THE UNIVERSITY OF BRITISH COLUMBIA

FORESTRY 430 and 533

FINAL EXAMINATION: December 9, 2005 Instructor: Val LeMay

Time: 2 hours

75 Marks FRST 430 90 Marks FRST 533 **(extra questions)**

This examination consists of **3** questions, plus SAS outputs for some questions. A t-table and an F-table are attached at the end of the exam. Show hypothesis for all tests, and state the alpha level that you used. **There are 3 extra part-questions for FRST 533 students only.**

(25) 1. A forest inventory specialist wanted to obtain a model to predict volume per ha (natural log is used; lnvolha) from basal area per ha (natural log is used; lnbaha) and average height (natural log is used; lnaveht), since these two other variables are easier to measure. Field samples were collected and analyzed in order to obtain the three variables for a number of sample plots, and graphs of volume versus the other variables are drawn. A linear model was fitted using the sample data (**see Output 1**).

(a) Based on the output:

i. Were the assumptions of multiple linear regression met for this equation;

ii. How good is this equation, based on the coefficient of determination (R^2) and Root MSE (also called SE_E)); and

iii. Is the regression significant?

iv. Are each of the variables in the model significant?

Show all hypotheses and give full evidence.

(b) Give the fitted equation to predict lnvolha.

(c) **For 533 only: We would to test whether the coefficient associate with lnaveht could be equal to 2. Set up an appropriate test for this constraint on your selected equation. (4 points)**

(25) 2. A study on thinning and fertilization of Douglas-fir trees is established on Vancouver Island. For this study, they first select two sites, out of many possible sites, with nine experimental units on each site. They randomly allocate the treatments (fertilizer (F0=none, F1=224 kg N/ha; F2=448 kg N/ha) by thinning (T0=none, T1=moderate, T2=heavy)combinations) to the nine experimental units for each site. After 24 years, the research group hires you to look for possible differences in volume/ha at the end of the 24 year period (volha_24yrs). They indicate that they are only interested in the levels of fertilizer and of thinning that are in the experiment.

(a) What would you call this design and why?

(b) You use SAS to analyze these data and produce some graphs for volha_24yrs. **(See Output 2).**

i. Are the assumptions of analysis of variance met? **Briefly** give evidence of why or why not. **(Note: There are two analyses – choose the one that best meets the assumptions)**

ii. Is there an interaction between thinning and fertilizer?

iii. If there is an interaction, which treatments differ? **(NOTE: might be easier to indicate which treatments do NOT differ).**

OR

iii. If there is no interaction,

1) is there a difference in volha_24yrs between fertilizer levels? If so, which levels differ?
2) is there a difference in volha_24yrs between thinning levels? If so, which levels differ?

(c) **FOR 533 only: List three ways that you might improve this design. (6 points)**

(25) 3. You are hired by researchers to help with analyze their experimental results. In a research report, they describe the project as: (NOTE: Trout is a fish):

"We are interested in how increased water temperature might affect trout morphological characteristics, including weight, length, and dorsal fin size. We selected one species of trout from BC. We obtained 30 juvenile fish of this species. We then simulated two water temperatures: equal to the expected temperature in natural streams, or increased by 3 degrees C. Six tanks were then obtained, and water temperature was randomly assigned to each tank. Five juveniles were then placed in each tank. The randomly assigned water temperature was then maintained, and all other conditions were the same over all tanks. At the end of 2 months, the fish were removed, and morphological measures (length, weight, and dorsal fin length) were taken on each fish."

(a) For this design:

i. What are the factors? How many levels in each? Fixed or random-effects? Were any factors nested? Any blocking?

ii. What is the experimental unit? How many are there in total? How many experimental units do you have per treatment?

iii. Any subsampling? How many observations are there in total?

iv. What are the response variables?

v. What would you call this design?

(b) For this design with one trout species:

i. List the linear model.

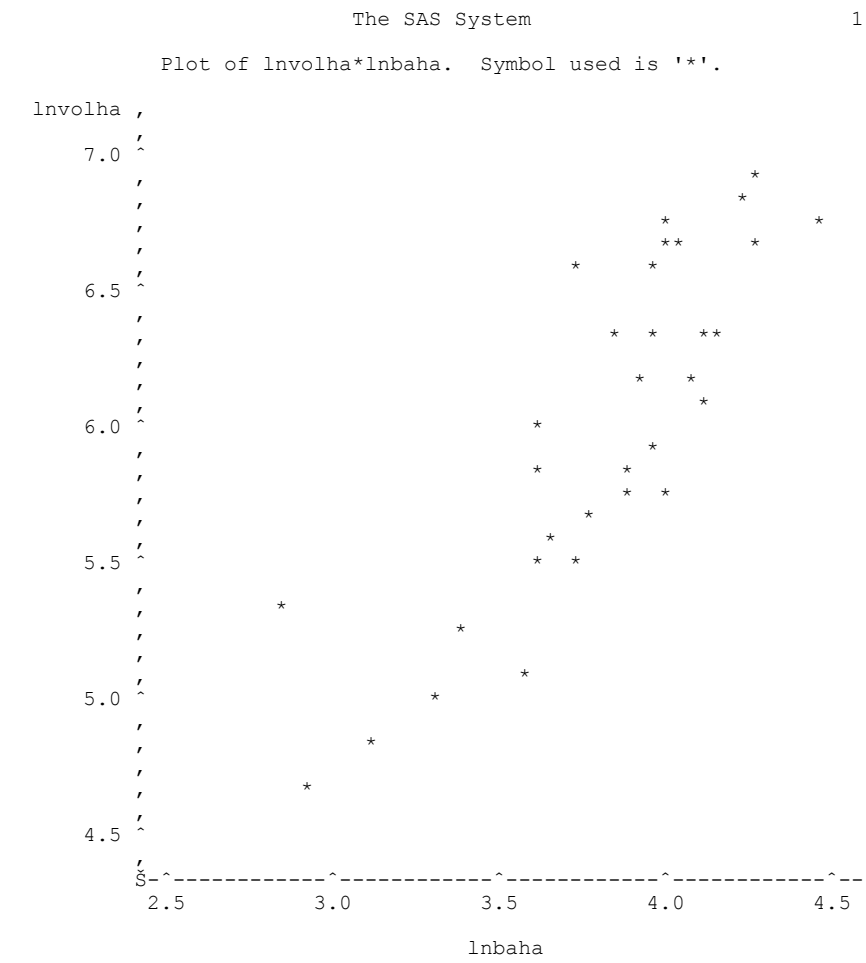
ii. Show an analysis of variance table with the 1) source (e.g., temperature, etc); 2) degrees of freedom (be specific for this design).

iii. What mean squares would you use for the numerator and the denominator of F-test for differences between temperatures, based on expected means squares for this design? Show the hypothesis statement also.

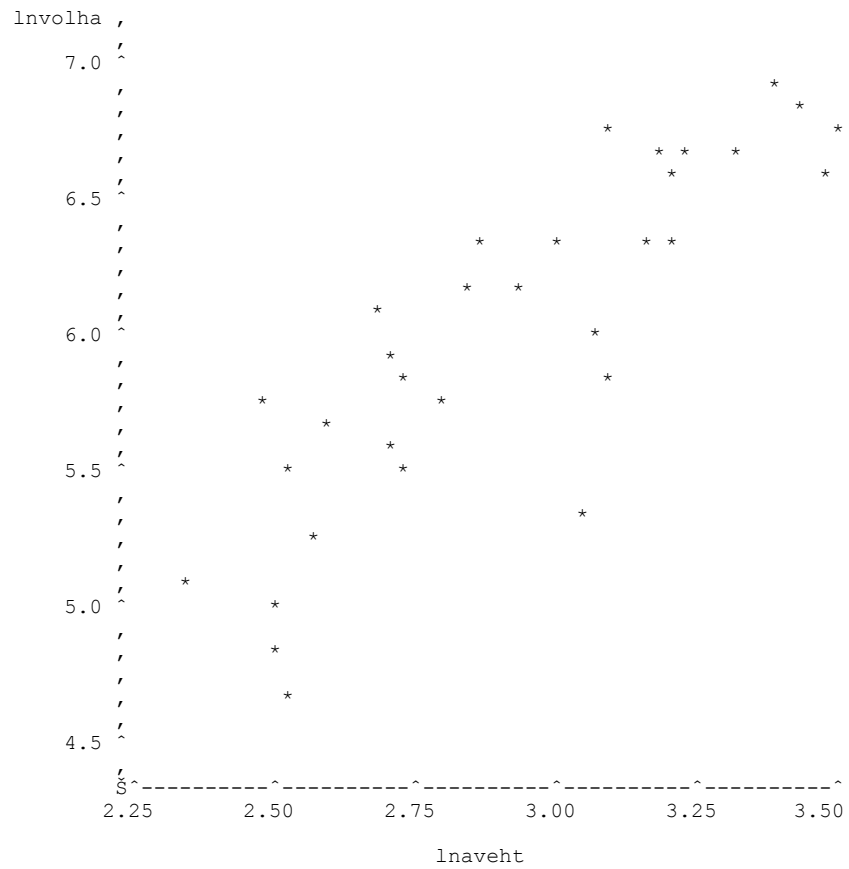
(c) **FRST 533 only: How would you modify this design for three trout species? (5 points)**

Output 1

```
* predict volume per ha from basal area per ha and
stems per ha. import the data from EXCEL into a SAS
temporary file called plots;

options ps=45 ls=65 nodate pageno=1;

data plots2;
set plots;
lnvolha=log(volha);
lnbaha=log(baha);
lnaveht=log(aveht);
run;

proc plot data=plots2;
plot (lnvolha)*(lnbaha lnaveht)='*';
run;

proc reg data=plots2;
MODEL1: model lnvolha=lnbaha lnaveht;
output out=pout1 r=resid1 p=pred1;
run;

proc plot data=pout1;
plot resid1*pred1='*';
run;

proc univariate data=pout1 normal plot;
var resid1;
run;
```



Plot of lnvolha*lnaveht. Symbol used is '*'.



The REG Procedure
Model: MODEL1
Dependent Variable: lnvolha

Number of Observations Read	32
Number of Observations Used	32

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value
Model	2	11.90402	5.95201	784.03
Error	29	0.22016	0.00759	
Corrected Total	31	12.12418		

Analysis of Variance

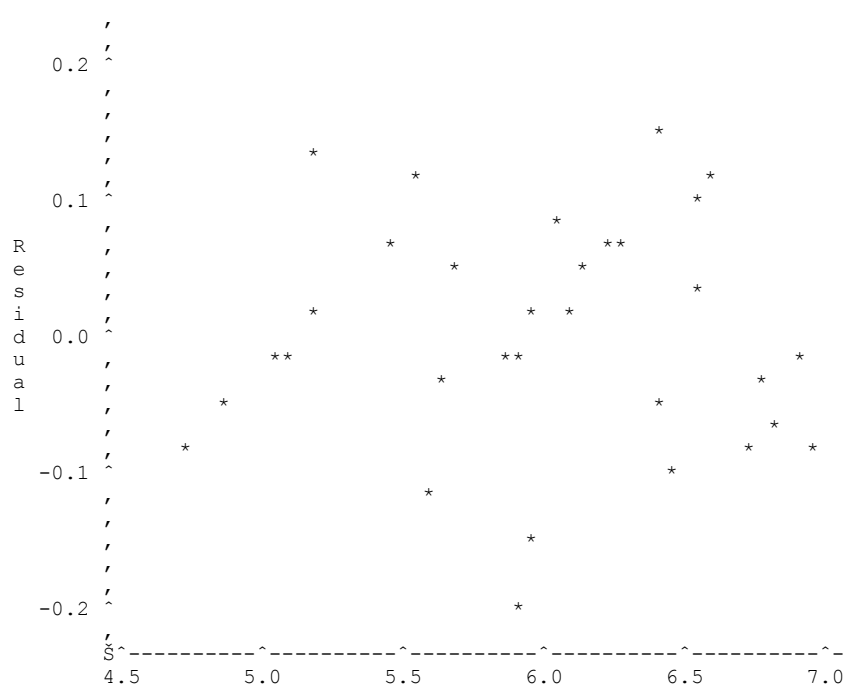
Source	Pr > F
Model	<.0001
Error	
Corrected Total	

Root MSE	0.08713	R-Square	0.9818
Dependent Mean	5.98540	Adj R-Sq	0.9806
Coeff Var	1.45570		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.83534	0.17423	-4.79	<.0001
lnbaha	1	0.95837	0.04669	20.53	<.0001
lnaveht	1	1.08608	0.05262	20.64	<.0001

Plot of resid1*pred1. Symbol used is '*'.



Predicted Value of lnvolha

The UNIVARIATE Procedure
Variable: resid1 (Residual)

Moments

N	32	Sum Weights	32
Mean	0	Sum Observations	0
Std Deviation	0.08427214	Variance	0.00710179
Skewness	-0.2622735	Kurtosis	-0.2978627
Uncorrected SS	0.2201556	Corrected SS	0.2201556
Coeff Variation	.	Std Error Mean	0.01489735

Basic Statistical Measures

Location		Variability	
Mean	0.00000	Std Deviation	0.08427
Median	-0.01065	Variance	0.00710
Mode	.	Range	0.34555
		Interquartile Range	0.12392

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	0	Pr > |t|	1.0000
Sign	M	-1	Pr >= |M|	0.8601
Signed Rank	S	8	Pr >= |S|	0.8839

Tests for Normality

Test	--Statistic---		-----p Value------	
Shapiro-Wilk	W	0.982096	Pr < W	0.8577
Kolmogorov-Smirnov	D	0.081392	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.023453	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.166345	Pr > A-Sq	>0.2500

The UNIVARIATE Procedure
Variable: resid1 (Residual)

Quantiles (Definition 5)

Quantile	Estimate
100% Max	0.1443100
99%	0.1443100
95%	0.1335733
90%	0.1132704
75% Q3	0.0642533
50% Median	-0.0106465
25% Q1	-0.0596654
10%	-0.1012861
5%	-0.1435343
1%	-0.2012391
0% Min	-0.2012391

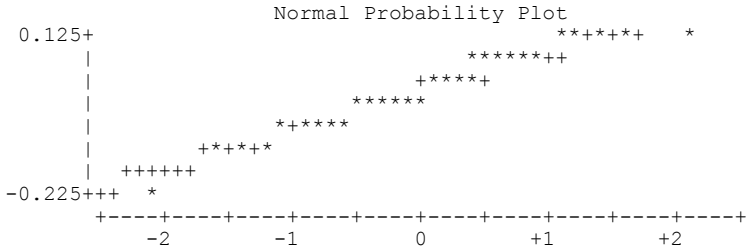
Extreme Observations

-------Lowest------		------Highest-----	
Value	Obs	Value	Obs
-0.2012391	6	0.106276	9
-0.1435343	19	0.113270	12
-0.1226224	5	0.115182	27
-0.1012861	1	0.133573	31
-0.0798806	2	0.144310	11

The UNIVARIATE Procedure
Variable: resid1 (Residual)

Stem	Leaf	#	Boxplot
1	11234	5	
0	556778	6	+-----+
0	2223	4	| + |
-0	3321111	7	*-----*
-0	888665	6	+-----+
-1	420	3	
-1			
-2	0	1	

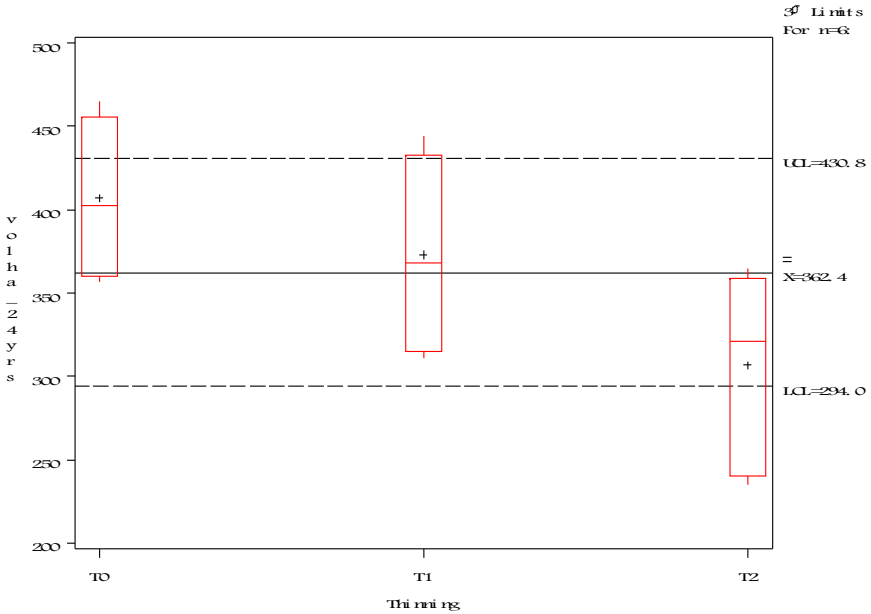
Multiply Stem.Leaf by 10**-1



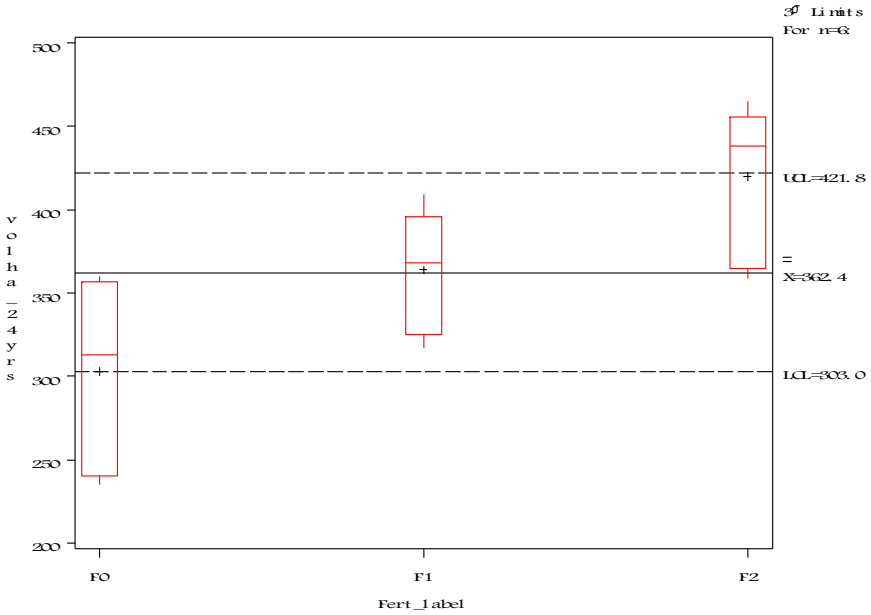
Output 2

```
PROC IMPORT OUT= WORK.volume
            DATAFILE= "E:\frst430\lemay\y05-
06\final\shannigan_lake.XLS"
            DBMS=EXCEL REPLACE;
     SHEET="data_reduced_blocked$";
     GETNAMES=YES;
     MIXED=NO;
     SCANTEXT=YES;
     USEDATE=YES;
     SCANTIME=YES;
RUN;
options ls=64 ps=50 nodate pageno=1;
run;
data volume2;
set volume;
logvol=log(volha_24yrs);
rtvol=(volha_24yrs)**0.5;
sqvol=(volha_24yrs)**2;
cuvol=(volha_24yrs)**3;
run;

proc sort data=volume2;
by thinning;
run;

proc shewhart data=volume2;
      boxchart volha_24yrs*thinning;
run;
proc sort data=volume2;
by fert_label;
run;

proc shewhart data=volume2;
  boxchart volha_24yrs*fert_label;
run;
```

```
* using no transformation for volume;
PROC GLM data=volume2;
CLASS site thinning fert_label;
MODEL volha_24yrs=site thinning fert_label
thinning*fert_label;
LSMEANS thinning fert_label thinning*fert_label/tdiff
pdiff;
OUTPUT OUT=GLMOUT PREDICTED=PREDICT RESIDUAL=RESID;
RUN;
PROC PLOT DATA=GLMOUT;
PLOT RESID*PREDICT='*';
RUN;
PROC UNIVARIATE DATA=GLMOUT PLOT NORMAL;
VAR RESID;
RUN;

* using a transformation of volume;
PROC GLM data=volume2;
CLASS site thinning fert_label;
MODEL cuvol=site thinning fert_label
thinning*fert_label;
LSMEANS thinning fert_label thinning*fert_label/tdiff
pdiff;
OUTPUT OUT=GLMOUT2 PREDICTED=PREDICT2 RESIDUAL=RESID2;
RUN;
PROC PLOT DATA=GLMOUT2;
PLOT RESID2*PREDICT2='*';
RUN;
PROC UNIVARIATE DATA=GLMOUT2 PLOT NORMAL;
VAR RESID2;
RUN;
```



Subgroup Sizes: + n=6



Subgroup Sizes: + n=6

The GLM Procedure

Class Level Information

Class	Levels	Values
Site	2	1 2
Thinning	3	T0 T1 T2
Fert_label	3	F0 F1 F2

Number of Observations Read	18
Number of Observations Used	18

The GLM Procedure

Dependent Variable: volha_24yrs

Source	DF	Sum of Squares	Mean Square
Model	9	73815.83333	8201.75926
Error	8	190.44444	23.80556
Corrected Total	17	74006.27778	

Source	F Value	Pr > F
Model	344.53	<.0001
Error		
Corrected Total		

R-Square	Coeff Var	Root MSE	volha_24yrs Mean
0.997427	1.346370	4.879094	362.3889

Source	DF	Type I SS	Mean Square
Site	1	168.05556	168.05556
Thinning	2	31245.77778	15622.88889
Fert_label	2	41320.11111	20660.05556
Thinning*Fert_label	4	1081.88889	270.47222

Source	F Value	Pr > F
Site	7.06	0.0289
Thinning	656.27	<.0001
Fert_label	867.87	<.0001
Thinning*Fert_label	11.36	0.0022

Source	DF	Type III SS	Mean Square
Site	1	168.05556	168.05556
Thinning	2	31245.77778	15622.88889
Fert_label	2	41320.11111	20660.05556
Thinning*Fert_label	4	1081.88889	270.47222

The GLM Procedure

Dependent Variable: volha_24yrs volha_24yrs

Source	F Value	Pr > F
Site	7.06	0.0289
Thinning	656.27	<.0001
Fert_label	867.87	<.0001
Thinning*Fert_label	11.36	0.0022

The GLM Procedure
Least Squares Means

Thinning	volha_24yrs LSMEAN	LSMEAN Number
T0	407.166667	1
T1	373.166667	2
T2	306.833333	3

Least Squares Means for Effect Thinning
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: volha_24yrs

i/j	1	2	3
1		12.06981 <.0001	35.61777 <.0001
2	-12.0698 <.0001		23.54796 <.0001
3	-35.6178 <.0001	-23.548 <.0001	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Fert_label	volha_24yrs LSMEAN	LSMEAN Number
F0	303.000000	1
F1	363.833333	2
F2	420.333333	3

The GLM Procedure
Least Squares Means

Least Squares Means for Effect Fert_label
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: volha_24yrs

i/j	1	2	3
1		-21.5955 <.0001	-41.6527 <.0001
2	21.59549 <.0001		-20.0572 <.0001
3	41.65267 <.0001	20.05718 <.0001	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Thinning	Fert_label	volha_24yrs LSMEAN	LSMEAN Number
T0	F0	358.500000	1
T0	F1	402.500000	2
T0	F2	460.500000	3
T1	F0	313.000000	4
T1	F1	368.000000	5
T1	F2	438.500000	6
T2	F0	237.500000	7
T2	F1	321.000000	8
T2	F2	362.000000	9

The GLM Procedure
Least Squares Means

Least Squares Means for Effect Thinning*Fert_label
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: volha_24yrs

i/j	1	2	3	4	5
1		-9.01807 <.0001	-20.9055 <.0001	9.325502 <.0001	-1.94708 0.0874
2	9.018068 <.0001		-11.8875 <.0001	18.34357 <.0001	7.070985 0.0001
3	20.90552 <.0001	11.88745 <.0001		30.23102 <.0001	18.95844 <.0001
4	-9.3255 <.0001	-18.3436 <.0001	-30.231 <.0001		-11.2726 <.0001
5	1.947083 0.0874	-7.07099 0.0001	-18.9584 <.0001	11.27259 <.0001	
6	16.39649 <.0001	7.378419 <.0001	-4.50903 0.0020	25.72199 <.0001	14.4494 <.0001
7	-24.7997 <.0001	-33.8178 <.0001	-45.7052 <.0001	-15.4742 <.0001	-26.7468 <.0001
8	-7.68585 <.0001	-16.7039 <.0001	-28.5914 <.0001	1.639649 0.1397	-9.63294 <.0001
9	0.717346 0.4936	-8.30072 <.0001	-20.1882 <.0001	10.04285 <.0001	-1.22974 0.2537

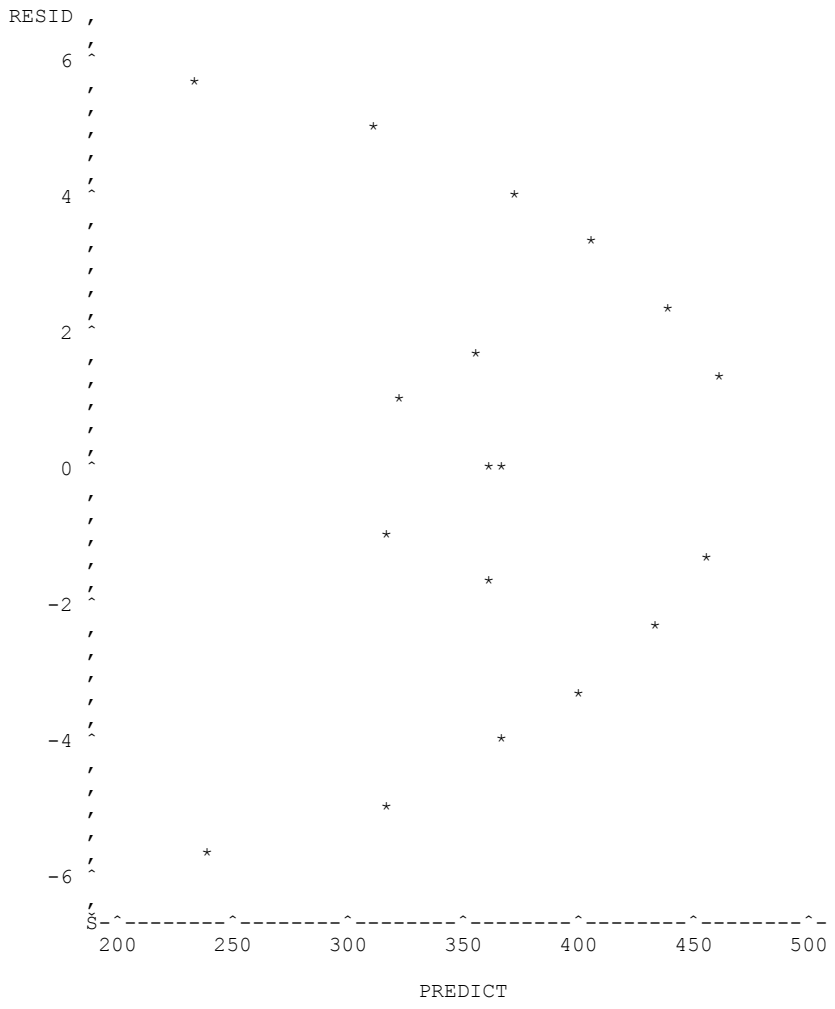
Least Squares Means for Effect Thinning*Fert_label
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: volha_24yrs

i/j	6	7	8	9
1	-16.3965 <.0001	24.79969 <.0001	7.685854 <.0001	-0.71735 0.4936
2	-7.37842 <.0001	33.81776 <.0001	16.70392 <.0001	8.300722 <.0001
3	4.509034 0.0020	45.70521 <.0001	28.59138 <.0001	20.18818 <.0001
4	-25.722 <.0001	15.47419 <.0001	-1.63965 0.1397	-10.0428 <.0001
5	-14.4494 <.0001	26.74677 <.0001	9.632936 <.0001	1.229737 0.2537
6		41.19618 <.0001	24.08234 <.0001	15.67914 <.0001
7	-41.1962 <.0001		-17.1138 <.0001	-25.517 <.0001
8	-24.0823 <.0001	17.11383 <.0001		-8.4032 <.0001
9	-15.6791 <.0001	25.51703 <.0001	8.4032 <.0001	

NOTE: To ensure overall protection level, only probabilities associated with pre-planned comparisons should be used.

Plot of RESID*PREDICT. Symbol used is '*'.



The UNIVARIATE Procedure
Variable: RESID

Moments

N	18	Sum Weights	18
Mean	0	Sum Observations	0
Std Deviation	3.34703068	Variance	11.2026144
Skewness	0	Kurtosis	-0.8935387
Uncorrected SS	190.444444	Corrected SS	190.444444
Coeff Variation	.	Std Error Mean	0.7889027

Basic Statistical Measures

Location		Variability	
Mean	0	Std Deviation	3.34703
Median	0	Variance	11.20261
Mode	.	Range	11.11111
		Interquartile Range	4.88889

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	0	Pr > |t|	1.0000
Sign	M	0	Pr >= |M|	1.0000
Signed Rank	S	0	Pr >= |S|	1.0000

Tests for Normality

Test	--Statistic---		-----p Value------	
Shapiro-Wilk	W	0.973094	Pr < W	0.8534
Kolmogorov-Smirnov	D	0.070507	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.015644	Pr > W-Sq	>0.2500
Anderson-Darling	A-Sq	0.135487	Pr > A-Sq	>0.2500

Quantiles (Definition 5)

Quantile	Estimate
100% Max	5.55556
99%	5.55556
95%	5.55556
90%	5.05556
75% Q3	2.44444
50% Median	0.00000
25% Q1	-2.44444
10%	-5.05556
5%	-5.55556
1%	-5.55556
0% Min	-5.55556

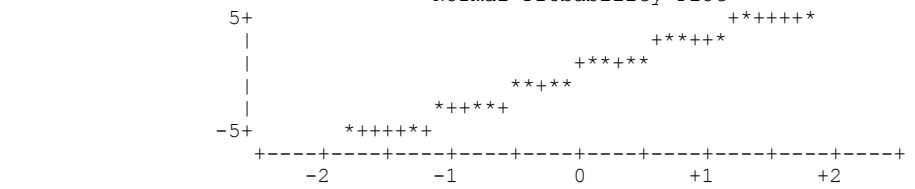
Extreme Observations

Lowest Value	Lowest Obs	Highest Value	Highest Obs
-5.55556	6	2.44444	16
-5.05556	4	3.44444	8
-3.94444	9	3.94444	10
-3.44444	7	5.05556	3
-2.44444	15	5.55556	5

```
Stem Leaf                     #             Boxplot
   4 16                       2                |
   2 449                      3               +-----+
   0 1946                     4               *--+--*
  -0 6491                     4               |     |
  -2 944                      3               +-----+
  -4 61                       2                |
     ----+----+----+----+
```


The UNIVARIATE Procedure
Variable: RESID

Normal Probability Plot



The GLM Procedure

Class Level Information

Class	Levels	Values
Site	2	1 2
Thinning	3	T0 T1 T2
Fert_label	3	F0 F1 F2

Number of Observations Read	18
Number of Observations Used	18

The GLM Procedure

Dependent Variable: cuvol

Source	DF	Sum of Squares	Mean Square
Model	9	1.138811E16	1.2653456E15
Error	8	3.6529695E13	4.5662119E12
Corrected Total	17	1.142464E16	

Source	F Value	Pr > F
Model	277.11	<.0001
Error		
Corrected Total		

R-Square	Coeff Var	Root MSE	cuvol Mean
0.996803	4.110490	2136870	51985761

Source	DF	Type I SS	Mean Square
Site	1	4.3697659E13	4.3697659E13
Thinning	2	4.4945098E15	2.2472549E15
Fert_label	2	6.5312778E15	3.2656389E15
Thinning*Fert_label	4	3.1862508E14	7.9656269E13

Source	F Value	Pr > F
Site	9.57	0.0148
Thinning	492.15	<.0001
Fert_label	715.17	<.0001
Thinning*Fert_label	17.44	0.0005

Source	DF	Type III SS	Mean Square
Site	1	4.3697659E13	4.3697659E13
Thinning	2	4.4945098E15	2.2472549E15
Fert_label	2	6.5312778E15	3.2656389E15
Thinning*Fert_label	4	3.1862508E14	7.9656269E13

The GLM Procedure

Dependent Variable: cuvol

Source	F Value	Pr > F
Site	9.57	0.0148
Thinning	492.15	<.0001
Fert_label	715.17	<.0001
Thinning*Fert_label	17.44	0.0005

The GLM Procedure
Least Squares Means

Thinning	cuvol LSMEAN	LSMEAN Number
T0	69672633.2	1
T1	54971247.2	2
T2	31313402.8	3

Least Squares Means for Effect Thinning
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: cuvol

i/j	1	2	3
1		11.91628 <.0001	31.09227 <.0001
2	-11.9163 <.0001		19.17599 <.0001
3	-31.0923 <.0001	-19.176 <.0001	

NOTE: To ensure overall protection level, only probabilities
associated with pre-planned comparisons should be used.

Fert_label	cuvol LSMEAN	LSMEAN Number
F0	30048879.0	1
F1	49413409.8	2
F2	76494994.3	3

The GLM Procedure
Least Squares Means

Least Squares Means for Effect Fert_label
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: cuvol

i/j	1	2	3
1		-15.696 <.0001	-37.6471 <.0001
2	15.69602 <.0001		-21.9511 <.0001
3	37.64714 <.0001	21.95112 <.0001	

NOTE: To ensure overall protection level, only probabilities
associated with pre-planned comparisons should be used.

Thinning	Fert_label	cuvol LSMEAN	LSMEAN Number
T0	F0	46077646.5	1
T0	F1	65258532.5	2
T0	F2	97681720.5	3
T1	F0	30668053.0	4
T1	F1	49890128.0	5
T1	F2	84355560.5	6
T2	F0	13400937.5	7
T2	F1	33091569.0	8
T2	F2	47447702.0	9

Least Squares Means for Effect Thinning*Fert_label
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: cuvol

i/j	1	2	3	4	5
1		-8.97616	-24.1494	7.211293	-1.78414
		<.0001	<.0001	<.0001	0.1122
2	8.976161		-15.1732	16.18745	7.192018
	<.0001		<.0001	<.0001	<.0001
3	24.14938	15.17322		31.36067	22.36524
	<.0001	<.0001		<.0001	<.0001
4	-7.21129	-16.1875	-31.3607		-8.99544
	<.0001	<.0001	<.0001		<.0001
5	1.784143	-7.19202	-22.3652	8.995436	
	0.1122	<.0001	<.0001	<.0001	
6	17.91308	8.936918	-6.2363	25.12437	16.12894
	<.0001	<.0001	0.0002	<.0001	<.0001
7	-15.2919	-24.268	-39.4412	-8.08057	-17.076
	<.0001	<.0001	<.0001	<.0001	<.0001
8	-6.07715	-15.0533	-30.2265	1.134143	-7.86129
	0.0003	<.0001	<.0001	0.2896	<.0001
9	0.641151	-8.33501	-23.5082	7.852444	-1.14299
	0.5394	<.0001	<.0001	<.0001	0.2861

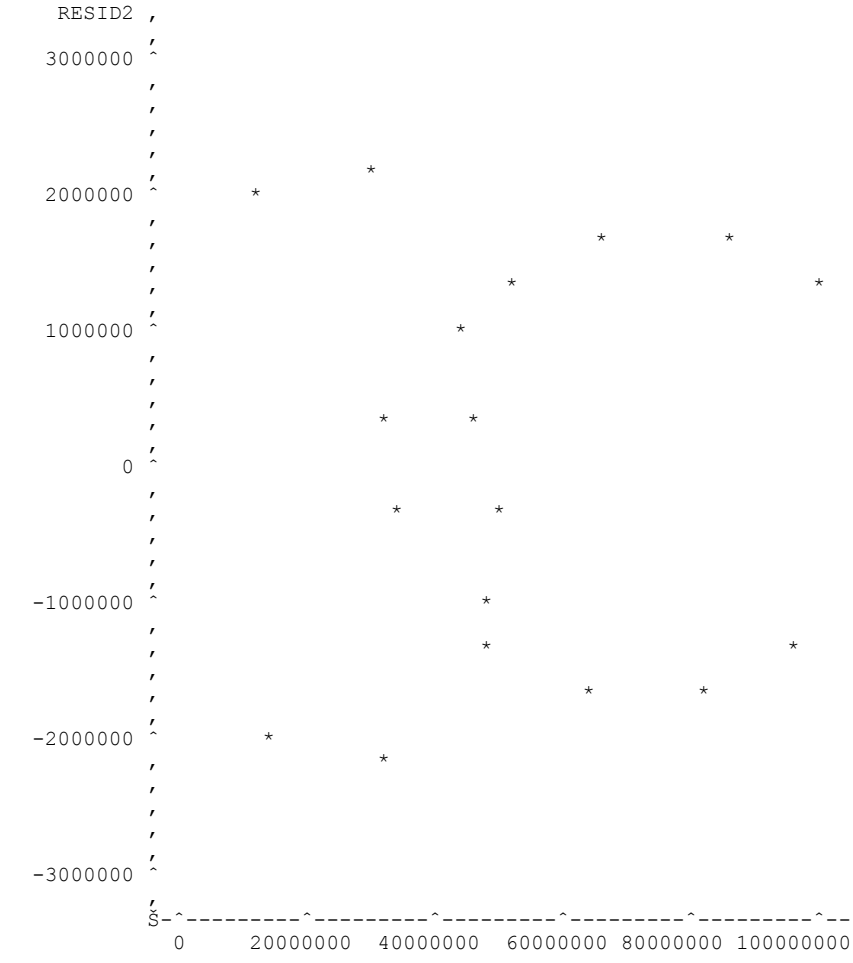
Least Squares Means for Effect Thinning*Fert_label
t for H0: LSMean(i)=LSMean(j) / Pr > |t|

Dependent Variable: cuvol

i/j	6	7	8	9
1	-17.9131	15.29186	6.07715	-0.64115
	<.0001	<.0001	0.0003	0.5394
2	-8.93692	24.26802	15.05331	8.33501
	<.0001	<.0001	<.0001	<.0001
3	6.2363	39.44124	30.22653	23.50823
	0.0002	<.0001	<.0001	<.0001
4	-25.1244	8.080566	-1.13414	-7.85244
	<.0001	<.0001	0.2896	<.0001
5	-16.1289	17.076	7.861293	1.142993
	<.0001	<.0001	<.0001	0.2861
6		33.20494	23.99023	17.27193
		<.0001	<.0001	<.0001
7	-33.2049		-9.21471	-15.933
	<.0001		<.0001	<.0001
8	-23.9902	9.214709		-6.7183
	<.0001	<.0001		0.0001
9	-17.2719	15.93301	6.718301	
	<.0001	<.0001	0.0001	

NOTE: To ensure overall protection level, only probabilities
associated with pre-planned comparisons should be used.

Plot of RESID2*PREDICT2. Symbol used is '*'.



The UNIVARIATE Procedure
Variable: RESID2

Moments

N	18	Sum Weights	18
Mean	0	Sum Observations	0
Std Deviation	1465880.48	Variance	2.14881E12
Skewness	0	Kurtosis	-1.5584918
Uncorrected SS	3.65297E13	Corrected SS	3.65297E13
Coeff Variation	.	Std Error Mean	345511.343

Basic Statistical Measures

Location		Variability	
Mean	0	Std Deviation	1465880
Median	-1.12E-8	Variance	2.14881E12
Mode	.	Range	4291826
		Interquartile Range	2609627

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	0	Pr > |t|	1.0000
Sign	M	0	Pr >= |M|	1.0000
Signed Rank	S	0.5	Pr >= |S|	0.9906

Tests for Normality

Test	--Statistic---		-----p Value------	
Shapiro-Wilk	W	0.918922	Pr < W	0.1237
Kolmogorov-Smirnov	D	0.143197	Pr > D	>0.1500
Cramer-von Mises	W-Sq	0.081219	Pr > W-Sq	0.1943
Anderson-Darling	A-Sq	0.522447	Pr > A-Sq	0.1645

Quantiles (Definition 5)

Quantile	Estimate
100% Max	2.14591E+06
99%	2.14591E+06
95%	2.14591E+06
90%	1.98115E+06
75% Q3	1.30481E+06
50% Median	-1.11759E-08
25% Q1	-1.30481E+06
10%	-1.98115E+06
5%	-2.14591E+06
1%	-2.14591E+06
0% Min	-2.14591E+06

Extreme Observations

------Lowest-----		-----Highest-----	
Value	Obs	Value	Obs
-2145913	4	1304813	14
-1981154	6	1601305	8
-1614732	15	1614732	16
-1601305	7	1981154	5
-1304813	13	2145913	3

```
Stem Leaf                     #             Boxplot
   2 01                       2                |
   1 66                       2                |
   1 033                      3             +-----+
   0                                        |     |
   0 34                       2             *--+--*
  -0 43                       2             |     |
  -0                                        |     |
  -1 330                     3             +-----+
  -1 66                      2                |
  -2 10                      2                |
     ----+----+----+----+
Multiply Stem.Leaf by 10**+6
```


The UNIVARIATE Procedure
Variable: RESID2

Normal Probability Plot