

SAS Lab 11 For Statistics 514**Topics:**

Chapter 29. Repeated Measures and Related Designs

```
*Attendance 11,29.2 repeated measures;
*one-factor studies;
DATA DRUGRESPONSE;
  INPUT RESPONSE DRUG $ SUBJECT $;
DATALINES;
5.90 1 1
5.92 1 2
5.91 1 3
5.89 1 4
5.88 1 5
5.50 2 1
5.50 2 2
5.50 2 3
5.49 2 4
5.50 2 5
5.01 3 1
5.00 3 2
4.99 3 3
4.98 3 4
5.02 3 5
;
PROC GLM DATA=DRUGRESPONSE;
  TITLE '29.2 repeated measures, one-factor studies';
  CLASS DRUG SUBJECT;
  MODEL RESPONSE = DRUG SUBJECT;
  MEANS DRUG SUBJECT;
  OUTPUT OUT=drugresponseout PREDICTED=PRED RESIDUAL=RESID;
RUN;
PROC PRINT DATA=drugresponseout;
  TITLE '29.2 residuals, repeated measures, drug response';
  VAR subject drug response pred RESID;
RUN;
PROC GPLOT DATA=drugresponseout;
  TITLE '29.2 residual vs fitted, repeated measures, drug response';
  PLOT RESID*PRED;
RUN;
proc capability data=drugresponseout noprint graphics;
  title '29.2 normal probability plot for residuals';
  probplot resid;
run;
PROC GPLOT DATA=drugresponseout;
  TITLE '29-3(c), treatment plot, repeated measures';
  PLOT response*drug=subject;
RUN;
PROC GLM DATA=DRUGRESPONSE;
  TITLE '29.2 completely randomized design';
  CLASS DRUG;
  MODEL RESPONSE = DRUG;
RUN;
QUIT;
```

```
*Attendance 11, 29.3 repeated measures;
*two-factor study with two repeated measures;
DATA TESTSCORE;
    INPUT score section $ test $ instructor $;
DATALINES;
69 1 1 1
75 1 1 2
46 1 1 3
71 1 2 1
80 1 2 2
77 1 2 3
88 2 1 1
90 2 1 2
91 2 1 3
92 2 2 1
85 2 2 2
95 2 2 3
51 3 1 1
65 3 1 2
57 3 1 3
49 3 2 1
71 3 2 2
63 3 2 3
;
PROC GLM DATA=testscore;
    TITLE 'repeated measures, both of two-factor, test scores';
    class instructor section test;
    model score = instructor section test section*test;
    means instructor section test section*test;
    OUTPUT OUT=testscoreout PREDICTED=PRED RESIDUAL=RESID;
RUN;
PROC PRINT DATA=testscoreout;
    TITLE '29.3, residuals, repeated measures, both of two factors';
    VAR instructor section test score PRED RESID;
RUN;
PROC GPLOT DATA=testscoreout;
    TITLE '29.3 residuals vs fitted, repeated measures, both of two factors';
    PLOT RESID*PRED;
RUN;
proc capability data=testscoreout noprint graphics;
    title '29.3, normal probability plot for residuals';
    probplot resid;
run;
QUIT;
```

```
*Attendance 11, 29.4 repeated measures;
*two-factor study with ONE repeated measure;
DATA TESTSCORE;
    INPUT score section $ test $ instructor $;
DATALINES;
69 1 1 1
75 1 1 2
46 1 1 3
71 1 2 1
80 1 2 2
77 1 2 3
88 2 1 1
90 2 1 2
91 2 1 3
92 2 2 1
85 2 2 2
95 2 2 3
51 3 1 1
65 3 1 2
57 3 1 3
49 3 2 1
71 3 2 2
63 3 2 3
;
PROC GLM DATA=testscore;
    TITLE '29.4 repeated measures, both of two-factor, test scores';
    class instructor section test;
    model score = section instructor(section) test section*test;
    means instructor section test;
    OUTPUT OUT=testscoreout PREDICTED=PRED RESIDUAL=RESID;
RUN;
PROC PRINT DATA=testscoreout;
    TITLE '29.4 residuals, repeated measures, both of two factors';
    VAR instructor section test score PRED RESID;
RUN;
PROC GPLOT DATA=testscoreout;
    TITLE '29.4 residuals vs fitted, repeated measures, both of two factors';
    PLOT RESID*PRED;
RUN;
proc capability data=testscoreout noprint graphics;
    title '29.4 normal probability plot for residuals';
    probplot resid;
run;
proc sort data=testscore;
    by section;
run;
proc means data=testscore;
    title '29.4 means';
    var score;
    by section;
run;
QUIT;
```

```
*Attendance 11,29.6 repeated measures;
*split plot;
DATA wheatyield;
  INPUT yield irrigation $ fertilizer $ field $;
DATALINES;
69 1 1 1
75 1 1 2
46 1 1 3
71 1 2 1
80 1 2 2
77 1 2 3
88 2 1 1
90 2 1 2
91 2 1 3
92 2 2 1
85 2 2 2
95 2 2 3
51 3 1 1
65 3 1 2
57 3 1 3
49 3 2 1
71 3 2 2
63 3 2 3
;
PROC GLM DATA=wheatyield;
  TITLE '29.6 split plot, wheat yield';
  class field irrigation fertilizer;
  model yield = irrigation field(irrigation) fertilizer irrigation*fertilizer;
RUN;
QUIT;
```

```

*Homework 6, 29.3, repeated measures;
*blood pressure, residuals;
DATA BLOODPRES;
  INPUT INCPRES RABBIT $ DOSE $;
DATALINES;
21 1 1
21 1 2
23 1 3
35 1 4
36 1 5
48 1 6
19 2 1
24 2 2
27 2 3
36 2 4
36 2 5
46 2 6
12 3 1
25 3 2
27 3 3
26 3 4
33 3 5
40 3 6
9 4 1
17 4 2
18 4 3
27 4 4
34 4 5
39 4 6
7 5 1
10 5 2
19 5 3
25 5 4
31 5 5
38 5 6
18 6 1
26 6 2
26 6 3
29 6 4
39 6 5
44 6 6
9 7 1
12 7 2
17 7 3
22 7 4
33 7 5
40 7 6
20 8 1
20 8 2
30 8 3
30 8 4
38 8 5
41 8 6
18 9 1
18 9 2
27 9 3
31 9 4
42 9 5
49 9 6
8 10 1
12 10 2
11 10 3
24 10 4
26 10 5
31 10 6
18 11 1
22 11 2
25 11 3
32 11 4
38 11 5
38 11 6
17 12 1
23 12 2
26 12 3
28 12 4
34 12 5
35 12 6
;
PROC GLM DATA=BLOODPRES;
  TITLE '29-3(a,b,c,d) repeated measures, blood pressure';
  CLASS RABBIT DOSE;
  MODEL INCPRES = RABBIT DOSE;
  means rabbit dose;
  OUTPUT OUT=BLOODPRES2 PREDICTED=INCPRES2 RESIDUAL=RESID;
RUN;
PROC PRINT DATA=BLOODPRES2;
  TITLE 'residuals, repeated measures, blood pressure';
  VAR RABBIT DOSE INCPRES INCPRES2 RESID;
RUN;
PROC GPLOT DATA=BLOODPRES2;
  TITLE '29-3(a), residual vs fitted, repeated measures, blood pressure';
  PLOT RESID*INCPRES2;
RUN;
proc capability data=bloodpres2 noprint graphics;
  title '29-3(a), normal probability plot for residuals';
  probplot resid;
run;
PROC CHART DATA=BLOODPRES2;
  TITLE '29-3(b), vbar plot, repeated measures, blood';
  VBAR RESID / GROUP = DOSE;
RUN;
PROC GPLOT DATA=BLOODPRES2;
  TITLE '29-3(c), treatment plot, repeated measures, blood';
  PLOT INCPRES*DOSE=RABBIT;
RUN;
QUIT;

```

```

*Homework 6, 29.4, repeated measures;
*blood pressure, inference;
DATA BLOODPRES;
  INPUT INCPRES RABBIT $ DOSE $;
  DATALINES;
21 1 1
21 1 2
23 1 3
35 1 4
36 1 5
48 1 6
19 2 1
24 2 2
27 2 3
36 2 4
36 2 5
46 2 6
12 3 1
25 3 2
27 3 3
26 3 4
33 3 5
40 3 6
9 4 1
17 4 2
18 4 3
27 4 4
34 4 5
39 4 6
7 5 1
10 5 2
19 5 3
25 5 4
31 5 5
38 5 6
18 6 1
26 6 2
26 6 3
29 6 4
39 6 5
44 6 6
9 7 1
12 7 2
17 7 3
22 7 4
33 7 5
40 7 6
20 8 1
20 8 2
30 8 3
30 8 4
38 8 5
41 8 6
18 9 1
18 9 2
27 9 3
31 9 4
42 9 5
49 9 6
8 10 1
12 10 2
11 10 3
24 10 4
26 10 5
31 10 6
18 11 1
22 11 2
25 11 3
32 11 4
38 11 5
38 11 6
17 12 1
23 12 2
26 12 3
28 12 4
34 12 5
35 12 6
;
PROC GLM DATA=BLOODPRES;
  TITLE '29-4(a) repeated measures, blood';
  CLASS RABBIT DOSE;
  MODEL INCPRES = RABBIT DOSE;
  means rabbit dose;
RUN;
QUIT;

```

Chapter 29. hw6-29-11-calculator-repeated-2way-residuals (ATTENDANCE 11) 101

```

*Homework 6, 29.11, repeated measures, 2 way;
*calculator efficiency, residuals;
DATA CALCEFF;
    INPUT TIME ENGINEER $ PROBLEM $ MODEL $;
DATALINES;
3.1 1 1 1
7.5 1 1 2
2.5 1 2 1
5.1 1 2 2
3.8 2 1 1
8.1 2 1 2
2.8 2 2 1
5.3 2 2 2
3 3 1 1
7.6 3 1 2
2 3 2 1
4.9 3 2 2
3.4 4 1 1
7.8 4 1 2
2.7 4 2 1
5.5 4 2 2
3.3 5 1 1
6.9 5 1 2
2.5 5 2 1
5.4 5 2 2
3.6 6 1 1
7.8 6 1 2
2.4 6 2 1
4.8 6 2 2
;
PROC GLM DATA=CALCEFF;
    TITLE '29-11(a,b,c,d) repeated measures, calculator efficiency';
    CLASS ENGINEER PROBLEM MODEL;
    MODEL TIME = ENGINEER PROBLEM MODEL problem*model;
    means engineer problem model problem*model;
    OUTPUT OUT=CALCEFF2 PREDICTED=CALCEFFPRED RESIDUAL=RESID;
RUN;
PROC PRINT DATA=CALCEFF2;
    TITLE '29-11(a), residuals, repeated measures, calculator';
    VAR ENGINEER PROBLEM MODEL CALCEFFPRED RESID;
RUN;
PROC GPLOT DATA=CALCEFF2;
    TITLE '29-11(A), residuals vs fitted, repeated measures, calculator';
    PLOT RESID*CALCEFFPRED;
RUN;
proc capability data=bloodpres2 noprint graphics;
    title '29-11(a), normal probability plot for residuals';
    probplot resid;
run;
PROC CHART DATA=CALCEFF2;
    TITLE '29-11(b), vbar residuals, repeated measures, calculator';
    VBAR RESID / GROUP = PROBLEM;
RUN;
PROC GPLOT DATA=CALCEFF2;
    TITLE '29-11(c), treatment plot, repeated measures, calculator';
    PLOT TIME*PROBLEM=ENGINEER;
RUN;
PROC GPLOT DATA=CALCEFF2;
    TITLE '29-11(c), treatment plot, repeated measures, calculator';
    PLOT TIME*MODEL=ENGINEER;
RUN;
QUIT;

```


102 Chapter 29. hw6-29-12-calculator-repeated-2way-inference (ATTENDANCE 11)

```

*Homework 6, 29.12, repeated measures, 2 way;
*calculator efficiency, inference;
DATA CALCEFF;
    INPUT TIME ENGINEER $ PROBLEM $ MODEL $;
DATALINES;
3.1 1 1 1
7.5 1 1 2
2.5 1 2 1
5.1 1 2 2
3.8 2 1 1
8.1 2 1 2
2.8 2 2 1
5.3 2 2 2
3 3 1 1
7.6 3 1 2
2 3 2 1
4.9 3 2 2
3.4 4 1 1
7.8 4 1 2
2.7 4 2 1
5.5 4 2 2
3.3 5 1 1
6.9 5 1 2
2.5 5 2 1
5.4 5 2 2
3.6 6 1 1
7.8 6 1 2
2.4 6 2 1
4.8 6 2 2
;
PROC GLM DATA=CALCEFF;
    TITLE '29-12(a,b,c,d,e) repeated measures, 2 way, calculator';
    CLASS ENGINEER PROBLEM MODEL;
    MODEL TIME = ENGINEER PROBLEM MODEL PROBLEM*MODEL;
    means engineer problem model problem*model;
    OUTPUT OUT=CALCEFF2 PREDICTED=CALCEFFPRED RESIDUAL=RESID;
RUN;
PROC GPLOT DATA=CALCEFF2;
    TITLE '29-12(b), interaction plot, repeated measures, 2 way, calculator';
    PLOT TIME*PROBLEM=MODEL;
RUN;
QUIT;

```

```

*Homework 6, 29.20, repeated measures;
*split plot, wheat yield, residuals;
DATA WHEATYIELD;
  INPUT YIELD FIELD $ IRRIGATION $ FERTILIZER $;
DATALINES;
43  1  1  1
48  1  1  2
63  1  2  1
70  1  2  2
40  2  1  1
43  2  1  2
52  2  2  1
53  2  2  2
31  3  1  1
36  3  1  2
45  3  2  1
48  3  2  2
27  4  1  1
30  4  1  2
47  4  2  1
51  4  2  2
36  5  1  1
39  5  1  2
54  5  2  1
57  5  2  2
;
PROC GLM DATA=WHEATYIELD noprint;
  TITLE '29-20(a) split plot, wheat yield';
  CLASS IRRIGATION FIELD FERTILIZER;
  MODEL YIELD = IRRIGATION IRRIGATION(FIELD)
    FERTILIZER IRRIGATION*FERTILIZER;
  OUTPUT OUT=WHEATYIELD2 PREDICTED=WHEATYIELDPRED RESIDUAL=RESID;
RUN;
PROC PRINT DATA=WHEATYIELD2;
  TITLE '29-20(a) residuals (from split plot error), split plot, wheat yield';
  VAR IRRIGATION FIELD FERTILIZER YIELD WHEATYIELDPRED RESID;
RUN;
PROC GPLOT DATA=WHEATYIELD2;
  TITLE '29-20(a) residuals (from split plot error) vs fitted, split plot, wheat yield';
  PLOT RESID*WHEATYIELDPRED;
RUN;
proc capability data=bloodpres2 noprint graphics;
  title '29-20(a), normal probability plot for residuals';
  probplot resid;
run;
PROC GPLOT DATA=WHEATYIELD2;
  TITLE '29-20(b) treatment plot, split plot, wheat yield';
  PLOT YIELD*FIELD=FERTILIZER;
RUN;
PROC GPLOT DATA=WHEATYIELD2;
  TITLE '29-20(b) treatment plot, split plot, wheat yield';
  PLOT YIELD*IRRIGATION=FERTILIZER;
RUN;
QUIT;

```

```

*Homework 6, 29.21, repeated measures;
*split plot, wheat yield, inference;
DATA WHEATYIELD;
  INPUT YIELD FIELD $ IRRIGATION $ FERTILIZER $;
  DATALINES;
43  1  1  1
48  1  1  2
63  1  2  1
70  1  2  2
40  2  1  1
43  2  1  2
52  2  2  1
53  2  2  2
31  3  1  1
36  3  1  2
45  3  2  1
48  3  2  2
27  4  1  1
30  4  1  2
47  4  2  1
51  4  2  2
36  5  1  1
39  5  1  2
54  5  2  1
57  5  2  2
;
PROC GLM DATA=WHEATYIELD;
  TITLE '29-20(a) split plot, wheat yield';
  CLASS IRRIGATION FIELD FERTILIZER;
  MODEL YIELD = IRRIGATION IRRIGATION(FIELD)
    FERTILIZER IRRIGATION*FERTILIZER
    FERTILIZER*IRRIGATION(FIELD);
  OUTPUT OUT=WHEATYIELD2 PREDICTED=WHEATYIELD2PRED RESIDUAL=RESID;
RUN;
proc sort data=wheatyield;
  by irrigation fertilizer;
run;
proc print;
  var irrigation fertilizer yield;
run;
proc means data=wheatyield;
  title '20-20(b), treatment means plot, wheat yield';
  var yield;
  by irrigation fertilizer;
  output out=wheatyieldout mean=mn;
run;
proc gplot data=wheatyieldout;
  title '20-20(b), treatment means plot, wheat yield';
  plot mn*irrigation=fertilizer;
run;
QUIT;

```