STAT 8320 Spring 2015 Assignment 2

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```
libname da2 'C:\Users\psy6b\Desktop\8320 datasets';
ods graphics on;
options ls=70 ps=35;

data da2.h6q2;
infile 'C:\Users\psy6b\Desktop\8320 datasets\PothoffRoy1964.dat';
input ID Gender $ Age8 Age10 Age12 Age14;
run;
PROC GLM;
     CLASS gender;
     MODEL AGE8--AGE14 = gender / NOUNI ;
     REPEATED AGE POLYNOMIAL  / SUMMARY PRINTM PRINTE;
RUN;
data unidata;
set da2.h6q2;
array m{4} age8--age14;
keep id Gender age measure;
do i=0 to 3;
age=8+i*2;
measure=m(i+1);
output;
end;
run;
proc mixed data=unidata;
class Gender age;
```

```
model measure=gender|age/ solution;
repeated /subject=ID type=cs;
run;
proc mixed data=unidata;
class Gender;
model measure=gender|age/ solution;
repeated /subject=ID type=cs;
run;
data da2.h6q3;
input Rein Cond1-Cond4;
datalines;
1 29 20 21 18
1 24 15 10 8
1 31 19 10 31
1 41 11 15 42
1 30 20 27 53
2 25 17 19 17
2 20 12 8  8
2 35 16 9  28
2 38 8  14 40
2 26 18 18 51
3 10 18 16 14
3 9  10 18 11
3 7  18 19 12
3 8  19 20 5
3 11 20 17 6
;
run;
PROC SUMMARY NWAY DATA=da2.h6q3;
CLASS rein;
VAR cond1-cond4;
OUTPUT OUT=new MEAN=cond1-cond4;
RUN;
DATA plot;
SET new;
ARRAY m{4} cond1-cond4;
DO time=1 TO 4;
response=m(time);
```

```
OUTPUT;
END;
keep time response rein;
RUN;
AXIS1 LABEL=(ANGLE=90 H=1.2 'Response');
AXIS2 OFFSET=(15) LABEL=(H=1.2 'Time');
SYMBOL VALUE=DOT I=JOIN;
TITLE 'Profile plot';
PROC GPLOT DATA=plot;
PLOT response*time=rein / VAXIS=AXIS1 HAXIS=AXIS2 HMINOR=0 VMINOR=1;
RUN;
PROC GLM DATA=da2.h6q3;
CLASS rein;
MODEL cond1-cond4=rein / NOUNI;
MANOVA H=rein / PRINTE PRINTH;
TITLE 'Overall Reinforcement Schedule Effect';
RUN;
PROC GLM DATA=da2.h6q3;
CLASS rein;
MODEL cond1-cond4=rein / NOUNI;
CONTRAST 'Compare Schedule 1 v.s. Schedule 2' rein 0 +1 -1;
CONTRAST 'Compare Schedule 1 & 2 v.s. Schedule 3' rein -1 -1 +2;
MANOVA M=(+1 -1  0  0,
    0 +1 -1  0,
    0  0 +1 -1);
RUN;
```

Figure 1: Regression Analysis

```
                  The GLM Procedure

             Class Level Information

         Class           Levels    Values

         Gender               2    F M
```

Figure 1: *continued*

```
                 Number of Observations Read           27
                 Number of Observations Used           27
                          The GLM Procedure
                 Repeated Measures Analysis of Variance


                   Repeated Measures Level Information


      Dependent Variable       Age8    Age10    Age12    Age14


           Level of AGE           1        2        3        4
                 Partial Correlation Coefficients from
                   the Error SSCP Matrix / Prob > |r|


   DF = 25          Age8          Age10           Age12           Age14


   Age8          1.000000       0.570699        0.661320        0.521583
                                 0.0023          0.0002          0.0063


   Age10         0.570699       1.000000        0.563167        0.726216
                 0.0023                          0.0027          <.0001


   Age12         0.661320       0.563167        1.000000        0.728098
                 0.0002         0.0027                           <.0001


   Age14         0.521583       0.726216        0.728098        1.000000
                 0.0063         <.0001          <.0001
     AGE_N represents the nth degree polynomial contrast for AGE


         M Matrix Describing Transformed Variables


                  Age8           Age10           Age12           Age14


   AGE_1    -.6708203932    -.2236067977    0.2236067977    0.6708203932
   AGE_2    0.5000000000    -.5000000000    -.5000000000    0.5000000000
   AGE_3    -.2236067977    0.6708203932    -.6708203932    0.2236067977
```

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Figure 1: *continued*

```
                        E = Error SSCP Matrix


   AGE_N represents the nth degree polynomial contrast for AGE


                    AGE_1           AGE_2           AGE_3


        AGE_1      59.1673        -11.2242         4.5278
        AGE_2     -11.2242         26.0412        -1.2819
        AGE_3       4.5278         -1.2819        62.9193
 Partial Correlation Coefficients from the Error SSCP Matrix of the
  Variables Defined by the Specified Transformation / Prob > |r|


      DF = 25          AGE_1           AGE_2           AGE_3


       AGE_1        1.000000       -0.285945        0.074209
                                    0.1567          0.7186


       AGE_2       -0.285945        1.000000       -0.031669
                    0.1567                           0.8779


       AGE_3        0.074209       -0.031669        1.000000
                    0.7186          0.8779
                        Sphericity Tests


                            Mauchly's
 Variables                DF  Criterion   Chi-Square    Pr > ChiSq

 Transformed Variates      5  0.7353334   7.2929515       0.1997
 Orthogonal Components     5  0.7353334   7.2929515       0.1997
```

Figure 1: *continued*

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


                   S=1     M=0.5     N=10.5


Statistic                      Value  F Value  Num DF  Den DF  Pr > F


Wilks' Lambda              0.19479424    31.69       3      23  <.0001
Pillai's Trace             0.80520576    31.69       3      23  <.0001
Hotelling-Lawley Trace     4.13362211    31.69       3      23  <.0001
Roy's Greatest Root        4.13362211    31.69       3      23  <.0001
           MANOVA Test Criteria and Exact F Statistics
              for the Hypothesis of no AGE*Gender Effect
               H = Type III SSCP Matrix for AGE*Gender
                       E = Error SSCP Matrix


                   S=1     M=0.5     N=10.5


Statistic                      Value  F Value  Num DF  Den DF  Pr > F


Wilks' Lambda              0.73988739     2.70       3      23  0.0696
Pillai's Trace             0.26011261     2.70       3      23  0.0696
Hotelling-Lawley Trace     0.35155702     2.70       3      23  0.0696
Roy's Greatest Root        0.35155702     2.70       3      23  0.0696
```

Figure 1: *continued*

```
                        The GLM Procedure
                 Repeated Measures Analysis of Variance
               Tests of Hypotheses for Between Subjects Effects

Source                      DF     Type III SS     Mean Square   F Value

Gender                       1     140.4648569     140.4648569      9.29
Error                       25     377.9147727      15.1165909


                  Source                        Pr > F

                  Gender                        0.0054
                  Error
                        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

AGE                          3     209.4369739      69.8123246     35.35
AGE*Gender                   3      13.9925295       4.6641765      2.36
Error(AGE)                  75     148.1278409       1.9750379

                                            Adj Pr > F
            Source                  Pr > F     G - G      H-F-L

            AGE                     <.0001    <.0001     <.0001
            AGE*Gender              0.0781    0.0878     0.0797
            Error(AGE)
                  Greenhouse-Geisser Epsilon      0.8672
                  Huynh-Feldt-Lecoutre Epsilon    0.9769
```

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Figure 1: *continued*

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

AGE_N represents the nth degree polynomial contrast for AGE

Contrast Variable: AGE_1
```

Source	DF	Type III SS	Mean Square	F Value
Mean	1	208.2660038	208.2660038	88.00
Gender	1	12.1141519	12.1141519	5.12
Error	25	59.1673295	2.3666932	

Source	Pr > F
Mean	<.0001
Gender	0.0326
Error	

```
Contrast Variable: AGE_2
```

Source	DF	Type III SS	Mean Square	F Value
Mean	1	0.95880682	0.95880682	0.92
Gender	1	1.19954756	1.19954756	1.15
Error	25	26.04119318	1.04164773	

Source	Pr > F
Mean	0.3465
Gender	0.2935
Error	

Figure 1: *continued*

```
Contrast Variable: AGE_3


Source                    DF    Type III SS    Mean Square    F Value

Mean                       1     0.21216330     0.21216330       0.08
Gender                     1     0.67882997     0.67882997       0.27
Error                     25    62.91931818     2.51677273

                Source                        Pr > F

                Mean                          0.7739
                Gender                        0.6081
                Error
                      The Mixed Procedure


                     Model Information

        Data Set                   WORK.UNIDATA
        Dependent Variable         measure
        Covariance Structure       Compound Symmetry
        Subject Effect             ID
        Estimation Method          REML
        Residual Variance Method   Profile
        Fixed Effects SE Method    Model-Based
        Degrees of Freedom Method  Between-Within
                  Class Level Information

      Class      Levels    Values

      Gender          2    F M
      age             4    8 10 12 14
```

Figure 1: *continued*

```
                  Dimensions

        Covariance Parameters              2
        Columns in X                      15
        Columns in Z                       0
        Subjects                          27
        Max Obs per Subject                4
               Number of Observations

    Number of Observations Read            108
    Number of Observations Used            108
    Number of Observations Not Used          0
                Iteration History

 Iteration    Evaluations    -2 Res Log Like        Criterion

     0               1         470.49084642
     1               1         423.40853283        0.00000000
            Convergence criteria met.
         Covariance Parameter Estimates


          Cov Parm      Subject      Estimate

          CS              ID          3.2854
          Residual                    1.9750
                Fit Statistics

    -2 Res Log Likelihood            423.4
    AIC (Smaller is Better)          427.4
    AICC (Smaller is Better)         427.5
    BIC (Smaller is Better)          430.0
        Null Model Likelihood Ratio Test


         DF     Chi-Square        Pr > ChiSq

          1          47.08           <.0001
```

Figure 1: *continued*

```
                Solution for Fixed Effects

                              Standard
Effect          Gender   age  Estimate    Error     DF   t Value   Pr > |t|

Intercept                     27.4687    0.5734     25    47.91    <.0001
Gender          F             -3.3778    0.8983     25    -3.76    0.0009
Gender          M                   0        .       .       .        .
age                       8   -4.5937    0.4969     75    -9.25    <.0001
age                      10   -3.6562    0.4969     75    -7.36    <.0001
age                      12   -1.7500    0.4969     75    -3.52    0.0007
age                      14         0        .       .       .        .
Gender*age      F         8    1.6847    0.7784     75     2.16    0.0336
Gender*age      F        10    1.7926    0.7784     75     2.30    0.0241
Gender*age      F        12    0.7500    0.7784     75     0.96    0.3384
Gender*age      F        14         0        .       .       .        .
Gender*age      M         8         0        .       .       .        .
Gender*age      M        10         0        .       .       .        .
Gender*age      M        12         0        .       .       .        .
Gender*age      M        14         0        .       .       .        .
              Type 3 Tests of Fixed Effects

                    Num     Den
         Effect      DF      DF     F Value    Pr > F

         Gender       1      25       9.29     0.0054
         age          3      75      35.35     <.0001
         Gender*age   3      75       2.36     0.0781
```

Figure 1: *continued*

```
                        The Mixed Procedure

                        Model Information

    Data Set                      WORK.UNIDATA
    Dependent Variable            measure
    Covariance Structure          Compound Symmetry
    Subject Effect                ID
    Estimation Method             REML
    Residual Variance Method      Profile
    Fixed Effects SE Method       Model-Based
    Degrees of Freedom Method     Between-Within
                    Class Level Information


      Class     Levels     Values


      Gender        2      F M
                        Dimensions


          Covariance Parameters         2
          Columns in X                  6
          Columns in Z                  0
          Subjects                     27
          Max Obs per Subject           4
                  Number of Observations


      Number of Observations Read           108
      Number of Observations Used           108
      Number of Observations Not Used         0
                    Iteration History


  Iteration    Evaluations    -2 Res Log Like      Criterion


         0              1        483.55911746
         1              1        433.75724920      0.00000000
                  Convergence criteria met.
```

Figure 1: *continued*

```
                   Covariance Parameter Estimates

                 Cov Parm      Subject     Estimate

                 CS              ID           3.2986
                 Residual                     1.9221
                         Fit Statistics

                 -2 Res Log Likelihood           433.8
                 AIC (Smaller is Better)         437.8
                 AICC (Smaller is Better)        437.9
                 BIC (Smaller is Better)         440.3
                     Null Model Likelihood Ratio Test

                   DF     Chi-Square       Pr > ChiSq

                    1        49.80            <.0001
                    Solution for Fixed Effects

                                 Standard
Effect         Gender    Estimate      Error      DF    t Value    Pr > |t|

Intercept                16.3406     0.9813      25      16.65      <.0001
Gender         F          1.0321     1.5374      25       0.67      0.5082
Gender         M               0          .       .         .           .
age                       0.7844     0.07750     79      10.12      <.0001
age*Gender     F         -0.3048     0.1214      79      -2.51      0.0141
age*Gender     M               0          .       .         .           .
                    Type 3 Tests of Fixed Effects

                        Num     Den
            Effect       DF      DF     F Value     Pr > F

            Gender        1      25       0.45      0.5082
            age           1      79     108.36      <.0001
            age*Gender    1      79       6.30      0.0141
```

Figure 1: *continued*

```
            Overall Reinforcement Schedule Effect

                  The GLM Procedure

               Class Level Information

          Class          Levels     Values

          Rein              3     1 2 3
     Number of Observations Read          15
     Number of Observations Used          15
      Overall Reinforcement Schedule Effect

                 The GLM Procedure
          Multivariate Analysis of Variance

             E = Error SSCP Matrix

          Cond1           Cond2           Cond3           Cond4

Cond1    386.8           -99.8           -5.4            535.8
Cond2    -99.8           194.8           87.4            10.2
Cond3    -5.4            87.4            328.4            452.4
Cond4    535.8           10.2            452.4           2553.2
```

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Figure 1: *continued*

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

 DF = 12          Cond1           Cond2           Cond3           Cond4


 Cond1         1.000000       -0.363574       -0.015151        0.539159
                                 0.2220          0.9608          0.0572


 Cond2        -0.363574        1.000000        0.345554        0.014463
                 0.2220                          0.2475          0.9626


 Cond3        -0.015151        0.345554        1.000000        0.494059
                 0.9608          0.2475                          0.0862


 Cond4         0.539159        0.014463        0.494059        1.000000
                 0.0572          0.9626          0.0862
              Overall Reinforcement Schedule Effect


                    The GLM Procedure
               Multivariate Analysis of Variance


                H = Type III SSCP Matrix for Rein


                 Cond1           Cond2           Cond3           Cond4


 Cond1   1468.1333333    -82.13333333    -185.5333333    1402.1333333
 Cond2   -82.13333333    26.133333333    34.533333333    -82.13333333
 Cond3   -185.5333333    34.533333333    50.533333333    -181.3333333
 Cond4   1402.1333333    -82.13333333    -181.3333333    1339.7333333
```

Figure 1: *continued*

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


Characteristic              Characteristic Vector   V'EV=1
       Root     Percent           Cond1              Cond2              Cond3
                                  Cond4


   4.52748560      95.57       0.06117242        0.02992718       -0.00648850
                            -0.00508768
   0.20978723       4.43       0.02215228        0.04489182        0.04553803
                            -0.01518185
   0.00000000       0.00      -0.00272754       -0.04849369        0.04413792
                             0.00585571
   0.00000000       0.00      -0.02461117        0.03992289       -0.03194950
                             0.02388060
            MANOVA Test Criteria and F Approximations for
               the Hypothesis of No Overall Rein Effect
                  H = Type III SSCP Matrix for Rein
                       E = Error SSCP Matrix


                   S=2    M=0.5    N=3.5


Statistic                     Value  F Value  Num DF  Den DF  Pr > F


Wilks' Lambda              0.14954207    3.57       8      18  0.0119
Pillai's Trace             0.99249428    2.46       8      20  0.0488
Hotelling-Lawley Trace     4.73727283    5.09       8   10.78  0.0081
Roy's Greatest Root        4.52748560   11.32       4      10  0.0010


   NOTE: F Statistic for Roy's Greatest Root is an upper bound.
           NOTE: F Statistic for Wilks' Lambda is exact.
```

Figure 1: *continued*

```
            Overall Reinforcement Schedule Effect

                    The GLM Procedure

                Class Level Information

            Class          Levels    Values

            Rein             3     1 2 3
      Number of Observations Read         15
      Number of Observations Used         15
       Overall Reinforcement Schedule Effect

                  The GLM Procedure
          Multivariate Analysis of Variance

        M Matrix Describing Transformed Variables

            Cond1          Cond2          Cond3          Cond4

MVAR1            1             -1              0              0
MVAR2            0              1             -1              0
MVAR3            0              0              1             -1
```

Figure 1: *continued*

```
                Overall Reinforcement Schedule Effect

                       The GLM Procedure
                 Multivariate Analysis of Variance

     Characteristic Roots and Vectors of: E Inverse * H, where
    H = Contrast SSCP Matrix for Compare Schedule 1 v.s. Schedule 2
                     E = Error SSCP Matrix


          Variables have been transformed by the M Matrix

Characteristic                   Characteristic Vector  V'EV=1
        Root    Percent              MVAR1            MVAR2            MVAR3


   2.17827609     100.00        0.03425264       0.02757876      -0.00488154
   0.00000000       0.00        0.02653577       0.00157455       0.02551812
   0.00000000       0.00       -0.00362754       0.05123902       0.00000000
    MANOVA Test Criteria and Exact F Statistics for the Hypothesis
        of No Overall Compare Schedule 1 v.s. Schedule 2 Effect
        on the Variables Defined by the M Matrix Transformation
    H = Contrast SSCP Matrix for Compare Schedule 1 v.s. Schedule 2
                     E = Error SSCP Matrix


                  S=1     M=0.5     N=4

Statistic                      Value  F Value  Num DF  Den DF  Pr > F

Wilks' Lambda              0.31463598     7.26       3      10  0.0072
Pillai's Trace            0.68536402     7.26       3      10  0.0072
Hotelling-Lawley Trace    2.17827609     7.26       3      10  0.0072
Roy's Greatest Root       2.17827609     7.26       3      10  0.0072
```

Figure 1: *continued*

```
        Characteristic Roots and Vectors of: E Inverse * H, where
  H = Contrast SSCP Matrix for Compare Schedule 1 & 2 v.s. Schedule 3
                      E = Error SSCP Matrix


            Variables have been transformed by the M Matrix


Characteristic                 Characteristic Vector  V'EV=1
          Root    Percent            MVAR1              MVAR2             MVAR3


    2.80326909    100.00         0.03454831         0.02736818        -0.00461007
    0.00000000      0.00         0.02617305         0.00124065         0.02556856
    0.00000000      0.00        -0.00345477         0.05136096         0.00000000
    MANOVA Test Criteria and Exact F Statistics for the Hypothesis
     of No Overall Compare Schedule 1 & 2 v.s. Schedule 3 Effect
       on the Variables Defined by the M Matrix Transformation
  H = Contrast SSCP Matrix for Compare Schedule 1 & 2 v.s. Schedule 3
                      E = Error SSCP Matrix


                   S=1    M=0.5    N=4


Statistic                       Value  F Value  Num DF  Den DF  Pr > F


Wilks' Lambda               0.26293170    9.34       3      10  0.0030
Pillai's Trace              0.73706830    9.34       3      10  0.0030
Hotelling-Lawley Trace      2.80326909    9.34       3      10  0.0030
Roy's Greatest Root         2.80326909    9.34       3      10  0.0030
```
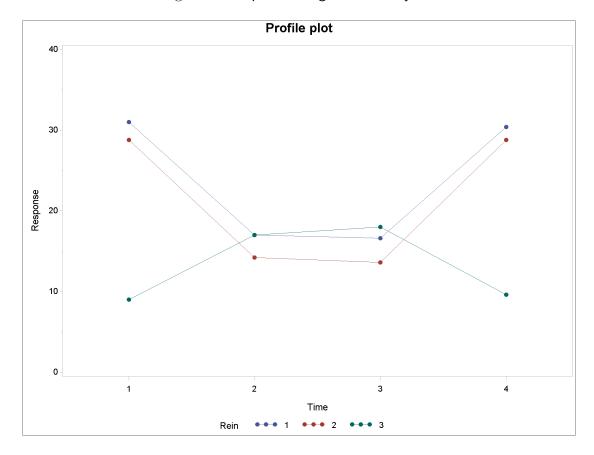
Figure 2: Graphs for Regression Analysis