

Examples of NOT OK using car package

Kyun-Seop Bae MD PhD

2021-04-15 00:27:30

Contents

1	Tested Version and Books used for the Validation	2
1.1	Packages Used	2
1.2	Books and Articles used for the Test	2
2	Snee EMS ANOVA 1974	3
3	Goodnight	21
3.1	p33	21
4	SAS for Linear Models 4e	23
4.1	p403	23
4.2	p417	29
4.3	p431	31
5	Sahai - Unbalanced	36
5.1	Table 15.3	36
5.2	Table 16.3	42
6	Federer - Variations	48
6.1	Example 2.2	48
6.2	Example 3.1	55
6.3	Example 5.1	73
6.4	Example 7.1	81
6.5	Example 7.3	90
6.6	Example 8.1	106
6.7	Example 9.2	121
6.8	Example 10.1	125
7	Hinkelmann & Kempthorne - Volume 1	151
7.1	p410	151
8	Searle - Linear Models 2e	156
8.1	7.2 (p390, 59%)	156
8.2	7.2 (p393, 60%)	157
9	Session Information	160

1 Tested Version and Books used for the Validation

1.1 Packages Used

- 'sasLM' version: 0.5.2
- 'SAS' version: 9.4 Licensed and University Edition
- 'car' version: 3.0.10
- R version: R version 4.0.5 (2021-03-31)

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	Std. Error	Df	t value	Pr(> t)
(Intercept)	6.8		0		
Day1	2.0		0		
Day2	1.3		0		
Day3	0.6		0		
Day4	1.2		0		
Day5	2.7		0		
Day6	2.4		0		
Day7	6.0		0		
Day8	2.4		0		
Day9	4.5		0		
Day10	2.5		0		
Day11	-2.8		0		
Day12	2.9		0		
Day13	-2.2		0		
Day14	-4.7		0		
Day15	2.9		0		
Day16	3.2		0		
Day17	3.4		0		
Day18	2.4		0		
Day19	4.0		0		
Day20	2.6		0		
Day21	3.5		0		
Day22	3.5		0		
Day23	1.5		0		
Day24	4.8		0		
Day25	2.6		0		
Day26	4.5		0		

Day27	4.6	0
Day28	2.8	0
Day29	-4.6	0
Day30	-0.2	0
Day31	4.7	0
Day32	2.3	0
Day33	-2.2	0
Day34	1.1	0
Day35	2.2	0
Day36	1.3	0
Day37	2.6	0
Day38	4.1	0
Day39	2.2	0
Day40	1.0	0
Day41	2.5	0
Day42	0.0	0
Day1:Machine1	-2.2	0
Day1:Machine2	0.0	0
Day2:Machine1	0.1	0
Day2:Machine2	0.0	0
Day3:Machine1	0.6	0
Day3:Machine2	0.0	0
Day4:Machine1	-1.5	0
Day4:Machine2	0.0	0
Day5:Machine1	-7.2	0
Day5:Machine2	0.0	0
Day6:Machine1	-5.2	0
Day6:Machine2	0.0	0
Day7:Machine1	-1.1	0
Day7:Machine2	0.0	0
Day8:Machine1	-2.4	0
Day8:Machine2	0.0	0
Day9:Machine1	-0.8	0
Day9:Machine2	0.0	0
Day10:Machine1	1.0	0
Day10:Machine2	0.0	0
Day11:Machine1	6.0	0
Day11:Machine2	0.0	0
Day12:Machine1	-0.9	0
Day12:Machine2	0.0	0
Day13:Machine1	2.1	0
Day13:Machine2	0.0	0
Day14:Machine1	6.8	0
Day14:Machine2	0.0	0
Day15:Machine1	0.2	0
Day15:Machine2	0.0	0
Day16:Machine1	-1.8	0
Day16:Machine2	0.0	0

Day17:Machine1	-2.7	0
Day17:Machine2	0.0	0
Day18:Machine1	-2.6	0
Day18:Machine2	0.0	0
Day19:Machine1	-7.7	0
Day19:Machine2	0.0	0
Day20:Machine1	-2.2	0
Day20:Machine2	0.0	0
Day21:Machine1	0.4	0
Day21:Machine2	0.0	0
Day22:Machine1	-1.9	0
Day22:Machine2	0.0	0
Day23:Machine1	-0.7	0
Day23:Machine2	0.0	0
Day24:Machine1	1.0	0
Day24:Machine2	0.0	0
Day25:Machine1	0.2	0
Day25:Machine2	0.0	0
Day26:Machine1	1.3	0
Day26:Machine2	0.0	0
Day27:Machine1	-0.6	0
Day27:Machine2	0.0	0
Day28:Machine1	-4.5	0
Day28:Machine2	0.0	0
Day29:Machine1	4.4	0
Day29:Machine2	0.0	0
Day30:Machine1	2.0	0
Day30:Machine2	0.0	0
Day31:Machine1	1.0	0
Day31:Machine2	0.0	0
Day32:Machine1	1.3	0
Day32:Machine2	0.0	0
Day33:Machine1	6.0	0
Day33:Machine2	0.0	0
Day34:Machine1	-0.7	0
Day34:Machine2	0.0	0
Day35:Machine1	-1.2	0
Day35:Machine2	0.0	0
Day36:Machine1	-3.7	0
Day36:Machine2	0.0	0
Day37:Machine1	-0.7	0
Day37:Machine2	0.0	0
Day38:Machine1	0.3	0
Day38:Machine2	0.0	0
Day39:Machine1	1.3	0
Day39:Machine2	0.0	0
Day40:Machine1	-0.8	0
Day40:Machine2	0.0	0

Day41:Machine1	-1.6	0
Day41:Machine2	0.0	0
Day42:Machine1	0.8	0
Day42:Machine2	0.0	0
Day1:Machine1:Analyst1	0.0	0
Day1:Machine1:Analyst2	0.0	0
Day1:Machine2:Analyst1	0.0	0
Day1:Machine2:Analyst2		
Day2:Machine1:Analyst1	1.4	0
Day2:Machine1:Analyst2	0.0	0
Day2:Machine2:Analyst1	0.0	0
Day2:Machine2:Analyst2		
Day3:Machine1:Analyst1	-1.3	0
Day3:Machine1:Analyst2	0.0	0
Day3:Machine2:Analyst1	0.0	0
Day3:Machine2:Analyst2		
Day4:Machine1:Analyst1	0.7	0
Day4:Machine1:Analyst2	0.0	0
Day4:Machine2:Analyst1	0.0	0
Day4:Machine2:Analyst2		
Day5:Machine1:Analyst1	4.8	0
Day5:Machine1:Analyst2	0.0	0
Day5:Machine2:Analyst1	0.0	0
Day5:Machine2:Analyst2		
Day6:Machine1:Analyst1	5.0	0
Day6:Machine1:Analyst2	0.0	0
Day6:Machine2:Analyst1	0.0	0
Day6:Machine2:Analyst2		
Day7:Machine1:Analyst1	-1.9	0
Day7:Machine1:Analyst2	0.0	0
Day7:Machine2:Analyst1	0.0	0
Day7:Machine2:Analyst2		
Day8:Machine1:Analyst1	1.2	0
Day8:Machine1:Analyst2	0.0	0
Day8:Machine2:Analyst1	0.0	0
Day8:Machine2:Analyst2		
Day9:Machine1:Analyst1	0.4	0
Day9:Machine1:Analyst2	0.0	0
Day9:Machine2:Analyst1	0.0	0
Day9:Machine2:Analyst2		
Day10:Machine1:Analyst1	0.3	0
Day10:Machine1:Analyst2	0.0	0
Day10:Machine2:Analyst1	0.0	0
Day10:Machine2:Analyst2		
Day11:Machine1:Analyst1	-1.6	0
Day11:Machine1:Analyst2	0.0	0
Day11:Machine2:Analyst1	0.0	0
Day11:Machine2:Analyst2		

Day12:Machine1:Analyst1	1.8	0
Day12:Machine1:Analyst2	0.0	0
Day12:Machine2:Analyst1	0.0	0
Day12:Machine2:Analyst2		
Day13:Machine1:Analyst1	0.5	0
Day13:Machine1:Analyst2	0.0	0
Day13:Machine2:Analyst1	0.0	0
Day13:Machine2:Analyst2		
Day14:Machine1:Analyst1	-0.9	0
Day14:Machine1:Analyst2	0.0	0
Day14:Machine2:Analyst1	0.0	0
Day14:Machine2:Analyst2		
Day15:Machine1:Analyst1	-1.2	0
Day15:Machine1:Analyst2	0.0	0
Day15:Machine2:Analyst1	0.0	0
Day15:Machine2:Analyst2		
Day16:Machine1:Analyst1	0.5	0
Day16:Machine1:Analyst2	0.0	0
Day16:Machine2:Analyst1	0.0	0
Day16:Machine2:Analyst2		
Day17:Machine1:Analyst1	-0.7	0
Day17:Machine1:Analyst2	0.0	0
Day17:Machine2:Analyst1	0.0	0
Day17:Machine2:Analyst2		
Day18:Machine1:Analyst1	0.0	0
Day18:Machine1:Analyst2	0.0	0
Day18:Machine2:Analyst1	0.0	0
Day18:Machine2:Analyst2		
Day19:Machine1:Analyst1	4.0	0
Day19:Machine1:Analyst2	0.0	0
Day19:Machine2:Analyst1	0.0	0
Day19:Machine2:Analyst2		
Day20:Machine1:Analyst1	2.8	0
Day20:Machine1:Analyst2	0.0	0
Day20:Machine2:Analyst1	0.0	0
Day20:Machine2:Analyst2		
Day21:Machine1:Analyst1	-1.2	0
Day21:Machine1:Analyst2	0.0	0
Day21:Machine2:Analyst1	0.0	0
Day21:Machine2:Analyst2		
Day22:Machine1:Analyst1	-0.7	0
Day22:Machine1:Analyst2	0.0	0
Day22:Machine2:Analyst1	0.0	0
Day22:Machine2:Analyst2		
Day23:Machine1:Analyst1	1.2	0
Day23:Machine1:Analyst2	0.0	0
Day23:Machine2:Analyst1	0.0	0
Day23:Machine2:Analyst2		

Day24:Machine1:Analyst1	-0.4	0
Day24:Machine1:Analyst2	0.0	0
Day24:Machine2:Analyst1	0.0	0
Day24:Machine2:Analyst2		
Day25:Machine1:Analyst1	0.8	0
Day25:Machine1:Analyst2	0.0	0
Day25:Machine2:Analyst1	0.0	0
Day25:Machine2:Analyst2		
Day26:Machine1:Analyst1	-2.0	0
Day26:Machine1:Analyst2	0.0	0
Day26:Machine2:Analyst1	0.0	0
Day26:Machine2:Analyst2		
Day27:Machine1:Analyst1	-0.2	0
Day27:Machine1:Analyst2	0.0	0
Day27:Machine2:Analyst1	0.0	0
Day27:Machine2:Analyst2		
Day28:Machine1:Analyst1	2.2	0
Day28:Machine1:Analyst2	0.0	0
Day28:Machine2:Analyst1	0.0	0
Day28:Machine2:Analyst2		
Day29:Machine1:Analyst1	0.4	0
Day29:Machine1:Analyst2	0.0	0
Day29:Machine2:Analyst1	0.0	0
Day29:Machine2:Analyst2		
Day30:Machine1:Analyst1	-1.6	0
Day30:Machine1:Analyst2	0.0	0
Day30:Machine2:Analyst1	0.0	0
Day30:Machine2:Analyst2		
Day31:Machine1:Analyst1	-3.3	0
Day31:Machine1:Analyst2	0.0	0
Day31:Machine2:Analyst1	0.0	0
Day31:Machine2:Analyst2		
Day32:Machine1:Analyst1	1.3	0
Day32:Machine1:Analyst2	0.0	0
Day32:Machine2:Analyst1	0.0	0
Day32:Machine2:Analyst2		
Day33:Machine1:Analyst1	0.0	0
Day33:Machine1:Analyst2	0.0	0
Day33:Machine2:Analyst1	0.0	0
Day33:Machine2:Analyst2		
Day34:Machine1:Analyst1	3.2	0
Day34:Machine1:Analyst2	0.0	0
Day34:Machine2:Analyst1	0.0	0
Day34:Machine2:Analyst2		
Day35:Machine1:Analyst1	0.6	0
Day35:Machine1:Analyst2	0.0	0
Day35:Machine2:Analyst1	0.0	0
Day35:Machine2:Analyst2		

Day36:Machine1:Analyst1	2.4	0
Day36:Machine1:Analyst2	0.0	0
Day36:Machine2:Analyst1	0.0	0
Day36:Machine2:Analyst2		
Day37:Machine1:Analyst1	1.4	0
Day37:Machine1:Analyst2	0.0	0
Day37:Machine2:Analyst1	0.0	0
Day37:Machine2:Analyst2		
Day38:Machine1:Analyst1	-0.2	0
Day38:Machine1:Analyst2	0.0	0
Day38:Machine2:Analyst1	0.0	0
Day38:Machine2:Analyst2		
Day39:Machine1:Analyst1	-0.3	0
Day39:Machine1:Analyst2	0.0	0
Day39:Machine2:Analyst1	0.0	0
Day39:Machine2:Analyst2		
Day40:Machine1:Analyst1	1.0	0
Day40:Machine1:Analyst2	0.0	0
Day40:Machine2:Analyst1	0.0	0
Day40:Machine2:Analyst2		
Day41:Machine1:Analyst1	-0.5	0
Day41:Machine1:Analyst2	0.0	0
Day41:Machine2:Analyst1	0.0	0
Day41:Machine2:Analyst2		
Day42:Machine1:Analyst1	1.2	0
Day42:Machine1:Analyst2	0.0	0
Day42:Machine2:Analyst1	0.0	0
Day42:Machine2:Analyst2		
Day1:Machine1:Analyst1:Test1	-0.5	0
Day1:Machine1:Analyst1:Test2	0.0	0
Day1:Machine1:Analyst2:Test1	0.0	0
Day1:Machine1:Analyst2:Test2		
Day1:Machine2:Analyst1:Test1	0.0	0
Day1:Machine2:Analyst1:Test2		
Day1:Machine2:Analyst2:Test1		
Day1:Machine2:Analyst2:Test2		
Day2:Machine1:Analyst1:Test1	-1.1	0
Day2:Machine1:Analyst1:Test2	0.0	0
Day2:Machine1:Analyst2:Test1	0.0	0
Day2:Machine1:Analyst2:Test2		
Day2:Machine2:Analyst1:Test1	0.0	0
Day2:Machine2:Analyst1:Test2		
Day2:Machine2:Analyst2:Test1		
Day2:Machine2:Analyst2:Test2		
Day3:Machine1:Analyst1:Test1	1.9	0
Day3:Machine1:Analyst1:Test2	0.0	0
Day3:Machine1:Analyst2:Test1	0.0	0
Day3:Machine1:Analyst2:Test2		

Day3:Machine2:Analyst1:Test1	0.0	0
Day3:Machine2:Analyst1:Test2		
Day3:Machine2:Analyst2:Test1		
Day3:Machine2:Analyst2:Test2		
Day4:Machine1:Analyst1:Test1	2.1	0
Day4:Machine1:Analyst1:Test2	0.0	0
Day4:Machine1:Analyst2:Test1	0.0	0
Day4:Machine1:Analyst2:Test2		
Day4:Machine2:Analyst1:Test1	0.0	0
Day4:Machine2:Analyst1:Test2		
Day4:Machine2:Analyst2:Test1		
Day4:Machine2:Analyst2:Test2		
Day5:Machine1:Analyst1:Test1	1.0	0
Day5:Machine1:Analyst1:Test2	0.0	0
Day5:Machine1:Analyst2:Test1	0.0	0
Day5:Machine1:Analyst2:Test2		
Day5:Machine2:Analyst1:Test1	0.0	0
Day5:Machine2:Analyst1:Test2		
Day5:Machine2:Analyst2:Test1		
Day5:Machine2:Analyst2:Test2		
Day6:Machine1:Analyst1:Test1	-0.5	0
Day6:Machine1:Analyst1:Test2	0.0	0
Day6:Machine1:Analyst2:Test1	0.0	0
Day6:Machine1:Analyst2:Test2		
Day6:Machine2:Analyst1:Test1	0.0	0
Day6:Machine2:Analyst1:Test2		
Day6:Machine2:Analyst2:Test1		
Day6:Machine2:Analyst2:Test2		
Day7:Machine1:Analyst1:Test1	0.0	0
Day7:Machine1:Analyst1:Test2	0.0	0
Day7:Machine1:Analyst2:Test1	0.0	0
Day7:Machine1:Analyst2:Test2		
Day7:Machine2:Analyst1:Test1	0.0	0
Day7:Machine2:Analyst1:Test2		
Day7:Machine2:Analyst2:Test1		
Day7:Machine2:Analyst2:Test2		
Day8:Machine1:Analyst1:Test1	1.0	0
Day8:Machine1:Analyst1:Test2	0.0	0
Day8:Machine1:Analyst2:Test1	0.0	0
Day8:Machine1:Analyst2:Test2		
Day8:Machine2:Analyst1:Test1	0.0	0
Day8:Machine2:Analyst1:Test2		
Day8:Machine2:Analyst2:Test1		
Day8:Machine2:Analyst2:Test2		
Day9:Machine1:Analyst1:Test1	0.1	0
Day9:Machine1:Analyst1:Test2	0.0	0
Day9:Machine1:Analyst2:Test1	0.0	0
Day9:Machine1:Analyst2:Test2		

Day9:Machine2:Analyst1:Test1	0.0	0
Day9:Machine2:Analyst1:Test2		
Day9:Machine2:Analyst2:Test1		
Day9:Machine2:Analyst2:Test2		
Day10:Machine1:Analyst1:Test1	-0.9	0
Day10:Machine1:Analyst1:Test2	0.0	0
Day10:Machine1:Analyst2:Test1	0.0	0
Day10:Machine1:Analyst2:Test2		
Day10:Machine2:Analyst1:Test1	0.0	0
Day10:Machine2:Analyst1:Test2		
Day10:Machine2:Analyst2:Test1		
Day10:Machine2:Analyst2:Test2		
Day11:Machine1:Analyst1:Test1	2.1	0
Day11:Machine1:Analyst1:Test2	0.0	0
Day11:Machine1:Analyst2:Test1	0.0	0
Day11:Machine1:Analyst2:Test2		
Day11:Machine2:Analyst1:Test1	0.0	0
Day11:Machine2:Analyst1:Test2		
Day11:Machine2:Analyst2:Test1		
Day11:Machine2:Analyst2:Test2		
Day12:Machine1:Analyst1:Test1	-2.3	0
Day12:Machine1:Analyst1:Test2	0.0	0
Day12:Machine1:Analyst2:Test1	0.0	0
Day12:Machine1:Analyst2:Test2		
Day12:Machine2:Analyst1:Test1	0.0	0
Day12:Machine2:Analyst1:Test2		
Day12:Machine2:Analyst2:Test1		
Day12:Machine2:Analyst2:Test2		
Day13:Machine1:Analyst1:Test1	1.2	0
Day13:Machine1:Analyst1:Test2	0.0	0
Day13:Machine1:Analyst2:Test1	0.0	0
Day13:Machine1:Analyst2:Test2		
Day13:Machine2:Analyst1:Test1	0.0	0
Day13:Machine2:Analyst1:Test2		
Day13:Machine2:Analyst2:Test1		
Day13:Machine2:Analyst2:Test2		
Day14:Machine1:Analyst1:Test1	2.2	0
Day14:Machine1:Analyst1:Test2	0.0	0
Day14:Machine1:Analyst2:Test1	0.0	0
Day14:Machine1:Analyst2:Test2		
Day14:Machine2:Analyst1:Test1	0.0	0
Day14:Machine2:Analyst1:Test2		
Day14:Machine2:Analyst2:Test1		
Day14:Machine2:Analyst2:Test2		
Day15:Machine1:Analyst1:Test1	0.6	0
Day15:Machine1:Analyst1:Test2	0.0	0
Day15:Machine1:Analyst2:Test1	0.0	0
Day15:Machine1:Analyst2:Test2		

Day15:Machine2:Analyst1:Test1	0.0	0
Day15:Machine2:Analyst1:Test2		
Day15:Machine2:Analyst2:Test1		
Day15:Machine2:Analyst2:Test2		
Day16:Machine1:Analyst1:Test1	-1.6	0
Day16:Machine1:Analyst1:Test2	0.0	0
Day16:Machine1:Analyst2:Test1	0.0	0
Day16:Machine1:Analyst2:Test2		
Day16:Machine2:Analyst1:Test1	0.0	0
Day16:Machine2:Analyst1:Test2		
Day16:Machine2:Analyst2:Test1		
Day16:Machine2:Analyst2:Test2		
Day17:Machine1:Analyst1:Test1	-1.0	0
Day17:Machine1:Analyst1:Test2	0.0	0
Day17:Machine1:Analyst2:Test1	0.0	0
Day17:Machine1:Analyst2:Test2		
Day17:Machine2:Analyst1:Test1	0.0	0
Day17:Machine2:Analyst1:Test2		
Day17:Machine2:Analyst2:Test1		
Day17:Machine2:Analyst2:Test2		
Day18:Machine1:Analyst1:Test1	2.3	0
Day18:Machine1:Analyst1:Test2	0.0	0
Day18:Machine1:Analyst2:Test1	0.0	0
Day18:Machine1:Analyst2:Test2		
Day18:Machine2:Analyst1:Test1	0.0	0
Day18:Machine2:Analyst1:Test2		
Day18:Machine2:Analyst2:Test1		
Day18:Machine2:Analyst2:Test2		
Day19:Machine1:Analyst1:Test1	4.4	0
Day19:Machine1:Analyst1:Test2	0.0	0
Day19:Machine1:Analyst2:Test1	0.0	0
Day19:Machine1:Analyst2:Test2		
Day19:Machine2:Analyst1:Test1	0.0	0
Day19:Machine2:Analyst1:Test2		
Day19:Machine2:Analyst2:Test1		
Day19:Machine2:Analyst2:Test2		
Day20:Machine1:Analyst1:Test1	0.3	0
Day20:Machine1:Analyst1:Test2	0.0	0
Day20:Machine1:Analyst2:Test1	0.0	0
Day20:Machine1:Analyst2:Test2		
Day20:Machine2:Analyst1:Test1	0.0	0
Day20:Machine2:Analyst1:Test2		
Day20:Machine2:Analyst2:Test1		
Day20:Machine2:Analyst2:Test2		
Day21:Machine1:Analyst1:Test1	-0.4	0
Day21:Machine1:Analyst1:Test2	0.0	0
Day21:Machine1:Analyst2:Test1	0.0	0
Day21:Machine1:Analyst2:Test2		

Day21:Machine2:Analyst1:Test1	0.0	0
Day21:Machine2:Analyst1:Test2		
Day21:Machine2:Analyst2:Test1		
Day21:Machine2:Analyst2:Test2		
Day22:Machine1:Analyst1:Test1	-2.0	0
Day22:Machine1:Analyst1:Test2	0.0	0
Day22:Machine1:Analyst2:Test1	0.0	0
Day22:Machine1:Analyst2:Test2		
Day22:Machine2:Analyst1:Test1	0.0	0
Day22:Machine2:Analyst1:Test2		
Day22:Machine2:Analyst2:Test1		
Day22:Machine2:Analyst2:Test2		
Day23:Machine1:Analyst1:Test1	-0.3	0
Day23:Machine1:Analyst1:Test2	0.0	0
Day23:Machine1:Analyst2:Test1	0.0	0
Day23:Machine1:Analyst2:Test2		
Day23:Machine2:Analyst1:Test1	0.0	0
Day23:Machine2:Analyst1:Test2		
Day23:Machine2:Analyst2:Test1		
Day23:Machine2:Analyst2:Test2		
Day24:Machine1:Analyst1:Test1	-2.6	0
Day24:Machine1:Analyst1:Test2	0.0	0
Day24:Machine1:Analyst2:Test1	0.0	0
Day24:Machine1:Analyst2:Test2		
Day24:Machine2:Analyst1:Test1	0.0	0
Day24:Machine2:Analyst1:Test2		
Day24:Machine2:Analyst2:Test1		
Day24:Machine2:Analyst2:Test2		
Day25:Machine1:Analyst1:Test1	-1.0	0
Day25:Machine1:Analyst1:Test2	0.0	0
Day25:Machine1:Analyst2:Test1	0.0	0
Day25:Machine1:Analyst2:Test2		
Day25:Machine2:Analyst1:Test1	0.0	0
Day25:Machine2:Analyst1:Test2		
Day25:Machine2:Analyst2:Test1		
Day25:Machine2:Analyst2:Test2		
Day26:Machine1:Analyst1:Test1	-0.3	0
Day26:Machine1:Analyst1:Test2	0.0	0
Day26:Machine1:Analyst2:Test1	0.0	0
Day26:Machine1:Analyst2:Test2		
Day26:Machine2:Analyst1:Test1	0.0	0
Day26:Machine2:Analyst1:Test2		
Day26:Machine2:Analyst2:Test1		
Day26:Machine2:Analyst2:Test2		
Day27:Machine1:Analyst1:Test1	-3.6	0
Day27:Machine1:Analyst1:Test2	0.0	0
Day27:Machine1:Analyst2:Test1	0.0	0
Day27:Machine1:Analyst2:Test2		

Day27:Machine2:Analyst1:Test1	0.0	0
Day27:Machine2:Analyst1:Test2		
Day27:Machine2:Analyst2:Test1		
Day27:Machine2:Analyst2:Test2		
Day28:Machine1:Analyst1:Test1	4.2	0
Day28:Machine1:Analyst1:Test2	0.0	0
Day28:Machine1:Analyst2:Test1	0.0	0
Day28:Machine1:Analyst2:Test2		
Day28:Machine2:Analyst1:Test1	0.0	0
Day28:Machine2:Analyst1:Test2		
Day28:Machine2:Analyst2:Test1		
Day28:Machine2:Analyst2:Test2		
Day29:Machine1:Analyst1:Test1	-1.0	0
Day29:Machine1:Analyst1:Test2	0.0	0
Day29:Machine1:Analyst2:Test1	0.0	0
Day29:Machine1:Analyst2:Test2		
Day29:Machine2:Analyst1:Test1	0.0	0
Day29:Machine2:Analyst1:Test2		
Day29:Machine2:Analyst2:Test1		
Day29:Machine2:Analyst2:Test2		
Day30:Machine1:Analyst1:Test1	1.0	0
Day30:Machine1:Analyst1:Test2	0.0	0
Day30:Machine1:Analyst2:Test1	0.0	0
Day30:Machine1:Analyst2:Test2		
Day30:Machine2:Analyst1:Test1	0.0	0
Day30:Machine2:Analyst1:Test2		
Day30:Machine2:Analyst2:Test1		
Day30:Machine2:Analyst2:Test2		
Day31:Machine1:Analyst1:Test1	4.2	0
Day31:Machine1:Analyst1:Test2	0.0	0
Day31:Machine1:Analyst2:Test1	0.0	0
Day31:Machine1:Analyst2:Test2		
Day31:Machine2:Analyst1:Test1	0.0	0
Day31:Machine2:Analyst1:Test2		
Day31:Machine2:Analyst2:Test1		
Day31:Machine2:Analyst2:Test2		
Day32:Machine1:Analyst1:Test1	0.4	0
Day32:Machine1:Analyst1:Test2	0.0	0
Day32:Machine1:Analyst2:Test1	0.0	0
Day32:Machine1:Analyst2:Test2		
Day32:Machine2:Analyst1:Test1	0.0	0
Day32:Machine2:Analyst1:Test2		
Day32:Machine2:Analyst2:Test1		
Day32:Machine2:Analyst2:Test2		
Day33:Machine1:Analyst1:Test1	3.6	0
Day33:Machine1:Analyst1:Test2	0.0	0
Day33:Machine1:Analyst2:Test1	0.0	0
Day33:Machine1:Analyst2:Test2		

Day33:Machine2:Analyst1:Test1	0.0	0
Day33:Machine2:Analyst1:Test2		
Day33:Machine2:Analyst2:Test1		
Day33:Machine2:Analyst2:Test2		
Day34:Machine1:Analyst1:Test1	-0.4	0
Day34:Machine1:Analyst1:Test2	0.0	0
Day34:Machine1:Analyst2:Test1	0.0	0
Day34:Machine1:Analyst2:Test2		
Day34:Machine2:Analyst1:Test1	0.0	0
Day34:Machine2:Analyst1:Test2		
Day34:Machine2:Analyst2:Test1		
Day34:Machine2:Analyst2:Test2		
Day35:Machine1:Analyst1:Test1	-1.9	0
Day35:Machine1:Analyst1:Test2	0.0	0
Day35:Machine1:Analyst2:Test1	0.0	0
Day35:Machine1:Analyst2:Test2		
Day35:Machine2:Analyst1:Test1	0.0	0
Day35:Machine2:Analyst1:Test2		
Day35:Machine2:Analyst2:Test1		
Day35:Machine2:Analyst2:Test2		
Day36:Machine1:Analyst1:Test1	-0.3	0
Day36:Machine1:Analyst1:Test2	0.0	0
Day36:Machine1:Analyst2:Test1	0.0	0
Day36:Machine1:Analyst2:Test2		
Day36:Machine2:Analyst1:Test1	0.0	0
Day36:Machine2:Analyst1:Test2		
Day36:Machine2:Analyst2:Test1		
Day36:Machine2:Analyst2:Test2		
Day37:Machine1:Analyst1:Test1	-0.9	0
Day37:Machine1:Analyst1:Test2	0.0	0
Day37:Machine1:Analyst2:Test1	0.0	0
Day37:Machine1:Analyst2:Test2		
Day37:Machine2:Analyst1:Test1	0.0	0
Day37:Machine2:Analyst1:Test2		
Day37:Machine2:Analyst2:Test1		
Day37:Machine2:Analyst2:Test2		
Day38:Machine1:Analyst1:Test1	0.0	0
Day38:Machine1:Analyst1:Test2	0.0	0
Day38:Machine1:Analyst2:Test1	0.0	0
Day38:Machine1:Analyst2:Test2		
Day38:Machine2:Analyst1:Test1	0.0	0
Day38:Machine2:Analyst1:Test2		
Day38:Machine2:Analyst2:Test1		
Day38:Machine2:Analyst2:Test2		
Day39:Machine1:Analyst1:Test1	-1.4	0
Day39:Machine1:Analyst1:Test2	0.0	0
Day39:Machine1:Analyst2:Test1	0.0	0
Day39:Machine1:Analyst2:Test2		

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

```
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 Std. Error Df t value Pr(>|t|)
(Intercept)    9.53         0
A1            -1.63         0
A2             0.02         0
A3             0.00         0
B1            -4.76         0
B2             0.00         0
B3             0.00         0
A1:B1         -0.18         0
A1:B2          0.00         0
A1:B3
A2:B1          0.00         0
A2:B2          0.00         0
A2:B3
A3:B1
A3:B2
A3:B3          0.00         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	Std. Error	Df	t value	Pr(> t)
(Intercept)	88.000	4.7287	42	18.6097	< 2.2e-16 ***
SEQUENCEA	6.208	6.2319	42	0.9962	0.3248514
SEQUENCEB	-19.333	6.1368	42	-3.1504	0.0030025 **
SEQUENCECE	-0.479	6.2319	42	-0.0769	0.9390770
SEQUENCED	-1.813	6.2319	42	-0.2908	0.7726044
SEQUENCEEE	-5.792	6.2319	42	-0.9294	0.3580166
SEQUENCEF	0.000	0.0000	42		
SEQUENCEA:PATIENT1					
SEQUENCEA:PATIENT2					
SEQUENCEA:PATIENT3					
SEQUENCEA:PATIENT4					

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

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

SEQUENCEE: PATIENT5					
SEQUENCEE: PATIENT6					
SEQUENCEE: PATIENT7					
SEQUENCEE: PATIENT8					
SEQUENCEE: PATIENT9					
SEQUENCEE: PATIENT10					
SEQUENCEE: PATIENT11					
SEQUENCEE: PATIENT12	12.000	6.1368	42	1.9554	0.0572081 .
SEQUENCEE: PATIENT13					
SEQUENCEE: PATIENT14					
SEQUENCEE: PATIENT15					
SEQUENCEE: PATIENT16	13.333	6.1368	42	2.1727	0.0354954 *
SEQUENCEE: PATIENT17					
SEQUENCEE: PATIENT18					
SEQUENCEE: PATIENT19	-0.667	6.1368	42	-0.1086	0.9140096
SEQUENCEE: PATIENT20					
SEQUENCEE: PATIENT21					
SEQUENCEE: PATIENT22					
SEQUENCEE: PATIENT23	0.000	0.0000	42		
SEQUENCEE: PATIENT24					
SEQUENCEF: PATIENT1					
SEQUENCEF: PATIENT2	-18.667	6.1368	42	-3.0418	0.0040426 **
SEQUENCEF: PATIENT3					
SEQUENCEF: PATIENT4					
SEQUENCEF: PATIENT5					
SEQUENCEF: PATIENT6					
SEQUENCEF: PATIENT7					
SEQUENCEF: PATIENT8					
SEQUENCEF: PATIENT9					
SEQUENCEF: PATIENT10					
SEQUENCEF: PATIENT11	-8.000	6.1368	42	-1.3036	0.1994653
SEQUENCEF: PATIENT12					
SEQUENCEF: PATIENT13					
SEQUENCEF: PATIENT14	-2.000	6.1368	42	-0.3259	0.7461154
SEQUENCEF: PATIENT15					
SEQUENCEF: PATIENT16					
SEQUENCEF: PATIENT17					
SEQUENCEF: PATIENT18	0.000	0.0000	42		
SEQUENCEF: PATIENT19					
SEQUENCEF: PATIENT20					
SEQUENCEF: PATIENT21					
SEQUENCEF: PATIENT22					
SEQUENCEF: PATIENT23					
SEQUENCEF: PATIENT24					
VISIT2	-2.583	2.1697	42	-1.1907	0.2404762
VISIT3	0.750	2.1697	42	0.3457	0.7313138
VISIT4	0.000	0.0000	42		
DRUGplacebo	-5.938	2.4258	42	-2.4477	0.0186398 *

```

DRUGstandard      -3.625      2.4258 42 -1.4944 0.1425553
DRUGtest          0.000      0.0000 42
RESIDS            -4.396      1.8790 42 -2.3395 0.0241414 *
RESIDT            0.229      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	Std. Error	Df	t value	Pr(> t)
(Intercept)	12.0000	0.78365	13	15.3130	1.070e-09 ***
TRT1	0.0000	1.91954	13	0.0000	1.00000
TRT2	8.2500	1.17547	13	7.0185	9.087e-06 ***
TRT3	0.0000	0.00000	13		
TRT1:POT1	2.6667	2.02337	13	1.3179	0.21028

```

TRT1:POT2      6.0000      2.14611 13  2.7958      0.01515 *
TRT1:POT3      0.0000      0.00000 13
TRT2:POT1      0.2500      1.51753 13  0.1647      0.87168
TRT2:POT2      0.0000      0.00000 13
TRT2:POT3
TRT3:POT1      1.0000      1.27969 13  0.7814      0.44854
TRT3:POT2     -1.0000      1.91954 13 -0.5210      0.61115
TRT3:POT3      0.0000      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	Std. Error	Df	t value	Pr(> t)	
(Intercept)	2.99627	0.51285	48	5.8423	4.361e-07	***
line1	0.07182	0.14551	48	0.4936	0.623826	
line2	0.25247	0.13717	48	1.8406	0.071867	.
line3	0.00000	0.00000	48			
line1:sire1	0.08573	0.13028	48	0.6580	0.513652	
line1:sire2	-0.12171	0.13622	48	-0.8934	0.376079	
line1:sire3	0.00000	0.00000	48			
line1:sire4						
line1:sire5						
line1:sire6						
line1:sire7						
line1:sire8						
line1:sire9						
line2:sire1						
line2:sire2						
line2:sire3						
line2:sire4	-0.24460	0.12669	48	-1.9307	0.059443	.
line2:sire5	0.00000	0.00000	48			
line2:sire6						
line2:sire7						
line2:sire8						
line2:sire9						
line3:sire1						
line3:sire2						
line3:sire3						
line3:sire4						
line3:sire5						
line3:sire6	0.10540	0.12909	48	0.8165	0.418267	
line3:sire7	-0.01952	0.12038	48	-0.1622	0.871856	
line3:sire8	-0.33024	0.12567	48	-2.6278	0.011504	*
line3:sire9	0.00000	0.00000	48			
agedam3	0.37039	0.11456	48	3.2332	0.002216	**
agedam4	0.27546	0.10378	48	2.6544	0.010746	*
agedam5	0.00000	0.00000	48			
line1:agedam3	-0.44894	0.19581	48	-2.2927	0.026291	*
line1:agedam4	-0.28283	0.16085	48	-1.7584	0.085062	.
line1:agedam5	0.00000	0.00000	48			
line2:agedam3	-0.26078	0.19529	48	-1.3354	0.188050	
line2:agedam4	-0.35026	0.17439	48	-2.0085	0.050232	.
line2:agedam5	0.00000	0.00000	48			
line3:agedam3	0.00000	0.00000	48			
line3:agedam4	0.00000	0.00000	48			
line3:agedam5	0.00000	0.00000	48			
age	-0.00853	0.00310	48	-2.7546	0.008277	**
intlwt	0.00203	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	Std. Error	Df	t value	Pr(> t)
(Intercept)	7.5020	0.022242	123	337.2849	< 2.2e-16 ***
Dam1	-0.0445	0.033363	123	-1.3338	0.1847360
Dam2	-0.0670	0.033363	123	-2.0082	0.0468144 *
Dam3	-0.0600	0.031455	123	-1.9075	0.0587923 .
Dam4	-0.1170	0.033363	123	-3.5068	0.0006338 ***
Dam5	0.0513	0.036322	123	1.4133	0.1600927
Dam6	-0.0420	0.031455	123	-1.3352	0.1842689
Dam7	-0.0580	0.031455	123	-1.8439	0.0676071 .
Dam8	-0.0440	0.031455	123	-1.3988	0.1643876
Dam9	-0.0895	0.033363	123	-2.6826	0.0083104 **
Dam10	-0.0545	0.033363	123	-1.6335	0.1049163
Dam11	-0.0140	0.031455	123	-0.4451	0.6570480
Dam12	-0.0870	0.033363	123	-2.6076	0.0102452 *
Dam13	-0.0495	0.033363	123	-1.4837	0.1404576
Dam14	-0.0340	0.031455	123	-1.0809	0.2818582
Dam15	0.0000	0.000000	123		
Dam1:Sire1	0.0475	0.035168	123	1.3507	0.1792866
Dam1:Sire2	0.0000	0.000000	123		
Dam1:Sire3					
Dam2:Sire1	-0.0010	0.033363	123	-0.0300	0.9761373
Dam2:Sire2	0.0000	0.000000	123		
Dam2:Sire3					
Dam3:Sire1	-0.0045	0.033363	123	-0.1349	0.8929288
Dam3:Sire2	-0.0320	0.033363	123	-0.9591	0.3393736
Dam3:Sire3	0.0000	0.000000	123		
Dam4:Sire1	0.0550	0.037986	123	1.4479	0.1501886
Dam4:Sire2	0.0000	0.000000	123		
Dam4:Sire3					
Dam5:Sire1	-0.0593	0.036322	123	-1.6336	0.1049091
Dam5:Sire2	-0.0608	0.037986	123	-1.6015	0.1118387


```

Dam5:Sire3      0.0000    0.000000 123
Dam6:Sire1     -0.0450    0.033363 123  -1.3488 0.1798857
Dam6:Sire2      0.0075    0.033363 123   0.2248 0.8225105
Dam6:Sire3      0.0000    0.000000 123
Dam7:Sire1     -0.0290    0.033363 123  -0.8692 0.3864232
Dam7:Sire2     -0.0340    0.031455 123  -1.0809 0.2818582
Dam7:Sire3      0.0000    0.000000 123
Dam8:Sire1      0.0520    0.036322 123   1.4317 0.1547783
Dam8:Sire2      0.0000    0.000000 123
Dam8:Sire3
Dam9:Sire1     -0.0225    0.035168 123  -0.6398 0.5235039
Dam9:Sire2      0.0000    0.000000 123
Dam9:Sire3
Dam10:Sire1    -0.0695    0.033363 123  -2.0831 0.0393121 *
Dam10:Sire2      0.0000    0.000000 123
Dam10:Sire3
Dam11:Sire1     0.0460    0.031455 123   1.4624 0.1461852
Dam11:Sire2      0.0000    0.000000 123
Dam11:Sire3
Dam12:Sire1     0.0470    0.033363 123   1.4087 0.1614391
Dam12:Sire2      0.0000    0.000000 123
Dam12:Sire3
Dam13:Sire1    -0.0645    0.033363 123  -1.9333 0.0555032 .
Dam13:Sire2    -0.0358    0.037986 123  -0.9433 0.3473613
Dam13:Sire3      0.0000    0.000000 123
Dam14:Sire1     0.0245    0.033363 123   0.7343 0.4641417
Dam14:Sire2    -0.0180    0.033363 123  -0.5395 0.5905089
Dam14:Sire3      0.0000    0.000000 123
Dam15:Sire1    -0.0500    0.031455 123  -1.5896 0.1145028
Dam15:Sire2    -0.0580    0.031455 123  -1.8439 0.0676071 .
Dam15:Sire3      0.0000    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	Std. Error	Df	t value	Pr(> t)
(Intercept)	0.390	0.10019	22	3.8925	0.0007836 ***
Plot1	0.130	0.14169	22	0.9175	0.3688465
Plot2	0.690	0.14169	22	4.8696	7.227e-05 ***
Plot3	-0.100	0.14169	22	-0.7057	0.4877535
Plot4	-0.290	0.14169	22	-2.0467	0.0528230 .
Plot5	0.530	0.14169	22	3.7404	0.0011335 **
Plot6	0.020	0.14169	22	0.1411	0.8890368
Plot7	0.050	0.14169	22	0.3529	0.7275426
Plot8	-0.030	0.14169	22	-0.2117	0.8342720
Plot9	0.530	0.14169	22	3.7404	0.0011335 **
Plot10	0.130	0.14169	22	0.9175	0.3688465
Plot11	0.000	0.00000	22		
Plot1:Sample1	-0.060	0.12271	22	-0.4890	0.6297131
Plot1:Sample2	0.020	0.14169	22	0.1411	0.8890368
Plot1:Sample3	0.000	0.00000	22		
Plot2:Sample1	-0.595	0.12271	22	-4.8488	7.603e-05 ***
Plot2:Sample2	-0.650	0.14169	22	-4.5873	0.0001437 ***
Plot2:Sample3	0.000	0.00000	22		
Plot3:Sample1	0.095	0.12271	22	0.7742	0.4470663
Plot3:Sample2	0.090	0.14169	22	0.6352	0.5318688

Plot3:Sample3	0.000	0.00000	22		
Plot4:Sample1	0.200	0.12271	22	1.6298	0.1173694
Plot4:Sample2	0.150	0.14169	22	1.0586	0.3012597
Plot4:Sample3	0.000	0.00000	22		
Plot5:Sample1	-0.365	0.12271	22	-2.9745	0.0069960 **
Plot5:Sample2	-0.080	0.14169	22	-0.5646	0.5780606
Plot5:Sample3	0.000	0.00000	22		
Plot6:Sample1	0.065	0.12271	22	0.5297	0.6016249
Plot6:Sample2	-0.150	0.14169	22	-1.0586	0.3012597
Plot6:Sample3	0.000	0.00000	22		
Plot7:Sample1	0.115	0.12271	22	0.9372	0.3588500
Plot7:Sample2	0.060	0.14169	22	0.4234	0.6760804
Plot7:Sample3	0.000	0.00000	22		
Plot8:Sample1	0.305	0.12271	22	2.4855	0.0210209 *
Plot8:Sample2	0.180	0.14169	22	1.2703	0.2172344
Plot8:Sample3	0.000	0.00000	22		
Plot9:Sample1	-0.355	0.12271	22	-2.8930	0.0084403 **
Plot9:Sample2	-0.210	0.14169	22	-1.4821	0.1525064
Plot9:Sample3	0.000	0.00000	22		
Plot10:Sample1	-0.020	0.12271	22	-0.1630	0.8720183
Plot10:Sample2	0.000	0.14169	22	0.0000	1.0000000
Plot10:Sample3	0.000	0.00000	22		
Plot11:Sample1	0.000	0.12271	22	0.0000	1.0000000
Plot11:Sample2	0.110	0.14169	22	0.7763	0.4458271
Plot11:Sample3	0.000	0.00000	22		
Plot1:Sample1:Subsample1	0.015	0.10019	22	0.1497	0.8823566
Plot1:Sample1:Subsample2	0.000	0.00000	22		
Plot1:Sample2:Subsample1	-0.280	0.14169	22	-1.9761	0.0608176 .
Plot1:Sample2:Subsample2	0.000	0.00000	22		
Plot1:Sample3:Subsample1	0.000	0.00000	22		
Plot1:Sample3:Subsample2					
Plot2:Sample1:Subsample1	0.060	0.10019	22	0.5988	0.5553935
Plot2:Sample1:Subsample2	0.000	0.00000	22		
Plot2:Sample2:Subsample1	-0.390	0.14169	22	-2.7524	0.0116232 *
Plot2:Sample2:Subsample2	0.000	0.00000	22		
Plot2:Sample3:Subsample1	0.000	0.00000	22		
Plot2:Sample3:Subsample2					
Plot3:Sample1:Subsample1	-0.085	0.10019	22	-0.8484	0.4053723
Plot3:Sample1:Subsample2	0.000	0.00000	22		
Plot3:Sample2:Subsample1	-0.130	0.14169	22	-0.9175	0.3688465
Plot3:Sample2:Subsample2	0.000	0.00000	22		
Plot3:Sample3:Subsample1	0.000	0.00000	22		
Plot3:Sample3:Subsample2					
Plot4:Sample1:Subsample1	-0.090	0.10019	22	-0.8983	0.3787697
Plot4:Sample1:Subsample2	0.000	0.00000	22		
Plot4:Sample2:Subsample1	-0.120	0.14169	22	-0.8469	0.4061732
Plot4:Sample2:Subsample2	0.000	0.00000	22		
Plot4:Sample3:Subsample1	0.000	0.00000	22		

```

Plot4:Sample3:Subsample2
Plot5:Sample1:Subsample1      0.300      0.10019 22  2.9942 0.0066835 **
Plot5:Sample1:Subsample2      0.000      0.00000 22
Plot5:Sample2:Subsample1      0.110      0.14169 22  0.7763 0.4458271
Plot5:Sample2:Subsample2      0.000      0.00000 22
Plot5:Sample3:Subsample1      0.000      0.00000 22
Plot5:Sample3:Subsample2
Plot6:Sample1:Subsample1      0.115      0.10019 22  1.1478 0.2633860
Plot6:Sample1:Subsample2      0.000      0.00000 22
Plot6:Sample2:Subsample1      0.070      0.14169 22  0.4940 0.6261876
Plot6:Sample2:Subsample2      0.000      0.00000 22
Plot6:Sample3:Subsample1      0.000      0.00000 22
Plot6:Sample3:Subsample2
Plot7:Sample1:Subsample1      0.110      0.10019 22  1.0979 0.2841276
Plot7:Sample1:Subsample2      0.000      0.00000 22
Plot7:Sample2:Subsample1     -0.060      0.14169 22 -0.4234 0.6760804
Plot7:Sample2:Subsample2      0.000      0.00000 22
Plot7:Sample3:Subsample1      0.000      0.00000 22
Plot7:Sample3:Subsample2
Plot8:Sample1:Subsample1      0.240      0.10019 22  2.3954 0.0255487 *
Plot8:Sample1:Subsample2      0.000      0.00000 22
Plot8:Sample2:Subsample1      0.100      0.14169 22  0.7057 0.4877535
Plot8:Sample2:Subsample2      0.000      0.00000 22
Plot8:Sample3:Subsample1      0.000      0.00000 22
Plot8:Sample3:Subsample2
Plot9:Sample1:Subsample1      0.020      0.10019 22  0.1996 0.8436154
Plot9:Sample1:Subsample2      0.000      0.00000 22
Plot9:Sample2:Subsample1     -0.110      0.14169 22 -0.7763 0.4458271
Plot9:Sample2:Subsample2      0.000      0.00000 22
Plot9:Sample3:Subsample1      0.000      0.00000 22
Plot9:Sample3:Subsample2
Plot10:Sample1:Subsample1     0.050      0.10019 22  0.4990 0.6227069
Plot10:Sample1:Subsample2     0.000      0.00000 22
Plot10:Sample2:Subsample1    -0.060      0.14169 22 -0.4234 0.6760804
Plot10:Sample2:Subsample2     0.000      0.00000 22
Plot10:Sample3:Subsample1     0.000      0.00000 22
Plot10:Sample3:Subsample2
Plot11:Sample1:Subsample1    -0.090      0.10019 22 -0.8983 0.3787697
Plot11:Sample1:Subsample2     0.000      0.00000 22
Plot11:Sample2:Subsample1     0.030      0.14169 22  0.2117 0.8342720
Plot11:Sample2:Subsample2     0.000      0.00000 22
Plot11:Sample3:Subsample1     0.000      0.00000 22
Plot11:Sample3:Subsample2

```

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	1	1027.85
2	1	1	1	2	982.74
3	1	1	1	3	1007.24
4	1	1	1	4	1008.47
5	1	2	2	1	1004.33
6	1	2	2	2	977.86
7	1	2	2	3	999.15
8	1	2	2	4	990.86
9	1	3	3	1	992.57
10	1	3	3	2	993.71
11	1	3	3	3	1012.57
12	1	3	3	4	968.25
13	1	4	4	1	994.60
14	1	4	4	2	1021.81
15	1	4	4	3	995.03
16	1	4	4	4	1002.17
17	1	5	5	1	1019.89
18	1	5	5	2	1017.48
19	1	5	5	3	987.82
20	1	5	5	4	995.63
21	2	4	1	1	996.18
22	2	4	1	2	981.96
23	2	4	1	3	985.63
24	2	4	1	4	965.80
25	2	5	2	1	996.61
26	2	5	2	2	1011.94
27	2	5	2	3	972.76
28	2	5	2	4	1011.99
29	2	2	3	1	1021.61
30	2	2	3	2	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	Std. Error	Df	t value	Pr(> t)
(Intercept)	1001.61		0		
Row1	-5.98		0		
Row2	16.88		0		
Row3	19.34		0		
Row4	-24.93		0		
Row5	0.00		0		
R1	9.12		0		
R2	-18.93		0		
R3	-2.75		0		
R4	3.02		0		
R5	0.00		0		
S1	24.26		0		
S2	21.85		0		
S3	-7.81		0		
S4	0.00		0		
R1:S1	-12.01		0		
R1:S2	17.28		0		
R1:S3	18.96		0		
R1:S4	0.00		0		
R2:S1	-39.64		0		
R2:S2	-21.90		0		
R2:S3	-31.42		0		
R2:S4	0.00		0		
R3:S1	-10.98		0		
R3:S2	-21.39		0		
R3:S3	14.46		0		
R3:S4	0.00		0		
R4:S1	-10.34		0		
R4:S2	-8.49		0		
R4:S3	18.78		0		
R4:S4	0.00		0		
R5:S1	0.00		0		
R5:S2	0.00		0		
R5:S3	0.00		0		

R5:S4	0.00	0
Row1:R1	3.72	0
Row1:R2	14.16	0
Row1:R3	-24.63	0
Row1:R4	3.52	0
Row1:R5	0.00	0
Row2:R1	-61.81	0
Row2:R2	12.43	0
Row2:R3	-0.94	0
Row2:R4	-20.79	0
Row2:R5	0.00	0
Row3:R1	-56.60	0
Row3:R2	-12.11	0
Row3:R3	-30.06	0
Row3:R4	-4.44	0
Row3:R5	0.00	0
Row4:R1	46.95	0
Row4:R2	26.04	0
Row4:R3	43.63	0
Row4:R4	12.51	0
Row4:R5	0.00	0
Row5:R1	0.00	0
Row5:R2	0.00	0
Row5:R3	0.00	0
Row5:R4	0.00	0
Row5:R5	0.00	0
S1:Column1	-47.84	0
S1:Column2	-58.48	0
S1:Column3	-40.38	0
S1:Column4	10.08	0
S1:Column5	0.00	0
S2:Column1	-40.43	0
S2:Column2	-13.68	0
S2:Column3	-58.94	0
S2:Column4	-15.74	0
S2:Column5	0.00	0
S3:Column1	-0.39	0
S3:Column2	33.69	0
S3:Column3	5.46	0
S3:Column4	49.36	0
S3:Column5	0.00	0
S4:Column1	0.00	0
S4:Column2	0.00	0
S4:Column3	0.00	0
S4:Column4	0.00	0
S4:Column5	0.00	0
R1:S1:Column1	54.97	0
R1:S1:Column2	5.27	0

R1:S1:Column3	10.94	0
R1:S1:Column4	8.05	0
R1:S1:Column5	0.00	0
R1:S2:Column1	-24.43	0
R1:S2:Column2	-78.73	0
R1:S2:Column3	15.88	0
R1:S2:Column4	-7.23	0
R1:S2:Column5	0.00	0
R1:S3:Column1	-11.99	0
R1:S3:Column2	-72.89	0
R1:S3:Column3	-26.10	0
R1:S3:Column4	-40.68	0
R1:S3:Column5	0.00	0
R1:S4:Column1	0.00	0
R1:S4:Column2	0.00	0
R1:S4:Column3	0.00	0
R1:S4:Column4	0.00	0
R1:S4:Column5	0.00	0
R2:S1:Column1	86.83	0
R2:S1:Column2	87.33	0
R2:S1:Column3	76.49	0
R2:S1:Column4	7.66	0
R2:S1:Column5	0.00	0
R2:S2:Column1	67.97	0
R2:S2:Column2	0.73	0
R2:S2:Column3	71.73	0
R2:S2:Column4	20.65	0
R2:S2:Column5	0.00	0
R2:S3:Column1	46.34	0
R2:S3:Column2	13.83	0
R2:S3:Column3	66.93	0
R2:S3:Column4	-2.28	0
R2:S3:Column5	0.00	0
R2:S4:Column1	0.00	0
R2:S4:Column2	0.00	0
R2:S4:Column3	0.00	0
R2:S4:Column4	0.00	0
R2:S4:Column5	0.00	0
R3:S1:Column1	7.17	0
R3:S1:Column2	52.01	0
R3:S1:Column3	51.42	0
R3:S1:Column4	-7.58	0
R3:S1:Column5	0.00	0
R3:S2:Column1	-5.38	0
R3:S2:Column2	12.88	0
R3:S2:Column3	83.94	0
R3:S2:Column4	26.47	0
R3:S2:Column5	0.00	0

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

```
R5:S4:Column4      0.00      0
R5:S4:Column5      0.00      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	Std. Error	Df	t value	Pr(> t)
(Intercept)	88		0		
row1	10		0		
row2	10		0		
row3	-10		0		
row4	-3		0		
row5	0		0		
R1	2		0		
R2	11		0		
R3	-5		0		
R4	4		0		
R5	0		0		
P1	10		0		
P2	0		0		
S1	10		0		
S2	-1		0		

S3	11	0
S4	0	0
R1:S1	-1	0
R1:S2	10	0
R1:S3	-6	0
R1:S4	0	0
R2:S1	-10	0
R2:S2	-2	0
R2:S3	-12	0
R2:S4	0	0
R3:S1	-7	0
R3:S2	6	0
R3:S3	-7	0
R3:S4	0	0
R4:S1	-3	0
R4:S2	8	0
R4:S3	-5	0
R4:S4	0	0
R5:S1	0	0
R5:S2	0	0
R5:S3	0	0
R5:S4	0	0
row1:P1	-11	0
row1:P2	0	0
row2:P1	-12	0
row2:P2	0	0
row3:P1	0	0
row3:P2	0	0
row4:P1	1	0
row4:P2	0	0
row5:P1	0	0
row5:P2	0	0
R1:P1	-11	0
R1:P2	0	0
R2:P1	-10	0
R2:P2	0	0
R3:P1	6	0
R3:P2	0	0
R4:P1	-14	0
R4:P2	0	0
R5:P1	0	0
R5:P2	0	0
row1:R1:P1	11	0
row1:R1:P2	-11	0
row1:R2:P1	2	0
row1:R2:P2	-22	0
row1:R3:P1	5	0
row1:R3:P2	8	0

row1:R4:P1	12	0
row1:R4:P2	-5	0
row1:R5:P1	0	0
row1:R5:P2	0	0
row2:R1:P1	11	0
row2:R1:P2	-4	0
row2:R2:P1	2	0
row2:R2:P2	-10	0
row2:R3:P1	-4	0
row2:R3:P2	3	0
row2:R4:P1	8	0
row2:R4:P2	-4	0
row2:R5:P1	0	0
row2:R5:P2	0	0
row3:R1:P1	9	0
row3:R1:P2	19	0
row3:R2:P1	6	0
row3:R2:P2	4	0
row3:R3:P1	-11	0
row3:R3:P2	10	0
row3:R4:P1	21	0
row3:R4:P2	6	0
row3:R5:P1	0	0
row3:R5:P2	0	0
row4:R1:P1	-7	0
row4:R1:P2	11	0
row4:R2:P1	-7	0
row4:R2:P2	-10	0
row4:R3:P1	2	0
row4:R3:P2	15	0
row4:R4:P1	12	0
row4:R4:P2	8	0
row4:R5:P1	0	0
row4:R5:P2	0	0
row5:R1:P1	0	0
row5:R1:P2	0	0
row5:R2:P1	0	0
row5:R2:P2	0	0
row5:R3:P1	0	0
row5:R3:P2	0	0
row5:R4:P1	0	0
row5:R4:P2	0	0
row5:R5:P1	0	0
row5:R5:P2	0	0
P1:S1	-11	0
P1:S2	1	0
P1:S3	-10	0
P1:S4	0	0

P2:S1	0	0
P2:S2	0	0
P2:S3	0	0
P2:S4	0	0
row1:P1:S1	3	0
row1:P1:S2	3	0
row1:P1:S3	1	0
row1:P1:S4	0	0
row1:P2:S1	-12	0
row1:P2:S2	-9	0
row1:P2:S3	-11	0
row1:P2:S4	0	0
row2:P1:S1	3	0
row2:P1:S2	-3	0
row2:P1:S3	1	0
row2:P1:S4	0	0
row2:P2:S1	-9	0
row2:P2:S2	-1	0
row2:P2:S3	-16	0
row2:P2:S4	0	0
row3:P1:S1	5	0
row3:P1:S2	10	0
row3:P1:S3	10	0
row3:P1:S4	0	0
row3:P2:S1	-11	0
row3:P2:S2	3	0
row3:P2:S3	-10	0
row3:P2:S4	0	0
row4:P1:S1	0	0
row4:P1:S2	-1	0
row4:P1:S3	-2	0
row4:P1:S4	0	0
row4:P2:S1	-7	0
row4:P2:S2	5	0
row4:P2:S3	-9	0
row4:P2:S4	0	0
row5:P1:S1	0	0
row5:P1:S2	0	0
row5:P1:S3	0	0
row5:P1:S4	0	0
row5:P2:S1	0	0
row5:P2:S2	0	0
row5:P2:S3	0	0
row5:P2:S4	0	0
R1:P1:S1	11	0
R1:P1:S2	-1	0
R1:P1:S3	13	0
R1:P1:S4	0	0

R1:P2:S1	0	0
R1:P2:S2	0	0
R1:P2:S3	0	0
R1:P2:S4	0	0
R2:P1:S1	10	0
R2:P1:S2	1	0
R2:P1:S3	7	0
R2:P1:S4	0	0
R2:P2:S1	0	0
R2:P2:S2	0	0
R2:P2:S3	0	0
R2:P2:S4	0	0
R3:P1:S1	4	0
R3:P1:S2	-7	0
R3:P1:S3	4	0
R3:P1:S4	0	0
R3:P2:S1	0	0
R3:P2:S2	0	0
R3:P2:S3	0	0
R3:P2:S4	0	0
R4:P1:S1	3	0
R4:P1:S2	-8	0
R4:P1:S3	4	0
R4:P1:S4	0	0
R4:P2:S1	0	0
R4:P2:S2	0	0
R4:P2:S3	0	0
R4:P2:S4	0	0
R5:P1:S1	0	0
R5:P1:S2	0	0
R5:P1:S3	0	0
R5:P1:S4	0	0
R5:P2:S1	0	0
R5:P2:S2	0	0
R5:P2:S3	0	0
R5:P2:S4	0	0
row1:R1:P1:S1	-9	0
row1:R1:P1:S2	-4	0
row1:R1:P1:S3	-10	0
row1:R1:P1:S4	0	0
row1:R1:P2:S1	12	0
row1:R1:P2:S2	9	0
row1:R1:P2:S3	16	0
row1:R1:P2:S4	0	0
row1:R2:P1:S1	0	0
row1:R2:P1:S2	-3	0
row1:R2:P1:S3	2	0
row1:R2:P1:S4	0	0

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

row2:R3:P2:S1	7	0
row2:R3:P2:S2	-2	0
row2:R3:P2:S3	7	0
row2:R3:P2:S4	0	0
row2:R4:P1:S1	-1	0
row2:R4:P1:S2	6	0
row2:R4:P1:S3	4	0
row2:R4:P1:S4	0	0
row2:R4:P2:S1	-7	0
row2:R4:P2:S2	-5	0
row2:R4:P2:S3	9	0
row2:R4:P2:S4	0	0
row2:R5:P1:S1	0	0
row2:R5:P1:S2	0	0
row2:R5:P1:S3	0	0
row2:R5:P1:S4	0	0
row2:R5:P2:S1	0	0
row2:R5:P2:S2	0	0
row2:R5:P2:S3	0	0
row2:R5:P2:S4	0	0
row3:R1:P1:S1	-15	0
row3:R1:P1:S2	-10	0
row3:R1:P1:S3	-10	0
row3:R1:P1:S4	0	0
row3:R1:P2:S1	0	0
row3:R1:P2:S2	-12	0
row3:R1:P2:S3	4	0
row3:R1:P2:S4	0	0
row3:R2:P1:S1	-14	0
row3:R2:P1:S2	-16	0
row3:R2:P1:S3	-3	0
row3:R2:P1:S4	0	0
row3:R2:P2:S1	9	0
row3:R2:P2:S2	-1	0
row3:R2:P2:S3	8	0
row3:R2:P2:S4	0	0
row3:R3:P1:S1	9	0
row3:R3:P1:S2	-2	0
row3:R3:P1:S3	-8	0
row3:R3:P1:S4	0	0
row3:R3:P2:S1	5	0
row3:R3:P2:S2	-10	0
row3:R3:P2:S3	5	0
row3:R3:P2:S4	0	0
row3:R4:P1:S1	-7	0
row3:R4:P1:S2	-21	0
row3:R4:P1:S3	-11	0
row3:R4:P1:S4	0	0

row3:R4:P2:S1	-4	0
row3:R4:P2:S2	-13	0
row3:R4:P2:S3	-6	0
row3:R4:P2:S4	0	0
row3:R5:P1:S1	0	0
row3:R5:P1:S2	0	0
row3:R5:P1:S3	0	0
row3:R5:P1:S4	0	0
row3:R5:P2:S1	0	0
row3:R5:P2:S2	0	0
row3:R5:P2:S3	0	0
row3:R5:P2:S4	0	0
row4:R1:P1:S1	-9	0
row4:R1:P1:S2	-7	0
row4:R1:P1:S3	-2	0
row4:R1:P1:S4	0	0
row4:R1:P2:S1	-1	0
row4:R1:P2:S2	-13	0
row4:R1:P2:S3	3	0
row4:R1:P2:S4	0	0
row4:R2:P1:S1	1	0
row4:R2:P1:S2	2	0
row4:R2:P1:S3	6	0
row4:R2:P1:S4	0	0
row4:R2:P2:S1	9	0
row4:R2:P2:S2	0	0
row4:R2:P2:S3	11	0
row4:R2:P2:S4	0	0
row4:R3:P1:S1	3	0
row4:R3:P1:S2	0	0
row4:R3:P1:S3	4	0
row4:R3:P1:S4	0	0
row4:R3:P2:S1	6	0
row4:R3:P2:S2	-9	0
row4:R3:P2:S3	9	0
row4:R3:P2:S4	0	0
row4:R4:P1:S1	2	0
row4:R4:P1:S2	-2	0
row4:R4:P1:S3	2	0
row4:R4:P1:S4	0	0
row4:R4:P2:S1	-7	0
row4:R4:P2:S2	-19	0
row4:R4:P2:S3	-4	0
row4:R4:P2:S4	0	0
row4:R5:P1:S1	0	0
row4:R5:P1:S2	0	0
row4:R5:P1:S3	0	0
row4:R5:P1:S4	0	0

row4:R5:P2:S1	0	0
row4:R5:P2:S2	0	0
row4:R5:P2:S3	0	0
row4:R5:P2:S4	0	0
row5:R1:P1:S1	0	0
row5:R1:P1:S2	0	0
row5:R1:P1:S3	0	0
row5:R1:P1:S4	0	0
row5:R1:P2:S1	0	0
row5:R1:P2:S2	0	0
row5:R1:P2:S3	0	0
row5:R1:P2:S4	0	0
row5:R2:P1:S1	0	0
row5:R2:P1:S2	0	0
row5:R2:P1:S3	0	0
row5:R2:P1:S4	0	0
row5:R2:P2:S1	0	0
row5:R2:P2:S2	0	0
row5:R2:P2:S3	0	0
row5:R2:P2:S4	0	0
row5:R3:P1:S1	0	0
row5:R3:P1:S2	0	0
row5:R3:P1:S3	0	0
row5:R3:P1:S4	0	0
row5:R3:P2:S1	0	0
row5:R3:P2:S2	0	0
row5:R3:P2:S3	0	0
row5:R3:P2:S4	0	0
row5:R4:P1:S1	0	0
row5:R4:P1:S2	0	0
row5:R4:P1:S3	0	0
row5:R4:P1:S4	0	0
row5:R4:P2:S1	0	0
row5:R4:P2:S2	0	0
row5:R4:P2:S3	0	0
row5:R4:P2:S4	0	0
row5:R5:P1:S1	0	0
row5:R5:P1:S2	0	0
row5:R5:P1:S3	0	0
row5:R5:P1:S4	0	0
row5:R5:P2:S1	0	0
row5:R5:P2:S2	0	0
row5:R5:P2:S3	0	0
row5:R5:P2:S4	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	Std. Error	Df	t value	Pr(> t)
(Intercept)	78.195	9.4953	34	8.2351	1.311e-09 ***
rep1	22.320	11.2116	34	1.9908	0.0545890 .
rep2	-9.827	9.9492	34	-0.9877	0.3302882
rep3	16.942	10.2780	34	1.6484	0.1084805
rep4	-24.656	10.6082	34	-2.3242	0.0262249 *

rep5	16.807	10.1264	34	1.6597	0.1061670	
rep6	0.000	0.0000	34			
var1	-23.629	12.0789	34	-1.9562	0.0586954	.
var2	-16.007	11.9933	34	-1.3346	0.1908629	
var3	0.000	0.0000	34			
rep1:var1	39.666	14.2816	34	2.7775	0.0088510	**
rep1:var2	24.703	14.1608	34	1.7445	0.0901108	.
rep1:var3	0.000	0.0000	34			
rep2:var1	8.452	13.6932	34	0.6172	0.5411868	
rep2:var2	35.142	13.4753	34	2.6079	0.0134358	*
rep2:var3	0.000	0.0000	34			
rep3:var1	-15.615	15.0163	34	-1.0399	0.3057408	
rep3:var2	5.214	14.8157	34	0.3519	0.7270537	
rep3:var3	0.000	0.0000	34			
rep4:var1	32.022	14.0835	34	2.2737	0.0294152	*
rep4:var2	32.597	14.2110	34	2.2938	0.0281056	*
rep4:var3	0.000	0.0000	34			
rep5:var1	-29.657	14.2036	34	-2.0880	0.0443605	*
rep5:var2	-20.826	14.0023	34	-1.4873	0.1461435	
rep5:var3	0.000	0.0000	34			
rep6:var1	0.000	0.0000	34			
rep6:var2	0.000	0.0000	34			
rep6:var3	0.000	0.0000	34			
nit1	20.904	6.8122	34	3.0686	0.0042045	**
nit2	25.790	7.9006	34	3.2643	0.0025052	**
nit3	43.888	8.4402	34	5.1999	9.452e-06	***
nit4	0.000	0.0000	34			
var1:nit1	1.136	9.7632	34	0.1164	0.9080219	
var1:nit2	14.232	10.2550	34	1.3878	0.1742328	
var1:nit3	-3.260	11.0914	34	-0.2939	0.7705879	
var1:nit4	0.000	0.0000	34			
var2:nit1	-1.428	9.1191	34	-0.1566	0.8764628	
var2:nit2	5.784	11.0936	34	0.5214	0.6054692	
var2:nit3	-6.461	11.3313	34	-0.5702	0.5722670	
var2:nit4	0.000	0.0000	34			
var3:nit1	0.000	0.0000	34			
var3:nit2	0.000	0.0000	34			
var3:nit3	0.000	0.0000	34			
var3:nit4	0.000	0.0000	34			
row1	1.613	9.9332	34	0.1624	0.8719639	
row2	0.000	0.0000	34			
row3	-10.016	8.3602	34	-1.1980	0.2391928	
row4	0.000	0.0000	34			
row5	-7.727	8.5301	34	-0.9059	0.3713775	
row6	0.000	0.0000	34			
row7	-3.594	8.6347	34	-0.4162	0.6798797	
row8	0.000	0.0000	34			
row9	13.706	8.4538	34	1.6213	0.1141882	


```

row10      0.000      0.0000 34
row11     -14.812      8.7800 34 -1.6870 0.1007506
row12      0.000      0.0000 34
row13      2.006      8.3976 34  0.2389 0.8126419
row14      0.000      0.0000 34
row15     -4.632      8.4677 34 -0.5470 0.5879538
row16      0.000      0.0000 34
row17     -0.198      8.7515 34 -0.0226 0.9820790
row18      0.000      0.0000 34
col1       11.566      3.9157 34  2.9538 0.0056610 **
col2        0.000      0.0000 34
col3       16.517      4.1675 34  3.9633 0.0003597 ***
col4        0.000      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	Std. Error	Df	t value	Pr(> t)
(Intercept)	7.9545	0.98427	11	8.0817	5.93e-06 ***
R1	-0.6318	0.73222	11	-0.8629	0.4066247
R2	-0.1636	0.66557	11	-0.2459	0.8103184
R3	0.0000	0.00000	11		
A1	0.2273	1.10928	11	0.2049	0.8414057
A2	0.0000	0.00000	11		

R1:A1	0.4636	1.09010	11	0.4253	0.6788082	
R1:A2	0.0000	0.00000	11			
R2:A1	-3.7682	0.98951	11	-3.8081	0.0029022	**
R2:A2	0.0000	0.00000	11			
R3:A1	0.0000	0.00000	11			
R3:A2	0.0000	0.00000	11			
C1	0.2682	0.73222	11	0.3663	0.7211200	
C2	0.4364	0.66557	11	0.6556	0.5255407	
C3	0.0000	0.00000	11			
B1	-0.2409	1.17470	11	-0.2051	0.8412545	
B2	0.0000	0.00000	11			
C1:B1	-0.2318	0.98951	11	-0.2343	0.8190745	
C1:B2	0.0000	0.00000	11			
C2:B1	0.0318	0.98951	11	0.0322	0.9749241	
C2:B2	0.0000	0.00000	11			
C3:B1	0.0000	0.00000	11			
C3:B2	0.0000	0.00000	11			
Tx1	-5.3485	1.04397	11	-5.1232	0.0003318	***
Tx2	-2.5152	1.00973	11	-2.4909	0.0299872	*
Tx3	-1.1667	1.04397	11	-1.1175	0.2875828	
Tx4	0.2424	1.22954	11	0.1972	0.8472929	
Tx5	-2.6167	1.17171	11	-2.2332	0.0472599	*
Tx6	0.0000	0.00000	11			
A1:Tx1	-0.4182	1.59983	11	-0.2614	0.7986202	
A1:Tx2	-0.6182	1.42305	11	-0.4344	0.6723913	
A1:Tx3	-0.2000	1.59983	11	-0.1250	0.9027684	
A1:Tx4	-2.0091	1.51170	11	-1.3290	0.2107461	
A1:Tx5	-0.1000	1.98612	11	-0.0503	0.9607465	
A1:Tx6	0.0000	0.00000	11			
A2:Tx1	0.0000	0.00000	11			
A2:Tx2	0.0000	0.00000	11			
A2:Tx3	0.0000	0.00000	11			
A2:Tx4	0.0000	0.00000	11			
A2:Tx5	0.0000	0.00000	11			
A2:Tx6	0.0000	0.00000	11			
B1:Tx1	1.7818	1.59983	11	1.1138	0.2891291	
B1:Tx2	-0.0182	1.42305	11	-0.0128	0.9900347	
B1:Tx3	1.2000	1.59983	11	0.7501	0.4689466	
B1:Tx4	1.1909	1.51170	11	0.7878	0.4474596	
B1:Tx5	0.0000	0.00000	11			
B1:Tx6	0.0000	0.00000	11			
B2:Tx1	0.0000	0.00000	11			
B2:Tx2	0.0000	0.00000	11			
B2:Tx3	0.0000	0.00000	11			
B2:Tx4	0.0000	0.00000	11			
B2:Tx5	0.0000	0.00000	11			
B2:Tx6	0.0000	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	Std. Error	Df	t value	Pr(> t)	
(Intercept)	8.5833	0.86189	7	9.9587	2.199e-05	***
R1	-1.2833	0.79282	7	-1.6187	0.1495477	
R2	-0.0500	0.55549	7	-0.0900	0.9308004	
R3	0.0000	0.00000	7			
A1	-0.5833	0.98561	7	-0.5918	0.5725621	
A2	0.0000	0.00000	7			
R1:A1	1.7250	1.00570	7	1.7152	0.1300172	
R1:A2	0.0000	0.00000	7			
R2:A1	-3.4083	1.01136	7	-3.3700	0.0119197	*
R2:A2	0.0000	0.00000	7			
R3:A1	0.0000	0.00000	7			
R3:A2	0.0000	0.00000	7			
C1	-0.3833	0.79282	7	-0.4835	0.6434958	
C2	0.5500	0.55549	7	0.9901	0.3551012	
C3	0.0000	0.00000	7			
B1	-0.4417	0.94112	7	-0.4693	0.6531236	
B2	0.0000	0.00000	7			
C1:B1	0.2833	0.96806	7	0.2927	0.7782513	
C1:B2	0.0000	0.00000	7			
C2:B1	-0.6917	0.82462	7	-0.8388	0.4293080	
C2:B2	0.0000	0.00000	7			
C3:B1	0.0000	0.00000	7			
C3:B2	0.0000	0.00000	7			
Tx1	-5.8333	0.95618	7	-6.1006	0.0004908	***
Tx2	-2.2500	0.92582	7	-2.4303	0.0454020	*
Tx3	-1.8333	0.95618	7	-1.9173	0.0967067	.
Tx4	2.0833	1.37321	7	1.5171	0.1730222	
Tx5	-2.6167	0.90079	7	-2.9048	0.0228276	*
Tx6	0.0000	0.00000	7			
A1:Tx1	-0.2250	1.75173	7	-0.1284	0.9014099	
A1:Tx2	-1.3000	1.69706	7	-0.7660	0.4686960	
A1:Tx3	0.6750	1.75173	7	0.3853	0.7114327	
A1:Tx4	-4.8500	1.70713	7	-2.8410	0.0250077	*
A1:Tx5	-0.1000	1.52690	7	-0.0655	0.9496134	
A1:Tx6	0.0000	0.00000	7			
A2:Tx1	0.0000	0.00000	7			
A2:Tx2	0.0000	0.00000	7			
A2:Tx3	0.0000	0.00000	7			
A2:Tx4	0.0000	0.00000	7			
A2:Tx5	0.0000	0.00000	7			
A2:Tx6	0.0000	0.00000	7			
B1:Tx1	1.9750	1.75173	7	1.1275	0.2967084	
B1:Tx2	-0.7000	1.69706	7	-0.4125	0.6923283	
B1:Tx3	2.0750	1.75173	7	1.1845	0.2748540	
B1:Tx4	-1.6500	1.70713	7	-0.9665	0.3659742	
B1:Tx5	0.0000	0.00000	7			
B1:Tx6	0.0000	0.00000	7			

B2:Tx1	0.0000	0.00000	7		
B2:Tx2	0.0000	0.00000	7		
B2:Tx3	0.0000	0.00000	7		
B2:Tx4	0.0000	0.00000	7		
B2:Tx5	0.0000	0.00000	7		
B2:Tx6	0.0000	0.00000	7		
A1:B1:Tx1	0.8750	2.32379	7	0.3765	0.7176693
A1:B1:Tx2	1.2500	2.37847	7	0.5255	0.6154343
A1:B1:Tx3	-0.6250	2.32379	7	-0.2690	0.7957174
A1:B1:Tx4	6.0000	2.02837	7	2.9580	0.0211639 *
A1:B1:Tx5					
A1:B1:Tx6	0.0000	0.00000	7		
A1:B2:Tx1	0.0000	0.00000	7		
A1:B2:Tx2	0.0000	0.00000	7		
A1:B2:Tx3	0.0000	0.00000	7		
A1:B2:Tx4	0.0000	0.00000	7		
A1:B2:Tx5	0.0000	0.00000	7		
A1:B2:Tx6	0.0000	0.00000	7		
A2:B1:Tx1	0.0000	0.00000	7		
A2:B1:Tx2	0.0000	0.00000	7		
A2:B1:Tx3	0.0000	0.00000	7		
A2:B1:Tx4	0.0000	0.00000	7		
A2:B1:Tx5	0.0000	0.00000	7		
A2:B1:Tx6	0.0000	0.00000	7		
A2:B2:Tx1	0.0000	0.00000	7		
A2:B2:Tx2	0.0000	0.00000	7		
A2:B2:Tx3	0.0000	0.00000	7		
A2:B2:Tx4	0.0000	0.00000	7		
A2:B2:Tx5					
A2:B2:Tx6	0.0000	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 :

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

Complete :

	(Intercept)	R1	R2	A1	C1	C2	B1	Tx1	Tx2	Tx3	Tx4	Tx5
B1:Tx5	0		0	-1/5	0	0	-1/5	0	0	0	0	0
A1:B1:Tx5	-1/6		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
	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
A1:B1:Tx5	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	Std. Error	Df	t value	Pr(> t)	
(Intercept)	8.0000	0.75691	24	10.5693	1.649e-10	***
R1	0.3333	0.87401	24	0.3814	0.7062732	
R2	0.0000	0.87401	24	0.0000	1.0000000	
R3	-0.3333	0.87401	24	-0.3814	0.7062732	
R4	0.0000	0.00000	24			
G1	-1.3333	1.31101	24	-1.0170	0.3192843	
G2	-3.3333	1.31101	24	-2.5426	0.0178716	*
G3	-2.3333	1.31101	24	-1.7798	0.0877763	.
G4	-4.3333	1.31101	24	-3.3053	0.0029729	**
G5	-0.3333	1.31101	24	-0.2543	0.8014631	
G6	-1.3333	1.31101	24	-1.0170	0.3192843	
G7	-5.0000	1.31101	24	-3.8139	0.0008422	***
G8	-3.0000	1.31101	24	-2.2883	0.0312238	*
G9	-4.0000	1.31101	24	-3.0511	0.0054948	**
G10	-3.0000	1.31101	24	-2.2883	0.0312238	*
G11	0.0000	1.31101	24	0.0000	1.0000000	
G12	-1.0000	1.31101	24	-0.7628	0.4530330	
G13	1.3333	1.31101	24	1.0170	0.3192843	
G14	0.3333	1.31101	24	0.2543	0.8014631	
G15	-1.6667	1.31101	24	-1.2713	0.2158111	
G16	1.3333	1.31101	24	1.0170	0.3192843	
G17	0.3333	1.31101	24	0.2543	0.8014631	
G18	0.3333	1.31101	24	0.2543	0.8014631	
G19	1.0000	1.31101	24	0.7628	0.4530330	
G20	0.0000	1.31101	24	0.0000	1.0000000	
G21	0.0000	1.31101	24	0.0000	1.0000000	
G22	1.0000	1.31101	24	0.7628	0.4530330	
G23	1.0000	1.31101	24	0.7628	0.4530330	
G24	1.0000	1.31101	24	0.7628	0.4530330	
G25	-1.0833	1.07044	24	-1.0120	0.3216098	
G26	-2.3333	1.07044	24	-2.1798	0.0393133	*
G27	1.0833	1.07044	24	1.0120	0.3216098	
G28	0.0000	0.00000	24			
R1:G1	0.0000	0.00000	24			
R1:G2	0.0000	0.00000	24			
R1:G3	0.0000	0.00000	24			
R1:G4	0.0000	0.00000	24			
R1:G5	0.0000	0.00000	24			
R1:G6	0.0000	0.00000	24			
R1:G7						

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

R2:G28	0.0000	0.00000	24		
R3:G1					
R3:G2					
R3:G3					
R3:G4					
R3:G5					
R3:G6					
R3:G7					
R3:G8					
R3:G9					
R3:G10					
R3:G11					
R3:G12					
R3:G13	0.0000	0.00000	24		
R3:G14	0.0000	0.00000	24		
R3:G15	0.0000	0.00000	24		
R3:G16	0.0000	0.00000	24		
R3:G17	0.0000	0.00000	24		
R3:G18	0.0000	0.00000	24		
R3:G19					
R3:G20					
R3:G21					
R3:G22					
R3:G23					
R3:G24					
R3:G25	1.3333	1.23603	24	1.0787	0.2914354
R3:G26	1.0000	1.23603	24	0.8090	0.4264404
R3:G27	-0.6667	1.23603	24	-0.5394	0.5946075
R3:G28	0.0000	0.00000	24		
R4:G1					
R4:G2					
R4:G3					
R4:G4					
R4:G5					
R4:G6					
R4:G7					
R4:G8					
R4:G9					
R4:G10					
R4:G11					
R4:G12					
R4:G13					
R4:G14					
R4:G15					
R4:G16					
R4:G17					
R4:G18					
R4:G19	0.0000	0.00000	24		

R4:G20	0.0000	0.00000	24		
R4:G21	0.0000	0.00000	24		
R4:G22	0.0000	0.00000	24		
R4:G23	0.0000	0.00000	24		
R4:G24	0.0000	0.00000	24		
R4:G25	0.0000	0.00000	24		
R4:G26	0.0000	0.00000	24		
R4:G27	0.0000	0.00000	24		
R4:G28	0.0000	0.00000	24		
F1	0.0000	0.75691	24	0.0000	1.0000000
F2	0.0000	0.75691	24	0.0000	1.0000000
F3	0.0000	0.00000	24		
G1:F1	-5.0000	1.69251	24	-2.9542	0.0069174 **
G1:F2	-2.0000	1.69251	24	-1.1817	0.2489103
G1:F3	0.0000	0.00000	24		
G2:F1	-2.0000	1.69251	24	-1.1817	0.2489103
G2:F2	1.0000	1.69251	24	0.5908	0.5601518
G2:F3	0.0000	0.00000	24		
G3:F1	-2.0000	1.69251	24	-1.1817	0.2489103
G3:F2	1.0000	1.69251	24	0.5908	0.5601518
G3:F3	0.0000	0.00000	24		
G4:F1	1.0000	1.69251	24	0.5908	0.5601518
G4:F2	4.0000	1.69251	24	2.3634	0.0265504 *
G4:F3	0.0000	0.00000	24		
G5:F1	-2.0000	1.69251	24	-1.1817	0.2489103
G5:F2	0.0000	1.69251	24	0.0000	1.0000000
G5:F3	0.0000	0.00000	24		
G6:F1	0.0000	1.69251	24	0.0000	1.0000000
G6:F2	1.0000	1.69251	24	0.5908	0.5601518
G6:F3	0.0000	0.00000	24		
G7:F1	-2.0000	1.69251	24	-1.1817	0.2489103
G7:F2	-1.0000	1.69251	24	-0.5908	0.5601518
G7:F3	0.0000	0.00000	24		
G8:F1	-3.0000	1.69251	24	-1.7725	0.0890040 .
G8:F2	-2.0000	1.69251	24	-1.1817	0.2489103
G8:F3	0.0000	0.00000	24		
G9:F1	-1.0000	1.69251	24	-0.5908	0.5601518
G9:F2	0.0000	1.69251	24	0.0000	1.0000000
G9:F3	0.0000	0.00000	24		
G10:F1	-1.0000	1.69251	24	-0.5908	0.5601518
G10:F2	-1.0000	1.69251	24	-0.5908	0.5601518
G10:F3	0.0000	0.00000	24		
G11:F1	0.0000	1.69251	24	0.0000	1.0000000
G11:F2	0.0000	1.69251	24	0.0000	1.0000000
G11:F3	0.0000	0.00000	24		
G12:F1	-4.0000	1.69251	24	-2.3634	0.0265504 *
G12:F2	-2.0000	1.69251	24	-1.1817	0.2489103
G12:F3	0.0000	0.00000	24		

G13:F1	-2.0000	1.69251	24	-1.1817	0.2489103	
G13:F2	-2.0000	1.69251	24	-1.1817	0.2489103	
G13:F3	0.0000	0.00000	24			
G14:F1	-3.0000	1.69251	24	-1.7725	0.0890040	.
G14:F2	-2.0000	1.69251	24	-1.1817	0.2489103	
G14:F3	0.0000	0.00000	24			
G15:F1	-3.0000	1.69251	24	-1.7725	0.0890040	.
G15:F2	-1.0000	1.69251	24	-0.5908	0.5601518	
G15:F3	0.0000	0.00000	24			
G16:F1	-2.0000	1.69251	24	-1.1817	0.2489103	
G16:F2	-2.0000	1.69251	24	-1.1817	0.2489103	
G16:F3	0.0000	0.00000	24			
G17:F1	-2.0000	1.69251	24	-1.1817	0.2489103	
G17:F2	0.0000	1.69251	24	0.0000	1.0000000	
G17:F3	0.0000	0.00000	24			
G18:F1	-3.0000	1.69251	24	-1.7725	0.0890040	.
G18:F2	-1.0000	1.69251	24	-0.5908	0.5601518	
G18:F3	0.0000	0.00000	24			
G19:F1	-4.0000	1.69251	24	-2.3634	0.0265504	*
G19:F2	-1.0000	1.69251	24	-0.5908	0.5601518	
G19:F3	0.0000	0.00000	24			
G20:F1	-2.0000	1.69251	24	-1.1817	0.2489103	
G20:F2	-2.0000	1.69251	24	-1.1817	0.2489103	
G20:F3	0.0000	0.00000	24			
G21:F1	-1.0000	1.69251	24	-0.5908	0.5601518	
G21:F2	-4.0000	1.69251	24	-2.3634	0.0265504	*
G21:F3	0.0000	0.00000	24			
G22:F1	-1.0000	1.69251	24	-0.5908	0.5601518	
G22:F2	-2.0000	1.69251	24	-1.1817	0.2489103	
G22:F3	0.0000	0.00000	24			
G23:F1	0.0000	1.69251	24	0.0000	1.0000000	
G23:F2	-1.0000	1.69251	24	-0.5908	0.5601518	
G23:F3	0.0000	0.00000	24			
G24:F1	0.0000	1.69251	24	0.0000	1.0000000	
G24:F2	-1.0000	1.69251	24	-0.5908	0.5601518	
G24:F3	0.0000	0.00000	24			
G25:F1	-3.5000	1.07044	24	-3.2697	0.0032428	**
G25:F2	-2.2500	1.07044	24	-2.1019	0.0462352	*
G25:F3	0.0000	0.00000	24			
G26:F1	-2.7500	1.07044	24	-2.5690	0.0168399	*
G26:F2	-2.2500	1.07044	24	-2.1019	0.0462352	*
G26:F3	0.0000	0.00000	24			
G27:F1	0.0000	1.07044	24	0.0000	1.0000000	
G27:F2	-0.2500	1.07044	24	-0.2335	0.8173152	
G27:F3	0.0000	0.00000	24			
G28:F1	0.0000	0.00000	24			
G28:F2	0.0000	0.00000	24			
G28:F3	0.0000	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 Std. Error Df t value  Pr(>|t|)
(Intercept)  9.0000     0.39675 36 22.6845 < 2.2e-16 ***
R1           -1.0000     0.45812 36 -2.1828 0.0356525 *
R2           -1.0000     0.45812 36 -2.1828 0.0356525 *
R3            0.0000     0.45812 36  0.0000 1.0000000
R4            0.0000     0.00000 36
T1           -0.2500     0.56108 36 -0.4456 0.6585786
T2            0.0000     0.00000 36
R1:T1         0.3333     0.64788 36  0.5145 0.6100498

```

R1:T2	0.0000	0.00000	36			
R2:T1	0.6667	0.64788	36	1.0290	0.3103479	
R2:T2	0.0000	0.00000	36			
R3:T1	0.0000	0.64788	36	0.0000	1.0000000	
R3:T2	0.0000	0.00000	36			
R4:T1	0.0000	0.00000	36			
R4:T2	0.0000	0.00000	36			
G1	-3.0000	0.68718	36	-4.3656	0.0001024	***
G2	0.0000	0.68718	36	0.0000	1.0000000	
G3	1.0000	0.68718	36	1.4552	0.1542753	
G4	1.0000	0.68718	36	1.4552	0.1542753	
G5	1.0000	0.68718	36	1.4552	0.1542753	
G6	-1.0000	0.68718	36	-1.4552	0.1542753	
G7	-1.0000	0.68718	36	-1.4552	0.1542753	
G8	0.0000	0.68718	36	0.0000	1.0000000	
G9	1.0000	0.68718	36	1.4552	0.1542753	
G10	-1.0000	0.68718	36	-1.4552	0.1542753	
G11	-3.0000	0.68718	36	-4.3656	0.0001024	***
G12	0.0000	0.68718	36	0.0000	1.0000000	
G13	0.0000	0.68718	36	0.0000	1.0000000	
G14	-1.0000	0.68718	36	-1.4552	0.1542753	
G15	-2.0000	0.68718	36	-2.9104	0.0061560	**
G16	-5.0000	0.68718	36	-7.2761	1.431e-08	***
G17	-3.0000	0.68718	36	-4.3656	0.0001024	***
G18	-2.0000	0.68718	36	-2.9104	0.0061560	**
G19	-2.0000	0.68718	36	-2.9104	0.0061560	**
G20	-1.0000	0.68718	36	-1.4552	0.1542753	
G21	-2.0000	0.56108	36	-3.5645	0.0010508	**
G22	-0.3333	0.56108	36	-0.5941	0.5561681	
G23	0.0000	0.00000	36			
T1:G1	0.9167	0.97183	36	0.9432	0.3518445	
T1:G2	-1.0833	0.97183	36	-1.1147	0.2723483	
T1:G3	-0.0833	0.97183	36	-0.0857	0.9321409	
T1:G4	-0.0833	0.97183	36	-0.0857	0.9321409	
T1:G5	-0.0833	0.97183	36	-0.0857	0.9321409	
T1:G6	-1.4167	0.97183	36	-1.4577	0.1535818	
T1:G7	0.5833	0.97183	36	0.6002	0.5521031	
T1:G8	0.5833	0.97183	36	0.6002	0.5521031	
T1:G9	-0.4167	0.97183	36	-0.4287	0.6706625	
T1:G10	-1.4167	0.97183	36	-1.4577	0.1535818	
T1:G11	0.2500	0.97183	36	0.2572	0.7984521	
T1:G12	-0.7500	0.97183	36	-0.7717	0.4453029	
T1:G13	-1.7500	0.97183	36	-1.8007	0.0801274	.
T1:G14	1.2500	0.97183	36	1.2862	0.2065706	
T1:G15	-2.7500	0.97183	36	-2.8297	0.0075715	**
T1:G16	1.2500	0.97183	36	1.2862	0.2065706	
T1:G17	-0.7500	0.97183	36	-0.7717	0.4453029	
T1:G18	-0.7500	0.97183	36	-0.7717	0.4453029	

T1:G19	0.2500	0.97183	36	0.2572	0.7984521
T1:G20	-0.7500	0.97183	36	-0.7717	0.4453029
T1:G21	1.1667	0.79349	36	1.4703	0.1501689
T1:G22	-1.0000	0.79349	36	-1.2603	0.2156865
T1:G23	0.0000	0.00000	36		
T2:G1	0.0000	0.00000	36		
T2:G2	0.0000	0.00000	36		
T2:G3	0.0000	0.00000	36		
T2:G4	0.0000	0.00000	36		
T2:G5	0.0000	0.00000	36		
T2:G6	0.0000	0.00000	36		
T2:G7	0.0000	0.00000	36		
T2:G8	0.0000	0.00000	36		
T2:G9	0.0000	0.00000	36		
T2:G10	0.0000	0.00000	36		
T2:G11	0.0000	0.00000	36		
T2:G12	0.0000	0.00000	36		
T2:G13	0.0000	0.00000	36		
T2:G14	0.0000	0.00000	36		
T2:G15	0.0000	0.00000	36		
T2:G16	0.0000	0.00000	36		
T2:G17	0.0000	0.00000	36		
T2:G18	0.0000	0.00000	36		
T2:G19	0.0000	0.00000	36		
T2:G20	0.0000	0.00000	36		
T2:G21	0.0000	0.00000	36		
T2:G22	0.0000	0.00000	36		
T2:G23	0.0000	0.00000	36		
R1:T1:G1	0.0000	0.00000	36		
R1:T1:G2	0.0000	0.00000	36		
R1:T1:G3	0.0000	0.00000	36		
R1:T1:G4	0.0000	0.00000	36		
R1:T1:G5	0.0000	0.00000	36		
R1:T1:G6					
R1:T1:G7					
R1:T1:G8					
R1:T1:G9					
R1:T1:G10					
R1:T1:G11					
R1:T1:G12					
R1:T1:G13					
R1:T1:G14					
R1:T1:G15					
R1:T1:G16					
R1:T1:G17					
R1:T1:G18					
R1:T1:G19					
R1:T1:G20					

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

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

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

R4:T2:G4						
R4:T2:G5						
R4:T2:G6						
R4:T2:G7						
R4:T2:G8						
R4:T2:G9						
R4:T2:G10						
R4:T2:G11						
R4:T2:G12						
R4:T2:G13						
R4:T2:G14						
R4:T2:G15						
R4:T2:G16	0.0000	0.00000	36			
R4:T2:G17	0.0000	0.00000	36			
R4:T2:G18	0.0000	0.00000	36			
R4:T2:G19	0.0000	0.00000	36			
R4:T2:G20	0.0000	0.00000	36			
R4:T2:G21	0.0000	0.00000	36			
R4:T2:G22	0.0000	0.00000	36			
R4:T2:G23	0.0000	0.00000	36			
F1	-2.0000	0.39675	36	-5.0410	1.325e-05	***
F2	-1.0000	0.39675	36	-2.5205	0.0162919	*
F3	0.0000	0.00000	36			
T1:F1	-0.2500	0.56108	36	-0.4456	0.6585786	
T1:F2	0.0000	0.56108	36	0.0000	1.0000000	
T1:F3	0.0000	0.00000	36			
T2:F1	0.0000	0.00000	36			
T2:F2	0.0000	0.00000	36			
T2:F3	0.0000	0.00000	36			
G1:F1	0.0000	0.88715	36	0.0000	1.0000000	
G1:F2	0.0000	0.88715	36	0.0000	1.0000000	
G1:F3	0.0000	0.00000	36			
G2:F1	-2.0000	0.88715	36	-2.2544	0.0303508	*
G2:F2	-1.0000	0.88715	36	-1.1272	0.2671137	
G2:F3	0.0000	0.00000	36			
G3:F1	0.0000	0.88715	36	0.0000	1.0000000	
G3:F2	0.0000	0.88715	36	0.0000	1.0000000	
G3:F3	0.0000	0.00000	36			
G4:F1	2.0000	0.88715	36	2.2544	0.0303508	*
G4:F2	0.0000	0.88715	36	0.0000	1.0000000	
G4:F3	0.0000	0.00000	36			
G5:F1	0.0000	0.88715	36	0.0000	1.0000000	
G5:F2	1.0000	0.88715	36	1.1272	0.2671137	
G5:F3	0.0000	0.00000	36			
G6:F1	0.0000	0.88715	36	0.0000	1.0000000	
G6:F2	0.0000	0.88715	36	0.0000	1.0000000	
G6:F3	0.0000	0.00000	36			
G7:F1	1.0000	0.88715	36	1.1272	0.2671137	

G7:F2	1.0000	0.88715	36	1.1272	0.2671137
G7:F3	0.0000	0.00000	36		
G8:F1	1.0000	0.88715	36	1.1272	0.2671137
G8:F2	2.0000	0.88715	36	2.2544	0.0303508 *
G8:F3	0.0000	0.00000	36		
G9:F1	0.0000	0.88715	36	0.0000	1.0000000
G9:F2	-1.0000	0.88715	36	-1.1272	0.2671137
G9:F3	0.0000	0.00000	36		
G10:F1	-1.0000	0.88715	36	-1.1272	0.2671137
G10:F2	-1.0000	0.88715	36	-1.1272	0.2671137
G10:F3	0.0000	0.00000	36		
G11:F1	1.0000	0.88715	36	1.1272	0.2671137
G11:F2	0.0000	0.88715	36	0.0000	1.0000000
G11:F3	0.0000	0.00000	36		
G12:F1	1.0000	0.88715	36	1.1272	0.2671137
G12:F2	0.0000	0.88715	36	0.0000	1.0000000
G12:F3	0.0000	0.00000	36		
G13:F1	0.0000	0.88715	36	0.0000	1.0000000
G13:F2	-1.0000	0.88715	36	-1.1272	0.2671137
G13:F3	0.0000	0.00000	36		
G14:F1	1.0000	0.88715	36	1.1272	0.2671137
G14:F2	1.0000	0.88715	36	1.1272	0.2671137
G14:F3	0.0000	0.00000	36		
G15:F1	-1.0000	0.88715	36	-1.1272	0.2671137
G15:F2	-1.0000	0.88715	36	-1.1272	0.2671137
G15:F3	0.0000	0.00000	36		
G16:F1	0.0000	0.88715	36	0.0000	1.0000000
G16:F2	-1.0000	0.88715	36	-1.1272	0.2671137
G16:F3	0.0000	0.00000	36		
G17:F1	-1.0000	0.88715	36	-1.1272	0.2671137
G17:F2	0.0000	0.88715	36	0.0000	1.0000000
G17:F3	0.0000	0.00000	36		
G18:F1	-1.0000	0.88715	36	-1.1272	0.2671137
G18:F2	0.0000	0.88715	36	0.0000	1.0000000
G18:F3	0.0000	0.00000	36		
G19:F1	0.0000	0.88715	36	0.0000	1.0000000
G19:F2	1.0000	0.88715	36	1.1272	0.2671137
G19:F3	0.0000	0.00000	36		
G20:F1	0.0000	0.88715	36	0.0000	1.0000000
G20:F2	0.0000	0.88715	36	0.0000	1.0000000
G20:F3	0.0000	0.00000	36		
G21:F1	-1.2500	0.56108	36	-2.2278	0.0322306 *
G21:F2	0.2500	0.56108	36	0.4456	0.6585786
G21:F3	0.0000	0.00000	36		
G22:F1	0.0000	0.56108	36	0.0000	1.0000000
G22:F2	0.0000	0.56108	36	0.0000	1.0000000
G22:F3	0.0000	0.00000	36		
G23:F1	0.0000	0.00000	36		

G23:F2	0.0000	0.00000	36		
G23:F3	0.0000	0.00000	36		
T1:G1:F1	-1.7500	1.25462	36	-1.3948	0.1716105
T1:G1:F2	-1.0000	1.25462	36	-0.7971	0.4306457
T1:G1:F3	0.0000	0.00000	36		
T1:G2:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G2:F2	0.0000	1.25462	36	0.0000	1.0000000
T1:G2:F3	0.0000	0.00000	36		
T1:G3:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G3:F2	-1.0000	1.25462	36	-0.7971	0.4306457
T1:G3:F3	0.0000	0.00000	36		
T1:G4:F1	-0.7500	1.25462	36	-0.5978	0.5537222
T1:G4:F2	0.0000	1.25462	36	0.0000	1.0000000
T1:G4:F3	0.0000	0.00000	36		
T1:G5:F1	1.2500	1.25462	36	0.9963	0.3257463
T1:G5:F2	-1.0000	1.25462	36	-0.7971	0.4306457
T1:G5:F3	0.0000	0.00000	36		
T1:G6:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G6:F2	0.0000	1.25462	36	0.0000	1.0000000
T1:G6:F3	0.0000	0.00000	36		
T1:G7:F1	-0.7500	1.25462	36	-0.5978	0.5537222
T1:G7:F2	-1.0000	1.25462	36	-0.7971	0.4306457
T1:G7:F3	0.0000	0.00000	36		
T1:G8:F1	-0.7500	1.25462	36	-0.5978	0.5537222
T1:G8:F2	-2.0000	1.25462	36	-1.5941	0.1196553
T1:G8:F3	0.0000	0.00000	36		
T1:G9:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G9:F2	1.0000	1.25462	36	0.7971	0.4306457
T1:G9:F3	0.0000	0.00000	36		
T1:G10:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G10:F2	1.0000	1.25462	36	0.7971	0.4306457
T1:G10:F3	0.0000	0.00000	36		
T1:G11:F1	-0.7500	1.25462	36	-0.5978	0.5537222
T1:G11:F2	0.0000	1.25462	36	0.0000	1.0000000
T1:G11:F3	0.0000	0.00000	36		
T1:G12:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G12:F2	1.0000	1.25462	36	0.7971	0.4306457
T1:G12:F3	0.0000	0.00000	36		
T1:G13:F1	1.2500	1.25462	36	0.9963	0.3257463
T1:G13:F2	2.0000	1.25462	36	1.5941	0.1196553
T1:G13:F3	0.0000	0.00000	36		
T1:G14:F1	-0.7500	1.25462	36	-0.5978	0.5537222
T1:G14:F2	-2.0000	1.25462	36	-1.5941	0.1196553
T1:G14:F3	0.0000	0.00000	36		
T1:G15:F1	1.2500	1.25462	36	0.9963	0.3257463
T1:G15:F2	1.0000	1.25462	36	0.7971	0.4306457
T1:G15:F3	0.0000	0.00000	36		
T1:G16:F1	-1.7500	1.25462	36	-1.3948	0.1716105

T1:G16:F2	0.0000	1.25462	36	0.0000	1.0000000
T1:G16:F3	0.0000	0.00000	36		
T1:G17:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G17:F2	0.0000	1.25462	36	0.0000	1.0000000
T1:G17:F3	0.0000	0.00000	36		
T1:G18:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G18:F2	-1.0000	1.25462	36	-0.7971	0.4306457
T1:G18:F3	0.0000	0.00000	36		
T1:G19:F1	-0.7500	1.25462	36	-0.5978	0.5537222
T1:G19:F2	-2.0000	1.25462	36	-1.5941	0.1196553
T1:G19:F3	0.0000	0.00000	36		
T1:G20:F1	0.2500	1.25462	36	0.1993	0.8431780
T1:G20:F2	-1.0000	1.25462	36	-0.7971	0.4306457
T1:G20:F3	0.0000	0.00000	36		
T1:G21:F1	0.2500	0.79349	36	0.3151	0.7545328
T1:G21:F2	-0.7500	0.79349	36	-0.9452	0.3508634
T1:G21:F3	0.0000	0.00000	36		
T1:G22:F1	0.0000	0.79349	36	0.0000	1.0000000
T1:G22:F2	0.0000	0.79349	36	0.0000	1.0000000
T1:G22:F3	0.0000	0.00000	36		
T1:G23:F1	0.0000	0.00000	36		
T1:G23:F2	0.0000	0.00000	36		
T1:G23:F3	0.0000	0.00000	36		
T2:G1:F1	0.0000	0.00000	36		
T2:G1:F2	0.0000	0.00000	36		
T2:G1:F3	0.0000	0.00000	36		
T2:G2:F1	0.0000	0.00000	36		
T2:G2:F2	0.0000	0.00000	36		
T2:G2:F3	0.0000	0.00000	36		
T2:G3:F1	0.0000	0.00000	36		
T2:G3:F2	0.0000	0.00000	36		
T2:G3:F3	0.0000	0.00000	36		
T2:G4:F1	0.0000	0.00000	36		
T2:G4:F2	0.0000	0.00000	36		
T2:G4:F3	0.0000	0.00000	36		
T2:G5:F1	0.0000	0.00000	36		
T2:G5:F2	0.0000	0.00000	36		
T2:G5:F3	0.0000	0.00000	36		
T2:G6:F1	0.0000	0.00000	36		
T2:G6:F2	0.0000	0.00000	36		
T2:G6:F3	0.0000	0.00000	36		
T2:G7:F1	0.0000	0.00000	36		
T2:G7:F2	0.0000	0.00000	36		
T2:G7:F3	0.0000	0.00000	36		
T2:G8:F1	0.0000	0.00000	36		
T2:G8:F2	0.0000	0.00000	36		
T2:G8:F3	0.0000	0.00000	36		
T2:G9:F1	0.0000	0.00000	36		

T2:G9:F2	0.0000	0.00000 36
T2:G9:F3	0.0000	0.00000 36
T2:G10:F1	0.0000	0.00000 36
T2:G10:F2	0.0000	0.00000 36
T2:G10:F3	0.0000	0.00000 36
T2:G11:F1	0.0000	0.00000 36
T2:G11:F2	0.0000	0.00000 36
T2:G11:F3	0.0000	0.00000 36
T2:G12:F1	0.0000	0.00000 36
T2:G12:F2	0.0000	0.00000 36
T2:G12:F3	0.0000	0.00000 36
T2:G13:F1	0.0000	0.00000 36
T2:G13:F2	0.0000	0.00000 36
T2:G13:F3	0.0000	0.00000 36
T2:G14:F1	0.0000	0.00000 36
T2:G14:F2	0.0000	0.00000 36
T2:G14:F3	0.0000	0.00000 36
T2:G15:F1	0.0000	0.00000 36
T2:G15:F2	0.0000	0.00000 36
T2:G15:F3	0.0000	0.00000 36
T2:G16:F1	0.0000	0.00000 36
T2:G16:F2	0.0000	0.00000 36
T2:G16:F3	0.0000	0.00000 36
T2:G17:F1	0.0000	0.00000 36
T2:G17:F2	0.0000	0.00000 36
T2:G17:F3	0.0000	0.00000 36
T2:G18:F1	0.0000	0.00000 36
T2:G18:F2	0.0000	0.00000 36
T2:G18:F3	0.0000	0.00000 36
T2:G19:F1	0.0000	0.00000 36
T2:G19:F2	0.0000	0.00000 36
T2:G19:F3	0.0000	0.00000 36
T2:G20:F1	0.0000	0.00000 36
T2:G20:F2	0.0000	0.00000 36
T2:G20:F3	0.0000	0.00000 36
T2:G21:F1	0.0000	0.00000 36
T2:G21:F2	0.0000	0.00000 36
T2:G21:F3	0.0000	0.00000 36
T2:G22:F1	0.0000	0.00000 36
T2:G22:F2	0.0000	0.00000 36
T2:G22:F3	0.0000	0.00000 36
T2:G23:F1	0.0000	0.00000 36
T2:G23:F2	0.0000	0.00000 36
T2:G23:F3	0.0000	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	Std. Error	Df	t value	Pr(> t)
(Intercept)	14		0		
R1	-10		0		
R2	-10		0		
R3	0		0		
A1	1		0		
A2	0		0		
A3	1		0		
A4	4		0		
A5	4		0		
A6	8		0		
A7	0		0		
A8	31		0		

A9	20	0
A10	-4	0
A11	0	0
A12	1	0
A13	0	0
R1:A1	0	0
R1:A2	0	0
R1:A3	0	0
R1:A4		
R1:A5		
R1:A6		
R1:A7		
R1:A8		
R1:A9		
R1:A10	5	0
R1:A11	0	0
R1:A12	0	0
R1:A13	0	0
R2:A1		
R2:A2		
R2:A3		
R2:A4	0	0
R2:A5	0	0
R2:A6	0	0
R2:A7		
R2:A8		
R2:A9		
R2:A10	5	0
R2:A11	0	0
R2:A12	0	0
R2:A13	0	0
R3:A1		
R3:A2		
R3:A3		
R3:A4		
R3:A5		
R3:A6		
R3:A7	0	0
R3:A8	0	0
R3:A9	0	0
R3:A10	0	0
R3:A11	0	0
R3:A12	0	0
R3:A13	0	0
B1	5	0
B2	3	0
B3	5	0
B4	3	0

B5	-5	0
B6	3	0
B7	-1	0
B8	1	0
B9	0	0
R1:B1	0	0
R1:B2	0	0
R1:B3		
R1:B4		
R1:B5		
R1:B6		
R1:B7	0	0
R1:B8	0	0
R1:B9	0	0
R2:B1		
R2:B2		
R2:B3	0	0
R2:B4	0	0
R2:B5		
R2:B6		
R2:B7	10	0
R2:B8	0	0
R2:B9	0	0
R3:B1		
R3:B2		
R3:B3		
R3:B4		
R3:B5	0	0
R3:B6	0	0
R3:B7	0	0
R3:B8	0	0
R3:B9	0	0
A1:B1	-1	0
A1:B2	-6	0
A1:B3		
A1:B4		
A1:B5		
A1:B6		
A1:B7	4	0
A1:B8	1	0
A1:B9	0	0
A2:B1	0	0
A2:B2	0	0
A2:B3		
A2:B4		
A2:B5		
A2:B6		
A2:B7	0	0

A2:B8	0	0
A2:B9	0	0
A3:B1	-1	0
A3:B2	-6	0
A3:B3		
A3:B4		
A3:B5		
A3:B6		
A3:B7	4	0
A3:B8	1	0
A3:B9	0	0
A4:B1		
A4:B2		
A4:B3	-4	0
A4:B4	-4	0
A4:B5		
A4:B6		
A4:B7	-4	0
A4:B8	-1	0
A4:B9	0	0
A5:B1		
A5:B2		
A5:B3	-4	0
A5:B4	1	0
A5:B5		
A5:B6		
A5:B7	-9	0
A5:B8	-2	0
A5:B9	0	0
A6:B1		
A6:B2		
A6:B3	-8	0
A6:B4	-8	0
A6:B5		
A6:B6		
A6:B7	-8	0
A6:B8	-4	0
A6:B9	0	0
A7:B1		
A7:B2		
A7:B3		
A7:B4		
A7:B5	10	0
A7:B6	0	0
A7:B7	0	0
A7:B8	0	0
A7:B9	0	0
A8:B1		

A8:B2		
A8:B3		
A8:B4		
A8:B5	-21	0
A8:B6	-36	0
A8:B7	-26	0
A8:B8	-29	0
A8:B9	0	0
A9:B1		
A9:B2		
A9:B3		
A9:B4		
A9:B5	-10	0
A9:B6	-20	0
A9:B7	-20	0
A9:B8	-10	0
A9:B9	0	0
A10:B1	-1	0
A10:B2	-7	0
A10:B3	-1	0
A10:B4	3	0
A10:B5	10	0
A10:B6	-4	0
A10:B7	2	0
A10:B8	-1	0
A10:B9	0	0
A11:B1	0	0
A11:B2	0	0
A11:B3	0	0
A11:B4	0	0
A11:B5	0	0
A11:B6	0	0
A11:B7	0	0
A11:B8	0	0
A11:B9	0	0
A12:B1	-1	0
A12:B2	-6	0
A12:B3	-1	0
A12:B4	4	0
A12:B5	-1	0
A12:B6	-6	0
A12:B7	-6	0
A12:B8	1	0
A12:B9	0	0
A13:B1	0	0
A13:B2	0	0
A13:B3	0	0
A13:B4	0	0

A13:B5	0	0
A13:B6	0	0
A13:B7	0	0
A13:B8	0	0
A13:B9	0	0
R1:A1:B1	0	0
R1:A1:B2	0	0
R1:A1:B3		
R1:A1:B4		
R1:A1:B5		
R1:A1:B6		
R1:A1:B7	0	0
R1:A1:B8	0	0
R1:A1:B9	0	0
R1:A2:B1	0	0
R1:A2:B2	0	0
R1:A2:B3		
R1:A2:B4		
R1:A2:B5		
R1:A2:B6		
R1:A2:B7	0	0
R1:A2:B8	0	0
R1:A2:B9	0	0
R1:A3:B1	0	0
R1:A3:B2	0	0
R1:A3:B3		
R1:A3:B4		
R1:A3:B5		
R1:A3:B6		
R1:A3:B7	0	0
R1:A3:B8	0	0
R1:A3:B9	0	0
R1:A4:B1		
R1:A4:B2		
R1:A4:B3		
R1:A4:B4		
R1:A4:B5		
R1:A4:B6		
R1:A4:B7		
R1:A4:B8		
R1:A4:B9		
R1:A5:B1		
R1:A5:B2		
R1:A5:B3		
R1:A5:B4		
R1:A5:B5		
R1:A5:B6		
R1:A5:B7		

R1:A5:B8		
R1:A5:B9		
R1:A6:B1		
R1:A6:B2		
R1:A6:B3		
R1:A6:B4		
R1:A6:B5		
R1:A6:B6		
R1:A6:B7		
R1:A6:B8		
R1:A6:B9		
R1:A7:B1		
R1:A7:B2		
R1:A7:B3		
R1:A7:B4		
R1:A7:B5		
R1:A7:B6		
R1:A7:B7		
R1:A7:B8		
R1:A7:B9		
R1:A8:B1		
R1:A8:B2		
R1:A8:B3		
R1:A8:B4		
R1:A8:B5		
R1:A8:B6		
R1:A8:B7		
R1:A8:B8		
R1:A8:B9		
R1:A9:B1		
R1:A9:B2		
R1:A9:B3		
R1:A9:B4		
R1:A9:B5		
R1:A9:B6		
R1:A9:B7		
R1:A9:B8		
R1:A9:B9		
R1:A10:B1	0	0
R1:A10:B2	0	0
R1:A10:B3		
R1:A10:B4		
R1:A10:B5		
R1:A10:B6		
R1:A10:B7	3	0
R1:A10:B8	2	0
R1:A10:B9	0	0
R1:A11:B1	0	0

R1:A11:B2	0	0
R1:A11:B3		
R1:A11:B4		
R1:A11:B5		
R1:A11:B6		
R1:A11:B7	0	0
R1:A11:B8	0	0
R1:A11:B9	0	0
R1:A12:B1	0	0
R1:A12:B2	0	0
R1:A12:B3		
R1:A12:B4		
R1:A12:B5		
R1:A12:B6		
R1:A12:B7	10	0
R1:A12:B8	0	0
R1:A12:B9	0	0
R1:A13:B1	0	0
R1:A13:B2	0	0
R1:A13:B3		
R1:A13:B4		
R1:A13:B5		
R1:A13:B6		
R1:A13:B7	0	0
R1:A13:B8	0	0
R1:A13:B9	0	0
R2:A1:B1		
R2:A1:B2		
R2:A1:B3		
R2:A1:B4		
R2:A1:B5		
R2:A1:B6		
R2:A1:B7		
R2:A1:B8		
R2:A1:B9		
R2:A2:B1		
R2:A2:B2		
R2:A2:B3		
R2:A2:B4		
R2:A2:B5		
R2:A2:B6		
R2:A2:B7		
R2:A2:B8		
R2:A2:B9		
R2:A3:B1		
R2:A3:B2		
R2:A3:B3		
R2:A3:B4		

R2:A3:B5		
R2:A3:B6		
R2:A3:B7		
R2:A3:B8		
R2:A3:B9		
R2:A4:B1		
R2:A4:B2		
R2:A4:B3	0	0
R2:A4:B4	0	0
R2:A4:B5		
R2:A4:B6		
R2:A4:B7	0	0
R2:A4:B8	0	0
R2:A4:B9	0	0
R2:A5:B1		
R2:A5:B2		
R2:A5:B3	0	0
R2:A5:B4	0	0
R2:A5:B5		
R2:A5:B6		
R2:A5:B7	0	0
R2:A5:B8	0	0
R2:A5:B9	0	0
R2:A6:B1		
R2:A6:B2		
R2:A6:B3	0	0
R2:A6:B4	0	0
R2:A6:B5		
R2:A6:B6		
R2:A6:B7	0	0
R2:A6:B8	0	0
R2:A6:B9	0	0
R2:A7:B1		
R2:A7:B2		
R2:A7:B3		
R2:A7:B4		
R2:A7:B5		
R2:A7:B6		
R2:A7:B7		
R2:A7:B8		
R2:A7:B9		
R2:A8:B1		
R2:A8:B2		
R2:A8:B3		
R2:A8:B4		
R2:A8:B5		
R2:A8:B6		
R2:A8:B7		

R2:A8:B8		
R2:A8:B9		
R2:A9:B1		
R2:A9:B2		
R2:A9:B3		
R2:A9:B4		
R2:A9:B5		
R2:A9:B6		
R2:A9:B7		
R2:A9:B8		
R2:A9:B9		
R2:A10:B1		
R2:A10:B2		
R2:A10:B3	0	0
R2:A10:B4	0	0
R2:A10:B5		
R2:A10:B6		
R2:A10:B7	-7	0
R2:A10:B8	2	0
R2:A10:B9	0	0
R2:A11:B1		
R2:A11:B2		
R2:A11:B3	0	0
R2:A11:B4	0	0
R2:A11:B5		
R2:A11:B6		
R2:A11:B7	0	0
R2:A11:B8	0	0
R2:A11:B9	0	0
R2:A12:B1		
R2:A12:B2		
R2:A12:B3	0	0
R2:A12:B4	0	0
R2:A12:B5		
R2:A12:B6		
R2:A12:B7	0	0
R2:A12:B8	0	0
R2:A12:B9	0	0
R2:A13:B1		
R2:A13:B2		
R2:A13:B3	0	0
R2:A13:B4	0	0
R2:A13:B5		
R2:A13:B6		
R2:A13:B7	0	0
R2:A13:B8	0	0
R2:A13:B9	0	0
R3:A1:B1		

R3:A1:B2
R3:A1:B3
R3:A1:B4
R3:A1:B5
R3:A1:B6
R3:A1:B7
R3:A1:B8
R3:A1:B9
R3:A2:B1
R3:A2:B2
R3:A2:B3
R3:A2:B4
R3:A2:B5
R3:A2:B6
R3:A2:B7
R3:A2:B8
R3:A2:B9
R3:A3:B1
R3:A3:B2
R3:A3:B3
R3:A3:B4
R3:A3:B5
R3:A3:B6
R3:A3:B7
R3:A3:B8
R3:A3:B9
R3:A4:B1
R3:A4:B2
R3:A4:B3
R3:A4:B4
R3:A4:B5
R3:A4:B6
R3:A4:B7
R3:A4:B8
R3:A4:B9
R3:A5:B1
R3:A5:B2
R3:A5:B3
R3:A5:B4
R3:A5:B5
R3:A5:B6
R3:A5:B7
R3:A5:B8
R3:A5:B9
R3:A6:B1
R3:A6:B2
R3:A6:B3
R3:A6:B4

R3:A6:B5		
R3:A6:B6		
R3:A6:B7		
R3:A6:B8		
R3:A6:B9		
R3:A7:B1		
R3:A7:B2		
R3:A7:B3		
R3:A7:B4		
R3:A7:B5	0	0
R3:A7:B6	0	0
R3:A7:B7	0	0
R3:A7:B8	0	0
R3:A7:B9	0	0
R3:A8:B1		
R3:A8:B2		
R3:A8:B3		
R3:A8:B4		
R3:A8:B5	0	0
R3:A8:B6	0	0
R3:A8:B7	0	0
R3:A8:B8	0	0
R3:A8:B9	0	0
R3:A9:B1		
R3:A9:B2		
R3:A9:B3		
R3:A9:B4		
R3:A9:B5	0	0
R3:A9:B6	0	0
R3:A9:B7	0	0
R3:A9:B8	0	0
R3:A9:B9	0	0
R3:A10:B1		
R3:A10:B2		
R3:A10:B3		
R3:A10:B4		
R3:A10:B5	0	0
R3:A10:B6	0	0
R3:A10:B7	0	0
R3:A10:B8	0	0
R3:A10:B9	0	0
R3:A11:B1		
R3:A11:B2		
R3:A11:B3		
R3:A11:B4		
R3:A11:B5	0	0
R3:A11:B6	0	0
R3:A11:B7	0	0

R3:A11:B8	0	0
R3:A11:B9	0	0
R3:A12:B1		
R3:A12:B2		
R3:A12:B3		
R3:A12:B4		
R3:A12:B5	0	0
R3:A12:B6	0	0
R3:A12:B7	0	0
R3:A12:B8	0	0
R3:A12:B9	0	0
R3:A13:B1		
R3:A13:B2		
R3:A13:B3		
R3:A13:B4		
R3:A13:B5	0	0
R3:A13:B6	0	0
R3:A13:B7	0	0
R3:A13:B8	0	0
R3:A13:B9	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	Std. Error	Df	t value	Pr(> t)
(Intercept)	46.556	0.98862	16	47.0915	< 2.2e-16 ***
rep1	0.889	1.06381	16	0.8356	0.415699
rep2	0.000	0.00000	16		
hyb0	-2.444	1.53826	16	-1.5891	0.131602
hyb1	2.667	1.36083	16	1.9596	0.067702 .
hyb2	1.000	1.36083	16	0.7348	0.473067
hyb3	-2.167	1.36083	16	-1.5922	0.130908

hyb4	1.000	1.36083	16	0.7348	0.473067	
hyb5	-1.333	1.36083	16	-0.9798	0.341771	
hyb6	1.500	1.36083	16	1.1023	0.286649	
hyb7	4.500	1.36083	16	3.3068	0.004455	**
hyb8	-0.167	1.36083	16	-0.1225	0.904048	
hyb9	0.000	0.00000	16			
rep1:hyb0	0.000	0.00000	16			
rep1:hyb1	-3.333	1.36083	16	-2.4495	0.026199	*
rep1:hyb2	-4.000	1.36083	16	-2.9394	0.009621	**
rep1:hyb3	0.333	1.36083	16	0.2449	0.809610	
rep1:hyb4	0.000	1.36083	16	0.0000	1.000000	
rep1:hyb5	2.667	1.36083	16	1.9596	0.067702	.
rep1:hyb6	-4.000	1.36083	16	-2.9394	0.009621	**
rep1:hyb7	-3.000	1.36083	16	-2.2045	0.042471	*
rep1:hyb8	-2.667	1.36083	16	-1.9596	0.067702	.
rep1:hyb9	0.000	0.00000	16			
rep2:hyb0						
rep2:hyb1	0.000	0.00000	16			
rep2:hyb2	0.000	0.00000	16			
rep2:hyb3	0.000	0.00000	16			
rep2:hyb4	0.000	0.00000	16			
rep2:hyb5	0.000	0.00000	16			
rep2:hyb6	0.000	0.00000	16			
rep2:hyb7	0.000	0.00000	16			
rep2:hyb8	0.000	0.00000	16			
rep2:hyb9	0.000	0.00000	16			
gen1	-3.056	1.24226	16	-2.4597	0.025671	*
gen2	-0.611	1.24226	16	-0.4919	0.629446	
gen3	0.000	0.00000	16			
rep1:gen1	2.111	0.78567	16	2.6870	0.016197	*
rep1:gen2	0.222	0.78567	16	0.2828	0.780924	
rep1:gen3	0.000	0.00000	16			
rep2:gen1	0.000	0.00000	16			
rep2:gen2	0.000	0.00000	16			
rep2:gen3	0.000	0.00000	16			
hyb0:gen1	3.944	2.07870	16	1.8976	0.075951	.
hyb0:gen2	0.389	2.07870	16	0.1871	0.853947	
hyb0:gen3	0.000	0.00000	16			
hyb1:gen1	-3.000	1.66667	16	-1.8000	0.090743	.
hyb1:gen2	-4.000	1.66667	16	-2.4000	0.028919	*
hyb1:gen3	0.000	0.00000	16			
hyb2:gen1	2.500	1.66667	16	1.5000	0.153088	
hyb2:gen2	-2.500	1.66667	16	-1.5000	0.153088	
hyb2:gen3	0.000	0.00000	16			
hyb3:gen1	2.000	1.66667	16	1.2000	0.247607	
hyb3:gen2	-0.500	1.66667	16	-0.3000	0.768040	
hyb3:gen3	0.000	0.00000	16			
hyb4:gen1	-2.000	1.66667	16	-1.2000	0.247607	

```

hyb4:gen2    -1.000    1.66667 16 -0.6000  0.556909
hyb4:gen3     0.000    0.00000 16
hyb5:gen1     1.000    1.66667 16  0.6000  0.556909
hyb5:gen2     0.000    1.66667 16  0.0000  1.000000
hyb5:gen3     0.000    0.00000 16
hyb6:gen1    -1.000    1.66667 16 -0.6000  0.556909
hyb6:gen2    -0.500    1.66667 16 -0.3000  0.768040
hyb6:gen3     0.000    0.00000 16
hyb7:gen1    -0.500    1.66667 16 -0.3000  0.768040
hyb7:gen2    -2.000    1.66667 16 -1.2000  0.247607
hyb7:gen3     0.000    0.00000 16
hyb8:gen1     2.500    1.66667 16  1.5000  0.153088
hyb8:gen2    -2.000    1.66667 16 -1.2000  0.247607
hyb8:gen3     0.000    0.00000 16
hyb9:gen1     0.000    0.00000 16
hyb9:gen2     0.000    0.00000 16
hyb9:gen3     0.000    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

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	

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

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

\$Parameter

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

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

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

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

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

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

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

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

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

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

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

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

Site4:AA1:BB1:CC1	0.0	0.000	240
Site4:AA1:BB1:CC2	0.0	0.000	240
Site4:AA1:BB1:CC3	0.0	0.000	240
Site4:AA1:BB1:CC4	0.0	0.000	240
Site4:AA1:BB2:CC1	0.0	0.000	240
Site4:AA1:BB2:CC2	0.0	0.000	240
Site4:AA1:BB2:CC3	0.0	0.000	240
Site4:AA1:BB2:CC4	0.0	0.000	240
Site4:AA2:BB1:CC1	0.0	0.000	240
Site4:AA2:BB1:CC2	0.0	0.000	240
Site4:AA2:BB1:CC3	0.0	0.000	240
Site4:AA2:BB1:CC4	0.0	0.000	240
Site4:AA2:BB2:CC1	0.0	0.000	240
Site4:AA2:BB2:CC2	0.0	0.000	240
Site4:AA2:BB2:CC3	0.0	0.000	240
Site4:AA2:BB2:CC4	0.0	0.000	240
Site4:AA3:BB1:CC1	0.0	0.000	240
Site4:AA3:BB1:CC2	0.0	0.000	240
Site4:AA3:BB1:CC3	0.0	0.000	240
Site4:AA3:BB1:CC4	0.0	0.000	240
Site4:AA3:BB2:CC1	0.0	0.000	240
Site4:AA3:BB2:CC2	0.0	0.000	240
Site4:AA3:BB2:CC3	0.0	0.000	240
Site4:AA3:BB2:CC4	0.0	0.000	240
Site4:AA4:BB1:CC1	0.0	0.000	240
Site4:AA4:BB1:CC2	0.0	0.000	240
Site4:AA4:BB1:CC3	0.0	0.000	240
Site4:AA4:BB1:CC4	0.0	0.000	240
Site4:AA4:BB2:CC1	0.0	0.000	240
Site4:AA4:BB2:CC2	0.0	0.000	240
Site4:AA4:BB2:CC3	0.0	0.000	240
Site4:AA4:BB2:CC4	0.0	0.000	240
Site4:AA5:BB1:CC1	0.0	0.000	240
Site4:AA5:BB1:CC2	0.0	0.000	240
Site4:AA5:BB1:CC3	0.0	0.000	240
Site4:AA5:BB1:CC4	0.0	0.000	240
Site4:AA5:BB2:CC1	0.0	0.000	240
Site4:AA5:BB2:CC2	0.0	0.000	240
Site4:AA5:BB2:CC3	0.0	0.000	240
Site4:AA5:BB2:CC4	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	Std. Error	Df	t value	Pr(> t)
----------	------------	----	---------	----------

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

```

sequence4:steer3
sequence4:steer4
sequence4:steer5
sequence4:steer6
sequence4:steer7    -3.333      2.4175 18 -1.3789 0.1848347
sequence4:steer8      0.000      0.0000 18
sequence4:steer9
sequence4:steer10
sequence4:steer11
sequence4:steer12
sequence5:steer1
sequence5:steer2
sequence5:steer3
sequence5:steer4
sequence5:steer5
sequence5:steer6
sequence5:steer7
sequence5:steer8
sequence5:steer9    -3.667      2.4175 18 -1.5167 0.1466983
sequence5:steer10     0.000      0.0000 18
sequence5:steer11
sequence5:steer12
sequence6:steer1
sequence6:steer2
sequence6:steer3
sequence6:steer4
sequence6:steer5
sequence6:steer6
sequence6:steer7
sequence6:steer8
sequence6:steer9
sequence6:steer10
sequence6:steer11   -3.333      2.4175 18 -1.3789 0.1848347
sequence6:steer12     0.000      0.0000 18
trt1                  9.542      1.3514 18  7.0606 1.384e-06 ***
trt2                  5.521      1.3514 18  4.0853 0.0006946 ***
trt3                  0.000      0.0000 18
carry1                0.375      1.8131 18  0.2068 0.8384657
carry2               -1.938      1.8131 18 -1.0686 0.2993665
carry3                0.000      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, v1p410), 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","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 Std. Error Df t value Pr(>|t|)
(Intercept)          12      1.1832 10 10.1419 1.397e-06 ***
treatmentta          -3      2.0494 10 -1.4639  0.17395
treatmenttb           5      2.3664 10  2.1129  0.06075 .
treatmenttc           0      0.0000 10
varietyva            -8      3.1305 10 -2.5555  0.02859 *
varietyvb            -4      2.0494 10 -1.9518  0.07951 .
varietyvc             3      2.0494 10  1.4639  0.17395
varietyvd             0      0.0000 10
treatmentta:varietyva  9      3.8035 10  2.3662  0.03953 *
treatmentta:varietyvb  0      3.5496 10  0.0000  1.00000
treatmentta:varietyvc  0      0.0000 10
treatmentta:varietyvd  0      0.0000 10
treatmenttb:varietyva  0      0.0000 10
treatmenttb:varietyvb  0      0.0000 10
treatmenttb:varietyvc  0      0.0000 10
treatmenttb:varietyvd  0      0.0000 10
treatmenttc:varietyva  0      0.0000 10
treatmenttc:varietyvb  0      0.0000 10
treatmenttc:varietyvc  0      0.0000 10
treatmenttc:varietyvd  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	Std. Error	Df	t value	Pr(> t)
(Intercept)	42.000	8.3409	14	5.0354	0.0001822 ***
refineryg	-2.000	9.0093	14	-0.2220	0.8275243
refineryn	-3.000	11.7959	14	-0.2543	0.8029412
refinerys	0.000	0.0000	14		
sourceci	-8.000	9.6313	14	-0.8306	0.4201255
sourcecm	-16.000	11.7959	14	-1.3564	0.1964425
sourceco	-0.667	9.6313	14	-0.0692	0.9457944
sourcet	0.000	0.0000	14		
refineryg:sourceci					
refineryg:sourcecm	2.000	14.8428	14	0.1347	0.8947314
refineryg:sourceco	0.667	11.7959	14	0.0565	0.9557287
refineryg:sourcet	0.000	0.0000	14		
refineryn:sourceci	3.667	13.6207	14	0.2692	0.7917042
refineryn:sourcecm	14.333	15.2284	14	0.9412	0.3625491

```

refineryn:sourceo -2.333    15.2284 14 -0.1532 0.8804095
refineryn:sourcet  0.000     0.0000 14
refinerys:sourcei  0.000     0.0000 14
refinerys:sourcem  0.000     0.0000 14
refinerys:sourceo  0.000     0.0000 14
refinerys:sourcet  0.000     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 4.0.5 (2021-03-31)

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] daewr_1.2-7 car_3.0-10 carData_3.0-4 sasLM_0.5.2 rmarkdown_2.7

loaded via a namespace (and not attached):

[1] tinytex_0.28	zoo_1.8-9	xfun_0.20
[4] partitions_1.10-2	haven_2.3.1	lattice_0.20-41
[7] colorspace_2.0-0	vctrs_0.3.7	htmltools_0.5.1.1
[10] yaml_2.2.1	gmp_0.6-2	utf8_1.2.1
[13] rlang_0.4.10	pillar_1.5.1	foreign_0.8-81
[16] readxl_1.3.1	lifecycle_1.0.0	stringr_1.4.0
[19] combinat_0.0-8	cellranger_1.1.0	DoE.base_1.1-6
[22] zip_2.1.1	evaluate_0.14	knitr_1.31
[25] rio_0.5.26	forcats_0.5.1	lmtest_0.9-38
[28] curl_4.3	numbers_0.7-5	fansi_0.4.2
[31] vcd_1.4-8	conf.design_2.0.0	Rcpp_1.0.6
[34] polynom_1.4-0	scatterplot3d_0.3-41	abind_1.4-5
[37] FrF2_2.2-2	hms_1.0.0	digest_0.6.27
[40] stringi_1.5.3	openxlsx_4.2.3	grid_4.0.5
[43] mathjaxr_1.4-0	tools_4.0.5	magrittr_2.0.1
[46] tibble_3.1.0	crayon_1.4.1	pkgconfig_2.0.3
[49] MASS_7.3-53.1	ellipsis_0.3.1	data.table_1.14.0
[52] sfsmisc_1.1-10	igraph_1.2.6	compiler_4.0.5