MANOVA also prints multivariate significance tests of the hypothesis that the regression coefficients are zero, under the heading EFFECT..WITHIN CELLS REGRESSION. (WITHIN CELLS indicates that the within-cells error matrix was used in the model.) These tests for the dental calculus data of Figure 1.37a are shown in Figure 1.37c. (See Section 1.38 for a more detailed discussion of regression analysis.)

Figure 1.37c

EFFECT .. WITHIN CELLS REGRESSION

MULTIVARIATE TESTS OF SIGNIFICANCE (S = 1, M = 1/2, N = 47 1/2)

TEST NAME	VALUE	APPROX. F	HYPOTH. DF	ERROR DF	SIG. OF F
PILLAIS	.72613	85.72625	3.00	97.00	0.0
HOTELLINGS	2.65133	85.72625	3.00	97.00	0.0
WILKS	.27387	85.72625	3.00	97.00	0.0
ROYS	.72613				

EIGENVALUES AND CANONICAL CORRELATIONS

ROOT NO.	EIGENVALUE	PCT.	CUM. PCT.	CANON. COR.	SQUARED COR.
1	2.65133	100.00000	100.00000	.85213	.72613

DIMENSION REDUCTION ANALYSIS

ROOTS	WILKS LAMBDA	F	HYPOTH. DF	ERROR DF	SIG. OF F
1 TO 1	.27387	85.72625	3.00	97.00	0.0

UNIVARIATE F-TESTS WITH (1,99) D. F.

VARIABLE	SQ. MUL. R	MUL. R	ADJ. R-SQ.	HYPOTH MS	ERROR MS	F	SIG. OF F
RCAN	.13468	.36699	.07350	18.57190	1.20529	15.40872	.000
RLI	.41804	.64656	.37689	109.47447	1.53939	71.11537	.000
RCI	.70832	.84162	.68770	300.31570	1.24914	240.41814	0.0

The estimated parameters for the regression of each response variable on the covariate are also listed, together with standard errors, t-values, and confidence intervals. For Figure 1.37a, the results in Figure 1.37d were obtained.

Figure 1.37d

REGRESSION ANALYSIS FOR WITHIN CELLS ERROR TERM

DEPENDENT VARIABLE ..RCAN

COVARIATE	B	BETA	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
LCI	.1731949251	.3669895761	.04412	3.92539	.000	.08565	.26074

DEPENDENT VARIABLE ..RLI

COVARIATE	B	BETA	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
LCI	.4204974555	.6465616861	.04986	8.43299	0.0	.32156	.51944

DEPENDENT VARIABLE ..RCI

COVARIATE	B	BETA	STD. ERR.	T-VALUE	SIG. OF T	LOWER .95 CL	UPPER .95 CL
LCI	.6964596479	.8416200881	.04492	15.50542	0.0	.60733	.78559

1.38 MULTIVARIATE MULTIPLE LINEAR REGRESSION

1.39 The Multivariate Linear Regression Model

The univariate regression model

$$Y_i = \beta_0 + \beta_1 X_{i1} + \ldots + \beta_p X_{ip} + \epsilon_i$$

expresses the *i*th observation of the dependent variable Y as a linear function of p independent variables X_i and the error term ϵ_i.