Figure 1.47a

```
RUN NAME        UNIVARIATE ANALYSIS OF REPEATED MEASURES DESIGN.
COMMENT         DATA ARE TAKEN FROM WINER(1971) PAGE 546.
VARIABLE LIST   NOISE SUBJECT PERIOD DIAL Y
INPUT FORMAT    FIXED(4F1.0,1X,F2.0)
N OF CASES      54
INPUT MEDIUM    CARD
MANOVA          Y BY NOISE(1,2) SUBJECT(1,3) PERIOD DIAL(1,3)/
                DESIGN=NOISE VS 1, SUBJECT W NOISE=1, PERIOD VS 2,
                       DIAL VS 3, PERIOD BY SUBJECT W NOISE=2,
                       DIAL BY SUBJECT W NOISE=3, NOISE BY PERIOD VS 2,
                       NOISE BY DIAL VS 3, PERIOD BY DIAL VS 4,
                       PERIOD BY DIAL BY SUBJECT W NOISE=4,
                       NOISE BY PERIOD BY DIAL VS 4/
READ INPUT DATA
1111 45
1112 53
1113 60
1121 40
1122 52
 ...  .
 ...  .
 ...  .
2322 39
2323 57
2331 31
2332 29
2333 46
FINISH
```

Figure 1.47b

TESTS OF SIGNIFICANCE FOR Y USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG. OF F
RESIDUAL	0.0	0			
CONSTANT	105868.16667	1	105868.16667	.	.
ERROR 1	2491.11111	4	622.77778		
NOISE	468.16667	1	468.16667	.75174	.435
ERROR 2	234.88889	8	29.36111		
PERIOD	3722.33333	2	1861.16667	63.38884	.000
NOISE BY PERIOD	333.00000	2	166.50000	5.67077	.029
ERROR 3	105.55556	8	13.19444		
DIAL	2370.33333	2	1185.16667	89.82316	0.0
NOISE BY DIAL	50.33333	2	25.16667	1.90737	.210
ERROR 4	127.11111	16	7.94444		
PERIOD BY DIAL	10.66667	4	2.66667	.33566	.850
NOISE BY PERIOD BY DIAL	11.33333	4	2.83333	.35664	.836

The mixed-model analysis requires that the variances of the dependent variable be equal for all factor combinations, and that the correlations of the dependent variable at different combinations of within-subjects factors be equal. The MANOVA procedure provides a test, discussed in the next section, for this assumption of compound symmetry.

If compound symmetry appears to be violated, the multivariate approach can be used. In general, the univariate approach is somewhat more powerful, especially for small sample sizes. Note that in the MANOVA procedure, the univariate results can be obtained from the multivariate analysis output. This is important since the multivariate specifications are much simpler than the univariate mixed- model approach just outlined.

1.48 Trend Analysis

Since both PERIOD and DIAL are statistically significant, one may wish to investigate the growth trends for PERIOD and DIAL. If a trend analysis for PERIOD is desired, this effect can be partitioned into a linear effect, PERIOD(1), and a quadratic effect, PERIOD(2), by using the following specifications.

```
CONTRAST(PERIOD)=POLYNOMIAL/
PARTITION(PERIOD)/
```

Equally spaced PERIOD levels are assumed here; for the use of CONTRAST and PARTITION subcommands when levels are unequally spaced, see Sections 1.88 and 1.89.

As shown in Table 1.47, the test for a PERIOD effect used the PERIOD × (subject within NOISE) error term. For the orthogonal polynomial components of PERIOD, we can either use this error term to test for PERIOD(1) and PERIOD(2) effects or decompose PERIOD × (subject