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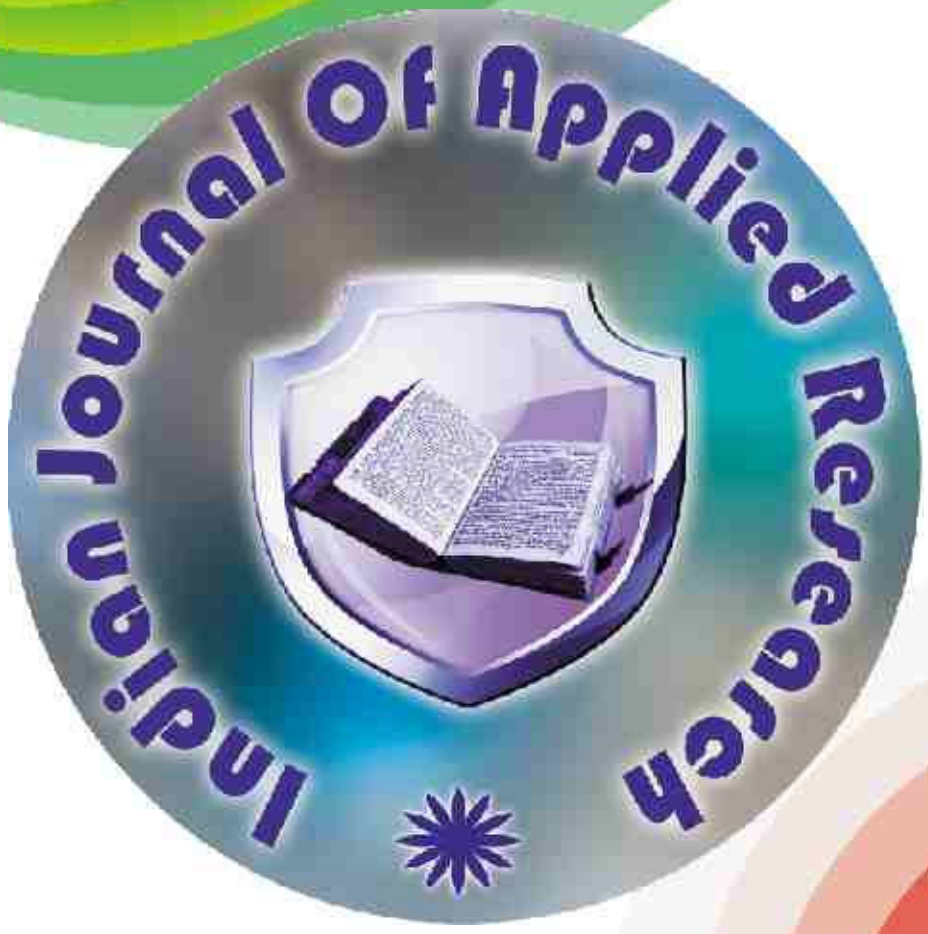

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Research Paper Statistics

Use Of Ranks For Analysis Of Groups Of Experiments

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ABSTRACT

The rank method for the analysis of groups of experiment is used when the procedure of analysis of variance technique is not valid and the error variances are not homogeneous. The present investigation is based on 10 year data recorded at cropping systems research unit for the years from 1994-95 to 2003-04.In all twelve (12) treatments were tested as detailed below. The analysis becomes complicated as the number of years and the volume of data increases. Identical results are obtained by analysis of groups of experiments and rank method indicating rank method is advantages over usual method of analysis of groups of experiments.

Keywords : Ranking Analysis, Statistics

Introduction

India is an agricultural country and its economy largely depends on agriculture .In ancient days, agriculture had been the main source of income of all rulers. The cost effective crop production is only possible by optimizing technological requirements for maintenance of tilth, selection of most adopted variety, nutrient supply, conservation and management of water and use of agrochemicals with the objective of increasing production to meet the present and future requirements .The effect of these aspects individually may not be that important as in combination leading to synchronized availability of most favorable conditions for higher crop yield. It is well established that realization of genetic potential of high yielding variety is linked with the adoption of optimum land and crop husbandry practices. To sustain crop production, integration of farming techniques with modern scientific advances is required.

Various methods are adopted for the analysis of Groups of Experiments. In the analysis of groups of experiment the methods in use and the methods suggested for analysis of data obtained from experiment conducted have some short comings and hence their use is restricted. Some methods for the experiment repeated at different or same locations more than once and over a longer period have deviation in the analysis from the normal methods in use. The objective of the study are to study the methodology available for analysis of Groups of experiments To study the advantage of Rank Method over the present method for Analysis of Groups Of Experiments.

Methodology

Statistical science is concerned with the twin aspect of theory of Design of Experiments and Sample Survey. Pooled analysis method for the analysis of groups of experiments is used with the limitation of the significancy of interaction between years or season with treatments.To avoid this heterogeneity of error variances and the non significant interaction effect method of ranking is used. Missing observations in the data also is one of the main limitations to the pooled analysis method causing the failure of the analysis and misinterpretation of the data.

The rank method was found to provide fairly accurate inference in testing the significance of treatment and Treatment X Years effects & also better practical interpretation of the results in conformity with the results based on individual year's analysis.

The rank method for the analysis of groups of experiment is used when the procedure of analysis of variance technique is not valid and the error variances are not homogeneous. Siegel and Castellan(1988).

The present investigation is based on 10 year data recorded at cropping systems research unit for the years from 1994-95 to 2003-04.In all twelve (12) treatments were tested as detailed below.

The analysis becomes complicated as the number of years and the volume of data increases.

Rank Method:

First ranking the observations in each of the individual experiments. Consider a set of 't' treatments assigned randomly to r blocks of a randomized block layout. Let Xij denotes the observation of treatment j in the i^{th} block then.

$$E(Rij) = \frac{t+1}{2} \quad COV(Rij,Rjk) = \frac{t+1}{12} \quad V(Rij) = \frac{t2-1}{12}$$

Where E, V and COV stands respectively for expectation, variance and Covariance .The sum of squares of deviations of the observed column totals around its expected values is a measure of the differences in treatment effect.

$$S = \sum_{j=1}^{r}\left[Rj - \frac{r(t+1)}{2}\right]^2$$

The Expectation and variance of S are given by

$$E(S) = \frac{rt(t^2-1)}{12}$$

$$Var(S) = \frac{t^2 r(r-1)(t-1)(t+1)^2}{72}$$

Friedman has shown that a linear function of S which is denoted as $\chi 2$ variate with (t-1)r degrees of freedom.

$$\Gamma^2_r = \frac{12S}{rt(t+1)} = \frac{12\sum_{j=1}^{t} Rj^2}{rt(t+1)} - 3r(t+1)$$

If S_r denote the total sum of squares of deviations of all the rt ranks around its average value then

$$S_r = \sum_{i=1}^{t}\sum_{j=1}^{t}\left[R_{ij} - \frac{t+1}{2}\right]^2 = \frac{rt(t^2-1)}{12}$$

$$\Gamma^2_r = \frac{(t-1)S}{S_r}$$

The total sum of squares of the ranked data can be partitioned into two components as follows:-

$$S_T = \sum_i\sum_j (R_{ij} - \bar{R}_j)^2 + \frac{S}{r} = S_R + \frac{S}{r}$$

Where, S_R is the residual sum of squares.

The analysis of variance on the basis of ranks can be given in the ANOVA table as usual.

The additive property of Γ^2 enables to extend this result to the case of three way tables with years as an additional factor. The years represent a random sample from an infinite population of years. Then it is possible to calculate Γ^2_r statistic for each year separately Corder, Gregory W., and Dale I. Foreman(2009). On the assumption of independence of these Γ^2 values can be pooled to get a total Γ^2 with y(t-1) degrees of freedom. This Γ^2 is split up into the two components.

$\Gamma^2_r T = \Gamma^2_r D + \Gamma^2_r H$

Where, of Γ^2_r D is the deviation chi-square calculated from the column totals of the pooled data. It can be used to provide a general test of equality of treatment effects over all the y years. The heterogeneity Γ^2_r H is a component of interaction between seasons and treatments. The significant Γ^2_r H indicates the presence of treatment X year interaction.

Results And Discussion

The methodology available for the analysis of groups of experiments is the simple analysis of variance for each and every year separately and then combed analysis done considering year as an additional factor.

The experiments were conducted in Randomised Block Design (R B D) .Pooled analysis of variance as reveled from the ANOVA given below that the differences among treatments ,Years and Interaction (Treat X Years) found to be highly significant, indicating that there is impact of season on performance of treatments.

The grain yield of sorghum was affected due to various treatments .Highest yield of sorghum (31.13 qtls/ha.) was obtained with the application of (T6) 50% RDF with 50% N through FYM, which was significantly superior over T10 (50% RDF with 50% N through Leucuena Loppings.T5 and T11 are at par.

The lowest yield of 2.71 was obtained in control plot which is inferior to all other treatments.

Table No.1:- Treatment Details

Sr.No.	Treatments	Sorghum
1	T_1	No Fertilizer, No Organic matter control
2	T_2	50% recommended NPK dose through Fertilizer
3	T_3	50% recommended NPK dose through Fertilizer
4	T_4	75% recommended NPK dose through Fertilizer
5	T_5	100% recommended NPK dose through Fertilizer
6	T_6	50% recommended NPK dose through Fertilizer +50% N through FYM
7	T_7	75% recommended NPK dose through Fertilizer +25% N through FYM
8	T_8	50% recommended NPK dose through Fertilizer +50% N through Crop Residue(Wheat Straw)
9	T_9	75% recommended NPK dose through Fertilizer +25% N through Crop Residue(Wheat Straw)
10	T_{10}	50% r ecommended NPK dose through Fertilizer +50% N through green organic matter (Leucuena Loppings)
11	T_{11}	75% recommended NPK dose through Fertilizer +25% N through green organic matter (Leucuena Loppings)
12	T_{12}	Farmer's Practice (50:25:0 NPK)

Table No. 2 :- Pooled Analysis(ANOVA)

Source	df	Sum of squares	Mean Sum of squares	F cal
Rep.SS	3	62.93	20.98	2.32
Treat.SS	11	27672.8	2515.7	278.3**
Error(a)	33	298.32	9.04	
Years S S	9	32525.4	3613.9	413.7**
INT Years X treat.	99	5902.12	59.62	6.83
Error(b)	324	2830.2	8.74	
Total SS	479	69291.8		

The grain yield of sorghum was affected due to various treatments .Highest yield of sorghum (31.13 qtls/ha.) was obtained with the application of (T_6) 50% RDF with 50% N through FYM, which was significantly superior over T_{10} (50% RDF with 50% N through Leucuena Loppings.T_5 and T_{11} are at par.

The lowest yield of 2.71 was obtained in control plot which is inferior to all other treatments.

The analysis becomes complicated as the number of years and the volume of data increases.

The alternative method suggested for the analysis of groups of experiment is Ranking of observations in each block of the individual experiment. If t treatments are compared in a block , the individual observation is ranked by giving rank 1, to the highest value, rank 2 to the next lower value, and so on Kruskal and Wallis(1952). The smallest value will be given rank t . Ranking is done afresh for each block and it will have variate values 1.,2,3……,t.

Table No 3 :- Rank Method (ANOVA)

Source	df	Sum of squares	Mean Sum of squares	F cal
Rep.SS	3	0	0	
Treat.SS	11	4002.61	363.87	8118.94**
Years S S	9	0	0	
INT Years X treat.	99	1701.39	17.19	383.46**
Residual SS	357	16.00	0.045	
Total SS	479	5720.00		

The results obtained by the usual analysis of variance method and Rank method are identical.

The advantage of Rank method is the analysis becomes simple than the usual method of analysis. The pooled ranks were worked and the results were compared with the usual method .The results obtained by rank method are overall in agreement with the usual method of analysis.

The result obtained from the usual method of Pooled analysis and Rank method are very much comparable. The pooled means and average ranks are presented in table no.4.given below-

Table No.4:- Treatment Means

Sr.No.	Treatments	Sorghum	Pooled Analysis	Rank Method
1	T_6	50% recommended NPK dose through Fertilizer +50% N through FYM	31.13	10.25
2	T_{10}	50% recommended NPK dose through Fertilizer +50% N through green organic matter (Leucuena Loppings)	30.26	12.85
3	T_5	100% recommended NPK dose through Fertilizer	29.75	16.30
4	T_{11}	75% recommended NPK dose through Fertilizer +25% N through green organic matter (Leucuena Loppings)	29.51	17.40
5	T_7	75% recommended NPK dose through Fertilizer +25% N through FYM	29.38	17.95
6	T_9	75% recommended NPK dose through Fertilizer +25% N through Crop Residue(Wheat Straw)	27.67	24.65
7	T_8	50% recommended NPK dose through Fertilizer +50% N through Crop Residue(Wheat Straw)	27.47	**22.55**
8	T_4	75% recommended NPK dose through Fertilizer	25.78	27.50
9	T_3	50% recommended NPK dose through Fertilizer	21.89	37.05
10	T_2	50% recommended NPK dose through Fertilizer	21.64	38.70
11	T_{12}	Farmer's Practice (50:25:0 NPK)	19.17	38.80
12	T_1	No Fertilizer, No Organic matter control	2.71	48.00

The table revealed that the chronological order of treatments remains almost identical for both pooled means and average rank except for treatment T_8 and T_9

In analysis of groups of experiment relatively higher pooled mean is observed for T_9 than T_8.Where as in average ranks method T_8 secured relatively higher position than T_9. The other means remained unaltered. However, the differences between the means of T_8 and T_9 treatments obtained by both the methods are statistically nonsignificant indicating that use of rank method is beneficial over usual method of pooled analysis.

Conclusions

The rank method is based on complete data however the advantage of this method is that variation is minimized and analysis becomes simple. Identical results are obtained by analysis of groups of experiments and rank method indicating rank method is advantages over usual method of analysis of groups of experiments.

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