

```

1      dm"log;clear;output;clear";
2
3      options ps=61 ls=78 nocenter nonumber nodate;
4      **EXAMPLE 7*****;
5      *** Example of a Factorial Design          ***;
6      *** From Snedecor & Cochran, 1980 (pg 305) ***;
7      *****;
8      OPTIONS PS=256 LS=78 NOCENTER NODATE PAGENO=1;
9      DATA RATS (KEEP=LEVEL SOURCE REP TREATMNT GAIN); INFILE CARDS MISSOEVER;
10     ARRAY G GAIN1-GAIN10;
11     INPUT LEVEL $ SOURCE $ TREATMNT $ 1-11 GAIN1-GAIN10;
12     DO REP = 1 TO 10;
13         GAIN = G{REP}; OUTPUT; END;
14         TITLE1 'EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS';
15         TITLE2 'FACTORIAL DESIGN (2 POR 3) WITH REPLICATES';
16     CARDS;

```

NOTE: The data set WORK.RATS has 60 observations and 5 variables.

NOTE: DATA statement used:

```

real time      3.46 seconds
cpu time       0.07 seconds

```

```
16     !           RUN;
```

```
23     ;
```

```
24     PROC PRINT; TITLE3 'RAW DATA LISTING'; RUN;
```

NOTE: There were 60 observations read from the data set WORK.RATS.

NOTE: The PROCEDURE PRINT printed page 1.

NOTE: PROCEDURE PRINT used:

```

real time      1.19 seconds
cpu time       0.03 seconds

```

**EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
RAW DATA LISTING**

Obs	LEVEL	SOURCE	TREATMNT	REP	GAIN	31	LOW	BEEF	LOW	BEEF	1	90
1	HIGH	BEEF	HIGH BEEF	1	73	32	LOW	BEEF	LOW	BEEF	2	76
2	HIGH	BEEF	HIGH BEEF	2	102	33	LOW	BEEF	LOW	BEEF	3	90
3	HIGH	BEEF	HIGH BEEF	3	118	34	LOW	BEEF	LOW	BEEF	4	64
4	HIGH	BEEF	HIGH BEEF	4	104	35	LOW	BEEF	LOW	BEEF	5	86
5	HIGH	BEEF	HIGH BEEF	5	81	36	LOW	BEEF	LOW	BEEF	6	51
6	HIGH	BEEF	HIGH BEEF	6	107	37	LOW	BEEF	LOW	BEEF	7	72
7	HIGH	BEEF	HIGH BEEF	7	100	38	LOW	BEEF	LOW	BEEF	8	90
8	HIGH	BEEF	HIGH BEEF	8	87	39	LOW	BEEF	LOW	BEEF	9	95
9	HIGH	BEEF	HIGH BEEF	9	117	40	LOW	BEEF	LOW	BEEF	10	78
10	HIGH	BEEF	HIGH BEEF	10	111	41	LOW	CEREAL	LOW	CEREAL	1	107
11	HIGH	CEREAL	HIGH CEREAL	1	98	42	LOW	CEREAL	LOW	CEREAL	2	95
12	HIGH	CEREAL	HIGH CEREAL	2	74	43	LOW	CEREAL	LOW	CEREAL	3	97
13	HIGH	CEREAL	HIGH CEREAL	3	56	44	LOW	CEREAL	LOW	CEREAL	4	80
14	HIGH	CEREAL	HIGH CEREAL	4	111	45	LOW	CEREAL	LOW	CEREAL	5	98
15	HIGH	CEREAL	HIGH CEREAL	5	95	46	LOW	CEREAL	LOW	CEREAL	6	74
16	HIGH	CEREAL	HIGH CEREAL	6	88	47	LOW	CEREAL	LOW	CEREAL	7	74
17	HIGH	CEREAL	HIGH CEREAL	7	82	48	LOW	CEREAL	LOW	CEREAL	8	67
18	HIGH	CEREAL	HIGH CEREAL	8	77	49	LOW	CEREAL	LOW	CEREAL	9	89
19	HIGH	CEREAL	HIGH CEREAL	9	86	50	LOW	CEREAL	LOW	CEREAL	10	58
20	HIGH	CEREAL	HIGH CEREAL	10	92	51	LOW	PORK	LOW	PORK	1	49
21	HIGH	PORK	HIGH PORK	1	94	52	LOW	PORK	LOW	PORK	2	82
22	HIGH	PORK	HIGH PORK	2	79	53	LOW	PORK	LOW	PORK	3	73
23	HIGH	PORK	HIGH PORK	3	96	54	LOW	PORK	LOW	PORK	4	86
24	HIGH	PORK	HIGH PORK	4	98	55	LOW	PORK	LOW	PORK	5	81
25	HIGH	PORK	HIGH PORK	5	102	56	LOW	PORK	LOW	PORK	6	97
26	HIGH	PORK	HIGH PORK	6	102	57	LOW	PORK	LOW	PORK	7	106
27	HIGH	PORK	HIGH PORK	7	108	58	LOW	PORK	LOW	PORK	8	70
28	HIGH	PORK	HIGH PORK	8	91	59	LOW	PORK	LOW	PORK	9	61
29	HIGH	PORK	HIGH PORK	9	120	60	LOW	PORK	LOW	PORK	10	82
30	HIGH	PORK	HIGH PORK	10	105							

```

25      PROC SORT DATA=RATS; BY LEVEL SOURCE; RUN;
NOTE: There were 60 observations read from the data set WORK.RATS.
NOTE: The data set WORK.RATS has 60 observations and 5 variables.
NOTE: PROCEDURE SORT used:
      real time          0.55 seconds
      cpu time           0.05 seconds
26      PROC mixed DATA=RATS CL METHOD=TYPE3; CLASSES LEVEL SOURCE;
27      TITLE3 'FACTORIAL DONE AS 2 WAY ANOVA IN PROC MIXED';
28      MODEL GAIN = LEVEL SOURCE LEVEL*SOURCE / htype=3
OUTP=ResidData;
29      RUN;
NOTE: The data set WORK.RESIDDATA has 60 observations and 12 variables.
NOTE: The PROCEDURE MIXED printed page 2.
NOTE: PROCEDURE MIXED used:
      real time          1.70 seconds
      cpu time           0.17 seconds

```

EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
FACTORIAL DONE AS 2 WAY ANOVA IN PROC MIXED

The Mixed Procedure

Model Information	
Data Set	WORK.RATS
Dependent Variable	GAIN
Covariance Structure	Diagonal
Estimation Method	Type 3
Residual Variance Method	Factor
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Residual

Class Level Information		
Class	Levels	Values
LEVEL	2	HIGH LOW
SOURCE	3	BEEF CEREAL PORK

Dimensions	
Covariance Parameters	1
Columns in X	12
Columns in Z	0
Subjects	1
Max Obs Per Subject	60
Observations Used	60
Observations Not Used	0
Total Observations	60

Type 3 Analysis of Variance			
Source	DF	Sum of Squares	Mean Square
LEVEL	1	3168.266667	3168.266667
SOURCE	2	266.533333	133.266667
LEVEL*SOURCE	2	1178.133333	589.066667
Residual	54	11586	214.555556

Type 3 Analysis of Variance			
Source	Expected Mean Square	Error Term	Error DF
LEVEL	Var(Residual)+Q(LEVEL,LEVEL*SOURCE)	MS(Residual)	54
SOURCE	Var(Residual)+ Q(SOURCE,LEVEL*SOURCE)	MS(Residual)	54
LEVEL*SOURCE	Var(Residual)+Q(LEVEL*SOURCE)	MS(Residual)	54
Residual	Var(Residual)	.	.

Type 3 Analysis of Variance

Source	F Value	Pr > F
LEVEL	14.77	0.0003
SOURCE	0.62	0.5411
LEVEL*SOURCE	2.75	0.0732
Residual	.	.

Covariance Parameter Estimates

Cov Parm	Estimate	Alpha	Lower	Upper
Residual	214.56	0.05	152.06	325.57

Fit Statistics

-2 Res Log Likelihood	457.0
AIC (smaller is better)	459.0
AICC (smaller is better)	459.0
BIC (smaller is better)	461.0

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
LEVEL	1	54	14.77	0.0003
SOURCE	2	54	0.62	0.5411
LEVEL*SOURCE	2	54	2.75	0.0732

```

30          PROC UNIVARIATE DATA=ResidData NORMAL PLOT; VAR RESID;
31          TITLE3 'PROC UNIVARIATE analysis of residuals'; RUN;
NOTE: The PROCEDURE UNIVARIATE printed page 3.
NOTE: PROCEDURE UNIVARIATE used:
      real time           0.09 seconds
      cpu time            0.02 seconds
  
```

EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
 FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
 PROC UNIVARIATE analysis of residuals

The UNIVARIATE Procedure
 Variable: Resid

Moments

N	60	Sum Weights	60
Mean	0	Sum Observations	0
Std Deviation	14.0133109	Variance	196.372881
Skewness	-0.3576888	Kurtosis	-0.3451246
Uncorrected SS	11586	Corrected SS	11586
Coeff Variation	.	Std Error Mean	1.80911065

Basic Statistical Measures

Location		Variability	
Mean	0.00000	Std Deviation	14.01331
Median	2.20000	Variance	196.37288
Mode	10.80000	Range	57.20000
		Interquartile Range	19.60000

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----
Student's t	t 0	Pr > t 1.0000
Sign	M 3.5	Pr >= M 0.4350
Signed Rank	S 40.5	Pr >= S 0.7627

Tests for Normality

Test	--Statistic--		-----p Value-----	
Shapiro-Wilk	W	0.976634	Pr < W	0.3032
Kolmogorov-Smirnov	D	0.090078	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.052988	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.361662	Pr > A-Sq	>0.2500

Quantiles (Definition 5)

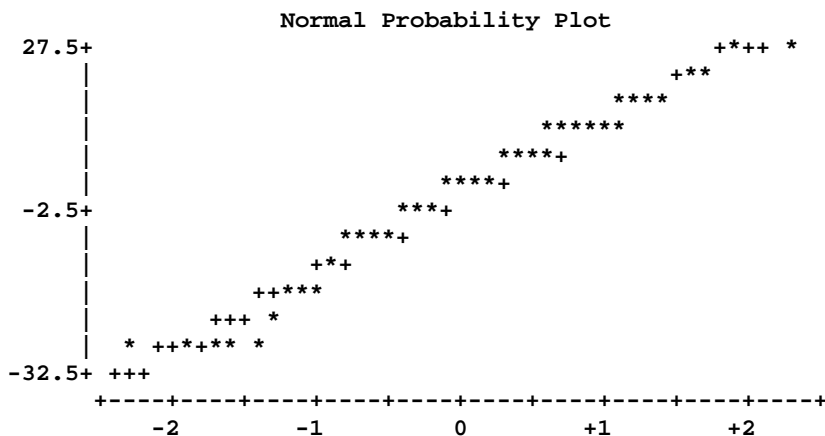
Quantile	Estimate
100% Max	27.30
99%	27.30
95%	21.80
90%	17.50
75% Q3	10.80
50% Median	2.20
25% Q1	-8.80
10%	-19.75
5%	-27.60
1%	-29.90
0% Min	-29.90

Extreme Observations

----Lowest----		----Highest----	
Value	Obs	Value	Obs
-29.9	13	18.3	56
-29.7	51	20.5	29
-28.2	36	23.1	41
-27.0	1	25.1	14
-25.9	50	27.3	57

Stem Leaf	#	Boxplot
2 57	2	
2 03	2	
1 6788	4	
1 11111234	8	+-----+
0 56677789	8	
0 0022222334	10	*-+---*
-0 444321	6	
-0 998766	6	+-----+
-1 3200	4	
-1 9875	4	
-2 0	1	
-2 876	3	
-3 00	2	

-----+
Multiply Stem.Leaf by 10**+1



```
33      PROC MEANS DATA=RATS NOPRINT; BY LEVEL SOURCE; VAR GAIN;
34      OUTPUT OUT=RATMEANS N=N MEAN=MEAN VAR=VAR; RUN;
NOTE: There were 60 observations read from the data set WORK.RATS.
NOTE: The data set WORK.RATMEANS has 6 observations and 7 variables.
NOTE: PROCEDURE MEANS used:
      real time      0.92 seconds
      cpu time       0.06 seconds
```

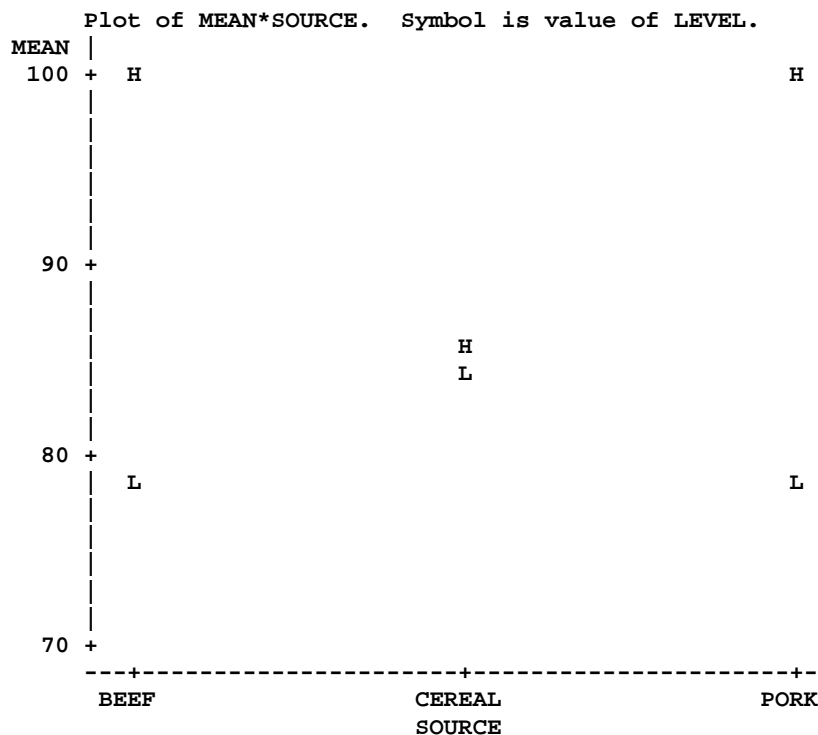
```
35      PROC PRINT DATA=RATMEANS; TITLE3 'LISTING OF MEANS'; RUN;
NOTE: There were 6 observations read from the data set WORK.RATMEANS.
NOTE: The PROCEDURE PRINT printed page 4.
NOTE: PROCEDURE PRINT used:
      real time      0.01 seconds
      cpu time       0.01 seconds
```

EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
LISTING OF MEANS

Obs	LEVEL	SOURCE	_TYPE_	_FREQ_	N	MEAN	VAR
1	HIGH	BEEF	0	10	10	100.0	229.111
2	HIGH	CEREAL	0	10	10	85.9	225.656
3	HIGH	PORK	0	10	10	99.5	119.167
4	LOW	BEEF	0	10	10	79.2	192.844
5	LOW	CEREAL	0	10	10	83.9	246.767
6	LOW	PORK	0	10	10	78.7	273.789

```
35      OPTIONS PS=35;
36      PROC PLOT DATA=RATMEANS; TITLE3 'PLOT OF MEANS'; PLOT
36      ! MEAN*SOURCE=LEVEL; RUN;
NOTE: There were 6 observations read from the data set WORK.RATMEANS.
NOTE: The PROCEDURE PLOT printed page 5.
NOTE: PROCEDURE PLOT used:
      real time      0.01 seconds
      cpu time       0.01 seconds
```

EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
PLOT OF MEANS



```
37      PROC PLOT DATA=RATMEANS; TITLE3 'VARIANCE ON MEANS PLOT'; PLOT
37      ! VAR*MEAN; RUN;
38      OPTIONS PS=256;
```

NOTE: There were 6 observations read from the data set WORK.RATMEANS.

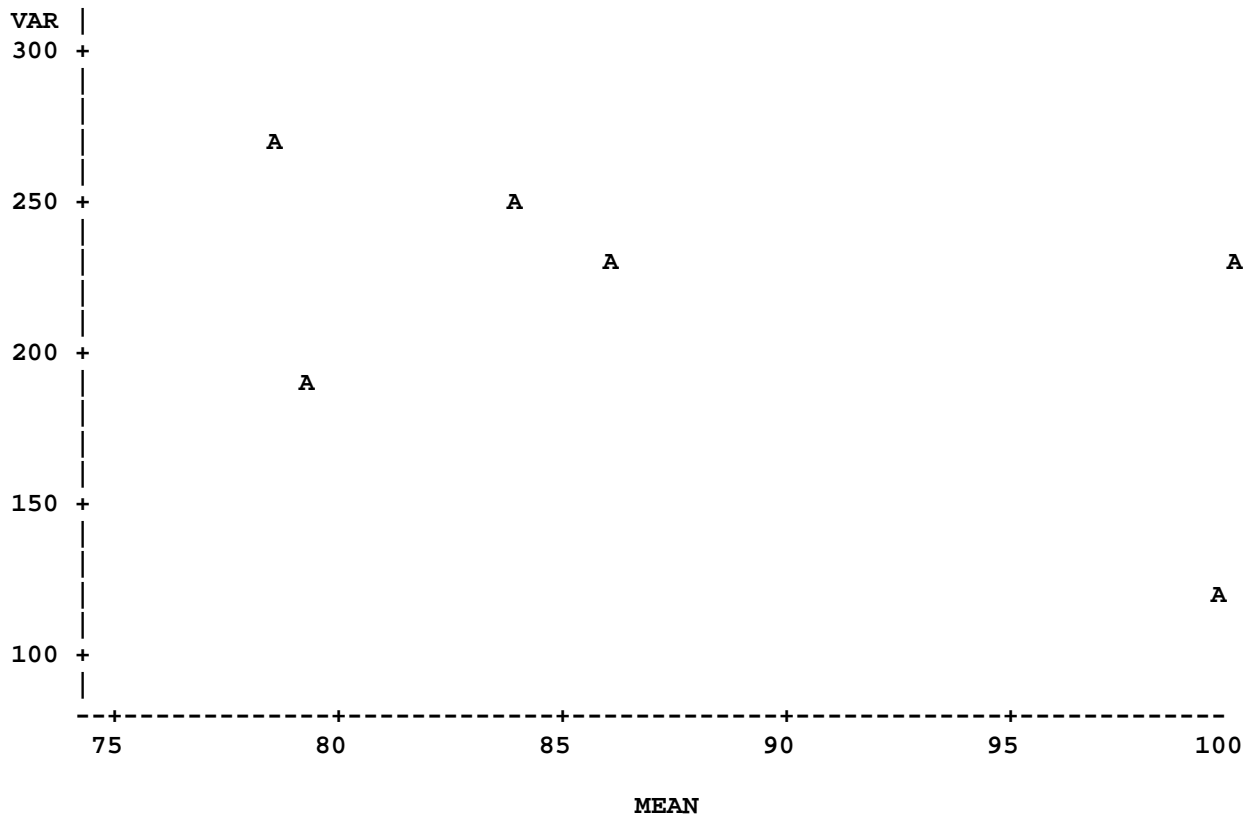
NOTE: The PROCEDURE PLOT printed page 6.

NOTE: PROCEDURE PLOT used:

```
real time      0.01 seconds
cpu time       0.01 seconds
```

EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
VARIANCE ON MEANS PLOT

Plot of VAR*MEAN. Legend: A = 1 obs, B = 2 obs, etc.



```
40      PROC GLM DATA=RATS; CLASSES LEVEL SOURCE;
41      TITLE3 'FACTORIAL DONE AS 2 WAY ANOVA IN GLM';
42      TITLE4 'ALL TREATMENTS PROBABLY SHOULD BE FIXED, RUN AS MIXED MODEL TO SHOW EMS';
43      MODEL GAIN = LEVEL SOURCE LEVEL*SOURCE;
44      RANDOM LEVEL SOURCE LEVEL*SOURCE / TEST;
45      RUN;
```

NOTE: TYPE I EMS not available without the E1 option.

46

47

NOTE: The PROCEDURE GLM printed pages 7-10.

NOTE: PROCEDURE GLM used:

```
real time      0.73 seconds
cpu time       0.04 seconds
```

EXST7015: WEIGHT GAIN IN RATS ON VARIOUS DIETS
 FACTORIAL DESIGN (2 POR 3) WITH REPLICATES
 FACTORIAL DONE AS 2 WAY ANOVA IN GLM
 ALL TREATMENTS PROBABLY SHOULD BE FIXED, RUN AS MIXED MODEL TO SHOW EMS

The GLM Procedure

```

Class Level Information
Class          Levels  Values
LEVEL          2      HIGH LOW
SOURCE         3      BEEF CEREAL PORK
Number of observations      60
    
```

Dependent Variable: GAIN

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	4612.93333	922.58667	4.30	0.0023
Error	54	11586.00000	214.55556		
Corrected Total	59	16198.93333			

R-Square	Coeff Var	Root MSE	GAIN Mean
0.284768	16.67039	14.64772	87.86667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
LEVEL	1	3168.266667	3168.266667	14.77	0.0003
SOURCE	2	266.533333	133.266667	0.62	0.5411
LEVEL*SOURCE	2	1178.133333	589.066667	2.75	0.0732

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LEVEL	1	3168.266667	3168.266667	14.77	0.0003
SOURCE	2	266.533333	133.266667	0.62	0.5411
LEVEL*SOURCE	2	1178.133333	589.066667	2.75	0.0732

Source	Type III Expected Mean Square
LEVEL	Var(Error) + 10 Var(LEVEL*SOURCE) + 30 Var(LEVEL)
SOURCE	Var(Error) + 10 Var(LEVEL*SOURCE) + 20 Var(SOURCE)
LEVEL*SOURCE	Var(Error) + 10 Var(LEVEL*SOURCE)

Tests of Hypotheses for Random Model Analysis of Variance

Dependent Variable: GAIN

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LEVEL	1	3168.266667	3168.266667	5.38	0.1462
SOURCE	2	266.533333	133.266667	0.23	0.8155
Error	2	1178.133333	589.066667		

Error: MS(LEVEL*SOURCE)

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LEVEL*SOURCE	2	1178.133333	589.066667	2.75	0.0732
Error: MS(Error)	54	11586	214.555556		

```

48      data rats; set rats;
49          if level eq 'HIGH' then gainh = gain;
50          if level eq 'LOW' then gainl = gain;
51      run;
    
```

NOTE: There were 60 observations read from the data set WORK.RATS.

NOTE: The data set WORK.RATS has 60 observations and 7 variables.

NOTE: DATA statement used:

real time	0.74 seconds
cpu time	0.02 seconds

52

```
53      GOPTIONS DEVICE=cgm GSFMODE=REPLACE GSFNAME=OUT1 NOPROMPT norotate;
54      FILENAME OUT1 'C:\Geaghan\EXST\EXST7015New\SAS\rats01.CGM';
55      PROC Gplot DATA=rats;
56          TITLE3 F=SWISS H=1 'Plot with standard 2x errors to examine
interaction';
57          PLOT gainh*source=1 gainl*source=2 / OVERLAY HAXIS=AXIS1 VAXIS=AXIS2;
58              AXIS1 LABEL=(F=SWISS H=1 'Protein source') WIDTH=5 MINOR=(N=4)
59                  VALUE=(F=SWISS H=1);
60              AXIS2 LABEL=(F=SWISS H=1 'Weight gain') WIDTH=6
61                  VALUE=(F=SWISS H=1) MINOR=(N=4) ORDER= 70 TO 110 BY 10;
62          SYMBOL1 C=RED      L=1 V=NONE I=STD1mjtp W=1 H=1mode=include;
63          SYMBOL2 C=BLUE     L=1 V=NONE I=STD1mjtp W=1 H=1mode=include;
64          **** V = dot would place a dot for each point;
65          **** I = requests STD (std dev) 1 (1 width, 2 or 3) M (of mean=std
66          ! err)
67              J (join means of bars) t (add top & bottom hash) p (use pooled
68          ! variance);
69          **** Other options: omit M=std dev, use B to get bar for min/max;
70          *   SYMBOL1 C=green  L=1 V=dot  I=none   W=1 H=1 mode=include;
71          *   SYMBOL2 C=magenta L=1 V=dot  I=none   W=1 H=1 mode=include;
72          RUN;
```

WARNING: The axis frame outline was drawn with line width 6 as specified on the left vertical axis. Any other axis line widths were ignored.

NOTE: 30 observation(s) contained a MISSING value for the gainh * SOURCE request.

NOTE: 6 observation(s) outside the axis range for the gainh * SOURCE request.

NOTE: 30 observation(s) contained a MISSING value for the gainl * SOURCE request.

NOTE: 6 observation(s) outside the axis range for the gainl * SOURCE request.

NOTE: 24 RECORDS WRITTEN TO C:\Geaghan\EXST\EXST7015New\SAS\rats01.CGM

70 ! QUIT;

NOTE: There were 60 observations read from the data set WORK.RATS.

NOTE: PROCEDURE Gplot used:

real time	4.13 seconds
cpu time	0.22 seconds

71

```
72      GOPTIONS GSFNAME=OUT2; FILENAME OUT2
73      ! 'C:\Geaghan\EXST\EXST7015New\SAS\RATS02.CGM';
74      PROC Gchart DATA=RATS; TITLE3 'BLOCK CHART TO EXAMINE INTERACTIONS'
75      ! ;
76          BLOCK SOURCE / GROUP=LEVEL SUMVAR=GAIN TYPE=MEAN DISCRETE;
77          PATTERN C=RED V=S;RUN;
```

NOTE: 25 RECORDS WRITTEN TO C:\Geaghan\EXST\EXST7015New\SAS\RATS02.CGM


```
80      *EXAMPLE 8 *****;
81      *** Example of a 2*2*2 Factorial Design      ***;
82      *** From Snedecor & Cochran, 1980 (pg 359)  ***;
83      *****;
84      OPTIONS PS=256 LS=78 NOCENTER NODATE PAGENO=1;
```

NOTE: There were 60 observations read from the data set WORK.RATS.

NOTE: PROCEDURE GCHART used:

```
real time      0.28 seconds
cpu time       0.04 seconds
```

```
85      DATA PIGS (KEEP=LYSINE PROTEIN REP SEX GAIN); INFILE CARDS MISSEVER
86      ! ;
87      ARRAY G GAIN1-GAIN8;
88      INPUT LYSINE PROTEIN SEX $ GAIN1-GAIN8;
89      FORMAT GAIN 5.1;
90      DO REP = 1 TO 8;
91      GAIN = G{REP}; OUTPUT; END;
92      TITLE1 'EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS';
93      TITLE2 'FACTORIAL DESIGN (2x2x2) WITH REPLICATES';
94      CARDS;
```

NOTE: The data set WORK.PIGS has 64 observations and 5 variables.

NOTE: DATA statement used:

```
real time      0.29 seconds
cpu time       0.02 seconds
```

```
93      !          RUN;
102     ;
103     PROC PRINT; TITLE3 'RAW DATA LISTING'; RUN;
```

NOTE: There were 64 observations read from the data set WORK.PIGS.

NOTE: The PROCEDURE PRINT printed page 1.

NOTE: PROCEDURE PRINT used:

```
real time      0.02 seconds
cpu time       0.01 seconds
```

**EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
FACTORIAL DESIGN (2x2x2) WITH REPLICATES
RAW DATA LISTING**

Obs	LYSINE	PROTEIN	SEX	GAIN	REP	33	0.6	12	M	1.2	1
1	0.0	12	M	1.1	1	34	0.6	12	M	1.1	2
2	0.0	12	M	1.0	2	35	0.6	12	M	1.3	3
3	0.0	12	M	1.1	3	36	0.6	12	M	1.4	4
4	0.0	12	M	1.0	4	37	0.6	12	M	1.3	5
5	0.0	12	M	0.9	5	38	0.6	12	M	1.2	6
6	0.0	12	M	1.2	6	39	0.6	12	M	1.3	7
7	0.0	12	M	1.3	7	40	0.6	12	M	1.3	8
8	0.0	12	M	1.0	8	41	0.6	12	F	0.9	1
9	0.0	12	F	1.0	1	42	0.6	12	F	1.0	2
10	0.0	12	F	1.0	2	43	0.6	12	F	1.2	3
11	0.0	12	F	1.0	3	44	0.6	12	F	1.3	4
12	0.0	12	F	1.0	4	45	0.6	12	F	1.0	5
13	0.0	12	F	1.0	5	46	0.6	12	F	1.1	6
14	0.0	12	F	1.2	6	47	0.6	12	F	1.4	7
15	0.0	12	F	1.2	7	48	0.6	12	F	1.3	8
16	0.0	12	F	1.2	8	49	0.6	14	M	1.4	1
17	0.0	14	M	1.5	1	50	0.6	14	M	1.1	2
18	0.0	14	M	1.5	2	51	0.6	14	M	1.4	3
19	0.0	14	M	1.3	3	52	0.6	14	M	1.2	4
20	0.0	14	M	1.2	4	53	0.6	14	M	1.5	5
21	0.0	14	M	1.7	5	54	0.6	14	M	1.4	6
22	0.0	14	M	1.2	6	55	0.6	14	M	1.2	7
23	0.0	14	M	1.3	7	56	0.6	14	M	1.2	8
24	0.0	14	M	1.3	8	57	0.6	14	F	1.1	1
25	0.0	14	F	1.5	1	58	0.6	14	F	1.1	2
26	0.0	14	F	1.2	2	59	0.6	14	F	1.5	3
27	0.0	14	F	1.5	3	60	0.6	14	F	1.4	4
28	0.0	14	F	1.2	4	61	0.6	14	F	1.2	5
29	0.0	14	F	1.2	5	62	0.6	14	F	1.2	6
30	0.0	14	F	1.6	6	63	0.6	14	F	1.0	7
31	0.0	14	F	1.1	7	64	0.6	14	F	1.1	8
32	0.0	14	F	1.4	8						

```

104      PROC SORT DATA=PIGS; BY LYSINE PROTEIN SEX; RUN;
NOTE: There were 64 observations read from the data set WORK.PIGS.
NOTE: The data set WORK.PIGS has 64 observations and 5 variables.
NOTE: PROCEDURE SORT used:
      real time          0.05 seconds
      cpu time           0.04 seconds
105      PROC MIXED DATA=PIGS CL METHOD=TYPE3; CLASSES LYSINE PROTEIN SEX;
106      TITLE3 'ANALYSIS OF VARIANCE WITH MIXED';
107      MODEL GAIN = LYSINE|PROTEIN|SEX / htype=3 OUTP=ResidData;
108      RUN;
NOTE: The data set WORK.RESIDDATA has 64 observations and 12 variables.
NOTE: The PROCEDURE MIXED printed page 2.
NOTE: PROCEDURE MIXED used:
      real time          0.53 seconds
      cpu time           0.13 seconds
108      !      QUIT;

```

EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
FACTORIAL DESIGN (2x2x2) WITH REPLICATES
ANALYSIS OF VARIANCE WITH MIXED

The Mixed Procedure

Model Information	
Data Set	WORK.PIGS
Dependent Variable	GAIN
Covariance Structure	Diagonal
Estimation Method	Type 3
Residual Variance Method	Factor
Fixed Effects SE Method	Model-Based
Degrees of Freedom Method	Residual

Class Level Information		
Class	Levels	Values
LYSINE	2	0 0.6
PROTEIN	2	12 14
SEX	2	F M

Dimensions	
Covariance Parameters	1
Columns in X	27
Columns in Z	0
Subjects	1
Max Obs Per Subject	64
Observations Used	64
Observations Not Used	0
Total Observations	64

Type 3 Analysis of Variance			
Source	DF	Sum of Squares	Mean Square
LYSINE	1	0.003164	0.003164
PROTEIN	1	0.430664	0.430664
LYSINE*PROTEIN	1	0.258827	0.258827
SEX	1	0.057002	0.057002
LYSINE*SEX	1	0.037539	0.037539
PROTEIN*SEX	1	0.000076562	0.000076562
LYSINE*PROTEIN*SEX	1	0.011289	0.011289
Residual	56	1.240538	0.022152

Type 3 Analysis of Variance

Source	Expected Mean Square	Error Term	Error DF
LYSINE	Var(Residual) + Q(LYSINE,LYSINE*PROTEIN,LYSINE* SEX,LYSINE*PROTEIN*SEX)	MS(Residual)	56
PROTEIN	Var(Residual) + Q(PROTEIN,LYSINE*PROTEIN,PROTEIN* SEX,LYSINE*PROTEIN*SEX)	MS(Residual)	56
LYSINE*PROTEIN	Var(Residual) + Q(LYSINE*PROTEIN,LYSINE* PROTEIN*SEX)	MS(Residual)	56
SEX	Var(Residual) + Q(SEX,LYSINE*SEX,PROTEIN* SEX,LYSINE*PROTEIN*SEX)	MS(Residual)	56
LYSINE*SEX	Var(Residual) + Q(LYSINE*SEX,LYSINE*PROTEIN*SEX)	MS(Residual)	56
PROTEIN*SEX	Var(Residual) + Q(PROTEIN*SEX,LYSINE*PROTEIN*SEX)	MS(Residual)	56
LYSINE*PROTEIN*SEX	Var(Residual) + Q(LYSINE*PROTEIN*SEX)	MS(Residual)	56
Residual	Var(Residual)	.	.

Type 3 Analysis of Variance

Source	F Value	Pr > F
LYSINE	0.14	0.7069
PROTEIN	19.44	<.0001
LYSINE*PROTEIN	11.68	0.0012
SEX	2.57	0.1143
LYSINE*SEX	1.69	0.1983
PROTEIN*SEX	0.00	0.9533
LYSINE*PROTEIN*SEX	0.51	0.4783
Residual	.	.

Covariance Parameter Estimates

Cov Parm	Estimate	Alpha	Lower	Upper
Residual	0.02215	0.05	0.01579	0.03334

Fit Statistics

-2 Res Log Likelihood	-37.8
AIC (smaller is better)	-35.8
AICC (smaller is better)	-35.7
BIC (smaller is better)	-33.8

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
LYSINE	1	56	0.14	0.7069
PROTEIN	1	56	19.44	<.0001
LYSINE*PROTEIN	1	56	11.68	0.0012
SEX	1	56	2.57	0.1143
LYSINE*SEX	1	56	1.69	0.1983
PROTEIN*SEX	1	56	0.00	0.9533
LYSINE*PROTEIN*SEX	1	56	0.51	0.4783

110 PROC UNIVARIATE DATA=ResidData NORMAL PLOT; VAR RESID;
111 TITLE3 'PROC UNIVARIATE analysis of residuals'; RUN;
NOTE: The PROCEDURE UNIVARIATE printed page 3.
NOTE: PROCEDURE UNIVARIATE used:

EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
FACTORIAL DESIGN (2x2x2) WITH REPLICATES
PROC UNIVARIATE analysis of residuals

The UNIVARIATE Procedure

Variable: Resid

		Moments	
N	64	Sum Weights	64
Mean	0	Sum Observations	0
Std Deviation	0.14032488	Variance	0.01969107
Skewness	0.24838382	Kurtosis	-0.9998829
Uncorrected SS	1.2405375	Corrected SS	1.2405375
Coeff Variation	.	Std Error Mean	0.01754061

Basic Statistical Measures

Location		Variability	
Mean	0.00000	Std Deviation	0.14032
Median	-0.03625	Variance	0.01969
Mode	-0.08625	Range	0.56375
		Interquartile Range	0.23500

Tests for Location: Mu0=0

Test	-Statistic-	-----p Value-----	
Student's t	t 0	Pr > t	1.0000
Sign	M -3	Pr >= M	0.5323
Signed Rank	S -9	Pr >= S	0.9526

Tests for Normality

Test	--Statistic--	-----p Value-----	
Shapiro-Wilk	W 0.959246	Pr < W	0.0334
Kolmogorov-Smirnov	D 0.12541	Pr > D	0.0137
Cramer-von Mises	W-Sq 0.193266	Pr > W-Sq	0.0064
Anderson-Darling	A-Sq 1.027144	Pr > A-Sq	0.0098

Quantiles (Definition 5)

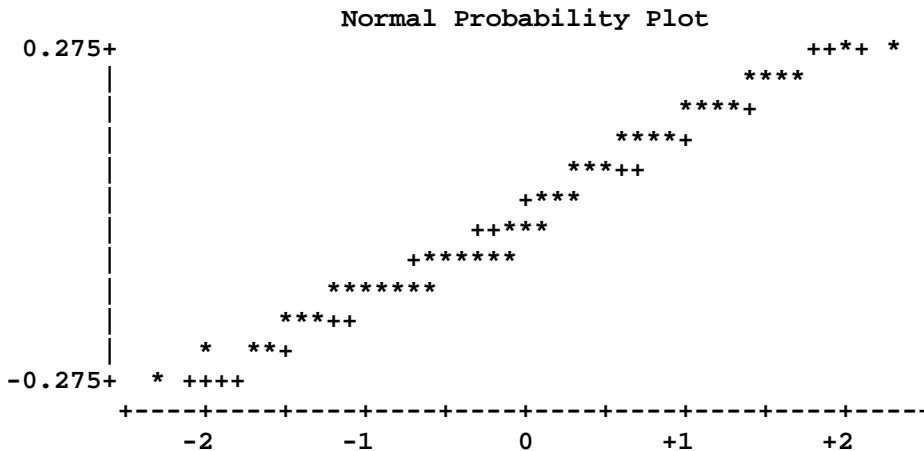
Quantile	Estimate
100% Max	0.29125
99%	0.29125
95%	0.23125
90%	0.19125
75% Q3	0.12375
50% Median	-0.03625
25% Q1	-0.11125
10%	-0.15875
5%	-0.20750
1%	-0.27250
0% Min	-0.27250

Extreme Observations

-----Lowest-----		-----Highest-----	
Value	Obs	Value	Obs
-0.27250	33	0.22625	52
-0.20875	13	0.23125	15
-0.20875	23	0.23125	22
-0.20750	58	0.26625	51
-0.19375	55	0.29125	29

Stem Leaf	#	Boxplot
2 79	2	
2 2333	4	
1 556789	6	
1 0113444	7	+-----+
0 566799	6	
0 2344	4	+
-0 4320	4	*-----*
-0 999988877665	12	
-1 44442211110	11	+-----+
-1 9865	4	
-2 111	3	
-2 7	1	

-----+-----+-----+-----+
Multiply Stem.Leaf by 10**⁻¹



```

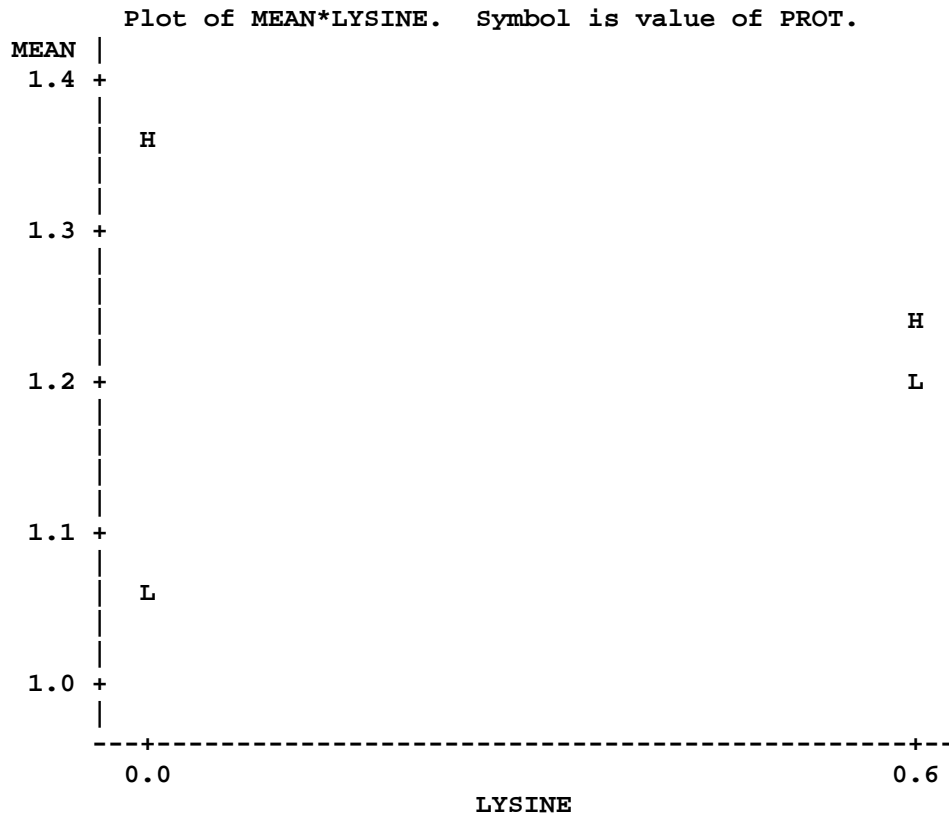
113      PROC MEANS DATA=PIGS NOPRINT; BY LYSINE PROTEIN; VAR GAIN;
114      OUTPUT OUT=PIGMEANS N=N MEAN=MEAN VAR=VAR; RUN;
NOTE: There were 64 observations read from the data set WORK.PIGS.
NOTE: The data set WORK.PIGMEANS has 4 observations and 7 variables.
NOTE: PROCEDURE MEANS used:
      real time          0.25 seconds
      cpu time           0.04 seconds
115      DATA PIGMEANS; SET PIGMEANS; PROT='H'; IF PROTEIN LE 12 THEN
116      ! PROT='L'; RUN;
NOTE: There were 4 observations read from the data set WORK.PIGMEANS.
NOTE: The data set WORK.PIGMEANS has 4 observations and 8 variables.
NOTE: DATA statement used:
      real time          0.08 seconds
      cpu time           0.04 seconds
116      PROC PRINT DATA=PIGMEANS; TITLE3 'LISTING OF MEANS'; RUN;
NOTE: There were 4 observations read from the data set WORK.PIGMEANS.
NOTE: The PROCEDURE PRINT printed page 4.
NOTE: PROCEDURE PRINT used:
      real time          0.02 seconds
      cpu time           0.01 seconds
117      OPTIONS PS=35;
118      PROC PLOT DATA=PIGMEANS; TITLE3 'PLOT OF MEANS';
119      PLOT MEAN*LYSINE=PROT; RUN;

```

EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
 FACTORIAL DESIGN (2x2x2) WITH REPLICATES
 LISTING OF MEANS

Obs	LYSINE	PROTEIN	_TYPE_	_FREQ_	N	MEAN	VAR	PROT
1	0.0	12	0	16	16	1.1	0.016033	L
2	0.0	14	0	16	16	1.4	0.027172	H
3	0.6	12	0	16	16	1.2	0.023105	L
4	0.6	14	0	16	16	1.2	0.023453	H

EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
 FACTORIAL DESIGN (2x2x2) WITH REPLICATES
 PLOT OF MEANS



```

120      GOPTIONS GSFNAME=OUT2;  FILENAME OUT2
120      ! 'C:\Geaghan\EXST\EXST7015New\SAS\PIGS.CGM';
NOTE: There were 4 observations read from the data set WORK.PIGMEANS.
NOTE: The PROCEDURE PLOT printed page 5.
NOTE: PROCEDURE PLOT used:
      real time          0.03 seconds
      cpu time           0.01 seconds
121      PROC GCHART DATA=PIGS; TITLE3 'BLOCK CHART TO EXAMINE
INTERACTIONS'
121      ! ;
122      BLOCK lysine / GROUP=PROTEIN SUMVAR=GAIN TYPE=MEAN DISCRETE;
123      PATTERN C=RED V=S; RUN;
NOTE: 22 RECORDS WRITTEN TO C:\Geaghan\EXST\EXST7015New\SAS\PIGS.CGM
124      OPTIONS PS=256 LS=78;
NOTE: There were 64 observations read from the data set WORK.PIGS.
NOTE: PROCEDURE GCHART used:
      real time          0.26 seconds
      cpu time           0.06 seconds
  
```

```

126      PROC GLM DATA=PIGS; CLASSES LYSINE PROTEIN SEX;
127          TITLE3 'ANALYSIS OF VARIANCE WITH GLM';
128          TITLE4 'ALL TREATMENTS PROBABLY SHOULD BE FIXED, RUN AS MIXED
128      ! MODEL TO SHOW EMS';
129          MODEL GAIN = LYSINE|PROTEIN|SEX;
130          RANDOM LYSINE|PROTEIN LYSINE*SEX PROTEIN*SEX LYSINE*PROTEIN*SEX
/
130      ! TEST;
131          RUN;
NOTE: TYPE I EMS not available without the E1 option.
131      ! QUIT;
NOTE: The PROCEDURE GLM printed pages 6-9.
NOTE: PROCEDURE GLM used:
      real time          0.09 seconds
      cpu time           0.09 seconds

```

EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
 FACTORIAL DESIGN (2x2x2) WITH REPLICATES
 ANALYSIS OF VARIANCE WITH GLM
 ALL TREATMENTS PROBABLY SHOULD BE FIXED, RUN AS MIXED MODEL TO SHOW EMS

The GLM Procedure

Class Level Information

Class	Levels	Values
LYSINE	2	0 0.6
PROTEIN	2	12 14
SEX	2	F M
Number of observations		64

Dependent Variable: GAIN

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	0.79856094	0.11408013	5.15	0.0001
Error	56	1.24053750	0.02215246		
Corrected Total	63	2.03909844			

R-Square	Coeff Var	Root MSE	GAIN Mean
0.391625	12.19819	0.148837	1.220156

Source	DF	Type I SS	Mean Square	F Value	Pr > F
LYSINE	1	0.00316406	0.00316406	0.14	0.7069
PROTEIN	1	0.43066406	0.43066406	19.44	<.0001
LYSINE*PROTEIN	1	0.25882656	0.25882656	11.68	0.0012
SEX	1	0.05700156	0.05700156	2.57	0.1143
LYSINE*SEX	1	0.03753906	0.03753906	1.69	0.1983
PROTEIN*SEX	1	0.00007656	0.00007656	0.00	0.9533
LYSINE*PROTEIN*SEX	1	0.01128906	0.01128906	0.51	0.4783

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LYSINE	1	0.00316406	0.00316406	0.14	0.7069
PROTEIN	1	0.43066406	0.43066406	19.44	<.0001
LYSINE*PROTEIN	1	0.25882656	0.25882656	11.68	0.0012
SEX	1	0.05700156	0.05700156	2.57	0.1143
LYSINE*SEX	1	0.03753906	0.03753906	1.69	0.1983
PROTEIN*SEX	1	0.00007656	0.00007656	0.00	0.9533
LYSINE*PROTEIN*SEX	1	0.01128906	0.01128906	0.51	0.4783

EXST7015: PIG WEIGHT GAIN WITH DIET SUPPLEMENTS
FACTORIAL DESIGN (2x2x2) WITH REPLICATES
ANALYSIS OF VARIANCE WITH GLM
ALL TREATMENTS PROBABLY SHOULD BE FIXED, RUN AS MIXED MODEL TO SHOW EMS

The GLM Procedure

Source	Type III Expected Mean Square
LYSINE	Var(Error) + 8 Var(LYSINE*PROTEIN*SEX) + 16 Var(LYSINE*SEX) + 16 Var(LYSINE*PROTEIN) + 32 Var(LYSINE)
PROTEIN	Var(Error) + 8 Var(LYSINE*PROTEIN*SEX) + 16 Var(PROTEIN*SEX) + 16 Var(LYSINE*PROTEIN) + 32 Var(PROTEIN)
LYSINE*PROTEIN	Var(Error) + 8 Var(LYSINE*PROTEIN*SEX) + 16 Var(LYSINE*PROTEIN)
SEX	Var(Error) + 8 Var(LYSINE*PROTEIN*SEX) + 16 Var(PROTEIN*SEX) + 16 Var(LYSINE*SEX) + Q(SEX)
LYSINE*SEX	Var(Error) + 8 Var(LYSINE*PROTEIN*SEX) + 16 Var(LYSINE*SEX)
PROTEIN*SEX	Var(Error) + 8 Var(LYSINE*PROTEIN*SEX) + 16 Var(PROTEIN*SEX)

Tests of Hypotheses for Mixed Model Analysis of Variance

Dependent Variable: GAIN

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LYSINE	1	0.003164	0.003164	0.01	0.9310
Error	1.1859	0.338079	0.285077		
Error: MS(LYSINE*PROTEIN) + MS(LYSINE*SEX) - MS(LYSINE*PROTEIN*SEX)					

Source	DF	Type III SS	Mean Square	F Value	Pr > F
PROTEIN	1	0.430664	0.430664	1.74	0.4279
Error	0.9135	0.226195	0.247614		
Error: MS(LYSINE*PROTEIN) + MS(PROTEIN*SEX) - MS(LYSINE*PROTEIN*SEX)					

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LYSINE*PROTEIN	1	0.258827	0.258827	22.93	0.1311
LYSINE*SEX	1	0.037539	0.037539	3.33	0.3193
PROTEIN*SEX	1	0.000076563	0.000076563	0.01	0.9477
Error	1	0.011289	0.011289		
Error: MS(LYSINE*PROTEIN*SEX)					

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SEX	1	0.057002	0.057002	2.17	0.5332
Error	0.451	0.011874	0.026327		
Error: MS(LYSINE*SEX) + MS(PROTEIN*SEX) - MS(LYSINE*PROTEIN*SEX)					

Source	DF	Type III SS	Mean Square	F Value	Pr > F
LYSINE*PROTEIN*SEX	1	0.011289	0.011289	0.51	0.4783
Error: MS(Error)	56	1.240537	0.022152		