

```

data one;
input id Y group X;
I1=0;I2=0;I3=0;if group=1 then I1=1;if group=2 then I2=1;if group=3 then I3=1;
IINT1=I1*X;IINT2=I2*X;IINT3=I3*X;
*****;
if group=1 then C1=-1;if group=2 then C1=0;if group=3 then C1=1;
if group=1 then C2=-1;if group=2 then C2=2;if group=3 then C2=-1;
CINT1=C1*X;CINT2=C2*X;
cards;
1 10 1 12
2 11 1 11
3 12 1 13
4 13 1 12
5 14 1 13
6 15 1 12
7 10 1 12
8 11 1 11
9 12 1 13
10 13 1 12
11 14 1 13
12 15 1 12
13 12 2 16
14 13 2 14
15 14 2 17
16 15 2 16
17 16 2 12
18 17 2 14
19 12 2 15
20 13 2 14
21 14 2 16
22 15 2 16
23 16 2 15
24 17 2 14
25 16 3 12
26 17 3 13
27 18 3 15
28 19 3 15
29 20 3 14
30 21 3 17
31 16 3 12
32 17 3 13
33 18 3 14
34 19 3 15
35 20 3 13
36 21 3 17
;

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proc sort data=one;by group;
proc corr data=one;var y x;by group;run;
proc reg data=one;
model y = X ;by group;run;
proc glm data=one;class group;
model y = group ;
means group;run;
proc glm data=one;class group;
model y = group X ;
means group;lsmeans group;run;
proc glm data=one;class group;
model y = group x group*x / solution ;
means group;
lsmeans group / adjust=Sidak tdiff; lsmeans group / adjust=Tukey tdiff;run;
proc reg data=one;
model y = C1 C2 X CINT1 CINT2;
CONMAIN: test C1=0, C2=0;
CONINT: test CINT1=0, CINT2=0;run;
proc reg data=one;
model y = I2 I3 X IINT2 IINT3;
DUMMAIN: test I2=0, I3=0;
DUMINT: test IINT2=0, IINT3=0;run;
proc reg data=one;
model y = I1 I2 I3 IINT1 IINT2 IINT3 /noint ;
CELLMAIN: test I1-I2=0, I2-I3=0;
CELLINT: test IINT1-IINT2=0, IINT2-IINT3=0;run;

```

----- group=1 -----  
 The CORR Procedure

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Y	12	12.50000	1.78377	150.00000	10.00000	15.00000
X	12	12.16667	0.71774	146.00000	11.00000	13.00000

Pearson Correlation Coefficients, N = 12  
 Prob > |r| under H0: Rho=0

	Y	X
Y	1.00000	0.35504
X		0.2574

----- group=2 -----  
 The CORR Procedure

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Y	12	14.50000	1.78377	174.00000	12.00000	17.00000
X	12	14.91667	1.37895	179.00000	12.00000	17.00000

Pearson Correlation Coefficients, N = 12  
 Prob > |r| under H0: Rho=0

	Y	X
Y	1.00000	-0.35111
X		0.2631

----- group=3 -----  
 The CORR Procedure

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum
Y	12	18.50000	1.78377	222.00000	16.00000	21.00000
X	12	14.16667	1.69670	170.00000	12.00000	17.00000

Pearson Correlation Coefficients, N = 12  
 Prob > |r| under H0: Rho=0

	Y	X
Y	1.00000	0.81101
X		0.0014

----- group=1 -----

The REG Procedure  
Model: MODEL1  
Dependent Variable: Y

Number of Observations Read 12  
Number of Observations Used 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	4.41176	4.41176	1.44	0.2574
Error	10	30.58824	3.05882		
Corrected Total	11	35.00000			

Root MSE	1.74895	R-Square	0.1261
Dependent Mean	12.50000	Adj R-Sq	0.0387
Coeff Var	13.99159		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	1.76471	8.95317	0.20	0.8477
X	1	0.88235	0.73471	1.20	0.2574

----- group=2 -----

The REG Procedure  
Model: MODEL1  
Dependent Variable: Y

Number of Observations Read 12  
Number of Observations Used 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	4.31474	4.31474	1.41	0.2631
Error	10	30.68526	3.06853		
Corrected Total	11	35.00000			

Root MSE	1.75172	R-Square	0.1233
Dependent Mean	14.50000	Adj R-Sq	0.0356
Coeff Var	12.08083		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	21.27490	5.73568	3.71	0.0040
X	1	-0.45418	0.38302	-1.19	0.2631

----- group=3 -----

The REG Procedure  
Model: MODEL1  
Dependent Variable: Y

Number of Observations Read 12  
Number of Observations Used 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	23.02105	23.02105	19.22	0.0014
Error	10	11.97895	1.19789		
Corrected Total	11	35.00000			

Root MSE	1.09448	R-Square	0.6577
Dependent Mean	18.50000	Adj R-Sq	0.6235
Coeff Var	5.91613		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	6.42105	2.77340	2.32	0.0431
X	1	0.85263	0.19449	4.38	0.0014

The GLM Procedure  
 Class Level Information  
 Class            Levels    Values  
 group            3        1 2 3

Number of Observations Read            36  
 Number of Observations Used           36

Dependent Variable: Y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	224.0000000	112.0000000	35.20	<.0001
Error	33	105.0000000	3.1818182		
Corrected Total	35	329.0000000			

R-Square            0.680851  
 Coeff Var           11.76109  
 Root MSE           1.783765  
 Y Mean              15.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
group	2	224.0000000	112.0000000	35.20	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
group	2	224.0000000	112.0000000	35.20	<.0001

Level of group	N	Mean	Std Dev
1	12	12.5000000	1.78376517
2	12	14.5000000	1.78376517
3	12	18.5000000	1.78376517

The GLM Procedure  
 Class Level Information  
 Class            Levels    Values  
 group            3        1 2 3

Number of Observations Read            36  
 Number of Observations Used           36

Dependent Variable: Y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	232.6909871	77.5636624	25.77	<.0001
Error	32	96.3090129	3.0096567		
Corrected Total	35	329.0000000			

R-Square            0.707267  
 Coeff Var           11.43848  
 Root MSE            1.734836  
 Y Mean               15.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
group	2	224.0000000	112.0000000	37.21	<.0001
X	1	8.6909871	8.6909871	2.89	0.0990

Source	DF	Type III SS	Mean Square	F Value	Pr > F
group	2	171.9860691	85.9930345	28.57	<.0001
X	1	8.6909871	8.6909871	2.89	0.0990

Level of group	N	-----Y-----		-----X-----	
		Mean	Std Dev	Mean	Std Dev
1	12	12.5000000	1.78376517	12.1666667	0.71774056
2	12	14.5000000	1.78376517	14.9166667	1.37895437
3	12	18.5000000	1.78376517	14.1666667	1.69669911

Least Squares Means

group	Y LSMEAN
1	13.1115880
2	14.0493562
3	18.3390558

The GLM Procedure  
Class Level Information

Class	Levels	Values
group	3	1 2 3
Number of Observations Read		36
Number of Observations Used		36

Dependent Variable: Y

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	255.7475584	51.1495117	20.95	<.0001
Error	30	73.2524416	2.4417481		
Corrected Total	35	329.0000000			

R-Square 0.777348  
Coeff Var 10.30292  
Root MSE 1.562609  
Y Mean 15.16667

Source	DF	Type I SS	Mean Square	F Value	Pr > F
group	2	224.0000000	112.0000000	45.87	<.0001
X	1	8.6909871	8.6909871	3.56	0.0689
X*group	2	23.0565712	11.5282856	4.72	0.0165

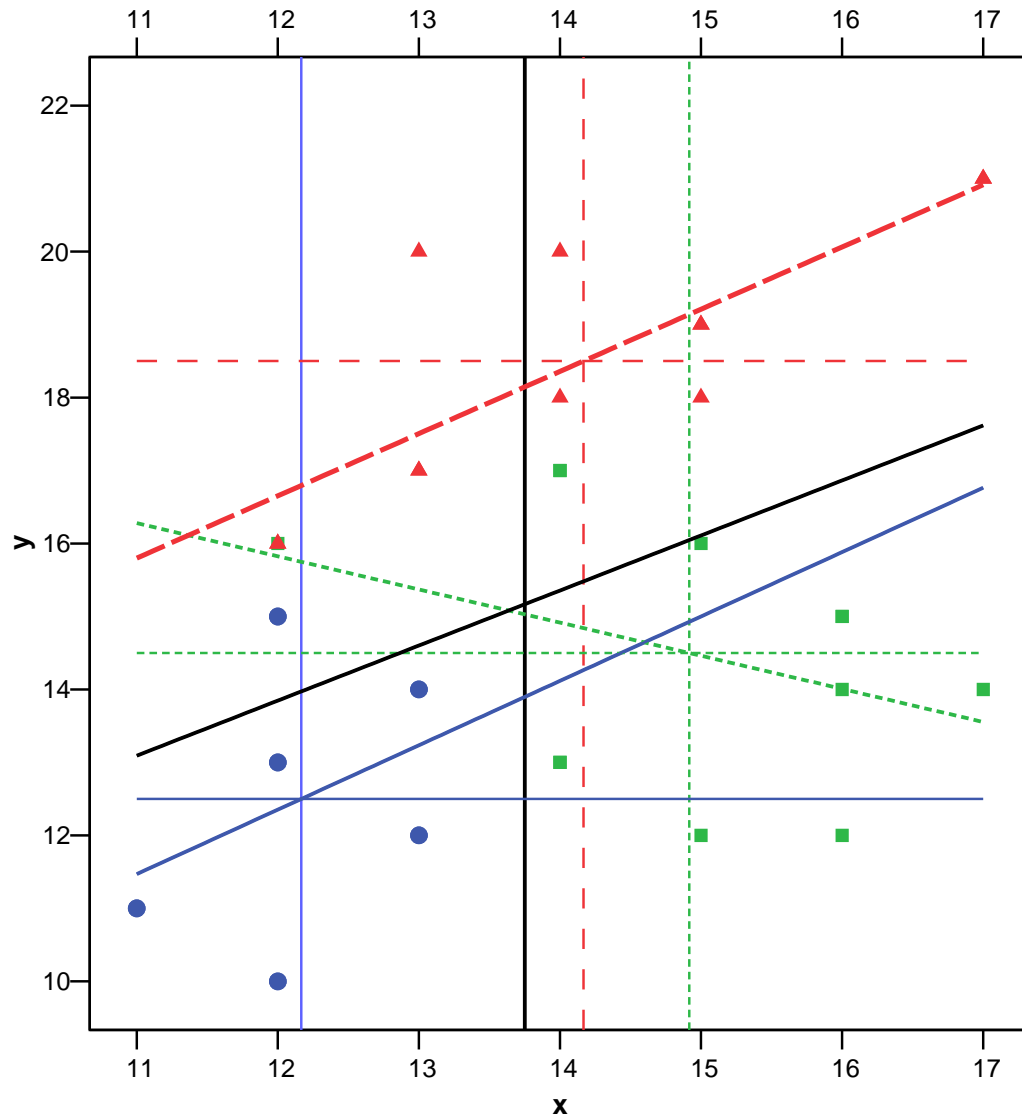
Source	DF	Type III SS	Mean Square	F Value	Pr > F
group	2	16.32723104	8.16361552	3.34	0.0489
X	1	6.41156393	6.41156393	2.63	0.1156
X*group	2	23.05657125	11.52828562	4.72	0.0165

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	6.42105263 B	3.95962028	1.62	0.1153
group 1	-4.65634675 B	8.92562351	-0.52	0.6057
group 2	14.85384777 B	6.46968746	2.30	0.0288
group 3	0.00000000 B	.	.	.
X	0.85263158 B	0.27768297	3.07	0.0045
X*group 1	0.02972136 B	0.71274438	0.04	0.9670
X*group 2	-1.30681485 B	0.44027808	-2.97	0.0058
X*group 3	0.00000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular, and a generalized inverse was used to solve the normal equations. Terms whose estimates are followed by the letter 'B' are not uniquely estimable.

Least Squares Means

Level of group	N	Mean	Std Dev	Mean	Std Dev	Y LSMEAN
1	12	12.5000000	1.78376517	12.1666667	0.71774056	13.8970588
2	12	14.5000000	1.78376517	14.9166667	1.37895437	15.0298805
3	12	18.5000000	1.78376517	14.1666667	1.69669911	18.1447368
Total	36	15.1666667	3.06594194	13.7500000	1.74624920	



group  
 ● 1.00  
 ■ 2.00  
 ▲ 3.00

$$\bar{Y}_{LS(j)} = \beta_{0(j)} + \beta_{1(j)}\bar{X}$$

$$\bar{Y}_{LS(1)} = 1.76471 + 0.88235(13.75) = 13.8970588$$

$$\bar{Y}_{LS(2)} = 21.27490 - 0.45418(13.75) = 15.0298805$$

$$\bar{Y}_{LS(3)} = 6.42105 + 0.85263(13.75) = 18.1447368$$

Sidak

Least Squares Means for effect group

t for H0: LSMean(i)=LSMean(j) / Pr > |t|

i/j	1	2	3
1		-0.88295	-3.46755
		0.7666	0.0048
2	0.882949		-4.0927
	0.7666		0.0009
3	3.467546	4.029701	
	0.0048	0.0009	

Tukey

Least Squares Means for effect group

t for H0: LSMean(i)=LSMean(j) / Pr > |t|

i/j	1	2	3
1		-.88295	-3.46755
		0.6550	0.0045
2	0.882949		-4.0927
	0.6550		0.0008
3	3.467546	4.092701	
	0.0045	0.0008	

The REG Procedure  
 Dependent Variable: Y

Number of Observations Read 36  
 Number of Observations Used 36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	255.74756	51.14951	20.95	<.0001
Error	30	73.25244	2.44175		
Corrected Total	35	329.00000			

Root MSE 1.56261 R-Square 0.7773  
 Dependent Mean 15.16667 Adj R-Sq 0.7402  
 Coeff Var 10.30292

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	9.82022	3.42937	2.86	0.0076
C1	1	2.32817	4.46281	0.52	0.6057
C2	1	5.72734	2.26311	2.53	0.0169
X	1	0.42693	0.26347	1.62	0.1156
CINT1	1	-0.01486	0.35637	-0.04	0.9670
CINT2	1	-0.44056	0.16457	-2.68	0.0119

Test **CONMAIN** Results for Dependent Variable Y

Source	DF	Mean Square	F Value	Pr > F
Numerator	2	8.16362	3.34	0.0489
Denominator	30	2.44175		

Test **CONINT** Results for Dependent Variable Y

Source	DF	Mean Square	F Value	Pr > F
Numerator	2	11.52829	4.72	0.0165
Denominator	30	2.44175		

The REG Procedure  
 Dependent Variable: Y

Number of Observations Read 36  
 Number of Observations Used 36

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	255.74756	51.14951	20.95	<.0001
Error	30	73.25244	2.44175		
Corrected Total	35	329.00000			

Root MSE 1.56261 R-Square 0.7773  
 Dependent Mean 15.16667 Adj R-Sq 0.7402  
 Coeff Var 10.30292

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
Intercept	1	1.76471	7.99926	0.22	0.8269
I2	1	19.51019	9.49560	2.05	0.0487
I3	1	4.65635	8.92562	0.52	0.6057
X	1	0.88235	0.65643	1.34	0.1890
IINT2	1	-1.33654	0.74002	-1.81	0.0809
IINT3	1	-0.02972	0.71274	-0.04	0.9670

Test **DUMMAIN** Results for Dependent Variable Y

Source	DF	Mean Square	F Value	Pr > F
Numerator	2	8.16362	3.34	0.0489
Denominator	30	2.44175		

Test **DUMINT** Results for Dependent Variable Y

Source	DF	Mean Square	F Value	Pr > F
Numerator	2	11.52829	4.72	0.0165
Denominator	30	2.44175		

The REG Procedure  
 Dependent Variable: Y

Number of Observations Read 36  
 Number of Observations Used 36

NOTE: No intercept in model. R-Square is redefined.

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	8536.74756	1422.79126	582.69	<.0001
Error	30	73.25244	2.44175		
Uncorrected Total	36	8610.00000			
Root MSE		1.56261	R-Square	0.9915	
Dependent Mean		15.16667	Adj R-Sq	0.9898	
Coeff Var		10.30292			

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr >  t
I1	1	1.76471	7.99926	0.22	0.8269
I2	1	21.27490	5.11647	4.16	0.0002
I3	1	6.42105	3.95962	1.62	0.1153
IINT1	1	0.88235	0.65643	1.34	0.1890
IINT2	1	-0.45418	0.34167	-1.33	0.1938
IINT3	1	0.85263	0.27768	3.07	0.0045

Test **CELLMAIN** Results for Dependent Variable Y

Source	DF	Mean Square	F Value	Pr > F
Numerator	2	8.16362	3.34	0.0489
Denominator	30	2.44175		

Test **CELLINT** Results for Dependent Variable Y

Source	DF	Mean Square	F Value	Pr > F
Numerator	2	11.52829	4.72	0.0165
Denominator	30	2.44175		