plant height, tillers per plant, EBT per plant, panicle length, grains per panicle, fill grain per plant, L : B ratio, 1000 grain weight and grain yield per plant were studied, based on samples of size 792 and 655 for the year 2004 and 2005, respectively. Mean, standard error, coefficient of skewness and coefficient of kurtosis of these characters were calculated and tested using parametric and non-parametric tests. Results for the year 2004 revealed that days to maturity and plant height were negatively skewed and highly significant. Leaf length, tillers per plant, EBT per plant, panicle length, grains per panicle, fill grain per plant, L : B ratio and grain yield per plant were found to be positively skewed and highly significant. However,

1000 grain weight was found to follow symmetric distribution by using both parametric and Non-parametric test. Days to maturity, leaf length, leaf width, plant height, tillers per plant, EBT per plant, fill grain per plant were found to be of leptokurtic nature based on coefficient of kurtosis. However, panicle length, grains per panicle, L : B ratio, 1000 grain weight and grain yield per plant followed mesokurtic distribution. Similarly, results of the year 2005 showed that days to maturity and plant height were negatively skewed and highly significant. Leaf length, leaf width, tillers per plant, EBT per plant, grains per panicle, fill grains per plant, L : B ratio and grain yield per plant were found to be positively skewed and highly significant. However, 1000 grain weight was found to follow symmetric distribution. Similarly, based upon test of kurtosis, days to maturity, leaf width, tillers per plant, EBT per plant panicle length, fill grains per plant were found to be leptokurtic in nature. 1000 grain weight, leaf length, plant height, grains per panicle, L : B ratio and grain yield per plant were found to be mesokurtic. Interestingly, 1000 grain weight was found to follow Normal distribution in both the years. Further, empirical study on selection intensity values for the above said traits of rice crop were carried out. Results revealed that selection intensity values of positively skewed and leptokurtic traits were underestimated as compared to normally distributed traits. However the traits which were negatively skewed and leptokurtic overestimated the selection intensity values than normally distributed traits.

5. Estimation of Genetic Variation in Reciprocal Recurrent Selection

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The primary objective of poultry breeder is to alter gene frequencies and distribution by employing various mating systems/selection methods to improve different traits of economic importance that will maximize the efficiency of production and increase profitability (Siegel and dunnington1997), such traits include egg number, egg weight, fertility, hatchability growth rate and meat quality and viability. There are different classes of selection methods, each with several traits. Reciprocal recurrent selection (RRS) is essentially a recurrent programme to mate selected males of line A with females of line B, this method of selection increases the frequency of both additive and non additive genes, hence improve the pure and cross line performance. The study is carried out at the poultry breeding unit of Department of Poultry Science, Bangalore during 2008 and 2009. A total of 64 pedigree hens and 8 cocks were used to mate with each line. The data was collected by respective crosses on body weight up to sixth week, age at sexual maturity ASM(D), body weight at sexual maturity (BWSW), 20th week body weight (BW), egg production at (EP)32nd week, egg production at 40th week, egg production at 52nd week, feed consumption ratio (FCR) and confirmatory traits like keel length, shank length, shape index are considered.

The means of various traits are computed. Heterosis, genetic correlation, heritability, breeding value, SCA, GCA are found by least square analysis. The results show that the crossbred hens had the earliest ASM (180.25d), followed by parental line (196.80d). Crossbred of PB2 gave the highest body weight at sexual maturity, hetrotic effect of crossbreds were highly significant ($p < 0.01$) on ASM and body weight.

It can be concluded from the findings of this study that significant differences are observed in crossbred line compared with pure line, the crossbred group had better performance in all traits.

6. AMMI Analysis of Rice Yield Trials (*Oryza sativa L.*)

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Rice (*Orzya sativa L.*) is one of the world's most important staple cereal food crop growing in at least 114 countries under diverse conditions such as irrigated, rainfed lowland, rainfed upland and flood prone ecosystems. The considerable variation in environment has resulted in significant variation in the yield performance of rice genotypes. Thus, genotype × environment interaction (GEI) is an important issue faced by the plant breeders and agronomists. There are different approaches for studying GEI *i.e.*, parametric, non-parametric and multivariate statistical methods. The objective of the present investigation was to analyze the pattern of genotype × environment interaction (GEI) for grain yield of 21 rice genotypes by Additive Main

Effect and Multiplicative Interaction (AMMI) model using the data generated from the four different locations (Nawagam, Vyara, Dabhoi and Thasra) of Gujarat State, India. The results revealed that the genotypes (G), environments (E) and genotypes × environments interaction (GEI) were highly significant and contributed 7.8, 80.1 and 12.1 per cent of trial variation, respectively. The partitioning of GEI variation into principal component axis indicated that the first two axis were found significant and contributed 63.13 and 27.97 per cent, respectively to the GEI variance. The genotype NWGR-3199 was winner and high yielding for Dabhoi and Thasra locations. IETY-19132 for vyara location and IET-19143 for Nawagam location. Genotypes NWGR-3026, NWGR-3006, IET-19147 and IET-19160 were close to the origin in biplot and hence, they were non-sensitive to environmental interactive forces. Therefore, they posses general adaptation with different mean grain yield. Dabhoi and Thasra were found to have similar interaction pattern in genotypes. Nawagam environment was high yielding potential location, whereas Vyara, Dabhoi and Thasra were found low yielding environments. According to AMMI Stability Value (ASV), $W_{i(AMMI)}$ and $ASTAB_i$, Genotypes NWGR-3026, IET-19147 and NWGR-3006 were found stable whereas genotypes IET-19132 and IET-19143 were unstable genotypes.

7. Prediction of Milk Yield of Hariana Cattle on the Basis of Reproduction Traits

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Least squares procedure yields unbiased estimates with minimum variance, but under certain assumptions. In particular, application of least squares method assumes that there is no multi-collinearity among the regressor variables. Presence of multi-collinearity inflates the variances of the least squares estimates and the prediction model. The common approach is to eliminate multi-collinearity causing variables or to adopt principal component and ridge regression methods. In the present study, principal component, ridge regression and latent root regression methods have been used and compared for prediction of location yield in Hariana cattle on the basis of reproduction traits. Performance of the estimates obtained by these methods has been compared with the ordinary least squares estimates. Direct and indirect effects of the reproduction traits on milk yield are also obtained using path coefficients analysis.

8. Analysis of Milk Production Statistics of India

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Milk production is an important activity of Indian agriculture playing important role in the Indian economy and socio-economic development of the country. India is the world's largest milk producer with 108.5 million tonnes in 2008-09. The milk group contribution in total livestock production is about 67%. Statistics are the ways and means of presenting and handling data, making inferences logically and drawing relevant conclusions. Earlier, the data on various aspects of dairying was unavailable, but now the situation has improved. The analysis of FAO estimates of Indian milk production is important since FAO estimates related to agriculture and livestock are internationally used. The values of FAO estimates never coincide with official estimates after 1991. Also, the breakup of milk production follows some standard formula for certain years (1967-1982). Milk production growth rate reached incredibly high levels during Operation Flood period from a marginal positive growth rates in earlier period. These statistics apparently ignored the occurrence of droughts in some years which certainly would impact feed-fodder availability and thereby affecting milk production. Also, the increase in total milk growth rate is mainly due to tremendous rate of growth rates of cow milk production which was as high as 2000% and the growth is mainly due to high growth rate of warranted milk yield of cow in Operation Flood period which raises a sense of suspicion towards these statistics. But in post-Operation Flood it is actually due to In-milk population of Crossbred cow which grew at an incredible rate (6% from 1999-2008). But in case of buffaloes, the milk production is combination of both increase in In-milk population as well as warranted milk yield, the growth of the former being higher in Operation flood (2.5%) and growth of both the factors *i.e.*, In-milk population and warranted milk yield in post-Operation flood. The share of cow milk in total bovine milk increased from 34% to 43% *i.e.*, an increase of 26% in cow milk over the Operation flood

period and then maintains same percentage in post-Operation flood period. So, FAO estimates can be considered unreliable because of highly erratic growth behaviour of cow and buffalo milk production and use of some standard formula for calculating milk production. Official statistics also raise many doubts as milk production continues to grow at high rates in the years of drought. Also, tremendous growth rates of Operational Flood period seem to be overestimates as growth rates of cow milk production and productivity do not fall in line with biological feasibility. Further, the official milk production statistics are much higher than FAO statistics. Moreover, it seems that there is a desperate attempt by the Govt. officials to show high growth rates in Operation Flood period and in post-Operation flood period. So, there is a need to plug the loop-holes in data handling, processing and estimation on the part of FAO as well as Government agencies.

9. Estimation of Milk Yield in Surti Buffalo

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In this article an effort is made to estimate 305 days milk yield and total milk yield considering service period, peak yield and peak day as independent variables.

The data was collected from the Dept. of Animal Sciences, UAS, Dharwad (1974-75 to 2004-05) *i.e.*, for 30 years. By utilizing the information available on 310 on farm born buffaloes, various models were tried and the best model obtained for 305 days milk yield is $Y = 0.5431\ x_1^{0.73}\ x_2^{1.09}\ x_3^{0.24}$ with $R^2 = 0.994$ and standard error is 0.1426 and for total milk yield is $Y = 0.3214\ x_1^{0.799}\ x_2^{0.99}\ x_3^{0.23}$ with $R^2 = 0.995$ and standard error is 0.1282.

10. Application of Receiver-operating Characteristic (ROC) Analysis for Predicting Metritis in Karan Fries (KF) Cows

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Receiver-operating characteristic (ROC) graph is a technique, useful for organizing classifiers and visualizing their performance. The ROC analysis is most commonly used for the evaluation of clinical laboratory tests in human medicine but its use in animal science is still in its infancy. Accuracy of diagnostic test is represented by area under ROC curve (AUC), sensitivity and specificity. In the present study, we used the ROC analysis for predicting metritis by using pre-partum feeding time. We collected pre-partum daily total feeding time data from day – 11 to day – 2, consisted two period viz. P1 (d – 11 to d – 7) and P2 (d – 6 to *d* – 2) of KF cows (n = 20) and their post-partum metritis incidence. The AUC was 0.64 (P = 0.29) and 0.86 (P = 0.006) for P1 and P2, respectively. Optimum threshold value (highest combined sensitivity and specificity) for P1 and P2 was 355.50 and 284.5 min/d, respectively. The sensitivity, specificity and likelihood ratio for P1 were 50%, 75% and 2, respectively and for P2 were 75%, 91.67% and 9, respectively. Thus the AUC and optimum threshold value during P2 can accurately predict ensuing post-partum metritis.

11. Maximum Likelihood Estimates for the Parameters of an Inflated Poisson-Lindley Distribution

Arun Jhajharia[1], MK Sharma[2] and HL Sharma[1]
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In the present paper, maximum likelihood estimates for the parameters of an inflated Poisson-Lindley distribution have been derived. The elements of the information matrix are given for the determination of asymptotic variances and covariance of the estimates. The suitability of the distribution is tested using the data of number of insects per leaf (Beall 1940) and number of accidents per woman (Shankaran 1970). The fit is also compared with inflated Poisson distribution.

12. Probability Analysis of Rainfall at Hyderabad by Markov Chain Model and its Distribution

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Project Directorate for Farming Systems Research, Modipuram, Meerut

The present study has been conducted on meteorological data of weekly rainfall for the period 1983-2008 at ANGRAU, Rajendra Nagar, Hyderabad. In the study Markov Chain model has been applied to

determine the probability occurrence of rainfall prevailing various conditions of dry and wet weeks. The probabilities occurrence of two or more dry/wet weeks preceded by dry/wet weeks has been evaluated. Also, the probabilities of two or more consecutive dry/wet weeks have been worked out for better planning of crop sowing. Further, the rainfall at different probability levels have been predicted using three different probability distributions functions, viz. Log-Normal, Log-Pearson III and Gumbel. The statistical comparison by Chi-square test for goodness of fit showed Log Pearson III is the best in predicting annual maximum weekly rainfall.

13. Probability Distributions: A Case Study of Rainfall Pattern

TA Raja, S Maqbool and AH Mir
SK University of Agricultural Sciences and Technology Kashmir, Shalimar, J&K, India

Rainfall data of previous occasions play an important role in predicting production of agricultural and horticultural crops. Utilizing the available data and pattern of rainfall, statistical modeling helps in drawing inferences that are helpful to planners of state policy. In this paper average monthly rainfall data of Kashmir province averaged over six different locations from last fourteen years (1995-2008) has been analysed with the help of statistical models viz; Weibull, Extreme Value, Normal, Lognormal, Logistic and Log-logistic. The study revealed that log-logistic turned out to be best fit for prediction of rainfall pattern. Statistical software package Minitab has been wielded in the investigation and analysis of data.

14. A Study of the General Zero Inflated Models with Reference to Poisson Distribution

HL Sharma and Arun Jhajharia
JNKVV, Jabalpur

In the present paper, a study of the general zero inflated models has been provided. A general expressions for the estimation of their parameters *i.e.*, proportion of zero'th cell, method of moments, and maximum likelihood has also been derived. A zero inflated Poisson distribution with three examples has been added as an application of the paper.

15. Robustness of the Sequential Testing Procedures for the Parameters of Zero-Truncated Binomial and Poisson Distributions

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The sequential probability ratio tests (SPRTs) are developed for the parameters of zero-truncated binomial and Poisson distributions. The robustness of the SPRTs for the parameters of zero-truncated binomial distributions has been studied. It is established that the zero-truncated Poisson distribution is a limiting form of zero-truncated binomial distribution. This result is used to 'assess' the OC and ASN functions of zero-truncated Poisson distribution with the help of OC and ASN functions of zero-truncated binomial distributions.

16. TMIS: Database cum Model based Decision Support System Tool to Monitor Timber Prices

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Kerala Forest Research Institute, Peechi

TMIS (Timber Market Intelligence System) is a computer based decision support system tool to gather, store, search and analyse price trends of various timber species taking into account timber attributes such as timber type, quality, girth and length classes. Especially, TMIS tracks the timber price movements over time by developing timber price indices using official transactional databases of the Timber Depots of the State Forest Departments. Selected models for forecasting future timber price trends are also integrated in the system. The paper also presents a case study of Kerala State to demonstrate the use of TMIS.

17. Probability Distributions of Meteorological Parameters and their Applications in Cotton Crop Insurance

AY Surve and RL Shinde
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Agriculture production and agribusiness are exposed to many weather-related risks. Also, recent years have witnessed an increased interest in weather-based crop insurance. In this paper, based on

meteorological data of last 38 years, we have studied the probability distributions of some important meteorological parameters and their distributional properties are discussed. We have also studied the distributions of some functions of meteorological parameters which are useful in studying yield-weather relationship. Using these distributional studies and data on yield of cotton in Jalgaon district of Maharashtra state in India, we have studied relationship between crop yield and weather parameters. It led to development of weather based index useful for cotton insurance. We describe the methodology used to design crop insurance, in order to choose the meteorological index, the indemnity schedule and the insurance premium.

18. Online Software for Fuzzy Clustering

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Clustering algorithm maps the data items into clusters based on proximity measure, such that similar data objects belong to the same cluster and dissimilar data objects to different clusters. Crisp clustering method allows objects to have membership in one and only one cluster. However, in real life applications, at times it is difficult to create crisp boundaries between clusters. For those cases fuzzy clustering has important role to play. Fuzzy clustering method allows objects to belong to several clusters simultaneously with different degrees of membership. Fuzzy c-means is the well-known fuzzy clustering algorithm in literature, presented by Dunn and further developed by J.C. Bezdek to carry out fuzzy clustering. Fuzzy clustering has found potential applications in many sector of science including agriculture too. After requirement analysis for fuzzy c-means clustering software, it was observed that there is a need to develop easily accessible, user friendly and interactive software. Hence web based fuzzy c-means clustering software (wFCM) is developed at IASRI.

Web based fuzzy c-means clustering software has been developed using standard three tier web architecture which includes, User Interface layer (UIL), Application layer (APL) and Database layer (DBL). The User interface layer is implemented using combination of HTML, jQuery, JavaScript and CSS. Application layer is implemented using ASP.NET and C#.NET. Database layer is implemented using SQL Server for user management. This software is completely menu driven and presents user-friendly GUI which is developed to minimize efforts in using the software.

Fuzzy clustering using wFCM can be carried out in three easy steps. Step1 deals with uploading the data file to wFCM. Software support uploading the data using three different formats; Excel, CSV and Image file. In the second step, user needs to input clustering parameters (number of clusters, fuzzification parameter, precision and number of iterations). Brief help has been provided alongside for these parameters. Once parameter values are input then clustering is performed on click of a button. Step3 deals with presentation of results to the users. Clustering results are presented to the user in graphical format in which membership value of every object is represented in all the clusters. At the same time, user has been given the option to download results (data file along with cluster membership value and cluster number) in excel and pdf format. Another important feature of wFCM is image segmentation. Image segmentation involves converting image file into appropriate format to carry out fuzzy clustering and once clustering is done then mapping the results to image file. This software will be useful for statisticians, researchers, students and teachers for clustering datasets from agricultural research as well as many diverse areas of other sciences.

19. A Methodological Study on Estimation of Production of Mushroom

AK Gupta and UC Sud
Indian Agricultural Statistics Research Institute, New Delhi

Presently, the estimates of production of mushroom are being developed on the basis of complete enumeration approach. This approach is time consuming, costly and cumbersome and there is possibility of non-sampling errors creeping in the statistics on production of mushroom. Therefore, a sample survey based approach has been applied for developing reliable estimates of mushroom production. The study demonstrates the feasibility of sample survey approach for developing the estimates of mushroom production with a reasonable degree of precision.

20. Estimation of Population Mean in Two Occasions Successive Sampling

GN Singh, D Majhi and S Prasad
Indian School of Mines, Dhanbad

In the present work an attempt to estimate the population mean on the current occasion based on the samples selected over two occasions has been made. Suitable estimators have been proposed. Optimum replacement policies of the propose estimators have been discussed. The proposed estimator are compared with sample mean estimator when there is no matching and the optimum estimator which is a linear combination of the means of the matched and unmatched portions of the sample at the current occasion. Empirical studies are carried out and recommendations are made.

21. Estimation of Crop Yield using Small Area Estimation Approach

Hukum Chandra, UC Sud and Yogita Gharde
Indian Agricultural Statistics Research Institute, New Delhi

In this paper we used small area estimation techniques to estimate average yield of paddy crop at district levels in the State of Uttar Pradesh in India by linking data generated under Improvement of Crop Statistics scheme by NSSO (data collected with much reduced sample size, however, the quality of data is very high) and the secondary data from Population Census**.** The spatial information was also exploited to further improve the district level estimates. The coefficient of variation of the estimates generated by small area estimation reduced substantially as compared to the direct estimates generated by using sample data alone. Further this approach also provided reasonable estimates for districts with no sample data (*i.e.,* out of sample districts) where direct estimates could not be produced.

22. Improved Product Type Estimators of Finite Population Mean

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There are three popular ways of utilizing auxiliary information at the estimation stage namely ratio, product and regression methods. When the auxiliary characteristic is negatively correlated with the characteristics under study, Robson (1957) and later on Murthy (1964) proposed the product estimator. The present paper presents comparative study of proposed product estimators with Conventional Robson Product (1957), Singh and Dubey (1993), Srivastava and Bhatnagar (1981), and Manish and Manoj (2002) estimators. It has been observed that estimators proposed by Manoj *et al.* (2011) gives a better performance under bivariate symmetric normal population.

23. A Methodology for Determination of Sample Size for Evaluation of Development Programme

Med Ram Verma[1], Rajiv Pandey[2], B Singh[1] and Shiv Prasad[1]
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Generally the development programmes such as poverty alleviation, literacy drive, health schemes etc are being implemented on the units across a large geographical area. Therefore the evaluation of all the units is not possible for assessment of the impact of the development programmes. Hence evaluation method based on the sample survey methodology can be applied for assessment of the impact of development programme. Usually the development programmes are being implemented in phased manner. Due to phased implementation of the development programme the time factor also play an important role. So usual sample allocation methods cannot be applied. We have suggested a methodology for the determination of the sample size for evaluation of the development programmes, which are usually implemented in phased manner.

24. Reduction of Negative Effect of Non-Response by Imputation Methods in Two-Occasion Successive Sampling

GN Singh, S Prasad and D Majhi
Indian School of Mines, Dhanbad

The present work shows the intelligible use of imputation methods in dealing with the problems of non-response on current occasion in two-occasion successive (rotation) sampling. Using imputation, estimators have been proposed to estimate the

population mean on the current occasion. To study the effectiveness of the suggested imputation methods, elaborate empirical studies are carried out to test the behaviors of the proposed estimators in two different situations: with and without non-response. Results are analyzed and conclusions are made.

25. An Efficient Class of Ratio-cum-Dual to Product Estimator of Finite Population Mean in Sample Survey

Sanjib Choudhury and Bhupendra Kumar Singh
North Eastern Regional Institute of Science and Technology, Nirjuli

We consider a class of ratio-cum-dual to product estimator for estimating a finite population mean of the study variate using auxiliary variate. The bias and mean square error of the proposed estimator have been obtained. The asymptotically optimum estimator (AOE) in this class has also been identified along with approximate bias and mean square error. Theoretical and empirical studies have been done to demonstrate the superiority of the proposed estimators over the other estimators.

26. An Alternative Method for Estimating the Population Proportion of Sensitive Variable using Randomized Response Technique

IS Grewal, SS Sidhu and M Javed
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An unbiased estimator has been developed based on population proportion of two sensitive variables using single randomized response technique. The condition under which the proposed estimator is more efficient than the usual Warner's model (1965) has been worked out.

27. Development of Prediction Equation for Body Weight in Kenguri Sheep

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Biometrical observations were recorded on 119 adult Kenguri Sheep from sheep flock maintained at Karnataka Veterinary, Animal and Fisheries Sciences University (KVAFSU) campus, Bidar, Karnataka, and from shepherds flock in its breeding tract. The measurements were recorded on body length (point of shoulder to pin bone), chest girth (circumference of chest immediately behind the forelimbs), height (ground level to wither) and live body weight of adult normal Kenguri Sheep. The correlation coefficients between various biometrical measurements were highly significant ($p < 0.01$). For estimating the body weight prediction equations were developed.

28. Preharvest Forecasting of Castor Yield on the basis of Weather Variables in Banaskantha District of Gujarat

GK Chaudhary, JK Patel, MG Chaudhary and
RI Prajapati
SD Agricultural University, Sardarkrushinagar

To suggest most suitable pre-harvest forecasting model for Banaskantha district of Gujarat state past 27 years (1982-83 to 2008-09) weather data (weekly average of maximum and minimum temperature, morning and evening relative humidity, bright sunshine hours/day and weekly total rainfall (mm) from 32nd to 52nd meteorological standard weeks, MSW) were collected from the Agro-Meteorological Observatory, Agronomy Instruction Farm, S.D. Agricultural University, Sardarkrushinagar. The time trend was also included as independent variable. The data on average castor yield (dependent variable) of Banaskantha district were obtained from the Directorate of Agriculture, Gujarat state, Ahmedabad. The step-wise regression procedure was employed by using 23 years data. The prediction equations and forecast of subsequent years were obtained separately for 21 to 23 years data set. The positive and significant effect of the time trend and beneficial effect of weekly total rainfall were observed. The correlation coefficient as weight approach was found superior compared to other approaches. This approach provided suitable pre-harvest forecasting model predicting yield 12 weeks before actual harvest and explained more than 94 % variation in castor yield. The deviations between the predicted and actual yields ranged from –19.85% to 12.32%.

29. Application of Logistic Regression in Estimating the Number of Households Engaged in Income Generating Farm Activities

ARS Bhat, and DN Shanbhag
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Estimation of proportion of households engaged in income generating farm activities in the coastal regions

of Karnataka using Logistic Regression is attempted in this investigation. In this study the coastal area is considered as a broad area and the villages in the coastal area are considered as small area. Later Udupi and Dakshina Kannada regions of coastal area were considered as individual broad areas and estimates were generated for the villages under individual broad area. Data was collected from 30 households each, from the selected villages in the coastal area. Ten villages were sampled from each region viz. Udupi and Dakshina Kannada.

30. Fitting of Fox Model with Autoregressive of Order One using Expected Value Parameters

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When we deal with nonlinear estimation procedures for estimating the parameters, high parameter correlation may be detected which is indeed undesirable. It is desirable to use expected-value parameters for choosing the values of the explanatory variable in such a way to make the parameter correlations low. Expected value-parameters should fall within the observed range of the data and not correspond to asymptotes or extrapolations outside the data range because outside the range of the observed data is less efficient. Further, expected-value parameters can be advantageously used, as they are nearly unbiased, normally distributed and minimum variance estimators. In the present paper, it is attempted to fit the Fox model using expected-value parameters by incorporating error term with autoregressive of order one. This is illustrated with an example, considering the serially correlated catch-effort data observed from Gobindsagar reservoir, leading to obtain the estimates of MSY (maximum sustainable yield) value along with the optimum effort to achieve it. A perusal of the estimates of MSY for different forms of Fox model reveals that a simple Fox model have over-estimated the MSY and optimum effort values as compare to the values of MSY (691 tones) and optimum effort (1217 no. of gill nets) estimated by reparameterization of the Fox model with AR(1).

31. Forecasting Area, Production and Yield of Maize in India using ARIMA Model

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Maize is the 3rd major crop in India, more than 8 million hectare of land is put under maize, contributing about 19 million tonnes to Indian food grain basket, So the production behaviour and its future has got tremendous importance on food security of the country. The present study is an attempt to find out trends in area, production and productivity of Maize in India. This study also focuses on forecasting the cultivated area and production of maize in India using Autoregressive Integrated Moving Average (ARIMA) model. Time Series data covering the period of 1950-2010 was used for the study. The study reveals a spectacular simple growth rates for area, production and productivity of maize. Parametric trend models like, inverse, power and exponential trend models can adequately delineate trends in area, production and productivity of maize. The analyses forecast maize production for the year 2020 to be about 24.20 millions tonns. The model also shows that the maize area would be 8.30 millions hectares in 2020. In case of yield model shown that the yield of maize would be 2543.81 Kg/ha in 2020. These projections will help information of good policies with respect to relative production, price structure as well as consumption of maize in the country.

32. Rice forecasting using Unobservable Components Model (UCM)

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The Unobservable Components Model (UCM) can be considered to be a multiple regression model with time-varying coefficients. It is based on the principles that (i) it is useful to view time series as being decomposable into trend, seasonal, and cyclical components and (ii) time series models that give equal weight to both near and far distant observations (as in the deterministic trend model) are often not very useful. With respect to point (i) inefficient and inaccurate forecasting is likely to arise for anyone who ignores the salient characteristics of the time series to be forecast. For example, if one builds a time series model that has no allowance for seasonal variation yet the time series has significant seasonal variation in it, then the

forecasting accuracy of such a naïve model is likely to be poor. With respect to point (ii), in many time series the adjacent observations are more closely correlated with each other than observations that are far apart. As a result time series models that are "local" in nature and weight recent observations more than observations in the far past, tend to predict better when applied to economic time series than models that treat time series data "globally" as in the deterministic time trend model. Apart from the deterministic time trend model that treats all observations as equally important when constructing forecasts, the other models viz. UCM, exponential smoothing, and Box-Jenkins models are local in nature in that the more distant an observation is from the point of forecast, the less weight the distant observation carries in determining forecasts of the time series in question. Since, rice production in India is an important part of the national economy and since India is the world's second largest producer of white rice, accounting for 80% of all world rice production. Modelling and forecasting all-India rice production is carried out by utilising data on all-India rice area, production and yield for the period 1975-76 to 2010-11 along with all-India rainfall data from June to September for the corresponding period using Unobservable Components Model. Fitting of UCM family of models is carried out using UCM procedure available in SAS version 10.2. This model is fitted to time series data and subsequently utilized for predicting for future years in the series (forecasting). UCM family of models is applied even when the data under consideration show evidence of non-stationarity. Time series data obtained from the Directorate of Economic and Statistics, Government of India along with rainfall data obtained from Indian Meteorological Department (IMD) is utilized for the development of UCM model. Based on the data on rice production and rainfall for the period 1975-76 to 2010-11, UCM models were developed by making use of 70% of the data for training the model, 20% for testing and remaining 10% of data is utilised for validating the developed model. Developed model is utilized for forecasting kharif 2011 rice production. Forecasting was carried out by making use of the most efficient model which satisfied the goodness of fit criteria for time series statistical modelling procedures. Based on the developed UCM model, prediction of rice production for the year 2011-12 was worked out and would be 93.4 million tons. Rice production estimate would help the policy planners in formulating suitable policy measures.

33. Influence of Ecological Factors on Growth of Ret Medicinal Plants

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Among the climatic and topographic factors correlation of species girth at breast height, tree height, total volume and basal area, most of them showed statistically non significant results, which is perhaps a fall out of the lower number of sample points as well as the geographical nearness of study locality. The same results have been obtained in case of chi-square test. Here also except rainfall, latitude, longitude other factors do not increases the density of RET medicinal plants. In general, disturbance levels increases the densities. Almost every disturbance parameter had positive and significant association with density of RET medicinal plants.

34. An Estimation of Technical Efficiency in Dairy Farming in Sub-mountainous Region of Punjab - An Application of Frontier Production Function Approach

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Sub-mountainous region of Punjab has been characterized by small size of holding, low input use, low land and animal productivity. The present study estimated the technical efficiency in milk production and association of various socio-economic variables with the inefficiency. A random sample of 225 households rearing livestock were selected for the year 2007-08. Maximum likelihood estimates were obtained using frontier production function for the buffaloes and cows separately. The milk production was considered as depended variable; independent variables included were herd size, green fodder, dry fodder, concentrates, veterinary expenses, all the variables were considered per animal per day. The socio economic variables effecting inefficiency were age, experience, education, family size and farm size of the dairy owner. In case of buffaloes, the variable concentrate was found to be the only positive significant variable, indicating more use of concentrate will increase milk productivity in buffaloes. The mean level of efficiency was 99 per cent. In case of cows the coefficient of herd size was negative

indicating increase in herd size decreases the milk productivity. The concentrates influenced milk production positively in case of cows. The mean technical efficiency was estimated at 87 per cent. Among the socio economic variables age and family size had negative and significant coefficient with inefficiency indicating more the age of the dairy farmer and larger the family more would be the efficiency. The results signify that the dairy holders do not have much scope to increase the milk productivity of buffaloes under the existing conditions of feed and fodder use but the productivity of cows can be improved to the extent of 13 per cent and if the efficiency could be improved, dairy owners particularly rearing cows will gain considerably in terms of higher profit.

35. Pre-harvest Forecasting of Castor Yield on the Basis of Biometrical Variables

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To suggest most suitable pre-harvest forecasting model for Banaskantha district of Gujarat state, two talukas (*i.e.*, Palanpur and Vadgam) of Banaskantha district were selected randomly. Five villages were also randomly selected from each of the two selected talukas. The fields of ten castor grower farmers were randomly selected from each of the selected villages. Biometrical variables were recorded from each of the randomly selected 100 samples (fields of farmers) during the years 2007-08 and 2008-09 by specially trained 10 workers, who had recorded the data from 100 farmers' field. The step-wise regression procedure was employed by using total 21 biometrical variables and two dummy variables. It was revealed that for all the three models (120, 150 and 180 DAS) fitted in this approach, the periods (150 and 180 DAS) were found suitable for predicting castor yield in Banaskantha district. The model 150 DAS was found more suitable because earliest forecasting is always better. Thus, précised castor yield forecast by applying 150 DAS model is possible two months before actual harvest by using biometrical variables.

36. Direction of Changing Pattern of Milk Products Production in Tumkur Milk Union Limited - An Application of Markov Chain Analysis

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Markov chain analysis of changes in the milk products production of Tumkur Milk Union Limited (TUMUL) was conducted using transition probabilities. Changes in milk products production and five sets of assumed conditions for butter, ghee, cream, curd and peda products. Results indicate a stable in curd production, butter, ghee, cream and peda were unstable in their production.

37. Use of Geographic Information System, Remote Sensing and Global Positioning System in Nutrient Management

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Optimum return on the investment on inputs and minimum environmental pollution are the two major issues to be addressed while prescribing soil test based nutrient recommendations. A comprehensive knowledge of the basic soil resources is of fundamental importance for efficient land use planning. Green revolution by using high yielding varieties and improved management technology has increased crop production at the cost of soil productivity and possible risk of soil degradation. Decrease in the soil fertility and imbalanced use of nutrients are important factors responsible for stagnation or decrease in the crop yields over the years. Thus is should be firmly understood that further increase in food production must be attained by judicious use of soil resource base. Singh *et al.* (2010) have developed the methodology to prepare soil fertility maps using GPS data points. In this paper, attempt has been made to use RS data to prepare soil fertility maps. Remote sensing data has been used to obtain relationship between NDVI values and different nutrients.

38. An Investigation into Production, Consumption and Supply-Demand Scenarios of Major Pulses in India - A Disaggregate Analysis

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Pulses play a dominant role in ensuring nutritional security of people in India who consume no or very less non-vegetarian products. India, in spite of being the largest producer, it has to imports huge quantities of different pulses to meet its domestic demand. The stagnation in productivity coupled with growing domestic demand owing to increase in population and per capita income would further widen the supply-demand gap and threaten the nutritional security of the people. This paper attempted to capture the pattern of production and consumption and to project supply-demand gap for the periods 2015 and 2020 under plausible scenarios. Tabular analysis, linear approximation form of Almost Ideal Demand System model and Holt exponential smoothing model were employed to study the consumption and supply patterns, to estimate the demand and to project the supply of major pulses in India. The results show that there were wide differences in the consumption of different pulses among sectors and regions. The supply-demand gap of total pulses was projected to be nearly four million tonnes and more than eight million tonnes under moderate and high growth scenarios. Technological break-through, better management practices, price support programmes, propagation of pulse substitutes, long-term import policies, etc. will help to enhance the supply of pulses to meet the growing demand in the future.

39. Market Integration in Coarse Cereals in India: A Case of Maize and Jowar

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Coarse cereals, being the staple diet of millions of poor people of India play a very important role in maintaining their nutritional status. However, due to change in per capita income and subsequently the dietary pattern, there is a gradual shift in consumption from coarse cereals to major cereals such as rice and wheat. Due to the imbalances in the production performance of different crops and relatively poor performance or stagnation of the important coarse cereals along with wide fluctuations in prices, the coarse cereals are decelerating at a very fast pace. Several studies have elucidated factors such as poor demand, rise in the per capita income, increase in irrigated area, and increase in the relative output prices in favour of major cereals, and market imperfections as the major reasons for this shift. In this backdrop, this study has been conducted to investigate spatial integration of Maize (Zea *mays*) and Jowar (Sorghum *bicolor*) markets in India. The multivariate cointegration methodology using Johansen's procedure was used to study the extent and nature of cointegration among the maize and jowar markets. The time series data pertaining to the period January 2001 to December 2008 on the wholesale prices of sixteen maize markets and eleven jowar markets were used for the analysis. The data were screened to impute the missing values and to remove the outliers. Further, the data was transformed by detrending and deseasonalizing. The results showed that the nine jowar price series and twelve maize price series were non-stationary and were integrated of the first order. The maximum eigen value and trace tests showed that there were six and five cointegrating vectors for jowar and maize markets respectively revealing reasonably good degree of integration among markets. The series though integrated in the longrun had shown disturbances in the shortrun. The ECM showed the pace of adjustment of the shortrun disturbances towards the longrun equilibrium.

40. An Overview of Contribution of National Agricultural Science Museum in Historical and Scientific Knowledge Management of Development of Agriculture

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Knowledge Management comprises strategies and practices used in an organization to identify and enable adoption of experiences, by a greater focus on the management of knowledge, as a strategic asset and a focus on encouraging the sharing of knowledge. National Agricultural Science Museum is a unique museum in agriculture, dealing with knowledge

management about development of agriculture in India through posters, various working models and interactive touch screen kiosks. Development of nomadic human from pre-historic period is presented through posters, which is a feast to the eyes for visitors of all age groups. Various tableaux and models, add spice to the curiosity and inquisitiveness of visitors from differing vocations by its coverage of the entire gamut of development of agriculture. Detailed information is available in respect of environmental changes occurring in the world. There is an exclusive section devoted to children. The present paper has been designed to appraise about the objective of this museum in management and dissemination of knowledge, pertaining to agriculture, including global issues. During 2010-11, knowledge was disseminated to 21,815 people. It may be concluded through this paper that a visit to this museum provides complete knowledge about agriculture and justifies the role of the museum in managing and disseminating knowledge to public at large.

41. Impact of Dairy Co-operatives on Income Generation in Meghalaya: A Comparative Study

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The present paper focuses on the impact of Dairy Co-operatives on income generation of beneficiary and non-beneficiary households in Meghalaya State, which has the second highest productivity of crossbred (8.96 kg/day) in the country next to Punjab (10.54 kg/day). The study was based on primary data collected during the year 2009 from 100 beneficiary and equal number of non-beneficiary households of Integrated Dairy Development Project (IDDP), from four districts viz. East Khasi Hills, Ri-Bhoi, Jaintia Hills and West Garo Hills of Meghalaya State. IDDP was launched in the state in 1994 and is working smoothly. The study reveals that the overall annual average gross income per household from dairying of the beneficiary household (₹201265) was much higher than that of non-beneficiaries (₹176279). A comparison of mean gross income for large herd size category showed statistically significant difference ($p < 0.05$). It was also found that the net income of beneficiary households was higher than that of non-beneficiary households in each of the small, medium and large herd size categories. In both groups, income increased with increase in herd size categories. The net income ranged from ₹ 6852 for small herd size category to ₹ 49544 for large category for beneficiary group, while it ranged from ₹ 2039 for small to ₹ 22786 for large herd size categories for non-beneficiary group, respectively. It was also found that there was more inequality in income distribution for non-beneficiary group as compared to beneficiary.

42. Data Envelopment Analysis for Estimation of Farm Efficiencies in Crop Production: A Case of Trans-gangetic Plains of India

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Trans-gangetic plains region of India plays an important role in achieving food security in the country. The region produces almost one-third of India's wheat and one-sixth of India's rice output. In this region, groundwater occupies an important position not only in increasing foodgrains production, but from the point of view of the economy as a whole. However, groundwater over exploitation is a major concern in this region. For instance, the level of exploitation in the region was already at the level of around 134 per cent as against only 58 per cent in India during 2004. It has created a number of sustainability, equity and efficiency concerns in the use of this resource. Keeping in view of the above facts, the present study envisaged to unfold efficiency issues prevalent in groundwater use in Trans -Gangetic plains region. The primary data on various aspects of crop production were collected from 422 randomly selected farmers for the agricultural year 2008-09. Tabular analysis was used to study cropping pattern, costs and returns, and Data Envelopment Analysis was used in the estimation of farm level technical, allocative and economic efficiency in crop production.

Although, wheat and paddy are the major staple food and cattle feed crops, the farmers were raising these crops as cash crops in Trans-Gangetic plains. Wheat and paddy crops occupied 38 and 35 per cent of gross cropped area in the region. Although, input costs of cultivation in these crops were high, the yields

and returns were also impressive in the region. The results showed that the economic efficiencies of farms in wheat and paddy cultivation were found to be low and varied in different sub-regions of trans-gangetic plains. The sub-region wise analysis showed that foothills of shivalik sub-region had lowest economic efficiencies (37 and 50 per cent) mainly because of poor allocative efficiency in wheat and poor technical efficiency in paddy cultivation, respectively. The resource use efficiency for irrigation in paddy crop was also poor in all the sub-regions. The findings of the study give some clear indications regarding some policy options for more efficient and sustainable groundwater use in this region. The farmers may be educated for better utilization of inputs to improve the farm level efficiencies and a flexible cropping pattern incorporating remunerative but less water consuming crops for sustainable groundwater development. Further, the demand of water under electric operated tubewells can be reduced through rational electricity tariff to agriculture. The development of the groundwater in Trans-Gangetic plains can be monitored and the canal water supply in canal command areas can be restored to the extent possible which would increase the sustainability of groundwater in the long run.

43. Determination of Inter-relationships between Root and Shoot Characters of Sunflower using Canonical Correlation Analysis

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Canonical correlation analysis (CCA) is one of the most popular multivariate analysis typically used to examine the potential relationships between two multivariate data sets. In this study canonical correlation analysis has been used to understand the relationship between and among shoot and root characters. The shoot characters viz., plant height (cm), Number of leaves , Leaf area index, shoot weight (g) considered as one set of variables and root characters root length (cm), root volume (ml) and root weight (g) as another set of variables. Wilk's Lambda 0.22 ($p<0.01$) indicates the presence of non-zero canonical correlations and there exists the linear relationship between shoot and root characters. The first canonical function shows a significant canonical correlation coefficient of 0.86 and second canonical function is with 0.36 significant canonical correlation. All the shoot variables are having high correlations ranging from 0.70 to 0.95 with first canonical variate. Among the root variables root weight and root volume having high correlation to first canonical varitate. The study revealed that all the shoot characters are contributing towards the root characters. And among the root character root weight and root volume are the important characters which influence more on shoot characters.

44. Path Coefficient Analysis of Sunflower Cultivars using Structural Equation Modelling (SEM)

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Sewall wright developed basic method of path analysis that enables drawing inferences about causal structure of data. However the path analysis method of wright has observed significant changes during the last few decades. Jureskog provided a new theory for estimation and testing in path analysis based on maximum likelihood approach. Structural Equation Modelling (SEM) offers a theoretical basis for developing an understanding of relationship between characters and behaviour. This paper imposes the SEM frame work focusing on seed yield of sunflower. The data of sunflower IHT 2009-2010 grown at multi-locations under AICRP program was used for this study. The model includes one latent variable 100 seed weight (SWT) for seed yield (SY), oil content (OC)) and oil yield of sunflower and determining exogenous factors were head diameter (HD), volume weight (VW), final plant stand(FPS), plant height (PHT). The result indicated that the oil yield was significantly correlated with exogenous variables. The predictors of OY explained 92 per cent of its variance and the error variance was only 8 per cent. All the path coefficients leading to OY from the four exogenous variables were significant ($p < 0.01$). A highest regression weight estimate was obtained for the loading from hundred seed weight to seed yield, indicating that when SWT goes up by 1, SY goes up by 92.18 ± 31.17 ($p < 0.01$). Similarly highest regression weight estimate was obtained for the loading from SWT and OC to OY,

indicating that when SWT and OC goes up by 1, OY goes up by 17.21 ± 5.2 ($p < 0.01$). The chi-square statistic for the model was non-significant ($p = 0.53$), which revealed that the model fits the data well indicated that estimated variances and covariances did not differ from the observed ones.

45. Multivariate Analysis of Morphometric Traits of Muzaffarnagri and Munjal Sheep of Northwestern Semi Arid Zone of India

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Muzaffarnagri and Munjal are both mutton-type and highly course-wooled sheep of northwestern semi arid zone of India. Muzaffarnagri is a descript sheep breed while Munjal is not recognized as a breed at the national level. Being very popular breeds for their mutton potential in their breeding tracts, the present field study examines the genetic differentiation based on morphometric traits using multivariate analysis. A total of 194 Munjal and 294 Muzaffarnagri animals were described for seven body measurements (body weight, body length, height at withers, chest girth, paunch girth, ear length and tail length) for morphometric characterization. The animals, raised under field conditions in semi arid environment, were between two-teeth to eight-teeth age. The univariate analysis revealed that the body measures of the two breeds were significantly ($p < 0.05$) different except height at withers. All morphometric traits of Munjal sheep were significantly ($p < 0.05$) higher than those of their Muzaffarnagri sheep. Stepwise discriminant analysis revealed that puach girth followed by tail length was more discriminating in separating the two sheep breeds. The Mahalanobis distance (3.65, female : 4.56, male and 3.79, overall) between two sheep breeds was high and significant, which is an indication that they belong to genetically different groups. In overall data (pooled across sexes), Nearest Neighbour Discriminant Analysis showed that 85.71% of Muzaffarnagri sheep and 82.47% of Munjal sheep were classified into their source population. The study provided information about the differentiation/ discrimination among Muzaffarnagri and Munjal sheep. The findings would serve as populations vis-à-vis other ovine genetic resources of India.