

# Examples of NOT OK using car package

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# 1 Tested Version and Books used for the Validation

## 1.1 Packages Used

- 'sasLM' version: 0.6.6
- 'SAS' version: 9.4 Licensed and University Edition
- 'car' version: 3.0.12
- R version: R version 4.1.2 (2021-11-01)

The 'car' package is not necessary for 'sasLM.' It is used for the comparison of the results.

If you see any difference between 'car' and 'sasLM', 'SAS' results coincide with 'sasLM', not with 'car.'

Before 'sasLM' is available on CRAN, you can download using the following command in R.

```
install.packages("sasLM", repos="http://r.acr.kr")
```

## 1.2 Books and Articles used for the Test

1. Snee RD. Computation and Use of Expected Mean Squares in Analysis of Variance. J Qual Tech. 1974;6(3):128-137.
2. Goodnight JH. The General Linear Models Procedure, Proceedings of the First International SAS User's Group, SAS Institute, Raleigh, N.C. 1976.
3. Littell RC, Stroup WW, Freund RJ. SAS for Linear Models 4e. John Wiley & Sons Inc. 2002.
4. Sahai H, Ojeda MM. Analysis of Variance for Random Models Volume 2 Unbalanced Data. 2005.
5. Federer WT, King F. Variations on Split Plot and Split Block Experiment Designs. John Wiley & Sons Inc. 2007.
6. Hinkelmann K, Kempthorne O. Design and Analysis of Experiments Volume 1 Introduction to Experimental Design. 2e. John Wiley & Sons Inc. 2008.
7. Searle SR, Gruber MHJ. Linear Models 2e, Kindle Edition. John Wiley & Sons Inc. 2016.

## 2 Snee EMS ANOVA 1974

### Reference

- Snee RD. Computation and Use of Expected Mean Squares in Analysis of Variance. J Qual Tech. 1974;6(3);128-137.

### (1) MODEL

```
Snee = read.csv("http://r.acr.kr/Snee_EMS_ANOVA1974.csv")
Snee = af(Snee, c("Machine", "Analyst", "Test", "Day"))
Snee
```

	Machine	Analyst	Test	Day	Y
1	1	1	1	1	6.1
2	1	1	1	2	8.5
3	1	1	1	3	8.6
4	1	1	1	4	9.3
5	1	1	1	5	8.1
6	1	1	1	6	8.5
7	1	1	1	7	9.8
8	1	1	1	8	9.0
9	1	1	1	9	11.0
10	1	1	1	10	9.7
11	1	1	1	11	10.5
12	1	1	1	12	8.3
13	1	1	1	13	8.4
14	1	1	1	14	10.2
15	1	1	1	15	9.3
16	1	1	1	16	7.1
17	1	1	1	17	5.8
18	1	1	1	18	8.9
19	1	1	1	19	11.5
20	1	1	1	20	10.3
21	1	1	1	21	9.1
22	1	1	1	22	5.7
23	1	1	1	23	8.5
24	1	1	1	24	9.6
25	1	1	1	25	9.4
26	1	1	1	26	10.3
27	1	1	1	27	7.0
28	1	1	1	28	11.5
29	1	1	1	29	6.0
30	1	1	1	30	8.0
31	1	1	1	31	13.4
32	1	1	1	32	12.1

33	1	1	1	33	14.2
34	1	1	1	34	10.0
35	1	1	1	35	6.5
36	1	1	1	36	6.5
37	1	1	1	37	9.2
38	1	1	1	38	11.0
39	1	1	1	39	8.6
40	1	1	1	40	8.9
41	1	1	1	41	6.6
42	1	1	1	42	8.4
43	1	1	2	1	6.6
44	1	1	2	2	9.6
45	1	1	2	3	6.7
46	1	1	2	4	7.2
47	1	1	2	5	7.1
48	1	1	2	6	9.0
49	1	1	2	7	9.8
50	1	1	2	8	8.0
51	1	1	2	9	10.9
52	1	1	2	10	10.6
53	1	1	2	11	8.4
54	1	1	2	12	10.6
55	1	1	2	13	7.2
56	1	1	2	14	8.0
57	1	1	2	15	8.7
58	1	1	2	16	8.7
59	1	1	2	17	6.8
60	1	1	2	18	6.6
61	1	1	2	19	7.1
62	1	1	2	20	10.0
63	1	1	2	21	9.5
64	1	1	2	22	7.7
65	1	1	2	23	8.8
66	1	1	2	24	12.2
67	1	1	2	25	10.4
68	1	1	2	26	10.6
69	1	1	2	27	10.6
70	1	1	2	28	7.3
71	1	1	2	29	7.0
72	1	1	2	30	7.0
73	1	1	2	31	9.2
74	1	1	2	32	11.7
75	1	1	2	33	10.6
76	1	1	2	34	10.4
77	1	1	2	35	8.4
78	1	1	2	36	6.8
79	1	1	2	37	10.1
80	1	1	2	38	11.0

81	1	1	2	39	10.0
82	1	1	2	40	8.0
83	1	1	2	41	7.2
84	1	1	2	42	8.8
85	1	2	1	1	6.6
86	1	2	1	2	8.2
87	1	2	1	3	8.0
88	1	2	1	4	6.5
89	1	2	1	5	2.3
90	1	2	1	6	4.0
91	1	2	1	7	11.7
92	1	2	1	8	6.8
93	1	2	1	9	10.5
94	1	2	1	10	10.3
95	1	2	1	11	10.0
96	1	2	1	12	8.8
97	1	2	1	13	6.7
98	1	2	1	14	8.9
99	1	2	1	15	9.9
100	1	2	1	16	8.2
101	1	2	1	17	7.5
102	1	2	1	18	6.6
103	1	2	1	19	3.1
104	1	2	1	20	7.2
105	1	2	1	21	10.7
106	1	2	1	22	8.4
107	1	2	1	23	7.6
108	1	2	1	24	12.6
109	1	2	1	25	9.6
110	1	2	1	26	12.6
111	1	2	1	27	10.8
112	1	2	1	28	5.1
113	1	2	1	29	6.6
114	1	2	1	30	8.6
115	1	2	1	31	12.5
116	1	2	1	32	10.4
117	1	2	1	33	10.6
118	1	2	1	34	7.2
119	1	2	1	35	7.8
120	1	2	1	36	4.4
121	1	2	1	37	8.7
122	1	2	1	38	11.2
123	1	2	1	39	10.3
124	1	2	1	40	7.0
125	1	2	1	41	7.7
126	1	2	1	42	7.6
127	2	1	1	1	8.8
128	2	1	1	2	8.1

129	2	1	1	3	7.4
130	2	1	1	4	8.0
131	2	1	1	5	9.5
132	2	1	1	6	9.2
133	2	1	1	7	12.8
134	2	1	1	8	9.2
135	2	1	1	9	11.3
136	2	1	1	10	9.3
137	2	1	1	11	4.0
138	2	1	1	12	9.7
139	2	1	1	13	4.6
140	2	1	1	14	2.1
141	2	1	1	15	9.7
142	2	1	1	16	10.0
143	2	1	1	17	10.2
144	2	1	1	18	9.2
145	2	1	1	19	10.8
146	2	1	1	20	9.4
147	2	1	1	21	10.3
148	2	1	1	22	10.3
149	2	1	1	23	8.3
150	2	1	1	24	11.6
151	2	1	1	25	9.4
152	2	1	1	26	11.3
153	2	1	1	27	11.4
154	2	1	1	28	9.6
155	2	1	1	29	2.2
156	2	1	1	30	6.6
157	2	1	1	31	11.5
158	2	1	1	32	9.1
159	2	1	1	33	4.6
160	2	1	1	34	7.9
161	2	1	1	35	9.0
162	2	1	1	36	8.1
163	2	1	1	37	9.4
164	2	1	1	38	10.9
165	2	1	1	39	9.0
166	2	1	1	40	7.8
167	2	1	1	41	9.3
168	2	1	1	42	6.8

```
GLM(Y ~ Day/Machine/Analyst/Test, Snee)
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	167	751.27	4.4986		

RESIDUALS 0 0.00  
CORRECTED TOTAL 167 751.27

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Day	41	365.58	8.9166		
Day:Machine	42	196.59	4.6807		
Day:Machine:Analyst	42	118.80	2.8285		
Day:Machine:Analyst:Test	42	70.30	1.6739		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Day	41	365.58	8.9166		
Day:Machine	42	196.59	4.6807		
Day:Machine:Analyst	42	118.80	2.8285		
Day:Machine:Analyst:Test	42	70.30	1.6739		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Day	41	359.44	8.7669		
Day:Machine	42	199.40	4.7477		
Day:Machine:Analyst	42	118.80	2.8285		
Day:Machine:Analyst:Test	42	70.30	1.6739		

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	6.8	0		0		
Day1	2.0	0		0		
Day2	1.3	0		0		
Day3	0.6	0		0		
Day4	1.2	0		0		
Day5	2.7	0		0		
Day6	2.4	0		0		
Day7	6.0	0		0		
Day8	2.4	0		0		
Day9	4.5	0		0		
Day10	2.5	0		0		
Day11	-2.8	0		0		
Day12	2.9	0		0		
Day13	-2.2	0		0		
Day14	-4.7	0		0		
Day15	2.9	0		0		
Day16	3.2	0		0		
Day17	3.4	0		0		
Day18	2.4	0		0		
Day19	4.0	0		0		
Day20	2.6	0		0		
Day21	3.5	0		0		



Day22	3.5	0	0
Day23	1.5	0	0
Day24	4.8	0	0
Day25	2.6	0	0
Day26	4.5	0	0
Day27	4.6	0	0
Day28	2.8	0	0
Day29	-4.6	0	0
Day30	-0.2	0	0
Day31	4.7	0	0
Day32	2.3	0	0
Day33	-2.2	0	0
Day34	1.1	0	0
Day35	2.2	0	0
Day36	1.3	0	0
Day37	2.6	0	0
Day38	4.1	0	0
Day39	2.2	0	0
Day40	1.0	0	0
Day41	2.5	0	0
Day42	0.0	0	0
Day1:Machine1	-2.2	0	0
Day1:Machine2	0.0	0	0
Day2:Machine1	0.1	0	0
Day2:Machine2	0.0	0	0
Day3:Machine1	0.6	0	0
Day3:Machine2	0.0	0	0
Day4:Machine1	-1.5	0	0
Day4:Machine2	0.0	0	0
Day5:Machine1	-7.2	0	0
Day5:Machine2	0.0	0	0
Day6:Machine1	-5.2	0	0
Day6:Machine2	0.0	0	0
Day7:Machine1	-1.1	0	0
Day7:Machine2	0.0	0	0
Day8:Machine1	-2.4	0	0
Day8:Machine2	0.0	0	0
Day9:Machine1	-0.8	0	0
Day9:Machine2	0.0	0	0
Day10:Machine1	1.0	0	0
Day10:Machine2	0.0	0	0
Day11:Machine1	6.0	0	0
Day11:Machine2	0.0	0	0
Day12:Machine1	-0.9	0	0
Day12:Machine2	0.0	0	0
Day13:Machine1	2.1	0	0
Day13:Machine2	0.0	0	0
Day14:Machine1	6.8	0	0

Day14:Machine2	0.0	0	0
Day15:Machine1	0.2	0	0
Day15:Machine2	0.0	0	0
Day16:Machine1	-1.8	0	0
Day16:Machine2	0.0	0	0
Day17:Machine1	-2.7	0	0
Day17:Machine2	0.0	0	0
Day18:Machine1	-2.6	0	0
Day18:Machine2	0.0	0	0
Day19:Machine1	-7.7	0	0
Day19:Machine2	0.0	0	0
Day20:Machine1	-2.2	0	0
Day20:Machine2	0.0	0	0
Day21:Machine1	0.4	0	0
Day21:Machine2	0.0	0	0
Day22:Machine1	-1.9	0	0
Day22:Machine2	0.0	0	0
Day23:Machine1	-0.7	0	0
Day23:Machine2	0.0	0	0
Day24:Machine1	1.0	0	0
Day24:Machine2	0.0	0	0
Day25:Machine1	0.2	0	0
Day25:Machine2	0.0	0	0
Day26:Machine1	1.3	0	0
Day26:Machine2	0.0	0	0
Day27:Machine1	-0.6	0	0
Day27:Machine2	0.0	0	0
Day28:Machine1	-4.5	0	0
Day28:Machine2	0.0	0	0
Day29:Machine1	4.4	0	0
Day29:Machine2	0.0	0	0
Day30:Machine1	2.0	0	0
Day30:Machine2	0.0	0	0
Day31:Machine1	1.0	0	0
Day31:Machine2	0.0	0	0
Day32:Machine1	1.3	0	0
Day32:Machine2	0.0	0	0
Day33:Machine1	6.0	0	0
Day33:Machine2	0.0	0	0
Day34:Machine1	-0.7	0	0
Day34:Machine2	0.0	0	0
Day35:Machine1	-1.2	0	0
Day35:Machine2	0.0	0	0
Day36:Machine1	-3.7	0	0
Day36:Machine2	0.0	0	0
Day37:Machine1	-0.7	0	0
Day37:Machine2	0.0	0	0
Day38:Machine1	0.3	0	0

Day38:Machine2	0.0	0	0
Day39:Machine1	1.3	0	0
Day39:Machine2	0.0	0	0
Day40:Machine1	-0.8	0	0
Day40:Machine2	0.0	0	0
Day41:Machine1	-1.6	0	0
Day41:Machine2	0.0	0	0
Day42:Machine1	0.8	0	0
Day42:Machine2	0.0	0	0
Day1:Machine1:Analyst1	0.0	0	0
Day1:Machine1:Analyst2	0.0	0	0
Day1:Machine2:Analyst1	0.0	0	0
Day1:Machine2:Analyst2		0	
Day2:Machine1:Analyst1	1.4	0	0
Day2:Machine1:Analyst2	0.0	0	0
Day2:Machine2:Analyst1	0.0	0	0
Day2:Machine2:Analyst2		0	
Day3:Machine1:Analyst1	-1.3	0	0
Day3:Machine1:Analyst2	0.0	0	0
Day3:Machine2:Analyst1	0.0	0	0
Day3:Machine2:Analyst2		0	
Day4:Machine1:Analyst1	0.7	0	0
Day4:Machine1:Analyst2	0.0	0	0
Day4:Machine2:Analyst1	0.0	0	0
Day4:Machine2:Analyst2		0	
Day5:Machine1:Analyst1	4.8	0	0
Day5:Machine1:Analyst2	0.0	0	0
Day5:Machine2:Analyst1	0.0	0	0
Day5:Machine2:Analyst2		0	
Day6:Machine1:Analyst1	5.0	0	0
Day6:Machine1:Analyst2	0.0	0	0
Day6:Machine2:Analyst1	0.0	0	0
Day6:Machine2:Analyst2		0	
Day7:Machine1:Analyst1	-1.9	0	0
Day7:Machine1:Analyst2	0.0	0	0
Day7:Machine2:Analyst1	0.0	0	0
Day7:Machine2:Analyst2		0	
Day8:Machine1:Analyst1	1.2	0	0
Day8:Machine1:Analyst2	0.0	0	0
Day8:Machine2:Analyst1	0.0	0	0
Day8:Machine2:Analyst2		0	
Day9:Machine1:Analyst1	0.4	0	0
Day9:Machine1:Analyst2	0.0	0	0
Day9:Machine2:Analyst1	0.0	0	0
Day9:Machine2:Analyst2		0	
Day10:Machine1:Analyst1	0.3	0	0
Day10:Machine1:Analyst2	0.0	0	0
Day10:Machine2:Analyst1	0.0	0	0

Day10:Machine2:Analyst2		0	
Day11:Machine1:Analyst1	-1.6	0	0
Day11:Machine1:Analyst2	0.0	0	0
Day11:Machine2:Analyst1	0.0	0	0
Day11:Machine2:Analyst2		0	
Day12:Machine1:Analyst1	1.8	0	0
Day12:Machine1:Analyst2	0.0	0	0
Day12:Machine2:Analyst1	0.0	0	0
Day12:Machine2:Analyst2		0	
Day13:Machine1:Analyst1	0.5	0	0
Day13:Machine1:Analyst2	0.0	0	0
Day13:Machine2:Analyst1	0.0	0	0
Day13:Machine2:Analyst2		0	
Day14:Machine1:Analyst1	-0.9	0	0
Day14:Machine1:Analyst2	0.0	0	0
Day14:Machine2:Analyst1	0.0	0	0
Day14:Machine2:Analyst2		0	
Day15:Machine1:Analyst1	-1.2	0	0
Day15:Machine1:Analyst2	0.0	0	0
Day15:Machine2:Analyst1	0.0	0	0
Day15:Machine2:Analyst2		0	
Day16:Machine1:Analyst1	0.5	0	0
Day16:Machine1:Analyst2	0.0	0	0
Day16:Machine2:Analyst1	0.0	0	0
Day16:Machine2:Analyst2		0	
Day17:Machine1:Analyst1	-0.7	0	0
Day17:Machine1:Analyst2	0.0	0	0
Day17:Machine2:Analyst1	0.0	0	0
Day17:Machine2:Analyst2		0	
Day18:Machine1:Analyst1	0.0	0	0
Day18:Machine1:Analyst2	0.0	0	0
Day18:Machine2:Analyst1	0.0	0	0
Day18:Machine2:Analyst2		0	
Day19:Machine1:Analyst1	4.0	0	0
Day19:Machine1:Analyst2	0.0	0	0
Day19:Machine2:Analyst1	0.0	0	0
Day19:Machine2:Analyst2		0	
Day20:Machine1:Analyst1	2.8	0	0
Day20:Machine1:Analyst2	0.0	0	0
Day20:Machine2:Analyst1	0.0	0	0
Day20:Machine2:Analyst2		0	
Day21:Machine1:Analyst1	-1.2	0	0
Day21:Machine1:Analyst2	0.0	0	0
Day21:Machine2:Analyst1	0.0	0	0
Day21:Machine2:Analyst2		0	
Day22:Machine1:Analyst1	-0.7	0	0
Day22:Machine1:Analyst2	0.0	0	0
Day22:Machine2:Analyst1	0.0	0	0

Day22:Machine2:Analyst2		0	
Day23:Machine1:Analyst1	1.2	0	0
Day23:Machine1:Analyst2	0.0	0	0
Day23:Machine2:Analyst1	0.0	0	0
Day23:Machine2:Analyst2		0	
Day24:Machine1:Analyst1	-0.4	0	0
Day24:Machine1:Analyst2	0.0	0	0
Day24:Machine2:Analyst1	0.0	0	0
Day24:Machine2:Analyst2		0	
Day25:Machine1:Analyst1	0.8	0	0
Day25:Machine1:Analyst2	0.0	0	0
Day25:Machine2:Analyst1	0.0	0	0
Day25:Machine2:Analyst2		0	
Day26:Machine1:Analyst1	-2.0	0	0
Day26:Machine1:Analyst2	0.0	0	0
Day26:Machine2:Analyst1	0.0	0	0
Day26:Machine2:Analyst2		0	
Day27:Machine1:Analyst1	-0.2	0	0
Day27:Machine1:Analyst2	0.0	0	0
Day27:Machine2:Analyst1	0.0	0	0
Day27:Machine2:Analyst2		0	
Day28:Machine1:Analyst1	2.2	0	0
Day28:Machine1:Analyst2	0.0	0	0
Day28:Machine2:Analyst1	0.0	0	0
Day28:Machine2:Analyst2		0	
Day29:Machine1:Analyst1	0.4	0	0
Day29:Machine1:Analyst2	0.0	0	0
Day29:Machine2:Analyst1	0.0	0	0
Day29:Machine2:Analyst2		0	
Day30:Machine1:Analyst1	-1.6	0	0
Day30:Machine1:Analyst2	0.0	0	0
Day30:Machine2:Analyst1	0.0	0	0
Day30:Machine2:Analyst2		0	
Day31:Machine1:Analyst1	-3.3	0	0
Day31:Machine1:Analyst2	0.0	0	0
Day31:Machine2:Analyst1	0.0	0	0
Day31:Machine2:Analyst2		0	
Day32:Machine1:Analyst1	1.3	0	0
Day32:Machine1:Analyst2	0.0	0	0
Day32:Machine2:Analyst1	0.0	0	0
Day32:Machine2:Analyst2		0	
Day33:Machine1:Analyst1	0.0	0	0
Day33:Machine1:Analyst2	0.0	0	0
Day33:Machine2:Analyst1	0.0	0	0
Day33:Machine2:Analyst2		0	
Day34:Machine1:Analyst1	3.2	0	0
Day34:Machine1:Analyst2	0.0	0	0
Day34:Machine2:Analyst1	0.0	0	0

Day34:Machine2:Analyst2		0	
Day35:Machine1:Analyst1	0.6	0	0
Day35:Machine1:Analyst2	0.0	0	0
Day35:Machine2:Analyst1	0.0	0	0
Day35:Machine2:Analyst2		0	
Day36:Machine1:Analyst1	2.4	0	0
Day36:Machine1:Analyst2	0.0	0	0
Day36:Machine2:Analyst1	0.0	0	0
Day36:Machine2:Analyst2		0	
Day37:Machine1:Analyst1	1.4	0	0
Day37:Machine1:Analyst2	0.0	0	0
Day37:Machine2:Analyst1	0.0	0	0
Day37:Machine2:Analyst2		0	
Day38:Machine1:Analyst1	-0.2	0	0
Day38:Machine1:Analyst2	0.0	0	0
Day38:Machine2:Analyst1	0.0	0	0
Day38:Machine2:Analyst2		0	
Day39:Machine1:Analyst1	-0.3	0	0
Day39:Machine1:Analyst2	0.0	0	0
Day39:Machine2:Analyst1	0.0	0	0
Day39:Machine2:Analyst2		0	
Day40:Machine1:Analyst1	1.0	0	0
Day40:Machine1:Analyst2	0.0	0	0
Day40:Machine2:Analyst1	0.0	0	0
Day40:Machine2:Analyst2		0	
Day41:Machine1:Analyst1	-0.5	0	0
Day41:Machine1:Analyst2	0.0	0	0
Day41:Machine2:Analyst1	0.0	0	0
Day41:Machine2:Analyst2		0	
Day42:Machine1:Analyst1	1.2	0	0
Day42:Machine1:Analyst2	0.0	0	0
Day42:Machine2:Analyst1	0.0	0	0
Day42:Machine2:Analyst2		0	
Day1:Machine1:Analyst1:Test1	-0.5	0	0
Day1:Machine1:Analyst1:Test2	0.0	0	0
Day1:Machine1:Analyst2:Test1	0.0	0	0
Day1:Machine1:Analyst2:Test2		0	
Day1:Machine2:Analyst1:Test1	0.0	0	0
Day1:Machine2:Analyst1:Test2		0	
Day1:Machine2:Analyst2:Test1		0	
Day1:Machine2:Analyst2:Test2		0	
Day2:Machine1:Analyst1:Test1	-1.1	0	0
Day2:Machine1:Analyst1:Test2	0.0	0	0
Day2:Machine1:Analyst2:Test1	0.0	0	0
Day2:Machine1:Analyst2:Test2		0	
Day2:Machine2:Analyst1:Test1	0.0	0	0
Day2:Machine2:Analyst1:Test2		0	
Day2:Machine2:Analyst2:Test1		0	

Day2:Machine2:Analyst2:Test2		0	
Day3:Machine1:Analyst1:Test1	1.9	0	0
Day3:Machine1:Analyst1:Test2	0.0	0	0
Day3:Machine1:Analyst2:Test1	0.0	0	0
Day3:Machine1:Analyst2:Test2		0	
Day3:Machine2:Analyst1:Test1	0.0	0	0
Day3:Machine2:Analyst1:Test2		0	
Day3:Machine2:Analyst2:Test1		0	
Day3:Machine2:Analyst2:Test2		0	
Day4:Machine1:Analyst1:Test1	2.1	0	0
Day4:Machine1:Analyst1:Test2	0.0	0	0
Day4:Machine1:Analyst2:Test1	0.0	0	0
Day4:Machine1:Analyst2:Test2		0	
Day4:Machine2:Analyst1:Test1	0.0	0	0
Day4:Machine2:Analyst1:Test2		0	
Day4:Machine2:Analyst2:Test1		0	
Day4:Machine2:Analyst2:Test2		0	
Day5:Machine1:Analyst1:Test1	1.0	0	0
Day5:Machine1:Analyst1:Test2	0.0	0	0
Day5:Machine1:Analyst2:Test1	0.0	0	0
Day5:Machine1:Analyst2:Test2		0	
Day5:Machine2:Analyst1:Test1	0.0	0	0
Day5:Machine2:Analyst1:Test2		0	
Day5:Machine2:Analyst2:Test1		0	
Day5:Machine2:Analyst2:Test2		0	
Day6:Machine1:Analyst1:Test1	-0.5	0	0
Day6:Machine1:Analyst1:Test2	0.0	0	0
Day6:Machine1:Analyst2:Test1	0.0	0	0
Day6:Machine1:Analyst2:Test2		0	
Day6:Machine2:Analyst1:Test1	0.0	0	0
Day6:Machine2:Analyst1:Test2		0	
Day6:Machine2:Analyst2:Test1		0	
Day6:Machine2:Analyst2:Test2		0	
Day7:Machine1:Analyst1:Test1	0.0	0	0
Day7:Machine1:Analyst1:Test2	0.0	0	0
Day7:Machine1:Analyst2:Test1	0.0	0	0
Day7:Machine1:Analyst2:Test2		0	
Day7:Machine2:Analyst1:Test1	0.0	0	0
Day7:Machine2:Analyst1:Test2		0	
Day7:Machine2:Analyst2:Test1		0	
Day7:Machine2:Analyst2:Test2		0	
Day8:Machine1:Analyst1:Test1	1.0	0	0
Day8:Machine1:Analyst1:Test2	0.0	0	0
Day8:Machine1:Analyst2:Test1	0.0	0	0
Day8:Machine1:Analyst2:Test2		0	
Day8:Machine2:Analyst1:Test1	0.0	0	0
Day8:Machine2:Analyst1:Test2		0	
Day8:Machine2:Analyst2:Test1		0	

Day8:Machine2:Analyst2:Test2		0	
Day9:Machine1:Analyst1:Test1	0.1	0	0
Day9:Machine1:Analyst1:Test2	0.0	0	0
Day9:Machine1:Analyst2:Test1	0.0	0	0
Day9:Machine1:Analyst2:Test2		0	
Day9:Machine2:Analyst1:Test1	0.0	0	0
Day9:Machine2:Analyst1:Test2		0	
Day9:Machine2:Analyst2:Test1		0	
Day9:Machine2:Analyst2:Test2		0	
Day10:Machine1:Analyst1:Test1	-0.9	0	0
Day10:Machine1:Analyst1:Test2	0.0	0	0
Day10:Machine1:Analyst2:Test1	0.0	0	0
Day10:Machine1:Analyst2:Test2		0	
Day10:Machine2:Analyst1:Test1	0.0	0	0
Day10:Machine2:Analyst1:Test2		0	
Day10:Machine2:Analyst2:Test1		0	
Day10:Machine2:Analyst2:Test2		0	
Day11:Machine1:Analyst1:Test1	2.1	0	0
Day11:Machine1:Analyst1:Test2	0.0	0	0
Day11:Machine1:Analyst2:Test1	0.0	0	0
Day11:Machine1:Analyst2:Test2		0	
Day11:Machine2:Analyst1:Test1	0.0	0	0
Day11:Machine2:Analyst1:Test2		0	
Day11:Machine2:Analyst2:Test1		0	
Day11:Machine2:Analyst2:Test2		0	
Day12:Machine1:Analyst1:Test1	-2.3	0	0
Day12:Machine1:Analyst1:Test2	0.0	0	0
Day12:Machine1:Analyst2:Test1	0.0	0	0
Day12:Machine1:Analyst2:Test2		0	
Day12:Machine2:Analyst1:Test1	0.0	0	0
Day12:Machine2:Analyst1:Test2		0	
Day12:Machine2:Analyst2:Test1		0	
Day12:Machine2:Analyst2:Test2		0	
Day13:Machine1:Analyst1:Test1	1.2	0	0
Day13:Machine1:Analyst1:Test2	0.0	0	0
Day13:Machine1:Analyst2:Test1	0.0	0	0
Day13:Machine1:Analyst2:Test2		0	
Day13:Machine2:Analyst1:Test1	0.0	0	0
Day13:Machine2:Analyst1:Test2		0	
Day13:Machine2:Analyst2:Test1		0	
Day13:Machine2:Analyst2:Test2		0	
Day14:Machine1:Analyst1:Test1	2.2	0	0
Day14:Machine1:Analyst1:Test2	0.0	0	0
Day14:Machine1:Analyst2:Test1	0.0	0	0
Day14:Machine1:Analyst2:Test2		0	
Day14:Machine2:Analyst1:Test1	0.0	0	0
Day14:Machine2:Analyst1:Test2		0	
Day14:Machine2:Analyst2:Test1		0	



Day14:Machine2:Analyst2:Test2		0	
Day15:Machine1:Analyst1:Test1	0.6	0	0
Day15:Machine1:Analyst1:Test2	0.0	0	0
Day15:Machine1:Analyst2:Test1	0.0	0	0
Day15:Machine1:Analyst2:Test2		0	
Day15:Machine2:Analyst1:Test1	0.0	0	0
Day15:Machine2:Analyst1:Test2		0	
Day15:Machine2:Analyst2:Test1		0	
Day15:Machine2:Analyst2:Test2		0	
Day16:Machine1:Analyst1:Test1	-1.6	0	0
Day16:Machine1:Analyst1:Test2	0.0	0	0
Day16:Machine1:Analyst2:Test1	0.0	0	0
Day16:Machine1:Analyst2:Test2		0	
Day16:Machine2:Analyst1:Test1	0.0	0	0
Day16:Machine2:Analyst1:Test2		0	
Day16:Machine2:Analyst2:Test1		0	
Day16:Machine2:Analyst2:Test2		0	
Day17:Machine1:Analyst1:Test1	-1.0	0	0
Day17:Machine1:Analyst1:Test2	0.0	0	0
Day17:Machine1:Analyst2:Test1	0.0	0	0
Day17:Machine1:Analyst2:Test2		0	
Day17:Machine2:Analyst1:Test1	0.0	0	0
Day17:Machine2:Analyst1:Test2		0	
Day17:Machine2:Analyst2:Test1		0	
Day17:Machine2:Analyst2:Test2		0	
Day18:Machine1:Analyst1:Test1	2.3	0	0
Day18:Machine1:Analyst1:Test2	0.0	0	0
Day18:Machine1:Analyst2:Test1	0.0	0	0
Day18:Machine1:Analyst2:Test2		0	
Day18:Machine2:Analyst1:Test1	0.0	0	0
Day18:Machine2:Analyst1:Test2		0	
Day18:Machine2:Analyst2:Test1		0	
Day18:Machine2:Analyst2:Test2		0	
Day19:Machine1:Analyst1:Test1	4.4	0	0
Day19:Machine1:Analyst1:Test2	0.0	0	0
Day19:Machine1:Analyst2:Test1	0.0	0	0
Day19:Machine1:Analyst2:Test2		0	
Day19:Machine2:Analyst1:Test1	0.0	0	0
Day19:Machine2:Analyst1:Test2		0	
Day19:Machine2:Analyst2:Test1		0	
Day19:Machine2:Analyst2:Test2		0	
Day20:Machine1:Analyst1:Test1	0.3	0	0
Day20:Machine1:Analyst1:Test2	0.0	0	0
Day20:Machine1:Analyst2:Test1	0.0	0	0
Day20:Machine1:Analyst2:Test2		0	
Day20:Machine2:Analyst1:Test1	0.0	0	0
Day20:Machine2:Analyst1:Test2		0	
Day20:Machine2:Analyst2:Test1		0	

Day20:Machine2:Analyst2:Test2		0	
Day21:Machine1:Analyst1:Test1	-0.4	0	0
Day21:Machine1:Analyst1:Test2	0.0	0	0
Day21:Machine1:Analyst2:Test1	0.0	0	0
Day21:Machine1:Analyst2:Test2		0	
Day21:Machine2:Analyst1:Test1	0.0	0	0
Day21:Machine2:Analyst1:Test2		0	
Day21:Machine2:Analyst2:Test1		0	
Day21:Machine2:Analyst2:Test2		0	
Day22:Machine1:Analyst1:Test1	-2.0	0	0
Day22:Machine1:Analyst1:Test2	0.0	0	0
Day22:Machine1:Analyst2:Test1	0.0	0	0
Day22:Machine1:Analyst2:Test2		0	
Day22:Machine2:Analyst1:Test1	0.0	0	0
Day22:Machine2:Analyst1:Test2		0	
Day22:Machine2:Analyst2:Test1		0	
Day22:Machine2:Analyst2:Test2		0	
Day23:Machine1:Analyst1:Test1	-0.3	0	0
Day23:Machine1:Analyst1:Test2	0.0	0	0
Day23:Machine1:Analyst2:Test1	0.0	0	0
Day23:Machine1:Analyst2:Test2		0	
Day23:Machine2:Analyst1:Test1	0.0	0	0
Day23:Machine2:Analyst1:Test2		0	
Day23:Machine2:Analyst2:Test1		0	
Day23:Machine2:Analyst2:Test2		0	
Day24:Machine1:Analyst1:Test1	-2.6	0	0
Day24:Machine1:Analyst1:Test2	0.0	0	0
Day24:Machine1:Analyst2:Test1	0.0	0	0
Day24:Machine1:Analyst2:Test2		0	
Day24:Machine2:Analyst1:Test1	0.0	0	0
Day24:Machine2:Analyst1:Test2		0	
Day24:Machine2:Analyst2:Test1		0	
Day24:Machine2:Analyst2:Test2		0	
Day25:Machine1:Analyst1:Test1	-1.0	0	0
Day25:Machine1:Analyst1:Test2	0.0	0	0
Day25:Machine1:Analyst2:Test1	0.0	0	0
Day25:Machine1:Analyst2:Test2		0	
Day25:Machine2:Analyst1:Test1	0.0	0	0
Day25:Machine2:Analyst1:Test2		0	
Day25:Machine2:Analyst2:Test1		0	
Day25:Machine2:Analyst2:Test2		0	
Day26:Machine1:Analyst1:Test1	-0.3	0	0
Day26:Machine1:Analyst1:Test2	0.0	0	0
Day26:Machine1:Analyst2:Test1	0.0	0	0
Day26:Machine1:Analyst2:Test2		0	
Day26:Machine2:Analyst1:Test1	0.0	0	0
Day26:Machine2:Analyst1:Test2		0	
Day26:Machine2:Analyst2:Test1		0	

Day26:Machine2:Analyst2:Test2		0	
Day27:Machine1:Analyst1:Test1	-3.6	0	0
Day27:Machine1:Analyst1:Test2	0.0	0	0
Day27:Machine1:Analyst2:Test1	0.0	0	0
Day27:Machine1:Analyst2:Test2		0	
Day27:Machine2:Analyst1:Test1	0.0	0	0
Day27:Machine2:Analyst1:Test2		0	
Day27:Machine2:Analyst2:Test1		0	
Day27:Machine2:Analyst2:Test2		0	
Day28:Machine1:Analyst1:Test1	4.2	0	0
Day28:Machine1:Analyst1:Test2	0.0	0	0
Day28:Machine1:Analyst2:Test1	0.0	0	0
Day28:Machine1:Analyst2:Test2		0	
Day28:Machine2:Analyst1:Test1	0.0	0	0
Day28:Machine2:Analyst1:Test2		0	
Day28:Machine2:Analyst2:Test1		0	
Day28:Machine2:Analyst2:Test2		0	
Day29:Machine1:Analyst1:Test1	-1.0	0	0
Day29:Machine1:Analyst1:Test2	0.0	0	0
Day29:Machine1:Analyst2:Test1	0.0	0	0
Day29:Machine1:Analyst2:Test2		0	
Day29:Machine2:Analyst1:Test1	0.0	0	0
Day29:Machine2:Analyst1:Test2		0	
Day29:Machine2:Analyst2:Test1		0	
Day29:Machine2:Analyst2:Test2		0	
Day30:Machine1:Analyst1:Test1	1.0	0	0
Day30:Machine1:Analyst1:Test2	0.0	0	0
Day30:Machine1:Analyst2:Test1	0.0	0	0
Day30:Machine1:Analyst2:Test2		0	
Day30:Machine2:Analyst1:Test1	0.0	0	0
Day30:Machine2:Analyst1:Test2		0	
Day30:Machine2:Analyst2:Test1		0	
Day30:Machine2:Analyst2:Test2		0	
Day31:Machine1:Analyst1:Test1	4.2	0	0
Day31:Machine1:Analyst1:Test2	0.0	0	0
Day31:Machine1:Analyst2:Test1	0.0	0	0
Day31:Machine1:Analyst2:Test2		0	
Day31:Machine2:Analyst1:Test1	0.0	0	0
Day31:Machine2:Analyst1:Test2		0	
Day31:Machine2:Analyst2:Test1		0	
Day31:Machine2:Analyst2:Test2		0	
Day32:Machine1:Analyst1:Test1	0.4	0	0
Day32:Machine1:Analyst1:Test2	0.0	0	0
Day32:Machine1:Analyst2:Test1	0.0	0	0
Day32:Machine1:Analyst2:Test2		0	
Day32:Machine2:Analyst1:Test1	0.0	0	0
Day32:Machine2:Analyst1:Test2		0	
Day32:Machine2:Analyst2:Test1		0	

Day32:Machine2:Analyst2:Test2		0	
Day33:Machine1:Analyst1:Test1	3.6	0	0
Day33:Machine1:Analyst1:Test2	0.0	0	0
Day33:Machine1:Analyst2:Test1	0.0	0	0
Day33:Machine1:Analyst2:Test2		0	
Day33:Machine2:Analyst1:Test1	0.0	0	0
Day33:Machine2:Analyst1:Test2		0	
Day33:Machine2:Analyst2:Test1		0	
Day33:Machine2:Analyst2:Test2		0	
Day34:Machine1:Analyst1:Test1	-0.4	0	0
Day34:Machine1:Analyst1:Test2	0.0	0	0
Day34:Machine1:Analyst2:Test1	0.0	0	0
Day34:Machine1:Analyst2:Test2		0	
Day34:Machine2:Analyst1:Test1	0.0	0	0
Day34:Machine2:Analyst1:Test2		0	
Day34:Machine2:Analyst2:Test1		0	
Day34:Machine2:Analyst2:Test2		0	
Day35:Machine1:Analyst1:Test1	-1.9	0	0
Day35:Machine1:Analyst1:Test2	0.0	0	0
Day35:Machine1:Analyst2:Test1	0.0	0	0
Day35:Machine1:Analyst2:Test2		0	
Day35:Machine2:Analyst1:Test1	0.0	0	0
Day35:Machine2:Analyst1:Test2		0	
Day35:Machine2:Analyst2:Test1		0	
Day35:Machine2:Analyst2:Test2		0	
Day36:Machine1:Analyst1:Test1	-0.3	0	0
Day36:Machine1:Analyst1:Test2	0.0	0	0
Day36:Machine1:Analyst2:Test1	0.0	0	0
Day36:Machine1:Analyst2:Test2		0	
Day36:Machine2:Analyst1:Test1	0.0	0	0
Day36:Machine2:Analyst1:Test2		0	
Day36:Machine2:Analyst2:Test1		0	
Day36:Machine2:Analyst2:Test2		0	
Day37:Machine1:Analyst1:Test1	-0.9	0	0
Day37:Machine1:Analyst1:Test2	0.0	0	0
Day37:Machine1:Analyst2:Test1	0.0	0	0
Day37:Machine1:Analyst2:Test2		0	
Day37:Machine2:Analyst1:Test1	0.0	0	0
Day37:Machine2:Analyst1:Test2		0	
Day37:Machine2:Analyst2:Test1		0	
Day37:Machine2:Analyst2:Test2		0	
Day38:Machine1:Analyst1:Test1	0.0	0	0
Day38:Machine1:Analyst1:Test2	0.0	0	0
Day38:Machine1:Analyst2:Test1	0.0	0	0
Day38:Machine1:Analyst2:Test2		0	
Day38:Machine2:Analyst1:Test1	0.0	0	0
Day38:Machine2:Analyst1:Test2		0	
Day38:Machine2:Analyst2:Test1		0	

Day38:Machine2:Analyst2:Test2		0	
Day39:Machine1:Analyst1:Test1	-1.4	0	0
Day39:Machine1:Analyst1:Test2	0.0	0	0
Day39:Machine1:Analyst2:Test1	0.0	0	0
Day39:Machine1:Analyst2:Test2		0	
Day39:Machine2:Analyst1:Test1	0.0	0	0
Day39:Machine2:Analyst1:Test2		0	
Day39:Machine2:Analyst2:Test1		0	
Day39:Machine2:Analyst2:Test2		0	
Day40:Machine1:Analyst1:Test1	0.9	0	0
Day40:Machine1:Analyst1:Test2	0.0	0	0
Day40:Machine1:Analyst2:Test1	0.0	0	0
Day40:Machine1:Analyst2:Test2		0	
Day40:Machine2:Analyst1:Test1	0.0	0	0
Day40:Machine2:Analyst1:Test2		0	
Day40:Machine2:Analyst2:Test1		0	
Day40:Machine2:Analyst2:Test2		0	
Day41:Machine1:Analyst1:Test1	-0.6	0	0
Day41:Machine1:Analyst1:Test2	0.0	0	0
Day41:Machine1:Analyst2:Test1	0.0	0	0
Day41:Machine1:Analyst2:Test2		0	
Day41:Machine2:Analyst1:Test1	0.0	0	0
Day41:Machine2:Analyst1:Test2		0	
Day41:Machine2:Analyst2:Test1		0	
Day41:Machine2:Analyst2:Test2		0	
Day42:Machine1:Analyst1:Test1	-0.4	0	0
Day42:Machine1:Analyst1:Test2	0.0	0	0
Day42:Machine1:Analyst2:Test1	0.0	0	0
Day42:Machine1:Analyst2:Test2		0	
Day42:Machine2:Analyst1:Test1	0.0	0	0
Day42:Machine2:Analyst1:Test2		0	
Day42:Machine2:Analyst2:Test1		0	
Day42:Machine2:Analyst2:Test2		0	

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ Day/Machine/Analyst/Test, Snee), type=3, singular.ok=TRUE)
# NOT WORKING
```

### 3 Goodnight

#### Reference

- Goodnight JH. The General Linear Models Procedure, Proceedings of the First International SAS User's Group, SAS Institute, Raleigh, N.C. 1976.

#### 3.1 p33

(2) MODEL

```
p33 = read.csv("http://r.acr.kr/Goodnight-p33.csv")
p33 = af(p33, c("A", "B"))
p33
```

```
  A B    y
1 1 1 2.96
2 1 2 7.90
3 2 1 4.79
4 2 2 9.55
5 3 3 9.53
```

```
GLM(y ~ A + B + A:B, p33) # p35
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	34.905	8.7261		
RESIDUALS	0	0.000			
CORRECTED TOTAL	4	34.905			

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	2	11.3739	5.6870		
B	1	23.5225	23.5225		
A:B	1	0.0081	0.0081		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	3.0276	3.0276		
B	1	23.5225	23.5225		
A:B	1	0.0081	0.0081		

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	3.0276	3.0276		
B	1	23.5225	23.5225		
A:B	1	0.0081	0.0081		

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	9.53	0		0		
A1	-1.63	0		0		
A2	0.02	0		0		
A3	0.00	0		0		
B1	-4.76	0		0		
B2	0.00	0		0		
B3	0.00	0		0		
A1:B1	-0.18	0		0		
A1:B2	0.00	0		0		
A1:B3		0				
A2:B1	0.00	0		0		
A2:B2	0.00	0		0		
A2:B3		0				
A3:B1		0				
A3:B2		0				
A3:B3	0.00	0		0		

```
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(y ~ A + B + A:B, p33), type=3, singular.ok=TRUE) # NOT WORKING
```

## 4 SAS for Linear Models 4e

### Reference

- Littell RC, Stroup WW, Freund RJ. SAS for Linear Models 4e. John Wiley & Sons Inc. 2002.

### 4.1 p403

(3) MODEL

```
p403 = read.table("http://r.acr.kr/sas4lm/p403.txt", header=TRUE)
p403 = af(p403, c("PATIENT", "VISIT"))
p403
```

	PATIENT	SEQUENCE	VISIT	BASEHR	HR	DRUG	RESIDT	RESIDS
1	1	B	2	86	86	placebo	0	0
2	1	B	3	86	106	test	-1	-1
3	1	B	4	62	79	standard	1	0
4	2	F	2	48	66	test	0	0
5	2	F	3	58	56	placebo	1	0
6	2	F	4	74	79	standard	-1	-1
7	3	B	2	78	84	placebo	0	0
8	3	B	3	78	76	test	-1	-1
9	3	B	4	82	91	standard	1	0
10	4	D	2	66	79	standard	0	0
11	4	D	3	72	100	test	0	1
12	4	D	4	90	82	placebo	1	0
13	5	C	2	74	74	test	0	0
14	5	C	3	90	71	standard	1	0
15	5	C	4	66	62	placebo	0	1
16	6	B	2	62	64	placebo	0	0
17	6	B	3	74	90	test	-1	-1
18	6	B	4	58	85	standard	1	0
19	7	A	2	94	75	standard	0	0
20	7	A	3	72	82	placebo	0	1
21	7	A	4	100	102	test	-1	-1
22	8	A	2	54	63	standard	0	0
23	8	A	3	54	58	placebo	0	1
24	8	A	4	66	62	test	-1	-1
25	9	D	2	82	91	standard	0	0
26	9	D	3	96	86	test	0	1
27	9	D	4	78	88	placebo	1	0
28	10	C	2	86	82	test	0	0
29	10	C	3	70	71	standard	1	0
30	10	C	4	58	62	placebo	0	1
31	11	F	2	82	80	test	0	0



32	11	F	3	80	78	placebo	1	0
33	11	F	4	72	75	standard	-1	-1
34	12	E	2	96	90	placebo	0	0
35	12	E	3	92	93	standard	-1	-1
36	12	E	4	82	88	test	0	1
37	13	D	2	78	87	standard	0	0
38	13	D	3	72	80	test	0	1
39	13	D	4	76	78	placebo	1	0
40	14	F	2	98	86	test	0	0
41	14	F	3	86	86	placebo	1	0
42	14	F	4	70	79	standard	-1	-1
43	15	A	2	86	71	standard	0	0
44	15	A	3	66	70	placebo	0	1
45	15	A	4	74	90	test	-1	-1
46	16	E	2	86	86	placebo	0	0
47	16	E	3	90	103	standard	-1	-1
48	16	E	4	82	86	test	0	1
49	17	A	2	66	83	standard	0	0
50	17	A	3	82	86	placebo	0	1
51	17	A	4	86	102	test	-1	-1
52	18	F	2	66	82	test	0	0
53	18	F	3	78	80	placebo	1	0
54	18	F	4	74	95	standard	-1	-1
55	19	E	2	74	80	placebo	0	0
56	19	E	3	78	79	standard	-1	-1
57	19	E	4	70	74	test	0	1
58	20	B	2	66	70	placebo	0	0
59	20	B	3	74	62	test	-1	-1
60	20	B	4	62	67	standard	1	0
61	21	C	2	82	90	test	0	0
62	21	C	3	90	103	standard	1	0
63	21	C	4	76	82	placebo	0	1
64	22	C	2	82	82	test	0	0
65	22	C	3	66	83	standard	1	0
66	22	C	4	90	82	placebo	0	1
67	23	E	2	82	66	placebo	0	0
68	23	E	3	74	87	standard	-1	-1
69	23	E	4	82	82	test	0	1
70	24	D	2	72	75	standard	0	0
71	24	D	3	82	86	test	0	1
72	24	D	4	74	82	placebo	1	0

```
GLM(HR ~ SEQUENCE + PATIENT %in% SEQUENCE + VISIT + DRUG + RESIDS + RESIDT, p403)
```

```
$ANOVA
```

```
Response : HR
```

```
Df Sum Sq Mean Sq F value Pr(>F)
```

MODEL	29	6408.7	220.99	3.912	3.127e-05	***
RESIDUALS	42	2372.6	56.49			
CORRECTED TOTAL	71	8781.3				

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SEQUENCE	5	508.9	101.79	1.8019	0.133346
SEQUENCE:PATIENT	18	4692.3	260.69	4.6147	2.21e-05 ***
VISIT	2	146.8	73.39	1.2991	0.283499
DRUG	2	668.8	334.39	5.9194	0.005435 **
RESIDS	1	391.0	391.02	6.9219	0.011854 *
RESIDT	1	0.8	0.84	0.0149	0.903511

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SEQUENCE	5	701.2	140.237	2.4825	0.04665 *
SEQUENCE:PATIENT	18	4692.3	260.685	4.6147	2.21e-05 ***
VISIT	2	146.8	73.389	1.2991	0.28350
DRUG	2	344.0	171.975	3.0443	0.05826 .
RESIDS	1	309.2	309.174	5.4731	0.02414 *
RESIDT	1	0.8	0.840	0.0149	0.90351

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SEQUENCE	5	701.2	140.237	2.4825	0.04665 *
SEQUENCE:PATIENT	18	4692.3	260.685	4.6147	2.21e-05 ***
VISIT	2	146.8	73.389	1.2991	0.28350
DRUG	2	343.9	171.975	3.0443	0.05826 .
RESIDS	1	309.2	309.174	5.4731	0.02414 *
RESIDT	1	0.8	0.840	0.0149	0.90351

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	88.000	0	4.7287	42	18.6097	< 2.2e-16 ***
SEQUENCEA	6.208	0	6.2319	42	0.9962	0.3248514
SEQUENCEB	-19.333	0	6.1368	42	-3.1504	0.0030025 **
SEQUENCEC	-0.479	0	6.2319	42	-0.0769	0.9390770
SEQUENCED	-1.813	0	6.2319	42	-0.2908	0.7726044
SEQUENCEE	-5.792	0	6.2319	42	-0.9294	0.3580166
SEQUENCEF	0.000	0	0.0000	42		

SEQUENCEA:PATIENT1		0				
SEQUENCEA:PATIENT2		0				
SEQUENCEA:PATIENT3		0				
SEQUENCEA:PATIENT4		0				
SEQUENCEA:PATIENT5		0				
SEQUENCEA:PATIENT6		0				
SEQUENCEA:PATIENT7	-4.000	0	6.1368	42	-0.6518	0.5180764
SEQUENCEA:PATIENT8	-29.333	0	6.1368	42	-4.7799	2.168e-05 ***
SEQUENCEA:PATIENT9		0				
SEQUENCEA:PATIENT10		0				
SEQUENCEA:PATIENT11		0				
SEQUENCEA:PATIENT12		0				
SEQUENCEA:PATIENT13		0				
SEQUENCEA:PATIENT14		0				
SEQUENCEA:PATIENT15	-13.333	0	6.1368	42	-2.1727	0.0354954 *
SEQUENCEA:PATIENT16		0				
SEQUENCEA:PATIENT17	0.000	0	0.0000	42		
SEQUENCEA:PATIENT18		0				
SEQUENCEA:PATIENT19		0				
SEQUENCEA:PATIENT20		0				
SEQUENCEA:PATIENT21		0				
SEQUENCEA:PATIENT22		0				
SEQUENCEA:PATIENT23		0				
SEQUENCEA:PATIENT24		0				
SEQUENCEB:PATIENT1	24.000	0	6.1368	42	3.9108	0.0003299 ***
SEQUENCEB:PATIENT2		0				
SEQUENCEB:PATIENT3	17.333	0	6.1368	42	2.8245	0.0072135 **
SEQUENCEB:PATIENT4		0				
SEQUENCEB:PATIENT5		0				
SEQUENCEB:PATIENT6	13.333	0	6.1368	42	2.1727	0.0354954 *
SEQUENCEB:PATIENT7		0				
SEQUENCEB:PATIENT8		0				
SEQUENCEB:PATIENT9		0				
SEQUENCEB:PATIENT10		0				
SEQUENCEB:PATIENT11		0				
SEQUENCEB:PATIENT12		0				
SEQUENCEB:PATIENT13		0				
SEQUENCEB:PATIENT14		0				
SEQUENCEB:PATIENT15		0				
SEQUENCEB:PATIENT16		0				
SEQUENCEB:PATIENT17		0				
SEQUENCEB:PATIENT18		0				
SEQUENCEB:PATIENT19		0				
SEQUENCEB:PATIENT20	0.000	0	0.0000	42		
SEQUENCEB:PATIENT21		0				
SEQUENCEB:PATIENT22		0				
SEQUENCEB:PATIENT23		0				
SEQUENCEB:PATIENT24		0				

SEQUENCEC:PATIENT1		0				
SEQUENCEC:PATIENT2		0				
SEQUENCEC:PATIENT3		0				
SEQUENCEC:PATIENT4		0				
SEQUENCEC:PATIENT5	-13.333	0	6.1368	42	-2.1727	0.0354954 *
SEQUENCEC:PATIENT6		0				
SEQUENCEC:PATIENT7		0				
SEQUENCEC:PATIENT8		0				
SEQUENCEC:PATIENT9		0				
SEQUENCEC:PATIENT10	-10.667	0	6.1368	42	-1.7382	0.0895112 .
SEQUENCEC:PATIENT11		0				
SEQUENCEC:PATIENT12		0				
SEQUENCEC:PATIENT13		0				
SEQUENCEC:PATIENT14		0				
SEQUENCEC:PATIENT15		0				
SEQUENCEC:PATIENT16		0				
SEQUENCEC:PATIENT17		0				
SEQUENCEC:PATIENT18		0				
SEQUENCEC:PATIENT19		0				
SEQUENCEC:PATIENT20		0				
SEQUENCEC:PATIENT21	9.333	0	6.1368	42	1.5209	0.1357823
SEQUENCEC:PATIENT22	0.000	0	0.0000	42		
SEQUENCEC:PATIENT23		0				
SEQUENCEC:PATIENT24		0				
SEQUENCED:PATIENT1		0				
SEQUENCED:PATIENT2		0				
SEQUENCED:PATIENT3		0				
SEQUENCED:PATIENT4	6.000	0	6.1368	42	0.9777	0.3338152
SEQUENCED:PATIENT5		0				
SEQUENCED:PATIENT6		0				
SEQUENCED:PATIENT7		0				
SEQUENCED:PATIENT8		0				
SEQUENCED:PATIENT9	7.333	0	6.1368	42	1.1950	0.2387989
SEQUENCED:PATIENT10		0				
SEQUENCED:PATIENT11		0				
SEQUENCED:PATIENT12		0				
SEQUENCED:PATIENT13	0.667	0	6.1368	42	0.1086	0.9140096
SEQUENCED:PATIENT14		0				
SEQUENCED:PATIENT15		0				
SEQUENCED:PATIENT16		0				
SEQUENCED:PATIENT17		0				
SEQUENCED:PATIENT18		0				
SEQUENCED:PATIENT19		0				
SEQUENCED:PATIENT20		0				
SEQUENCED:PATIENT21		0				
SEQUENCED:PATIENT22		0				
SEQUENCED:PATIENT23		0				
SEQUENCED:PATIENT24	0.000	0	0.0000	42		

SEQUENCEE: PATIENT1		0				
SEQUENCEE: PATIENT2		0				
SEQUENCEE: PATIENT3		0				
SEQUENCEE: PATIENT4		0				
SEQUENCEE: PATIENT5		0				
SEQUENCEE: PATIENT6		0				
SEQUENCEE: PATIENT7		0				
SEQUENCEE: PATIENT8		0				
SEQUENCEE: PATIENT9		0				
SEQUENCEE: PATIENT10		0				
SEQUENCEE: PATIENT11		0				
SEQUENCEE: PATIENT12	12.000	0	6.1368	42	1.9554	0.0572081 .
SEQUENCEE: PATIENT13		0				
SEQUENCEE: PATIENT14		0				
SEQUENCEE: PATIENT15		0				
SEQUENCEE: PATIENT16	13.333	0	6.1368	42	2.1727	0.0354954 *
SEQUENCEE: PATIENT17		0				
SEQUENCEE: PATIENT18		0				
SEQUENCEE: PATIENT19	-0.667	0	6.1368	42	-0.1086	0.9140096
SEQUENCEE: PATIENT20		0				
SEQUENCEE: PATIENT21		0				
SEQUENCEE: PATIENT22		0				
SEQUENCEE: PATIENT23	0.000	0	0.0000	42		
SEQUENCEE: PATIENT24		0				
SEQUENCEF: PATIENT1		0				
SEQUENCEF: PATIENT2	-18.667	0	6.1368	42	-3.0418	0.0040426 **
SEQUENCEF: PATIENT3		0				
SEQUENCEF: PATIENT4		0				
SEQUENCEF: PATIENT5		0				
SEQUENCEF: PATIENT6		0				
SEQUENCEF: PATIENT7		0				
SEQUENCEF: PATIENT8		0				
SEQUENCEF: PATIENT9		0				
SEQUENCEF: PATIENT10		0				
SEQUENCEF: PATIENT11	-8.000	0	6.1368	42	-1.3036	0.1994653
SEQUENCEF: PATIENT12		0				
SEQUENCEF: PATIENT13		0				
SEQUENCEF: PATIENT14	-2.000	0	6.1368	42	-0.3259	0.7461154
SEQUENCEF: PATIENT15		0				
SEQUENCEF: PATIENT16		0				
SEQUENCEF: PATIENT17		0				
SEQUENCEF: PATIENT18	0.000	0	0.0000	42		
SEQUENCEF: PATIENT19		0				
SEQUENCEF: PATIENT20		0				
SEQUENCEF: PATIENT21		0				
SEQUENCEF: PATIENT22		0				
SEQUENCEF: PATIENT23		0				
SEQUENCEF: PATIENT24		0				

```

VISIT2          -2.583          0      2.1697 42 -1.1907 0.2404762
VISIT3           0.750          0      2.1697 42  0.3457 0.7313138
VISIT4           0.000          0      0.0000 42
DRUGplacebo     -5.938          0      2.4258 42 -2.4477 0.0186398 *
DRUGstandard    -3.625          0      2.4258 42 -1.4944 0.1425553
DRUGtest         0.000          0      0.0000 42
RESIDS          -4.396          1      1.8790 42 -2.3395 0.0241414 *
RESIDT           0.229          1      1.8790 42  0.1220 0.9035106

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(HR ~ SEQUENCE + PATIENT %in% SEQUENCE + VISIT + DRUG + RESIDS + RESIDT,
          p403), type=3, singular.ok=TRUE) # NOT OK

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: HR

	Sum Sq	Df	F values	Pr(>F)
SEQUENCE	0.0	0		
VISIT	146.8	2	1.2991	0.28350
DRUG	344.0	2	3.0443	0.05826 .
RESIDS	309.2	1	5.4731	0.02414 *
RESIDT	0.8	1	0.0149	0.90351
SEQUENCE:PATIENT	4692.3	18	4.6147	2.21e-05 ***
Residuals	2372.6	42		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 4.2 p417

(4) MODEL

```

p417 = read.table("http://r.acr.kr/sas4lm/p417.txt", header=TRUE)
p417 = af(p417, c("TRT", "POT", "PLANT"))
p417

```

	Obs	TRT	POT	PLANT	Y
1	1	1	1	1	15
2	2	1	1	2	13
3	3	1	1	3	16
4	4	1	2	1	17

5	5	1	2	2	19
6	6	1	3	1	12
7	7	2	1	1	20
8	8	2	1	2	21
9	9	2	2	1	20
10	10	2	2	2	23
11	11	2	2	3	19
12	12	2	2	4	19
13	13	3	1	1	12
14	14	3	1	2	13
15	15	3	1	3	14
16	16	3	2	1	11
17	17	3	3	1	12
18	18	3	3	2	13
19	19	3	3	3	15
20	20	3	3	4	11
21	21	3	3	5	9

GLM(Y ~ TRT + POT %in% TRT, p417) # *p418 Output 11.28*

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	267.226	38.175	12.433	7.522e-05 ***
RESIDUALS	13	39.917	3.071		
CORRECTED TOTAL	20	307.143			

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
TRT	2	236.921	118.460	38.580	3.412e-06 ***
TRT:POT	5	30.306	6.061	1.974	0.1499

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
TRT	2	236.921	118.460	38.580	3.412e-06 ***
TRT:POT	5	30.306	6.061	1.974	0.1499

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
TRT	2	200.111	100.055	32.586	8.626e-06 ***
TRT:POT	5	30.306	6.061	1.974	0.1499

```

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
      Estimate Estimable Std. Error Df t value Pr(>|t|)
(Intercept) 12.0000      0    0.78365 13 15.3130 1.070e-09 ***
TRT1         0.0000      0    1.91954 13  0.0000  1.00000
TRT2         8.2500      0    1.17547 13  7.0185 9.087e-06 ***
TRT3         0.0000      0    0.00000 13
TRT1:POT1    2.6667      0    2.02337 13  1.3179  0.21028
TRT1:POT2    6.0000      0    2.14611 13  2.7958  0.01515 *
TRT1:POT3    0.0000      0    0.00000 13
TRT2:POT1    0.2500      0    1.51753 13  0.1647  0.87168
TRT2:POT2    0.0000      0    0.00000 13
TRT2:POT3    0.0000      0
TRT3:POT1    1.0000      0    1.27969 13  0.7814  0.44854
TRT3:POT2   -1.0000      0    1.91954 13 -0.5210  0.61115
TRT3:POT3    0.0000      0    0.00000 13
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ TRT + POT %in% TRT, p417), type=3, singular.ok=TRUE) # NOT OK

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

```

Response: Y
      Sum Sq Df F values Pr(>F)
TRT      22.310  1    7.266 0.01835 *
TRT:POT   30.306  5    1.974 0.14991
Residuals 39.917 13
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

### 4.3 p431

(5) MODEL

```

p431 = read.table("http://r.acr.kr/sas4lm/p431.txt", header=TRUE)
p431 = af(p431, c("line", "sire", "agedam", "steerno"))
p431

```



	Obs	line	sire	agedam	steerno	age	intlwt	avdlygn
1	1	1	1	3	1	192	390	2.24
2	2	1	1	3	2	154	403	2.65
3	3	1	1	4	3	185	432	2.41
4	4	1	1	4	4	193	457	2.25
5	5	1	1	5	5	186	483	2.58
6	6	1	1	5	6	177	469	2.67
7	7	1	1	5	7	177	428	2.71
8	8	1	1	5	8	163	439	2.47
9	9	1	2	4	9	188	439	2.29
10	10	1	2	4	10	178	407	2.26
11	11	1	2	5	11	198	498	1.97
12	12	1	2	5	12	193	459	2.14
13	13	1	2	5	13	186	459	2.44
14	14	1	2	5	14	175	375	2.52
15	15	1	2	5	15	171	382	1.72
16	16	1	2	5	16	168	417	2.75
17	17	1	3	3	17	154	389	2.38
18	18	1	3	4	18	184	414	2.46
19	19	1	3	5	19	174	483	2.29
20	20	1	3	5	20	170	430	2.30
21	21	1	3	5	21	169	443	2.94
22	22	2	4	3	22	158	381	2.50
23	23	2	4	3	23	158	365	2.44
24	24	2	4	4	24	169	386	2.44
25	25	2	4	4	25	144	339	2.15
26	26	2	4	5	26	159	419	2.54
27	27	2	4	5	27	152	469	2.74
28	28	2	4	5	28	149	379	2.50
29	29	2	4	5	29	149	375	2.54
30	30	2	5	3	30	189	395	2.65
31	31	2	5	4	31	187	447	2.52
32	32	2	5	4	32	165	430	2.67
33	33	2	5	5	33	181	453	2.79
34	34	2	5	5	34	177	385	2.33
35	35	2	5	5	35	151	414	2.67
36	36	2	5	5	36	147	353	2.69
37	37	3	6	4	37	184	411	3.00
38	38	3	6	4	38	184	420	2.49
39	39	3	6	5	39	187	427	2.25
40	40	3	6	5	40	184	409	2.49
41	41	3	6	5	41	183	337	2.02
42	42	3	6	5	42	177	352	2.31
43	43	3	7	3	43	205	472	2.57
44	44	3	7	3	44	193	340	2.37
45	45	3	7	4	45	162	375	2.64
46	46	3	7	5	46	206	451	2.37
47	47	3	7	5	47	205	472	2.22

48	48	3	7	5	48	187	402	1.90
49	49	3	7	5	49	178	464	2.61
50	50	3	7	5	50	175	414	2.13
51	51	3	8	3	51	200	466	2.16
52	52	3	8	3	52	184	356	2.33
53	53	3	8	3	53	175	449	2.52
54	54	3	8	4	54	178	360	2.45
55	55	3	8	5	55	189	385	1.44
56	56	3	8	5	56	184	431	1.72
57	57	3	8	5	57	183	401	2.17
58	58	3	9	3	58	166	404	2.68
59	59	3	9	4	59	187	482	2.43
60	60	3	9	4	60	186	350	2.36
61	61	3	9	4	61	184	483	2.44
62	62	3	9	5	62	180	425	2.66
63	63	3	9	5	63	177	420	2.46
64	64	3	9	5	64	175	440	2.52
65	65	3	9	5	65	164	405	2.42

```
GLM(avdlygn ~ line + line:sire + agedam + line:agedam + age + intlwt, p431)
```

```
$ANOVA
```

```
Response : avdlygn
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	16	2.5275	0.157966	3.1437	0.001091 **
RESIDUALS	48	2.4119	0.050248		
CORRECTED TOTAL	64	4.9394			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
line	2	0.38009	0.190046	3.7821	0.02983 *
line:sire	6	0.92634	0.154391	3.0726	0.01260 *
agedam	2	0.11894	0.059471	1.1835	0.31497
line:agedam	4	0.64889	0.162222	3.2284	0.02000 *
age	1	0.18349	0.183487	3.6516	0.06200 .
intlwt	1	0.26970	0.269704	5.3674	0.02483 *

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
line	2	0.05526	0.02763	0.5498	0.580636
line:sire	6	0.97389	0.16231	3.2303	0.009543 **
agedam	2	0.33106	0.16553	3.2943	0.045640 *
line:agedam	4	0.45343	0.11336	2.2560	0.076821 .

```
age          1 0.38128 0.38128 7.5878 0.008277 **
intlwt       1 0.26970 0.26970 5.3674 0.024830 *
```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
line	2	0.13620	0.06810	1.3553	0.267560
line:sire	6	0.97389	0.16231	3.2303	0.009543 **
agedam	2	0.13011	0.06505	1.2946	0.283392
line:agedam	4	0.45343	0.11336	2.2560	0.076821 .
age	1	0.38128	0.38128	7.5878	0.008277 **
intlwt	1	0.26970	0.26970	5.3674	0.024830 *

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	2.99627	0	0.51285	48	5.8423	4.361e-07 ***
line1	0.07182	0	0.14551	48	0.4936	0.623826
line2	0.25247	0	0.13717	48	1.8406	0.071867 .
line3	0.00000	0	0.00000	48		
line1:sire1	0.08573	0	0.13028	48	0.6580	0.513652
line1:sire2	-0.12171	0	0.13622	48	-0.8934	0.376079
line1:sire3	0.00000	0	0.00000	48		
line1:sire4		0				
line1:sire5		0				
line1:sire6		0				
line1:sire7		0				
line1:sire8		0				
line1:sire9		0				
line2:sire1		0				
line2:sire2		0				
line2:sire3		0				
line2:sire4	-0.24460	0	0.12669	48	-1.9307	0.059443 .
line2:sire5	0.00000	0	0.00000	48		
line2:sire6		0				
line2:sire7		0				
line2:sire8		0				
line2:sire9		0				
line3:sire1		0				
line3:sire2		0				
line3:sire3		0				
line3:sire4		0				
line3:sire5		0				
line3:sire6	0.10540	0	0.12909	48	0.8165	0.418267
line3:sire7	-0.01952	0	0.12038	48	-0.1622	0.871856
line3:sire8	-0.33024	0	0.12567	48	-2.6278	0.011504 *

```

line3:sire9      0.00000      0      0.00000 48
agedam3         0.37039      0      0.11456 48  3.2332  0.002216 **
agedam4         0.27546      0      0.10378 48  2.6544  0.010746 *
agedam5         0.00000      0      0.00000 48
line1:agedam3   -0.44894      0      0.19581 48 -2.2927  0.026291 *
line1:agedam4   -0.28283      0      0.16085 48 -1.7584  0.085062 .
line1:agedam5    0.00000      0      0.00000 48
line2:agedam3   -0.26078      0      0.19529 48 -1.3354  0.188050
line2:agedam4   -0.35026      0      0.17439 48 -2.0085  0.050232 .
line2:agedam5    0.00000      0      0.00000 48
line3:agedam3    0.00000      0      0.00000 48
line3:agedam4    0.00000      0      0.00000 48
line3:agedam5    0.00000      0      0.00000 48
age             -0.00853      1      0.00310 48 -2.7546  0.008277 **
intlwt          0.00203      1      0.00087 48  2.3168  0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

*# p433 Output 11.40*

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(avdlygn ~ line + line:sire + agedam + line:agedam + age + intlwt, p431),
      type=3, singular.ok=TRUE) # NOT OK for line

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

```

Response: avdlygn
      Sum Sq Df F values    Pr(>F)
line      0.00000  0
agedam    0.13011  2   1.2946 0.283392
age       0.38128  1   7.5878 0.008277 **
intlwt    0.26970  1   5.3674 0.024830 *
line:sire  0.97389  6   3.2303 0.009543 **
line:agedam 0.45343  4   2.2560 0.076821 .
Residuals 2.41192 48
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

## 5 Sahai - Unbalanced

### Reference

- Sahai H, Ojeda MM. Analysis of Variance for Random Models Volume 2 Unbalanced Data. 2005.

### 5.1 Table 15.3

(6) MODEL

```
T15.3 = read.table("http://r.acr.kr/sahai/T15.3.txt")
colnames(T15.3) = c("Dam", "Sire", "pH")
T15.3 = af(T15.3, c("Dam", "Sire"))
T15.3
```

	Dam	Sire	pH
1	1	1	7.48
2	1	1	7.48
3	1	1	7.52
4	1	1	7.54
5	6	1	7.54
6	6	1	7.36
7	6	1	7.36
8	6	1	7.40
9	11	1	7.52
10	11	1	7.54
11	11	1	7.52
12	11	1	7.56
13	11	1	7.53
14	1	2	7.48
15	1	2	7.53
16	1	2	7.43
17	1	2	7.39
18	6	2	7.44
19	6	2	7.47
20	6	2	7.48
21	6	2	7.48
22	11	2	7.56
23	11	2	7.39
24	11	2	7.52
25	11	2	7.49
26	11	2	7.48
27	2	1	7.45
28	2	1	7.43
29	2	1	7.49
30	2	1	7.40

31	2	1 7.40
32	6	3 7.43
33	6	3 7.52
34	6	3 7.50
35	6	3 7.46
36	6	3 7.39
37	12	1 7.50
38	12	1 7.45
39	12	1 7.43
40	12	1 7.44
41	12	1 7.49
42	2	2 7.50
43	2	2 7.45
44	2	2 7.43
45	2	2 7.36
46	7	1 7.41
47	7	1 7.42
48	7	1 7.36
49	7	1 7.47
50	12	2 7.52
51	12	2 7.43
52	12	2 7.38
53	12	2 7.33
54	3	1 7.40
55	3	1 7.45
56	3	1 7.42
57	3	1 7.48
58	7	2 7.47
59	7	2 7.36
60	7	2 7.43
61	7	2 7.38
62	7	2 7.41
63	13	1 7.39
64	13	1 7.37
65	13	1 7.33
66	13	1 7.43
67	13	1 7.42
68	3	2 7.45
69	3	2 7.33
70	3	2 7.40
71	3	2 7.46
72	7	3 7.53
73	7	3 7.40
74	7	3 7.44
75	7	3 7.40
76	7	3 7.45
77	13	2 7.43
78	13	2 7.38

79	13	2 7.44
80	3	3 7.40
81	3	3 7.47
82	3	3 7.40
83	3	3 7.47
84	3	3 7.47
85	8	1 7.52
86	8	1 7.53
87	8	1 7.48
88	13	3 7.46
89	13	3 7.44
90	13	3 7.37
91	13	3 7.54
92	4	1 7.38
93	4	1 7.48
94	4	1 7.46
95	8	2 7.40
96	8	2 7.48
97	8	2 7.50
98	8	2 7.40
99	8	2 7.51
100	14	1 7.50
101	14	1 7.53
102	14	1 7.51
103	14	1 7.43
104	4	2 7.37
105	4	2 7.31
106	4	2 7.45
107	4	2 7.41
108	9	1 7.40
109	9	1 7.34
110	9	1 7.37
111	9	1 7.45
112	14	2 7.44
113	14	2 7.45
114	14	2 7.39
115	14	2 7.52
116	5	1 7.44
117	5	1 7.51
118	5	1 7.49
119	5	1 7.51
120	5	1 7.52
121	9	2 7.42
122	9	2 7.37
123	9	2 7.46
124	9	2 7.40
125	14	3 7.42
126	14	3 7.48

127	14	3	7.45
128	14	3	7.51
129	14	3	7.48
130	5	2	7.49
131	5	2	7.49
132	5	2	7.49
133	5	2	7.50
134	10	1	7.39
135	10	1	7.31
136	10	1	7.30
137	10	1	7.41
138	10	1	7.48
139	15	1	7.47
140	15	1	7.49
141	15	1	7.45
142	15	1	7.43
143	15	1	7.42
144	5	3	7.48
145	5	3	7.59
146	5	3	7.59
147	10	2	7.50
148	10	2	7.44
149	10	2	7.40
150	10	2	7.45
151	15	2	7.45
152	15	2	7.42
153	15	2	7.52
154	15	2	7.51
155	15	2	7.32
156	15	3	7.51
157	15	3	7.51
158	15	3	7.53
159	15	3	7.45
160	15	3	7.51

```
GLM(pH ~ Dam/Sire, T15.3) # p301
```

```
$ANOVA
```

```
Response : pH
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	36	0.25804	0.0071678	2.8977	7.2e-06 ***
RESIDUALS	123	0.30425	0.0024736		
CORRECTED TOTAL	159	0.56229			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```



	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Dam	14	0.178017	0.0127155	5.1405	1.563e-07 ***
Dam:Sire	22	0.080024	0.0036374	1.4705	0.09662 .

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Dam	14	0.178017	0.0127155	5.1405	1.563e-07 ***
Dam:Sire	22	0.080024	0.0036374	1.4705	0.09662 .

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Dam	14	0.179405	0.0128146	5.1805	1.347e-07 ***
Dam:Sire	22	0.080024	0.0036374	1.4705	0.09662 .

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	7.5020	0	0.022242	123	337.2849	< 2.2e-16 ***
Dam1	-0.0445	0	0.033363	123	-1.3338	0.1847360
Dam2	-0.0670	0	0.033363	123	-2.0082	0.0468144 *
Dam3	-0.0600	0	0.031455	123	-1.9075	0.0587923 .
Dam4	-0.1170	0	0.033363	123	-3.5068	0.0006338 ***
Dam5	0.0513	0	0.036322	123	1.4133	0.1600927
Dam6	-0.0420	0	0.031455	123	-1.3352	0.1842689
Dam7	-0.0580	0	0.031455	123	-1.8439	0.0676071 .
Dam8	-0.0440	0	0.031455	123	-1.3988	0.1643876
Dam9	-0.0895	0	0.033363	123	-2.6826	0.0083104 **
Dam10	-0.0545	0	0.033363	123	-1.6335	0.1049163
Dam11	-0.0140	0	0.031455	123	-0.4451	0.6570480
Dam12	-0.0870	0	0.033363	123	-2.6076	0.0102452 *
Dam13	-0.0495	0	0.033363	123	-1.4837	0.1404576
Dam14	-0.0340	0	0.031455	123	-1.0809	0.2818582
Dam15	0.0000	0	0.000000	123		
Dam1:Sire1	0.0475	0	0.035168	123	1.3507	0.1792866
Dam1:Sire2	0.0000	0	0.000000	123		
Dam1:Sire3		0				
Dam2:Sire1	-0.0010	0	0.033363	123	-0.0300	0.9761373
Dam2:Sire2	0.0000	0	0.000000	123		
Dam2:Sire3		0				
Dam3:Sire1	-0.0045	0	0.033363	123	-0.1349	0.8929288
Dam3:Sire2	-0.0320	0	0.033363	123	-0.9591	0.3393736
Dam3:Sire3	0.0000	0	0.000000	123		
Dam4:Sire1	0.0550	0	0.037986	123	1.4479	0.1501886

Dam4:Sire2	0.0000	0	0.000000	123		
Dam4:Sire3		0				
Dam5:Sire1	-0.0593	0	0.036322	123	-1.6336	0.1049091
Dam5:Sire2	-0.0608	0	0.037986	123	-1.6015	0.1118387
Dam5:Sire3	0.0000	0	0.000000	123		
Dam6:Sire1	-0.0450	0	0.033363	123	-1.3488	0.1798857
Dam6:Sire2	0.0075	0	0.033363	123	0.2248	0.8225105
Dam6:Sire3	0.0000	0	0.000000	123		
Dam7:Sire1	-0.0290	0	0.033363	123	-0.8692	0.3864232
Dam7:Sire2	-0.0340	0	0.031455	123	-1.0809	0.2818582
Dam7:Sire3	0.0000	0	0.000000	123		
Dam8:Sire1	0.0520	0	0.036322	123	1.4317	0.1547783
Dam8:Sire2	0.0000	0	0.000000	123		
Dam8:Sire3		0				
Dam9:Sire1	-0.0225	0	0.035168	123	-0.6398	0.5235039
Dam9:Sire2	0.0000	0	0.000000	123		
Dam9:Sire3		0				
Dam10:Sire1	-0.0695	0	0.033363	123	-2.0831	0.0393121 *
Dam10:Sire2	0.0000	0	0.000000	123		
Dam10:Sire3		0				
Dam11:Sire1	0.0460	0	0.031455	123	1.4624	0.1461852
Dam11:Sire2	0.0000	0	0.000000	123		
Dam11:Sire3		0				
Dam12:Sire1	0.0470	0	0.033363	123	1.4087	0.1614391
Dam12:Sire2	0.0000	0	0.000000	123		
Dam12:Sire3		0				
Dam13:Sire1	-0.0645	0	0.033363	123	-1.9333	0.0555032 .
Dam13:Sire2	-0.0358	0	0.037986	123	-0.9433	0.3473613
Dam13:Sire3	0.0000	0	0.000000	123		
Dam14:Sire1	0.0245	0	0.033363	123	0.7343	0.4641417
Dam14:Sire2	-0.0180	0	0.033363	123	-0.5395	0.5905089
Dam14:Sire3	0.0000	0	0.000000	123		
Dam15:Sire1	-0.0500	0	0.031455	123	-1.5896	0.1145028
Dam15:Sire2	-0.0580	0	0.031455	123	-1.8439	0.0676071 .
Dam15:Sire3	0.0000	0	0.000000	123		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(pH ~ Dam/Sire, T15.3), type=3, singular.ok=TRUE) # NOT OK
```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: pH

	Sum Sq	Df	F values	Pr(>F)	
Dam	0.081011	6	5.4584	4.898e-05	***
Dam:Sire	0.080024	22	1.4705	0.09662	.
Residuals	0.304253	123			

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 5.2 Table 16.3

(7) MODEL

```
T16.3 = read.csv("http://r.acr.kr/sahai/T16.3.csv")
colnames(T16.3) = c("Plot", "Sample", "Subsample", "Residue")
T16.3 = af(T16.3, c("Plot", "Sample", "Subsample"))
T16.3
```

	Plot	Sample	Subsample	Residue
1	1	1	1	0.52
2	1	1	1	0.43
3	1	1	2	0.40
4	1	1	2	0.52
5	1	2	1	0.26
6	1	2	2	0.54
7	1	3	1	0.52
8	2	1	1	0.50
9	2	1	1	0.59
10	2	1	2	0.47
11	2	1	2	0.50
12	2	2	1	0.04
13	2	2	2	0.43
14	2	3	1	1.08
15	3	1	1	0.34
16	3	1	1	0.26
17	3	1	2	0.32
18	3	1	2	0.45
19	3	2	1	0.25
20	3	2	2	0.38
21	3	3	1	0.29
22	4	1	1	0.18
23	4	1	1	0.24
24	4	1	2	0.31
25	4	1	2	0.29
26	4	2	1	0.13
27	4	2	2	0.25
28	4	3	1	0.10
29	5	1	1	1.05
30	5	1	1	0.66

31	5	1	2	0.60
32	5	1	2	0.51
33	5	2	1	0.95
34	5	2	2	0.84
35	5	3	1	0.92
36	6	1	1	0.52
37	6	1	1	0.66
38	6	1	2	0.55
39	6	1	2	0.40
40	6	2	1	0.33
41	6	2	2	0.26
42	6	3	1	0.41
43	7	1	1	0.77
44	7	1	1	0.56
45	7	1	2	0.51
46	7	1	2	0.60
47	7	2	1	0.44
48	7	2	2	0.50
49	7	3	1	0.44
50	8	1	1	0.89
51	8	1	1	0.92
52	8	1	2	0.75
53	8	1	2	0.58
54	8	2	1	0.64
55	8	2	2	0.54
56	8	3	1	0.36
57	9	1	1	0.50
58	9	1	1	0.67
59	9	1	2	0.60
60	9	1	2	0.53
61	9	2	1	0.60
62	9	2	2	0.71
63	9	3	1	0.92
64	10	1	1	0.58
65	10	1	1	0.52
66	10	1	2	0.56
67	10	1	2	0.44
68	10	2	1	0.46
69	10	2	2	0.52
70	10	3	1	0.52
71	11	1	1	0.24
72	11	1	1	0.36
73	11	1	2	0.48
74	11	1	2	0.30
75	11	2	1	0.53
76	11	2	2	0.50
77	11	3	1	0.39

```
GLM(Residue ~ Plot/Sample/Subsample, T16.3) # p344
```

```
$ANOVA
```

```
Response : Residue
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	54	3.1897	0.059069	5.8842	1.476e-05 ***
RESIDUALS	22	0.2208	0.010039		
CORRECTED TOTAL	76	3.4106			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Plot	10	1.84041	0.184041	18.3332	1.929e-08 ***
Plot:Sample	22	0.99175	0.045079	4.4906	0.0004209 ***
Plot:Sample:Subsample	22	0.35757	0.016253	1.6191	0.1330632

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Plot	10	1.84041	0.184041	18.3332	1.929e-08 ***
Plot:Sample	22	0.99175	0.045079	4.4906	0.0004209 ***
Plot:Sample:Subsample	22	0.35757	0.016253	1.6191	0.1330632

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Plot	10	1.78686	0.178686	17.7998	2.547e-08 ***
Plot:Sample	22	0.99175	0.045079	4.4906	0.0004209 ***
Plot:Sample:Subsample	22	0.35757	0.016253	1.6191	0.1330632

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
```

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	0.390	0	0.10019	22	3.8925	0.0007836 ***
Plot1	0.130	0	0.14169	22	0.9175	0.3688465
Plot2	0.690	0	0.14169	22	4.8696	7.227e-05 ***
Plot3	-0.100	0	0.14169	22	-0.7057	0.4877535
Plot4	-0.290	0	0.14169	22	-2.0467	0.0528230 .
Plot5	0.530	0	0.14169	22	3.7404	0.0011335 **
Plot6	0.020	0	0.14169	22	0.1411	0.8890368
Plot7	0.050	0	0.14169	22	0.3529	0.7275426
Plot8	-0.030	0	0.14169	22	-0.2117	0.8342720
Plot9	0.530	0	0.14169	22	3.7404	0.0011335 **

Plot10	0.130	0	0.14169	22	0.9175	0.3688465	
Plot11	0.000	0	0.00000	22			
Plot1:Sample1	-0.060	0	0.12271	22	-0.4890	0.6297131	
Plot1:Sample2	0.020	0	0.14169	22	0.1411	0.8890368	
Plot1:Sample3	0.000	0	0.00000	22			
Plot2:Sample1	-0.595	0	0.12271	22	-4.8488	7.603e-05	***
Plot2:Sample2	-0.650	0	0.14169	22	-4.5873	0.0001437	***
Plot2:Sample3	0.000	0	0.00000	22			
Plot3:Sample1	0.095	0	0.12271	22	0.7742	0.4470663	
Plot3:Sample2	0.090	0	0.14169	22	0.6352	0.5318688	
Plot3:Sample3	0.000	0	0.00000	22			
Plot4:Sample1	0.200	0	0.12271	22	1.6298	0.1173694	
Plot4:Sample2	0.150	0	0.14169	22	1.0586	0.3012597	
Plot4:Sample3	0.000	0	0.00000	22			
Plot5:Sample1	-0.365	0	0.12271	22	-2.9745	0.0069960	**
Plot5:Sample2	-0.080	0	0.14169	22	-0.5646	0.5780606	
Plot5:Sample3	0.000	0	0.00000	22			
Plot6:Sample1	0.065	0	0.12271	22	0.5297	0.6016249	
Plot6:Sample2	-0.150	0	0.14169	22	-1.0586	0.3012597	
Plot6:Sample3	0.000	0	0.00000	22			
Plot7:Sample1	0.115	0	0.12271	22	0.9372	0.3588500	
Plot7:Sample2	0.060	0	0.14169	22	0.4234	0.6760804	
Plot7:Sample3	0.000	0	0.00000	22			
Plot8:Sample1	0.305	0	0.12271	22	2.4855	0.0210209	*
Plot8:Sample2	0.180	0	0.14169	22	1.2703	0.2172344	
Plot8:Sample3	0.000	0	0.00000	22			
Plot9:Sample1	-0.355	0	0.12271	22	-2.8930	0.0084403	**
Plot9:Sample2	-0.210	0	0.14169	22	-1.4821	0.1525064	
Plot9:Sample3	0.000	0	0.00000	22			
Plot10:Sample1	-0.020	0	0.12271	22	-0.1630	0.8720183	
Plot10:Sample2	0.000	0	0.14169	22	0.0000	1.0000000	
Plot10:Sample3	0.000	0	0.00000	22			
Plot11:Sample1	0.000	0	0.12271	22	0.0000	1.0000000	
Plot11:Sample2	0.110	0	0.14169	22	0.7763	0.4458271	
Plot11:Sample3	0.000	0	0.00000	22			
Plot1:Sample1:Subsample1	0.015	0	0.10019	22	0.1497	0.8823566	
Plot1:Sample1:Subsample2	0.000	0	0.00000	22			
Plot1:Sample2:Subsample1	-0.280	0	0.14169	22	-1.9761	0.0608176	.
Plot1:Sample2:Subsample2	0.000	0	0.00000	22			
Plot1:Sample3:Subsample1	0.000	0	0.00000	22			
Plot1:Sample3:Subsample2		0					
Plot2:Sample1:Subsample1	0.060	0	0.10019	22	0.5988	0.5553935	
Plot2:Sample1:Subsample2	0.000	0	0.00000	22			
Plot2:Sample2:Subsample1	-0.390	0	0.14169	22	-2.7524	0.0116232	*
Plot2:Sample2:Subsample2	0.000	0	0.00000	22			
Plot2:Sample3:Subsample1	0.000	0	0.00000	22			
Plot2:Sample3:Subsample2		0					
Plot3:Sample1:Subsample1	-0.085	0	0.10019	22	-0.8484	0.4053723	

Plot3:Sample1:Subsample2	0.000	0	0.00000	22			
Plot3:Sample2:Subsample1	-0.130	0	0.14169	22	-0.9175	0.3688465	
Plot3:Sample2:Subsample2	0.000	0	0.00000	22			
Plot3:Sample3:Subsample1	0.000	0	0.00000	22			
Plot3:Sample3:Subsample2		0					
Plot4:Sample1:Subsample1	-0.090	0	0.10019	22	-0.8983	0.3787697	
Plot4:Sample1:Subsample2	0.000	0	0.00000	22			
Plot4:Sample2:Subsample1	-0.120	0	0.14169	22	-0.8469	0.4061732	
Plot4:Sample2:Subsample2	0.000	0	0.00000	22			
Plot4:Sample3:Subsample1	0.000	0	0.00000	22			
Plot4:Sample3:Subsample2		0					
Plot5:Sample1:Subsample1	0.300	0	0.10019	22	2.9942	0.0066835	**
Plot5:Sample1:Subsample2	0.000	0	0.00000	22			
Plot5:Sample2:Subsample1	0.110	0	0.14169	22	0.7763	0.4458271	
Plot5:Sample2:Subsample2	0.000	0	0.00000	22			
Plot5:Sample3:Subsample1	0.000	0	0.00000	22			
Plot5:Sample3:Subsample2		0					
Plot6:Sample1:Subsample1	0.115	0	0.10019	22	1.1478	0.2633860	
Plot6:Sample1:Subsample2	0.000	0	0.00000	22			
Plot6:Sample2:Subsample1	0.070	0	0.14169	22	0.4940	0.6261876	
Plot6:Sample2:Subsample2	0.000	0	0.00000	22			
Plot6:Sample3:Subsample1	0.000	0	0.00000	22			
Plot6:Sample3:Subsample2		0					
Plot7:Sample1:Subsample1	0.110	0	0.10019	22	1.0979	0.2841276	
Plot7:Sample1:Subsample2	0.000	0	0.00000	22			
Plot7:Sample2:Subsample1	-0.060	0	0.14169	22	-0.4234	0.6760804	
Plot7:Sample2:Subsample2	0.000	0	0.00000	22			
Plot7:Sample3:Subsample1	0.000	0	0.00000	22			
Plot7:Sample3:Subsample2		0					
Plot8:Sample1:Subsample1	0.240	0	0.10019	22	2.3954	0.0255487	*
Plot8:Sample1:Subsample2	0.000	0	0.00000	22			
Plot8:Sample2:Subsample1	0.100	0	0.14169	22	0.7057	0.4877535	
Plot8:Sample2:Subsample2	0.000	0	0.00000	22			
Plot8:Sample3:Subsample1	0.000	0	0.00000	22			
Plot8:Sample3:Subsample2		0					
Plot9:Sample1:Subsample1	0.020	0	0.10019	22	0.1996	0.8436154	
Plot9:Sample1:Subsample2	0.000	0	0.00000	22			
Plot9:Sample2:Subsample1	-0.110	0	0.14169	22	-0.7763	0.4458271	
Plot9:Sample2:Subsample2	0.000	0	0.00000	22			
Plot9:Sample3:Subsample1	0.000	0	0.00000	22			
Plot9:Sample3:Subsample2		0					
Plot10:Sample1:Subsample1	0.050	0	0.10019	22	0.4990	0.6227069	
Plot10:Sample1:Subsample2	0.000	0	0.00000	22			
Plot10:Sample2:Subsample1	-0.060	0	0.14169	22	-0.4234	0.6760804	
Plot10:Sample2:Subsample2	0.000	0	0.00000	22			
Plot10:Sample3:Subsample1	0.000	0	0.00000	22			
Plot10:Sample3:Subsample2		0					
Plot11:Sample1:Subsample1	-0.090	0	0.10019	22	-0.8983	0.3787697	

```

Plot11:Sample1:Subsample2    0.000          0    0.00000 22
Plot11:Sample2:Subsample1    0.030          0    0.14169 22  0.2117 0.8342720
Plot11:Sample2:Subsample2    0.000          0    0.00000 22
Plot11:Sample3:Subsample1    0.000          0    0.00000 22
Plot11:Sample3:Subsample2          0

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```

options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(Residue ~ Plot/Sample/Subsample, T16.3), type=3, singular.ok=TRUE)

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Residue

	Sum Sq	Df	F values	Pr(>F)
Plot	0.00000	0		
Plot:Sample	0.36613	11	3.3156	0.00805 **
Plot:Sample:Subsample	0.35758	22	1.6191	0.13306
Residuals	0.22085	22		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

*# NOT OK*



## 6 Federer - Variations

### Reference

- Federer WT, King F. Variations on Split Plot and Split Block Experiment Designs. John Wiley & Sons Inc. 2007.

### 6.1 Example 2.2

(8) MODEL

```
ex2.2 = read.table("http://r.acr.kr/split/sbex2_2.txt", header=TRUE)
ex2.2 = af(ex2.2, c("Row", "Column", "R", "S"))
ex2.2
```

	Row	Column	R	S	Y
1	1		1	1	1027.85
2	1		1	2	982.74
3	1		1	3	1007.24
4	1		1	4	1008.47
5	1		2	1	1004.33
6	1		2	2	977.86
7	1		2	3	999.15
8	1		2	4	990.86
9	1		3	1	992.57
10	1		3	2	993.71
11	1		3	3	1012.57
12	1		3	4	968.25
13	1		4	1	994.60
14	1		4	2	1021.81
15	1		4	3	995.03
16	1		4	4	1002.17
17	1		5	1	1019.89
18	1		5	2	1017.48
19	1		5	3	987.82
20	1		5	4	995.63
21	2		4	1	996.18
22	2		4	2	981.96
23	2		4	3	985.63
24	2		4	4	965.80
25	2		5	1	996.61
26	2		5	2	1011.94
27	2		5	3	972.76
28	2		5	4	1011.99
29	2		2	3	1021.61
30	2		2	3	1014.46

31	2	2 3 3	980.03
32	2	2 3 4	1014.80
33	2	3 4 1	1028.78
34	2	3 4 2	1006.01
35	2	3 4 3	1015.04
36	2	3 4 4	1000.72
37	2	1 5 1	994.91
38	2	1 5 2	999.91
39	2	1 5 3	1010.29
40	2	1 5 4	1018.49
41	3	5 1 1	985.72
42	3	5 1 2	1012.60
43	3	5 1 3	984.62
44	3	5 1 4	973.47
45	3	1 2 1	1013.52
46	3	1 2 2	1017.40
47	3	1 2 3	996.63
48	3	1 2 4	989.91
49	3	4 3 1	1003.92
50	3	4 3 2	999.33
51	3	4 3 3	995.70
52	3	4 3 4	988.14
53	3	2 4 1	1010.08
54	3	2 4 2	997.66
55	3	2 4 3	1012.12
56	3	2 4 4	1019.53
57	3	3 5 1	1004.83
58	3	3 5 2	983.86
59	3	3 5 3	1018.60
60	3	3 5 4	1020.95
61	4	2 1 1	991.79
62	4	2 1 2	979.47
63	4	2 1 3	1004.70
64	4	2 1 4	1032.75
65	4	3 2 1	1004.52
66	4	3 2 2	996.53
67	4	3 2 3	1016.95
68	4	3 2 4	983.79
69	4	1 3 1	990.17
70	4	1 3 2	972.21
71	4	1 3 3	1002.17
72	4	1 3 4	1017.56
73	4	5 4 1	1006.13
74	4	5 4 2	1005.57
75	4	5 4 3	1003.18
76	4	5 4 4	992.21
77	4	4 5 1	1011.02
78	4	4 5 2	982.79

79	4	4 5 3	1018.23
80	4	4 5 4	976.68
81	5	3 1 1	993.54
82	5	3 1 2	1006.80
83	5	3 1 3	1001.24
84	5	3 1 4	1010.73
85	5	4 2 1	985.04
86	5	4 2 2	987.54
87	5	4 2 3	990.53
88	5	4 2 4	982.68
89	5	5 3 1	1012.14
90	5	5 3 2	999.32
91	5	5 3 3	1005.51
92	5	5 3 4	998.86
93	5	1 4 1	985.12
94	5	1 4 2	984.14
95	5	1 4 3	1010.74
96	5	1 4 4	1004.63
97	5	2 5 1	967.39
98	5	2 5 2	1009.78
99	5	2 5 3	1027.49
100	5	2 5 4	1001.61

```
GLM(Y ~ Row + R + S + R:S + Row:R + Column:S + Column:R:S, ex2.2)
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	99	22310	225.36		
RESIDUALS	0	0			
CORRECTED TOTAL	99	22310			

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	4	147.4	36.86		
R	4	1159.8	289.94		
S	3	351.9	117.29		
R:S	12	826.0	68.83		
Row:R	16	3979.8	248.74		
S:Column	12	3863.3	321.94		
R:S:Column	48	11982.3	249.63		

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	0				
R	4	1159.8	289.94		
S	3	351.9	117.29		

R:S	12	826.0	68.83
Row:R	0		
S:Column	12	3863.3	321.94
R:S:Column	48	11982.3	249.63

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	0				
R	4	1159.8	289.94		
S	3	351.9	117.29		
R:S	12	826.0	68.83		
Row:R	0				
S:Column	12	3863.3	321.94		
R:S:Column	48	11982.3	249.63		

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	1001.61	0		0		
Row1	-5.98	0		0		
Row2	16.88	0		0		
Row3	19.34	0		0		
Row4	-24.93	0		0		
Row5	0.00	0		0		
R1	9.12	0		0		
R2	-18.93	0		0		
R3	-2.75	0		0		
R4	3.02	0		0		
R5	0.00	0		0		
S1	24.26	0		0		
S2	21.85	0		0		
S3	-7.81	0		0		
S4	0.00	0		0		
R1:S1	-12.01	0		0		
R1:S2	17.28	0		0		
R1:S3	18.96	0		0		
R1:S4	0.00	0		0		
R2:S1	-39.64	0		0		
R2:S2	-21.90	0		0		
R2:S3	-31.42	0		0		
R2:S4	0.00	0		0		
R3:S1	-10.98	0		0		
R3:S2	-21.39	0		0		
R3:S3	14.46	0		0		
R3:S4	0.00	0		0		
R4:S1	-10.34	0		0		
R4:S2	-8.49	0		0		
R4:S3	18.78	0		0		

R4:S4	0.00	0	0
R5:S1	0.00	0	0
R5:S2	0.00	0	0
R5:S3	0.00	0	0
R5:S4	0.00	0	0
Row1:R1	3.72	0	0
Row1:R2	14.16	0	0
Row1:R3	-24.63	0	0
Row1:R4	3.52	0	0
Row1:R5	0.00	0	0
Row2:R1	-61.81	0	0
Row2:R2	12.43	0	0
Row2:R3	-0.94	0	0
Row2:R4	-20.79	0	0
Row2:R5	0.00	0	0
Row3:R1	-56.60	0	0
Row3:R2	-12.11	0	0
Row3:R3	-30.06	0	0
Row3:R4	-4.44	0	0
Row3:R5	0.00	0	0
Row4:R1	46.95	0	0
Row4:R2	26.04	0	0
Row4:R3	43.63	0	0
Row4:R4	12.51	0	0
Row4:R5	0.00	0	0
Row5:R1	0.00	0	0
Row5:R2	0.00	0	0
Row5:R3	0.00	0	0
Row5:R4	0.00	0	0
Row5:R5	0.00	0	0
S1:Column1	-47.84	0	0
S1:Column2	-58.48	0	0
S1:Column3	-40.38	0	0
S1:Column4	10.08	0	0
S1:Column5	0.00	0	0
S2:Column1	-40.43	0	0
S2:Column2	-13.68	0	0
S2:Column3	-58.94	0	0
S2:Column4	-15.74	0	0
S2:Column5	0.00	0	0
S3:Column1	-0.39	0	0
S3:Column2	33.69	0	0
S3:Column3	5.46	0	0
S3:Column4	49.36	0	0
S3:Column5	0.00	0	0
S4:Column1	0.00	0	0
S4:Column2	0.00	0	0
S4:Column3	0.00	0	0

S4:Column4	0.00	0	0
S4:Column5	0.00	0	0
R1:S1:Column1	54.97	0	0
R1:S1:Column2	5.27	0	0
R1:S1:Column3	10.94	0	0
R1:S1:Column4	8.05	0	0
R1:S1:Column5	0.00	0	0
R1:S2:Column1	-24.43	0	0
R1:S2:Column2	-78.73	0	0
R1:S2:Column3	15.88	0	0
R1:S2:Column4	-7.23	0	0
R1:S2:Column5	0.00	0	0
R1:S3:Column1	-11.99	0	0
R1:S3:Column2	-72.89	0	0
R1:S3:Column3	-26.10	0	0
R1:S3:Column4	-40.68	0	0
R1:S3:Column5	0.00	0	0
R1:S4:Column1	0.00	0	0
R1:S4:Column2	0.00	0	0
R1:S4:Column3	0.00	0	0
R1:S4:Column4	0.00	0	0
R1:S4:Column5	0.00	0	0
R2:S1:Column1	86.83	0	0
R2:S1:Column2	87.33	0	0
R2:S1:Column3	76.49	0	0
R2:S1:Column4	7.66	0	0
R2:S1:Column5	0.00	0	0
R2:S2:Column1	67.97	0	0
R2:S2:Column2	0.73	0	0
R2:S2:Column3	71.73	0	0
R2:S2:Column4	20.65	0	0
R2:S2:Column5	0.00	0	0
R2:S3:Column1	46.34	0	0
R2:S3:Column2	13.83	0	0
R2:S3:Column3	66.93	0	0
R2:S3:Column4	-2.28	0	0
R2:S3:Column5	0.00	0	0
R2:S4:Column1	0.00	0	0
R2:S4:Column2	0.00	0	0
R2:S4:Column3	0.00	0	0
R2:S4:Column4	0.00	0	0
R2:S4:Column5	0.00	0	0
R3:S1:Column1	7.17	0	0
R3:S1:Column2	52.01	0	0
R3:S1:Column3	51.42	0	0
R3:S1:Column4	-7.58	0	0
R3:S1:Column5	0.00	0	0
R3:S2:Column1	-5.38	0	0

R3:S2:Column2	12.88	0	0
R3:S2:Column3	83.94	0	0
R3:S2:Column4	26.47	0	0
R3:S2:Column5	0.00	0	0
R3:S3:Column1	-21.65	0	0
R3:S3:Column2	-75.11	0	0
R3:S3:Column3	32.21	0	0
R3:S3:Column4	-48.45	0	0
R3:S3:Column5	0.00	0	0
R3:S4:Column1	0.00	0	0
R3:S4:Column2	0.00	0	0
R3:S4:Column3	0.00	0	0
R3:S4:Column4	0.00	0	0
R3:S4:Column5	0.00	0	0
R4:S1:Column1	14.41	0	0
R4:S1:Column2	35.11	0	0
R4:S1:Column3	54.52	0	0
R4:S1:Column4	-31.57	0	0
R4:S1:Column5	0.00	0	0
R4:S2:Column1	6.58	0	0
R4:S2:Column2	-21.55	0	0
R4:S2:Column3	50.87	0	0
R4:S2:Column4	22.02	0	0
R4:S2:Column5	0.00	0	0
R4:S3:Column1	-4.47	0	0
R4:S3:Column2	-52.07	0	0
R4:S3:Column3	-2.11	0	0
R4:S3:Column4	-67.47	0	0
R4:S3:Column5	0.00	0	0
R4:S4:Column1	0.00	0	0
R4:S4:Column2	0.00	0	0
R4:S4:Column3	0.00	0	0
R4:S4:Column4	0.00	0	0
R4:S4:Column5	0.00	0	0
R5:S1:Column1	0.00	0	0
R5:S1:Column2	0.00	0	0
R5:S1:Column3	0.00	0	0
R5:S1:Column4	0.00	0	0
R5:S1:Column5	0.00	0	0
R5:S2:Column1	0.00	0	0
R5:S2:Column2	0.00	0	0
R5:S2:Column3	0.00	0	0
R5:S2:Column4	0.00	0	0
R5:S2:Column5	0.00	0	0
R5:S3:Column1	0.00	0	0
R5:S3:Column2	0.00	0	0
R5:S3:Column3	0.00	0	0
R5:S3:Column4	0.00	0	0

R5:S3:Column5	0.00	0	0
R5:S4:Column1	0.00	0	0
R5:S4:Column2	0.00	0	0
R5:S4:Column3	0.00	0	0
R5:S4:Column4	0.00	0	0
R5:S4:Column5	0.00	0	0

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ Row + R + S + R:S + Row:R + Column:S + Column:R:S, ex2.2), type=3,
      singular.ok=TRUE) # NOT WORKING
```

## 6.2 Example 3.1

### (9) MODEL

```
ex3.1a = read.table("http://r.acr.kr/split/Ex3.1-example.txt", header=TRUE)
ex3.1a = af(ex3.1a, c("row", "P", "column", "R", "S"))
ex3.1a
```

	row	P	column	R	S	height
1	1	1	1	3	4	103
2	1	1	1	3	2	98
3	1	1	1	3	3	101
4	1	1	1	3	1	101
5	1	1	2	4	2	100
6	1	1	2	4	3	98
7	1	1	2	4	1	100
8	1	1	2	4	4	99
9	1	1	3	5	3	99
10	1	1	3	5	1	99
11	1	1	3	5	2	100
12	1	1	3	5	4	97
13	1	1	4	2	2	99
14	1	1	4	2	1	102
15	1	1	4	2	3	99
16	1	1	4	2	4	100
17	1	1	5	1	1	102
18	1	1	5	1	2	107
19	1	1	5	1	3	98
20	1	1	5	1	4	99
21	1	2	1	3	4	101
22	1	2	1	3	2	101
23	1	2	1	3	3	99
24	1	2	1	3	1	100
25	1	2	2	4	2	97
26	1	2	2	4	3	85



27	1 2	2 4 1	99
28	1 2	2 4 4	97
29	1 2	3 5 3	98
30	1 2	3 5 1	96
31	1 2	3 5 2	88
32	1 2	3 5 4	98
33	1 2	4 2 2	95
34	1 2	4 2 1	90
35	1 2	4 2 3	99
36	1 2	4 2 4	87
37	1 2	5 1 1	98
38	1 2	5 1 2	98
39	1 2	5 1 3	99
40	1 2	5 1 4	89
41	2 1	1 2 4	99
42	2 1	1 2 2	97
43	2 1	1 2 3	98
44	2 1	1 2 1	95
45	2 1	2 3 2	99
46	2 1	2 3 3	98
47	2 1	2 3 1	96
48	2 1	2 3 4	93
49	2 1	3 1 3	97
50	2 1	3 1 1	99
51	2 1	3 1 2	95
52	2 1	3 1 4	98
53	2 1	4 4 2	97
54	2 1	4 4 1	95
55	2 1	4 4 3	99
56	2 1	4 4 4	94
57	2 1	5 5 1	98
58	2 1	5 5 2	93
59	2 1	5 5 3	98
60	2 1	5 5 4	96
61	2 2	1 2 4	99
62	2 2	1 2 2	89
63	2 2	1 2 3	98
64	2 2	1 2 1	94
65	2 2	2 3 2	98
66	2 2	2 3 3	91
67	2 2	2 3 1	97
68	2 2	2 3 4	96
69	2 2	3 1 3	94
70	2 2	3 1 1	97
71	2 2	3 1 2	98
72	2 2	3 1 4	96
73	2 2	4 4 2	99
74	2 2	4 4 1	89

75	2 2	4 4 3	97
76	2 2	4 4 4	98
77	2 2	5 5 1	99
78	2 2	5 5 2	96
79	2 2	5 5 3	93
80	2 2	5 5 4	98
81	3 1	1 4 4	99
82	3 1	1 4 2	88
83	3 1	1 4 3	98
84	3 1	1 4 1	96
85	3 1	2 5 2	98
86	3 1	2 5 3	99
87	3 1	2 5 1	92
88	3 1	2 5 4	88
89	3 1	3 2 3	98
90	3 1	3 2 1	85
91	3 1	3 2 2	88
92	3 1	3 2 4	95
93	3 1	4 1 2	97
94	3 1	4 1 1	87
95	3 1	4 1 3	96
96	3 1	4 1 4	88
97	3 1	5 3 1	88
98	3 1	5 3 2	85
99	3 1	5 3 3	78
100	3 1	5 3 4	78
101	3 2	1 4 4	88
102	3 2	1 4 2	85
103	3 2	1 4 3	78
104	3 2	1 4 1	80
105	3 2	2 5 2	80
106	3 2	2 5 3	79
107	3 2	2 5 1	77
108	3 2	2 5 4	78
109	3 2	3 2 3	90
110	3 2	3 2 1	91
111	3 2	3 2 2	92
112	3 2	3 2 4	93
113	3 2	4 1 2	99
114	3 2	4 1 1	97
115	3 2	4 1 3	98
116	3 2	4 1 4	99
117	3 2	5 3 1	80
118	3 2	5 3 2	81
119	3 2	5 3 3	82
120	3 2	5 3 4	83
121	4 1	1 1 4	80
122	4 1	1 1 2	81

123	4 1	1 1 3	84
124	4 1	1 1 1	80
125	4 1	2 2 2	90
126	4 1	2 2 3	90
127	4 1	2 2 1	90
128	4 1	2 2 4	90
129	4 1	3 3 3	99
130	4 1	3 3 1	98
131	4 1	3 3 2	97
132	4 1	3 3 4	99
133	4 1	4 5 2	95
134	4 1	4 5 1	95
135	4 1	4 5 3	95
136	4 1	4 5 4	96
137	4 1	5 4 1	99
138	4 1	5 4 2	95
139	4 1	5 4 3	98
140	4 1	5 4 4	98
141	4 2	1 1 4	98
142	4 2	1 1 2	99
143	4 2	1 1 3	97
144	4 2	1 1 1	99
145	4 2	2 2 2	88
146	4 2	2 2 3	87
147	4 2	2 2 1	88
148	4 2	2 2 4	86
149	4 2	3 3 3	99
150	4 2	3 3 1	97
151	4 2	3 3 2	96
152	4 2	3 3 4	95
153	4 2	4 5 2	89
154	4 2	4 5 1	88
155	4 2	4 5 3	87
156	4 2	4 5 4	85
157	4 2	5 4 1	90
158	4 2	5 4 2	90
159	4 2	5 4 3	90
160	4 2	5 4 4	97
161	5 1	1 5 4	98
162	5 1	1 5 2	98
163	5 1	1 5 3	99
164	5 1	1 5 1	97
165	5 1	2 1 2	98
166	5 1	2 1 3	97
167	5 1	2 1 1	98
168	5 1	2 1 4	89
169	5 1	3 4 3	88
170	5 1	3 4 1	87

171	5 1	3 4 2	88
172	5 1	3 4 4	88
173	5 1	4 3 2	98
174	5 1	4 3 1	95
175	5 1	4 3 3	97
176	5 1	4 3 4	99
177	5 1	5 2 1	98
178	5 1	5 2 2	98
179	5 1	5 2 3	95
180	5 1	5 2 4	99
181	5 2	1 5 4	88
182	5 2	1 5 2	87
183	5 2	1 5 3	99
184	5 2	1 5 1	98
185	5 2	2 1 2	99
186	5 2	2 1 3	95
187	5 2	2 1 1	99
188	5 2	2 1 4	90
189	5 2	3 4 3	98
190	5 2	3 4 1	99
191	5 2	3 4 2	99
192	5 2	3 4 4	92
193	5 2	4 3 2	88
194	5 2	4 3 1	86
195	5 2	4 3 3	87
196	5 2	4 3 4	83
197	5 2	5 2 1	99
198	5 2	5 2 2	96
199	5 2	5 2 3	98
200	5 2	5 2 4	99

```
GLM(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P + S:P:row +
      S:R:P + R:S:P:row, ex3.1a)
```

\$ANOVA

Response : height

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	199	7534.8	37.863		
RESIDUALS	0	0.0			
CORRECTED TOTAL	199	7534.8			

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
row	4	2017.03	504.26		
R	4	90.63	22.66		
P	1	253.12	253.12		
S	3	16.38	5.46		

R:S	12	195.05	16.25
row:P	4	167.25	41.81
R:P	4	504.95	126.24
row:R:P	32	2933.52	91.67
P:S	3	14.29	4.76
row:P:S	24	234.68	9.78
R:P:S	12	100.33	8.36
row:R:P:S	96	1007.52	10.49

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
row	4	2017.03	504.26		
R	4	90.63	22.66		
P	1	253.12	253.12		
S	3	16.38	5.46		
R:S	12	195.05	16.25		
row:P	4	167.25	41.81		
R:P	4	504.95	126.24		
row:R:P	32	2933.52	91.67		
P:S	3	14.29	4.76		
row:P:S	24	234.68	9.78		
R:P:S	12	100.33	8.36		
row:R:P:S	96	1007.52	10.49		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
row	4	2017.03	504.26		
R	4	90.63	22.66		
P	1	253.12	253.12		
S	3	16.38	5.46		
R:S	12	195.05	16.25		
row:P	4	167.25	41.81		
R:P	4	504.95	126.24		
row:R:P	32	2933.52	91.67		
P:S	3	14.30	4.77		
row:P:S	24	234.68	9.78		
R:P:S	12	100.33	8.36		
row:R:P:S	96	1007.52	10.50		

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	88	0		0		
row1	10	0		0		
row2	10	0		0		
row3	-10	0		0		
row4	-3	0		0		
row5	0	0		0		
R1	2	0		0		

R2	11	0	0
R3	-5	0	0
R4	4	0	0
R5	0	0	0
P1	10	0	0
P2	0	0	0
S1	10	0	0
S2	-1	0	0
S3	11	0	0
S4	0	0	0
R1:S1	-1	0	0
R1:S2	10	0	0
R1:S3	-6	0	0
R1:S4	0	0	0
R2:S1	-10	0	0
R2:S2	-2	0	0
R2:S3	-12	0	0
R2:S4	0	0	0
R3:S1	-7	0	0
R3:S2	6	0	0
R3:S3	-7	0	0
R3:S4	0	0	0
R4:S1	-3	0	0
R4:S2	8	0	0
R4:S3	-5	0	0
R4:S4	0	0	0
R5:S1	0	0	0
R5:S2	0	0	0
R5:S3	0	0	0
R5:S4	0	0	0
row1:P1	-11	0	0
row1:P2	0	0	0
row2:P1	-12	0	0
row2:P2	0	0	0
row3:P1	0	0	0
row3:P2	0	0	0
row4:P1	1	0	0
row4:P2	0	0	0
row5:P1	0	0	0
row5:P2	0	0	0
R1:P1	-11	0	0
R1:P2	0	0	0
R2:P1	-10	0	0
R2:P2	0	0	0
R3:P1	6	0	0
R3:P2	0	0	0
R4:P1	-14	0	0
R4:P2	0	0	0

R5:P1	0	0	0
R5:P2	0	0	0
row1:R1:P1	11	0	0
row1:R1:P2	-11	0	0
row1:R2:P1	2	0	0
row1:R2:P2	-22	0	0
row1:R3:P1	5	0	0
row1:R3:P2	8	0	0
row1:R4:P1	12	0	0
row1:R4:P2	-5	0	0
row1:R5:P1	0	0	0
row1:R5:P2	0	0	0
row2:R1:P1	11	0	0
row2:R1:P2	-4	0	0
row2:R2:P1	2	0	0
row2:R2:P2	-10	0	0
row2:R3:P1	-4	0	0
row2:R3:P2	3	0	0
row2:R4:P1	8	0	0
row2:R4:P2	-4	0	0
row2:R5:P1	0	0	0
row2:R5:P2	0	0	0
row3:R1:P1	9	0	0
row3:R1:P2	19	0	0
row3:R2:P1	6	0	0
row3:R2:P2	4	0	0
row3:R3:P1	-11	0	0
row3:R3:P2	10	0	0
row3:R4:P1	21	0	0
row3:R4:P2	6	0	0
row3:R5:P1	0	0	0
row3:R5:P2	0	0	0
row4:R1:P1	-7	0	0
row4:R1:P2	11	0	0
row4:R2:P1	-7	0	0
row4:R2:P2	-10	0	0
row4:R3:P1	2	0	0
row4:R3:P2	15	0	0
row4:R4:P1	12	0	0
row4:R4:P2	8	0	0
row4:R5:P1	0	0	0
row4:R5:P2	0	0	0
row5:R1:P1	0	0	0
row5:R1:P2	0	0	0
row5:R2:P1	0	0	0
row5:R2:P2	0	0	0
row5:R3:P1	0	0	0
row5:R3:P2	0	0	0

row5:R4:P1	0	0	0
row5:R4:P2	0	0	0
row5:R5:P1	0	0	0
row5:R5:P2	0	0	0
P1:S1	-11	0	0
P1:S2	1	0	0
P1:S3	-10	0	0
P1:S4	0	0	0
P2:S1	0	0	0
P2:S2	0	0	0
P2:S3	0	0	0
P2:S4	0	0	0
row1:P1:S1	3	0	0
row1:P1:S2	3	0	0
row1:P1:S3	1	0	0
row1:P1:S4	0	0	0
row1:P2:S1	-12	0	0
row1:P2:S2	-9	0	0
row1:P2:S3	-11	0	0
row1:P2:S4	0	0	0
row2:P1:S1	3	0	0
row2:P1:S2	-3	0	0
row2:P1:S3	1	0	0
row2:P1:S4	0	0	0
row2:P2:S1	-9	0	0
row2:P2:S2	-1	0	0
row2:P2:S3	-16	0	0
row2:P2:S4	0	0	0
row3:P1:S1	5	0	0
row3:P1:S2	10	0	0
row3:P1:S3	10	0	0
row3:P1:S4	0	0	0
row3:P2:S1	-11	0	0
row3:P2:S2	3	0	0
row3:P2:S3	-10	0	0
row3:P2:S4	0	0	0
row4:P1:S1	0	0	0
row4:P1:S2	-1	0	0
row4:P1:S3	-2	0	0
row4:P1:S4	0	0	0
row4:P2:S1	-7	0	0
row4:P2:S2	5	0	0
row4:P2:S3	-9	0	0
row4:P2:S4	0	0	0
row5:P1:S1	0	0	0
row5:P1:S2	0	0	0
row5:P1:S3	0	0	0
row5:P1:S4	0	0	0



row5:P2:S1	0	0	0
row5:P2:S2	0	0	0
row5:P2:S3	0	0	0
row5:P2:S4	0	0	0
R1:P1:S1	11	0	0
R1:P1:S2	-1	0	0
R1:P1:S3	13	0	0
R1:P1:S4	0	0	0
R1:P2:S1	0	0	0
R1:P2:S2	0	0	0
R1:P2:S3	0	0	0
R1:P2:S4	0	0	0
R2:P1:S1	10	0	0
R2:P1:S2	1	0	0
R2:P1:S3	7	0	0
R2:P1:S4	0	0	0
R2:P2:S1	0	0	0
R2:P2:S2	0	0	0
R2:P2:S3	0	0	0
R2:P2:S4	0	0	0
R3:P1:S1	4	0	0
R3:P1:S2	-7	0	0
R3:P1:S3	4	0	0
R3:P1:S4	0	0	0
R3:P2:S1	0	0	0
R3:P2:S2	0	0	0
R3:P2:S3	0	0	0
R3:P2:S4	0	0	0
R4:P1:S1	3	0	0
R4:P1:S2	-8	0	0
R4:P1:S3	4	0	0
R4:P1:S4	0	0	0
R4:P2:S1	0	0	0
R4:P2:S2	0	0	0
R4:P2:S3	0	0	0
R4:P2:S4	0	0	0
R5:P1:S1	0	0	0
R5:P1:S2	0	0	0
R5:P1:S3	0	0	0
R5:P1:S4	0	0	0
R5:P2:S1	0	0	0
R5:P2:S2	0	0	0
R5:P2:S3	0	0	0
R5:P2:S4	0	0	0
row1:R1:P1:S1	-9	0	0
row1:R1:P1:S2	-4	0	0
row1:R1:P1:S3	-10	0	0
row1:R1:P1:S4	0	0	0

row1:R1:P2:S1	12	0	0
row1:R1:P2:S2	9	0	0
row1:R1:P2:S3	16	0	0
row1:R1:P2:S4	0	0	0
row1:R2:P1:S1	0	0	0
row1:R2:P1:S2	-3	0	0
row1:R2:P1:S3	2	0	0
row1:R2:P1:S4	0	0	0
row1:R2:P2:S1	15	0	0
row1:R2:P2:S2	20	0	0
row1:R2:P2:S3	24	0	0
row1:R2:P2:S4	0	0	0
row1:R3:P1:S1	-1	0	0
row1:R3:P1:S2	-7	0	0
row1:R3:P1:S3	-1	0	0
row1:R3:P1:S4	0	0	0
row1:R3:P2:S1	8	0	0
row1:R3:P2:S2	4	0	0
row1:R3:P2:S3	5	0	0
row1:R3:P2:S4	0	0	0
row1:R4:P1:S1	-1	0	0
row1:R4:P1:S2	-2	0	0
row1:R4:P1:S3	-2	0	0
row1:R4:P1:S4	0	0	0
row1:R4:P2:S1	7	0	0
row1:R4:P2:S2	2	0	0
row1:R4:P2:S3	-7	0	0
row1:R4:P2:S4	0	0	0
row1:R5:P1:S1	0	0	0
row1:R5:P1:S2	0	0	0
row1:R5:P1:S3	0	0	0
row1:R5:P1:S4	0	0	0
row1:R5:P2:S1	0	0	0
row1:R5:P2:S2	0	0	0
row1:R5:P2:S3	0	0	0
row1:R5:P2:S4	0	0	0
row2:R1:P1:S1	-11	0	0
row2:R1:P1:S2	-9	0	0
row2:R1:P1:S3	-10	0	0
row2:R1:P1:S4	0	0	0
row2:R1:P2:S1	1	0	0
row2:R1:P2:S2	-6	0	0
row2:R1:P2:S3	9	0	0
row2:R1:P2:S4	0	0	0
row2:R2:P1:S1	-6	0	0
row2:R2:P1:S2	2	0	0
row2:R2:P1:S3	2	0	0
row2:R2:P1:S4	0	0	0

row2:R2:P2:S1	4	0	0
row2:R2:P2:S2	-6	0	0
row2:R2:P2:S3	16	0	0
row2:R2:P2:S4	0	0	0
row2:R3:P1:S1	4	0	0
row2:R3:P1:S2	10	0	0
row2:R3:P1:S3	6	0	0
row2:R3:P1:S4	0	0	0
row2:R3:P2:S1	7	0	0
row2:R3:P2:S2	-2	0	0
row2:R3:P2:S3	7	0	0
row2:R3:P2:S4	0	0	0
row2:R4:P1:S1	-1	0	0
row2:R4:P1:S2	6	0	0
row2:R4:P1:S3	4	0	0
row2:R4:P1:S4	0	0	0
row2:R4:P2:S1	-7	0	0
row2:R4:P2:S2	-5	0	0
row2:R4:P2:S3	9	0	0
row2:R4:P2:S4	0	0	0
row2:R5:P1:S1	0	0	0
row2:R5:P1:S2	0	0	0
row2:R5:P1:S3	0	0	0
row2:R5:P1:S4	0	0	0
row2:R5:P2:S1	0	0	0
row2:R5:P2:S2	0	0	0
row2:R5:P2:S3	0	0	0
row2:R5:P2:S4	0	0	0
row3:R1:P1:S1	-15	0	0
row3:R1:P1:S2	-10	0	0
row3:R1:P1:S3	-10	0	0
row3:R1:P1:S4	0	0	0
row3:R1:P2:S1	0	0	0
row3:R1:P2:S2	-12	0	0
row3:R1:P2:S3	4	0	0
row3:R1:P2:S4	0	0	0
row3:R2:P1:S1	-14	0	0
row3:R2:P1:S2	-16	0	0
row3:R2:P1:S3	-3	0	0
row3:R2:P1:S4	0	0	0
row3:R2:P2:S1	9	0	0
row3:R2:P2:S2	-1	0	0
row3:R2:P2:S3	8	0	0
row3:R2:P2:S4	0	0	0
row3:R3:P1:S1	9	0	0
row3:R3:P1:S2	-2	0	0
row3:R3:P1:S3	-8	0	0
row3:R3:P1:S4	0	0	0

row3:R3:P2:S1	5	0	0
row3:R3:P2:S2	-10	0	0
row3:R3:P2:S3	5	0	0
row3:R3:P2:S4	0	0	0
row3:R4:P1:S1	-7	0	0
row3:R4:P1:S2	-21	0	0
row3:R4:P1:S3	-11	0	0
row3:R4:P1:S4	0	0	0
row3:R4:P2:S1	-4	0	0
row3:R4:P2:S2	-13	0	0
row3:R4:P2:S3	-6	0	0
row3:R4:P2:S4	0	0	0
row3:R5:P1:S1	0	0	0
row3:R5:P1:S2	0	0	0
row3:R5:P1:S3	0	0	0
row3:R5:P1:S4	0	0	0
row3:R5:P2:S1	0	0	0
row3:R5:P2:S2	0	0	0
row3:R5:P2:S3	0	0	0
row3:R5:P2:S4	0	0	0
row4:R1:P1:S1	-9	0	0
row4:R1:P1:S2	-7	0	0
row4:R1:P1:S3	-2	0	0
row4:R1:P1:S4	0	0	0
row4:R1:P2:S1	-1	0	0
row4:R1:P2:S2	-13	0	0
row4:R1:P2:S3	3	0	0
row4:R1:P2:S4	0	0	0
row4:R2:P1:S1	1	0	0
row4:R2:P1:S2	2	0	0
row4:R2:P1:S3	6	0	0
row4:R2:P1:S4	0	0	0
row4:R2:P2:S1	9	0	0
row4:R2:P2:S2	0	0	0
row4:R2:P2:S3	11	0	0
row4:R2:P2:S4	0	0	0
row4:R3:P1:S1	3	0	0
row4:R3:P1:S2	0	0	0
row4:R3:P1:S3	4	0	0
row4:R3:P1:S4	0	0	0
row4:R3:P2:S1	6	0	0
row4:R3:P2:S2	-9	0	0
row4:R3:P2:S3	9	0	0
row4:R3:P2:S4	0	0	0
row4:R4:P1:S1	2	0	0
row4:R4:P1:S2	-2	0	0
row4:R4:P1:S3	2	0	0
row4:R4:P1:S4	0	0	0

row4:R4:P2:S1	-7	0	0
row4:R4:P2:S2	-19	0	0
row4:R4:P2:S3	-4	0	0
row4:R4:P2:S4	0	0	0
row4:R5:P1:S1	0	0	0
row4:R5:P1:S2	0	0	0
row4:R5:P1:S3	0	0	0
row4:R5:P1:S4	0	0	0
row4:R5:P2:S1	0	0	0
row4:R5:P2:S2	0	0	0
row4:R5:P2:S3	0	0	0
row4:R5:P2:S4	0	0	0
row5:R1:P1:S1	0	0	0
row5:R1:P1:S2	0	0	0
row5:R1:P1:S3	0	0	0
row5:R1:P1:S4	0	0	0
row5:R1:P2:S1	0	0	0
row5:R1:P2:S2	0	0	0
row5:R1:P2:S3	0	0	0
row5:R1:P2:S4	0	0	0
row5:R2:P1:S1	0	0	0
row5:R2:P1:S2	0	0	0
row5:R2:P1:S3	0	0	0
row5:R2:P1:S4	0	0	0
row5:R2:P2:S1	0	0	0
row5:R2:P2:S2	0	0	0
row5:R2:P2:S3	0	0	0
row5:R2:P2:S4	0	0	0
row5:R3:P1:S1	0	0	0
row5:R3:P1:S2	0	0	0
row5:R3:P1:S3	0	0	0
row5:R3:P1:S4	0	0	0
row5:R3:P2:S1	0	0	0
row5:R3:P2:S2	0	0	0
row5:R3:P2:S3	0	0	0
row5:R3:P2:S4	0	0	0
row5:R4:P1:S1	0	0	0
row5:R4:P1:S2	0	0	0
row5:R4:P1:S3	0	0	0
row5:R4:P1:S4	0	0	0
row5:R4:P2:S1	0	0	0
row5:R4:P2:S2	0	0	0
row5:R4:P2:S3	0	0	0
row5:R4:P2:S4	0	0	0
row5:R5:P1:S1	0	0	0
row5:R5:P1:S2	0	0	0
row5:R5:P1:S3	0	0	0
row5:R5:P1:S4	0	0	0

row5:R5:P2:S1	0	0	0
row5:R5:P2:S2	0	0	0
row5:R5:P2:S3	0	0	0
row5:R5:P2:S4	0	0	0

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P +
          S:P:row + S:R:P + R:S:P:row, ex3.1a), type=3, singular.ok=TRUE)
# NOT WORKING
```

```
alias(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P + S:P:row +
          S:R:P + R:S:P:row, ex3.1a) # NO ALIAS
```

Model :

```
height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P +
          S:P:row + S:R:P + R:S:P:row
```

## (10) MODEL

- p94 Appendix 3.1

```
ex3.1b = read.table("http://r.acr.kr/split/spexvar3.txt", header=TRUE)
ex3.1b = af(ex3.1b, c("rep", "var", "nit", "row", "col"))
ex3.1b
```

	row	col	rep	var	nit	set	reps	yield
1	1	1	1	3	3	1	1	156
2	1	2	1	3	2	1	1	118
3	1	3	4	3	2	2	1	109
4	1	4	4	3	3	2	1	99
5	2	1	1	3	1	1	1	140
6	2	2	1	3	4	1	1	105
7	2	3	4	3	4	2	1	63
8	2	4	4	3	1	2	1	70
9	3	1	1	1	4	1	1	111
10	3	2	1	1	1	1	1	130
11	3	3	4	2	4	2	1	80
12	3	4	4	2	2	2	1	94
13	4	1	1	1	3	1	1	174
14	4	2	1	1	2	1	1	157
15	4	3	4	2	3	2	1	126
16	4	4	4	2	1	2	1	82
17	5	1	1	2	4	1	1	117
18	5	2	1	2	1	1	1	114
19	5	3	4	1	1	2	1	90
20	5	4	4	1	2	2	1	100

21	6	1	1	2	2	1	1	161
22	6	2	1	2	3	1	1	141
23	6	3	4	1	3	2	1	116
24	6	4	4	1	4	2	1	62
25	7	1	2	3	2	1	2	104
26	7	2	2	3	4	1	2	70
27	7	3	5	2	3	2	2	96
28	7	4	5	2	4	2	2	60
29	8	1	2	3	1	1	2	89
30	8	2	2	3	3	1	2	117
31	8	3	5	2	2	2	2	89
32	8	4	5	2	1	2	2	102
33	9	1	2	1	3	1	2	122
34	9	2	2	1	4	1	2	74
35	9	3	5	1	2	2	2	112
36	9	4	5	1	3	2	2	86
37	10	1	2	1	1	1	2	89
38	10	2	2	1	2	1	2	81
39	10	3	5	1	4	2	2	68
40	10	4	5	1	1	2	2	64
41	11	1	2	2	1	1	2	103
42	11	2	2	2	4	1	2	64
43	11	3	5	3	2	2	2	132
44	11	4	5	3	3	2	2	124
45	12	1	2	2	2	1	2	132
46	12	2	2	2	3	1	2	133
47	12	3	5	3	1	2	2	129
48	12	4	5	3	4	2	2	89
49	13	1	3	2	1	1	3	108
50	13	2	3	2	2	1	3	126
51	13	3	6	1	2	2	3	118
52	13	4	6	1	4	2	3	53
53	14	1	3	2	3	1	3	149
54	14	2	3	2	4	1	3	70
55	14	3	6	1	3	2	3	113
56	14	4	6	1	1	2	3	74
57	15	1	3	3	3	1	3	144
58	15	2	3	3	1	1	3	124
59	15	3	6	2	3	2	3	104
60	15	4	6	2	2	2	3	86
61	16	1	3	3	2	1	3	121
62	16	2	3	3	4	1	3	96
63	16	3	6	2	4	2	3	89
64	16	4	6	2	1	2	3	82
65	17	1	3	1	4	1	3	61
66	17	2	3	1	3	1	3	100
67	17	3	6	3	4	2	3	97
68	17	4	6	3	1	2	3	99

69	18	1	3	1	1	1	3	91
70	18	2	3	1	2	1	3	97
71	18	3	6	3	2	2	3	119
72	18	4	6	3	3	2	3	121

```
GLM(yield ~ rep + var + rep:var + nit + var:nit + row + col, ex3.1b)
```

```
$ANOVA
```

```
Response : yield
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	37	48090	1299.7	11.341	6.734e-11 ***
RESIDUALS	34	3896	114.6		
CORRECTED TOTAL	71	51986			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	5	15875.3	3175.1	27.7056	4.391e-11 ***
var	2	1786.4	893.2	7.7939	0.0016359 **
rep:var	10	6013.3	601.3	5.2472	0.0001207 ***
nit	3	20020.5	6673.5	58.2331	1.754e-13 ***
var:nit	6	321.7	53.6	0.4679	0.8271333
row	9	900.9	100.1	0.8734	0.5575581
col	2	3171.5	1585.7	13.8373	4.012e-05 ***

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	2	5942.5	2971.3	25.9273	1.449e-07 ***
var	2	2799.8	1399.9	12.2155	0.0001005 ***
rep:var	4	997.8	249.4	2.1767	0.0926008 .
nit	3	12559.3	4186.4	36.5308	9.683e-11 ***
var:nit	6	477.8	79.6	0.6949	0.6553307
row	9	945.0	105.0	0.9162	0.5230151
col	2	3171.5	1585.7	13.8373	4.012e-05 ***

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
```

```
CAUTION: Singularity Exists !
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	2	5942.5	2971.3	25.9273	1.449e-07 ***
var	2	2799.8	1399.9	12.2155	0.0001005 ***
rep:var	4	997.8	249.4	2.1767	0.0926008 .
nit	3	11977.9	3992.6	34.8397	1.775e-10 ***



```
var:nit 6 477.8 79.6 0.6949 0.6553307
row 9 945.0 105.0 0.9162 0.5230151
col 2 3171.5 1585.7 13.8373 4.012e-05 ***
```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )	
(Intercept)	78.195	0	9.4953	34	8.2351	1.311e-09	***
rep1	22.320	0	11.2116	34	1.9908	0.0545890	.
rep2	-9.827	0	9.9492	34	-0.9877	0.3302882	
rep3	16.942	0	10.2780	34	1.6484	0.1084805	
rep4	-24.656	0	10.6082	34	-2.3242	0.0262249	*
rep5	16.807	0	10.1264	34	1.6597	0.1061670	
rep6	0.000	0	0.0000	34			
var1	-23.629	0	12.0789	34	-1.9562	0.0586954	.
var2	-16.007	0	11.9933	34	-1.3346	0.1908629	
var3	0.000	0	0.0000	34			
rep1:var1	39.666	0	14.2816	34	2.7775	0.0088510	**
rep1:var2	24.703	0	14.1608	34	1.7445	0.0901108	.
rep1:var3	0.000	0	0.0000	34			
rep2:var1	8.452	0	13.6932	34	0.6172	0.5411868	
rep2:var2	35.142	0	13.4753	34	2.6079	0.0134358	*
rep2:var3	0.000	0	0.0000	34			
rep3:var1	-15.615	0	15.0163	34	-1.0399	0.3057408	
rep3:var2	5.214	0	14.8157	34	0.3519	0.7270537	
rep3:var3	0.000	0	0.0000	34			
rep4:var1	32.022	0	14.0835	34	2.2737	0.0294152	*
rep4:var2	32.597	0	14.2110	34	2.2938	0.0281056	*
rep4:var3	0.000	0	0.0000	34			
rep5:var1	-29.657	0	14.2036	34	-2.0880	0.0443605	*
rep5:var2	-20.826	0	14.0023	34	-1.4873	0.1461435	
rep5:var3	0.000	0	0.0000	34			
rep6:var1	0.000	0	0.0000	34			
rep6:var2	0.000	0	0.0000	34			
rep6:var3	0.000	0	0.0000	34			
nit1	20.904	0	6.8122	34	3.0686	0.0042045	**
nit2	25.790	0	7.9006	34	3.2643	0.0025052	**
nit3	43.888	0	8.4402	34	5.1999	9.452e-06	***
nit4	0.000	0	0.0000	34			
var1:nit1	1.136	0	9.7632	34	0.1164	0.9080219	
var1:nit2	14.232	0	10.2550	34	1.3878	0.1742328	
var1:nit3	-3.260	0	11.0914	34	-0.2939	0.7705879	
var1:nit4	0.000	0	0.0000	34			
var2:nit1	-1.428	0	9.1191	34	-0.1566	0.8764628	
var2:nit2	5.784	0	11.0936	34	0.5214	0.6054692	
var2:nit3	-6.461	0	11.3313	34	-0.5702	0.5722670	
var2:nit4	0.000	0	0.0000	34			

```

var3:nit1      0.000      0      0.0000 34
var3:nit2      0.000      0      0.0000 34
var3:nit3      0.000      0      0.0000 34
var3:nit4      0.000      0      0.0000 34
row1           1.613      0      9.9332 34  0.1624 0.8719639
row2           0.000      0      0.0000 34
row3          -10.016      0      8.3602 34 -1.1980 0.2391928
row4           0.000      0      0.0000 34
row5          -7.727      0      8.5301 34 -0.9059 0.3713775
row6           0.000      0      0.0000 34
row7          -3.594      0      8.6347 34 -0.4162 0.6798797
row8           0.000      0      0.0000 34
row9          13.706      0      8.4538 34  1.6213 0.1141882
row10          0.000      0      0.0000 34
row11         -14.812      0      8.7800 34 -1.6870 0.1007506
row12          0.000      0      0.0000 34
row13          2.006      0      8.3976 34  0.2389 0.8126419
row14          0.000      0      0.0000 34
row15         -4.632      0      8.4677 34 -0.5470 0.5879538
row16          0.000      0      0.0000 34
row17         -0.198      0      8.7515 34 -0.0226 0.9820790
row18          0.000      0      0.0000 34
col1          11.566      0      3.9157 34  2.9538 0.0056610 **
col2           0.000      0      0.0000 34
col3          16.517      0      4.1675 34  3.9633 0.0003597 ***
col4           0.000      0      0.0000 34

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(yield ~ rep + var + rep:var + nit + var:nit + row + col, ex3.1b),
      type=3, singular.ok=TRUE) # NOT OK for var

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: yield

	Sum Sq	Df	F values	Pr(>F)
rep	5942.5	2	25.9273	1.449e-07 ***
var	0.0	0		
nit	11977.9	3	34.8397	1.775e-10 ***
row	945.0	9	0.9162	0.5230
col	3171.5	2	13.8373	4.012e-05 ***
rep:var	997.8	4	2.1767	0.0926 .
var:nit	477.8	6	0.6949	0.6553

Residuals 3896.4 34

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

### 6.3 Example 5.1

(11) MODEL

```
ex5.1 = read.table("http://r.acr.kr/split/sbsp.txt", header=TRUE)
ex5.1 = af(ex5.1, c("R", "A", "C", "B", "Tx"))
ex5.1
```

	R	A	C	B	Tx	Y
1	1	1	1	2	1	2
2	1	1	1	1	2	5
3	1	1	2	2	4	6
4	1	1	2	1	3	9
5	1	1	3	1	6	8
6	1	1	3	2	5	5
7	1	2	1	2	4	9
8	1	2	1	1	3	7
9	1	2	2	2	6	8
10	1	2	2	1	5	4
11	1	2	3	1	1	3
12	1	2	3	2	2	5
13	2	2	1	2	6	8
14	2	2	1	1	5	5
15	2	2	2	2	1	3
16	2	2	2	1	2	5
17	2	2	3	1	4	9
18	2	2	3	2	3	7
19	2	1	1	2	3	3
20	2	1	1	1	6	4
21	2	1	2	2	5	3
22	2	1	2	1	1	0
23	2	1	3	1	2	1
24	2	1	3	2	4	2
25	3	1	1	2	5	5
26	3	1	1	1	1	5
27	3	1	2	2	2	5
28	3	1	2	1	4	9
29	3	1	3	1	3	7
30	3	1	3	2	6	8
31	3	2	1	2	2	6
32	3	2	1	1	4	8
33	3	2	2	2	3	7
34	3	2	2	1	6	8

```
35 3 2 3 1 5 6
36 3 2 3 2 1 3
```

```
GLM(Y ~ R + A + A:R + C + B + B:C + Tx + A:Tx + B:Tx, ex5.1)
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	24	196.238	8.1766	7.0476	0.0008758 ***
RESIDUALS	11	12.762	1.1602		
CORRECTED TOTAL	35	209.000			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	33.500	16.7500	14.4373	0.0008391 ***
A	1	16.000	16.0000	13.7908	0.0034197 **
R:A	2	32.167	16.0833	13.8626	0.0009856 ***
C	2	0.500	0.2500	0.2155	0.8094766
B	1	1.778	1.7778	1.5323	0.2415358
C:B	2	0.389	0.1944	0.1676	0.8478141
Tx	5	103.333	20.6667	17.8131	6.055e-05 ***
A:Tx	5	6.521	1.3042	1.1241	0.4027183
B:Tx	4	2.050	0.5126	0.4418	0.7761730

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	23.116	11.5581	9.9622	0.003396 **
A	1	12.375	12.3751	10.6664	0.007519 **
R:A	2	27.426	13.7132	11.8197	0.001820 **
C	2	0.970	0.4850	0.4180	0.668392
B	1	1.757	1.7574	1.5148	0.244080
C:B	2	0.085	0.0424	0.0366	0.964202
Tx	5	103.333	20.6667	17.8131	6.055e-05 ***
A:Tx	4	2.655	0.6636	0.5720	0.688652
B:Tx	4	2.050	0.5126	0.4418	0.776173

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
```

```
CAUTION: Singularity Exists !
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	22.186	11.0928	9.5611	0.003924 **
A	1	15.185	15.1853	13.0886	0.004042 **

```

R:A    2  27.426 13.7132 11.8197  0.001820 **
C      2   1.010  0.5049  0.4352  0.657839
B      1   1.792  1.7922  1.5448  0.239751
C:B    2   0.085  0.0424  0.0366  0.964202
Tx     5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx   4   2.655  0.6636  0.5720  0.688652
B:Tx   4   2.050  0.5126  0.4418  0.776173

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	7.9545	0	0.98427	11	8.0817	5.93e-06 ***
R1	-0.6318	0	0.73222	11	-0.8629	0.4066247
R2	-0.1636	0	0.66557	11	-0.2459	0.8103184
R3	0.0000	0	0.00000	11		
A1	0.2273	0	1.10928	11	0.2049	0.8414057
A2	0.0000	0	0.00000	11		
R1:A1	0.4636	0	1.09010	11	0.4253	0.6788082
R1:A2	0.0000	0	0.00000	11		
R2:A1	-3.7682	0	0.98951	11	-3.8081	0.0029022 **
R2:A2	0.0000	0	0.00000	11		
R3:A1	0.0000	0	0.00000	11		
R3:A2	0.0000	0	0.00000	11		
C1	0.2682	0	0.73222	11	0.3663	0.7211200
C2	0.4364	0	0.66557	11	0.6556	0.5255407
C3	0.0000	0	0.00000	11		
B1	-0.2409	0	1.17470	11	-0.2051	0.8412545
B2	0.0000	0	0.00000	11		
C1:B1	-0.2318	0	0.98951	11	-0.2343	0.8190745
C1:B2	0.0000	0	0.00000	11		
C2:B1	0.0318	0	0.98951	11	0.0322	0.9749241
C2:B2	0.0000	0	0.00000	11		
C3:B1	0.0000	0	0.00000	11		
C3:B2	0.0000	0	0.00000	11		
Tx1	-5.3485	0	1.04397	11	-5.1232	0.0003318 ***
Tx2	-2.5152	0	1.00973	11	-2.4909	0.0299872 *
Tx3	-1.1667	0	1.04397	11	-1.1175	0.2875828
Tx4	0.2424	0	1.22954	11	0.1972	0.8472929
Tx5	-2.6167	0	1.17171	11	-2.2332	0.0472599 *
Tx6	0.0000	0	0.00000	11		
A1:Tx1	-0.4182	0	1.59983	11	-0.2614	0.7986202
A1:Tx2	-0.6182	0	1.42305	11	-0.4344	0.6723913
A1:Tx3	-0.2000	0	1.59983	11	-0.1250	0.9027684
A1:Tx4	-2.0091	0	1.51170	11	-1.3290	0.2107461
A1:Tx5	-0.1000	0	1.98612	11	-0.0503	0.9607465
A1:Tx6	0.0000	0	0.00000	11		
A2:Tx1	0.0000	0	0.00000	11		

A2:Tx2	0.0000	0	0.00000	11		
A2:Tx3	0.0000	0	0.00000	11		
A2:Tx4	0.0000	0	0.00000	11		
A2:Tx5	0.0000	0	0.00000	11		
A2:Tx6	0.0000	0	0.00000	11		
B1:Tx1	1.7818	0	1.59983	11	1.1138	0.2891291
B1:Tx2	-0.0182	0	1.42305	11	-0.0128	0.9900347
B1:Tx3	1.2000	0	1.59983	11	0.7501	0.4689466
B1:Tx4	1.1909	0	1.51170	11	0.7878	0.4474596
B1:Tx5	0.0000	0	0.00000	11		
B1:Tx6	0.0000	0	0.00000	11		
B2:Tx1	0.0000	0	0.00000	11		
B2:Tx2	0.0000	0	0.00000	11		
B2:Tx3	0.0000	0	0.00000	11		
B2:Tx4	0.0000	0	0.00000	11		
B2:Tx5	0.0000	0	0.00000	11		
B2:Tx6	0.0000	0	0.00000	11		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
alias(Y ~ R + A + A:R + C + B + B:C + Tx + A:Tx + B:Tx, ex5.1)
```

Model :

$Y \sim R + A + A:R + C + B + B:C + Tx + A:Tx + B:Tx$

Complete :

	(Intercept)	R1	R2	A1	C1	C2	B1	Tx1	Tx2	Tx3	Tx4	Tx5	R1:A1
B1:Tx5	0		0	-1/5	0	0	-1/5	0	0	0	0	0	0
		R2:A1	C1:B1	C2:B1	A1:Tx1	A1:Tx2	A1:Tx3	A1:Tx4	A1:Tx5	B1:Tx1	B1:Tx2	B1:Tx3	
B1:Tx5	0	0	0	1/5	1/5	1/5	1/5	-1	1/5	1/5	1/5		
				B1:Tx4									
B1:Tx5				1/5									

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + A + A:R + C + B + B:C + Tx + A:Tx + B:Tx, ex5.1),
      type=3, singular.ok=TRUE) # NOT OK
```

Note: model has aliased coefficients

sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y

	Sum Sq	Df	F values	Pr(>F)
R	22.186	2	9.5611	0.003924 **
A	0.000	0		

C	1.010	2	0.4352	0.657839
B	0.000	0		
Tx	103.333	5	17.8131	6.055e-05 ***
R:A	27.426	2	11.8197	0.001820 **
C:B	0.085	2	0.0366	0.964202
A:Tx	2.655	4	0.5720	0.688652
B:Tx	2.050	4	0.4418	0.776173
Residuals	12.762	11		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

(12) MODEL

```
GLM(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	28	204.2	7.2929	10.635	0.001719 **
RESIDUALS	7	4.8	0.6857		
CORRECTED TOTAL	35	209.0			

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	33.500	16.7500	24.4271	0.0006969 ***
A	1	16.000	16.0000	23.3333	0.0018985 **
R:A	2	32.167	16.0833	23.4549	0.0007889 ***
C	2	0.500	0.2500	0.3646	0.7069339
B	1	1.778	1.7778	2.5926	0.1513998
C:B	2	0.389	0.1944	0.2836	0.7613494
Tx	5	103.333	20.6667	30.1389	0.0001357 ***
A:Tx	5	6.521	1.3042	1.9019	0.2123307
B:Tx	4	2.050	0.5126	0.7475	0.5896365
A:B:Tx	4	7.962	1.9905	2.9029	0.1038803

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	31.838	15.9191	23.2153	0.0008139 ***
A	1	12.375	12.3751	18.0470	0.0038017 **
R:A	1	2.017	2.0174	2.9420	0.1300172
C	2	0.500	0.2500	0.3645	0.7069558
B	1	1.757	1.7574	2.5629	0.1534298
C:B	1	0.644	0.6445	0.9399	0.3646045

```

Tx      5 103.333 20.6667 30.1389 0.0001357 ***
A:Tx    4   2.655  0.6636  0.9678 0.4812226
B:Tx    4   2.050  0.5126  0.7475 0.5896365
A:B:Tx  4   7.962  1.9905  2.9029 0.1038803

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	28.112	14.0562	20.4986	0.0011846 **
A	1	14.655	14.6551	21.3720	0.0024176 **
R:A	1	2.017	2.0174	2.9420	0.1300172
C	2	0.471	0.2356	0.3436	0.7205632
B	1	1.769	1.7694	2.5804	0.1522328
C:B	1	0.644	0.6445	0.9399	0.3646045
Tx	5	103.815	20.7630	30.2793	0.0001336 ***
A:Tx	4	2.951	0.7378	1.0760	0.4358837
B:Tx	4	3.553	0.8882	1.2954	0.3579988
A:B:Tx	4	7.962	1.9905	2.9029	0.1038803

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	8.5833	0	0.86189	7	9.9587	2.199e-05 ***
R1	-1.2833	0	0.79282	7	-1.6187	0.1495477
R2	-0.0500	0	0.55549	7	-0.0900	0.9308004
R3	0.0000	0	0.00000	7		
A1	-0.5833	0	0.98561	7	-0.5918	0.5725621
A2	0.0000	0	0.00000	7		
R1:A1	1.7250	0	1.00570	7	1.7152	0.1300172
R1:A2	0.0000	0	0.00000	7		
R2:A1	-3.4083	0	1.01136	7	-3.3700	0.0119197 *
R2:A2	0.0000	0	0.00000	7		
R3:A1	0.0000	0	0.00000	7		
R3:A2	0.0000	0	0.00000	7		
C1	-0.3833	0	0.79282	7	-0.4835	0.6434958
C2	0.5500	0	0.55549	7	0.9901	0.3551012
C3	0.0000	0	0.00000	7		
B1	-0.4417	0	0.94112	7	-0.4693	0.6531236
B2	0.0000	0	0.00000	7		
C1:B1	0.2833	0	0.96806	7	0.2927	0.7782513
C1:B2	0.0000	0	0.00000	7		
C2:B1	-0.6917	0	0.82462	7	-0.8388	0.4293080
C2:B2	0.0000	0	0.00000	7		
C3:B1	0.0000	0	0.00000	7		
C3:B2	0.0000	0	0.00000	7		



Tx1	-5.8333	0	0.95618	7	-6.1006	0.0004908	***
Tx2	-2.2500	0	0.92582	7	-2.4303	0.0454020	*
Tx3	-1.8333	0	0.95618	7	-1.9173	0.0967067	.
Tx4	2.0833	0	1.37321	7	1.5171	0.1730222	
Tx5	-2.6167	0	0.90079	7	-2.9048	0.0228276	*
Tx6	0.0000	0	0.00000	7			
A1:Tx1	-0.2250	0	1.75173	7	-0.1284	0.9014099	
A1:Tx2	-1.3000	0	1.69706	7	-0.7660	0.4686960	
A1:Tx3	0.6750	0	1.75173	7	0.3853	0.7114327	
A1:Tx4	-4.8500	0	1.70713	7	-2.8410	0.0250077	*
A1:Tx5	-0.1000	0	1.52690	7	-0.0655	0.9496134	
A1:Tx6	0.0000	0	0.00000	7			
A2:Tx1	0.0000	0	0.00000	7			
A2:Tx2	0.0000	0	0.00000	7			
A2:Tx3	0.0000	0	0.00000	7			
A2:Tx4	0.0000	0	0.00000	7			
A2:Tx5	0.0000	0	0.00000	7			
A2:Tx6	0.0000	0	0.00000	7			
B1:Tx1	1.9750	0	1.75173	7	1.1275	0.2967084	
B1:Tx2	-0.7000	0	1.69706	7	-0.4125	0.6923283	
B1:Tx3	2.0750	0	1.75173	7	1.1845	0.2748540	
B1:Tx4	-1.6500	0	1.70713	7	-0.9665	0.3659742	
B1:Tx5	0.0000	0	0.00000	7			
B1:Tx6	0.0000	0	0.00000	7			
B2:Tx1	0.0000	0	0.00000	7			
B2:Tx2	0.0000	0	0.00000	7			
B2:Tx3	0.0000	0	0.00000	7			
B2:Tx4	0.0000	0	0.00000	7			
B2:Tx5	0.0000	0	0.00000	7			
B2:Tx6	0.0000	0	0.00000	7			
A1:B1:Tx1	0.8750	0	2.32379	7	0.3765	0.7176693	
A1:B1:Tx2	1.2500	0	2.37847	7	0.5255	0.6154343	
A1:B1:Tx3	-0.6250	0	2.32379	7	-0.2690	0.7957174	
A1:B1:Tx4	6.0000	0	2.02837	7	2.9580	0.0211639	*
A1:B1:Tx5		0					
A1:B1:Tx6	0.0000	0	0.00000	7			
A1:B2:Tx1	0.0000	0	0.00000	7			
A1:B2:Tx2	0.0000	0	0.00000	7			
A1:B2:Tx3	0.0000	0	0.00000	7			
A1:B2:Tx4	0.0000	0	0.00000	7			
A1:B2:Tx5	0.0000	0	0.00000	7			
A1:B2:Tx6	0.0000	0	0.00000	7			
A2:B1:Tx1	0.0000	0	0.00000	7			
A2:B1:Tx2	0.0000	0	0.00000	7			
A2:B1:Tx3	0.0000	0	0.00000	7			
A2:B1:Tx4	0.0000	0	0.00000	7			
A2:B1:Tx5	0.0000	0	0.00000	7			
A2:B1:Tx6	0.0000	0	0.00000	7			

```

A2:B2:Tx1      0.0000      0      0.00000  7
A2:B2:Tx2      0.0000      0      0.00000  7
A2:B2:Tx3      0.0000      0      0.00000  7
A2:B2:Tx4      0.0000      0      0.00000  7
A2:B2:Tx5      0.0000      0      0.00000  7
A2:B2:Tx6      0.0000      0      0.00000  7

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
alias(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1)
```

Model :

```
Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx
```

Complete :

	(Intercept)	R1	R2	A1	C1	C2	B1	Tx1	Tx2	Tx3	Tx4	Tx5
B1:Tx5	0	0	0	-1/5	0	0	-1/5	0	0	0	0	0
A1:B1:Tx5	-1/6	0	0	0	0	0	0	1/6	1/6	1/6	1/6	-5/6
A1:B1:Tx6	0	2/3	0	4/45	2/3	-2/3	4/45	-1/3	1/3	-1/3	0	0
	R1:A1	R2:A1	C1:B1	C2:B1	A1:Tx1	A1:Tx2	A1:Tx3	A1:Tx4	A1:Tx5	B1:Tx1		
B1:Tx5	0	0	0	0	1/5	1/5	1/5	1/5	-1	1/5		
A1:B1:Tx5	0	0	0	0	0	0	0	0	0	0		
A1:B1:Tx6	-2/9	4/9	-2/9	-2/9	-1/5	-1/5	-1/5	4/5	0	-1/5		
	B1:Tx2	B1:Tx3	B1:Tx4	A1:B1:Tx1	A1:B1:Tx2	A1:B1:Tx3	A1:B1:Tx4					
B1:Tx5	1/5	1/5	1/5	0	0	0	0	0				
A1:B1:Tx5	0	0	0	0	0	0	0	0				
A1:B1:Tx6	-1/5	-1/5	4/5	1	-1	1	0					

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1),
      type=3, singular.ok=TRUE) # NOT OK

```

Note: model has aliased coefficients

sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y

	Sum Sq	Df	F values	Pr(>F)
R	11.643	1	16.9793	0.004456 **
A	0.000	0		
C	0.002	1	0.0025	0.961483
B	0.000	0		
Tx	89.178	3	43.3503	6.87e-05 ***
R:A	2.017	1	2.9420	0.130017
C:B	0.644	1	0.9399	0.364604

```

A:Tx      0.543  3   0.2640 0.849381
B:Tx      3.384  3   1.6451 0.264128
A:B:Tx    7.962  4   2.9029 0.103880
Residuals 4.800  7

```

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 6.4 Example 7.1

(13) MODEL

```

ex7.1 = read.table("http://r.acr.kr/split/asped.txt", header=TRUE)
ex7.1 = af(ex7.1, c("R", "G", "F"))
ex7.1

```

```

      Y R  G F
1     2 1 25 1
2     4 1 25 2
3     6 1 25 3
4     1 1 26 1
5     3 1 26 2
6     5 1 26 3
7     9 1 27 1
8     9 1 27 2
9     8 1 27 3
10    9 1 28 1
11    9 1 28 2
12    7 1 28 3
13    2 1  1 1
14    5 1  1 2
15    7 1  1 3
16    3 1  2 1
17    6 1  2 2
18    5 1  2 3
19    4 1  3 1
20    7 1  3 2
21    6 1  3 3
22    5 1  4 1
23    8 1  4 2
24    4 1  4 3
25    6 1  5 1
26    8 1  5 2
27    8 1  5 3
28    7 1  6 1
29    8 1  6 2
30    7 1  6 3
31    3 2 25 1

```

32 3 2 25 2  
33 7 2 25 3  
34 2 2 26 1  
35 2 2 26 2  
36 4 2 26 3  
37 8 2 27 1  
38 8 2 27 2  
39 8 2 27 3  
40 7 2 28 1  
41 8 2 28 2  
42 9 2 28 3  
43 1 2 7 1  
44 2 2 7 2  
45 3 2 7 3  
46 2 2 8 1  
47 3 2 8 2  
48 5 2 8 3  
49 3 2 9 1  
50 4 2 9 2  
51 4 2 9 3  
52 4 2 10 1  
53 4 2 10 2  
54 5 2 10 3  
55 8 2 11 1  
56 8 2 11 2  
57 8 2 11 3  
58 3 2 12 1  
59 5 2 12 2  
60 7 2 12 3  
61 4 3 25 1  
62 6 3 25 2  
63 8 3 25 3  
64 2 3 26 1  
65 5 3 26 2  
66 7 3 26 3  
67 8 3 27 1  
68 7 3 27 2  
69 9 3 27 3  
70 7 3 28 1  
71 7 3 28 2  
72 9 3 28 3  
73 7 3 13 1  
74 7 3 13 2  
75 9 3 13 3  
76 5 3 14 1  
77 6 3 14 2  
78 8 3 14 3  
79 3 3 15 1

```

80  5 3 15 2
81  6 3 15 3
82  7 3 16 1
83  7 3 16 2
84  9 3 16 3
85  6 3 17 1
86  8 3 17 2
87  8 3 17 3
88  5 3 18 1
89  7 3 18 2
90  8 3 18 3
91  4 4 25 1
92  5 4 25 2
93  6 4 25 3
94  5 4 26 1
95  2 4 26 2
96  5 4 26 3
97  9 4 27 1
98  9 4 27 2
99  9 4 27 3
100 9 4 28 1
101 8 4 28 2
102 7 4 28 3
103 5 4 19 1
104 8 4 19 2
105 9 4 19 3
106 6 4 20 1
107 6 4 20 2
108 8 4 20 3
109 7 4 21 1
110 4 4 21 2
111 8 4 21 3
112 8 4 22 1
113 7 4 22 2
114 9 4 22 3
115 9 4 23 1
116 8 4 23 2
117 9 4 23 3
118 9 4 24 1
119 8 4 24 2
120 9 4 24 3

```

```
GLM(Y ~ R + G + R:G + F + F:G, ex7.1)
```

```
$ANOVA
```

```
Response : Y
```

```

Df Sum Sq Mean Sq F value    Pr(>F)

```

```

MODEL          95 577.83  6.0824  5.3082 1.068e-05 ***
RESIDUALS      24 27.50  1.1458
CORRECTED TOTAL 119 605.33

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	84.76	28.2528	24.6570	1.655e-07 ***
G	27	343.48	12.7216	11.1025	4.286e-08 ***
R:G	9	11.75	1.3056	1.1394	0.3749
F	2	59.85	29.9250	26.1164	9.481e-07 ***
G:F	54	77.98	1.4441	1.2603	0.2718

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	5.75	1.9167	1.6727	0.1994
G	27	343.48	12.7216	11.1025	4.286e-08 ***
R:G	9	11.75	1.3056	1.1394	0.3749
F	2	59.85	29.9250	26.1164	9.481e-07 ***
G:F	54	77.98	1.4441	1.2603	0.2718

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	5.75	1.9167	1.6727	0.1994
G	27	343.48	12.7216	11.1025	4.286e-08 ***
R:G	9	11.75	1.3056	1.1394	0.3749
F	2	50.51	25.2525	22.0385	3.686e-06 ***
G:F	54	77.98	1.4441	1.2603	0.2718

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	8.0000	0	0.75691	24	10.5693	1.649e-10 ***
R1	0.3333	0	0.87401	24	0.3814	0.7062732
R2	0.0000	0	0.87401	24	0.0000	1.0000000
R3	-0.3333	0	0.87401	24	-0.3814	0.7062732
R4	0.0000	0	0.00000	24		
G1	-1.3333	0	1.31101	24	-1.0170	0.3192843
G2	-3.3333	0	1.31101	24	-2.5426	0.0178716 *
G3	-2.3333	0	1.31101	24	-1.7798	0.0877763 .
G4	-4.3333	0	1.31101	24	-3.3053	0.0029729 **
G5	-0.3333	0	1.31101	24	-0.2543	0.8014631

G6	-1.3333	0	1.31101	24	-1.0170	0.3192843	
G7	-5.0000	0	1.31101	24	-3.8139	0.0008422	***
G8	-3.0000	0	1.31101	24	-2.2883	0.0312238	*
G9	-4.0000	0	1.31101	24	-3.0511	0.0054948	**
G10	-3.0000	0	1.31101	24	-2.2883	0.0312238	*
G11	0.0000	0	1.31101	24	0.0000	1.0000000	
G12	-1.0000	0	1.31101	24	-0.7628	0.4530330	
G13	1.3333	0	1.31101	24	1.0170	0.3192843	
G14	0.3333	0	1.31101	24	0.2543	0.8014631	
G15	-1.6667	0	1.31101	24	-1.2713	0.2158111	
G16	1.3333	0	1.31101	24	1.0170	0.3192843	
G17	0.3333	0	1.31101	24	0.2543	0.8014631	
G18	0.3333	0	1.31101	24	0.2543	0.8014631	
G19	1.0000	0	1.31101	24	0.7628	0.4530330	
G20	0.0000	0	1.31101	24	0.0000	1.0000000	
G21	0.0000	0	1.31101	24	0.0000	1.0000000	
G22	1.0000	0	1.31101	24	0.7628	0.4530330	
G23	1.0000	0	1.31101	24	0.7628	0.4530330	
G24	1.0000	0	1.31101	24	0.7628	0.4530330	
G25	-1.0833	0	1.07044	24	-1.0120	0.3216098	
G26	-2.3333	0	1.07044	24	-2.1798	0.0393133	*
G27	1.0833	0	1.07044	24	1.0120	0.3216098	
G28	0.0000	0	0.00000	24			
R1:G1	0.0000	0	0.00000	24			
R1:G2	0.0000	0	0.00000	24			
R1:G3	0.0000	0	0.00000	24			
R1:G4	0.0000	0	0.00000	24			
R1:G5	0.0000	0	0.00000	24			
R1:G6	0.0000	0	0.00000	24			
R1:G7		0					
R1:G8		0					
R1:G9		0					
R1:G10		0					
R1:G11		0					
R1:G12		0					
R1:G13		0					
R1:G14		0					
R1:G15		0					
R1:G16		0					
R1:G17		0					
R1:G18		0					
R1:G19		0					
R1:G20		0					
R1:G21		0					
R1:G22		0					
R1:G23		0					
R1:G24		0					
R1:G25	-1.3333	0	1.23603	24	-1.0787	0.2914354	

R1:G26	-1.3333	0	1.23603 24 -1.0787 0.2914354
R1:G27	-0.6667	0	1.23603 24 -0.5394 0.5946075
R1:G28	0.0000	0	0.00000 24
R2:G1		0	
R2:G2		0	
R2:G3		0	
R2:G4		0	
R2:G5		0	
R2:G6		0	
R2:G7	0.0000	0	0.00000 24
R2:G8	0.0000	0	0.00000 24
R2:G9	0.0000	0	0.00000 24
R2:G10	0.0000	0	0.00000 24
R2:G11	0.0000	0	0.00000 24
R2:G12	0.0000	0	0.00000 24
R2:G13		0	
R2:G14		0	
R2:G15		0	
R2:G16		0	
R2:G17		0	
R2:G18		0	
R2:G19		0	
R2:G20		0	
R2:G21		0	
R2:G22		0	
R2:G23		0	
R2:G24		0	
R2:G25	-0.6667	0	1.23603 24 -0.5394 0.5946075
R2:G26	-1.3333	0	1.23603 24 -1.0787 0.2914354
R2:G27	-1.0000	0	1.23603 24 -0.8090 0.4264404
R2:G28	0.0000	0	0.00000 24
R3:G1		0	
R3:G2		0	
R3:G3		0	
R3:G4		0	
R3:G5		0	
R3:G6		0	
R3:G7		0	
R3:G8		0	
R3:G9		0	
R3:G10		0	
R3:G11		0	
R3:G12		0	
R3:G13	0.0000	0	0.00000 24
R3:G14	0.0000	0	0.00000 24
R3:G15	0.0000	0	0.00000 24
R3:G16	0.0000	0	0.00000 24
R3:G17	0.0000	0	0.00000 24



R3:G18	0.0000	0	0.00000	24		
R3:G19		0				
R3:G20		0				
R3:G21		0				
R3:G22		0				
R3:G23		0				
R3:G24		0				
R3:G25	1.3333	0	1.23603	24	1.0787	0.2914354
R3:G26	1.0000	0	1.23603	24	0.8090	0.4264404
R3:G27	-0.6667	0	1.23603	24	-0.5394	0.5946075
R3:G28	0.0000	0	0.00000	24		
R4:G1		0				
R4:G2		0				
R4:G3		0				
R4:G4		0				
R4:G5		0				
R4:G6		0				
R4:G7		0				
R4:G8		0				
R4:G9		0				
R4:G10		0				
R4:G11		0				
R4:G12		0				
R4:G13		0				
R4:G14		0				
R4:G15		0				
R4:G16		0				
R4:G17		0				
R4:G18		0				
R4:G19	0.0000	0	0.00000	24		
R4:G20	0.0000	0	0.00000	24		
R4:G21	0.0000	0	0.00000	24		
R4:G22	0.0000	0	0.00000	24		
R4:G23	0.0000	0	0.00000	24		
R4:G24	0.0000	0	0.00000	24		
R4:G25	0.0000	0	0.00000	24		
R4:G26	0.0000	0	0.00000	24		
R4:G27	0.0000	0	0.00000	24		
R4:G28	0.0000	0	0.00000	24		
F1	0.0000	0	0.75691	24	0.0000	1.0000000
F2	0.0000	0	0.75691	24	0.0000	1.0000000
F3	0.0000	0	0.00000	24		
G1:F1	-5.0000	0	1.69251	24	-2.9542	0.0069174 **
G1:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103
G1:F3	0.0000	0	0.00000	24		
G2:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G2:F2	1.0000	0	1.69251	24	0.5908	0.5601518
G2:F3	0.0000	0	0.00000	24		

G3:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G3:F2	1.0000	0	1.69251	24	0.5908	0.5601518
G3:F3	0.0000	0	0.00000	24		
G4:F1	1.0000	0	1.69251	24	0.5908	0.5601518
G4:F2	4.0000	0	1.69251	24	2.3634	0.0265504 *
G4:F3	0.0000	0	0.00000	24		
G5:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G5:F2	0.0000	0	1.69251	24	0.0000	1.0000000
G5:F3	0.0000	0	0.00000	24		
G6:F1	0.0000	0	1.69251	24	0.0000	1.0000000
G6:F2	1.0000	0	1.69251	24	0.5908	0.5601518
G6:F3	0.0000	0	0.00000	24		
G7:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G7:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518
G7:F3	0.0000	0	0.00000	24		
G8:F1	-3.0000	0	1.69251	24	-1.7725	0.0890040 .
G8:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103
G8:F3	0.0000	0	0.00000	24		
G9:F1	-1.0000	0	1.69251	24	-0.5908	0.5601518
G9:F2	0.0000	0	1.69251	24	0.0000	1.0000000
G9:F3	0.0000	0	0.00000	24		
G10:F1	-1.0000	0	1.69251	24	-0.5908	0.5601518
G10:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518
G10:F3	0.0000	0	0.00000	24		
G11:F1	0.0000	0	1.69251	24	0.0000	1.0000000
G11:F2	0.0000	0	1.69251	24	0.0000	1.0000000
G11:F3	0.0000	0	0.00000	24		
G12:F1	-4.0000	0	1.69251	24	-2.3634	0.0265504 *
G12:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103
G12:F3	0.0000	0	0.00000	24		
G13:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G13:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103
G13:F3	0.0000	0	0.00000	24		
G14:F1	-3.0000	0	1.69251	24	-1.7725	0.0890040 .
G14:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103
G14:F3	0.0000	0	0.00000	24		
G15:F1	-3.0000	0	1.69251	24	-1.7725	0.0890040 .
G15:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518
G15:F3	0.0000	0	0.00000	24		
G16:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G16:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103
G16:F3	0.0000	0	0.00000	24		
G17:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103
G17:F2	0.0000	0	1.69251	24	0.0000	1.0000000
G17:F3	0.0000	0	0.00000	24		
G18:F1	-3.0000	0	1.69251	24	-1.7725	0.0890040 .
G18:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518
G18:F3	0.0000	0	0.00000	24		

G19:F1	-4.0000	0	1.69251	24	-2.3634	0.0265504	*
G19:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518	
G19:F3	0.0000	0	0.00000	24			
G20:F1	-2.0000	0	1.69251	24	-1.1817	0.2489103	
G20:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103	
G20:F3	0.0000	0	0.00000	24			
G21:F1	-1.0000	0	1.69251	24	-0.5908	0.5601518	
G21:F2	-4.0000	0	1.69251	24	-2.3634	0.0265504	*
G21:F3	0.0000	0	0.00000	24			
G22:F1	-1.0000	0	1.69251	24	-0.5908	0.5601518	
G22:F2	-2.0000	0	1.69251	24	-1.1817	0.2489103	
G22:F3	0.0000	0	0.00000	24			
G23:F1	0.0000	0	1.69251	24	0.0000	1.0000000	
G23:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518	
G23:F3	0.0000	0	0.00000	24			
G24:F1	0.0000	0	1.69251	24	0.0000	1.0000000	
G24:F2	-1.0000	0	1.69251	24	-0.5908	0.5601518	
G24:F3	0.0000	0	0.00000	24			
G25:F1	-3.5000	0	1.07044	24	-3.2697	0.0032428	**
G25:F2	-2.2500	0	1.07044	24	-2.1019	0.0462352	*
G25:F3	0.0000	0	0.00000	24			
G26:F1	-2.7500	0	1.07044	24	-2.5690	0.0168399	*
G26:F2	-2.2500	0	1.07044	24	-2.1019	0.0462352	*
G26:F3	0.0000	0	0.00000	24			
G27:F1	0.0000	0	1.07044	24	0.0000	1.0000000	
G27:F2	-0.2500	0	1.07044	24	-0.2335	0.8173152	
G27:F3	0.0000	0	0.00000	24			
G28:F1	0.0000	0	0.00000	24			
G28:F2	0.0000	0	0.00000	24			
G28:F3	0.0000	0	0.00000	24			

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + G + R:G + F + F:G, ex7.1), type=3, singular.ok=TRUE) # NOT OK
```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y

	Sum Sq	Df	F values	Pr(>F)
R	0.000	0		
G	202.417	3	58.8848	3.258e-11 ***
F	50.505	2	22.0385	3.686e-06 ***
R:G	11.750	9	1.1394	0.3749

```
G:F          77.983 54    1.2603    0.2718
Residuals    27.500 24
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

## 6.5 Example 7.3

(14) MODEL

```
ex7.3 = read.table("http://r.acr.kr/split/assped.txt", header=TRUE)
ex7.3 = af(ex7.3, c("R", "T", "G", "F"))
ex7.3
```

	Y	R	T	G	F
1	2	1	1	1	1
2	4	1	1	1	2
3	6	1	1	1	3
4	3	1	1	2	1
5	5	1	1	2	2
6	7	1	1	2	3
7	7	1	1	3	1
8	7	1	1	3	2
9	9	1	1	3	3
10	8	1	1	4	1
11	8	1	1	4	2
12	9	1	1	4	3
13	8	1	1	5	1
14	8	1	1	5	2
15	9	1	1	5	3
16	2	1	1	21	1
17	5	1	1	21	2
18	7	1	1	21	3
19	4	1	1	22	1
20	6	1	1	22	2
21	7	1	1	22	3
22	6	1	1	23	1
23	7	1	1	23	2
24	8	1	1	23	3
25	3	1	2	1	1
26	4	1	2	1	2
27	5	1	2	1	3
28	4	1	2	2	1
29	6	1	2	2	2
30	8	1	2	2	3
31	7	1	2	3	1
32	8	1	2	3	2
33	9	1	2	3	3

34 9 1 2 4 1  
 35 8 1 2 4 2  
 36 9 1 2 4 3  
 37 7 1 2 5 1  
 38 9 1 2 5 2  
 39 9 1 2 5 3  
 40 3 1 2 21 1  
 41 6 1 2 21 2  
 42 7 1 2 21 3  
 43 5 1 2 22 1  
 44 7 1 2 22 2  
 45 8 1 2 22 3  
 46 6 1 2 23 1  
 47 7 1 2 23 2  
 48 8 1 2 23 3  
 49 4 2 1 6 1  
 50 5 2 1 6 2  
 51 6 2 1 6 3  
 52 6 2 1 7 1  
 53 7 2 1 7 2  
 54 8 2 1 7 3  
 55 7 2 1 8 1  
 56 8 2 1 8 2  
 57 9 2 1 8 3  
 58 7 2 1 9 1  
 59 8 2 1 9 2  
 60 9 2 1 9 3  
 61 3 2 1 10 1  
 62 5 2 1 10 2  
 63 6 2 1 10 3  
 64 3 2 1 21 1  
 65 5 2 1 21 2  
 66 7 2 1 21 3  
 67 5 2 1 22 1  
 68 5 2 1 22 2  
 69 7 2 1 22 3  
 70 6 2 1 23 1  
 71 7 2 1 23 2  
 72 9 2 1 23 3  
 73 5 2 2 6 1  
 74 6 2 2 6 2  
 75 7 2 2 6 3  
 76 6 2 2 7 1  
 77 7 2 2 7 2  
 78 7 2 2 7 3  
 79 7 2 2 8 1  
 80 9 2 2 8 2  
 81 8 2 2 8 3

82 7 2 2 9 1  
83 7 2 2 9 2  
84 9 2 2 9 3  
85 4 2 2 10 1  
86 5 2 2 10 2  
87 7 2 2 10 3  
88 2 2 2 21 1  
89 4 2 2 21 2  
90 5 2 2 21 3  
91 6 2 2 22 1  
92 7 2 2 22 2  
93 8 2 2 22 3  
94 6 2 2 23 1  
95 7 2 2 23 2  
96 8 2 2 23 3  
97 4 3 1 11 1  
98 5 3 1 11 2  
99 6 3 1 11 3  
100 7 3 1 12 1  
101 8 3 1 12 2  
102 8 3 1 12 3  
103 6 3 1 13 1  
104 7 3 1 13 2  
105 7 3 1 13 3  
106 7 3 1 14 1  
107 7 3 1 14 2  
108 9 3 1 14 3  
109 2 3 1 15 1  
110 3 3 1 15 2  
111 4 3 1 15 3  
112 4 3 1 21 1  
113 5 3 1 21 2  
114 5 3 1 21 3  
115 6 3 1 22 1  
116 7 3 1 22 2  
117 8 3 1 22 3  
118 7 3 1 23 1  
119 8 3 1 23 2  
120 8 3 1 23 3  
121 5 3 2 11 1  
122 5 3 2 11 2  
123 6 3 2 11 3  
124 8 3 2 12 1  
125 8 3 2 12 2  
126 9 3 2 12 3  
127 7 3 2 13 1  
128 7 3 2 13 2  
129 9 3 2 13 3

130 7 3 2 14 1  
131 8 3 2 14 2  
132 8 3 2 14 3  
133 4 3 2 15 1  
134 5 3 2 15 2  
135 7 3 2 15 3  
136 3 3 2 21 1  
137 6 3 2 21 2  
138 6 3 2 21 3  
139 7 3 2 22 1  
140 7 3 2 22 2  
141 9 3 2 22 3  
142 7 3 2 23 1  
143 8 3 2 23 2  
144 9 3 2 23 3  
145 1 4 1 16 1  
146 3 4 1 16 2  
147 5 4 1 16 3  
148 2 4 1 17 1  
149 4 4 1 17 2  
150 5 4 1 17 3  
151 3 4 1 18 1  
152 4 4 1 18 2  
153 6 4 1 18 3  
154 4 4 1 19 1  
155 5 4 1 19 2  
156 7 4 1 19 3  
157 5 4 1 20 1  
158 5 4 1 20 2  
159 7 4 1 20 3  
160 5 4 1 21 1  
161 6 4 1 21 2  
162 8 4 1 21 3  
163 5 4 1 22 1  
164 7 4 1 22 2  
165 7 4 1 22 3  
166 6 4 1 23 1  
167 8 4 1 23 2  
168 9 4 1 23 3  
169 2 4 2 16 1  
170 2 4 2 16 2  
171 4 4 2 16 3  
172 3 4 2 17 1  
173 5 4 2 17 2  
174 6 4 2 17 3  
175 4 4 2 18 1  
176 6 4 2 18 2  
177 7 4 2 18 3

```

178 5 4 2 19 1
179 7 4 2 19 2
180 7 4 2 19 3
181 6 4 2 20 1
182 7 4 2 20 2
183 8 4 2 20 3
184 4 4 2 21 1
185 6 4 2 21 2
186 7 4 2 21 3
187 7 4 2 22 1
188 8 4 2 22 2
189 8 4 2 22 3
190 7 4 2 23 1
191 8 4 2 23 2
192 9 4 2 23 3

```

```
GLM(Y ~ R + T + R:T + G + G:T + R:T:G + F + F:T + F:G + F:G:T, ex7.3)
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	155	656.12	4.2330	13.446	3.997e-14 ***
RESIDUALS	36	11.33	0.3148		
CORRECTED TOTAL	191	667.45			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	27.06	9.019	28.6489	1.203e-09 ***
T	1	10.55	10.547	33.5018	1.334e-06 ***
R:T	3	2.97	0.991	3.1489	0.036705 *
G	22	389.01	17.682	56.1668	< 2.2e-16 ***
T:G	22	18.42	0.837	2.6601	0.004445 **
R:T:G	12	8.78	0.731	2.3235	0.025315 *
F	2	164.28	82.141	260.9173	< 2.2e-16 ***
T:F	2	0.84	0.422	1.3401	0.274574
G:F	44	23.47	0.533	1.6943	0.053191 .
T:G:F	44	10.74	0.244	0.7753	0.790640

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	12.49	4.162	13.2206	5.655e-06 ***
T	1	10.55	10.547	33.5018	1.334e-06 ***
R:T	3	1.15	0.384	1.2206	0.316281



```

G      22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G    22  18.42   0.837   2.6601  0.004445 **
R:T:G  12   8.78   0.731   2.3235  0.025315 *
F       2 164.28  82.141 260.9173 < 2.2e-16 ***
T:F     2   0.84   0.422   1.3401  0.274574
G:F    44  23.47   0.533   1.6943  0.053191 .
T:G:F  44  10.74   0.244   0.7753  0.790640

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	12.49	4.162	13.2206	5.655e-06 ***
T	1	11.16	11.158	35.4430	8.021e-07 ***
R:T	3	1.15	0.384	1.2206	0.316281
G	22	389.01	17.682	56.1668	< 2.2e-16 ***
T:G	22	18.42	0.837	2.6601	0.004445 **
R:T:G	12	8.78	0.731	2.3235	0.025315 *
F	2	120.56	60.282	191.4828	< 2.2e-16 ***
T:F	2	0.82	0.411	1.3060	0.283432
G:F	44	23.47	0.533	1.6943	0.053191 .
T:G:F	44	10.74	0.244	0.7753	0.790640

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	9.0000	0	0.39675	36	22.6845	< 2.2e-16 ***
R1	-1.0000	0	0.45812	36	-2.1828	0.0356525 *
R2	-1.0000	0	0.45812	36	-2.1828	0.0356525 *
R3	0.0000	0	0.45812	36	0.0000	1.0000000
R4	0.0000	0	0.00000	36		
T1	-0.2500	0	0.56108	36	-0.4456	0.6585786
T2	0.0000	0	0.00000	36		
R1:T1	0.3333	0	0.64788	36	0.5145	0.6100498
R1:T2	0.0000	0	0.00000	36		
R2:T1	0.6667	0	0.64788	36	1.0290	0.3103479
R2:T2	0.0000	0	0.00000	36		
R3:T1	0.0000	0	0.64788	36	0.0000	1.0000000
R3:T2	0.0000	0	0.00000	36		
R4:T1	0.0000	0	0.00000	36		
R4:T2	0.0000	0	0.00000	36		
G1	-3.0000	0	0.68718	36	-4.3656	0.0001024 ***
G2	0.0000	0	0.68718	36	0.0000	1.0000000
G3	1.0000	0	0.68718	36	1.4552	0.1542753
G4	1.0000	0	0.68718	36	1.4552	0.1542753
G5	1.0000	0	0.68718	36	1.4552	0.1542753
G6	-1.0000	0	0.68718	36	-1.4552	0.1542753

G7	-1.0000	0	0.68718 36	-1.4552	0.1542753	
G8	0.0000	0	0.68718 36	0.0000	1.0000000	
G9	1.0000	0	0.68718 36	1.4552	0.1542753	
G10	-1.0000	0	0.68718 36	-1.4552	0.1542753	
G11	-3.0000	0	0.68718 36	-4.3656	0.0001024	***
G12	0.0000	0	0.68718 36	0.0000	1.0000000	
G13	0.0000	0	0.68718 36	0.0000	1.0000000	
G14	-1.0000	0	0.68718 36	-1.4552	0.1542753	
G15	-2.0000	0	0.68718 36	-2.9104	0.0061560	**
G16	-5.0000	0	0.68718 36	-7.2761	1.431e-08	***
G17	-3.0000	0	0.68718 36	-4.3656	0.0001024	***
G18	-2.0000	0	0.68718 36	-2.9104	0.0061560	**
G19	-2.0000	0	0.68718 36	-2.9104	0.0061560	**
G20	-1.0000	0	0.68718 36	-1.4552	0.1542753	
G21	-2.0000	0	0.56108 36	-3.5645	0.0010508	**
G22	-0.3333	0	0.56108 36	-0.5941	0.5561681	
G23	0.0000	0	0.00000 36			
T1:G1	0.9167	0	0.97183 36	0.9432	0.3518445	
T1:G2	-1.0833	0	0.97183 36	-1.1147	0.2723483	
T1:G3	-0.0833	0	0.97183 36	-0.0857	0.9321409	
T1:G4	-0.0833	0	0.97183 36	-0.0857	0.9321409	
T1:G5	-0.0833	0	0.97183 36	-0.0857	0.9321409	
T1:G6	-1.4167	0	0.97183 36	-1.4577	0.1535818	
T1:G7	0.5833	0	0.97183 36	0.6002	0.5521031	
T1:G8	0.5833	0	0.97183 36	0.6002	0.5521031	
T1:G9	-0.4167	0	0.97183 36	-0.4287	0.6706625	
T1:G10	-1.4167	0	0.97183 36	-1.4577	0.1535818	
T1:G11	0.2500	0	0.97183 36	0.2572	0.7984521	
T1:G12	-0.7500	0	0.97183 36	-0.7717	0.4453029	
T1:G13	-1.7500	0	0.97183 36	-1.8007	0.0801274	.
T1:G14	1.2500	0	0.97183 36	1.2862	0.2065706	
T1:G15	-2.7500	0	0.97183 36	-2.8297	0.0075715	**
T1:G16	1.2500	0	0.97183 36	1.2862	0.2065706	
T1:G17	-0.7500	0	0.97183 36	-0.7717	0.4453029	
T1:G18	-0.7500	0	0.97183 36	-0.7717	0.4453029	
T1:G19	0.2500	0	0.97183 36	0.2572	0.7984521	
T1:G20	-0.7500	0	0.97183 36	-0.7717	0.4453029	
T1:G21	1.1667	0	0.79349 36	1.4703	0.1501689	
T1:G22	-1.0000	0	0.79349 36	-1.2603	0.2156865	
T1:G23	0.0000	0	0.00000 36			
T2:G1	0.0000	0	0.00000 36			
T2:G2	0.0000	0	0.00000 36			
T2:G3	0.0000	0	0.00000 36			
T2:G4	0.0000	0	0.00000 36			
T2:G5	0.0000	0	0.00000 36			
T2:G6	0.0000	0	0.00000 36			
T2:G7	0.0000	0	0.00000 36			
T2:G8	0.0000	0	0.00000 36			

T2:G9	0.0000	0	0.00000	36		
T2:G10	0.0000	0	0.00000	36		
T2:G11	0.0000	0	0.00000	36		
T2:G12	0.0000	0	0.00000	36		
T2:G13	0.0000	0	0.00000	36		
T2:G14	0.0000	0	0.00000	36		
T2:G15	0.0000	0	0.00000	36		
T2:G16	0.0000	0	0.00000	36		
T2:G17	0.0000	0	0.00000	36		
T2:G18	0.0000	0	0.00000	36		
T2:G19	0.0000	0	0.00000	36		
T2:G20	0.0000	0	0.00000	36		
T2:G21	0.0000	0	0.00000	36		
T2:G22	0.0000	0	0.00000	36		
T2:G23	0.0000	0	0.00000	36		
R1:T1:G1	0.0000	0	0.00000	36		
R1:T1:G2	0.0000	0	0.00000	36		
R1:T1:G3	0.0000	0	0.00000	36		
R1:T1:G4	0.0000	0	0.00000	36		
R1:T1:G5	0.0000	0	0.00000	36		
R1:T1:G6		0				
R1:T1:G7		0				
R1:T1:G8		0				
R1:T1:G9		0				
R1:T1:G10		0				
R1:T1:G11		0				
R1:T1:G12		0				
R1:T1:G13		0				
R1:T1:G14		0				
R1:T1:G15		0				
R1:T1:G16		0				
R1:T1:G17		0				
R1:T1:G18		0				
R1:T1:G19		0				
R1:T1:G20		0				
R1:T1:G21	-1.0000	0	0.64788	36	-1.5435	0.1314585
R1:T1:G22	0.0000	0	0.64788	36	0.0000	1.0000000
R1:T1:G23	0.0000	0	0.00000	36		
R1:T2:G1	0.0000	0	0.00000	36		
R1:T2:G2	0.0000	0	0.00000	36		
R1:T2:G3	0.0000	0	0.00000	36		
R1:T2:G4	0.0000	0	0.00000	36		
R1:T2:G5	0.0000	0	0.00000	36		
R1:T2:G6		0				
R1:T2:G7		0				
R1:T2:G8		0				
R1:T2:G9		0				
R1:T2:G10		0				

R1:T2:G11		0			
R1:T2:G12		0			
R1:T2:G13		0			
R1:T2:G14		0			
R1:T2:G15		0			
R1:T2:G16		0			
R1:T2:G17		0			
R1:T2:G18		0			
R1:T2:G19		0			
R1:T2:G20		0			
R1:T2:G21	0.6667	0	0.64788 36	1.0290	0.3103479
R1:T2:G22	0.0000	0	0.64788 36	0.0000	1.0000000
R1:T2:G23	0.0000	0	0.00000 36		
R2:T1:G1		0			
R2:T1:G2		0			
R2:T1:G3		0			
R2:T1:G4		0			
R2:T1:G5		0			
R2:T1:G6	0.0000	0	0.00000 36		
R2:T1:G7	0.0000	0	0.00000 36		
R2:T1:G8	0.0000	0	0.00000 36		
R2:T1:G9	0.0000	0	0.00000 36		
R2:T1:G10	0.0000	0	0.00000 36		
R2:T1:G11		0			
R2:T1:G12		0			
R2:T1:G13		0			
R2:T1:G14		0			
R2:T1:G15		0			
R2:T1:G16		0			
R2:T1:G17		0			
R2:T1:G18		0			
R2:T1:G19		0			
R2:T1:G20		0			
R2:T1:G21	-1.0000	0	0.64788 36	-1.5435	0.1314585
R2:T1:G22	-0.3333	0	0.64788 36	-0.5145	0.6100498
R2:T1:G23	0.0000	0	0.00000 36		
R2:T2:G1		0			
R2:T2:G2		0			
R2:T2:G3		0			
R2:T2:G4		0			
R2:T2:G5		0			
R2:T2:G6	0.0000	0	0.00000 36		
R2:T2:G7	0.0000	0	0.00000 36		
R2:T2:G8	0.0000	0	0.00000 36		
R2:T2:G9	0.0000	0	0.00000 36		
R2:T2:G10	0.0000	0	0.00000 36		
R2:T2:G11		0			
R2:T2:G12		0			

R2:T2:G13		0			
R2:T2:G14		0			
R2:T2:G15		0			
R2:T2:G16		0			
R2:T2:G17		0			
R2:T2:G18		0			
R2:T2:G19		0			
R2:T2:G20		0			
R2:T2:G21	-1.0000	0	0.64788 36	-1.5435	0.1314585
R2:T2:G22	0.3333	0	0.64788 36	0.5145	0.6100498
R2:T2:G23	0.0000	0	0.00000 36		
R3:T1:G1		0			
R3:T1:G2		0			
R3:T1:G3		0			
R3:T1:G4		0			
R3:T1:G5		0			
R3:T1:G6		0			
R3:T1:G7		0			
R3:T1:G8		0			
R3:T1:G9		0			
R3:T1:G10		0			
R3:T1:G11	0.0000	0	0.00000 36		
R3:T1:G12	0.0000	0	0.00000 36		
R3:T1:G13	0.0000	0	0.00000 36		
R3:T1:G14	0.0000	0	0.00000 36		
R3:T1:G15	0.0000	0	0.00000 36		
R3:T1:G16		0			
R3:T1:G17		0			
R3:T1:G18		0			
R3:T1:G19		0			
R3:T1:G20		0			
R3:T1:G21	-1.6667	0	0.64788 36	-2.5725	0.0143678 *
R3:T1:G22	0.6667	0	0.64788 36	1.0290	0.3103479
R3:T1:G23	0.0000	0	0.00000 36		
R3:T2:G1		0			
R3:T2:G2		0			
R3:T2:G3		0			
R3:T2:G4		0			
R3:T2:G5		0			
R3:T2:G6		0			
R3:T2:G7		0			
R3:T2:G8		0			
R3:T2:G9		0			
R3:T2:G10		0			
R3:T2:G11	0.0000	0	0.00000 36		
R3:T2:G12	0.0000	0	0.00000 36		
R3:T2:G13	0.0000	0	0.00000 36		
R3:T2:G14	0.0000	0	0.00000 36		

R3:T2:G15	0.0000	0	0.00000 36
R3:T2:G16		0	
R3:T2:G17		0	
R3:T2:G18		0	
R3:T2:G19		0	
R3:T2:G20		0	
R3:T2:G21	-0.6667	0	0.64788 36 -1.0290 0.3103479
R3:T2:G22	0.0000	0	0.64788 36 0.0000 1.0000000
R3:T2:G23	0.0000	0	0.00000 36
R4:T1:G1		0	
R4:T1:G2		0	
R4:T1:G3		0	
R4:T1:G4		0	
R4:T1:G5		0	
R4:T1:G6		0	
R4:T1:G7		0	
R4:T1:G8		0	
R4:T1:G9		0	
R4:T1:G10		0	
R4:T1:G11		0	
R4:T1:G12		0	
R4:T1:G13		0	
R4:T1:G14		0	
R4:T1:G15		0	
R4:T1:G16	0.0000	0	0.00000 36
R4:T1:G17	0.0000	0	0.00000 36
R4:T1:G18	0.0000	0	0.00000 36
R4:T1:G19	0.0000	0	0.00000 36
R4:T1:G20	0.0000	0	0.00000 36
R4:T1:G21	0.0000	0	0.00000 36
R4:T1:G22	0.0000	0	0.00000 36
R4:T1:G23	0.0000	0	0.00000 36
R4:T2:G1		0	
R4:T2:G2		0	
R4:T2:G3		0	
R4:T2:G4		0	
R4:T2:G5		0	
R4:T2:G6		0	
R4:T2:G7		0	
R4:T2:G8		0	
R4:T2:G9		0	
R4:T2:G10		0	
R4:T2:G11		0	
R4:T2:G12		0	
R4:T2:G13		0	
R4:T2:G14		0	
R4:T2:G15		0	
R4:T2:G16	0.0000	0	0.00000 36

R4:T2:G17	0.0000	0	0.00000	36		
R4:T2:G18	0.0000	0	0.00000	36		
R4:T2:G19	0.0000	0	0.00000	36		
R4:T2:G20	0.0000	0	0.00000	36		
R4:T2:G21	0.0000	0	0.00000	36		
R4:T2:G22	0.0000	0	0.00000	36		
R4:T2:G23	0.0000	0	0.00000	36		
F1	-2.0000	0	0.39675	36	-5.0410	1.325e-05 ***
F2	-1.0000	0	0.39675	36	-2.5205	0.0162919 *
F3	0.0000	0	0.00000	36		
T1:F1	-0.2500	0	0.56108	36	-0.4456	0.6585786
T1:F2	0.0000	0	0.56108	36	0.0000	1.0000000
T1:F3	0.0000	0	0.00000	36		
T2:F1	0.0000	0	0.00000	36		
T2:F2	0.0000	0	0.00000	36		
T2:F3	0.0000	0	0.00000	36		
G1:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G1:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G1:F3	0.0000	0	0.00000	36		
G2:F1	-2.0000	0	0.88715	36	-2.2544	0.0303508 *
G2:F2	-1.0000	0	0.88715	36	-1.1272	0.2671137
G2:F3	0.0000	0	0.00000	36		
G3:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G3:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G3:F3	0.0000	0	0.00000	36		
G4:F1	2.0000	0	0.88715	36	2.2544	0.0303508 *
G4:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G4:F3	0.0000	0	0.00000	36		
G5:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G5:F2	1.0000	0	0.88715	36	1.1272	0.2671137
G5:F3	0.0000	0	0.00000	36		
G6:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G6:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G6:F3	0.0000	0	0.00000	36		
G7:F1	1.0000	0	0.88715	36	1.1272	0.2671137
G7:F2	1.0000	0	0.88715	36	1.1272	0.2671137
G7:F3	0.0000	0	0.00000	36		
G8:F1	1.0000	0	0.88715	36	1.1272	0.2671137
G8:F2	2.0000	0	0.88715	36	2.2544	0.0303508 *
G8:F3	0.0000	0	0.00000	36		
G9:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G9:F2	-1.0000	0	0.88715	36	-1.1272	0.2671137
G9:F3	0.0000	0	0.00000	36		
G10:F1	-1.0000	0	0.88715	36	-1.1272	0.2671137
G10:F2	-1.0000	0	0.88715	36	-1.1272	0.2671137
G10:F3	0.0000	0	0.00000	36		
G11:F1	1.0000	0	0.88715	36	1.1272	0.2671137
G11:F2	0.0000	0	0.88715	36	0.0000	1.0000000

G11:F3	0.0000	0	0.00000	36		
G12:F1	1.0000	0	0.88715	36	1.1272	0.2671137
G12:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G12:F3	0.0000	0	0.00000	36		
G13:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G13:F2	-1.0000	0	0.88715	36	-1.1272	0.2671137
G13:F3	0.0000	0	0.00000	36		
G14:F1	1.0000	0	0.88715	36	1.1272	0.2671137
G14:F2	1.0000	0	0.88715	36	1.1272	0.2671137
G14:F3	0.0000	0	0.00000	36		
G15:F1	-1.0000	0	0.88715	36	-1.1272	0.2671137
G15:F2	-1.0000	0	0.88715	36	-1.1272	0.2671137
G15:F3	0.0000	0	0.00000	36		
G16:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G16:F2	-1.0000	0	0.88715	36	-1.1272	0.2671137
G16:F3	0.0000	0	0.00000	36		
G17:F1	-1.0000	0	0.88715	36	-1.1272	0.2671137
G17:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G17:F3	0.0000	0	0.00000	36		
G18:F1	-1.0000	0	0.88715	36	-1.1272	0.2671137
G18:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G18:F3	0.0000	0	0.00000	36		
G19:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G19:F2	1.0000	0	0.88715	36	1.1272	0.2671137
G19:F3	0.0000	0	0.00000	36		
G20:F1	0.0000	0	0.88715	36	0.0000	1.0000000
G20:F2	0.0000	0	0.88715	36	0.0000	1.0000000
G20:F3	0.0000	0	0.00000	36		
G21:F1	-1.2500	0	0.56108	36	-2.2278	0.0322306 *
G21:F2	0.2500	0	0.56108	36	0.4456	0.6585786
G21:F3	0.0000	0	0.00000	36		
G22:F1	0.0000	0	0.56108	36	0.0000	1.0000000
G22:F2	0.0000	0	0.56108	36	0.0000	1.0000000
G22:F3	0.0000	0	0.00000	36		
G23:F1	0.0000	0	0.00000	36		
G23:F2	0.0000	0	0.00000	36		
G23:F3	0.0000	0	0.00000	36		
T1:G1:F1	-1.7500	0	1.25462	36	-1.3948	0.1716105
T1:G1:F2	-1.0000	0	1.25462	36	-0.7971	0.4306457
T1:G1:F3	0.0000	0	0.00000	36		
T1:G2:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G2:F2	0.0000	0	1.25462	36	0.0000	1.0000000
T1:G2:F3	0.0000	0	0.00000	36		
T1:G3:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G3:F2	-1.0000	0	1.25462	36	-0.7971	0.4306457
T1:G3:F3	0.0000	0	0.00000	36		
T1:G4:F1	-0.7500	0	1.25462	36	-0.5978	0.5537222
T1:G4:F2	0.0000	0	1.25462	36	0.0000	1.0000000



T1:G4:F3	0.0000	0	0.00000	36		
T1:G5:F1	1.2500	0	1.25462	36	0.9963	0.3257463
T1:G5:F2	-1.0000	0	1.25462	36	-0.7971	0.4306457
T1:G5:F3	0.0000	0	0.00000	36		
T1:G6:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G6:F2	0.0000	0	1.25462	36	0.0000	1.0000000
T1:G6:F3	0.0000	0	0.00000	36		
T1:G7:F1	-0.7500	0	1.25462	36	-0.5978	0.5537222
T1:G7:F2	-1.0000	0	1.25462	36	-0.7971	0.4306457
T1:G7:F3	0.0000	0	0.00000	36		
T1:G8:F1	-0.7500	0	1.25462	36	-0.5978	0.5537222
T1:G8:F2	-2.0000	0	1.25462	36	-1.5941	0.1196553
T1:G8:F3	0.0000	0	0.00000	36		
T1:G9:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G9:F2	1.0000	0	1.25462	36	0.7971	0.4306457
T1:G9:F3	0.0000	0	0.00000	36		
T1:G10:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G10:F2	1.0000	0	1.25462	36	0.7971	0.4306457
T1:G10:F3	0.0000	0	0.00000	36		
T1:G11:F1	-0.7500	0	1.25462	36	-0.5978	0.5537222
T1:G11:F2	0.0000	0	1.25462	36	0.0000	1.0000000
T1:G11:F3	0.0000	0	0.00000	36		
T1:G12:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G12:F2	1.0000	0	1.25462	36	0.7971	0.4306457
T1:G12:F3	0.0000	0	0.00000	36		
T1:G13:F1	1.2500	0	1.25462	36	0.9963	0.3257463
T1:G13:F2	2.0000	0	1.25462	36	1.5941	0.1196553
T1:G13:F3	0.0000	0	0.00000	36		
T1:G14:F1	-0.7500	0	1.25462	36	-0.5978	0.5537222
T1:G14:F2	-2.0000	0	1.25462	36	-1.5941	0.1196553
T1:G14:F3	0.0000	0	0.00000	36		
T1:G15:F1	1.2500	0	1.25462	36	0.9963	0.3257463
T1:G15:F2	1.0000	0	1.25462	36	0.7971	0.4306457
T1:G15:F3	0.0000	0	0.00000	36		
T1:G16:F1	-1.7500	0	1.25462	36	-1.3948	0.1716105
T1:G16:F2	0.0000	0	1.25462	36	0.0000	1.0000000
T1:G16:F3	0.0000	0	0.00000	36		
T1:G17:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G17:F2	0.0000	0	1.25462	36	0.0000	1.0000000
T1:G17:F3	0.0000	0	0.00000	36		
T1:G18:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G18:F2	-1.0000	0	1.25462	36	-0.7971	0.4306457
T1:G18:F3	0.0000	0	0.00000	36		
T1:G19:F1	-0.7500	0	1.25462	36	-0.5978	0.5537222
T1:G19:F2	-2.0000	0	1.25462	36	-1.5941	0.1196553
T1:G19:F3	0.0000	0	0.00000	36		
T1:G20:F1	0.2500	0	1.25462	36	0.1993	0.8431780
T1:G20:F2	-1.0000	0	1.25462	36	-0.7971	0.4306457

T1:G20:F3	0.0000	0	0.00000	36		
T1:G21:F1	0.2500	0	0.79349	36	0.3151	0.7545328
T1:G21:F2	-0.7500	0	0.79349	36	-0.9452	0.3508634
T1:G21:F3	0.0000	0	0.00000	36		
T1:G22:F1	0.0000	0	0.79349	36	0.0000	1.0000000
T1:G22:F2	0.0000	0	0.79349	36	0.0000	1.0000000
T1:G22:F3	0.0000	0	0.00000	36		
T1:G23:F1	0.0000	0	0.00000	36		
T1:G23:F2	0.0000	0	0.00000	36		
T1:G23:F3	0.0000	0	0.00000	36		
T2:G1:F1	0.0000	0	0.00000	36		
T2:G1:F2	0.0000	0	0.00000	36		
T2:G1:F3	0.0000	0	0.00000	36		
T2:G2:F1	0.0000	0	0.00000	36		
T2:G2:F2	0.0000	0	0.00000	36		
T2:G2:F3	0.0000	0	0.00000	36		
T2:G3:F1	0.0000	0	0.00000	36		
T2:G3:F2	0.0000	0	0.00000	36		
T2:G3:F3	0.0000	0	0.00000	36		
T2:G4:F1	0.0000	0	0.00000	36		
T2:G4:F2	0.0000	0	0.00000	36		
T2:G4:F3	0.0000	0	0.00000	36		
T2:G5:F1	0.0000	0	0.00000	36		
T2:G5:F2	0.0000	0	0.00000	36		
T2:G5:F3	0.0000	0	0.00000	36		
T2:G6:F1	0.0000	0	0.00000	36		
T2:G6:F2	0.0000	0	0.00000	36		
T2:G6:F3	0.0000	0	0.00000	36		
T2:G7:F1	0.0000	0	0.00000	36		
T2:G7:F2	0.0000	0	0.00000	36		
T2:G7:F3	0.0000	0	0.00000	36		
T2:G8:F1	0.0000	0	0.00000	36		
T2:G8:F2	0.0000	0	0.00000	36		
T2:G8:F3	0.0000	0	0.00000	36		
T2:G9:F1	0.0000	0	0.00000	36		
T2:G9:F2	0.0000	0	0.00000	36		
T2:G9:F3	0.0000	0	0.00000	36		
T2:G10:F1	0.0000	0	0.00000	36		
T2:G10:F2	0.0000	0	0.00000	36		
T2:G10:F3	0.0000	0	0.00000	36		
T2:G11:F1	0.0000	0	0.00000	36		
T2:G11:F2	0.0000	0	0.00000	36		
T2:G11:F3	0.0000	0	0.00000	36		
T2:G12:F1	0.0000	0	0.00000	36		
T2:G12:F2	0.0000	0	0.00000	36		
T2:G12:F3	0.0000	0	0.00000	36		
T2:G13:F1	0.0000	0	0.00000	36		
T2:G13:F2	0.0000	0	0.00000	36		

T2:G13:F3	0.0000	0	0.00000	36
T2:G14:F1	0.0000	0	0.00000	36
T2:G14:F2	0.0000	0	0.00000	36
T2:G14:F3	0.0000	0	0.00000	36
T2:G15:F1	0.0000	0	0.00000	36
T2:G15:F2	0.0000	0	0.00000	36
T2:G15:F3	0.0000	0	0.00000	36
T2:G16:F1	0.0000	0	0.00000	36
T2:G16:F2	0.0000	0	0.00000	36
T2:G16:F3	0.0000	0	0.00000	36
T2:G17:F1	0.0000	0	0.00000	36
T2:G17:F2	0.0000	0	0.00000	36
T2:G17:F3	0.0000	0	0.00000	36
T2:G18:F1	0.0000	0	0.00000	36
T2:G18:F2	0.0000	0	0.00000	36
T2:G18:F3	0.0000	0	0.00000	36
T2:G19:F1	0.0000	0	0.00000	36
T2:G19:F2	0.0000	0	0.00000	36
T2:G19:F3	0.0000	0	0.00000	36
T2:G20:F1	0.0000	0	0.00000	36
T2:G20:F2	0.0000	0	0.00000	36
T2:G20:F3	0.0000	0	0.00000	36
T2:G21:F1	0.0000	0	0.00000	36
T2:G21:F2	0.0000	0	0.00000	36
T2:G21:F3	0.0000	0	0.00000	36
T2:G22:F1	0.0000	0	0.00000	36
T2:G22:F2	0.0000	0	0.00000	36
T2:G22:F3	0.0000	0	0.00000	36
T2:G23:F1	0.0000	0	0.00000	36
T2:G23:F2	0.0000	0	0.00000	36
T2:G23:F3	0.0000	0	0.00000	36

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + T + R:T + G + G:T + R:T:G + F + F:T + F:G + F:G:T, ex7.3),
      type=3, singular.ok=TRUE) # NOT OK
```

Note: model has aliased coefficients

sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y

	Sum Sq	Df	F values	Pr(>F)
R	0.000	0		
T	0.000	0		

```

G          73.444  2 116.6471 < 2.2e-16 ***
F          120.563  2 191.4828 < 2.2e-16 ***
R:T         0.000  0
T:G          5.778  2   9.1765 0.0006018 ***
T:F          0.822  2   1.3060 0.2834316
G:F          23.469 44   1.6943 0.0531910 .
R:T:G         8.778 12   2.3235 0.0253153 *
T:G:F        10.740 44   0.7753 0.7906401
Residuals   11.333 36
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

## 6.6 Example 8.1

(15) MODEL

```

ex8.1 = read.table("http://r.acr.kr/split/asbed.txt", header=TRUE)
ex8.1 = af(ex8.1, c("R", "A", "B"))
ex8.1

```

```

      Y R  A B
1     9 1  1 1
2     2 1  1 2
3     8 1  1 7
4     7 1  1 8
5     5 1  1 9
6     9 1  2 1
7     7 1  2 2
8     3 1  2 7
9     5 1  2 8
10    4 1  2 9
11    9 1  3 1
12    2 1  3 2
13    8 1  3 7
14    7 1  3 8
15    5 1  3 9
16    9 1 10 1
17    1 1 10 2
18    9 1 10 7
19    7 1 10 8
20    5 1 10 9
21    9 1 11 1
22    7 1 11 2
23    3 1 11 7
24    5 1 11 8
25    4 1 11 9
26    9 1 12 1

```

27	2	1	12	2
28	8	1	12	7
29	7	1	12	8
30	5	1	12	9
31	9	1	13	1
32	7	1	13	2
33	3	1	13	7
34	5	1	13	8
35	4	1	13	9
36	9	2	4	3
37	7	2	4	4
38	13	2	4	7
39	8	2	4	8
40	8	2	4	9
41	9	2	5	3
42	12	2	5	4
43	8	2	5	7
44	7	2	5	8
45	8	2	5	9
46	9	2	6	3
47	7	2	6	4
48	13	2	6	7
49	9	2	6	8
50	12	2	6	9
51	9	2	10	3
52	11	2	10	4
53	9	2	10	7
54	7	2	10	8
55	5	2	10	9
56	9	2	11	3
57	7	2	11	4
58	13	2	11	7
59	5	2	11	8
60	4	2	11	9
61	9	2	12	3
62	12	2	12	4
63	8	2	12	7
64	7	2	12	8
65	5	2	12	9
66	9	2	13	3
67	7	2	13	4
68	13	2	13	7
69	5	2	13	8
70	4	2	13	9
71	19	3	7	5
72	17	3	7	6
73	13	3	7	7
74	15	3	7	8

```

75  14 3  7 9
76  19 3  8 5
77  12 3  8 6
78  18 3  8 7
79  17 3  8 8
80  45 3  8 9
81  19 3  9 5
82  17 3  9 6
83  13 3  9 7
84  25 3  9 8
85  34 3  9 9
86  15 3 10 5
87   9 3 10 6
88  11 3 10 7
89  10 3 10 8
90  10 3 10 9
91   9 3 11 5
92  17 3 11 6
93  13 3 11 7
94  15 3 11 8
95  14 3 11 9
96   9 3 12 5
97  12 3 12 6
98   8 3 12 7
99  17 3 12 8
100 15 3 12 9
101  9 3 13 5
102 17 3 13 6
103 13 3 13 7
104 15 3 13 8
105 14 3 13 9

```

```
GLM(Y ~ R + A + R:A + B + B:R + A:B + A:B:R, ex8.1)
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	104	3951.8	37.999		
RESIDUALS	0	0.0			
CORRECTED TOTAL	104	3951.8			

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	1787.68	893.84		
A	12	601.24	50.10		
R:A	6	24.93	4.16		
B	8	156.87	19.61		

R:B	4	319.87	79.97
A:B	60	1012.26	16.87
R:A:B	12	49.00	4.08

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	372.22	186.111		
A	12	601.24	50.103		
R:A	6	50.00	8.333		
B	8	156.87	19.609		
R:B	4	87.44	21.861		
A:B	60	1012.26	16.871		
R:A:B	12	49.00	4.083		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	372.22	186.111		
A	12	572.31	47.692		
R:A	6	50.00	8.333		
B	8	185.85	23.231		
R:B	4	87.44	21.861		
A:B	60	1012.26	16.871		
R:A:B	12	49.00	4.083		

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	14	0	0	0		
R1	-10	0	0	0		
R2	-10	0	0	0		
R3	0	0	0	0		
A1	1	0	0	0		
A2	0	0	0	0		
A3	1	0	0	0		
A4	4	0	0	0		
A5	4	0	0	0		
A6	8	0	0	0		
A7	0	0	0	0		
A8	31	0	0	0		
A9	20	0	0	0		
A10	-4	0	0	0		
A11	0	0	0	0		
A12	1	0	0	0		
A13	0	0	0	0		
R1:A1	0	0	0	0		
R1:A2	0	0	0	0		
R1:A3	0	0	0	0		
R1:A4		0				
R1:A5		0				

R1:A6		0	
R1:A7		0	
R1:A8		0	
R1:A9		0	
R1:A10	5	0	0
R1:A11	0	0	0
R1:A12	0	0	0
R1:A13	0	0	0
R2:A1		0	
R2:A2		0	
R2:A3		0	
R2:A4	0	0	0
R2:A5	0	0	0
R2:A6	0	0	0
R2:A7		0	
R2:A8		0	
R2:A9		0	
R2:A10	5	0	0
R2:A11	0	0	0
R2:A12	0	0	0
R2:A13	0	0	0
R3:A1		0	
R3:A2		0	
R3:A3		0	
R3:A4		0	
R3:A5		0	
R3:A6		0	
R3:A7	0	0	0
R3:A8	0	0	0
R3:A9	0	0	0
R3:A10	0	0	0
R3:A11	0	0	0
R3:A12	0	0	0
R3:A13	0	0	0
B1	5	0	0
B2	3	0	0
B3	5	0	0
B4	3	0	0
B5	-5	0	0
B6	3	0	0
B7	-1	0	0
B8	1	0	0
B9	0	0	0
R1:B1	0	0	0
R1:B2	0	0	0
R1:B3		0	
R1:B4		0	
R1:B5		0	



R1:B6		0	
R1:B7	0	0	0
R1:B8	0	0	0
R1:B9	0	0	0
R2:B1		0	
R2:B2		0	
R2:B3	0	0	0
R2:B4	0	0	0
R2:B5		0	
R2:B6		0	
R2:B7	10	0	0
R2:B8	0	0	0
R2:B9	0	0	0
R3:B1		0	
R3:B2		0	
R3:B3		0	
R3:B4		0	
R3:B5	0	0	0
R3:B6	0	0	0
R3:B7	0	0	0
R3:B8	0	0	0
R3:B9	0	0	0
A1:B1	-1	0	0
A1:B2	-6	0	0
A1:B3		0	
A1:B4		0	
A1:B5		0	
A1:B6		0	
A1:B7	4	0	0
A1:B8	1	0	0
A1:B9	0	0	0
A2:B1	0	0	0
A2:B2	0	0	0
A2:B3		0	
A2:B4		0	
A2:B5		0	
A2:B6		0	
A2:B7	0	0	0
A2:B8	0	0	0
A2:B9	0	0	0
A3:B1	-1	0	0
A3:B2	-6	0	0
A3:B3		0	
A3:B4		0	
A3:B5		0	
A3:B6		0	
A3:B7	4	0	0
A3:B8	1	0	0

A3:B9	0	0	0
A4:B1		0	
A4:B2		0	
A4:B3	-4	0	0
A4:B4	-4	0	0
A4:B5		0	
A4:B6		0	
A4:B7	-4	0	0
A4:B8	-1	0	0
A4:B9	0	0	0
A5:B1		0	
A5:B2		0	
A5:B3	-4	0	0
A5:B4	1	0	0
A5:B5		0	
A5:B6		0	
A5:B7	-9	0	0
A5:B8	-2	0	0
A5:B9	0	0	0
A6:B1		0	
A6:B2		0	
A6:B3	-8	0	0
A6:B4	-8	0	0
A6:B5		0	
A6:B6		0	
A6:B7	-8	0	0
A6:B8	-4	0	0
A6:B9	0	0	0
A7:B1		0	
A7:B2		0	
A7:B3		0	
A7:B4		0	
A7:B5	10	0	0
A7:B6	0	0	0
A7:B7	0	0	0
A7:B8	0	0	0
A7:B9	0	0	0
A8:B1		0	
A8:B2		0	
A8:B3		0	
A8:B4		0	
A8:B5	-21	0	0
A8:B6	-36	0	0
A8:B7	-26	0	0
A8:B8	-29	0	0
A8:B9	0	0	0
A9:B1		0	
A9:B2		0	

A9:B3		0	
A9:B4		0	
A9:B5	-10	0	0
A9:B6	-20	0	0
A9:B7	-20	0	0
A9:B8	-10	0	0
A9:B9	0	0	0
A10:B1	-1	0	0
A10:B2	-7	0	0
A10:B3	-1	0	0
A10:B4	3	0	0
A10:B5	10	0	0
A10:B6	-4	0	0
A10:B7	2	0	0
A10:B8	-1	0	0
A10:B9	0	0	0
A11:B1	0	0	0
A11:B2	0	0	0
A11:B3	0	0	0
A11:B4	0	0	0
A11:B5	0	0	0
A11:B6	0	0	0
A11:B7	0	0	0
A11:B8	0	0	0
A11:B9	0	0	0
A12:B1	-1	0	0
A12:B2	-6	0	0
A12:B3	-1	0	0
A12:B4	4	0	0
A12:B5	-1	0	0
A12:B6	-6	0	0
A12:B7	-6	0	0
A12:B8	1	0	0
A12:B9	0	0	0
A13:B1	0	0	0
A13:B2	0	0	0
A13:B3	0	0	0
A13:B4	0	0	0
A13:B5	0	0	0
A13:B6	0	0	0
A13:B7	0	0	0
A13:B8	0	0	0
A13:B9	0	0	0
R1:A1:B1	0	0	0
R1:A1:B2	0	0	0
R1:A1:B3		0	
R1:A1:B4		0	
R1:A1:B5		0	

R1:A1:B6		0	
R1:A1:B7	0	0	0
R1:A1:B8	0	0	0
R1:A1:B9	0	0	0
R1:A2:B1	0	0	0
R1:A2:B2	0	0	0
R1:A2:B3		0	
R1:A2:B4		0	
R1:A2:B5		0	
R1:A2:B6		0	
R1:A2:B7	0	0	0
R1:A2:B8	0	0	0
R1:A2:B9	0	0	0
R1:A3:B1	0	0	0
R1:A3:B2	0	0	0
R1:A3:B3		0	
R1:A3:B4		0	
R1:A3:B5		0	
R1:A3:B6		0	
R1:A3:B7	0	0	0
R1:A3:B8	0	0	0
R1:A3:B9	0	0	0
R1:A4:B1		0	
R1:A4:B2		0	
R1:A4:B3		0	
R1:A4:B4		0	
R1:A4:B5		0	
R1:A4:B6		0	
R1:A4:B7		0	
R1:A4:B8		0	
R1:A4:B9		0	
R1:A5:B1		0	
R1:A5:B2		0	
R1:A5:B3		0	
R1:A5:B4		0	
R1:A5:B5		0	
R1:A5:B6		0	
R1:A5:B7		0	
R1:A5:B8		0	
R1:A5:B9		0	
R1:A6:B1		0	
R1:A6:B2		0	
R1:A6:B3		0	
R1:A6:B4		0	
R1:A6:B5		0	
R1:A6:B6		0	
R1:A6:B7		0	
R1:A6:B8		0	

R1:A6:B9		0	
R1:A7:B1		0	
R1:A7:B2		0	
R1:A7:B3		0	
R1:A7:B4		0	
R1:A7:B5		0	
R1:A7:B6		0	
R1:A7:B7		0	
R1:A7:B8		0	
R1:A7:B9		0	
R1:A8:B1		0	
R1:A8:B2		0	
R1:A8:B3		0	
R1:A8:B4		0	
R1:A8:B5		0	
R1:A8:B6		0	
R1:A8:B7		0	
R1:A8:B8		0	
R1:A8:B9		0	
R1:A9:B1		0	
R1:A9:B2		0	
R1:A9:B3		0	
R1:A9:B4		0	
R1:A9:B5		0	
R1:A9:B6		0	
R1:A9:B7		0	
R1:A9:B8		0	
R1:A9:B9		0	
R1:A10:B1	0	0	0
R1:A10:B2	0	0	0
R1:A10:B3		0	
R1:A10:B4		0	
R1:A10:B5		0	
R1:A10:B6		0	
R1:A10:B7	3	0	0
R1:A10:B8	2	0	0
R1:A10:B9	0	0	0
R1:A11:B1	0	0	0
R1:A11:B2	0	0	0
R1:A11:B3		0	
R1:A11:B4		0	
R1:A11:B5		0	
R1:A11:B6		0	
R1:A11:B7	0	0	0
R1:A11:B8	0	0	0
R1:A11:B9	0	0	0
R1:A12:B1	0	0	0
R1:A12:B2	0	0	0

R1:A12:B3		0	
R1:A12:B4		0	
R1:A12:B5		0	
R1:A12:B6		0	
R1:A12:B7	10	0	0
R1:A12:B8	0	0	0
R1:A12:B9	0	0	0
R1:A13:B1	0	0	0
R1:A13:B2	0	0	0
R1:A13:B3		0	
R1:A13:B4		0	
R1:A13:B5		0	
R1:A13:B6		0	
R1:A13:B7	0	0	0
R1:A13:B8	0	0	0
R1:A13:B9	0	0	0
R2:A1:B1		0	
R2:A1:B2		0	
R2:A1:B3		0	
R2:A1:B4		0	
R2:A1:B5		0	
R2:A1:B6		0	
R2:A1:B7		0	
R2:A1:B8		0	
R2:A1:B9		0	
R2:A2:B1		0	
R2:A2:B2		0	
R2:A2:B3		0	
R2:A2:B4		0	
R2:A2:B5		0	
R2:A2:B6		0	
R2:A2:B7		0	
R2:A2:B8		0	
R2:A2:B9		0	
R2:A3:B1		0	
R2:A3:B2		0	
R2:A3:B3		0	
R2:A3:B4		0	
R2:A3:B5		0	
R2:A3:B6		0	
R2:A3:B7		0	
R2:A3:B8		0	
R2:A3:B9		0	
R2:A4:B1		0	
R2:A4:B2		0	
R2:A4:B3	0	0	0
R2:A4:B4	0	0	0
R2:A4:B5		0	

R2:A4:B6		0	
R2:A4:B7	0	0	0
R2:A4:B8	0	0	0
R2:A4:B9	0	0	0
R2:A5:B1		0	
R2:A5:B2		0	
R2:A5:B3	0	0	0
R2:A5:B4	0	0	0
R2:A5:B5		0	
R2:A5:B6		0	
R2:A5:B7	0	0	0
R2:A5:B8	0	0	0
R2:A5:B9	0	0	0
R2:A6:B1		0	
R2:A6:B2		0	
R2:A6:B3	0	0	0
R2:A6:B4	0	0	0
R2:A6:B5		0	
R2:A6:B6		0	
R2:A6:B7	0	0	0
R2:A6:B8	0	0	0
R2:A6:B9	0	0	0
R2:A7:B1		0	
R2:A7:B2		0	
R2:A7:B3		0	
R2:A7:B4		0	
R2:A7:B5		0	
R2:A7:B6		0	
R2:A7:B7		0	
R2:A7:B8		0	
R2:A7:B9		0	
R2:A8:B1		0	
R2:A8:B2		0	
R2:A8:B3		0	
R2:A8:B4		0	
R2:A8:B5		0	
R2:A8:B6		0	
R2:A8:B7		0	
R2:A8:B8		0	
R2:A8:B9		0	
R2:A9:B1		0	
R2:A9:B2		0	
R2:A9:B3		0	
R2:A9:B4		0	
R2:A9:B5		0	
R2:A9:B6		0	
R2:A9:B7		0	
R2:A9:B8		0	

R2:A9:B9		0	
R2:A10:B1		0	
R2:A10:B2		0	
R2:A10:B3	0	0	0
R2:A10:B4	0	0	0
R2:A10:B5		0	
R2:A10:B6		0	
R2:A10:B7	-7	0	0
R2:A10:B8	2	0	0
R2:A10:B9	0	0	0
R2:A11:B1		0	
R2:A11:B2		0	
R2:A11:B3	0	0	0
R2:A11:B4	0	0	0
R2:A11:B5		0	
R2:A11:B6		0	
R2:A11:B7	0	0	0
R2:A11:B8	0	0	0
R2:A11:B9	0	0	0
R2:A12:B1		0	
R2:A12:B2		0	
R2:A12:B3	0	0	0
R2:A12:B4	0	0	0
R2:A12:B5		0	
R2:A12:B6		0	
R2:A12:B7	0	0	0
R2:A12:B8	0	0	0
R2:A12:B9	0	0	0
R2:A13:B1		0	
R2:A13:B2		0	
R2:A13:B3	0	0	0
R2:A13:B4	0	0	0
R2:A13:B5		0	
R2:A13:B6		0	
R2:A13:B7	0	0	0
R2:A13:B8	0	0	0
R2:A13:B9	0	0	0
R3:A1:B1		0	
R3:A1:B2		0	
R3:A1:B3		0	
R3:A1:B4		0	
R3:A1:B5		0	
R3:A1:B6		0	
R3:A1:B7		0	
R3:A1:B8		0	
R3:A1:B9		0	
R3:A2:B1		0	
R3:A2:B2		0	



R3:A2:B3	0
R3:A2:B4	0
R3:A2:B5	0
R3:A2:B6	0
R3:A2:B7	0
R3:A2:B8	0
R3:A2:B9	0
R3:A3:B1	0
R3:A3:B2	0
R3:A3:B3	0
R3:A3:B4	0
R3:A3:B5	0
R3:A3:B6	0
R3:A3:B7	0
R3:A3:B8	0
R3:A3:B9	0
R3:A4:B1	0
R3:A4:B2	0
R3:A4:B3	0
R3:A4:B4	0
R3:A4:B5	0
R3:A4:B6	0
R3:A4:B7	0
R3:A4:B8	0
R3:A4:B9	0
R3:A5:B1	0
R3:A5:B2	0
R3:A5:B3	0
R3:A5:B4	0
R3:A5:B5	0
R3:A5:B6	0
R3:A5:B7	0
R3:A5:B8	0
R3:A5:B9	0
R3:A6:B1	0
R3:A6:B2	0
R3:A6:B3	0
R3:A6:B4	0
R3:A6:B5	0
R3:A6:B6	0
R3:A6:B7	0
R3:A6:B8	0
R3:A6:B9	0
R3:A7:B1	0
R3:A7:B2	0
R3:A7:B3	0
R3:A7:B4	0
R3:A7:B5	0 0 0

R3:A7:B6	0	0	0
R3:A7:B7	0	0	0
R3:A7:B8	0	0	0
R3:A7:B9	0	0	0
R3:A8:B1		0	
R3:A8:B2		0	
R3:A8:B3		0	
R3:A8:B4		0	
R3:A8:B5	0	0	0
R3:A8:B6	0	0	0
R3:A8:B7	0	0	0
R3:A8:B8	0	0	0
R3:A8:B9	0	0	0
R3:A9:B1		0	
R3:A9:B2		0	
R3:A9:B3		0	
R3:A9:B4		0	
R3:A9:B5	0	0	0
R3:A9:B6	0	0	0
R3:A9:B7	0	0	0
R3:A9:B8	0	0	0
R3:A9:B9	0	0	0
R3:A10:B1		0	
R3:A10:B2		0	
R3:A10:B3		0	
R3:A10:B4		0	
R3:A10:B5	0	0	0
R3:A10:B6	0	0	0
R3:A10:B7	0	0	0
R3:A10:B8	0	0	0
R3:A10:B9	0	0	0
R3:A11:B1		0	
R3:A11:B2		0	
R3:A11:B3		0	
R3:A11:B4		0	
R3:A11:B5	0	0	0
R3:A11:B6	0	0	0
R3:A11:B7	0	0	0
R3:A11:B8	0	0	0
R3:A11:B9	0	0	0
R3:A12:B1		0	
R3:A12:B2		0	
R3:A12:B3		0	
R3:A12:B4		0	
R3:A12:B5	0	0	0
R3:A12:B6	0	0	0
R3:A12:B7	0	0	0
R3:A12:B8	0	0	0

R3:A12:B9	0	0	0
R3:A13:B1		0	
R3:A13:B2		0	
R3:A13:B3		0	
R3:A13:B4		0	
R3:A13:B5	0	0	0
R3:A13:B6	0	0	0
R3:A13:B7	0	0	0
R3:A13:B8	0	0	0
R3:A13:B9	0	0	0

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(Y ~ R + A + R:A + B + B:R + A:B + A:B:R, ex8.1), type="III",
      singular.ok=TRUE) # NOT WORKING
```

## 6.7 Example 9.2

(16) MODEL

```
ex9.2 = read.table("http://r.acr.kr/split/Ex9.2-sbex.txt", header=TRUE)
ex9.2 = af(ex9.2, c("rep", "hyb", "gen"))
ex9.2
```

	yield	rep	hyb	gen
1	48	1	3	1
2	46	1	3	3
3	43	1	3	2
4	46	1	8	1
5	45	1	8	3
6	42	1	8	2
7	46	1	2	1
8	44	1	2	3
9	42	1	2	2
10	42	1	1	1
11	46	1	1	3
12	44	1	1	2
13	43	1	6	1
14	45	1	6	3
15	44	1	6	2
16	47	1	7	1
17	49	1	7	3
18	47	1	7	2
19	48	1	0	1
20	45	1	0	3
21	45	1	0	2
22	46	1	9	1

23	48	1	9	3
24	47	1	9	2
25	46	1	4	1
26	48	1	4	3
27	47	1	4	2
28	49	1	5	1
29	49	1	5	3
30	48	1	5	2
31	46	2	4	2
32	48	2	4	3
33	42	2	4	1
34	45	2	3	2
35	44	2	3	3
36	42	2	3	1
37	46	2	9	2
38	46	2	9	3
39	44	2	9	1
40	45	2	5	2
41	45	2	5	3
42	43	2	5	1
43	43	2	1	2
44	50	2	1	3
45	44	2	1	1
46	48	2	7	2
47	51	2	7	3
48	48	2	7	1
49	44	2	2	2
50	48	2	2	3
51	47	2	2	1
52	44	2	8	2
53	46	2	8	3
54	46	2	8	1
55	47	2	6	2
56	48	2	6	3
57	44	2	6	1

```
GLM(yield ~ rep + hyb + rep:hyb + gen + gen:rep + gen:hyb, ex9.2)
```

```
$ANOVA
```

```
Response : yield
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	40	247.813	6.1953	4.4606	0.001119 **
RESIDUALS	16	22.222	1.3889		
CORRECTED TOTAL	56	270.035			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	0.239	0.2388	0.1719	0.6839085
hyb	9	66.796	7.4218	5.3437	0.0018370 **
rep:hyb	8	67.000	8.3750	6.0300	0.0011569 **
gen	2	36.351	18.1754	13.0863	0.0004293 ***
rep:gen	2	16.923	8.4616	6.0924	0.0107858 *
hyb:gen	18	60.504	3.3613	2.4201	0.0408545 *

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	0.167	0.1667	0.1200	0.7335481
hyb	9	66.796	7.4218	5.3437	0.0018370 **
rep:hyb	8	67.000	8.3750	6.0300	0.0011569 **
gen	2	36.351	18.1754	13.0863	0.0004293 ***
rep:gen	2	12.111	6.0556	4.3600	0.0308015 *
hyb:gen	18	60.504	3.3613	2.4201	0.0408545 *

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	0.167	0.1667	0.1200	0.7335481
hyb	9	66.796	7.4218	5.3437	0.0018370 **
rep:hyb	8	67.000	8.3750	6.0300	0.0011569 **
gen	2	30.671	15.3356	11.0416	0.0009707 ***
rep:gen	2	12.111	6.0556	4.3600	0.0308015 *
hyb:gen	18	60.504	3.3613	2.4201	0.0408545 *

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	46.556	0	0.98862	16	47.0915	< 2.2e-16 ***
rep1	0.889	0	1.06381	16	0.8356	0.415699
rep2	0.000	0	0.00000	16		
hyb0	-2.444	0	1.53826	16	-1.5891	0.131602
hyb1	2.667	0	1.36083	16	1.9596	0.067702 .
hyb2	1.000	0	1.36083	16	0.7348	0.473067
hyb3	-2.167	0	1.36083	16	-1.5922	0.130908
hyb4	1.000	0	1.36083	16	0.7348	0.473067
hyb5	-1.333	0	1.36083	16	-0.9798	0.341771
hyb6	1.500	0	1.36083	16	1.1023	0.286649
hyb7	4.500	0	1.36083	16	3.3068	0.004455 **
hyb8	-0.167	0	1.36083	16	-0.1225	0.904048
hyb9	0.000	0	0.00000	16		

rep1:hyb0	0.000	0	0.00000	16		
rep1:hyb1	-3.333	0	1.36083	16	-2.4495	0.026199 *
rep1:hyb2	-4.000	0	1.36083	16	-2.9394	0.009621 **
rep1:hyb3	0.333	0	1.36083	16	0.2449	0.809610
rep1:hyb4	0.000	0	1.36083	16	0.0000	1.000000
rep1:hyb5	2.667	0	1.36083	16	1.9596	0.067702 .
rep1:hyb6	-4.000	0	1.36083	16	-2.9394	0.009621 **
rep1:hyb7	-3.000	0	1.36083	16	-2.2045	0.042471 *
rep1:hyb8	-2.667	0	1.36083	16	-1.9596	0.067702 .
rep1:hyb9	0.000	0	0.00000	16		
rep2:hyb0		0				
rep2:hyb1	0.000	0	0.00000	16		
rep2:hyb2	0.000	0	0.00000	16		
rep2:hyb3	0.000	0	0.00000	16		
rep2:hyb4	0.000	0	0.00000	16		
rep2:hyb5	0.000	0	0.00000	16		
rep2:hyb6	0.000	0	0.00000	16		
rep2:hyb7	0.000	0	0.00000	16		
rep2:hyb8	0.000	0	0.00000	16		
rep2:hyb9	0.000	0	0.00000	16		
gen1	-3.056	0	1.24226	16	-2.4597	0.025671 *
gen2	-0.611	0	1.24226	16	-0.4919	0.629446
gen3	0.000	0	0.00000	16		
rep1:gen1	2.111	0	0.78567	16	2.6870	0.016197 *
rep1:gen2	0.222	0	0.78567	16	0.2828	0.780924
rep1:gen3	0.000	0	0.00000	16		
rep2:gen1	0.000	0	0.00000	16		
rep2:gen2	0.000	0	0.00000	16		
rep2:gen3	0.000	0	0.00000	16		
hyb0:gen1	3.944	0	2.07870	16	1.8976	0.075951 .
hyb0:gen2	0.389	0	2.07870	16	0.1871	0.853947
hyb0:gen3	0.000	0	0.00000	16		
hyb1:gen1	-3.000	0	1.66667	16	-1.8000	0.090743 .
hyb1:gen2	-4.000	0	1.66667	16	-2.4000	0.028919 *
hyb1:gen3	0.000	0	0.00000	16		
hyb2:gen1	2.500	0	1.66667	16	1.5000	0.153088
hyb2:gen2	-2.500	0	1.66667	16	-1.5000	0.153088
hyb2:gen3	0.000	0	0.00000	16		
hyb3:gen1	2.000	0	1.66667	16	1.2000	0.247607
hyb3:gen2	-0.500	0	1.66667	16	-0.3000	0.768040
hyb3:gen3	0.000	0	0.00000	16		
hyb4:gen1	-2.000	0	1.66667	16	-1.2000	0.247607
hyb4:gen2	-1.000	0	1.66667	16	-0.6000	0.556909
hyb4:gen3	0.000	0	0.00000	16		
hyb5:gen1	1.000	0	1.66667	16	0.6000	0.556909
hyb5:gen2	0.000	0	1.66667	16	0.0000	1.000000
hyb5:gen3	0.000	0	0.00000	16		
hyb6:gen1	-1.000	0	1.66667	16	-0.6000	0.556909

```

hyb6:gen2      -0.500          0    1.66667 16 -0.3000  0.768040
hyb6:gen3       0.000          0    0.00000 16
hyb7:gen1      -0.500          0    1.66667 16 -0.3000  0.768040
hyb7:gen2      -2.000          0    1.66667 16 -1.2000  0.247607
hyb7:gen3       0.000          0    0.00000 16
hyb8:gen1       2.500          0    1.66667 16  1.5000  0.153088
hyb8:gen2      -2.000          0    1.66667 16 -1.2000  0.247607
hyb8:gen3       0.000          0    0.00000 16
hyb9:gen1       0.000          0    0.00000 16
hyb9:gen2       0.000          0    0.00000 16
hyb9:gen3       0.000          0    0.00000 16

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(yield ~ rep + hyb + rep:hyb + gen + gen:rep + gen:hyb, ex9.2), type=3,
      singular.ok=TRUE) # NOT OK

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

```

Response: yield
      Sum Sq Df F values    Pr(>F)
rep      0.000  0
hyb     66.704  8    6.0033 0.0011847 **
gen     30.671  2   11.0416 0.0009707 ***
rep:hyb  67.000  8    6.0300 0.0011569 **
rep:gen  12.111  2    4.3600 0.0308015 *
hyb:gen  60.504 18    2.4201 0.0408545 *
Residuals 22.222 16

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 6.8 Example 10.1

(17) MODEL

```

ex10.1 = read.table("http://r.acr.kr/split/Ex10.1-New.txt", header=TRUE)
ex10.1 = af(ex10.1, c("Site", "Block", "A", "B", "C"))
ex10.1

```

```

      Obs Site Block  A  B  C Yield
1       1    1    R1 A1 B1 C1  6979

```

2	2	1	R1 A1 B1 C2	7272
3	3	1	R1 A1 B1 C3	7565
4	4	1	R1 A1 B1 C4	7827
5	5	1	R1 A1 B2 C1	8113
6	6	1	R1 A1 B2 C2	7025
7	7	1	R1 A1 B2 C3	7340
8	8	1	R1 A1 B2 C4	7637
9	9	1	R1 A2 B1 C1	7910
10	10	1	R1 A2 B1 C2	8250
11	11	1	R1 A2 B1 C3	8611
12	12	1	R1 A2 B1 C4	8865
13	13	1	R1 A2 B2 C1	9090
14	14	1	R1 A2 B2 C2	9453
15	15	1	R1 A2 B2 C3	9762
16	16	1	R1 A2 B2 C4	8440
17	17	1	R1 A3 B1 C1	8785
18	18	1	R1 A3 B1 C2	8963
19	19	1	R1 A3 B1 C3	9278
20	20	1	R1 A3 B1 C4	11100
21	21	1	R1 A3 B2 C1	10800
22	22	1	R1 A3 B2 C2	10600
23	23	1	R1 A3 B2 C3	10200
24	24	1	R1 A3 B2 C4	10100
25	25	1	R1 A4 B1 C1	9834
26	26	1	R1 A4 B1 C2	10200
27	27	1	R1 A4 B1 C3	10400
28	28	1	R1 A4 B1 C4	10900
29	29	1	R1 A4 B2 C1	11000
30	30	1	R1 A4 B2 C2	12600
31	31	1	R1 A4 B2 C3	12400
32	32	1	R1 A4 B2 C4	12100
33	33	1	R1 A5 B1 C1	11900
34	34	1	R1 A5 B1 C2	11500
35	35	1	R1 A5 B1 C3	11800
36	36	1	R1 A5 B1 C4	12100
37	37	1	R1 A5 B2 C1	12400
38	38	1	R1 A5 B2 C2	12700
39	39	1	R1 A5 B2 C3	12800
40	40	1	R1 A5 B2 C4	13300
41	41	1	R2 A1 B1 C1	7132
42	42	1	R2 A1 B1 C2	7412
43	43	1	R2 A1 B1 C3	7659
44	44	1	R2 A1 B1 C4	7947
45	45	1	R2 A1 B2 C1	8241
46	46	1	R2 A1 B2 C2	7273
47	47	1	R2 A1 B2 C3	7493
48	48	1	R2 A1 B2 C4	7837
49	49	1	R2 A2 B1 C1	8050



50	50	1	R2 A2 B1 C2	8398
51	51	1	R2 A2 B1 C3	8700
52	52	1	R2 A2 B1 C4	8954
53	53	1	R2 A2 B2 C1	9380
54	54	1	R2 A2 B2 C2	9478
55	55	1	R2 A2 B2 C3	10000
56	56	1	R2 A2 B2 C4	8498
57	57	1	R2 A3 B1 C1	8944
58	58	1	R2 A3 B1 C2	9070
59	59	1	R2 A3 B1 C3	9388
60	60	1	R2 A3 B1 C4	11300
61	61	1	R2 A3 B2 C1	10900
62	62	1	R2 A3 B2 C2	10600
63	63	1	R2 A3 B2 C3	10400
64	64	1	R2 A3 B2 C4	10100
65	65	1	R2 A4 B1 C1	10100
66	66	1	R2 A4 B1 C2	10300
67	67	1	R2 A4 B1 C3	10500
68	68	1	R2 A4 B1 C4	10900
69	69	1	R2 A4 B2 C1	11200
70	70	1	R2 A4 B2 C2	12800
71	71	1	R2 A4 B2 C3	12600
72	72	1	R2 A4 B2 C4	12300
73	73	1	R2 A5 B1 C1	11900
74	74	1	R2 A5 B1 C2	11700
75	75	1	R2 A5 B1 C3	11800
76	76	1	R2 A5 B1 C4	12200
77	77	1	R2 A5 B2 C1	12500
78	78	1	R2 A5 B2 C2	12800
79	79	1	R2 A5 B2 C3	12900
80	80	1	R2 A5 B2 C4	13500
81	81	1	R3 A1 B1 C1	6794
82	82	1	R3 A1 B1 C2	7055
83	83	1	R3 A1 B1 C3	7368
84	84	1	R3 A1 B1 C4	7664
85	85	1	R3 A1 B2 C1	7918
86	86	1	R3 A1 B2 C2	6842
87	87	1	R3 A1 B2 C3	7215
88	88	1	R3 A1 B2 C4	7454
89	89	1	R3 A2 B1 C1	7768
90	90	1	R3 A2 B1 C2	7976
91	91	1	R3 A2 B1 C3	8356
92	92	1	R3 A2 B1 C4	8555
93	93	1	R3 A2 B2 C1	8885
94	94	1	R3 A2 B2 C2	9164
95	95	1	R3 A2 B2 C3	9592
96	96	1	R3 A2 B2 C4	8204
97	97	1	R3 A3 B1 C1	8464

98	98	1	R3 A3 B1 C2	8901
99	99	1	R3 A3 B1 C3	9021
100	100	1	R3 A3 B1 C4	11000
101	101	1	R3 A3 B2 C1	10700
102	102	1	R3 A3 B2 C2	10400
103	103	1	R3 A3 B2 C3	10200
104	104	1	R3 A3 B2 C4	9949
105	105	1	R3 A4 B1 C1	9642
106	106	1	R3 A4 B1 C2	9990
107	107	1	R3 A4 B1 C3	10300
108	108	1	R3 A4 B1 C4	10500
109	109	1	R3 A4 B2 C1	10900
110	110	1	R3 A4 B2 C2	12400
111	111	1	R3 A4 B2 C3	12200
112	112	1	R3 A4 B2 C4	11900
113	113	1	R3 A5 B1 C1	11600
114	114	1	R3 A5 B1 C2	11400
115	115	1	R3 A5 B1 C3	11600
116	116	1	R3 A5 B1 C4	11800
117	117	1	R3 A5 B2 C1	12200
118	118	1	R3 A5 B2 C2	12400
119	119	1	R3 A5 B2 C3	12700
120	120	1	R3 A5 B2 C4	13200
121	121	2	R1 A1 B1 C1	6940
122	122	2	R1 A1 B1 C2	7267
123	123	2	R1 A1 B1 C3	7475
124	124	2	R1 A1 B1 C4	7868
125	125	2	R1 A1 B2 C1	8077
126	126	2	R1 A1 B2 C2	7078
127	127	2	R1 A1 B2 C3	7299
128	128	2	R1 A1 B2 C4	7643
129	129	2	R1 A2 B1 C1	7916
130	130	2	R1 A2 B1 C2	8193
131	131	2	R1 A2 B1 C3	8653
132	132	2	R1 A2 B1 C4	8873
133	133	2	R1 A2 B2 C1	9036
134	134	2	R1 A2 B2 C2	9449
135	135	2	R1 A2 B2 C3	9770
136	136	2	R1 A2 B2 C4	8316
137	137	2	R1 A3 B1 C1	8793
138	138	2	R1 A3 B1 C2	8943
139	139	2	R1 A3 B1 C3	9291
140	140	2	R1 A3 B1 C4	11100
141	141	2	R1 A3 B2 C1	10900
142	142	2	R1 A3 B2 C2	10600
143	143	2	R1 A3 B2 C3	10200
144	144	2	R1 A3 B2 C4	9879
145	145	2	R1 A4 B1 C1	9861

146	146	2	R1	A4	B1	C2	10200
147	147	2	R1	A4	B1	C3	10300
148	148	2	R1	A4	B1	C4	10800
149	149	2	R1	A4	B2	C1	10900
150	150	2	R1	A4	B2	C2	12600
151	151	2	R1	A4	B2	C3	12400
152	152	2	R1	A4	B2	C4	12100
153	153	2	R1	A5	B1	C1	11800
154	154	2	R1	A5	B1	C2	11500
155	155	2	R1	A5	B1	C3	11600
156	156	2	R1	A5	B1	C4	12100
157	157	2	R1	A5	B2	C1	12400
158	158	2	R1	A5	B2	C2	12600
159	159	2	R1	A5	B2	C3	12800
160	160	2	R1	A5	B2	C4	13300
161	161	2	R2	A1	B1	C1	6819
162	162	2	R2	A1	B1	C2	7137
163	163	2	R2	A1	B1	C3	7398
164	164	2	R2	A1	B1	C4	7680
165	165	2	R2	A1	B2	C1	7903
166	166	2	R2	A1	B2	C2	6968
167	167	2	R2	A1	B2	C3	7172
168	168	2	R2	A1	B2	C4	7494
169	169	2	R2	A2	B1	C1	7811
170	170	2	R2	A2	B1	C2	8000
171	171	2	R2	A2	B1	C3	8350
172	172	2	R2	A2	B1	C4	8730
173	173	2	R2	A2	B2	C1	8956
174	174	2	R2	A2	B2	C2	9195
175	175	2	R2	A2	B2	C3	9547
176	176	2	R2	A2	B2	C4	8183
177	177	2	R2	A3	B1	C1	8484
178	178	2	R2	A3	B1	C2	8865
179	179	2	R2	A3	B1	C3	9115
180	180	2	R2	A3	B1	C4	11100
181	181	2	R2	A3	B2	C1	10700
182	182	2	R2	A3	B2	C2	10400
183	183	2	R2	A3	B2	C3	10000
184	184	2	R2	A3	B2	C4	9830
185	185	2	R2	A4	B1	C1	9789
186	186	2	R2	A4	B1	C2	9977
187	187	2	R2	A4	B1	C3	10200
188	188	2	R2	A4	B1	C4	10500
189	189	2	R2	A4	B2	C1	10900
190	190	2	R2	A4	B2	C2	12500
191	191	2	R2	A4	B2	C3	12300
192	192	2	R2	A4	B2	C4	11800
193	193	2	R2	A5	B1	C1	11600

194	194	2	R2	A5	B1	C2	11300
195	195	2	R2	A5	B1	C3	11500
196	196	2	R2	A5	B1	C4	12000
197	197	2	R2	A5	B2	C1	12100
198	198	2	R2	A5	B2	C2	12600
199	199	2	R2	A5	B2	C3	12700
200	200	2	R2	A5	B2	C4	13100
201	201	2	R3	A1	B1	C1	7189
202	202	2	R3	A1	B1	C2	7371
203	203	2	R3	A1	B1	C3	7700
204	204	2	R3	A1	B1	C4	8047
205	205	2	R3	A1	B2	C1	8337
206	206	2	R3	A1	B2	C2	7327
207	207	2	R3	A1	B2	C3	7595
208	208	2	R3	A1	B2	C4	7867
209	209	2	R3	A2	B1	C1	8105
210	210	2	R3	A2	B1	C2	8396
211	211	2	R3	A2	B1	C3	8807
212	212	2	R3	A2	B1	C4	8953
213	213	2	R3	A2	B2	C1	9390
214	214	2	R3	A2	B2	C2	9733
215	215	2	R3	A2	B2	C3	9858
216	216	2	R3	A2	B2	C4	8640
217	217	2	R3	A3	B1	C1	9035
218	218	2	R3	A3	B1	C2	9194
219	219	2	R3	A3	B1	C3	9442
220	220	2	R3	A3	B1	C4	11400
221	221	2	R3	A3	B2	C1	11000
222	222	2	R3	A3	B2	C2	10800
223	223	2	R3	A3	B2	C3	10600
224	224	2	R3	A3	B2	C4	10200
225	225	2	R3	A4	B1	C1	9976
226	226	2	R3	A4	B1	C2	10300
227	227	2	R3	A4	B1	C3	10600
228	228	2	R3	A4	B1	C4	11000
229	229	2	R3	A4	B2	C1	11200
230	230	2	R3	A4	B2	C2	12800
231	231	2	R3	A4	B2	C3	12600
232	232	2	R3	A4	B2	C4	12200
233	233	2	R3	A5	B1	C1	11900
234	234	2	R3	A5	B1	C2	11700
235	235	2	R3	A5	B1	C3	11800
236	236	2	R3	A5	B1	C4	12300
237	237	2	R3	A5	B2	C1	12600
238	238	2	R3	A5	B2	C2	12900
239	239	2	R3	A5	B2	C3	13000
240	240	2	R3	A5	B2	C4	13500
241	241	3	R1	A1	B1	C1	7035

242	242	3	R1	A1	B1	C2	7161
243	243	3	R1	A1	B1	C3	7590
244	244	3	R1	A1	B1	C4	7909
245	245	3	R1	A1	B2	C1	8123
246	246	3	R1	A1	B2	C2	7088
247	247	3	R1	A1	B2	C3	7270
248	248	3	R1	A1	B2	C4	7705
249	249	3	R1	A2	B1	C1	7992
250	250	3	R1	A2	B1	C2	8293
251	251	3	R1	A2	B1	C3	8574
252	252	3	R1	A2	B1	C4	8872
253	253	3	R1	A2	B2	C1	9159
254	254	3	R1	A2	B2	C2	9451
255	255	3	R1	A2	B2	C3	9779
256	256	3	R1	A2	B2	C4	8399
257	257	3	R1	A3	B1	C1	8683
258	258	3	R1	A3	B1	C2	8991
259	259	3	R1	A3	B1	C3	9314
260	260	3	R1	A3	B1	C4	11300
261	261	3	R1	A3	B2	C1	10800
262	262	3	R1	A3	B2	C2	10600
263	263	3	R1	A3	B2	C3	10400
264	264	3	R1	A3	B2	C4	10100
265	265	3	R1	A4	B1	C1	9803
266	266	3	R1	A4	B1	C2	10100
267	267	3	R1	A4	B1	C3	10500
268	268	3	R1	A4	B1	C4	10700
269	269	3	R1	A4	B2	C1	11100
270	270	3	R1	A4	B2	C2	12600
271	271	3	R1	A4	B2	C3	12500
272	272	3	R1	A4	B2	C4	12100
273	273	3	R1	A5	B1	C1	11900
274	274	3	R1	A5	B1	C2	11600
275	275	3	R1	A5	B1	C3	11700
276	276	3	R1	A5	B1	C4	12000
277	277	3	R1	A5	B2	C1	12400
278	278	3	R1	A5	B2	C2	12600
279	279	3	R1	A5	B2	C3	12900
280	280	3	R1	A5	B2	C4	13400
281	281	3	R2	A1	B1	C1	7007
282	282	3	R2	A1	B1	C2	7311
283	283	3	R2	A1	B1	C3	7557
284	284	3	R2	A1	B1	C4	7935
285	285	3	R2	A1	B2	C1	8209
286	286	3	R2	A1	B2	C2	7048
287	287	3	R2	A1	B2	C3	7322
288	288	3	R2	A1	B2	C4	7783
289	289	3	R2	A2	B1	C1	8055

290	290	3	R2	A2	B1	C2	8247
291	291	3	R2	A2	B1	C3	8590
292	292	3	R2	A2	B1	C4	8901
293	293	3	R2	A2	B2	C1	9210
294	294	3	R2	A2	B2	C2	9521
295	295	3	R2	A2	B2	C3	9746
296	296	3	R2	A2	B2	C4	8480
297	297	3	R2	A3	B1	C1	8766
298	298	3	R2	A3	B1	C2	9014
299	299	3	R2	A3	B1	C3	9370
300	300	3	R2	A3	B1	C4	11200
301	301	3	R2	A3	B2	C1	11000
302	302	3	R2	A3	B2	C2	10700
303	303	3	R2	A3	B2	C3	10300
304	304	3	R2	A3	B2	C4	10100
305	305	3	R2	A4	B1	C1	9872
306	306	3	R2	A4	B1	C2	10100
307	307	3	R2	A4	B1	C3	10400
308	308	3	R2	A4	B1	C4	10800
309	309	3	R2	A4	B2	C1	11100
310	310	3	R2	A4	B2	C2	12600
311	311	3	R2	A4	B2	C3	12500
312	312	3	R2	A4	B2	C4	12200
313	313	3	R2	A5	B1	C1	11900
314	314	3	R2	A5	B1	C2	11600
315	315	3	R2	A5	B1	C3	11700
316	316	3	R2	A5	B1	C4	12100
317	317	3	R2	A5	B2	C1	12400
318	318	3	R2	A5	B2	C2	12700
319	319	3	R2	A5	B2	C3	12900
320	320	3	R2	A5	B2	C4	13400
321	321	3	R3	A1	B1	C1	7108
322	322	3	R3	A1	B1	C2	7295
323	323	3	R3	A1	B1	C3	7675
324	324	3	R3	A1	B1	C4	7948
325	325	3	R3	A1	B2	C1	8220
326	326	3	R3	A1	B2	C2	7142
327	327	3	R3	A1	B2	C3	7413
328	328	3	R3	A1	B2	C4	7826
329	329	3	R3	A2	B1	C1	8038
330	330	3	R3	A2	B1	C2	8358
331	331	3	R3	A2	B1	C3	8718
332	332	3	R3	A2	B1	C4	9000
333	333	3	R3	A2	B2	C1	9410
334	334	3	R3	A2	B2	C2	9520
335	335	3	R3	A2	B2	C3	9812
336	336	3	R3	A2	B2	C4	8452
337	337	3	R3	A3	B1	C1	8894

338	338	3	R3	A3	B1	C2	9137
339	339	3	R3	A3	B1	C3	9409
340	340	3	R3	A3	B1	C4	11300
341	341	3	R3	A3	B2	C1	10900
342	342	3	R3	A3	B2	C2	10700
343	343	3	R3	A3	B2	C3	10400
344	344	3	R3	A3	B2	C4	10100
345	345	3	R3	A4	B1	C1	9975
346	346	3	R3	A4	B1	C2	10200
347	347	3	R3	A4	B1	C3	10500
348	348	3	R3	A4	B1	C4	10900
349	349	3	R3	A4	B2	C1	11200
350	350	3	R3	A4	B2	C2	12700
351	351	3	R3	A4	B2	C3	12500
352	352	3	R3	A4	B2	C4	12200
353	353	3	R3	A5	B1	C1	11900
354	354	3	R3	A5	B1	C2	11600
355	355	3	R3	A5	B1	C3	11800
356	356	3	R3	A5	B1	C4	12300
357	357	3	R3	A5	B2	C1	12500
358	358	3	R3	A5	B2	C2	12800
359	359	3	R3	A5	B2	C3	12900
360	360	3	R3	A5	B2	C4	13500
361	361	4	R1	A1	B1	C1	6995
362	362	4	R1	A1	B1	C2	7287
363	363	4	R1	A1	B1	C3	7580
364	364	4	R1	A1	B1	C4	7774
365	365	4	R1	A1	B2	C1	8150
366	366	4	R1	A1	B2	C2	7026
367	367	4	R1	A1	B2	C3	7322
368	368	4	R1	A1	B2	C4	7698
369	369	4	R1	A2	B1	C1	7970
370	370	4	R1	A2	B1	C2	8243
371	371	4	R1	A2	B1	C3	8520
372	372	4	R1	A2	B1	C4	8812
373	373	4	R1	A2	B2	C1	9088
374	374	4	R1	A2	B2	C2	9508
375	375	4	R1	A2	B2	C3	9718
376	376	4	R1	A2	B2	C4	8326
377	377	4	R1	A3	B1	C1	8744
378	378	4	R1	A3	B1	C2	9061
379	379	4	R1	A3	B1	C3	9310
380	380	4	R1	A3	B1	C4	11300
381	381	4	R1	A3	B2	C1	10900
382	382	4	R1	A3	B2	C2	10600
383	383	4	R1	A3	B2	C3	10200
384	384	4	R1	A3	B2	C4	9971
385	385	4	R1	A4	B1	C1	9832

386	386	4	R1	A4	B1	C2	10200
387	387	4	R1	A4	B1	C3	10500
388	388	4	R1	A4	B1	C4	10700
389	389	4	R1	A4	B2	C1	11000
390	390	4	R1	A4	B2	C2	12600
391	391	4	R1	A4	B2	C3	12500
392	392	4	R1	A4	B2	C4	12100
393	393	4	R1	A5	B1	C1	11800
394	394	4	R1	A5	B1	C2	11600
395	395	4	R1	A5	B1	C3	11800
396	396	4	R1	A5	B1	C4	12100
397	397	4	R1	A5	B2	C1	12300
398	398	4	R1	A5	B2	C2	12600
399	399	4	R1	A5	B2	C3	12900
400	400	4	R1	A5	B2	C4	13300
401	401	4	R2	A1	B1	C1	6796
402	402	4	R2	A1	B1	C2	7122
403	403	4	R2	A1	B1	C3	7489
404	404	4	R2	A1	B1	C4	7695
405	405	4	R2	A1	B2	C1	8050
406	406	4	R2	A1	B2	C2	7010
407	407	4	R2	A1	B2	C3	7324
408	408	4	R2	A1	B2	C4	7540
409	409	4	R2	A2	B1	C1	7933
410	410	4	R2	A2	B1	C2	8130
411	411	4	R2	A2	B1	C3	8423
412	412	4	R2	A2	B1	C4	8674
413	413	4	R2	A2	B2	C1	9138
414	414	4	R2	A2	B2	C2	9380
415	415	4	R2	A2	B2	C3	9704
416	416	4	R2	A2	B2	C4	8313
417	417	4	R2	A3	B1	C1	8584
418	418	4	R2	A3	B1	C2	8890
419	419	4	R2	A3	B1	C3	9246
420	420	4	R2	A3	B1	C4	11100
421	421	4	R2	A3	B2	C1	10700
422	422	4	R2	A3	B2	C2	10500
423	423	4	R2	A3	B2	C3	10200
424	424	4	R2	A3	B2	C4	9882
425	425	4	R2	A4	B1	C1	9785
426	426	4	R2	A4	B1	C2	10100
427	427	4	R2	A4	B1	C3	10300
428	428	4	R2	A4	B1	C4	10800
429	429	4	R2	A4	B2	C1	11000
430	430	4	R2	A4	B2	C2	12500
431	431	4	R2	A4	B2	C3	12400
432	432	4	R2	A4	B2	C4	12100
433	433	4	R2	A5	B1	C1	11700



434	434	4	R2	A5	B1	C2	11500
435	435	4	R2	A5	B1	C3	11700
436	436	4	R2	A5	B1	C4	12100
437	437	4	R2	A5	B2	C1	12300
438	438	4	R2	A5	B2	C2	12600
439	439	4	R2	A5	B2	C3	12800
440	440	4	R2	A5	B2	C4	13300
441	441	4	R3	A1	B1	C1	7125
442	442	4	R3	A1	B1	C2	7505
443	443	4	R3	A1	B1	C3	7752
444	444	4	R3	A1	B1	C4	8099
445	445	4	R3	A1	B2	C1	8409
446	446	4	R3	A1	B2	C2	7332
447	447	4	R3	A1	B2	C3	7512
448	448	4	R3	A1	B2	C4	7917
449	449	4	R3	A2	B1	C1	8176
450	450	4	R3	A2	B1	C2	8382
451	451	4	R3	A2	B1	C3	8861
452	452	4	R3	A2	B1	C4	9056
453	453	4	R3	A2	B2	C1	9419
454	454	4	R3	A2	B2	C2	9700
455	455	4	R3	A2	B2	C3	10000
456	456	4	R3	A2	B2	C4	8573
457	457	4	R3	A3	B1	C1	8953
458	458	4	R3	A3	B1	C2	9278
459	459	4	R3	A3	B1	C3	9538
460	460	4	R3	A3	B1	C4	11400
461	461	4	R3	A3	B2	C1	11100
462	462	4	R3	A3	B2	C2	10800
463	463	4	R3	A3	B2	C3	10600
464	464	4	R3	A3	B2	C4	10300
465	465	4	R3	A4	B1	C1	10000
466	466	4	R3	A4	B1	C2	10400
467	467	4	R3	A4	B1	C3	10700
468	468	4	R3	A4	B1	C4	11000
469	469	4	R3	A4	B2	C1	11200
470	470	4	R3	A4	B2	C2	12900
471	471	4	R3	A4	B2	C3	12600
472	472	4	R3	A4	B2	C4	12400
473	473	4	R3	A5	B1	C1	12000
474	474	4	R3	A5	B1	C2	11700
475	475	4	R3	A5	B1	C3	12000
476	476	4	R3	A5	B1	C4	12300
477	477	4	R3	A5	B2	C1	12500
478	478	4	R3	A5	B2	C2	12900
479	479	4	R3	A5	B2	C3	13000
480	480	4	R3	A5	B2	C4	13700

```
f10.1 = Yield ~ Site/Block + A/Site + B/Site + A:B + A:B:Site + A:B:Site:Block +
      C + A:C + B:C + A:B:C + C:Site + A:C:Site + B:C:Site + A:B:C:Site
GLM(f10.1, ex10.1)
```

\$ANOVA

Response : Yield

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	239	1639561484	6860090	2162	< 2.2e-16 ***
RESIDUALS	240	761522	3173		
CORRECTED TOTAL	479	1640323006			

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	3	552717	184239	5.8064e+01	< 2e-16 ***
Site:Block	8	7062320	882790	2.7822e+02	< 2e-16 ***
A	4	1387680917	346920229	1.0933e+05	< 2e-16 ***
Site:A	12	34068	2839	8.9470e-01	0.55301
B	1	100939695	100939695	3.1812e+04	< 2e-16 ***
Site:B	3	1618	539	1.6990e-01	0.91662
A:B	4	31444008	7861002	2.4775e+03	< 2e-16 ***
Site:A:B	12	33737	2811	8.8600e-01	0.56185
Site:Block:A:B	72	186911	2596	8.1810e-01	0.84155
C	3	19356264	6452088	2.0334e+03	< 2e-16 ***
A:C	12	26075792	2172983	6.8483e+02	< 2e-16 ***
B:C	3	23901388	7967129	2.5109e+03	< 2e-16 ***
A:B:C	12	41996729	3499727	1.1030e+03	< 2e-16 ***
Site:C	9	47625	5292	1.6677e+00	0.09747 .
Site:A:C	36	104110	2892	9.1140e-01	0.61768
Site:B:C	9	61111	6790	2.1400e+00	0.02701 *
Site:A:B:C	36	82475	2291	7.2200e-01	0.87941

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	3	552717	184239	5.8064e+01	< 2e-16 ***
Site:Block	8	7062320	882790	2.7822e+02	< 2e-16 ***
A	4	1387680917	346920229	1.0933e+05	< 2e-16 ***
Site:A	12	34068	2839	8.9470e-01	0.55301
B	1	100939695	100939695	3.1812e+04	< 2e-16 ***
Site:B	3	1618	539	1.6990e-01	0.91662
A:B	4	31444008	7861002	2.4775e+03	< 2e-16 ***
Site:A:B	12	33737	2811	8.8600e-01	0.56185
Site:Block:A:B	72	186911	2596	8.1810e-01	0.84155
C	3	19356264	6452088	2.0334e+03	< 2e-16 ***

A:C	12	26075792	2172983	6.8483e+02	< 2e-16	***
B:C	3	23901388	7967129	2.5109e+03	< 2e-16	***
A:B:C	12	41996729	3499727	1.1030e+03	< 2e-16	***
Site:C	9	47625	5292	1.6677e+00	0.09747	.
Site:A:C	36	104110	2892	9.1140e-01	0.61768	
Site:B:C	9	61111	6790	2.1400e+00	0.02701	*
Site:A:B:C	36	82475	2291	7.2200e-01	0.87941	

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	3	552717	184239	5.8064e+01	< 2e-16 ***
Site:Block	8	7062320	882790	2.7822e+02	< 2e-16 ***
A	4	1387680917	346920229	1.0933e+05	< 2e-16 ***
Site:A	12	34068	2839	8.9470e-01	0.55301
B	1	100939695	100939695	3.1812e+04	< 2e-16 ***
Site:B	3	1618	539	1.6990e-01	0.91662
A:B	4	31444008	7861002	2.4775e+03	< 2e-16 ***
Site:A:B	12	33737	2811	8.8600e-01	0.56185
Site:Block:A:B	72	186911	2596	8.1810e-01	0.84155
C	3	19356264	6452088	2.0334e+03	< 2e-16 ***
A:C	12	26075792	2172983	6.8483e+02	< 2e-16 ***
B:C	3	23901388	7967129	2.5109e+03	< 2e-16 ***
A:B:C	12	41996729	3499727	1.1030e+03	< 2e-16 ***
Site:C	9	47625	5292	1.6677e+00	0.09747 .
Site:A:C	36	104110	2892	9.1140e-01	0.61768
Site:B:C	9	61111	6790	2.1400e+00	0.02701 *
Site:A:B:C	36	82475	2291	7.2200e-01	0.87941

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Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	13608.3	0	39.831	240	341.6522	< 2.2e-16 ***
Site1	-433.3	0	56.329	240	-7.6928	3.713e-13 ***
Site2	-108.3	0	56.329	240	-1.9232	0.055637 .
Site3	-116.7	0	56.329	240	-2.0711	0.039414 *
Site4	0.0	0	0.000	240		
Site1:BlockR1	175.0	0	39.831	240	4.3936	1.674e-05 ***
Site1:BlockR2	300.0	0	39.831	240	7.5318	1.013e-12 ***
Site1:BlockR3	0.0	0	0.000	240		
Site2:BlockR1	-225.0	0	39.831	240	-5.6489	4.554e-08 ***
Site2:BlockR2	-375.0	0	39.831	240	-9.4148	< 2.2e-16 ***
Site2:BlockR3	0.0	0	0.000	240		
Site3:BlockR1	-100.0	0	39.831	240	-2.5106	0.012711 *
Site3:BlockR2	-75.0	0	39.831	240	-1.8830	0.060916 .
Site3:BlockR3	0.0	0	0.000	240		

Site4:BlockR1	-250.0	0	39.831	240	-6.2765	1.605e-09	***
Site4:BlockR2	-275.0	0	39.831	240	-6.9042	4.483e-11	***
Site4:BlockR3	0.0	0	0.000	240			
AA1	-5705.0	0	56.329	240	-101.2791	< 2.2e-16	***
AA2	-5020.2	0	56.329	240	-89.1230	< 2.2e-16	***
AA3	-3336.7	0	56.329	240	-59.2363	< 2.2e-16	***
AA4	-1241.7	0	56.329	240	-22.0429	< 2.2e-16	***
AA5	0.0	0	0.000	240			
Site1:AA1	-2.4	0	79.662	240	-0.0303	0.975824	
Site1:AA2	25.0	0	79.662	240	0.3138	0.753926	
Site1:AA3	111.2	0	79.662	240	1.3965	0.163846	
Site1:AA4	-16.7	0	79.662	240	-0.2092	0.834456	
Site1:AA5	0.0	0	0.000	240			
Site2:AA1	91.2	0	79.662	240	1.1444	0.253590	
Site2:AA2	132.4	0	79.662	240	1.6622	0.097771	
Site2:AA3	30.7	0	79.662	240	0.3850	0.700608	
Site2:AA4	-50.0	0	79.662	240	-0.6277	0.530828	
Site2:AA5	0.0	0	0.000	240			
Site3:AA1	39.2	0	79.662	240	0.4917	0.623408	
Site3:AA2	25.8	0	79.662	240	0.3243	0.746003	
Site3:AA3	-38.3	0	79.662	240	-0.4802	0.631555	
Site3:AA4	-41.7	0	79.662	240	-0.5230	0.601426	
Site3:AA5	0.0	0	0.000	240			
Site4:AA1	0.0	0	0.000	240			
Site4:AA2	0.0	0	0.000	240			
Site4:AA3	0.0	0	0.000	240			
Site4:AA4	0.0	0	0.000	240			
Site4:AA5	0.0	0	0.000	240			
BB1	-1300.0	0	56.329	240	-23.0785	< 2.2e-16	***
BB2	0.0	0	0.000	240			
Site1:BB1	-16.7	0	79.662	240	-0.2092	0.834456	
Site1:BB2	0.0	0	0.000	240			
Site2:BB1	100.0	0	79.662	240	1.2553	0.210589	
Site2:BB2	0.0	0	0.000	240			
Site3:BB1	0.0	0	79.662	240	0.0000	1.000000	
Site3:BB2	0.0	0	0.000	240			
Site4:BB1	0.0	0	0.000	240			
Site4:BB2	0.0	0	0.000	240			
AA1:BB1	1438.0	0	79.662	240	18.0513	< 2.2e-16	***
AA1:BB2	0.0	0	0.000	240			
AA2:BB1	1746.3	0	79.662	240	21.9218	< 2.2e-16	***
AA2:BB2	0.0	0	0.000	240			
AA3:BB1	2470.3	0	79.662	240	31.0102	< 2.2e-16	***
AA3:BB2	0.0	0	0.000	240			
AA4:BB1	-68.1	0	79.662	240	-0.8547	0.393595	
AA4:BB2	0.0	0	0.000	240			
AA5:BB1	0.0	0	0.000	240			
AA5:BB2	0.0	0	0.000	240			

Site1:AA1:BB1	54.5	0	112.659	240	0.4838	0.628997
Site1:AA1:BB2	0.0	0	0.000	240		
Site1:AA2:BB1	-20.4	0	112.659	240	-0.1812	0.856344
Site1:AA2:BB2	0.0	0	0.000	240		
Site1:AA3:BB1	-141.2	0	112.659	240	-1.2530	0.211409
Site1:AA3:BB2	0.0	0	0.000	240		
Site1:AA4:BB1	45.6	0	112.659	240	0.4046	0.686122
Site1:AA4:BB2	0.0	0	0.000	240		
Site1:AA5:BB1	0.0	0	0.000	240		
Site1:AA5:BB2	0.0	0	0.000	240		
Site2:AA1:BB1	-90.0	0	112.659	240	-0.7989	0.425155
Site2:AA1:BB2	0.0	0	0.000	240		
Site2:AA2:BB1	-140.2	0	112.659	240	-1.2442	0.214651
Site2:AA2:BB2	0.0	0	0.000	240		
Site2:AA3:BB1	-60.0	0	112.659	240	-0.5326	0.594816
Site2:AA3:BB2	0.0	0	0.000	240		
Site2:AA4:BB1	3.5	0	112.659	240	0.0311	0.975242
Site2:AA4:BB2	0.0	0	0.000	240		
Site2:AA5:BB1	0.0	0	0.000	240		
Site2:AA5:BB2	0.0	0	0.000	240		
Site3:AA1:BB1	12.4	0	112.659	240	0.1102	0.912331
Site3:AA1:BB2	0.0	0	0.000	240		
Site3:AA2:BB1	39.4	0	112.659	240	0.3499	0.726739
Site3:AA2:BB2	0.0	0	0.000	240		
Site3:AA3:BB1	49.8	0	112.659	240	0.4423	0.658643
Site3:AA3:BB2	0.0	0	0.000	240		
Site3:AA4:BB1	32.7	0	112.659	240	0.2900	0.772097
Site3:AA4:BB2	0.0	0	0.000	240		
Site3:AA5:BB1	0.0	0	0.000	240		
Site3:AA5:BB2	0.0	0	0.000	240		
Site4:AA1:BB1	0.0	0	0.000	240		
Site4:AA1:BB2	0.0	0	0.000	240		
Site4:AA2:BB1	0.0	0	0.000	240		
Site4:AA2:BB2	0.0	0	0.000	240		
Site4:AA3:BB1	0.0	0	0.000	240		
Site4:AA3:BB2	0.0	0	0.000	240		
Site4:AA4:BB1	0.0	0	0.000	240		
Site4:AA4:BB2	0.0	0	0.000	240		
Site4:AA5:BB1	0.0	0	0.000	240		
Site4:AA5:BB2	0.0	0	0.000	240		
Site1:BlockR1:AA1:BB1	15.5	0	56.329	240	0.2752	0.783425
Site1:BlockR1:AA1:BB2	-3.5	0	56.329	240	-0.0621	0.950507
Site1:BlockR1:AA2:BB1	70.2	0	56.329	240	1.2471	0.213567
Site1:BlockR1:AA2:BB2	50.0	0	56.329	240	0.8876	0.375626
Site1:BlockR1:AA3:BB1	10.0	0	56.329	240	0.1775	0.859244
Site1:BlockR1:AA3:BB2	-62.3	0	56.329	240	-1.1051	0.270221
Site1:BlockR1:AA4:BB1	50.5	0	56.329	240	0.8965	0.370878
Site1:BlockR1:AA4:BB2	0.0	0	56.329	240	0.0000	1.000000

Site1:BlockR1:AA5:BB1	50.0	0	56.329	240	0.8876	0.375626
Site1:BlockR1:AA5:BB2	0.0	0	0.000	240		
Site1:BlockR2:AA1:BB1	17.2	0	56.329	240	0.3062	0.759692
Site1:BlockR2:AA1:BB2	53.7	0	56.329	240	0.9542	0.340939
Site1:BlockR2:AA2:BB1	61.7	0	56.329	240	1.0962	0.274077
Site1:BlockR2:AA2:BB2	77.7	0	56.329	240	1.3803	0.168787
Site1:BlockR2:AA3:BB1	29.0	0	56.329	240	0.5148	0.607147
Site1:BlockR2:AA3:BB2	-112.3	0	56.329	240	-1.9927	0.047423 *
Site1:BlockR2:AA4:BB1	42.0	0	56.329	240	0.7456	0.456631
Site1:BlockR2:AA4:BB2	75.0	0	56.329	240	1.3315	0.184303
Site1:BlockR2:AA5:BB1	0.0	0	56.329	240	0.0000	1.000000
Site1:BlockR2:AA5:BB2	0.0	0	0.000	240		
Site1:BlockR3:AA1:BB1	0.0	0	0.000	240		
Site1:BlockR3:AA1:BB2	0.0	0	0.000	240		
Site1:BlockR3:AA2:BB1	0.0	0	0.000	240		
Site1:BlockR3:AA2:BB2	0.0	0	0.000	240		
Site1:BlockR3:AA3:BB1	0.0	0	0.000	240		
Site1:BlockR3:AA3:BB2	0.0	0	0.000	240		
Site1:BlockR3:AA4:BB1	0.0	0	0.000	240		
Site1:BlockR3:AA4:BB2	0.0	0	0.000	240		
Site1:BlockR3:AA5:BB1	0.0	0	0.000	240		
Site1:BlockR3:AA5:BB2	0.0	0	0.000	240		
Site2:BlockR1:AA1:BB1	35.7	0	56.329	240	0.6347	0.526255
Site2:BlockR1:AA1:BB2	-32.3	0	56.329	240	-0.5725	0.567503
Site2:BlockR1:AA2:BB1	68.5	0	56.329	240	1.2161	0.225157
Site2:BlockR1:AA2:BB2	-37.5	0	56.329	240	-0.6657	0.506225
Site2:BlockR1:AA3:BB1	-11.0	0	56.329	240	-0.1953	0.845339
Site2:BlockR1:AA3:BB2	-30.3	0	56.329	240	-0.5370	0.591752
Site2:BlockR1:AA4:BB1	46.2	0	56.329	240	0.8211	0.412426
Site2:BlockR1:AA4:BB2	25.0	0	56.329	240	0.4438	0.657574
Site2:BlockR1:AA5:BB1	50.0	0	56.329	240	0.8876	0.375626
Site2:BlockR1:AA5:BB2	0.0	0	0.000	240		
Site2:BlockR2:AA1:BB1	56.7	0	56.329	240	1.0075	0.314726
Site2:BlockR2:AA1:BB2	-22.3	0	56.329	240	-0.3950	0.693196
Site2:BlockR2:AA2:BB1	32.5	0	56.329	240	0.5770	0.564505
Site2:BlockR2:AA2:BB2	-60.0	0	56.329	240	-1.0652	0.287873
Site2:BlockR2:AA3:BB1	-1.8	0	56.329	240	-0.0311	0.975242
Site2:BlockR2:AA3:BB2	-42.5	0	56.329	240	-0.7545	0.451295
Site2:BlockR2:AA4:BB1	22.5	0	56.329	240	0.3994	0.689927
Site2:BlockR2:AA4:BB2	50.0	0	56.329	240	0.8876	0.375626
Site2:BlockR2:AA5:BB1	50.0	0	56.329	240	0.8876	0.375626
Site2:BlockR2:AA5:BB2	0.0	0	0.000	240		
Site2:BlockR3:AA1:BB1	0.0	0	0.000	240		
Site2:BlockR3:AA1:BB2	0.0	0	0.000	240		
Site2:BlockR3:AA2:BB1	0.0	0	0.000	240		
Site2:BlockR3:AA2:BB2	0.0	0	0.000	240		
Site2:BlockR3:AA3:BB1	0.0	0	0.000	240		
Site2:BlockR3:AA3:BB2	0.0	0	0.000	240		

Site2:BlockR3:AA4:BB1	0.0	0	0.000	240		
Site2:BlockR3:AA4:BB2	0.0	0	0.000	240		
Site2:BlockR3:AA5:BB1	0.0	0	0.000	240		
Site2:BlockR3:AA5:BB2	0.0	0	0.000	240		
Site3:BlockR1:AA1:BB1	17.2	0	56.329	240	0.3062	0.759692
Site3:BlockR1:AA1:BB2	-3.8	0	56.329	240	-0.0666	0.946977
Site3:BlockR1:AA2:BB1	4.2	0	56.329	240	0.0754	0.939920
Site3:BlockR1:AA2:BB2	-1.5	0	56.329	240	-0.0266	0.978778
Site3:BlockR1:AA3:BB1	-13.0	0	56.329	240	-0.2308	0.817678
Site3:BlockR1:AA3:BB2	50.0	0	56.329	240	0.8876	0.375626
Site3:BlockR1:AA4:BB1	-18.0	0	56.329	240	-0.3195	0.749589
Site3:BlockR1:AA4:BB2	25.0	0	56.329	240	0.4438	0.657574
Site3:BlockR1:AA5:BB1	0.0	0	56.329	240	0.0000	1.000000
Site3:BlockR1:AA5:BB2	0.0	0	0.000	240		
Site3:BlockR2:AA1:BB1	21.0	0	56.329	240	0.3728	0.709621
Site3:BlockR2:AA1:BB2	15.2	0	56.329	240	0.2707	0.786832
Site3:BlockR2:AA2:BB1	-5.3	0	56.329	240	-0.0932	0.925821
Site3:BlockR2:AA2:BB2	15.7	0	56.329	240	0.2796	0.780021
Site3:BlockR2:AA3:BB1	-22.5	0	56.329	240	-0.3994	0.689927
Site3:BlockR2:AA3:BB2	75.0	0	56.329	240	1.3315	0.184303
Site3:BlockR2:AA4:BB1	-25.8	0	56.329	240	-0.4571	0.647990
Site3:BlockR2:AA4:BB2	25.0	0	56.329	240	0.4438	0.657574
Site3:BlockR2:AA5:BB1	0.0	0	56.329	240	0.0000	1.000000
Site3:BlockR2:AA5:BB2	0.0	0	0.000	240		
Site3:BlockR3:AA1:BB1	0.0	0	0.000	240		
Site3:BlockR3:AA1:BB2	0.0	0	0.000	240		
Site3:BlockR3:AA2:BB1	0.0	0	0.000	240		
Site3:BlockR3:AA2:BB2	0.0	0	0.000	240		
Site3:BlockR3:AA3:BB1	0.0	0	0.000	240		
Site3:BlockR3:AA3:BB2	0.0	0	0.000	240		
Site3:BlockR3:AA4:BB1	0.0	0	0.000	240		
Site3:BlockR3:AA4:BB2	0.0	0	0.000	240		
Site3:BlockR3:AA5:BB1	0.0	0	0.000	240		
Site3:BlockR3:AA5:BB2	0.0	0	0.000	240		
Site4:BlockR1:AA1:BB1	38.7	0	56.329	240	0.6879	0.492169
Site4:BlockR1:AA1:BB2	6.5	0	56.329	240	0.1154	0.908230
Site4:BlockR1:AA2:BB1	17.5	0	56.329	240	0.3107	0.756319
Site4:BlockR1:AA2:BB2	-13.0	0	56.329	240	-0.2308	0.817678
Site4:BlockR1:AA3:BB1	61.5	0	56.329	240	1.0918	0.276020
Site4:BlockR1:AA3:BB2	-32.3	0	56.329	240	-0.5725	0.567503
Site4:BlockR1:AA4:BB1	33.0	0	56.329	240	0.5858	0.558534
Site4:BlockR1:AA4:BB2	25.0	0	56.329	240	0.4438	0.657574
Site4:BlockR1:AA5:BB1	75.0	0	56.329	240	1.3315	0.184303
Site4:BlockR1:AA5:BB2	0.0	0	0.000	240		
Site4:BlockR2:AA1:BB1	-69.8	0	56.329	240	-1.2383	0.216833
Site4:BlockR2:AA1:BB2	-36.5	0	56.329	240	-0.6480	0.517622
Site4:BlockR2:AA2:BB1	-53.8	0	56.329	240	-0.9542	0.340939
Site4:BlockR2:AA2:BB2	-14.3	0	56.329	240	-0.2530	0.800503

Site4:BlockR2:AA3:BB1	-62.3	0	56.329	240	-1.1051	0.270221	
Site4:BlockR2:AA3:BB2	-104.5	0	56.329	240	-1.8552	0.064800	.
Site4:BlockR2:AA4:BB1	-3.8	0	56.329	240	-0.0666	0.946977	
Site4:BlockR2:AA4:BB2	0.0	0	56.329	240	0.0000	1.000000	
Site4:BlockR2:AA5:BB1	25.0	0	56.329	240	0.4438	0.657574	
Site4:BlockR2:AA5:BB2	0.0	0	0.000	240			
Site4:BlockR3:AA1:BB1	0.0	0	0.000	240			
Site4:BlockR3:AA1:BB2	0.0	0	0.000	240			
Site4:BlockR3:AA2:BB1	0.0	0	0.000	240			
Site4:BlockR3:AA2:BB2	0.0	0	0.000	240			
Site4:BlockR3:AA3:BB1	0.0	0	0.000	240			
Site4:BlockR3:AA3:BB2	0.0	0	0.000	240			
Site4:BlockR3:AA4:BB1	0.0	0	0.000	240			
Site4:BlockR3:AA4:BB2	0.0	0	0.000	240			
Site4:BlockR3:AA5:BB1	0.0	0	0.000	240			
Site4:BlockR3:AA5:BB2	0.0	0	0.000	240			
CC1	-1066.7	0	45.993	240	-23.1920	< 2.2e-16	***
CC2	-733.3	0	45.993	240	-15.9445	< 2.2e-16	***
CC3	-533.3	0	45.993	240	-11.5960	< 2.2e-16	***
CC4	0.0	0	0.000	240			
AA1:CC1	1551.3	0	65.044	240	23.8506	< 2.2e-16	***
AA1:CC2	137.7	0	65.044	240	2.1165	0.035330	*
AA1:CC3	201.0	0	65.044	240	3.0902	0.002236	**
AA1:CC4	0.0	0	0.000	240			
AA2:CC1	1877.7	0	65.044	240	28.8678	< 2.2e-16	***
AA2:CC2	1858.7	0	65.044	240	28.5757	< 2.2e-16	***
AA2:CC3	1936.7	0	65.044	240	29.7749	< 2.2e-16	***
AA2:CC4	0.0	0	0.000	240			
AA3:CC1	1915.7	0	65.044	240	29.4520	< 2.2e-16	***
AA3:CC2	1315.7	0	65.044	240	20.2274	< 2.2e-16	***
AA3:CC3	815.7	0	65.044	240	12.5403	< 2.2e-16	***
AA3:CC4	0.0	0	0.000	240			
AA4:CC1	-66.7	0	65.044	240	-1.0250	0.306418	
AA4:CC2	1200.0	0	65.044	240	18.4491	< 2.2e-16	***
AA4:CC3	833.3	0	65.044	240	12.8119	< 2.2e-16	***
AA4:CC4	0.0	0	0.000	240			
AA5:CC1	0.0	0	0.000	240			
AA5:CC2	0.0	0	0.000	240			
AA5:CC3	0.0	0	0.000	240			
AA5:CC4	0.0	0	0.000	240			
BB1:CC1	733.3	0	65.044	240	11.2745	< 2.2e-16	***
BB1:CC2	166.7	0	65.044	240	2.5624	0.011007	*
BB1:CC3	200.0	0	65.044	240	3.0749	0.002350	**
BB1:CC4	0.0	0	0.000	240			
BB2:CC1	0.0	0	0.000	240			
BB2:CC2	0.0	0	0.000	240			
BB2:CC3	0.0	0	0.000	240			
BB2:CC4	0.0	0	0.000	240			



AA1:BB1:CC1	-2102.0	0	91.986	240	-22.8514	< 2.2e-16	***
AA1:BB1:CC2	-122.3	0	91.986	240	-1.3299	0.184808	
AA1:BB1:CC3	-116.7	0	91.986	240	-1.2683	0.205915	
AA1:BB1:CC4	0.0	0	0.000	240			
AA1:BB2:CC1	0.0	0	0.000	240			
AA1:BB2:CC2	0.0	0	0.000	240			
AA1:BB2:CC3	0.0	0	0.000	240			
AA1:BB2:CC4	0.0	0	0.000	240			
AA2:BB1:CC1	-2365.3	0	91.986	240	-25.7142	< 2.2e-16	***
AA2:BB1:CC2	-1887.7	0	91.986	240	-20.5213	< 2.2e-16	***
AA2:BB1:CC3	-1849.3	0	91.986	240	-20.1046	< 2.2e-16	***
AA2:BB1:CC4	0.0	0	0.000	240			
AA2:BB2:CC1	0.0	0	0.000	240			
AA2:BB2:CC2	0.0	0	0.000	240			
AA2:BB2:CC3	0.0	0	0.000	240			
AA2:BB2:CC4	0.0	0	0.000	240			
AA3:BB1:CC1	-4088.7	0	91.986	240	-44.4490	< 2.2e-16	***
AA3:BB1:CC2	-2939.3	0	91.986	240	-31.9543	< 2.2e-16	***
AA3:BB1:CC3	-2384.3	0	91.986	240	-25.9207	< 2.2e-16	***
AA3:BB1:CC4	0.0	0	0.000	240			
AA3:BB2:CC1	0.0	0	0.000	240			
AA3:BB2:CC2	0.0	0	0.000	240			
AA3:BB2:CC3	0.0	0	0.000	240			
AA3:BB2:CC4	0.0	0	0.000	240			
AA4:BB1:CC1	-561.0	0	91.986	240	-6.0988	4.243e-09	***
AA4:BB1:CC2	-1233.3	0	91.986	240	-13.4079	< 2.2e-16	***
AA4:BB1:CC3	-833.3	0	91.986	240	-9.0594	< 2.2e-16	***
AA4:BB1:CC4	0.0	0	0.000	240			
AA4:BB2:CC1	0.0	0	0.000	240			
AA4:BB2:CC2	0.0	0	0.000	240			
AA4:BB2:CC3	0.0	0	0.000	240			
AA4:BB2:CC4	0.0	0	0.000	240			
AA5:BB1:CC1	0.0	0	0.000	240			
AA5:BB1:CC2	0.0	0	0.000	240			
AA5:BB1:CC3	0.0	0	0.000	240			
AA5:BB1:CC4	0.0	0	0.000	240			
AA5:BB2:CC1	0.0	0	0.000	240			
AA5:BB2:CC2	0.0	0	0.000	240			
AA5:BB2:CC3	0.0	0	0.000	240			
AA5:BB2:CC4	0.0	0	0.000	240			
Site1:CC1	100.0	0	65.044	240	1.5374	0.125506	
Site1:CC2	33.3	0	65.044	240	0.5125	0.608789	
Site1:CC3	0.0	0	65.044	240	0.0000	1.000000	
Site1:CC4	0.0	0	0.000	240			
Site2:CC1	133.3	0	65.044	240	2.0499	0.041461	*
Site2:CC2	133.3	0	65.044	240	2.0499	0.041461	*
Site2:CC3	66.7	0	65.044	240	1.0250	0.306418	
Site2:CC4	0.0	0	0.000	240			

Site3:CC1	66.7	0	65.044	240	1.0250	0.306418
Site3:CC2	0.0	0	65.044	240	0.0000	1.000000
Site3:CC3	0.0	0	65.044	240	0.0000	1.000000
Site3:CC4	0.0	0	0.000	240		
Site4:CC1	0.0	0	0.000	240		
Site4:CC2	0.0	0	0.000	240		
Site4:CC3	0.0	0	0.000	240		
Site4:CC4	0.0	0	0.000	240		
Site1:AA1:CC1	-136.7	0	91.986	240	-1.4857	0.138660
Site1:AA1:CC2	-33.7	0	91.986	240	-0.3660	0.714688
Site1:AA1:CC3	39.0	0	91.986	240	0.4240	0.671961
Site1:AA1:CC4	0.0	0	0.000	240		
Site1:AA2:CC1	-173.3	0	91.986	240	-1.8844	0.060726 .
Site1:AA2:CC2	-174.3	0	91.986	240	-1.8952	0.059265 .
Site1:AA2:CC3	0.7	0	91.986	240	0.0072	0.994223
Site1:AA2:CC4	0.0	0	0.000	240		
Site1:AA3:CC1	-198.7	0	91.986	240	-2.1598	0.031782 *
Site1:AA3:CC2	-132.0	0	91.986	240	-1.4350	0.152587
Site1:AA3:CC3	-65.3	0	91.986	240	-0.7103	0.478235
Site1:AA3:CC4	0.0	0	0.000	240		
Site1:AA4:CC1	-33.3	0	91.986	240	-0.3624	0.717390
Site1:AA4:CC2	0.0	0	91.986	240	0.0000	1.000000
Site1:AA4:CC3	0.0	0	91.986	240	0.0000	1.000000
Site1:AA4:CC4	0.0	0	0.000	240		
Site1:AA5:CC1	0.0	0	0.000	240		
Site1:AA5:CC2	0.0	0	0.000	240		
Site1:AA5:CC3	0.0	0	0.000	240		
Site1:AA5:CC4	0.0	0	0.000	240		
Site2:AA1:CC1	-180.3	0	91.986	240	-1.9605	0.051100 .
Site2:AA1:CC2	-81.3	0	91.986	240	-0.8842	0.377475
Site2:AA1:CC3	-47.0	0	91.986	240	-0.5109	0.609856
Site2:AA1:CC4	0.0	0	0.000	240		
Site2:AA2:CC1	-196.7	0	91.986	240	-2.1380	0.033526 *
Site2:AA2:CC2	-179.3	0	91.986	240	-1.9496	0.052391 .
Site2:AA2:CC3	-124.7	0	91.986	240	-1.3553	0.176601
Site2:AA2:CC4	0.0	0	0.000	240		
Site2:AA3:CC1	-85.3	0	91.986	240	-0.9277	0.354505
Site2:AA3:CC2	-85.3	0	91.986	240	-0.9277	0.354505
Site2:AA3:CC3	-52.0	0	91.986	240	-0.5653	0.572394
Site2:AA3:CC4	0.0	0	0.000	240		
Site2:AA4:CC1	-33.3	0	91.986	240	-0.3624	0.717390
Site2:AA4:CC2	0.0	0	91.986	240	0.0000	1.000000
Site2:AA4:CC3	33.3	0	91.986	240	0.3624	0.717390
Site2:AA4:CC4	0.0	0	0.000	240		
Site2:AA5:CC1	0.0	0	0.000	240		
Site2:AA5:CC2	0.0	0	0.000	240		
Site2:AA5:CC3	0.0	0	0.000	240		
Site2:AA5:CC4	0.0	0	0.000	240		

Site3:AA1:CC1	-138.7	0	91.986	240	-1.5075	0.133002
Site3:AA1:CC2	-83.0	0	91.986	240	-0.9023	0.367794
Site3:AA1:CC3	-104.0	0	91.986	240	-1.1306	0.259347
Site3:AA1:CC4	0.0	0	0.000	240		
Site3:AA2:CC1	-61.7	0	91.986	240	-0.6704	0.503251
Site3:AA2:CC2	-71.7	0	91.986	240	-0.7791	0.436684
Site3:AA2:CC3	-68.0	0	91.986	240	-0.7392	0.460480
Site3:AA2:CC4	0.0	0	0.000	240		
Site3:AA3:CC1	-115.7	0	91.986	240	-1.2574	0.209816
Site3:AA3:CC2	-15.7	0	91.986	240	-0.1703	0.864905
Site3:AA3:CC3	-15.7	0	91.986	240	-0.1703	0.864905
Site3:AA3:CC4	0.0	0	0.000	240		
Site3:AA4:CC1	33.3	0	91.986	240	0.3624	0.717390
Site3:AA4:CC2	0.0	0	91.986	240	0.0000	1.000000
Site3:AA4:CC3	33.3	0	91.986	240	0.3624	0.717390
Site3:AA4:CC4	0.0	0	0.000	240		
Site3:AA5:CC1	0.0	0	0.000	240		
Site3:AA5:CC2	0.0	0	0.000	240		
Site3:AA5:CC3	0.0	0	0.000	240		
Site3:AA5:CC4	0.0	0	0.000	240		
Site4:AA1:CC1	0.0	0	0.000	240		
Site4:AA1:CC2	0.0	0	0.000	240		
Site4:AA1:CC3	0.0	0	0.000	240		
Site4:AA1:CC4	0.0	0	0.000	240		
Site4:AA2:CC1	0.0	0	0.000	240		
Site4:AA2:CC2	0.0	0	0.000	240		
Site4:AA2:CC3	0.0	0	0.000	240		
Site4:AA2:CC4	0.0	0	0.000	240		
Site4:AA3:CC1	0.0	0	0.000	240		
Site4:AA3:CC2	0.0	0	0.000	240		
Site4:AA3:CC3	0.0	0	0.000	240		
Site4:AA3:CC4	0.0	0	0.000	240		
Site4:AA4:CC1	0.0	0	0.000	240		
Site4:AA4:CC2	0.0	0	0.000	240		
Site4:AA4:CC3	0.0	0	0.000	240		
Site4:AA4:CC4	0.0	0	0.000	240		
Site4:AA5:CC1	0.0	0	0.000	240		
Site4:AA5:CC2	0.0	0	0.000	240		
Site4:AA5:CC3	0.0	0	0.000	240		
Site4:AA5:CC4	0.0	0	0.000	240		
Site1:BB1:CC1	0.0	0	91.986	240	0.0000	1.000000
Site1:BB1:CC2	33.3	0	91.986	240	0.3624	0.717390
Site1:BB1:CC3	33.3	0	91.986	240	0.3624	0.717390
Site1:BB1:CC4	0.0	0	0.000	240		
Site1:BB2:CC1	0.0	0	0.000	240		
Site1:BB2:CC2	0.0	0	0.000	240		
Site1:BB2:CC3	0.0	0	0.000	240		
Site1:BB2:CC4	0.0	0	0.000	240		

Site2:BB1:CC1	-166.7	0	91.986	240	-1.8119	0.071255	.
Site2:BB1:CC2	-200.0	0	91.986	240	-2.1743	0.030664	*
Site2:BB1:CC3	-233.3	0	91.986	240	-2.5366	0.011827	*
Site2:BB1:CC4	0.0	0	0.000	240			
Site2:BB2:CC1	0.0	0	0.000	240			
Site2:BB2:CC2	0.0	0	0.000	240			
Site2:BB2:CC3	0.0	0	0.000	240			
Site2:BB2:CC4	0.0	0	0.000	240			
Site3:BB1:CC1	33.3	0	91.986	240	0.3624	0.717390	
Site3:BB1:CC2	33.3	0	91.986	240	0.3624	0.717390	
Site3:BB1:CC3	-66.7	0	91.986	240	-0.7248	0.469311	
Site3:BB1:CC4	0.0	0	0.000	240			
Site3:BB2:CC1	0.0	0	0.000	240			
Site3:BB2:CC2	0.0	0	0.000	240			
Site3:BB2:CC3	0.0	0	0.000	240			
Site3:BB2:CC4	0.0	0	0.000	240			
Site4:BB1:CC1	0.0	0	0.000	240			
Site4:BB1:CC2	0.0	0	0.000	240			
Site4:BB1:CC3	0.0	0	0.000	240			
Site4:BB1:CC4	0.0	0	0.000	240			
Site4:BB2:CC1	0.0	0	0.000	240			
Site4:BB2:CC2	0.0	0	0.000	240			
Site4:BB2:CC3	0.0	0	0.000	240			
Site4:BB2:CC4	0.0	0	0.000	240			
Site1:AA1:BB1:CC1	76.3	0	130.087	240	0.5868	0.557899	
Site1:AA1:BB1:CC2	-48.0	0	130.087	240	-0.3690	0.712466	
Site1:AA1:BB1:CC3	-105.3	0	130.087	240	-0.8097	0.418908	
Site1:AA1:BB1:CC4	0.0	0	0.000	240			
Site1:AA1:BB2:CC1	0.0	0	0.000	240			
Site1:AA1:BB2:CC2	0.0	0	0.000	240			
Site1:AA1:BB2:CC3	0.0	0	0.000	240			
Site1:AA1:BB2:CC4	0.0	0	0.000	240			
Site1:AA2:BB1:CC1	12.3	0	130.087	240	0.0948	0.924546	
Site1:AA2:BB1:CC2	120.0	0	130.087	240	0.9225	0.357217	
Site1:AA2:BB1:CC3	-23.7	0	130.087	240	-0.1819	0.855792	
Site1:AA2:BB1:CC4	0.0	0	0.000	240			
Site1:AA2:BB2:CC1	0.0	0	0.000	240			
Site1:AA2:BB2:CC2	0.0	0	0.000	240			
Site1:AA2:BB2:CC3	0.0	0	0.000	240			
Site1:AA2:BB2:CC4	0.0	0	0.000	240			
Site1:AA3:BB1:CC1	202.7	0	130.087	240	1.5579	0.120568	
Site1:AA3:BB1:CC2	100.3	0	130.087	240	0.7713	0.441302	
Site1:AA3:BB1:CC3	29.7	0	130.087	240	0.2281	0.819800	
Site1:AA3:BB1:CC4	0.0	0	0.000	240			
Site1:AA3:BB2:CC1	0.0	0	0.000	240			
Site1:AA3:BB2:CC2	0.0	0	0.000	240			
Site1:AA3:BB2:CC3	0.0	0	0.000	240			
Site1:AA3:BB2:CC4	0.0	0	0.000	240			

Site1:AA4:BB1:CC1	-13.7	0	130.087	240	-0.1051	0.916418
Site1:AA4:BB1:CC2	-70.0	0	130.087	240	-0.5381	0.591007
Site1:AA4:BB1:CC3	-66.7	0	130.087	240	-0.5125	0.608789
Site1:AA4:BB1:CC4	0.0	0	0.000	240		
Site1:AA4:BB2:CC1	0.0	0	0.000	240		
Site1:AA4:BB2:CC2	0.0	0	0.000	240		
Site1:AA4:BB2:CC3	0.0	0	0.000	240		
Site1:AA4:BB2:CC4	0.0	0	0.000	240		
Site1:AA5:BB1:CC1	0.0	0	0.000	240		
Site1:AA5:BB1:CC2	0.0	0	0.000	240		
Site1:AA5:BB1:CC3	0.0	0	0.000	240		
Site1:AA5:BB1:CC4	0.0	0	0.000	240		
Site1:AA5:BB2:CC1	0.0	0	0.000	240		
Site1:AA5:BB2:CC2	0.0	0	0.000	240		
Site1:AA5:BB2:CC3	0.0	0	0.000	240		
Site1:AA5:BB2:CC4	0.0	0	0.000	240		
Site2:AA1:BB1:CC1	215.3	0	130.087	240	1.6553	0.099171 .
Site2:AA1:BB1:CC2	92.7	0	130.087	240	0.7123	0.476945
Site2:AA1:BB1:CC3	122.0	0	130.087	240	0.9378	0.349274
Site2:AA1:BB1:CC4	0.0	0	0.000	240		
Site2:AA1:BB2:CC1	0.0	0	0.000	240		
Site2:AA1:BB2:CC2	0.0	0	0.000	240		
Site2:AA1:BB2:CC3	0.0	0	0.000	240		
Site2:AA1:BB2:CC4	0.0	0	0.000	240		
Site2:AA2:BB1:CC1	143.0	0	130.087	240	1.0993	0.272755
Site2:AA2:BB1:CC2	186.0	0	130.087	240	1.4298	0.154072
Site2:AA2:BB1:CC3	288.7	0	130.087	240	2.2190	0.027421 *
Site2:AA2:BB1:CC4	0.0	0	0.000	240		
Site2:AA2:BB2:CC1	0.0	0	0.000	240		
Site2:AA2:BB2:CC2	0.0	0	0.000	240		
Site2:AA2:BB2:CC3	0.0	0	0.000	240		
Site2:AA2:BB2:CC4	0.0	0	0.000	240		
Site2:AA3:BB1:CC1	195.7	0	130.087	240	1.5041	0.133866
Site2:AA3:BB1:CC2	143.0	0	130.087	240	1.0993	0.272755
Site2:AA3:BB1:CC3	203.3	0	130.087	240	1.5631	0.119358
Site2:AA3:BB1:CC4	0.0	0	0.000	240		
Site2:AA3:BB2:CC1	0.0	0	0.000	240		
Site2:AA3:BB2:CC2	0.0	0	0.000	240		
Site2:AA3:BB2:CC3	0.0	0	0.000	240		
Site2:AA3:BB2:CC4	0.0	0	0.000	240		
Site2:AA4:BB1:CC1	136.3	0	130.087	240	1.0480	0.295686
Site2:AA4:BB1:CC2	59.0	0	130.087	240	0.4535	0.650569
Site2:AA4:BB1:CC3	66.7	0	130.087	240	0.5125	0.608789
Site2:AA4:BB1:CC4	0.0	0	0.000	240		
Site2:AA4:BB2:CC1	0.0	0	0.000	240		
Site2:AA4:BB2:CC2	0.0	0	0.000	240		
Site2:AA4:BB2:CC3	0.0	0	0.000	240		
Site2:AA4:BB2:CC4	0.0	0	0.000	240		

Site2:AA5:BB1:CC1	0.0	0	0.000	240		
Site2:AA5:BB1:CC2	0.0	0	0.000	240		
Site2:AA5:BB1:CC3	0.0	0	0.000	240		
Site2:AA5:BB1:CC4	0.0	0	0.000	240		
Site2:AA5:BB2:CC1	0.0	0	0.000	240		
Site2:AA5:BB2:CC2	0.0	0	0.000	240		
Site2:AA5:BB2:CC3	0.0	0	0.000	240		
Site2:AA5:BB2:CC4	0.0	0	0.000	240		
Site3:AA1:BB1:CC1	42.0	0	130.087	240	0.3229	0.747082
Site3:AA1:BB1:CC2	-74.0	0	130.087	240	-0.5688	0.569991
Site3:AA1:BB1:CC3	96.3	0	130.087	240	0.7405	0.459703
Site3:AA1:BB1:CC4	0.0	0	0.000	240		
Site3:AA1:BB2:CC1	0.0	0	0.000	240		
Site3:AA1:BB2:CC2	0.0	0	0.000	240		
Site3:AA1:BB2:CC3	0.0	0	0.000	240		
Site3:AA1:BB2:CC4	0.0	0	0.000	240		
Site3:AA2:BB1:CC1	-113.3	0	130.087	240	-0.8712	0.384510
Site3:AA2:BB1:CC2	9.0	0	130.087	240	0.0692	0.944901
Site3:AA2:BB1:CC3	83.7	0	130.087	240	0.6432	0.520736
Site3:AA2:BB1:CC4	0.0	0	0.000	240		
Site3:AA2:BB2:CC1	0.0	0	0.000	240		
Site3:AA2:BB2:CC2	0.0	0	0.000	240		
Site3:AA2:BB2:CC3	0.0	0	0.000	240		
Site3:AA2:BB2:CC4	0.0	0	0.000	240		
Site3:AA3:BB1:CC1	36.3	0	130.087	240	0.2793	0.780255
Site3:AA3:BB1:CC2	-46.7	0	130.087	240	-0.3587	0.720110
Site3:AA3:BB1:CC3	82.0	0	130.087	240	0.6303	0.529068
Site3:AA3:BB1:CC4	0.0	0	0.000	240		
Site3:AA3:BB2:CC1	0.0	0	0.000	240		
Site3:AA3:BB2:CC2	0.0	0	0.000	240		
Site3:AA3:BB2:CC3	0.0	0	0.000	240		
Site3:AA3:BB2:CC4	0.0	0	0.000	240		
Site3:AA4:BB1:CC1	-89.0	0	130.087	240	-0.6842	0.494537
Site3:AA4:BB1:CC2	-100.0	0	130.087	240	-0.7687	0.442819
Site3:AA4:BB1:CC3	33.3	0	130.087	240	0.2562	0.797986
Site3:AA4:BB1:CC4	0.0	0	0.000	240		
Site3:AA4:BB2:CC1	0.0	0	0.000	240		
Site3:AA4:BB2:CC2	0.0	0	0.000	240		
Site3:AA4:BB2:CC3	0.0	0	0.000	240		
Site3:AA4:BB2:CC4	0.0	0	0.000	240		
Site3:AA5:BB1:CC1	0.0	0	0.000	240		
Site3:AA5:BB1:CC2	0.0	0	0.000	240		
Site3:AA5:BB1:CC3	0.0	0	0.000	240		
Site3:AA5:BB1:CC4	0.0	0	0.000	240		
Site3:AA5:BB2:CC1	0.0	0	0.000	240		
Site3:AA5:BB2:CC2	0.0	0	0.000	240		
Site3:AA5:BB2:CC3	0.0	0	0.000	240		
Site3:AA5:BB2:CC4	0.0	0	0.000	240		

Site4:AA1:BB1:CC1	0.0	0	0.000	240
Site4:AA1:BB1:CC2	0.0	0	0.000	240
Site4:AA1:BB1:CC3	0.0	0	0.000	240
Site4:AA1:BB1:CC4	0.0	0	0.000	240
Site4:AA1:BB2:CC1	0.0	0	0.000	240
Site4:AA1:BB2:CC2	0.0	0	0.000	240
Site4:AA1:BB2:CC3	0.0	0	0.000	240
Site4:AA1:BB2:CC4	0.0	0	0.000	240
Site4:AA2:BB1:CC1	0.0	0	0.000	240
Site4:AA2:BB1:CC2	0.0	0	0.000	240
Site4:AA2:BB1:CC3	0.0	0	0.000	240
Site4:AA2:BB1:CC4	0.0	0	0.000	240
Site4:AA2:BB2:CC1	0.0	0	0.000	240
Site4:AA2:BB2:CC2	0.0	0	0.000	240
Site4:AA2:BB2:CC3	0.0	0	0.000	240
Site4:AA2:BB2:CC4	0.0	0	0.000	240
Site4:AA3:BB1:CC1	0.0	0	0.000	240
Site4:AA3:BB1:CC2	0.0	0	0.000	240
Site4:AA3:BB1:CC3	0.0	0	0.000	240
Site4:AA3:BB1:CC4	0.0	0	0.000	240
Site4:AA3:BB2:CC1	0.0	0	0.000	240
Site4:AA3:BB2:CC2	0.0	0	0.000	240
Site4:AA3:BB2:CC3	0.0	0	0.000	240
Site4:AA3:BB2:CC4	0.0	0	0.000	240
Site4:AA4:BB1:CC1	0.0	0	0.000	240
Site4:AA4:BB1:CC2	0.0	0	0.000	240
Site4:AA4:BB1:CC3	0.0	0	0.000	240
Site4:AA4:BB1:CC4	0.0	0	0.000	240
Site4:AA4:BB2:CC1	0.0	0	0.000	240
Site4:AA4:BB2:CC2	0.0	0	0.000	240
Site4:AA4:BB2:CC3	0.0	0	0.000	240
Site4:AA4:BB2:CC4	0.0	0	0.000	240
Site4:AA5:BB1:CC1	0.0	0	0.000	240
Site4:AA5:BB1:CC2	0.0	0	0.000	240
Site4:AA5:BB1:CC3	0.0	0	0.000	240
Site4:AA5:BB1:CC4	0.0	0	0.000	240
Site4:AA5:BB2:CC1	0.0	0	0.000	240
Site4:AA5:BB2:CC2	0.0	0	0.000	240
Site4:AA5:BB2:CC3	0.0	0	0.000	240
Site4:AA5:BB2:CC4	0.0	0	0.000	240

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(f10.1, ex10.1), type=3, singular.ok=TRUE) # NOT OK for Site:Block
```

Note: model has aliased coefficients

sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Yield

	Sum Sq	Df	F values	Pr(>F)
Site	552717	3	5.8064e+01	< 2e-16 ***
A	1387680917	4	1.0933e+05	< 2e-16 ***
B	100939695	1	3.1812e+04	< 2e-16 ***
C	19356264	3	2.0334e+03	< 2e-16 ***
Site:Block	0	0		
Site:A	34068	12	8.9470e-01	0.55301
Site:B	1618	3	1.6990e-01	0.91662
A:B	31444008	4	2.4775e+03	< 2e-16 ***
A:C	26075792	12	6.8483e+02	< 2e-16 ***
B:C	23901388	3	2.5109e+03	< 2e-16 ***
Site:C	47625	9	1.6677e+00	0.09747 .
Site:A:B	33737	12	8.8600e-01	0.56185
A:B:C	41996729	12	1.1030e+03	< 2e-16 ***
Site:A:C	104110	36	9.1140e-01	0.61768
Site:B:C	61111	9	2.1400e+00	0.02701 *
Site:Block:A:B	186911	72	8.1810e-01	0.84155
Site:A:B:C	82475	36	7.2200e-01	0.87941
Residuals	761522	240		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1



## 7 Hinkelmann & Kempthorne - Volume 1

### Reference

- Hinkelmann K, Kempthorne O. Design and Analysis of Experiments Volume 1 Introduction to Experimental Design. 2e. John Wiley & Sons Inc. 2008.

### 7.1 p410

(18) MODEL

```
v1p410 = read.table("http://r.acr.kr/kemp/v1p410.txt", head=TRUE)
v1p410$carry = ifelse(v1p410$carry == 0, 3, v1p410$carry)
v1p410 = af(v1p410, c("period", "sequence", "steer", "trt", "carry"))
v1p410
```

	period	sequence	steer	trt	carry	y
1	1	1	1	1	3	50
2	2	1	1	2	1	61
3	3	1	1	3	2	53
4	1	1	2	1	3	55
5	2	1	2	2	1	63
6	3	1	2	3	2	57
7	1	2	3	2	3	44
8	2	2	3	3	2	42
9	3	2	3	1	3	57
10	1	2	4	2	3	51
11	2	2	4	3	2	46
12	3	2	4	1	3	59
13	1	3	5	3	3	35
14	2	3	5	1	3	55
15	3	3	5	2	1	47
16	1	3	6	3	3	41
17	2	3	6	1	3	56
18	3	3	6	2	1	50
19	1	4	7	1	3	54
20	2	4	7	3	1	48
21	3	4	7	2	3	51
22	1	4	8	1	3	58
23	2	4	8	3	1	51
24	3	4	8	2	3	54
25	1	5	9	2	3	50
26	2	5	9	1	2	57
27	3	5	9	3	1	51
28	1	5	10	2	3	55
29	2	5	10	1	2	59

30	3	5	10	3	1	55
31	1	6	11	3	3	41
32	2	6	11	2	3	56
33	3	6	11	1	2	58
34	1	6	12	3	3	46
35	2	6	12	2	3	58
36	3	6	12	1	2	61

```
GLM(y ~ period + sequence + steer:sequence + trt + carry, v1p410) # OK
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	17	1302.51	76.618	8.7402	1.572e-05 ***
RESIDUALS	18	157.79	8.766		
CORRECTED TOTAL	35	1460.31			

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
period	2	292.06	146.028	16.6580	8.038e-05 ***
sequence	5	326.47	65.294	7.4484	0.0006072 ***
sequence:steer	6	118.50	19.750	2.2530	0.0849122 .
trt	2	549.06	274.528	31.3166	1.377e-06 ***
carry	2	16.43	8.215	0.9372	0.4100385

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
period	2	172.31	86.154	9.8279	0.0013030 **
sequence	5	318.69	63.738	7.2709	0.0006954 ***
sequence:steer	6	118.50	19.750	2.2530	0.0849122 .
trt	2	440.61	220.304	25.1311	6.164e-06 ***
carry	2	16.43	8.215	0.9372	0.4100385

```
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
period	2	172.31	86.154	9.8279	0.0013030 **
sequence	5	318.69	63.738	7.2709	0.0006954 ***
sequence:steer	6	118.50	19.750	2.2530	0.0849122 .
trt	2	440.61	220.304	25.1311	6.164e-06 ***
carry	2	16.43	8.215	0.9372	0.4100385

```
---
```

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )	
(Intercept)	52.854	0	2.3407	18	22.5805	1.177e-14	***
period1	-6.604	0	1.5990	18	-4.1302	0.0006286	***
period2	-0.083	0	1.2087	18	-0.0689	0.9457953	
period3	0.000	0	0.0000	18			
sequence1	3.208	0	2.4919	18	1.2875	0.2142212	
sequence2	-3.000	0	2.4175	18	-1.2410	0.2305478	
sequence3	-6.771	0	2.4919	18	-2.7172	0.0141265	*
sequence4	-1.438	0	2.4919	18	-0.5769	0.5711674	
sequence5	1.208	0	2.4919	18	0.4849	0.6335881	
sequence6	0.000	0	0.0000	18			
sequence1:steer1	-3.667	0	2.4175	18	-1.5167	0.1466983	
sequence1:steer2	0.000	0	0.0000	18			
sequence1:steer3		0					
sequence1:steer4		0					
sequence1:steer5		0					
sequence1:steer6		0					
sequence1:steer7		0					
sequence1:steer8		0					
sequence1:steer9		0					
sequence1:steer10		0					
sequence1:steer11		0					
sequence1:steer12		0					
sequence2:steer1		0					
sequence2:steer2		0					
sequence2:steer3	-4.333	0	2.4175	18	-1.7925	0.0898747	.
sequence2:steer4	0.000	0	0.0000	18			
sequence2:steer5		0					
sequence2:steer6		0					
sequence2:steer7		0					
sequence2:steer8		0					
sequence2:steer9		0					
sequence2:steer10		0					
sequence2:steer11		0					
sequence2:steer12		0					
sequence3:steer1		0					
sequence3:steer2		0					
sequence3:steer3		0					
sequence3:steer4		0					
sequence3:steer5	-3.333	0	2.4175	18	-1.3789	0.1848347	
sequence3:steer6	0.000	0	0.0000	18			
sequence3:steer7		0					
sequence3:steer8		0					
sequence3:steer9		0					
sequence3:steer10		0					

sequence3:steer11		0				
sequence3:steer12		0				
sequence4:steer1		0				
sequence4:steer2		0				
sequence4:steer3		0				
sequence4:steer4		0				
sequence4:steer5		0				
sequence4:steer6		0				
sequence4:steer7	-3.333	0	2.4175	18	-1.3789	0.1848347
sequence4:steer8	0.000	0	0.0000	18		
sequence4:steer9		0				
sequence4:steer10		0				
sequence4:steer11		0				
sequence4:steer12		0				
sequence5:steer1		0				
sequence5:steer2		0				
sequence5:steer3		0				
sequence5:steer4		0				
sequence5:steer5		0				
sequence5:steer6		0				
sequence5:steer7		0				
sequence5:steer8		0				
sequence5:steer9	-3.667	0	2.4175	18	-1.5167	0.1466983
sequence5:steer10	0.000	0	0.0000	18		
sequence5:steer11		0				
sequence5:steer12		0				
sequence6:steer1		0				
sequence6:steer2		0				
sequence6:steer3		0				
sequence6:steer4		0				
sequence6:steer5		0				
sequence6:steer6		0				
sequence6:steer7		0				
sequence6:steer8		0				
sequence6:steer9		0				
sequence6:steer10		0				
sequence6:steer11	-3.333	0	2.4175	18	-1.3789	0.1848347
sequence6:steer12	0.000	0	0.0000	18		
trt1	9.542	0	1.3514	18	7.0606	1.384e-06 ***
trt2	5.521	0	1.3514	18	4.0853	0.0006946 ***
trt3	0.000	0	0.0000	18		
carry1	0.375	0	1.8131	18	0.2068	0.8384657
carry2	-1.938	0	1.8131	18	-1.0686	0.2993665
carry3	0.000	0	0.0000	18		
---						

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(y ~ period + sequence + steer:sequence + trt + carry, vlp410), type=3,
      singular.ok=TRUE) # NOT OK for sequence
```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: y

	Sum Sq	Df	F values	Pr(>F)
period	172.31	2	9.8279	0.001303 **
sequence	0.00	0		
trt	440.61	2	25.1311	6.164e-06 ***
carry	16.43	2	0.9372	0.410038
sequence:steer	118.50	6	2.2530	0.084912 .
Residuals	157.79	18		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 8 Searle - Linear Models 2e

### Reference

- Searle SR, Gruber MHJ. Linear Models 2e, Kindle Edition. John Wiley & Sons Inc. 2016.

### 8.1 7.2 (p390, 59%)

(19) MODEL

```
weight = c(8,13,9,12,7,11,6,12,12,14,9,7,14,16,10,14,11,13)
treatment = c("ta","ta","ta","ta","ta","ta","tb","tb","tb","tb","tc","tc","tc",
              "tc","tc","tc","tc","tc")
variety = c("va","va","va","vc","vd","vd","va","va","vb","vb","vb","vb","vb","vc",
            "vc","vd","vd","vd","vd")
d1 = data.frame(weight, treatment, variety)
GLM(weight ~ treatment*variety, d1)
```

\$ANOVA

Response : weight

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	82	11.714	2.0918	0.14
RESIDUALS	10	56	5.600		
CORRECTED TOTAL	17	138			

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
treatment	2	10.500	5.250	0.9375	0.42348
variety	3	36.786	12.262	2.1896	0.15232
treatment:variety	2	34.714	17.357	3.0995	0.08965 .

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
treatment	2	9.486	4.7429	0.8469	0.45731
variety	3	36.786	12.2619	2.1896	0.15232
treatment:variety	2	34.714	17.3571	3.0995	0.08965 .

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
treatment	2	12.471	6.2353	1.1134	0.36595
variety	3	34.872	11.6240	2.0757	0.16719
treatment:variety	2	34.714	17.3571	3.0995	0.08965 .

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	12	0	1.1832	10	10.1419	1.397e-06 ***
treatmentta	-3	0	2.0494	10	-1.4639	0.17395
treatmenttb	5	0	2.3664	10	2.1129	0.06075 .
treatmenttc	0	0	0.0000	10		
varietyva	-8	0	3.1305	10	-2.5555	0.02859 *
varietyvb	-4	0	2.0494	10	-1.9518	0.07951 .
varietyvc	3	0	2.0494	10	1.4639	0.17395
varietyvd	0	0	0.0000	10		
treatmentta:varietyva	9	0	3.8035	10	2.3662	0.03953 *
treatmentta:varietyvb		0				
treatmentta:varietyvc	0	0	3.5496	10	0.0000	1.00000
treatmentta:varietyvd	0	0	0.0000	10		
treatmenttb:varietyva	0	0	0.0000	10		
treatmenttb:varietyvb	0	0	0.0000	10		
treatmenttb:varietyvc		0				
treatmenttb:varietyvd		0				
treatmenttc:varietyva		0				
treatmenttc:varietyvb	0	0	0.0000	10		
treatmenttc:varietyvc	0	0	0.0000	10		
treatmenttc:varietyvd	0	0	0.0000	10		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```
options(contrasts = c("contr.sum", "contr.poly"))
Anova(lm(weight ~ treatment*variety, d1), type=3, singular.ok=TRUE) # NOT OK
```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

Response: weight

	Sum Sq	Df	F values	Pr(>F)
treatment	0.000	0		
variety	0.000	0		
treatment:variety	34.714	2	3.0995	0.08965 .
Residuals	56.000	10		

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

## 8.2 7.2 (p393, 60%)

(20) MODEL

```
percent = c(31,33,44,36,38,26,37,59,42,42,34,42,28,39,36,32,38,42,36,22,42,46,
            26,37,43)
refinery = c(rep("g",9),rep("n",8),rep("s",8))
process = as.factor(c(1,1,1,1,1,1,2,2,2,1,1,1,1,2,2,2,2,1,1,1,2,2,2,2,2))
source0 = c("t","t","t","t","o","m","t","t","o","m","i","i","i","t","o","m","m",
            "t","o","i","o","o","m","i","i")
d2 = data.frame(percent, refinery, process, source=source0)
GLM(percent ~ refinery*source, d2)
```

\$ANOVA

Response : percent

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	10	442.56	44.256	0.6361	0.7616
RESIDUALS	14	974.00	69.571		
CORRECTED TOTAL	24	1416.56			

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
refinery	2	20.963	10.481	0.1507	0.8615
source	3	266.124	88.708	1.2751	0.3212
refinery:source	5	155.474	31.095	0.4469	0.8086

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
refinery	2	25.535	12.767	0.1835	0.8343
source	3	266.124	88.708	1.2751	0.3212
refinery:source	5	155.474	31.095	0.4469	0.8086

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
refinery	2	10.766	5.383	0.0774	0.9259
source	3	282.633	94.211	1.3542	0.2972
refinery:source	5	155.474	31.095	0.4469	0.8086

\$Parameter

	Estimate	Estimable	Std. Error	Df	t value	Pr(> t )
(Intercept)	42.000	0	8.3409	14	5.0354	0.0001822 ***
refineryg	-2.000	0	9.0093	14	-0.2220	0.8275243
refineryn	-3.000	0	11.7959	14	-0.2543	0.8029412
refinerys	0.000	0	0.0000	14		
sourcei	-8.000	0	9.6313	14	-0.8306	0.4201255
sourcem	-16.000	0	11.7959	14	-1.3564	0.1964425
sourceo	-0.667	0	9.6313	14	-0.0692	0.9457944



```

sourcet          0.000          0      0.0000 14
refineryg:sourcei          0
refineryg:sourcem      2.000          0      14.8428 14      0.1347 0.8947314
refineryg:sourceo      0.667          0      11.7959 14      0.0565 0.9557287
refineryg:sourcet      0.000          0      0.0000 14
refineryn:sourcei      3.667          0      13.6207 14      0.2692 0.7917042
refineryn:sourcem     14.333          0      15.2284 14      0.9412 0.3625491
refineryn:sourceo     -2.333          0      15.2284 14     -0.1532 0.8804095
refineryn:sourcet      0.000          0      0.0000 14
refinerys:sourcei      0.000          0      0.0000 14
refinerys:sourcem      0.000          0      0.0000 14
refinerys:sourceo      0.000          0      0.0000 14
refinerys:sourcet      0.000          0      0.0000 14

```

---

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1

```

options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(percent ~ refinery*source, d2), type=3, singular.ok=TRUE) # NOT OK

```

Note: model has aliased coefficients  
 sums of squares computed by model comparison

Anova Table (Type III tests)

```

Response: percent
          Sum Sq Df F values Pr(>F)
refinery      2.52  1    0.0362 0.8518
source     268.19  2    1.9275 0.1822
refinery:source 155.47  5    0.4469 0.8086
Residuals    974.00 14

```

## 9 Session Information

R version 4.1.2 (2021-11-01)

Platform: x86\_64-w64-mingw32/x64 (64-bit)

Running under: Windows 10 x64 (build 17763)

Matrix products: default

locale:

[1] LC\_COLLATE=Korean\_Korea.949 LC\_CTYPE=Korean\_Korea.949

[3] LC\_MONETARY=Korean\_Korea.949 LC\_NUMERIC=C

[5] LC\_TIME=Korean\_Korea.949

attached base packages:

[1] stats graphics grDevices utils datasets methods base

other attached packages:

[1] car\_3.0-12 carData\_3.0-5 sasLM\_0.6.6 mvtnorm\_1.1-3 rmarkdown\_2.11

loaded via a namespace (and not attached):

[1] digest\_0.6.29 MASS\_7.3-55 magrittr\_2.0.2 evaluate\_0.15

[5] rlang\_1.0.1 stringi\_1.7.6 cli\_3.2.0 tools\_4.1.2

[9] stringr\_1.4.0 tinytex\_0.37 abind\_1.4-5 xfun\_0.29

[13] yaml\_2.3.4 fastmap\_1.1.0 compiler\_4.1.2 htmltools\_0.5.2

[17] knitr\_1.37