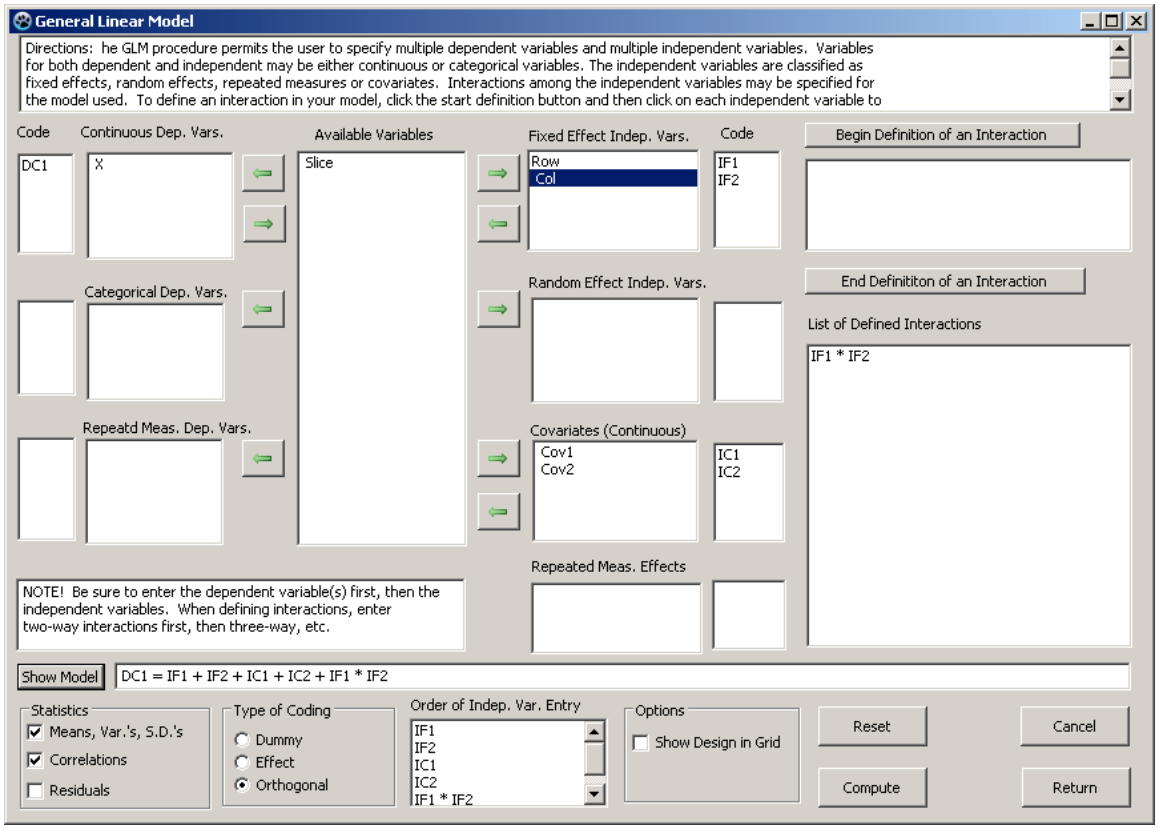
The General Linear Model

Introduction

A variety of statistical analyses involve the use of linear models in which one or more dependent variables are hypothesized to be related to one or more independent variables. Analyses included are various Analysis of Variance models, multiple regression models, discriminant analysis, and others. Dependent and independent variables can be continuous or discrete. In some cases, the solution to these complex models requires the use of the maximum liklihood methods rather than methods involving the traditional "least-squares" method. This procedure is limited to the use of these later methods that are based on a set of partial differential equations.

To demonstrate this procedure, we will use the Anova2.LAZ file to complete an analysis of covariance. The dependent variable x is a continuous variable, row and col are two discrete independent variables and cov1 and cov2 are two covariates. We have entered these variables in their appropriate positions on the form shown below. We have also elected to show the correlation matrix. To obtain the interaction of the row and col variables, we clicked the "Start Interaction" button and clicked row and then col previously selected and shown in the fixed factors list. After the two variables of the interaction are shown we clicked the "End Interaction" button. This results in the interaction defined being shown in the list below. One can define multiple interaction terms in this manner to construct the linear model to be analyzed. You can examine the model to be analyzed by clicking the "Show Model" button. When you are using discrete variables like row and col, you can elect the method (dummy, effect, or orthogonal) for generating vectors to represent the levels of those factors.

When you click the Compute button, you will receive a fairly large amount of output. Each independent variable is entered in a "stepwise" fashion with the results of each step shown. Following that, each variable is eliminated from the "full" model to assess it's unique contribution to the model. Finally, you will receive a summary of both analyses (full model contributions and unique contributions) and a summary table of effects.



Not all output will be shown below. For example, only the first variable entered is shown as

Means with 36 valid cases.

Variables	DC1	IF1_1
	4.083	0.000

Correlations with 36 cases.

Variables	DC1	IF1_1
DC1	1.000	-0.302
IF1_1	-0.302	1.000

R	R2	F	PROB>F	DF1	DF2
0.302	0.091	3.400	0.074	1	34

Std. Error of Estimate = 1.898

VARIABLE	BETA	B	STD.ERR.	T	PROB>T
IF1_1	-0.302	-0.583	0.316	-1.844	0.074
CONSTANT		4.083			

Increment in Squared R = 0.091

F with degrees freedom 1 and 34 = 3.400, Prob.>F = 0.074

After entry of the predictor (independent variables) the results of eliminating each one from the full model is done as shown in this output:

R	R2	F	PROB>F	DF1	DF2
0.643	0.414	4.240	0.005	5	30

Adjusted R Squared = 0.316
Std. Error of Estimate = 1.622

Variable	Beta	B	Std.Error	T	Prob>t
IF2_1	-0.592	-1.146	0.293	-3.904	0.000
IC1	0.088	0.103	0.167	0.614	0.544
IC2	-0.048	-0.058	0.181	-0.319	0.752
IA1_1	0.315	0.610	0.274	2.224	0.034
Constant		3.905			

Decrement in Squared R = 0.096
F with degrees freedom 1 and 30 = 5.896, Prob.>F = 0.021

The incremental and unique effects of the independent variables are shown as below:

Summary Table for GLM Effects

Incremental Effects.

SOURCE	DF1	DF2	SS	MS	F	PROB>F
IF1	1	34	12.250	12.250	3.400	0.074
IF2	1	33	42.250	42.250	17.374	0.000
IC1	1	32	0.003	0.003	0.001	0.975
IC2	1	31	1.839	1.839	0.727	0.400
IF1*IF2	1	30	12.421	12.421	5.647	0.024

Unique Effects.

SOURCE	DF1	DF2	SS	MS	F	PROB>F
IF1	1	30	12.969	12.969	5.896	0.021
IF2	1	30	42.697	42.697	19.411	0.000
IC1	1	30	0.347	0.347	0.158	0.694
IC2	1	30	1.583	1.583	0.719	0.403
IF1*IF2	1	30	12.421	12.421	5.647	0.024

The summary table is then produced:

SOURCE	DF	SS	MS	F	PROB>F
FULL MODEL	5	68.762	13.752	6.252	0.000
IF1	1	12.250	12.250	5.569	0.025
IF2	1	42.250	42.250	19.208	0.000
IC1	1	0.003	0.003	0.001	0.973
IC2	1	1.839	1.839	0.836	0.368
IF1 * IF2	1	12.421	12.421	5.647	0.024
Residual	30	65.988	2.200		
Total	35	134.750			