

# Validation of 'sasLM' Package

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# 1 Tested Version and Books used for the Validation

## 1.1 Packages Used

- 'sasLM' version: 0.9.5
- 'SAS' version: 9.4 Licensed and University Edition
- 'car' version: 3.1.1
- R version: R version 4.2.2 (2022-10-31 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, p751) # 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/reps + 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:reps	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:reps	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:reps	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 ~ reps + irrig + reps: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
```

```
$`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
```

\$`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/SAS41m/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	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	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		0			
A1:B1:Tx5	0	0	0	0	0	0	0		0			
A1:B1:Tx6	-1/5	-1/5	4/5	1	-1	1	0		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/aspectt.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, vip265) # 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, 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 ***
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 -2.23358      0      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)
```

### 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 + teehgt, 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 ***
teehgt	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 ***
teehgt	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 ***
teehgt	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 0.0307444  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 0.0307444  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	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","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	0.9.5	195	195 (100%)	0 (0%)
car	3.1.1	195	173 (89%)	22 (11%)

All of the results by sasLM 0.9.5 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 4.2.2 (2022-10-31 ucrt)  
Platform: x86\_64-w64-mingw32/x64 (64-bit)  
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

attached base packages:

[1] stats graphics grDevices utils datasets methods base

other attached packages:

[1] daewr\_1.2-7 car\_3.1-1 carData\_3.0-5 rmarkdown\_2.19 sasLM\_0.9.5  
[6] mvtnorm\_1.1-3

loaded via a namespace (and not attached):

[1] gmp_0.6-9	compiler_4.2.2	mathjaxr_1.6-0
[4] numbers_0.8-5	tools_4.2.2	partitions_1.10-7
[7] digest_0.6.31	evaluate_0.19	lifecycle_1.0.3
[10] lattice_0.20-45	pkgconfig_2.0.3	rlang_1.0.6
[13] igraph_1.3.5	cli_3.5.0	yaml_2.3.6
[16] polynom_1.4-1	xfun_0.36	fastmap_1.1.0
[19] stringr_1.5.0	knitr_1.41	vctrs_0.5.1
[22] scatterplot3d_0.3-42	combinat_0.0-8	lmtest_0.9-40
[25] grid_4.2.2	vcd_1.4-10	DoE.base_1.2-1
[28] glue_1.6.2	Rdpack_2.4	conf.design_2.0.0
[31] FrF2_2.2-3	magrittr_2.0.3	sfsmisc_1.1-14
[34] htmltools_0.5.4	rbibutils_2.2.11	MASS_7.3-58.1
[37] abind_1.4-5	colorspace_2.0-3	tinytex_0.43
[40] stringi_1.7.8	zoo_1.8-11	