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Relative Efficiency of split plot design

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The efficiency of split plot design relative to redomised blocks design is linearly expressed as Relative Efficiency (%) = A + (100-A) F where, A is a constant determined by the number of sub-plot treatments [q] and main plot treatments [p] and F is the ratio of Error [a] mean squares to Error [b] mean squares. The values of A are calculated and tabulated for different values of p and q both ranging from 2 to 20. The method of using the liner expression is illustrated by means of a numerical example.

Split-plot is one of the widely used designs in Agricultural experiments. It is used to obtain precise estimate on sub-plot treatments and the interaction between sub-plot and main plot treatments. Abou-el - Fittouh. H. A (1976. 1977) has reduced the relative efficiency formula of Randomized complete blocks design and Latin Square design to linear forms and has suggested easier ways of calculating the relative efficiency. Similar work has not been done in split plot design In the present study the efficiency formula of split plot design over randomized complete block design is reduced to a linear from and the constants involved in the linear form are calculated and tabulated (for sub-plot treatments and main-plot treatments both ranging from 2 to 20.) Method of calculating the efficiency making use of the table is also illustrated with a numerical example. This will facilitate research workers, who adopt split-plot design, to know whether the increase in precision of the estimates on sub-plot treatments and the interaction between main-plot treatments and sub-plot treatments have been achieved.

MATERIAL AND METHODS:

Efficiency of the split-plot design relative to the Randomised Complete blocksdesign on the sub-plot treatments and the interaction between main-plot treatments and sub-plot treatments is given as (Federer 1955).

$$RE\ (\%) = \frac{(p-1)\,Ea + p\,(q-1)\,Eb}{(pq-1)\,Eb} + 100 \quad (1)$$

where p = number of main-plot treatments

q = number of sub-plot treatments

Ea = Error (a) mean Squares

Eb = Error (b) mean Squares

The numerical example taken for illustration relates to the result of the analysis of the experiment Conducted at paddy Breeding Station. Tamil Nadu Agricultural University Coimbatore-3 in Kharif 1975 by adopting split-plot design. Main plot treatments were five

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varieties (IET 2895, IET 2937, IET 2295 IET 2315 and IR 26 (Table 1). Sub plot treatments were four different levels of nitrogen. (0. kg/ha, 40 kg/ha, 80 kg/ha and 120 kg/ha). The character under study was yield of grain in kg/plot with net plot size being $3 \times 2m^2$.

RESULTS AND DISCUSSIONS :

Formula (1) can be reduced as

$$RE\ (\%) = A + BF \quad ..\ (2)$$

where $A = \frac{p(q-1)}{(pq-1)} \times 100$

$B = \frac{(p-1)}{(pq-1)} \times 100$ and

$F = Ea/Eb.$

It can also be verified that $A+B=100$. Hence (2) can be written as $RE(\%) = A + (100 - A)F$.

Table 1 gives the values of 'A' for different values of 'p' and 'q' ranging from 2 to 20. Given the Calculated 'F' value and the values of p and q, the relative efficiency of split-plot design is simply estimated by the linear equation $RE\ (\%) = A + (100-A)F$ after extracting the appropriate value of A.

In order to obtain 100% RE, it can be easily verified that 'F' must be equal to Unity; which implies that Ea must be greater than Eb to get RE more than 100%

The RE(%) of the split-plot design relative the Randomised Complete blocks design on the sub-plot treatments and the interaction between main-plot and sub-plot treatments is obtained after extracting the appropriate value of 'A' for $p=5$ and $q=4$ from Table-1 and substituting in (3).

$$RE(\%) = 78\ 95 + 21\ 05 \left(\frac{0.22}{0.09}\right) = 130.4056$$

Therefore the increase in efficiency in adopting split-plot design is equal to 30 percent. Thus the RE(%) is obtained easily by picking out the appropriate value of A from the table for the given values of p and q, and calculating 'F' from the A. V. Table.

REFERENCES

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The following A. V. Table is the result of the analysis of the experiment cited in materials and methods

Source	d. f.	SS	MS	F
Main-plot analysis :-				
Replication	2	0.06	0.03	
Variety	4	10.73	2.68	12.186**
Error (a)	8	1.77	0.22	
Sub-plot analysis :-				
Nitrogen	3	11.21	3.74	41.56**
Interaction :				
Variety × Nitrogen	12	2.66	0.22	2.44
Error (b)	30	2 72	0.09	–
Total	59	29.16		

** Significant at P = 0.01.

p/q

TABLE-1 Values a A

1	2	3	4	5	6	7	8	9	10
2	66.67	80.00	85.17	88.89	90.91	92.31	93.33	94.12	94.74
3	60.00	75.00	81.82	85.71	88.26	90.00	91.30	92.31	93.10
4	57.14	72 73	80 00	84.21	86.96	88.89	90.32	91.43	92.31
5	55.56	71.43	78.95	83.33	86.21	88 24	89.74	90.91	91.84
6	54.56	70.59	78.26	82.76	85.71	87.80	89.36	90.57	91.53
7	53.85	70.00	77.78	82 35	85.37	87.50	89.09	90.32	91.30
8	53.33	69.57	77.42	82.05	85.11	87.27	88.89	90.14	91.14
9	52.94	69.23	77.14	81.82	84.91	87.10	88.73	90.00	91.01
10	52.63	68.97	76.92	81.63	84.75	86.96	88.61	89.89	90.91
11	52.38	68.75	76.74	81.48	84.62	86.84	88.51	89.80	90.83
12	52.17	68.57	76.60	81.36	84.51	86.75	88.42	89.72	90.76
13	52.00	68.42	77.47	81.28	84.42	86.67	88.35	89.66	90.70
14	51.85	68.29	76.36	81.16	84.34	86.60	88.29	89.60	90.65
15	51.72	68.18	76.27	81.08	84·27	86.54	88.24	89.55	90 60
16	51.61	68.09	76.19	81.01	84.21	86.49	88.19	89.51	90.57
17	51.52	68.00	76.12	80.95	84.16	86.44	88.15	89.47	90.53
18	51.43	67.92	76.06	80.90	84.11	86.40	88.11	89.44	90.50
19	51.35	67.86	76.00	80.85	84.07	86.36	88.08	89.41	90.49
20	51.28	67.80	76.95	80.81	84.03	86.33	88 05	89.39	90.45

Table 1 Values of A (Contd.)

11	12	13	14	15	16	17	18	19	20
95.24	95.65	96.00	96.30	96.55	96.77	96.97	97.14	97.30	97.44
93.78	94.79	94.74	95.12	95.45	95.74	96.00	96.23	96.43	96.61
93.02	93.62	94.12	94.55	94.92	95.24	95.52	95.77	96.00	96.20
92.59	93.22	93.75	94.20	94.59	94.94	95.24	95.51	95.74	95.96
92.31	92.96	93.51	93.98	94.38	94.74	95.05	95.33	95.58	95.80
92.11	92.77	93.33	93.81	94.23	94.59	94.92	95.20	95.4	95.68
91.95	92.63	93.20	93.69	94.12	94.49	94.81	95.10	95.[illegible]	95.60
91.84	92.52	93.10	93.60	94.08	94.41	94.74	95.03	95.2	95.53
91.74	92.44	93.02	93.53	93.96	94.34	94.67	94.97	95.24	95.48
91.67	92.37	92.96	93.46	93.90	94.29	94.62	94.92	95.19	95.43
91.60	92.31	92.90	93.41	93.85	94.24	94.58	94.88	95.15	95.40
91.55	92.26	92.85	93.37	93.81	94.20	94.55	94.85	95.12	95.37
91.50	92.22	92.82	93.33	93.78	94.17	94.51	94.82	95.09	95.34
91.46	92.18	92.78	93.30	93.75	94.14	94.49	94.80	95.07	95.32
91.43	92.15	92.75	93.27	93.72	94.12	94.46	94.77	95.05	95.30
91.40	92.12	92.73	93.25	93.70	94.10	94.44	94.75	95.03	95.28
91.37	92.09	92.70	93.23	93.68	94.08	94.43	94.74	95.01	95.26
91.35	92.07	92.68	93.21	93.66	94.06	94.41	94.72	95.00	95.25
91.32	92.05	92.66	93.19	93.65	94.04	94.40	94.71	94.99	95.25