

Bijesh Mishra

STAT 5023 Statistics for Experimenters II (With Complete Data and Analysis)

SAS Assignment I

SAS CODE:

*** Filename: STAT 5023: Assignment 1.sas ***

TITLE 'STAT 5023: Assignment 1';

DM 'LOG; CLEAR; ODSRESULTS; CLEAR;';

OPTIONS LS = 80 PAGENO = 1;

DATA metal;

INPUT supplier tenstren @@;

CARDS;

1 21.1 1 24.6 1 26.2 1 22.9

2 27.3 2 30.3 2 24.2 2 29.9

3 31.8 3 30.0 3 21.9 3 25.1

4 26.9 4 26.9 4 12.7 4 15.5

5 8.08 5 18.9 5 31.4 5 27.1

;

* PROC PRINT DATA = metal;

TITLE 'ANOVA, HOVS (LEVENE AND BARTLETT), MEANS, STANDARD DEVIATIONS, PLOTS';

PROC GLM DATA = metal ALPHA = 0.02 PLOTS = (BOXPLOT RESIDUALS DIAGNOSTICS);

CLASS supplier;

MODEL tenstren = supplier;

MEANS supplier / HOVTEST = LEVENE (TYPE = ABS)HOVTEST = BARTLETT ALPHA = 0.02;

PROC MIXED DATA = metal PLOTS = RESIDUALPANEL;

CLASS supplier;

MODEL tenstren = supplier /DDFM = SATTERTH;

```

REPEATED / GROUP = supplier;

LSMEANS supplier;

TITLE MIXED Procedure When the Variances are Unequal;

;

RUN;

QUIT;

```

SAS Assignment II

```

SAS CODE:

DM 'LOG; CLEAR; ODSRESULTS; CLEAR; ';
DATA sas2; INPUT coating wear @@;
LABEL coating ='Layers of Coating' wear='Wear';
DATALINES;
0 21.0434 1 17.0270 2 13.2604 3 13.2798 4 13.9394
0 23.7164 1 15.1824 2 16.0983 3 14.6028 4 09.0165
0 26.3993 1 16.1865 2 15.1277 3 12.7176 4 15.5906
0 25.5745 1 15.2647 2 14.3230 3 11.7969 4 11.2414
0 23.2901 1 14.7997 2 14.5364 3 10.6507 4 10.0621
0 26.6883 1 16.0777 2 16.0863 3 14.3297 4 10.4367
0 24.8230 1 14.5333 2 13.7632 3 09.4774 4 13.6440
;
TITLE "ANOVA, Control Vs Rest, Tukey Comparison, Trend Analysis, CI: 0.02";
PROC GLM DATA = sas2 PLOTS = NONE;
CLASS coating;
MODEL wear = coating;
/* Simultaneous Contrast: Method 1.1: SS != SSH0*/
CONTRAST '1 = 2' coating 0 1 -1 0 0;
CONTRAST '1 + 2 = 2*3' coating 0 1 0 -1 0;
CONTRAST '1 + 2 + 3 = 3*4' coating 0 1 0 0 -1;
/* Simultaneous Contrast: Method 1.2 (~ Method 1.1)*/
CONTRAST 'M1.2: 1 = 2 = 3 = 4 ' coating 0 1 -1 0 0,
coating 0 1 0 -1 0,
coating 0 1 0 0 -1;

/* Simultaneous Contrast: Method 2.1: SS = SSH0*/
CONTRAST '1 = 2' coating 0 1 -1 0 0;
CONTRAST '1 + 2 = 2*3' coating 0 1 1 -2 0;
CONTRAST '1 + 2 + 3 = 3*4' coating 0 1 1 1 -3;
/* Simultaneous Contrast: Method 2.2 (~ Method 2.1)*/
CONTRAST ' M2.2: 1 = 2 = 3 = 4 ' coating 0 1 -1 0 0,
coating 0 1 1 -2 0,
coating 0 1 1 1 -3;
TITLE3 'Simultaneous Contrast: Single Test, mean difference, Non Control
Trts';
RUN; QUIT;
PROC GLM DATA = sas2 PLOTS = (BOXPLOT);
CLASS coating;
MODEL wear = coating;
/* Tukey Comparison of the Means */

```

```

MEANS coating / ALPHA = 0.02 LINES TUKEY CLDIFF;
/* Trend Values from Book Page 740. t = 5 */
CONTRAST "Linear Trend (x1)"          coating      -2 -1 0 1 2;
CONTRAST "Quadratic Trend (x2)"       coating      2 -1 -2 -1 2;
CONTRAST "Cubic Trend (x3)"          coating      -1 2 0 -2 1;
CONTRAST "Quartic Trend/LoF (x4)"     coating      1 -4 6 -4 1;
LSMEANS coating /STDERR;
TITLE3 ' Tukey Comparison of Mean and Trend Analysis'; RUN; QUIT;
PROC GPLOT DATA = sas2;
PLOT wear*coating / VAXIS = 8 12 16 20 24 28 HAXIS = 0 1 2 3 4;
SYMBOL1 VALUE = # CV = RED I = NONE;
TITLE2 ' Trend Analysis Using Gplot'; RUN; QUIT;

PROC SGPLOT DATA = sas2;
SCATTER Y = wear X = coating;
TITLE2 "SGPLOT option for Statistical Graphing"; RUN; QUIT;

```

SAS LOG:

```

747 DM 'LOG; CLEAR; ODSRESULTS; CLEAR; ';
748 DATA sas2; INPUT coating wear @@;
749 LABEL coating ='Layers of Coating' wear='Wear';
750 DATALINES;

NOTE: SAS went to a new line when INPUT statement reached past the end of a line.
NOTE: The data set WORK.SAS2 has 35 observations and 2 variables.
NOTE: DATA statement used (Total process time):
    real time    0.01 seconds
    cpu time     0.01 seconds

758 ;
759 TITLE "ANOVA, Control Vs Rest, Tukey Comparison, Trend Analysis, CI: 0.02";
760 PROC GLM DATA = sas2 PLOTS = NONE;
761 CLASS coating;
762 MODEL wear = coating;
763 /* Simultaneous Contrast: Method 1.1: SS != SSH0*/
764 CONTRAST '1 = 2'          coating 0 1 -1 0 0;
765 CONTRAST '1 + 2 = 2*3'    coating 0 1 0 -1 0;
766 CONTRAST '1 + 2 + 3 = 3*4' coating 0 1 0 0 -1;
767 /* Simultaneous Contrast: Method 1.2 (~ Method 1.1)*/
768 CONTRAST 'M1.2: 1 = 2 = 3 = 4 ' coating 0 1 -1 0 0,
769          coating 0 1 0 -1 0,
770          coating 0 1 0 0 -1;
771
772 /* Simultaneous Contrast: Method 2.1: SS = SSH0*/
773 CONTRAST '1 = 2'          coating 0 1 -1 0 0;
774 CONTRAST '1 + 2 = 2*3'    coating 0 1 1 -2 0;
775 CONTRAST '1 + 2 + 3 = 3*4' coating 0 1 1 1 -3;
776 /* Simultaneous Contrast: Method 2.2 (~ Method 2.1)*/
777 CONTRAST 'M2.2: 1 = 2 = 3 = 4 ' coating 0 1 -1 0 0,
778          coating 0 1 1 -2 0,
779          coating 0 1 1 1 -3;
780 TITLE3 'Simultaneous Contrast: Single Test, mean difference, Non Control Trts';
781 RUN;

```

NOTE: Writing HTML Body file: sashtml15.htm
781! QUIT;

NOTE: PROCEDURE GLM used (Total process time):
 real time 1.08 seconds
 cpu time 0.45 seconds

```

782 PROC GLM DATA = sas2 PLOTS = (BOXPLOT);
783 CLASS coating;
784 MODEL wear = coating;
785 /* Tukey Comparison of the Means */
786 MEANS coating / ALPHA = 0.02 LINES TUKEY CLDIFF;
787 /* Trend Values from Book Page 740. t = 5 */
788 CONTRAST "Linear Trend (x1)"      coating  -2 -1 0 1 2;
789 CONTRAST "Quadratic Trend (x2)"   coating   2 -1 -2 -1 2;
790 CONTRAST "Cubic Trend (x3)"       coating  -1 2 0 -2 1;
791 CONTRAST "Quartic Trend/LoF (x4)" coating   1 -4 6 -4 1;
792 LSMEANS coating /STDERR;
793 TITLE3 ' Tukey Comparison of Mean and Trend Analysis'; RUN;

```

```

793!                               QUIT;

```

NOTE: PROCEDURE GLM used (Total process time):

```

    real time      2.27 seconds
    cpu time       0.87 seconds

```

```

794 PROC GPLOT DATA = sas2;
795 PLOT wear*coating / VAXIS = 8 12 16 20 24 28 HAXIS = 0 1 2 3 4;
796 SYMBOL1 VALUE = # CV = RED I = NONE;
797 TITLE2 ' Trend Analysis Using Gplot'; RUN;

```

NOTE: 18542 bytes written to C:\Users\bmishra\AppData\Local\Temp\SAS Temporary
Files_TD93932_NREM-9HTXG02_gplot15.png.

```

797!                               QUIT;

```

NOTE: There were 35 observations read from the data set WORK.SAS2.

NOTE: PROCEDURE Gplot used (Total process time):

```

    real time      0.30 seconds
    cpu time       0.14 seconds

```

```

798
799 PROC SGplot DATA = sas2;
800 SCATTER Y = wear X = coating;
801 TITLE2 "SGplot option for Statistical Graphing"; RUN;

```

```

801!                               QUIT;

```

NOTE: PROCEDURE SGplot used (Total process time):

```

    real time      0.55 seconds
    cpu time       0.04 seconds

```

NOTE: There were 35 observations read from the data set WORK.SAS2.

Complete SAS Code:

```

DM 'LOG; CLEAR; ODSRESULTS; CLEAR; ';
DATA sas2; INPUT coating wear @@;
LABEL coating ='Layers of Coating' wear='Wear';
DATALINES;
0 21.0434 1 17.0270 2 13.2604 3 13.2798 4 13.9394
0 23.7164 1 15.1824 2 16.0983 3 14.6028 4 09.0165
0 26.3993 1 16.1865 2 15.1277 3 12.7176 4 15.5906
0 25.5745 1 15.2647 2 14.3230 3 11.7969 4 11.2414
0 23.2901 1 14.7997 2 14.5364 3 10.6507 4 10.0621
0 26.6883 1 16.0777 2 16.0863 3 14.3297 4 10.4367
0 24.8230 1 14.5333 2 13.7632 3 09.4774 4 13.6440
;
TITLE "ANOVA, Tukey Comparison, Trend Analysis: Control Vs Rest, CI: 0.02";

```

```

PROC PRINT DATA = sas2;
TITLE2 'Data Set';

PROC GLM DATA = sas2 PLOTS = NONE;
CLASS coating;
MODEL wear = coating;
/* Single Test of differences of non-zero layer coating */
/* Simultaneous Contrast: Method 1.1: SS != SSH0*/
CONTRAST '1 = 2' coating 0 1 -1 0 0;
CONTRAST '1 + 2 = 2*3' coating 0 1 0 -1 0;
CONTRAST '1 + 2 + 3 = 3*4' coating 0 1 0 0 -1;
/* Simultaneous Contrast: Method 1.2 (~ Method 1.1)*/
CONTRAST 'M1.2: 1 = 2 = 3 = 4 ' coating 0 1 -1 0 0,
coating 0 1 0 -1 0,
coating 0 1 0 0 -1;

/* Simultaneous Contrast: Method 2.1: SS = SSH0*/
CONTRAST '1 = 2' coating 0 1 -1 0 0;
CONTRAST '1 + 2 = 2*3' coating 0 1 1 -2 0;
CONTRAST '1 + 2 + 3 = 3*4' coating 0 1 1 1 -3;
/* Simultaneous Contrast: Method 2.2 (~ Method 2.1)*/
CONTRAST ' M2.2: 1 = 2 = 3 = 4 ' coating 0 1 -1 0 0,
coating 0 1 1 -2 0,
coating 0 1 1 1 -3;

TITLE3 'Simultaneous Contrast: Single Test, mean difference, Non Control
Trts'; RUN; QUIT;

PROC GLM DATA = sas2 PLOTS = (RESIDUALS DIAGNOSTICS RESIDUALS);
CLASS coating;
MODEL wear = coating;
/* Tukey Comparison of the Means */
LSMEANS coating / STDERR ADJUST = TUKEY LINES ALPHA = 0.02;
MEANS coating / HOVTEST = LEVENE (TYPE = ABS) HOVTEST = BARTLETT ALPHA =
0.02 LINES LSD SCHEFFÉ TUKEY CLM CLDIFF;
TITLE2 'Mean Statements, Tukey Comparison, HOV Tests';

/* Trend Values from Book Page 740. t = 5 */
CONTRAST "Linear Trend (x1)" coating -2 -1 0 1 2;
CONTRAST "Quadratic Trend (x2)" coating 2 -1 -2 -1 2;
CONTRAST "Cubic Trend (x3)" coating -1 2 0 -2 1;
CONTRAST "Quartic Trend/LoF (x4)" coating 1 -4 6 -4 1;
LSMEANS coating / STDERR;
TITLE2 'Trend Analysis using Various Degree Trend'; RUN; QUIT;

PROC GPLOT DATA = sas2;
PLOT wear*coating / VAXIS = 8 12 16 20 24 28 HAXIS = 0 1 2 3 4;
SYMBOL1 VALUE = # CV = RED I = NONE;
TITLE2 ' Trend Analysis Using GPLOT'; RUN; QUIT;

PROC SGPLOT DATA = sas2;
SCATTER Y = wear X = coating;
TITLE2 "SGPLOT option for Statistical Graphing"; RUN; QUIT;

```

SAS Assignment III

```

DM 'LOG; CLEAR; ODSRESULTS; CLEAR; ';
DATA sas3;
INPUT center program gender $ subject wtloss @@;
DATALINES;
1 1 F 1 17.2299 5 1 F 1 11.6695 1 1 F 2 15.7648 5 1 F 2 12.1876
1 2 F 1 19.2342 5 2 F 1 11.6978 1 2 F 2 18.0468 5 2 F 2 10.0957
1 3 F 1 9.1973 5 3 F 1 7.4432 1 3 F 2 8.6906 5 3 F 2 5.9384
1 1 M 1 17.4656 5 1 M 1 10.9597 1 1 M 2 15.9233 5 1 M 2 11.2989
1 2 M 1 24.2613 5 2 M 1 18.3452 1 2 M 2 25.3422 5 2 M 2 18.1953
1 3 M 1 19.6999 5 3 M 1 17.3051 1 3 M 2 18.3468 5 3 M 2 17.2238
2 1 F 1 14.9102 6 1 F 1 16.4390 2 1 F 2 15.5265 6 1 F 2 16.9725
2 2 F 1 24.5785 6 2 F 1 26.3404 2 2 F 2 22.9297 6 2 F 2 25.6193
2 3 F 1 21.4465 6 3 F 1 23.5122 2 3 F 2 19.4496 6 3 F 2 20.7551
2 1 M 1 17.7488 6 1 M 1 19.4338 2 1 M 2 18.6772 6 1 M 2 16.2848
2 2 M 1 18.6206 6 2 M 1 19.9519 2 2 M 2 19.6741 6 2 M 2 22.5633
2 3 M 1 16.2433 6 3 M 1 17.4446 2 3 M 2 16.9580 6 3 M 2 19.0843
3 1 F 1 9.4561 7 1 F 1 10.1201 3 1 F 2 10.0818 7 1 F 2 10.9801
3 2 F 1 19.9627 7 2 F 1 15.4252 3 2 F 2 21.6687 7 2 F 2 14.9049
3 3 F 1 20.5674 7 3 F 1 16.3866 3 3 F 2 20.1926 7 3 F 2 17.3304
3 1 M 1 14.5206 7 1 M 1 13.9226 3 1 M 2 15.4205 7 1 M 2 14.7064
3 2 M 1 16.1217 7 2 M 1 25.6431 3 2 M 2 16.7883 7 2 M 2 25.9734
3 3 M 1 11.7393 7 3 M 1 20.9447 3 3 M 2 11.8407 7 3 M 2 21.4765
4 1 F 1 18.4680 8 1 F 1 11.4767 4 1 F 2 17.8540 8 1 F 2 12.4374
4 2 F 1 25.7911 8 2 F 1 34.4723 4 2 F 2 24.0275 8 2 F 2 34.6249
4 3 F 1 15.1685 8 3 F 1 20.8010 4 3 F 2 16.4565 8 3 F 2 20.3882
4 1 M 1 15.0173 8 1 M 1 25.4748 4 1 M 2 15.0015 8 1 M 2 25.3372
4 2 M 1 23.0530 8 2 M 1 25.1632 4 2 M 2 23.3327 8 2 M 2 25.9337
4 3 M 1 20.8105 8 3 M 1 19.9659 4 3 M 2 20.9137 8 3 M 2 20.9266
;
/* USING MIXED PROCEDURE METHOD =TYPE3 PRODUCES EXPECTED MEAN SQUARES */
TITLE3 "USING METHOD = TYPE3 PRODUCES EXPECTED MEAN SQUARES";
PROC MIXED DATA = sas3 METHOD = TYPE3; /* TYPE3 = Method of Moments */
CLASS center program gender subject; /* All Treatments */
MODEL wtloss = program | gender | subject ; /* Only Fixed Effects; DDFM = KR
*/
RANDOM center center*program center*gender center*subject; /* Random
Statement */
LSMEANS program / PDIF CL ALPHA = 0.01; /* Default ADJUST is F-LSD */
RUN; QUIT;

/* USING MIXED PROCEDURE, REML METHOD */
TITLE3 "USING MIXED PROCEDURE, METHOD = REML";
PROC MIXED DATA = sas3 METHOD = REML PLOT = RESIDUALPANEL; /* DEFAULT METHOD
IS REML */
CLASS center program gender subject; /* All Treatments */
MODEL wtloss = program | gender | subject / DDFM = SATTERTH; /* Only Fixed
Effects; DDFM = KR */
RANDOM center center*program center*gender center*subject; /* Random
Component */
LSMEANS program / PDIF CL ALPHA = 0.01; /* Default ADJUST is F-LSD */
RUN; QUIT;

```

SAS IV:

SAS CODE:

```
DM 'LOG; CLEAR; ODSRESULTS; CLEAR;';
TITLE 'Split plot Assignment 4 Height';
DATA sas4;
INPUT rep water color $ height width;
/* WP = Water, SP = Color, Blocks = Rep Response = height & Width */
DATALINES;
1 1 Red 10.4641 18.9764
1 1 White 8.6361 18.5999
1 1 Coral 8.6836 17.6397
1 2 Red 11.2051 22.5655
1 2 White 11.5241 21.1620
1 2 Coral 7.9262 16.5507
2 1 Red 15.3595 16.6630
2 1 White 14.7127 16.7290
2 1 Coral 13.4858 16.6223
2 2 Red 16.5188 20.3693
2 2 White 15.3492 19.2496
2 2 Coral 13.1782 17.4857
3 1 Red 14.2442 13.8697
3 1 White 15.2705 12.3667
3 1 Coral 14.8693 10.9506
3 2 Red 14.1018 17.2177
3 2 White 13.8954 16.5381
3 2 Coral 10.4144 13.6593
4 1 Red 11.4202 15.3572
4 1 White 8.4697 14.8884
4 1 Coral 8.6994 13.6597
4 2 Red 15.9493 20.9637
4 2 White 15.1878 21.5276
4 2 Coral 11.7707 17.3201
;
/* Height */
PROC GLIMMIX DATA=sas4 NOBOUND PLOTS = RESIDUALPANEL;
CLASS rep water color; /* Block, Whole Plot, Sub Plot */
MODEL height = water | color / DDFM=SATTERTH; /*WP SP WP*SP */
RANDOM rep rep*water; /*WPBlock WPBlock*SP */
LSMEANS water color / LINES ADJUST = TUKEY PDIFF; /* N/A IF SIGNIFICANT
INTERACTION */
LSMEANS water*color / ADJUST = TUKEY LINES PDIFF SLICE =(water color) ALPHA
= 0.05 PLOTS = MEANPLOT(SLICEBY = water JOIN);
RUN; QUIT;

PROC SORT DATA=sas4;
BY water color;

PROC MEANS DATA = sas4 NOPRINT;
BY water color;
VAR height;
OUTPUT OUT=plotdata1 MEAN = MeanYield1;
GOPTIONS FTEXT="Arial";

PROC GPLOT DATA = plotdata1 ;
PLOT meanyield1*water = color ; *Or, PLOT meanyield*trt=seed ;
TITLE3 'Interaction Plot';
SYMBOL1 VALUE=circle CV=BLUE I=join L=1 W=2 H=2;
```

```

SYMBOL2 VALUE=dot      CV=RED I=join L=3 W=2 H=2;
SYMBOL3 VALUE=square  CV=GREEN I=join L=8 W=2 H=2;
RUN; QUIT;

TITLE 'Split plot Assignment 4 Width';
/* Width */
PROC GLIMMIX DATA=sas4 NOBOUND PLOTS = RESIDUALPANEL;
CLASS rep water color; /* Block, Whole Plot, Sub Plot */
MODEL width = water | color / DDFM=SATTERTH; /*WP SP WP*SP */
RANDOM rep rep*water; /*WPBlock WPBlock*SP */
LSMEANS water color / LINES ADJUST = TUKEY PDIFF; /* N/A IF SIGNIFICANT
INTERACTION */
LSMEANS water*color / ADJUST = TUKEY LINES PDIFF SLICE =(water color) ALPHA
= 0.05 PLOTS = MEANPLOT(SLICEBY = water JOIN);
RUN; QUIT;

PROC SORT DATA=sas4;
BY water color;

PROC MEANS DATA = sas4 NOPRINT;
BY water color;
VAR width;
OUTPUT OUT=plotdata2 MEAN = MeanYield2;
GOPTIONS FTEXT="Arial";

PROC GPLOT DATA = plotdata2 ;
PLOT meanyield2*water = color ; *Or, PLOT meanyield*trt=seed ;
TITLE3 'Interaction Plot';
SYMBOL1 VALUE=circle CV=BLUE I=join L=1 W=2 H=2;
SYMBOL2 VALUE=dot CV=RED I=join L=3 W=2 H=2;
SYMBOL3 VALUE=square CV=GREEN I=join L=8 W=2 H=2;
RUN; QUIT;

```

SAS Log file:

```

1199 DM 'LOG; CLEAR; ODSRESULTS; CLEAR;';
1200 TITLE 'Split plot Assignment 4 Height';
1201 DATA sas4;
1202 INPUT rep water color $ height width;
1203 /* WP = Water, SP = Color, Blocks = Rep Response = height & Width */
1204 DATALINES;

NOTE: The data set WORK.SAS4 has 24 observations and 5 variables.
NOTE: DATA statement used (Total process time):
      real time      0.01 seconds
      cpu time       0.00 seconds

1229 ;
1230 /* Height */
NOTE: Writing HTML Body file: sashtml20.htm
1231 PROC GLIMMIX DATA=sas4 NOBOUND PLOTS = RESIDUALPANEL;
1232 CLASS rep water color; /* Block, Whole Plot, Sub Plot */
1233 MODEL height = water | color / DDFM=SATTERTH; /*WP SP WP*SP */
1234 RANDOM rep rep*water; /*WPBlock WPBlock*SP */
1235 LSMEANS water color / LINES ADJUST = TUKEY PDIFF; /* N/A IF SIGNIFICANT INTERACTION */
1236 LSMEANS water*color / ADJUST = TUKEY LINES PDIFF SLICE =(water color) ALPHA = 0.05 PLOTS =
1236! MEANPLOT(SLICEBY = water JOIN);
1237 RUN;

```


NOTE: With DDFM=SATTERTHWAITE or DDFM=KENWARDROGER, unadjusted p-values in tests are based on the degrees of freedom specific to that comparison. P-values that are adjusted for multiplicity, however, are by default based on the denominator degrees of freedom for the Type III test of the fixed effect. If you specify the ADJDFE=ROW option in the LSMEANS or LSMESTIMATE statement, the adjusted p-values take into account the row-wise degrees of freedom.

1237! QUIT;

NOTE: Convergence criterion (ABSGCONV=0.00001) satisfied.

NOTE: PROCEDURE GLIMMIX used (Total process time):

real time	2.88 seconds
cpu time	1.31 seconds

1238

1239 PROC SORT DATA=sas4;

1240 BY water color;

1241

NOTE: There were 24 observations read from the data set WORK.SAS4.

NOTE: The data set WORK.SAS4 has 24 observations and 5 variables.

NOTE: PROCEDURE SORT used (Total process time):

real time	0.02 seconds
cpu time	0.00 seconds

1242 PROC MEANS DATA = sas4 NOPRINT;

1243 BY water color;

1244 VAR height;

1245 OUTPUT OUT=plotdata1 MEAN = MeanYield1;

1246 GOPTIONS FTEXT="Arial";

1247

NOTE: There were 24 observations read from the data set WORK.SAS4.

NOTE: The data set WORK.PLOTDATA1 has 6 observations and 5 variables.

NOTE: PROCEDURE MEANS used (Total process time):

real time	0.10 seconds
cpu time	0.03 seconds

1248 PROC GPLOT DATA = plotdata1 ;

1249 PLOT meanyield1*water = color ; *Or, PLOT meanyield*trt=seed ;

1250 TITLE3 'Interaction Plot';

1251 SYMBOL1 VALUE=circle CV=BLUE I=join L=1 W=2 H=2;

1252 SYMBOL2 VALUE=dot CV=RED I=join L=3 W=2 H=2;

1253 SYMBOL3 VALUE=square CV=GREEN I=join L=8 W=2 H=2;

1254 SYMBOL4 VALUE=triangle CV=BLACK I=join L=42 W=2 H=2;

1255 RUN;

NOTE: 22013 bytes written to C:\Users\bmishra\AppData\Local\Temp\SAS Temporary
Files_TD10952_NREM-9HTXG02_\gplot21.png.

1255! QUIT;

NOTE: There were 6 observations read from the data set WORK.PLOTDATA1.

NOTE: PROCEDURE GPLOT used (Total process time):

real time	0.22 seconds
cpu time	0.14 seconds

1256

1257 TITLE 'Split plot Assignment 4 Width';

1258 /* Width */

1259 PROC GLIMMIX DATA=sas4 NOBOUND PLOTS = RESIDUALPANEL;

1260 CLASS rep water color; /* Block, Whole Plot, Sub Plot */

```
1261 MODEL width = water | color / DDFM=SATTERTH; /*WP SP WP*SP */
1262 RANDOM rep rep*water; /*WPBlock WPBlock*SP */
1263 LSMEANS water color / LINES ADJUST = TUKEY PDIF; /* N/A IF SIGNIFICANT INTERACTION */
1264 LSMEANS water*color / ADJUST = TUKEY LINES PDIF SLICE =(water color) ALPHA = 0.05 PLOTS =
1264! MEANPLOT(SLICEBY = water JOIN);
1265 RUN;
```

NOTE: With DDFM=SATTERTHWAITE or DDFM=KENWARDROGER, unadjusted p-values in tests are based on the degrees of freedom specific to that comparison. P-values that are adjusted for multiplicity, however, are by default based on the denominator degrees of freedom for the Type III test of the fixed effect. If you specify the ADJDFE=ROW option in the LSMEANS or LSMESTIMATE statement, the adjusted p-values take into account the row-wise degrees of freedom.

```
1265! QUIT;
```

NOTE: Convergence criterion (ABSGCONV=0.00001) satisfied.

NOTE: PROCEDURE GLIMMIX used (Total process time):

real time	1.13 seconds
cpu time	0.56 seconds

```
1266
1267 PROC SORT DATA=sas4;
1268 BY water color;
1269
```

NOTE: Input data set is already sorted, no sorting done.

NOTE: PROCEDURE SORT used (Total process time):

real time	0.00 seconds
cpu time	0.00 seconds

```
1270 PROC MEANS DATA = sas4 NOPRINT;
1271 BY water color;
1272 VAR width;
1273 OUTPUT OUT=plotdata2 MEAN = MeanYield2;
1274 GOPTIONS FTEXT="Arial";
1275
```

NOTE: There were 24 observations read from the data set WORK.SAS4.

NOTE: The data set WORK.PLOTDATA2 has 6 observations and 5 variables.

NOTE: PROCEDURE MEANS used (Total process time):

real time	0.01 seconds
cpu time	0.00 seconds

```
1276 PROC GPLOT DATA = plotdata2 ;
1277 PLOT meanyield2*water = color ; *Or, PLOT meanyield*trt=seed ;
1278 TITLE3 'Interaction Plot';
1279 SYMBOL1 VALUE=circle CV=BLUE I=join L=1 W=2 H=2;
1280 SYMBOL2 VALUE=dot CV=RED I=join L=3 W=2 H=2;
1281 SYMBOL3 VALUE=square CV=GREEN I=join L=8 W=2 H=2;
1282 SYMBOL4 VALUE=triangle CV=BLACK I=join L=42 W=2 H=2;
1283 RUN;
```

NOTE: 26806 bytes written to C:\Users\bmishra\AppData\Local\Temp\SAS Temporary
Files_TD10952_NREM-9HTXG02_\gplot22.png.

```
1283! QUIT;
```

NOTE: There were 6 observations read from the data set WORK.PLOTDATA2.

NOTE: PROCEDURE GPLOT used (Total process time):

real time	0.19 seconds
cpu time	0.12 seconds