Figure 1.27b

TESTS OF SIGNIFICANCE FOR RESP USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG. OF F
RESIDUAL	13.40499	54	.24824		
CONSTANT	14697.66168	1	14697.66168	59207.32736	0.0
BLOCK	9.41435	3	3.13812	12.64143	0.0
MIX	145.71785	2	72.85893	293.50127	0.0
LAB BY MIX	.33926	4	.08482	.34167	.849
TEM BY MIX	43.68696	4	10.92174	43.99659	0.0
LAB BY TEM BY MIX	1.07740	8	.13467	.54252	.819
ERROR 1	16.10982	6	2.68497		
LAB	40.66356	2	20.33178	7.57244	.023
ERROR 2	9.88335	18	.54907		
TEM	3119.50650	2	1559.75325	2840.69330	0.0
LAB BY TEM	4.93650	4	1.23412	2.24764	.104

1.28 Analysis of Carry-over Effects

If different treatments are applied in sequence to the same unit, residual or carry-over effects may be present in the experiment. By including dummy factors, MANOVA enables the user to perform an analysis of variance with residual effects.

The following example is taken from Cochran and Cox (1957, p. 133). The experiment compares three feeding methods (A, B, and C) on the milk yield of dairy cows. The experiment consists of two 3 × 3 Latin squares. The rows of the squares represent the successive periods of application, while the columns represent the cows. The data are as follows:

	Square 1			Square 2		
	Cow 1	Cow 2	Cow 3	Cow 4	Cow 5	Cow 6
Period 1	A(38)	B(109)	C(124)	A(86)	B(75)	C(101)
Period 2	B(25)	C(86)	A(72)	C(76)	A(35)	B(63)
Period 3	C(15)	A(39)	B(27)	B(46)	C(34)	A(1)

In addition to the direct (treatment) effects τ_a, τ_b and τ_c, the treatments also contain the residual effects r_a, r_b, and r_c for the period immediately following the one in which they are applied. Thus for cow 2 in the third period, the expected total treatment effect is $\tau_a + r_c$, since A is applied in this period and C in the preceding period. Similarly, the expected total treatment effect is $\tau_a + r_b$ for cow 2 in the second period.

If we let CEFFECT be the (dummy) factor of residual effects and assign

CEFFECT = 1 if no residual effects
2 if r_a is the residual effect
3 if r_b is the residual effect
4 if r_c is the residual effect

then the values of CEFFECT in this example would be

	Square 1			Square 2		
	Cow 1	Cow 2	Cow 3	Cow 4	Cow 5	Cow 6
Period 1	1	1	1	1	1	1
Period 2	2	3	4	2	3	4
Period 3	3	4	2	4	2	3

If the effects of CEFFECT are divided into groups using the following contrasts:

```
( 1   1   1   1 )
( 3  -1  -1  -1 )
( 0   2  -1  -1 )
( 0   0   1  -1 )
```

and the pooled effect of second and third contrasts is CEFFECT(2), then CEFFECT(2) can be used to obtain a test of $r_a = r_b = r_c$. Since the second contrast (0, 2, -1, -1) specifies a test on $r_a = (r_b + r_c)/2$, and the third contrast (0, 0, 1, -1) a test of $r_b = r_c$, jointly they test the hypothesis $r_a = r_b = r_c$.

The above can be done by using the following MANOVA specifications.

```
CONTRAST(CEFFECT)=SPECIAL(1 1 1 1, 3 -1 -1 -1,
                          0 2 -1 -1,0 0 1 -1)/
PARTITION (CEFFECT)=(1,2)/
```