$R \times C \times S$ INTERACTION

$$\sum^{R}\sum^{C}\sum^{N} X^2_{rcs} - \frac{1}{N}\sum^{R}\sum^{C} T^2_{rc.} - \frac{1}{C}\sum^{R}\sum^{N} T^2_{r.s} - \frac{1}{R}\sum^{C}\sum^{N} T^2_{.cs} + \frac{1}{CN}\sum^{R} T^2_{r..}$$

$$+ \frac{1}{RN}\sum^{C} T^2_{.c.} + \frac{1}{RC}\sum^{N} T^2_{..s} - \frac{T^2}{RCN} = 1{,}360.00 - 1{,}242.67$$

$$- 1{,}180.00 - 1{,}272.00 + 1{,}107.22 + 1{,}190.50$$

$$+ 1{,}115.33 - 1{,}067.11 = 11.27$$

TOTAL

$$\sum^{R}\sum^{C}\sum^{N} X^2_{rcs} - \frac{T^2}{RCN} = 1{,}360.00 - 1{,}067.11 = 292.89$$

The analysis-of-variance table for these data is given in Table 19.3. As indicated in Section 19.5 the appropriate error term for testing row effects is s_{rs}^2, for column effects s_{cs}^2, and for $R \times C$ interaction s^2_{rcs}. The F ratios are as follows:

$$F_r = \frac{s_r^2}{s_{rs}^2} = \frac{40.11}{4.91} = 8.17 \qquad p < .05$$

$$F_c = \frac{s_c^2}{s_{cs}^2} = \frac{61.70}{3.33} = 18.53 \qquad p < .01$$

$$F_{rc} = \frac{s_{rc}^2}{s^2_{rcs}} = \frac{6.03}{1.13} = 5.34 \qquad p < .05$$

In this illustrative example the column effects are significant at better than the .01 level, whereas row effects and $R \times C$ interaction fall between the .05 and .01 levels of significance.

Table 19.3

Analysis-of-variance table for illustrative examples of two-factor experiment with repeated measures

Source of variation	Sum of squares	Degrees of freedom	Variance estimate
Rows	40.11	1	$40.11 = s_r^2$
Columns	123.39	2	$61.70 = s_c^2$
Subjects	48.22	5	$9.64 = s_s^2$
$R \times C$	12.06	2	$6.03 = s_{rc}^2$
$R \times S$	24.56	5	$4.91 = s_{rs}^2$
$C \times S$	33.28	10	$3.33 = s_{cs}^2$
$R \times C \times S$	11.27	10	$1.13 = s^2_{rcs}$
Total	292.89	35	