STRIPSPLIT: A SAS MACRO FOR ANLYSIS OF STRIP SPLIT PLOT DESIGNS (VERTICAL: A, HORIZONTAL: B, SUB: C)

Introduction

The SAS macro, **StripSplit.sas** provides a convenient way to analyze the data from Strip Split (Vertical: A, Horizontal: B, Sub: C) Plot Designs. The macro produces the output as Rich Text Format (RTF) file. It also gives the list output in SAS Output Window. The macro will run correctly in the version SAS 9.2 or higher. In the sequel, we give some guidelines on How to use this macro?

Dataset Preparation

The macro (**StripSplit.sas**) requires that the dataset should be prepared as follows:

- Create a SAS dataset with at least 5 variables, one for block or replication, one for Vertical treatment factor1, one for Horizontal treatment factor2, one for subplot treatment Factor3 and one for the dependent or analysis variables. If the data on more than one dependent variable is collected in the same experiment, the data on all variables may be entered in additional columns. The macro can analyze data on more than one dependent variable in one go.
- One may give actual levels used for different factors applied in Vertical treatment factor1, Horizontal treatment factor2 and subplot treatment factor3. Please remember that there should not be any space between a single data value. Vertical treatment factor1, Horizontal treatment factor2, subplot treatment and block number may be coded as 1, 2, 3 and so on. One can have character values also.

Using Macro StripSplit

- Download **StripSplit.sas** and **Using_StripSplit_Macro.sas** program files to your computer system.
- First file viz. **StripSplit.sas** contains the macro program and the second one **Using_StripSplit_Macro.sas** contains an example experimental data conducted in Strip Split Plot design having six dependent variables.
- Copy the "StripSplit.sas" in any folder.
- Open Using_StripSplit_Macro.sas program in SAS.

The codes for creating the SAS dataset using DATA step are included in the file. If one would like to use the same file, replace the datalines within the DATA step with the data to be analyzed. Remember to add/remove dependent variables in INPUT line of the DATA step. An example of data set preparation with 4 levels of Vertical factor1, 4 levels of Horizontzal factor2 and 4 levels of factor applied to subplot arranged in 3 blocks or replications is given below.

```
data StripSplit;
input Crop $      Irrigation  Nitrogen    Rep   GrainYield  Panicle
      paniclewt   numgrains   plotyield   grainwt1000;
cards;
C1    1     1     1     2560  131   3.09  7263  2.96  23.33
C1    1     2     1     2872  138   3.29  7325  4.03  26.55
C1    1     3     1     2905  140   3.43  7775  3.30  27.80
C1    1     4     1     3169  142   3.86  8676  5.09  31.59
C1    2     1     1     2782  133   3.46  5608  2.71  25.93
C1    2     2     1     2988  138   3.74  6638  4.62  27.18
C1    2     3     1     3202  143   4.18  7137  4.51  32.41
C1    2     4     1     3490  142   4.46  7339  6.26  32.67
C1    3     1     1     3037  143   3.74  5867  1.69  26.22
```

C1	3	2	1	3416	142	4.07	6525	2.49	31.56
C1	3	3	1	3605	144	4.28	6835	3.09	31.92
C1	3	4	1	3720	153	4.48	8411	4.12	33.69
C1	4	1	1	2947	136	3.81	6875	3.81	30.01
C1	4	2	1	3481	144	4.36	7130	5.09	30.26
C1	4	3	1	3605	143	4.38	7175	6.46	32.86
C1	4	4	1	3852	144	4.71	7843	4.86	34.89
C2	1	1	1	1934	118	2.47	4637	3.15	22.62
C2	1	2	1	2683	137	3.34	4658	2.21	24.35
C2	1	3	1	2774	127	3.47	5376	1.69	28.24
C2	1	4	1	3309	131	4.12	5874	3.02	31.62
C2	2	1	1	2510	136	3.25	4574	2.13	23.84
C2	2	2	1	3259	134	4.02	5074	1.38	26.94
C2	2	3	1	3276	133	3.88	5932	1.69	31.44
C2	2	4	1	3358	134	4.09	6488	2.65	36.21
C2	3	1	1	2535	136	3.11	4355	2.12	25.04
C2	3	2	1	3160	136	4.12	6684	1.72	28.53
C2	3	3	1	3473	143	4.32	7130	2.14	31.42
C2	3	4	1	3523	146	4.39	7317	2.67	37.91
C2	4	1	1	2617	130	3.41	5249	3.39	26.29
C2	4	2	1	3514	138	4.36	5535	3.94	28.91
C2	4	3	1	3728	144	4.50	5664	7.56	34.35
C2	4	4	1	3720	145	4.68	5765	3.46	38.26
C3	1	1	1	1868	126	2.52	5729	1.32	21.92
C3	1	2	1	2173	129	2.58	6128	3.43	24.93
C3	1	3	1	2510	131	3.22	6234	4.62	29.31
C3	1	4	1	2733	136	3.62	7368	3.05	31.34
C3	2	1	1	2313	134	2.76	5168	1.95	23.63
C3	2	2	1	2848	131	3.66	6348	3.18	27.61
C3	2	3	1	3160	138	3.83	6791	2.99	30.17
C3	2	4	1	3358	134	4.13	7163	3.53	33.27
C3	3	1	1	2329	116	2.95	5870	2.05	25.88
C3	3	2	1	3012	128	3.65	6310	1.66	28.51
C3	3	3	1	3169	130	4.19	6535	2.19	32.14
C3	3	4	1	3383	132	4.25	6689	2.75	36.05
C3	4	1	1	2691	122	3.43	6125	3.62	28.21
C3	4	2	1	3160	134	4.13	6268	4.34	32.64
C3	4	3	1	3235	134	4.26	6312	4.45	33.14
C3	4	4	1	3374	142	4.33	6532	5.25	35.43
C4	1	1	1	1794	126	2.24	4964	2.37	23.85
C4	1	2	1	2288	132	2.37	6130	2.58	25.14
C4	1	3	1	2370	134	2.58	7040	2.25	27.93
C4	1	4	1	2519	136	3.10	8658	4.10	29.36
C4	2	1	1	2247	122	2.67	5449	2.12	24.51
C4	2	2	1	2502	122	3.16	6394	2.46	25.93
C4	2	3	1	2609	123	3.26	6619	2.26	29.48
C4	2	4	1	3226	125	3.30	6680	3.80	32.85
C4	3	1	1	2362	123	2.83	4742	3.54	25.12
C4	3	2	1	2477	134	3.14	5539	2.92	27.06
C4	3	3	1	2765	134	3.17	5547	5.48	31.29
C4	3	4	1	2872	136	3.27	5733	3.57	34.80
C4	4	1	1	2420	124	2.82	5770	5.40	26.38
C4	4	2	1	2617	133	3.27	6708	6.07	28.49
C4	4	3	1	2823	132	3.45	7464	4.32	33.61
C4	4	4	1	2864	136	3.63	8776	5.07	34.87
C1	1	1	2	2403	127	3.01	7286	3.31	23.57
C1	1	2	2	2724	138	3.76	7354	4.44	26.59
C1	1	3	2	2815	145	3.62	7619	3.76	27.92
C1	1	4	2	3251	144	3.92	8743	5.50	31.69
C1	2	1	2	2922	138	3.87	5702	3.08	26.10
C1	2	2	2	3160	142	3.89	6530	5.00	27.21

C1	2	3	2	3465	148	4.22	7208	4.94	32.45
C1	2	4	2	3630	146	4.73	7275	6.62	32.79
C1	3	1	2	3111	139	3.81	5894	2.07	27.34
C1	3	2	2	3399	146	4.12	6687	2.93	31.66
C1	3	3	2	3646	147	4.63	6854	3.48	32.98
C1	3	4	2	3770	148	4.75	8650	4.57	33.74
C1	4	1	2	3111	142	4.08	6830	4.21	29.98
C1	4	2	2	3811	146	4.62	7227	5.55	31.91
C1	4	3	2	3893	147	4.68	7249	6.86	33.74
C1	4	4	2	3885	148	4.76	7886	5.23	34.23
C2	1	1	2	2025	122	2.49	4614	3.57	22.18
C2	1	2	2	2535	123	3.28	4674	2.55	26.64
C2	1	3	2	2897	136	3.68	5449	2.04	29.56
C2	1	4	2	3366	137	4.19	5811	3.43	31.92
C2	2	1	2	2469	131	3.05	4622	2.49	24.42
C2	2	2	2	3177	137	3.97	5180	1.76	26.78
C2	2	3	2	3366	138	4.18	5894	2.07	31.24
C2	2	4	2	3424	141	4.27	6391	3.09	35.32
C2	3	1	2	2568	134	3.31	4393	2.45	24.46
C2	3	2	2	3358	141	4.19	6588	2.16	28.23
C2	3	3	2	3449	146	4.29	7242	2.54	32.74
C2	3	4	2	3523	144	4.26	7401	3.03	38.23
C2	4	1	2	2675	124	3.26	5317	3.80	26.37
C2	4	2	2	3613	142	4.50	5634	4.35	29.38
C2	4	3	2	3638	143	4.66	5729	7.95	34.96
C2	4	4	2	3737	148	4.82	5770	3.80	38.72
C3	1	1	2	1802	128	2.78	5792	1.66	21.69
C3	1	2	2	1992	131	2.83	6160	3.79	25.24
C3	1	3	2	2609	131	3.39	6322	5.09	29.97
C3	1	4	2	2527	132	3.60	7348	3.41	32.52
C3	2	1	2	2263	131	2.88	5194	2.30	23.71
C3	2	2	2	2988	130	3.68	6384	3.53	27.68
C3	2	3	2	3243	133	4.01	6805	3.38	30.12
C3	2	4	2	3424	140	3.85	7209	3.85	33.62
C3	3	1	2	2593	119	3.07	5827	2.42	25.84
C3	3	2	2	2914	129	3.68	6484	2.07	28.43
C3	3	3	2	3235	133	4.26	6667	2.62	31.98
C3	3	4	2	3424	134	4.31	6747	3.18	36.28
C3	4	1	2	2749	129	3.61	6255	4.07	27.89
C3	4	2	2	3325	137	4.28	6382	4.84	32.93
C3	4	3	2	3440	138	4.22	6428	4.83	33.72
C3	4	4	2	3465	147	4.21	6598	5.70	39.48
C4	1	1	2	1761	125	2.21	4893	2.71	24.75
C4	1	2	2	2379	126	2.71	6201	2.97	25.32
C4	1	3	2	2222	136	2.97	7020	2.52	28.09
C4	1	4	2	2757	140	3.29	8665	4.49	29.89
C4	2	1	2	2165	126	2.72	5575	2.43	24.29
C4	2	2	2	2535	128	3.10	6354	2.74	26.28
C4	2	3	2	2568	126	3.14	6695	2.63	29.63
C4	2	4	2	3152	127	3.38	6818	4.14	33.28
C4	3	1	2	2263	124	2.86	4812	3.92	25.39
C4	3	2	2	2486	135	3.22	5573	3.33	27.14
C4	3	3	2	2601	136	3.28	5585	5.89	31.64
C4	3	4	2	2856	138	3.34	5638	4.01	34.81
C4	4	1	2	2313	126	2.74	5696	5.82	26.38
C4	4	2	2	2609	137	3.23	6891	6.53	28.83
C4	4	3	2	2683	138	3.62	7637	4.63	33.74
C4	4	4	2	2905	142	3.75	8650	5.53	35.05
C1	1	1	3	2749	134	3.38	7128	3.50	23.51
C1	1	2	3	3078	142	3.54	7456	3.53	26.68
C1	1	3	3	3144	143	3.89	7808	5.19	27.96

C1	1	4	3	3432	152	4.27	8876	4.86	31.79
C1	2	1	3	3095	143	3.94	5782	3.27	26.34
C1	2	2	3	3317	146	3.97	6756	4.28	27.23
C1	2	3	3	3539	153	4.37	7305	4.81	32.53
C1	2	4	3	3753	157	4.81	7438	3.89	33.71
C1	3	1	3	3160	144	3.95	5976	3.56	27.43
C1	3	2	3	3827	152	4.02	6772	3.67	31.55
C1	3	3	3	3975	154	4.83	6956	4.88	32.96
C1	3	4	3	4049	156	4.91	8706	5.92	33.87
C1	4	1	3	3366	140	3.89	6979	4.28	30.02
C1	4	2	3	3885	152	4.73	7234	5.08	32.71
C1	4	3	3	4082	154	4.86	7285	4.22	33.72
C1	4	4	3	4016	155	4.88	7949	3.39	34.33
C2	1	1	3	2082	123	2.52	4718	5.20	22.38
C2	1	2	3	2823	126	3.53	4791	3.62	27.98
C2	1	3	3	3078	140	3.56	5497	5.31	31.34
C2	1	4	3	3465	145	4.32	5897	5.57	32.34
C2	2	1	3	2642	138	3.22	4678	4.20	24.58
C2	2	2	3	3399	146	4.23	5207	4.71	27.09
C2	2	3	3	3399	149	4.24	5943	3.33	32.34
C2	2	4	3	3498	152	4.32	6504	4.88	36.56
C2	3	1	3	2815	139	3.42	4404	2.41	25.34
C2	3	2	3	3531	146	4.22	6730	7.59	28.98
C2	3	3	3	3572	149	4.38	7307	4.92	32.53
C2	3	4	3	3671	147	4.48	7429	2.51	38.93
C2	4	1	3	2864	131	3.47	5346	4.32	26.45
C2	4	2	3	3877	148	4.54	5687	3.06	29.64
C2	4	3	3	3934	152	4.83	5796	4.27	36.11
C2	4	4	3	3975	154	4.88	5897	3.88	39.25
C3	1	1	3	2444	131	2.86	5808	4.91	21.88
C3	1	2	3	2395	133	2.94	6216	4.46	25.34
C3	1	3	3	2897	134	3.51	6384	8.60	29.91
C3	1	4	3	3169	135	3.69	7425	4.11	31.98
C3	2	1	3	2510	136	3.01	5288	2.82	23.82
C3	2	2	3	3078	135	3.81	6400	3.14	27.59
C3	2	3	3	3309	137	4.03	6839	4.75	30.45
C3	2	4	3	3473	142	4.75	7186	3.37	33.45
C3	3	1	3	2428	120	3.11	5863	2.00	25.82
C3	3	2	3	3169	138	3.98	6418	4.64	28.85
C3	3	3	3	3440	134	4.29	6622	2.62	32.04
C3	3	4	3	3523	137	4.46	6684	3.92	36.35
C3	4	1	3	2938	138	3.87	6242	4.75	28.02
C3	4	2	3	3465	138	4.35	6371	5.23	33.15
C3	4	3	3	3490	141	4.38	6402	3.62	33.43
C3	4	4	3	3580	147	4.39	6619	4.95	35.03
C4	1	1	3	1893	127	2.31	4993	3.41	24.81
C4	1	2	3	2403	137	2.84	6258	4.00	25.46
C4	1	3	3	2642	135	3.01	7114	2.88	28.59
C4	1	4	3	2897	143	3.27	8769	5.11	29.86
C4	2	1	3	2527	127	3.14	5499	2.31	25.10
C4	2	2	3	2617	131	3.20	6434	2.70	26.76
C4	2	3	3	2617	133	3.43	6721	3.03	29.87
C4	2	4	3	1860	135	3.46	6745	3.30	33.70
C4	3	1	3	2428	134	2.92	4824	4.86	25.56
C4	3	2	3	2733	138	3.31	5654	3.50	27.65
C4	3	3	3	2815	137	3.34	5666	1.93	32.30
C4	3	4	3	3029	141	3.52	5794	4.08	34.93
C4	4	1	3	2444	135	2.92	5741	2.67	26.56
C4	4	2	3	2700	139	3.47	6842	5.32	28.95
C4	4	3	3	2988	141	3.68	7704	0.78	34.11
C4	4	4	3	3333	143	3.83	8754	5.39	35.41

```
;run;
```

The different variable names used in the above example are

1. **Rep** - Block variable name. In this Example there are 3 blocks numbered as 1, 2 and 3.
2. **Crop** - Vertical Plot treatment Factor1 variable name. In this example there are 4 crops coded as C1, C2, C3 and C4.
3. **Irrigation** – Horizontal plot treatment Factor2 variable name. In this Example there are 4 irrigation levels numbered as 1, 2, 3 and 4.
4. **Nitrogen** - Subplot variable name. In this Example there are 4 nitrogen levels numbered as 1, 2, 3 and 4.
5.
6. **GrainYield Panicle paniclewt numgrains plotyield grainwt1000** - One can have several response/dependent variables. In this Example there are six dependent variables.

For details on assigning values to various macro variables names, please see after this paragraph

```
%let ds = StripSplit;
%let dep_var=GrainYield Panicle paniclewt numgrains   plotyield grainwt1000;
%let block_var = Rep;
%let main_plot1 = Crop ;
%let main_plot2 = Irrigation;
%let sub_plot = Nitrogen;
%let adjust = t;
%let alpha = 0.05;
%let rtf = StripSplit_result.rtf;
```

The macro takes the following arguments. All these are macro variables written after %let statement.

1. **ds -** Write data set name. It should be same as defined in data step.
2. **dep_var** - Write response variable(s) names separated by a single space. In this example there are six dependent variables, namely GrainYield, Panicle, paniclewt, numgrains, plotyield and grainwt1000. So these are written separated by a space.
3. **block_var** - Write block variable name as given in above dataset. In this example its rep.
4. **main_plot1** - Write Vertical treatment factor1 variable name as defined in above dataset. In this example its Crop.
5. **main_plot2** - Write Horizontal treatment factor2 variable name as defined in above dataset. In this example its Irrigation.
6. **sub_plot** - Write subplot treatment variable name as defined in above dataset. In this example its Nitrogen.
7. **adjust** - Enter Multiple Comparison Adjustment variable here. Accepted values are TUKEY for Tuley's Honest Significant Difference or T for Least Significant Difference.
8. **alpha** - Level of Significance (as a fraction) to be used in the multiple comparison test. Typically, 0.01 or 0.05 for 1% and 5% level of significance respectively. One can specify any value for level of significance between 0 and 1.
9. **rtf** - Output file Name. In this Example the output file name is StripSplit_result. You may change the folder in which output is desired. Make sure that you have write permissions for the defined folder. It is advisable to save the output file before opening instead of opening before saving. It may be noted that in the Versions earlier than 9.2 file would not open before saving. The important thing to remember the extension .rtf should remain as such.

```
/* Modify to change the path to the file containing Strip SplitPlot macro.
(StripSplit.sas) */
%include 'C:\Documents and Settings\Sukanta\Desktop\Strip_split\
Stripsplit.sas';
```

This can be used when the directory in which macro is saved is :\Documents and Settings\ Sukanta\Desktop\Strip_split\. In case the macro is saved at another location then the path of that location should be completely specified.

If one is not sure of the path of the macro and don't want to use this, then open the file **StripSplit.sas** and run it once. It will not produce any output. Don't include above statement in program or make it as comment by writing * in the beginning of %include statement.

```
%StripSplit(ds=&ds, dep=&dep_var, block_var=&block_var, main1=&main_plot1,
main21=&main_plot2, sub1=&sub_plot, adjust=&adjust, alpha=&alpha,
rtffile=&rtf);
```

This above statement is calling the macro. Make sure you are using appropriate macro variables. If you have changed it, make sure that you have changed it here also.

1. **ds=&ds** - passing the name of data set to macro variable ds
2. **dep=&dep_var** - passing the dependent variable(s) to macro variable dep.
3. **block_var=&block_var** - passing the block variable to macro variable block_var.
4. **main1=&main_plot1** - passing the main plot treatment factor 1 variable to macro variable main1.
5. **Main2=&main_plot2** - passing the Horizontal treatment Factor2 variable to macro variable main2.
6. **Sub1=&sub_plot** - passing the subplot treatment variable to macro variable sub1.
7. **adjust=&adjust** - passing the value of adjust macro variable to adjust.
8. **alpha=&alpha** - passing the value of alpha macro variable to alpha.
9. **rtffile=&rtf** – passing the value of rtf macro variable to rtffile.

STANDARD ERRORS OF DIFFERENCES AND RESPECTIVE LEAST SIGNIFICANT DIFFERENCES

No	Type of pair Comparison Between	$s_{\bar{d}}$	LSD
1	Vertical Factor1 - Crop means	$\sqrt{\frac{2\,E_a}{rbc}}$	S.E.(1) * t_a
2	Horizontal Factor2 - Irrigation means	$\sqrt{\frac{2\,E_b}{rac}}$	S.E.(2) * t_b
3	Vertical Factor1 at the same level of Horizontal Factor2	$\sqrt{\frac{2\,[(b-1)\,E_c + E_a}{rb}}$	S.E.(3) * t_c
4	Horizontal Factor2 at the same level of Vertical Factor1	$\sqrt{\frac{2\,[(a-1)\,E_c + E_b}{ra}}$	S.E.(4) * t_c
5	Sub Plot - Nitrogen means	$\sqrt{\frac{2\,E_d}{rab}}$	S.E.(5) * t_d
6	Vertical Factor1 at the same level of Sub Plot	$\sqrt{\frac{2\,[(c-1)\,E_d + E_a}{rc}}$	S.E.(6) * t_d

7	Sub Plot at the same level of Vertical Factor1	$\sqrt{\frac{2\,[(a-1)\,E_d + E_d}{ra}}$	S.E.(7) * t_d
8	Horizontal Factor2 at the same level of Sub Plot	$\sqrt{\frac{2\,[(c-1)\,E_d + E_b}{rc}}$	S.E.(8) * t_d
9	Sub Plot at the same level of Horizontal Factor2	$\sqrt{\frac{2\,[(b-1)\,E_d + E_d}{r(b-1)}}$	S.E.(9) * t_d
10	Vertical Factor1 * Horizontal Factor2 * Sub Plot :- Crop*Irrigation*Nitrogen	$\sqrt{\frac{2\,E_d}{r}}$	S.E.(10) * t_d

where
E_a = Error(a) MS,
E_b = Error(b) MS,
E_c = Error(c) MS,
E_d= Error(d) MS,
r = number of replications,
a = number of vertical treatment factor1,
b = number of horizontal treatment factor2,
c = number of subplot treatments,
t_a = t-value at Error(A) df and at desired level of significance
t_b = t-value at Error(B) df and at desired level of significance
t_c = t-value at Error(C) df and at desired level of significance
t_d = t-value at Error(D) df and at desired level of significance

If one is interested to obtain Tukey's HSD, then t_a, t_b, t_c *and* t_d may be replaced with corresponding Studentized range values.

Output Produced
The outputs are shown for the sample data included in the second file, **Using_StripSplit_Macro.sas**. The variable names are "Rep", "Crop" "Irrigation", and "Nitogen" for block, Vertical treatment factor1, Horizontal treatment factor2 and sub plot plot treatment respectively.

Strip Split Plot Details
This table provides the details of the Strip Split Plot Design used.

Strip-Split Plot Design Analysis

Strip-Split Plot Details

Details	Number of Levels
Number of Replications	3
Number of Factor1 (Crop)	4
Number of Factor2 (Irrigation)	4
Number of Factor3 (Nitrogen)	4

ANOVA Table - Dependent Variable: GRAINYIELD

Source	DF	Sum of Squares	Mean Square	F-Ratio	p-Value	Significant
Rep	2	1595717.53	797858.77	20.62	0.0020	*
Crop	3	16841847.68	5613949.23	145.08	<.0001	*
Error(a)	6	232165.80	38694.30	.	.	
Irrigation	3	11991190.56	3997063.52	82.90	<.0001	*
Error(b)	6	289288.43	48214.74	.	.	
Crop*Irrigation	9	913879.51	101542.17	4.24	0.0045	*
Error(c)	18	431527.07	23973.73	.	.	
Nitrogen	3	18309823.85	6103274.62	354.76	<.0001	*
Crop*Nitrogen	9	1138431.38	126492.38	7.35	<.0001	*
Irrigation*Nitrogen	9	345917.67	38435.30	2.23	0.0260	*
Crop*Irrigation*Nitrogen	27	866035.52	32075.39	1.86	0.0146	*
Error(d)	96	1651573.83	17203.89	.	.	
Total	191	54607398.83	.	.	.	

* - Significant at 5% (level of significance opted by user), NS - Non Significant
p-Value < 0.05 - Significant at 5%, p-Value < 0.01 - Significant at 1%

The model used for analysis

$Y_{ijkl}=\mu+r_i+\alpha_j+e_{ij}+\beta_k+ e_{ik}+(\alpha\beta)_{jk}+e_{ijk}+\gamma_l+(\alpha\gamma)_{jl}+(\beta\gamma)_{kl}+(\alpha\beta\gamma)_{jkl}+e_{ijkl}$.

Where:

Y_{ijkl} : Observation corresponding to l^{th} level of subplot treatment factor (C), k^{th} level of horizontal treatment factor2 (B), j^{th} level of vertical treatment factor1 (A) and the i^{th} replication.

μ : General mean.

r_i : i^{th} block effect.

α_j : j^{th} vertical treatment factor1 effect.

β_k : k^{th} horizontal treatment factor2 effect.

$(\alpha\beta)_{jk}$: Intraction between j^{th} level of vertical treatment factor1and k^{th} level of horizontal treatment factor2 .

γ_l : l^{th} level of subplot treatment factor.

$(\alpha\gamma)_{jl}$: Intraction between j^{th} level of vertical treatment factor1 and l^{th} level of subplot treatment factor.

$(\beta\gamma)_{kl}$: Intraction between k^{th} level of horizontal treatment factor2 and l^{th} level of subplot treatment factor.

$(\alpha\beta\gamma)_{jkl}$: Intraction between j^{th} level of vertical treatment factor1, k^{th} level of horizontal treatment factor2 and l^{th} level of subplot treatment factor.

e_{ijkl}: The error component e_{ij}, $e_{ik,}$ e_{ilk} and e_{ijkl} are independently and normally distributed with means 0 and respective variances σ_1^2 and σ_2^2.

In this model, term e_{ij} denotes Error(A), e_{ik} denotes Error(B), e_{ilk} denotes Error(C) and e_{ijkl}. Note that the last column provides the significance level of each of the sources. A note at the bottom is given for the interpretation. * indicates significant at specified alpha level opted by user. If p-value < 0.05 indicates significant at 5% alpha level and p-Value < 0.01 indicated significant at 1% alpha level and NS indicates non-significant.

Mean Interaction Table - Vertical treatment Factor1 vs Horizontal treatment Factor2 (Crop*Irrigation)

This is the mean interaction table for Vertical treatment Factor1 vs Horizontal treatment Factor2 variable. The last horizontal column shows the averaged mean of Horizontal treatment Factor2 levels with grouping letters as superscripts only if Horizontal treatment Factor2 is significant in above ANOVA table. Similarly last vertical column shows the Vertical treatment Factor1 mean with grouping letters as Vertical treatment Factor1 is also significant for dependent variable - grainyield.

Mean Interaction Table - Crop * Irrigation

Crop_Irrigation	$MP2_1$	$MP2_2$	$MP2_3$	$MP2_4$	Factor 1 Mean
$MP1_1$	2925.17	3278.58	3559.58	3661.17	3356.13^A
$MP1_2$	2747.58	3148.08	3264.83	3491.00	3162.88^B
$MP1_3$	2426.58	2997.25	3051.58	3242.67	2929.52^C
$MP1_4$	2327.08	2552.08	2640.58	2724.92	2561.17^D
Factor 2 Mean	2606.60^D	2994.00^C	3129.15^B	3279.94^A	General Mean=3002.42
MP1 - Factor1, MP2 - Factor2					

Mean Interaction Table - Crop * Nitrogen

Crop_Nitrogen	$SP1_1$	$SP1_2$	$SP1_3$	$SP1_4$	Factor1 Mean
$MP1_1$	2936.92	3329.83	3489.67	3668.08	3356.13^A
$MP1_2$	2478.00	3244.08	3382.00	3547.42	3162.88^B
$MP1_3$	2410.67	2876.58	3144.75	3286.08	2929.52^C
$MP1_4$	2218.08	2528.83	2641.92	2855.83	2561.17^D
Sub Plot Mean	2510.92^D	2994.83^C	3164.58^B	3339.35^A	General Mean=3002.42
MP1 - Factor1, SP1 - Sub Plot					

*Mean Interaction Table - Irrigation * Nitrogen*

Irrigation_Nitrogen	$SP1_1$	$SP1_2$	$SP1_3$	$SP1_4$	Factor2 Mean
$MP2_1$	2109.58	2528.75	2738.58	3049.50	2606.60^{D}
$MP2_2$	2537.08	2989.00	3146.08	3303.83	2994.00^{C}
$MP2_3$	2635.75	3123.50	3312.08	3445.25	3129.15^{B}
$MP2_4$	2761.25	3338.08	3461.58	3558.83	3279.94^{A}
Sub Plot Mean	2510.92^{D}	2994.83^{C}	3164.58^{B}	3339.35^{A}	General Mean=3002.42
MP2 - Factor2, SP1 - Sub Plot					

*Mean Interaction Table - Crop * Irrigation * Nitrogen*

	$MP1_1$					$MP1_2$				
Crop_Irrigation_ Nitrogen	$MP2_1$	$MP2_2$	$MP2_3$	$MP2_4$	Mean	$MP2_1$	$MP2_2$	$MP2_3$	$MP2_4$	Mean
$SP1_1$	2570.67	2933.00	3102.67	3141.33	2936.92	2013.67	2540.33	2639.33	2718.67	2478.00
$SP1_2$	2891.33	3155.00	3547.33	3725.67	3329.83	2680.33	3278.33	3349.67	3668.00	3244.08
$SP1_3$	2954.67	3402.00	3742.00	3860.00	3489.67	2916.33	3347.00	3498.00	3766.67	3382.00
$SP1_4$	3284.00	3624.33	3846.33	3917.67	3668.08	3380.00	3426.67	3572.33	3810.67	3547.42
Mean	2925.17	3278.58	3559.58	3661.17	3356.13	2747.58	3148.08	3264.83	3491.00	3162.88
MP1 - Factor1, MP2 - Factor2, SP1 - Sub Plot										

$MP1_3$					$MP1_4$					
$MP2_1$	$MP2_2$	$MP2_3$	$MP2_4$	Mean	$MP2_1$	$MP2_2$	$MP2_3$	$MP2_4$	Mean	Sub Plot Mean
2038.00	2362.00	2450.00	2792.67	2410.67	1816.00	2313.00	2351.00	2392.33	2218.08	2510.92
2186.67	2971.33	3031.67	3316.67	2876.58	2356.67	2551.33	2565.33	2642.00	2528.83	2994.83
2672.00	3237.33	3281.33	3388.33	3144.75	2411.33	2598.00	2727.00	2831.33	2641.92	3164.58
2809.67	3418.33	3443.33	3473.00	3286.08	2724.33	2746.00	2919.00	3034.00	2855.83	3339.35
2426.58	2997.25	3051.58	3242.67	2929.52	2327.08	2552.08	2640.58	2724.92	2561.17	General Mean=3002.42
MP1 - Factor1, MP2 - Factor2, SP1 - Sub Plot										

Following note is coming below the Mean Interaction Table only when one use **adjust=t** in **Using_StripSplit_Macro.sas** and if any of the Factor1, Factor2 and Factor3 is coming significant.

Note: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

The following footnote also appears below the table:

Means with at least one letter common are not statistically significant. In case, treatment effect is non-significant, no grouping letter is produced in the output

Note that when the treatment effect is not significant, there would be no grouping letter as it is meaningless to conduct multiple comparison test when the treatment effects are not significant.

The group letters are produced using the macro, PDGLM800.SAS by Arnold M. Saxton (asaxton@utk.edu) University of Tennessee, Knoxville TN 37996-4500.

p-Value, CV and R-Square for Dependent Variable GRAINYIELD

Source	p-Value	CV%	R-Square
Crop	<.0001	6.55167	0.969755
Irrigation	<.0001	7.31338	.
Crop*Irrigation	0.0045	5.15699	.
Nitrogen	<.0001	4.36859	.
Crop*Nitrogen	<.0001	4.36859	.
Irrigation*Nitrogen	0.0260	4.36859	.
Crop*Irrigation*Nitrogen	0.0146	4.36859	.

The above table provides the p-Value of the corresponding effects, CV% for Vertical treatment Factor1, Horizontal treatment Factor2 and sub plot Factor3 respectively. It also gives the Model R-Square value.

Standard Errors

This table provides the standard error of difference between various combinations along with t-value and CD or Tukey's HSD at given alpha level. Note that NS is shown for the corresponding source if its non-significant in above ANOVA table.

Standard Errors for GRAINYIELD

Source	S.E. of Difference	t-value at 5%	CD at 5%
Factor1 - Crop means	40.15	2.45	98.25
Factor2 - Irrigation means	44.82	2.45	109.67
Crop at the same level of Irrigation	135.78	2.10	285.26

Source	S.E. of Difference	t-value at 5%	CD at 5%
Irrigation at the same level of Crop	141.50	2.10	297.28
Sub Plot - Nitrogen means	26.77	1.98	53.15
Crop at the same level of Nitrogen	122.68	1.98	243.52
Nitrogen at the same level of Crop	107.09	1.98	212.58
Irrigation at the same level of Nitrogen	128.99	1.98	256.04
Nitrogen at the same level of Irrigation	123.66	1.98	245.47
Factor1*Factor2*Factor3 - Crop*Irrigation*Nitrogen	107.09	1.98	212.58
NS - Non Significant			

Similar output were generated for rest of all dependent variable also.
Following table appears in the last of output generated by the macro **StripSplit.**

Macro Developed under Strengthening Statistical Computing for NARS by Rajender Parsad, Pramod Kumar, R.S. Tomar and Sachin Kumar at IASRI
Grouping letters on treatments were made using pdglm800.sas which can be downloaded from http://animalscience.ag.utk.edu/FacultyStaff/ArnoldSaxton.html#software
Output Produced using macro StripSplit developed on:10JUN2014

Errors in Log Files

When you are running the macro, it is better to check the log files to make sure that the macro runs correctly. Some basic checks such as number of parameters, acceptable values are included in the program. However, the following warning may appear in the SAS Log if you run "**StripSplit.sas**" macro:

WARNING: DATA step interface is preproduction in this release.

This error can be safely ignored.