1.29 Tukey's Test for Nonadditivity

In factorial designs with only one observation per cell there is no within-cell error and thus no direct estimate of the experimental error. Frequently, the highest-order interaction is assumed to be part of the experimental error and its mean square is used to provide a denominator for *F* tests on the remaining model terms. One method of checking the tenability of this no- interaction assumption is provided by Tukey's test for nonadditivity (Tukey(1949)).

SPSS-MANOVA can perform Tukey's test by using the fact that Tukey's sum of squares for nonadditivity is the linear × linear component of interaction in the metric of the estimates of the main effects (see Winer(1971) page 395). Tukey's test requires two separate runs:

1. The first run obtains main effect parameter estimates using an additive main effects model.
2. The second run uses the parameter estimates from the first run as the metric in polynomial contrasts for the factors; the design specifies a linear × linear single-degree-of-freedom interaction term which actually provides the sum of squares for Tukey's test.

To illustrate this procedure consider the data in Table 1.29 taken from Winer(1971), page 474. These data comprise a 3 × 4 factorial with one observation per cell.

Table 1.29

		B			
		1	2	3	4
A	1	8	12	16	20
	2	2	2	14	18
	3	5	4	9	22

First, estimates of main effects are computed by using the following MANOVA specifications.

```
MANOVA          Y BY A(1,3) B(1,4)/
                PRINT=PARAMETERS(NEGSUM)/
                DESIGN= A, B/
```

The PRINT=PARAMETERS(NEGSUM) results in the printing of the estimate of the last main effect as the negative sum of the previous estimates. The default deviation contrast must be used to get these estimates. Figure 1.29a displays the estimates.

Figure 1.29a

ESTIMATES FOR Y

CONSTANT

PARAMETER	COEFF.	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
1	11.0000000000	.84984	12.94366	.000	8.92054	13.07946

A

PARAMETER	COEFF.	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
2	3.0000000000	1.20185	2.49615	.047	.05919	5.94081
3	-2.0000000000	1.20185	-1.66410	.147	-4.94081	.94081
4	-1.0000000000	.	.	.	.	.

B

PARAMETER	COEFF.	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
4	-6.0000000000	1.47196	-4.07620	.007	-9.60174	-2.39826
5	-5.0000000000	1.47196	-3.39683	.015	-8.60174	-1.39826
6	2.0000000000	1.47196	1.35873	.223	-1.60174	5.60174
7	9.0000000000	.	.	.	.	.

In the second run, orthogonal polynomial contrasts for each factor are requested. The metric for each factor consists of the parameter estimates for that factor's categories produced by the initial run:

```
CONTRAST(A)=POLYNOMIAL(3 -2 -1)/
CONTRAST(B)=POLYNOMIAL(-6 -5 2 9)/
```