Within-Cases: Multivariate approach part two

pain1.data

```
         pain1 pain2 pain3 pain4 pain5 pain6
1         7.0   8.0   9.0  10.0   7.0   6.5
2         7.5   6.0   5.5   6.0   4.5   7.5
3         3.0   4.5   6.0   6.5   5.5   8.5
4         3.0   1.5   0.0   5.0   0.0   2.0
5         5.0   3.5   4.5   5.5   1.5   5.5
6         8.0   6.0   4.0   6.5   5.5   4.5
7         7.5   4.5   5.5   5.0   5.5   6.0
8         7.5   4.0   0.5   3.5   4.5   7.5
9         7.5   4.5   4.0   7.5   4.5   6.0
10        6.0   7.5   5.5   7.5   6.0   6.5
```

```
/* pain1.sas */
options linesize=79 pagesize=100 noovp formdlim='_';
title 'Multivariate repeated measures analysis of the pain data';

/*          Dose 1    Dose 2    Dose 3
            ------    -----     ------
Drug 1      pain1     pain2     pain3
Drug 2      pain4     pain5     pain6           */

data ouch;
    infile 'pain1.data' firstobs=2; /* Skip the labels */
    input patient pain1-pain6;
    Drug1 = mean(of pain1-pain3); Drug2 = mean(of pain4-pain6);
    Dose1 = (pain1+pain4)/2; Dose2=(pain2+pain5)/2; Dose3 = (pain3+pain6)/2;
    drugdiff = drug1-drug2;
    dosed1 = dose1-dose2; dosed2 = dose2-dose3;
    int1 = (pain1-pain4)-(pain2-pain5); int2 = (pain2-pain5)-(pain3-pain6);
    d12 = pain1-pain2; d13 = pain1-pain3; d14 = pain1-pain4;
    d15 = pain1-pain5; d16 = pain1-pain6; d23 = pain2-pain3;
    d24 = pain2-pain4; d25 = pain2-pain5; d26 = pain2-pain6;
    d34 = pain3-pain4; d35 = pain3-pain5; d36 = pain3-pain6;
    d45 = pain4-pain5; d46 = pain4-pain6; d56 = pain5-pain6;
    int3 = (pain1-pain4)-(pain3-pain6);

proc means n mean stddev;
    var Drug1 -- Dose3  pain1-pain6;

proc reg;
    title2 'Overall test';
    model d12-d16 = ;
    Overall: mtest intercept = 0;

proc reg;
    title2 'Main Effect of Drug';
    model drugdiff = ;
    Drug: mtest intercept = 0;
    /* Could have used test or just looked at the t statistic. */

proc reg;
```

```
    title2 'Main Effect of Dose Level';
    model dosed1 dosed2 = ;
    Dose: mtest intercept = 0;

proc reg;
    title2 'Drug by Dose Interaction';
    model int1 int2 = ;
    Drug_by_Dose: mtest intercept = 0;

proc means n mean t probt;
    title2 'Follow up with matched t-tests';
    var d12 -- d56 int1-int3;

proc glm;
    title2 'Two-factor within cases the easy way';
    model pain1-pain6 = ;
    repeated Drug 2, Dosage 3 / short summary mean;
    /* Factor on the right changes fastest (like numbers) */

proc glm;
    title2 'Overall test the easy way';
    model pain1-pain6 = ;
    repeated treatment / short summary mean;
```

_____

Multivariate repeated measures analysis of the pain data   1

The MEANS Procedure

```
Variable     N        Mean         Std Dev
---------------------------------------------
Drug1        10    5.2166667      1.7586646
Drug2        10    5.6000000      1.5238839
Dose1        10    6.2500000      1.3743685
Dose2        10    4.7250000      1.9523846
Dose3        10    5.2500000      1.9257033
pain1        10    6.2000000      1.9032137
pain2        10    5.0000000      1.9293062
pain3        10    4.4500000      2.6294275
pain4        10    6.3000000      1.7826323
pain5        10    4.4500000      2.1272047
pain6        10    6.0500000      1.8173546
---------------------------------------------
```

_____

Multivariate repeated measures analysis of the pain data   2
                        Overall test

The REG Procedure
Model: MODEL1
Dependent Variable: d12

Number of Observations Read   10
Number of Observations Used   10

Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   0   0   .   .   .
Error   9   32.10000   3.56667
Corrected Total   9   32.10000

                Root MSE   1.88856   R-Square   0.0000
                Dependent Mean   1.20000   Adj R-Sq   0.0000
                Coeff Var   157.38017

                          Parameter Estimates

                       Parameter   Standard
       Variable   DF   Estimate   Error   t Value   Pr > |t|

       Intercept   1   1.20000   0.59722   2.01   0.0754

                          The REG Procedure
                           Model: MODEL1
                        Dependent Variable: d13

                   Number of Observations Read   10
                   Number of Observations Used   10

                          Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   0   0   .   .   .
Error   9   77.12500   8.56944
Corrected Total   9   77.12500

                Root MSE   2.92736   R-Square   0.0000
                Dependent Mean   1.75000   Adj R-Sq   0.0000
                Coeff Var   167.27779

                          Parameter Estimates

                       Parameter   Standard
       Variable   DF   Estimate   Error   t Value   Pr > |t|

       Intercept   1   1.75000   0.92571   1.89   0.0913

                          The REG Procedure
                           Model: MODEL1
                        Dependent Variable: d14

                   Number of Observations Read   10
                   Number of Observations Used   10

                          Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   0   0   .   .   .
Error   9   54.40000   6.04444
Corrected Total   9   54.40000

                Root MSE   2.45855   R-Square   0.0000
                Dependent Mean   -0.10000   Adj R-Sq   0.0000
                Coeff Var   -2458.54519

                          Parameter Estimates

                       Parameter   Standard
       Variable   DF   Estimate   Error   t Value   Pr > |t|

       Intercept   1   -0.10000   0.77746   -0.13   0.9005

                          The REG Procedure
                           Model: MODEL1
                        Dependent Variable: d15

                   Number of Observations Read   10
                   Number of Observations Used   10

                          Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   0   0   .   .   .
Error   9   34.12500   3.79167
Corrected Total   9   34.12500

```
          Root MSE              1.94722    R-Square     0.0000
          Dependent Mean        1.75000    Adj R-Sq     0.0000
          Coeff Var           111.26973


                        Parameter Estimates

                        Parameter      Standard
     Variable     DF     Estimate        Error     t Value    Pr > |t|

     Intercept     1      1.75000       0.61577       2.84      0.0193
```

```
                            The REG Procedure
                             Model: MODEL1
                          Dependent Variable: d16

                    Number of Observations Read        10
                    Number of Observations Used        10


                        Analysis of Variance

                                    Sum of         Mean
Source                    DF        Squares        Square     F Value    Pr > F

Model                      0            0                        .         .         .
Error                      9       48.52500       5.39167
Corrected Total            9       48.52500


          Root MSE              2.32200    R-Square     0.0000
          Dependent Mean        0.15000    Adj R-Sq     0.0000
          Coeff Var          1547.99751


                        Parameter Estimates

                        Parameter      Standard
     Variable     DF     Estimate        Error     t Value    Pr > |t|

     Intercept     1      0.15000       0.73428       0.20      0.8427
```

```
                            The REG Procedure
                             Model: MODEL1
                        Multivariate Test: Overall

               Multivariate Statistics and Exact F Statistics

                        S=1     M=1.5     N=1.5

Statistic                         Value    F Value    Num DF    Den DF    Pr > F

Wilks' Lambda                 0.26024160       2.84         5         5    0.1381
Pillai's Trace                0.73975840       2.84         5         5    0.1381
Hotelling-Lawley Trace        2.84258317       2.84         5         5    0.1381
Roy's Greatest Root           2.84258317       2.84         5         5    0.1381
```

```
                            The REG Procedure
                             Model: MODEL1
                        Dependent Variable: drugdiff

                    Number of Observations Read        10
                    Number of Observations Used        10


                        Analysis of Variance

                                    Sum of         Mean
Source                    DF        Squares        Square     F Value    Pr > F

Model                      0            0                        .         .         .
Error                      9        7.11389       0.79043
Corrected Total            9        7.11389


          Root MSE              0.88906    R-Square     0.0000
          Dependent Mean       -0.38333    Adj R-Sq     0.0000
          Coeff Var          -231.92934


                        Parameter Estimates

                        Parameter      Standard
     Variable     DF     Estimate        Error     t Value    Pr > |t|

     Intercept     1     -0.38333       0.28115      -1.36      0.2059
```

The REG Procedure
Model: MODEL1
Multivariate Test: Drug

Multivariate Statistics and Exact F Statistics

S=1   M=-0.5   N=3.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.82880259	1.86	1	9	0.2059
Pillai's Trace	0.17119741	1.86	1	9	0.2059
Hotelling-Lawley Trace	0.20655994	1.86	1	9	0.2059
Roy's Greatest Root	0.20655994	1.86	1	9	0.2059

The REG Procedure
Model: MODEL1
Dependent Variable: dosed1

Number of Observations Read   10
Number of Observations Used   10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	0	0	.	.	.
Error	9	12.55625	1.39514		
Corrected Total	9	12.55625			

Root MSE	1.18116	R-Square	0.0000	
Dependent Mean	1.52500	Adj R-Sq	0.0000	
Coeff Var	77.45311			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	1.52500	0.37352	4.08	0.0027

The REG Procedure
Model: MODEL1
Dependent Variable: dosed2

Number of Observations Read   10
Number of Observations Used   10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	0	0	.	.	.
Error	9	13.93125	1.54792		
Corrected Total	9	13.93125			

Root MSE	1.24415	R-Square	0.0000	
Dependent Mean	-0.52500	Adj R-Sq	0.0000	
Coeff Var	-236.98152			

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.52500	0.39344	-1.33	0.2148

The REG Procedure
Model: MODEL1
Multivariate Test: Dose

Multivariate Statistics and Exact F Statistics

S=1   M=0   N=3

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.33765103	7.85	2	8	0.0130
Pillai's Trace	0.66234897	7.85	2	8	0.0130
Hotelling-Lawley Trace	1.96163760	7.85	2	8	0.0130
Roy's Greatest Root	1.96163760	7.85	2	8	0.0130

                          The REG Procedure
                            Model: MODEL1
                      Dependent Variable: int1

                  Number of Observations Read   10
                  Number of Observations Used   10

                         Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   0   0   .   .   .
Error   9   79.02500   8.78056
Corrected Total   9   79.02500

              Root MSE   2.96320   R-Square   0.0000
              Dependent Mean   -0.65000   Adj R-Sq   0.0000
              Coeff Var   -455.87696

                        Parameter Estimates

                       Parameter   Standard
     Variable   DF   Estimate   Error   t Value   Pr > |t|

     Intercept   1   -0.65000   0.93705   -0.69   0.5054

_____

                          The REG Procedure
                            Model: MODEL1
                      Dependent Variable: int2

                  Number of Observations Read   10
                  Number of Observations Used   10

                         Analysis of Variance

                                    Sum of   Mean
Source   DF   Squares   Square   F Value   Pr > F

Model   0   0   .   .   .
Error   9   45.52500   5.05833
Corrected Total   9   45.52500

              Root MSE   2.24907   R-Square   0.0000

          Dependent Mean   2.15000   Adj R-Sq   0.0000
          Coeff Var   104.60809

                        Parameter Estimates

                       Parameter   Standard
     Variable   DF   Estimate   Error   t Value   Pr > |t|

     Intercept   1   2.15000   0.71122   3.02   0.0144

_____

   Multivariate Test: Drug_by_Dose

            Multivariate Statistics and Exact F Statistics

                        S=1   M=0   N=3

Statistic   Value   F Value   Num DF   Den DF   Pr > F

Wilks' Lambda   0.43171577   5.27   2   8   0.0347
Pillai's Trace   0.56828423   5.27   2   8   0.0347
Hotelling-Lawley Trace   1.31633881   5.27   2   8   0.0347
Roy's Greatest Root   1.31633881   5.27   2   8   0.0347

_____

                         The MEANS Procedure

          Variable   N   Mean   t Value   Pr > |t|
          ----
          d12   10   1.2000000   2.01   0.0754
          d13   10   1.7500000   1.89   0.0913
          d14   10   -0.1000000   -0.13   0.9005
          d15   10   1.7500000   2.84   0.0193
          d16   10   0.1500000   0.20   0.8427
          d23   10   0.5500000   1.04   0.3260
          d24   10   -1.3000000   -2.98   0.0154
          d25   10   0.5500000   1.56   0.1538
          d26   10   -1.0500000   -1.72   0.1204
          d34   10   -1.8500000   -3.51   0.0066
          d35   10   0   0.00   1.0000
          d36   10   -1.6000000   -2.14   0.0612
          d45   10   1.8500000   3.08   0.0132
          d46   10   0.2500000   0.33   0.7477
          d56   10   -1.6000000   -3.01   0.0147
          int1   10   -0.6500000   -0.69   0.5054
          int2   10   2.1500000   3.02   0.0144
          int3   10   1.5000000   1.13   0.2890

Mean Pain Ratings
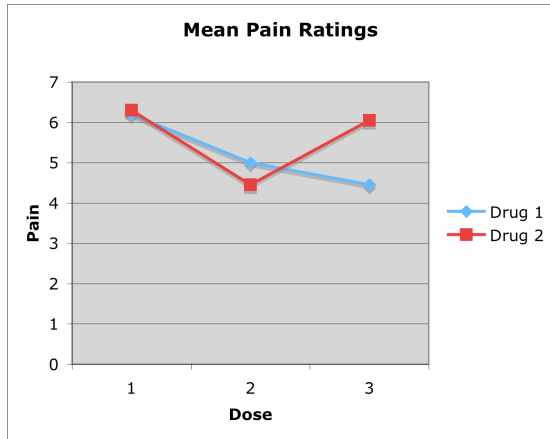
P-values for pairwise difference tests (unadjusted)

Drug	Dose	Drug 1			Drug 2		
		Dose 1	Dose 2	Dose 3	Dose 1	Dose 2	Dose 3
1	1		0.0754	0.0913	0.9005	0.0193	0.8427
1	2			0.3260	0.0154	0.1538	0.1204
1	3				0.0066	1.0000	0.0612
2	1					0.0132	0.7477
2	2						0.0147
2	3						

But note: 0.0066 * 15 = 0.099

Multivariate repeated measures analysis of the pain data   17
Two-factor within cases the easy way

The GLM Procedure

Number of Observations Read   10
Number of Observations Used   10

Multivariate repeated measures analysis of the pain data   18
Two-factor within cases the easy way

The GLM Procedure

Dependent Variable: pain1

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	384.4000000	384.4000000	106.12	<.0001
Error	9	32.6000000	3.6222222		
Uncorrected Total	10	417.0000000			

R-Square	Coeff Var	Root MSE	pain1 Mean
0.000000	30.69699	1.903214	6.200000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	384.4000000	384.4000000	106.12	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	384.4000000	384.4000000	106.12	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.200000000	0.60184900	10.30	<.0001

Multivariate repeated measures analysis of the pain data   19
Two-factor within cases the easy way
The GLM Procedure

Dependent Variable: pain2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	250.0000000	250.0000000	67.16	<.0001
Error	9	33.5000000	3.7222222		
Uncorrected Total	10	283.5000000			

R-Square	Coeff Var	Root MSE	pain2 Mean
0.000000	38.58612	1.929306	5.000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	250.0000000	250.0000000	67.16	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	250.0000000	250.0000000	67.16	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	5.000000000	0.61010017	8.20	<.0001

_____

Dependent Variable: pain3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	198.0250000	198.0250000	28.64	0.0005
Error	9	62.2250000	6.9138889		
Uncorrected Total	10	260.2500000			

R-Square	Coeff Var	Root MSE	pain3 Mean
0.000000	59.08826	2.629427	4.450000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	198.0250000	198.0250000	28.64	0.0005

Source	DF	Type III SS	Mean Square	F Value	Pr > F

Intercept	1	198.0250000	198.0250000	28.64	0.0005

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.450000000	0.83149798	5.35	0.0005

_____

Dependent Variable: pain4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	396.9000000	396.9000000	124.90	<.0001
Error	9	28.6000000	3.1777778		
Uncorrected Total	10	425.5000000			

R-Square	Coeff Var	Root MSE	pain4 Mean
0.000000	28.29575	1.782632	6.300000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	396.9000000	396.9000000	124.90	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	396.9000000	396.9000000	124.90	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.300000000	0.56371782	11.18	<.0001

_____

Dependent Variable: pain5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	198.0250000	198.0250000	43.76	<.0001
Error	9	40.7250000	4.5250000		
Uncorrected Total	10	238.7500000			

R-Square	Coeff Var	Root MSE	pain5 Mean

```
            0.000000      47.80235       2.127205      4.450000
```

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	198.0250000	198.0250000	43.76	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	198.0250000	198.0250000	43.76	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.450000000	0.67268120	6.62	<.0001

Dependent Variable: pain6

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	366.0250000	366.0250000	110.82	<.0001
Error	9	29.7250000	3.3027778		
Uncorrected Total	10	395.7500000			

R-Square	Coeff Var	Root MSE	pain6 Mean
0.000000	30.03892	1.817355	6.050000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	366.0250000	366.0250000	110.82	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	366.0250000	366.0250000	110.82	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.050000000	0.57469799	10.53	<.0001

The GLM Procedure
Repeated Measures Analysis of Variance

Repeated Measures Level Information

Dependent Variable	pain1	pain2	pain3	pain4	pain5	pain6
Level of Drug	1	1	1	2	2	2
Level of Dosage	1	2	3	1	2	3

MANOVA Test Criteria and Exact F Statistics
for the Hypothesis of no Drug Effect
H = Type III SSCP Matrix for Drug
E = Error SSCP Matrix

S=1   M=-0.5   N=3.5

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.82880259	1.86	1	9	0.2059
Pillai's Trace	0.17119741	1.86	1	9	0.2059
Hotelling-Lawley Trace	0.20655994	1.86	1	9	0.2059
Roy's Greatest Root	0.20655994	1.86	1	9	0.2059

MANOVA Test Criteria and Exact F Statistics
for the Hypothesis of no Dosage Effect
H = Type III SSCP Matrix for Dosage
E = Error SSCP Matrix

S=1   M=0   N=3

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.33765103	7.85	2	8	0.0130
Pillai's Trace	0.66234897	7.85	2	8	0.0130
Hotelling-Lawley Trace	1.96163760	7.85	2	8	0.0130
Roy's Greatest Root	1.96163760	7.85	2	8	0.0130

MANOVA Test Criteria and Exact F Statistics
for the Hypothesis of no Drug*Dosage Effect
H = Type III SSCP Matrix for Drug*Dosage
E = Error SSCP Matrix

S=1   M=0   N=3

Statistic	Value	F Value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.43171577	5.27	2	8	0.0347
Pillai's Trace	0.56828423	5.27	2	8	0.0347
Hotelling-Lawley Trace	1.31633881	5.27	2	8	0.0347
Roy's Greatest Root	1.31633881	5.27	2	8	0.0347

```

The GLM Procedure
Repeated Measures Analysis of Variance
Univariate Tests of Hypotheses for Within Subject Effects

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Drug | 1 | 2.20416667 | 2.20416667 | 1.86 | 0.2059 |
| Error(Drug) | 9 | 10.67083333 | 1.18564815 | | |

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Dosage | 2 | 24.00833333 | 12.00416667 | 6.39 | 0.0080 |
| Error(Dosage) | 18 | 33.82500000 | 1.87916667 | | |

| | Adj Pr > F | |
|---|---|---|
| Source | G - G | H - F |
| Dosage | 0.0125 | 0.0080 |
| Error(Dosage) | | |

Greenhouse-Geisser Epsilon  0.8400
Huynh-Feldt Epsilon    1.0110

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Drug*Dosage | 2 | 12.15833333 | 6.07916667 | 2.31 | 0.1278 |
| Error(Drug*Dosage) | 18 | 47.34166667 | 2.63009259 | | |

| | Adj Pr > F | |
|---|---|---|
| Source | G - G | H - F |
| Drug*Dosage | 0.1514 | 0.1463 |
| Error(Drug*Dosage) | | |

Greenhouse-Geisser Epsilon  0.6621
Huynh-Feldt Epsilon    0.7323

The GLM Procedure
Repeated Measures Analysis of Variance
Analysis of Variance of Contrast Variables

Drug_N represents the contrast between the nth level of Drug and the last

Contrast Variable: Drug_1

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Mean | 1 | 13.22500000 | 13.22500000 | 1.86 | 0.2059 |
| Error | 9 | 64.02500000 | 7.11388889 | | |

The GLM Procedure
Repeated Measures Analysis of Variance
Analysis of Variance of Contrast Variables

Dosage_N represents the contrast between the nth level of Dosage and the last

Contrast Variable: Dosage_1

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Mean | 1 | 40.00000000 | 40.00000000 | 3.71 | 0.0862 |
| Error | 9 | 97.00000000 | 10.77777778 | | |

Contrast Variable: Dosage_2

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|---|---|---|---|---|---|
| Mean | 1 | 11.02500000 | 11.02500000 | 1.78 | 0.2148 |
| Error | 9 | 55.72500000 | 6.19166667 | | |

The GLM Procedure
Repeated Measures Analysis of Variance
Analysis of Variance of Contrast Variables

Drug_N represents the contrast between the nth level of Drug and the last
Dosage_N represents the contrast between the nth level of Dosage and the last

```
Contrast Variable: Drug_1*Dosage_1

Source   DF   Type III SS   Mean Square   F Value   Pr > F

Mean   1   22.5000000   22.5000000   1.27   0.2890
Error   9   159.5000000   17.7222222

Contrast Variable: Drug_1*Dosage_2

Source   DF   Type III SS   Mean Square   F Value   Pr > F

Mean   1   46.22500000   46.22500000   9.14   0.0144
Error   9   45.52500000   5.05833333
```

```
                 Multivariate repeated measures analysis of the pain data          29
                            Two-factor within cases the easy way
```

```
                                  The GLM Procedure
                          Repeated Measures Analysis of Variance

                              Means of Within Subjects Effects

             Level of
             Drug          N             Mean            Std Dev

              1            30          5.21666667       2.23098607
              2            30          5.60000000       2.02739854


             Level of
             Dosage        N             Mean            Std Dev

              1            20          6.25000000       1.79546212
              2            20          4.72500000       1.99654307
              3            20          5.25000000       2.34801148


      Level of     Level of
      Drug         Dosage       N             Mean            Std Dev

       1            1           10          6.20000000       1.90321366
       1            2           10          5.00000000       1.92930615
       1            3           10          4.45000000       2.62942748
       2            1           10          6.30000000       1.78263226
       2            2           10          4.45000000       2.12720474
       2            3           10          6.05000000       1.81735461
```

```
                 Multivariate repeated measures analysis of the pain data          30
                                 Overall test the easy way
```

```
                                  The GLM Procedure

                     Number of Observations Read          10
                     Number of Observations Used          10
```

```
                 Multivariate repeated measures analysis of the pain data          31
                                 Overall test the easy way
```

```
                                  The GLM Procedure

Dependent Variable: pain1

                                    Sum of
Source                  DF         Squares     Mean Square    F Value    Pr > F

Model                    1      384.4000000    384.4000000     106.12    <.0001

Error                    9       32.6000000      3.6222222

Uncorrected Total       10      417.0000000


            R-Square     Coeff Var      Root MSE     pain1 Mean

            0.000000      30.69699      1.903214       6.200000


Source                  DF        Type I SS     Mean Square    F Value    Pr > F

Intercept                1      384.4000000     384.4000000     106.12    <.0001


Source                  DF       Type III SS    Mean Square    F Value    Pr > F

Intercept                1      384.4000000     384.4000000     106.12    <.0001


                                        Standard
         Parameter      Estimate          Error     t Value    Pr > |t|

         Intercept    6.200000000     0.60184900      10.30      <.0001
```

```
                 Multivariate repeated measures analysis of the pain data          32
                                 Overall test the easy way
```

```
                                  The GLM Procedure
```

Dependent Variable: pain2

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	250.0000000	250.0000000	67.16	<.0001
Error	9	33.5000000	3.7222222		
Uncorrected Total	10	283.5000000			

R-Square	Coeff Var	Root MSE	pain2 Mean
0.000000	38.58612	1.929306	5.000000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	250.0000000	250.0000000	67.16	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	250.0000000	250.0000000	67.16	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	5.000000000	0.61010017	8.20	<.0001

Dependent Variable: pain3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	198.0250000	198.0250000	28.64	0.0005
Error	9	62.2250000	6.9138889		
Uncorrected Total	10	260.2500000			

R-Square	Coeff Var	Root MSE	pain3 Mean
0.000000	59.08826	2.629427	4.450000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	198.0250000	198.0250000	28.64	0.0005

Source	DF	Type III SS	Mean Square	F Value	Pr > F

Intercept	1	198.0250000	198.0250000	28.64	0.0005

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.450000000	0.83149798	5.35	0.0005

Multivariate repeated measures analysis of the pain data   34
Overall test the easy way

The GLM Procedure

Dependent Variable: pain4

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	396.9000000	396.9000000	124.90	<.0001
Error	9	28.6000000	3.1777778		
Uncorrected Total	10	425.5000000			

R-Square	Coeff Var	Root MSE	pain4 Mean
0.000000	28.29575	1.782632	6.300000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Intercept	1	396.9000000	396.9000000	124.90	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Intercept	1	396.9000000	396.9000000	124.90	<.0001

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	6.300000000	0.56371782	11.18	<.0001

Dependent Variable: pain5

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	198.0250000	198.0250000	43.76	<.0001
Error	9	40.7250000	4.5250000		
Uncorrected Total	10	238.7500000			

```
            R-Square     Coeff Var      Root MSE     pain5 Mean

            0.000000     47.80235       2.127205      4.450000

Source                  DF     Type I SS     Mean Square    F Value   Pr > F

Intercept                1    198.0250000    198.0250000     43.76    <.0001


Source                  DF    Type III SS    Mean Square    F Value   Pr > F

Intercept                1    198.0250000    198.0250000     43.76    <.0001


                                     Standard
       Parameter     Estimate         Error      t Value    Pr > |t|

       Intercept    4.450000000    0.67268120      6.62      <.0001
```

```
Dependent Variable: pain6
                                Sum of
Source                  DF      Squares     Mean Square    F Value   Pr > F

Model                    1    366.0250000    366.0250000    110.82    <.0001

Error                    9     29.7250000      3.3027778

Uncorrected Total       10    395.7500000


            R-Square     Coeff Var      Root MSE     pain6 Mean

            0.000000     30.03892       1.817355      6.050000


Source                  DF     Type I SS     Mean Square    F Value   Pr > F

Intercept                1    366.0250000    366.0250000    110.82    <.0001


Source                  DF    Type III SS    Mean Square    F Value   Pr > F

Intercept                1    366.0250000    366.0250000    110.82    <.0001


                                     Standard
       Parameter     Estimate         Error      t Value    Pr > |t|

       Intercept    6.050000000    0.57469799     10.53      <.0001
```

```
                        The GLM Procedure
                Repeated Measures Analysis of Variance

                Repeated Measures Level Information

Dependent Variable    pain1    pain2    pain3    pain4    pain5    pain6

Level of treatment       1        2        3        4        5        6


          MANOVA Test Criteria and Exact F Statistics
        for the Hypothesis of no treatment Effect
           H = Type III SSCP Matrix for treatment
                  E = Error SSCP Matrix

                   S=1     M=1.5    N=1.5

Statistic                    Value    F Value   Num DF   Den DF   Pr > F

Wilks' Lambda              0.26024160    2.84       5        5     0.1381
Pillai's Trace            0.73975840    2.84       5        5     0.1381
Hotelling-Lawley Trace    2.84258317    2.84       5        5     0.1381
Roy's Greatest Root       2.84258317    2.84       5        5     0.1381
```

```
                        The GLM Procedure
                Repeated Measures Analysis of Variance
        Univariate Tests of Hypotheses for Within Subject Effects

Source                  DF    Type III SS    Mean Square    F Value   Pr > F

treatment                5     38.37083333     7.67416667     3.76    0.0063
Error(treatment)        45     91.83750000     2.04083333

                                         Adj Pr > F
                      Source          G - G      H - F

                      treatment       0.0207     0.0064
                      Error(treatment)


              Greenhouse-Geisser Epsilon     0.6243
              Huynh-Feldt Epsilon            0.9940
```

The GLM Procedure
Repeated Measures Analysis of Variance
Analysis of Variance of Contrast Variables

treatment_N represents the contrast between the nth level of treatment and the last

Contrast Variable: treatment_1

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Mean	1	0.22500000	0.22500000	0.04	0.8427
Error	9	48.52500000	5.39166667		

Contrast Variable: treatment_2

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Mean	1	11.02500000	11.02500000	2.94	0.1204
Error	9	33.72500000	3.74722222		

Contrast Variable: treatment_3

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Mean	1	25.60000000	25.60000000	4.57	0.0612
Error	9	50.40000000	5.60000000		

Contrast Variable: treatment_4

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Mean	1	0.62500000	0.62500000	0.11	0.7477
Error	9	51.12500000	5.68055556		

Contrast Variable: treatment_5

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Mean	1	25.60000000	25.60000000	9.07	0.0147
Error	9	25.40000000	2.82222222		

The GLM Procedure
Repeated Measures Analysis of Variance

Means of Within Subjects Effects

Level of treatment	N	Mean	Std Dev
1	10	6.20000000	1.90321366
2	10	5.00000000	1.92930615
3	10	4.45000000	2.62942748
4	10	6.30000000	1.78263226
5	10	4.45000000	2.12720474
6	10	6.05000000	1.81735461