

SAS Lab 7 For Statistics 514

Topics:

Chapter 25. Analysis of Covariance

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*Attendance 7, 25.1 ANCOVA, drug response;
DATA DRUGRESPONSE;
  INPUT response prvsick drug $ patient $;
DATA LINES;
5.90 231 1
5.92 101 2
5.91 451 3
5.89 221 4
5.88 291 5
5.51 332 1
5.50 312 2
5.50 102 3
5.49 512 4
5.50 432 5
5.01 053 1
5.00 473 2
4.99 193 3
4.98 383 4
5.02 333 5
;
PROC GPLOT;
  TITLE '25.1 ANOVA: response vs patient (drug type)';
  PLOT response*patient=drug;
RUN;
PROC GPLOT;
  TITLE '25.1 ANCOVA: response vs concomitant prev illness (drug type)';
  PLOT response*prvsick=drug;
RUN;
DATA READABILITY;
  INPUT illum readability readtype;
DATA LINES;
1.5 3.6 1
2.2 5.3 1
2.9 4.3 1
3.8 5.2 1
4.1 6.6 1
5.5 8.5 1
6.4 9.6 1
6.8 9.5 1
1.2 8.6 2
2.5 9.8 2
3.5 10.6 2
4.1 11.9 2
4.6 12.2 2
5.6 13.9 2
6.6 14.8 2
;
PROC GPLOT;
  TITLE '25.1 ANCOVA: readability vs concomitant illum (readtype)';
  PLOT readability*illum=readtype;
RUN;
QUIT;
```

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*Attendance 7, 25.3 single-factor covariance;
*reading ability versus concomitant illumination (reading type);
DATA READABILITY;
  INPUT ILLUM ABILITY READTYPE I1;
          x = ILLUM - 4.09;
          INTERACT1 = DIFF*I1;
DATALINES;
1.5   3.6   1 1
2.2   5.3   1 1
2.9   4.3   1 1
3.8   5.2   1 1
4.1   6.6   1 1
5.5   8.5   1 1
6.4   9.6   1 1
6.8   9.5   1 1
1.2   8.6   2 -1
2.5   9.8   2 -1
3.5  10.6   2 -1
4.1  11.9   2 -1
4.6  12.2   2 -1
5.6  13.9   2 -1
6.6  14.8   2 -1
;
PROC GLM DATA=READABILITY;
  TITLE '25.2 ANCOVA reading vs concomitant illum';
  MODEL ABILITY = I1 illum;
RUN;
PROC GLM DATA=READABILITY;
  TITLE '25.2 ANCOVA reading vs x = illum - ave illum';
  MODEL ABILITY = I1 x;
RUN;
QUIT;
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*Attendance 7, 25.3 single-factor covariance;
*reading ability versus reading type, concomitant illumination;
DATA READABILITY;
  INPUT ILLUM ABILITY READTYPE I1;
         centerX = ILLUM - 4.09;
         interact1 = centerX*I1;
DATALINES;
1.5 3.6 1 1
2.2 5.3 1 1
2.9 4.3 1 1
3.8 5.2 1 1
4.1 6.6 1 1
5.5 8.5 1 1
6.4 9.6 1 1
6.8 9.5 1 1
1.2 8.6 2 -1
2.5 9.8 2 -1
3.5 10.6 2 -1
4.1 11.9 2 -1
4.6 12.2 2 -1
5.6 13.9 2 -1
6.6 14.8 2 -1
;
PROC GLM DATA=readability noprint;
  TITLE '25.3 check ANCOVA assumptions, reading ability';
  class I1;
  MODEL ability = I1 centerX;
  OUTPUT out=readabilityout P=PRED R=RESID;
RUN;
PROC PRINT data=readabilityout;
  TITLE '25.3 ANCOVA residuals, reading ability';
  VAR readtype illum ability PRED RESID;
RUN;
PROC GPLOT data=readabilityout;
  TITLE '25.3 residuals vs predicted reading ability';
  PLOT resid*pred=readtype;
RUN;
proc capability data=readabilityout noprint graphics;
  title '25.3 normal probability plot for residuals, reading ability';
  probplot resid;
run;
PROC GLM DATA=readability;
  TITLE '25.3 full covariance model, with interaction, reading ability';
  MODEL ability = I1 centerX interact1;
RUN;
PROC GLM DATA=readability;
  TITLE '25.3 reduced covariance model, without interaction (parallel), reading';
  MODEL ability = I1 centerX;
RUN;
PROC GLM DATA=readability;
  TITLE '25.3 reduced covariance model, treatments same?, reading';
  MODEL ability = centerX;
RUN;
PROC reg DATA=readability covout outest=covest noprint;
  TITLE '25.3 variance-covariance matrix, reading ability';
  MODEL ability = I1 centerX;
  output out=readabilitycov;
RUN;
PROC PRINT data = COVEST;
RUN;
*Attendance 7, 25.3 single-factor covariance;
*drug response vs drug type, concomitant previous illness;
DATA DRUGRESPONSE;
  INPUT RESPONSE PRVSICK DRUG $ SUBJECT $ I1 I2;
         DIFF = PRVSICK - 29.27;
         INTERACT1 = DIFF*I1;
         INTERACT2 = DIFF*I2;
DATALINES;
5.90 231 1 1 0
5.92 101 2 1 0
5.91 451 3 1 0
5.89 221 4 1 0
5.88 291 5 1 0
5.50 332 1 0 1
5.50 312 2 0 1
5.50 102 3 0 1
5.49 512 4 0 1
5.50 432 5 0 1
5.01 053 1 -1 -1
5.00 473 2 -1 -1
4.99 193 3 -1 -1
4.98 383 4 -1 -1
5.02 333 5 -1 -1
;
PROC GLM DATA=drugresponse noprint;
  TITLE '25.3 check ANCOVA assumptions, drug';
  class I1 I2;
  MODEL response = I1 diff;
  OUTPUT out=drugresponseout P=PRED R=RESID;
RUN;
PROC PRINT data=drugresponseout;
  TITLE '25.3 ANCOVA residuals, drug response';
  VAR drug prvsick response PRED RESID;
RUN;
PROC GPLOT data=drugresponseout;
  TITLE '25.3 residuals vs predicted drug response';
  PLOT resid*pred=drug;
RUN;
proc capability data=drugresponseout noprint graphics;
  title '25.3 normal probability plot for residuals, drug response';
  probplot resid;
run;
PROC GLM DATA=DRUGRESPONSE;
  TITLE '25.3 full covariance model, with interaction, drug response';
  MODEL RESPONSE = I1 I2 DIFF INTERACT1 INTERACT2;
RUN;
PROC GLM DATA=DRUGRESPONSE;
  TITLE '25.3 reduced covariance model, lines parallel?, drug response';
  MODEL RESPONSE = I1 I2 DIFF;
RUN;
PROC REG DATA=DRUGRESPONSE;
  TITLE '25.3 reduced covariance model, treatments same?, drug response';
  MODEL RESPONSE = DIFF;
RUN;
PROC REG DATA=DRUGRESPONSE COVOUT OUTEST=COVEST;
  TITLE '25.3 variance-covariance, drug response';
  MODEL RESPONSE = I1 I2 DIFF;
RUN;
PROC PRINT
  DATA = COVEST;
RUN;
QUIT;

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*Attendance 7, 25.3 single-factor covariance;
*reading ability versus reading type, concomitant illumination;
DATA READABILITY;
  INPUT ILLUM ABILITY READTYPE I1;
      diffANOVA = ability - illum;
      centerX = ILLUM - 4.09;
      interact1 = centerX*I1;
DATALINES;
1.5  3.6  1 1
2.2  5.3  1 1
2.9  4.3  1 1
3.8  5.2  1 1
4.1  6.6  1 1
5.5  8.5  1 1
6.4  9.6  1 1
6.8  9.5  1 1
1.2  8.6  2 -1
2.5  9.8  2 -1
3.5  10.6 2 -1
4.1  11.9 2 -1
4.6  12.2 2 -1
5.6  13.9 2 -1
6.6  14.8 2 -1
;
PROC anova DATA=readability;
  TITLE '25.5 ANOVA model: diffANOVA = expend';
  CLASS readtype;
  MODEL diffANOVA = readtype;
RUN;
PROC glm DATA=readability;
  TITLE '25.5 full ANCOVA: ability = I1 I2 centerX';
  MODEL ability = I1 centerX;
RUN;
QUIT;
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*Homework 4, 25.7 ANCOVA;
*Productivity improvement, pp 1034-1041;
DATA PRODANCOVA;
  INPUT THISYRimprov EXPEND $ FIRM $ LASTYRimprov I1 I2;
  DIFF = LASTYRimprov - 9.4;
  INTERACT1 = DIFF*I1;
  INTERACT2 = DIFF*I2;

DATALINES;
7.6 1 1 8.2 1 0
8.2 1 2 7.9 1 0
6.8 1 3 7 1 0
5.8 1 4 5.7 1 0
6.9 1 5 7.2 1 0
6.6 1 6 7 1 0
6.3 1 7 6.5 1 0
7.7 1 8 7.9 1 0
6 1 9 6.3 1 0
6.7 2 1 8.8 0 1
8.1 2 2 10 0 1
9.4 2 3 10.7 0 1
8.6 2 4 10 0 1
7.8 2 5 9.7 0 1
7.7 2 6 9.4 0 1
8.9 2 7 10.6 0 1
7.9 2 8 9.8 0 1
8.3 2 9 10 0 1
8.7 2 10 10.3 0 1
7.1 2 11 8.9 0 1
8.4 2 12 10 0 1
8.5 3 1 11.5 -1 -1
9.7 3 2 12.2 -1 -1
10.1 3 3 12.8 -1 -1
7.8 3 4 11 -1 -1
9.6 3 5 12.3 -1 -1
9.5 3 6 12.1 -1 -1
;
PROC GLM DATA=PRODANCOVA noprint;
  TITLE '25.7 ANCOVA AND PRODUCTIVITY IMPROVEMENT';
  CLASS EXPEND;
  MODEL thisyrimprov = EXPEND LASTYRimprov / SOLUTION;
  OUTPUT out=prodancovaout P=PRED R=RESID;
RUN;
PROC PRINT;
  TITLE '25.7(a) ANCOVA residuals, productivity';
  VAR EXPEND FIRM LASTYRimprov thisyrimprov PRED RESID;
RUN;
PROC GPLOT data=prodancovaout;
  TITLE '25.7(b) residuals vs predicted improvement';
  PLOT resid*pred=expend;
RUN;
proc capability data=prodancovaout noprint graphics;
  title '25.7(b) normal probability plot for residuals, productivity';
  probplot resid;
run;
PROC GLM DATA=PRODANCOVA;
  TITLE '25.7(c,d) full covariance model, 25.23, p 1026';
  CLASS I1 I2;
  MODEL thisyrimprov = I1 I2 DIFF INTERACT1 INTERACT2;
RUN;
PROC GLM DATA=PRODANCOVA;
  TITLE '25.7(c) reduced covariance model, 25.13, p 1020';
  CLASS I1 I2;
  MODEL thisyrimprov = I1 I2 DIFF;
RUN;
QUIT;

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*Homework 4,25.8 ANCOVA productivity,pp 1034-1041;
DATA PRODANCOVA;
  INPUT THISYRimprov EXPEND $ FIRM $ LASTYRimprov I1 I2;
  DIFF = LASTYRimprov - 9.4;
  INTERACT1 = DIFF*I1;
  INTERACT2 = DIFF*I2;

DATALINES;
7.6 1 1 8.2 1 0
8.2 1 2 7.9 1 0
6.8 1 3 7 1 0
5.8 1 4 5.7 1 0
6.9 1 5 7.2 1 0
6.6 1 6 7 1 0
6.3 1 7 6.5 1 0
7.7 1 8 7.9 1 0
6 1 9 6.3 1 0
6.7 2 1 8.8 0 1
8.1 2 2 10 0 1
9.4 2 3 10.7 0 1
8.6 2 4 10 0 1
7.8 2 5 9.7 0 1
7.7 2 6 9.4 0 1
8.9 2 7 10.6 0 1
7.9 2 8 9.8 0 1
8.3 2 9 10 0 1
8.7 2 10 10.3 0 1
7.1 2 11 8.9 0 1
8.4 2 12 10 0 1
8.5 3 1 11.5 -1 -1
9.7 3 2 12.2 -1 -1
10.1 3 3 12.8 -1 -1
7.8 3 4 11 -1 -1
9.6 3 5 12.3 -1 -1
9.5 3 6 12.1 -1 -1
;

PROC GPLOT data=prodancova;
  TITLE '25.8(a) thisyr*lastyr=expend';
  PLOT THISYRimprov*LASTYRimprov=EXPEND;
RUN;

PROC glm DATA=PRODANCOVA;
  TITLE '25.8(c,d) full ANCOVA: thisyr = I1 I2 diff';
  MODEL THISYRimprov = I1 I2 DIFF;
RUN;

PROC glm DATA=PRODANCOVA;
  TITLE '25.8(c) reduced ANCOVA: thisyr = diff';
  MODEL THISYRimprov = DIFF;
RUN;

PROC GLM DATA=PRODANCOVA;
  TITLE '25.8(d) ANOVA model: thisyr = expend';
  CLASS EXPEND;
  MODEL THISYRimprov = EXPEND;
RUN;

PROC glm DATA=PRODANCOVA COVOUT OUTEST=COVEST;
  TITLE '25.8(e,f) ANCOVA CI for mean prod';
  MODEL THISYRimprov = I1 I2 DIFF;
RUN;

PROC PRINT
  DATA = COVEST;
RUN;

PROC glm DATA=PRODANCOVA;
  TITLE '25.8(f) ANCOVA pairwise comparisons';
  MODEL THISYRimprov = I1 I2 DIFF;
RUN;
QUIT;

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*Homework 4, 25.19 ANCOVA productivity, pp 1034-1041;
DATA PRODANCOVA;
  INPUT THISYRimprov EXPEND $ FIRM $ LASTYRimprov I1 I2;
    diffANOVA = thisyrimprov - LASTYRimprov;
    diff = lastyrimprov - 9.4;
    INTERACT1 = DIFF*I1;
    INTERACT2 = DIFF*I2;
  DATALINES;
7.6 1 1 8.2 1 0
8.2 1 2 7.9 1 0
6.8 1 3 7 1 0
5.8 1 4 5.7 1 0
6.9 1 5 7.2 1 0
6.6 1 6 7 1 0
6.3 1 7 6.5 1 0
7.7 1 8 7.9 1 0
6 1 9 6.3 1 0
6.7 2 1 8.8 0 1
8.1 2 2 10 0 1
9.4 2 3 10.7 0 1
8.6 2 4 10 0 1
7.8 2 5 9.7 0 1
7.7 2 6 9.4 0 1
8.9 2 7 10.6 0 1
7.9 2 8 9.8 0 1
8.3 2 9 10 0 1
8.7 2 10 10.3 0 1
7.1 2 11 8.9 0 1
8.4 2 12 10 0 1
8.5 3 1 11.5 -1 -1
9.7 3 2 12.2 -1 -1
10.1 3 3 12.8 -1 -1
7.8 3 4 11 -1 -1
9.6 3 5 12.3 -1 -1
9.5 3 6 12.1 -1 -1
;
PROC anova DATA=PRODANCOVA;
  TITLE '25.17(a) ANOVA model: diffANOVA = expend';
  CLASS EXPEND;
  MODEL diffANOVA = expend;
RUN;
PROC glm DATA=PRODANCOVA;
  TITLE '25.17(b) full ANCOVA: thisyr = I1 I2 diff';
  MODEL THISYRimprov = I1 I2 DIFF;
RUN;
QUIT;

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