

Two-Factor Experiment
 Primary Factor: Day length (short or long)
 Nuisance Factor: Litter (1 to 6)
 Response: NI enzyme level

Six litters of hamsters with 2 hamsters from each litter is available for the experiment. The treatments of *short* and *long* are randomly assigned within litter. (We will consider Litter a fixed effect for now).

SAS Program Part 1:

```
data hamster;
input litter daylength $ enzyme;
cards;
1 short 2.1
2 short 1.8
3 short 1.4
4 short 1.2
5 short 1.9
6 short 2.4
1 long 2.6
2 long 2.2
3 long 2.4
4 long 1.7
5 long 2.9
6 long 2.3
;
```

```
proc contents data=hamster;
run;
```

```
proc print data=hamster;
run;
```

```
SYMBOL1 value=plus c=black;
SYMBOL2 value=circle c=blue;
proc gplot data=hamster;
  plot enzyme*litter=daylength;
run;
```

```
/*We will consider litter a fixed effect for right now.*/
proc glm data=hamster;
  class litter daylength;
  model enzyme=daylength litter;
  output out=diagnostics p=predicted r=residual;
run;
```

```
proc print data=diagnostics;
run;
```

declares a comment
 /* \$ makes *daylength* a character variable.*/

create data set

plot observed data

fit Additive model

view residuals & predicted values

SAS Output from Part 1:

The SAS System 1

The CONTENTS Procedure

Data Set Name	WORK.HAMSTER	Observations	12	←
Member Type	DATA	Variables	3	←
Engine	V9	Indexes	0	
Created	Tuesday, February 10, 2009 01:28:41 PM	Observation Length	24	
Last Modified	Tuesday, February 10, 2009 01:28:41 PM	Deleted Observations	0	
Protection		Compressed	NO	
Data Set Type		Sorted	NO	
Label				
Data Representation	LINUX_32, INTEL_ABI			
Encoding	latin1 Western (ISO)			

Engine/Host Dependent Information

Data Set Page Size	8192
Number of Data Set Pages	1
First Data Page	1
Max Obs per Page	338
Obs in First Data Page	12
Number of Data Set Repairs	0
File Name	/usr/tmp/SAS_workCEE900003566_1-lnx206. divms.uiowa.edu/hamster.sas7bdat
Release Created	9.0101M3
Host Created	Linux
Inode Number	1925854
Access Permission	rw-r--r--

The SAS System 2

The CONTENTS Procedure

Engine/Host Dependent Information

Owner Name	rdecook
File Size (bytes)	16384

Alphabetic List of Variables and Attributes

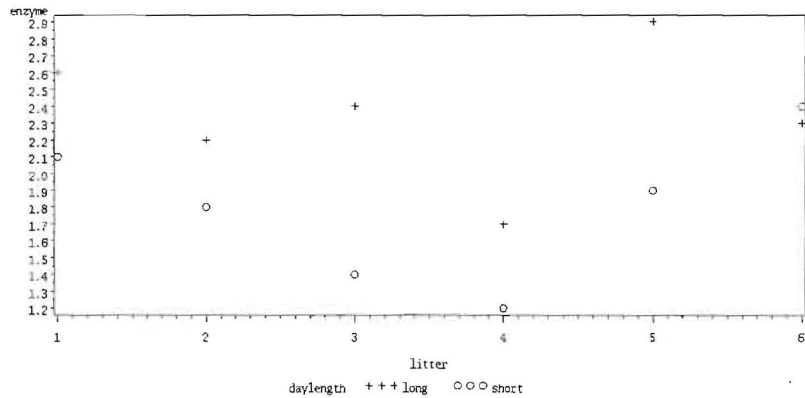
#	Variable	Type	Len
2	daylength	Char	8
3	enzyme	Num	8
1	litter	Num	8

The SAS System

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Obs	litter	daylength	enzyme
1	1	short	2.1
2	2	short	1.8
3	3	short	1.4
4	4	short	1.2
5	5	short	1.9
6	6	short	2.4
7	1	long	2.6
8	2	long	2.2
9	3	long	2.4
10	4	long	1.7
11	5	long	2.9
12	6	long	2.3

} observed data
↓



The SAS System

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The GLM Procedure

Class Level Information

Class	Levels	Values
litter	6	1 2 3 4 5 6
daylength	2	long short

} levels of factors

Number of Observations Read 12
Number of Observations Used 12

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The SAS System

The GLM Procedure

Dependent Variable: enzyme

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	2.2750000	0.37916667	4.43	0.0618
Error	5	0.42750000	0.08550000		
Corrected Total	11	2.70250000			

R-Square 0.841813 Coeff Var 14.09175 Root MSE 0.292404 enzyme Mean 2.075000

1 d.f. for daylength
5 d.f. for litter

Source	DF	Type I SS	Mean Square	F Value	Pr > F
daylength	1	0.90750000	0.90750000	10.61	0.0225
litter	5	1.36750000	0.27350000	3.20	0.1138

Source	DF	Type III SS	Mean Square	F Value	Pr > F
daylength	1	0.90750000	0.90750000	10.61	0.0225
litter	5	1.36750000	0.27350000	3.20	0.1138

Same because balanced

The SAS System

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Obs	litter	daylength	enzyme	predicted	residual
1	1	short	2.1	2.075	0.025
2	2	short	1.8	1.725	0.075
3	3	short	1.4	1.625	-0.225
4	4	short	1.2	1.175	0.025
5	5	short	1.9	2.125	-0.225
6	6	short	2.4	2.075	0.325
7	1	long	2.6	2.625	-0.025
8	2	long	2.2	2.275	-0.075
9	3	long	2.4	2.175	0.225
10	4	long	1.7	1.725	-0.025
11	5	long	2.9	2.675	0.225
12	6	long	2.3	2.625	-0.325

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SAS Program Part 2:

```

SYMBOL1 value=circle interpol=join line=1 c=blue;
SYMBOL2 value=circle interpol=join line=2 c=blue;
proc gplot data=diagnostics;
  plot predicted*litter=daylength/vref=2.075;
run;

/*Get a normal probability plot of the residuals.*/
proc univariate data=diagnostics normal;
  var residual;
run;

/*Get a more refined normal probability plot.*/
proc rank data=diagnostics normal=blom out=modrank;
  var residual;
  ranks rankvalue;
run;
proc plot data=modrank;
  plot residual*rankvalue;
run;

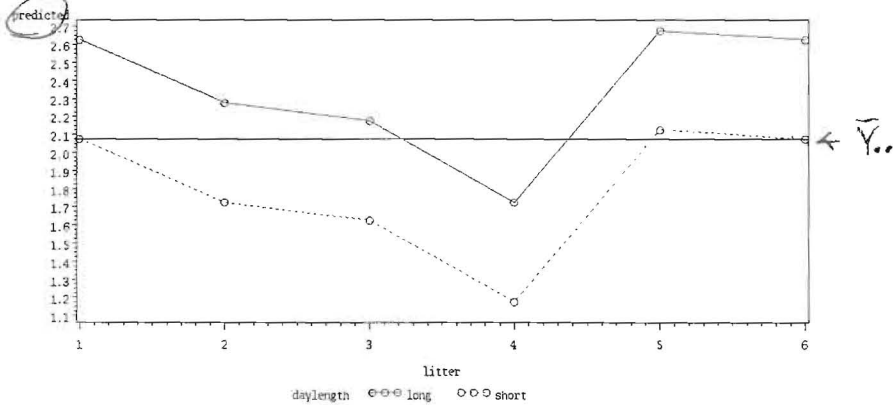
proc plot data=diagnostics;
  plot residual*predicted/vref=0;
run;

```

Plot predicted
diagnostics

SAS Output from Part 2:

shows fitted model



The UNIVARIATE Procedure
Variable: residual

Moments

	N	Sum Weights	
Mean	12	0	0
Std Deviation	0.19713862	Variance	0.03886364
Skewness	0	Kurtosis	-0.6291303
Uncorrected SS	0.4275	Corrected SS	0.4275
Coeff Variation	.	Std Error Mean	0.05690902

Basic Statistical Measures

Location		Variability	
Mean	0.00000	Std Deviation	0.19714
Median	-0.00000	Variance	0.03886
Mode	-0.22500	Range	0.65000
		Interquartile Range	0.30000

NOTE: The mode displayed is the smallest of 2 modes with a count of 2.

The UNIVARIATE Procedure
Variable: residual

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 0.961137	Pr < W 0.7999
Kolmogorov-Smirnov	D 0.123133	Pr > D >0.1500
Cramer-von Mises	W-Sq 0.038854	Pr > W-Sq >0.2500
Anderson-Darling	A-Sq 0.251256	Pr > A-Sq >0.2500

Quantiles (Definition 5)

Quantile	Estimate
100% Max	0.325
99%	0.325
95%	0.325
90%	0.225

The SAS System

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The UNIVARIATE Procedure
Variable: residual

Quantiles (Definition 5)

Quantile	Estimate
75% Q3	0.150
50% Median	-0.000
25% Q1	-0.150
10%	-0.225
5%	-0.325
1%	-0.325
0% Min	-0.325

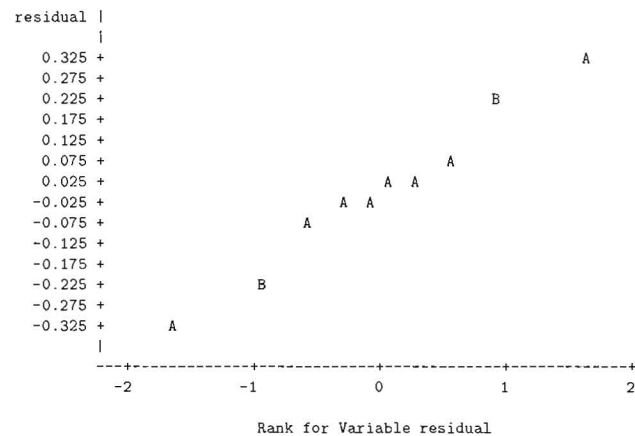
Extreme Observations

----Lowest----		----Highest----	
Value	Obs	Value	Obs
-0.325	12	0.025	1
-0.225	5	0.075	2
-0.225	3	0.225	9
-0.075	8	0.225	11
-0.025	10	0.325	6

The SAS System

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Plot of residual*rankvalue. Legend: A = 1 obs, B = 2 obs, etc.



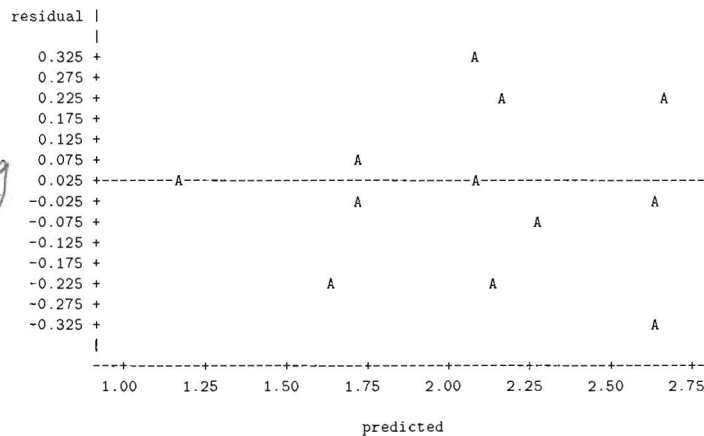
checking normality

99 plot

The SAS System

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Plot of residual*predicted. Legend: A = 1 obs, B = 2 obs, etc.



checking constant variance