/* SAS program for two-way AOV, with unbalanced */
/* design and interaction. Data are from Kutner */
/* program is an example in the SAS documentation */
/* for the GLM procedure. */
options nocenter ls=72;

data;
  input drug disease @;
  do i=1 to 6;
    input y @;
    output;
  end;
cards;
  1 1 42 44 36 13 19 22
  1 2 33 . 26 . 33 21
  1 3 31 -3 . 25 25 24
  2 1 28 . 23 34 42 13
  2 2 . 34 33 31 . 36
  2 3 3 26 28 32 4 16
  3 1 . 1 29 . 19
  3 2 . 11 9 7 1 -6
  3 3 21 1 . 9 3 .
  4 1 24 . 9 22 -2 15
  4 2 27 12 12 -5 16 15
  4 3 22 7 25 5 12 .
;
proc glm;
  class drug disease;
  model y=drug disease drug*disease / ss1 ss2 ss3;
  means drug*disease;
  output out=new1 predicted=yhat1 residual=res1;
proc plot;
  plot yhat1*disease=drug;
proc glm;
  class drug disease;
  model y=drug disease;
  means drug;
  contrast '1 vs 2' drug 1 -1 0 0;
  contrast '1 vs 3' drug 1 0 -1 0;
  contrast '1 vs 4' drug 1 0 0 -1;
  contrast '2 vs 3' drug 0 1 -1 0;
  contrast '2 vs 4' drug 0 1 0 -1;
  contrast '3 vs 4' drug 0 0 1 -1;
  output out=new0 predicted=yhat0 residual=res0;
proc plot;
  plot res0*yhat0;
run;
The GLM Procedure

Class Level Information

<table>
<thead>
<tr>
<th>Class</th>
<th>Levels</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>drug</td>
<td>4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>disease</td>
<td>3</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>

Number of observations 72

NOTE: Due to missing values, only 58 observations can be used in this analysis.

Dependent Variable: y

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>11</td>
<td>4259.338506</td>
<td>387.212591</td>
<td>3.51</td>
<td>0.0013</td>
</tr>
<tr>
<td>Error</td>
<td>46</td>
<td>5080.816667</td>
<td>110.452536</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>57</td>
<td>9340.155172</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R-Square 0.456024  Coeff Var 55.66750  Root MSE 10.50964  y Mean 18.87931
Source                      DF    Type I SS     Mean Square     F Value
drug                        3      3133.238506    1044.412835     9.46
disease                    2       418.833741     209.416870     1.90
drug*disease               6      707.266259     117.877710     1.07

Source                  Pr > F
drug                   <.0001
disease               0.1617
drug*disease         0.3958

Source                      DF    Type II SS     Mean Square     F Value
drug                        3      3063.432863    1021.144288     9.25
disease                    2       418.833741     209.416870     1.90

Source                  Pr > F
drug                   <.0001
disease               0.1617
drug*disease         0.3958

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The GLM Procedure
Dependent Variable: y

Source                      DF    Type II SS     Mean Square     F Value
drug*disease                6      707.266259     117.877710     1.07

Source                  Pr > F
drug*disease         0.3958

Source                      DF    Type III SS     Mean Square     F Value
drug                        3      2997.471860     999.157287     9.05
disease                    2       415.873046     207.936523     1.88
drug*disease                6      707.266259     117.877710     1.07

Source                  Pr > F
drug                   <.0001
disease               0.1637
drug*disease         0.3958
<table>
<thead>
<tr>
<th>Level of drug</th>
<th>Level of disease</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>6</td>
<td>29.3333333</td>
<td>13.0179363</td>
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<tr>
<td>1</td>
<td>2</td>
<td>4</td>
<td>28.2500000</td>
<td>5.8523500</td>
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<tr>
<td>1</td>
<td>3</td>
<td>5</td>
<td>20.4000000</td>
<td>13.3716117</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>5</td>
<td>28.0000000</td>
<td>10.9772492</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>33.5000000</td>
<td>2.0816660</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>6</td>
<td>18.1666667</td>
<td>12.5286339</td>
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<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>16.3333333</td>
<td>14.1891978</td>
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<tr>
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<td>2</td>
<td>5</td>
<td>4.4000000</td>
<td>6.9137544</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>4</td>
<td>8.5000000</td>
<td>9.0000000</td>
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<tr>
<td>4</td>
<td>1</td>
<td>5</td>
<td>13.6000000</td>
<td>10.5498815</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>6</td>
<td>12.8333333</td>
<td>10.3424691</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>5</td>
<td>14.2000000</td>
<td>8.9274856</td>
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</table>
Plot of yhat1*disease. Symbol is value of drug.

NOTE: 60 obs hidden.
The GLM Procedure

Class Level Information

<table>
<thead>
<tr>
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<th>Levels</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>drug</td>
<td>4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>disease</td>
<td>3</td>
<td>1 2 3</td>
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</tbody>
</table>

Number of observations 72

NOTE: Due to missing values, only 58 observations can be used in this analysis.

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The GLM Procedure

Dependent Variable: y

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
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</thead>
<tbody>
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<td>5788.082926</td>
<td>111.309287</td>
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<tr>
<td>Corrected Total</td>
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<td>9340.155172</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source  Pr > F
Model    0.0001

Error

Corrected Total

R-Square  Coeff Var  Root MSE  y Mean
0.380301  55.88298   10.55032  18.87931
<table>
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<th>Type I SS</th>
<th>Mean Square</th>
<th>F Value</th>
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</thead>
<tbody>
<tr>
<td>drug</td>
<td>3</td>
<td>3133.238506</td>
<td>1044.412835</td>
<td>9.38</td>
</tr>
<tr>
<td>disease</td>
<td>2</td>
<td>418.833741</td>
<td>209.416870</td>
<td>1.88</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>drug</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>disease</td>
<td>0.1626</td>
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</tbody>
</table>

<table>
<thead>
<tr>
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<tr>
<td>drug</td>
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<td>3063.432863</td>
<td>1021.144288</td>
<td>9.17</td>
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<tr>
<td>disease</td>
<td>2</td>
<td>418.833741</td>
<td>209.416870</td>
<td>1.88</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Source</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>drug</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>disease</td>
<td>0.1626</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Level of y</th>
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</thead>
<tbody>
<tr>
<td>drug</td>
</tr>
<tr>
<td>N</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
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</tbody>
</table>

Dependent Variable: y

<table>
<thead>
<tr>
<th>Contrast</th>
<th>DF</th>
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<th>Mean Square</th>
<th>F Value</th>
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<tbody>
<tr>
<td>1 vs 2</td>
<td>1</td>
<td>0.081457</td>
<td>0.081457</td>
<td>0.00</td>
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<tr>
<td>1 vs 3</td>
<td>1</td>
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<td>1895.203303</td>
<td>17.03</td>
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<tr>
<td>1 vs 4</td>
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<td>1193.846933</td>
<td>1193.846933</td>
<td>10.73</td>
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<tr>
<td>2 vs 3</td>
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<tr>
<td>2 vs 4</td>
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<td>1174.163344</td>
<td>10.55</td>
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<tr>
<td>3 vs 4</td>
<td>1</td>
<td>140.206432</td>
<td>140.206432</td>
<td>1.26</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Contrast</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 vs 2</td>
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</tr>
<tr>
<td>1 vs 3</td>
<td>0.0001</td>
</tr>
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<td>1 vs 4</td>
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<tr>
<td>2 vs 3</td>
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<td>3 vs 4</td>
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</table>
NOTE: 14 obs had missing values.