Examples of NOT OK using car package

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Contents

1 Tested Version and Books used for the Validation

1.1 Packages Used

- 'sasLM' version: 0.5.3

- '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 betwwen 'car' and 'sasLM', 'SAS' results coincide with 'sasLM', not with 'car.'

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

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

1.2 Books and Articles used for the Test

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

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

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

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

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

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

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

2   Snee EMS ANOVA 1974

Reference

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

(1) MODEL

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

```
   Machine Analyst Test Day    Y
1        1       1    1   1  6.1
2        1       1    1   2  8.5
3        1       1    1   3  8.6
4        1       1    1   4  9.3
5        1       1    1   5  8.1
6        1       1    1   6  8.5
7        1       1    1   7  9.8
8        1       1    1   8  9.0
9        1       1    1   9 11.0
10       1       1    1  10  9.7
11       1       1    1  11 10.5
12       1       1    1  12  8.3
13       1       1    1  13  8.4
14       1       1    1  14 10.2
15       1       1    1  15  9.3
16       1       1    1  16  7.1
17       1       1    1  17  5.8
18       1       1    1  18  8.9
19       1       1    1  19 11.5
20       1       1    1  20 10.3
21       1       1    1  21  9.1
22       1       1    1  22  5.7
23       1       1    1  23  8.5
24       1       1    1  24  9.6
25       1       1    1  25  9.4
26       1       1    1  26 10.3
27       1       1    1  27  7.0
28       1       1    1  28 11.5
29       1       1    1  29  6.0
30       1       1    1  30  8.0
31       1       1    1  31 13.4
32       1       1    1  32 12.1
33       1       1    1  33 14.2
34       1       1    1  34 10.0
35       1       1    1  35  6.5
36       1       1    1  36  6.5
```

37	1	1	1	37	9.2
38	1	1	1	38	11.0
39	1	1	1	39	8.6
40	1	1	1	40	8.9
41	1	1	1	41	6.6
42	1	1	1	42	8.4
43	1	1	2	1	6.6
44	1	1	2	2	9.6
45	1	1	2	3	6.7
46	1	1	2	4	7.2
47	1	1	2	5	7.1
48	1	1	2	6	9.0
49	1	1	2	7	9.8
50	1	1	2	8	8.0
51	1	1	2	9	10.9
52	1	1	2	10	10.6
53	1	1	2	11	8.4
54	1	1	2	12	10.6
55	1	1	2	13	7.2
56	1	1	2	14	8.0
57	1	1	2	15	8.7
58	1	1	2	16	8.7
59	1	1	2	17	6.8
60	1	1	2	18	6.6
61	1	1	2	19	7.1
62	1	1	2	20	10.0
63	1	1	2	21	9.5
64	1	1	2	22	7.7
65	1	1	2	23	8.8
66	1	1	2	24	12.2
67	1	1	2	25	10.4
68	1	1	2	26	10.6
69	1	1	2	27	10.6
70	1	1	2	28	7.3
71	1	1	2	29	7.0
72	1	1	2	30	7.0
73	1	1	2	31	9.2
74	1	1	2	32	11.7
75	1	1	2	33	10.6
76	1	1	2	34	10.4
77	1	1	2	35	8.4
78	1	1	2	36	6.8
79	1	1	2	37	10.1
80	1	1	2	38	11.0
81	1	1	2	39	10.0
82	1	1	2	40	8.0
83	1	1	2	41	7.2
84	1	1	2	42	8.8

```
85        1        2        1        1   6.6
86        1        2        1        2   8.2
87        1        2        1        3   8.0
88        1        2        1        4   6.5
89        1        2        1        5   2.3
90        1        2        1        6   4.0
91        1        2        1        7  11.7
92        1        2        1        8   6.8
93        1        2        1        9  10.5
94        1        2        1       10  10.3
95        1        2        1       11  10.0
96        1        2        1       12   8.8
97        1        2        1       13   6.7
98        1        2        1       14   8.9
99        1        2        1       15   9.9
100       1        2        1       16   8.2
101       1        2        1       17   7.5
102       1        2        1       18   6.6
103       1        2        1       19   3.1
104       1        2        1       20   7.2
105       1        2        1       21  10.7
106       1        2        1       22   8.4
107       1        2        1       23   7.6
108       1        2        1       24  12.6
109       1        2        1       25   9.6
110       1        2        1       26  12.6
111       1        2        1       27  10.8
112       1        2        1       28   5.1
113       1        2        1       29   6.6
114       1        2        1       30   8.6
115       1        2        1       31  12.5
116       1        2        1       32  10.4
117       1        2        1       33  10.6
118       1        2        1       34   7.2
119       1        2        1       35   7.8
120       1        2        1       36   4.4
121       1        2        1       37   8.7
122       1        2        1       38  11.2
123       1        2        1       39  10.3
124       1        2        1       40   7.0
125       1        2        1       41   7.7
126       1        2        1       42   7.6
127       2        1        1        1   8.8
128       2        1        1        2   8.1
129       2        1        1        3   7.4
130       2        1        1        4   8.0
131       2        1        1        5   9.5
132       2        1        1        6   9.2
```

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

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

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL          167 751.27  4.4986
RESIDUALS        0   0.00
CORRECTED TOTAL 167 751.27


$`Type I`
                        Df Sum Sq Mean Sq F value Pr(>F)
```

```
Day                        41 365.58  8.9166
Day:Machine                42 196.59  4.6807
Day:Machine:Analyst        42 118.80  2.8285
Day:Machine:Analyst:Test 42  70.30  1.6739


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


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


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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3 Goodnight

Reference

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

3.1 p33

(2) MODEL

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

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

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

```
$ANOVA
Response : y
                Df Sum Sq Mean Sq F value Pr(>F)
MODEL            4 34.905  8.7261
RESIDUALS        0  0.000
CORRECTED TOTAL  4 34.905

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

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

$`Type III`
CAUTION: Singularity Exists !
    Df  Sum Sq Mean Sq F value Pr(>F)
A    1  3.0276  3.0276
B    1 23.5225 23.5225
A:B  1  0.0081  0.0081
```

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

```r
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	1	B	2	86	86 placebo	0	0
2	2	1	B	3	86	106 test	-1	-1
3	3	1	B	4	62	79 standard	1	0
4	4	2	F	2	48	66 test	0	0
5	5	2	F	3	58	56 placebo	1	0
6	6	2	F	4	74	79 standard	-1	-1
7	7	3	B	2	78	84 placebo	0	0
8	8	3	B	3	78	76 test	-1	-1
9	9	3	B	4	82	91 standard	1	0
10	10	4	D	2	66	79 standard	0	0
11	11	4	D	3	72	100 test	0	1
12	12	4	D	4	90	82 placebo	1	0
13	13	5	C	2	74	74 test	0	0
14	14	5	C	3	90	71 standard	1	0
15	15	5	C	4	66	62 placebo	0	1
16	16	6	B	2	62	64 placebo	0	0
17	17	6	B	3	74	90 test	-1	-1
18	18	6	B	4	58	85 standard	1	0
19	19	7	A	2	94	75 standard	0	0
20	20	7	A	3	72	82 placebo	0	1
21	21	7	A	4	100	102 test	-1	-1
22	22	8	A	2	54	63 standard	0	0
23	23	8	A	3	54	58 placebo	0	1
24	24	8	A	4	66	62 test	-1	-1
25	25	9	D	2	82	91 standard	0	0
26	26	9	D	3	96	86 test	0	1
27	27	9	D	4	78	88 placebo	1	0
28	28	10	C	2	86	82 test	0	0
29	29	10	C	3	70	71 standard	1	0
30	30	10	C	4	58	62 placebo	0	1
31	31	11	F	2	82	80 test	0	0
32	32	11	F	3	80	78 placebo	1	0
33	33	11	F	4	72	75 standard	-1	-1
34	34	12	E	2	96	90 placebo	0	0

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

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

```
$ANOVA
Response : HR
                Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           29 6408.7  220.99   3.912 3.127e-05 ***
RESIDUALS       42 2372.6   56.49
CORRECTED TOTAL 71 8781.3
---
```

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


$`Type I`
                Df Sum Sq Mean Sq F value   Pr(>F)
SEQUENCE         5  508.9  101.79  1.8019 0.133346
SEQUENCE:PATIENT 18 4692.3  260.69  4.6147 2.21e-05 ***
VISIT            2  146.8   73.39  1.2991 0.283499
DRUG             2  668.8  334.39  5.9194 0.005435 **
RESIDS           1  391.0  391.02  6.9219 0.011854 *
RESIDT           1    0.8    0.84  0.0149 0.903511
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
                Df Sum Sq Mean Sq F value   Pr(>F)
SEQUENCE         5  701.2 140.237  2.4825  0.04665 *
SEQUENCE:PATIENT 18 4692.3 260.685  4.6147 2.21e-05 ***
VISIT            2  146.8  73.389  1.2991  0.28350
DRUG             2  344.0 171.975  3.0443  0.05826 .
RESIDS           1  309.2 309.174  5.4731  0.02414 *
RESIDT           1    0.8   0.840  0.0149  0.90351
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
                Df Sum Sq Mean Sq F value   Pr(>F)
SEQUENCE         5  701.2 140.237  2.4825  0.04665 *
SEQUENCE:PATIENT 18 4692.3 260.685  4.6147 2.21e-05 ***
VISIT            2  146.8  73.389  1.2991  0.28350
DRUG             2  343.9 171.975  3.0443  0.05826 .
RESIDS           1  309.2 309.174  5.4731  0.02414 *
RESIDT           1    0.8   0.840  0.0149  0.90351
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
                  Estimate Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)        88.000         0    4.7287 42 18.6097 < 2.2e-16 ***
SEQUENCEA           6.208         0    6.2319 42  0.9962 0.3248514
SEQUENCEB         -19.333         0    6.1368 42 -3.1504 0.0030025 **
SEQUENCEC          -0.479         0    6.2319 42 -0.0769 0.9390770
SEQUENCED          -1.813         0    6.2319 42 -0.2908 0.7726044
SEQUENCEE          -5.792         0    6.2319 42 -0.9294 0.3580166
SEQUENCEF           0.000         0    0.0000 42
SEQUENCEA:PATIENT1               0
SEQUENCEA:PATIENT2               0
SEQUENCEA:PATIENT3               0
SEQUENCEA:PATIENT4               0
```

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

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

```
SEQUENCEE:PATIENT5                       0
SEQUENCEE:PATIENT6                       0
SEQUENCEE:PATIENT7                       0
SEQUENCEE:PATIENT8                       0
SEQUENCEE:PATIENT9                       0
SEQUENCEE:PATIENT10                      0
SEQUENCEE:PATIENT11                      0
SEQUENCEE:PATIENT12    12.000            0        6.1368 42  1.9554 0.0572081 .
SEQUENCEE:PATIENT13                      0
SEQUENCEE:PATIENT14                      0
SEQUENCEE:PATIENT15                      0
SEQUENCEE:PATIENT16    13.333            0        6.1368 42  2.1727 0.0354954 *
SEQUENCEE:PATIENT17                      0
SEQUENCEE:PATIENT18                      0
SEQUENCEE:PATIENT19    -0.667            0        6.1368 42 -0.1086 0.9140096
SEQUENCEE:PATIENT20                      0
SEQUENCEE:PATIENT21                      0
SEQUENCEE:PATIENT22                      0
SEQUENCEE:PATIENT23     0.000            0        0.0000 42
SEQUENCEE:PATIENT24                      0
SEQUENCEF:PATIENT1                       0
SEQUENCEF:PATIENT2    -18.667            0        6.1368 42 -3.0418 0.0040426 **
SEQUENCEF:PATIENT3                       0
SEQUENCEF:PATIENT4                       0
SEQUENCEF:PATIENT5                       0
SEQUENCEF:PATIENT6                       0
SEQUENCEF:PATIENT7                       0
SEQUENCEF:PATIENT8                       0
SEQUENCEF:PATIENT9                       0
SEQUENCEF:PATIENT10                      0
SEQUENCEF:PATIENT11    -8.000            0        6.1368 42 -1.3036 0.1994653
SEQUENCEF:PATIENT12                      0
SEQUENCEF:PATIENT13                      0
SEQUENCEF:PATIENT14    -2.000            0        6.1368 42 -0.3259 0.7461154
SEQUENCEF:PATIENT15                      0
SEQUENCEF:PATIENT16                      0
SEQUENCEF:PATIENT17                      0
SEQUENCEF:PATIENT18     0.000            0        0.0000 42
SEQUENCEF:PATIENT19                      0
SEQUENCEF:PATIENT20                      0
SEQUENCEF:PATIENT21                      0
SEQUENCEF:PATIENT22                      0
SEQUENCEF:PATIENT23                      0
SEQUENCEF:PATIENT24                      0
VISIT2                 -2.583            0        2.1697 42 -1.1907 0.2404762
VISIT3                  0.750            0        2.1697 42  0.3457 0.7313138
VISIT4                  0.000            0        0.0000 42
DRUGplacebo            -5.938            0        2.4258 42 -2.4477 0.0186398 *
```

```
DRUGstandard           -3.625        0     2.4258 42 -1.4944 0.1425553
DRUGtest                0.000        0     0.0000 42
RESIDS                 -4.396        1     1.8790 42 -2.3395 0.0241414 *
RESIDT                  0.229        1     1.8790 42  0.1220 0.9035106
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```
```r
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

```r
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   2   1     2 13
3    3   3   1     3 16
4    4   4   1     2 17
5    5   5   1     2 19
6    6   6   1     3 12
7    7   7   2     1 20
8    8   8   2     1 21
9    9   9   2     2 20
10  10  10   2     2 23
11  11  11   2     2 19
12  12  12   2     2 19
13  13  13   3     1 12
```

```
14  14   3   1     2 13
15  15   3   1     3 14
16  16   3   2     1 11
17  17   3   3     1 12
18  18   3   3     2 13
19  19   3   3     3 15
20  20   3   3     4 11
21  21   3   3     5  9
```

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

```
$ANOVA
Response : Y
                Df  Sum Sq Mean Sq F value    Pr(>F)
MODEL            7 267.226  38.175  12.433 7.522e-05 ***
RESIDUALS       13  39.917   3.071
CORRECTED TOTAL 20 307.143
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type I`
        Df  Sum Sq Mean Sq F value    Pr(>F)
TRT      2 236.921 118.460  38.580 3.412e-06 ***
TRT:POT  5  30.306   6.061   1.974    0.1499
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
        Df  Sum Sq Mean Sq F value    Pr(>F)
TRT      2 236.921 118.460  38.580 3.412e-06 ***
TRT:POT  5  30.306   6.061   1.974    0.1499
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
        Df  Sum Sq Mean Sq F value    Pr(>F)
TRT      2 200.111 100.055  32.586 8.626e-06 ***
TRT:POT  5  30.306   6.061   1.974    0.1499
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
            Estimate Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)  12.0000         0    0.78365 13 15.3130 1.070e-09 ***
TRT1          0.0000         0    1.91954 13  0.0000   1.00000
TRT2          8.2500         0    1.17547 13  7.0185 9.087e-06 ***
TRT3          0.0000         0    0.00000 13
TRT1:POT1     2.6667         0    2.02337 13  1.3179   0.21028
```

```
TRT1:POT2      6.0000         0     2.14611 13  2.7958    0.01515 *
TRT1:POT3      0.0000         0     0.00000 13
TRT2:POT1      0.2500         0     1.51753 13  0.1647    0.87168
TRT2:POT2      0.0000         0     0.00000 13
TRT2:POT3                     0
TRT3:POT1      1.0000         0     1.27969 13  0.7814    0.44854
TRT3:POT2     -1.0000         0     1.91954 13 -0.5210    0.61115
TRT3:POT3      0.0000         0     0.00000 13
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
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

```r
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      1       3   1 192    390    2.24
2    2    2    1      1       3   2 154    403    2.65
3    3    3    1      1       4   3 185    432    2.41
4    4    4    1      1       4   4 193    457    2.25
5    5    5    1      1       5   5 186    483    2.58
6    6    6    1      1       5   6 177    469    2.67
7    7    7    1      1       5   7 177    428    2.71
8    8    8    1      1       5   8 163    439    2.47
9    9    9    1      2       4   9 188    439    2.29
10  10   10    1      2       4  10 178    407    2.26
11  11   11    1      2       5  11 198    498    1.97
12  12   12    1      2       5  12 193    459    2.14
13  13   13    1      2       5  13 186    459    2.44
14  14   14    1      2       5  14 175    375    2.52
```

15	15	1	2	5	15	171	382	1.72
16	16	1	2	5	16	168	417	2.75
17	17	1	3	3	17	154	389	2.38
18	18	1	3	4	18	184	414	2.46
19	19	1	3	5	19	174	483	2.29
20	20	1	3	5	20	170	430	2.30
21	21	1	3	5	21	169	443	2.94
22	22	2	4	3	22	158	381	2.50
23	23	2	4	3	23	158	365	2.44
24	24	2	4	4	24	169	386	2.44
25	25	2	4	4	25	144	339	2.15
26	26	2	4	5	26	159	419	2.54
27	27	2	4	5	27	152	469	2.74
28	28	2	4	5	28	149	379	2.50
29	29	2	4	5	29	149	375	2.54
30	30	2	5	3	30	189	395	2.65
31	31	2	5	4	31	187	447	2.52
32	32	2	5	4	32	165	430	2.67
33	33	2	5	5	33	181	453	2.79
34	34	2	5	5	34	177	385	2.33
35	35	2	5	5	35	151	414	2.67
36	36	2	5	5	36	147	353	2.69
37	37	3	6	4	37	184	411	3.00
38	38	3	6	4	38	184	420	2.49
39	39	3	6	5	39	187	427	2.25
40	40	3	6	5	40	184	409	2.49
41	41	3	6	5	41	183	337	2.02
42	42	3	6	5	42	177	352	2.31
43	43	3	7	3	43	205	472	2.57
44	44	3	7	3	44	193	340	2.37
45	45	3	7	4	45	162	375	2.64
46	46	3	7	5	46	206	451	2.37
47	47	3	7	5	47	205	472	2.22
48	48	3	7	5	48	187	402	1.90
49	49	3	7	5	49	178	464	2.61
50	50	3	7	5	50	175	414	2.13
51	51	3	8	3	51	200	466	2.16
52	52	3	8	3	52	184	356	2.33
53	53	3	8	3	53	175	449	2.52
54	54	3	8	4	54	178	360	2.45
55	55	3	8	5	55	189	385	1.44
56	56	3	8	5	56	184	431	1.72
57	57	3	8	5	57	183	401	2.17
58	58	3	9	3	58	166	404	2.68
59	59	3	9	4	59	187	482	2.43
60	60	3	9	4	60	186	350	2.36
61	61	3	9	4	61	184	483	2.44
62	62	3	9	5	62	180	425	2.66

```
63  63   3   9     5       63 177    420     2.46
64  64   3   9     5       64 175    440     2.52
65  65   3   9     5       65 164    405     2.42
```

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

```
$ANOVA
Response : avdlygn
                Df Sum Sq  Mean Sq F value   Pr(>F)
MODEL           16 2.5275 0.157966  3.1437 0.001091 **
RESIDUALS       48 2.4119 0.050248
CORRECTED TOTAL 64 4.9394
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type I`
            Df  Sum Sq  Mean Sq F value  Pr(>F)
line         2 0.38009 0.190046  3.7821 0.02983 *
line:sire    6 0.92634 0.154391  3.0726 0.01260 *
agedam       2 0.11894 0.059471  1.1835 0.31497
line:agedam  4 0.64889 0.162222  3.2284 0.02000 *
age          1 0.18349 0.183487  3.6516 0.06200 .
intlwt       1 0.26970 0.269704  5.3674 0.02483 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
            Df  Sum Sq Mean Sq F value   Pr(>F)
line         2 0.05526 0.02763  0.5498 0.580636
line:sire    6 0.97389 0.16231  3.2303 0.009543 **
agedam       2 0.33106 0.16553  3.2943 0.045640 *
line:agedam  4 0.45343 0.11336  2.2560 0.076821 .
age          1 0.38128 0.38128  7.5878 0.008277 **
intlwt       1 0.26970 0.26970  5.3674 0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
            Df  Sum Sq Mean Sq F value   Pr(>F)
line         2 0.13620 0.06810  1.3553 0.267560
line:sire    6 0.97389 0.16231  3.2303 0.009543 **
agedam       2 0.13011 0.06505  1.2946 0.283392
line:agedam  4 0.45343 0.11336  2.2560 0.076821 .
age          1 0.38128 0.38128  7.5878 0.008277 **
intlwt       1 0.26970 0.26970  5.3674 0.024830 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Parameter
                Estimate Estimable Std. Error Df t value   Pr(>|t|)
(Intercept)      2.99627         0    0.51285 48   5.8423 4.361e-07 ***
line1            0.07182         0    0.14551 48   0.4936  0.623826
line2            0.25247         0    0.13717 48   1.8406  0.071867 .
line3            0.00000         0    0.00000 48
line1:sire1      0.08573         0    0.13028 48   0.6580  0.513652
line1:sire2     -0.12171         0    0.13622 48  -0.8934  0.376079
line1:sire3      0.00000         0    0.00000 48
line1:sire4                      0
line1:sire5                      0
line1:sire6                      0
line1:sire7                      0
line1:sire8                      0
line1:sire9                      0
line2:sire1                      0
line2:sire2                      0
line2:sire3                      0
line2:sire4     -0.24460         0    0.12669 48  -1.9307  0.059443 .
line2:sire5      0.00000         0    0.00000 48
line2:sire6                      0
line2:sire7                      0
line2:sire8                      0
line2:sire9                      0
line3:sire1                      0
line3:sire2                      0
line3:sire3                      0
line3:sire4                      0
line3:sire5                      0
line3:sire6      0.10540         0    0.12909 48   0.8165  0.418267
line3:sire7     -0.01952         0    0.12038 48  -0.1622  0.871856
line3:sire8     -0.33024         0    0.12567 48  -2.6278  0.011504 *
line3:sire9      0.00000         0    0.00000 48
agedam3          0.37039         0    0.11456 48   3.2332  0.002216 **
agedam4          0.27546         0    0.10378 48   2.6544  0.010746 *
agedam5          0.00000         0    0.00000 48
line1:agedam3   -0.44894         0    0.19581 48  -2.2927  0.026291 *
line1:agedam4   -0.28283         0    0.16085 48  -1.7584  0.085062 .
line1:agedam5    0.00000         0    0.00000 48
line2:agedam3   -0.26078         0    0.19529 48  -1.3354  0.188050
line2:agedam4   -0.35026         0    0.17439 48  -2.0085  0.050232 .
line2:agedam5    0.00000         0    0.00000 48
line3:agedam3    0.00000         0    0.00000 48
line3:agedam4    0.00000         0    0.00000 48
line3:agedam5    0.00000         0    0.00000 48
age             -0.00853         1    0.00310 48  -2.7546  0.008277 **
intlwt           0.00203         1    0.00087 48   2.3168  0.024830 *
---
```

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

 # p433 Output 11.40

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

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

Anova Table (Type III tests)

Response: avdlygn

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

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

5 Sahai - Unbalanced

Reference

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

5.1 Table 15.3

(6) MODEL

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

```
    Dam Sire   pH
1     1    1 7.48
2     1    1 7.48
3     1    1 7.52
4     1    1 7.54
5     6    1 7.54
6     6    1 7.36
7     6    1 7.36
8     6    1 7.40
9    11    1 7.52
10   11    1 7.54
11   11    1 7.52
12   11    1 7.56
13   11    1 7.53
14    1    2 7.48
15    1    2 7.53
16    1    2 7.43
17    1    2 7.39
18    6    2 7.44
19    6    2 7.47
20    6    2 7.48
21    6    2 7.48
22   11    2 7.56
23   11    2 7.39
24   11    2 7.52
25   11    2 7.49
26   11    2 7.48
27    2    1 7.45
28    2    1 7.43
29    2    1 7.49
30    2    1 7.40
31    2    1 7.40
32    6    3 7.43
33    6    3 7.52
```

34	6	3	7.50
35	6	3	7.46
36	6	3	7.39
37	12	1	7.50
38	12	1	7.45
39	12	1	7.43
40	12	1	7.44
41	12	1	7.49
42	2	2	7.50
43	2	2	7.45
44	2	2	7.43
45	2	2	7.36
46	7	1	7.41
47	7	1	7.42
48	7	1	7.36
49	7	1	7.47
50	12	2	7.52
51	12	2	7.43
52	12	2	7.38
53	12	2	7.33
54	3	1	7.40
55	3	1	7.45
56	3	1	7.42
57	3	1	7.48
58	7	2	7.47
59	7	2	7.36
60	7	2	7.43
61	7	2	7.38
62	7	2	7.41
63	13	1	7.39
64	13	1	7.37
65	13	1	7.33
66	13	1	7.43
67	13	1	7.42
68	3	2	7.45
69	3	2	7.33
70	3	2	7.40
71	3	2	7.46
72	7	3	7.53
73	7	3	7.40
74	7	3	7.44
75	7	3	7.40
76	7	3	7.45
77	13	2	7.43
78	13	2	7.38
79	13	2	7.44
80	3	3	7.40
81	3	3	7.47

82	3	3	7.40
83	3	3	7.47
84	3	3	7.47
85	8	1	7.52
86	8	1	7.53
87	8	1	7.48
88	13	3	7.46
89	13	3	7.44
90	13	3	7.37
91	13	3	7.54
92	4	1	7.38
93	4	1	7.48
94	4	1	7.46
95	8	2	7.40
96	8	2	7.48
97	8	2	7.50
98	8	2	7.40
99	8	2	7.51
100	14	1	7.50
101	14	1	7.53
102	14	1	7.51
103	14	1	7.43
104	4	2	7.37
105	4	2	7.31
106	4	2	7.45
107	4	2	7.41
108	9	1	7.40
109	9	1	7.34
110	9	1	7.37
111	9	1	7.45
112	14	2	7.44
113	14	2	7.45
114	14	2	7.39
115	14	2	7.52
116	5	1	7.44
117	5	1	7.51
118	5	1	7.49
119	5	1	7.51
120	5	1	7.52
121	9	2	7.42
122	9	2	7.37
123	9	2	7.46
124	9	2	7.40
125	14	3	7.42
126	14	3	7.48
127	14	3	7.45
128	14	3	7.51
129	14	3	7.48

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

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

```
$ANOVA
Response : pH
                Df  Sum Sq   Mean Sq F value  Pr(>F)
MODEL           36 0.25804 0.0071678  2.8977 7.2e-06 ***
RESIDUALS      123 0.30425 0.0024736
CORRECTED TOTAL 159 0.56229
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


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

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


$`Type II`
         Df   Sum Sq  Mean Sq F value    Pr(>F)
Dam      14 0.178017 0.0127155  5.1405 1.563e-07 ***
Dam:Sire 22 0.080024 0.0036374  1.4705   0.09662 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
         Df   Sum Sq  Mean Sq F value    Pr(>F)
Dam      14 0.179405 0.0128146  5.1805 1.347e-07 ***
Dam:Sire 22 0.080024 0.0036374  1.4705   0.09662 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
            Estimate Estimable Std. Error  Df   t value  Pr(>|t|)
(Intercept)   7.5020         0   0.022242 123 337.2849 < 2.2e-16 ***
Dam1         -0.0445         0   0.033363 123  -1.3338 0.1847360
Dam2         -0.0670         0   0.033363 123  -2.0082 0.0468144 *
Dam3         -0.0600         0   0.031455 123  -1.9075 0.0587923 .
Dam4         -0.1170         0   0.033363 123  -3.5068 0.0006338 ***
Dam5          0.0513         0   0.036322 123   1.4133 0.1600927
Dam6         -0.0420         0   0.031455 123  -1.3352 0.1842689
Dam7         -0.0580         0   0.031455 123  -1.8439 0.0676071 .
Dam8         -0.0440         0   0.031455 123  -1.3988 0.1643876
Dam9         -0.0895         0   0.033363 123  -2.6826 0.0083104 **
Dam10        -0.0545         0   0.033363 123  -1.6335 0.1049163
Dam11        -0.0140         0   0.031455 123  -0.4451 0.6570480
Dam12        -0.0870         0   0.033363 123  -2.6076 0.0102452 *
Dam13        -0.0495         0   0.033363 123  -1.4837 0.1404576
Dam14        -0.0340         0   0.031455 123  -1.0809 0.2818582
Dam15         0.0000         0   0.000000 123
Dam1:Sire1    0.0475         0   0.035168 123   1.3507 0.1792866
Dam1:Sire2    0.0000         0   0.000000 123
Dam1:Sire3               0
Dam2:Sire1   -0.0010         0   0.033363 123  -0.0300 0.9761373
Dam2:Sire2    0.0000         0   0.000000 123
Dam2:Sire3               0
Dam3:Sire1   -0.0045         0   0.033363 123  -0.1349 0.8929288
Dam3:Sire2   -0.0320         0   0.033363 123  -0.9591 0.3393736
Dam3:Sire3    0.0000         0   0.000000 123
Dam4:Sire1    0.0550         0   0.037986 123   1.4479 0.1501886
Dam4:Sire2    0.0000         0   0.000000 123
Dam4:Sire3               0
Dam5:Sire1   -0.0593         0   0.036322 123  -1.6336 0.1049091
Dam5:Sire2   -0.0608         0   0.037986 123  -1.6015 0.1118387
```

```
Dam5:Sire3    0.0000            0    0.000000 123
Dam6:Sire1   -0.0450            0    0.033363 123   -1.3488 0.1798857
Dam6:Sire2    0.0075            0    0.033363 123    0.2248 0.8225105
Dam6:Sire3    0.0000            0    0.000000 123
Dam7:Sire1   -0.0290            0    0.033363 123   -0.8692 0.3864232
Dam7:Sire2   -0.0340            0    0.031455 123   -1.0809 0.2818582
Dam7:Sire3    0.0000            0    0.000000 123
Dam8:Sire1    0.0520            0    0.036322 123    1.4317 0.1547783
Dam8:Sire2    0.0000            0    0.000000 123
Dam8:Sire3                      0
Dam9:Sire1   -0.0225            0    0.035168 123   -0.6398 0.5235039
Dam9:Sire2    0.0000            0    0.000000 123
Dam9:Sire3                      0
Dam10:Sire1  -0.0695            0    0.033363 123   -2.0831 0.0393121 *
Dam10:Sire2   0.0000            0    0.000000 123
Dam10:Sire3                     0
Dam11:Sire1   0.0460            0    0.031455 123    1.4624 0.1461852
Dam11:Sire2   0.0000            0    0.000000 123
Dam11:Sire3                     0
Dam12:Sire1   0.0470            0    0.033363 123    1.4087 0.1614391
Dam12:Sire2   0.0000            0    0.000000 123
Dam12:Sire3                     0
Dam13:Sire1  -0.0645            0    0.033363 123   -1.9333 0.0555032 .
Dam13:Sire2  -0.0358            0    0.037986 123   -0.9433 0.3473613
Dam13:Sire3   0.0000            0    0.000000 123
Dam14:Sire1   0.0245            0    0.033363 123    0.7343 0.4641417
Dam14:Sire2  -0.0180            0    0.033363 123   -0.5395 0.5905089
Dam14:Sire3   0.0000            0    0.000000 123
Dam15:Sire1  -0.0500            0    0.031455 123   -1.5896 0.1145028
Dam15:Sire2  -0.0580            0    0.031455 123   -1.8439 0.0676071 .
Dam15:Sire3   0.0000            0    0.000000 123
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

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

Anova Table (Type III tests)

Response: pH
           Sum Sq  Df F values    Pr(>F)
Dam       0.081011   6   5.4584 4.898e-05 ***
Dam:Sire  0.080024  22   1.4705   0.09662 .
Residuals 0.304253 123
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5.2 Table 16.3

(7) MODEL

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

	Plot	Sample	Subsample	Residue
1	1	1	1	0.52
2	1	1	1	0.43
3	1	1	2	0.40
4	1	1	2	0.52
5	1	2	1	0.26
6	1	2	2	0.54
7	1	3	1	0.52
8	2	1	1	0.50
9	2	1	1	0.59
10	2	1	2	0.47
11	2	1	2	0.50
12	2	2	1	0.04
13	2	2	2	0.43
14	2	3	1	1.08
15	3	1	1	0.34
16	3	1	1	0.26
17	3	1	2	0.32
18	3	1	2	0.45
19	3	2	1	0.25
20	3	2	2	0.38
21	3	3	1	0.29
22	4	1	1	0.18
23	4	1	1	0.24
24	4	1	2	0.31
25	4	1	2	0.29
26	4	2	1	0.13
27	4	2	2	0.25
28	4	3	1	0.10
29	5	1	1	1.05
30	5	1	1	0.66
31	5	1	2	0.60
32	5	1	2	0.51
33	5	2	1	0.95
34	5	2	2	0.84
35	5	3	1	0.92
36	6	1	1	0.52
37	6	1	1	0.66
38	6	1	2	0.55
39	6	1	2	0.40

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

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

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

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


$`Type I`
                      Df  Sum Sq  Mean Sq F value    Pr(>F)
Plot                  10 1.84041 0.184041 18.3332 1.929e-08 ***
Plot:Sample           22 0.99175 0.045079  4.4906 0.0004209 ***
Plot:Sample:Subsample 22 0.35757 0.016253  1.6191 0.1330632
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
                      Df  Sum Sq  Mean Sq F value    Pr(>F)
Plot                  10 1.84041 0.184041 18.3332 1.929e-08 ***
Plot:Sample           22 0.99175 0.045079  4.4906 0.0004209 ***
Plot:Sample:Subsample 22 0.35757 0.016253  1.6191 0.1330632
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
                      Df  Sum Sq  Mean Sq F value    Pr(>F)
Plot                  10 1.78686 0.178686 17.7998 2.547e-08 ***
Plot:Sample           22 0.99175 0.045079  4.4906 0.0004209 ***
Plot:Sample:Subsample 22 0.35757 0.016253  1.6191 0.1330632
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
                   Estimate Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)           0.390         0    0.10019 22  3.8925 0.0007836 ***
Plot1                 0.130         0    0.14169 22  0.9175 0.3688465
Plot2                 0.690         0    0.14169 22  4.8696 7.227e-05 ***
Plot3                -0.100         0    0.14169 22 -0.7057 0.4877535
Plot4                -0.290         0    0.14169 22 -2.0467 0.0528230 .
Plot5                 0.530         0    0.14169 22  3.7404 0.0011335 **
Plot6                 0.020         0    0.14169 22  0.1411 0.8890368
Plot7                 0.050         0    0.14169 22  0.3529 0.7275426
Plot8                -0.030         0    0.14169 22 -0.2117 0.8342720
Plot9                 0.530         0    0.14169 22  3.7404 0.0011335 **
Plot10                0.130         0    0.14169 22  0.9175 0.3688465
Plot11                0.000         0    0.00000 22
Plot1:Sample1        -0.060         0    0.12271 22 -0.4890 0.6297131
Plot1:Sample2         0.020         0    0.14169 22  0.1411 0.8890368
Plot1:Sample3         0.000         0    0.00000 22
Plot2:Sample1        -0.595         0    0.12271 22 -4.8488 7.603e-05 ***
Plot2:Sample2        -0.650         0    0.14169 22 -4.5873 0.0001437 ***
Plot2:Sample3         0.000         0    0.00000 22
Plot3:Sample1         0.095         0    0.12271 22  0.7742 0.4470663
Plot3:Sample2         0.090         0    0.14169 22  0.6352 0.5318688
```

```
Plot3:Sample3                    0.000        0      0.00000 22
Plot4:Sample1                    0.200        0      0.12271 22   1.6298 0.1173694
Plot4:Sample2                    0.150        0      0.14169 22   1.0586 0.3012597
Plot4:Sample3                    0.000        0      0.00000 22
Plot5:Sample1                   -0.365        0      0.12271 22  -2.9745 0.0069960 **
Plot5:Sample2                   -0.080        0      0.14169 22  -0.5646 0.5780606
Plot5:Sample3                    0.000        0      0.00000 22
Plot6:Sample1                    0.065        0      0.12271 22   0.5297 0.6016249
Plot6:Sample2                   -0.150        0      0.14169 22  -1.0586 0.3012597
Plot6:Sample3                    0.000        0      0.00000 22
Plot7:Sample1                    0.115        0      0.12271 22   0.9372 0.3588500
Plot7:Sample2                    0.060        0      0.14169 22   0.4234 0.6760804
Plot7:Sample3                    0.000        0      0.00000 22
Plot8:Sample1                    0.305        0      0.12271 22   2.4855 0.0210209 *
Plot8:Sample2                    0.180        0      0.14169 22   1.2703 0.2172344
Plot8:Sample3                    0.000        0      0.00000 22
Plot9:Sample1                   -0.355        0      0.12271 22  -2.8930 0.0084403 **
Plot9:Sample2                   -0.210        0      0.14169 22  -1.4821 0.1525064
Plot9:Sample3                    0.000        0      0.00000 22
Plot10:Sample1                  -0.020        0      0.12271 22  -0.1630 0.8720183
Plot10:Sample2                   0.000        0      0.14169 22   0.0000 1.0000000
Plot10:Sample3                   0.000        0      0.00000 22
Plot11:Sample1                   0.000        0      0.12271 22   0.0000 1.0000000
Plot11:Sample2                   0.110        0      0.14169 22   0.7763 0.4458271
Plot11:Sample3                   0.000        0      0.00000 22
Plot1:Sample1:Subsample1         0.015        0      0.10019 22   0.1497 0.8823566
Plot1:Sample1:Subsample2         0.000        0      0.00000 22
Plot1:Sample2:Subsample1        -0.280        0      0.14169 22  -1.9761 0.0608176 .
Plot1:Sample2:Subsample2         0.000        0      0.00000 22
Plot1:Sample3:Subsample1         0.000        0      0.00000 22
Plot1:Sample3:Subsample2                      0
Plot2:Sample1:Subsample1         0.060        0      0.10019 22   0.5988 0.5553935
Plot2:Sample1:Subsample2         0.000        0      0.00000 22
Plot2:Sample2:Subsample1        -0.390        0      0.14169 22  -2.7524 0.0116232 *
Plot2:Sample2:Subsample2         0.000        0      0.00000 22
Plot2:Sample3:Subsample1         0.000        0      0.00000 22
Plot2:Sample3:Subsample2                      0
Plot3:Sample1:Subsample1        -0.085        0      0.10019 22  -0.8484 0.4053723
Plot3:Sample1:Subsample2         0.000        0      0.00000 22
Plot3:Sample2:Subsample1        -0.130        0      0.14169 22  -0.9175 0.3688465
Plot3:Sample2:Subsample2         0.000        0      0.00000 22
Plot3:Sample3:Subsample1         0.000        0      0.00000 22
Plot3:Sample3:Subsample2                      0
Plot4:Sample1:Subsample1        -0.090        0      0.10019 22  -0.8983 0.3787697
Plot4:Sample1:Subsample2         0.000        0      0.00000 22
Plot4:Sample2:Subsample1        -0.120        0      0.14169 22  -0.8469 0.4061732
Plot4:Sample2:Subsample2         0.000        0      0.00000 22
Plot4:Sample3:Subsample1         0.000        0      0.00000 22
```

```
Plot4:Sample3:Subsample2                    0
Plot5:Sample1:Subsample1      0.300          0    0.10019 22   2.9942 0.0066835 **
Plot5:Sample1:Subsample2      0.000          0    0.00000 22
Plot5:Sample2:Subsample1      0.110          0    0.14169 22   0.7763 0.4458271
Plot5:Sample2:Subsample2      0.000          0    0.00000 22
Plot5:Sample3:Subsample1      0.000          0    0.00000 22
Plot5:Sample3:Subsample2                    0
Plot6:Sample1:Subsample1      0.115          0    0.10019 22   1.1478 0.2633860
Plot6:Sample1:Subsample2      0.000          0    0.00000 22
Plot6:Sample2:Subsample1      0.070          0    0.14169 22   0.4940 0.6261876
Plot6:Sample2:Subsample2      0.000          0    0.00000 22
Plot6:Sample3:Subsample1      0.000          0    0.00000 22
Plot6:Sample3:Subsample2                    0
Plot7:Sample1:Subsample1      0.110          0    0.10019 22   1.0979 0.2841276
Plot7:Sample1:Subsample2      0.000          0    0.00000 22
Plot7:Sample2:Subsample1     -0.060          0    0.14169 22  -0.4234 0.6760804
Plot7:Sample2:Subsample2      0.000          0    0.00000 22
Plot7:Sample3:Subsample1      0.000          0    0.00000 22
Plot7:Sample3:Subsample2                    0
Plot8:Sample1:Subsample1      0.240          0    0.10019 22   2.3954 0.0255487 *
Plot8:Sample1:Subsample2      0.000          0    0.00000 22
Plot8:Sample2:Subsample1      0.100          0    0.14169 22   0.7057 0.4877535
Plot8:Sample2:Subsample2      0.000          0    0.00000 22
Plot8:Sample3:Subsample1      0.000          0    0.00000 22
Plot8:Sample3:Subsample2                    0
Plot9:Sample1:Subsample1      0.020          0    0.10019 22   0.1996 0.8436154
Plot9:Sample1:Subsample2      0.000          0    0.00000 22
Plot9:Sample2:Subsample1     -0.110          0    0.14169 22  -0.7763 0.4458271
Plot9:Sample2:Subsample2      0.000          0    0.00000 22
Plot9:Sample3:Subsample1      0.000          0    0.00000 22
Plot9:Sample3:Subsample2                    0
Plot10:Sample1:Subsample1     0.050          0    0.10019 22   0.4990 0.6227069
Plot10:Sample1:Subsample2     0.000          0    0.00000 22
Plot10:Sample2:Subsample1    -0.060          0    0.14169 22  -0.4234 0.6760804
Plot10:Sample2:Subsample2     0.000          0    0.00000 22
Plot10:Sample3:Subsample1     0.000          0    0.00000 22
Plot10:Sample3:Subsample2                   0
Plot11:Sample1:Subsample1    -0.090          0    0.10019 22  -0.8983 0.3787697
Plot11:Sample1:Subsample2     0.000          0    0.00000 22
Plot11:Sample2:Subsample1     0.030          0    0.14169 22   0.2117 0.8342720
Plot11:Sample2:Subsample2     0.000          0    0.00000 22
Plot11:Sample3:Subsample1     0.000          0    0.00000 22
Plot11:Sample3:Subsample2                   0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

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

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

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

```
R5:S4:Column4      0.00          0              0
R5:S4:Column5      0.00          0              0
```

```r
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

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

```
    row P column R S height
1     1 1      1 3 4    103
2     1 1      1 3 2     98
3     1 1      1 3 3    101
4     1 1      1 3 1    101
5     1 1      2 4 2    100
6     1 1      2 4 3     98
7     1 1      2 4 1    100
8     1 1      2 4 4     99
9     1 1      3 5 3     99
10    1 1      3 5 1     99
11    1 1      3 5 2    100
12    1 1      3 5 4     97
13    1 1      4 2 2     99
14    1 1      4 2 1    102
15    1 1      4 2 3     99
16    1 1      4 2 4    100
17    1 1      5 1 1    102
18    1 1      5 1 2    107
19    1 1      5 1 3     98
20    1 1      5 1 4     99
21    1 2      1 3 4    101
22    1 2      1 3 2    101
23    1 2      1 3 3     99
24    1 2      1 3 1    100
25    1 2      2 4 2     97
26    1 2      2 4 3     85
27    1 2      2 4 1     99
28    1 2      2 4 4     97
29    1 2      3 5 3     98
30    1 2      3 5 1     96
31    1 2      3 5 2     88
32    1 2      3 5 4     98
33    1 2      4 2 2     95
```

34	1 2	4 2 1	90
35	1 2	4 2 3	99
36	1 2	4 2 4	87
37	1 2	5 1 1	98
38	1 2	5 1 2	98
39	1 2	5 1 3	99
40	1 2	5 1 4	89
41	2 1	1 2 4	99
42	2 1	1 2 2	97
43	2 1	1 2 3	98
44	2 1	1 2 1	95
45	2 1	2 3 2	99
46	2 1	2 3 3	98
47	2 1	2 3 1	96
48	2 1	2 3 4	93
49	2 1	3 1 3	97
50	2 1	3 1 1	99
51	2 1	3 1 2	95
52	2 1	3 1 4	98
53	2 1	4 4 2	97
54	2 1	4 4 1	95
55	2 1	4 4 3	99
56	2 1	4 4 4	94
57	2 1	5 5 1	98
58	2 1	5 5 2	93
59	2 1	5 5 3	98
60	2 1	5 5 4	96
61	2 2	1 2 4	99
62	2 2	1 2 2	89
63	2 2	1 2 3	98
64	2 2	1 2 1	94
65	2 2	2 3 2	98
66	2 2	2 3 3	91
67	2 2	2 3 1	97
68	2 2	2 3 4	96
69	2 2	3 1 3	94
70	2 2	3 1 1	97
71	2 2	3 1 2	98
72	2 2	3 1 4	96
73	2 2	4 4 2	99
74	2 2	4 4 1	89
75	2 2	4 4 3	97
76	2 2	4 4 4	98
77	2 2	5 5 1	99
78	2 2	5 5 2	96
79	2 2	5 5 3	93
80	2 2	5 5 4	98
81	3 1	1 4 4	99

82	3 1		1	4	2	88
83	3 1		1	4	3	98
84	3 1		1	4	1	96
85	3 1		2	5	2	98
86	3 1		2	5	3	99
87	3 1		2	5	1	92
88	3 1		2	5	4	88
89	3 1		3	2	3	98
90	3 1		3	2	1	85
91	3 1		3	2	2	88
92	3 1		3	2	4	95
93	3 1		4	1	2	97
94	3 1		4	1	1	87
95	3 1		4	1	3	96
96	3 1		4	1	4	88
97	3 1		5	3	1	88
98	3 1		5	3	2	85
99	3 1		5	3	3	78
100	3 1		5	3	4	78
101	3 2		1	4	4	88
102	3 2		1	4	2	85
103	3 2		1	4	3	78
104	3 2		1	4	1	80
105	3 2		2	5	2	80
106	3 2		2	5	3	79
107	3 2		2	5	1	77
108	3 2		2	5	4	78
109	3 2		3	2	3	90
110	3 2		3	2	1	91
111	3 2		3	2	2	92
112	3 2		3	2	4	93
113	3 2		4	1	2	99
114	3 2		4	1	1	97
115	3 2		4	1	3	98
116	3 2		4	1	4	99
117	3 2		5	3	1	80
118	3 2		5	3	2	81
119	3 2		5	3	3	82
120	3 2		5	3	4	83
121	4 1		1	1	4	80
122	4 1		1	1	2	81
123	4 1		1	1	3	84
124	4 1		1	1	1	80
125	4 1		2	2	2	90
126	4 1		2	2	3	90
127	4 1		2	2	1	90
128	4 1		2	2	4	90
129	4 1		3	3	3	99

```
130    4 1     3 3 1     98
131    4 1     3 3 2     97
132    4 1     3 3 4     99
133    4 1     4 5 2     95
134    4 1     4 5 1     95
135    4 1     4 5 3     95
136    4 1     4 5 4     96
137    4 1     5 4 1     99
138    4 1     5 4 2     95
139    4 1     5 4 3     98
140    4 1     5 4 4     98
141    4 2     1 1 4     98
142    4 2     1 1 2     99
143    4 2     1 1 3     97
144    4 2     1 1 1     99
145    4 2     2 2 2     88
146    4 2     2 2 3     87
147    4 2     2 2 1     88
148    4 2     2 2 4     86
149    4 2     3 3 3     99
150    4 2     3 3 1     97
151    4 2     3 3 2     96
152    4 2     3 3 4     95
153    4 2     4 5 2     89
154    4 2     4 5 1     88
155    4 2     4 5 3     87
156    4 2     4 5 4     85
157    4 2     5 4 1     90
158    4 2     5 4 2     90
159    4 2     5 4 3     90
160    4 2     5 4 4     97
161    5 1     1 5 4     98
162    5 1     1 5 2     98
163    5 1     1 5 3     99
164    5 1     1 5 1     97
165    5 1     2 1 2     98
166    5 1     2 1 3     97
167    5 1     2 1 1     98
168    5 1     2 1 4     89
169    5 1     3 4 3     88
170    5 1     3 4 1     87
171    5 1     3 4 2     88
172    5 1     3 4 4     88
173    5 1     4 3 2     98
174    5 1     4 3 1     95
175    5 1     4 3 3     97
176    5 1     4 3 4     99
177    5 1     5 2 1     98
```

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

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

$ANOVA
Response : height

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

$`Type I`

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

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


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


$Parameter
            Estimate Estimable Std. Error Df t value Pr(>|t|)
(Intercept)       88         0          0  0
row1              10         0          0  0
row2              10         0          0  0
row3             -10         0          0  0
row4              -3         0          0  0
row5               0         0          0  0
R1                 2         0          0  0
R2                11         0          0  0
R3                -5         0          0  0
R4                 4         0          0  0
R5                 0         0          0  0
P1                10         0          0  0
P2                 0         0          0  0
S1                10         0          0  0
S2                -1         0          0  0
```

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

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

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

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

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

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

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

```
row4:R5:P2:S1          0          0          0
row4:R5:P2:S2          0          0          0
row4:R5:P2:S3          0          0          0
row4:R5:P2:S4          0          0          0
row5:R1:P1:S1          0          0          0
row5:R1:P1:S2          0          0          0
row5:R1:P1:S3          0          0          0
row5:R1:P1:S4          0          0          0
row5:R1:P2:S1          0          0          0
row5:R1:P2:S2          0          0          0
row5:R1:P2:S3          0          0          0
row5:R1:P2:S4          0          0          0
row5:R2:P1:S1          0          0          0
row5:R2:P1:S2          0          0          0
row5:R2:P1:S3          0          0          0
row5:R2:P1:S4          0          0          0
row5:R2:P2:S1          0          0          0
row5:R2:P2:S2          0          0          0
row5:R2:P2:S3          0          0          0
row5:R2:P2:S4          0          0          0
row5:R3:P1:S1          0          0          0
row5:R3:P1:S2          0          0          0
row5:R3:P1:S3          0          0          0
row5:R3:P1:S4          0          0          0
row5:R3:P2:S1          0          0          0
row5:R3:P2:S2          0          0          0
row5:R3:P2:S3          0          0          0
row5:R3:P2:S4          0          0          0
row5:R4:P1:S1          0          0          0
row5:R4:P1:S2          0          0          0
row5:R4:P1:S3          0          0          0
row5:R4:P1:S4          0          0          0
row5:R4:P2:S1          0          0          0
row5:R4:P2:S2          0          0          0
row5:R4:P2:S3          0          0          0
row5:R4:P2:S4          0          0          0
row5:R5:P1:S1          0          0          0
row5:R5:P1:S2          0          0          0
row5:R5:P1:S3          0          0          0
row5:R5:P1:S4          0          0          0
row5:R5:P2:S1          0          0          0
row5:R5:P2:S2          0          0          0
row5:R5:P2:S3          0          0          0
row5:R5:P2:S4          0          0          0
```

```r
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(height ~ row + R + P + S + S:R + row:P + R:P + row:R:P + S:P +
        S:P:row + S:R:P + R:S:P:row, ex3.1a), type=3, singular.ok=TRUE)
```

```
        # NOT WORKING
```

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

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

(10) MODEL

- p94 Appendix 3.1

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

```
   row col rep var nit set reps yield
1    1   1   1   3   3   1    1   156
2    1   2   1   3   2   1    1   118
3    1   3   4   3   2   2    1   109
4    1   4   4   3   3   2    1    99
5    2   1   1   3   1   1    1   140
6    2   2   1   3   4   1    1   105
7    2   3   4   3   4   2    1    63
8    2   4   4   3   1   2    1    70
9    3   1   1   1   4   1    1   111
10   3   2   1   1   1   1    1   130
11   3   3   4   2   4   2    1    80
12   3   4   4   2   2   2    1    94
13   4   1   1   1   3   1    1   174
14   4   2   1   1   2   1    1   157
15   4   3   4   2   3   2    1   126
16   4   4   4   2   1   2    1    82
17   5   1   1   2   4   1    1   117
18   5   2   1   2   1   1    1   114
19   5   3   4   1   1   2    1    90
20   5   4   4   1   2   2    1   100
21   6   1   1   2   2   1    1   161
22   6   2   1   2   3   1    1   141
23   6   3   4   1   3   2    1   116
24   6   4   4   1   4   2    1    62
25   7   1   2   3   2   1    2   104
26   7   2   2   3   4   1    2    70
27   7   3   5   2   3   2    2    96
28   7   4   5   2   4   2    2    60
29   8   1   2   3   1   1    2    89
30   8   2   2   3   3   1    2   117
31   8   3   5   2   2   2    2    89
32   8   4   5   2   1   2    2   102
```

```
33   9   1   2   1   3   1   2   122
34   9   2   2   1   4   1   2    74
35   9   3   5   1   2   2   2   112
36   9   4   5   1   3   2   2    86
37  10   1   2   1   1   1   2    89
38  10   2   2   1   2   1   2    81
39  10   3   5   1   4   2   2    68
40  10   4   5   1   1   2   2    64
41  11   1   2   2   1   1   2   103
42  11   2   2   2   4   1   2    64
43  11   3   5   3   2   2   2   132
44  11   4   5   3   3   2   2   124
45  12   1   2   2   2   1   2   132
46  12   2   2   2   3   1   2   133
47  12   3   5   3   1   2   2   129
48  12   4   5   3   4   2   2    89
49  13   1   3   2   1   1   3   108
50  13   2   3   2   2   1   3   126
51  13   3   6   1   2   2   3   118
52  13   4   6   1   4   2   3    53
53  14   1   3   2   3   1   3   149
54  14   2   3   2   4   1   3    70
55  14   3   6   1   3   2   3   113
56  14   4   6   1   1   2   3    74
57  15   1   3   3   3   1   3   144
58  15   2   3   3   1   1   3   124
59  15   3   6   2   3   2   3   104
60  15   4   6   2   2   2   3    86
61  16   1   3   3   2   1   3   121
62  16   2   3   3   4   1   3    96
63  16   3   6   2   4   2   3    89
64  16   4   6   2   1   2   3    82
65  17   1   3   1   4   1   3    61
66  17   2   3   1   3   1   3   100
67  17   3   6   3   4   2   3    97
68  17   4   6   3   1   2   3    99
69  18   1   3   1   1   1   3    91
70  18   2   3   1   2   1   3    97
71  18   3   6   3   2   2   3   119
72  18   4   6   3   3   2   3   121
```

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

```
$ANOVA
Response : yield
             Df  Sum Sq  Mean Sq  F value    Pr(>F)
MODEL        37   48090   1299.7   11.341  6.734e-11 ***
RESIDUALS    34    3896    114.6
```

```
CORRECTED TOTAL 71  51986
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type I`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      5 15875.3  3175.1 27.7056 4.391e-11 ***
var      2  1786.4   893.2  7.7939 0.0016359 **
rep:var 10  6013.3   601.3  5.2472 0.0001207 ***
nit      3 20020.5  6673.5 58.2331 1.754e-13 ***
var:nit  6   321.7    53.6  0.4679 0.8271333
row      9   900.9   100.1  0.8734 0.5575581
col      2  3171.5  1585.7 13.8373 4.012e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      2  5942.5  2971.3 25.9273 1.449e-07 ***
var      2  2799.8  1399.9 12.2155 0.0001005 ***
rep:var  4   997.8   249.4  2.1767 0.0926008 .
nit      3 12559.3  4186.4 36.5308 9.683e-11 ***
var:nit  6   477.8    79.6  0.6949 0.6553307
row      9   945.0   105.0  0.9162 0.5230151
col      2  3171.5  1585.7 13.8373 4.012e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
CAUTION: Singularity Exists !
        Df  Sum Sq Mean Sq F value    Pr(>F)
rep      2  5942.5  2971.3 25.9273 1.449e-07 ***
var      2  2799.8  1399.9 12.2155 0.0001005 ***
rep:var  4   997.8   249.4  2.1767 0.0926008 .
nit      3 11977.9  3992.6 34.8397 1.775e-10 ***
var:nit  6   477.8    79.6  0.6949 0.6553307
row      9   945.0   105.0  0.9162 0.5230151
col      2  3171.5  1585.7 13.8373 4.012e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
            Estimate Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)   78.195         0     9.4953 34  8.2351 1.311e-09 ***
rep1          22.320         0    11.2116 34  1.9908 0.0545890 .
rep2          -9.827         0     9.9492 34 -0.9877 0.3302882
rep3          16.942         0    10.2780 34  1.6484 0.1084805
rep4         -24.656         0    10.6082 34 -2.3242 0.0262249 *
```

```
rep5          16.807        0     10.1264 34  1.6597 0.1061670
rep6           0.000        0      0.0000 34
var1         -23.629        0     12.0789 34 -1.9562 0.0586954  .
var2         -16.007        0     11.9933 34 -1.3346 0.1908629
var3           0.000        0      0.0000 34
rep1:var1     39.666        0     14.2816 34  2.7775 0.0088510 **
rep1:var2     24.703        0     14.1608 34  1.7445 0.0901108  .
rep1:var3      0.000        0      0.0000 34
rep2:var1      8.452        0     13.6932 34  0.6172 0.5411868
rep2:var2     35.142        0     13.4753 34  2.6079 0.0134358 *
rep2:var3      0.000        0      0.0000 34
rep3:var1    -15.615        0     15.0163 34 -1.0399 0.3057408
rep3:var2      5.214        0     14.8157 34  0.3519 0.7270537
rep3:var3      0.000        0      0.0000 34
rep4:var1     32.022        0     14.0835 34  2.2737 0.0294152 *
rep4:var2     32.597        0     14.2110 34  2.2938 0.0281056 *
rep4:var3      0.000        0      0.0000 34
rep5:var1    -29.657        0     14.2036 34 -2.0880 0.0443605 *
rep5:var2    -20.826        0     14.0023 34 -1.4873 0.1461435
rep5:var3      0.000        0      0.0000 34
rep6:var1      0.000        0      0.0000 34
rep6:var2      0.000        0      0.0000 34
rep6:var3      0.000        0      0.0000 34
nit1          20.904        0      6.8122 34  3.0686 0.0042045 **
nit2          25.790        0      7.9006 34  3.2643 0.0025052 **
nit3          43.888        0      8.4402 34  5.1999 9.452e-06 ***
nit4           0.000        0      0.0000 34
var1:nit1      1.136        0      9.7632 34  0.1164 0.9080219
var1:nit2     14.232        0     10.2550 34  1.3878 0.1742328
var1:nit3     -3.260        0     11.0914 34 -0.2939 0.7705879
var1:nit4      0.000        0      0.0000 34
var2:nit1     -1.428        0      9.1191 34 -0.1566 0.8764628
var2:nit2      5.784        0     11.0936 34  0.5214 0.6054692
var2:nit3     -6.461        0     11.3313 34 -0.5702 0.5722670
var2:nit4      0.000        0      0.0000 34
var3:nit1      0.000        0      0.0000 34
var3:nit2      0.000        0      0.0000 34
var3:nit3      0.000        0      0.0000 34
var3:nit4      0.000        0      0.0000 34
row1           1.613        0      9.9332 34  0.1624 0.8719639
row2           0.000        0      0.0000 34
row3         -10.016        0      8.3602 34 -1.1980 0.2391928
row4           0.000        0      0.0000 34
row5          -7.727        0      8.5301 34 -0.9059 0.3713775
row6           0.000        0      0.0000 34
row7          -3.594        0      8.6347 34 -0.4162 0.6798797
row8           0.000        0      0.0000 34
row9          13.706        0      8.4538 34  1.6213 0.1141882
```

```
row10          0.000          0      0.0000 34
row11        -14.812          0      8.7800 34 -1.6870 0.1007506
row12          0.000          0      0.0000 34
row13          2.006          0      8.3976 34   0.2389 0.8126419
row14          0.000          0      0.0000 34
row15         -4.632          0      8.4677 34 -0.5470 0.5879538
row16          0.000          0      0.0000 34
row17         -0.198          0      8.7515 34 -0.0226 0.9820790
row18          0.000          0      0.0000 34
col1          11.566          0      3.9157 34   2.9538 0.0056610 **
col2           0.000          0      0.0000 34
col3          16.517          0      4.1675 34   3.9633 0.0003597 ***
col4           0.000          0      0.0000 34
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

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

Anova Table (Type III tests)

Response: yield
          Sum Sq Df F values     Pr(>F)
rep       5942.5  2  25.9273 1.449e-07 ***
var          0.0  0
nit      11977.9  3  34.8397 1.775e-10 ***
row        945.0  9   0.9162    0.5230
col       3171.5  2  13.8373 4.012e-05 ***
rep:var    997.8  4   2.1767    0.0926 .
var:nit    477.8  6   0.6949    0.6553
Residuals 3896.4 34
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

6.3 Example 5.1

(11) MODEL

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

```
  R A C B Tx Y
1 1 1 1 2  1 2
2 1 1 1 1  2 5
3 1 1 2 2  4 6
```

```
4  1 1 2 1   3 9
5  1 1 3 1   6 8
6  1 1 3 2   5 5
7  1 2 1 2   4 9
8  1 2 1 1   3 7
9  1 2 2 2   6 8
10 1 2 2 1   5 4
11 1 2 3 1   1 3
12 1 2 3 2   2 5
13 2 2 1 2   6 8
14 2 2 1 1   5 5
15 2 2 2 2   1 3
16 2 2 2 1   2 5
17 2 2 3 1   4 9
18 2 2 3 2   3 7
19 2 1 1 2   3 3
20 2 1 1 1   6 4
21 2 1 2 2   5 3
22 2 1 2 1   1 0
23 2 1 3 1   2 1
24 2 1 3 2   4 2
25 3 1 1 2   5 5
26 3 1 1 1   1 5
27 3 1 2 2   2 5
28 3 1 2 1   4 9
29 3 1 3 1   3 7
30 3 1 3 2   6 8
31 3 2 1 2   2 6
32 3 2 1 1   4 8
33 3 2 2 2   3 7
34 3 2 2 1   6 8
35 3 2 3 1   5 6
36 3 2 3 2   1 3
```

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

```
$ANOVA
Response : Y
                 Df  Sum Sq Mean Sq F value     Pr(>F)
MODEL            24 196.238  8.1766  7.0476 0.0008758 ***
RESIDUALS        11  12.762  1.1602
CORRECTED TOTAL  35 209.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type I`
     Df  Sum Sq Mean Sq F value     Pr(>F)
R     2  33.500 16.7500 14.4373 0.0008391 ***
```

```
A     1  16.000 16.0000 13.7908 0.0034197 **
R:A   2  32.167 16.0833 13.8626 0.0009856 ***
C     2   0.500  0.2500  0.2155 0.8094766
B     1   1.778  1.7778  1.5323 0.2415358
C:B   2   0.389  0.1944  0.1676 0.8478141
Tx    5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx  5   6.521  1.3042  1.1241 0.4027183
B:Tx  4   2.050  0.5126  0.4418 0.7761730
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  23.116 11.5581  9.9622  0.003396 **
A     1  12.375 12.3751 10.6664  0.007519 **
R:A   2  27.426 13.7132 11.8197  0.001820 **
C     2   0.970  0.4850  0.4180  0.668392
B     1   1.757  1.7574  1.5148  0.244080
C:B   2   0.085  0.0424  0.0366  0.964202
Tx    5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx  4   2.655  0.6636  0.5720  0.688652
B:Tx  4   2.050  0.5126  0.4418  0.776173
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
CAUTION: Singularity Exists !
     Df  Sum Sq Mean Sq F value    Pr(>F)
R     2  22.186 11.0928  9.5611  0.003924 **
A     1  15.185 15.1853 13.0886  0.004042 **
R:A   2  27.426 13.7132 11.8197  0.001820 **
C     2   1.010  0.5049  0.4352  0.657839
B     1   1.792  1.7922  1.5448  0.239751
C:B   2   0.085  0.0424  0.0366  0.964202
Tx    5 103.333 20.6667 17.8131 6.055e-05 ***
A:Tx  4   2.655  0.6636  0.5720  0.688652
B:Tx  4   2.050  0.5126  0.4418  0.776173
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
            Estimate Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)   7.9545         0    0.98427 11  8.0817  5.93e-06 ***
R1           -0.6318         0    0.73222 11 -0.8629 0.4066247
R2           -0.1636         0    0.66557 11 -0.2459 0.8103184
R3            0.0000         0    0.00000 11
A1            0.2273         0    1.10928 11  0.2049 0.8414057
A2            0.0000         0    0.00000 11
```

```
R1:A1          0.4636       0    1.09010 11   0.4253 0.6788082
R1:A2          0.0000       0    0.00000 11
R2:A1         -3.7682       0    0.98951 11  -3.8081 0.0029022 **
R2:A2          0.0000       0    0.00000 11
R3:A1          0.0000       0    0.00000 11
R3:A2          0.0000       0    0.00000 11
C1             0.2682       0    0.73222 11   0.3663 0.7211200
C2             0.4364       0    0.66557 11   0.6556 0.5255407
C3             0.0000       0    0.00000 11
B1            -0.2409       0    1.17470 11  -0.2051 0.8412545
B2             0.0000       0    0.00000 11
C1:B1         -0.2318       0    0.98951 11  -0.2343 0.8190745
C1:B2          0.0000       0    0.00000 11
C2:B1          0.0318       0    0.98951 11   0.0322 0.9749241
C2:B2          0.0000       0    0.00000 11
C3:B1          0.0000       0    0.00000 11
C3:B2          0.0000       0    0.00000 11
Tx1           -5.3485       0    1.04397 11  -5.1232 0.0003318 ***
Tx2           -2.5152       0    1.00973 11  -2.4909 0.0299872 *
Tx3           -1.1667       0    1.04397 11  -1.1175 0.2875828
Tx4            0.2424       0    1.22954 11   0.1972 0.8472929
Tx5           -2.6167       0    1.17171 11  -2.2332 0.0472599 *
Tx6            0.0000       0    0.00000 11
A1:Tx1        -0.4182       0    1.59983 11  -0.2614 0.7986202
A1:Tx2        -0.6182       0    1.42305 11  -0.4344 0.6723913
A1:Tx3        -0.2000       0    1.59983 11  -0.1250 0.9027684
A1:Tx4        -2.0091       0    1.51170 11  -1.3290 0.2107461
A1:Tx5        -0.1000       0    1.98612 11  -0.0503 0.9607465
A1:Tx6         0.0000       0    0.00000 11
A2:Tx1         0.0000       0    0.00000 11
A2:Tx2         0.0000       0    0.00000 11
A2:Tx3         0.0000       0    0.00000 11
A2:Tx4         0.0000       0    0.00000 11
A2:Tx5         0.0000       0    0.00000 11
A2:Tx6         0.0000       0    0.00000 11
B1:Tx1         1.7818       0    1.59983 11   1.1138 0.2891291
B1:Tx2        -0.0182       0    1.42305 11  -0.0128 0.9900347
B1:Tx3         1.2000       0    1.59983 11   0.7501 0.4689466
B1:Tx4         1.1909       0    1.51170 11   0.7878 0.4474596
B1:Tx5         0.0000       0    0.00000 11
B1:Tx6         0.0000       0    0.00000 11
B2:Tx1         0.0000       0    0.00000 11
B2:Tx2         0.0000       0    0.00000 11
B2:Tx3         0.0000       0    0.00000 11
B2:Tx4         0.0000       0    0.00000 11
B2:Tx5         0.0000       0    0.00000 11
B2:Tx6         0.0000       0    0.00000 11
---
```

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

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

```
Model :
Y ~ 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    0  -1/5    0     0  -1/5    0    0    0    0    0    0
       R2:A1 C1:B1 C2:B1 A1:Tx1 A1:Tx2 A1:Tx3 A1:Tx4 A1:Tx5 B1:Tx1 B1:Tx2 B1:Tx3
B1:Tx5    0     0     0    1/5    1/5    1/5    1/5     -1    1/5    1/5    1/5
       B1:Tx4
B1:Tx5  1/5
```

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

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

Anova Table (Type III tests)

Response: Y
          Sum Sq Df F values     Pr(>F)
R         22.186  2   9.5611   0.003924 **
A          0.000  0
C          1.010  2   0.4352   0.657839
B          0.000  0
Tx       103.333  5  17.8131 6.055e-05 ***
R:A       27.426  2  11.8197   0.001820 **
C:B        0.085  2   0.0366   0.964202
A:Tx       2.655  4   0.5720   0.688652
B:Tx       2.050  4   0.4418   0.776173
Residuals 12.762 11
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

 (12) MODEL

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

```
$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value   Pr(>F)
MODEL           28  204.2  7.2929  10.635 0.001719 **
RESIDUALS        7    4.8  0.6857
CORRECTED TOTAL 35  209.0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type I`
       Df  Sum Sq Mean Sq F value     Pr(>F)
R        2  33.500 16.7500 24.4271 0.0006969 ***
A        1  16.000 16.0000 23.3333 0.0018985 **
R:A      2  32.167 16.0833 23.4549 0.0007889 ***
C        2   0.500  0.2500  0.3646 0.7069339
B        1   1.778  1.7778  2.5926 0.1513998
C:B      2   0.389  0.1944  0.2836 0.7613494
Tx       5 103.333 20.6667 30.1389 0.0001357 ***
A:Tx     5   6.521  1.3042  1.9019 0.2123307
B:Tx     4   2.050  0.5126  0.7475 0.5896365
A:B:Tx   4   7.962  1.9905  2.9029 0.1038803
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
       Df  Sum Sq Mean Sq F value     Pr(>F)
R        2  31.838 15.9191 23.2153 0.0008139 ***
A        1  12.375 12.3751 18.0470 0.0038017 **
R:A      1   2.017  2.0174  2.9420 0.1300172
C        2   0.500  0.2500  0.3645 0.7069558
B        1   1.757  1.7574  2.5629 0.1534298
C:B      1   0.644  0.6445  0.9399 0.3646045
Tx       5 103.333 20.6667 30.1389 0.0001357 ***
A:Tx     4   2.655  0.6636  0.9678 0.4812226
B:Tx     4   2.050  0.5126  0.7475 0.5896365
A:B:Tx   4   7.962  1.9905  2.9029 0.1038803
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
CAUTION: Singularity Exists !
       Df  Sum Sq Mean Sq F value     Pr(>F)
R        2  28.112 14.0562 20.4986 0.0011846 **
A        1  14.655 14.6551 21.3720 0.0024176 **
R:A      1   2.017  2.0174  2.9420 0.1300172
C        2   0.471  0.2356  0.3436 0.7205632
B        1   1.769  1.7694  2.5804 0.1522328
C:B      1   0.644  0.6445  0.9399 0.3646045
Tx       5 103.815 20.7630 30.2793 0.0001336 ***
A:Tx     4   2.951  0.7378  1.0760 0.4358837
B:Tx     4   3.553  0.8882  1.2954 0.3579988
A:B:Tx   4   7.962  1.9905  2.9029 0.1038803
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
```

	Estimate	Estimable	Std. Error	Df	t value	Pr(>|t|)	
(Intercept)	8.5833	0	0.86189	7	9.9587	2.199e-05	***
R1	-1.2833	0	0.79282	7	-1.6187	0.1495477	
R2	-0.0500	0	0.55549	7	-0.0900	0.9308004	
R3	0.0000	0	0.00000	7			
A1	-0.5833	0	0.98561	7	-0.5918	0.5725621	
A2	0.0000	0	0.00000	7			
R1:A1	1.7250	0	1.00570	7	1.7152	0.1300172	
R1:A2	0.0000	0	0.00000	7			
R2:A1	-3.4083	0	1.01136	7	-3.3700	0.0119197	*
R2:A2	0.0000	0	0.00000	7			
R3:A1	0.0000	0	0.00000	7			
R3:A2	0.0000	0	0.00000	7			
C1	-0.3833	0	0.79282	7	-0.4835	0.6434958	
C2	0.5500	0	0.55549	7	0.9901	0.3551012	
C3	0.0000	0	0.00000	7			
B1	-0.4417	0	0.94112	7	-0.4693	0.6531236	
B2	0.0000	0	0.00000	7			
C1:B1	0.2833	0	0.96806	7	0.2927	0.7782513	
C1:B2	0.0000	0	0.00000	7			
C2:B1	-0.6917	0	0.82462	7	-0.8388	0.4293080	
C2:B2	0.0000	0	0.00000	7			
C3:B1	0.0000	0	0.00000	7			
C3:B2	0.0000	0	0.00000	7			
Tx1	-5.8333	0	0.95618	7	-6.1006	0.0004908	***
Tx2	-2.2500	0	0.92582	7	-2.4303	0.0454020	*
Tx3	-1.8333	0	0.95618	7	-1.9173	0.0967067	.
Tx4	2.0833	0	1.37321	7	1.5171	0.1730222	
Tx5	-2.6167	0	0.90079	7	-2.9048	0.0228276	*
Tx6	0.0000	0	0.00000	7			
A1:Tx1	-0.2250	0	1.75173	7	-0.1284	0.9014099	
A1:Tx2	-1.3000	0	1.69706	7	-0.7660	0.4686960	
A1:Tx3	0.6750	0	1.75173	7	0.3853	0.7114327	
A1:Tx4	-4.8500	0	1.70713	7	-2.8410	0.0250077	*
A1:Tx5	-0.1000	0	1.52690	7	-0.0655	0.9496134	
A1:Tx6	0.0000	0	0.00000	7			
A2:Tx1	0.0000	0	0.00000	7			
A2:Tx2	0.0000	0	0.00000	7			
A2:Tx3	0.0000	0	0.00000	7			
A2:Tx4	0.0000	0	0.00000	7			
A2:Tx5	0.0000	0	0.00000	7			
A2:Tx6	0.0000	0	0.00000	7			
B1:Tx1	1.9750	0	1.75173	7	1.1275	0.2967084	
B1:Tx2	-0.7000	0	1.69706	7	-0.4125	0.6923283	
B1:Tx3	2.0750	0	1.75173	7	1.1845	0.2748540	
B1:Tx4	-1.6500	0	1.70713	7	-0.9665	0.3659742	
B1:Tx5	0.0000	0	0.00000	7			
B1:Tx6	0.0000	0	0.00000	7			

```
B2:Tx1          0.0000          0     0.00000  7
B2:Tx2          0.0000          0     0.00000  7
B2:Tx3          0.0000          0     0.00000  7
B2:Tx4          0.0000          0     0.00000  7
B2:Tx5          0.0000          0     0.00000  7
B2:Tx6          0.0000          0     0.00000  7
A1:B1:Tx1       0.8750          0     2.32379  7   0.3765 0.7176693
A1:B1:Tx2       1.2500          0     2.37847  7   0.5255 0.6154343
A1:B1:Tx3      -0.6250          0     2.32379  7  -0.2690 0.7957174
A1:B1:Tx4       6.0000          0     2.02837  7   2.9580 0.0211639 *
A1:B1:Tx5                       0
A1:B1:Tx6       0.0000          0     0.00000  7
A1:B2:Tx1       0.0000          0     0.00000  7
A1:B2:Tx2       0.0000          0     0.00000  7
A1:B2:Tx3       0.0000          0     0.00000  7
A1:B2:Tx4       0.0000          0     0.00000  7
A1:B2:Tx5       0.0000          0     0.00000  7
A1:B2:Tx6       0.0000          0     0.00000  7
A2:B1:Tx1       0.0000          0     0.00000  7
A2:B1:Tx2       0.0000          0     0.00000  7
A2:B1:Tx3       0.0000          0     0.00000  7
A2:B1:Tx4       0.0000          0     0.00000  7
A2:B1:Tx5       0.0000          0     0.00000  7
A2:B1:Tx6       0.0000          0     0.00000  7
A2:B2:Tx1       0.0000          0     0.00000  7
A2:B2:Tx2       0.0000          0     0.00000  7
A2:B2:Tx3       0.0000          0     0.00000  7
A2:B2:Tx4       0.0000          0     0.00000  7
A2:B2:Tx5                       0
A2:B2:Tx6       0.0000          0     0.00000  7
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
alias(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1)

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


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

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

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

```
R2:G28       0.0000        0    0.00000 24
R3:G1                      0
R3:G2                      0
R3:G3                      0
R3:G4                      0
R3:G5                      0
R3:G6                      0
R3:G7                      0
R3:G8                      0
R3:G9                      0
R3:G10                     0
R3:G11                     0
R3:G12                     0
R3:G13       0.0000        0    0.00000 24
R3:G14       0.0000        0    0.00000 24
R3:G15       0.0000        0    0.00000 24
R3:G16       0.0000        0    0.00000 24
R3:G17       0.0000        0    0.00000 24
R3:G18       0.0000        0    0.00000 24
R3:G19                     0
R3:G20                     0
R3:G21                     0
R3:G22                     0
R3:G23                     0
R3:G24                     0
R3:G25       1.3333        0    1.23603 24   1.0787 0.2914354
R3:G26       1.0000        0    1.23603 24   0.8090 0.4264404
R3:G27      -0.6667        0    1.23603 24  -0.5394 0.5946075
R3:G28       0.0000        0    0.00000 24
R4:G1                      0
R4:G2                      0
R4:G3                      0
R4:G4                      0
R4:G5                      0
R4:G6                      0
R4:G7                      0
R4:G8                      0
R4:G9                      0
R4:G10                     0
R4:G11                     0
R4:G12                     0
R4:G13                     0
R4:G14                     0
R4:G15                     0
R4:G16                     0
R4:G17                     0
R4:G18                     0
R4:G19       0.0000        0    0.00000 24
```

```
R4:G20          0.0000        0    0.00000 24
R4:G21          0.0000        0    0.00000 24
R4:G22          0.0000        0    0.00000 24
R4:G23          0.0000        0    0.00000 24
R4:G24          0.0000        0    0.00000 24
R4:G25          0.0000        0    0.00000 24
R4:G26          0.0000        0    0.00000 24
R4:G27          0.0000        0    0.00000 24
R4:G28          0.0000        0    0.00000 24
F1              0.0000        0    0.75691 24   0.0000 1.0000000
F2              0.0000        0    0.75691 24   0.0000 1.0000000
F3              0.0000        0    0.00000 24
G1:F1          -5.0000        0    1.69251 24  -2.9542 0.0069174 **
G1:F2          -2.0000        0    1.69251 24  -1.1817 0.2489103
G1:F3           0.0000        0    0.00000 24
G2:F1          -2.0000        0    1.69251 24  -1.1817 0.2489103
G2:F2           1.0000        0    1.69251 24   0.5908 0.5601518
G2:F3           0.0000        0    0.00000 24
G3:F1          -2.0000        0    1.69251 24  -1.1817 0.2489103
G3:F2           1.0000        0    1.69251 24   0.5908 0.5601518
G3:F3           0.0000        0    0.00000 24
G4:F1           1.0000        0    1.69251 24   0.5908 0.5601518
G4:F2           4.0000        0    1.69251 24   2.3634 0.0265504 *
G4:F3           0.0000        0    0.00000 24
G5:F1          -2.0000        0    1.69251 24  -1.1817 0.2489103
G5:F2           0.0000        0    1.69251 24   0.0000 1.0000000
G5:F3           0.0000        0    0.00000 24
G6:F1           0.0000        0    1.69251 24   0.0000 1.0000000
G6:F2           1.0000        0    1.69251 24   0.5908 0.5601518
G6:F3           0.0000        0    0.00000 24
G7:F1          -2.0000        0    1.69251 24  -1.1817 0.2489103
G7:F2          -1.0000        0    1.69251 24  -0.5908 0.5601518
G7:F3           0.0000        0    0.00000 24
G8:F1          -3.0000        0    1.69251 24  -1.7725 0.0890040 .
G8:F2          -2.0000        0    1.69251 24  -1.1817 0.2489103
G8:F3           0.0000        0    0.00000 24
G9:F1          -1.0000        0    1.69251 24  -0.5908 0.5601518
G9:F2           0.0000        0    1.69251 24   0.0000 1.0000000
G9:F3           0.0000        0    0.00000 24
G10:F1         -1.0000        0    1.69251 24  -0.5908 0.5601518
G10:F2         -1.0000        0    1.69251 24  -0.5908 0.5601518
G10:F3          0.0000        0    0.00000 24
G11:F1          0.0000        0    1.69251 24   0.0000 1.0000000
G11:F2          0.0000        0    1.69251 24   0.0000 1.0000000
G11:F3          0.0000        0    0.00000 24
G12:F1         -4.0000        0    1.69251 24  -2.3634 0.0265504 *
G12:F2         -2.0000        0    1.69251 24  -1.1817 0.2489103
G12:F3          0.0000        0    0.00000 24
```

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```
G13:F1      -2.0000          0     1.69251 24 -1.1817 0.2489103
G13:F2      -2.0000          0     1.69251 24 -1.1817 0.2489103
G13:F3       0.0000          0     0.00000 24
G14:F1      -3.0000          0     1.69251 24 -1.7725 0.0890040 .
G14:F2      -2.0000          0     1.69251 24 -1.1817 0.2489103
G14:F3       0.0000          0     0.00000 24
G15:F1      -3.0000          0     1.69251 24 -1.7725 0.0890040 .
G15:F2      -1.0000          0     1.69251 24 -0.5908 0.5601518
G15:F3       0.0000          0     0.00000 24
G16:F1      -2.0000          0     1.69251 24 -1.1817 0.2489103
G16:F2      -2.0000          0     1.69251 24 -1.1817 0.2489103
G16:F3       0.0000          0     0.00000 24
G17:F1      -2.0000          0     1.69251 24 -1.1817 0.2489103
G17:F2       0.0000          0     1.69251 24  0.0000 1.0000000
G17:F3       0.0000          0     0.00000 24
G18:F1      -3.0000          0     1.69251 24 -1.7725 0.0890040 .
G18:F2      -1.0000          0     1.69251 24 -0.5908 0.5601518
G18:F3       0.0000          0     0.00000 24
G19:F1      -4.0000          0     1.69251 24 -2.3634 0.0265504 *
G19:F2      -1.0000          0     1.69251 24 -0.5908 0.5601518
G19:F3       0.0000          0     0.00000 24
G20:F1      -2.0000          0     1.69251 24 -1.1817 0.2489103
G20:F2      -2.0000          0     1.69251 24 -1.1817 0.2489103
G20:F3       0.0000          0     0.00000 24
G21:F1      -1.0000          0     1.69251 24 -0.5908 0.5601518
G21:F2      -4.0000          0     1.69251 24 -2.3634 0.0265504 *
G21:F3       0.0000          0     0.00000 24
G22:F1      -1.0000          0     1.69251 24 -0.5908 0.5601518
G22:F2      -2.0000          0     1.69251 24 -1.1817 0.2489103
G22:F3       0.0000          0     0.00000 24
G23:F1       0.0000          0     1.69251 24  0.0000 1.0000000
G23:F2      -1.0000          0     1.69251 24 -0.5908 0.5601518
G23:F3       0.0000          0     0.00000 24
G24:F1       0.0000          0     1.69251 24  0.0000 1.0000000
G24:F2      -1.0000          0     1.69251 24 -0.5908 0.5601518
G24:F3       0.0000          0     0.00000 24
G25:F1      -3.5000          0     1.07044 24 -3.2697 0.0032428 **
G25:F2      -2.2500          0     1.07044 24 -2.1019 0.0462352 *
G25:F3       0.0000          0     0.00000 24
G26:F1      -2.7500          0     1.07044 24 -2.5690 0.0168399 *
G26:F2      -2.2500          0     1.07044 24 -2.1019 0.0462352 *
G26:F3       0.0000          0     0.00000 24
G27:F1       0.0000          0     1.07044 24  0.0000 1.0000000
G27:F2      -0.2500          0     1.07044 24 -0.2335 0.8173152
G27:F3       0.0000          0     0.00000 24
G28:F1       0.0000          0     0.00000 24
G28:F2       0.0000          0     0.00000 24
G28:F3       0.0000          0     0.00000 24
```

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

```r
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

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

```
    Y R T  G F
1   2 1 1  1 1
2   4 1 1  1 2
3   6 1 1  1 3
4   3 1 1  2 1
5   5 1 1  2 2
6   7 1 1  2 3
7   7 1 1  3 1
8   7 1 1  3 2
9   9 1 1  3 3
10  8 1 1  4 1
11  8 1 1  4 2
12  9 1 1  4 3
13  8 1 1  5 1
14  8 1 1  5 2
15  9 1 1  5 3
16  2 1 1 21 1
17  5 1 1 21 2
18  7 1 1 21 3
19  4 1 1 22 1
```

```
20   6  1  1  22  2
21   7  1  1  22  3
22   6  1  1  23  1
23   7  1  1  23  2
24   8  1  1  23  3
25   3  1  2   1  1
26   4  1  2   1  2
27   5  1  2   1  3
28   4  1  2   2  1
29   6  1  2   2  2
30   8  1  2   2  3
31   7  1  2   3  1
32   8  1  2   3  2
33   9  1  2   3  3
34   9  1  2   4  1
35   8  1  2   4  2
36   9  1  2   4  3
37   7  1  2   5  1
38   9  1  2   5  2
39   9  1  2   5  3
40   3  1  2  21  1
41   6  1  2  21  2
42   7  1  2  21  3
43   5  1  2  22  1
44   7  1  2  22  2
45   8  1  2  22  3
46   6  1  2  23  1
47   7  1  2  23  2
48   8  1  2  23  3
49   4  2  1   6  1
50   5  2  1   6  2
51   6  2  1   6  3
52   6  2  1   7  1
53   7  2  1   7  2
54   8  2  1   7  3
55   7  2  1   8  1
56   8  2  1   8  2
57   9  2  1   8  3
58   7  2  1   9  1
59   8  2  1   9  2
60   9  2  1   9  3
61   3  2  1  10  1
62   5  2  1  10  2
63   6  2  1  10  3
64   3  2  1  21  1
65   5  2  1  21  2
66   7  2  1  21  3
67   5  2  1  22  1
```

```
68    5 2 1 22 2
69    7 2 1 22 3
70    6 2 1 23 1
71    7 2 1 23 2
72    9 2 1 23 3
73    5 2 2  6 1
74    6 2 2  6 2
75    7 2 2  6 3
76    6 2 2  7 1
77    7 2 2  7 2
78    7 2 2  7 3
79    7 2 2  8 1
80    9 2 2  8 2
81    8 2 2  8 3
82    7 2 2  9 1
83    7 2 2  9 2
84    9 2 2  9 3
85    4 2 2 10 1
86    5 2 2 10 2
87    7 2 2 10 3
88    2 2 2 21 1
89    4 2 2 21 2
90    5 2 2 21 3
91    6 2 2 22 1
92    7 2 2 22 2
93    8 2 2 22 3
94    6 2 2 23 1
95    7 2 2 23 2
96    8 2 2 23 3
97    4 3 1 11 1
98    5 3 1 11 2
99    6 3 1 11 3
100 7 3 1 12 1
101 8 3 1 12 2
102 8 3 1 12 3
103 6 3 1 13 1
104 7 3 1 13 2
105 7 3 1 13 3
106 7 3 1 14 1
107 7 3 1 14 2
108 9 3 1 14 3
109 2 3 1 15 1
110 3 3 1 15 2
111 4 3 1 15 3
112 4 3 1 21 1
113 5 3 1 21 2
114 5 3 1 21 3
115 6 3 1 22 1
```

```
116  7  3  1  22  2
117  8  3  1  22  3
118  7  3  1  23  1
119  8  3  1  23  2
120  8  3  1  23  3
121  5  3  2  11  1
122  5  3  2  11  2
123  6  3  2  11  3
124  8  3  2  12  1
125  8  3  2  12  2
126  9  3  2  12  3
127  7  3  2  13  1
128  7  3  2  13  2
129  9  3  2  13  3
130  7  3  2  14  1
131  8  3  2  14  2
132  8  3  2  14  3
133  4  3  2  15  1
134  5  3  2  15  2
135  7  3  2  15  3
136  3  3  2  21  1
137  6  3  2  21  2
138  6  3  2  21  3
139  7  3  2  22  1
140  7  3  2  22  2
141  9  3  2  22  3
142  7  3  2  23  1
143  8  3  2  23  2
144  9  3  2  23  3
145  1  4  1  16  1
146  3  4  1  16  2
147  5  4  1  16  3
148  2  4  1  17  1
149  4  4  1  17  2
150  5  4  1  17  3
151  3  4  1  18  1
152  4  4  1  18  2
153  6  4  1  18  3
154  4  4  1  19  1
155  5  4  1  19  2
156  7  4  1  19  3
157  5  4  1  20  1
158  5  4  1  20  2
159  7  4  1  20  3
160  5  4  1  21  1
161  6  4  1  21  2
162  8  4  1  21  3
163  5  4  1  22  1
```

```
164 7 4 1 22 2
165 7 4 1 22 3
166 6 4 1 23 1
167 8 4 1 23 2
168 9 4 1 23 3
169 2 4 2 16 1
170 2 4 2 16 2
171 4 4 2 16 3
172 3 4 2 17 1
173 5 4 2 17 2
174 6 4 2 17 3
175 4 4 2 18 1
176 6 4 2 18 2
177 7 4 2 18 3
178 5 4 2 19 1
179 7 4 2 19 2
180 7 4 2 19 3
181 6 4 2 20 1
182 7 4 2 20 2
183 8 4 2 20 3
184 4 4 2 21 1
185 6 4 2 21 2
186 7 4 2 21 3
187 7 4 2 22 1
188 8 4 2 22 2
189 8 4 2 22 3
190 7 4 2 23 1
191 8 4 2 23 2
192 9 4 2 23 3
```

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

```
$ANOVA
Response : Y
                 Df Sum Sq Mean Sq F value    Pr(>F)
MODEL           155 656.12  4.2330  13.446 3.997e-14 ***
RESIDUALS        36  11.33  0.3148
CORRECTED TOTAL 191 667.45
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type I`
      Df Sum Sq Mean Sq  F value    Pr(>F)
R      3  27.06   9.019  28.6489 1.203e-09 ***
T      1  10.55  10.547  33.5018 1.334e-06 ***
R:T    3   2.97   0.991   3.1489  0.036705 *
G     22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G   22  18.42   0.837   2.6601  0.004445 **
```

```
R:T:G 12   8.78   0.731   2.3235  0.025315 *
F      2 164.28  82.141 260.9173 < 2.2e-16 ***
T:F    2   0.84   0.422   1.3401  0.274574
G:F   44  23.47   0.533   1.6943  0.053191 .
T:G:F 44  10.74   0.244   0.7753  0.790640
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type II`
      Df Sum Sq Mean Sq  F value    Pr(>F)
R      3  12.49   4.162  13.2206 5.655e-06 ***
T      1  10.55  10.547  33.5018 1.334e-06 ***
R:T    3   1.15   0.384   1.2206  0.316281
G     22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G   22  18.42   0.837   2.6601  0.004445 **
R:T:G 12   8.78   0.731   2.3235  0.025315 *
F      2 164.28  82.141 260.9173 < 2.2e-16 ***
T:F    2   0.84   0.422   1.3401  0.274574
G:F   44  23.47   0.533   1.6943  0.053191 .
T:G:F 44  10.74   0.244   0.7753  0.790640
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$`Type III`
      Df Sum Sq Mean Sq  F value    Pr(>F)
R      3  12.49   4.162  13.2206 5.655e-06 ***
T      1  11.16  11.158  35.4430 8.021e-07 ***
R:T    3   1.15   0.384   1.2206  0.316281
G     22 389.01  17.682  56.1668 < 2.2e-16 ***
T:G   22  18.42   0.837   2.6601  0.004445 **
R:T:G 12   8.78   0.731   2.3235  0.025315 *
F      2 120.56  60.282 191.4828 < 2.2e-16 ***
T:F    2   0.82   0.411   1.3060  0.283432
G:F   44  23.47   0.533   1.6943  0.053191 .
T:G:F 44  10.74   0.244   0.7753  0.790640
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1


$Parameter
            Estimate Estimable Std. Error Df t value   Pr(>|t|)
(Intercept)   9.0000         0    0.39675 36 22.6845 < 2.2e-16 ***
R1           -1.0000         0    0.45812 36 -2.1828 0.0356525 *
R2           -1.0000         0    0.45812 36 -2.1828 0.0356525 *
R3            0.0000         0    0.45812 36  0.0000 1.0000000
R4            0.0000         0    0.00000 36
T1           -0.2500         0    0.56108 36 -0.4456 0.6585786
T2            0.0000         0    0.00000 36
R1:T1         0.3333         0    0.64788 36  0.5145 0.6100498
```

```
R1:T2        0.0000        0      0.00000 36
R2:T1        0.6667        0      0.64788 36   1.0290 0.3103479
R2:T2        0.0000        0      0.00000 36
R3:T1        0.0000        0      0.64788 36   0.0000 1.0000000
R3:T2        0.0000        0      0.00000 36
R4:T1        0.0000        0      0.00000 36
R4:T2        0.0000        0      0.00000 36
G1          -3.0000        0      0.68718 36  -4.3656 0.0001024 ***
G2           0.0000        0      0.68718 36   0.0000 1.0000000
G3           1.0000        0      0.68718 36   1.4552 0.1542753
G4           1.0000        0      0.68718 36   1.4552 0.1542753
G5           1.0000        0      0.68718 36   1.4552 0.1542753
G6          -1.0000        0      0.68718 36  -1.4552 0.1542753
G7          -1.0000        0      0.68718 36  -1.4552 0.1542753
G8           0.0000        0      0.68718 36   0.0000 1.0000000
G9           1.0000        0      0.68718 36   1.4552 0.1542753
G10         -1.0000        0      0.68718 36  -1.4552 0.1542753
G11         -3.0000        0      0.68718 36  -4.3656 0.0001024 ***
G12          0.0000        0      0.68718 36   0.0000 1.0000000
G13          0.0000        0      0.68718 36   0.0000 1.0000000
G14         -1.0000        0      0.68718 36  -1.4552 0.1542753
G15         -2.0000        0      0.68718 36  -2.9104 0.0061560 **
G16         -5.0000        0      0.68718 36  -7.2761 1.431e-08 ***
G17         -3.0000        0      0.68718 36  -4.3656 0.0001024 ***
G18         -2.0000        0      0.68718 36  -2.9104 0.0061560 **
G19         -2.0000        0      0.68718 36  -2.9104 0.0061560 **
G20         -1.0000        0      0.68718 36  -1.4552 0.1542753
G21         -2.0000        0      0.56108 36  -3.5645 0.0010508 **
G22         -0.3333        0      0.56108 36  -0.5941 0.5561681
G23          0.0000        0      0.00000 36
T1:G1        0.9167        0      0.97183 36   0.9432 0.3518445
T1:G2       -1.0833        0      0.97183 36  -1.1147 0.2723483
T1:G3       -0.0833        0      0.97183 36  -0.0857 0.9321409
T1:G4       -0.0833        0      0.97183 36  -0.0857 0.9321409
T1:G5       -0.0833        0      0.97183 36  -0.0857 0.9321409
T1:G6       -1.4167        0      0.97183 36  -1.4577 0.1535818
T1:G7        0.5833        0      0.97183 36   0.6002 0.5521031
T1:G8        0.5833        0      0.97183 36   0.6002 0.5521031
T1:G9       -0.4167        0      0.97183 36  -0.4287 0.6706625
T1:G10      -1.4167        0      0.97183 36  -1.4577 0.1535818
T1:G11       0.2500        0      0.97183 36   0.2572 0.7984521
T1:G12      -0.7500        0      0.97183 36  -0.7717 0.4453029
T1:G13      -1.7500        0      0.97183 36  -1.8007 0.0801274 .
T1:G14       1.2500        0      0.97183 36   1.2862 0.2065706
T1:G15      -2.7500        0      0.97183 36  -2.8297 0.0075715 **
T1:G16       1.2500        0      0.97183 36   1.2862 0.2065706
T1:G17      -0.7500        0      0.97183 36  -0.7717 0.4453029
T1:G18      -0.7500        0      0.97183 36  -0.7717 0.4453029
```

```
T1:G19          0.2500          0    0.97183 36   0.2572 0.7984521
T1:G20         -0.7500          0    0.97183 36  -0.7717 0.4453029
T1:G21          1.1667          0    0.79349 36   1.4703 0.1501689
T1:G22         -1.0000          0    0.79349 36  -1.2603 0.2156865
T1:G23          0.0000          0    0.00000 36
T2:G1           0.0000          0    0.00000 36
T2:G2           0.0000          0    0.00000 36
T2:G3           0.0000          0    0.00000 36
T2:G4           0.0000          0    0.00000 36
T2:G5           0.0000          0    0.00000 36
T2:G6           0.0000          0    0.00000 36
T2:G7           0.0000          0    0.00000 36
T2:G8           0.0000          0    0.00000 36
T2:G9           0.0000          0    0.00000 36
T2:G10          0.0000          0    0.00000 36
T2:G11          0.0000          0    0.00000 36
T2:G12          0.0000          0    0.00000 36
T2:G13          0.0000          0    0.00000 36
T2:G14          0.0000          0    0.00000 36
T2:G15          0.0000          0    0.00000 36
T2:G16          0.0000          0    0.00000 36
T2:G17          0.0000          0    0.00000 36
T2:G18          0.0000          0    0.00000 36
T2:G19          0.0000          0    0.00000 36
T2:G20          0.0000          0    0.00000 36
T2:G21          0.0000          0    0.00000 36
T2:G22          0.0000          0    0.00000 36
T2:G23          0.0000          0    0.00000 36
R1:T1:G1        0.0000          0    0.00000 36
R1:T1:G2        0.0000          0    0.00000 36
R1:T1:G3        0.0000          0    0.00000 36
R1:T1:G4        0.0000          0    0.00000 36
R1:T1:G5        0.0000          0    0.00000 36
R1:T1:G6                        0
R1:T1:G7                        0
R1:T1:G8                        0
R1:T1:G9                        0
R1:T1:G10                       0
R1:T1:G11                       0
R1:T1:G12                       0
R1:T1:G13                       0
R1:T1:G14                       0
R1:T1:G15                       0
R1:T1:G16                       0
R1:T1:G17                       0
R1:T1:G18                       0
R1:T1:G19                       0
R1:T1:G20                       0
```

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

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

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

```
R4:T2:G4                          0
R4:T2:G5                          0
R4:T2:G6                          0
R4:T2:G7                          0
R4:T2:G8                          0
R4:T2:G9                          0
R4:T2:G10                         0
R4:T2:G11                         0
R4:T2:G12                         0
R4:T2:G13                         0
R4:T2:G14                         0
R4:T2:G15                         0
R4:T2:G16    0.0000               0    0.00000 36
R4:T2:G17    0.0000               0    0.00000 36
R4:T2:G18    0.0000               0    0.00000 36
R4:T2:G19    0.0000               0    0.00000 36
R4:T2:G20    0.0000               0    0.00000 36
R4:T2:G21    0.0000               0    0.00000 36
R4:T2:G22    0.0000               0    0.00000 36
R4:T2:G23    0.0000               0    0.00000 36
F1          -2.0000               0    0.39675 36 -5.0410 1.325e-05 ***
F2          -1.0000               0    0.39675 36 -2.5205 0.0162919 *
F3           0.0000               0    0.00000 36
T1:F1       -0.2500               0    0.56108 36 -0.4456 0.6585786
T1:F2        0.0000               0    0.56108 36  0.0000 1.0000000
T1:F3        0.0000               0    0.00000 36
T2:F1        0.0000               0    0.00000 36
T2:F2        0.0000               0    0.00000 36
T2:F3        0.0000               0    0.00000 36
G1:F1        0.0000               0    0.88715 36  0.0000 1.0000000
G1:F2        0.0000               0    0.88715 36  0.0000 1.0000000
G1:F3        0.0000               0    0.00000 36
G2:F1       -2.0000               0    0.88715 36 -2.2544 0.0303508 *
G2:F2       -1.0000               0    0.88715 36 -1.1272 0.2671137
G2:F3        0.0000               0    0.00000 36
G3:F1        0.0000               0    0.88715 36  0.0000 1.0000000
G3:F2        0.0000               0    0.88715 36  0.0000 1.0000000
G3:F3        0.0000               0    0.00000 36
G4:F1        2.0000               0    0.88715 36  2.2544 0.0303508 *
G4:F2        0.0000               0    0.88715 36  0.0000 1.0000000
G4:F3        0.0000               0    0.00000 36
G5:F1        0.0000               0    0.88715 36  0.0000 1.0000000
G5:F2        1.0000               0    0.88715 36  1.1272 0.2671137
G5:F3        0.0000               0    0.00000 36
G6:F1        0.0000               0    0.88715 36  0.0000 1.0000000
G6:F2        0.0000               0    0.88715 36  0.0000 1.0000000
G6:F3        0.0000               0    0.00000 36
G7:F1        1.0000               0    0.88715 36  1.1272 0.2671137
```

```
G7:F2      1.0000      0   0.88715 36  1.1272 0.2671137
G7:F3      0.0000      0   0.00000 36
G8:F1      1.0000      0   0.88715 36  1.1272 0.2671137
G8:F2      2.0000      0   0.88715 36  2.2544 0.0303508 *
G8:F3      0.0000      0   0.00000 36
G9:F1      0.0000      0   0.88715 36  0.0000 1.0000000
G9:F2     -1.0000      0   0.88715 36 -1.1272 0.2671137
G9:F3      0.0000      0   0.00000 36
G10:F1    -1.0000      0   0.88715 36 -1.1272 0.2671137
G10:F2    -1.0000      0   0.88715 36 -1.1272 0.2671137
G10:F3     0.0000      0   0.00000 36
G11:F1     1.0000      0   0.88715 36  1.1272 0.2671137
G11:F2     0.0000      0   0.88715 36  0.0000 1.0000000
G11:F3     0.0000      0   0.00000 36
G12:F1     1.0000      0   0.88715 36  1.1272 0.2671137
G12:F2     0.0000      0   0.88715 36  0.0000 1.0000000
G12:F3     0.0000      0   0.00000 36
G13:F1     0.0000      0   0.88715 36  0.0000 1.0000000
G13:F2    -1.0000      0   0.88715 36 -1.1272 0.2671137
G13:F3     0.0000      0   0.00000 36
G14:F1     1.0000      0   0.88715 36  1.1272 0.2671137
G14:F2     1.0000      0   0.88715 36  1.1272 0.2671137
G14:F3     0.0000      0   0.00000 36
G15:F1    -1.0000      0   0.88715 36 -1.1272 0.2671137
G15:F2    -1.0000      0   0.88715 36 -1.1272 0.2671137
G15:F3     0.0000      0   0.00000 36
G16:F1     0.0000      0   0.88715 36  0.0000 1.0000000
G16:F2    -1.0000      0   0.88715 36 -1.1272 0.2671137
G16:F3     0.0000      0   0.00000 36
G17:F1    -1.0000      0   0.88715 36 -1.1272 0.2671137
G17:F2     0.0000      0   0.88715 36  0.0000 1.0000000
G17:F3     0.0000      0   0.00000 36
G18:F1    -1.0000      0   0.88715 36 -1.1272 0.2671137
G18:F2     0.0000      0   0.88715 36  0.0000 1.0000000
G18:F3     0.0000      0   0.00000 36
G19:F1     0.0000      0   0.88715 36  0.0000 1.0000000
G19:F2     1.0000      0   0.88715 36  1.1272 0.2671137
G19:F3     0.0000      0   0.00000 36
G20:F1     0.0000      0   0.88715 36  0.0000 1.0000000
G20:F2     0.0000      0   0.88715 36  0.0000 1.0000000
G20:F3     0.0000      0   0.00000 36
G21:F1    -1.2500      0   0.56108 36 -2.2278 0.0322306 *
G21:F2     0.2500      0   0.56108 36  0.4456 0.6585786
G21:F3     0.0000      0   0.00000 36
G22:F1     0.0000      0   0.56108 36  0.0000 1.0000000
G22:F2     0.0000      0   0.56108 36  0.0000 1.0000000
G22:F3     0.0000      0   0.00000 36
G23:F1     0.0000      0   0.00000 36
```

```
G23:F2          0.0000          0       0.00000 36
G23:F3          0.0000          0       0.00000 36
T1:G1:F1       -1.7500          0       1.25462 36 -1.3948 0.1716105
T1:G1:F2       -1.0000          0       1.25462 36 -0.7971 0.4306457
T1:G1:F3        0.0000          0       0.00000 36
T1:G2:F1        0.2500          0       1.25462 36  0.1993 0.8431780
T1:G2:F2        0.0000          0       1.25462 36  0.0000 1.0000000
T1:G2:F3        0.0000          0       0.00000 36
T1:G3:F1        0.2500          0       1.25462 36  0.1993 0.8431780
T1:G3:F2       -1.0000          0       1.25462 36 -0.7971 0.4306457
T1:G3:F3        0.0000          0       0.00000 36
T1:G4:F1       -0.7500          0       1.25462 36 -0.5978 0.5537222
T1:G4:F2        0.0000          0       1.25462 36  0.0000 1.0000000
T1:G4:F3        0.0000          0       0.00000 36
T1:G5:F1        1.2500          0       1.25462 36  0.9963 0.3257463
T1:G5:F2       -1.0000          0       1.25462 36 -0.7971 0.4306457
T1:G5:F3        0.0000          0       0.00000 36
T1:G6:F1        0.2500          0       1.25462 36  0.1993 0.8431780
T1:G6:F2        0.0000          0       1.25462 36  0.0000 1.0000000
T1:G6:F3        0.0000          0       0.00000 36
T1:G7:F1       -0.7500          0       1.25462 36 -0.5978 0.5537222
T1:G7:F2       -1.0000          0       1.25462 36 -0.7971 0.4306457
T1:G7:F3        0.0000          0       0.00000 36
T1:G8:F1       -0.7500          0       1.25462 36 -0.5978 0.5537222
T1:G8:F2       -2.0000          0       1.25462 36 -1.5941 0.1196553
T1:G8:F3        0.0000          0       0.00000 36
T1:G9:F1        0.2500          0       1.25462 36  0.1993 0.8431780
T1:G9:F2        1.0000          0       1.25462 36  0.7971 0.4306457
T1:G9:F3        0.0000          0       0.00000 36
T1:G10:F1       0.2500          0       1.25462 36  0.1993 0.8431780
T1:G10:F2       1.0000          0       1.25462 36  0.7971 0.4306457
T1:G10:F3       0.0000          0       0.00000 36
T1:G11:F1      -0.7500          0       1.25462 36 -0.5978 0.5537222
T1:G11:F2       0.0000          0       1.25462 36  0.0000 1.0000000
T1:G11:F3       0.0000          0       0.00000 36
T1:G12:F1       0.2500          0       1.25462 36  0.1993 0.8431780
T1:G12:F2       1.0000          0       1.25462 36  0.7971 0.4306457
T1:G12:F3       0.0000          0       0.00000 36
T1:G13:F1       1.2500          0       1.25462 36  0.9963 0.3257463
T1:G13:F2       2.0000          0       1.25462 36  1.5941 0.1196553
T1:G13:F3       0.0000          0       0.00000 36
T1:G14:F1      -0.7500          0       1.25462 36 -0.5978 0.5537222
T1:G14:F2      -2.0000          0       1.25462 36 -1.5941 0.1196553
T1:G14:F3       0.0000          0       0.00000 36
T1:G15:F1       1.2500          0       1.25462 36  0.9963 0.3257463
T1:G15:F2       1.0000          0       1.25462 36  0.7971 0.4306457
T1:G15:F3       0.0000          0       0.00000 36
T1:G16:F1      -1.7500          0       1.25462 36 -1.3948 0.1716105
```

```
T1:G16:F2     0.0000        0     1.25462 36    0.0000 1.0000000
T1:G16:F3     0.0000        0     0.00000 36
T1:G17:F1     0.2500        0     1.25462 36    0.1993 0.8431780
T1:G17:F2     0.0000        0     1.25462 36    0.0000 1.0000000
T1:G17:F3     0.0000        0     0.00000 36
T1:G18:F1     0.2500        0     1.25462 36    0.1993 0.8431780
T1:G18:F2    -1.0000        0     1.25462 36   -0.7971 0.4306457
T1:G18:F3     0.0000        0     0.00000 36
T1:G19:F1    -0.7500        0     1.25462 36   -0.5978 0.5537222
T1:G19:F2    -2.0000        0     1.25462 36   -1.5941 0.1196553
T1:G19:F3     0.0000        0     0.00000 36
T1:G20:F1     0.2500        0     1.25462 36    0.1993 0.8431780
T1:G20:F2    -1.0000        0     1.25462 36   -0.7971 0.4306457
T1:G20:F3     0.0000        0     0.00000 36
T1:G21:F1     0.2500        0     0.79349 36    0.3151 0.7545328
T1:G21:F2    -0.7500        0     0.79349 36   -0.9452 0.3508634
T1:G21:F3     0.0000        0     0.00000 36
T1:G22:F1     0.0000        0     0.79349 36    0.0000 1.0000000
T1:G22:F2     0.0000        0     0.79349 36    0.0000 1.0000000
T1:G22:F3     0.0000        0     0.00000 36
T1:G23:F1     0.0000        0     0.00000 36
T1:G23:F2     0.0000        0     0.00000 36
T1:G23:F3     0.0000        0     0.00000 36
T2:G1:F1      0.0000        0     0.00000 36
T2:G1:F2      0.0000        0     0.00000 36
T2:G1:F3      0.0000        0     0.00000 36
T2:G2:F1      0.0000        0     0.00000 36
T2:G2:F2      0.0000        0     0.00000 36
T2:G2:F3      0.0000        0     0.00000 36
T2:G3:F1      0.0000        0     0.00000 36
T2:G3:F2      0.0000        0     0.00000 36
T2:G3:F3      0.0000        0     0.00000 36
T2:G4:F1      0.0000        0     0.00000 36
T2:G4:F2      0.0000        0     0.00000 36
T2:G4:F3      0.0000        0     0.00000 36
T2:G5:F1      0.0000        0     0.00000 36
T2:G5:F2      0.0000        0     0.00000 36
T2:G5:F3      0.0000        0     0.00000 36
T2:G6:F1      0.0000        0     0.00000 36
T2:G6:F2      0.0000        0     0.00000 36
T2:G6:F3      0.0000        0     0.00000 36
T2:G7:F1      0.0000        0     0.00000 36
T2:G7:F2      0.0000        0     0.00000 36
T2:G7:F3      0.0000        0     0.00000 36
T2:G8:F1      0.0000        0     0.00000 36
T2:G8:F2      0.0000        0     0.00000 36
T2:G8:F3      0.0000        0     0.00000 36
T2:G9:F1      0.0000        0     0.00000 36
```

```
T2:G9:F2       0.0000          0      0.00000 36
T2:G9:F3       0.0000          0      0.00000 36
T2:G10:F1      0.0000          0      0.00000 36
T2:G10:F2      0.0000          0      0.00000 36
T2:G10:F3      0.0000          0      0.00000 36
T2:G11:F1      0.0000          0      0.00000 36
T2:G11:F2      0.0000          0      0.00000 36
T2:G11:F3      0.0000          0      0.00000 36
T2:G12:F1      0.0000          0      0.00000 36
T2:G12:F2      0.0000          0      0.00000 36
T2:G12:F3      0.0000          0      0.00000 36
T2:G13:F1      0.0000          0      0.00000 36
T2:G13:F2      0.0000          0      0.00000 36
T2:G13:F3      0.0000          0      0.00000 36
T2:G14:F1      0.0000          0      0.00000 36
T2:G14:F2      0.0000          0      0.00000 36
T2:G14:F3      0.0000          0      0.00000 36
T2:G15:F1      0.0000          0      0.00000 36
T2:G15:F2      0.0000          0      0.00000 36
T2:G15:F3      0.0000          0      0.00000 36
T2:G16:F1      0.0000          0      0.00000 36
T2:G16:F2      0.0000          0      0.00000 36
T2:G16:F3      0.0000          0      0.00000 36
T2:G17:F1      0.0000          0      0.00000 36
T2:G17:F2      0.0000          0      0.00000 36
T2:G17:F3      0.0000          0      0.00000 36
T2:G18:F1      0.0000          0      0.00000 36
T2:G18:F2      0.0000          0      0.00000 36
T2:G18:F3      0.0000          0      0.00000 36
T2:G19:F1      0.0000          0      0.00000 36
T2:G19:F2      0.0000          0      0.00000 36
T2:G19:F3      0.0000          0      0.00000 36
T2:G20:F1      0.0000          0      0.00000 36
T2:G20:F2      0.0000          0      0.00000 36
T2:G20:F3      0.0000          0      0.00000 36
T2:G21:F1      0.0000          0      0.00000 36
T2:G21:F2      0.0000          0      0.00000 36
T2:G21:F3      0.0000          0      0.00000 36
T2:G22:F1      0.0000          0      0.00000 36
T2:G22:F2      0.0000          0      0.00000 36
T2:G22:F3      0.0000          0      0.00000 36
T2:G23:F1      0.0000          0      0.00000 36
T2:G23:F2      0.0000          0      0.00000 36
T2:G23:F3      0.0000          0      0.00000 36
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

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

Anova Table (Type III tests)

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

6.6 Example 8.1

(15) MODEL

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

```
     Y R  A B
1    9 1  1 1
2    2 1  1 2
3    8 1  1 7
4    7 1  1 8
5    5 1  1 9
6    9 1  2 1
7    7 1  2 2
8    3 1  2 7
9    5 1  2 8
10   4 1  2 9
11   9 1  3 1
12   2 1  3 2
13   8 1  3 7
14   7 1  3 8
15   5 1  3 9
```

```
16     9 1 10 1
17     1 1 10 2
18     9 1 10 7
19     7 1 10 8
20     5 1 10 9
21     9 1 11 1
22     7 1 11 2
23     3 1 11 7
24     5 1 11 8
25     4 1 11 9
26     9 1 12 1
27     2 1 12 2
28     8 1 12 7
29     7 1 12 8
30     5 1 12 9
31     9 1 13 1
32     7 1 13 2
33     3 1 13 7
34     5 1 13 8
35     4 1 13 9
36     9 2  4 3
37     7 2  4 4
38    13 2  4 7
39     8 2  4 8
40     8 2  4 9
41     9 2  5 3
42    12 2  5 4
43     8 2  5 7
44     7 2  5 8
45     8 2  5 9
46     9 2  6 3
47     7 2  6 4
48    13 2  6 7
49     9 2  6 8
50    12 2  6 9
51     9 2 10 3
52    11 2 10 4
53     9 2 10 7
54     7 2 10 8
55     5 2 10 9
56     9 2 11 3
57     7 2 11 4
58    13 2 11 7
59     5 2 11 8
60     4 2 11 9
61     9 2 12 3
62    12 2 12 4
63     8 2 12 7
```

```
64    7 2 12 8
65    5 2 12 9
66    9 2 13 3
67    7 2 13 4
68   13 2 13 7
69    5 2 13 8
70    4 2 13 9
71   19 3  7 5
72   17 3  7 6
73   13 3  7 7
74   15 3  7 8
75   14 3  7 9
76   19 3  8 5
77   12 3  8 6
78   18 3  8 7
79   17 3  8 8
80   45 3  8 9
81   19 3  9 5
82   17 3  9 6
83   13 3  9 7
84   25 3  9 8
85   34 3  9 9
86   15 3 10 5
87    9 3 10 6
88   11 3 10 7
89   10 3 10 8
90   10 3 10 9
91    9 3 11 5
92   17 3 11 6
93   13 3 11 7
94   15 3 11 8
95   14 3 11 9
96    9 3 12 5
97   12 3 12 6
98    8 3 12 7
99   17 3 12 8
100  15 3 12 9
101   9 3 13 5
102  17 3 13 6
103  13 3 13 7
104  15 3 13 8
105  14 3 13 9
```

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


$ANOVA
Response : Y
                Df Sum Sq Mean Sq F value Pr(>F)
```

```
MODEL            104 3951.8  37.999
RESIDUALS          0    0.0
CORRECTED TOTAL 104 3951.8

$`Type I`
      Df  Sum Sq Mean Sq F value Pr(>F)
R      2 1787.68  893.84
A     12  601.24   50.10
R:A    6   24.93    4.16
B      8  156.87   19.61
R:B    4  319.87   79.97
A:B   60 1012.26   16.87
R:A:B 12   49.00    4.08

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

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

$Parameter
            Estimate Estimable Std. Error Df t value Pr(>|t|)
(Intercept)       14         0          0
R1               -10         0          0
R2               -10         0          0
R3                 0         0          0
A1                 1         0          0
A2                 0         0          0
A3                 1         0          0
A4                 4         0          0
A5                 4         0          0
A6                 8         0          0
A7                 0         0          0
A8                31         0          0
```

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

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

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

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

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

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

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

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

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

```
R3:A1:B2                    0
R3:A1:B3                    0
R3:A1:B4                    0
R3:A1:B5                    0
R3:A1:B6                    0
R3:A1:B7                    0
R3:A1:B8                    0
R3:A1:B9                    0
R3:A2:B1                    0
R3:A2:B2                    0
R3:A2:B3                    0
R3:A2:B4                    0
R3:A2:B5                    0
R3:A2:B6                    0
R3:A2:B7                    0
R3:A2:B8                    0
R3:A2:B9                    0
R3:A3:B1                    0
R3:A3:B2                    0
R3:A3:B3                    0
R3:A3:B4                    0
R3:A3:B5                    0
R3:A3:B6                    0
R3:A3:B7                    0
R3:A3:B8                    0
R3:A3:B9                    0
R3:A4:B1                    0
R3:A4:B2                    0
R3:A4:B3                    0
R3:A4:B4                    0
R3:A4:B5                    0
R3:A4:B6                    0
R3:A4:B7                    0
R3:A4:B8                    0
R3:A4:B9                    0
R3:A5:B1                    0
R3:A5:B2                    0
R3:A5:B3                    0
R3:A5:B4                    0
R3:A5:B5                    0
R3:A5:B6                    0
R3:A5:B7                    0
R3:A5:B8                    0
R3:A5:B9                    0
R3:A6:B1                    0
R3:A6:B2                    0
R3:A6:B3                    0
R3:A6:B4                    0
```

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

R3:A11:B8	0	0	0
R3:A11:B9	0	0	0
R3:A12:B1		0	
R3:A12:B2		0	
R3:A12:B3		0	
R3:A12:B4		0	
R3:A12:B5	0	0	0
R3:A12:B6	0	0	0
R3:A12:B7	0	0	0
R3:A12:B8	0	0	0
R3:A12:B9	0	0	0
R3:A13:B1		0	
R3:A13:B2		0	
R3:A13:B3		0	
R3:A13:B4		0	
R3:A13:B5	0	0	0
R3:A13:B6	0	0	0
R3:A13:B7	0	0	0
R3:A13:B8	0	0	0
R3:A13:B9	0	0	0

```r
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

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

	yield	rep	hyb	gen
1	48	1	3	1
2	46	1	3	3
3	43	1	3	2
4	46	1	8	1
5	45	1	8	3
6	42	1	8	2
7	46	1	2	1
8	44	1	2	3
9	42	1	2	2
10	42	1	1	1
11	46	1	1	3
12	44	1	1	2
13	43	1	6	1
14	45	1	6	3
15	44	1	6	2

```
16    47    1    7    1
17    49    1    7    3
18    47    1    7    2
19    48    1    0    1
20    45    1    0    3
21    45    1    0    2
22    46    1    9    1
23    48    1    9    3
24    47    1    9    2
25    46    1    4    1
26    48    1    4    3
27    47    1    4    2
28    49    1    5    1
29    49    1    5    3
30    48    1    5    2
31    46    2    4    2
32    48    2    4    3
33    42    2    4    1
34    45    2    3    2
35    44    2    3    3
36    42    2    3    1
37    46    2    9    2
38    46    2    9    3
39    44    2    9    1
40    45    2    5    2
41    45    2    5    3
42    43    2    5    1
43    43    2    1    2
44    50    2    1    3
45    44    2    1    1
46    48    2    7    2
47    51    2    7    3
48    48    2    7    1
49    44    2    2    2
50    48    2    2    3
51    47    2    2    1
52    44    2    8    2
53    46    2    8    3
54    46    2    8    1
55    47    2    6    2
56    48    2    6    3
57    44    2    6    1
```

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

$ANOVA
Response : yield

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

```
MODEL            40 247.813  6.1953   4.4606 0.001119 **
RESIDUALS        16  22.222  1.3889
CORRECTED TOTAL 56 270.035
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
        Df Sum Sq Mean Sq F value     Pr(>F)
rep      1  0.239  0.2388  0.1719 0.6839085
hyb      9 66.796  7.4218  5.3437 0.0018370 **
rep:hyb  8 67.000  8.3750  6.0300 0.0011569 **
gen      2 36.351 18.1754 13.0863 0.0004293 ***
rep:gen  2 16.923  8.4616  6.0924 0.0107858 *
hyb:gen 18 60.504  3.3613  2.4201 0.0408545 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
        Df Sum Sq Mean Sq F value     Pr(>F)
rep      1  0.167  0.1667  0.1200 0.7335481
hyb      9 66.796  7.4218  5.3437 0.0018370 **
rep:hyb  8 67.000  8.3750  6.0300 0.0011569 **
gen      2 36.351 18.1754 13.0863 0.0004293 ***
rep:gen  2 12.111  6.0556  4.3600 0.0308015 *
hyb:gen 18 60.504  3.3613  2.4201 0.0408545 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
        Df Sum Sq Mean Sq F value     Pr(>F)
rep      1  0.167  0.1667  0.1200 0.7335481
hyb      9 66.796  7.4218  5.3437 0.0018370 **
rep:hyb  8 67.000  8.3750  6.0300 0.0011569 **
gen      2 30.671 15.3356 11.0416 0.0009707 ***
rep:gen  2 12.111  6.0556  4.3600 0.0308015 *
hyb:gen 18 60.504  3.3613  2.4201 0.0408545 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
           Estimate Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)  46.556         0    0.98862 16 47.0915 < 2.2e-16 ***
rep1          0.889         0    1.06381 16  0.8356  0.415699
rep2          0.000         0    0.00000 16
hyb0         -2.444         0    1.53826 16 -1.5891  0.131602
hyb1          2.667         0    1.36083 16  1.9596  0.067702 .
hyb2          1.000         0    1.36083 16  0.7348  0.473067
hyb3         -2.167         0    1.36083 16 -1.5922  0.130908
```

hyb4	1.000	0	1.36083	16	0.7348	0.473067	
hyb5	-1.333	0	1.36083	16	-0.9798	0.341771	
hyb6	1.500	0	1.36083	16	1.1023	0.286649	
hyb7	4.500	0	1.36083	16	3.3068	0.004455	**
hyb8	-0.167	0	1.36083	16	-0.1225	0.904048	
hyb9	0.000	0	0.00000	16			
rep1:hyb0	0.000	0	0.00000	16			
rep1:hyb1	-3.333	0	1.36083	16	-2.4495	0.026199	*
rep1:hyb2	-4.000	0	1.36083	16	-2.9394	0.009621	**
rep1:hyb3	0.333	0	1.36083	16	0.2449	0.809610	
rep1:hyb4	0.000	0	1.36083	16	0.0000	1.000000	
rep1:hyb5	2.667	0	1.36083	16	1.9596	0.067702	.
rep1:hyb6	-4.000	0	1.36083	16	-2.9394	0.009621	**
rep1:hyb7	-3.000	0	1.36083	16	-2.2045	0.042471	*
rep1:hyb8	-2.667	0	1.36083	16	-1.9596	0.067702	.
rep1:hyb9	0.000	0	0.00000	16			
rep2:hyb0		0					
rep2:hyb1	0.000	0	0.00000	16			
rep2:hyb2	0.000	0	0.00000	16			
rep2:hyb3	0.000	0	0.00000	16			
rep2:hyb4	0.000	0	0.00000	16			
rep2:hyb5	0.000	0	0.00000	16			
rep2:hyb6	0.000	0	0.00000	16			
rep2:hyb7	0.000	0	0.00000	16			
rep2:hyb8	0.000	0	0.00000	16			
rep2:hyb9	0.000	0	0.00000	16			
gen1	-3.056	0	1.24226	16	-2.4597	0.025671	*
gen2	-0.611	0	1.24226	16	-0.4919	0.629446	
gen3	0.000	0	0.00000	16			
rep1:gen1	2.111	0	0.78567	16	2.6870	0.016197	*
rep1:gen2	0.222	0	0.78567	16	0.2828	0.780924	
rep1:gen3	0.000	0	0.00000	16			
rep2:gen1	0.000	0	0.00000	16			
rep2:gen2	0.000	0	0.00000	16			
rep2:gen3	0.000	0	0.00000	16			
hyb0:gen1	3.944	0	2.07870	16	1.8976	0.075951	.
hyb0:gen2	0.389	0	2.07870	16	0.1871	0.853947	
hyb0:gen3	0.000	0	0.00000	16			
hyb1:gen1	-3.000	0	1.66667	16	-1.8000	0.090743	.
hyb1:gen2	-4.000	0	1.66667	16	-2.4000	0.028919	*
hyb1:gen3	0.000	0	0.00000	16			
hyb2:gen1	2.500	0	1.66667	16	1.5000	0.153088	
hyb2:gen2	-2.500	0	1.66667	16	-1.5000	0.153088	
hyb2:gen3	0.000	0	0.00000	16			
hyb3:gen1	2.000	0	1.66667	16	1.2000	0.247607	
hyb3:gen2	-0.500	0	1.66667	16	-0.3000	0.768040	
hyb3:gen3	0.000	0	0.00000	16			
hyb4:gen1	-2.000	0	1.66667	16	-1.2000	0.247607	

```
hyb4:gen2     -1.000        0    1.66667 16 -0.6000   0.556909
hyb4:gen3      0.000        0    0.00000 16
hyb5:gen1      1.000        0    1.66667 16   0.6000   0.556909
hyb5:gen2      0.000        0    1.66667 16   0.0000   1.000000
hyb5:gen3      0.000        0    0.00000 16
hyb6:gen1     -1.000        0    1.66667 16 -0.6000   0.556909
hyb6:gen2     -0.500        0    1.66667 16 -0.3000   0.768040
hyb6:gen3      0.000        0    0.00000 16
hyb7:gen1     -0.500        0    1.66667 16 -0.3000   0.768040
hyb7:gen2     -2.000        0    1.66667 16 -1.2000   0.247607
hyb7:gen3      0.000        0    0.00000 16
hyb8:gen1      2.500        0    1.66667 16   1.5000   0.153088
hyb8:gen2     -2.000        0    1.66667 16 -1.2000   0.247607
hyb8:gen3      0.000        0    0.00000 16
hyb9:gen1      0.000        0    0.00000 16
hyb9:gen2      0.000        0    0.00000 16
hyb9:gen3      0.000        0    0.00000 16
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
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

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

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

```
Site1:AA1:BB1             54.5          0   112.659 240    0.4838  0.628997
Site1:AA1:BB2              0.0          0     0.000 240
Site1:AA2:BB1            -20.4          0   112.659 240   -0.1812  0.856344
Site1:AA2:BB2              0.0          0     0.000 240
Site1:AA3:BB1           -141.2          0   112.659 240   -1.2530  0.211409
Site1:AA3:BB2              0.0          0     0.000 240
Site1:AA4:BB1             45.6          0   112.659 240    0.4046  0.686122
Site1:AA4:BB2              0.0          0     0.000 240
Site1:AA5:BB1              0.0          0     0.000 240
Site1:AA5:BB2              0.0          0     0.000 240
Site2:AA1:BB1            -90.0          0   112.659 240   -0.7989  0.425155
Site2:AA1:BB2              0.0          0     0.000 240
Site2:AA2:BB1           -140.2          0   112.659 240   -1.2442  0.214651
Site2:AA2:BB2              0.0          0     0.000 240
Site2:AA3:BB1            -60.0          0   112.659 240   -0.5326  0.594816
Site2:AA3:BB2              0.0          0     0.000 240
Site2:AA4:BB1              3.5          0   112.659 240    0.0311  0.975242
Site2:AA4:BB2              0.0          0     0.000 240
Site2:AA5:BB1              0.0          0     0.000 240
Site2:AA5:BB2              0.0          0     0.000 240
Site3:AA1:BB1             12.4          0   112.659 240    0.1102  0.912331
Site3:AA1:BB2              0.0          0     0.000 240
Site3:AA2:BB1             39.4          0   112.659 240    0.3499  0.726739
Site3:AA2:BB2              0.0          0     0.000 240
Site3:AA3:BB1             49.8          0   112.659 240    0.4423  0.658643
Site3:AA3:BB2              0.0          0     0.000 240
Site3:AA4:BB1             32.7          0   112.659 240    0.2900  0.772097
Site3:AA4:BB2              0.0          0     0.000 240
Site3:AA5:BB1              0.0          0     0.000 240
Site3:AA5:BB2              0.0          0     0.000 240
Site4:AA1:BB1              0.0          0     0.000 240
Site4:AA1:BB2              0.0          0     0.000 240
Site4:AA2:BB1              0.0          0     0.000 240
Site4:AA2:BB2              0.0          0     0.000 240
Site4:AA3:BB1              0.0          0     0.000 240
Site4:AA3:BB2              0.0          0     0.000 240
Site4:AA4:BB1              0.0          0     0.000 240
Site4:AA4:BB2              0.0          0     0.000 240
Site4:AA5:BB1              0.0          0     0.000 240
Site4:AA5:BB2              0.0          0     0.000 240
Site1:BlockR1:AA1:BB1     15.5          0    56.329 240    0.2752  0.783425
Site1:BlockR1:AA1:BB2     -3.5          0    56.329 240   -0.0621  0.950507
Site1:BlockR1:AA2:BB1     70.2          0    56.329 240    1.2471  0.213567
Site1:BlockR1:AA2:BB2     50.0          0    56.329 240    0.8876  0.375626
Site1:BlockR1:AA3:BB1     10.0          0    56.329 240    0.1775  0.859244
Site1:BlockR1:AA3:BB2    -62.3          0    56.329 240   -1.1051  0.270221
Site1:BlockR1:AA4:BB1     50.5          0    56.329 240    0.8965  0.370878
Site1:BlockR1:AA4:BB2      0.0          0    56.329 240    0.0000  1.000000
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Site1:BlockR1:AA5:BB1     50.0       0      56.329 240     0.8876  0.375626
Site1:BlockR1:AA5:BB2      0.0       0       0.000 240
Site1:BlockR2:AA1:BB1     17.2       0      56.329 240     0.3062  0.759692
Site1:BlockR2:AA1:BB2     53.7       0      56.329 240     0.9542  0.340939
Site1:BlockR2:AA2:BB1     61.7       0      56.329 240     1.0962  0.274077
Site1:BlockR2:AA2:BB2     77.7       0      56.329 240     1.3803  0.168787
Site1:BlockR2:AA3:BB1     29.0       0      56.329 240     0.5148  0.607147
Site1:BlockR2:AA3:BB2   -112.3       0      56.329 240    -1.9927  0.047423 *
Site1:BlockR2:AA4:BB1     42.0       0      56.329 240     0.7456  0.456631
Site1:BlockR2:AA4:BB2     75.0       0      56.329 240     1.3315  0.184303
Site1:BlockR2:AA5:BB1      0.0       0      56.329 240     0.0000  1.000000
Site1:BlockR2:AA5:BB2      0.0       0       0.000 240
Site1:BlockR3:AA1:BB1      0.0       0       0.000 240
Site1:BlockR3:AA1:BB2      0.0       0       0.000 240
Site1:BlockR3:AA2:BB1      0.0       0       0.000 240
Site1:BlockR3:AA2:BB2      0.0       0       0.000 240
Site1:BlockR3:AA3:BB1      0.0       0       0.000 240
Site1:BlockR3:AA3:BB2      0.0       0       0.000 240
Site1:BlockR3:AA4:BB1      0.0       0       0.000 240
Site1:BlockR3:AA4:BB2      0.0       0       0.000 240
Site1:BlockR3:AA5:BB1      0.0       0       0.000 240
Site1:BlockR3:AA5:BB2      0.0       0       0.000 240
Site2:BlockR1:AA1:BB1     35.7       0      56.329 240     0.6347  0.526255
Site2:BlockR1:AA1:BB2    -32.3       0      56.329 240    -0.5725  0.567503
Site2:BlockR1:AA2:BB1     68.5       0      56.329 240     1.2161  0.225157
Site2:BlockR1:AA2:BB2    -37.5       0      56.329 240    -0.6657  0.506225
Site2:BlockR1:AA3:BB1    -11.0       0      56.329 240    -0.1953  0.845339
Site2:BlockR1:AA3:BB2    -30.3       0      56.329 240    -0.5370  0.591752
Site2:BlockR1:AA4:BB1     46.2       0      56.329 240     0.8211  0.412426
Site2:BlockR1:AA4:BB2     25.0       0      56.329 240     0.4438  0.657574
Site2:BlockR1:AA5:BB1     50.0       0      56.329 240     0.8876  0.375626
Site2:BlockR1:AA5:BB2      0.0       0       0.000 240
Site2:BlockR2:AA1:BB1     56.7       0      56.329 240     1.0075  0.314726
Site2:BlockR2:AA1:BB2    -22.3       0      56.329 240    -0.3950  0.693196
Site2:BlockR2:AA2:BB1     32.5       0      56.329 240     0.5770  0.564505
Site2:BlockR2:AA2:BB2    -60.0       0      56.329 240    -1.0652  0.287873
Site2:BlockR2:AA3:BB1     -1.8       0      56.329 240    -0.0311  0.975242
Site2:BlockR2:AA3:BB2    -42.5       0      56.329 240    -0.7545  0.451295
Site2:BlockR2:AA4:BB1     22.5       0      56.329 240     0.3994  0.689927
Site2:BlockR2:AA4:BB2     50.0       0      56.329 240     0.8876  0.375626
Site2:BlockR2:AA5:BB1     50.0       0      56.329 240     0.8876  0.375626
Site2:BlockR2:AA5:BB2      0.0       0       0.000 240
Site2:BlockR3:AA1:BB1      0.0       0       0.000 240
Site2:BlockR3:AA1:BB2      0.0       0       0.000 240
Site2:BlockR3:AA2:BB1      0.0       0       0.000 240
Site2:BlockR3:AA2:BB2      0.0       0       0.000 240
Site2:BlockR3:AA3:BB1      0.0       0       0.000 240
Site2:BlockR3:AA3:BB2      0.0       0       0.000 240
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Site2:BlockR3:AA4:BB1      0.0        0       0.000 240
Site2:BlockR3:AA4:BB2      0.0        0       0.000 240
Site2:BlockR3:AA5:BB1      0.0        0       0.000 240
Site2:BlockR3:AA5:BB2      0.0        0       0.000 240
Site3:BlockR1:AA1:BB1     17.2        0      56.329 240     0.3062  0.759692
Site3:BlockR1:AA1:BB2     -3.8        0      56.329 240    -0.0666  0.946977
Site3:BlockR1:AA2:BB1      4.2        0      56.329 240     0.0754  0.939920
Site3:BlockR1:AA2:BB2     -1.5        0      56.329 240    -0.0266  0.978778
Site3:BlockR1:AA3:BB1    -13.0        0      56.329 240    -0.2308  0.817678
Site3:BlockR1:AA3:BB2     50.0        0      56.329 240     0.8876  0.375626
Site3:BlockR1:AA4:BB1    -18.0        0      56.329 240    -0.3195  0.749589
Site3:BlockR1:AA4:BB2     25.0        0      56.329 240     0.4438  0.657574
Site3:BlockR1:AA5:BB1      0.0        0      56.329 240     0.0000  1.000000
Site3:BlockR1:AA5:BB2      0.0        0       0.000 240
Site3:BlockR2:AA1:BB1     21.0        0      56.329 240     0.3728  0.709621
Site3:BlockR2:AA1:BB2     15.2        0      56.329 240     0.2707  0.786832
Site3:BlockR2:AA2:BB1     -5.3        0      56.329 240    -0.0932  0.925821
Site3:BlockR2:AA2:BB2     15.7        0      56.329 240     0.2796  0.780021
Site3:BlockR2:AA3:BB1    -22.5        0      56.329 240    -0.3994  0.689927
Site3:BlockR2:AA3:BB2     75.0        0      56.329 240     1.3315  0.184303
Site3:BlockR2:AA4:BB1    -25.8        0      56.329 240    -0.4571  0.647990
Site3:BlockR2:AA4:BB2     25.0        0      56.329 240     0.4438  0.657574
Site3:BlockR2:AA5:BB1      0.0        0      56.329 240     0.0000  1.000000
Site3:BlockR2:AA5:BB2      0.0        0       0.000 240
Site3:BlockR3:AA1:BB1      0.0        0       0.000 240
Site3:BlockR3:AA1:BB2      0.0        0       0.000 240
Site3:BlockR3:AA2:BB1      0.0        0       0.000 240
Site3:BlockR3:AA2:BB2      0.0        0       0.000 240
Site3:BlockR3:AA3:BB1      0.0        0       0.000 240
Site3:BlockR3:AA3:BB2      0.0        0       0.000 240
Site3:BlockR3:AA4:BB1      0.0        0       0.000 240
Site3:BlockR3:AA4:BB2      0.0        0       0.000 240
Site3:BlockR3:AA5:BB1      0.0        0       0.000 240
Site3:BlockR3:AA5:BB2      0.0        0       0.000 240
Site4:BlockR1:AA1:BB1     38.7        0      56.329 240     0.6879  0.492169
Site4:BlockR1:AA1:BB2      6.5        0      56.329 240     0.1154  0.908230
Site4:BlockR1:AA2:BB1     17.5        0      56.329 240     0.3107  0.756319
Site4:BlockR1:AA2:BB2    -13.0        0      56.329 240    -0.2308  0.817678
Site4:BlockR1:AA3:BB1     61.5        0      56.329 240     1.0918  0.276020
Site4:BlockR1:AA3:BB2    -32.3        0      56.329 240    -0.5725  0.567503
Site4:BlockR1:AA4:BB1     33.0        0      56.329 240     0.5858  0.558534
Site4:BlockR1:AA4:BB2     25.0        0      56.329 240     0.4438  0.657574
Site4:BlockR1:AA5:BB1     75.0        0      56.329 240     1.3315  0.184303
Site4:BlockR1:AA5:BB2      0.0        0       0.000 240
Site4:BlockR2:AA1:BB1    -69.8        0      56.329 240    -1.2383  0.216833
Site4:BlockR2:AA1:BB2    -36.5        0      56.329 240    -0.6480  0.517622
Site4:BlockR2:AA2:BB1    -53.8        0      56.329 240    -0.9542  0.340939
Site4:BlockR2:AA2:BB2    -14.3        0      56.329 240    -0.2530  0.800503
```

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

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

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

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

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

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

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

```
Site4:AA1:BB1:CC1          0.0          0       0.000 240
Site4:AA1:BB1:CC2          0.0          0       0.000 240
Site4:AA1:BB1:CC3          0.0          0       0.000 240
Site4:AA1:BB1:CC4          0.0          0       0.000 240
Site4:AA1:BB2:CC1          0.0          0       0.000 240
Site4:AA1:BB2:CC2          0.0          0       0.000 240
Site4:AA1:BB2:CC3          0.0          0       0.000 240
Site4:AA1:BB2:CC4          0.0          0       0.000 240
Site4:AA2:BB1:CC1          0.0          0       0.000 240
Site4:AA2:BB1:CC2          0.0          0       0.000 240
Site4:AA2:BB1:CC3          0.0          0       0.000 240
Site4:AA2:BB1:CC4          0.0          0       0.000 240
Site4:AA2:BB2:CC1          0.0          0       0.000 240
Site4:AA2:BB2:CC2          0.0          0       0.000 240
Site4:AA2:BB2:CC3          0.0          0       0.000 240
Site4:AA2:BB2:CC4          0.0          0       0.000 240
Site4:AA3:BB1:CC1          0.0          0       0.000 240
Site4:AA3:BB1:CC2          0.0          0       0.000 240
Site4:AA3:BB1:CC3          0.0          0       0.000 240
Site4:AA3:BB1:CC4          0.0          0       0.000 240
Site4:AA3:BB2:CC1          0.0          0       0.000 240
Site4:AA3:BB2:CC2          0.0          0       0.000 240
Site4:AA3:BB2:CC3          0.0          0       0.000 240
Site4:AA3:BB2:CC4          0.0          0       0.000 240
Site4:AA4:BB1:CC1          0.0          0       0.000 240
Site4:AA4:BB1:CC2          0.0          0       0.000 240
Site4:AA4:BB1:CC3          0.0          0       0.000 240
Site4:AA4:BB1:CC4          0.0          0       0.000 240
Site4:AA4:BB2:CC1          0.0          0       0.000 240
Site4:AA4:BB2:CC2          0.0          0       0.000 240
Site4:AA4:BB2:CC3          0.0          0       0.000 240
Site4:AA4:BB2:CC4          0.0          0       0.000 240
Site4:AA5:BB1:CC1          0.0          0       0.000 240
Site4:AA5:BB1:CC2          0.0          0       0.000 240
Site4:AA5:BB1:CC3          0.0          0       0.000 240
Site4:AA5:BB1:CC4          0.0          0       0.000 240
Site4:AA5:BB2:CC1          0.0          0       0.000 240
Site4:AA5:BB2:CC2          0.0          0       0.000 240
Site4:AA5:BB2:CC3          0.0          0       0.000 240
Site4:AA5:BB2:CC4          0.0          0       0.000 240
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

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

```
Anova Table (Type III tests)

Response: Yield
                  Sum Sq  Df   F values  Pr(>F)
Site               552717   3 5.8064e+01 < 2e-16 ***
A              1387680917   4 1.0933e+05 < 2e-16 ***
B               100939695   1 3.1812e+04 < 2e-16 ***
C                19356264   3 2.0334e+03 < 2e-16 ***
Site:Block              0   0
Site:A              34068  12 8.9470e-01 0.55301
Site:B               1618   3 1.6990e-01 0.91662
A:B              31444008   4 2.4775e+03 < 2e-16 ***
A:C              26075792  12 6.8483e+02 < 2e-16 ***
B:C              23901388   3 2.5109e+03 < 2e-16 ***
Site:C              47625   9 1.6677e+00 0.09747 .
Site:A:B            33737  12 8.8600e-01 0.56185
A:B:C            41996729  12 1.1030e+03 < 2e-16 ***
Site:A:C           104110  36 9.1140e-01 0.61768
Site:B:C            61111   9 2.1400e+00 0.02701 *
Site:Block:A:B     186911  72 8.1810e-01 0.84155
Site:A:B:C          82475  36 7.2200e-01 0.87941
Residuals          761522 240
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

7 Hinkelmann & Kempthorne - Volume 1

Reference

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

7.1 p410

(18) MODEL

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

	period	sequence	steer	trt	carry	y
1	1	1	1	1	3	50
2	2	1	1	2	1	61
3	3	1	1	3	2	53
4	1	1	2	1	3	55
5	2	1	2	2	1	63
6	3	1	2	3	2	57
7	1	2	3	2	3	44
8	2	2	3	3	2	42
9	3	2	3	1	3	57
10	1	2	4	2	3	51
11	2	2	4	3	2	46
12	3	2	4	1	3	59
13	1	3	5	3	3	35
14	2	3	5	1	3	55
15	3	3	5	2	1	47
16	1	3	6	3	3	41
17	2	3	6	1	3	56
18	3	3	6	2	1	50
19	1	4	7	1	3	54
20	2	4	7	3	1	48
21	3	4	7	2	3	51
22	1	4	8	1	3	58
23	2	4	8	3	1	51
24	3	4	8	2	3	54
25	1	5	9	2	3	50
26	2	5	9	1	2	57
27	3	5	9	3	1	51
28	1	5	10	2	3	55
29	2	5	10	1	2	59
30	3	5	10	3	1	55
31	1	6	11	3	3	41
32	2	6	11	2	3	56

```
33      3        6    11    1      2 58
34      1        6    12    3      3 46
35      2        6    12    2      3 58
36      3        6    12    1      2 61
```

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

```
$ANOVA
Response : y
                Df  Sum Sq Mean Sq F value     Pr(>F)
MODEL           17 1302.51  76.618  8.7402 1.572e-05 ***
RESIDUALS       18  157.79   8.766
CORRECTED TOTAL 35 1460.31
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type I`
              Df Sum Sq Mean Sq F value     Pr(>F)
period         2 292.06 146.028 16.6580 8.038e-05 ***
sequence       5 326.47  65.294  7.4484 0.0006072 ***
sequence:steer 6 118.50  19.750  2.2530 0.0849122 .
trt            2 549.06 274.528 31.3166 1.377e-06 ***
carry          2  16.43   8.215  0.9372 0.4100385
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
              Df Sum Sq Mean Sq F value     Pr(>F)
period         2 172.31  86.154  9.8279 0.0013030 **
sequence       5 318.69  63.738  7.2709 0.0006954 ***
sequence:steer 6 118.50  19.750  2.2530 0.0849122 .
trt            2 440.61 220.304 25.1311 6.164e-06 ***
carry          2  16.43   8.215  0.9372 0.4100385
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
              Df Sum Sq Mean Sq F value     Pr(>F)
period         2 172.31  86.154  9.8279 0.0013030 **
sequence       5 318.69  63.738  7.2709 0.0006954 ***
sequence:steer 6 118.50  19.750  2.2530 0.0849122 .
trt            2 440.61 220.304 25.1311 6.164e-06 ***
carry          2  16.43   8.215  0.9372 0.4100385
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Parameter
                  Estimate Estimable Std. Error Df t value  Pr(>|t|)
```

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

```
sequence4:steer3                         0
sequence4:steer4                         0
sequence4:steer5                         0
sequence4:steer6                         0
sequence4:steer7       -3.333            0      2.4175 18 -1.3789 0.1848347
sequence4:steer8        0.000            0      0.0000 18
sequence4:steer9                         0
sequence4:steer10                        0
sequence4:steer11                        0
sequence4:steer12                        0
sequence5:steer1                         0
sequence5:steer2                         0
sequence5:steer3                         0
sequence5:steer4                         0
sequence5:steer5                         0
sequence5:steer6                         0
sequence5:steer7                         0
sequence5:steer8                         0
sequence5:steer9       -3.667            0      2.4175 18 -1.5167 0.1466983
sequence5:steer10       0.000            0      0.0000 18
sequence5:steer11                        0
sequence5:steer12                        0
sequence6:steer1                         0
sequence6:steer2                         0
sequence6:steer3                         0
sequence6:steer4                         0
sequence6:steer5                         0
sequence6:steer6                         0
sequence6:steer7                         0
sequence6:steer8                         0
sequence6:steer9                         0
sequence6:steer10                        0
sequence6:steer11      -3.333            0      2.4175 18 -1.3789 0.1848347
sequence6:steer12       0.000            0      0.0000 18
trt1                    9.542            0      1.3514 18  7.0606 1.384e-06 ***
trt2                    5.521            0      1.3514 18  4.0853 0.0006946 ***
trt3                    0.000            0      0.0000 18
carry1                  0.375            0      1.8131 18  0.2068 0.8384657
carry2                 -1.938            0      1.8131 18 -1.0686 0.2993665
carry3                  0.000            0      0.0000 18
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
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 Estimable Std. Error Df t value  Pr(>|t|)
(Intercept)                  12         0     1.1832 10 10.1419 1.397e-06 ***
treatmentta                  -3         0     2.0494 10 -1.4639   0.17395
treatmenttb                   5         0     2.3664 10  2.1129   0.06075 .
treatmenttc                   0         0     0.0000 10
varietyva                    -8         0     3.1305 10 -2.5555   0.02859 *
varietyvb                    -4         0     2.0494 10 -1.9518   0.07951 .
varietyvc                     3         0     2.0494 10  1.4639   0.17395
varietyvd                     0         0     0.0000 10
treatmentta:varietyva         9         0     3.8035 10  2.3662   0.03953 *
treatmentta:varietyvb                   0
treatmentta:varietyvc         0         0     3.5496 10  0.0000   1.00000
treatmentta:varietyvd         0         0     0.0000 10
treatmenttb:varietyva         0         0     0.0000 10
treatmenttb:varietyvb         0         0     0.0000 10
treatmenttb:varietyvc                   0
treatmenttb:varietyvd                   0
treatmenttc:varietyva                   0
treatmenttc:varietyvb         0         0     0.0000 10
treatmenttc:varietyvc         0         0     0.0000 10
treatmenttc:varietyvd         0         0     0.0000 10
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
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

```r
percent = c(31,33,44,36,38,26,37,59,42,42,34,42,28,39,36,32,38,42,36,22,42,46,
            26,37,43)
refinery = c(rep("g",9),rep("n",8),rep("s",8))
```

```
process = as.factor(c(1,1,1,1,1,1,2,2,2,1,1,1,1,2,2,2,2,1,1,1,2,2,2,2,2))
source0 = c("t","t","t","t","o","m","t","t","o","m","i","i","i","t","o","m","m",
            "t","o","i","o","o","m","i","i")
d2 = data.frame(percent, refinery, process, source=source0)
GLM(percent ~ refinery*source, d2)
```

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

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

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

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

$Parameter
```
                  Estimate Estimable Std. Error Df t value   Pr(>|t|)
(Intercept)         42.000         0     8.3409 14  5.0354 0.0001822 ***
refineryg           -2.000         0     9.0093 14 -0.2220 0.8275243
refineryn           -3.000         0    11.7959 14 -0.2543 0.8029412
refinerys            0.000         0     0.0000 14
sourcei             -8.000         0     9.6313 14 -0.8306 0.4201255
sourcem            -16.000         0    11.7959 14 -1.3564 0.1964425
sourceo             -0.667         0     9.6313 14 -0.0692 0.9457944
sourcet              0.000         0     0.0000 14
refineryg:sourcei                  0
refineryg:sourcem    2.000         0    14.8428 14  0.1347 0.8947314
refineryg:sourceo    0.667         0    11.7959 14  0.0565 0.9557287
refineryg:sourcet    0.000         0     0.0000 14
refineryn:sourcei    3.667         0    13.6207 14  0.2692 0.7917042
refineryn:sourcem   14.333         0    15.2284 14  0.9412 0.3625491
```

```
refineryn:sourceo   -2.333          0     15.2284 14 -0.1532 0.8804095
refineryn:sourcet    0.000          0      0.0000 14
refinerys:sourcei    0.000          0      0.0000 14
refinerys:sourcem    0.000          0      0.0000 14
refinerys:sourceo    0.000          0      0.0000 14
refinerys:sourcet    0.000          0      0.0000 14
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
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 Sesssion 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_0.5.3   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
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