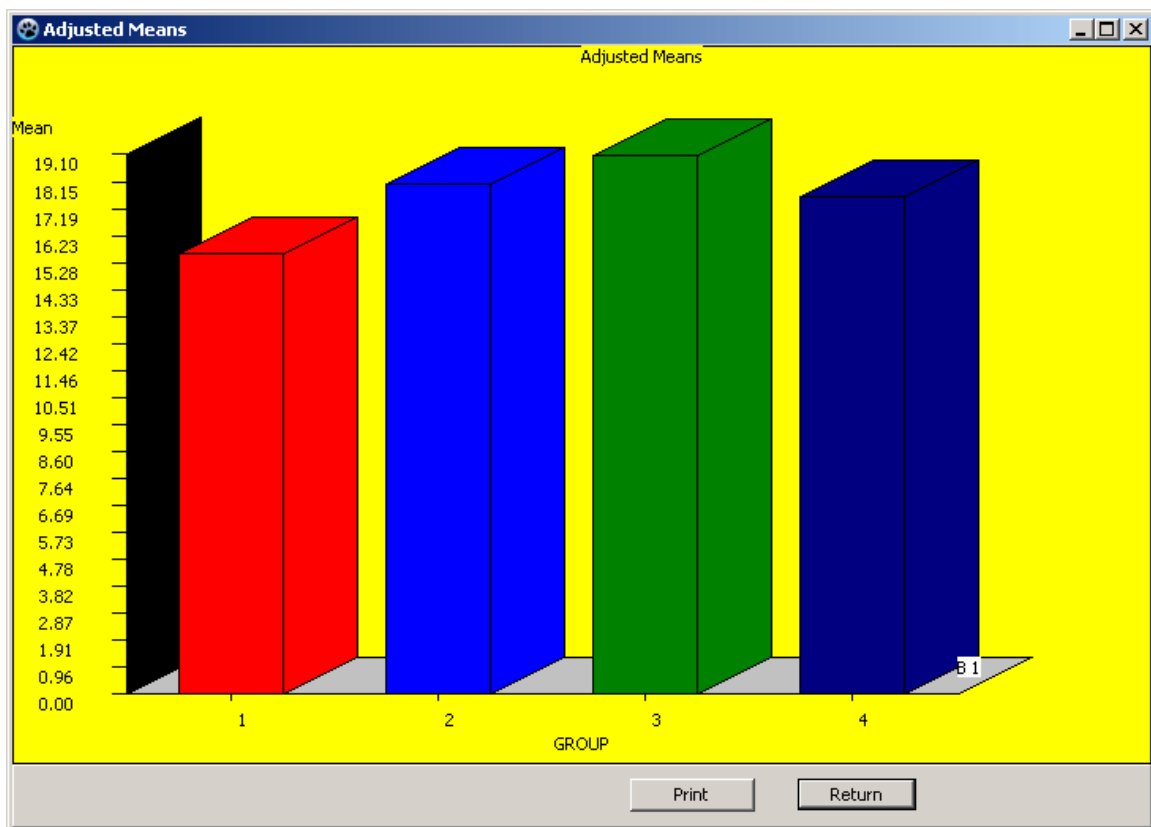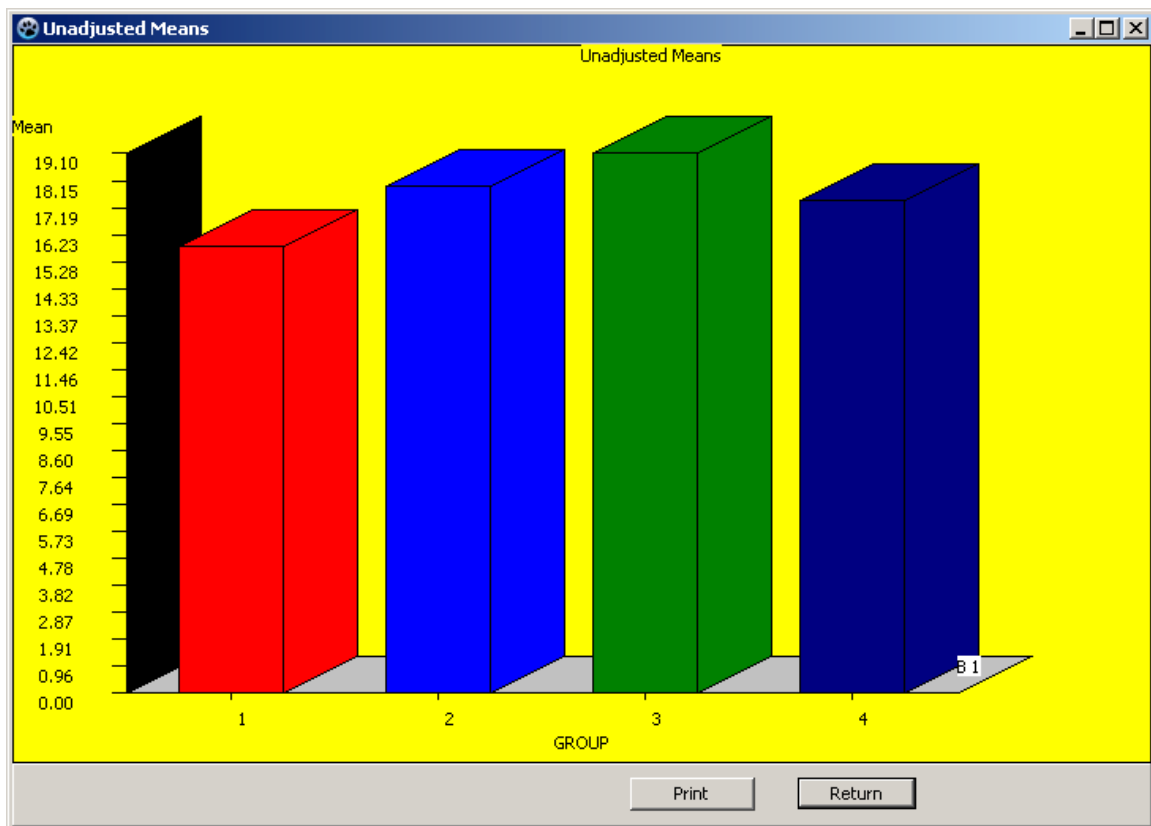# Analysis of Covariance by Multiple Regression

All of the analysis of variance designs may be considered as different problems in multiple regression. The model of each ANOVA is actually a multiple regression model. In some cases, it is easier to specify the analysis as a multiple regression equation to do the analysis than to "partition" variance into separate components as is done for many of the more simple designs. This procedure demonstrates the use of multiple regression to obtain an analysis of covariance. We will use the file labeled ANCOVA.LAZ. When you choose this analysis option, you see the form below:

Clicking the compute button yields the results displayed next. Examine your grid data following the output results. You will see that additional variables have been created that reflect the contributions of each level of each treatment variable using effect coding as well as interactions among these level variables.

Unadjusted Means

Mean

19.10	
18.15	
17.19	
16.23	
15.28	
14.33	
13.37	
12.42	
11.46	
10.51	
9.55	
8.60	
7.64	
6.69	
5.73	
4.78	
3.82	
2.87	
1.91	
0.96	
0.00	

GROUP   1   2   3   4

Print   Return

Adjusted Means

Mean

19.10	
18.15	
17.19	
16.23	
15.28	
14.33	
13.37	
12.42	
11.46	
10.51	
9.55	
8.60	
7.64	
6.69	
5.73	
4.78	
3.82	
2.87	
1.91	
0.96	
0.00	

GROUP   1   2   3   4

Print   Return

ANALYSIS OF COVARIANCE USING MULTIPLE REGRESSION

File Analyzed: C:\lazarus\Projects\LazStats\ANCOVA.LAZ

Model for Testing Assumption of Zero Interactions with Covariates

MEANS with   40 valid cases.

Variables	X	Z	A1	A2	A3
	7.125	14.675	0.000	0.000	0.000

Variables	XxA1	XxA2	XxA3	ZxA1	ZxA2
	0.125	0.025	0.075	-0.400	-0.125

Variables	ZxA3	Y
	-0.200	17.550

VARIANCES with   40 valid cases.

Variables	X	Z	A1	A2	A3
	4.163	13.866	0.513	0.513	0.513

Variables	XxA1	XxA2	XxA3	ZxA1	ZxA2
	28.010	27.102	27.712	116.759	125.035

Variables	ZxA3	Y
	124.113	8.254

STD. DEV.S with   40 valid cases.

Variables	X	Z	A1	A2	A3
	2.040	3.724	0.716	0.716	0.716

Variables	XxA1	XxA2	XxA3	ZxA1	ZxA2
	5.292	5.206	5.264	10.806	11.182

Variables	ZxA3	Y
	11.141	2.873

Analysis of Variance for the Model to Test Regression Homogeneity

SOURCE	Deg.F.	SS	MS	F	Prob>F
Explained	11	228.08	20.73	6.188	0.0000
Error	28	93.82	3.35		
Total	39	321.90			

R Squared =   0.709

Model for Analysis of Covariance

MEANS with   40 valid cases.

Variables	X	Z	A1	A2	A3
	7.125	14.675	0.000	0.000	0.000

Variables   Y
      17.550

VARIANCES with 40 valid cases.

Variables	X	Z	A1	A2	A3
	4.163	13.866	0.513	0.513	0.513

Variables	Y
	8.254

STD. DEV.S with 40 valid cases.

Variables	X	Z	A1	A2	A3
	2.040	3.724	0.716	0.716	0.716

Variables	Y
	2.873

Test for Homogeneity of Group Regression Coefficients
Change in $R2 = 0.0192$. $F = 0.308$ Prob.$> F = 0.9275$ with d.f. 6 and 28

R Squared = 0.689

Analysis of Variance for the ANCOVA Model

SOURCE	Deg.F.	SS	MS	F	Prob>F
Explained	5	221.89	44.38	15.087	0.0000
Error	34	100.01	2.94		
Total	39	321.90			

Unadjusted Group Means for Group Variables Group
Means with 40 valid cases.

Variables			
15.800	17.900	19.100	17.400

Intercepts for Each Group Regression Equation for Variable: Group
Inercepts with 40 valid cases.

Variables	Group 1	Group 2	Group 3	Group 4
	8.076	10.505	11.528	10.076

Adjusted Group Means for Group Variables Group
Means with 40 valid cases.

Variables	Group 1	Group 2	Group 3	Group 4
	15.580	18.008	19.032	17.579

Test for Each Source of Variance - Type III SS

SOURCE	Deg.F.	SS	MS	F	Prob>F
Cov0	1	78.70	78.70	26.754	0.0000
Cov1	1	0.66	0.66	0.225	0.6379
A	3	60.98	20.33	6.911	0.0009
ERROR	34	100.01	2.94		