

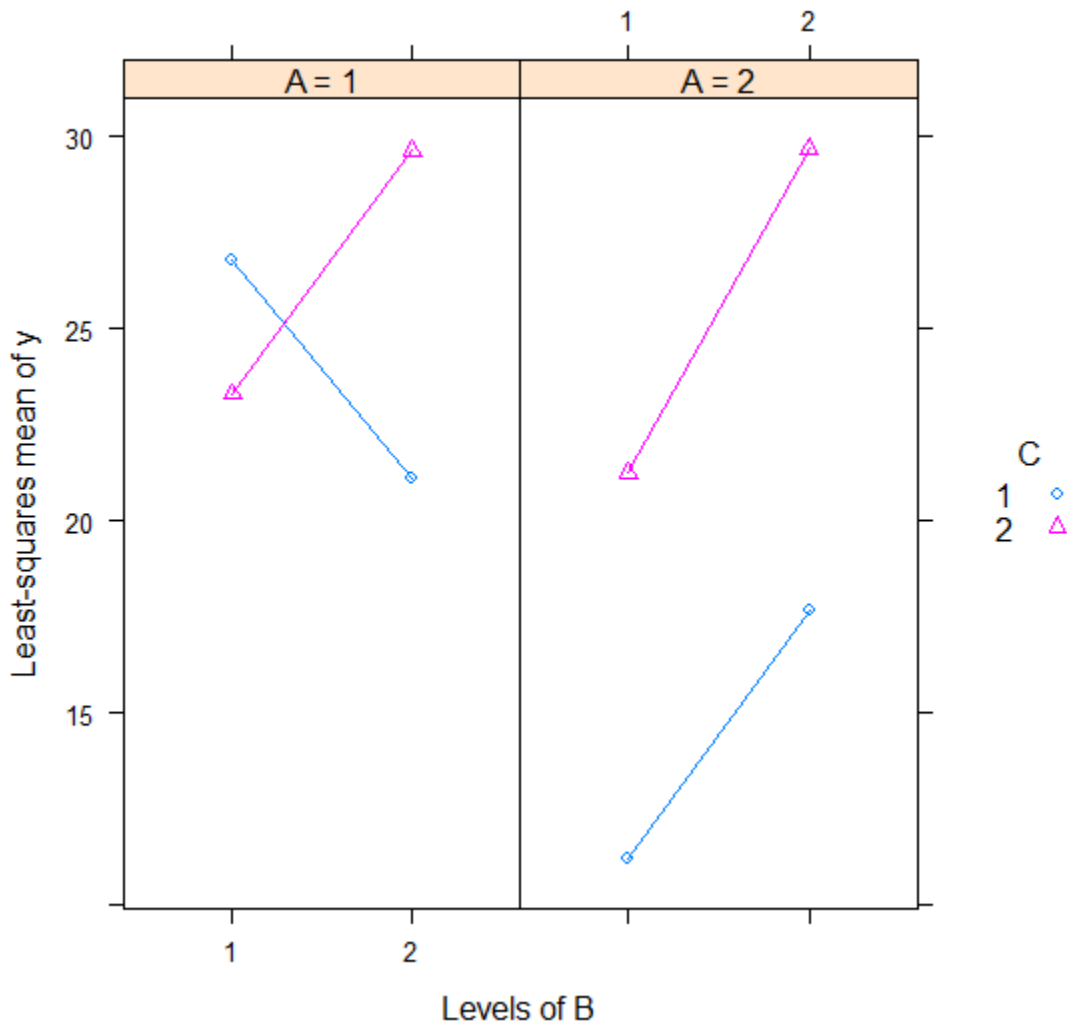
Output from onecell1.R

```
> # onecell1.R
>
> library(lsmmeans)
>
> # get the data
> onecell<-read.table(file="onecell1.dat",header=T,
+   colClasses=c("factor","factor","factor","factor","numeric"))
> head(onecell)
  A B C D    y
1 1 1 1 1 26.1
2 1 1 1 1 27.5
3 1 1 1 2 23.5
4 1 1 1 2 21.1
5 1 1 2 1 22.8
6 1 1 2 1 23.8
> is.factor(onecell$A)
[1] TRUE
>
> # create variable all_low
> onecell$all_low <- 0
> onecell$all_low[onecell$A==1 & onecell$B==1 & onecell$C==1 & onecell$D==1] <- 1
> onecell$all_low <- factor(onecell$all_low)
>
> # create dataframe onecell1 where D=1
> onecell1<-onecell[onecell$D==1,]
>
> # fit m1: 3-way ANOVA Model to data from D=1 (low)
> m1<-aov(y~A*B*C,data=onecell1)
> summary(m1)
          Df Sum Sq Mean Sq F value    Pr(>F)
A           1  110.78   110.78   100.99 8.18e-06 ***
B           1   60.45    60.45    55.11 7.45e-05 ***
C           1  184.28   184.28   168.00 1.19e-06 ***
A:B         1   50.77    50.77    46.28 0.000137 ***
A:C         1   72.68    72.68    66.26 3.85e-05 ***
B:C         1   49.35    49.35    44.99 0.000152 ***
A:B:C       1   25.25    25.25    23.02 0.001359 **
Residuals   8    8.78     1.10
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
> # get lsmeans for each combination
> lsmeans(m1,specs=~A*B*C)
$`A:B:C lsmeans`
  A B C lsmean      SE df  lower.CL upper.CL
1 1 1  26.80 0.7405657  8 25.092253 28.50775
2 1 1  11.20 0.7405657  8  9.492253 12.90775
1 2 1  21.10 0.7405657  8 19.392253 22.80775
2 2 1  17.65 0.7405657  8 15.942253 19.35775
1 1 2  23.30 0.7405657  8 21.592253 25.00775
2 1 2  21.25 0.7405657  8 19.542253 22.95775
1 2 2  29.65 0.7405657  8 27.942253 31.35775
2 2 2  29.70 0.7405657  8 27.992253 31.40775
```

```

>
> # profile plots (use lsmeans package)
> lsmip(m1,C~B|A)

```



```

>
> # fit m2: Full 4-way ANOVA Model to entire data set
> m2<-aov(y~A*B*C*D,data=onecell)
> summary(m2)

```

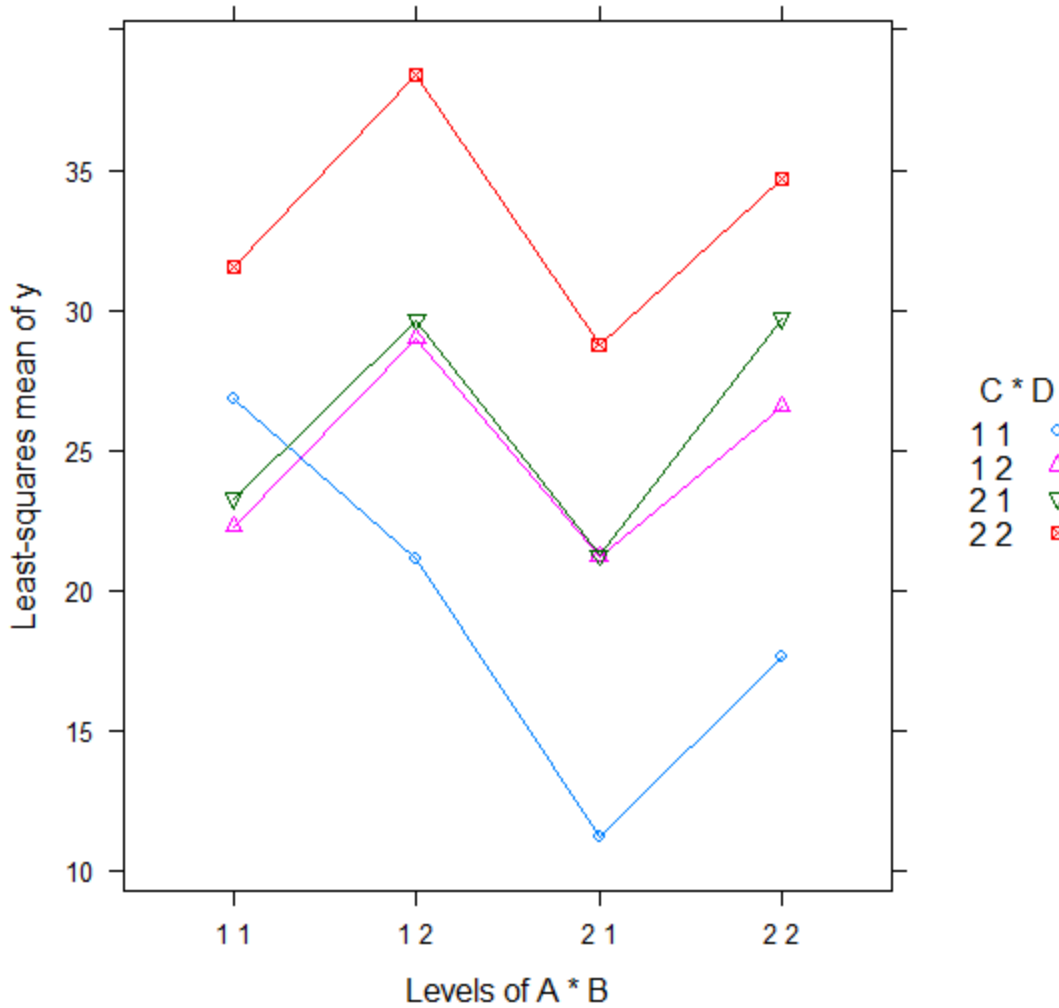
	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
A	1	120.9	120.9	117.451	8.87e-09	***
B	1	204.0	204.0	198.198	1.97e-10	***
C	1	472.8	472.8	459.290	3.29e-13	***
D	1	335.4	335.4	325.834	4.62e-12	***
A:B	1	18.0	18.0	17.486	0.000705	***
A:C	1	24.9	24.9	24.142	0.000156	***
B:C	1	27.4	27.4	26.599	9.54e-05	***
A:D	1	15.1	15.1	14.693	0.001466	**
B:D	1	10.8	10.8	10.503	0.005119	**
C:D	1	6.5	6.5	6.295	0.023249	*
A:B:C	1	11.5	11.5	11.191	0.004108	**
A:B:D	1	34.0	34.0	33.060	2.98e-05	***
A:C:D	1	50.0	50.0	48.573	3.16e-06	***
B:C:D	1	22.1	22.1	21.480	0.000275	***
A:B:C:D	1	13.8	13.8	13.388	0.002118	**
Residuals	16	16.5	1.0			

```

---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
>
> # get lsmeans for each combination
> lsmeans(m2, specs=~A*B*C*D)
$`A:B:C:D lsmeans`
  A B C D lsmean      SE df  lower.CL upper.CL
1 1 1 1  26.80 0.7174172 16 25.279143 28.32086
2 1 1 1  11.20 0.7174172 16  9.679143 12.72086
1 2 1 1  21.10 0.7174172 16 19.579143 22.62086
2 2 1 1  17.65 0.7174172 16 16.129143 19.17086
1 1 2 1  23.30 0.7174172 16 21.779143 24.82086
2 1 2 1  21.25 0.7174172 16 19.729143 22.77086
1 2 2 1  29.65 0.7174172 16 28.129143 31.17086
2 2 2 1  29.70 0.7174172 16 28.179143 31.22086
1 1 1 2  22.30 0.7174172 16 20.779143 23.82086
2 1 1 2  21.20 0.7174172 16 19.679143 22.72086
1 2 1 2  29.00 0.7174172 16 27.479143 30.52086
2 2 1 2  26.55 0.7174172 16 25.029143 28.07086
1 1 2 2  31.55 0.7174172 16 30.029143 33.07086
2 1 2 2  28.75 0.7174172 16 27.229143 30.27086
1 2 2 2  38.40 0.7174172 16 36.879143 39.92086
2 2 2 2  34.70 0.7174172 16 33.179143 36.22086

>
> # profile plots (use lsmeans package)
> lsmip(m2, C*D~A*B)

```



```
>
> # fit m3: Additive main effects model plus once cell interaction
> m3<-glm(y~A+B+C+D+all_low,data=onecell)
> summary(m3)
```

Call:
 glm(formula = y ~ A + B + C + D + all_low, data = onecell)

Deviance Residuals:

Min	1Q	Median	3Q	Max
-2.13295	-0.79858	-0.09375	0.76676	2.04205

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	31.3193	0.4666	67.121	< 2e-16	***
A1	1.1580	0.2087	5.549	7.94e-06	***
B1	-3.3108	0.2087	-15.866	6.88e-15	***
C1	-4.6295	0.2087	-22.186	< 2e-16	***
D1	-4.0233	0.2087	-19.280	< 2e-16	***
all_low1	-6.2864	0.4819	-13.045	6.45e-13	***

 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

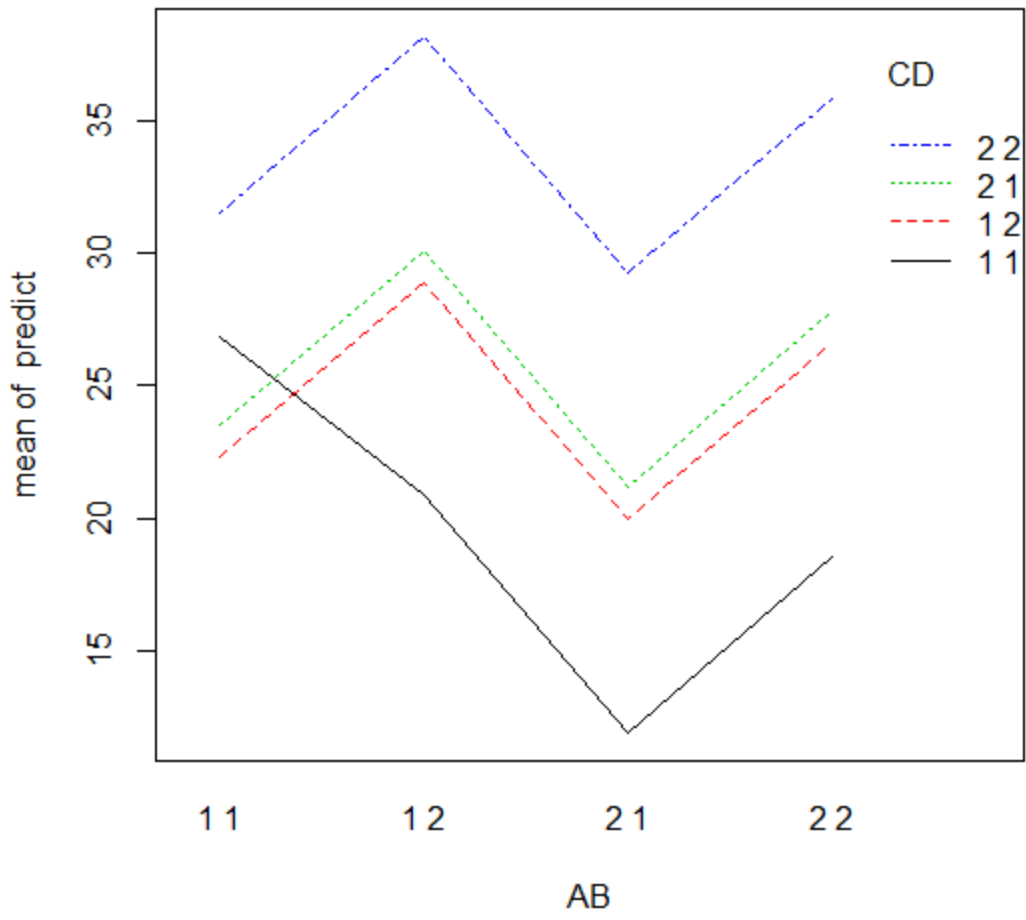
(Dispersion parameter for gaussian family taken to be 1.277316)

Null deviance: 1383.67 on 31 degrees of freedom
Residual deviance: 33.21 on 26 degrees of freedom
AIC: 106

Number of Fisher Scoring iterations: 2

```
>
> # test whether the simpler model fits via F test of nested models
> anova(m2,m3)
Analysis of Variance Table

Model 1: y ~ A * B * C * D
Model 2: y ~ A + B + C + D + all_low
  Res.Df  RSS  Df Sum of Sq    F Pr(>F)
1      16 16.47
2      26 33.21 -10    -16.74 1.6263 0.1861
>
> # add the predicted values from m3 to the original data onecell
> onecell$predict<-fitted(m3)
>
> onecell$AB <- paste(onecell$A,onecell$B)
> onecell$CD <- paste(onecell$C,onecell$D)
>
> # show the data
> head(onecell)
  A B C D    y all_low predict  AB  CD
1 1 1 1 1 26.1      1 26.80000 1 1 1 1
2 1 1 1 1 27.5      1 26.80000 1 1 1 1
3 1 1 1 2 23.5      0 22.27386 1 1 1 2
4 1 1 1 2 21.1      0 22.27386 1 1 1 2
5 1 1 2 1 22.8      0 23.48636 1 1 2 1
6 1 1 2 1 23.8      0 23.48636 1 1 2 1
>
> # interaction plot
> attach(onecell)
> interaction.plot(AB,CD,predict,col = 1:4, lty = 1:4)
```



```
> detach(onecell)
>
>
>
>
```