Figure 1.25b

TESTS OF SIGNIFICANCE FOR RESP USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG. OF F
WITHIN CELLS	41.58993	18	2.31055		
CONSTANT	13455.99443	1	13455.99443	5823.71557	0.0
ERROR 1	10.72164	6	1.78694		
METHOD	651.95062	1	651.95062	364.84200	0.0
METHOD BY GROUP	1.18721	2	.59361	.33219	.730
ERROR 2	39.25829	6	6.54305		
GROUP	16.05166	2	8.02583	1.22662	.358

1.26 Confounding Designs

In some factorial designs it may not be possible to apply all factor combinations in every block. Two methods can be used to handle this problem. The first one is the BIB designs discussed in Section 1.21. Another method for circumventing this difficulty is to reduce the size of a block by sacrificing the estimation of certain higher-order interactions. Consider a $2 \times 2 \times 2$ factorial experiment, with factors A, B, and C. Let abc denote the experimental unit with all three factors at the high level (since each factor has two levels, one is low and one is high), ab denote the unit where A and B are at the high level and c is at the low level. Thus if a letter appears, that factor is at the high level; otherwise, it is at the low level. When all factors appear at the low level it is designated by (1). Suppose we arrange the $2 \times 2 \times 2$ factorial in two blocks as in Table 1.26a.

Table 1.26a

Block	
1	2
abc	ab
a	ac
b	bc
c	(1)

The effect of A is estimated by comparing the observations receiving high and low levels of A, i.e.,

abc + a + ab + ac − b − c − bc − (1)

and so on.

Note that the ABC interaction is estimated from the comparison

abc + a + b + c − ab − ac − bc − (1)

which is the same as the difference between blocks 1 and 2. Hence we cannot distinguish between the block effects and the ABC interaction. The ABC interaction is said to be *confounded* with the block effect.

If this experiment were replicated four times, the layout might be as shown in Table 1.26b.

Table 1.26b

Replication 1 Block		Replication 2 Block		Replication 3 Block		Replication 4 Block	
1	2	1	2	1	2	1	2
abc	ab	abc	(1)	bc	b	c	ab
a	ac	b	bc	ac	a	b	ac
b	bc	a	ac	ab	c	abc	(1)
c	(1)	c	ab	(1)	abc	a	bc

Since the confounded effect (ABC) is the same for all four replications, ABC is *completely* confounded with blocks. The MANOVA specifications needed for this example are

```
MANOVA      Y BY REPLIC(1,4), BLOCK(1,2), A, B, C(1,2)/
            DESIGN=REPLIC,BLOCK W REPLIC, A, B, C, A BY B, A BY C, B BY C/
```