

Two Factor Experiments with Repeated Measures on One of the Factors

A national retail chain wanted to study the effects of two advertising campaigns (factor A) on the volume of sales of athletic shoes over time (factor B). Ten similar test markets (subjects) were chosen at random to participate in this study. Sales data were collected for three 2-week periods.

```

title1 " ";
options nodate nonumber ls=80 nocenter;
data shoes;
input sales market campaign time @@;
cards;
958 1 1 1      1005 2 1 1      351 3 1 1      549 4 1 1      730 5 1 1
1047 1 1 2      1122 2 1 2      436 3 1 2      632 4 1 2      784 5 1 2
933 1 1 3      986 2 1 3      339 3 1 3      512 4 1 3      707 5 1 3
780 1 2 1      229 2 2 1      883 3 2 1      624 4 2 1      375 5 2 1
897 1 2 2      275 2 2 2      964 3 2 2      695 4 2 2      436 5 2 2
718 1 2 3      202 2 2 3      817 3 2 3      599 4 2 3      351 5 2 3
;

```

```

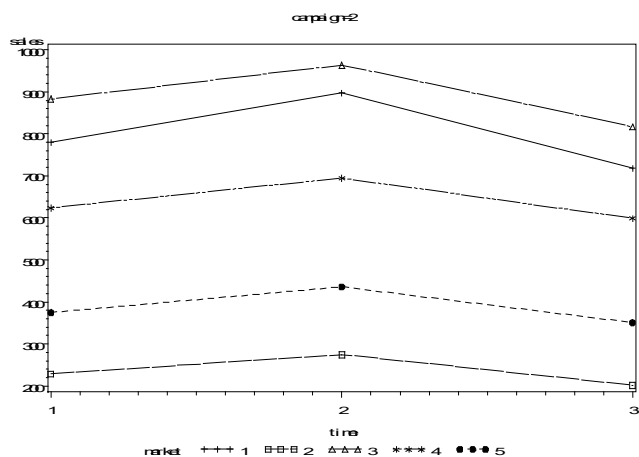
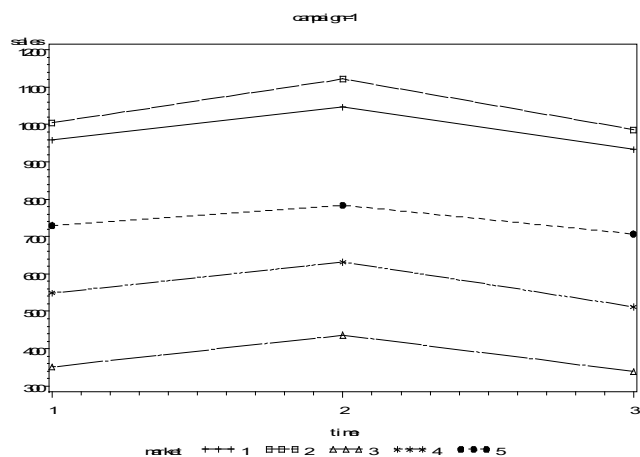
symbol1 i=j line=1 v=plus c=black;
symbol2 i=j line=5 v=square c=black;
symbol3 i=j line=10 v=triangle c=black;
symbol4 i=j line=15 v=star c=black;
symbol5 i=j line=20 v=dot c=black;

```

```

proc gplot;
plot sales*time=market;
by campaign;
run;

```



```
proc glm;
class market campaign time;
model sales = campaign market(campaign) time campaign*time;
random market(campaign) / test;
lsmeans time / pdiff cl adj=tukey alpha=0.01;
run;
```

Tests of Hypotheses for Mixed Model Analysis of Variance

Dependent Variable: sales

Source	DF	Type III SS	Mean Square	F Value	Pr > F
campaign	1	168151	168151	0.73	0.4166
Error	8	1833681	229210		

Error: MS(market(campaign))

Source	DF	Type III SS	Mean Square	F Value	Pr > F
market(campaign)	8	1833681	229210	640.31	<.0001
time	2	67073	33537	93.69	<.0001 ← time effect!!
campaign*time	2	391.466667	195.733333	0.55	0.5892
Error: MS(Error)	16	5727.466667	357.966667		

Adjustment for Multiple Comparisons: Tukey

time	sales LSMEAN	LSMEAN Number
1	648.400000	1
2	728.800000	2
3	616.400000	3

Least Squares Means for Effect time

i	j	Difference Between Means	Simultaneous 99% Confidence Limits for LSMean(i) -LSMean(j)	
1	2	-80.400000	-109.031863	-51.768137
1	3	32.000000	3.368137	60.631863
2	3	112.400000	83.768137	141.031863

... conclude with overall confidence coefficient 0.99 that the two advertising campaigns lead to an immediate increase in mean sales of between 52 and 109, but that mean sales in the following period fall below those for the period preceding the campaign by somewhere between 3 and 61.