Displaying Main Effects and Interactions

Supplement for Section 9.3

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One of the major difficulties in a two-way (or higher-way) ANOVA is how to represent the interactions. One example of how this can be done is shown in figure 9.1 on page 431 and figure 9.6 on page 451 of the text.

To demonstrate another way, consider the "seaweed" example in class that we examined as a one-way ANOVA. If we considered only the limpets and the small fish we could work this out as a two-way factorial design.

```
DATA seaweed2;
INPUT cover L $ f $ @@;
Scov=sqrt(cover);
CARDS;
14 o o      23 o o      22 o o      35 o o      67 o o      82 o o   94 o o   95 o o
34 o o      53 o o      58 o o      75 o o      19 o o      47 o o   53 o o   61 o o
4  L o      4  L o      7  L o      8  L o      28 L o      58 L o   27 L o   35 L o
11 L o      33 L o      16 L o      31 L o      6  L o      8  L o   15 L o   17 L o
11 o f      24 o f      14 o f      31 o f      52 o f      59 o f   83 o f   89 o f
33 o f      34 o f      39 o f      52 o f      43 o f      53 o f   30 o f   37 o f
3  L f      5  L f      3 L f       6  L f      9  L f      31 L f   21 L f   57 L f
5 L f       9  L f      26 L f      43 L f      4  L f      12 L f   12 L f   18 L f
;
```

```
PROC INSIGHT;
OPEN seaweed2;
FIT Scov = L f L*f;
RUN;
```

▲
Note that we needed to include the interaction term.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Stat	Pr > F
Model	3	127.1744	42.3915	13.82	<.0001
Error	60	183.9969	3.0666		
C Total	63	311.1713			

Type III Tests

Source	DF	Sum of Squares	Mean Square	F Stat	Pr > F
L	1	122.6553	122.6553	40.00	<.0001
f	1	4.3116	4.3116	1.41	0.2404
f*L	1	0.2075	0.2075	0.07	0.7956

Parameter Estimates

Variable	L	f	DF	Estimate	Std Error	t Stat	Pr >|t|	Tolerance	Var Inflation
Intercept			1	6.9699	0.4378	15.92	<.0001	.	0
L	L		1	-2.8826	0.6191	-4.66	<.0001	0.5000	2.0000
	o		0	0	.	.	.	.	.
f		f	1	-0.6330	0.6191	-1.02	0.3107	0.5000	2.0000
		o	0	0	.	.	.	.	.
f*L	L	f	1	0.2278	0.8756	0.26	0.7956	0.3333	3.0000
	o	f	0	0	.	.	.	.	.
	L	o	0	0	.	.	.	.	.
	o	o	0	0	.	.	.	.	.

Notice that SAS gave estimates for all of the main effects and interactions even though only the L effect was significant. Because only the L effect appeared significant, that is the only one I really need to report. I could represent this output as:

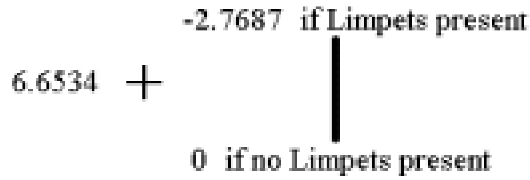
A problem with this is it ignores the fact that these values are going to be too high. (The average of the f and no f levels is -.3165 for example... and we need to take this into account.) One way of taking this into account would be to fit a one way ANOVA with just the L factor, since we know that is the only one that is significant.

```
PROC INSIGHT;
OPEN seaweed2;
FIT Scov = L;
RUN;
```

Parameter Estimates

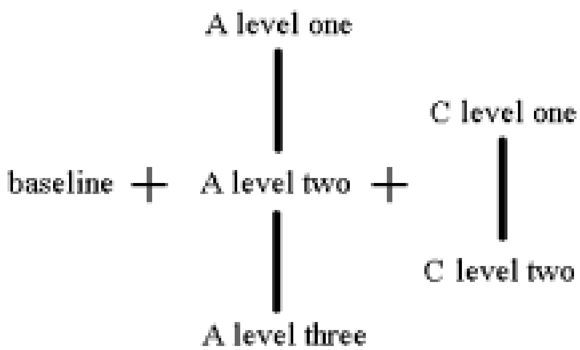
Variable	L	DF	Estimate	Std Error	t Stat	Pr >|t|	Tolerance	Var Inflation
Intercept		1	6.6534	0.3083	21.58	<.0001	.	0
L	L	1	-2.7687	0.4359	-6.35	<.0001	1.0000	1.0000
	o	0	0	.	.	.	.	.

The correct display would thus be:

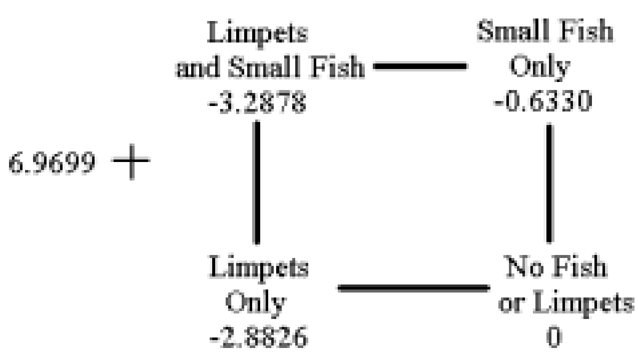


If the f effect had also been significant, but not the interaction, we could have just added the f effect to the model in INSIGHT, gotten the parameter estimates, and added a second "line" for the f effect. We could view each effect as a switch that had two settings. Now, if one of the factors had more than two levels, it would simply work like a switch that had more than three settings.

For example, if there were two significant: factors A (which had three levels), C (which had two levels), and the interaction was not significant, we would get a display like the following.



If there were an interaction, however, then we would have to display the two main effects together in a matrix to show that you can't change them independently. That is, if there is an interaction then you can't just choose to change one factor level and see what affect that has... you have to take into account what the other effect is. For the Limpets and Small Fish example, if the interaction effect was significant, we could make the following display:



Can you tell how I got those numbers? (Limpets and Small Fish = -2.8826 - 0.6330 + 0.2278)

If there we had a third factor that didn't interact with either of the first two, we could then just add a "line" for that factor. If there was a third factor that did interact with the first two then we would need to construct a three dimensional display, or use some other trick to present the result.