

4-15-04
Factorial Arrangement of Treatment experiments

Terms

1. Interaction of factors A & B

The failure of the difference in means of different levels of factor A to be consistent across all levels of B (or vice versa)

2. Simple Effect The difference in means when changing the level of one factor while keeping the levels of all other factors fixed (Appropriate any time especially when interaction is significant).

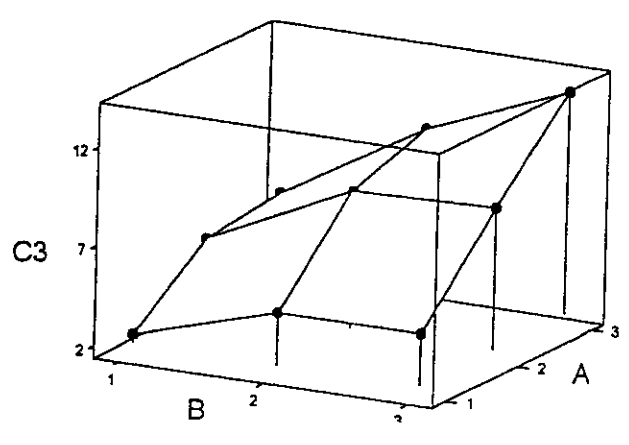
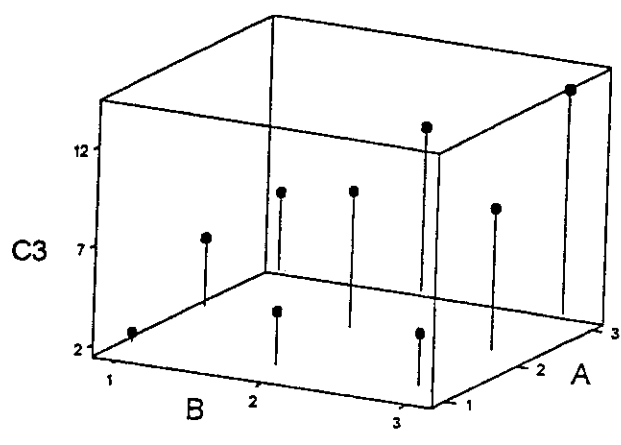
3. Main Effect (Marginal)

The difference in means when changing the level of one factor averaged across all other levels.

(Avoid when interaction is present)

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3-d plot of means
problem 19, 14 page
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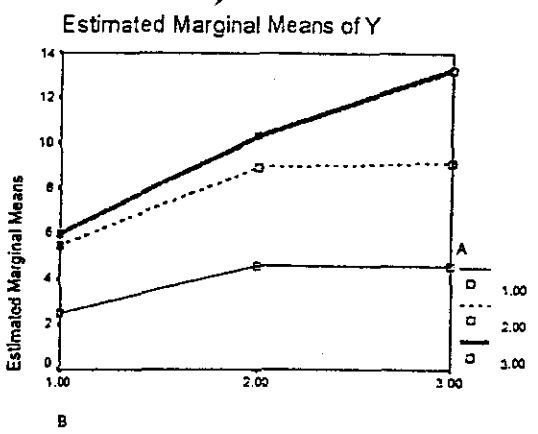
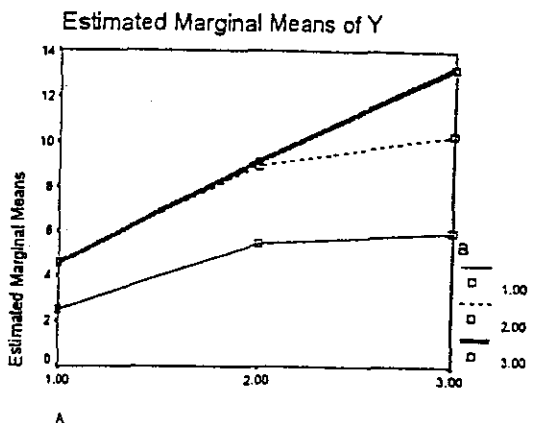
(2)
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3.A*B Table MEANS for all 9 cells

Dependent Variable: Y

A	B	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
1.00	1.00	2.475	.123	2.223	2.727
	2.00	4.600	.123	4.348	4.852
	3.00	4.575	.123	4.323	4.827
2.00	1.00	5.450	.123	5.198	5.702
	2.00	8.925	.123	8.673	9.177
	3.00	9.125	.123	8.873	9.377
3.00	1.00	5.975	.123	5.723	6.227
	2.00	10.275	.123	10.023	10.527
	3.00	13.250	.123	12.998	13.502

	B		
	1	2	3
1	2.475	4.6	4.575
2	5.45	8.925	9.125
3	5.975	10.275	13.25



Some info
Two different Looks

	B			
	1	2	3	
1	2.475	4.6	4.575	3.883
2	5.45	8.925	9.125	7.833
3	5.975	10.275	13.25	9.833
	4.633	7.933	8.983	

A main effects
B main effects

A simple effect
 $\bar{Y}_{3,1} - \bar{Y}_{3,2} = 10.275 - 5.975 = 4.3$

B main effects
main effect
 $\bar{Y}_{.2} - \bar{Y}_{.1} = 7.933 - 4.663 = 3.27$

```

data t19_14;
input y a b sub;
cards;
  2.4      1      1      1
  2.7      1      1      2
  2.3      1      1      3
  2.5      1      1      4
  4.6      1      2      1
  4.2      1      2      2
  4.9      1      2      3
  4.7      1      2      4
  4.8      1      3      1
  4.5      1      3      2
  4.4      1      3      3
  4.6      1      3      4
  5.8      2      1      1
  5.2      2      1      2
  5.5      2      1      3
  5.3      2      1      4
  8.9      2      2      1
  9.1      2      2      2
  8.7      2      2      3
  9.0      2      2      4
  9.1      2      3      1
  9.3      2      3      2
  8.7      2      3      3
  9.4      2      3      4
  6.1      3      1      1
  5.7      3      1      2
  5.9      3      1      3
  6.2      3      1      4
  9.9      3      2      1
 10.5      3      2      2
 10.6      3      2      3
 10.1      3      2      4
 13.5      3      3      1
 13.0      3      3      2
 13.3      3      3      3
 13.2      3      3      4

```

```

;
Proc glm data=t19_14;
class a b;
model y=a|b;
lsmeans a*b /cl slice=b;
estimate 'alb1' intercept 1 a 1 0 0 b 1 0 0 a*b 1 0 0 0 0 0 0 0/est;
estimate 'alb2' intercept 1 a 1 0 0 b 0 1 0 a*b 0 1 ;
estimate 'alb1 - alb2' intercept 0 a 0 0 0 b 1 -1 0 a*b 1 -1 0 ;
estimate 'alb3' intercept 1 a 1 0 0 b 0 0 1 a*b 0 0 1 ;
estimate 'alb1 - alb3' intercept 0 b 1 0 -1 a*b 1 0 -1;
run; quit;

```

The GLM Procedure

Class Level Information

Class	Levels	Values
a	3	1 2 3
b	3	1 2 3
Number of observations		36

The GLM Procedure

Dependent Variable: y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	373.1050000	46.6381250	774.91	<.0001
Error	27	1.6250000	0.0601852		
Corrected Total	35	374.7300000	<i>MSE</i>		

R-Square	Coeff Var	Root MSE	y Mean
0.995664	3.415221	0.245327	7.183333

Source	DF	Type I SS	Mean Square	F Value	Pr > F
a	2	220.0200000	110.0100000	1827.86	<.0001
b	2	123.6600000	61.8300000	1027.33	<.0001
a*b	4	29.4250000	7.3562500	122.23	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
a	2	220.0200000	110.0100000	1827.86	<.0001
b	2	123.6600000	61.8300000	1027.33	<.0001
a*b	4	29.4250000	7.3562500	122.23	<.0001

The GLM Procedure

Least Squares Means

a	y LSMEAN
1	3.88333333
2	7.83333333
3	9.83333333

b	y LSMEAN
1	4.63333333
2	7.93333333
3	8.98333333

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The SAS System

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The GLM Procedure
Least Squares Means

a	b	y LSMEAN
1	1	2.4750000
1	2	4.6000000
1	3	4.5750000
2	1	5.4500000
2	2	8.9250000
2	3	9.1250000
3	1	5.9750000
3	2	10.2750000
3	3	13.2500000

a	b	y LSMEAN	95% Confidence Limits	
1	1	2.475000	2.223316	2.726684
1	2	4.600000	4.348316	4.851684
1	3	4.575000	4.323316	4.826684
2	1	5.450000	5.198316	5.701684
2	2	8.925000	8.673316	9.176684
2	3	9.125000	8.873316	9.376684
3	1	5.975000	5.723316	6.226684
3	2	10.275000	10.023316	10.526684
3	3	13.250000	12.998316	13.501684

The GLM Procedure
Least Squares Means

a*b Effect Sliced by b for y

b	DF	Sum of Squares	Mean Square	F Value	Pr > F
1	2	28.501667	14.250833	236.78	<.0001
2	2	70.311667	35.155833	584.13	<.0001
3	2	150.631667	75.315833	1251.40	<.0001

The GLM Procedure

Coefficients for Estimate a1b1

		Row 1
Intercept		1
a	1	1
a	2	0
a	3	0
b	1	1
b	2	0
b	3	0
a*b	1 1	1
a*b	1 2	0
a*b	1 3	0
a*b	2 1	0
a*b	2 2	0
a*b	2 3	0
a*b	3 1	0
a*b	3 2	0
a*b	3 3	0

The SAS System

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The GLM Procedure

Dependent Variable: y

Parameter	Estimate	Standard Error	t Value	Pr > t
a1b1	2.47500000	0.12266335	20.18	<.0001
a1b2	4.60000000	0.12266335	37.50	<.0001
a1b1 - a1b2	-2.12500000	0.17347217	-12.25	<.0001
a1b3	4.57500000	0.12266335	37.30	<.0001
a1b1 - a1b3	-2.10000000	0.17347217	-12.11	<.0001