```
/* x6_3.sas */
/* Purpose:  */

title1 'Example 6.3.';

data a;
  input sex$ person height sweat temp;
  cards;
M  1 177 18.1 33.9
M  2 189 18.8 33.2
M  3 181 20.4 33.9
M  4 184 19.5 33.8
M  5 183 30.5 33.3
M  6 178 22.2 33.6
M  7 162 19.4 34.2
M  8 176 26.7 33.2
M  9 190 16.6 33.2
M 10 180 45.4 33.5
M 11 179 24.0 33.9
M 12 175 34.6 33.8
M 13 183 21.3 33.5
M 14 177 33.3 33.9
M 15 185 22.9 33.8
M 16 176 18.6 33.5
F  1 160 14.6 32.9
F  2 171 27.0 33.7
F  3 168 27.6 32.3
F  4 171 20.2 33.1
F  5 169 30.8 33.4
F  6 169 17.4 33.5
F  7 167 21.1 33.0
F  8 170 19.3 34.1
F  9 162 21.5 33.8
F 10 160 15.2 33.0
F 11 168 15.4 33.7
F 12 157 25.2 33.9
F 13 161 13.9 34.8
F 14 164 20.2 31.9
F 15 161 25.3 34.0
F 16 180 12.6 33.5
;

proc print data=a;
title2 'List of data.';

proc means data=a;
  var height sweat temp;
  by sex NOTSORTED;
title2 'Simple statistics by sex.';

proc glm data=a;
  class sex;
  model height sweat temp=sex;
  manova h=sex /printe printh;
title2 'Test all 3 coordinates using GLM manova.';

proc glm data=a;
  class sex;
  model sweat temp=sex;
  manova h=sex /printe printh;
title2 'Test 2 coordinates using GLM manova.';
```



```
run;
```

Example 6.3. 1
List of data.

Obs	sex	person	height	sweat	temp
1	M	1	177	18.1	33.9
2	M	2	189	18.8	33.2
3	M	3	181	20.4	33.9
4	M	4	184	19.5	33.8
5	M	5	183	30.5	33.3
6	M	6	178	22.2	33.6
7	M	7	162	19.4	34.2
8	M	8	176	26.7	33.2
9	M	9	190	16.6	33.2
10	M	10	180	45.4	33.5
11	M	11	179	24.0	33.9
12	M	12	175	34.6	33.8
13	M	13	183	21.3	33.5
14	M	14	177	33.3	33.9
15	M	15	185	22.9	33.8
16	M	16	176	18.6	33.5
17	F	1	160	14.6	32.9
18	F	2	171	27.0	33.7
19	F	3	168	27.6	32.3
20	F	4	171	20.2	33.1
21	F	5	169	30.8	33.4
22	F	6	169	17.4	33.5
23	F	7	167	21.1	33.0
24	F	8	170	19.3	34.1
25	F	9	162	21.5	33.8
26	F	10	160	15.2	33.0
27	F	11	168	15.4	33.7
28	F	12	157	25.2	33.9
29	F	13	161	13.9	34.8
30	F	14	164	20.2	31.9
31	F	15	161	25.3	34.0
32	F	16	180	12.6	33.5

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Example 6.3. 2
Simple statistics by sex.

------------------------------------ sex=M ------------------------------------

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
height	16	179.6875000	6.5494911	162.0000000	190.0000000
sweat	16	24.5187500	7.8056577	16.6000000	45.4000000
temp	16	33.6375000	0.3074085	33.2000000	34.2000000

------------------------------------ sex=F ------------------------------------

Variable	N	Mean	Std Dev	Minimum	Maximum
height	16	166.1250000	5.8409474	157.0000000	180.0000000
sweat	16	20.4562500	5.4852492	12.6000000	30.8000000
temp	16	33.4125000	0.7088723	31.9000000	34.8000000

```
                      Example 6.3.                                       3
          Test all 3 coordinates using GLM manova.

                     The GLM Procedure

                  Class Level Information

               Class         Levels    Values

               sex                2    F M


          Number of Observations Read          32
          Number of Observations Used          32

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                      Example 6.3.                                       4
          Test all 3 coordinates using GLM manova.

                     The GLM Procedure

Dependent Variable: height

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

 Model                        1   1471.531250    1471.531250     38.22   <.0001

 Error                       30   1155.187500      38.506250

 Corrected Total             31   2626.718750


             R-Square     Coeff Var      Root MSE    height Mean

             0.560217      3.588847      6.205340       172.9063


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

 sex                          1   1471.531250    1471.531250     38.22   <.0001


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

 sex                          1   1471.531250    1471.531250     38.22   <.0001
```



```
                      Example 6.3.                                       5
          Test all 3 coordinates using GLM manova.

                     The GLM Procedure

Dependent Variable: sweat

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

 Model                        1    132.031250     132.031250      2.90   0.0988

 Error                       30   1365.243750      45.508125

 Corrected Total             31   1497.275000


             R-Square     Coeff Var      Root MSE    sweat Mean

             0.088181      29.99876      6.745971      22.48750


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

 sex                          1   132.0312500    132.0312500      2.90   0.0988


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

 sex                          1   132.0312500    132.0312500      2.90   0.0988
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                      Example 6.3.                                       6
          Test all 3 coordinates using GLM manova.

                     The GLM Procedure

Dependent Variable: temp

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

 Model                        1    0.40500000     0.40500000      1.36   0.2533

 Error                       30    8.95500000     0.29850000

 Corrected Total             31    9.36000000


             R-Square     Coeff Var      Root MSE     temp Mean

             0.043269      1.629684      0.546352      33.52500


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

 sex                          1    0.40500000     0.40500000      1.36   0.2533


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

 sex                          1    0.40500000     0.40500000      1.36   0.2533
```

Example 6.3. 7
Test all 3 coordinates using GLM manova.

The GLM Procedure
Multivariate Analysis of Variance

E = Error SSCP Matrix

	height	sweat	temp
height	1155.1875	-127.51875	-23.6375
sweat	-127.51875	1365.24375	-9.0125
temp	-23.6375	-9.0125	8.955

Partial Correlation Coefficients from the Error SSCP Matrix / Prob > |r|

DF = 30	height	sweat	temp
height	1.000000	-0.101541	-0.232403
		0.5868	0.2084
sweat	-0.101541	1.000000	-0.081509
	0.5868		0.6629
temp	-0.232403	-0.081509	1.000000
	0.2084	0.6629	

```
                           Example 6.3.                                 8
              Test all 3 coordinates using GLM manova.

                         The GLM Procedure
                Multivariate Analysis of Variance

                 H = Type III SSCP Matrix for sex

                     height              sweat              temp

        height      1471.53125          440.78125          24.4125
        sweat        440.78125          132.03125           7.3125
        temp          24.4125             7.3125            0.405


          Characteristic Roots and Vectors of: E Inverse * H, where
                 H = Type III SSCP Matrix for sex
                      E = Error SSCP Matrix

   Characteristic               Characteristic Vector  V'EV=1
             Root     Percent          height             sweat              temp

       1.74629035      100.00      0.02911388        0.01001719       0.14070802
       0.00000000        0.00     -0.00729935        0.02546458      -0.01978849
       0.00000000        0.00     -0.00534271        0.00038682       0.31506268


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

                       S=1    M=0.5    N=13

Statistic                       Value    F Value    Num DF    Den DF    Pr > F

Wilks' Lambda              0.36412756      16.30         3        28    <.0001
Pillai's Trace             0.63587244      16.30         3        28    <.0001
Hotelling-Lawley Trace     1.74629035      16.30         3        28    <.0001
Roy's Greatest Root        1.74629035      16.30         3        28    <.0001

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                           Example 6.3.                                 9
               Test 2 coordinates using GLM manova.

                         The GLM Procedure

                      Class Level Information

                   Class          Levels    Values

                   sex                 2    F M


              Number of Observations Read          32
              Number of Observations Used          32
```



```
                           Example 6.3.                                10
               Test 2 coordinates using GLM manova.

                         The GLM Procedure

Dependent Variable: sweat

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

 Model                        1       132.031250      132.031250      2.90   0.0988

 Error                       30      1365.243750       45.508125

 Corrected Total             31      1497.275000


               R-Square     Coeff Var      Root MSE    sweat Mean

               0.088181      29.99876      6.745971      22.48750


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

 sex                          1      132.0312500     132.0312500      2.90   0.0988


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

 sex                          1      132.0312500     132.0312500      2.90   0.0988
/><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<>><<
                           Example 6.3.                                11
               Test 2 coordinates using GLM manova.

                         The GLM Procedure

Dependent Variable: temp

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

 Model                        1        0.40500000      0.40500000      1.36   0.2533

 Error                       30        8.95500000      0.29850000

 Corrected Total             31        9.36000000


               R-Square     Coeff Var      Root MSE     temp Mean

               0.043269      1.629684      0.546352      33.52500


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

 sex                          1        0.40500000      0.40500000      1.36   0.2533


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

 sex                          1        0.40500000      0.40500000      1.36   0.2533
```

```
                           Example 6.3.                                    12
               Test 2 coordinates using GLM manova.

                        The GLM Procedure
                Multivariate Analysis of Variance

                      E = Error SSCP Matrix

                              sweat             temp

              sweat        1365.24375          -9.0125
              temp            -9.0125            8.955


   Partial Correlation Coefficients from the Error SSCP Matrix / Prob > |r|

                DF = 30          sweat           temp

                sweat         1.000000      -0.081509
                                               0.6629

                temp         -0.081509       1.000000
                                0.6629

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                           Example 6.3.                                    13
               Test 2 coordinates using GLM manova.

                        The GLM Procedure
                Multivariate Analysis of Variance

                H = Type III SSCP Matrix for sex

                              sweat             temp

              sweat         132.03125           7.3125
              temp             7.3125            0.405


          Characteristic Roots and Vectors of: E Inverse * H, where
                 H = Type III SSCP Matrix for sex
                      E = Error SSCP Matrix

          Characteristic               Characteristic Vector  V'EV=1
                    Root    Percent              sweat             temp

              0.15373761     100.00       0.02281341       0.20420733
              0.00000000       0.00      -0.01472811       0.26592423


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

                            S=1    M=0    N=13.5

Statistic                        Value    F Value    Num DF    Den DF    Pr > F

Wilks' Lambda               0.86674821       2.23         2        29    0.1257
Pillai's Trace              0.13325179       2.23         2        29    0.1257
Hotelling-Lawley Trace      0.15373761       2.23         2        29    0.1257
```

```
Roy's Greatest Root          0.15373761        2.23           2          29     0.1257
```