

Written test, date: 9. December 2008

Course no. : 02409

Course name: Multivariate Statistics "Multivariat Statistik".

Aids allowed: All usual ones

"Weighting": The questions are given equal weight.

This exam is answered by:

\_\_\_\_\_  
(name)\_\_\_\_\_  
(signature)\_\_\_\_\_  
(study no.)

There is a total of 30 questions for the 8 problems. The answers to the 30 questions must be written into the table below.

<b>Problem</b>	1	1	1	1	1	1	1	1	1	1
<b>Question</b>	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10
<b>Answer</b>										

<b>Problem</b>	1	2	2	2	2	2	3	3	3	3
<b>Question</b>	1.11	2.1	2.2	2.3	2.4	2.5	3.1	3.2	3.3	3.4
<b>Answer</b>										

<b>Problem</b>	3	3	3	3	3	4	5	6	7	8
<b>Question</b>	3.5	3.6	3.7	3.8	3.9	4.1	5.1	6.1	7.1	8.1
<b>Answer</b>										

The possible answers for each question are numbered from 1 to 6. If you enter a wrong number, you may correct it by crossing the wrong number in the table and writing the correct answer immediately below. If there is any doubt about the meaning of a correction then the question will be considered not answered.

**Only the front page must be returned.** The front page must be returned even if you do not answer any of the questions or if you leave the exam prematurely. Drafts and/or comments are **not** considered, only the numbers entered above are registered.

A correct answer gives 5 points, a wrong answer gives -1 point. Unanswered questions or a 6 (corresponding to "don't know") gives 0 points. The total number of points, needed for a satisfactorily answered exam is determined at the final evaluation of the exam.

Remember to write your name, signature and study number on the front page.

Please note, that there is one and only one correct answer to each question. Furthermore, some of the possible alternative answers may not make sense. When the text refers to SAS-output the values may be rounded to fewer decimal places than in the output itself. Please check that all pages of the exam paper and the enclosure are present.

# About Enclosures A, B, and C.

The data are part of a larger study by Dr. Rick Linthurst while he was doing his PhD at North Carolina State University. He considered the aerial biomass of a certain marsh grass *Spartina Alterniflora* in the Cape Fear Estuary of North Carolina.

There are corresponding observations of aerial biomass, and soil characteristics: salinity, acidity, potassium, sodium, zinc. Furthermore, there are recordings of locality and type of vegetation.

The variables are:

Variable	Description
Location	: OI=Oak Island, SI=Smith Island, SM=Snows Marsh
Type	: DVEG=revegetated "dead" areas, SHRT="short" Spartina areas, TALL="tall" Spartina areas
Biomass	: aerial biomass (g/m <sup>2</sup> )
Salinity	: salinity (o/oo)
pH	: acidity as measured in water (pH)
K	: potassium (ppm)
Na	: sodium (ppm)
Zn	: zinc (ppm)

These data are used for different analyses in Enclosures A, B, and C.

## Problem 1.

The marked part of the SAS-program and Enclosure A with the corresponding SAS-output belongs to this problem.

The origin of the data and the different variables are explained on page 2 of this exam.

*The problem continues on the next page*

## Question 1.1.

Consider the correlation matrix where we condition on pH.

The usual test for hypotheses of the type:  $\rho_{ij|\text{pH}} = 0$  has the following degrees of freedom:

- 1  41
- 2  42
- 3  43
- 4  44
- 5  45
- 6  Don't know.

## Question 1.2.

Consider the correlation matrix where we condition on pH.

The usual test for the hypothesis:  $\rho_{\text{Biomass},\text{K}|\text{pH}} = 0$ :

- 1  is not significant at level 0.0001, but is significant at level 0.001
- 2  is not significant at level 0.001, but is significant at level 0.005
- 3  is not significant at level 0.005, but is significant at level 0.01
- 4  is not significant at level 0.01, but is significant at level 0.025
- 5  is not significant at level 0.025, but is significant at level 0.05
- 6  Don't know.

## Question 1.3.

The partial correlation  $\rho_{\text{Salinity},\text{Zn}|\text{pH}}$  can be calculated by:

- 1   $-0.42$
- 2   $\frac{-0.42}{\sqrt{(-0.051)^2(-0.72)^2}}$
- 3   $\frac{-0.42 - (-0.051)(-0.72)}{\sqrt{(1 - (-0.051)^2)(1 - (-0.72)^2)}}$
- 4   $\frac{-0.42}{\sqrt{(-0.051)(-0.72)}}$
- 5  Cannot be given using the information provided
- 6  Don't know.

*The problem continues on the next page*

### Question 1.4.

Consider the unconditional correlation matrix used in the factor analysis. Which correlation between two variables will be most significant, when considering the usual test for hypotheses of the type:  $\rho_{ij} = 0$

- 1   $\rho_{\text{Salinity}, \text{K}}$
- 2   $\rho_{\text{pH}, \text{K}}$
- 3   $\rho_{\text{pH}, \text{Zn}}$
- 4   $\rho_{\text{pH}, \text{Salinity}}$
- 5   $\rho_{\text{K}, \text{Na}}$
- 6  Don't know.

### Question 1.5.

The first 3 factors together:

- 1  explain more than or equal to 20%, but less than 50% of the total variation
- 2  explain more than or equal to 50%, but less than 75% of the total variation
- 3  explain more than or equal to 75%, but less than 90% of the total variation
- 4  explain more than or equal to 90%, but less than 95% of the total variation
- 5  explain more than or equal to 95%, but less than 99% of the total variation
- 6  Don't know.

### Question 1.6.

The first normed eigenvector of the correlation-matrix used in the factor analysis is:

- 1   $[-0.21 \ -0.61 \ 0.67 \ 0.68 \ 0.75]'$
- 2   $1.88[-0.21 \ -0.61 \ 0.67 \ 0.68 \ 0.75]'$
- 3   $\sqrt{1.88}[-0.21 \ -0.61 \ 0.67 \ 0.68 \ 0.75]'$
- 4   $\frac{1}{1.88}[-0.21 \ -0.61 \ 0.67 \ 0.68 \ 0.75]'$
- 5   $\frac{1}{\sqrt{1.88}}[-0.21 \ -0.61 \ 0.67 \ 0.68 \ 0.75]'$
- 6  Don't know.

*The problem continues on the next page*

## Question 1.7.

Consider the correlation-matrix used in the factor analysis. In order to calculate the usual test statistic for the hypothesis:  $\lambda_1 \geq \lambda_2 \geq \lambda_3 \geq \lambda_4 = \lambda_5$  we (among other things) need the following piece of information:

- 1  5
- 2   $\frac{0.0428+0.0212}{2}$
- 3   $0.9101 \cdot 0.9356$
- 4   $\sqrt{1.8838}$
- 5   $\frac{0.2138+0.1059}{2}$
- 6  Don't know.

## Question 1.8.

Consider the correlation-matrix used in the factor analysis. The usual test statistic under the hypothesis:  $\lambda_1 \geq \lambda_2 \geq \lambda_3 \geq \lambda_4 = \lambda_5$  has the following approximate distribution:

- 1   $\chi^2(1)$
- 2   $\chi^2(2)$
- 3   $\chi^2(3)$
- 4   $\chi^2(4)$
- 5   $\chi^2(5)$
- 6  Don't know.

## Question 1.9.

Consider the factor analysis. The variable with the **largest** value of uniqueness is:

- 1  Salinity
- 2  pH
- 3  K
- 4  Na
- 5  Zn
- 6  Don't know.

*The problem continues on the next page*

## Question 1.10.

Consider the factor analysis. The 3 varimax-rotated factors can be interpreted as:

- 1  Varimax-rotated factor 1: mainly describes variation in pH, K, Na, and Zn; Varimax-rotated factor 2: mainly describes variation in K, Na, and Zn; Varimax-rotated factor 3: mainly describes variation in Salinity.
- 2  Varimax-rotated factor 1: mainly describes variation in K and Na; Varimax-rotated factor 2: mainly describes variation in pH and Zn; Varimax-rotated factor 3: mainly describes variation in Salinity.
- 3  Varimax-rotated factor 1: mainly describes variation in Salinity, pH, and Zn; Varimax-rotated factor 2: mainly describes variation in Salinity, K, and Na; Varimax-rotated factor 3: mainly describes variation in pH, K, Na, and Zn.
- 4  Varimax-rotated factor 1: mainly describes variation in Zn; Varimax-rotated factor 2: mainly describes variation in K and Na; Varimax-rotated factor 3: mainly describes variation in Salinity and pH.
- 5  Varimax-rotated factor 1: mainly describes variation in Salinity; Varimax-rotated factor 2: mainly describes variation in pH and K; Varimax-rotated factor 3: mainly describes variation in Na and Zn.
- 6  Don't know.

## Question 1.11.

Consider the factor analysis. The factor loading for variable Salinity in varimax-rotated factor 1 can be found by:

$$1 \quad \begin{bmatrix} 0.70 \\ -0.68 \\ -0.20 \end{bmatrix} \cdot [-0.21 \ 0.44 \ 0.86]$$

$$2 \quad [-0.21 \ 0.44 \ 0.86] \cdot \begin{bmatrix} 0.70 \\ -0.68 \\ -0.20 \end{bmatrix}$$

$$3 \quad 0.0498^2 + 0.0681^2 + 0.9877^2$$

$$4 \quad \begin{bmatrix} 0.70 \\ 0.70 \\ -0.13 \end{bmatrix} \cdot [-0.21 \ 0.44 \ 0.86]$$

$$5 \quad [-0.21 \ 0.44 \ 0.86] \cdot \begin{bmatrix} 0.70 \\ 0.70 \\ -0.13 \end{bmatrix}$$

- 6  Don't know.

# Problem 2.

The marked part of the SAS-program and Enclosure B with the corresponding SAS-output belongs to this problem.

The origin of the data and the different variables are explained on page 2 of this exam.

Option "simple" in the "proc discrim" statement gives various univariate statistics.

## Question 2.1.

Consider the output from the first "proc discrim". The estimate of the variance-covariance matrix used to construct the classification functions is based on:

- 1  1 degree of freedom
- 2  14 degrees of freedom
- 3  28 degrees of freedom
- 4  29 degrees of freedom
- 5  30 degrees of freedom
- 6  Don't know.

## Question 2.2.

Consider the output from the first "proc discrim". The value of the usual F-distributed test statistic for the hypothesis  $\mu_{OI} = \mu_{SI}$  amounts to: 9.0245

In that case the test is

- 1  significant at level 0.25, but not at level 0.1
- 2  significant at level 0.1, but not at level 0.05
- 3  significant at level 0.05, but not at level 0.01
- 4  significant at level 0.01, but not at level 0.005
- 5  significant at level 0.005
- 6  Don't know.

*The problem continues on the next page*

### Question 2.3.

Consider the output from the first "proc discrim". A new observation ( $x_{\text{Salinity}}, x_{\text{K}}$ ) is classified as "OI" if:

- 1   $-70.47 + 4.02x_{\text{Salinity}} + 0.00846x_{\text{K}} > 0$
- 2   $-61.17 + 3.85x_{\text{Salinity}} + 0.00326x_{\text{K}} > 0$
- 3   $-70.47 + 4.02x_{\text{Salinity}} + 0.00846x_{\text{K}} > -61.17 + 3.85x_{\text{Salinity}} + 0.00326x_{\text{K}}$
- 4   $-70.47 + 4.02x_{\text{Salinity}} + 0.00846x_{\text{K}} < -61.17 + 3.85x_{\text{Salinity}} + 0.00326x_{\text{K}}$
- 5   $-70.47 + 4.02x_{\text{Salinity}} + 0.00846x_{\text{K}} > 0 \wedge -61.17 + 3.85x_{\text{Salinity}} + 0.00326x_{\text{K}} > 0$
- 6  Don't know.

### Question 2.4.

The usual test statistic for the hypothesis: "variable "K" does not contribute to a better discrimination" is found as:

- 1   $\frac{15+15-2-1}{1} \frac{15 \cdot 15(2.4957-0.3718)}{(15+15)(15+15-2)+15 \cdot 15 \cdot 0.3718}$
- 2   $\frac{15+15-2-1}{2(15+15-2)} \frac{15 \cdot 15}{15+15} 2.4957$
- 3   $\frac{15+15-2-1}{2(15+15-2)} \frac{15 \cdot 15}{15+15} 0.3718$
- 4   $\frac{14+14-2-1}{1} \frac{14 \cdot 14(2.4957-0.3718)}{(14+14)(14+14-2)+14 \cdot 14 \cdot 0.3718}$
- 5   $\frac{14+14-2-1}{2(14+14-2)} \frac{14 \cdot 14}{14+14} 2.4957$
- 6  Don't know.

### Question 2.5.

We wish to construct a quadratic discriminant rule with equal priors based on one single variable: "Salinity".

Which one of the following numbers is **not** needed:

- 1  33.07
- 2  31.33
- 3  8.579
- 4  7.781
- 5  8.381
- 6  Don't know.

# Problem 3.

The marked part of the SAS-program and Enclosure C with the corresponding SAS-output belongs to this problem. #### indicates that information has been concealed (*Danish: skjult el. fjernet*).

Note: the first "proc reg" is based on all 45 observations, the second "proc reg" is based on 44 observations (observation 34 has been deleted).

The origin of the data and the different variables are explained on page 2 of this exam.

For several of the following questions we will be referring to the following models:

"Model M<sub>1</sub>": corresponds to the first "proc reg" and is a regression model based on all 45 observations which might be written as:

$$\begin{bmatrix} 676 \\ 516 \\ \vdots \\ 1560 \end{bmatrix} = \begin{bmatrix} 1 & 5.00 & 35184.5 \\ 1 & 4.75 & 28170.4 \\ & \vdots & \\ 1 & 5.40 & 16892.2 \end{bmatrix} \begin{bmatrix} \alpha \\ \beta_1 \\ \beta_2 \end{bmatrix} + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_{45} \end{bmatrix}$$

The residuals are assumed identically, independently, and normally distributed.

"Model M<sub>2</sub>": is a regression model based on all 45 observations which might be written as:

$$\begin{bmatrix} 676 \\ 516 \\ \vdots \\ 1560 \end{bmatrix} = \mu + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \\ \vdots \\ \epsilon_{45} \end{bmatrix}$$

The residuals are assumed identically, independently, and normally distributed.

## Question 3.1.

Using maximum likelihood  $\alpha$  in model M<sub>1</sub> is estimated at:

- 1  -475.73
- 2  404.95
- 3  -0.02333
- 4  0.0893
- 5  0.0101
- 6  Don't know.

*The problem continues on the next page*

### Question 3.2.

The reduction in variance when going from model  $M_2$  to model  $M_1$  amounts to the following fraction:

- 1  1.0
- 2  0.6584
- 3  40.48
- 4  394.85
- 5  45
- 6  Don't know.

### Question 3.3.

For model  $M_1$  the usual (formal) test statistic for the hypothesis: " $R^2 = 0$ " has the value:

- 1  40.48
- 2   $-1.74 + 8.48 - 2.70$
- 3  0.6584
- 4  394.85
- 5  39.45
- 6  Don't know.

### Question 3.4.

Consider model  $M_1$ . Under the null-hypothesis " $R^2 = 0$ " the usual (formal) test statistic is distributed as:

- 1   $F(42,44)$
- 2   $F(3,44)$
- 3   $F(3,42)$
- 4   $F(2,44)$
- 5   $F(2,42)$
- 6  Don't know.

*The problem continues on the next page*

### Question 3.5.

Using model  $M_1$  the first observation is predicted at:

- 1  728.30
- 2  -475.72
- 3  394.85
- 4  404.94
- 5  -52.30
- 6  Don't know.

**Question 3.6.** Values of Cook's D for model  $M_1$  can be compared to a suitable percentile in the following distribution:

- 1   $F(1,44)$
- 2   $F(2,43)$
- 3   $F(3,42)$
- 4   $F(4,41)$
- 5   $F(5,40)$
- 6  Don't know.

### Question 3.7.

$RSTUDENT_{34}$  (corresponding to observation 34) for model  $M_1$  is estimated at:

- 1  1168
- 2   $\frac{1168}{394.85}$
- 3   $\frac{1168}{353.47}$
- 4   $\frac{1168}{394.85\sqrt{1-0.0423}}$
- 5   $\frac{1168}{353.47\sqrt{1-0.0423}}$
- 6  Don't know.

*The problem continues on the next page*

### Question 3.8.

In order to calculate a 95% prediction interval for model  $M_1$  we need a suitable percentile in a t-distribution. The value we need is:

- 1  1.68 (approximately)
- 2  2.02 (approximately)
- 3  2.92 (approximately)
- 4  3.18 (approximately)
- 5  4.30 (approximately)
- 6  Don't know.

### Question 3.9.

A general linear model "Model  $M_3$ " based on all 45 observations with separate intercepts for the three localities might be written as:

$$\begin{bmatrix} 676 \\ 516 \\ \vdots \\ 352 \\ \vdots \\ 1560 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 5.00 & 35184.5 \\ 1 & 0 & 0 & 4.75 & 28170.4 \\ & & \vdots & & \\ 0 & 1 & 0 & 3.35 & 12822.0 \\ & & \vdots & & \\ 0 & 0 & 1 & 5.40 & 16892.2 \end{bmatrix} \begin{bmatrix} \alpha_{OI} \\ \alpha_{SI} \\ \alpha_{SM} \\ \gamma_1 \\ \gamma_2 \end{bmatrix} + \begin{bmatrix} \omega_1 \\ \omega_2 \\ \vdots \\ \omega_{17} \\ \vdots \\ \omega_{45} \end{bmatrix}$$

The residuals are assumed identically, independently, and normally distributed.

An ANOVA table for this model is:

Source of Variation	Sum of squares	Degrees of Freedom
$\  \mathbf{p}_{M_3}(\mathbf{Y}) - \mathbf{p}_{M_2}(\mathbf{Y}) \ ^2$	13908507	4
$\  \mathbf{Y} - \mathbf{p}_{M_3}(\mathbf{Y}) \ ^2$	5262456	40
$\sum_{i=1}^{45} (Y_i - \frac{1}{45} \sum_{i=1}^{45} Y_i)^2$	19170963	44

The usual test statistic for testing if there is a difference in intercept between the three locations is found as:

- 1   $\frac{(13908507 - 5262456)/2}{19170963/44}$
- 2   $\frac{(13908507 - 6548174)/2}{5262456/42}$
- 3   $\frac{(13908507 - 12622789)/2}{19170963/44}$
- 4   $\frac{(13908507 - 12622789)/1}{5262456/40}$
- 5   $\frac{(13908507 - 12622789)/2}{5262456/40}$
- 6  Don't know.

# Problem 4.

The following data corresponds to a subset of the original data in e.g. Enclosure A

Location	Type	Salinity	pH
OI	DVEG	33	5.00
OI	SHRT	33	5.05
OI	TALL	30	4.10
SI	DVEG	30	3.25
SI	SHRT	30	3.25
SI	TALL	29	7.10
SM	DVEG	26	4.85
SM	SHRT	25	4.55
SM	TALL	24	5.60

## Question 4.1.

The following questions are to be answered: a) Is there a difference in mean content of (Salinity, pH) with respect to "Location"? b) Is there a difference in mean content of (Salinity, pH) with respect to "Type"?

The most sensible way of analysing this is by means of:

- 1  A one-sided multivariate analysis of variance with three observations in each group.
- 2  A two-sided multivariate analysis of variance with one observation per cell.
- 3  Four univariate one-sided analyses of variance, testing for differences in "Location" and "Type" for each of the variables "Salinity" and "Type".
- 4  Two univariate two-sided analyses of variance, testing for differences in "Location" and "Type" for each of the variables "Salinity" and "Type".
- 5  A general linear model, where "Salinity" is the dependent variable and "Location", "Type", and "pH" are independent variables.
- 6  Don't know.

## Problem 5.

Consider the two random vectors:  $\mathbf{X}$  and  $\mathbf{Y} = \begin{bmatrix} \mathbf{X} \\ U \end{bmatrix}$  where  $E(\mathbf{Y}) = \mathbf{0}$

### Question 5.1.

Then the covariance between  $\mathbf{X}$  and  $\mathbf{Y}$ , denoted  $C(\mathbf{X}, \mathbf{Y})$  equals

- 1   $[D(\mathbf{X}), D(U)]$
- 2   $[C(U, \mathbf{X}), D(\mathbf{X})]$
- 3   $[D(\mathbf{X}), C(U, \mathbf{X})]$
- 4   $[D(\mathbf{X}), C(\mathbf{X}, U)]$
- 5   $[C(\mathbf{X}, U), D(\mathbf{X})]$
- 6  Don't know.

## Problem 6.

Consider the random vector:  $\mathbf{X}$ , the constant vector  $\mathbf{b}$ , and the constant matrix  $\mathbf{A}$

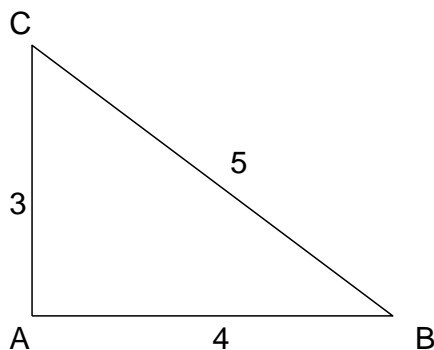
### Question 6.1.

Then  $D(\mathbf{A}(\mathbf{b} + \mathbf{X}))$  equals

- 1   $\mathbf{A}D(\mathbf{X})$
- 2   $\mathbf{b} + \mathbf{A}D(\mathbf{X})$
- 3   $\mathbf{b} + \mathbf{A}D(\mathbf{X})\mathbf{A}'$
- 4   $\mathbf{A}D(\mathbf{X})\mathbf{A}'$
- 5   $\mathbf{A}\mathbf{b}\mathbf{A}' + \mathbf{A}D(\mathbf{X})\mathbf{A}'$
- 6  Don't know.

# Problem 7.

Consider the following spatial layout of data-sampling points  $A, B, C$ . The distances between the data points is also indicated.



It is assumed that each of the 3 observations have equal variance  $\sigma^2$ , such that:  $\begin{bmatrix} X_A \\ X_B \\ X_C \end{bmatrix} \in N(\boldsymbol{\mu}, \sigma^2 \boldsymbol{\Sigma})$

Furthermore, the spatial correlation between any pair of data points is assumed to be inversely proportional to the distance between the points.

## Question 7.1.

Then  $\boldsymbol{\Sigma}$  equals:

1   $\begin{bmatrix} \sigma^2 & \frac{1}{4} & \frac{1}{3} \\ \frac{1}{4} & \sigma^2 & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{5} & \sigma^2 \end{bmatrix}$

2   $\begin{bmatrix} 1 & \frac{1}{4} & \frac{1}{3} \\ \frac{1}{4} & 1 & \frac{1}{5} \\ \frac{1}{3} & \frac{1}{5} & 1 \end{bmatrix}$

3   $\begin{bmatrix} 1 & \frac{1}{16} & \frac{1}{9} \\ \frac{1}{16} & 1 & \frac{1}{25} \\ \frac{1}{9} & \frac{1}{25} & 1 \end{bmatrix}$

4   $\begin{bmatrix} 1 & 4 & 3 \\ 4 & 1 & 5 \\ 3 & 5 & 1 \end{bmatrix}$

5   $\begin{bmatrix} \frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{4} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$

6  Don't know.

# Problem 8.

Below is given values for four polynomials for a certain set of numbers.

$\xi_a$	$\xi_b$	$\xi_c$	$\xi_d$
1	-2	-1	-3
-1	1	3	-1
-1	-1	-3	1
1	2	1	3

## Question 8.1.

In that case the following polynomials are pairwise orthogonal, namely:

- 1   $\xi_a, \xi_c, \xi_d$
- 2   $\xi_b, \xi_c, \xi_d$
- 3   $\xi_a, \xi_b, \xi_d$
- 4   $\xi_a, \xi_b, \xi_c$
- 5   $\xi_a, \xi_b, \xi_c, \xi_d$
- 6  Don't know.

Dec 02, 08 23:05      **EnclIABC.sas**      Page 1/2

```

/* enclabc.sas Crtd: 28-11-08 13:09 by BKE. Updt: 02-12-08 23:05 */
/* Purpose: Enclosures for 02409 exam on 9 December 2008 */

*** start of SAS-statements for Enclosure A ***;

title1 'Enclosure A - Linthurst''s Spartina Alterniflora data';
title2 'Print of data';
proc print data=stat2.linthurst;
run;

title2 'Correlations conditioned on pH';
proc corr data=stat2.linthurst;
var Biomass Salinity K Na Zn;
partial pH;
run;

title2 'Factor analysis';
proc factor data=stat2.linthurst corr nfactored=3 rotate=varimax;
var Salinity pH K Na Zn;
run;

*** end of SAS-statements for Enclosure A ***;

*** start of SAS-statements for Enclosure B ***;

title1 'Enclosure B - Linthurst''s Spartina Alterniflora data - locations OI and S
data OIandSI;
set stat2.linthurst;
if Location = 'SM' then delete;

title2 'Print of data';
proc print data=OIandSI;
run;

title2 'Linear discriminant analysis - two variables';
proc discrim data=OIandSI simple wcorr pcov pcorr pool=yes;
class Location;
var Salinity K;
run;

title2 'Linear discriminant analysis - one variable';
proc discrim data=OIandSI pool=yes;
class Location;
var Salinity;
run;

*** end of SAS-statements for Enclosure B ***;

*** start of SAS-statements for Enclosure C ***;

title1 'Enclosure C - Linthurst''s Spartina Alterniflora data';
title2 'Print of data';
proc print data=stat2.linthurst;
run;

title2 'Regression analysis - all 45 observations';
proc reg data=stat2.linthurst;
model Biomass=pH Na / r influence;
run;

data Except34;
set stat2.linthurst;
if _N_=34 then delete;

```

Dec 02, 08 23:05

**EnclIABC.sas**

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title2 'Regression analysis - 44 observations - Obs No 34 deleted';
proc reg data=Except34;
model Biomass=pH Na;
run;

*** end of SAS-statements for Enclosure C ***;

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Enclosure A - Linthurst's Spartina Alterniflora data						
Correlations conditioned on pH						
The CORR Procedure						
1 Partial Variables: pH Na Zn						
5 Biomass Salinity K						
Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
pH	45	4.60222	1.24699	207.10000	3.20000	7.45000
Biomass	45	1001	660.07856	45036	236.00000	2436
Salinity	45	30.26667	3.71973	1362	24.00000	38.00000
K	45	797.62289	297.60234	35893	350.73000	1442
Na	45	16597	6882	746852	7887	35185
Zn	45	17.87524	8.27991	804.38580	0.21050	31.28650
Simple Statistics						
Variable	Partial Variance	Partial Std Dev				
pH	178618	422.63225				
Biomass	14.12083	3.75777				
Salinity	90593	300.98729				
K	48400365	6957				
Na	33.56475	5.79351				
Zn						
Pearson Partial Correlation Coefficients, N = 45						
Prob >  r  under H0: Partial Rho=0						
Biomass	Salinity	K	Na	Zn		
1.00000	-0.10034	-0.34690	-0.38398	-0.14918		
	0.5170	0.0211	0.0101	0.3338		
Salinity	1.00000	-0.01968	0.16066	-0.66285		
	0.5170	0.8991	0.2975	<.0001		
K	-0.34690	1.00000	0.79353	0.12651		
	0.0211	0.8991	<.0001	0.4132		
Na	-0.38398	0.16066	1.00000	0.12992		
	0.0101	0.2975	<.0001	0.4006		
Zn	-0.14918	-0.66285	0.12651	1.00000		
	0.3338	<.0001	0.4132	0.4006		

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Enclosure A - Linthurst's Spartina Alterniflora data								
Print of data								
Obs	Location	Type	Biomass	Salinity	pH	K	Na	Zn
1	OI	DVEG	676	33	5.00	1441.67	35184.5	16.4524
2	OI	DVEG	516	35	4.75	1299.19	28170.4	13.9852
3	OI	DVEG	1052	32	4.20	1154.27	26455.0	15.3276
4	OI	DVEG	868	30	4.40	1045.15	25072.9	17.3128
5	OI	DVEG	1008	33	5.55	521.62	31664.2	22.3312
6	OI	SHRT	436	33	5.05	1273.02	25491.7	12.2778
7	OI	SHRT	544	36	4.25	1346.35	20877.3	17.8225
8	OI	SHRT	680	30	4.45	1253.88	25621.3	14.3516
9	OI	SHRT	640	38	4.75	1242.65	27587.3	13.6826
10	OI	SHRT	492	30	4.60	1281.95	26511.7	11.7566
11	OI	TALL	984	30	4.10	553.69	7886.5	9.8820
12	OI	TALL	1400	37	3.45	494.74	14596.0	16.6752
13	OI	TALL	1276	33	3.45	525.97	9826.8	12.3730
14	OI	TALL	1736	36	4.10	571.14	11978.4	9.4058
15	OI	TALL	1004	30	3.50	408.64	10368.6	14.9302
16	SI	DVEG	396	30	3.25	646.65	17307.4	31.2865
17	SI	DVEG	352	27	3.35	514.03	12822.0	30.1652
18	SI	DVEG	328	29	3.20	350.73	8582.6	28.5901
19	SI	DVEG	392	34	3.35	496.29	12369.5	19.8795
20	SI	DVEG	236	36	3.30	580.92	14731.9	18.5056
21	SI	SHRT	392	30	3.25	535.82	15060.6	22.1344
22	SI	SHRT	268	28	3.25	490.34	11056.3	28.6101
23	SI	SHRT	252	31	3.20	552.39	8118.9	23.1908
24	SI	SHRT	236	31	3.20	661.32	13009.5	24.6917
25	SI	SHRT	340	35	3.35	672.15	15003.7	22.6758
26	SI	TALL	2436	29	7.10	528.65	10225.0	0.3729
27	SI	TALL	2216	35	7.35	563.13	8024.2	0.2703
28	SI	TALL	2096	35	7.45	497.96	10393.0	0.3205
29	SI	TALL	1660	30	7.45	458.38	8711.6	0.2648
30	SI	TALL	2272	30	7.40	498.25	10239.6	0.2105
31	SM	DVEG	824	26	4.85	936.26	20436.0	18.9875
32	SM	DVEG	1196	29	4.60	894.79	12519.9	20.9687
33	SM	DVEG	1960	25	5.20	941.36	18979.0	23.9841
34	SM	DVEG	2080	26	4.75	1038.79	22986.1	19.9727
35	SM	DVEG	1764	26	5.20	898.05	11704.5	21.3864
36	SM	SHRT	412	25	4.55	989.87	17721.0	23.7063
37	SM	SHRT	416	26	3.95	951.28	16485.2	30.5389
38	SM	SHRT	504	26	3.70	939.83	17101.3	26.8415
39	SM	SHRT	492	27	3.75	925.42	17849.0	27.7292
40	SM	SHRT	636	27	4.15	954.11	16949.6	21.5699
41	SM	TALL	1756	24	5.60	720.72	11344.6	19.6531
42	SM	TALL	1232	27	5.35	782.09	14752.4	20.3295
43	SM	TALL	1400	26	5.50	773.30	13649.8	19.5880
44	SM	TALL	1620	28	5.50	829.26	14533.0	20.1328
45	SM	TALL	1560	28	5.40	856.96	16892.2	19.2420

Enclosure A - Linthurst's Spartina Alterniflora data  
Factor analysis

The FACTOR Procedure  
Rotation Method: Varimax

Orthogonal Transformation Matrix

	1	2	3
1	0.70085	-0.68462	-0.20026
2	0.70168	0.61120	0.36617
3	-0.12828	-0.39715	0.90874

Rotated Factor Pattern

	Factor1	Factor2	Factor3
Salinity	0.04981	0.06812	0.98772
pH	0.02488	0.96140	-0.14566
K	0.94870	0.01976	-0.07278
Na	0.94261	-0.07068	0.12902
Zn	0.09414	-0.87510	-0.40118

Variance Explained by Each Factor

	Factor1	Factor2	Factor3
1.8005062	1.7001063	1.1797041	

Final Communality Estimates: Total = 4.680317

	pH	K	Na	Zn
Salinity	0.98271746	0.90572598	0.91014691	0.93560638

Enclosure A - Linthurst's Spartina Alterniflora data  
Factor analysis

The FACTOR Procedure

Correlations

	pH	K	Na	Zn
Salinity	-0.05133	-0.02063	0.16227	-0.42083
pH	1.00000	0.01923	-0.03772	-0.72217
K	-0.02063	1.00000	0.79210	0.07361
Na	0.16227	-0.03772	1.00000	0.11705
Zn	-0.42083	-0.72217	0.07361	1.00000

Enclosure A - Linthurst's Spartina Alterniflora data  
Factor analysis

The FACTOR Procedure  
Initial Factor Method: Principal Components

Prior Communality Estimates: ONE

Eigenvalues of the Correlation Matrix: Total = 5 Average = 1

	Eigenvalue	Difference	Proportion	Cumulative
1	1.88382449	0.14149384	0.3768	0.3768
2	1.74233065	0.68816912	0.3485	0.7252
3	1.05416153	0.84036735	0.2108	0.9361
4	0.21379417	0.10790501	0.0428	0.9788
5	0.10588916		0.0212	1.0000

3 factors will be retained by the NFACTOR criterion.

Factor Pattern

	Factor1	Factor2	Factor3
Salinity	-0.20953	0.43826	0.86414
pH	-0.61158	0.55173	-0.51738
K	0.66595	0.65111	-0.19569
Na	0.68318	0.66544	0.02439
Zn	0.74543	-0.61571	-0.02911

Variance Explained by Each Factor

	Factor1	Factor2	Factor3
1.8838245	1.7423306	1.0541615	

Final Communality Estimates: Total = 4.680317

	pH	K	Na	Zn
Salinity	0.94611993	0.90572598	0.91014691	0.93560638

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI onl 8  
 Linear discriminant analysis - two variables

The DISCRIM Procedure  
 Within-Class Covariance Matrices

Location = OI, DF = 14  
 Variable Salinity K  
 Salinity 7.7810 56.9951 56.9951 151893.8632  
 K

Location = SI, DF = 14  
 Variable Salinity K  
 Salinity 8.380952 87.078095 87.078095 6923.210264  
 K

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI onl 9  
 Linear discriminant analysis - two variables

The DISCRIM Procedure

Pooled Within-Class Covariance Matrix, DF = 28  
 Variable Salinity K  
 Salinity 8.08095 72.03660 72.03660 79408.53672  
 K

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI onl 6  
 Print of data

Obs	Location	Type	Biomass	Salinity	pH	K	Na	Zn
1	OI	DVEG	676	33	5.00	1441.67	35184.5	16.4524
2	OI	DVEG	516	35	4.75	1299.19	28170.4	13.9852
3	OI	DVEG	1052	32	4.20	1154.27	26455.0	15.3276
4	OI	DVEG	868	30	4.40	1045.15	25072.9	17.3128
5	OI	DVEG	1008	33	5.55	521.62	31664.2	22.3312
6	OI	SHRT	436	33	5.05	1273.02	25491.7	12.2778
7	OI	SHRT	544	36	4.25	1346.35	20877.3	17.8225
8	OI	SHRT	680	30	4.45	1253.88	25621.3	14.3516
9	OI	SHRT	640	38	4.75	1242.65	27587.3	13.6826
10	OI	SHRT	492	30	4.60	1281.95	26511.7	11.7566
11	OI	TALL	984	30	4.10	553.69	7886.5	9.8820
12	OI	TALL	1400	37	3.45	494.74	14596.0	16.6752
13	OI	TALL	1276	33	3.45	525.97	9826.8	12.3730
14	OI	TALL	1736	36	4.10	571.14	11978.4	9.4058
15	OI	TALL	1004	30	3.50	408.64	10368.6	14.9302
16	SI	DVEG	396	30	3.25	646.65	17307.4	31.2865
17	SI	DVEG	352	27	3.35	514.03	12822.0	30.1652
18	SI	DVEG	328	29	3.20	350.73	8582.6	28.5901
19	SI	DVEG	392	34	3.35	496.29	12369.5	19.8795
20	SI	DVEG	236	36	3.30	580.92	14731.9	18.5056
21	SI	SHRT	392	30	3.25	535.82	15060.6	22.1344
22	SI	SHRT	268	28	3.25	490.34	11056.3	28.6101
23	SI	SHRT	252	31	3.20	552.39	8118.9	23.1908
24	SI	SHRT	236	31	3.20	661.32	13009.5	24.6917
25	SI	SHRT	340	35	3.35	672.15	15003.7	22.6758
26	SI	TALL	2436	29	7.10	528.65	10225.0	0.3729
27	SI	TALL	2216	35	7.35	563.13	8024.2	0.2703
28	SI	TALL	2096	35	7.45	497.96	10393.0	0.3205
29	SI	TALL	1660	30	7.45	458.38	8711.6	0.2648
30	SI	TALL	2272	30	7.40	498.25	10239.6	0.2105

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI onl 7  
 Linear discriminant analysis - two variables

The DISCRIM Procedure

Observations 30 DF Total 29  
 Variables 2 DF Within Classes 28  
 Classes 2 DF Between Classes 1

Class Level Information

Location	Variable Name	Frequency	Weight	Proportion	Prior Probability
OI	OI	15	15.0000	0.500000	0.500000
SI	SI	15	15.0000	0.500000	0.500000



Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI on 14  
 Linear discriminant analysis - two variables

The DISCRIM Procedure  
 Classification Summary for Calibration Data: WORK.OIANDSI  
 Resubstitution Summary using Linear Discriminant Function

Generalized Squared Distance Function

$$D^2(i|j) = (\bar{X}_i - \bar{X}_j)' \text{COV}^{-1} (\bar{X}_i - \bar{X}_j)$$

Posterior Probability of Membership in Each Location

$$\text{Pr}(j|X) = \frac{\exp(-.5 D^2(X)) / \sum_k \exp(-.5 D^2(X))}{\sum_k \exp(-.5 D^2(X))}$$

Number of Observations and Percent Classified into Location

From Location	OI	SI	Total
OI	9	6	15
SI	1	14	15
Total	10	20	30
Priors	0.5	0.5	

Error Count Estimates for Location

	OI	SI	Total
Rate	0.4000	0.0667	0.2333
Priors	0.5000	0.5000	

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI on 13  
 Linear discriminant analysis - two variables

The DISCRIM Procedure

Pairwise Generalized Squared Distances Between Groups

$$D^2(i|j) = (\bar{X}_i - \bar{X}_j)' \text{COV}^{-1} (\bar{X}_i - \bar{X}_j)$$

Generalized Squared Distance to Location

From Location	OI	SI
OI	0	2.49566
SI	2.49566	0

Linear Discriminant Function

$$\text{Constant} = -.5 \bar{X}' \text{COV}^{-1} \bar{X} \quad \text{Coefficient Vector} = \text{COV}^{-1} \bar{X}$$

Linear Discriminant Function for Location

Variable	OI	SI
Constant	-70.47019	-61.16618
Salinity	4.01653	3.84833
K	0.00846	0.00326

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI on 17  
 Linear discriminant analysis - one variable

The DISCRIM Procedure  
 Classification Summary for Calibration Data: WORK.OIANDSI  
 Resubstitution Summary using Linear Discriminant Function  
 Generalized Squared Distance Function

$$D_j^2(X) = (X - \bar{X}_j)' \text{COV}_j^{-1} (X - \bar{X}_j)$$

Posterior Probability of Membership in Each Location

$$\text{Pr}(j|X) = \frac{\exp(-.5 D_j^2(X)) / \sum_k \exp(-.5 D_k^2(X))}{\sum_k \exp(-.5 D_k^2(X))}$$

Number of Observations and Percent Classified into Location

From Location	OI	SI	Total
OI	9	6	15
SI	5	10	15
Total	14	16	30
Priors	0.5	0.5	

Error Count Estimates for Location

	OI	SI	Total
Rate	0.4000	0.3333	0.3667
Priors	0.5000	0.5000	

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI on 15  
 Linear discriminant analysis - one variable

The DISCRIM Procedure  
 Observations 30 DF Total 29  
 Variables 1 DF Within Classes 28  
 Classes 2 DF Between Classes 1

Class Level Information

Location	Variable Name	Frequency	Weight	Proportion	Prior Probability
OI	OI	15	15.0000	0.500000	0.500000
SI	SI	15	15.0000	0.500000	0.500000

Pooled Covariance Matrix Information

Natural Log of the  
 Covariance Determinant of the  
 Matrix Rank 1 2.08951  
 Covariance Matrix

Enclosure B - Linthurst's Spartina Alterniflora data - locations OI and SI on 16  
 Linear discriminant analysis - one variable

The DISCRIM Procedure

Pairwise Generalized Squared Distances Between Groups

$$D^2(i|j) = (\bar{X}_i - \bar{X}_j)' \text{COV}^{-1} (\bar{X}_i - \bar{X}_j)$$

Generalized Squared Distance to Location

From Location	OI	SI
OI	0	0.37179
SI	0.37179	0

Linear Discriminant Function

$$\text{Constant} = -.5 \bar{X}_j' \text{COV}_j^{-1} \bar{X}_j \quad \text{Coefficient Vector} = \text{COV}_j^{-1} (\bar{X}_j - \bar{X}_j)$$

Linear Discriminant Function for Location

Variable	OI	SI
Constant	-67.65319	-60.74642
Salinity	4.09193	3.87743

Enclosure C - Linthurst's Spartina Alterniflora data  
 Regression analysis - all 45 observations

The REG Procedure  
 Model: MODEL1

Dependent Variable: Biomass

Number of Observations Read 45  
 Number of Observations Used 45

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	12622789	6311394	40.48	<.0001
Error	42	6548174	155909		
Corrected Total	44	19170963			

Root MSE 394.85302 R-Square 0.6584  
 Dependent Mean 1000.80000 Adj R-Sq 0.6422  
 Coeff Var 39.45374

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	-475.72558	273.52269	-1.74	0.0893
pH	1	404.94819	47.76984	8.48	<.0001
Na	1	-0.02333	0.00866	-2.70	0.0101

Enclosure C - Linthurst's Spartina Alterniflora data  
 Print of data

Obs	Location	Type	Biomass	Salinity	pH	K	Na	Zn
1	OI	DVEG	676	33	5.00	1441.67	35184.5	16.4524
2	OI	DVEG	516	35	4.75	1299.19	28170.4	13.9852
3	OI	DVEG	1052	32	4.20	1154.27	26455.0	15.3276
4	OI	DVEG	868	30	4.40	1045.15	25072.9	17.3128
5	OI	DVEG	1008	33	5.55	521.62	31664.2	22.3312
6	OI	SHRT	436	33	5.05	1273.02	25491.7	12.2778
7	OI	SHRT	544	36	4.25	1346.35	20877.3	17.8225
8	OI	SHRT	680	30	4.45	1253.88	25621.3	14.3516
9	OI	SHRT	640	38	4.75	1242.65	27587.3	13.6826
10	OI	SHRT	492	30	4.60	1281.95	26511.7	11.7566
11	OI	TALL	984	30	4.10	553.69	7886.5	9.8820
12	OI	TALL	1400	37	3.45	494.74	14596.0	16.6752
13	OI	TALL	1276	33	3.45	525.97	9826.8	12.3730
14	OI	TALL	1736	36	4.10	571.14	11978.4	9.4058
15	OI	TALL	1004	30	3.50	408.64	10368.6	14.9302
16	SI	DVEG	396	30	3.25	646.65	17307.4	31.2865
17	SI	DVEG	352	27	3.35	514.03	12822.0	30.1652
18	SI	DVEG	328	29	3.20	350.73	8582.6	28.5901
19	SI	DVEG	392	34	3.35	496.29	12369.5	19.8795
20	SI	DVEG	236	36	3.30	580.92	14731.9	18.5056
21	SI	SHRT	392	30	3.25	535.82	15060.6	22.1344
22	SI	SHRT	268	28	3.25	490.34	11056.3	28.6101
23	SI	SHRT	252	31	3.20	552.39	8118.9	23.1908
24	SI	SHRT	236	31	3.20	661.32	13009.5	24.6917
25	SI	SHRT	340	35	3.35	672.15	15003.7	22.6758
26	SI	TALL	2436	29	7.10	528.65	10225.0	0.3729
27	SI	TALL	2216	35	7.35	563.13	8024.2	0.2703
28	SI	TALL	2096	35	7.45	497.96	10393.0	0.3205
29	SI	TALL	1660	30	7.45	458.38	8711.6	0.2648
30	SI	TALL	2272	30	7.40	498.25	10239.6	0.2105
31	SM	DVEG	824	26	4.85	936.26	20436.0	18.9875
32	SM	DVEG	1196	29	4.60	894.79	12519.9	20.9687
33	SM	DVEG	1960	25	5.20	941.36	18979.0	23.9841
34	SM	DVEG	2080	26	4.75	1038.79	22986.1	19.9727
35	SM	DVEG	1764	26	5.20	898.05	11704.5	21.3864
36	SM	SHRT	412	25	4.55	989.87	17721.0	23.7063
37	SM	SHRT	416	26	3.95	951.28	16485.2	30.5589
38	SM	SHRT	504	26	3.70	939.83	17101.3	26.8415
39	SM	SHRT	492	27	3.75	925.42	17849.0	27.7292
40	SM	SHRT	636	27	4.15	954.11	16949.6	21.5699
41	SM	TALL	1756	24	5.60	720.72	11344.6	19.6531
42	SM	TALL	1232	27	5.35	782.09	14752.4	20.3295
43	SM	TALL	1400	26	5.50	773.30	13649.8	19.5880
44	SM	TALL	1620	28	5.50	829.26	14533.0	20.1328
45	SM	TALL	1560	28	5.40	856.96	16892.2	19.2420

Enclosure C - Linthurst's Spartina Alterniflora data  
 Regression analysis - all 45 observations

The REG Procedure  
 Model: MODEL1  
 Dependent Variable: Biomass

Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	Residual	Std Error Residual	Student Residual
1	676.0000	728.2994	173.0289	-52.2994	354.9	-0.147
2	516.0000	790.6737	116.6292	-274.6737	377.2	-0.728
3	1052	607.9657	104.8359	444.0343	380.7	1.166
4	868.0000	721.1943	94.2690	146.8057	383.4	0.383
5	1008	1033	151.5494	-25.1357	364.6	-0.0689
6	436.0000	974.6417	99.8677	-538.6417	382.0	-1.410
7	544.0000	758.3190	71.2276	-214.3190	388.4	-0.552
8	680.0000	728.6497	97.8559	-48.6497	382.5	-0.127
9	640.0000	804.2751	112.3122	-164.2751	378.5	-0.434
10	492.0000	768.6224	104.0595	-276.6224	380.9	-0.726
11	984.0000	1001	99.2980	-16.6010	382.2	-0.0434
12	1400	580.8784	82.8612	819.1216	386.1	2.122
13	1276	692.1251	100.8508	583.8749	381.8	1.529
14	1736	905.1530	69.7311	830.8470	387.6	2.144
15	1004	699.7344	96.7311	304.2656	382.8	0.795
16	396.0000	436.6425	87.4361	-40.6425	385.1	-0.106
17	352.0000	581.7640	90.8719	-229.7640	384.3	-0.598
18	328.0000	619.9103	114.5134	-291.9103	377.9	-0.772
19	392.0000	592.3191	92.4480	-200.3191	383.9	-0.522
20	236.0000	516.9662	87.5820	-280.9662	385.0	-0.730
21	392.0000	489.0515	88.7624	-97.0515	384.7	-0.252
22	268.0000	582.4561	100.8485	-314.4561	381.8	-0.824
23	252.0000	630.7266	117.0747	-378.7266	377.1	-1.004
24	236.0000	516.6482	95.2490	-280.6482	383.2	-0.732
25	340.0000	530.8736	85.4120	-190.8736	385.5	-0.495
26	2436	2161	142.2901	275.1025	368.3	0.747
27	2216	2313	159.5760	-97.4706	361.2	-0.270
28	2096	2299	155.8941	-202.7106	362.8	-0.559
29	1660	2338	161.0225	-677.9311	360.5	-1.880
30	2272	2282	154.2708	-10.0414	363.5	-0.0276
31	824.0000	1012	68.8377	-187.5817	388.8	-0.482
32	1196	1095	68.6295	101.0039	388.8	0.260
33	1960	1187	68.9177	772.7004	388.8	1.987
34	2080	911.6030	81.2538	1168	386.4	3.024
35	1764	1357	77.3420	407.0149	387.2	1.051
36	412.0000	953.4275	59.6969	-541.4275	390.3	-1.387
37	416.0000	739.2849	66.6226	-323.2849	389.2	-0.831
38	504.0000	623.6767	72.9866	-119.6767	388.0	-0.308
39	492.0000	626.4832	72.1539	-134.4832	388.2	-0.346
40	636.0000	809.4419	62.7349	-173.4419	389.8	-0.445
41	1756	1527	87.4039	228.6406	385.1	0.594
42	1232	1347	70.3736	-114.6318	388.5	-0.295
43	1400	1433	76.6287	-33.0933	387.7	-0.0854
44	1620	1412	74.6000	207.5083	387.3	0.535
45	1560	1317	70.2203	243.0339	388.6	0.625

Output Statistics

Obs	-2	-1	0	1	2	Cook's D	RStudent	Hat	Diag	H	Cov	Ratio	DFFITs
1						0.002	-0.1456	0.1920			1.3284		-0.0710
2			*			0.017	-0.7240	0.0872			1.1337		-0.2238

-----DFBETAS-----  
 Intercept                      Na

1	0.0379	-0.0103	-0.0663
2	0.0936	-0.0208	-0.1928
3	-0.0582	-0.0492	0.2604
4	-0.0199	-0.0068	0.0721

Enclosure C - Linthurst's Spartina Alterniflora data  
 Regression analysis - all 45 observations

The REG Procedure  
 Model: MODEL1  
 Dependent Variable: Biomass

Output Statistics

Obs	-2	-1	0	1	2	Cook's D	RStudent	Hat	Diag	H	Cov	Ratio	DFFITs
3			**			0.034	1.1716	0.0705			1.0477		0.3226
4						0.003	0.3789	0.0570			1.1281		0.0932
5						0.000	-0.0681	0.1473			1.2603		-0.0283
6		**				0.045	-1.4273	0.0640			0.9929		-0.3731
7			*			0.003	-0.5472	0.0325			1.0871		-0.1004
8						0.000	-0.1257	0.0614			1.1440		-0.0321
9						0.006	-0.4297	0.0809			1.1539		-0.1275
10						0.013	-0.7221	0.0695			1.1122		-0.1973
11						0.000	-0.0429	0.0632			1.1474		-0.0112
12			***			0.069	2.2186	0.0440			0.8003		0.4762
13			***			0.054	1.5551	0.0652			0.9683		0.4108
14			***			0.058	2.2445	0.0366			0.7882		0.4376
15					*	0.013	0.7913	0.0600			1.0928		0.1999
16						0.000	-0.1043	0.0490			1.1295		-0.0237
17				*		0.007	-0.5933	0.0530			1.1063		-0.1403
18				*		0.018	-0.7687	0.0841			1.1244		-0.2330
19				*		0.005	-0.5173	0.0548			1.1153		-0.1246
20				*		0.009	-0.7256	0.0492			1.0881		-0.1651
21						0.001	-0.2494	0.0505			1.1270		0.0575
22				*		0.016	-0.8205	0.0652			1.0951		-0.2167
23			**			0.032	-1.0044	0.0879			1.0957		-0.3118
24				*		0.011	-0.7283	0.0582			1.0982		-0.1810
25						0.004	-0.4906	0.0468			1.1081		-0.1087
26				*		0.028	-0.7429	0.1299			1.1868		0.2870
27						0.005	-0.2669	0.1633			1.2781		-0.1179
28				*		0.019	-0.5541	0.1559			1.2453		-0.2381
29			***			0.235	-1.9414	0.1663			0.9904		-0.8671
30						0.000	-0.0273	0.1526			1.2686		-0.0116
31						0.002	-0.4780	0.0304			1.0903		-0.0846
32						0.001	0.2569	0.0302			1.1031		0.0453
33			***			0.041	2.0630	0.0305			0.8244		0.3657
34			***			0.135	##	0.0423			0.5374		0.7103
35			**			0.015	1.0525	0.0384			1.0319		0.2102
36			**			0.015	-1.4031	0.0229			0.9557		-0.2146
37			*			0.007	-0.8275	0.0285			1.0528		-0.1417
38						0.001	-0.3051	0.0342			1.1055		-0.0574
39						0.001	-0.3428	0.0334			1.1026		-0.0637
40						0.002	-0.4406	0.0252			1.0873		-0.0709
41				*		0.006	0.5891	0.0490			1.1021		0.1337
42						0.001	-0.2918	0.0318			1.1033		-0.0529
43						0.000	-0.0844	0.0377			1.1165		-0.0167
44			*			0.004	0.5306	0.0357			1.0921		0.1021
45				*		0.004	0.6209	0.0316			1.0793		0.1122

Output Statistics

1	0.0379	-0.0103	-0.0663
2	0.0936	-0.0208	-0.1928
3	-0.0582	-0.0492	0.2604
4	-0.0199	-0.0068	0.0721

Enclosure C - Linthurst's Spartina Alterniflora data  
 Regression analysis - 44 observations - Obs No 34 deleted

The REG Procedure  
 Model: MODEL1  
 Dependent Variable: Biomass

Number of Observations Read 44  
 Number of Observations Used 44

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	12857163	6428582	51.45	<.0001
Error	41	5122657	124943		
Corrected Total	43	17979821			

Root MSE 353.47258 R-Square 0.7151  
 Dependent Mean 976.27273 Adj R-Sq 0.7012  
 Coeff Var 36.20634

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	-424.64004	245.32425	-1.73	0.0910
pH	1	401.52948	42.77556	9.39	<.0001
Na	1	-0.02709	0.00783	-3.46	0.0013

Enclosure C - Linthurst's Spartina Alterniflora data  
 Regression analysis - all 45 observations

The REG Procedure  
 Model: MODEL1  
 Dependent Variable: Biomass

Output Statistics

Obs	Intercept	pH	Na
5	0.0181	-0.0094	-0.0247
6	0.1783	-0.0908	-0.2907
7	-0.0084	0.0217	-0.0513
8	0.0081	0.0014	-0.0256
9	0.0522	-0.0121	-0.1083
10	0.0662	-0.0059	-0.1627
11	-0.0083	0.0030	0.0086
12	0.3886	-0.3201	-0.1114
13	0.3688	-0.2332	-0.2471
14	0.3164	-0.1477	-0.2367
15	0.1777	-0.1130	-0.1155
16	-0.0169	0.0174	-0.0010
17	-0.1236	0.0943	0.0539
18	-0.2164	0.1416	0.1462
19	-0.1108	0.0825	0.0523
20	-0.1373	0.1184	0.0348
21	-0.0475	0.0422	0.0102
22	-0.1988	0.1427	0.1083
23	-0.2892	0.1858	0.2022
24	-0.1617	0.1295	0.0638
25	-0.0886	0.0768	0.0204
26	-0.1109	0.2365	-0.1022
27	0.0401	-0.0949	0.0512
28	0.1062	-0.2047	0.0742
29	0.3309	-0.7187	0.3399
30	0.0050	-0.0099	0.0038
31	0.0191	-0.0161	-0.0414
32	0.0214	-0.0009	-0.0233
33	-0.1184	0.1557	0.1151
34	-0.2086	0.0799	0.4858
35	0.0344	0.0733	-0.1122
36	-0.0335	0.0076	-0.0346
37	-0.0826	0.0663	0.0046
38	-0.0360	0.0338	-0.0022
39	-0.0355	0.0356	-0.0082
40	-0.0325	0.0243	-0.0025
41	-0.0020	0.0703	-0.0668
42	0.0059	-0.0264	0.0110
43	0.0018	-0.0091	0.0052
44	-0.0174	0.0578	-0.0222
45	-0.0322	0.0611	0.0064

Sum of Residuals 0  
 Sum of Squared Residuals 6548174  
 Predicted Residual SS (PRESS) 7394089