bacilli at these sites before the experiment began. Variate Y is a similar score after several months of treatment. Drugs 1 and 2 are antibiotics, while drug 3 is an inert drug included as a control. Ten patients were selected for each treatment. The MANOVA commands are as follows:

```
MANOVA          Y BY DRUG(1,3) WITH X/
                PRINT= PMEANS/
```

Inclusion of covariates in a model is indicated by the keyword WITH on the MANOVA command. The PRINT = PMEANS (see Section 1.50) specification requests the predicted and adjusted (for covariate) means of treatments.

The output includes the analysis of covariance summary table shown in Figure 1.17a, which gives the sum of squares due to regression (adjusted for the factor DRUG), and the sum of squares due to DRUG adjusted for regression.

Figure 1.17a

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	417.20260	26	16.04625		
REGRESSION	577.89740	1	577.89740	36.01447	0.0
CONSTANT	31.92864	1	31.92864	1.98979	.170
DRUG	68.55371	2	34.27686	2.13613	.138

In addition, the estimated regression coefficient (B), the standardized regression coefficient (BETA), the standard error of the regression coefficient and the t-value of the test that $\beta = 0$ are also given (Figure 1.17b). Note that $(6.00121)^2 = 36.014$, which is the F value for the regression in the ANOVA table.

Figure 1.17b

REGRESSION ANALYSIS FOR WITHIN CELLS ERROR TERM

DEPENDENT VARIABLE ..Y

COVARIATE	B	BETA	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
X	.9871838111	.7620649867	.16450	6.00121	.000	.64905	1.32531

The adjusted and predicted means for the factor DRUG are shown in Figure 1.17c.

Figure 1.17c

ADJUSTED AND ESTIMATED MEANS

VARIABLE .. Y

FACTOR	CODE	OBS. MEAN	ADJ. MEAN	EST. MEAN	RAW RESID.	STD. RESID.
DRUG	1	5.30000	6.71496	5.30000	0.0	0.0
DRUG	2	6.10000	6.82393	6.10000	0.0	0.0
DRUG	3	12.30000	10.16110	12.30000	0.0	0.0

Since MANOVA allows the inclusion of interval-scaled variables in the DESIGN specification, the analysis of covariance can also be obtained using the following MANOVA commands:

```
MANOVA          Y,X, BY DRUG(1,3)/
                ANALYSIS = Y/
                DESIGN = X, DRUG/
                DESIGN = DRUG,X/
```

The ANALYSIS subcommand is used to select Y as the dependent variable. The first DESIGN subcommand produces the DRUG effects adjusted for the covariate (X). The output is given in Figure 1.17d.

Figure 1.17d

TESTS OF SIGNIFICANCE FOR Y USING SEQUENTIAL SUMS OF SQUARES

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIG. OF F
WITHIN+RESIDUAL	417.20260	26	16.04625		
CONSTANT	1872.30000	1	1872.30000	116.68144	0.0
X	802.94369	1	802.94369	50.03932	0.0
DRUG	68.55371	2	34.27686	2.13613	.138