```
1          ********************************************************;
2          *** The effect of light on Meadowfoam flowering.      ***;
3          *** Results of an experiment where the effedt of six  ***;
4          *** levels of light intensity and the timing of the   ***;
5          *** light treatment was investigated.                 ***;
6          ********************************************************;
7
8          dm'log;clear;output;clear';
9          options nodate nocenter nonumber ps=512 ls=99 nolabel;
10         ODS HTML style=minimal rs=none
10       ! body='C:\Geaghan\Current\EXST3201\Fall2005\SAS\Meadowfoam01.html' ;
NOTE: Writing HTML Body file: C:\Geaghan\Current\EXST3201\Fall2005\SAS\Meadowfoam01.html
11
12         Title1 'Chapter 9 : The effect of light on Meadowfoam flowering';
13         filename input1 'C:\Geaghan\Current\EXST3201\Datasets\ASCII\case0901.csv';
14
15         data Meadowfoam; infile input1 missover DSD dlm="," firstobs=2;
16            input FLOWERS TIME INTENSity;
17              label Flowers = 'Average number of flowers per plant'
18                    Time = 'Early and Late'
19                    Intensity = 'Level of light intensity';
20           IntensityAgain = Intensity;
21              Time0 = Time - 1;
22           TimeName = 'Early'; if time eq 1 then Timename = 'Late';
23              intensity_Time0 = intensity*Time0;
24         datalines;
NOTE: The infile INPUT1 is:
      File Name=C:\Geaghan\Current\EXST3201\Datasets\ASCII\case0901.csv,
      RECFM=V,LRECL=256
NOTE: 24 records were read from the infile INPUT1.
      The minimum record length was 8.
      The maximum record length was 24.
NOTE: The data set WORK.MEADOWFOAM has 24 observations and 7 variables.
NOTE: DATA statement used (Total process time):
      real time           0.03 seconds
      cpu time            0.03 seconds
25         run;
26
27         Title2 'Two-way analysis of variance (CRD factorial)';
28         Title3 'Note interaction request with vertical bar';
29         options ps=512 ls=111;
30         PROC GLM DATA=Meadowfoam; class Intensity TimeName;
31            MODEL Flowers = Intensity | TimeName;
32            output out=next r=resid p=YHat;
33         RUN;
NOTE: The data set WORK.NEXT has 24 observations and 9 variables.
NOTE: The PROCEDURE GLM printed pages 1-2.
NOTE: PROCEDURE GLM used (Total process time):
      real time           0.25 seconds
      cpu time            0.13 seconds
34
```

The first model is a traditional one-way ANOVA, or more properly a Completely Randomized Design (CRD) with a 2x6 factorial treatment arrangement. Notice how the treatments and interactions are maintained as groups of indicator variables.

```
Chapter 9 : The effect of light on Meadowfoam flowering
Two-way analysis of variance (CRD factorial)
Note interaction request with vertical bar

The GLM Procedure

             Class Level Information
Class          Levels    Values
INTENSity           6    150 300 450 600 750 900
TimeName            2    Early Late

Number of Observations Read          24
Number of Observations Used          24

Dependent Variable: FLOWERS
                                    Sum of
Source                      DF         Squares     Mean Square    F Value    Pr > F
Model                       11     3682.011162      334.728287       6.12    0.0020
Error                       12      655.925105       54.660425
Corrected Total             23     4337.936267

R-Square     Coeff Var      Root MSE    FLOWERS Mean
0.848793      13.16993      7.393269        56.13750

Source                      DF       Type I SS     Mean Square    F Value    Pr > F
INTENSity                    5     2683.513751      536.702750       9.82    0.0006
TimeName                     1      886.950342      886.950342      16.23    0.0017
INTENSity*TimeName           5      111.547069       22.309414       0.41    0.8342

Source                      DF     Type III SS     Mean Square    F Value    Pr > F
INTENSity                    5     2683.513751      536.702750       9.82    0.0006
TimeName                     1      886.950342      886.950342      16.23    0.0017
INTENSity*TimeName           5      111.547069       22.309414       0.41    0.8342


35         Title2 'AnCova with PROC GLM';
36         Title3 'This ANCOVA was previously done with PROC REG';
37         Title4 'Note request of solution to get regression coefficients';
38         PROC GLM DATA=Meadowfoam;
39            MODEL Flowers = Intensity Time0 intensity*Time0 / solution;
40         RUN;
NOTE: The PROCEDURE GLM printed pages 3-4.
NOTE: PROCEDURE GLM used (Total process time):
      real time           0.12 seconds
      cpu time            0.06 seconds

Chapter 9 : The effect of light on Meadowfoam flowering
AnCova with PROC GLM
This ANCOVA was previously done with PROC REG
Note request of solution to get regression coefficients

The GLM Procedure

Number of Observations Read          24
Number of Observations Used          24
```

This model is the Analysis of Covariance (AnCova) we saw earlier. Recall the model is fitted as $\hat{Y}_i = b_0 + b_1 X_{1i} + b_2 X_{2i} + b_3 X_{1i} X_{2i}$ where the group coded as 0 is estimated as $\hat{Y}_i = b_0 + b_1 X_{1i}$ while the group coded as 1 is estimated as $\hat{Y}_i = (b_0 + b_2) + (b_1 + b_3) X_{1i}$

```
Dependent Variable: FLOWERS
                                        Sum of
Source                      DF         Squares     Mean Square    F Value    Pr > F
Model                        3     3467.276422     1155.758807      26.55    <.0001
Error                       20      870.659845       43.532992
Corrected Total             23     4337.936267

R-Square     Coeff Var      Root MSE    FLOWERS Mean
0.799292      11.75320      6.597954        56.13750

Source                      DF       Type I SS     Mean Square    F Value    Pr > F
INTENSity                    1     2579.750045     2579.750045      59.26    <.0001
Time0                        1      886.950342      886.950342      20.37    0.0002
intensity*Time0              1        0.576035        0.576035       0.01    0.9096

Source                      DF     Type III SS     Mean Square    F Value    Pr > F
INTENSity                    1     1328.712043     1328.712043      30.52    <.0001
Time0                        1      153.216013      153.216013       3.52    0.0753
intensity*Time0              1        0.576035        0.576035       0.01    0.9096

                                        Standard
Parameter                Estimate           Error    t Value    Pr > |t|
Intercept            71.62333349      4.34330481      16.49      <.0001
INTENSity            -0.04107619      0.00743505      -5.52      <.0001
Time0                11.52333336      6.14236056       1.88      0.0753
Intensity*Time0       0.00120952      0.01051475       0.12      0.9096


42         Title2 'Analysis of Covariance with LOF';
43         PROC GLM DATA=Meadowfoam; class IntensityAgain TimeName;
44            MODEL Flowers = Intensity TimeName intensity*TimeName
                              IntensityAgain IntensityAgain*TimeName;
45         RUN;
47         Title2 'Analysis of Covariance with pooled LOF';
NOTE: The PROCEDURE GLM printed pages 5-6.
NOTE: PROCEDURE GLM used (Total process time):
      real time           0.13 seconds
      cpu time            0.08 seconds

Chapter 9 : The effect of light on Meadowfoam flowering
Analysis of Covariance with LOF

The GLM Procedure

               Class Level Information
Class               Levels    Values
IntensityAgain           6    150 300 450 600 750 900
TimeName                 2    Early Late

Number of Observations Read          24
Number of Observations Used          24

Dependent Variable: FLOWERS
                                        Sum of
Source                      DF         Squares     Mean Square    F Value    Pr > F
Model                       11     3682.011162      334.728287       6.12    0.0020
Error                       12      655.925105       54.660425
Corrected Total             23     4337.936267

R-Square     Coeff Var      Root MSE    FLOWERS Mean
0.848793      13.16993      7.393269        56.13750
```

Source	DF	Type I SS	Mean Square	F Value	Pr > F
INTENSity	1	2579.750045	2579.750045	47.20	<.0001
TimeName	1	886.950342	886.950342	16.23	0.0017
INTENSity*TimeName	1	0.576035	0.576035	0.01	0.9199
IntensityAgain	4	103.763706	25.940926	0.47	0.7538
IntensityAg*TimeName	4	110.971034	27.742759	0.51	0.7314

Source	DF	Type III SS	Mean Square	F Value	Pr > F
INTENSity	0	0.0000000	.	.	.
TimeName	1	153.2160135	153.2160135	2.80	0.1199
INTENSity*TimeName	0	0.0000000	.	.	.
IntensityAgain	4	103.7637056	25.9409264	0.47	0.7538
IntensityAg*TimeName	4	110.9710344	27.7427586	0.51	0.7314

```
48         PROC GLM DATA=Meadowfoam; class IntensityAgain TimeName;
49            MODEL Flowers = Intensity TimeName intensity*TimeName IntensityAgain*TimeName;
50         RUN;
51         quit;
NOTE: The PROCEDURE GLM printed pages 7-8.
NOTE: PROCEDURE GLM used (Total process time):
      real time           0.12 seconds
      cpu time            0.08 seconds
53         ODS HTML close;
```

Chapter 9 : The effect of light on Meadowfoam flowering
Analysis of Covariance with pooled LOF

The GLM Procedure

Class Level Information

Class	Levels	Values
IntensityAgain	6	150 300 450 600 750 900
TimeName	2	Early Late

Number of Observations Read 24
Number of Observations Used 24

Dependent Variable: FLOWERS

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	11	3682.011162	334.728287	6.12	0.0020
Error	12	655.925105	54.660425		
Corrected Total	23	4337.936267			

R-Square	Coeff Var	Root MSE	FLOWERS Mean
0.848793	13.16993	7.393269	56.13750

Source	DF	Type I SS	Mean Square	F Value	Pr > F
INTENSity	1	2579.750045	2579.750045	47.20	<.0001
TimeName	1	886.950342	886.950342	16.23	0.0017
INTENSity*TimeName	1	0.576035	0.576035	0.01	0.9199
IntensityAg*TimeName	8	214.734740	26.841842	0.49	0.8405

Source	DF	Type III SS	Mean Square	F Value	Pr > F
INTENSity	0	0.0000000	.	.	.
TimeName	1	153.2160135	153.2160135	2.80	0.1199
INTENSity*TimeName	0	0.0000000	.	.	.
IntensityAg*TimeName	8	214.7347399	26.8418425	0.49	0.8405