Figure 1.9

TESTS OF SIGNIFICANCE FOR Y USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG. OF F
WITHIN CELLS	106.00000	12	8.83333		
CONSTANT	882.00000	1	882.00000	99.84906	0.0
CAT	18.00000	1	18.00000	2.03774	.179
DRUG(1)	36.00000	1	36.00000	4.07547	.066
DRUG(2)	12.00000	1	12.00000	1.35849	.266
CAT BY DRUG(1)	144.00000	1	144.00000	16.30189	.002
CAT BY DRUG(2)	0.0	1	0.0	0.0	1.000

The above discussion of orthogonal contrasts assumes that the cell frequencies are equal. For the use of the orthogonal contrasts in unbalanced designs, see Section 1.16.

1.10 Designs with Unequal Cell Frequencies

In many experiments, it may not be possible to have equal numbers of observations for each cell. Such designs are termed *unbalanced* or *nonorthogonal.* In nonorthogonal designs the effects are correlated with each other and cannot be estimated independently of one another. That is, the component sum of squares will not add up to the total sum of squares because the main effects will usually not be independent of each other and the interaction effects will not be independent of the main effects. Different ANOVA solutions can be obtained for the same design depending on the "type" of sum of squares calculated. For example, in an unbalanced design with two factors A and B, the sum of squares for main effect A differs depending on whether effect A is the only one in the model or whether it is added to a model already containing effect B.

1.11 Sequential Sums of Squares (Fitting Constants)

Sequential sums of squares are the default type calculated by MANOVA. The sums of squares for each effect are "adjusted" for all effects previously entered into the model. That is, the sum of squares for an effect is adjusted only for all terms to the left of it in the DESIGN subcommand. All terms to the right are ignored. Therefore the order in which terms are specified on the DESIGN subcommand, or the MANOVA command if a DESIGN subcommand is not present, is important. Different orders may produce different results. For the two-factor design specified using

```
DESIGN=A,B/
```

the B main effect is adjusted for A and the overall mean, while A is adjusted only for the mean. If the model is specified as

```
DESIGN=B,A/
```

the A main effect is adjusted for B and the mean, while the B effect is adjusted only for the mean.

Since several DESIGN subcommands can be used in one invocation of the MANOVA procedure, it is possible to obtain easily various sums of squares. For example, in a two-factor model, to obtain the main effect sum of squares adjusted for other main effects and the interaction effect adjusted for main effects, specify both

```
DESIGN=A,B,A BY B/
DESIGN=B,A, A BY B/
```

The first ANOVA table will contain B adjusted for A, and A BY B adjusted for both main effects. The second ANOVA table will contain A adjusted for B and the interaction adjusted for both main effects.

1.12 Regression Model Sum of Squares (Weighted Squares of Means)

It is possible to obtain sums of squares adjusted for all effects listed on the DESIGN subcommand, by specifying

```
METHOD=SSTYPE(UNIQUE)/
```

For the two-factor model this results in main effect A being adjusted for both B and the A BY B interaction. Similarly B is adjusted for A and the interaction, while the interaction is adjusted for main effects A and B.

1.13 Decomposition and Bias Matrices

If the design is unbalanced and the default sequential sums of squares are used, the decomposition and bias matrices may be of interest. They are obtained by specifying

```
PRINT=DESIGN(DECOMP,BIAS)/
```