

Validation of 'sasLM' Package

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1 Tested Version and Books used for the Validation

1.1 Packages Used

- 'sasLM' version: 0.10.5
- 'SAS' version: 9.4 Licensed and University Edition
- 'car' version: 3.1.2
- R version: R version 4.4.1 (2024-06-14 ucrt)

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

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

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

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

1.2 Books and Articles used for the Test

1. Harvey WR. Least-Squares Analysis of Data with Unequal Subclass Frequencies. USDA, Agriculture Research Service, ARS 20-8. 1960. reprinted with corrections as ARS H-4, 1975, also reprinted 1979.
2. Snee RD. Computation and Use of Expected Mean Squares in Analysis of Variance. J Qual Tech. 1974;6(3);128-137.
3. Goodnight JH. The General Linear Models Procedure, Proceedings of the First International SAS User's Group, SAS Institute, Raleigh, N.C. 1976.
4. Littell RC, Stroup WW, Freund RJ. SAS for Linear Models 4e. John Wiley & Sons Inc. 2002.
5. Sahai H, Ojeda MM. Analysis of Variance for Random Models Volume 2 Unbalanced Data. 2005.
6. Federer WT, King F. Variations on Split Plot and Split Block Experiment Designs. John Wiley & Sons Inc. 2007.
7. Hinkelmann K, Kempthorne O. Design and Analysis of Experiments Volume 1 Introduction to Experimental Design. 2e. John Wiley & Sons Inc. 2008.
8. Hinkelmann K, Kempthorne O. Design and Analysis of Experiments Volume 2 Advanced Experimental Design. John Wiley & Sons Inc. 2005.
9. Lawson J. Design and Analysis of Experiments with SAS. Taylor and Francis Group. 2010.
10. Searle SR, Gruber MHJ. Linear Models 2e, Kindle Edition. John Wiley & Sons Inc. 2016.

2 ARS20-8

Reference

- Harvey WR. Least-Squares Analysis of Data with Unequal Subclass Frequencies. USDA, Agriculture Research Service, ARS 20-8. 1960. reprinted with corrections as ARS H-4, 1975, also reprinted 1979.

2.1 p8

(1) MODEL

```
p8 = read.csv("C:/G/Rt/ANOVA/ARS20-8p8.csv")
p8 = af(p8, c("PigNo", "Ration"))
GLM(Barrow ~ Ration, p8)
```

\$ANOVA

Response : Barrow

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	2	11.111	5.5556	1.2626	0.3113
RESIDUALS	15	66.000	4.4000		
CORRECTED TOTAL	17	77.111			

\$Fitness

Root MSE	Barrow	Mean	Coef Var	R-square	Adj R-sq
2.097618	5.222222	40.16715	0.1440922	0.02997118	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Ration	2	11.111	5.5556	1.2626	0.3113

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Ration	2	11.111	5.5556	1.2626	0.3113

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Ration	2	11.111	5.5556	1.2626	0.3113

2.2 p42

(2) MODEL

```
p42 = read.csv("C:/G/Rt/ANOVA/ARS20-8p42.csv")
p42 = af(p42, c("Ration", "Pig", "Sire"))
GLM(Y ~ Sire + Ration, p42)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	20.819	6.9397	1.7259	0.2075

```
RESIDUALS      14 56.292  4.0209
CORRECTED TOTAL 17 77.111
```

\$Fitness

```
Root MSE    Y Mean Coef Var  R-square  Adj R-sq
 2.00521 5.222222 38.39764 0.2699867 0.1135553
```

\$`Type I`

```
      Df  Sum Sq Mean Sq F value Pr(>F)
Sire    2 11.1111  5.5556  1.3817 0.2834
Ration  1  9.7079  9.7079  2.4144 0.1425
```

\$`Type II`

```
      Df  Sum Sq Mean Sq F value Pr(>F)
Sire    2 15.6829  7.8414  1.9502 0.1790
Ration  1  9.7079  9.7079  2.4144 0.1425
```

\$`Type III`

```
      Df  Sum Sq Mean Sq F value Pr(>F)
Sire    2 15.6829  7.8414  1.9502 0.1790
Ration  1  9.7079  9.7079  2.4144 0.1425
```

(3) MODEL

```
GLM(Y ~ Sire + Ration + Sire:Ration, p42)
```

\$ANOVA

Response : Y

```
      Df Sum Sq Mean Sq F value  Pr(>F)
MODEL      5 51.044 10.2089  4.6997 0.01311 *
RESIDUALS  12 26.067  2.1722
CORRECTED TOTAL 17 77.111
```

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

\$Fitness

```
Root MSE    Y Mean Coef Var  R-square  Adj R-sq
 1.473846 5.222222 28.22258 0.6619597 0.5211095
```

\$`Type I`

```
      Df  Sum Sq Mean Sq F value  Pr(>F)
Sire    2 11.1111  5.5556  2.5575 0.118799
Ration  1  9.7079  9.7079  4.4691 0.056129 .
Sire:Ration 2 30.2255 15.1127  6.9573 0.009859 **
```

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

\$`Type II`

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

```
Sire          2 15.6829  7.8414  3.6099 0.059238 .
Ration        1  9.7079  9.7079  4.4691 0.056129 .
Sire:Ration    2 30.2255 15.1127  6.9573 0.009859 **
```

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

\$`Type III`

```
      Df  Sum Sq Mean Sq F value    Pr(>F)
Sire      2 21.0007 10.5004  4.8339 0.028853 *
Ration     1  3.5919  3.5919  1.6535 0.222736
Sire:Ration 2 30.2255 15.1127  6.9573 0.009859 **
```

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

2.3 p101

(4) MODEL

```
p101 = read.csv("C:/G/Rt/ANOVA/ARS20-8p101.csv")
p101 = af(p101, c("Line", "Sire", "Dam", "Steer"))
GLM(Gain ~ Line + Sire + Dam + Line:Dam + Age + Weight, p101)
```

\$ANOVA

Response : Gain

```
      Df Sum Sq  Mean Sq F value    Pr(>F)
MODEL      16 2.4972 0.156073  3.0675 0.001364 **
RESIDUALS    48 2.4422 0.050879
CORRECTED TOTAL 64 4.9394
```

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

\$Fitness

```
Root MSE Gain Mean Coef Var  R-square  Adj R-sq
0.2255642  2.411385 9.354136 0.5055646 0.3407528
```

\$`Type I`

```
      Df  Sum Sq  Mean Sq F value    Pr(>F)
Line      2 0.38009 0.190046  3.7352 0.03107 *
Sire      6 0.92634 0.154391  3.0345 0.01347 *
Dam       2 0.11894 0.059471  1.1689 0.31940
Line:Dam   4 0.64889 0.162222  3.1884 0.02113 *
Age       1 0.16462 0.164622  3.2356 0.07835 .
Weight    1 0.25828 0.258283  5.0764 0.02886 *
```

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

\$`Type II`

```
      Df  Sum Sq Mean Sq F value    Pr(>F)
Line      0
```

```

Sire      6 0.95299 0.15883  3.1217 0.01155 *
Dam       2 0.32039 0.16019  3.1485 0.05190 .
Line:Dam  4 0.46516 0.11629  2.2856 0.07373 .
Age       1 0.34830 0.34830  6.8456 0.01185 *
Weight    1 0.25828 0.25828  5.0764 0.02886 *
---
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)
Line    0
Sire     6 0.95299 0.15883  3.1217 0.01155 *
Dam      2 0.12469 0.06234  1.2253 0.30268
Line:Dam  4 0.46516 0.11629  2.2856 0.07373 .
Age      1 0.34830 0.34830  6.8456 0.01185 *
Weight   1 0.25828 0.25828  5.0764 0.02886 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

(5) MODEL

```
GLM(Gain ~ Sire + Dam + Line:Dam, p101)
```

\$ANOVA

Response : Gain

```

      Df Sum Sq Mean Sq F value Pr(>F)
MODEL    14 2.0743 0.148162  2.5856 0.006996 **
RESIDUALS  50 2.8651 0.057302
CORRECTED TOTAL 64 4.9394

```

```

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

```

\$Fitness

```

Root MSE Gain Mean Coef Var  R-square Adj R-sq
0.2393787  2.411385 9.927022 0.4199453  0.25753

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value Pr(>F)
Sire    8 1.30644 0.163305  2.8499 0.01089 *
Dam     2 0.11894 0.059471  1.0379 0.36172
Dam:Line  4 0.64889 0.162222  2.8310 0.03412 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type II`

```

      Df Sum Sq Mean Sq F value Pr(>F)
Sire    6 1.06000 0.176667  3.0831 0.01202 *
Dam     2 0.11894 0.059471  1.0379 0.36172

```


Dam:Line 4 0.64889 0.162222 2.8310 0.03412 *

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)
Sire	6	1.06000	0.176667	3.0831	0.01202 *
Dam	2	0.02569	0.012844	0.2242	0.79999
Dam:Line	4	0.64889	0.162222	2.8310	0.03412 *

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

3 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.

(6) MODEL

```
Snee = read.csv("C:/G/Rt/ANOVA/Snee_EMS_ANOVA1974.csv")
Snee = af(Snee, c("Machine", "Analyst", "Test", "Day"))
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			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square
NA	8.736905	NA	1

\$`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		

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

4 Goodnight

Reference

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

4.1 Type I SS

4.1.1 p7

(7) MODEL

```
p7 = read.csv("C:/G/Rt/ANOVA/Goodnight-p7.csv")
p7 = af(p7, c("A", "B"))
GLM(y ~ A + B + A:B, p7)
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	13.6027	4.5342	2.807	0.1721
RESIDUALS	4	6.4613	1.6153		
CORRECTED TOTAL	7	20.0639			

\$Fitness

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
1.270954	5.4725	23.22438	0.6779647	0.4364382	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.8113	10.8113	6.6929	0.06087 .
B	1	1.3122	1.3122	0.8123	0.41839
A:B	1	1.4792	1.4792	0.9157	0.39279

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.8113	10.8113	6.6929	0.06087 .
B	1	1.3122	1.3122	0.8123	0.41839
A:B	1	1.4792	1.4792	0.9157	0.39279

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.8113	10.8113	6.6929	0.06087 .
B	1	1.3122	1.3122	0.8123	0.41839
A:B	1	1.4792	1.4792	0.9157	0.39279

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

(8) MODEL

```
GLM(y ~ A + A:B + B, p7)
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	13.6027	4.5342	2.807	0.1721
RESIDUALS	4	6.4613	1.6153		
CORRECTED TOTAL	7	20.0639			

\$Fitness

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
1.270954	5.4725	23.22438	0.6779647	0.4364382	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.8113	10.8113	6.6929	0.06087 .
A:B	2	2.7914	1.3957	0.8640	0.48764
B	0				

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.8113	10.8113	6.6929	0.06087 .
A:B	1	1.4792	1.4792	0.9157	0.39279
B	1	1.3122	1.3122	0.8123	0.41839

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.8113	10.8113	6.6929	0.06087 .
A:B	1	1.4792	1.4792	0.9157	0.39279
B	1	1.3122	1.3122	0.8123	0.41839

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

(9) MODEL

```
GLM(y ~ B + A + A:B, p7)
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	13.6027	4.5342	2.807	0.1721
RESIDUALS	4	6.4613	1.6153		

CORRECTED TOTAL 7 20.0639

\$Fitness

Root MSE	y	Mean	Coef	Var	R-square	Adj R-sq
1.270954	5.4725	23.22438	0.6779647	0.4364382		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	1	1.3122	1.3122	0.8123	0.41839
A	1	10.8113	10.8113	6.6929	0.06087 .
B:A	1	1.4792	1.4792	0.9157	0.39279

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	1	1.3122	1.3122	0.8123	0.41839
A	1	10.8113	10.8113	6.6929	0.06087 .
B:A	1	1.4792	1.4792	0.9157	0.39279

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	1	1.3122	1.3122	0.8123	0.41839
A	1	10.8113	10.8113	6.6929	0.06087 .
B:A	1	1.4792	1.4792	0.9157	0.39279

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

(10) MODEL

GLM(y ~ B + A:B + A, p7)

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	13.6027	4.5342	2.807	0.1721
RESIDUALS	4	6.4613	1.6153		
CORRECTED TOTAL	7	20.0639			

\$Fitness

Root MSE	y	Mean	Coef	Var	R-square	Adj R-sq
1.270954	5.4725	23.22438	0.6779647	0.4364382		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	1	1.3122	1.3122	0.8123	0.4184
B:A	2	12.2905	6.1452	3.8043	0.1187

A 0

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	1	1.3122	1.3122	0.8123	0.41839
B:A	1	1.4792	1.4792	0.9157	0.39279
A	1	10.8113	10.8113	6.6929	0.06087 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	1	1.3122	1.3122	0.8123	0.41839
B:A	1	1.4792	1.4792	0.9157	0.39279
A	1	10.8113	10.8113	6.6929	0.06087 .

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

(11) MODEL

GLM(y ~ A:B + A + B, p7)

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	13.6027	4.5342	2.807	0.1721
RESIDUALS	4	6.4613	1.6153		
CORRECTED TOTAL	7	20.0639			

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
1.270954	5.4725	23.22438	0.6779647	0.4364382

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A:B	3	13.603	4.5342	2.807	0.1721
A	0				
B	0				

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A:B	1	1.4792	1.4792	0.9157	0.39279
A	1	10.8113	10.8113	6.6929	0.06087 .
B	1	1.3122	1.3122	0.8123	0.41839

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

\$`Type III`

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

```
A:B  1  1.4792  1.4792  0.9157 0.39279
A    1 10.8113 10.8113  6.6929 0.06087 .
B    1  1.3122  1.3122  0.8123 0.41839
```

```
---
```

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

```
(12) MODEL
```

```
GLM(y ~ A:B + A + B, p7)
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	13.6027	4.5342	2.807	0.1721
RESIDUALS	4	6.4613	1.6153		
CORRECTED TOTAL	7	20.0639			

```
$Fitness
```

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
1.270954	5.4725	23.22438	0.6779647	0.4364382	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A:B	3	13.603	4.5342	2.807	0.1721
A	0				
B	0				

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A:B	1	1.4792	1.4792	0.9157	0.39279
A	1	10.8113	10.8113	6.6929	0.06087 .
B	1	1.3122	1.3122	0.8123	0.41839

```
---
```

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A:B	1	1.4792	1.4792	0.9157	0.39279
A	1	10.8113	10.8113	6.6929	0.06087 .
B	1	1.3122	1.3122	0.8123	0.41839

```
---
```

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

4.2 Type II SS

4.2.1 p14

```
(13) MODEL
```

```
GLM(y ~ A + B + A:B, p7[-8,]) # p16
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	12.7672	4.2557	2.0088	0.2906
RESIDUALS	3	6.3555	2.1185		
CORRECTED TOTAL	6	19.1227			

```
$Fitness
```

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
1.455507	5.342857	27.24211	0.6676471	0.3352941	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	9.9567	9.9567	4.6999	0.1187
B	1	1.9225	1.9225	0.9075	0.4111
A:B	1	0.8880	0.8880	0.4192	0.5635

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	11.1715	11.1715	5.2733	0.1053
B	1	1.9225	1.9225	0.9075	0.4111
A:B	1	0.8880	0.8880	0.4192	0.5635

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	9.5258	9.5258	4.4965	0.1241
B	1	1.3690	1.3690	0.6462	0.4803
A:B	1	0.8880	0.8880	0.4192	0.5635

4.2.2 p24

```
(14) MODEL
```

```
p24 = read.csv("C:/G/Rt/ANOVA/Goodnight-p24.csv")
p24 = af(p24, c("A", "B", "C"))
GLM(Y ~ A + B + C, p24) # p27
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	6	45.924	7.6540	9.1615	0.00499 **
RESIDUALS	7	5.848	0.8354		
CORRECTED TOTAL	13	51.772			

```
---
```

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


\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
0.9140295	6.159286	14.83986	0.8870405	0.7902181

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	4.724	4.7235	5.6538	0.04904 *
B	3	37.998	12.6660	15.1606	0.00191 **
C	2	3.203	1.6013	1.9167	0.21686

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	0				
B	2	0.4424	0.2212	0.2648	0.7747
C	2	3.2025	1.6013	1.9167	0.2169

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	0				
B	2	0.4424	0.2212	0.2648	0.7747
C	2	3.2025	1.6013	1.9167	0.2169

4.3 Type III SS

4.3.1 p27

(15) MODEL

```
p27 = read.csv("C:/G/Rt/ANOVA/Goodnight-p27.csv")
p27 = af(p27, c("A", "B"))
GLM(y ~ A + B + A:B, p27) # p29
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	5	128.193	25.6386	53.469	6.77e-05 ***
RESIDUALS	6	2.877	0.4795		
CORRECTED TOTAL	11	131.070			

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

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
0.6924594	9.34	7.413912	0.9780499	0.9597582

\$`Type I`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
A      2  89.580   44.790  93.4102 3.013e-05 ***
B      2  38.542   19.271  40.1901 0.0003351 ***
A:B    1   0.071    0.071   0.1471 0.7145464
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
A      2 126.778   63.389 132.1977 1.093e-05 ***
B      2  38.542   19.271  40.1901 0.0003351 ***
A:B    1   0.071    0.071   0.1471 0.7145464
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
A      2 126.778   63.389 132.1977 1.093e-05 ***
B      2  38.542   19.271  40.1901 0.0003351 ***
A:B    1   0.071    0.071   0.1471 0.7145464
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

4.3.2 p33

(16) MODEL

```

p33 = read.csv("C:/G/Rt/ANOVA/Goodnight-p33.csv")
p33 = af(p33, c("A", "B"))
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

```

```

$Fitness
Root MSE y Mean Coef Var R-square
      NA  6.946      NA      1

```

```

$`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		

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

5 SAS for Linear Models 4e

Reference

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

5.1 Chapter 2

5.1.1 p5

(17) MODEL

```
p5 = read.table("C:/G/Rt/SAS4lm/p5.txt", head=TRUE)
GLM(COST ~ CATTLE, p5) # p6 Output 2.2
```

\$ANOVA

Response : COST

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	1	6582.1	6582.1	59.34	6.083e-07 ***
RESIDUALS	17	1885.7	110.9		
CORRECTED TOTAL	18	8467.8			

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

\$Fitness

Root MSE	COST	Mean Coef	Var	R-square	Adj R-sq
10.53198	35.29342	29.84119	0.7773107	0.7642113	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	6582.1	6582.1	59.34	6.083e-07 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	6582.1	6582.1	59.34	6.083e-07 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	6582.1	6582.1	59.34	6.083e-07 ***

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

5.1.2 p12

(18) MODEL

```
p12 = read.table("C:/G/Rt/SAS4lm/p12.txt", head=TRUE)
GLM(COST ~ CATTLE + CALVES + HOGS + SHEEP, p12)
```

\$ANOVA

Response : COST

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	7936.7	1984.18	52.31	2.885e-08 ***
RESIDUALS	14	531.0	37.93		
CORRECTED TOTAL	18	8467.8			

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

\$Fitness

Root MSE	COST	Mean Coef	Var	R-square	Adj R-sq
6.158842	35.29342	17.4504	0.9372871	0.9193691	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	6582.1	6582.1	173.5265	2.801e-09 ***
CALVES	1	186.7	186.7	4.9213	0.0435698 *
HOGS	1	489.9	489.9	12.9145	0.0029351 **
SHEEP	1	678.1	678.1	17.8773	0.0008431 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	2200.71	2200.71	58.0183	2.413e-06 ***
CALVES	1	136.08	136.08	3.5876	0.0790616 .
HOGS	1	113.66	113.66	2.9964	0.1054198
SHEEP	1	678.11	678.11	17.8773	0.0008431 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	2200.71	2200.71	58.0183	2.413e-06 ***
CALVES	1	136.08	136.08	3.5876	0.0790616 .
HOGS	1	113.66	113.66	2.9964	0.1054198
SHEEP	1	678.11	678.11	17.8773	0.0008431 ***

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

(19) MODEL

```
GLM(COST ~ CATTLE + CALVES + SHEEP, p12)
```

\$ANOVA

Response : COST

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	7823.1	2607.69	60.673	1.281e-08 ***
RESIDUALS	15	644.7	42.98		
CORRECTED TOTAL	18	8467.8			

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

\$Fitness

Root MSE	COST	Mean Coef	Var	R-square	Adj R-sq
6.555887	35.29342	18.57538	0.9238649	0.9086379	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	6582.1	6582.1	153.1443	2.835e-09 ***
CALVES	1	186.7	186.7	4.3432	0.0546701 .
SHEEP	1	1054.3	1054.3	24.5306	0.0001735 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	2519.8	2519.8	58.6265	1.471e-06 ***
CALVES	1	260.6	260.6	6.0634	0.0263909 *
SHEEP	1	1054.3	1054.3	24.5306	0.0001735 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	2519.8	2519.8	58.6265	1.471e-06 ***
CALVES	1	260.6	260.6	6.0634	0.0263909 *
SHEEP	1	1054.3	1054.3	24.5306	0.0001735 ***

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

(20) MODEL

```
GLM(COST ~ CATTLE + CALVES + offset(1*HOGS) + SHEEP, p12)
```

\$ANOVA

Response : COST

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	7823.1	2607.69	60.673	1.281e-08 ***
RESIDUALS	15	644.7	42.98		
CORRECTED TOTAL	18	8467.8			

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

\$Fitness

```
Root MSE COST Mean Coef Var R-square Adj R-sq
6.555887 35.29342 18.57538 0.9238649 0.9086379
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 6582.1  6582.1 153.1443 2.835e-09 ***
CALVES  1  186.7   186.7   4.3432 0.0546701 .
SHEEP   1 1054.3  1054.3  24.5306 0.0001735 ***
```

```
---
```

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

```
$`Type II`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2519.8  2519.8 58.6265 1.471e-06 ***
CALVES  1  260.6   260.6   6.0634 0.0263909 *
SHEEP   1 1054.3  1054.3  24.5306 0.0001735 ***
```

```
---
```

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

```
$`Type III`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE  1 2519.8  2519.8 58.6265 1.471e-06 ***
CALVES  1  260.6   260.6   6.0634 0.0263909 *
SHEEP   1 1054.3  1054.3  24.5306 0.0001735 ***
```

```
---
```

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

```
(21) MODEL
```

```
GLM(COST ~ CATTLE + CALVES + I(HOGS + SHEEP), p12)
```

```
$ANOVA
```

```
Response : COST
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      3 7936.7  2645.6  74.726 3.011e-09 ***
RESIDUALS  15  531.1    35.4
CORRECTED TOTAL 18 8467.8
```

```
---
```

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

```
$Fitness
```

```
Root MSE COST Mean Coef Var R-square Adj R-sq
5.950105 35.29342 16.85896 0.937285 0.924742
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
CATTLE      1 6582.1  6582.1 185.9151 7.406e-10 ***
CALVES      1  186.7   186.7   5.2726  0.03649 *
I(HOGS + SHEEP) 1 1168.0  1168.0  32.9896 3.883e-05 ***
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	2215.48	2215.48	62.5775	9.887e-07 ***
CALVES	1	155.03	155.03	4.3788	0.0538 .
I(HOGS + SHEEP)	1	1167.96	1167.96	32.9896	3.883e-05 ***

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
CATTLE	1	2215.48	2215.48	62.5775	9.887e-07 ***
CALVES	1	155.03	155.03	4.3788	0.0538 .
I(HOGS + SHEEP)	1	1167.96	1167.96	32.9896	3.883e-05 ***

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

```
(22) MODEL
```

```
REG(COST ~ CATTLE + CALVES + I(HOGS + SHEEP) - 1, p12)
```

```
$ANOVA
```

```
Response : COST
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	31586	10528.5	306.83	2.398e-14 ***
RESIDUALS	16	549	34.3		
UNCORRECTED TOTAL	19	32135			

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

```
$Fitness
```

Root MSE	COST	Mean Coef	Var	R-square	Adj R-sq	PRESS	R2pred
5.857788	35.29342	16.59739	0.9829151	0.9797116	1365.162	0.9575175	

```
$Coefficients
```

	Estimate	Std. Error	Df	Lower CL	Upper CL	t value	Pr(> t)
CATTLE	3.3000	0.38314	16	2.48782	4.1123	8.6131	2.100e-07 ***
CALVES	1.9672	0.59108	16	0.71414	3.2202	3.3281	0.004259 **
I(HOGS + SHEEP)	0.8068	0.13800	16	0.51428	1.0994	5.8466	2.479e-05 ***

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

5.2 Chapter 3

5.2.1 p63

```
(23) MODEL
```



```
p63w = read.table("C:/G/Rt/SAS4lm/p63.txt", header=TRUE)
p63l = reshape(p63w,
               direction = "long",
               varying = list(names(p63w)[2:9]),
               v.names = "fruitwt",
               idvar = c("irrig"),
               timevar = "bloc",
               times = 1:8)
p63l = af(p63l, c("bloc"))
GLM(fruitwt ~ bloc + irrig, p63l) # p64
```

\$ANOVA

Response : fruitwt

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	445334	40485	12.04	6.643e-08 ***
RESIDUALS	28	94147	3362		
CORRECTED TOTAL	39	539481			

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

\$Fitness

Root MSE	fruitwt	Mean Coef	Var	R-square	Adj R-sq
57.98607	267.075	21.71153	0.8254864	0.7569274	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bloc	7	401308	57330	17.0503	1.452e-08 ***
irrig	4	44026	11006	3.2734	0.02539 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bloc	7	401308	57330	17.0503	1.452e-08 ***
irrig	4	44026	11006	3.2734	0.02539 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bloc	7	401308	57330	17.0503	1.452e-08 ***
irrig	4	44026	11006	3.2734	0.02539 *

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

5.2.2 p72

(24) MODEL

```
p72 = read.table("C:/G/Rt/SAS4lm/p72.txt", header=TRUE)
p72 = af(p72, c("run", "pos", "mat"))
GLM(wtloss ~ run + pos + mat, p72) # p73
```

\$ANOVA

Response : wtloss

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	9	7076.5	786.28	12.837	0.002828 **
RESIDUALS	6	367.5	61.25		
CORRECTED TOTAL	15	7444.0			

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

\$Fitness

Root MSE	wtloss	Mean Coef	Var	R-square	Adj R-sq
7.826238	239.5	3.26774	0.9506314	0.8765785	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
run	3	986.5	328.83	5.3687	0.0390130 *
pos	3	1468.5	489.50	7.9918	0.0161685 *
mat	3	4621.5	1540.50	25.1510	0.0008498 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
run	3	986.5	328.83	5.3687	0.0390130 *
pos	3	1468.5	489.50	7.9918	0.0161685 *
mat	3	4621.5	1540.50	25.1510	0.0008498 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
run	3	986.5	328.83	5.3687	0.0390130 *
pos	3	1468.5	489.50	7.9918	0.0161685 *
mat	3	4621.5	1540.50	25.1510	0.0008498 ***

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

```
GLM(shrink ~ run + pos + mat, p72) # p73
```

\$ANOVA

Response : shrink

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	9	265.75	29.528	9.8426	0.005775 **
RESIDUALS	6	18.00	3.000		

```
CORRECTED TOTAL 15 283.75
```

```
---
```

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

```
$Fitness
```

```
Root MSE shrink Mean Coef Var  R-square  Adj R-sq  
1.732051      47.125 3.675439 0.9365639 0.8414097
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
run   3   33.25   11.083    3.6944 0.081254 .  
pos   3   60.25   20.083    6.6944 0.024212 *  
mat   3  172.25   57.417   19.1389 0.001786 **
```

```
---
```

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

```
$`Type II`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
run   3   33.25   11.083    3.6944 0.081254 .  
pos   3   60.25   20.083    6.6944 0.024212 *  
mat   3  172.25   57.417   19.1389 0.001786 **
```

```
---
```

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

```
$`Type III`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
run   3   33.25   11.083    3.6944 0.081254 .  
pos   3   60.25   20.083    6.6944 0.024212 *  
mat   3  172.25   57.417   19.1389 0.001786 **
```

```
---
```

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

5.2.3 p75

(25) MODEL

```
p75w = read.table("C:/G/Rt/SAS4lm/p75.txt", header=TRUE)  
p75l = reshape(p75w,  
  direction = "long",  
  varying = list(names(p75w)[4:9]),  
  v.names = "Y",  
  idvar = c("method", "variety", "trt"),  
  timevar = "yield",  
  times = 1:6)  
p75l = af(p75l, c("variety", "yield"))  
GLM(Y ~ method*variety, p75l) # p78
```

```
$ANOVA
```

```
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	14	1339.0	95.645	4.8674	2.723e-06 ***
RESIDUALS	75	1473.8	19.650		
CORRECTED TOTAL	89	2812.8			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
4.432857	18.43778	24.04225	0.4760484	0.3782441

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
method	2	953.16	476.58	24.2531	7.525e-09 ***
variety	4	11.38	2.85	0.1448	0.96476
method:variety	8	374.49	46.81	2.3822	0.02409 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
method	2	953.16	476.58	24.2531	7.525e-09 ***
variety	4	11.38	2.85	0.1448	0.96476
method:variety	8	374.49	46.81	2.3822	0.02409 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
method	2	953.16	476.58	24.2531	7.525e-09 ***
variety	4	11.38	2.85	0.1448	0.96476
method:variety	8	374.49	46.81	2.3822	0.02409 *

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

5.3 Chapter 4

5.3.1 p94

(26) MODEL

```
p94w = read.table("C:/G/Rt/SAS4lm/p94.txt", head=TRUE)
p94l = reshape(p94w,
  direction = "long",
  varying = list(names(p94w)[3:8]),
  v.names = "ct",
  idvar = c("package"),
  timevar = "sample",
  times = 1:6)
```

```
p94l$sampleA = floor((p94l$sample + 1)/2)
p94l$sampleB = 2 - (p94l$sample) %% 2
p94l$logct = log10(p94l$ct)
p94l = af(p94l, c("sample", "sampleA", "sampleB", "package"))
GLM(logct ~ package + sampleA %in% package, p94l) # p97
```

\$ANOVA

Response : logct

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	59	50.463	0.85531	22.229	< 2.2e-16 ***
RESIDUALS	60	2.309	0.03848		
CORRECTED TOTAL	119	52.772			

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

\$Fitness

Root MSE	logct	Mean	Coef Var	R-square	Adj R-sq
0.196156	3.049459	6.432487	0.9562528	0.9132347	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
package	19	30.529	1.60680	41.760	< 2.2e-16 ***
package:sampleA	40	19.934	0.49836	12.952	< 2.2e-16 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
package	19	30.529	1.60680	41.760	< 2.2e-16 ***
package:sampleA	40	19.934	0.49836	12.952	< 2.2e-16 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
package	19	30.529	1.60680	41.760	< 2.2e-16 ***
package:sampleA	40	19.934	0.49836	12.952	< 2.2e-16 ***

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

5.3.2 p116

(27) MODEL

```
GLM(Y ~ method + variety + method:variety, p75l) # p116
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	14	1339.0	95.645	4.8674	2.723e-06 ***
RESIDUALS	75	1473.8	19.650		
CORRECTED TOTAL	89	2812.8			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
4.432857	18.43778	24.04225	0.4760484	0.3782441

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
method	2	953.16	476.58	24.2531	7.525e-09 ***
variety	4	11.38	2.85	0.1448	0.96476
method:variety	8	374.49	46.81	2.3822	0.02409 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
method	2	953.16	476.58	24.2531	7.525e-09 ***
variety	4	11.38	2.85	0.1448	0.96476
method:variety	8	374.49	46.81	2.3822	0.02409 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
method	2	953.16	476.58	24.2531	7.525e-09 ***
variety	4	11.38	2.85	0.1448	0.96476
method:variety	8	374.49	46.81	2.3822	0.02409 *

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

5.3.3 p122

(28) MODEL

```
p122 = read.table("C:/G/Rt/SAS4lm/p122.txt", header=TRUE)
p122 = af(p122, c("et", "wafer", "pos"))
GLM(resista ~ et + wafer %in% et + pos + et:pos, p122)
```

\$ANOVA

Response : resista

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	23	9.3250	0.40544	3.6477	0.001263 **
RESIDUALS	24	2.6676	0.11115		
CORRECTED TOTAL	47	11.9926			

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

```
$Fitness
```

```
Root MSE resista Mean Coef Var R-square Adj R-sq
0.3333906      6.002917 5.553811 0.7775641 0.5643963
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
et	3	3.1122	1.03739	9.3333	0.0002851 ***
et:wafer	8	4.2745	0.53431	4.8071	0.0012742 **
pos	3	1.1289	0.37630	3.3855	0.0345139 *
et:pos	9	0.8095	0.08994	0.8092	0.6125279

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
et	3	3.1122	1.03739	9.3333	0.0002851 ***
et:wafer	8	4.2745	0.53431	4.8071	0.0012742 **
pos	3	1.1289	0.37630	3.3855	0.0345139 *
et:pos	9	0.8095	0.08994	0.8092	0.6125279

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
et	3	3.1122	1.03739	9.3333	0.0002851 ***
et:wafer	8	4.2745	0.53431	4.8071	0.0012742 **
pos	3	1.1289	0.37630	3.3855	0.0345139 *
et:pos	9	0.8095	0.08994	0.8092	0.6125279

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

5.3.4 p136

```
(29) MODEL
```

```
p136 = read.table("C:/G/Rt/SAS4lm/p136.txt", header=TRUE)
p136 = af(p136, "rep")
GLM(drywt ~ rep + cult + rep:cult + inoc + cult:inoc, p136)
```

```
$ANOVA
```

```
Response : drywt
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	157.208	14.2917	20.26	4.594e-06 ***
RESIDUALS	12	8.465	0.7054		
CORRECTED TOTAL	23	165.673			

```
---
```

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

```
$Fitness
```

```
Root MSE drywt Mean Coef Var  R-square  Adj R-sq  
0.8398909  30.41667 2.761285 0.9489055 0.9020688
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	3	25.320	8.440	11.9646	0.0006428 ***
cult	1	2.407	2.407	3.4117	0.0895283 .
rep:cult	3	9.480	3.160	4.4796	0.0249095 *
inoc	2	118.176	59.088	83.7631	8.919e-08 ***
cult:inoc	2	1.826	0.913	1.2942	0.3097837

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	3	25.320	8.440	11.9646	0.0006428 ***
cult	1	2.407	2.407	3.4117	0.0895283 .
rep:cult	3	9.480	3.160	4.4796	0.0249095 *
inoc	2	118.176	59.088	83.7631	8.919e-08 ***
cult:inoc	2	1.826	0.913	1.2942	0.3097837

```
---
```

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	3	25.320	8.440	11.9646	0.0006428 ***
cult	1	2.407	2.407	3.4117	0.0895283 .
rep:cult	3	9.480	3.160	4.4796	0.0249095 *
inoc	2	118.176	59.088	83.7631	8.919e-08 ***
cult:inoc	2	1.826	0.913	1.2942	0.3097837

```
---
```

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

5.4 Chapter 5

5.4.1 p142

```
(30) MODEL
```

```
p142 = read.table("C:/G/Rt/SAS4lm/p142.txt", header=TRUE, na.strings=".")  
p142 = af(p142, c("STUDY", "PATIENT"))  
GLM(FLUSH ~ STUDY + TRT, p142) # Incomplete data, 56 lines are truncated.
```

```
$ANOVA
```

```
Response : FLUSH
```

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


```

MODEL          5  3619.9  723.98   2.392 0.04607 *
RESIDUALS      71 21489.2  302.67
CORRECTED TOTAL 76 25109.1

```

```

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

```

\$Fitness

```

Root MSE FLUSH Mean Coef Var  R-square  Adj R-sq
17.39728   23.12697  75.2251 0.1441665 0.08389657

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value Pr(>F)
STUDY  4 3553.9   888.46   2.9355 0.02638 *
TRT     1   66.0    66.04   0.2182 0.64185

```

```

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

```

\$`Type II`

```

      Df Sum Sq Mean Sq F value Pr(>F)
STUDY  4 3599.4   899.85   2.9731 0.02496 *
TRT     1   66.0    66.04   0.2182 0.64185

```

```

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

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value Pr(>F)
STUDY  4 3599.4   899.85   2.9731 0.02496 *
TRT     1   66.0    66.04   0.2182 0.64185

```

```

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

```

(31) MODEL

```

GLM(FLUSH ~ TRT + STUDY + TRT:STUDY, p142) # Different data

```

\$ANOVA

Response : FLUSH

```

      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      9 4093.7   454.86   1.4501 0.1851
RESIDUALS  67 21015.4   313.66
CORRECTED TOTAL 76 25109.1

```

\$Fitness

```

Root MSE FLUSH Mean Coef Var  R-square  Adj R-sq
17.71054   23.12697  76.57962 0.1630364 0.05060842

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value Pr(>F)
TRT     1   20.5    20.49   0.0653 0.79906

```

```
STUDY      4 3599.4  899.85  2.8688 0.02956 *
TRT:STUDY  4  473.8  118.45  0.3776 0.82383
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$`Type II`

```
      Df Sum Sq Mean Sq F value Pr(>F)
TRT      1    66.0    66.04  0.2105 0.64783
STUDY     4 3599.4   899.85  2.8688 0.02956 *
TRT:STUDY 4  473.8   118.45  0.3776 0.82383
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$`Type III`

```
      Df Sum Sq Mean Sq F value Pr(>F)
TRT      1     1.9     1.93  0.0062 0.9377
STUDY     4 3339.4   834.85  2.6616 0.0400 *
TRT:STUDY 4  473.8   118.45  0.3776 0.8238
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5.5 Chapter 6

5.5.1 p171

(32) MODEL

```
p171 = read.table("C:/G/Rt/SAS4lm/p171.txt", header=TRUE)
GLM(score2 ~ teach, p171) # p173 Output 6.2, p174 Output 6.5
```

\$ANOVA

Response : score2

```
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      2    49.74   24.868  0.5598 0.5776
RESIDUALS   28 1243.94   44.426
CORRECTED TOTAL 30 1293.68
```

\$Fitness

```
Root MSE score2 Mean Coef Var   R-square   Adj R-sq
  6.66532    73.54839 9.062496 0.03844533 -0.03023714
```

\$`Type I`

```
      Df Sum Sq Mean Sq F value Pr(>F)
teach   2 49.736   24.868  0.5598 0.5776
```

\$`Type II`

```
      Df Sum Sq Mean Sq F value Pr(>F)
teach   2 49.736   24.868  0.5598 0.5776
```

```
$`Type III`
      Df Sum Sq Mean Sq F value Pr(>F)
teach  2 49.736  24.868   0.5598 0.5776
```

5.5.2 p188

(33) MODEL

```
p188 = read.table("C:/G/Rt/SAS4lm/p188.txt", header=TRUE)
p188 = af(p188, c("a", "b"))
GLM(y ~ a + b + a:b, p188) # p189
```

\$ANOVA

Response : y

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      5 63.711  12.7422    5.866 0.005724 **
RESIDUALS  12 26.067   2.1722
CORRECTED TOTAL 17 89.778
```

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

\$Fitness

```
Root MSE   y Mean Coef Var  R-square  Adj R-sq
1.473846  5.111111 28.83612 0.7096535 0.5886757
```

\$`Type I`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
a      1  7.803   7.8028   3.5921 0.082395 .
b      2 20.492  10.2459   4.7168 0.030798 *
a:b    2 35.416  17.7082   8.1521 0.005807 **
```

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

\$`Type II`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
a      1 15.850  15.850   7.2968 0.019265 *
b      2 20.492  10.246   4.7168 0.030798 *
a:b    2 35.416  17.708   8.1521 0.005807 **
```

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

\$`Type III`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
a      1  9.641   9.6407   4.4382 0.056865 .
b      2 30.866  15.4330   7.1047 0.009212 **
a:b    2 35.416  17.7082   8.1521 0.005807 **
```

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

5.5.3 p203

(34) MODEL

```
GLM(y ~ a + b + a:b, p188[-8,])
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	45.816	11.4539	5.2729	0.01097 *
RESIDUALS	12	26.067	2.1722		
CORRECTED TOTAL	16	71.882			

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

\$Fitness

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
1.473846	5.352941	27.53339	0.6373704	0.5164939	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
a	1	2.9252	2.9252	1.3466	0.268432
b	2	13.3224	6.6612	3.0665	0.083997 .
a:b	1	29.5681	29.5681	13.6119	0.003095 **

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
a	1	5.5652	5.5652	2.5620	0.135442
b	2	13.3224	6.6612	3.0665	0.083997 .
a:b	1	29.5681	29.5681	13.6119	0.003095 **

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
a	1	0.3507	0.3507	0.1615	0.694881
b	2	16.0733	8.0367	3.6997	0.056021 .
a:b	1	29.5681	29.5681	13.6119	0.003095 **

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

5.5.4 p215

(35) MODEL

```
p215 = read.table("C:/G/Rt/SAS4lm/p215.txt", header=TRUE)
p215 = af(p215, c("irrig", "reps"))
```

```
GLM(yield ~ irrig/rep + cult + irrig:cult, p215) # p216 Book is wrong.
```

```
$ANOVA
```

```
Response : yield
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	67.662	6.1511	0.6253	0.7636
RESIDUALS	6	59.023	9.8372		
CORRECTED TOTAL	17	126.685			

```
$Fitness
```

Root MSE	yield	Mean	Coef	Var	R-square	Adj R-sq
3.136435	30.91667	10.1448	0.5340937	-0.3200677		

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
irrig	2	7.320	3.6600	0.3721	0.7042
irrig:rep	6	59.870	9.9783	1.0143	0.4933
cult	1	0.467	0.4672	0.0475	0.8347
irrig:cult	2	0.004	0.0022	0.0002	0.9998

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
irrig	2	7.320	3.6600	0.3721	0.7042
irrig:rep	6	59.870	9.9783	1.0143	0.4933
cult	1	0.467	0.4672	0.0475	0.8347
irrig:cult	2	0.004	0.0022	0.0002	0.9998

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
irrig	2	7.320	3.6600	0.3721	0.7042
irrig:rep	6	59.870	9.9783	1.0143	0.4933
cult	1	0.467	0.4672	0.0475	0.8347
irrig:cult	2	0.004	0.0022	0.0002	0.9998

```
# Compare with SAS output
```

```
(36) MODEL
```

```
GLM(yield ~ rep + irrig + rep:irrig + cult + cult:irrig, p215)
```

```
$ANOVA
```

```
Response : yield
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	67.662	6.1511	0.6253	0.7636
RESIDUALS	6	59.023	9.8372		
CORRECTED TOTAL	17	126.685			

```
$Fitness
```

Root MSE	yield	Mean	Coef	Var	R-square	Adj R-sq
3.136435	30.91667	10.1448	0.5340937	-0.3200677		

```
3.136435 30.91667 10.1448 0.5340937 -0.3200677
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
reps	2	49.703	24.8517	2.5263	0.1600
irrig	2	7.320	3.6600	0.3721	0.7042
reps:irrig	4	10.167	2.5417	0.2584	0.8944
cult	1	0.467	0.4672	0.0475	0.8347
irrig:cult	2	0.004	0.0022	0.0002	0.9998

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
reps	2	49.703	24.8517	2.5263	0.1600
irrig	2	7.320	3.6600	0.3721	0.7042
reps:irrig	4	10.167	2.5417	0.2584	0.8944
cult	1	0.467	0.4672	0.0475	0.8347
irrig:cult	2	0.004	0.0022	0.0002	0.9998

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
reps	2	49.703	24.8517	2.5263	0.1600
irrig	2	7.320	3.6600	0.3721	0.7042
reps:irrig	4	10.167	2.5417	0.2584	0.8944
cult	1	0.467	0.4672	0.0475	0.8347
irrig:cult	2	0.004	0.0022	0.0002	0.9998

5.6 Chapter 7

5.6.1 p232

```
(37) MODEL
```

```
p232 = read.table("C:/G/Rt/SAS4lm/p232.txt", header=TRUE)
p232 = af(p232, c("trt", "rep"))
GLM(final ~ trt + initial, p232) # p233
```

```
$ANOVA
```

```
Response : final
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	5	354.45	70.889	235.05	5.493e-13 ***
RESIDUALS	14	4.22	0.302		
CORRECTED TOTAL	19	358.67			

```
---
```

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

```
$Fitness
```

Root MSE	final	Mean	Coef	Var	R-square	Adj R-sq
0.5491762	30.845	1.780438	0.9882278	0.9840235		

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
trt      4 198.41   49.602   164.47 1.340e-11 ***
initial  1 156.04 156.040   517.38 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
trt      4  12.089    3.022   10.021 0.0004819 ***
initial  1 156.040 156.040  517.384 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
trt      4  12.089    3.022   10.021 0.0004819 ***
initial  1 156.040 156.040  517.384 1.867e-12 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5.6.2 p240

(38) MODEL

```
GLM(final ~ initial + trt + trt:initial, p232) # p240
```

\$ANOVA

Response : final

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      9 355.84   39.537   139.51 2.572e-09 ***
RESIDUALS  10   2.83    0.283
CORRECTED TOTAL 19 358.67
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$Fitness

```
Root MSE final Mean Coef Var  R-square  Adj R-sq
0.5323541      30.845 1.725901 0.9920985 0.9849872
```

```
$`Type I`
      Df Sum Sq Mean Sq  F value    Pr(>F)
initial  1 342.36   342.36 1208.0336 9.211e-12 ***
trt       4  12.09    3.02   10.6645 0.001247 **
initial:trt 4   1.39    0.35    1.2247 0.360175
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
initial	1	156.040	156.040	550.5987	4.478e-10 ***
trt	4	12.089	3.022	10.6645	0.001247 **
initial:trt	4	1.388	0.347	1.2247	0.360175

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
initial	1	68.529	68.529	241.8091	2.472e-08 ***
trt	4	1.696	0.424	1.4963	0.2752
initial:trt	4	1.388	0.347	1.2247	0.3602

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

5.6.3 p241

(39) MODEL

```
p241 = read.table("C:/G/Rt/SAS4lm/p241.txt", header=TRUE)
p241 = af(p241, c("STORE", "DAY"))
GLM(Q1 ~ P1 + DAY + P1:DAY, p241) # p242
```

\$ANOVA

Response : Q1

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	1111.52	101.048	4.6445	0.0008119 ***
RESIDUALS	24	522.15	21.756		
CORRECTED TOTAL	35	1633.68			

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

\$Fitness

Root MSE	Q1 Mean	Coef Var	R-square	Adj R-sq
4.664374	10.21711	45.65257	0.6803814	0.5338895

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P1	1	516.59	516.59	23.7444	5.739e-05 ***
DAY	5	430.54	86.11	3.9578	0.009275 **
P1:DAY	5	164.39	32.88	1.5112	0.223566

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P1	1	696.73	696.73	32.0243	7.925e-06 ***
DAY	5	430.54	86.11	3.9578	0.009275 **
P1:DAY	5	164.39	32.88	1.5112	0.223566


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

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
P1      1 554.79   554.79 25.4999 3.665e-05 ***
DAY     5 201.17    40.23  1.8493   0.1412
P1:DAY  5 164.39    32.88  1.5112   0.2236
```

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

5.6.4 p243

(40) MODEL

```
GLM(Q1 ~ DAY + DAY:P1, p241)
```

```
$ANOVA
Response : Q1
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL    11 1111.52  101.048   4.6445 0.0008119 ***
RESIDUALS 24   522.15   21.756
CORRECTED TOTAL 35 1633.68
```

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

```
$Fitness
      Root MSE   Q1 Mean Coef Var  R-square  Adj R-sq
4.664374 10.21711 45.65257 0.6803814 0.5338895
```

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
DAY     5 250.40   50.079  2.3018 0.0764717 .
DAY:P1  6 861.13  143.521  6.5967 0.0003239 ***
```

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

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
DAY     5 250.40   50.079  2.3018 0.0764717 .
DAY:P1  6 861.13  143.521  6.5967 0.0003239 ***
```

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

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
DAY     5 201.17    40.234  1.8493 0.1411648
DAY:P1  6 861.13  143.521  6.5967 0.0003239 ***
```

```
---
```

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

```
REG(Q1 ~ DAY + DAY:P1 - 1, p241) # Output 7.10
```

\$ANOVA

Response : Q1

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	12	4869.5	405.79	18.652	2.638e-09 ***
RESIDUALS	24	522.2	21.76		
UNCORRECTED TOTAL	36	5391.7			

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

\$Fitness

Root MSE	Q1	Mean	Coef Var	R-square	Adj R-sq	PRESS	R2pred
4.664374	10.21711	45.65257	0.903156	0.854734	1431.83	0.7344377	

\$Coefficients

	Estimate	Std. Error	Df	Lower CL	Upper CL	t value	Pr(> t)
DAY1	18.675	14.4110	24	-11.067	48.418	1.2959	0.2073286
DAY2	38.487	15.1094	24	7.303	69.671	2.5472	0.0176863 *
DAY3	45.330	26.1576	24	-8.657	99.316	1.7329	0.0959384 .
DAY4	49.149	16.6092	24	14.870	83.429	2.9592	0.0068366 **
DAY5	77.899	27.5007	24	21.140	134.658	2.8326	0.0092034 **
DAY6	73.273	13.4837	24	45.444	101.102	5.4341	1.39e-05 ***
DAY1:P1	-0.220	0.2915	24	-0.822	0.381	-0.7562	0.4568599
DAY2:P1	-0.624	0.2978	24	-1.238	-0.009	-2.0940	0.0470031 *
DAY3:P1	-0.611	0.5049	24	-1.653	0.431	-1.2102	0.2379998
DAY4:P1	-0.796	0.3193	24	-1.455	-0.137	-2.4914	0.0200350 *
DAY5:P1	-1.196	0.5049	24	-2.238	-0.154	-2.3683	0.0262648 *
DAY6:P1	-1.225	0.2652	24	-1.773	-0.678	-4.6199	0.0001092 ***

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

(41) MODEL

```
GLM(Q1 ~ P1 + DAY + P1:DAY, p241)
```

\$ANOVA

Response : Q1

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	1111.52	101.048	4.6445	0.0008119 ***
RESIDUALS	24	522.15	21.756		
CORRECTED TOTAL	35	1633.68			

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

\$Fitness

Root MSE	Q1	Mean	Coef Var	R-square	Adj R-sq
4.664374	10.21711	45.65257	0.6803814	0.5338895	

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
P1      1  516.59   516.59  23.7444 5.739e-05 ***
DAY     5   430.54    86.11   3.9578 0.009275 **
P1:DAY   5   164.39    32.88   1.5112 0.223566
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
P1      1  696.73   696.73  32.0243 7.925e-06 ***
DAY     5   430.54    86.11   3.9578 0.009275 **
P1:DAY   5   164.39    32.88   1.5112 0.223566
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
P1      1  554.79   554.79  25.4999 3.665e-05 ***
DAY     5   201.17    40.23   1.8493  0.1412
P1:DAY   5   164.39    32.88   1.5112  0.2236
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(42) MODEL

```
GLM(Q1 ~ STORE + DAY + P1 + P2, p241)
```

\$ANOVA

Response : Q1

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      12 1225.37  102.114   5.7521 0.0001688 ***
RESIDUALS   23   408.31   17.753
CORRECTED TOTAL 35 1633.68
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$Fitness

```
Root MSE  Q1 Mean Coef Var  R-square  Adj R-sq
4.213375 10.21711 41.23842 0.7500678 0.6196683
```

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
STORE  5  313.42    62.68   3.5310  0.01629 *
DAY     5  250.40    50.08   2.8210  0.03957 *
P1      1  622.01   622.01  35.0377 4.924e-06 ***
P2      1   39.54    39.54   2.2274  0.14917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
STORE	5	223.83	44.77	2.5217	0.058346 .
DAY	5	433.10	86.62	4.8793	0.003456 **
P1	1	538.17	538.17	30.3150	1.342e-05 ***
P2	1	39.54	39.54	2.2274	0.149171

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
STORE	5	223.83	44.77	2.5217	0.058346 .
DAY	5	433.10	86.62	4.8793	0.003456 **
P1	1	538.17	538.17	30.3150	1.342e-05 ***
P2	1	39.54	39.54	2.2274	0.149171

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

5.6.5 p250

(43) MODEL

```
p250 = read.table("C:/G/Rt/SAS4lm/p250.txt", header=TRUE)
p250 = af(p250, c("variety", "spacing", "plant"))
GLM(lint ~ bollwt + variety + spacing + variety:spacing + variety:spacing:plant,
     p250) # p252 Output 7.18, Parameter is different due to different order
```

\$ANOVA

Response : lint

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	8	31.160	3.8950	80.704	< 2.2e-16 ***
RESIDUALS	40	1.931	0.0483		
CORRECTED TOTAL	48	33.091			

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

\$Fitness

Root MSE	lint	Mean	Coef Var	R-square	Adj R-sq
0.2196884	1.77551	12.37325	0.9416596	0.9299915	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bollwt	1	29.0693	29.0693	602.3107	< 2.2e-16 ***
variety	1	1.2635	1.2635	26.1802	8.158e-06 ***
spacing	1	0.4666	0.4666	9.6689	0.003447 **
variety:spacing	1	0.0933	0.0933	1.9325	0.172169
variety:spacing:plant	4	0.2673	0.0668	1.3847	0.256548

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bollwt	1	11.1186	11.1186	230.3745	< 2.2e-16 ***
variety	1	1.1973	1.1973	24.8084	1.259e-05 ***
spacing	1	0.4666	0.4666	9.6689	0.003447 **
variety:spacing	1	0.0933	0.0933	1.9325	0.172169
variety:spacing:plant	4	0.2673	0.0668	1.3847	0.256548

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bollwt	1	11.1186	11.1186	230.3745	< 2.2e-16 ***
variety	1	0.9424	0.9424	19.5269	7.379e-05 ***
spacing	1	0.3748	0.3748	7.7666	0.008101 **
variety:spacing	1	0.0479	0.0479	0.9915	0.325350
variety:spacing:plant	4	0.2673	0.0668	1.3847	0.256548

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

5.6.6 p254 Output 7.20

(44) MODEL

```
GLM(lint ~ bollwt + variety + spacing, p250)
```

```
$ANOVA
```

```
Response : lint
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	30.799	10.2665	201.65	< 2.2e-16 ***
RESIDUALS	45	2.291	0.0509		
CORRECTED TOTAL	48	33.091			

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

```
$Fitness
```

Root MSE	lint	Mean Coef	Var	R-square	Adj R-sq
0.2256406	1.77551	12.70849	0.9307624	0.9261466	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
bollwt	1	29.0693	29.0693	570.9531	< 2.2e-16 ***
variety	1	1.2635	1.2635	24.8172	9.777e-06 ***
spacing	1	0.4666	0.4666	9.1655	0.004072 **

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

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
bollwt  1 11.5717 11.5717 227.2815 < 2.2e-16 ***
variety  1  1.1973  1.1973  23.5168 1.516e-05 ***
spacing  1  0.4666  0.4666   9.1655 0.004072 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
bollwt  1 11.5717 11.5717 227.2815 < 2.2e-16 ***
variety  1  1.1973  1.1973  23.5168 1.516e-05 ***
spacing  1  0.4666  0.4666   9.1655 0.004072 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5.6.7 p256

(45) MODEL

```
p256 = read.table("C:/G/Rt/SAS4lm/p256.txt", header=TRUE)
p256b = af(p256, c("bloc", "type", "logdose"))
GLM(y ~ bloc + type + logdose + type:logdose, p256b) # p258 Output 7.22
```

```
$ANOVA
Response : y
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      8  816.50 102.063   6.0641 0.0014 **
RESIDUALS  15  252.46  16.831
CORRECTED TOTAL 23 1068.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Fitness
Root MSE   y Mean Coef Var  R-square  Adj R-sq
4.102506 54.95833 7.464757 0.7638277 0.6378692
```

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1  12.04  12.042  0.7155 0.4109264
logdose    2 121.58  60.792  3.6120 0.0524231 .
type:logdose 2 144.08  72.042  4.2804 0.0338265 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

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

```

bloc          3 538.79 179.597 10.6709 0.0005223 ***
type          1 12.04 12.042 0.7155 0.4109264
logdose       2 121.58 60.792 3.6120 0.0524231 .
type:logdose  2 144.08 72.042 4.2804 0.0338265 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

          Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1 12.04 12.042 0.7155 0.4109264
logdose   2 121.58 60.792 3.6120 0.0524231 .
type:logdose 2 144.08 72.042 4.2804 0.0338265 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.6.8 p261 Output 7.27

(46) MODEL

```

p256 = af(p256, c("bloc", "type"))
p256$logd2 = (p256$logdose)^2
GLM(y ~ bloc + type + logdose + logd2 + type:logdose + type:logd2, p256)

```

\$ANOVA

```

Response : y
          Df Sum Sq Mean Sq F value Pr(>F)
MODEL      8 816.50 102.062 6.0641 0.0014 **
RESIDUALS  15 252.46 16.831
CORRECTED TOTAL 23 1068.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$Fitness

```

Root MSE   y Mean Coef Var  R-square  Adj R-sq
4.102506 54.95833 7.464757 0.7638277 0.6378692

```

\$`Type I`

```

          Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1 12.04 12.042 0.7155 0.4109264
logdose   1 115.56 115.562 6.8662 0.0193005 *
logd2      1 6.02 6.021 0.3577 0.5586917
type:logdose 1 138.06 138.062 8.2031 0.0118242 *
type:logd2  1 6.02 6.021 0.3577 0.5586917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type II`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1  12.04  12.042  0.7155 0.4109264
logdose    1   0.39   0.389  0.0231 0.8811262
logd2      1   6.02   6.021  0.3577 0.5586917
type:logdose 1   0.81   0.812  0.0483 0.8290541
type:logd2  1   6.02   6.021  0.3577 0.5586917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1 28.12  28.125  1.6711 0.2156736
logdose    1   0.39   0.389  0.0231 0.8811262
logd2      1   6.02   6.021  0.3577 0.5586917
type:logdose 1   0.81   0.812  0.0483 0.8290541
type:logd2  1   6.02   6.021  0.3577 0.5586917
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.6.9 p262 Output 7.28

(47) MODEL

```
GLM(y ~ bloc + type + type:logdose, p256b)
```

```

$ANOVA
Response : y
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      8 816.50 102.063  6.0641 0.0014 **
RESIDUALS   15 252.46  16.831
CORRECTED TOTAL 23 1068.96
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$Fitness
Root MSE   y Mean Coef Var  R-square  Adj R-sq
4.102506 54.95833 7.464757 0.7638277 0.6378692

```

```

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1  12.04  12.042  0.7155 0.4109264
type:logdose 4 265.67  66.417  3.9462 0.0220552 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```
$`Type II`
```



```

      Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1  12.04   12.042   0.7155 0.4109264
type:logdose 4 265.67  66.417   3.9462 0.0220552 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
bloc      3 538.79 179.597 10.6709 0.0005223 ***
type      1  12.04   12.042   0.7155 0.4109264
type:logdose 4 265.67  66.417   3.9462 0.0220552 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.7 Chapter 8

5.7.1 p269

(48) MODEL

```

p269 = read.csv("C:/G/Rt/SAS4lm/fev1uni.csv")
p269 = af(p269, c("drug", "hour", "patient"))
GLM(fev1 ~ drug + patient %in% drug + hour + drug:hour, p269) # p271 Output 8.3

```

\$ANOVA

Response : fev1

```

      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      92 296.65   3.2244  51.078 < 2.2e-16 ***
RESIDUALS  483  30.49   0.0631
CORRECTED TOTAL 575 327.14
---

```

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

\$Fitness

```

Root MSE fev1 Mean Coef Var  R-square  Adj R-sq
0.2512505  3.087049 8.138859 0.9067963 0.8890432

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
drug      2  25.783 12.8913 204.212 < 2.2e-16 ***
drug:patient 69 247.412   3.5857  56.801 < 2.2e-16 ***
hour      7  17.170   2.4529  38.857 < 2.2e-16 ***
drug:hour  14   6.280   0.4486   7.106 1.923e-13 ***
---

```

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

\$`Type II`

```

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

```

```

drug          2  25.783 12.8913 204.212 < 2.2e-16 ***
drug:patient 69 247.412  3.5857  56.801 < 2.2e-16 ***
hour          7  17.170  2.4529  38.857 < 2.2e-16 ***
drug:hour     14   6.280  0.4486   7.106 1.923e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

          Df Sum Sq Mean Sq F value    Pr(>F)
drug          2  25.783 12.8913 204.212 < 2.2e-16 ***
drug:patient 69 247.412  3.5857  56.801 < 2.2e-16 ***
hour          7  17.170  2.4529  38.857 < 2.2e-16 ***
drug:hour     14   6.280  0.4486   7.106 1.923e-13 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.8 Chapter 11

5.8.1 p390

(49) MODEL

```

p390 = read.table("C:/G/Rt/SAS4lm/p390.txt", header=TRUE)
p390$ca = ifelse(p390$a == 0, -1, 1)
p390$cb = ifelse(p390$b == 0, -1, 1)
p390$cc = ifelse(p390$c == 0, -1, 1)
p390 = af(p390, c("rep", "blk", "a", "b", "c"))
GLM(y ~ rep/blk + ca*cb*cc, p390)

```

\$ANOVA

```

Response : y
          Df Sum Sq Mean Sq F value    Pr(>F)
MODEL          12  81.75  6.8125  33.601 6.618e-07 ***
RESIDUALS        11   2.23  0.2027
CORRECTED TOTAL  23  83.98
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$Fitness

```

Root MSE y Mean Coef Var R-square Adj R-sq
0.4502714 2.37375 18.96878 0.9734438 0.9444733

```

\$`Type I`

```

          Df Sum Sq Mean Sq F value    Pr(>F)
rep          2  0.051  0.025  0.1256 0.8832237
rep:blk       3  7.432  2.477 12.2194 0.0007966 ***
ca           1 21.075 21.075 103.9487 6.090e-07 ***
cb           1  0.005  0.005  0.0224 0.8837872
ca:cb         1  1.723  1.723  8.4969 0.0140640 *

```

```

cc          1 37.776  37.776 186.3209 3.063e-08 ***
ca:cc       1  2.318   2.318  11.4332 0.0061285 **
cb:cc       1 11.340  11.340  55.9328 1.232e-05 ***
ca:cb:cc    1  0.031   0.031   0.1511 0.7049490
---
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  0.051   0.025   0.1256 0.883224
rep:blk   3  1.668   0.556   2.7416 0.093789 .
ca        1 21.075  21.075 103.9487 6.090e-07 ***
cb        1  0.005   0.005   0.0224 0.883787
ca:cb     1  1.723   1.723   8.4969 0.014064 *
cc        1 37.776  37.776 186.3209 3.063e-08 ***
ca:cc     1  2.318   2.318  11.4332 0.006129 **
cb:cc     1 11.340  11.340  55.9328 1.232e-05 ***
ca:cb:cc  1  0.031   0.031   0.1511 0.704949
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
rep      2  0.051   0.025   0.1256 0.883224
rep:blk   3  1.668   0.556   2.7416 0.093789 .
ca        1 21.075  21.075 103.9487 6.090e-07 ***
cb        1  0.005   0.005   0.0224 0.883787
ca:cb     1  1.723   1.723   8.4969 0.014064 *
cc        1 37.776  37.776 186.3209 3.063e-08 ***
ca:cc     1  2.318   2.318  11.4332 0.006129 **
cb:cc     1 11.340  11.340  55.9328 1.232e-05 ***
ca:cb:cc  1  0.031   0.031   0.1511 0.704949
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.8.2 p394

(50) MODEL

```

p394 = read.table("C:/G/Rt/SAS4lm/p394.txt", header=TRUE)
p394 = af(p394, c("a", "b", "c", "d"))
GLM(y ~ ca*cb*cc*cd, p394)

```

\$ANOVA

Response : y

```

      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      7 6.3559 0.90798
RESIDUALS   0 0.0000
CORRECTED TOTAL 7 6.3559

```

\$Fitness

Root MSE	y	Mean Coef	Var	R-square
NA	2.68875		NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ca	1	2.07061	2.07061		
cb	1	0.59951	0.59951		
ca:cb	1	0.00031	0.00031		
cc	1	0.00551	0.00551		
ca:cc	1	0.80011	0.80011		
cb:cc	1	2.82031	2.82031		
ca:cb:cc	1	0.05951	0.05951		
cd	0				
ca:cd	0				
cb:cd	0				
ca:cb:cd	0				
cc:cd	0				
ca:cc:cd	0				
cb:cc:cd	0				
ca:cb:cc:cd	0				

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ca	0				
cb	0				
ca:cb	0				
cc	0				
ca:cc	0				
cb:cc	0				
ca:cb:cc	0				
cd	0				
ca:cd	0				
cb:cd	0				
ca:cb:cd	0				
cc:cd	0				
ca:cc:cd	0				
cb:cc:cd	0				
ca:cb:cc:cd	0				

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
ca	0				
cb	0				
ca:cb	0				
cc	0				

```

ca:cc      0
cb:cc      0
ca:cb:cc   0
cd         0
ca:cd      0
cb:cd      0
ca:cb:cd   0
cc:cd      0
ca:cc:cd   0
cb:cc:cd   0
ca:cb:cc:cd 0

```

(51) MODEL

```
GLM(y ~ a*b*c*d, p394)
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	6.3559	0.90798		
RESIDUALS	0	0.0000			
CORRECTED TOTAL	7	6.3559			

\$Fitness

Root MSE	y	Mean Coef	Var	R-square
NA	2.68875		NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
a	1	2.07061	2.07061		
b	1	0.59951	0.59951		
a:b	1	0.00031	0.00031		
c	1	0.00551	0.00551		
a:c	1	0.80011	0.80011		
b:c	1	2.82031	2.82031		
a:b:c	1	0.05951	0.05951		
d	0				
a:d	0				
b:d	0				
a:b:d	0				
c:d	0				
a:c:d	0				
b:c:d	0				
a:b:c:d	0				

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
a	0				
b	0				

```

a:b      0
c        0
a:c      0
b:c      0
a:b:c    0
d        0
a:d      0
b:d      0
a:b:d    0
c:d      0
a:c:d    0
b:c:d    0
a:b:c:d  0

```

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
a	0				
b	0				
a:b	0				
c	0				
a:c	0				
b:c	0				
a:b:c	0				
d	0				
a:d	0				
b:d	0				
a:b:d	0				
c:d	0				
a:c:d	0				
b:c:d	0				
a:b:c:d	0				

5.8.3 p399

(52) MODEL

```

p399 = read.table("C:/G/Rt/SAS4lm/p399.txt", header=TRUE)
p399 = af(p399, c("blk", "trt"))
GLM(y ~ trt + blk, p399)

```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	8	281.128	35.141	40.822	0.005606 **
RESIDUALS	3	2.583	0.861		
CORRECTED TOTAL	11	283.710			

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

```

$Fitness
  Root MSE y Mean Coef Var  R-square  Adj R-sq
  0.927811   9.75 9.516011 0.9908974 0.9666238

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
trt   3 102.26   34.086   39.596 0.006515 **
blk   5 178.87   35.774   41.558 0.005691 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
trt   3  59.018   19.673   22.853 0.014388 *
blk   5 178.871   35.774   41.558 0.005691 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
trt   3  59.018   19.673   22.853 0.014388 *
blk   5 178.871   35.774   41.558 0.005691 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.8.4 p403

(53) MODEL

```

p403 = read.table("C:/G/Rt/SAS4lm/p403.txt", header=TRUE)
p403 = af(p403, c("PATIENT", "VISIT"))
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

```

```

$Fitness
  Root MSE HR Mean Coef Var  R-square  Adj R-sq
  7.515988 80.80556 9.301326 0.7298134 0.543256

```

```

$`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	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

```
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	343.9	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
```

5.8.5 p409 11.5

(54) MODEL

```
p409 = read.table("C:/G/Rt/SAS4lm/p409.txt", header=TRUE)
GLM(TS ~ SOURCE*AMT, p409) # p410 Output 11.21
```

\$ANOVA

Response : TS

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	5	258.727	51.745	263.71	1.785e-09 ***
RESIDUALS	9	1.766	0.196		
CORRECTED TOTAL	14	260.493			

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

\$Fitness

Root MSE	TS	Mean Coef	Var	R-square	Adj R-sq
0.4429698	16.03333	2.762805	0.9932206	0.9894542	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SOURCE	2	98.001	49.001	249.720	1.306e-08 ***
AMT	1	138.245	138.245	704.534	7.392e-10 ***
SOURCE:AMT	2	22.481	11.240	57.284	7.595e-06 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SOURCE	2	98.001	49.001	249.720	1.306e-08 ***
AMT	1	138.245	138.245	704.534	7.392e-10 ***
SOURCE:AMT	2	22.481	11.240	57.284	7.595e-06 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SOURCE	2	0.070	0.035	0.179	0.839
AMT	1	138.245	138.245	704.534	7.392e-10 ***
SOURCE:AMT	2	22.481	11.240	57.284	7.595e-06 ***

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

5.8.6 p412

(55) MODEL

```
p412 = read.table("C:/G/Rt/SAS4lm/p412.txt", header=TRUE)
GLM(ts ~ source:amt, p412) # p413 Output 11.24
```

\$ANOVA

Response : ts

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	393.01	131.002	903.34	< 2.2e-16 ***
RESIDUALS	16	2.32	0.145		
CORRECTED TOTAL	19	395.33			

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

\$Fitness

Root MSE	ts	Mean Coef	Var	R-square	Adj R-sq
0.380815	14.535	2.619986	0.9941306	0.9930301	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
source:amt	3	393.01	131	903.34	< 2.2e-16 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
source:amt	3	393.01	131	903.34	< 2.2e-16 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
source:amt	3	393.01	131	903.34	< 2.2e-16 ***

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

5.8.7 p414

(56) MODEL

```
p414 = read.table("C:/G/Rt/SAS4lm/p414.txt", header=TRUE)
p414 = af(p414, c("lackofit"))
GLM(loglivcu ~ level + lackofit, p414) # p415 Output 11.26
```

\$ANOVA

Response : loglivcu

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	5.2310	1.74365	155.47	5.018e-14 ***

```

RESIDUALS          20 0.2243 0.01122
CORRECTED TOTAL 23 5.4553
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Fitness
  Root MSE loglivcu Mean Coef Var  R-square  Adj R-sq
  0.1059034      1.750172 6.051026 0.9588819 0.9527142

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
level    1 4.9859   4.9859 444.555 3.997e-15 ***
lackofit  2 0.2450   0.1225  10.924 0.0006216 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
level    0
lackofit  2 0.24504 0.12252  10.924 0.0006216 ***
---
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)
level    0
lackofit  2 0.24504 0.12252  10.924 0.0006216 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

5.8.8 p417

(57) MODEL

```

p417 = read.table("C:/G/Rt/SAS4lm/p417.txt", header=TRUE)
p417 = af(p417, c("TRT", "POT", "PLANT"))
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

$Fitness

```

```
Root MSE    Y Mean Coef Var    R-square    Adj R-sq
1.752288 15.42857 11.35742 0.8700388 0.8000596
```

```
$`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
```

```
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
```

5.8.9 p431

```
(58) MODEL
```

```
p431 = read.table("C:/G/Rt/SAS4lm/p431.txt", header=TRUE)
p431 = af(p431, c("line", "sire", "agedam", "steerno"))
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

\$Fitness

Root MSE	avdlygn	Mean Coef	Var	R-square	Adj R-sq
0.2241612	2.411385	9.295956	0.511696	0.348928	

\$`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

p433 Output 11.40

```
options(contrasts=c("contr.sum", "contr.poly"))
Anova(lm(avdlygn ~ line + line:sire + agedam + line:agedam + age + intlwt, p431),
```

```
type=3, singular.ok=TRUE) # NOT OK for line
```

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

Anova Table (Type III tests)

Response: avdlygn

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

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

(59) MODEL

```
GLM(avdlygn ~ sire + agedam, p431) # # p434 Output 11.41
```

\$ANOVA

Response : avdlygn

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	10	1.4254	0.142538	2.1904	0.03237 *
RESIDUALS	54	3.5140	0.065074		
CORRECTED TOTAL	64	4.9394			

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

\$Fitness

Root MSE	avdlygn	Mean Coef	Var	R-square	Adj R-sq
0.2550961	2.411385	10.57882	0.2885747	0.1568292	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
sire	8	1.30644	0.163305	2.5095	0.02138 *
agedam	2	0.11894	0.059471	0.9139	0.40707

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
sire	8	1.33017	0.166271	2.5551	0.01937 *
agedam	2	0.11894	0.059471	0.9139	0.40707

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

```
$`Type III`
      Df  Sum Sq  Mean Sq F value   Pr(>F)
sire    8 1.33017  0.166271   2.5551 0.01937 *
agedam  2 0.11894  0.059471   0.9139 0.40707
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

5.8.10 p437 ABSORB option in SAS

(60) MODEL

```
GLM(avdlygn ~ 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
```

```
$Fitness
      Root MSE avdlygn Mean Coef Var R-square Adj R-sq
      0.2241612      2.411385 9.295956 0.511696 0.348928
```

```
$`Type I`
      Df  Sum Sq  Mean Sq F value   Pr(>F)
line    2 0.38009  0.190046   3.7821 0.02983 *
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    0
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`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
line	0					
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

p437 Output 11.43

6 Sahai - Unbalanced

Reference

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

6.1 Table 11.2

(61) MODEL

```
T11.2 = read.table("C:/G/Rt/ANOVA/T11.2.txt")
colnames(T11.2) = c("Group", "Y")
T11.2 = af(T11.2, "Group")
GLM(Y ~ Group, T11.2) # p115
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	80.401	20.1003	5.9884	0.0004103 ***
RESIDUALS	59	198.036	3.3565		
CORRECTED TOTAL	63	278.438			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
1.832089	64.15625	2.855667	0.2887583	0.2405385

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Group	4	80.401	20.1	5.9884	0.0004103 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Group	4	80.401	20.1	5.9884	0.0004103 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Group	4	80.401	20.1	5.9884	0.0004103 ***

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

6.2 Table 12.6

(62) MODEL

```
T12.6 = read.table("C:/G/Rt/ANOVA/T12.6.txt")
colnames(T12.6) = c("Location", "Family", "Y")
T12.6 = af(T12.6, c("Location", "Family"))
GLM(Y ~ Location + Family, T12.6) # p184
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	1.6144	0.230636	8.9562	7.223e-07 ***
RESIDUALS	45	1.1588	0.025752		
CORRECTED TOTAL	52	2.7733			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
0.160473	0.6279434	25.55532	0.5821469	0.5171475

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Location	3	0.74036	0.24679	9.5833	5.219e-05 ***
Family	4	0.87410	0.21852	8.4859	3.436e-05 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Location	3	0.83765	0.27921	10.8426	1.753e-05 ***
Family	4	0.87410	0.21852	8.4859	3.436e-05 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Location	3	0.83765	0.27921	10.8426	1.753e-05 ***
Family	4	0.87410	0.21852	8.4859	3.436e-05 ***

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

6.3 Table 13.6

(63) MODEL

```
T13.6 = read.table("C:/G/Rt/ANOVA/T13.6.txt")
colnames(T13.6) = c("Site", "Worker", "Y")
T13.6 = af(T13.6, c("Site", "Worker"))
GLM(Y ~ Site + Worker + Site:Worker, T13.6)
```

```
$ANOVA
Response : Y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	2643.11	240.283	60.323	< 2.2e-16 ***
RESIDUALS	35	139.42	3.983		
CORRECTED TOTAL	46	2782.52			

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

```
$Fitness
Root MSE   Y Mean Coef Var  R-square  Adj R-sq
1.995817 84.18936 2.370629 0.9498962 0.9341493
```

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	2	1281.55	640.77	160.866	< 2.2e-16 ***
Worker	3	399.27	133.09	33.412	2.234e-10 ***
Site:Worker	6	962.29	160.38	40.264	2.720e-14 ***

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	2	1322.24	661.12	165.973	< 2.2e-16 ***
Worker	3	399.27	133.09	33.412	2.234e-10 ***
Site:Worker	6	962.29	160.38	40.264	2.720e-14 ***

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	2	804.83	402.42	101.026	2.887e-15 ***
Worker	3	430.88	143.63	36.058	8.310e-11 ***
Site:Worker	6	962.29	160.38	40.264	2.720e-14 ***

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

6.4 Table 14.2

(64) MODEL

```
T14.2 = read.csv("C:/G/Rt/ANOVA/T14.2.csv")
T14.2 = T14.2[!is.na(T14.2$Y),]
T14.2 = af(T14.2, c("Day", "Machine", "Operator"))
GLM(Y ~ Day + Machine + Operator, T14.2)
```

```
$ANOVA
Response : Y
```

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

```

MODEL          7  6345.4  906.48  8.1297 5.931e-08 ***
RESIDUALS      110 12265.3  111.50
CORRECTED TOTAL 117 18610.6
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Fitness
  Root MSE   Y Mean Coef Var R-square  Adj R-sq
  10.55946  192.1373 5.495791 0.340954 0.2990147

$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
Day      2 3737.8  1868.90  16.7611 4.426e-07 ***
Machine  2 2440.7  1220.33  10.9445 4.625e-05 ***
Operator  3  166.9    55.63   0.4989  0.6838
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
Day      2 3795.1  1897.56  17.0181 3.636e-07 ***
Machine  2 2464.8  1232.39  11.0526 4.227e-05 ***
Operator  3  166.9    55.63   0.4989  0.6838
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
Day      2 3795.1  1897.56  17.0181 3.636e-07 ***
Machine  2 2464.8  1232.39  11.0526 4.227e-05 ***
Operator  3  166.9    55.63   0.4989  0.6838
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

6.5 Table 15.3

(65) MODEL

```

T15.3 = read.table("C:/G/Rt/ANOVA/T15.3.txt")
colnames(T15.3) = c("Dam", "Sire", "pH")
T15.3 = af(T15.3, c("Dam", "Sire"))
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

$Fitness
  Root MSE  pH Mean  Coef Var  R-square  Adj R-sq
0.04973534 7.449813 0.6676053 0.4589074 0.3005388

$`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
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

```

6.6 Table 16.3

(66) MODEL

```

T16.3 = read.csv("C:/G/Rt/ANOVA/T16.3.csv")
colnames(T16.3) = c("Plot", "Sample", "Subsample", "Residue")
T16.3 = af(T16.3, c("Plot", "Sample", "Subsample"))
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

$Fitness
Root MSE Residue Mean Coef Var  R-square Adj R-sq
0.100193    0.5023377 19.94535 0.9352456 0.776303

$`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
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

7 Federer - Variations

Reference

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

7.1 Example 1.1

(67) MODEL

```
ex1.1 = read.table("C:/G/Rt/Split/Ex1.1-spex1.txt", header=TRUE)
ex1.1 = af(ex1.1, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + A:B, ex1.1)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	27	4905.7	181.694	10.75	1.994e-10 ***
RESIDUALS	36	608.5	16.902		
CORRECTED TOTAL	63	5514.2			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
4.111227	66.14375	6.215594	0.8896527	0.8068923

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	223.8	74.60	4.4138	0.00963 **
A	3	194.6	64.85	3.8370	0.01756 *
R:A	9	158.2	17.58	1.0402	0.42842
B	3	4107.4	1369.13	81.0030	4.441e-16 ***
A:B	9	221.7	24.64	1.4577	0.20117

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	223.8	74.60	4.4138	0.00963 **
A	3	194.6	64.85	3.8370	0.01756 *
R:A	9	158.2	17.58	1.0402	0.42842
B	3	4107.4	1369.13	81.0030	4.441e-16 ***
A:B	9	221.7	24.64	1.4577	0.20117

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	223.8	74.60	4.4138	0.00963 **
A	3	194.6	64.85	3.8370	0.01756 *
R:A	9	158.2	17.58	1.0402	0.42842
B	3	4107.4	1369.13	81.0030	4.441e-16 ***
A:B	9	221.7	24.64	1.4577	0.20117

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

7.2 Example 1.2

(68) MODEL

```
ex1.2 = read.table("C:/G/Rt/Split/Ex1.2-spex2.txt", header=TRUE)
ex1.2 = af(ex1.2, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + A:B, ex1.2)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	47	35573	756.88	31.243	< 2.2e-16 ***
RESIDUALS	48	1163	24.23		
CORRECTED TOTAL	95	36736			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
4.92196	25.30208	19.45279	0.9683464	0.9373523

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	38.6	19.3	0.7963	0.4568480
A	7	763.2	109.0	4.5003	0.0006418 ***
R:A	14	1377.2	98.4	4.0608	0.0001343 ***
B	3	30774.3	10258.1	423.4386	< 2.2e-16 ***
A:B	21	2620.1	124.8	5.1502	1.327e-06 ***

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	38.6	19.3	0.7963	0.4568480
A	7	763.2	109.0	4.5003	0.0006418 ***
R:A	14	1377.2	98.4	4.0608	0.0001343 ***
B	3	30774.3	10258.1	423.4386	< 2.2e-16 ***
A:B	21	2620.1	124.8	5.1502	1.327e-06 ***

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

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
R      2   38.6    19.3   0.7963 0.4568480
A      7  763.2   109.0   4.5003 0.0006418 ***
R:A    14 1377.2    98.4   4.0608 0.0001343 ***
B      3 30774.3 10258.1 423.4386 < 2.2e-16 ***
A:B    21  2620.1   124.8   5.1502 1.327e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

7.3 Example 2.1

(69) MODEL

```
ex2.1 = read.table("C:/G/Rt/Split/sbex.txt", header=TRUE)
colnames(ex2.1) = c("Y", "R", "A", "B")
ex2.1 = af(ex2.1, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + R:B + A:B, ex2.1)
```

\$ANOVA

Response : Y

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      41 274.750   6.7012   5.1475 0.0002305 ***
RESIDUALS    18  23.433   1.3019
CORRECTED TOTAL 59 298.183
```

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

\$Fitness

```
Root MSE    Y Mean Coef Var R-square Adj R-sq
1.140987 45.61667 2.501251 0.921413 0.7424093
```

\$`Type I`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
R      1  2.817   2.8167   2.1636 0.1585807
A      9 77.683   8.6315   6.6302 0.0003456 ***
R:A    9 81.017   9.0019   6.9147 0.0002658 ***
B      2 35.433  17.7167  13.6088 0.0002510 ***
R:B    2 16.233   8.1167   6.2347 0.0087635 **
A:B   18 61.567   3.4204   2.6273 0.0236253 *
```

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

\$`Type II`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
R      1  2.817   2.8167   2.1636 0.1585807
A      9 77.683   8.6315   6.6302 0.0003456 ***
R:A    9 81.017   9.0019   6.9147 0.0002658 ***
```

```

B      2 35.433 17.7167 13.6088 0.0002510 ***
R:B    2 16.233  8.1167  6.2347 0.0087635 **
A:B   18 61.567  3.4204  2.6273 0.0236253 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
R       1  2.817   2.8167   2.1636 0.1585807
A       9 77.683   8.6315   6.6302 0.0003456 ***
R:A     9 81.017   9.0019   6.9147 0.0002658 ***
B       2 35.433  17.7167  13.6088 0.0002510 ***
R:B     2 16.233   8.1167   6.2347 0.0087635 **
A:B    18 61.567   3.4204   2.6273 0.0236253 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

7.4 Example 2.2

(70) MODEL

```

ex2.2 = read.table("C:/G/Rt/Split/sbex2_2.txt", header=TRUE)
ex2.2 = af(ex2.2, c("Row", "Column", "R", "S"))
GLM(Y ~ Column + R + R:Column + S + S:Column + R:S, ex2.2)

```

```

$ANOVA
Response : Y
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      51  10328   202.51   0.8112 0.7688
RESIDUALS   48  11982    249.63
CORRECTED TOTAL 99  22310

```

```

$Fitness
Root MSE    Y Mean Coef Var  R-square    Adj R-sq
15.79971 1000.098 1.579816 0.4629279 -0.1077112

```

```

$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
Column    4 1318.6   329.66   1.3206 0.2758
R          4 1159.8   289.94   1.1615 0.3396
Column:R  16 2808.6   175.54   0.7032 0.7766
S          3  351.9   117.29   0.4699 0.7047
Column:S  12 3863.3   321.94   1.2897 0.2555
R:S       12  826.0    68.83   0.2757 0.9906

```

```

$`Type II`
      Df Sum Sq Mean Sq F value Pr(>F)
Column    4 1318.6   329.66   1.3206 0.2758
R          4 1159.8   289.94   1.1615 0.3396

```

Column:R	16	2808.6	175.54	0.7032	0.7766
S	3	351.9	117.29	0.4699	0.7047
Column:S	12	3863.3	321.94	1.2897	0.2555
R:S	12	826.0	68.83	0.2757	0.9906

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Column	4	1318.6	329.66	1.3206	0.2758
R	4	1159.8	289.94	1.1615	0.3396
Column:R	16	2808.6	175.54	0.7032	0.7766
S	3	351.9	117.29	0.4699	0.7047
Column:S	12	3863.3	321.94	1.2897	0.2555
R:S	12	826.0	68.83	0.2757	0.9906

(71) MODEL

```
GLM(Y ~ Row + R + Row:R + S + Column:S + R: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			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square
NA	1000.098	NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	4	147.4	36.86		
R	4	1159.8	289.94		
Row:R	16	3979.8	248.74		
S	3	351.9	117.29		
S:Column	12	3863.3	321.94		
R:S	12	826.0	68.83		
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		
Row:R	0				
S	3	351.9	117.29		
S:Column	12	3863.3	321.94		
R:S	12	826.0	68.83		
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		
Row:R	0				
S	3	351.9	117.29		
S:Column	12	3863.3	321.94		
R:S	12	826.0	68.83		
R:S:Column	48	11982.3	249.63		

(72) MODEL

```
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			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square
NA	1000.098	NA	1

\$`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

```

```

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

```

7.5 Example 3.1

(73) MODEL

```

ex3.1 = read.table("C:/G/Rt/Split/spedsite.txt", header=TRUE)
ex3.1 = af(ex3.1, c("Site", "A", "B", "C", "Block"))
GLM(Yield ~ Site + Site:Block + A + B + A:B + A:Site + B:Site + 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, ex3.1)

```

\$ANOVA

Response : Yield

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	239	2724374186	11399055	23.682	< 2.2e-16 ***
RESIDUALS	240	115521933	481341		
CORRECTED TOTAL	479	2839896119			

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

\$Fitness

Root MSE	Yield	Mean	Coef	Var	R-square	Adj R-sq
693.7877	8290.769	8.368195	0.9593218	0.918813		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	3	621230991	207076997	430.2082	< 2e-16 ***
Site:Block	8	1305369943	163171243	338.9928	< 2e-16 ***
A	1	1333205	1333205	2.7698	0.09737 .
B	4	47928577	11982144	24.8932	< 2e-16 ***
A:B	4	14849	3712	0.0077	0.99988
Site:A	3	33010	11003	0.0229	0.99531
Site:B	12	37932	3161	0.0066	1.00000
Site:A:B	12	11494	958	0.0020	1.00000
Site:Block:A:B	72	8239680	114440	0.2378	1.00000
C	3	739890389	246630130	512.3809	< 2e-16 ***
A:C	3	3233	1078	0.0022	0.99985
B:C	12	34961	2913	0.0061	1.00000

```

A:B:C          12      11077      923    0.0019 1.00000
Site:C          9      25983     2887    0.0060 1.00000
Site:A:C        9      22227     2470    0.0051 1.00000
Site:B:C       36      88610     2461    0.0051 1.00000
Site:A:B:C     36      98025     2723    0.0057 1.00000
---
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	621230991	207076997	430.2082	< 2e-16 ***
Site:Block	8	1305369943	163171243	338.9928	< 2e-16 ***
A	1	1333205	1333205	2.7698	0.09737 .
B	4	47928577	11982144	24.8932	< 2e-16 ***
A:B	4	14849	3712	0.0077	0.99988
Site:A	3	33010	11003	0.0229	0.99531
Site:B	12	37932	3161	0.0066	1.00000
Site:A:B	12	11494	958	0.0020	1.00000
Site:Block:A:B	72	8239680	114440	0.2378	1.00000
C	3	739890389	246630130	512.3809	< 2e-16 ***
A:C	3	3233	1078	0.0022	0.99985
B:C	12	34961	2913	0.0061	1.00000
A:B:C	12	11077	923	0.0019	1.00000
Site:C	9	25983	2887	0.0060	1.00000
Site:A:C	9	22227	2470	0.0051	1.00000
Site:B:C	36	88610	2461	0.0051	1.00000
Site:A:B:C	36	98025	2723	0.0057	1.00000

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	621230991	207076997	430.2082	< 2e-16 ***
Site:Block	8	1305369943	163171243	338.9928	< 2e-16 ***
A	1	1333205	1333205	2.7698	0.09737 .
B	4	47928577	11982144	24.8932	< 2e-16 ***
A:B	4	14849	3712	0.0077	0.99988
Site:A	3	33010	11003	0.0229	0.99531
Site:B	12	37932	3161	0.0066	1.00000
Site:A:B	12	11494	958	0.0020	1.00000
Site:Block:A:B	72	8239680	114440	0.2378	1.00000
C	3	739890389	246630130	512.3809	< 2e-16 ***
A:C	3	3233	1078	0.0022	0.99985
B:C	12	34961	2913	0.0061	1.00000
A:B:C	12	11077	923	0.0019	1.00000
Site:C	9	25983	2887	0.0060	1.00000
Site:A:C	9	22227	2470	0.0051	1.00000
Site:B:C	36	88610	2461	0.0051	1.00000

Site:A:B:C 36 98025 2723 0.0057 1.00000

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

(74) MODEL

```
ex3.1a = read.table("C:/G/Rt/Split/Ex3.1-example.txt", header=TRUE)
ex3.1a = af(ex3.1a, c("row", "P", "column", "R", "S"))
GLM(height ~ P + column + column:P + R + P:R + column:R + column:R:P + S +
      P:S + column:S + column:S:P + R:S + R:S:column + R:S:P + R:S:P:column, 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			

\$Fitness

Root MSE	height	Mean Coef	Var	R-square
NA	93.965		NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	1	253.1	253.125		
column	4	109.4	27.357		
P:column	4	207.9	51.987		
R	4	90.6	22.657		
P:R	4	505.0	126.238		
column:R	16	3357.8	209.864		
P:column:R	16	1442.6	90.163		
S	3	16.4	5.458		
P:S	3	14.3	4.765		
column:S	12	265.5	22.121		
P:column:S	12	96.5	8.044		
R:S	12	195.1	16.254		
column:R:S	48	365.5	7.615		
P:R:S	12	100.3	8.361		
P:column:R:S	48	514.7	10.723		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	1	253.1	253.125		
column	4	109.4	27.358		
P:column	4	207.9	51.987		
R	4	90.6	22.657		
P:R	4	505.0	126.238		
column:R	16	3357.8	209.864		
P:column:R	16	1442.6	90.162		

S	3	16.4	5.458
P:S	3	14.3	4.765
column:S	12	265.4	22.121
P:column:S	12	96.5	8.044
R:S	12	195.0	16.254
column:R:S	48	365.5	7.615
P:R:S	12	100.3	8.361
P:column:R:S	48	514.7	10.723

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	1	253.1	253.125		
column	4	109.4	27.358		
P:column	4	207.9	51.987		
R	4	90.6	22.657		
P:R	4	505.0	126.238		
column:R	16	3357.8	209.864		
P:column:R	16	1442.6	90.163		
S	3	16.4	5.458		
P:S	3	14.3	4.765		
column:S	12	265.4	22.121		
P:column:S	12	96.5	8.044		
R:S	12	195.0	16.254		
column:R:S	48	365.5	7.615		
P:R:S	12	100.3	8.361		
P:column:R:S	48	514.7	10.723		

(75) MODEL

```
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			

\$Fitness

Root MSE	height	Mean Coef	Var	R-square
NA	93.965	NA	NA	1

\$`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	253.13	253.13		
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	10.49		

```
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

(76) MODEL

- p94 Appendix 3.1

```
ex3.1b = read.table("C:/G/Rt/Split/spexvar3.txt", header=TRUE)
ex3.1b = af(ex3.1b, c("rep", "var", "nit", "row", "col"))
GLM(yield ~ rep + var + rep:var + nit + var:nit, ex3.1b)
```

\$ANOVA

Response : yield

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	26	44017	1692.97	9.5603	4.779e-11 ***
RESIDUALS	45	7969	177.08		
CORRECTED TOTAL	71	51986			

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

\$Fitness

Root MSE	yield	Mean Coef	Var	R-square	Adj R-sq
13.30727	103.9722	12.79887	0.8467134	0.7581478	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	5	15875.3	3175.1	17.9297	9.525e-10 ***
var	2	1786.4	893.2	5.0438	0.010557 *
rep:var	10	6013.3	601.3	3.3957	0.002251 **
nit	3	20020.5	6673.5	37.6856	2.458e-12 ***
var:nit	6	321.7	53.6	0.3028	0.932199

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	5	15875.3	3175.1	17.9297	9.525e-10 ***
var	2	1786.4	893.2	5.0438	0.010557 *
rep:var	10	6013.3	601.3	3.3957	0.002251 **
nit	3	20020.5	6673.5	37.6856	2.458e-12 ***
var:nit	6	321.7	53.6	0.3028	0.932199

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	5	15875.3	3175.1	17.9297	9.525e-10 ***
var	2	1786.4	893.2	5.0438	0.010557 *
rep:var	10	6013.3	601.3	3.3957	0.002251 **
nit	3	20020.5	6673.5	37.6856	2.458e-12 ***

```

var:nit 6 321.7 53.6 0.3028 0.932199
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(77) MODEL
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

$Fitness
Root MSE yield Mean Coef Var R-square Adj R-sq
10.70513 103.9722 10.29615 0.9250491 0.8434848

$`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

```

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

7.6 Example 4.1

(78) MODEL

```

ex4.1 = read.table("C:/G/Rt/Split/Ex4.1-example.txt", header=TRUE)
ex4.1 = af(ex4.1, c("row", "P", "column", "R", "S"))
GLM(height ~ P + column + column:P + R + P:R + column:R + column:R:P + S +
      P:S + column:S + column:S:P + R:S + R:S:column + R:S:P + R:S:P:column, ex4.1)

```

\$ANOVA

Response : height

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	199	1710.2	8.5937		
RESIDUALS	0	0.0			
CORRECTED TOTAL	199	1710.2			

\$Fitness

Root MSE	height	Mean Coef	Var	R-square
NA	6.815	NA	1	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	1	28.12	28.1250		
column	4	34.33	8.5825		
P:column	4	91.45	22.8625		
R	4	31.03	7.7575		
P:R	4	48.95	12.2375		
column:R	16	467.92	29.2450		
P:column:R	16	350.10	21.8813		
S	3	3.77	1.2583		
P:S	3	3.29	1.0983		
column:S	12	74.55	6.2125		
P:column:S	12	47.03	3.9192		
R:S	12	36.65	3.0542		
column:R:S	48	197.40	4.1125		
P:R:S	12	26.33	2.1942		
P:column:R:S	48	269.22	5.6087		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	1	28.12	28.1250		
column	4	34.33	8.5825		
P:column	4	91.45	22.8625		
R	4	31.03	7.7575		
P:R	4	48.95	12.2375		
column:R	16	467.92	29.2450		
P:column:R	16	350.10	21.8812		
S	3	3.77	1.2583		
P:S	3	3.30	1.0983		
column:S	12	74.55	6.2125		
P:column:S	12	47.03	3.9192		
R:S	12	36.65	3.0542		
column:R:S	48	197.40	4.1125		
P:R:S	12	26.33	2.1942		
P:column:R:S	48	269.22	5.6087		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	1	28.12	28.1250		
column	4	34.33	8.5825		
P:column	4	91.45	22.8625		
R	4	31.03	7.7575		
P:R	4	48.95	12.2375		
column:R	16	467.92	29.2450		
P:column:R	16	350.10	21.8813		
S	3	3.77	1.2583		
P:S	3	3.29	1.0983		

column:S	12	74.55	6.2125
P:column:S	12	47.03	3.9192
R:S	12	36.65	3.0542
column:R:S	48	197.40	4.1125
P:R:S	12	26.33	2.1942
P:column:R:S	48	269.22	5.6087

(79) MODEL

```
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, ex4.1)
```

\$ANOVA

Response : height

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	199	1710.2	8.5937		
RESIDUALS	0	0.0			
CORRECTED TOTAL	199	1710.2			

\$Fitness

Root MSE	height	Mean Coef	Var	R-square
NA	6.815		NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
row	4	309.43	77.357		
R	4	31.03	7.758		
P	1	28.12	28.125		
S	3	3.77	1.258		
R:S	12	36.65	3.054		
row:P	4	130.25	32.563		
R:P	4	48.95	12.237		
row:R:P	32	504.12	15.754		
P:S	3	3.29	1.098		
row:P:S	24	171.28	7.137		
R:P:S	12	26.33	2.194		
row:R:P:S	96	416.92	4.343		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
row	4	309.43	77.357		
R	4	31.03	7.757		
P	1	28.12	28.125		
S	3	3.78	1.258		
R:S	12	36.65	3.054		
row:P	4	130.25	32.563		
R:P	4	48.95	12.237		
row:R:P	32	504.12	15.754		
P:S	3	3.30	1.098		

```
row:P:S    24 171.28    7.137
R:P:S      12  26.33    2.194
row:R:P:S  96 416.92    4.343
```

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
row	4	309.43	77.357		
R	4	31.03	7.758		
P	1	28.12	28.125		
S	3	3.77	1.258		
R:S	12	36.65	3.054		
row:P	4	130.25	32.562		
R:P	4	48.95	12.238		
row:R:P	32	504.12	15.754		
P:S	3	3.29	1.098		
row:P:S	24	171.28	7.137		
R:P:S	12	26.33	2.194		
row:R:P:S	96	416.92	4.343		

7.7 Example 5.1

(80) MODEL

```
ex5.1 = read.table("C:/G/Rt/Split/sbsp.txt", header=TRUE)
ex5.1 = af(ex5.1, c("R", "A", "C", "B", "Tx"))
GLM(Y ~ R + A + R:A + C + B + C:B + Tx + B:Tx, ex5.1)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	20	193.583	9.6792	9.4176	2.969e-05 ***
RESIDUALS	15	15.417	1.0278		
CORRECTED TOTAL	35	209.000			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
1.013794	5.5	18.43261	0.926236	0.8278841

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	33.500	16.7500	16.2973	0.0001734 ***
A	1	16.000	16.0000	15.5676	0.0012951 **
R:A	2	32.167	16.0833	15.6486	0.0002133 ***
C	2	0.500	0.2500	0.2432	0.7871141
B	1	1.778	1.7778	1.7297	0.2081966
C:B	2	0.389	0.1944	0.1892	0.8295745
Tx	5	103.333	20.6667	20.1081	3.63e-06 ***


```

B:Tx  5    5.917  1.1833  1.1514 0.3770453
---
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  23.047  11.5236  11.2122 0.0010520 **
A       1  12.375  12.3751  12.0406 0.0034285 **
R:A     2  27.164  13.5819  13.2148 0.0004907 ***
C       2   0.500   0.2500   0.2432 0.7871141
B       1   1.778   1.7778   1.7297 0.2081966
C:B     2   0.389   0.1944   0.1892 0.8295745
Tx      5 103.333  20.6667  20.1081 3.63e-06 ***
B:Tx    5   5.917   1.1833   1.1514 0.3770453
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
R       2  22.451  11.2254  10.9220 0.0011828 **
A       1  15.001  15.0013  14.5958 0.0016719 **
R:A     2  27.164  13.5819  13.2148 0.0004907 ***
C       2   0.500   0.2500   0.2432 0.7871141
B       1   1.778   1.7778   1.7297 0.2081966
C:B     2   0.389   0.1944   0.1892 0.8295745
Tx      5 103.333  20.6667  20.1081 3.63e-06 ***
B:Tx    5   5.917   1.1833   1.1514 0.3770453
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

(81) MODEL

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

```

$ANOVA
Response : Y
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL    20 194.188   9.7094   9.8323 2.254e-05 ***
RESIDUALS 15  14.813   0.9875
CORRECTED TOTAL 35 209.000
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$Fitness
      Root MSE Y Mean Coef Var  R-square  Adj R-sq
0.9937303      5.5 18.06782 0.9291268 0.8346292

```

```

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

```

```

R      2  33.500 16.7500 16.9620 0.0001410 ***
A      1  16.000 16.0000 16.2025 0.0011013 **
R:A    2  32.167 16.0833 16.2869 0.0001739 ***
C      2   0.500  0.2500  0.2532 0.7795913
B      1   1.778  1.7778  1.8003 0.1996385
C:B    2   0.389  0.1944  0.1969 0.8233570
Tx     5 103.333 20.6667 20.9283 2.813e-06 ***
A:Tx   5   6.521  1.3042  1.3207 0.3078554

```

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	33.500	16.7500	16.9620	0.0001410 ***
A	1	16.000	16.0000	16.2025	0.0011013 **
R:A	2	32.167	16.0833	16.2869	0.0001739 ***
C	2	0.807	0.4037	0.4088	0.6716130
B	1	1.757	1.7574	1.7797	0.2020905
C:B	2	0.030	0.0150	0.0152	0.9849064
Tx	5	103.333	20.6667	20.9283	2.813e-06 ***
A:Tx	5	6.521	1.3042	1.3207	0.3078554

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	33.500	16.7500	16.9620	0.0001410 ***
A	1	16.000	16.0000	16.2025	0.0011013 **
R:A	2	32.167	16.0833	16.2869	0.0001739 ***
C	2	0.780	0.3902	0.3952	0.6803789
B	1	1.776	1.7756	1.7980	0.1999029
C:B	2	0.030	0.0150	0.0152	0.9849064
Tx	5	103.333	20.6667	20.9283	2.813e-06 ***
A:Tx	5	6.521	1.3042	1.3207	0.3078554

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

(82) MODEL

```
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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
1.077122	5.5	19.58405	0.9389372	0.8057093

\$`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

```
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
      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

(83) 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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
0.8280787	5.5	15.05598	0.9770335	0.8851675

\$`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

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

Model :

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

Complete :

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

```
options(contrasts=c("contr.sum", "contr.poly"))
```

```
Anova(lm(Y ~ R + A + A:R + C + B + C:B + Tx + A:Tx + B:Tx + A:B:Tx, ex5.1),
      type=3, singular.ok=TRUE) # NOT OK
```

Note: model has aliased coefficients

sums of squares computed by model comparison

Anova Table (Type III tests)

Response: Y

	Sum Sq	Df	F values	Pr(>F)	
R	11.643	1	16.9793	0.004456	**
A	0.000	0			
C	0.002	1	0.0025	0.961483	
B	0.000	0			
Tx	89.178	3	43.3503	6.87e-05	***
R:A	2.017	1	2.9420	0.130017	
C:B	0.644	1	0.9399	0.364604	
A:Tx	0.543	3	0.2640	0.849381	
B:Tx	3.384	3	1.6451	0.264128	
A:B:Tx	7.962	4	2.9029	0.103880	
Residuals	4.800	7			

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

7.8 Example 7.1

(84) MODEL

```
ex7.1 = read.table("C:/G/Rt/Split/asped.txt", header=TRUE)
ex7.1 = af(ex7.1, c("R", "G", "F"))
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	577.82	6.0824	5.3082	1.068e-05 ***
RESIDUALS	24	27.50	1.1458		
CORRECTED TOTAL	119	605.32			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
1.070436	6.175	17.335	0.9545699	0.7747422

\$`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	50.50	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

```
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

7.9 Example 7.2

(85) MODEL

```
ex7.2 = read.table("C:/G/Rt/Split/aspedt.txt", header=TRUE)
ex7.2 = af(ex7.2, c("R", "T", "G"))
GLM(Y ~ R + T + R:T + G + G:T, ex7.2)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	99	538.70	5.4415	5.1892	1.286e-05 ***
RESIDUALS	24	25.17	1.0486		
CORRECTED TOTAL	123	563.87			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
1.024017	6.032258	16.97569	0.955368	0.7712612

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	73.255	24.4183	23.2863	2.752e-07 ***
T	3	32.000	10.6667	10.1722	0.0001645 ***
R:T	9	28.402	3.1558	3.0095	0.0149568 *
G	21	309.908	14.7575	14.0734	7.158e-09 ***
T:G	63	95.140	1.5102	1.4401	0.1617931

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   4.229   1.4097   1.3444 0.2834998
T      3  32.000  10.6667  10.1722 0.0001645 ***
R:T    9  10.854   1.2060   1.1501 0.3684706
G     21 309.908  14.7575  14.0734 7.158e-09 ***
T:G   63  95.140   1.5102   1.4401 0.1617931
---
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   4.229   1.4097   1.3444 0.283500
T      3  22.668   7.5559   7.2056 0.001299 **
R:T    9  10.854   1.2060   1.1501 0.368471
G     21 309.908  14.7575  14.0734 7.158e-09 ***
T:G   63  95.140   1.5102   1.4401 0.161793
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

7.10 Example 7.3

(86) MODEL

```
ex7.3 = read.table("C:/G/Rt/Split/assped.txt", header=TRUE)
ex7.3 = af(ex7.3, c("R", "T", "G", "F"))
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
```

```
$Fitness
      Root MSE    Y Mean Coef Var R-square  Adj R-sq
0.5610836 6.265625  8.95495  0.98302 0.9099118
```

```
$`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
```

```
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

```

7.11 Example 8.1

(87) MODEL

```

ex8.1 = read.table("C:/G/Rt/Split/asbed.txt", header=TRUE)
ex8.1 = af(ex8.1, c("R", "A", "B"))
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			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square
NA	10.0381	NA	1

\$`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
```

```
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
```

7.12 Example 9.1

(88) MODEL

```
ex9.1 = read.table("C:/G/Rt/Split/Ex9.1-spex1.txt", header=TRUE)
ex9.1 = af(ex9.1, c("R", "A", "B"))
GLM(Y ~ R + A + R:A + B + A:B, ex9.1)
```

\$ANOVA

Response : Y

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      27 4920.8  182.251   10.594 5.927e-10 ***
RESIDUALS   34   584.9   17.203
CORRECTED TOTAL 61 5505.6
```

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

\$Fitness

```
Root MSE   Y Mean Coef Var  R-square  Adj R-sq
4.147591 66.19839 6.265396 0.8937663 0.8094043
```

\$`Type I`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
R       3   218.7    72.89   4.2369   0.01199 *
A       3   194.9    64.96   3.7760   0.01930 *
R:A     9   186.9    20.76   1.2070   0.32287
B       3 4087.4  1362.47  79.2018 1.998e-15 ***
A:B     9   233.0    25.88   1.5047   0.18602
```

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  157.8   52.61   3.0583  0.04134 *
A      3  227.2   75.73   4.4020  0.01014 *
R:A    9   94.5   10.50   0.6106  0.77932
B      3 4087.4 1362.47  79.2018 1.998e-15 ***
A:B    9  233.0   25.88   1.5047  0.18602
---
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  171.0   57.01   3.3138  0.03143 *
A      3  209.7   69.92   4.0643  0.01431 *
R:A    9   94.5   10.50   0.6106  0.77932
B      3 4089.9 1363.29  79.2493 1.998e-15 ***
A:B    9  233.0   25.88   1.5047  0.18602
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

7.13 Example 9.2

(89) MODEL

```
ex9.2 = read.table("C:/G/Rt/Split/Ex9.2-sbex.txt", header=TRUE)
ex9.2 = af(ex9.2, c("rep", "hyb", "gen"))
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
```

```
$Fitness
Root MSE yield Mean Coef Var  R-square  Adj R-sq
1.178511  45.77193 2.574747 0.9177062 0.7119716
```

```
$`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
```

```
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
```

7.14 Example 10.1

(90) MODEL

```
ex10.1 = read.table("C:/G/Rt/Split/Ex10.1-new.txt", header=TRUE)
ex10.1 = af(ex10.1, c("Site", "Block", "A", "B", "C"))
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

\$Fitness

Root MSE	Yield Mean	Coef Var	R-square	Adj R-sq
56.32947	9967.354	0.5651396	0.9995357	0.9990734

\$`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	23901387	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

```

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

```

7.15 Example 10.2

(91) MODEL

```

ex10.2 = read.table("C:/G/Rt/Split/Ex10.2-spbsite.txt", header=TRUE)
ex10.2 = af(ex10.2, c("Site", "Block", "A", "B"))
GLM(Yield ~ Site + Site:Block + A + A:Site + A:Site:Block + B + B:Site +
      B:Site:Block + A:B + A:B:Site, ex10.2)

```

\$ANOVA

Response : Yield

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	227	6370995084	28066058	10814 < 2.2e-16	***
RESIDUALS	252	654049	2595		
CORRECTED TOTAL	479	6371649132			

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

\$Fitness

Root MSE	Yield Mean	Coef Var	R-square	Adj R-sq
50.94537	11083.06	0.4596687	0.9998974	0.9998049

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	2	523573968	261786984	1.0086e+05 < 2.2e-16	***
Site:Block	9	3756646710	417405190	1.6082e+05 < 2.2e-16	***
A	4	29288163	7322041	2.8211e+03 < 2.2e-16	***
Site:A	8	247899	30987	1.1939e+01 1.998e-14	***
Site:Block:A	36	1783391	49539	1.9087e+01 < 2.2e-16	***

```

B          7 1937592291 276798899 1.0665e+05 < 2.2e-16 ***
Site:B     14  15903698  1135978 4.3768e+02 < 2.2e-16 ***
Site:Block:B 63 105727288  1678211 6.4660e+02 < 2.2e-16 ***
A:B        28      91141      3255 1.2541e+00  0.1838
Site:A:B   56   140534      2510 9.6690e-01  0.5461

```

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	2	523573968	261786984	1.0086e+05	< 2.2e-16 ***
Site:Block	9	3756646710	417405190	1.6082e+05	< 2.2e-16 ***
A	4	29288163	7322041	2.8211e+03	< 2.2e-16 ***
Site:A	8	247899	30987	1.1939e+01	1.998e-14 ***
Site:Block:A	36	1783391	49539	1.9087e+01	< 2.2e-16 ***
B	7	1937592291	276798899	1.0665e+05	< 2.2e-16 ***
Site:B	14	15903698	1135978	4.3768e+02	< 2.2e-16 ***
Site:Block:B	63	105727288	1678211	6.4660e+02	< 2.2e-16 ***
A:B	28	91141	3255	1.2541e+00	0.1838
Site:A:B	56	140534	2510	9.6690e-01	0.5461

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Site	2	523573968	261786984	1.0086e+05	< 2.2e-16 ***
Site:Block	9	3756646710	417405190	1.6082e+05	< 2.2e-16 ***
A	4	29288163	7322041	2.8211e+03	< 2.2e-16 ***
Site:A	8	247899	30987	1.1939e+01	1.998e-14 ***
Site:Block:A	36	1783391	49539	1.9087e+01	< 2.2e-16 ***
B	7	1937592291	276798899	1.0665e+05	< 2.2e-16 ***
Site:B	14	15903698	1135978	4.3768e+02	< 2.2e-16 ***
Site:Block:B	63	105727288	1678211	6.4660e+02	< 2.2e-16 ***
A:B	28	91141	3255	1.2541e+00	0.1838
Site:A:B	56	140534	2510	9.6690e-01	0.5461

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

7.16 Example 11.1

(92) MODEL

```

ex11.1 = read.table("C:/G/Rt/Split/Ex11.1-cov.txt", header=TRUE)
ex11.1 = af(ex11.1, c("R", "T", "S"))
GLM(Y ~ R + T + R:T + S + S:T, ex11.1)

```

\$ANOVA

Response : Y

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

```

MODEL          11      328 29.8182  3.1948 0.02875 *
RESIDUALS       12      112  9.3333
CORRECTED TOTAL 23      440

```

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

\$Fitness

```

Root MSE Y Mean Coef Var  R-square  Adj R-sq
 3.05505      7 43.64358 0.7454545 0.5121212

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
R      2      48      24  2.5714 0.11765
T      1      24      24  2.5714 0.13479
R:T    2      16       8  0.8571 0.44880
S      3     156      52  5.5714 0.01251 *
T:S    3      84      28  3.0000 0.07277 .

```

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      48      24  2.5714 0.11765
T      1      24      24  2.5714 0.13479
R:T    2      16       8  0.8571 0.44880
S      3     156      52  5.5714 0.01251 *
T:S    3      84      28  3.0000 0.07277 .

```

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

\$`Type III`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
R      2      48      24  2.5714 0.11765
T      1      24      24  2.5714 0.13479
R:T    2      16       8  0.8571 0.44880
S      3     156      52  5.5714 0.01251 *
T:S    3      84      28  3.0000 0.07277 .

```

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

(93) MODEL

```
GLM(Z ~ R + T + R:T + S + S:T, ex11.1)
```

\$ANOVA

Response : Z

```

      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      11      46  4.1818  2.5091 0.06452 .
RESIDUALS  12      20  1.6667

```

CORRECTED TOTAL 23 66

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

\$Fitness

Root MSE	Z	Mean Coef	Var	R-square	Adj R-sq
1.290994	2.5	51.63978	0.6969697	0.4191919	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	9	4.5	2.7	0.1076
T	1	6	6.0	3.6	0.0821 .
R:T	2	1	0.5	0.3	0.7462
S	3	9	3.0	1.8	0.2008
T:S	3	21	7.0	4.2	0.0301 *

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	9	4.5	2.7	0.1076
T	1	6	6.0	3.6	0.0821 .
R:T	2	1	0.5	0.3	0.7462
S	3	9	3.0	1.8	0.2008
T:S	3	21	7.0	4.2	0.0301 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	2	9	4.5	2.7	0.1076
T	1	6	6.0	3.6	0.0821 .
R:T	2	1	0.5	0.3	0.7462
S	3	9	3.0	1.8	0.2008
T:S	3	21	7.0	4.2	0.0301 *

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

(94) MODEL

```
GLM(Y ~ R + T + R:T + S + S:T + Z, ex11.1)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	12	342.45	28.5375	3.218	0.03116 *
RESIDUALS	11	97.55	8.8682		
CORRECTED TOTAL	23	440.00			

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

```
$Fitness
```

```
Root MSE Y Mean Coef Var  R-square Adj R-sq
2.977949      7 42.54213 0.7782955 0.536436
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value Pr(>F)
R      2  48.00   24.00   2.7063 0.11071
T      1  24.00   24.00   2.7063 0.12820
R:T    2  16.00    8.00   0.9021 0.43373
S      3 156.00   52.00   5.8637 0.01211 *
T:S    3  84.00   28.00   3.1574 0.06828 .
Z      1  14.45   14.45   1.6294 0.22807
```

```
---
```

```
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 18.300   9.1500   1.0318 0.38844
T      1  2.679   2.6786   0.3020 0.59359
R:T    2  9.450   4.7250   0.5328 0.60137
S      3 79.196  26.3985   2.9768 0.07822 .
T:S    3 37.474  12.4915   1.4086 0.29234
Z      1 14.450  14.4500   1.6294 0.22807
```

```
---
```

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

```
$`Type III`
```

```
      Df Sum Sq Mean Sq F value Pr(>F)
R      2 20.209  10.1043   1.1394 0.35505
T      1  6.104   6.1038   0.6883 0.42439
R:T    2  9.450   4.7250   0.5328 0.60137
S      3 84.243  28.0810   3.1665 0.06782 .
T:S    3 37.474  12.4915   1.4086 0.29234
Z      1 14.450  14.4500   1.6294 0.22807
```

```
---
```

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

7.17 Example 11.2

(95) MODEL

```
ex11.2a = read.table("C:/G/Rt/Split/Ex11.2-sp3.txt", header=TRUE)
ex11.2a = af(ex11.2a, "A")
ex11.2a$MY = (ex11.2a$Y1 + ex11.2a$Y2)/sqrt(2)
ex11.2a$Z = 2*ex11.2a$Z/sqrt(2)
GLM(MY ~ Z + A, ex11.2a)
```

```

$ANOVA
Response : MY
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      2 234.639   117.32   9.5696 0.01953 *
RESIDUALS    5  61.298    12.26
CORRECTED TOTAL 7 295.938
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$Fitness
      Root MSE MY Mean Coef Var  R-square  Adj R-sq
3.501377 20.06415 17.45091 0.7928678 0.7100149

$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
Z  1 190.148 190.148 15.5101 0.01098 *
A  1  44.492  44.492  3.6291 0.11512
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type II`
      Df Sum Sq Mean Sq F value Pr(>F)
Z  1 166.577 166.577 13.5874 0.0142 *
A  1  44.492  44.492  3.6291 0.1151
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

$`Type III`
      Df Sum Sq Mean Sq F value Pr(>F)
Z  1 166.577 166.577 13.5874 0.0142 *
A  1  44.492  44.492  3.6291 0.1151
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(96) MODEL
ex11.2b = read.table("C:/G/Rt/Split/Ex11.2-two.txt", header=TRUE)
ex11.2b = af(ex11.2b, c("sub", "A", "B"))
GLM(Y ~ A + A:sub + B + A:B, ex11.2b)

```

```

$ANOVA
Response : Y
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      9 382.06   42.451   39.954 0.0001135 ***
RESIDUALS    6   6.38    1.062
CORRECTED TOTAL 15 388.44
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```
$Fitness
Root MSE  Y Mean Coef Var  R-square  Adj R-sq
1.030776 14.1875 7.265384 0.9835881 0.9589702
```

```
$`Type I`
      Df  Sum Sq Mean Sq F value    Pr(>F)
A       1   68.062   68.062  64.0588 0.0002029 ***
A:sub    6  227.875   37.979  35.7451 0.0001934 ***
B       1   85.562   85.562  80.5294 0.0001070 ***
A:B      1    0.562    0.562   0.5294 0.4942562
```

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

```
$`Type II`
      Df  Sum Sq Mean Sq F value    Pr(>F)
A       1   68.062   68.062  64.0588 0.0002029 ***
A:sub    6  227.875   37.979  35.7451 0.0001934 ***
B       1   85.562   85.562  80.5294 0.0001070 ***
A:B      1    0.562    0.562   0.5294 0.4942562
```

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

```
$`Type III`
      Df  Sum Sq Mean Sq F value    Pr(>F)
A       1   68.062   68.062  64.0588 0.0002029 ***
A:sub    6  227.875   37.979  35.7451 0.0001934 ***
B       1   85.562   85.562  80.5294 0.0001070 ***
A:B      1    0.562    0.562   0.5294 0.4942562
```

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

(97) MODEL

```
ex11.2c = read.table("C:/G/Rt/Split/Ex11.2-spcov2.txt", header=TRUE)
ex11.2c = af(ex11.2c, c("block", "whole", "split"))
GLM(Y ~ block + whole + block:whole + split + split:whole, ex11.2c)
```

```
$ANOVA
```

```
Response : Y
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      11     328  29.8182   3.1948 0.02875 *
RESIDUALS   12     112   9.3333
CORRECTED TOTAL 23     440
```

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

```
$Fitness
Root MSE  Y Mean Coef Var  R-square  Adj R-sq
3.05505      7 43.64358 0.7454545 0.5121212
```

```
$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
block    2     48      24  2.5714 0.11765
whole    1     24      24  2.5714 0.13479
block:whole 2     16       8  0.8571 0.44880
split     3    156      52  5.5714 0.01251 *
whole:split 3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
      Df Sum Sq Mean Sq F value Pr(>F)
block    2     48      24  2.5714 0.11765
whole    1     24      24  2.5714 0.13479
block:whole 2     16       8  0.8571 0.44880
split     3    156      52  5.5714 0.01251 *
whole:split 3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq F value Pr(>F)
block    2     48      24  2.5714 0.11765
whole    1     24      24  2.5714 0.13479
block:whole 2     16       8  0.8571 0.44880
split     3    156      52  5.5714 0.01251 *
whole:split 3     84      28  3.0000 0.07277 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(98) MODEL

```
GLM(Z ~ block + whole + block:whole + split + split:whole, ex11.2c)
```

```
$ANOVA
Response : Z
      Df Sum Sq Mean Sq    F value    Pr(>F)
MODEL    11      38  3.4545 3.5903e+15 < 2.2e-16 ***
RESIDUALS 12       0  0.0000
CORRECTED TOTAL 23      38
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$Fitness
      Root MSE Z Mean      Coef Var R-square Adj R-sq
3.101924e-08    3.5 8.86264e-07          1          1
```

```
$`Type I`
```


	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	36.000	18.0000	1.8707e+16	<2e-16 ***
whole	1	0.667	0.6667	6.9286e+14	<2e-16 ***
block:whole	2	1.333	0.6667	6.9286e+14	<2e-16 ***
split	3	0.000	0.0000	0.0000e+00	1
whole:split	3	0.000	0.0000	0.0000e+00	1

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	36.000	18.0000	1.8707e+16	<2e-16 ***
whole	1	0.667	0.6667	6.9286e+14	<2e-16 ***
block:whole	2	1.333	0.6667	6.9286e+14	<2e-16 ***
split	3	0.000	0.0000	0.0000e+00	1
whole:split	3	0.000	0.0000	0.0000e+00	1

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	36.000	18.0000	1.8707e+16	<2e-16 ***
whole	1	0.667	0.6667	6.9286e+14	<2e-16 ***
block:whole	2	1.333	0.6667	6.9286e+14	<2e-16 ***
split	3	0.000	0.0000	0.0000e+00	1
whole:split	3	0.000	0.0000	0.0000e+00	1

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

(99) MODEL

```
GLM(Y ~ block + whole + block:whole + split + split:whole + Z, ex11.2c)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	328	29.8182	3.1948	0.02875 *
RESIDUALS	12	112	9.3333		
CORRECTED TOTAL	23	440			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
3.05505	7	43.64358	0.7454545	0.5121212

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	48	24	2.5714	0.11765

```

whole          1      24      24  2.5714 0.13479
block:whole    2      16       8  0.8571 0.44880
split          3     156      52  5.5714 0.01251 *
whole:split    3      84      28  3.0000 0.07277 .
Z              0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type II`

```

          Df Sum Sq Mean Sq F value Pr(>F)
block      2  13.286   6.643   0.7117 0.51039
whole      1  16.000  16.000   1.7143 0.21495
block:whole 1  16.000  16.000   1.7143 0.21495
split      3 156.000  52.000   5.5714 0.01251 *
whole:split 3  84.000  28.000   3.0000 0.07277 .
Z          0
---
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)
block      2  13.286   6.643   0.7117 0.51039
whole      1  16.000  16.000   1.7143 0.21495
block:whole 1  16.000  16.000   1.7143 0.21495
split      3 156.000  52.000   5.5714 0.01251 *
whole:split 3  84.000  28.000   3.0000 0.07277 .
Z          0
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

7.18 Example 11.3

(100) MODEL

```

ex11.3 = read.table("C:/G/Rt/Split/Ex11.3-sbcov.txt", header=TRUE)
ex11.3 = af(ex11.3, c("block", "A", "B"))
GLM(Y ~ block + A + block:A + B + block:B + A:B, ex11.3)

```

\$ANOVA

Response : Y

```

          Df Sum Sq Mean Sq F value Pr(>F)
MODEL      17 16.833   0.9902   1.9804 0.2038
RESIDUALS    6   3.000   0.5000
CORRECTED TOTAL 23 19.833

```

\$Fitness

```

Root MSE   Y Mean Coef Var  R-square  Adj R-sq
0.7071068  2.916667 24.24366 0.8487395 0.4201681

```

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
block   3 4.5000   1.5000   3.0000 0.11696
A        1 1.5000   1.5000   3.0000 0.13397
block:A  3 0.5000   0.1667   0.3333 0.80220
B        2 8.3333   4.1667   8.3333 0.01855 *
block:B  6 1.0000   0.1667   0.3333 0.89648
A:B      2 1.0000   0.5000   1.0000 0.42188
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
block   3 4.5000   1.5000   3.0000 0.11696
A        1 1.5000   1.5000   3.0000 0.13397
block:A  3 0.5000   0.1667   0.3333 0.80220
B        2 8.3333   4.1667   8.3333 0.01855 *
block:B  6 1.0000   0.1667   0.3333 0.89648
A:B      2 1.0000   0.5000   1.0000 0.42188
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
block   3 4.5000   1.5000   3.0000 0.11696
A        1 1.5000   1.5000   3.0000 0.13397
block:A  3 0.5000   0.1667   0.3333 0.80220
B        2 8.3333   4.1667   8.3333 0.01855 *
block:B  6 1.0000   0.1667   0.3333 0.89648
A:B      2 1.0000   0.5000   1.0000 0.42188
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

(101) MODEL

```
GLM(Z ~ block + A + block:A + B + block:B + A:B, ex11.3)
```

\$ANOVA

Response : Z

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL    17 31.167  1.83333      3.3 0.07324 .
RESIDUALS    6   3.333  0.55556
CORRECTED TOTAL 23 34.500
```

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

\$Fitness

```
Root MSE Z Mean Coef Var  R-square  Adj R-sq
```

0.745356 1.75 42.59177 0.9033816 0.6296296

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	3	6.8333	2.2778	4.1	0.06689 .
A	1	6.0000	6.0000	10.8	0.01669 *
block:A	3	1.6667	0.5556	1.0	0.45472
B	2	13.0000	6.5000	11.7	0.00850 **
block:B	6	3.6667	0.6111	1.1	0.45542
A:B	2	0.0000	0.0000	0.0	1.00000

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	3	6.8333	2.2778	4.1	0.06689 .
A	1	6.0000	6.0000	10.8	0.01669 *
block:A	3	1.6667	0.5556	1.0	0.45472
B	2	13.0000	6.5000	11.7	0.00850 **
block:B	6	3.6667	0.6111	1.1	0.45542
A:B	2	0.0000	0.0000	0.0	1.00000

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	3	6.8333	2.2778	4.1	0.06689 .
A	1	6.0000	6.0000	10.8	0.01669 *
block:A	3	1.6667	0.5556	1.0	0.45472
B	2	13.0000	6.5000	11.7	0.00850 **
block:B	6	3.6667	0.6111	1.1	0.45542
A:B	2	0.0000	0.0000	0.0	1.00000

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

(102) MODEL

```
GLM(Y ~ block + A + block:A + B + block:B + A:B + Z, ex11.3)
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	18	17.8417	0.99120	2.4884	0.1589
RESIDUALS	5	1.9917	0.39833		
CORRECTED TOTAL	23	19.8333			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
0.6311365	2.916667	21.63897	0.8995798	0.5380672

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	3	4.5000	1.5000	3.7657	0.09378 .
A	1	1.5000	1.5000	3.7657	0.10999
block:A	3	0.5000	0.1667	0.4184	0.74788
B	2	8.3333	4.1667	10.4603	0.01634 *
block:B	6	1.0000	0.1667	0.4184	0.84059
A:B	2	1.0000	0.5000	1.2552	0.36163
Z	1	1.0083	1.0083	2.5314	0.17248

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	3	3.6203	1.20678	3.0296	0.1319
A	1	0.0000	0.00000	0.0000	1.0000
block:A	3	0.2583	0.08611	0.2162	0.8813
B	2	1.0317	0.51587	1.2951	0.3522
block:B	6	0.4210	0.07017	0.1762	0.9717
A:B	2	1.0000	0.50000	1.2552	0.3616
Z	1	1.0083	1.00833	2.5314	0.1725

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	3	3.6613	1.22045	3.0639	0.1297
A	1	0.0054	0.00536	0.0134	0.9122
block:A	3	0.2583	0.08611	0.2162	0.8813
B	2	0.7685	0.38427	0.9647	0.4423
block:B	6	0.4210	0.07017	0.1762	0.9717
A:B	2	1.0000	0.50000	1.2552	0.3616
Z	1	1.0083	1.00833	2.5314	0.1725

8 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.

8.1 Chapter 6

8.1.1 p202

(103) MODEL

```
v1p202 = read.table("C:/G/Rt/Kemp/v1p202.txt", head=TRUE)
v1p202 = af(v1p202,c("brand"))
GLM(miles ~ brand, v1p202) # OK
```

\$ANOVA

Response : miles

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	47.234	11.809	15.661	0.004924 **
RESIDUALS	5	3.770	0.754		
CORRECTED TOTAL	9	51.004			

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

\$Fitness

Root MSE	miles	Mean Coef	Var	R-square	Adj R-sq
0.8683317	26.24	3.309191	0.9260842	0.8669516	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	4	47.234	11.809	15.661	0.004924 **

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	4	47.234	11.809	15.661	0.004924 **

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	4	47.234	11.809	15.661	0.004924 **

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

8.1.2 p205

(104) MODEL

```
v1p205 = read.table("C:/G/Rt/Kemp/v1p205.txt", head=TRUE)
v1p205 = af(v1p205,c("brand", "car"))
GLM(miles ~ brand + car %in% brand, v1p205) # OK
```

\$ANOVA

Response : miles

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	9	140.05	15.561	80.21	1.017e-13 ***
RESIDUALS	20	3.88	0.194		
CORRECTED TOTAL	29	143.93			

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

\$Fitness

Root MSE	miles	Mean Coef	Var	R-square	Adj R-sq
0.4404543	26.16667	1.683265	0.9730418	0.9609106	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	4	133.243	33.311	171.7053	3.553e-15 ***
brand:car	5	6.803	1.361	7.0137	0.0006214 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	4	133.243	33.311	171.7053	3.553e-15 ***
brand:car	5	6.803	1.361	7.0137	0.0006214 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
brand	4	133.243	33.311	171.7053	3.553e-15 ***
brand:car	5	6.803	1.361	7.0137	0.0006214 ***

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

8.2 Chapter 7

8.2.1 p232

(105) MODEL

```
v1p232 = read.table("C:/G/Rt/Kemp/v1p232.txt", head=TRUE)
v1p232 = af(v1p232,c("trt"))
```

```
GLM(yield ~ trt, v1p232) # OK
```

```
$ANOVA
```

```
Response : yield
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	59.174	14.793	28.781	0.0012 **
RESIDUALS	5	2.570	0.514		
CORRECTED TOTAL	9	61.744			

```
---
```

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

```
$Fitness
```

Root MSE	yield	Mean Coef	Var	R-square	Adj R-sq
0.7169379	15.94	4.497729	0.9583765	0.9250777	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
trt	4	59.174	14.793	28.781	0.0012 **

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
trt	4	59.174	14.793	28.781	0.0012 **

```
---
```

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
trt	4	59.174	14.793	28.781	0.0012 **

```
---
```

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

8.2.2 p235

```
(106) MODEL
```

```
v1p235 = read.table("C:/G/Rt/Kemp/v1p235.txt", head=TRUE)
v1p235 = af(v1p235,c("density"))
GLM(yield ~ density, v1p235) # OK
```

```
$ANOVA
```

```
Response : yield
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	88.007	22.0017	32.198	1.095e-05 ***
RESIDUALS	10	6.833	0.6833		
CORRECTED TOTAL	14	94.840			

```
---
```



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

```
$Fitness
```

```
Root MSE yield Mean Coef Var  R-square  Adj R-sq
0.8266398      16.4 5.040486 0.9279488 0.8991284
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
density  4 88.007  22.002  32.198 1.095e-05 ***
```

```
---
```

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

```
$`Type II`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
density  4 88.007  22.002  32.198 1.095e-05 ***
```

```
---
```

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

```
$`Type III`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
density  4 88.007  22.002  32.198 1.095e-05 ***
```

```
---
```

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

8.3 Chapter 8

8.3.1 p265

```
(107) MODEL
```

```
v1p265 = read.table("C:/G/Rt/Kemp/v1p265.txt", head=TRUE)
v1p265 = af(v1p265,c("trt"))
GLM(y ~ trt + x, v1p265) # OK
```

```
$ANOVA
```

```
Response : y
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      3 84.678  28.2260  36.866 4.941e-06 ***
RESIDUALS  11  8.422   0.7656
CORRECTED TOTAL 14 93.100
```

```
---
```

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

```
$Fitness
```

```
Root MSE y Mean Coef Var  R-square  Adj R-sq
0.8750081      9 9.722312 0.9095378 0.8848663
```

```
$`Type I`
```

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

```
trt  2 66.868  33.434  43.668 5.858e-06 ***
x    1 17.810  17.810  23.262 0.0005333 ***
---
```

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 83.147  41.573   54.299 1.996e-06 ***
x      1 17.810  17.810   23.262 0.0005333 ***
---
```

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 83.147  41.573   54.299 1.996e-06 ***
x      1 17.810  17.810   23.262 0.0005333 ***
---
```

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

8.3.2 p272

(108) MODEL

```
GLM(y ~ trt + x %in% trt, v1p265) # OK
```

\$ANOVA

Response : y

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      5 85.711  17.142  20.881 0.0001046 ***
RESIDUALS   9  7.389   0.821
CORRECTED TOTAL 14 93.100
---
```

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

\$Fitness

```
      Root MSE y Mean Coef Var  R-square Adj R-sq
      0.9060697      9 10.06744 0.9206374 0.876547
```

\$`Type I`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
trt    2 66.868  33.434  40.7254 3.092e-05 ***
trt:x  3 18.843   6.281   7.6509 0.007578 **
---
```

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 66.868  33.434  40.7254 3.092e-05 ***
trt:x  3 18.843   6.281   7.6509 0.007578 **
```

```
---
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	6.1392	3.0696	3.7390	0.065769 .
trt:x	3	18.8433	6.2811	7.6509	0.007578 **

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

8.3.3 p273

(109) MODEL

```
GLM(y ~ trt + x + x %in% trt, vlp265) # OK
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	5	85.711	17.142	20.881	0.0001046 ***
RESIDUALS	9	7.389	0.821		
CORRECTED TOTAL	14	93.100			

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

```
$Fitness
```

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
0.9060697	9	10.06744	0.9206374	0.876547

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
trt	2	66.868	33.434	40.7254	3.092e-05 ***
x	1	17.810	17.810	21.6940	0.001189 **
trt:x	2	1.033	0.517	0.6294	0.554843

```
---
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	83.147	41.573	50.6397	1.267e-05 ***
x	1	17.810	17.810	21.6940	0.001189 **
trt:x	2	1.033	0.517	0.6294	0.554843

```
---
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	6.1392	3.0696	3.7390	0.065769 .
x	1	17.2071	17.2071	20.9597	0.001331 **

```
trt:x 2 1.0334 0.5167 0.6294 0.554843
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

8.4 Chapter 9

8.4.1 p344

(110) MODEL

```
v1p344 = read.table("C:/G/Rt/Kemp/v1p344.txt", head=TRUE)
v1p344 = af(v1p344,c("diet", "litter"))
GLM(gain ~ litter + diet, v1p344)
```

\$ANOVA

Response : gain

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	9	4915.6	546.18	15.544	3.363e-07 ***
RESIDUALS	20	702.8	35.14		
CORRECTED TOTAL	29	5618.4			

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

\$Fitness

	Root MSE	gain	Mean Coef	Var	R-square	Adj R-sq
	5.927698	68.31333	8.677219	0.874919	0.8186325	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
litter	5	4438.0	887.6	25.2608	5.298e-08 ***
diet	4	477.6	119.4	3.3981	0.02824 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
litter	5	4438.0	887.6	25.2608	5.298e-08 ***
diet	4	477.6	119.4	3.3981	0.02824 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
litter	5	4438.0	887.6	25.2608	5.298e-08 ***
diet	4	477.6	119.4	3.3981	0.02824 *

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

8.4.2 p349

(111) MODEL

```
v1p349 = read.table("C:/G/Rt/Kemp/v1p349.txt", head=TRUE)
v1p349 = af(v1p349,c("subject", "exercise"))
GLM(diast ~ subject + exercise + subject:exercise, v1p349) # OK
```

\$ANOVA

Response : diast

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	14	1541.5	110.105	28.475	2.953e-08 ***
RESIDUALS	15	58.0	3.867		
CORRECTED TOTAL	29	1599.5			

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

\$Fitness

Root MSE	diast	Mean Coef	Var	R-square	Adj R-sq
1.966384	134.5333	1.461633	0.9637379	0.9298933	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
subject	4	905.13	226.283	58.5216	5.672e-09 ***
exercise	2	591.27	295.633	76.4569	1.357e-08 ***
subject:exercise	8	45.07	5.633	1.4569	0.2522

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
subject	4	905.13	226.283	58.5216	5.672e-09 ***
exercise	2	591.27	295.633	76.4569	1.357e-08 ***
subject:exercise	8	45.07	5.633	1.4569	0.2522

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
subject	4	905.13	226.283	58.5216	5.672e-09 ***
exercise	2	591.27	295.633	76.4569	1.357e-08 ***
subject:exercise	8	45.07	5.633	1.4569	0.2522

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

8.4.3 p354

(112) MODEL

```
v1p354 = read.table("C:/G/Rt/Kemp/v1p354.txt", head=TRUE)
v1p354 = af(v1p354,c("loc", "block", "HSF"))
GLM(height ~ loc + block %in% loc + HSF + loc:HSF + block:loc:HSF, v1p354) # OK
```

\$ANOVA

Response : height

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	23	40782	1773.12	80.444	< 2.2e-16 ***
RESIDUALS	24	529	22.04		
CORRECTED TOTAL	47	41311			

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

\$Fitness

Root MSE	height	Mean Coef	Var	R-square	Adj R-sq
4.694855	210.6667	2.228571	0.9871946	0.9749227	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
loc	1	20336.3	20336.3	922.6314	< 2.2e-16 ***
loc:block	6	1462.3	243.7	11.0573	6.408e-06 ***
HSF	2	12170.7	6085.3	276.0832	< 2.2e-16 ***
loc:HSF	2	6511.2	3255.6	147.7013	3.242e-14 ***
loc:block:HSF	12	301.2	25.1	1.1386	0.3769

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
loc	1	20336.3	20336.3	922.6314	< 2.2e-16 ***
loc:block	6	1462.3	243.7	11.0573	6.408e-06 ***
HSF	2	12170.7	6085.3	276.0832	< 2.2e-16 ***
loc:HSF	2	6511.2	3255.6	147.7013	3.242e-14 ***
loc:block:HSF	12	301.2	25.1	1.1386	0.3769

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
loc	1	20336.3	20336.3	922.6314	< 2.2e-16 ***
loc:block	6	1462.3	243.7	11.0573	6.408e-06 ***
HSF	2	12170.7	6085.3	276.0832	< 2.2e-16 ***
loc:HSF	2	6511.2	3255.6	147.7013	3.242e-14 ***
loc:block:HSF	12	301.2	25.1	1.1386	0.3769

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

8.4.4 p357

(113) MODEL

```
v1p357 = read.table("C:/G/Rt/Kemp/v1p357.txt", head=TRUE)
v1p357 = af(v1p357,c("var", "N"))
GLM(y ~ var + N + var:N, v1p357) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	9	4465.4	496.16	14.116	0.000142 ***
RESIDUALS	10	351.5	35.15		
CORRECTED TOTAL	19	4816.9			

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

\$Fitness

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
5.928744	137.55	4.310246	0.9270285	0.8613542	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
var	1	140.5	140.45	3.9957	0.073519 .
N	4	3393.7	848.42	24.1373	4.027e-05 ***
var:N	4	931.3	232.82	6.6238	0.007152 **

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
var	1	140.5	140.45	3.9957	0.073519 .
N	4	3393.7	848.43	24.1373	4.027e-05 ***
var:N	4	931.3	232.82	6.6238	0.007152 **

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
var	1	140.5	140.45	3.9957	0.073519 .
N	4	3393.7	848.43	24.1373	4.027e-05 ***
var:N	4	931.3	232.82	6.6238	0.007152 **

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

8.4.5 p361

(114) MODEL

```
v1p361 = read.table("C:/G/Rt/Kemp/v1p361.txt", head=TRUE)
v1p361 = af(v1p361,c("block", "trt"))
GLM(y ~ block + trt, v1p361) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	241.33	60.333	40.222	0.1176
RESIDUALS	1	1.50	1.500		
CORRECTED TOTAL	5	242.83			

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
1.224745	19.83333	6.175184	0.9938229	0.9691146

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	24.333	12.167	8.1111	0.24097
trt	2	217.000	108.500	72.3333	0.08286 .

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	108	54.0	36.000	0.11704
trt	2	217	108.5	72.333	0.08286 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	2	108	54.0	36.000	0.11704
trt	2	217	108.5	72.333	0.08286 .

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

```
y = model.frame(y ~ block + trt, v1p361)[,1]
x = ModelMatrix(y ~ block + trt, v1p361)
rx = lfit(x, y)
K = cbind(rep(1, 3), matrix(1/3, nrow=3, ncol=3), diag(3)) ; K
```

	[,1]	[,2]	[,3]	[,4]	[,5]	[,6]	[,7]
[1,]	1	0.3333333	0.3333333	0.3333333	1	0	0
[2,]	1	0.3333333	0.3333333	0.3333333	0	1	0
[3,]	1	0.3333333	0.3333333	0.3333333	0	0	1

```
est(K, x$X, rx)
```

Estimate	Lower CL	Upper CL	Std. Error	t value	Df	Pr(> t)
----------	----------	----------	------------	---------	----	----------


```
[1,]      29.5 17.334735 41.66526 0.9574271 30.81175 1 0.02065434
[2,]      16.5  4.334735 28.66526 0.9574271 17.23369 1 0.03689905
[3,]      13.5  1.334735 25.66526 0.9574271 14.10029 1 0.04507394
attr("Estimability")
[1] TRUE TRUE TRUE
```

8.5 Chapter 10

8.5.1 p405

(115) MODEL

```
v1p405 = read.table("C:/G/Rt/Kemp/v1p405.txt", head=TRUE)
v1p405 = af(v1p405,c("trt", "Row", "Col"))
GLM(y ~ Row + Col + trt, v1p405) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	12	4094.7	341.23	2.3416	0.07739 .
RESIDUALS	12	1748.7	145.73		
CORRECTED TOTAL	24	5843.4			

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

\$Fitness

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
12.07173	93.32	12.93584	0.7007379	0.4014758	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	4	514.24	128.56	0.8822	0.50328
Col	4	1711.44	427.86	2.9360	0.06611 .
trt	4	1869.04	467.26	3.2064	0.05229 .

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	4	514.24	128.56	0.8822	0.50328
Col	4	1711.44	427.86	2.9360	0.06611 .
trt	4	1869.04	467.26	3.2064	0.05229 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Row	4	514.24	128.56	0.8822	0.50328
Col	4	1711.44	427.86	2.9360	0.06611 .

```
trt 4 1869.04 467.26 3.2064 0.05229 .
```

```
---
```

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

8.5.2 p408

(116) MODEL

```
v1p408 = read.table("C:/G/Rt/Kemp/v1p408.txt", head=TRUE)
v1p408 = af(v1p408, c("breed", "farm", "wclass", "dosage"))
GLM(response ~ breed + breed:farm + wclass + dosage + breed:dosage, v1p408) # OK
```

\$ANOVA

Response : response

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	16	4470.3	279.391	140.87	2.039e-13 ***
RESIDUALS	15	29.7	1.983		
CORRECTED TOTAL	31	4500.0			

```
---
```

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

\$Fitness

Root MSE	response	Mean Coef	Var	R-square	Adj R-sq
1.408309		155.75	0.904211	0.9933889	0.986337

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
breed	1	3280.5	3280.5	1654.0336	< 2.2e-16 ***
breed:farm	6	9.0	1.5	0.7563	0.6146
wclass	3	466.8	155.6	78.4454	2.142e-09 ***
dosage	3	580.2	193.4	97.5210	4.596e-10 ***
breed:dosage	3	133.8	44.6	22.4790	8.366e-06 ***

```
---
```

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
breed	1	3280.5	3280.5	1654.0336	< 2.2e-16 ***
breed:farm	6	9.0	1.5	0.7563	0.6146
wclass	3	466.8	155.6	78.4454	2.142e-09 ***
dosage	3	580.2	193.4	97.5210	4.596e-10 ***
breed:dosage	3	133.8	44.6	22.4790	8.366e-06 ***

```
---
```

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
breed	1	3280.5	3280.5	1654.0336	< 2.2e-16 ***
breed:farm	6	9.0	1.5	0.7563	0.6146

```
wclass      3  466.8   155.6   78.4454 2.142e-09 ***
dosage      3  580.2   193.4   97.5210 4.596e-10 ***
breed:dosage 3  133.8    44.6   22.4790 8.366e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

8.5.3 p410

(117) MODEL

```
v1p410 = read.table("C:/G/Rt/Kemp/v1p410.txt", head=TRUE)
v1p410$carry = ifelse(v1p410$carry == 0, 3, v1p410$carry)
v1p410 = af(v1p410, c("period", "sequence", "steer", "trt", "carry"))
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

\$Fitness

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
2.960778	52.36111	5.654535	0.8919461	0.7898953	

\$`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

```
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

8.6 Chapter 11

8.6.1 p432

(118) MODEL

```
v1p432 = read.table("C:/G/Rt/Kemp/v1p432.txt", head=TRUE)
v1p432 = af(v1p432, c("V", "Block", "A", "B", "C"))
GLM(Y ~ V + Block:V + A + B + A:B + V:A + V:B + V:A:B + Block:A:V + Block:B:V,
     v1p432) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	94	261663	2783.65	30.584	2.065e-14 ***
RESIDUALS	25	2275	91.02		
CORRECTED TOTAL	119	263939			

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

\$Fitness

Root MSE Y Mean Coef Var R-square Adj R-sq
 9.540266 612.9 1.556578 0.991379 0.958964

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	282.2094	< 2.2e-16 ***
V:Block	25	50019	2001	21.9825	1.588e-11 ***
A	1	18451	18451	202.7233	1.692e-13 ***
B	1	78541	78541	862.9280	< 2.2e-16 ***
A:B	1	108	108	1.1899	0.28575
V:A	4	3751	938	10.3023	4.532e-05 ***
V:B	4	307	77	0.8421	0.51168
V:A:B	4	1495	374	4.1058	0.01081 *
V:Block:A	25	3416	137	1.5011	0.15818
V:Block:B	25	2833	113	1.2451	0.29390

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	282.2094	< 2.2e-16 ***
V:Block	25	50019	2001	21.9825	1.588e-11 ***
A	1	18451	18451	202.7233	1.692e-13 ***
B	1	78541	78541	862.9280	< 2.2e-16 ***
A:B	1	108	108	1.1899	0.28575
V:A	4	3751	938	10.3023	4.532e-05 ***
V:B	4	307	77	0.8421	0.51168
V:A:B	4	1495	374	4.1058	0.01081 *
V:Block:A	25	3416	137	1.5011	0.15818
V:Block:B	25	2833	113	1.2451	0.29390

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	282.2094	< 2.2e-16 ***
V:Block	25	50019	2001	21.9825	1.588e-11 ***
A	1	18451	18451	202.7233	1.692e-13 ***
B	1	78541	78541	862.9280	< 2.2e-16 ***
A:B	1	108	108	1.1899	0.28575
V:A	4	3751	938	10.3023	4.532e-05 ***
V:B	4	307	77	0.8421	0.51168
V:A:B	4	1495	374	4.1058	0.01081 *
V:Block:A	25	3416	137	1.5011	0.15818
V:Block:B	25	2833	113	1.2451	0.29390

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

8.6.2 p434

(119) MODEL

```
GLM(Y ~ V + Block:V + A + B + A:B + V:A + V:B + V:A:B, v1p432) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	44	255415	5804.9	51.075	< 2.2e-16 ***
RESIDUALS	75	8524	113.7		
CORRECTED TOTAL	119	263939			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
10.66088	612.9	1.739417	0.9677043	0.9487575

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	225.9988	< 2.2e-16 ***
V:Block	25	50019	2001	17.6040	< 2.2e-16 ***
A	1	18451	18451	162.3447	< 2.2e-16 ***
B	1	78541	78541	691.0494	< 2.2e-16 ***
A:B	1	108	108	0.9529	0.33212
V:A	4	3751	938	8.2503	1.435e-05 ***
V:B	4	307	77	0.6744	0.61182
V:A:B	4	1495	374	3.2880	0.01541 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	225.9988	< 2.2e-16 ***
V:Block	25	50019	2001	17.6040	< 2.2e-16 ***
A	1	18451	18451	162.3447	< 2.2e-16 ***
B	1	78541	78541	691.0494	< 2.2e-16 ***
A:B	1	108	108	0.9529	0.33212
V:A	4	3751	938	8.2503	1.435e-05 ***
V:B	4	307	77	0.6744	0.61182
V:A:B	4	1495	374	3.2880	0.01541 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	225.9988	< 2.2e-16 ***
V:Block	25	50019	2001	17.6040	< 2.2e-16 ***

```

A      1  18451  18451 162.3447 < 2.2e-16 ***
B      1  78541  78541 691.0494 < 2.2e-16 ***
A:B    1   108   108  0.9529  0.33212
V:A    4  3751   938  8.2503 1.435e-05 ***
V:B    4   307    77  0.6744  0.61182
V:A:B  4  1495   374  3.2880  0.01541 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

8.6.3 p438

(120) MODEL

```
GLM(Y ~ V + Block:V + C + V:C, vlp432) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	44	255415	5804.9	51.075	< 2.2e-16 ***
RESIDUALS	75	8524	113.7		
CORRECTED TOTAL	119	263939			

```

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

```

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
10.66088	612.9	1.739417	0.9677043	0.9487575

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	225.9988	< 2.2e-16 ***
V:Block	25	50019	2001	17.6040	< 2.2e-16 ***
C	3	97100	32367	284.7823	< 2.2e-16 ***
V:C	12	5552	463	4.0709	7.23e-05 ***

```

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

```

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	225.9988	< 2.2e-16 ***
V:Block	25	50019	2001	17.6040	< 2.2e-16 ***
C	3	97100	32367	284.7823	< 2.2e-16 ***
V:C	12	5552	463	4.0709	7.23e-05 ***

```

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

```

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	102743	25686	225.9988	< 2.2e-16 ***

```
V:Block 25 50019 2001 17.6040 < 2.2e-16 ***
C      3 97100 32367 284.7823 < 2.2e-16 ***
V:C    12 5552 463 4.0709 7.23e-05 ***
```

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

8.6.4 p444

(121) MODEL

```
v1p444 = v1p432[v1p432$Block==5,]
GLM(Y ~ V + A + B + A:B + V:A, v1p444) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	39278	3570.8	59.787	1.897e-06 ***
RESIDUALS	8	478	59.7		
CORRECTED TOTAL	19	39756			

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

\$Fitness

Root MSE	Y	Mean	Coef Var	R-square	Adj R-sq
7.728195	630.7	1.225336	0.9879817	0.9714567	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	19287.7	4821.9	80.7355	1.674e-06 ***
A	1	3380.0	3380.0	56.5927	6.780e-05 ***
B	1	14045.0	14045.0	235.1612	3.247e-07 ***
A:B	1	115.2	115.2	1.9288	0.202326
V:A	4	2450.5	612.6	10.2574	0.003081 **

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	19287.7	4821.9	80.7355	1.674e-06 ***
A	1	3380.0	3380.0	56.5927	6.780e-05 ***
B	1	14045.0	14045.0	235.1612	3.247e-07 ***
A:B	1	115.2	115.2	1.9288	0.202326
V:A	4	2450.5	612.6	10.2574	0.003081 **

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
V	4	19287.7	4821.9	80.7355	1.674e-06 ***


```

A      1  3380.0  3380.0  56.5927  6.780e-05 ***
B      1 14045.0 14045.0 235.1612  3.247e-07 ***
A:B    1   115.2   115.2   1.9288  0.202326
V:A    4   2450.5   612.6  10.2574  0.003081 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

8.6.5 p482

(122) MODEL

```

v1p482 = read.table("C:/G/Rt/Kemp/v1p482.txt", head=TRUE)
v1p482 = af(v1p482,c("block", "A", "B"))
GLM(y ~ block + A + B + A:B, v1p482) # OK

```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	8	156.88	19.6094	9.8871	9.377e-05 ***
RESIDUALS	15	29.75	1.9833		
CORRECTED TOTAL	23	186.62			

```

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

```

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
1.408309	7.875	17.88328	0.8405894	0.7555704

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	5	108.38	21.675	10.9286	0.0001415 ***
A	1	4.00	4.000	2.0168	0.1760166
B	1	42.25	42.250	21.3025	0.0003365 ***
A:B	1	2.25	2.250	1.1345	0.3036727

```

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

```

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	5	31.417	6.283	3.1681	0.0377804 *
A	1	4.000	4.000	2.0168	0.1760166
B	1	42.250	42.250	21.3025	0.0003365 ***
A:B	1	2.250	2.250	1.1345	0.3036727

```

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

```

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	5	31.417	6.283	3.1681	0.0377804 *

```

A      1  4.000   4.000  2.0168 0.1760166
B      1 42.250  42.250 21.3025 0.0003365 ***
A:B    1  2.250   2.250  1.1345 0.3036727
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

8.7 Chapter 12

8.7.1 p525

(123) MODEL

```

v1p525 = read.table("C:/G/Rt/Kemp/v1p525.txt", head=TRUE)
REG(y ~ x1 + x2 + x3, v1p525)

```

\$ANOVA

```

Response : y
              Df Sum Sq Mean Sq F value    Pr(>F)
MODEL              3  84.948  28.3158   164.15 5.26e-10 ***
RESIDUALS          12   2.070   0.1725
CORRECTED TOTAL   15  87.017
---

```

```

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

```

\$Fitness

```

Root MSE y Mean Coef Var R-square Adj R-sq PRESS R2pred
0.4153312 14.2125 2.922295 0.9762117 0.9702646 3.68 0.9577097

```

\$Coefficients

```

              Estimate Std. Error Df Lower CL Upper CL t value Pr(>|t|)
(Intercept) 14.2125     0.10383 12  13.9863  14.4387 136.8787 < 2.2e-16 ***
x1           0.7875     0.10383 12   0.5613   1.0137   7.5843 6.465e-06 ***
x2           1.3875     0.10383 12   1.1613   1.6137  13.3628 1.446e-08 ***
x3           1.6625     0.10383 12   1.4363   1.8887  16.0113 1.839e-09 ***
---

```

```

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

```

```

GLM(y ~ x1 + x2 + x3, v1p525) # OK

```

\$ANOVA

```

Response : y
              Df Sum Sq Mean Sq F value    Pr(>F)
MODEL              3  84.948  28.3158   164.15 5.26e-10 ***
RESIDUALS          12   2.070   0.1725
CORRECTED TOTAL   15  87.017
---

```

```

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

```

\$Fitness

```

Root MSE y Mean Coef Var R-square Adj R-sq

```

0.4153312 14.2125 2.922295 0.9762117 0.9702646

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
x1	1	9.923	9.923	57.522	6.465e-06 ***
x2	1	30.803	30.803	178.565	1.446e-08 ***
x3	1	44.223	44.223	256.362	1.839e-09 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
x1	1	9.923	9.923	57.522	6.465e-06 ***
x2	1	30.803	30.803	178.565	1.446e-08 ***
x3	1	44.223	44.223	256.362	1.839e-09 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
x1	1	9.923	9.923	57.522	6.465e-06 ***
x2	1	30.803	30.803	178.565	1.446e-08 ***
x3	1	44.223	44.223	256.362	1.839e-09 ***

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

8.7.2 p527

(124) MODEL

```
v1p527 = read.table("C:/G/Rt/Kemp/v1p527.txt", head=TRUE)
GLM(y ~ A + B, v1p527) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	2	22.99	11.4952	4.8917	0.04686 *
RESIDUALS	7	16.45	2.3499		
CORRECTED TOTAL	9	39.44			

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

\$Fitness

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
1.532954		5.2	29.47989	0.5829197	0.4637539

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	10.364	10.364	4.4103	0.07386 .

```

B  1 12.626  12.626  5.3730 0.05355 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type II`
  Df Sum Sq Mean Sq F value Pr(>F)
A  1 10.364  10.364  4.4103 0.07386 .
B  1 12.626  12.626  5.3730 0.05355 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
  Df Sum Sq Mean Sq F value Pr(>F)
A  1 10.364  10.364  4.4103 0.07386 .
B  1 12.626  12.626  5.3730 0.05355 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

8.7.3 p529

(125) MODEL

```

v1p529 = read.table("C:/G/Rt/Kemp/v1p529.txt", head=TRUE)
GLM(y ~ A + B + I(A*A) + I(B*B) + I(A*B), v1p529) # OK

```

```

$ANOVA
Response : y
          Df Sum Sq Mean Sq F value Pr(>F)
MODEL          5 35.713   7.1427  6.7928 0.01857 *
RESIDUALS       6  6.309   1.0515
CORRECTED TOTAL 11 42.023
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$Fitness
Root MSE y Mean Coef Var  R-square  Adj R-sq
1.025434  5.275  19.4395 0.8498641 0.7247508

```

```

$`Type I`
  Df Sum Sq Mean Sq F value Pr(>F)
A    1 11.6012 11.6012 11.0329 0.01597 *
B    1 12.6263 12.6263 12.0077 0.01338 *
I(A * A) 1  1.7167  1.7167  1.6326 0.24855
I(B * B) 1  5.3593  5.3593  5.0967 0.06476 .
I(A * B) 1  4.4100  4.4100  4.1940 0.08649 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type II`

```

```

      Df Sum Sq Mean Sq F value Pr(>F)
A      1 11.6012 11.6012 11.0329 0.01597 *
B      1 12.6263 12.6263 12.0077 0.01338 *
I(A * A) 1  5.5468  5.5468  5.2750 0.06137 .
I(B * B) 1  5.3593  5.3593  5.0967 0.06476 .
I(A * B) 1  4.4100  4.4100  4.1940 0.08649 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value Pr(>F)
A      1 11.6012 11.6012 11.0329 0.01597 *
B      1 12.6263 12.6263 12.0077 0.01338 *
I(A * A) 1  5.5468  5.5468  5.2750 0.06137 .
I(B * B) 1  5.3593  5.3593  5.0967 0.06476 .
I(A * B) 1  4.4100  4.4100  4.1940 0.08649 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

8.8 Chapter 13

8.8.1 p563

(126) MODEL

```

v1p563 = read.table("C:/G/Rt/Kemp/v1p563.txt", head=TRUE)
v1p563 = af(v1p563, c("rep", "A", "B"))
GLM(y ~ rep + A + rep:A + B + A:B, v1p563) # OK

```

\$ANOVA

```

Response : y
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      14 2097.08 149.792   17.228 8.385e-05 ***
RESIDUALS      9   78.25   8.694
CORRECTED TOTAL 23 2175.33
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$Fitness

```

Root MSE    y Mean Coef Var  R-square  Adj R-sq
2.948634 31.16667 9.460859 0.9640285 0.9080728

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
rep     3 1241.00  413.67  47.5783 7.606e-06 ***
A       2  353.08  176.54  20.3051 0.0004613 ***
rep:A   6  192.25   32.04   3.6853 0.0393557 *
B       1  216.00  216.00  24.8435 0.0007550 ***
A:B     2   94.75   47.38   5.4489 0.0281496 *

```

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

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
rep     3 1241.00   413.67  47.5783 7.606e-06 ***
A       2   353.08   176.54  20.3051 0.0004613 ***
rep:A    6   192.25    32.04   3.6853 0.0393557 *
B       1   216.00   216.00  24.8435 0.0007550 ***
A:B      2    94.75    47.38   5.4489 0.0281496 *
```

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

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
rep     3 1241.00   413.67  47.5783 7.606e-06 ***
A       2   353.08   176.54  20.3051 0.0004613 ***
rep:A    6   192.25    32.04   3.6853 0.0393557 *
B       1   216.00   216.00  24.8435 0.0007550 ***
A:B      2    94.75    47.38   5.4489 0.0281496 *
```

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

8.8.2 p566

(127) MODEL

```
v1p566 = read.table("C:/G/Rt/Kemp/v1p566.txt", head=TRUE)
v1p566 = af(v1p566, c("subject", "A", "B"))
GLM(y ~ A + B + A:B, v1p566) # OK
```

\$ANOVA

```
Response : y
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      5 1469.58   293.92    86.2 5.592e-09 ***
RESIDUALS  12   40.92     3.41
CORRECTED TOTAL 17 1510.50
```

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

\$Fitness

```
Root MSE   y Mean Coef Var  R-square  Adj R-sq
1.846543 35.83333 5.153144 0.9729118 0.9616251
```

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
A       2 1390.04   695.02  203.8350 5.466e-10 ***
B       1   76.06    76.06   22.3055 0.0004945 ***
A:B     2    3.49     1.74    0.5112 0.6122667
```

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

```
$`Type II`
      Df Sum Sq Mean Sq F value    Pr(>F)
A      2 1390.04  695.02 203.8350 5.466e-10 ***
B      1   76.06   76.06  22.3055 0.0004945 ***
A:B    2    3.49    1.74   0.5112 0.6122667
```

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

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
A      2 1390.04  695.02 203.8350 5.466e-10 ***
B      1   79.00   79.00  23.1700 0.0004237 ***
A:B    2    3.49    1.74   0.5112 0.6122667
```

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

8.9 Chapter 14

8.9.1 p581

(128) MODEL

```
v1p581 = read.table("C:/G/Rt/Kemp/v1p581.txt", head=TRUE)
v1p581 = af(v1p581, c("drug", "person", "time"))
GLM(rate ~ drug + person:drug + time + drug:time, v1p581) # OK
```

```
$ANOVA
Response : rate
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      23 2449.5  106.500  12.733 3.469e-11 ***
RESIDUALS   36  301.1    8.364
CORRECTED TOTAL 59 2750.6
```

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

```
$Fitness
Root MSE rate Mean Coef Var R-square Adj R-sq
2.892039      77.7 3.722058 0.890533 0.8205957
```

```
$`Type I`
      Df Sum Sq Mean Sq F value    Pr(>F)
drug      2  337.60  168.800  20.1820 1.323e-06 ***
drug:person 12 1498.50  124.875  14.9303 1.501e-10 ***
time      3  256.33   85.444  10.2159 5.230e-05 ***
drug:time  6  357.07   59.511   7.1152 4.707e-05 ***
```

```
---
```

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
drug	2	337.60	168.800	20.1820	1.323e-06	***
drug:person	12	1498.50	124.875	14.9303	1.501e-10	***
time	3	256.33	85.444	10.2159	5.230e-05	***
drug:time	6	357.07	59.511	7.1152	4.707e-05	***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
drug	2	337.60	168.800	20.1820	1.323e-06	***
drug:person	12	1498.50	124.875	14.9303	1.501e-10	***
time	3	256.33	85.444	10.2159	5.230e-05	***
drug:time	6	357.07	59.511	7.1152	4.707e-05	***

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

9 Hinkelmann & Kempthorne - Volume 2

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

9.1 Chapter 1

9.1.1 p53

(129) MODEL

```
v2p53 = read.table("C:/G/Rt/Kemp/v2p53.txt", head=TRUE)
v2p53 = af(v2p53, c("TRT", "BLOCK"))
GLM(Y ~ BLOCK + TRT, v2p53) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	518.21	74.030	8.1408	0.1137
RESIDUALS	2	18.19	9.094		
CORRECTED TOTAL	9	536.40			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
3.015585	19.4	15.54425	0.9660934	0.8474203

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
BLOCK	4	261.40	65.350	7.1863	0.12587
TRT	3	256.81	85.604	9.4135	0.09755 .

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
BLOCK	4	79.146	19.786	2.1758	0.33880
TRT	3	256.812	85.604	9.4135	0.09755 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
BLOCK	4	79.146	19.786	2.1758	0.33880
TRT	3	256.812	85.604	9.4135	0.09755 .

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

9.1.2 p62

(130) MODEL

```
GLM(Y ~ TRT + BLOCK, v2p53) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	518.21	74.030	8.1408	0.1137
RESIDUALS	2	18.19	9.094		
CORRECTED TOTAL	9	536.40			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
3.015585	19.4	15.54425	0.9660934	0.8474203

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
TRT	3	439.07	146.356	16.0941	0.05907 .
BLOCK	4	79.15	19.786	2.1758	0.33880

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
TRT	3	256.812	85.604	9.4135	0.09755 .
BLOCK	4	79.146	19.786	2.1758	0.33880

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
TRT	3	256.812	85.604	9.4135	0.09755 .
BLOCK	4	79.146	19.786	2.1758	0.33880

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

9.2 Chapter 2

9.2.1 p82

(131) MODEL

```
v2p82 = read.table("C:/G/Rt/Kemp/v2p82.txt", head=TRUE)
v2p82 = af(v2p82, c("B", "Tx"))
GLM(Y ~ B + Tx, v2p82) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	14	889.11	63.508	6.3183	0.000518 ***
RESIDUALS	15	150.77	10.052		
CORRECTED TOTAL	29	1039.89			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
3.170413	38.46667	8.241975	0.8550104	0.7196867

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	9	730.39	81.154	8.0738	0.0002454 ***
Tx	5	158.73	31.745	3.1583	0.0381655 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	9	595.74	66.193	6.5854	0.0007602 ***
Tx	5	158.73	31.745	3.1583	0.0381655 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
B	9	595.74	66.193	6.5854	0.0007602 ***
Tx	5	158.73	31.745	3.1583	0.0381655 *

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

9.2.2 p87

(132) MODEL

```
v2p87 = read.table("C:/G/Rt/Kemp/v2p87.txt", head=TRUE)
GLM(y ~ x1 + x2 + x3 + x4 + x5 + x6, v2p87) # OK
```

Warning in min(abs(rx\$coefficients[rx\$coefficients != 0])): no non-missing arguments to min; returning Inf

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	5	1613.25	322.65	2.2332	0.2282
RESIDUALS	4	577.91	144.48		
CORRECTED TOTAL	9	2191.16			

```
$Fitness
```

```
Root MSE y Mean Coef Var R-square Adj R-sq  
12.01991 115.4 10.41587 0.7362523 0.4065678
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value Pr(>F)  
x1  1 1044.48 1044.48  7.2293 0.05473 .  
x2  1   89.79   89.79  0.6215 0.47459  
x3  1   10.45   10.45  0.0724 0.80124  
x4  1  407.08  407.08  2.8176 0.16854  
x5  1   61.44   61.44  0.4253 0.54990  
x6  0
```

```
---
```

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

```
$`Type II`
```

```
      Df Sum Sq Mean Sq F value Pr(>F)  
x1  0  
x2  0  
x3  0  
x4  0  
x5  0  
x6  0
```

```
$`Type III`
```

```
CAUTION: Singularity Exists !
```

```
      Df Sum Sq Mean Sq F value Pr(>F)  
x1  0  
x2  0  
x3  0  
x4  0  
x5  0  
x6  0
```

9.3 Chapter 6

9.3.1 p217

(133) MODEL

```
v2p217 = read.table("C:/G/Rt/Kemp/v2p217.txt", head=TRUE)  
v2p217 = af(v2p217, c("R", "C", "Tx"))  
GLM(Y ~ R + C + Tx, v2p217) # OK
```

```
$ANOVA
```

```
Response : Y
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
MODEL      22 4305.1  195.687   7.5094 0.0002682 ***  
RESIDUALS   13  338.8   26.059
```

CORRECTED TOTAL 35 4643.9

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

\$Fitness

	Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
	5.104813	27.05556	18.86789	0.9270507	0.803598

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
R	3	3951.4	1317.15	50.5446	1.998e-07 ***
C	8	168.9	21.11	0.8101	0.6062
Tx	11	184.8	16.80	0.6446	0.7638

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	3403.5	1134.51	43.5360	4.83e-07 ***
C	8	112.4	14.05	0.5390	0.8077
Tx	11	184.8	16.80	0.6446	0.7638

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	3403.5	1134.51	43.5360	4.83e-07 ***
C	8	112.4	14.05	0.5390	0.8077
Tx	11	184.8	16.80	0.6446	0.7638

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

9.3.2 p234

(134) MODEL

```
v2p234 = read.table("C:/G/Rt/Kemp/v2p234.txt", head=TRUE)
v2p234 = af(v2p234, c("R", "C", "Tx"))
GLM(Y ~ C + R + Tx, v2p234) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	13	426.50	32.808	7.0936	0.1302
RESIDUALS	2	9.25	4.625		
CORRECTED TOTAL	15	435.75			

\$Fitness

	Root MSE	Y Mean	Coef Var	R-square	Adj R-sq

```
2.150581 29.625 7.259346 0.9787722 0.8407917
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
C       3   16.25    5.417   1.1712 0.49129
R       3  357.25  119.083  25.7477 0.03762 *
Tx      7   53.00    7.571   1.6371 0.43052
```

```
---
```

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

```
$`Type II`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
C       3   10.25    3.417   0.7387 0.6189
R       3  285.50   95.167  20.5766 0.0467 *
Tx      7   53.00    7.571   1.6371 0.4305
```

```
---
```

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

```
$`Type III`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
C       3   10.25    3.417   0.7387 0.6189
R       3  285.50   95.167  20.5766 0.0467 *
Tx      7   53.00    7.571   1.6371 0.4305
```

```
---
```

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

9.4 Chapter 7

9.4.1 p268

(135) MODEL

```
v2p268 = read.table("C:/G/Rt/Kemp/v2p268.txt", head=TRUE)
v2p268 = af(v2p268, c("A", "B", "C"))
GLM(y ~ block + A*B*C, v2p268) # OK
```

```
$ANOVA
```

```
Response : y
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      8 1026.00  128.250   24.981 0.0001765 ***
RESIDUALS   7   35.94    5.134
CORRECTED TOTAL 15 1061.94
```

```
---
```

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

```
$Fitness
```

```
Root MSE   y Mean Coef Var  R-square  Adj R-sq
2.265817 25.5625 8.863833 0.9661586 0.9274826
```

```
$`Type I`
      Df Sum Sq Mean Sq  F value    Pr(>F)
block  1 715.56   715.56 139.3791 7.093e-06 ***
A       1  68.06    68.06  13.2574 0.0082753 **
B       1   0.06     0.06   0.0122 0.9152401
A:B     1   0.56     0.56   0.1096 0.7503276
C       1 232.56   232.56  45.2991 0.0002698 ***
A:C     1   0.06     0.06   0.0122 0.9152401
B:C     1   7.56     7.56   1.4730 0.2642229
A:B:C   1   1.56     1.56   0.3043 0.5983312
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type II`
      Df Sum Sq Mean Sq  F value    Pr(>F)
block  1 715.56   715.56 139.3791 7.093e-06 ***
A       1  68.06    68.06  13.2574 0.0082753 **
B       1   0.06     0.06   0.0122 0.9152401
A:B     1   0.56     0.56   0.1096 0.7503276
C       1 232.56   232.56  45.2991 0.0002698 ***
A:C     1   0.06     0.06   0.0122 0.9152401
B:C     1   7.56     7.56   1.4730 0.2642229
A:B:C   1   1.56     1.56   0.3043 0.5983312
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
$`Type III`
      Df Sum Sq Mean Sq  F value    Pr(>F)
block  1 715.56   715.56 139.3791 7.093e-06 ***
A       1  68.06    68.06  13.2574 0.0082753 **
B       1   0.06     0.06   0.0122 0.9152401
A:B     1   0.56     0.56   0.1096 0.7503276
C       1 232.56   232.56  45.2991 0.0002698 ***
A:C     1   0.06     0.06   0.0122 0.9152401
B:C     1   7.56     7.56   1.4730 0.2642229
A:B:C   1   1.56     1.56   0.3043 0.5983312
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

9.4.2 p273

(136) MODEL

```
v2p273 = read.table("C:/G/Rt/Kemp/v2p273.txt", head=TRUE)
v2p273 = af(v2p273, c("block", "A", "B", "C"))
GLM(y ~ block + A*B*C + block:A*B:C, v2p273) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	15	2245.0	149.665	129.44	8.427e-14 ***
RESIDUALS	16	18.5	1.156		
CORRECTED TOTAL	31	2263.5			

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

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
1.075291	25.78125	4.170824	0.9918267	0.9841642

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	1	1498.78	1498.78	1296.2432	< 2.2e-16 ***
A	1	132.03	132.03	114.1892	1.083e-08 ***
B	1	0.03	0.03	0.0270	0.87148
A:B	1	1.53	1.53	1.3243	0.26673
C	1	504.03	504.03	435.9189	4.926e-13 ***
A:C	1	0.78	0.78	0.6757	0.42316
B:C	1	3.78	3.78	3.2703	0.08938 .
A:B:C	1	2.53	2.53	2.1892	0.15840
block:A:B:C	7	101.47	14.50	12.5367	1.965e-05 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	1	1498.78	1498.78	1296.2432	< 2.2e-16 ***
A	1	132.03	132.03	114.1892	1.083e-08 ***
B	1	0.03	0.03	0.0270	0.87148
A:B	1	1.53	1.53	1.3243	0.26673
C	1	504.03	504.03	435.9189	4.926e-13 ***
A:C	1	0.78	0.78	0.6757	0.42316
B:C	1	3.78	3.78	3.2703	0.08938 .
A:B:C	1	2.53	2.53	2.1892	0.15840
block:A:B:C	7	101.47	14.50	12.5367	1.965e-05 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	1	1498.78	1498.78	1296.2432	< 2.2e-16 ***
A	1	132.03	132.03	114.1892	1.083e-08 ***
B	1	0.03	0.03	0.0270	0.87148
A:B	1	1.53	1.53	1.3243	0.26673
C	1	504.03	504.03	435.9189	4.926e-13 ***
A:C	1	0.78	0.78	0.6757	0.42316
B:C	1	3.78	3.78	3.2703	0.08938 .


```

A:B:C          1      2.53      2.53      2.1892      0.15840
block:A:B:C    7    101.47     14.50     12.5367  1.965e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

9.5 Chapter 8

9.5.1 p304

(137) MODEL

```

v2p304 = read.table("C:/G/Rt/Kemp/v2p304.txt", head=TRUE)
v2p304 = af(v2p304, c("rep", "block", "A", "B", "C"))
GLM(y ~ rep + block %in% rep + A*B*C - A:B:C, v2p304) # OK

```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	9	699.06	77.674	248.56	5.096e-07 ***
RESIDUALS	6	1.88	0.312		
CORRECTED TOTAL	15	700.94			

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

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
0.559017	23.0625	2.423922	0.997325	0.9933125

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	390.06	390.06	1248.2	3.428e-08 ***
rep:block	2	8.12	4.06	13.0	0.0065918 **
A	1	18.06	18.06	57.8	0.0002696 ***
B	1	175.56	175.56	561.8	3.702e-07 ***
A:B	1	0.06	0.06	0.2	0.6704121
C	1	68.06	68.06	217.8	6.083e-06 ***
A:C	1	0.06	0.06	0.2	0.6704121
B:C	1	39.06	39.06	125.0	3.056e-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	1	390.06	390.06	1248.2	3.428e-08 ***
rep:block	2	8.12	4.06	13.0	0.0065918 **
A	1	18.06	18.06	57.8	0.0002696 ***
B	1	175.56	175.56	561.8	3.702e-07 ***
A:B	1	0.06	0.06	0.2	0.6704121
C	1	68.06	68.06	217.8	6.083e-06 ***

```

A:C      1    0.06    0.06    0.2 0.6704121
B:C      1   39.06   39.06   125.0 3.056e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
rep      1 390.06   390.06  1248.2 3.428e-08 ***
rep:block 2   8.12    4.06   13.0 0.0065918 **
A         1  18.06   18.06   57.8 0.0002696 ***
B         1 175.56  175.56  561.8 3.702e-07 ***
A:B       1   0.06    0.06    0.2 0.6704121
C         1  68.06   68.06  217.8 6.083e-06 ***
A:C       1   0.06    0.06    0.2 0.6704121
B:C       1   39.06   39.06  125.0 3.056e-05 ***
---

```

```

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

```

9.5.2 p309

(138) MODEL

```
GLM(y ~ rep*A*B*C, v2p304) # OK
```

\$ANOVA

Response : y

```

      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      15 700.94   46.729
RESIDUALS    0   0.00
CORRECTED TOTAL 15 700.94

```

\$Fitness

```

Root MSE y Mean Coef Var R-square
NA 23.0625 NA 1

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value Pr(>F)
rep      1 390.06   390.06
A         1  18.06   18.06
rep:A     1   0.06    0.06
B         1 175.56  175.56
rep:B     1   1.56    1.56
A:B       1   0.06    0.06
rep:A:B   1   0.06    0.06
C         1  68.06   68.06
rep:C     1   0.06    0.06
A:C       1   0.06    0.06
rep:A:C   1   0.06    0.06
B:C       1   39.06   39.06

```

rep:B:C	1	0.06	0.06
A:B:C	1	7.56	7.56
rep:A:B:C	1	0.56	0.56

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	390.06	390.06		
A	1	18.06	18.06		
rep:A	1	0.06	0.06		
B	1	175.56	175.56		
rep:B	1	1.56	1.56		
A:B	1	0.06	0.06		
rep:A:B	1	0.06	0.06		
C	1	68.06	68.06		
rep:C	1	0.06	0.06		
A:C	1	0.06	0.06		
rep:A:C	1	0.06	0.06		
B:C	1	39.06	39.06		
rep:B:C	1	0.06	0.06		
A:B:C	1	7.56	7.56		
rep:A:B:C	1	0.56	0.56		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	390.06	390.06		
A	1	18.06	18.06		
rep:A	1	0.06	0.06		
B	1	175.56	175.56		
rep:B	1	1.56	1.56		
A:B	1	0.06	0.06		
rep:A:B	1	0.06	0.06		
C	1	68.06	68.06		
rep:C	1	0.06	0.06		
A:C	1	0.06	0.06		
rep:A:C	1	0.06	0.06		
B:C	1	39.06	39.06		
rep:B:C	1	0.06	0.06		
A:B:C	1	7.56	7.56		
rep:A:B:C	1	0.56	0.56		

9.6 Chapter 9

9.6.1 p343

(139) MODEL

```
v2p343 = read.table("C:/G/Rt/Kemp/v2p343.txt", head=TRUE)
v2p343 = af(v2p343, c("rep", "block", "A", "B", "C"))
GLM(y ~ rep + block %in% rep + A*B*C - A:B:C, v2p343) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	17	1889.8	111.167	14.659	0.001608 **
RESIDUALS	6	45.5	7.583		
CORRECTED TOTAL	23	1935.3			

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

\$Fitness

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
2.753785	21.66667	12.70978	0.9764898	0.9098777	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	2	1537.33	768.67	101.3626	2.375e-05 ***
rep:block	9	127.00	14.11	1.8608	0.23163
A	1	36.00	36.00	4.7473	0.07218 .
B	1	36.00	36.00	4.7473	0.07218 .
A:B	1	12.25	12.25	1.6154	0.25079
C	1	56.25	56.25	7.4176	0.03448 *
A:C	1	81.00	81.00	10.6813	0.01707 *
B:C	1	4.00	4.00	0.5275	0.49502

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	1537.33	768.67	101.3626	2.375e-05 ***
rep:block	9	119.83	13.31	1.7558	0.25388
A	1	36.00	36.00	4.7473	0.07218 .
B	1	36.00	36.00	4.7473	0.07218 .
A:B	1	12.25	12.25	1.6154	0.25079
C	1	56.25	56.25	7.4176	0.03448 *
A:C	1	81.00	81.00	10.6813	0.01707 *
B:C	1	4.00	4.00	0.5275	0.49502

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	2	1537.33	768.67	101.3626	2.375e-05 ***
rep:block	9	119.83	13.31	1.7558	0.25388
A	1	36.00	36.00	4.7473	0.07218 .
B	1	36.00	36.00	4.7473	0.07218 .
A:B	1	12.25	12.25	1.6154	0.25079

```

C          1    56.25    56.25    7.4176    0.03448 *
A:C        1    81.00    81.00   10.6813    0.01707 *
B:C        1     4.00     4.00    0.5275    0.49502
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

9.6.2 p348

(140) MODEL

```
GLM(y ~ rep + A*B*C + block %in% rep, v2p343) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	17	1889.8	111.167	14.659	0.001608 **
RESIDUALS	6	45.5	7.583		
CORRECTED TOTAL	23	1935.3			

```

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

```

\$Fitness

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
2.753785	21.66667	12.70978	0.9764898	0.9098777	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	2	1537.33	768.67	101.3626	2.375e-05 ***
A	1	88.17	88.17	11.6264	0.01432 *
B	1	37.50	37.50	4.9451	0.06785 .
A:B	1	2.67	2.67	0.3516	0.57484
C	1	66.67	66.67	8.7912	0.02512 *
A:C	1	37.50	37.50	4.9451	0.06785 .
B:C	1	0.17	0.17	0.0220	0.88700
A:B:C	1	24.00	24.00	3.1648	0.12555
rep:block	8	95.83	11.98	1.5797	0.29730

```

---
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	1537.33	768.67	101.3626	2.375e-05 ***
A	1	36.00	36.00	4.7473	0.07218 .
B	1	36.00	36.00	4.7473	0.07218 .
A:B	1	12.25	12.25	1.6154	0.25079
C	1	56.25	56.25	7.4176	0.03448 *
A:C	1	81.00	81.00	10.6813	0.01707 *
B:C	1	4.00	4.00	0.5275	0.49502
A:B:C	0				

```
rep:block 8 95.83 11.98 1.5797 0.29730
---
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	1537.33	768.67	101.3626	2.375e-05 ***
A	1	36.00	36.00	4.7473	0.07218 .
B	1	36.00	36.00	4.7473	0.07218 .
A:B	1	12.25	12.25	1.6154	0.25079
C	1	56.25	56.25	7.4176	0.03448 *
A:C	1	81.00	81.00	10.6813	0.01707 *
B:C	1	4.00	4.00	0.5275	0.49502
A:B:C	0				
rep:block	8	95.83	11.98	1.5797	0.29730

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

9.6.3 p353

(141) MODEL

```
v2p353 = read.table("C:/G/Rt/Kemp/v2p353.txt", head=TRUE)
v2p353 = af(v2p353, c("rep", "block", "A", "B", "C", "D"))
GLM(y ~ rep + rep:block + A*B*C*D - A:B:C:D, v2p353) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	21	7132.2	339.63	56.022	9.795e-08 ***
RESIDUALS	10	60.6	6.06		
CORRECTED TOTAL	31	7192.9			

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

\$Fitness

Root MSE	y	Mean	Coef	Var	R-square	Adj R-sq
2.462214	37.1875	6.621081	0.9915715	0.9738717		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	5940.5	5940.5	979.8763	2.600e-11 ***
rep:block	6	777.4	129.6	21.3711	3.675e-05 ***
A	1	171.1	171.1	28.2268	0.0003412 ***
B	1	18.0	18.0	2.9691	0.1155937
A:B	1	1.6	1.6	0.2577	0.6226914
C	1	120.1	120.1	19.8144	0.0012326 **
A:C	1	0.6	0.6	0.0928	0.7669127

B:C	1	2.0	2.0	0.3299	0.5784103
A:B:C	1	4.5	4.5	0.7423	0.4091189
D	1	6.1	6.1	1.0103	0.3385304
A:D	1	1.1	1.1	0.1856	0.6757693
B:D	1	5.1	5.1	0.8351	0.3823203
A:B:D	1	0.5	0.5	0.0825	0.7798349
C:D	1	1.6	1.6	0.2577	0.6226914
A:C:D	1	10.1	10.1	1.6701	0.2253083
B:C:D	1	72.0	72.0	11.8763	0.0062660 **

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	5940.5	5940.5	979.8763	2.6e-11	***
rep:block	6	406.9	67.8	11.1856	0.0006129	***
A	1	171.1	171.1	28.2268	0.0003412	***
B	1	18.0	18.0	2.9691	0.1155937	
A:B	1	1.6	1.6	0.2577	0.6226914	
C	1	120.1	120.1	19.8144	0.0012326	**
A:C	1	0.6	0.6	0.0928	0.7669127	
B:C	1	2.0	2.0	0.3299	0.5784103	
A:B:C	1	4.5	4.5	0.7423	0.4091189	
D	1	6.1	6.1	1.0103	0.3385304	
A:D	1	1.1	1.1	0.1856	0.6757693	
B:D	1	5.1	5.1	0.8351	0.3823203	
A:B:D	1	0.5	0.5	0.0825	0.7798349	
C:D	1	1.6	1.6	0.2577	0.6226914	
A:C:D	1	10.1	10.1	1.6701	0.2253083	
B:C:D	1	72.0	72.0	11.8763	0.0062660	**

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	5940.5	5940.5	979.8763	2.6e-11	***
rep:block	6	406.9	67.8	11.1856	0.0006129	***
A	1	171.1	171.1	28.2268	0.0003412	***
B	1	18.0	18.0	2.9691	0.1155937	
A:B	1	1.6	1.6	0.2577	0.6226914	
C	1	120.1	120.1	19.8144	0.0012326	**
A:C	1	0.6	0.6	0.0928	0.7669127	
B:C	1	2.0	2.0	0.3299	0.5784103	
A:B:C	1	4.5	4.5	0.7423	0.4091189	
D	1	6.1	6.1	1.0103	0.3385304	
A:D	1	1.1	1.1	0.1856	0.6757693	
B:D	1	5.1	5.1	0.8351	0.3823203	
A:B:D	1	0.5	0.5	0.0825	0.7798349	

```

C:D      1      1.6      1.6      0.2577 0.6226914
A:C:D    1     10.1     10.1     1.6701 0.2253083
B:C:D    1     72.0     72.0    11.8763 0.0062660 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

9.7 Chapter 10

9.7.1 p388

(142) MODEL

```

v2p388 = read.table("C:/G/Rt/Kemp/v2p388.txt", head=TRUE)
v2p388 = af(v2p388, c("rep", "block", "A", "B"))
GLM(y ~ rep + A*B + rep:block, v2p388) # OK

```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	1136.8	103.343	124.01	3.698e-06 ***
RESIDUALS	6	5.0	0.833		
CORRECTED TOTAL	17	1141.8			

```

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

```

\$Fitness

Root MSE	y	Mean Coef	Var	R-square	Adj R-sq
0.9128709	26.11111	3.496101	0.9956209	0.9875924	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rep	1	410.89	410.89	493.0667	5.455e-07 ***
A	2	228.11	114.06	136.8667	9.868e-06 ***
B	2	3.44	1.72	2.0667	0.207585
A:B	4	464.22	116.06	139.2667	4.801e-06 ***
rep:block	2	30.11	15.06	18.0667	0.002888 **

```

---
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	410.89	410.89	493.0667	5.455e-07 ***
A	2	228.11	114.06	136.8667	9.868e-06 ***
B	2	3.44	1.72	2.0667	0.207585
A:B	2	18.78	9.39	11.2667	0.009298 **
rep:block	2	30.11	15.06	18.0667	0.002888 **

```

---
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      1 410.89   410.89 493.0667 5.455e-07 ***
A        2 228.11   114.06 136.8667 9.868e-06 ***
B        2   3.44    1.72   2.0667 0.207585
A:B       2  18.78    9.39  11.2667 0.009298 **
rep:block 2  30.11   15.06  18.0667 0.002888 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

9.8 Chapter 14

9.8.1 p570

(143) MODEL

```

v2p570 = read.table("C:/G/Rt/Kemp/v2p570.txt", head=TRUE)
v2p570 = af(v2p570, c("A", "B", "C", "D"))
GLM(Y ~ A + B + C + D + A:B + A:C + A:D + B:C + B:D + C:D, v2p570) # OK

```

\$ANOVA

Response : Y

```

      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      8 22.222   2.7778
RESIDUALS   0  0.000
CORRECTED TOTAL 8 22.222

```

\$Fitness

```

Root MSE   Y Mean Coef Var R-square
      NA 6.555556      NA      1

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value Pr(>F)
A      2  2.8889   1.4444
B      2  2.8889   1.4444
C      2  1.5556   0.7778
D      2 14.8889   7.4444
A:B    0
A:C    0
A:D    0
B:C    0
B:D    0
C:D    0

```

\$`Type II`

```

      Df Sum Sq Mean Sq F value Pr(>F)
A      0
B      0

```

```

C      0
D      0
A:B    0
A:C    0
A:D    0
B:C    0
B:D    0
C:D    0

```

\$`Type III`

CAUTION: Singularity Exists !

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	0				
B	0				
C	0				
D	0				
A:B	0				
A:C	0				
A:D	0				
B:C	0				
B:D	0				
C:D	0				

9.8.2 p578

(144) MODEL

```

v2p578 = read.table("C:/G/Rt/Kemp/v2p578.txt", head=TRUE)
v2p578 = af(v2p578, 1:11)
GLM(Y ~ A + B + C + D + E + F + G + H + J + K + L, v2p578) # OK

```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	11	575	52.273		
RESIDUALS	0	0			
CORRECTED TOTAL	11	575			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square
NA	25.5	NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	3.000	3.000		
B	1	27.000	27.000		
C	1	12.000	12.000		
D	1	16.333	16.333		
E	1	176.333	176.333		

F	1	133.333	133.333
G	1	1.333	1.333
H	1	21.333	21.333
J	1	108.000	108.000
K	1	1.333	1.333
L	1	75.000	75.000

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	3.000	3.000		
B	1	27.000	27.000		
C	1	12.000	12.000		
D	1	16.333	16.333		
E	1	176.333	176.333		
F	1	133.333	133.333		
G	1	1.333	1.333		
H	1	21.333	21.333		
J	1	108.000	108.000		
K	1	1.333	1.333		
L	1	75.000	75.000		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	3.000	3.000		
B	1	27.000	27.000		
C	1	12.000	12.000		
D	1	16.333	16.333		
E	1	176.333	176.333		
F	1	133.333	133.333		
G	1	1.333	1.333		
H	1	21.333	21.333		
J	1	108.000	108.000		
K	1	1.333	1.333		
L	1	75.000	75.000		

(145) MODEL

```
GLM(Y ~ E*F + E*J + F*J + E*L + F*L + J*L, v2p578) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	10	574.5	57.45	114.9	0.07249 .
RESIDUALS	1	0.5	0.50		
CORRECTED TOTAL	11	575.0			

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

\$Fitness

Root MSE Y Mean Coef Var R-square Adj R-sq
0.7071068 25.5 2.772968 0.9991304 0.9904348

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
E	1	176.333	176.333	352.6667	0.03387 *
F	1	133.333	133.333	266.6667	0.03894 *
E:F	1	65.333	65.333	130.6667	0.05555 .
J	1	66.667	66.667	133.3333	0.05500 .
E:J	1	2.667	2.667	5.3333	0.26015
F:J	1	112.667	112.667	225.3333	0.04235 *
L	1	10.800	10.800	21.6000	0.13492
E:L	1	5.486	5.486	10.9714	0.18666
F:L	1	0.176	0.176	0.3516	0.65925
J:L	1	1.038	1.038	2.0769	0.38618

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
E	1	61.633	61.633	123.2667	0.05719 .
F	1	75.208	75.208	150.4167	0.05179 .
E:F	1	9.346	9.346	18.6923	0.14470
J	1	54.675	54.675	109.3500	0.06069 .
E:J	1	0.115	0.115	0.2308	0.71490
F:J	1	72.115	72.115	144.2308	0.05289 .
L	1	10.800	10.800	21.6000	0.13492
E:L	1	5.654	5.654	11.3077	0.18402
F:L	1	0.115	0.115	0.2308	0.71490
J:L	1	1.038	1.038	2.0769	0.38618

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
E	1	61.038	61.038	122.0769	0.05746 .
F	1	61.038	61.038	122.0769	0.05746 .
E:F	1	9.346	9.346	18.6923	0.14470
J	1	61.038	61.038	122.0769	0.05746 .
E:J	1	0.115	0.115	0.2308	0.71490
F:J	1	72.115	72.115	144.2308	0.05289 .
L	1	9.346	9.346	18.6923	0.14470
E:L	1	5.654	5.654	11.3077	0.18402
F:L	1	0.115	0.115	0.2308	0.71490
J:L	1	1.038	1.038	2.0769	0.38618

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

9.9 Chapter 16

9.9.1 p619

(146) MODEL

```
v2p619 = read.table("C:/G/Rt/Kemp/v2p619.txt", head=TRUE)
v2p619 = af(v2p619, c("A", "B", "C"))
GLM(y ~ A + B + C + A:B, v2p619) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	31.429	7.8571		
RESIDUALS	2	0.000	0.0000		
CORRECTED TOTAL	6	31.429			

\$Fitness

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
0	10.78571		0	1	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	13.7619	13.7619	Inf < 2.2e-16 ***	
B	1	1.6667	1.6667	Inf < 2.2e-16 ***	
C	1	10.0000	10.0000	Inf < 2.2e-16 ***	
A:B	1	6.0000	6.0000	Inf < 2.2e-16 ***	

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	19.6	19.6	Inf < 2.2e-16 ***	
B	1	3.6	3.6	Inf < 2.2e-16 ***	
C	1	13.5	13.5	Inf < 2.2e-16 ***	
A:B	1	6.0	6.0	Inf < 2.2e-16 ***	

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	24.0	24.0	Inf < 2.2e-16 ***	
B	1	6.0	6.0	Inf < 2.2e-16 ***	
C	1	13.5	13.5	Inf < 2.2e-16 ***	
A:B	1	6.0	6.0	Inf < 2.2e-16 ***	

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

(147) MODEL

```
GLM(y ~ A + B + C + A:C, v2p619) # OK
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	26.0952	6.5238	2.4464	0.3106
RESIDUALS	2	5.3333	2.6667		
CORRECTED TOTAL	6	31.4286			

```
$Fitness
```

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
1.632993	10.78571	15.14033	0.830303	0.4909091	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	13.7619	13.7619	5.1607	0.1511
B	1	1.6667	1.6667	0.6250	0.5120
C	1	10.0000	10.0000	3.7500	0.1924
A:C	1	0.6667	0.6667	0.2500	0.6667

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	19.6000	19.6000	7.35	0.1134
B	1	2.6667	2.6667	1.00	0.4226
C	1	10.0000	10.0000	3.75	0.1924
A:C	1	0.6667	0.6667	0.25	0.6667

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	16.6667	16.6667	6.2500	0.1296
B	1	2.6667	2.6667	1.0000	0.4226
C	1	8.1667	8.1667	3.0625	0.2222
A:C	1	0.6667	0.6667	0.2500	0.6667

```
(148) MODEL
```

```
GLM(y ~ A + B + C + B:C, v2p619) # OK
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	26.0952	6.5238	2.4464	0.3106
RESIDUALS	2	5.3333	2.6667		
CORRECTED TOTAL	6	31.4286			

```
$Fitness
```

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
1.632993	10.78571	15.14033	0.830303	0.4909091	

```
$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
A      1 13.7619 13.7619  5.1607 0.1511
B      1  1.6667  1.6667  0.6250 0.5120
C      1 10.0000 10.0000  3.7500 0.1924
B:C    1  0.6667  0.6667  0.2500 0.6667
```

```
$`Type II`
      Df Sum Sq Mean Sq F value Pr(>F)
A      1 16.6667 16.6667   6.25 0.1296
B      1  3.6000  3.6000   1.35 0.3652
C      1 10.0000 10.0000   3.75 0.1924
B:C    1  0.6667  0.6667   0.25 0.6667
```

```
$`Type III`
      Df Sum Sq Mean Sq F value Pr(>F)
A      1 16.6667 16.6667  6.2500 0.1296
B      1  2.6667  2.6667  1.0000 0.4226
C      1  8.1667  8.1667  3.0625 0.2222
B:C    1  0.6667  0.6667  0.2500 0.6667
```

9.9.2 p626

(149) MODEL

```
v2p626 = read.table("C:/G/Rt/Kemp/v2p626.txt", head=TRUE)
v2p626 = af(v2p626, c("A", "B", "C"))
GLM(y ~ A + B + C + A:B, v2p626) # OK
```

\$ANOVA

Response : y

```
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      4 42.092 10.5231  22.002 0.04395 *
RESIDUALS    2  0.957  0.4783
CORRECTED TOTAL 6 43.049
```

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

\$Fitness

```
Root MSE   y Mean Coef Var  R-square  Adj R-sq
0.6915708 11.12243 6.217804 0.9777801 0.9333402
```

```
$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
A      1 16.2088 16.2088  33.890 0.02826 *
B      1  4.8150  4.8150  10.068 0.08662 .
C      1 15.7339 15.7339  32.898 0.02908 *
A:B    1  5.3346  5.3346  11.154 0.07916 .
```

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	25.4131	25.4131	53.136	0.01830 *
B	1	8.6630	8.6630	18.113	0.05102 .
C	1	19.5193	19.5193	40.812	0.02364 *
A:B	1	5.3346	5.3346	11.154	0.07916 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	29.7950	29.7950	62.297	0.01568 *
B	1	11.7460	11.7460	24.559	0.03839 *
C	1	19.5193	19.5193	40.812	0.02364 *
A:B	1	5.3346	5.3346	11.154	0.07916 .

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

(150) MODEL

```
GLM(y ~ A + B + C + A:C, v2p626) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	39.229	9.8072	5.1346	0.1696
RESIDUALS	2	3.820	1.9100		
CORRECTED TOTAL	6	43.049			

\$Fitness

Root MSE	y	Mean	Coef Var	R-square	Adj R-sq
1.382033	11.12243	12.42564	0.9112627	0.733788	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	16.2088	16.2088	8.4862	0.1004
B	1	4.8150	4.8150	2.5209	0.2533
C	1	15.7339	15.7339	8.2376	0.1030
A:C	1	2.4711	2.4711	1.2937	0.3733

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	25.4131	25.4131	13.3052	0.06762 .
B	1	6.0361	6.0361	3.1602	0.21743
C	1	15.7339	15.7339	8.2376	0.10298
A:C	1	2.4711	2.4711	1.2937	0.37327

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	20.1428	20.1428	10.5459	0.08317
B	1	6.0361	6.0361	3.1602	0.21743
C	1	11.8863	11.8863	6.2232	0.13007
A:C	1	2.4711	2.4711	1.2937	0.37327

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

(151) MODEL

```
GLM(y ~ A + B + C + B:C, v2p626) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	4	37.340	9.3349	3.2701	0.2477
RESIDUALS	2	5.709	2.8546		
CORRECTED TOTAL	6	43.049			

\$Fitness

Root MSE	y	Mean	Coef	Var	R-square	Adj R-sq
1.689558	11.12243	15.19055	0.8673781	0.6021342		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	16.2088	16.2088	5.6781	0.1400
B	1	4.8150	4.8150	1.6867	0.3236
C	1	15.7339	15.7339	5.5118	0.1434
B:C	1	0.5819	0.5819	0.2038	0.6959

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	21.9995	21.9995	7.7067	0.1090
B	1	8.6630	8.6630	3.0347	0.2236
C	1	15.7339	15.7339	5.5118	0.1434
B:C	1	0.5819	0.5819	0.2038	0.6959

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	21.9995	21.9995	7.7067	0.1090
B	1	7.0709	7.0709	2.4770	0.2562
C	1	13.3221	13.3221	4.6669	0.1633
B:C	1	0.5819	0.5819	0.2038	0.6959

9.10 Chapter 17

9.10.1 p642

(152) MODEL

```
v2p642 = read.table("C:/G/Rt/Kemp/v2p642.txt", head=TRUE)
v2p642 = af(v2p642, 2:11)
GLM(Y ~ A + B + C + D + E + F + G, v2p642) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	11.0	1.57143	1.6688	0.1646
RESIDUALS	24	22.6	0.94167		
CORRECTED TOTAL	31	33.6			

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
0.9703951	2.25	43.12867	0.327381	0.1312004

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	5.7800	5.7800	6.1381	0.02066 *
B	1	0.1800	0.1800	0.1912	0.66587
C	1	0.1250	0.1250	0.1327	0.71879
D	1	2.5312	2.5312	2.6881	0.11415
E	1	0.6613	0.6613	0.7022	0.41031
F	1	0.0112	0.0112	0.0119	0.91387
G	1	1.7113	1.7113	1.8173	0.19023

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	5.7800	5.7800	6.1381	0.02066 *
B	1	0.1800	0.1800	0.1912	0.66587
C	1	0.1250	0.1250	0.1327	0.71879
D	1	2.5312	2.5312	2.6881	0.11415
E	1	0.6613	0.6613	0.7022	0.41031
F	1	0.0112	0.0112	0.0119	0.91387
G	1	1.7113	1.7113	1.8173	0.19023

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	5.7800	5.7800	6.1381	0.02066 *
B	1	0.1800	0.1800	0.1912	0.66587

```
C 1 0.1250 0.1250 0.1327 0.71879
D 1 2.5312 2.5312 2.6881 0.11415
E 1 0.6613 0.6613 0.7022 0.41031
F 1 0.0112 0.0112 0.0119 0.91387
G 1 1.7113 1.7113 1.8173 0.19023
```

```
---
```

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

```
(153) MODEL
```

```
GLM(log(S) ~ A + B + C + D + E + F + G, v2p642) # OK
```

```
$ANOVA
```

```
Response : log(S)
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	266.43	38.062		
RESIDUALS	24	0.00	0.000		
CORRECTED TOTAL	31	266.43			

```
$Fitness
```

	Root MSE	log(S)	Mean Coef	Var	R-square	Adj R-sq
	0	-2.233358	0	1	1	1

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1.511	1.511	Inf	< 2.2e-16 ***
B	1	0.600	0.600	Inf	< 2.2e-16 ***
C	1	0.284	0.284	Inf	< 2.2e-16 ***
D	1	0.384	0.384	Inf	< 2.2e-16 ***
E	1	0.741	0.741	Inf	< 2.2e-16 ***
F	1	261.783	261.783	Inf	< 2.2e-16 ***
G	1	1.127	1.127	Inf	< 2.2e-16 ***

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1.511	1.511	Inf	< 2.2e-16 ***
B	1	0.600	0.600	Inf	< 2.2e-16 ***
C	1	0.284	0.284	Inf	< 2.2e-16 ***
D	1	0.384	0.384	Inf	< 2.2e-16 ***
E	1	0.741	0.741	Inf	< 2.2e-16 ***
F	1	261.783	261.783	Inf	< 2.2e-16 ***
G	1	1.127	1.127	Inf	< 2.2e-16 ***

```
---
```

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

```
$`Type III`
```

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

```

A 1 1.511 1.511 Inf < 2.2e-16 ***
B 1 0.600 0.600 Inf < 2.2e-16 ***
C 1 0.284 0.284 Inf < 2.2e-16 ***
D 1 0.384 0.384 Inf < 2.2e-16 ***
E 1 0.741 0.741 Inf < 2.2e-16 ***
F 1 261.783 261.783 Inf < 2.2e-16 ***
G 1 1.127 1.127 Inf < 2.2e-16 ***

```

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

9.11 Chapter 19

9.11.1 p700

(154) MODEL

```

v2p700 = read.table("C:/G/Rt/Kemp/v2p700.txt", head=TRUE)
v2p700 = af(v2p700, 2:5)
GLM(Y ~ P + S + T + C, v2p700) # OK

```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	12	378.80	31.5670	57.256	0.003319 **
RESIDUALS	3	1.65	0.5513		
CORRECTED TOTAL	15	380.46			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
0.7425182	19.6375	3.781124	0.9956526	0.978263

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	3	53.888	17.963	32.580	0.008646 **
S	3	154.508	51.503	93.414	0.001845 **
T	3	149.848	49.949	90.597	0.001930 **
C	3	20.561	6.854	12.431	0.033708 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	2	2.220	1.110	2.0133	0.278974
S	3	111.966	37.322	67.6941	0.002969 **
T	3	161.828	53.943	97.8403	0.001722 **
C	3	20.561	6.854	12.4311	0.033708 *

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)
P	2	2.220	1.110	2.0133	0.278974
S	3	111.966	37.322	67.6941	0.002969 **
T	3	161.828	53.943	97.8403	0.001722 **
C	3	20.561	6.854	12.4311	0.033708 *

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

9.11.2 p703

(155) MODEL

```
v2p703 = read.table("C:/G/Rt/Kemp/v2p703.txt", head=TRUE)
v2p703$C = ifelse(v2p703$C == 0, 4, v2p703$C)
v2p703 = af(v2p703, 2:5)
GLM(Y ~ P + S + T + C, v2p703) # OK
```

\$ANOVA

Response : Y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	13	385.18	29.6293	21.766	0.0005673 ***
RESIDUALS	6	8.17	1.3613		
CORRECTED TOTAL	19	393.35			

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

\$Fitness

Root MSE	Y Mean	Coef Var	R-square	Adj R-sq
1.166726	19.46	5.99551	0.9792359	0.9342472

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	4	56.408	14.102	10.3596	0.0073255 **
S	3	119.260	39.753	29.2036	0.0005620 ***
T	3	190.430	63.477	46.6312	0.0001498 ***
C	3	19.083	6.361	4.6728	0.0518237 .

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	4	52.288	13.072	9.6028	0.0088641 **
S	3	167.414	55.805	40.9952	0.0002163 ***
T	3	190.430	63.477	46.6312	0.0001498 ***
C	3	19.083	6.361	4.6728	0.0518237 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
P	4	52.288	13.072	9.6028	0.0088641 **
S	3	167.414	55.805	40.9952	0.0002163 ***
T	3	190.430	63.477	46.6312	0.0001498 ***
C	3	19.083	6.361	4.6728	0.0518237 .

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

10 Lawson - DAE with SAS

Reference

- Lawson J. Design and Analysis of Experiments with SAS. Taylor and Francis Group. 2010.

```
require(daewr)
```

Loading required package: daewr

10.1 Chapter 2

10.1.1 p22

(156) MODEL

```
GLM(height ~ time, bread) # OK
```

\$ANOVA

Response : height

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	2	21.573	10.7865	4.6022	0.042 *
RESIDUALS	9	21.094	2.3438		
CORRECTED TOTAL	11	42.667			

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

\$Fitness

Root MSE	height	Mean Coef	Var	R-square	Adj R-sq
1.530931	7.333333	20.87633	0.5056152	0.395752	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
time	2	21.573	10.787	4.6022	0.042 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
time	2	21.573	10.787	4.6022	0.042 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
time	2	21.573	10.787	4.6022	0.042 *

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

10.1.2 p32

(157) MODEL

```
GLM(height^(1 - 1.294869) ~ time, bread) # OK
```

\$ANOVA

Response : height^(1 - 1.294869)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	2	0.0130560	0.0065280	5.9356	0.02271 *
RESIDUALS	9	0.0098983	0.0010998		
CORRECTED TOTAL	11	0.0229544			

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

\$Fitness

Root MSE	height^(1 - 1.294869)	Mean Coef	Var	R-square	Adj R-sq
0.03316344		0.5629811	5.890685	0.5687825	0.4729564

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
time	2	0.013056	0.006528	5.9356	0.02271 *

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
time	2	0.013056	0.006528	5.9356	0.02271 *

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
time	2	0.013056	0.006528	5.9356	0.02271 *

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

10.1.3 p42

(158) MODEL

```
GLM(yield ~ treat, sugarbeet) # OK
```

\$ANOVA

Response : yield

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	291.00	97.002	45.9	1.718e-07 ***
RESIDUALS	14	29.59	2.113		
CORRECTED TOTAL	17	320.59			

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

```
$Fitness
```

```
Root MSE yield Mean Coef Var  R-square  Adj R-sq  
1.453727  45.68333 3.182182 0.9077128 0.8879369
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
treat  3    291  97.002    45.9 1.718e-07 ***
```

```
---
```

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

```
$`Type II`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
treat  3    291  97.002    45.9 1.718e-07 ***
```

```
---
```

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

```
$`Type III`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
treat  3    291  97.002    45.9 1.718e-07 ***
```

```
---
```

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

10.2 Chapter 3

10.2.1 p63

```
(159) MODEL
```

```
GLM(CO ~ Eth + Ratio + Eth:Ratio, COdata) # OK
```

```
$ANOVA
```

```
Response : CO
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
MODEL      8 1654.0 206.750  40.016 3.861e-06 ***  
RESIDUALS   9   46.5   5.167  
CORRECTED TOTAL 17 1700.5
```

```
---
```

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

```
$Fitness
```

```
Root MSE  CO Mean Coef Var  R-square  Adj R-sq  
2.27303 72.83333 3.120865 0.9726551 0.9483485
```

```
$`Type I`
```

```
      Df Sum Sq Mean Sq F value    Pr(>F)  
Eth      2    324   162.0  31.355 8.790e-05 ***  
Ratio    2    652   326.0  63.097 5.067e-06 ***
```

```
Eth:Ratio 4 678 169.5 32.806 2.240e-05 ***
```

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Eth	2	324	162.0	31.355	8.790e-05 ***
Ratio	2	652	326.0	63.097	5.067e-06 ***
Eth:Ratio	4	678	169.5	32.806	2.240e-05 ***

```
---
```

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Eth	2	324	162.0	31.355	8.790e-05 ***
Ratio	2	652	326.0	63.097	5.067e-06 ***
Eth:Ratio	4	678	169.5	32.806	2.240e-05 ***

```
---
```

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

```
(160) MODEL
```

```
GLM(CO ~ Ratio + Eth + Ratio:Eth, COdata) # OK
```

```
$ANOVA
```

```
Response : CO
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	8	1654.0	206.750	40.016	3.861e-06 ***
RESIDUALS	9	46.5	5.167		
CORRECTED TOTAL	17	1700.5			

```
---
```

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

```
$Fitness
```

Root MSE	CO	Mean	Coef Var	R-square	Adj R-sq
2.27303	72.83333	3.120865	0.9726551	0.9483485	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Ratio	2	652	326.0	63.097	5.067e-06 ***
Eth	2	324	162.0	31.355	8.790e-05 ***
Ratio:Eth	4	678	169.5	32.806	2.240e-05 ***

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Ratio	2	652	326.0	63.097	5.067e-06 ***
Eth	2	324	162.0	31.355	8.790e-05 ***

```
Ratio:Eth 4 678 169.5 32.806 2.240e-05 ***
```

```
---
```

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Ratio	2	652	326.0	63.097	5.067e-06 ***
Eth	2	324	162.0	31.355	8.790e-05 ***
Ratio:Eth	4	678	169.5	32.806	2.240e-05 ***

```
---
```

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

10.2.2 p74

```
(161) MODEL
```

```
GLM(CO ~ Eth + Ratio + Eth:Ratio, COdata[-18,]) # OK
```

```
$ANOVA
```

```
Response : CO
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	8	1423.0	177.879	31.978	2.749e-05 ***
RESIDUALS	8	44.5	5.563		
CORRECTED TOTAL	16	1467.5			

```
---
```

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

```
$Fitness
```

Root MSE	CO Mean	Coef Var	R-square	Adj R-sq
2.358495	73.70588	3.199874	0.9696769	0.9393539

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Eth	2	472.66	236.33	42.486	5.482e-05 ***
Ratio	2	395.33	197.66	35.535	0.0001048 ***
Eth:Ratio	4	555.04	138.76	24.945	0.0001427 ***

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Eth	2	398.26	199.13	35.799	0.0001020 ***
Ratio	2	395.33	197.66	35.535	0.0001048 ***
Eth:Ratio	4	555.04	138.76	24.945	0.0001427 ***

```
---
```

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

```
$`Type III`
```

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

```

Eth          2 319.45  159.73  28.715 0.0002235 ***
Ratio        2 511.45  255.73  45.973 4.105e-05 ***
Eth:Ratio    4 555.04  138.76  24.945 0.0001427 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.2.3 p91

(162) MODEL

```

volt$XA = (as.numeric(as.character(volt$A)) - 27)/5
volt$XB = (as.numeric(as.character(volt$B)) - 2.75)/2.25
volt$XC = (as.numeric(as.character(volt$C)) - 2.75)/2.25
GLM(y ~ XA + XB + XC + XA:XB + XA:XC + XB:XC + XA:XB:XC, volt) # OK

```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	8843.4	1263.35	3.8686	0.0385 *
RESIDUALS	8	2612.5	326.56		
CORRECTED TOTAL	15	11455.9			

```

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

```

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
18.07104	668.5625	2.702969	0.7719523	0.5724106

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
XA	1	4522.6	4522.6	13.8490	0.005859 **
XB	1	14.1	14.1	0.0431	0.840793
XC	1	473.1	473.1	1.4486	0.263154
XA:XB	1	715.6	715.6	2.1912	0.177071
XA:XC	1	2525.1	2525.1	7.7322	0.023899 *
XB:XC	1	52.6	52.6	0.1610	0.698780
XA:XB:XC	1	540.6	540.6	1.6553	0.234218

```

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

```

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
XA	1	4522.6	4522.6	13.8490	0.005859 **
XB	1	14.1	14.1	0.0431	0.840793
XC	1	473.1	473.1	1.4486	0.263154
XA:XB	1	715.6	715.6	2.1912	0.177071
XA:XC	1	2525.1	2525.1	7.7322	0.023899 *
XB:XC	1	52.6	52.6	0.1610	0.698780
XA:XB:XC	1	540.6	540.6	1.6553	0.234218

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

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
XA      1 4522.6   4522.6  13.8490 0.005859 **
XB      1   14.1    14.1   0.0431 0.840793
XC      1  473.1   473.1   1.4486 0.263154
XA:XB    1  715.6   715.6   2.1912 0.177071
XA:XC    1 2525.1  2525.1   7.7322 0.023899 *
XB:XC    1   52.6    52.6   0.1610 0.698780
XA:XB:XC  1  540.6   540.6   1.6553 0.234218
```

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

10.2.4 p97

(163) MODEL

```
chem2 = af(chem, c("A","B","C","D"))
GLM(y ~ A*B*C*D, chem2) # OK
```

```
$ANOVA
Response : y
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      15 6369.4   424.63
RESIDUALS    0    0.0
CORRECTED TOTAL 15 6369.4
```

```
$Fitness
Root MSE y Mean Coef Var R-square
      NA 62.3125      NA      1
```

```
$`Type I`
      Df Sum Sq Mean Sq F value Pr(>F)
A      1  637.6   637.6
B      1 5076.6  5076.6
A:B    1  451.6   451.6
C      1    0.6     0.6
A:C    1  10.6    10.6
B:C    1    1.6     1.6
A:B:C  1    0.6     0.6
D      1    7.6     7.6
A:D    1  68.1    68.1
B:D    1    0.1     0.1
A:B:D  1    7.6     7.6
C:D    1    7.6     7.6
A:C:D  1  95.1    95.1
B:C:D  1    3.1     3.1
```

A:B:C:D 1 1.6 1.6

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	637.6	637.6		
B	1	5076.6	5076.6		
A:B	1	451.6	451.6		
C	1	0.6	0.6		
A:C	1	10.6	10.6		
B:C	1	1.6	1.6		
A:B:C	1	0.6	0.6		
D	1	7.6	7.6		
A:D	1	68.1	68.1		
B:D	1	0.1	0.1		
A:B:D	1	7.6	7.6		
C:D	1	7.6	7.6		
A:C:D	1	95.1	95.1		
B:C:D	1	3.1	3.1		
A:B:C:D	1	1.6	1.6		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	637.6	637.6		
B	1	5076.6	5076.6		
A:B	1	451.6	451.6		
C	1	0.6	0.6		
A:C	1	10.6	10.6		
B:C	1	1.6	1.6		
A:B:C	1	0.6	0.6		
D	1	7.6	7.6		
A:D	1	68.1	68.1		
B:D	1	0.1	0.1		
A:B:D	1	7.6	7.6		
C:D	1	7.6	7.6		
A:C:D	1	95.1	95.1		
B:C:D	1	3.1	3.1		
A:B:C:D	1	1.6	1.6		

10.2.5 p104

(164) MODEL

```
GLM(y ~ A*B*C*D, BoxM) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	15	207.1	13.807		
RESIDUALS	0	0.0			

CORRECTED TOTAL 15 207.1

\$Fitness

Root MSE	y	Mean Coef	Var	R-square
NA	48.245		NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	2.560	2.560		
B	1	71.234	71.234		
A:B	1	3.312	3.312		
C	1	55.056	55.056		
A:C	1	24.800	24.800		
B:C	1	2.560	2.560		
A:B:C	1	5.760	5.760		
D	1	4.080	4.080		
A:D	1	1.346	1.346		
B:D	1	5.570	5.570		
A:B:D	1	2.074	2.074		
C:D	1	8.880	8.880		
A:C:D	1	0.640	0.640		
B:C:D	1	9.986	9.986		
A:B:C:D	1	9.242	9.242		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	2.560	2.560		
B	1	71.234	71.234		
A:B	1	3.312	3.312		
C	1	55.056	55.056		
A:C	1	24.800	24.800		
B:C	1	2.560	2.560		
A:B:C	1	5.760	5.760		
D	1	4.080	4.080		
A:D	1	1.346	1.346		
B:D	1	5.570	5.570		
A:B:D	1	2.074	2.074		
C:D	1	8.880	8.880		
A:C:D	1	0.640	0.640		
B:C:D	1	9.986	9.986		
A:B:C:D	1	9.242	9.242		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	2.560	2.560		
B	1	71.234	71.234		
A:B	1	3.312	3.312		
C	1	55.056	55.056		

A:C	1	24.800	24.800
B:C	1	2.560	2.560
A:B:C	1	5.760	5.760
D	1	4.080	4.080
A:D	1	1.346	1.346
B:D	1	5.570	5.570
A:B:D	1	2.074	2.074
C:D	1	8.880	8.880
A:C:D	1	0.640	0.640
B:C:D	1	9.986	9.986
A:B:C:D	1	9.242	9.242

10.3 Chapter 4

10.3.1 p122

(165) MODEL

```
GLM(rate ~ rat + dose, drug) # OK
```

\$ANOVA

Response : rate

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	13	2.12867	0.163744	19.613	1.59e-12 ***
RESIDUALS	36	0.30055	0.008349		
CORRECTED TOTAL	49	2.42922			

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

\$Fitness

	Root MSE	rate	Mean	Coef Var	R-square	Adj R-sq
	0.09137104	0.9142	9.994644	0.8762762	0.8315982	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rat	9	1.66846	0.18538	22.205	3.749e-12 ***
dose	4	0.46021	0.11505	13.781	6.535e-07 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
rat	9	1.66846	0.18538	22.205	3.749e-12 ***
dose	4	0.46021	0.11505	13.781	6.535e-07 ***

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

\$`Type III`

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


```
rat    9 1.66846 0.18538 22.205 3.749e-12 ***
dose   4 0.46021 0.11505 13.781 6.535e-07 ***
```

```
---
```

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

10.3.2 p127

(166) MODEL

```
GLM(y ~ block + treat + strain + treat:strain, bha) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	8	543.22	67.902	26.203	0.0001507 ***
RESIDUALS	7	18.14	2.591		
CORRECTED TOTAL	15	561.36			

```
---
```

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

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
1.609791	12.9875	12.39493	0.9676855	0.9307546

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	1	47.61	47.61	18.3721	0.003627 **
treat	1	422.30	422.30	162.9613	4.194e-06 ***
strain	3	32.96	10.99	4.2399	0.052741 .
treat:strain	3	40.34	13.45	5.1892	0.033685 *

```
---
```

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	1	47.61	47.61	18.3721	0.003627 **
treat	1	422.30	422.30	162.9613	4.194e-06 ***
strain	3	32.96	10.99	4.2399	0.052741 .
treat:strain	3	40.34	13.45	5.1892	0.033685 *

```
---
```

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
block	1	47.61	47.61	18.3721	0.003627 **
treat	1	422.30	422.30	162.9613	4.194e-06 ***
strain	3	32.96	10.99	4.2399	0.052741 .
treat:strain	3	40.34	13.45	5.1892	0.033685 *

```
---
```

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

10.3.3 p129

(167) MODEL

```
GLM(cdistance ~ id + teehtg, rcb) # OK
```

\$ANOVA

Response : cdistance

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	10	126465	12646.5	161.72	< 2.2e-16 ***
RESIDUALS	124	9697	78.2		
CORRECTED TOTAL	134	136162			

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

\$Fitness

Root MSE	cdistance	Mean Coef	Var	R-square	Adj R-sq
8.8431	176.3778	5.013727	0.9287846	0.9230414	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
id	8	124741	15593	199.394	< 2.2e-16 ***
teehtg	2	1724	862	11.023	3.926e-05 ***

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
id	8	124741	15593	199.394	< 2.2e-16 ***
teehtg	2	1724	862	11.023	3.926e-05 ***

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
id	8	124741	15593	199.394	< 2.2e-16 ***
teehtg	2	1724	862	11.023	3.926e-05 ***

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

10.3.4 p136

(168) MODEL

```
GLM(AUC ~ Subject + Period + Treat, bioeqv) # OK
```

\$ANOVA

Response : AUC

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	6	174461	29077	0.1315	0.9774
RESIDUALS	2	442158	221079		
CORRECTED TOTAL	8	616618			

\$Fitness

Root MSE	AUC	Mean Coef Var	R-square	Adj R-sq
470.1902	1141.556	41.18855	0.2829314	-1.868274

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	2	114264	57132	0.2584	0.7946
Period	2	45196	22598	0.1022	0.9073
Treat	2	15000	7500	0.0339	0.9672

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	2	114264	57132	0.2584	0.7946
Period	2	45196	22598	0.1022	0.9073
Treat	2	15000	7500	0.0339	0.9672

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	2	114264	57132	0.2584	0.7946
Period	2	45196	22598	0.1022	0.9073
Treat	2	15000	7500	0.0339	0.9672

10.4 Chapter 5

10.4.1 p152

(169) MODEL

```
GLM(conc ~ lab, Apo) # OK
```

\$ANOVA

Response : conc

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	3	0.092233	0.0307444	42.107	4.009e-10 ***
RESIDUALS	26	0.018984	0.0007302		
CORRECTED TOTAL	29	0.111217			

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

\$Fitness

Root MSE	conc	Mean Coef Var	R-square	Adj R-sq
0.02702142	1.141567	2.367047	0.8293064	0.809611

\$`Type I`

```

      Df    Sum Sq  Mean Sq F value    Pr(>F)
lab    3 0.092233 0.030744  42.107 4.009e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type II`
      Df    Sum Sq  Mean Sq F value    Pr(>F)
lab    3 0.092233 0.030744  42.107 4.009e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
      Df    Sum Sq  Mean Sq F value    Pr(>F)
lab    3 0.092233 0.030744  42.107 4.009e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.4.2 p181

(170) MODEL

```
GLM(residue ~ form + tech + form:tech + plot:form:tech, pesticide) # OK
```

```

$ANOVA
Response : residue
      Df    Sum Sq  Mean Sq F value    Pr(>F)
MODEL      7 0.036857 0.0052653  11.804 0.001187 **
RESIDUALS   8 0.003569 0.0004461
CORRECTED TOTAL 15 0.040426
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$Fitness
      Root MSE residue Mean Coef Var  R-square Adj R-sq
0.02112019    0.3165625 6.671729 0.9117275 0.834489

```

```

$`Type I`
      Df    Sum Sq  Mean Sq F value    Pr(>F)
form      1 0.000018 0.000018  0.0405  0.84554
tech      1 0.032310 0.032310 72.4339 2.789e-05 ***
form:tech  1 0.002186 0.002186  4.8997  0.05776 .
form:tech:plot 4 0.002344 0.000586  1.3136  0.34317
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type II`
      Df    Sum Sq  Mean Sq F value    Pr(>F)
form      1 0.000018 0.000018  0.0405  0.84554
tech      1 0.032310 0.032310 72.4339 2.789e-05 ***

```

```

form:tech      1 0.002186 0.002186  4.8997  0.05776 .
form:tech:plot  4 0.002344 0.000586  1.3136  0.34317
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
form      1 0.000018 0.000018  0.0405  0.84554
tech      1 0.032310 0.032310 72.4339 2.789e-05 ***
form:tech  1 0.002186 0.002186  4.8997  0.05776 .
form:tech:plot 4 0.002344 0.000586  1.3136  0.34317
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.5 Chapter 7

10.5.1 p260

(171) MODEL

```
GLM(score ~ recipe + panelist, taste) # OK
```

\$ANOVA

Response : score

```

      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL    14 28.458  2.03274    2.661 0.0719 .
RESIDUALS    9  6.875  0.76389
CORRECTED TOTAL 23 35.333
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$Fitness

```

Root MSE score Mean Coef Var  R-square  Adj R-sq
0.8740074    5.833333 14.98298 0.8054245 0.5027516

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
recipe    3 21.0000    7.000  9.1636 0.004246 **
panelist 11  7.4583    0.678  0.8876 0.581099
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type II`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
recipe    3 9.1250 3.04167  3.9818 0.04649 *
panelist 11 7.4583 0.67803  0.8876 0.58110
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```
$`Type III`
      Df Sum Sq Mean Sq F value    Pr(>F)
recipe    3  9.1250  3.04167    3.9818 0.04649 *
panelist 11  7.4583  0.67803    0.8876 0.58110
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

10.5.2 p262

(172) MODEL

```
GLM(pressure ~ Block + Treatment, BPmonitor) # OK
```

\$ANOVA

Response : pressure

```
      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL          8 321.00   40.125    4.4174 0.1245
RESIDUALS       3  27.25    9.083
CORRECTED TOTAL 11 348.25
```

\$Fitness

```
Root MSE pressure Mean Coef Var  R-square  Adj R-sq
3.013857          77.75 3.876343 0.9217516 0.7130893
```

\$`Type I`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
Block    5  73.75   14.750    1.6239 0.36606
Treatment 3 247.25   82.417    9.0734 0.05149 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$`Type II`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
Block    5  83.25   16.650    1.8330 0.32772
Treatment 3 247.25   82.417    9.0734 0.05149 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$`Type III`

```
      Df Sum Sq Mean Sq F value    Pr(>F)
Block    5  83.25   16.650    1.8330 0.32772
Treatment 3 247.25   82.417    9.0734 0.05149 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

10.5.3 p276

(173) MODEL

```
GLM(weight ~ Blocks + A + B + C + D + E + F + G + H, Bff) # OK
```

```
$ANOVA
```

```
Response : weight
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	15	158.37	10.558		
RESIDUALS	0	0.00			
CORRECTED TOTAL	15	158.37			

```
$Fitness
```

Root MSE	weight	Mean Coef	Var	R-square
NA	5.925625		NA	1

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Blocks	7	30.567	4.367		
A	1	21.879	21.879		
B	1	8.338	8.338		
C	1	6.213	6.213		
D	1	12.870	12.870		
E	1	0.098	0.098		
F	1	1.260	1.260		
G	1	71.868	71.868		
H	1	5.279	5.279		

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Blocks	7	30.567	4.367		
A	1	21.879	21.879		
B	1	8.338	8.338		
C	1	6.213	6.213		
D	1	12.870	12.870		
E	1	0.098	0.098		
F	1	1.260	1.260		
G	1	71.868	71.868		
H	1	5.279	5.279		

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Blocks	7	30.567	4.367		
A	1	21.879	21.879		
B	1	8.338	8.338		
C	1	6.213	6.213		
D	1	12.870	12.870		
E	1	0.098	0.098		
F	1	1.260	1.260		
G	1	71.868	71.868		

H 1 5.279 5.279

10.6 Chapter 8

10.6.1 p315

(174) MODEL

```
GLM(ys ~ Block + A*B + Block:A:B + C*D + A:C + A:D + B:C + B:D + A:B:C + A:B:D +  
      A:C:D + B:C:D + A:B:C:D, sausage) # OK
```

\$ANOVA

Response : ys

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	19	0.064059	0.0033715	14.134	1.74e-05 ***
RESIDUALS	12	0.002862	0.0002385		
CORRECTED TOTAL	31	0.066922			

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

\$Fitness

Root MSE	ys Mean	Coef Var	R-square	Adj R-sq
0.01544479	2.023438	0.7632948	0.9572262	0.8895011

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Block	1	0.000903	0.000903	3.7860	0.075482 .
A	1	0.045753	0.045753	191.8035	9.647e-09 ***
B	1	0.002628	0.002628	11.0175	0.006119 **
A:B	1	0.001128	0.001128	4.7293	0.050371 .
Block:A:B	3	0.005484	0.001828	7.6638	0.004007 **
C	1	0.003828	0.003828	16.0480	0.001743 **
D	1	0.000528	0.000528	2.2140	0.162566
C:D	1	0.000253	0.000253	1.0611	0.323272
A:C	1	0.000153	0.000153	0.6419	0.438593
A:D	1	0.000903	0.000903	3.7860	0.075482 .
B:C	1	0.000078	0.000078	0.3275	0.577693
B:D	1	0.000253	0.000253	1.0611	0.323272
A:B:C	1	0.001378	0.001378	5.7773	0.033299 *
A:B:D	1	0.000703	0.000703	2.9476	0.111680
A:C:D	1	0.000028	0.000028	0.1179	0.737260
B:C:D	1	0.000028	0.000028	0.1179	0.737260
A:B:C:D	1	0.000028	0.000028	0.1179	0.737260

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Block	1	0.000903	0.000903	3.7860	0.075482 .


```

A          1 0.045753 0.045753 191.8035 9.647e-09 ***
B          1 0.002628 0.002628  11.0175 0.006119 **
A:B        1 0.001128 0.001128   4.7293 0.050371 .
Block:A:B  3 0.005484 0.001828   7.6638 0.004007 **
C          1 0.003828 0.003828  16.0480 0.001743 **
D          1 0.000528 0.000528   2.2140 0.162566
C:D        1 0.000253 0.000253   1.0611 0.323272
A:C        1 0.000153 0.000153   0.6419 0.438593
A:D        1 0.000903 0.000903   3.7860 0.075482 .
B:C        1 0.000078 0.000078   0.3275 0.577693
B:D        1 0.000253 0.000253   1.0611 0.323272
A:B:C      1 0.001378 0.001378   5.7773 0.033299 *
A:B:D      1 0.000703 0.000703   2.9476 0.111680
A:C:D      1 0.000028 0.000028   0.1179 0.737260
B:C:D      1 0.000028 0.000028   0.1179 0.737260
A:B:C:D    1 0.000028 0.000028   0.1179 0.737260
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df    Sum Sq  Mean Sq  F value    Pr(>F)
Block   1 0.000903 0.000903   3.7860 0.075482 .
A        1 0.045753 0.045753 191.8035 9.647e-09 ***
B        1 0.002628 0.002628  11.0175 0.006119 **
A:B      1 0.001128 0.001128   4.7293 0.050371 .
Block:A:B 3 0.005484 0.001828   7.6638 0.004007 **
C        1 0.003828 0.003828  16.0480 0.001743 **
D        1 0.000528 0.000528   2.2140 0.162566
C:D      1 0.000253 0.000253   1.0611 0.323272
A:C      1 0.000153 0.000153   0.6419 0.438593
A:D      1 0.000903 0.000903   3.7860 0.075482 .
B:C      1 0.000078 0.000078   0.3275 0.577693
B:D      1 0.000253 0.000253   1.0611 0.323272
A:B:C    1 0.001378 0.001378   5.7773 0.033299 *
A:B:D    1 0.000703 0.000703   2.9476 0.111680
A:C:D    1 0.000028 0.000028   0.1179 0.737260
B:C:D    1 0.000028 0.000028   0.1179 0.737260
A:B:C:D  1 0.000028 0.000028   0.1179 0.737260
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.6.2 p320

(175) MODEL

```
GLM(y ~ A*B*C*D*E, plasma) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	31	6672.9	215.26		
RESIDUALS	0	0.0			
CORRECTED TOTAL	31	6672.9			

\$Fitness

Root MSE	y	Mean	Coef	Var	R-square
NA	40.98125		NA		1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1118.65	1118.65		
B	1	142.81	142.81		
A:B	1	141.96	141.96		
C	1	91.80	91.80		
A:C	1	70.81	70.81		
B:C	1	5.78	5.78		
A:B:C	1	65.55	65.55		
D	1	1824.08	1824.08		
A:D	1	2194.53	2194.53		
B:D	1	87.78	87.78		
A:B:D	1	87.12	87.12		
C:D	1	22.45	22.45		
A:C:D	1	42.78	42.78		
B:C:D	1	12.25	12.25		
A:B:C:D	1	375.38	375.38		
E	1	78.75	78.75		
A:E	1	278.48	278.48		
B:E	1	0.72	0.72		
A:B:E	1	0.10	0.10		
C:E	1	0.15	0.15		
A:C:E	1	0.24	0.24		
B:C:E	1	6.48	6.48		
A:B:C:E	1	1.53	1.53		
D:E	1	8.40	8.40		
A:D:E	1	5.28	5.28		
B:D:E	1	0.28	0.28		
A:B:D:E	1	0.60	0.60		
C:D:E	1	0.85	0.85		
A:C:D:E	1	0.55	0.55		
B:C:D:E	1	6.30	6.30		
A:B:C:D:E	1	0.50	0.50		

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1118.65	1118.65		
B	1	142.81	142.81		
A:B	1	141.96	141.96		

C	1	91.80	91.80
A:C	1	70.81	70.81
B:C	1	5.78	5.78
A:B:C	1	65.55	65.55
D	1	1824.08	1824.08
A:D	1	2194.53	2194.53
B:D	1	87.78	87.78
A:B:D	1	87.12	87.12
C:D	1	22.45	22.45
A:C:D	1	42.78	42.78
B:C:D	1	12.25	12.25
A:B:C:D	1	375.38	375.38
E	1	78.75	78.75
A:E	1	278.48	278.48
B:E	1	0.72	0.72
A:B:E	1	0.10	0.10
C:E	1	0.15	0.15
A:C:E	1	0.24	0.24
B:C:E	1	6.48	6.48
A:B:C:E	1	1.53	1.53
D:E	1	8.40	8.40
A:D:E	1	5.28	5.28
B:D:E	1	0.28	0.28
A:B:D:E	1	0.60	0.60
C:D:E	1	0.85	0.85
A:C:D:E	1	0.55	0.55
B:C:D:E	1	6.30	6.30
A:B:C:D:E	1	0.50	0.50

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1118.64	1118.64		
B	1	142.80	142.80		
A:B	1	141.96	141.96		
C	1	91.80	91.80		
A:C	1	70.81	70.81		
B:C	1	5.78	5.78		
A:B:C	1	65.55	65.55		
D	1	1824.08	1824.08		
A:D	1	2194.53	2194.53		
B:D	1	87.78	87.78		
A:B:D	1	87.12	87.12		
C:D	1	22.45	22.45		
A:C:D	1	42.78	42.78		
B:C:D	1	12.25	12.25		
A:B:C:D	1	375.38	375.38		
E	1	78.75	78.75		
A:E	1	278.48	278.48		

B:E	1	0.72	0.72
A:B:E	1	0.10	0.10
C:E	1	0.15	0.15
A:C:E	1	0.24	0.24
B:C:E	1	6.48	6.48
A:B:C:E	1	1.53	1.53
D:E	1	8.40	8.40
A:D:E	1	5.28	5.28
B:D:E	1	0.28	0.28
A:B:D:E	1	0.60	0.60
C:D:E	1	0.85	0.85
A:C:D:E	1	0.55	0.55
B:C:D:E	1	6.30	6.30
A:B:C:D:E	1	0.50	0.50

10.6.3 p335

(176) MODEL

```
gear$A = as.numeric(as.character(gear$A))
gear$B = as.numeric(as.character(gear$B))
gear$C = as.numeric(as.character(gear$C))
gear$P = as.numeric(as.character(gear$P))
gear$Q = as.numeric(as.character(gear$Q))
REG(y ~ A*B*C + P + Q + A:P + A:Q + B:P + B:Q + C:P + C:Q, gear) # OK
```

Warning in qt(0.5 + conf.level/2, Res0[, "Df"]): NaNs produced

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	15	1104.6	73.641		
RESIDUALS	0	0.0			
CORRECTED TOTAL	15	1104.6			

\$Fitness

Root MSE	y Mean	Coef Var	R-square	PRESS	R2pred
NA	15.40625	NA	1	NaN	NaN

\$Coefficients

	Estimate	Std. Error	Df	Lower CL	Upper CL	t value	Pr(> t)
(Intercept)	15.4062		0				
A	-4.9062		0				
B	-0.1562		0				
A:B	0.5312		0				
C	3.9688		0				
A:C	2.9062		0				
B:C	0.4062		0				
A:B:C	0.5938		0				

P	-2.3438	0
Q	-3.4062	0
A:P	-0.9062	0
A:Q	-0.3438	0
B:P	1.0938	0
B:Q	0.1562	0
C:P	-0.2812	0
C:Q	0.7812	0

10.7 Chapter 9

10.7.1 p349

(177) MODEL

```
GLM(pl ~ Subject + Period + Treat, antifungal) # OK
```

\$ANOVA

Response : pl

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	18	118.558	6.5866	1.4435	0.2388
RESIDUALS	15	68.444	4.5630		
CORRECTED TOTAL	33	187.002			

\$Fitness

Root MSE	pl	Mean	Coef	Var	R-square	Adj R-sq
2.136109	13.15882	16.23328	0.6339915	0.1947814		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	16	114.642	7.1651	1.5703	0.1942
Period	1	0.922	0.9224	0.2021	0.6594
Treat	1	2.993	2.9932	0.6560	0.4306

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	16	114.642	7.1651	1.5703	0.1942
Period	1	0.734	0.7344	0.1609	0.6939
Treat	1	2.993	2.9932	0.6560	0.4306

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	16	114.642	7.1651	1.5703	0.1942
Period	1	0.734	0.7344	0.1609	0.6939
Treat	1	2.993	2.9932	0.6560	0.4306

10.7.2 p355

(178) MODEL

```
GLM(y ~ Group + Subject:Group + Period + Treat + Carry, bioequiv) # OK
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	39	417852	10714.1	20.367	< 2.2e-16 ***
RESIDUALS	68	35772	526.1		
CORRECTED TOTAL	107	453624			

```
---
```

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

```
$Fitness
```

Root MSE	y	Mean Coef Var	R-square	Adj R-sq
22.93611	101.3846	22.62287	0.9211408	0.8759128

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Group	1	43335	43335	82.3763	2.46e-13 ***
Group:Subject	34	370970	10911	20.7406	< 2.2e-16 ***
Period	2	287	143	0.2723	0.7624
Treat	1	2209	2209	4.1993	0.0443 *
Carry	1	1051	1051	1.9970	0.1622

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Group	1	32616	32616	61.9998	3.712e-11 ***
Group:Subject	34	370970	10911	20.7406	< 2.2e-16 ***
Period	1	38	38	0.0724	0.7888
Treat	1	2209	2209	4.1993	0.0443 *
Carry	1	1051	1051	1.9970	0.1622

```
---
```

```
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)
Group	1	32616	32616	61.9998	3.712e-11 ***
Group:Subject	34	370970	10911	20.7406	< 2.2e-16 ***
Period	1	38	38	0.0724	0.7888
Treat	1	2209	2209	4.1993	0.0443 *
Carry	1	1051	1051	1.9970	0.1622

```
---
```

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

```
(179) MODEL
```

```
GLM(y ~ Subject + Period + Treat + Carry, bioequiv) # OK
```

```
$ANOVA
```

```
Response : y
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	39	417852	10714.1	20.367	< 2.2e-16 ***
RESIDUALS	68	35772	526.1		
CORRECTED TOTAL	107	453624			

```
---
```

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

```
$Fitness
```

Root MSE	y	Mean Coef Var	R-square	Adj R-sq
22.93611	101.3846	22.62287	0.9211408	0.8759128

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	35	414306	11837.3	22.5016	<2e-16 ***
Period	2	287	143.3	0.2723	0.7624
Treat	1	2209	2209.1	4.1993	0.0443 *
Carry	1	1051	1050.6	1.9970	0.1622

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	35	403586	11531.0	21.9194	<2e-16 ***
Period	1	38	38.1	0.0724	0.7888
Treat	1	2209	2209.1	4.1993	0.0443 *
Carry	1	1051	1050.6	1.9970	0.1622

```
---
```

```
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)
Subject	35	403586	11531.0	21.9194	<2e-16 ***
Period	1	38	38.1	0.0724	0.7888
Treat	1	2209	2209.1	4.1993	0.0443 *
Carry	1	1051	1050.6	1.9970	0.1622

```
---
```

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

10.7.3 p361

(180) MODEL

```
GLM(Time ~ Subject + Period + Treat + Carry, chipman) # OK
```

```
$ANOVA
```

```
Response : Time
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	17	28.0757	1.65151	64.421	1.139e-12 ***
RESIDUALS	18	0.4615	0.02564		
CORRECTED TOTAL	35	28.5372			

```
---
```

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

```
$Fitness
```

Root MSE	Time	Mean Coef	Var	R-square	Adj R-sq
0.1601128	6.250556	2.561577	0.9838299	0.9685581	

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	11	24.2084	2.20076	85.8462	3.157e-13 ***
Period	2	3.2065	1.60325	62.5388	7.894e-09 ***
Treat	2	0.4276	0.21382	8.3406	0.002733 **
Carry	2	0.2332	0.11660	4.5484	0.025188 *

```
---
```

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

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
Subject	11	24.2547	2.20497	86.0105	3.104e-13 ***
Period	1	0.0018	0.00184	0.0717	0.7919554
Treat	2	0.6392	0.31958	12.4661	0.0004003 ***
Carry	2	0.2332	0.11660	4.5484	0.0251881 *

```
---
```

```
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)
Subject	11	24.2547	2.20497	86.0105	3.104e-13 ***
Period	1	0.0018	0.00184	0.0717	0.7919554
Treat	2	0.6392	0.31958	12.4661	0.0004003 ***
Carry	2	0.2332	0.11660	4.5484	0.0251881 *

```
---
```

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

10.7.4 p372

(181) MODEL


```

residue$lc1 = log(residue$X1)
residue$lc2 = log(residue$X2)
residue$lc3 = log(residue$X3)
residue$lc4 = log(residue$X4)
residue$lc5 = log(residue$X5)
residue$sp = 7*residue$lc2+ 14*residue$lc3 + 30*residue$lc4 + 60*residue$lc5
residue$sm = residue$lc1 + residue$lc2+ residue$lc3 + residue$lc4 + residue$lc5
residue$num = 5*residue$sp - 111*residue$sm
residue$den = 5*4745 - 111^2
residue$k = residue$num/residue$den
residue$HL = -log(2)/residue$k
residue$logHL = log(residue$HL)
GLM(logHL ~ temp*moisture*soil, residue) # OK

```

\$ANOVA

Response : logHL

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	7.5133	1.07332	13.543	0.0007329 ***
RESIDUALS	8	0.6340	0.07925		
CORRECTED TOTAL	15	8.1473			

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

\$Fitness

Root MSE	logHL	Mean Coef	Var	R-square	Adj R-sq
0.2815174	4.875155	5.774532	0.9221806	0.8540886	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
temp	1	6.0503	6.0503	76.3427	2.303e-05 ***
moisture	1	0.9521	0.9521	12.0134	0.008492 **
temp:moisture	1	0.0013	0.0013	0.0162	0.901779
soil	1	0.4098	0.4098	5.1712	0.052559 .
temp:soil	1	0.0086	0.0086	0.1081	0.750753
moisture:soil	1	0.0860	0.0860	1.0855	0.327921
temp:moisture:soil	1	0.0051	0.0051	0.0648	0.805427

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
temp	1	6.0503	6.0503	76.3427	2.303e-05 ***
moisture	1	0.9521	0.9521	12.0134	0.008492 **
temp:moisture	1	0.0013	0.0013	0.0162	0.901779
soil	1	0.4098	0.4098	5.1712	0.052559 .
temp:soil	1	0.0086	0.0086	0.1081	0.750753
moisture:soil	1	0.0860	0.0860	1.0855	0.327921

```
temp:moisture:soil  1 0.0051  0.0051  0.0648  0.805427
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
temp	1	6.0503	6.0503	76.3427	2.303e-05 ***
moisture	1	0.9521	0.9521	12.0134	0.008492 **
temp:moisture	1	0.0013	0.0013	0.0162	0.901779
soil	1	0.4098	0.4098	5.1712	0.052559 .
temp:soil	1	0.0086	0.0086	0.1081	0.750753
moisture:soil	1	0.0860	0.0860	1.0855	0.327921
temp:moisture:soil	1	0.0051	0.0051	0.0648	0.805427

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

10.8 Chapter 11

10.8.1 p461

(182) MODEL

```
GLM(y ~ x1 + x2 + x1:x2 + x1:x3 + x2:x3, pest) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	5	275.642	55.128	160.38	4.631e-07 ***
RESIDUALS	7	2.406	0.344		
CORRECTED TOTAL	12	278.048			

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

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq
0.5862902	52.63077	1.113968	0.9913463	0.985165

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
x1	1	83.402	83.402	242.6351	1.086e-06 ***
x2	1	161.734	161.734	470.5191	1.116e-07 ***
x1:x2	1	0.246	0.246	0.7169	0.4251627
x1:x3	1	15.663	15.663	45.5660	0.0002649 ***
x2:x3	1	14.596	14.596	42.4614	0.0003291 ***

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

\$`Type II`

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

```

x1      1 215.951 215.951 628.246 4.105e-08 ***
x2      1 175.256 175.256 509.855 8.458e-08 ***
x1:x2   1   0.025   0.025   0.072 0.7961658
x1:x3   1  14.539  14.539  42.298 0.0003330 ***
x2:x3   1  14.596  14.596  42.461 0.0003291 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type III`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
x1      1 178.372 178.372 518.922 7.958e-08 ***
x2      1 145.518 145.518 423.341 1.608e-07 ***
x1:x2   1   0.025   0.025   0.072 0.7961658
x1:x3   1  14.539  14.539  42.298 0.0003330 ***
x2:x3   1  14.596  14.596  42.461 0.0003291 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.8.2 p469

(183) MODEL

```
GLM(y ~ x1 + x2 + x1:x2 + x1:x3 + x2:x3 + x1:x2:x3, polvdat) # OK
```

\$ANOVA

Response : y

```

      Df Sum Sq Mean Sq F value    Pr(>F)
MODEL      6 12.5313 2.08854  37.056 0.0005473 ***
RESIDUALS   5  0.2818 0.05636
CORRECTED TOTAL 11 12.8131
---

```

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

\$Fitness

```

      Root MSE    y Mean Coef Var  R-square  Adj R-sq
0.2374067  5.406667    4.391 0.9780061 0.9516133

```

\$`Type I`

```

      Df Sum Sq Mean Sq F value    Pr(>F)
x1      1 5.4668  5.4668 96.9942 0.0001839 ***
x2      1 0.3660  0.3660  6.4944 0.0513654 .
x1:x2   1 4.6897  4.6897 83.2068 0.0002652 ***
x1:x3   1 1.2450  1.2450 22.0887 0.0053378 **
x2:x3   1 0.4707  0.4707  8.3509 0.0341949 *
x1:x2:x3 1 0.2931  0.2931  5.2004 0.0714991 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
x1	1	0.0184	0.0184	0.3265	0.5924707
x2	1	0.2419	0.2419	4.2911	0.0930613 .
x1:x2	1	3.8824	3.8824	68.8834	0.0004147 ***
x1:x3	1	1.4383	1.4383	25.5196	0.0039276 **
x2:x3	1	0.4707	0.4707	8.3509	0.0341949 *
x1:x2:x3	1	0.2931	0.2931	5.2004	0.0714991 .

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
x1	1	0.25744	0.25744	4.5677	0.08562 .
x2	1	0.12956	0.12956	2.2987	0.18992
x1:x2	1	0.65909	0.65909	11.6939	0.01885 *
x1:x3	1	0.26323	0.26323	4.6704	0.08307 .
x2:x3	1	0.12999	0.12999	2.3063	0.18931
x1:x2:x3	1	0.29310	0.29310	5.2004	0.07150 .

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

10.8.3 p482

(184) MODEL

```
REG(y ~ x1 + x2 + x3 + x1:x2 + x1:x3 + x2:x3 + x1:z1 + x2:z1 + x3:z1 +
      x1:x2:z1 + x1:x3:z1 + x2:x3:z1 + x1:z2 + x2:z2 + x3:z2 +
      x1:x2:z2 + x1:x3:z2 + x2:x3:z2 + x1:z1:z2 + x2:z1:z2 + x3:z1:z2 +
      x1:x2:z1:z2 + x1:x3:z1:z2 + x2:x3:z1:z2 - 1, MPV) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	24	535997257	22333219	96.728	1.142e-09 ***
RESIDUALS	11	2539743	230886		
UNCORRECTED TOTAL	35	538537000			

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

\$Fitness

Root MSE	y Mean	Coef Var	R-square	Adj R-sq	PRESS	R2pred
480.5057	3582.857	13.41124	0.995284	0.9849945	51495197	0.9043795

\$Coefficients

	Estimate	Std. Error	Df	Lower CL	Upper CL	t value	Pr(> t)
x1	346948	294197	11	-300575	994471	1.1793	0.2631550
x2	8223	490	11	7144	9301	16.7869	3.467e-09 ***
x3	1656	459	11	646	2665	3.6104	0.0040950 **
x1:x2	-414463	312262	11	-1101748	272822	-1.3273	0.2113017

```

x1:x3      -334747      311426 11 -1020190      350696 -1.0749 0.3054382
x2:x3      -6476        1199 11   -9114      -3838 -5.4032 0.0002156 ***
x1:z1      103044      328922 11  -620909      826997  0.3133 0.7599297
x2:z1      -2241        548 11   -3446      -1036 -4.0924 0.0017824 **
x3:z1       823         513 11    -305       1952  1.6056 0.1366709
x1:x2:z1   -64013      349120 11  -832421      704395 -0.1834 0.8578546
x1:x3:z1   -123730     348184 11  -890079      642618 -0.3554 0.7290412
x2:x3:z1    4659       1340 11    1709       7608  3.4765 0.0051806 **
x1:z2      244320     328922 11  -479632      968273  0.7428 0.4731733
x2:z2       886        548 11    -319       2092  1.6187 0.1338108
x3:z2       86         513 11   -1043       1214  0.1670 0.8704301
x1:x2:z2   -266052     349120 11 -1034460      502356 -0.7621 0.4620497
x1:x3:z2   -253151     348184 11 -1019500      513198 -0.7271 0.4823761
x2:x3:z2   -1822       1340 11   -4771       1128 -1.3593 0.2012686
x1:z1:z2   259038     328922 11  -464915      982990  0.7875 0.4476062
x2:z1:z2   -137        548 11   -1342       1068 -0.2500 0.8071853
x3:z1:z2    100        513 11   -1028       1229  0.1955 0.8485983
x1:x2:z1:z2 -269527     349120 11 -1037935      498881 -0.7720 0.4563702
x1:x3:z1:z2 -269249     348184 11 -1035597      497100 -0.7733 0.4556454
x2:x3:z1:z2  -328       1340 11   -3278       2621 -0.2448 0.8111141
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.9 Chapter 12

10.9.1 p513

(185) MODEL

```
GLM(ybar ~ A + B + C + D + E + F + G, tile) # OK
```

\$ANOVA

Response : ybar

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	7	0.68737	0.098196		
RESIDUALS	0	0.00000			
CORRECTED TOTAL	7	0.68737			

\$Fitness

Root MSE	ybar	Mean Coef	Var	R-square
NA	0.7424626		NA	1

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.04984	0.04984		
B	1	0.01992	0.01992		
C	1	0.51534	0.51534		
D	1	0.01532	0.01532		
E	1	0.05965	0.05965		

```
F 1 0.00879 0.00879
G 1 0.01851 0.01851
```

```
$`Type II`
```

```
  Df Sum Sq Mean Sq F value Pr(>F)
A  1 0.04984 0.04984
B  1 0.01992 0.01992
C  1 0.51534 0.51534
D  1 0.01532 0.01532
E  1 0.05965 0.05965
F  1 0.00879 0.00879
G  1 0.01851 0.01851
```

```
$`Type III`
```

```
  Df Sum Sq Mean Sq F value Pr(>F)
A  1 0.04984 0.04984
B  1 0.01992 0.01992
C  1 0.51534 0.51534
D  1 0.01532 0.01532
E  1 0.05965 0.05965
F  1 0.00879 0.00879
G  1 0.01851 0.01851
```

```
(186) MODEL
```

```
GLM(lns2 ~ A + B + C + D + E + F + G, tile) # OK
```

```
$ANOVA
```

```
Response : lns2
```

```
      Df Sum Sq Mean Sq F value Pr(>F)
MODEL      7 12.305   1.7578
RESIDUALS    0  0.000
CORRECTED TOTAL 7 12.305
```

```
$Fitness
```

```
Root MSE lns2 Mean Coef Var R-square
      NA -2.623421      NA      1
```

```
$`Type I`
```

```
  Df Sum Sq Mean Sq F value Pr(>F)
A  1 1.6436  1.6436
B  1 0.3109  0.3109
C  1 7.1858  7.1858
D  1 2.3199  2.3199
E  1 0.0248  0.0248
F  1 0.7379  0.7379
G  1 0.0820  0.0820
```

```
$`Type II`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1.6436	1.6436		
B	1	0.3109	0.3109		
C	1	7.1858	7.1858		
D	1	2.3199	2.3199		
E	1	0.0248	0.0248		
F	1	0.7379	0.7379		
G	1	0.0820	0.0820		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	1.6436	1.6436		
B	1	0.3109	0.3109		
C	1	7.1858	7.1858		
D	1	2.3199	2.3199		
E	1	0.0248	0.0248		
F	1	0.7379	0.7379		
G	1	0.0820	0.0820		

10.9.2 p521

(187) MODEL

```
strng = reshape(tile,
  direction = "long",
  varying = list(c("y1", "y2")),
  v.names = "y",
  idvar = c("A", "B", "C", "D", "E", "F", "G"),
  timevar = "H",
  times = c(-1, 1))
GLM(y ~ A/H + B/H + C/H + D/H + E/H + F/H + G/H, strng) # OK
```

\$ANOVA

Response : y

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	14	1.65427	0.11816	0.1433	0.9807
RESIDUALS	1	0.82473	0.82473		
CORRECTED TOTAL	15	2.47901			

\$Fitness

Root MSE	y	Mean	Coef	Var	R-square	Adj R-sq
0.9081486	0.7424626	122.3157	0.667313	-3.990305		

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.09968	0.09968	0.1209	0.7870
A:H	1	0.04015	0.04015	0.0487	0.8618
B	1	0.03984	0.03984	0.0483	0.8623
H:B	1	0.00043	0.00043	0.0005	0.9854

C	1	1.03069	1.03069	1.2497	0.4646
H:C	1	0.15307	0.15307	0.1856	0.7410
D	1	0.03064	0.03064	0.0372	0.8788
H:D	1	0.04690	0.04690	0.0569	0.8510
E	1	0.11929	0.11929	0.1446	0.7686
H:E	1	0.01883	0.01883	0.0228	0.9045
F	1	0.01758	0.01758	0.0213	0.9077
H:F	1	0.01384	0.01384	0.0168	0.9180
G	1	0.03702	0.03702	0.0449	0.8671
H:G	1	0.00632	0.00632	0.0077	0.9444

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.09968	0.09968	0.1209	0.7870
A:H	1	0.04015	0.04015	0.0487	0.8618
B	1	0.03984	0.03984	0.0483	0.8623
H:B	1	0.00043	0.00043	0.0005	0.9854
C	1	1.03069	1.03069	1.2497	0.4646
H:C	1	0.15307	0.15307	0.1856	0.7410
D	1	0.03064	0.03064	0.0372	0.8788
H:D	1	0.04690	0.04690	0.0569	0.8510
E	1	0.11929	0.11929	0.1446	0.7686
H:E	1	0.01883	0.01883	0.0228	0.9045
F	1	0.01758	0.01758	0.0213	0.9077
H:F	1	0.01384	0.01384	0.0168	0.9180
G	1	0.03702	0.03702	0.0449	0.8671
H:G	1	0.00632	0.00632	0.0077	0.9444

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.09968	0.09968	0.1209	0.7870
A:H	1	0.04015	0.04015	0.0487	0.8618
B	1	0.03984	0.03984	0.0483	0.8623
H:B	1	0.00043	0.00043	0.0005	0.9854
C	1	1.03069	1.03069	1.2497	0.4646
H:C	1	0.15307	0.15307	0.1856	0.7410
D	1	0.03064	0.03064	0.0372	0.8788
H:D	1	0.04690	0.04690	0.0569	0.8510
E	1	0.11929	0.11929	0.1446	0.7686
H:E	1	0.01883	0.01883	0.0228	0.9045
F	1	0.01758	0.01758	0.0213	0.9077
H:F	1	0.01384	0.01384	0.0168	0.9180
G	1	0.03702	0.03702	0.0449	0.8671
H:G	1	0.00632	0.00632	0.0077	0.9444

10.9.3 p525

(188) MODEL


```
prod2 = af(prodstd, 1:7)
GLM(Pof ~ A + B + C + D + E + F + G + A:G + A:E:F + B:E:G + C:E:G + C:E:G:F +
      D:E + D:F, prod2) # OK
```

\$ANOVA

Response : Pof

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	47	769.49	16.3721	5.1667	2.737e-05 ***
RESIDUALS	24	76.05	3.1688		
CORRECTED TOTAL	71	845.54			

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

\$Fitness

Root MSE	Pof	Mean Coef	Var	R-square	Adj R-sq
1.780098	19.73194	9.021403	0.9100571	0.7339189	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	2	50.577	25.288	7.9806	0.0022023 **
B	2	13.384	6.692	2.1118	0.1429491
C	2	68.594	34.297	10.8234	0.0004463 ***
D	2	23.674	11.837	3.7355	0.0386914 *
E	1	275.733	275.733	87.0165	1.878e-09 ***
F	1	161.700	161.700	51.0296	2.204e-07 ***
G	1	1.051	1.051	0.3318	0.5699896
A:G	2	26.567	13.284	4.1921	0.0274494 *
A:E:F	7	28.404	4.058	1.2806	0.3013844
B:E:G	7	22.453	3.208	1.0123	0.4475160
C:E:G	6	35.546	5.924	1.8696	0.1277692
C:E:F:G	10	24.607	2.461	0.7766	0.6500534
D:E	2	21.745	10.873	3.4312	0.0489076 *
D:F	2	15.450	7.725	2.4379	0.1086730

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	2	50.577	25.288	7.9806	0.0022023 **
B	2	13.384	6.692	2.1118	0.1429491
C	2	68.594	34.297	10.8234	0.0004463 ***
D	2	23.674	11.837	3.7355	0.0386914 *
E	1	275.733	275.733	87.0165	1.878e-09 ***
F	1	161.700	161.700	51.0296	2.204e-07 ***
G	1	1.051	1.051	0.3318	0.5699896
A:G	2	26.567	13.284	4.1921	0.0274494 *
A:E:F	6	24.623	4.104	1.2951	0.2970196

```

B:E:G      6  19.770   3.295  1.0398 0.4246194
C:E:G      6  35.546   5.924  1.8696 0.1277692
C:E:F:G  10  24.607   2.461  0.7766 0.6500534
D:E        2  21.745  10.873  3.4312 0.0489076 *
D:F        2  15.450   7.725  2.4379 0.1086730
---
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)	
A	2	50.577	25.288	7.9806	0.0022023	**
B	2	13.384	6.692	2.1118	0.1429491	
C	2	68.594	34.297	10.8234	0.0004463	***
D	2	23.674	11.837	3.7355	0.0386914	*
E	1	275.733	275.733	87.0165	1.878e-09	***
F	1	161.700	161.700	51.0296	2.204e-07	***
G	1	1.051	1.051	0.3318	0.5699896	
A:G	2	26.567	13.284	4.1921	0.0274494	*
A:E:F	6	24.623	4.104	1.2951	0.2970196	
B:E:G	6	19.770	3.295	1.0398	0.4246194	
C:E:G	6	35.546	5.924	1.8696	0.1277692	
C:E:F:G	10	24.607	2.461	0.7766	0.6500534	
D:E	2	21.745	10.873	3.4312	0.0489076	*
D:F	2	15.450	7.725	2.4379	0.1086730	

```

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

```

10.9.4 p532

(189) MODEL

```
GLM(torque ~ A + B + C + D + E + A:B + A:C + A:D + A:E, Smotor) # OK
```

\$ANOVA

Response : torque

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	15	0.0112217	0.00074811	102.2	0.009731 **
RESIDUALS	2	0.0000146	0.00000732		
CORRECTED TOTAL	17	0.0112363			

```

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

```

\$Fitness

Root MSE	torque	Mean	Coef	Var	R-square	Adj R-sq
0.002705567	0.2572743	1.051627	0.9986971	0.988925		

\$`Type I`

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

```

A      1 0.0039545 0.0039545 540.2187 0.001846 **
B      2 0.0003817 0.0001909  26.0732 0.036937 *
C      2 0.0057241 0.0028620 390.9837 0.002551 **
D      2 0.0000265 0.0000133   1.8104 0.355820
E      1 0.0000984 0.0000984  13.4406 0.067009 .
A:B    2 0.0010068 0.0005034  68.7668 0.014333 *
A:C    2 0.0000031 0.0000016   0.2134 0.824110
A:D    2 0.0000009 0.0000004   0.0599 0.943521
A:E    1 0.0000258 0.0000258   3.5198 0.201458
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type II`
      Df      Sum Sq    Mean Sq  F value    Pr(>F)
A      1 0.0039545 0.0039545 540.2187 0.001846 **
B      2 0.0003817 0.0001909  26.0732 0.036937 *
C      2 0.0032014 0.0016007 218.6753 0.004552 **
D      2 0.0000268 0.0000134   1.8319 0.353123
E      1 0.0000423 0.0000423   5.7744 0.138172
A:B    2 0.0010068 0.0005034  68.7668 0.014333 *
A:C    2 0.0000031 0.0000016   0.2134 0.824110
A:D    2 0.0000052 0.0000026   0.3536 0.738760
A:E    1 0.0000258 0.0000258   3.5198 0.201458
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

```

$`Type III`
      Df      Sum Sq    Mean Sq  F value    Pr(>F)
A      1 0.0034241 0.0034241 467.7636 0.002131 **
B      2 0.0003817 0.0001909  26.0732 0.036937 *
C      2 0.0032014 0.0016007 218.6753 0.004552 **
D      2 0.0000268 0.0000134   1.8319 0.353123
E      1 0.0000423 0.0000423   5.7744 0.138172
A:B    2 0.0010068 0.0005034  68.7668 0.014333 *
A:C    2 0.0000031 0.0000016   0.2134 0.824110
A:D    2 0.0000052 0.0000026   0.3536 0.738760
A:E    1 0.0000258 0.0000258   3.5198 0.201458
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

10.9.5 p535

(190) MODEL

```
GLM(shrinkage ~ A + B + C + D + E + F + G + A:B + A:C + A:D + A:E + A:F + A:G +
      B:D, inject) # OK
```

\$ANOVA

Response : shrinkage

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	14	6659.4	475.67	129.08	1.97e-05 ***
RESIDUALS	5	18.4	3.68		
CORRECTED TOTAL	19	6677.8			

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

\$Fitness

Root MSE	shrinkage	Mean Coef	Var	R-square	Adj R-sq
1.919635		27.1	7.083525	0.9972409	0.9895153

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	770.1	770.1	208.9722	2.858e-05 ***
B	1	5076.6	5076.6	1377.6289	2.674e-07 ***
C	1	3.1	3.1	0.8311	0.403773
D	1	7.6	7.6	2.0522	0.211416
E	1	0.6	0.6	0.1526	0.712112
F	1	0.6	0.6	0.1526	0.712112
G	1	95.1	95.1	25.7972	0.003837 **
A:B	1	564.1	564.1	153.0699	6.112e-05 ***
A:C	1	10.6	10.6	2.8664	0.151230
A:D	1	115.6	115.6	31.3602	0.002508 **
A:E	1	14.1	14.1	3.8161	0.108185
A:F	1	1.6	1.6	0.4240	0.543677
A:G	1	0.1	0.1	0.0170	0.901459
B:D	1	0.1	0.1	0.0170	0.901459

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	770.1	770.1	208.9722	2.858e-05 ***
B	1	5076.6	5076.6	1377.6289	2.674e-07 ***
C	1	3.1	3.1	0.8311	0.403773
D	1	7.6	7.6	2.0522	0.211416
E	1	0.6	0.6	0.1526	0.712112
F	1	0.6	0.6	0.1526	0.712112
G	1	95.1	95.1	25.7972	0.003837 **
A:B	1	564.1	564.1	153.0699	6.112e-05 ***
A:C	1	10.6	10.6	2.8664	0.151230
A:D	1	115.6	115.6	31.3602	0.002508 **
A:E	1	14.1	14.1	3.8161	0.108185
A:F	1	1.6	1.6	0.4240	0.543677
A:G	1	0.1	0.1	0.0170	0.901459
B:D	1	0.1	0.1	0.0170	0.901459

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

```
$`Type III`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
A	1	770.1	770.1	208.9722	2.858e-05	***
B	1	5076.6	5076.6	1377.6289	2.674e-07	***
C	1	3.1	3.1	0.8311	0.403773	
D	1	7.6	7.6	2.0522	0.211416	
E	1	0.6	0.6	0.1526	0.712112	
F	1	0.6	0.6	0.1526	0.712112	
G	1	95.1	95.1	25.7972	0.003837	**
A:B	1	564.1	564.1	153.0699	6.112e-05	***
A:C	1	10.6	10.6	2.8664	0.151230	
A:D	1	115.6	115.6	31.3602	0.002508	**
A:E	1	14.1	14.1	3.8161	0.108185	
A:F	1	1.6	1.6	0.4240	0.543677	
A:G	1	0.1	0.1	0.0170	0.901459	
B:D	1	0.1	0.1	0.0170	0.901459	

```
---
```

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

10.9.6 p539

```
(191) MODEL
```

```
eptax = cbind(eptaxr[1:16,], y2=eptaxr[17:32,9], y3=eptaxr[33:48,9],
              y5=eptaxr[49:64,9])
eptax$ybar = (eptax$y + eptax$y2 + eptax$y3 + eptax$y5)/4
GLM(ybar ~ A + B + C + D + E + F + G + H + A:B + A:C + A:D + A:E + A:F + A:G +
     A:H, eptax) # OK
```

```
$ANOVA
```

```
Response : ybar
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	15	2.8452	0.18968		
RESIDUALS	0	0.0000			
CORRECTED TOTAL	15	2.8452			

```
$Fitness
```

Root MSE	ybar	Mean Coef	Var	R-square
NA	14.36122	NA	NA	1

```
$`Type I`
```

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.02686	0.02686		
B	1	0.00042	0.00042		
C	1	0.06306	0.06306		
D	1	2.49443	2.49443		
E	1	0.00304	0.00304		
F	1	0.03209	0.03209		

G	1	0.02954	0.02954
H	1	0.12879	0.12879
A:B	1	0.00047	0.00047
A:C	1	0.03218	0.03218
A:D	1	0.01185	0.01185
A:E	1	0.00380	0.00380
A:F	1	0.01674	0.01674
A:G	1	0.00186	0.00186
A:H	1	0.00012	0.00012

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.02686	0.02686		
B	1	0.00042	0.00042		
C	1	0.06306	0.06306		
D	1	2.49443	2.49443		
E	1	0.00304	0.00304		
F	1	0.03209	0.03209		
G	1	0.02954	0.02954		
H	1	0.12879	0.12879		
A:B	1	0.00047	0.00047		
A:C	1	0.03218	0.03218		
A:D	1	0.01185	0.01185		
A:E	1	0.00380	0.00380		
A:F	1	0.01674	0.01674		
A:G	1	0.00186	0.00186		
A:H	1	0.00012	0.00012		

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
A	1	0.02686	0.02686		
B	1	0.00042	0.00042		
C	1	0.06306	0.06306		
D	1	2.49443	2.49443		
E	1	0.00304	0.00304		
F	1	0.03209	0.03209		
G	1	0.02954	0.02954		
H	1	0.12879	0.12879		
A:B	1	0.00047	0.00047		
A:C	1	0.03218	0.03218		
A:D	1	0.01185	0.01185		
A:E	1	0.00380	0.00380		
A:F	1	0.01674	0.01674		
A:G	1	0.00186	0.00186		
A:H	1	0.00012	0.00012		

11 Searle - Linear Models 2e

Reference

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

11.1 7.2 (p390, 59%)

(192) 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			

\$Fitness

Root MSE	weight	Mean	Coef	Var	R-square	Adj R-sq
2.366432		11	21.51302	0.5942029	0.3101449	

\$`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
```

```
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
```

11.2 7.2 (p393, 60%)

(193) MODEL

```
percent = c(31,33,44,36,38,26,37,59,42,42,34,42,28,39,36,32,38,42,36,22,42,46,
            26,37,43)
refinery = c(rep("g",9),rep("n",8),rep("s",8))
process = as.factor(c(1,1,1,1,1,1,2,2,2,1,1,1,1,2,2,2,2,1,1,1,2,2,2,2))
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			

\$Fitness

Root MSE	percent	Mean Coef	Var	R-square	Adj R-sq
8.340949	37.24	22.39782	0.3124188	-0.1787106	

\$`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

```
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		

12 Web site examples

12.1 <https://github.com/djnavarro/psyr>

(194) MODEL

```
d21 = read.csv("http://r.acr.kr/psyr/coffee.csv")
GLM(babble ~ sugar*milk - 1, d21)
```

\$ANOVA

Response : babble

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	6	472.54	78.756	298.84	2.39e-12 ***
RESIDUALS	12	3.16	0.264		
UNCORRECTED TOTAL	18	475.70			

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

\$Fitness

Root MSE	babble	Mean Coef	Var	R-square	Adj R-sq
0.5133631	5.066667	10.13217	0.9933519	0.9900279	

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
sugar	3	465.64	155.213	588.9486	2.756e-13 ***
milk	1	0.96	0.956	3.6279	0.081061 .
sugar:milk	2	5.94	2.972	11.2769	0.001754 **

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
sugar	2	3.0696	1.53482	5.8238	0.017075 *
milk	1	0.9561	0.95611	3.6279	0.081061 .
sugar:milk	2	5.9439	2.97193	11.2769	0.001754 **

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)
sugar	2	2.1318	1.0659	4.0446	0.045426 *
milk	1	1.0041	1.0041	3.8102	0.074672 .
sugar:milk	2	5.9439	2.9719	11.2769	0.001754 **

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

```
options(contrasts=c("contr.sum", "contr.poly"))
r21 = lm(babble ~ sugar*milk - 1, d21)
```

```
anova(r21) # Type I SS OK
```

Analysis of Variance Table

Response: babble

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
sugar	3	465.64	155.213	588.9486	2.756e-13	***
milk	1	0.96	0.956	3.6279	0.081061	.
sugar:milk	2	5.94	2.972	11.2769	0.001754	**
Residuals	12	3.16	0.264			

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

```
Anova(r21, type=2) # NOT OK
```

Anova Table (Type II tests)

Response: babble

	Sum Sq	Df	F value	Pr(>F)	
sugar	453.76	3	573.9233	3.214e-13	***
milk	0.96	1	3.6279	0.081061	.
sugar:milk	5.94	2	11.2769	0.001754	**
Residuals	3.16	12			

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

```
Anova(r21, type=3) # NOT OK
```

Anova Table (Type III tests)

Response: babble

	Sum Sq	Df	F value	Pr(>F)	
sugar	454.77	3	575.1970	3.172e-13	***
milk	1.00	1	3.8102	0.074672	.
sugar:milk	5.94	2	11.2769	0.001754	**
Residuals	3.16	12			

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

13 Bioequivalence (BE) data example

(195) MODEL

```
GLM(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata) # a BE dataset in sasLM package
```

\$ANOVA

Response : log(CMAX)

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
MODEL	48	23.1924	0.48317	5.6278	4.395e-08 ***
RESIDUALS	42	3.6059	0.08585		
CORRECTED TOTAL	90	26.7983			

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

\$Fitness

Root MSE	log(CMAX)	Mean Coef	Var	R-square	Adj R-sq
0.2930098		6.071036	4.826355	0.8654428	0.7116631

\$`Type I`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SEQ	1	0.6454	0.64544	7.5178	0.008938 **
SEQ:SUBJ	45	22.4395	0.49866	5.8081	3.359e-08 ***
PRD	1	0.0969	0.09686	1.1281	0.294242
TRT	1	0.0106	0.01057	0.1231	0.727410

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

\$`Type II`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SEQ	1	0.6440	0.64395	7.5005	0.009011 **
SEQ:SUBJ	45	22.5232	0.50052	5.8298	3.173e-08 ***
PRD	1	0.0996	0.09958	1.1599	0.287632
TRT	1	0.0106	0.01057	0.1231	0.727410

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

\$`Type III`

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
SEQ	1	0.3368	0.33679	3.9228	0.05421 .
SEQ:SUBJ	45	22.5232	0.50052	5.8298	3.173e-08 ***
PRD	1	0.0996	0.09958	1.1599	0.28763
TRT	1	0.0106	0.01057	0.1231	0.72741

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

```
options(contrasts=c("contr.sum", "contr.poly"))
```

```
Anova(lm(log(CMAX) ~ SEQ/SUBJ + PRD + TRT, BEdata), type=3, singular.ok=TRUE)
```

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

Anova Table (Type III tests)

Response: log(CMAX)

	Sum Sq	Df	F values	Pr(>F)
SEQ	0.0000	0		
PRD	0.0996	1	1.1599	0.2876
TRT	0.0106	1	0.1231	0.7274
SEQ:SUBJ	22.5232	45	5.8298	3.173e-08 ***
Residuals	3.6059	42		

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

14 Test Summary

Package	Version	Total Count	Identical to SAS	Different from SAS
sasLM	0.10.5	195	195 (100%)	0 (0%)
car	3.1.2	195	173 (89%)	22 (11%)

All of the results by sasLM 0.10.5 were practically identical to those of SAS.

Last digit difference by 1 is resulted from the round-to-even number way of R rounding function.

If you are uncertain about the equivalence of the 'sasLM' to 'SAS,' you can check these examples using 'SAS onDemand' for free.

If you have any question, please mail to the author, Kyun-Seop Bae k@acr.kr.

15 Sesssion Information

R version 4.4.1 (2024-06-14 ucrt)
Platform: x86_64-w64-mingw32/x64
Running under: Windows 10 x64 (build 19044)

Matrix products: default

locale:

[1] LC_COLLATE=Korean_Korea.utf8 LC_CTYPE=Korean_Korea.utf8
[3] LC_MONETARY=Korean_Korea.utf8 LC_NUMERIC=C
[5] LC_TIME=Korean_Korea.utf8

time zone: Asia/Seoul

tzcode source: internal

attached base packages:

[1] stats graphics grDevices utils datasets methods base

other attached packages:

[1] daewr_1.2-11 car_3.1-2 carData_3.0-5 sasLM_0.10.5 mvtnorm_1.3-1
[6] rmarkdown_2.28

loaded via a namespace (and not attached):

[1] digest_0.6.37 fastmap_1.2.0 xfun_0.47 abind_1.4-8
[5] knitr_1.48 htmltools_0.5.8.1 tinytex_0.53 cli_3.6.3
[9] compiler_4.4.1 tools_4.4.1 evaluate_1.0.0 yaml_2.3.10
[13] rlang_1.1.4 MASS_7.3-61