One-way ANOVA με το SPSS

Επιστημονική Επιμέλεια
Δρ. Γεώργιος Μενεξές

Τομέας Φυτών Μεγάλης Καλλιέργειας και Οικολογίας,
Εργαστήριο Γεωργίας

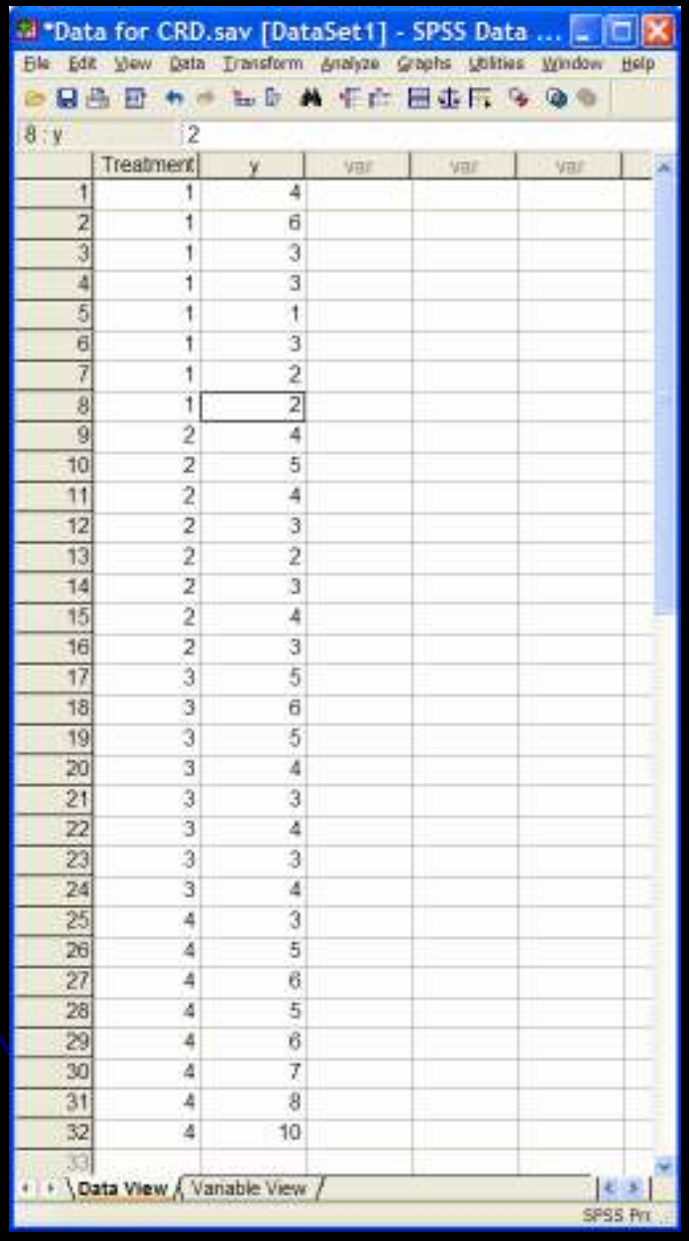
To call in a statistician after the experiment is done may be no more than asking him to perform a post-mortem examination; he may be able to say what the experiment died of.

Sir Ronald Fisher

CRD (fixed effects)

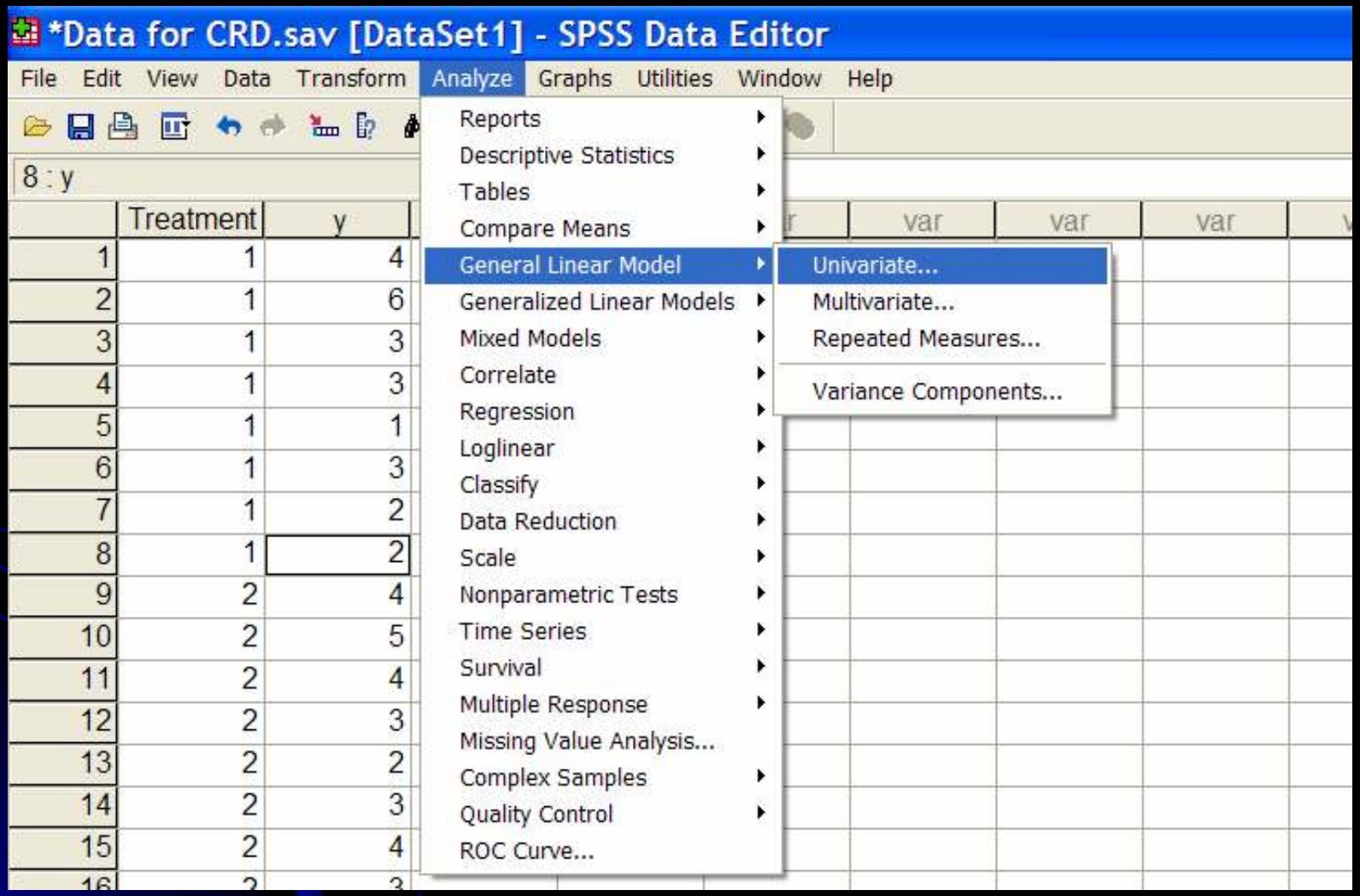
- Σύγκριση 4 επεμβάσεων (Treatments), 8 επαναλήψεις ανά επέμβαση.
- Ανεξάρτητη μεταβλητή (Παράγοντας): Treatment με 4 επίπεδα.
- Εξαρτημένη μεταβλητή: y
- Μέθοδος: One-way ANOVA

Εισαγωγή Δεδομένων

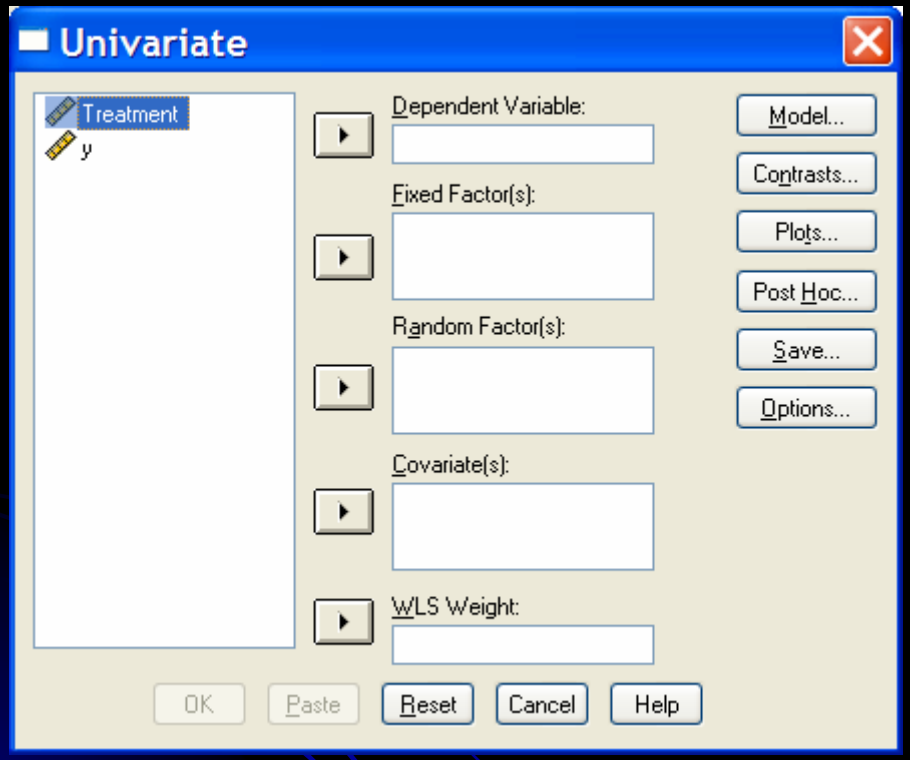


	Treatment	y	var	var	var
1	1	4			
2	1	6			
3	1	3			
4	1	3			
5	1	1			
6	1	3			
7	1	2			
8	1	2			
9	2	4			
10	2	5			
11	2	4			
12	2	3			
13	2	2			
14	2	3			
15	2	4			
16	2	3			
17	3	5			
18	3	6			
19	3	5			
20	3	4			
21	3	3			
22	3	4			
23	3	3			
24	3	4			
25	4	3			
26	4	5			
27	4	6			
28	4	5			
29	4	6			
30	4	7			
31	4	8			
32	4	10			

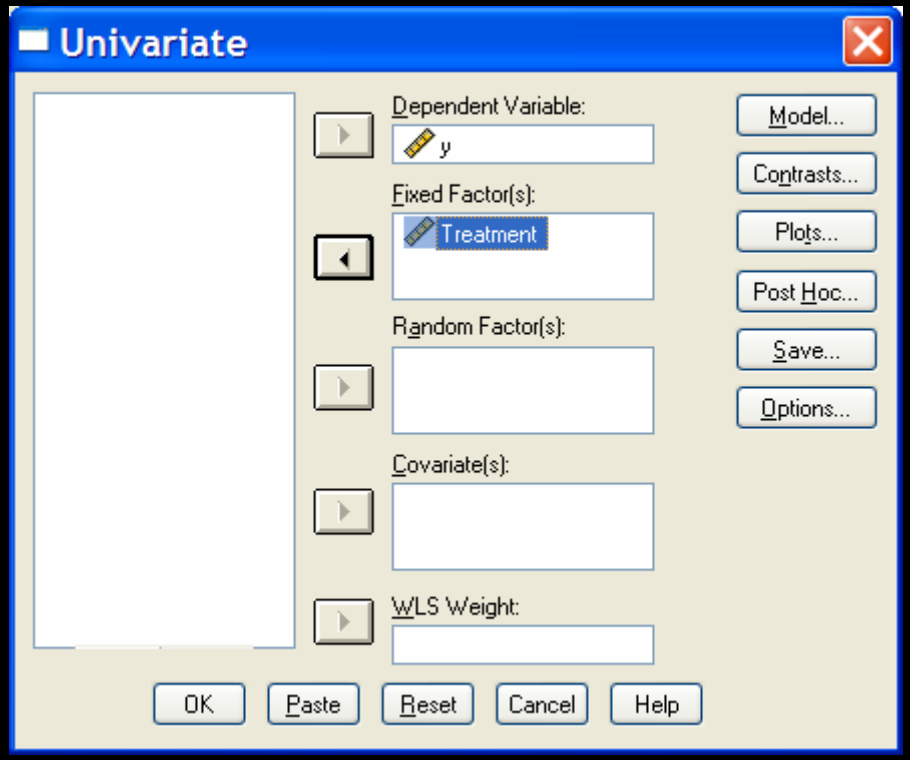
Επιλογή Στατιστικής Διαδικασίας



Εντολές και Ρυθμίσεις (1)

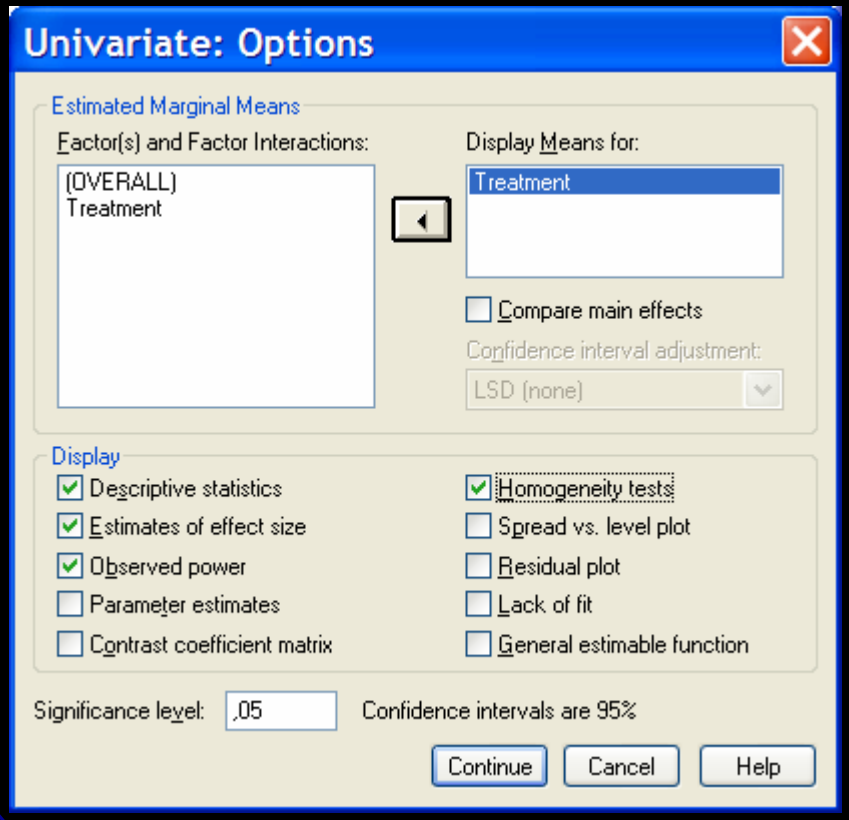


1

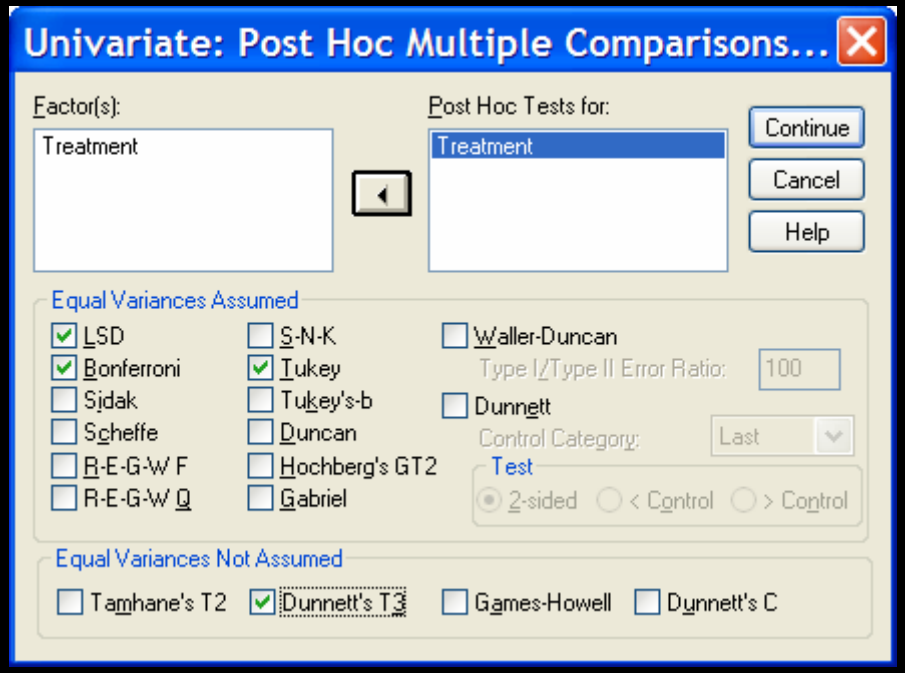


2

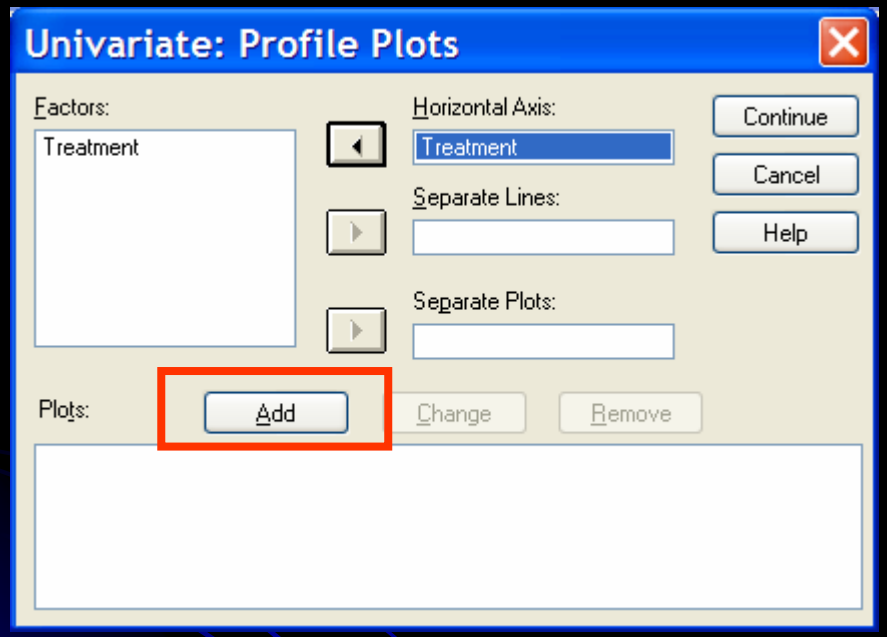
Εντολές και Ρυθμίσεις (2)



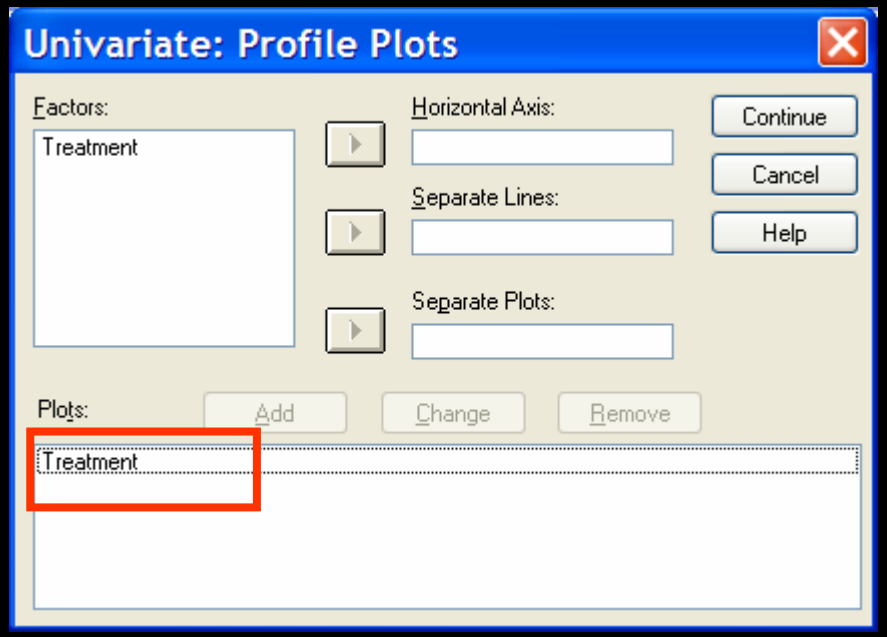
Εντολές και Ρυθμίσεις (3)



Εντολές και Ρυθμίσεις (4)

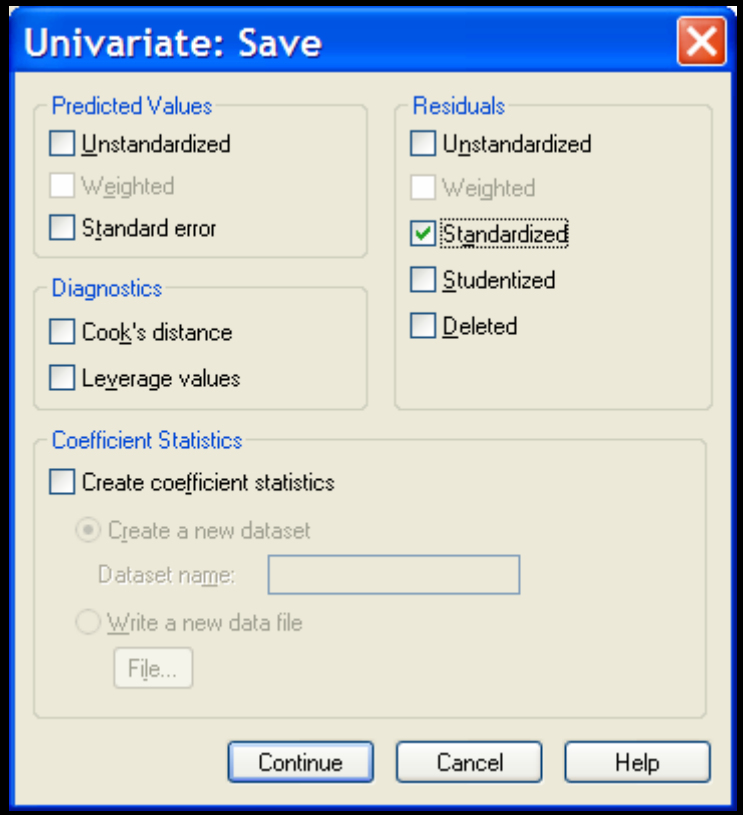


1



2

Εντολές και Ρυθμίσεις (5)



Τυποποιημένα Σφάλματα ή Κατάλοιπα

*Data for CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

8 : y 2

	Treatment	y	ZRE_1	var	var	var	var	var
1	1	4	,68					
2	1	6	2,03					
3	1	3	,00					
4	1	3	,00					
5	1	1	-1,36					
6	1	3	,00					
7	1	2	-,68					
8	1	2	-,68					
9	2	4	,34					
10	2	5	1,02					
11	2	4	,34					
12	2	3	-,34					
13	2	2	-1,02					
14	2	3	-,34					
15	2	4	,34					
16	2	3	-,34					
17	3	5	,51					
18	3	6	1,19					
19	3	5	,51					
20	3	4	-,17					
21	3	3	-,85					
22	3	4	-,17					
23	3	3	-,85					
24	3	4	-,17					

Αποτελέσματα SPSS (1)

Between-Subjects Factors

		N
Treatment	1	8
	2	8
	3	8
	4	8

Descriptive Statistics

Dependent Variable: y

Treatment	Mean	Std. Deviation	N
1	3,00	1,512	8
2	3,50	,926	8
3	4,25	1,035	8
4	6,25	2,121	8
Total	4,25	1,884	32

Levene's Test of Equality of Error Variances[a]

Dependent Variable: y

F	df1	df2	Sig.
1,293	3	28	,296

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept+Treatment

Αποτελέσματα SPSS (2)

Tests of Between-Subjects Effects

Dependent Variable: y

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Corrected Model	49,000[b]	3	16,333	7,497	,001	,445	22,492	,972
Intercept	578,000	1	578,000	265,311	,000	,905	265,311	1,000
Treatment	49,000	3	16,333	7,497	,001	,445	22,492	,972
Error	61,000	28	2,179					
Total	688,000	32						
Corrected Total	110,000	31						

a. Computed using alpha = ,05

b. R Squared = ,445 (Adjusted R Squared = ,386)

Αποτελέσματα SPSS (3)

Multiple Comparisons

Dependent Variable: y

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
LSD	1	2	-,50	,738	,504	-2,01	1,01
		3	-1,25	,738	,101	-2,76	,26
		4	-3,25*	,738	,000	-4,76	-1,74
	2	1	,50	,738	,504	-1,01	2,01
		3	-,75	,738	,318	-2,26	,76
		4	-2,75*	,738	,001	-4,26	-1,24
	3	1	1,25	,738	,101	-,26	2,76
		2	,75	,738	,318	-,76	2,26
		4	-2,00*	,738	,011	-3,51	-,49
	4	1	3,25*	,738	,000	1,74	4,76
		2	2,75*	,738	,001	1,24	4,26
		3	2,00*	,738	,011	,49	3,51
Bonferroni	1	2	-,50	,738	1,000	-2,60	1,60
		3	-1,25	,738	,608	-3,35	,85
		4	-3,25*	,738	,001	-5,35	-1,15
	2	1	,50	,738	1,000	-1,60	2,60
		3	-,75	,738	1,000	-2,85	1,35
		4	-2,75*	,738	,005	-4,85	-,65
	3	1	1,25	,738	,608	-,85	3,35
		2	,75	,738	1,000	-1,35	2,85
		4	-2,00	,738	,068	-4,10	,10
	4	1	3,25*	,738	,001	1,15	5,35
		2	2,75*	,738	,005	,65	4,85
		3	2,00	,738	,068	-,10	4,10

Based on observed means.

*. The mean difference is significant at the ,05 level.

Αποτελέσματα SPSS (4)

Multiple Comparisons

Dependent Variable: y

	(I) Treatment	(J) Treatment	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tukey HSD	1	2	-,50	,738	,905	-2,51	1,51
		3	-1,25	,738	,346	-3,26	,76
		4	-3,25*	,738	,001	-5,26	-1,24
	2	1	,50	,738	,905	-1,51	2,51
		3	-,75	,738	,741	-2,76	1,26
		4	-2,75*	,738	,005	-4,76	-,74
	3	1	1,25	,738	,346	-,76	3,26
		2	,75	,738	,741	-1,26	2,76
		4	-2,00	,738	,052	-4,01	,01
	4	1	3,25*	,738	,001	1,24	5,26
		2	2,75*	,738	,005	,74	4,76
		3	2,00	,738	,052	-,01	4,01
Dunnett T3	1	2	-,50	,627	,956	-2,45	1,45
		3	-1,25	,648	,345	-3,24	,74
		4	-3,25*	,921	,021	-6,08	-,42
	2	1	,50	,627	,956	-1,45	2,45
		3	-,75	,491	,577	-2,24	,74
		4	-2,75*	,818	,041	-5,39	-,11
	3	1	1,25	,648	,345	-,74	3,24
		2	,75	,491	,577	-,74	2,24
		4	-2,00	,835	,179	-4,66	,66
	4	1	3,25*	,921	,021	,42	6,08
		2	2,75*	,818	,041	,11	5,39
		3	2,00	,835	,179	-,66	4,66

Based on observed means.

*. The mean difference is significant at the ,05 level.

Αποτελέσματα SPSS (5)

y

	Treatment	N	Subset 1	Subset 2
Tukey HSD[a,b]	1	8	3,00	
	2	8	3,50	
	3	8	4,25	4,25
	4	8		6,25
	Sig.		,346	,052

Means for groups in homogeneous subsets are displayed.
Based on Type III Sum of Squares
The error term is Mean Square(Error) = 2,179.

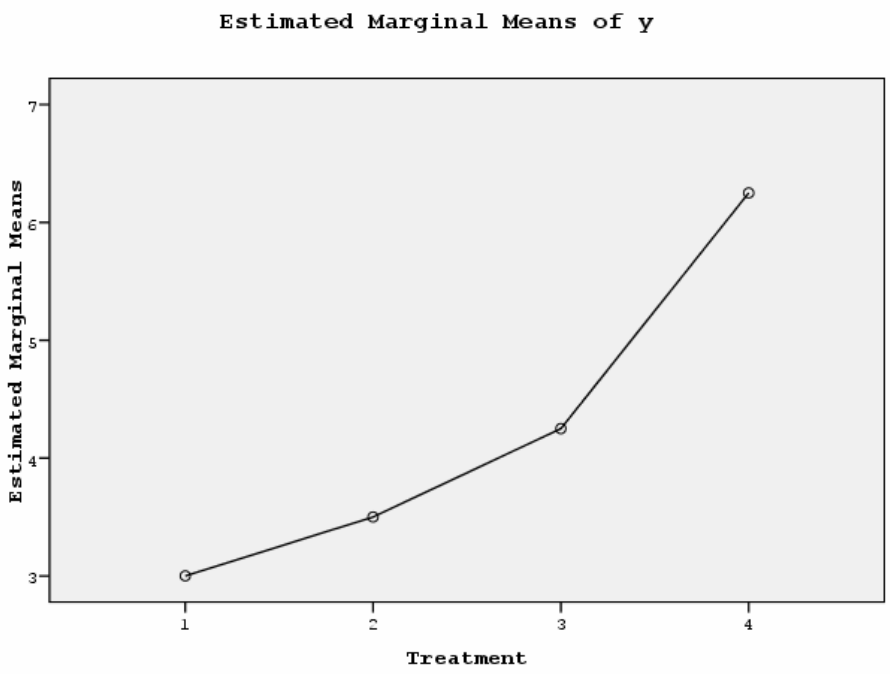
a. Uses Harmonic Mean Sample Size = 8,000.

b. Alpha = ,05.

Treatment

Dependent Variable: y

Treatment	Mean	Std. Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1	3,000	,522	1,931	4,069
2	3,500	,522	2,431	4,569
3	4,250	,522	3,181	5,319
4	6,250	,522	5,181	7,319



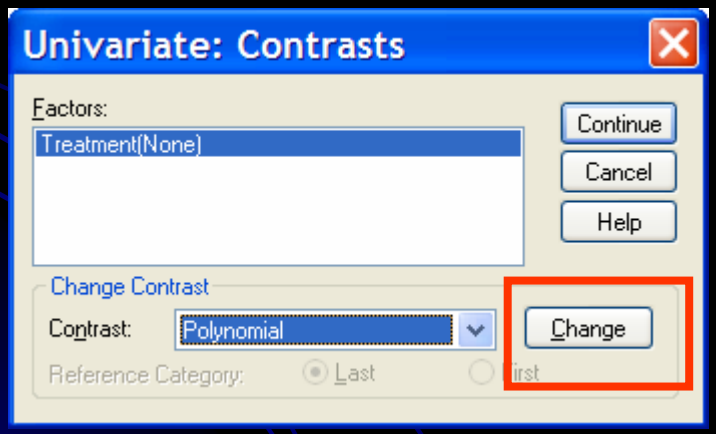
Ειδική Περίπτωση (Α)

- Τα 4 επίπεδα του παράγοντα είναι ποσοτικά, παράδειγμα ποσότητα λιπάσματος, 0, 2, 4 και 6.

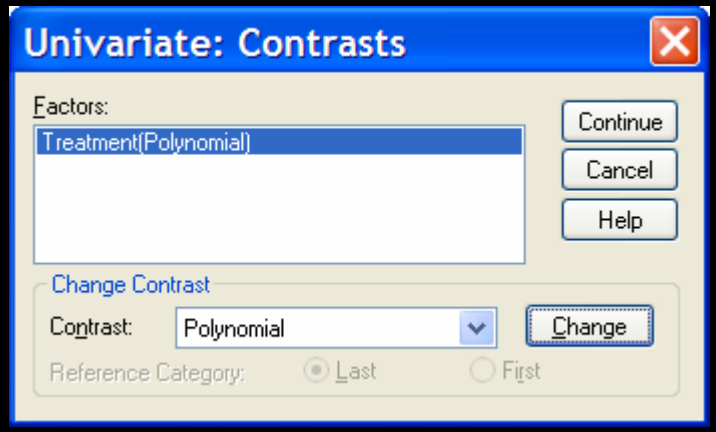
Εντολές και Ρυθμίσεις (1)

1

2



3



Αποτελέσματα SPSS (1)

Contrast Results (K Matrix)

Treatment Polynomial Contrast[a]			Dependent Variable y
Linear	Contrast Estimate		2,348
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		2,348
	Std. Error		,522
	Sig.		,000
	95% Confidence Interval for Difference	Lower Bound	1,279
		Upper Bound	3,417
Quadratic	Contrast Estimate		,750
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		,750
	Std. Error		,522
	Sig.		,162
	95% Confidence Interval for Difference	Lower Bound	-,319
		Upper Bound	1,819
Cubic	Contrast Estimate		,224
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		,224
	Std. Error		,522
	Sig.		,672
	95% Confidence Interval for Difference	Lower Bound	-,845
		Upper Bound	1,293

a. Metric = 1,000, 2,000, 3,000, 4,000

Αποτελέσματα SPSS (2)

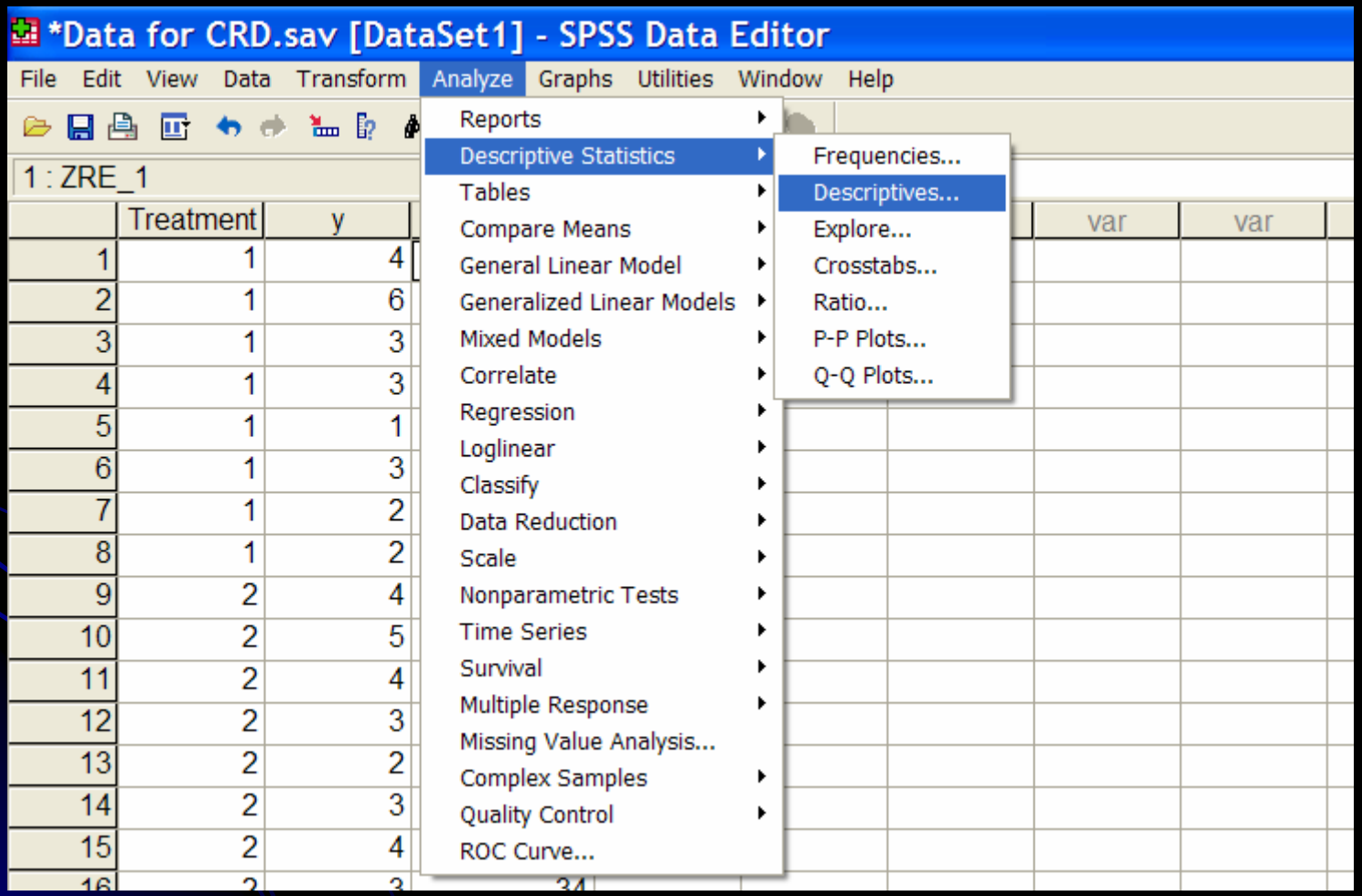
Test Results

Dependent Variable: y

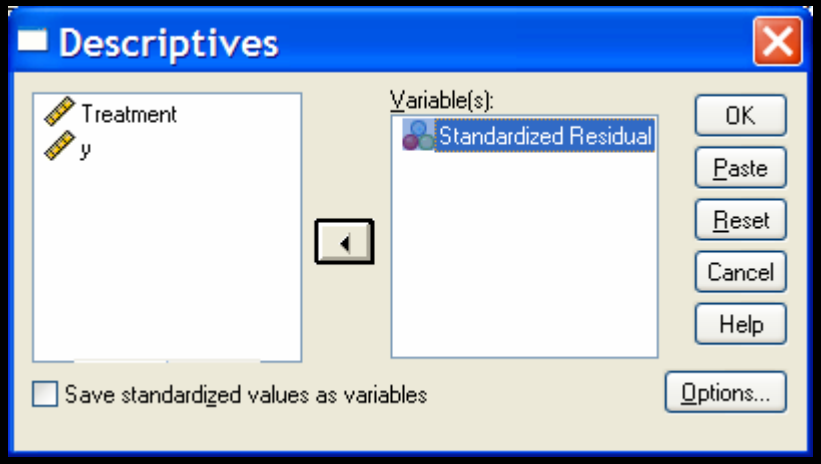
Source	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	49,000	3	16,333	7,497	,001	,445	22,492	,972
Error	61,000	28	2,179					

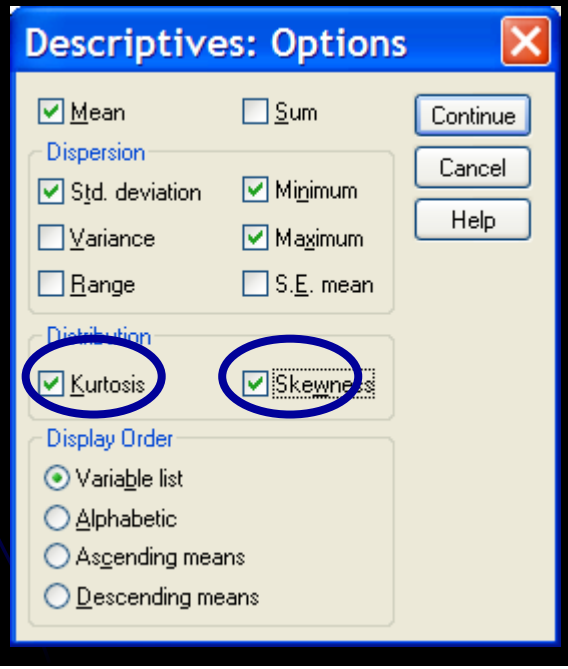
a. Computed using alpha = ,05

Έλεγχος Κανονικότητας Σφαλμάτων (Μ1)



Εντολές και Ρυθμίσεις



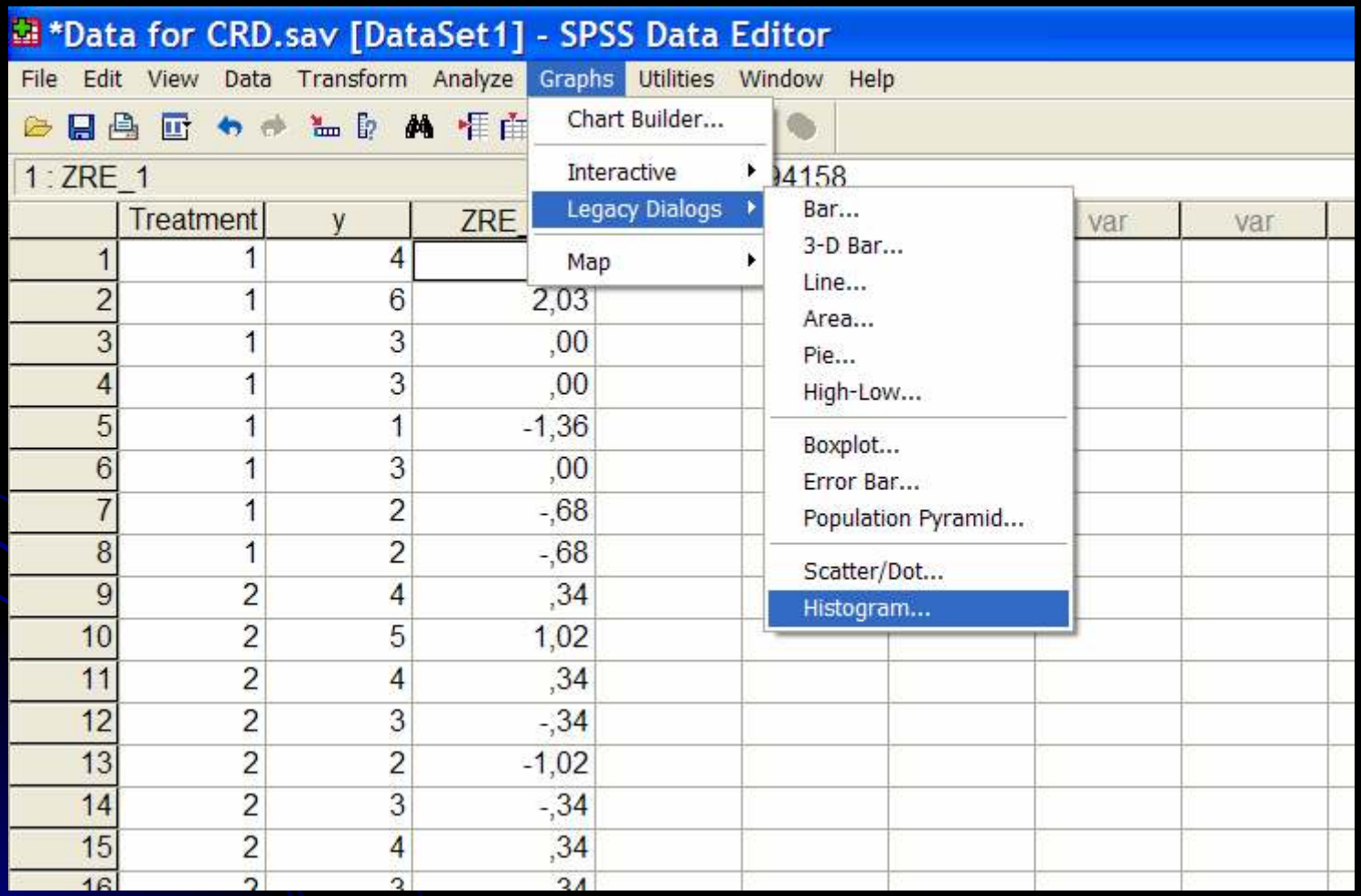


Αποτελέσματα SPSS

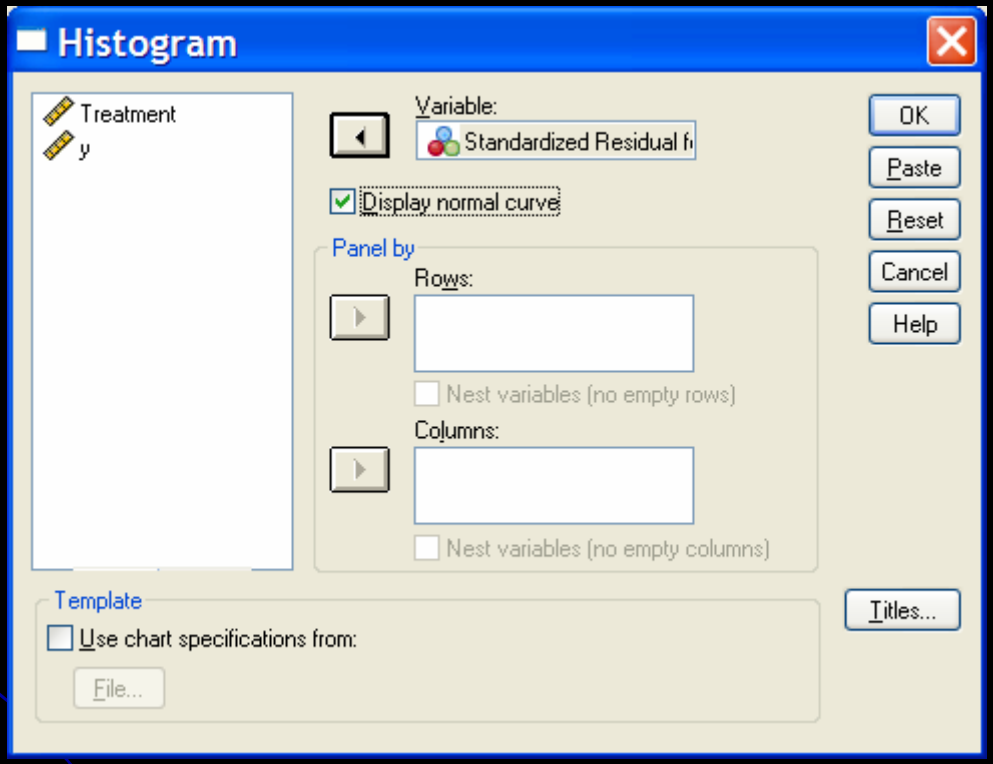
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Standardized Residual for y	32	-2,20	2,54	,0000	,95038	,505	,414	1,230	,809
Valid N (listwise)	32								

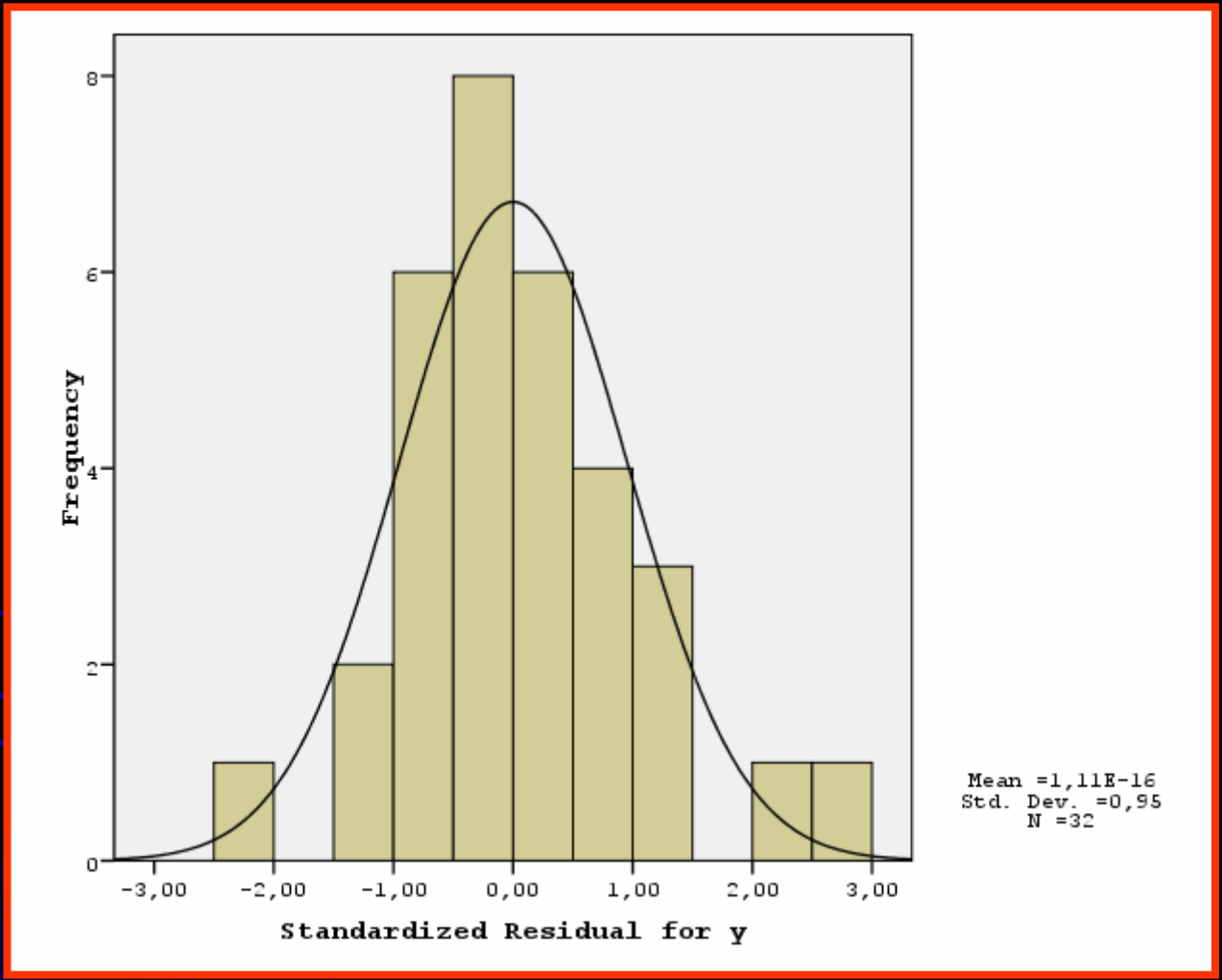
Έλεγχος Κανονικότητας Σφαλμάτων (M2)



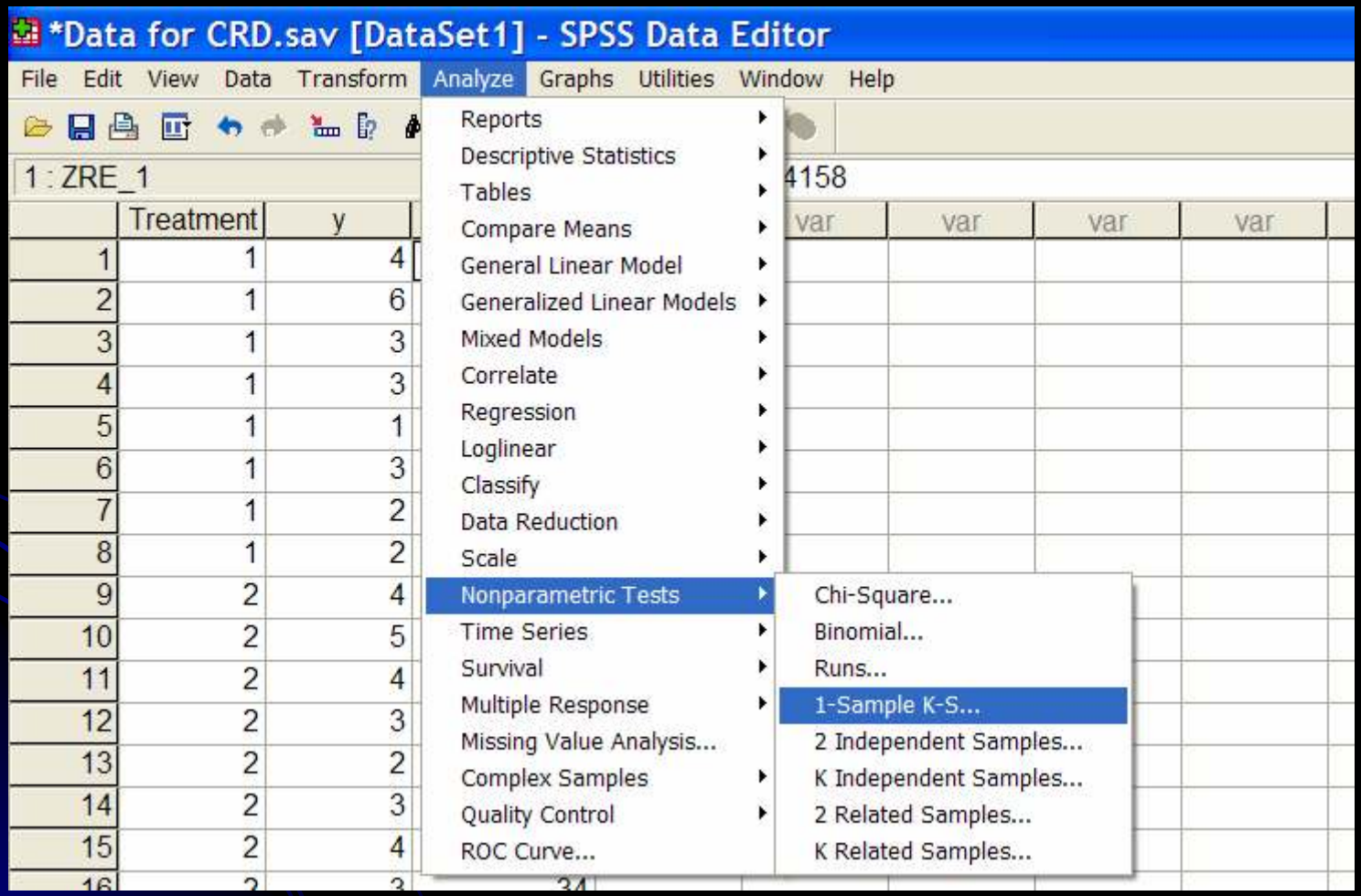
Εντολές και Ρυθμίσεις



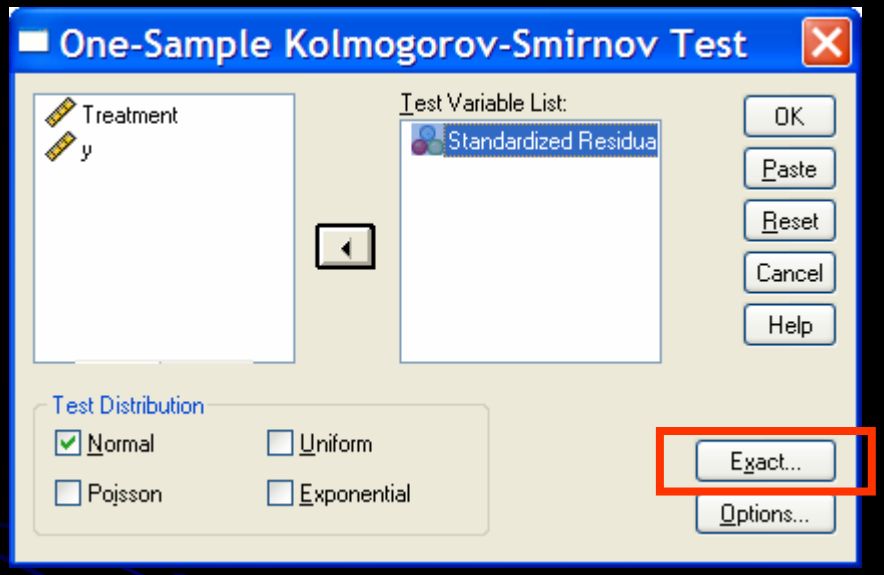
Αποτελέσματα SPSS



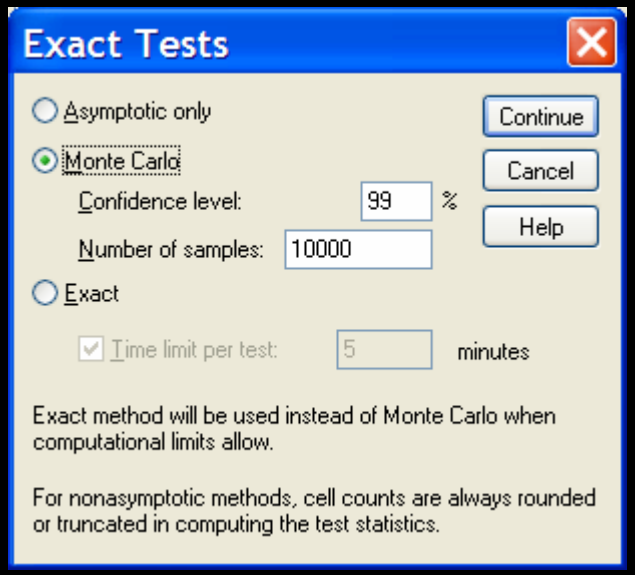
Έλεγχος Κανονικότητας Σφαλμάτων (Μ3)



Εντολές και Ρυθμίσεις



1



2

Αποτελέσματα SPSS

One-Sample Kolmogorov-Smirnov Test

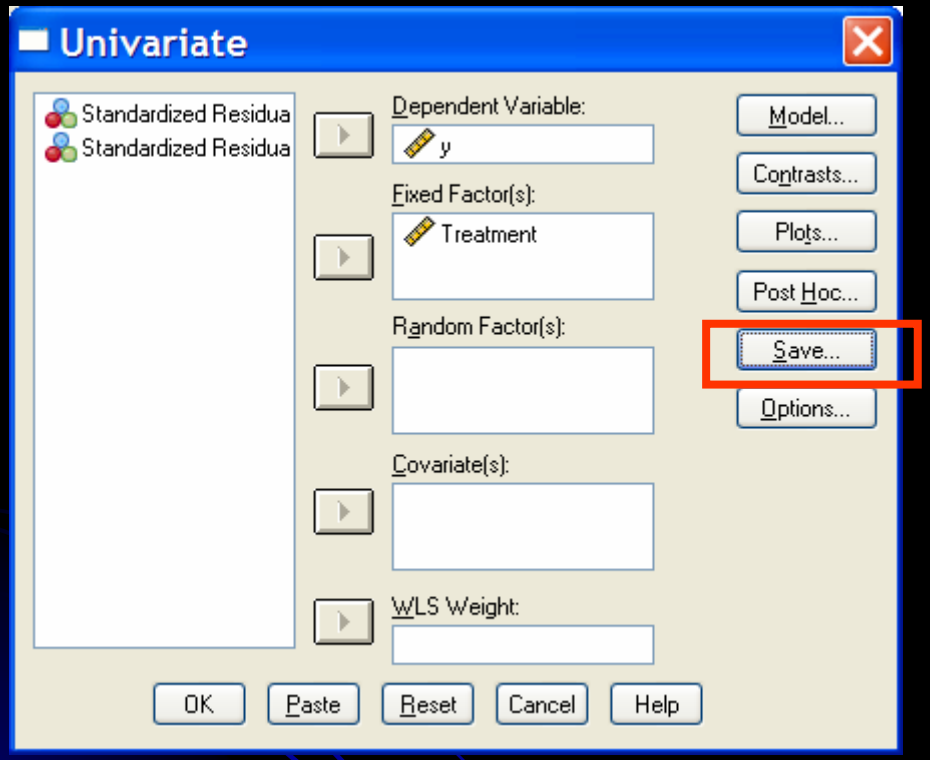
			Standardized Residual for y
N			32
Normal Parameters[a,b]	Mean		,0000
	Std. Deviation		,95038
Most Extreme Differences	Absolute		,125
	Positive		,125
	Negative		-,093
Kolmogorov-Smirnov Z			,707
Asymp. Sig. (2-tailed)			,699
Monte Carlo Sig. (2-tailed)	Sig.		,662[c]
	99% Confidence Interval	Lower Bound	,650
		Upper Bound	,674

a. Test distribution is Normal.

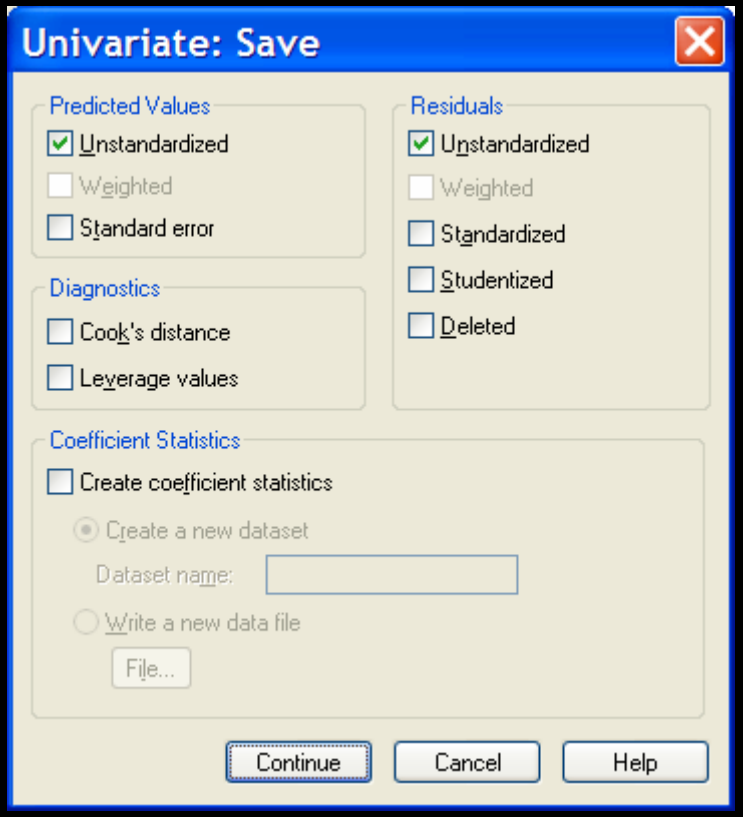
b. Calculated from data.

c. Based on 10000 sampled tables with starting seed 2000000.

Έλεγχος Ομοσκεδαστικότητας Σφαλμάτων (M1)



1



2

Εκτιμώμενες Τιμές και Σφάλματα

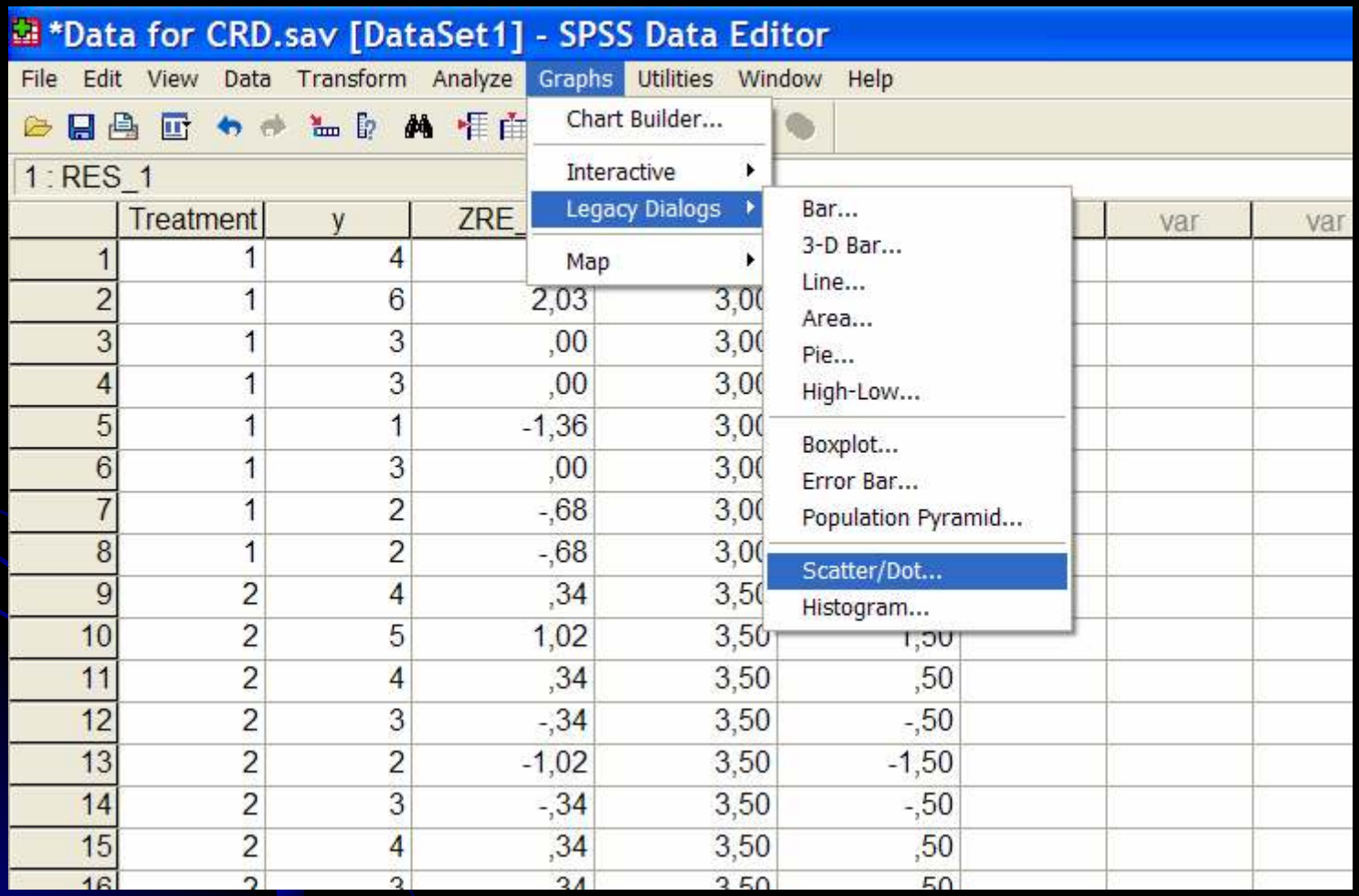
*Data for CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

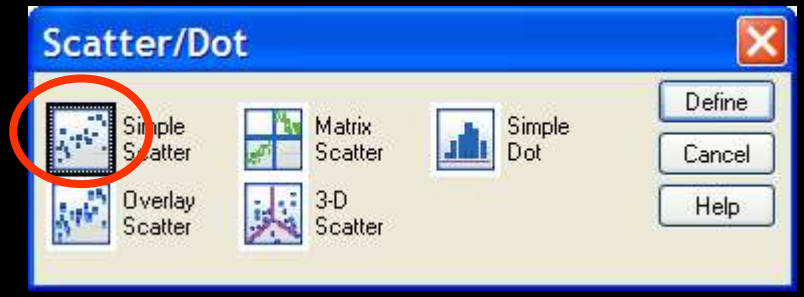
1 : RES_1 1

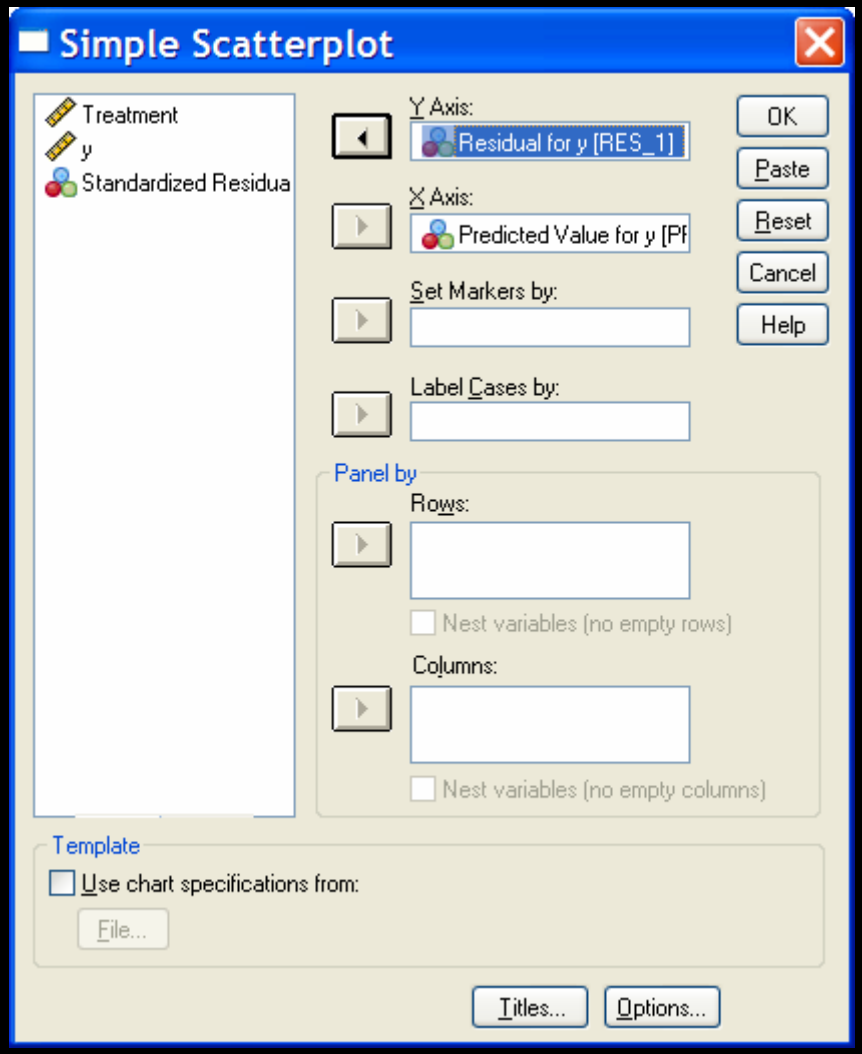
	Treatment	y	ZRE_1	PRE_1	RES_1	var	var	var
1	1	4	,68	3,00	1,00			
2	1	6	2,03	3,00	3,00			
3	1	3	,00	3,00	,00			
4	1	3	,00	3,00	,00			
5	1	1	-1,36	3,00	-2,00			
6	1	3	,00	3,00	,00			
7	1	2	-,68	3,00	-1,00			
8	1	2	-,68	3,00	-1,00			
9	2	4	,34	3,50	,50			
10	2	5	1,02	3,50	1,50			
11	2	4	,34	3,50	,50			
12	2	3	-,34	3,50	-,50			
13	2	2	-1,02	3,50	-1,50			
14	2	3	-,34	3,50	-,50			
15	2	4	,34	3,50	,50			
16	2	3	-,34	3,50	-,50			
17	3	5	,51	4,25	,75			
18	3	6	1,19	4,25	1,75			
19	3	5	,51	4,25	,75			
20	3	4	-,17	4,25	-,25			
21	3	3	-,85	4,25	-1,25			
22	3	4	-,17	4,25	-,25			
23	3	3	-,85	4,25	-1,25			
24	3	4	-,17	4,25	-,25			
25	4	3	-2,20	6,25	-3,25			
26	4	5	-,85	6,25	-1,25			
27	4	6	-,17	6,25	-,25			
28	4	5	-,85	6,25	-1,25			
29	4	6	-,17	6,25	-,25			
30	4	7	,51	6,25	,75			
31	4	8	1,19	6,25	1,75			
32	4	10	2,54	6,25	3,75			

Εντολές και Ρυθμίσεις (1)

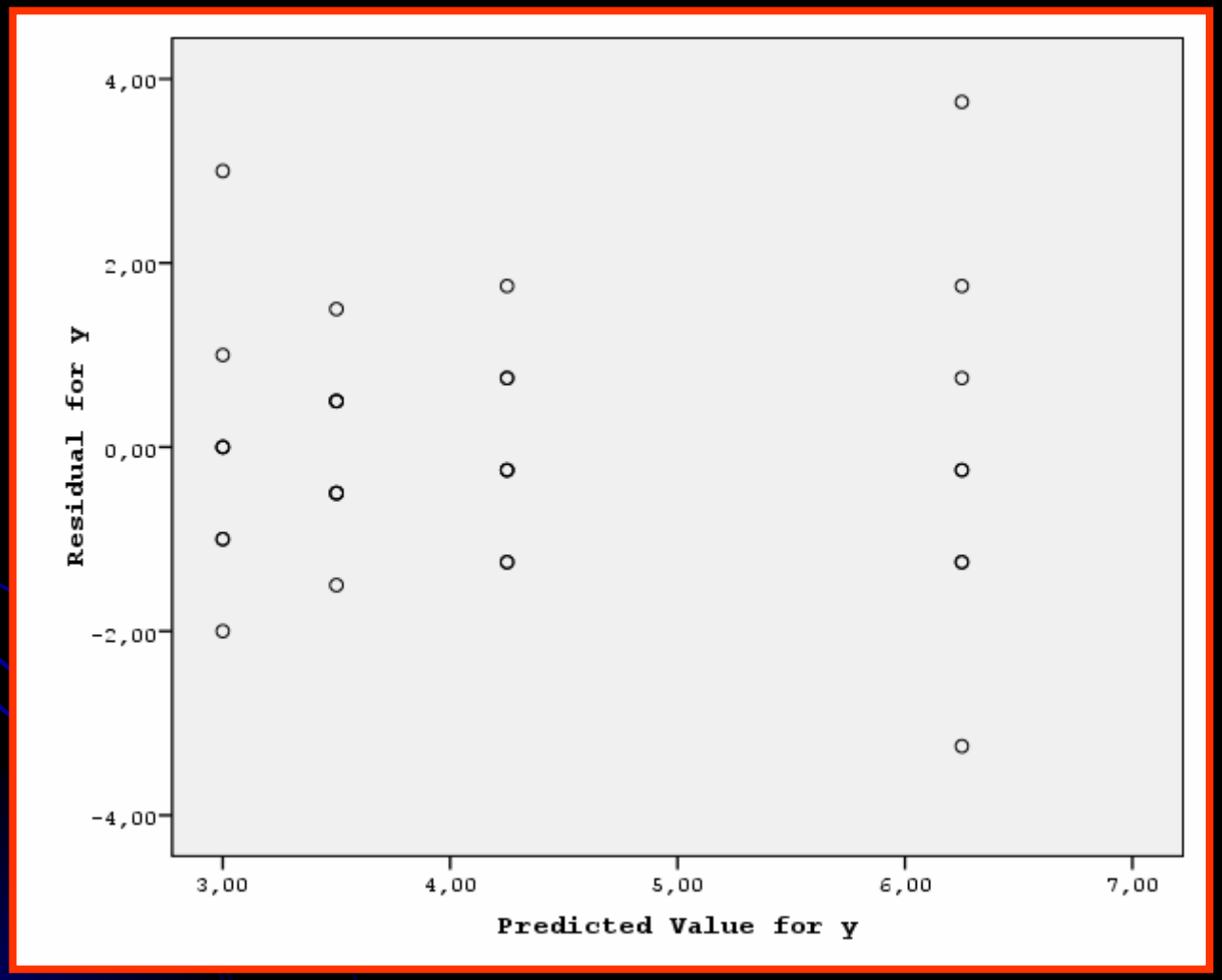


Εντολές και Ρυθμίσεις (2)

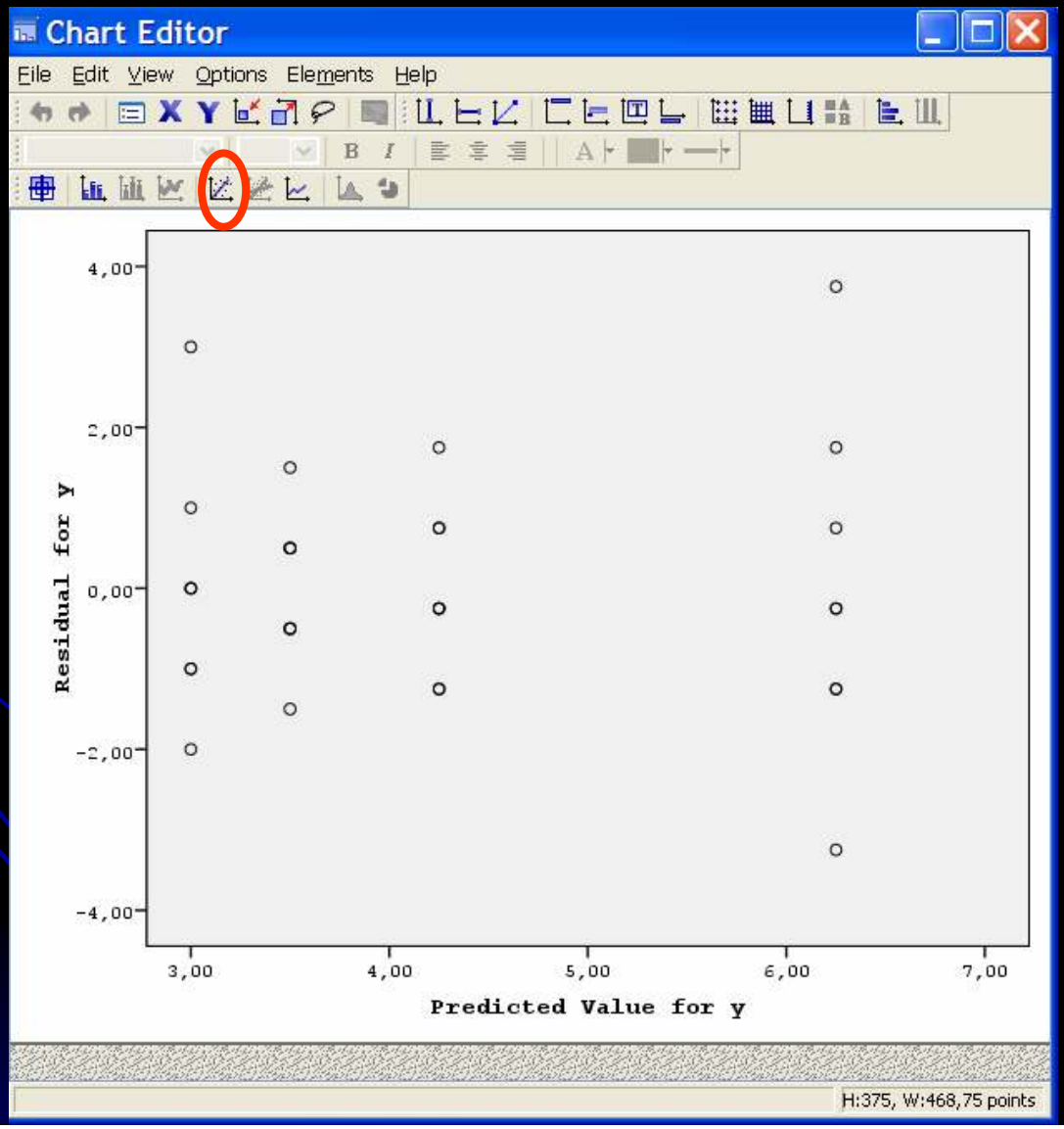




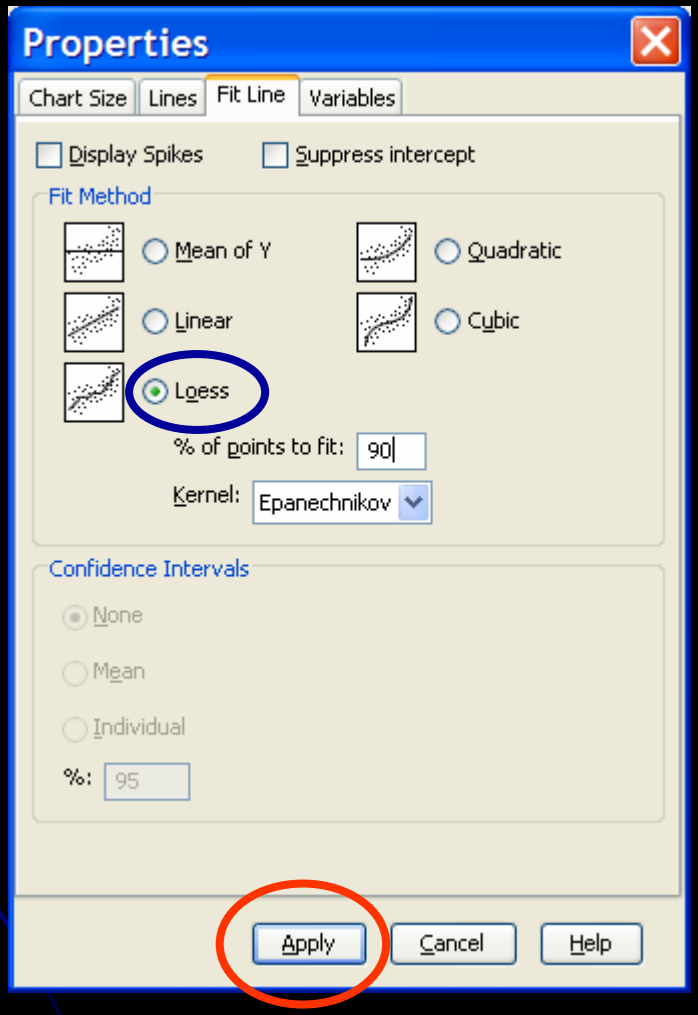
Αποτελέσματα SPSS



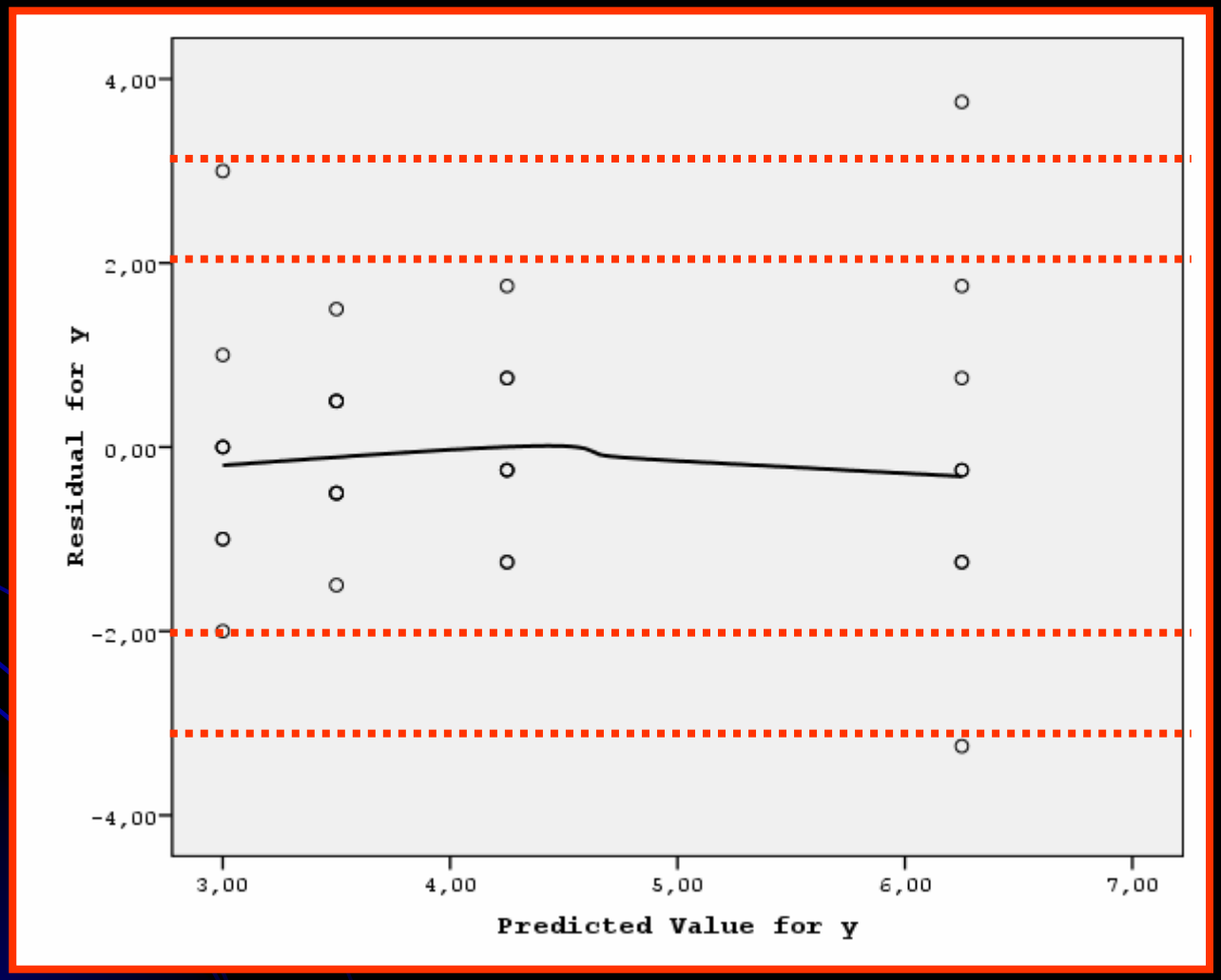
Επεξεργασία Διαγράμματος



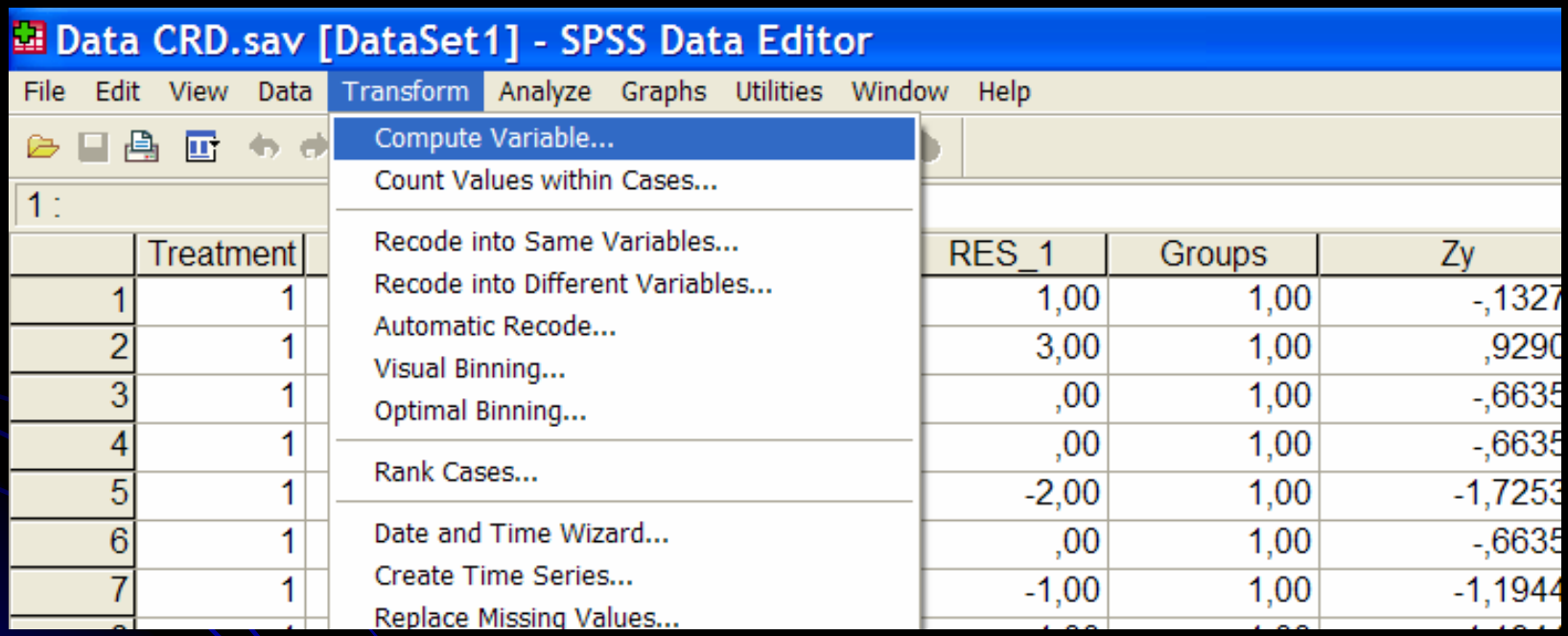
Εντολές και Ρυθμίσεις (3)



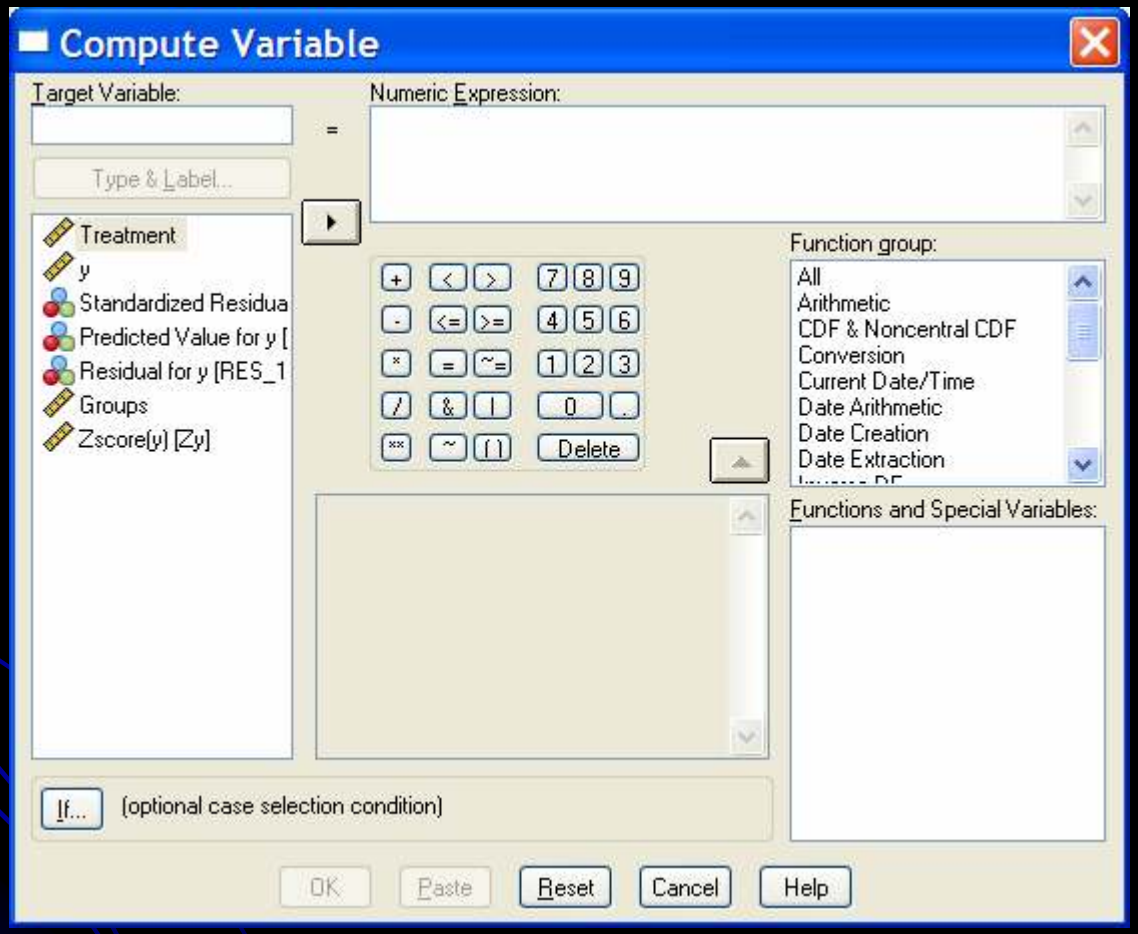
Αποτελέσματα SPSS



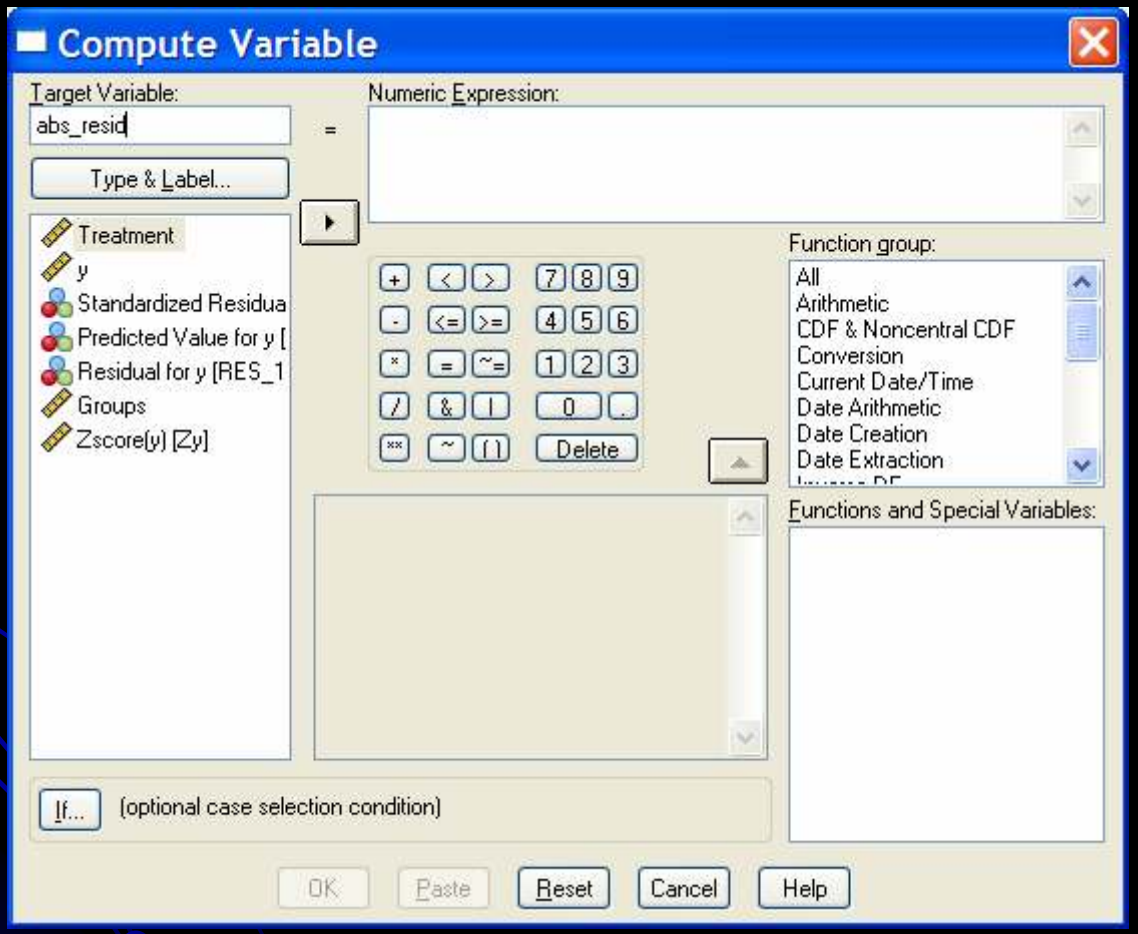
Έλεγχος Ομοσκεδαστικότητας Σφαλμάτων (M2)



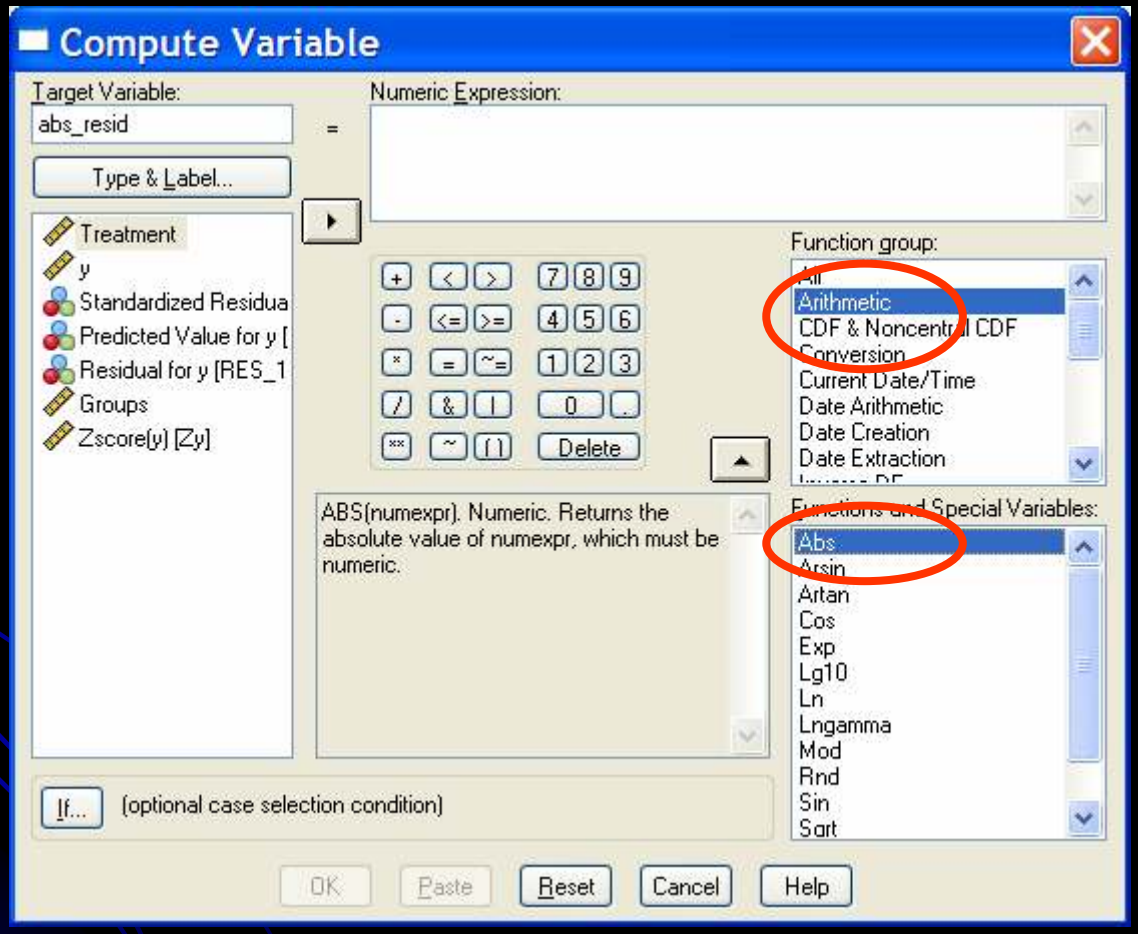
Εντολές και Ρυθμίσεις (1)



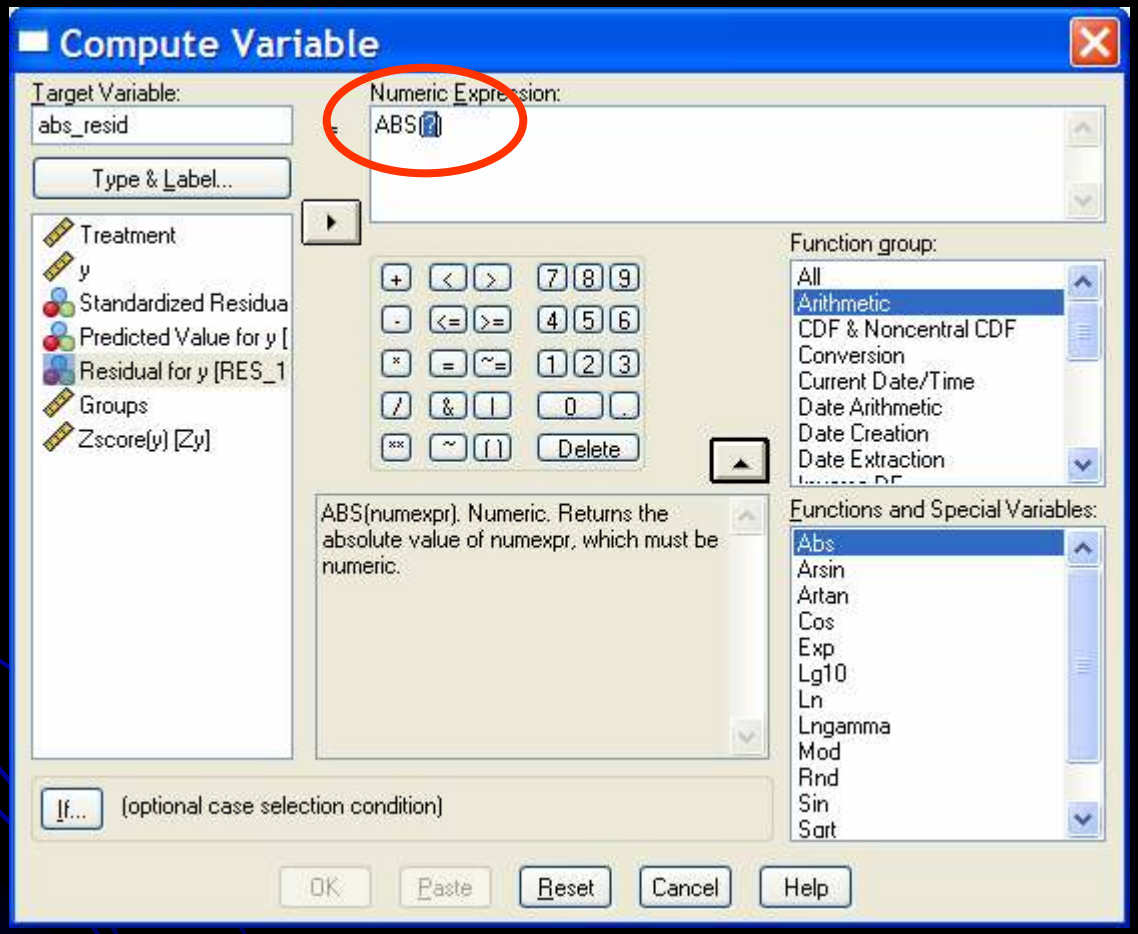
Εντολές και Ρυθμίσεις (2)



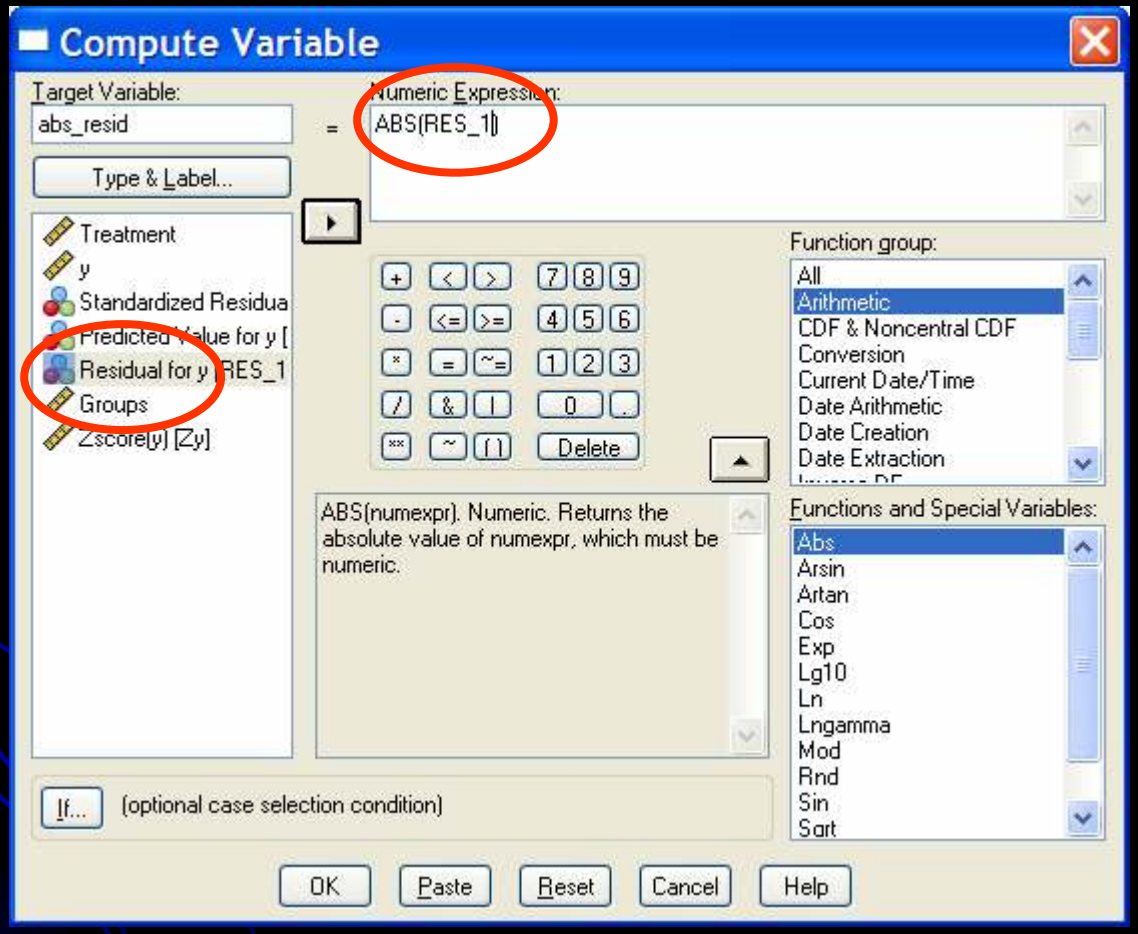
Εντολές και Ρυθμίσεις (3)



Εντολές και Ρυθμίσεις (4)



Εντολές και Ρυθμίσεις (5)



Εντολές και Ρυθμίσεις (6)

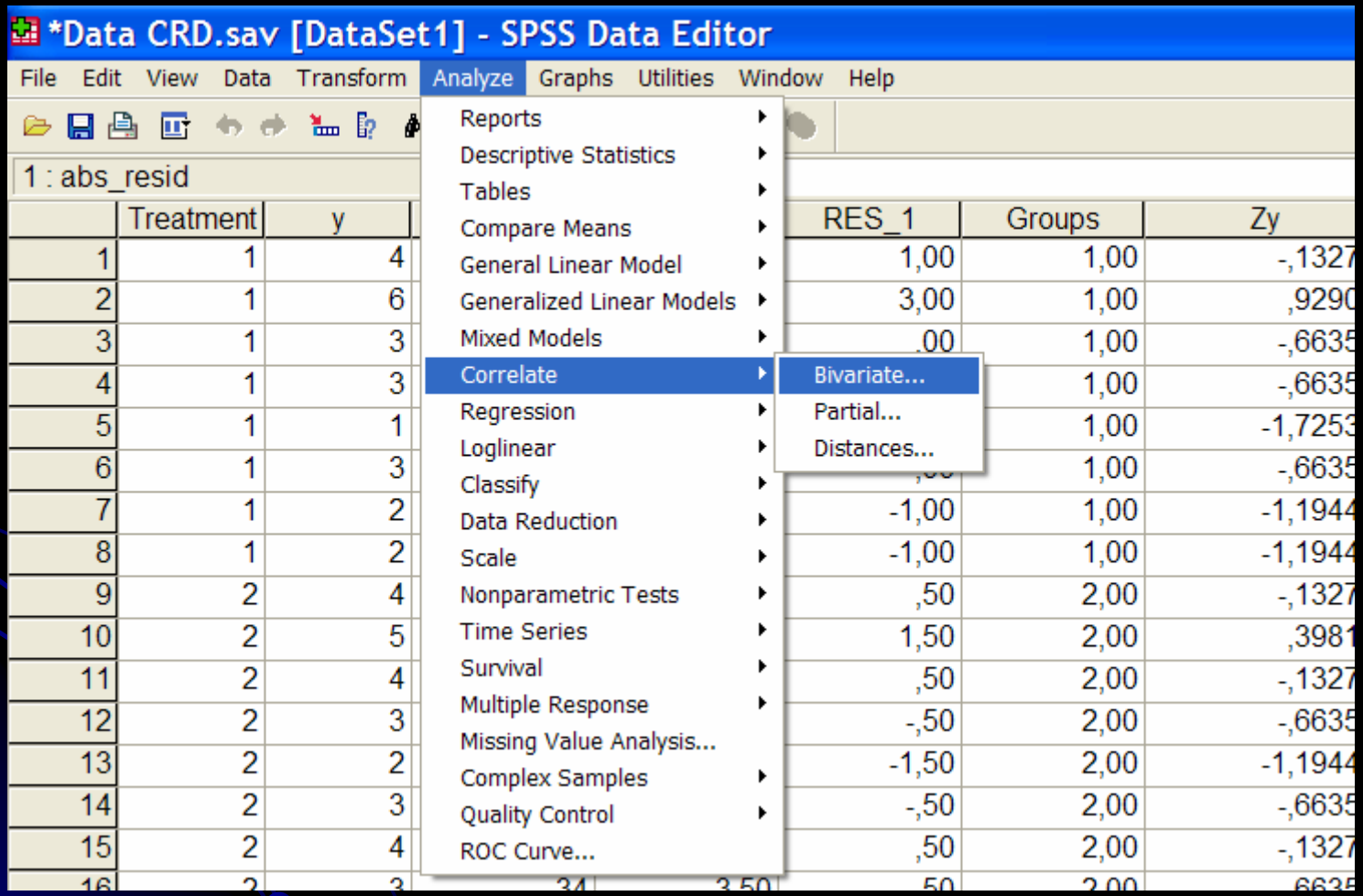
*Data CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

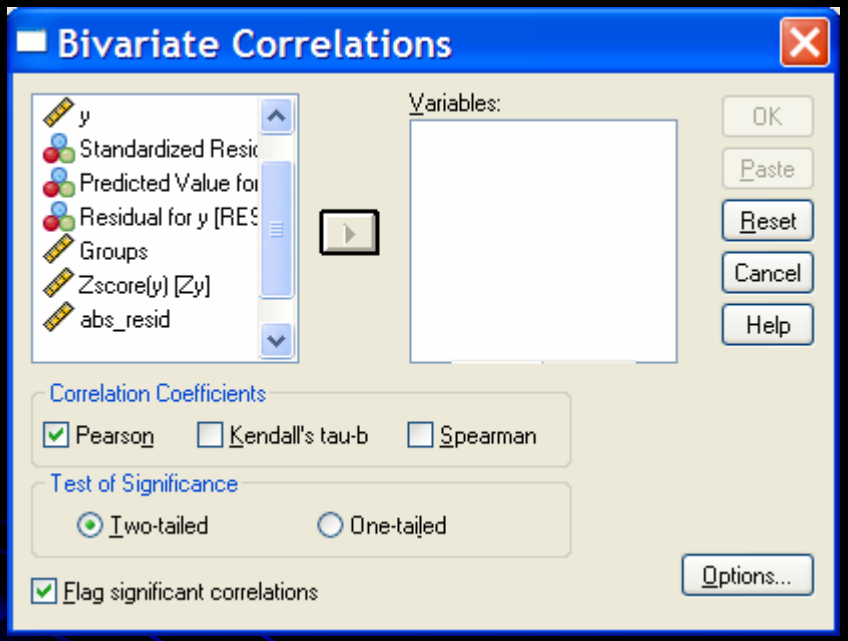
1 : abs_resid 1

	Treatment	y	ZRE_1	PRE_1	RES_1	Groups	Zy	abs_resid	var
1	1	4	,68	3,00	1,00	1,00	-,13272	1,00	
2	1	6	2,03	3,00	3,00	1,00	,92901	3,00	
3	1	3	,00	3,00	,00	1,00	-,66358	,00	
4	1	3	,00	3,00	,00	1,00	-,66358	,00	
5	1	1	-1,36	3,00	-2,00	1,00	-1,72531	2,00	
6	1	3	,00	3,00	,00	1,00	-,66358	,00	
7	1	2	-,68	3,00	-1,00	1,00	-1,19445	1,00	
8	1	2	-,68	3,00	-1,00	1,00	-1,19445	1,00	
9	2	4	,34	3,50	,50	2,00	-,13272	,50	
10	2	5	1,02	3,50	1,50	2,00	,39815	1,50	
11	2	4	,34	3,50	,50	2,00	-,13272	,50	
12	2	3	-,34	3,50	-,50	2,00	-,66358	,50	
13	2	2	-1,02	3,50	-1,50	2,00	-1,19445	1,50	
14	2	3	-,34	3,50	-,50	2,00	-,66358	,50	
15	2	4	,34	3,50	,50	2,00	-,13272	,50	
16	2	3	,34	3,50	,50	2,00	-,66358	,50	

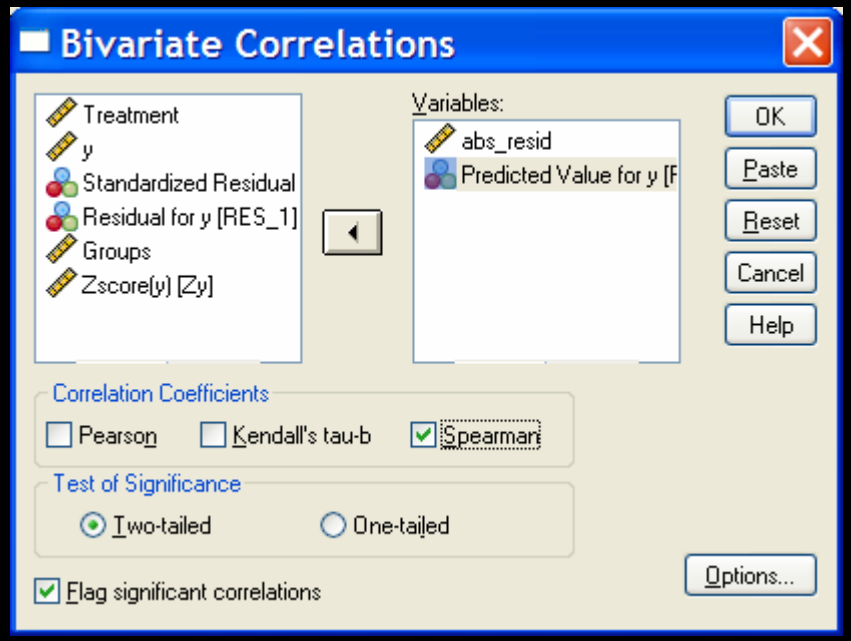
Εντολές και Ρυθμίσεις (7)



Εντολές και Ρυθμίσεις (8)



1



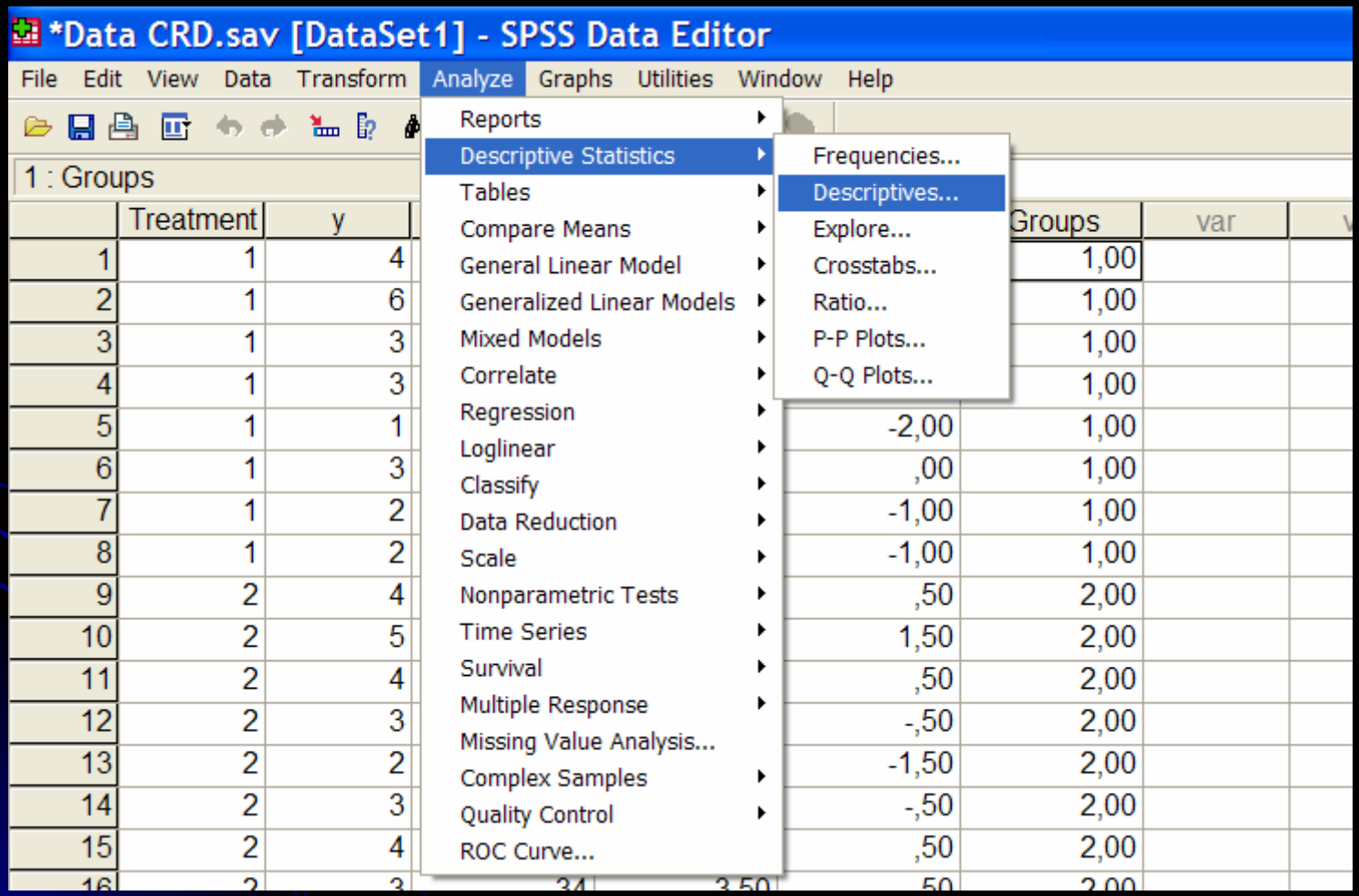
2

Αποτελέσματα SPSS

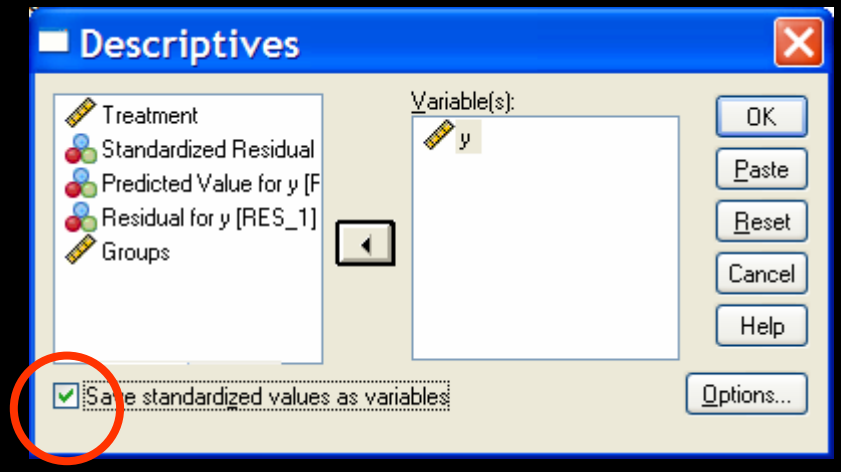
Correlations

			abs_resid	Predicted Value for y
Spearman's rho	abs_resid	Correlation Coefficient	1,000	,193
		Sig. (2-tailed)	.	,290
		N	32	32
	Predicted Value for y	Correlation Coefficient	,193	1,000
		Sig. (2-tailed)	,290	.
		N	32	32

Έλεγχος για Παράτυπα Σημεία (outliers) της Εξαρτημένης Μεταβλητής



Εντολές και Ρυθμίσεις (1)



Δημιουργία z-score

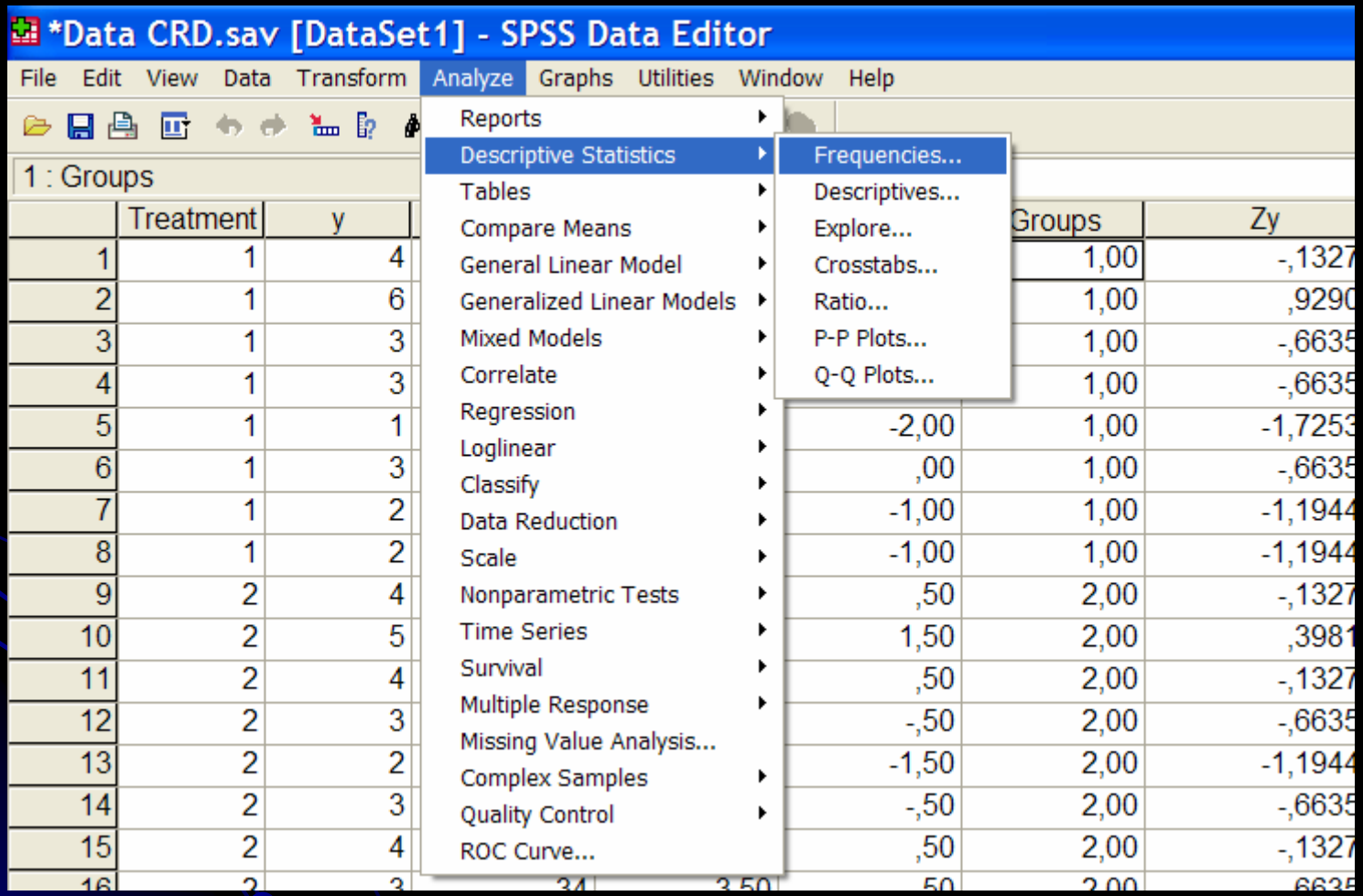
*Data CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

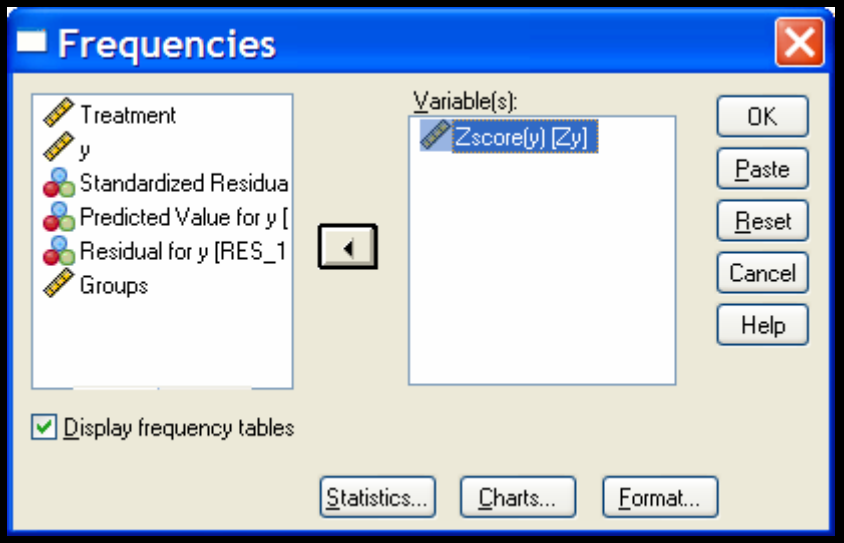
1 : Groups 1

	Treatment	y	ZRE_1	PRE_1	RES_1	Groups	Zy	var	var
1	1	4	,68	3,00	1,00	1,00	-,13272		
2	1	6	2,03	3,00	3,00	1,00	,92901		
3	1	3	,00	3,00	,00	1,00	-,66358		
4	1	3	,00	3,00	,00	1,00	-,66358		
5	1	1	-1,36	3,00	-2,00	1,00	-1,72531		
6	1	3	,00	3,00	,00	1,00	-,66358		
7	1	2	-,68	3,00	-1,00	1,00	-1,19445		
8	1	2	-,68	3,00	-1,00	1,00	-1,19445		
9	2	4	,34	3,50	,50	2,00	-,13272		
10	2	5	1,02	3,50	1,50	2,00	,39815		
11	2	4	,34	3,50	,50	2,00	-,13272		
12	2	3	-,34	3,50	-,50	2,00	-,66358		
13	2	2	-1,02	3,50	-1,50	2,00	-1,19445		
14	2	3	-,34	3,50	-,50	2,00	-,66358		
15	2	4	,34	3,50	,50	2,00	-,13272		
16	2	3	,34	3,50	,50	2,00	,66358		

Εντολές και Ρυθμίσεις (2)



Εντολές και Ρυθμίσεις (3)



Αποτελέσματα SPSS

Statistics

Zscore(y)

N	Valid	32
	Missing	0

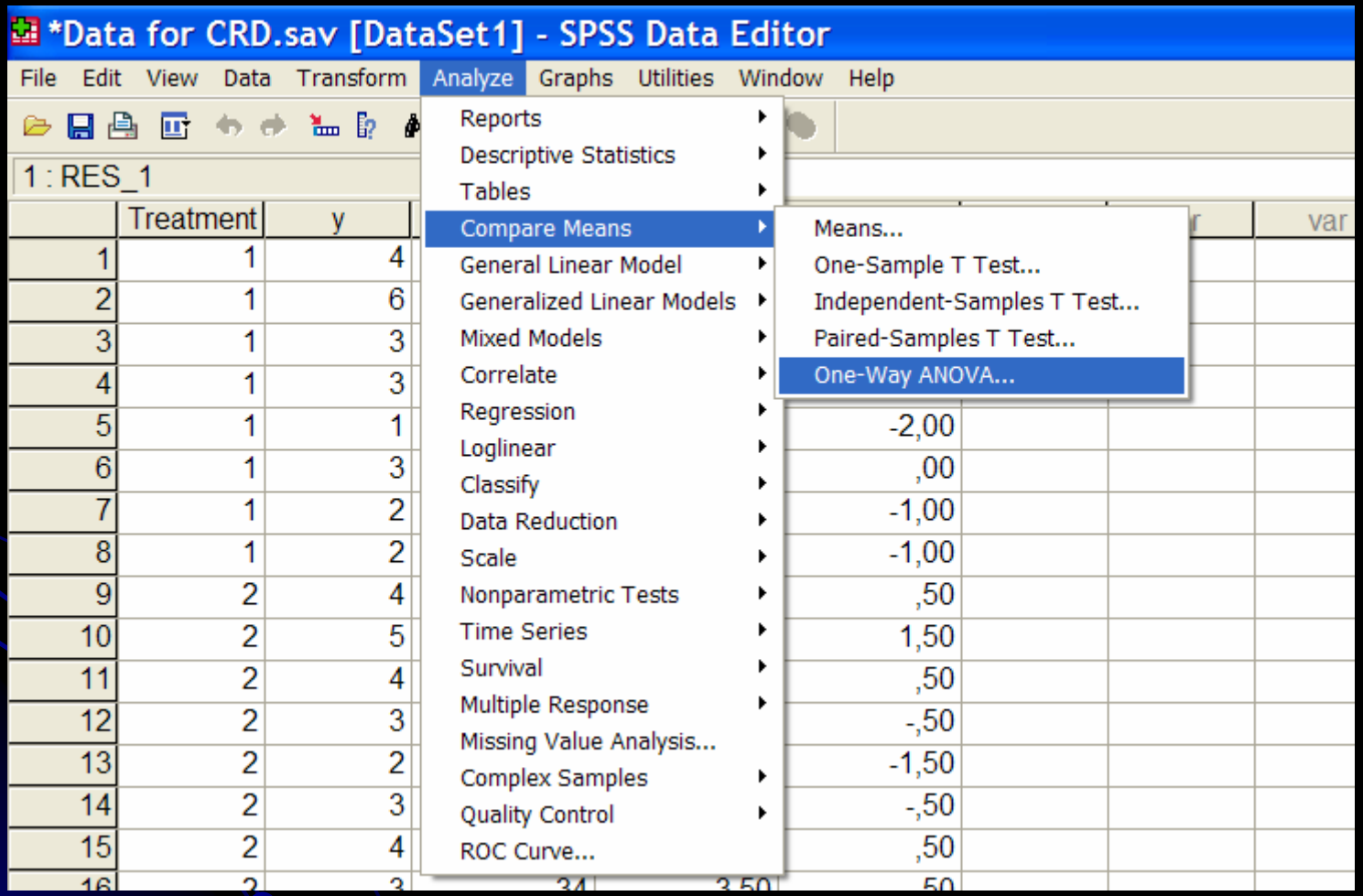
Zscore(y)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	-1,72531	1	3,1	3,1	3,1
	-1,19445	3	9,4	9,4	12,5
	-,66358	9	28,1	28,1	40,6
	-,13272	7	21,9	21,9	62,5
	,39815	5	15,6	15,6	78,1
	,92901	4	12,5	12,5	90,6
	1,45988	1	3,1	3,1	93,8
	1,99075	1	3,1	3,1	96,9
	3,05248	1	3,1	3,1	100,0
	Total	32	100,0	100,0	

Ειδική Περίπτωση (Β)

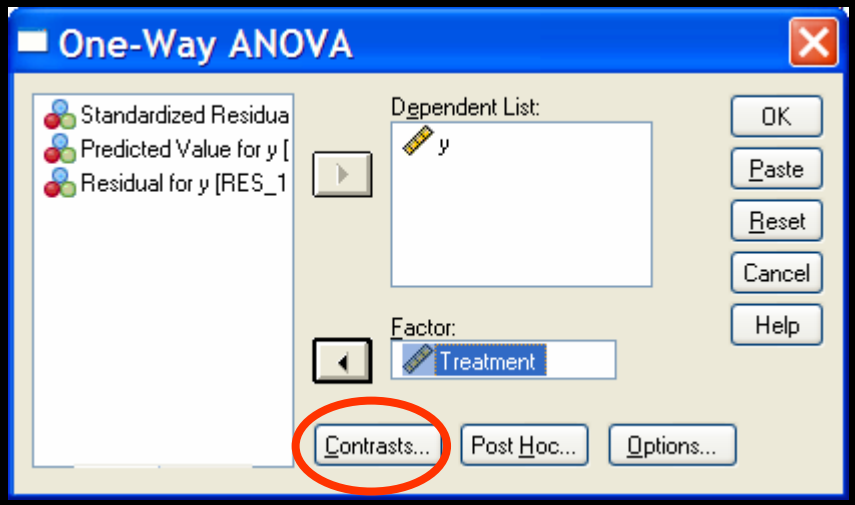
- Σύγκριση Ομάδων Μέσων Όρων (a priori contrasts, orthogonal contrasts)-Αντιθέσεις
- Παράδειγμα: Μας ενδιαφέρει να ελέγξουμε αν ο μέσος όρος της ομάδας που περιλαμβάνει τις επεμβάσεις 1 και 3 διαφοροποιείται στατιστικά σημαντικά από το μέσο όρο της ομάδας που περιλαμβάνει τις επεμβάσεις 2 και 4.

Επιλογή Στατιστικής Διαδικασίας (1)

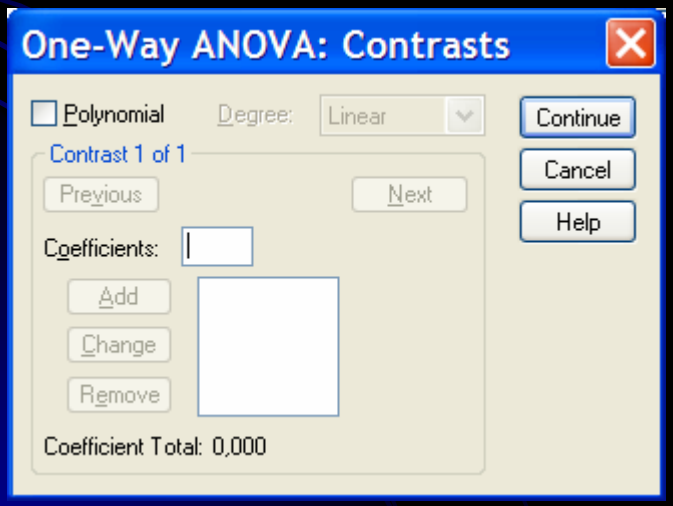


Εντολές και Ρυθμίσεις (1)

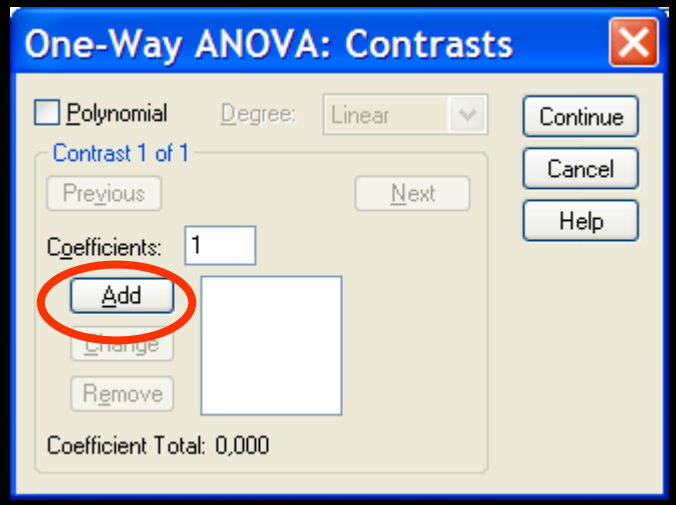
1



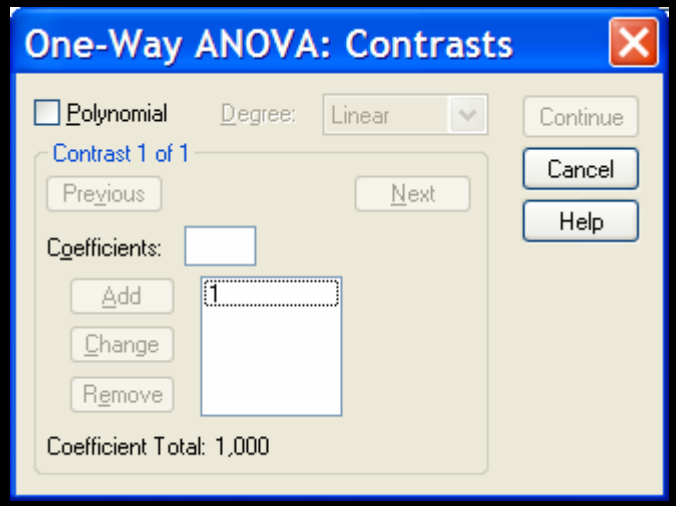
2



3

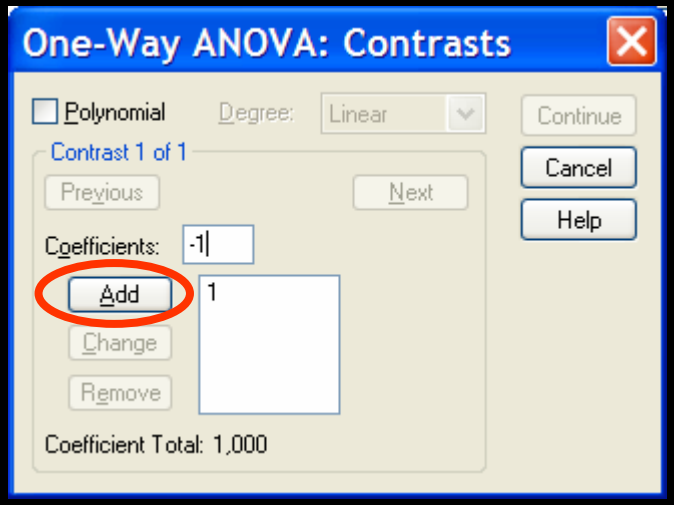


4

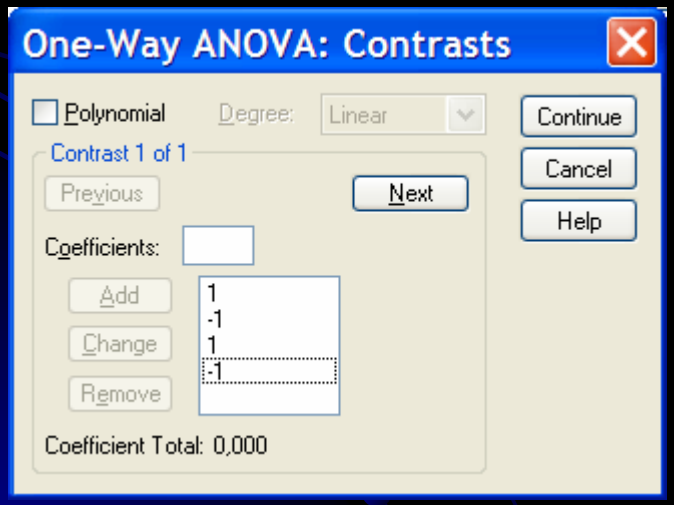


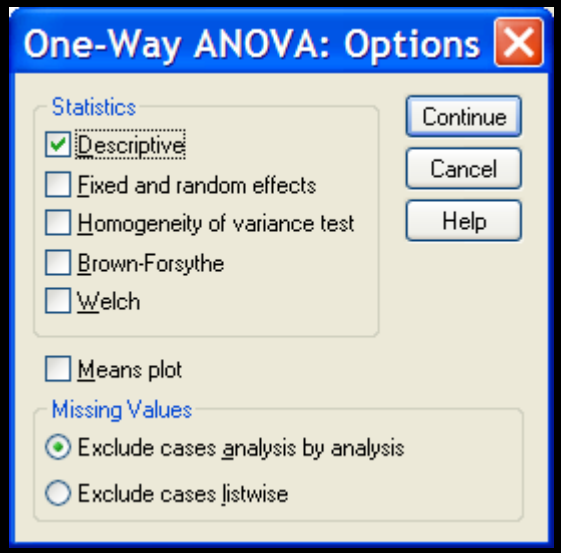
Εντολές και Ρυθμίσεις (2)

5



6





Αποτελέσματα SPSS

Descriptives

y

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	8	3,00	1,512	,535	1,74	4,26	1	6
2	8	3,50	,926	,327	2,73	4,27	2	5
3	8	4,25	1,035	,366	3,38	5,12	3	6
4	8	6,25	2,121	,750	4,48	8,02	3	10
Total	32	4,25	1,884	,333	3,57	4,93	1	10

ANOVA

y

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	49,000	3	16,333	7,497	,001
Within Groups	61,000	28	2,179		
Total	110,000	31			

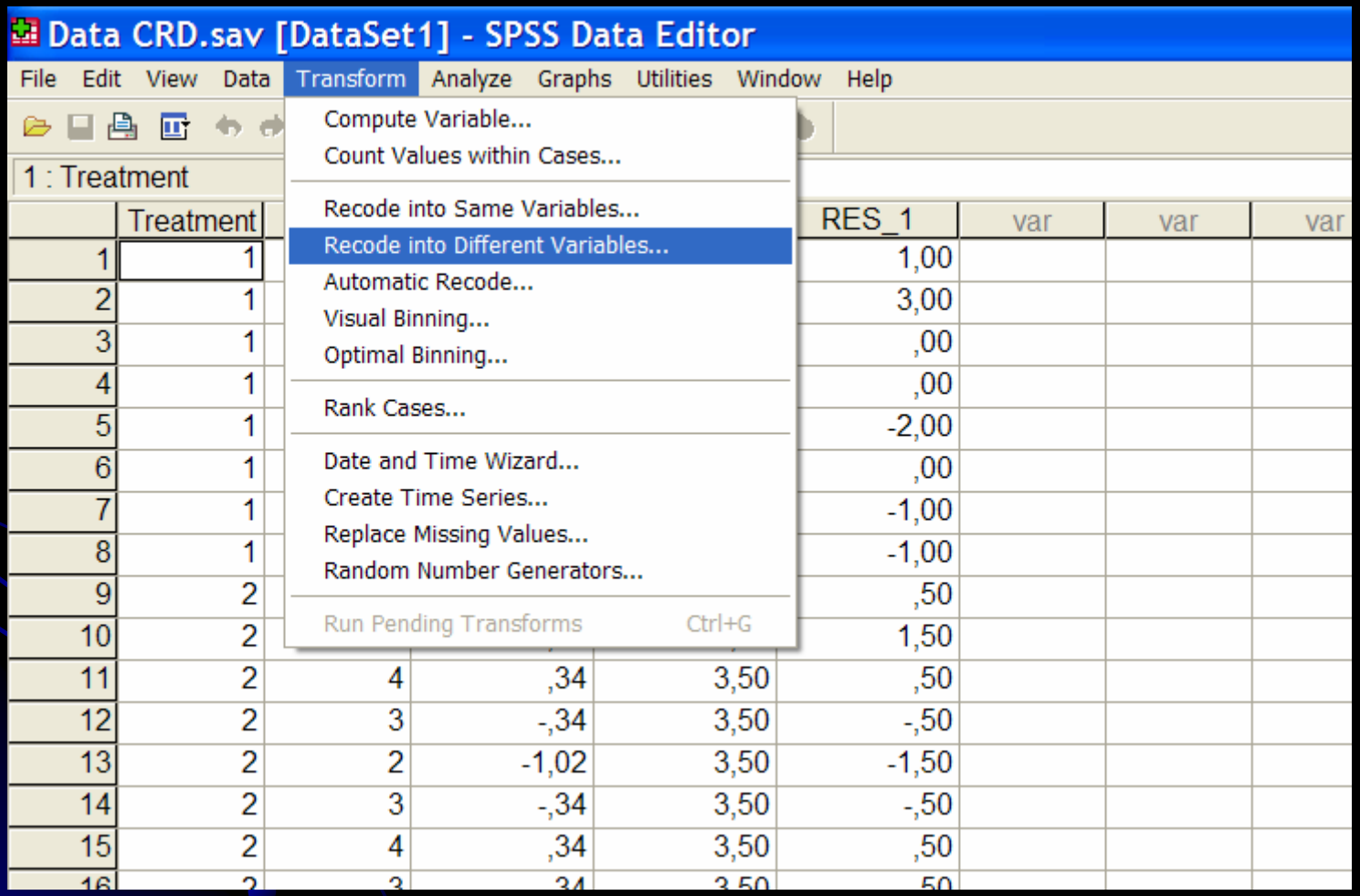
Contrast Coefficients

Contrast	Treatment			
	1	2	3	4
1	1	-1	1	-1

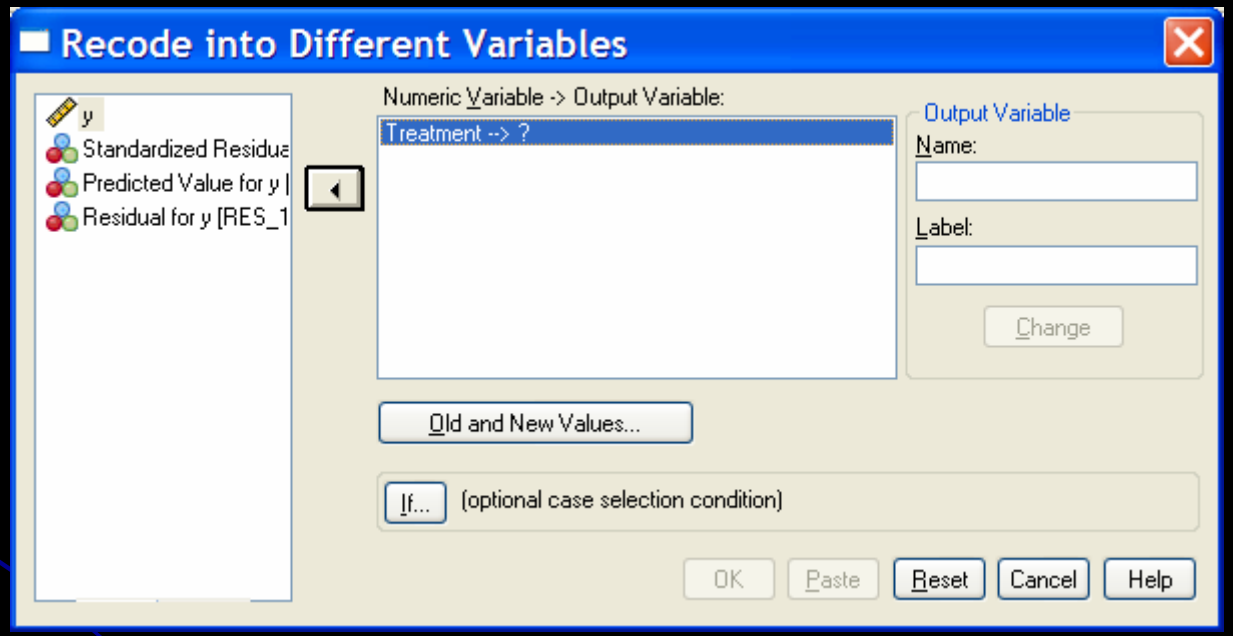
Contrast Tests

		Contrast	Value of Contrast	Std. Error	t	df	Sig. (2-tailed)
y	Assume equal variances	1	-2,50	1,044	-2,395	28	,024
	Does not assume equal	1	-2,50	1,044	-2,395	19,431	,027

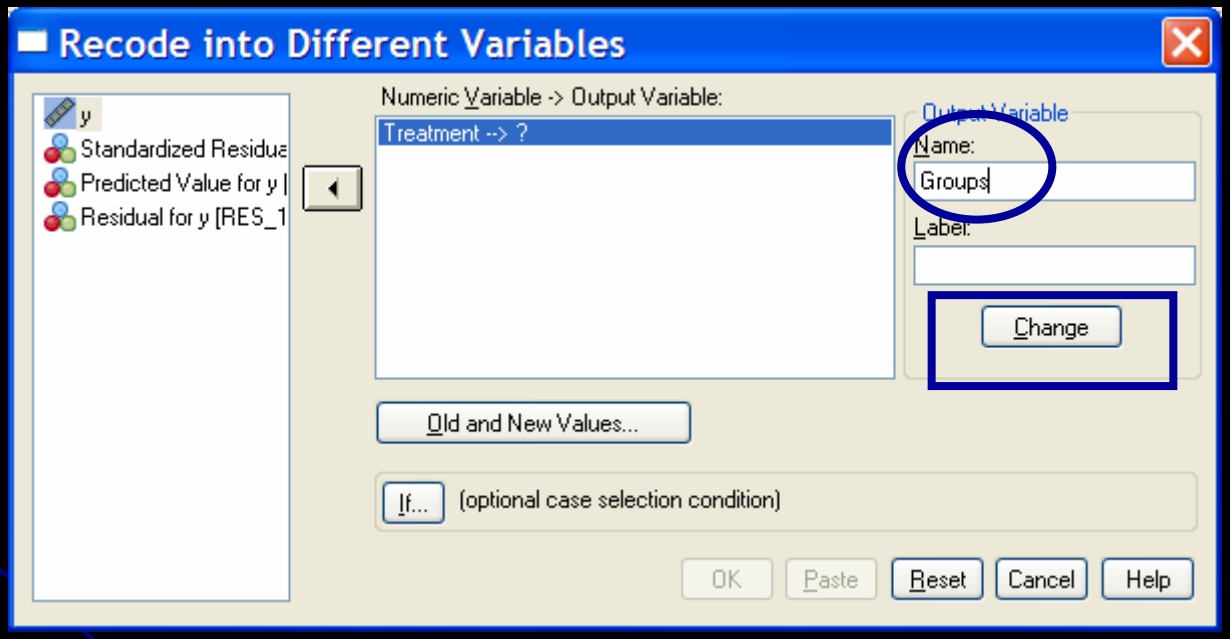
Αλλαγή Κωδικοποίησης (1)



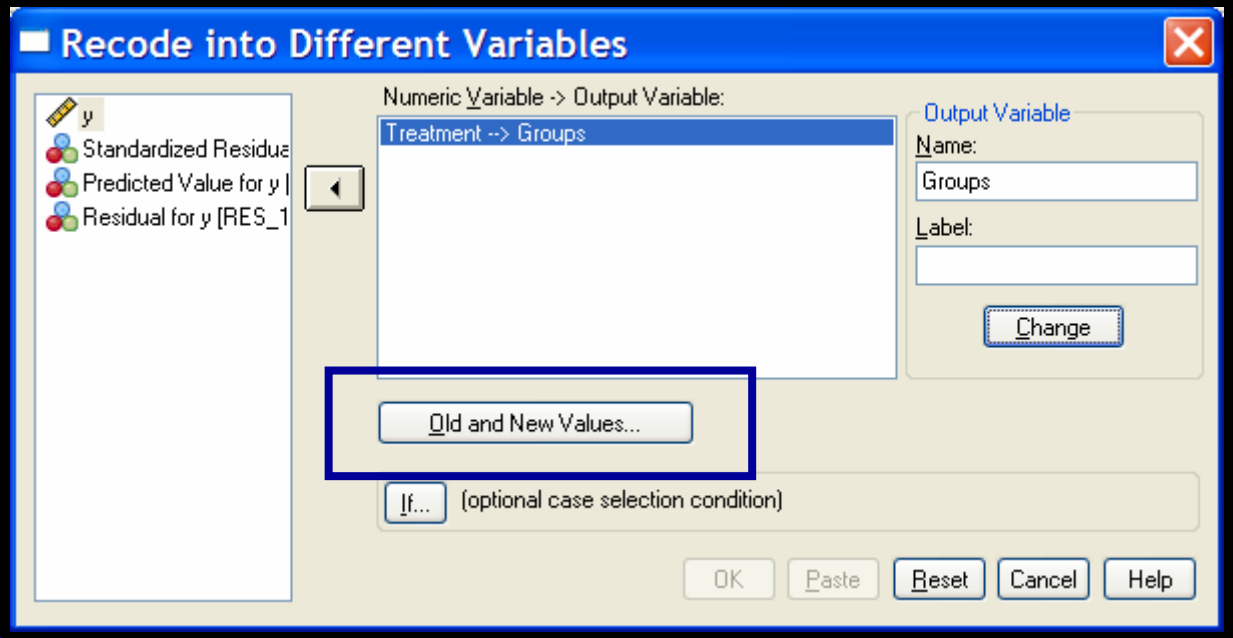
Αλλαγή Κωδικοποίησης (2)



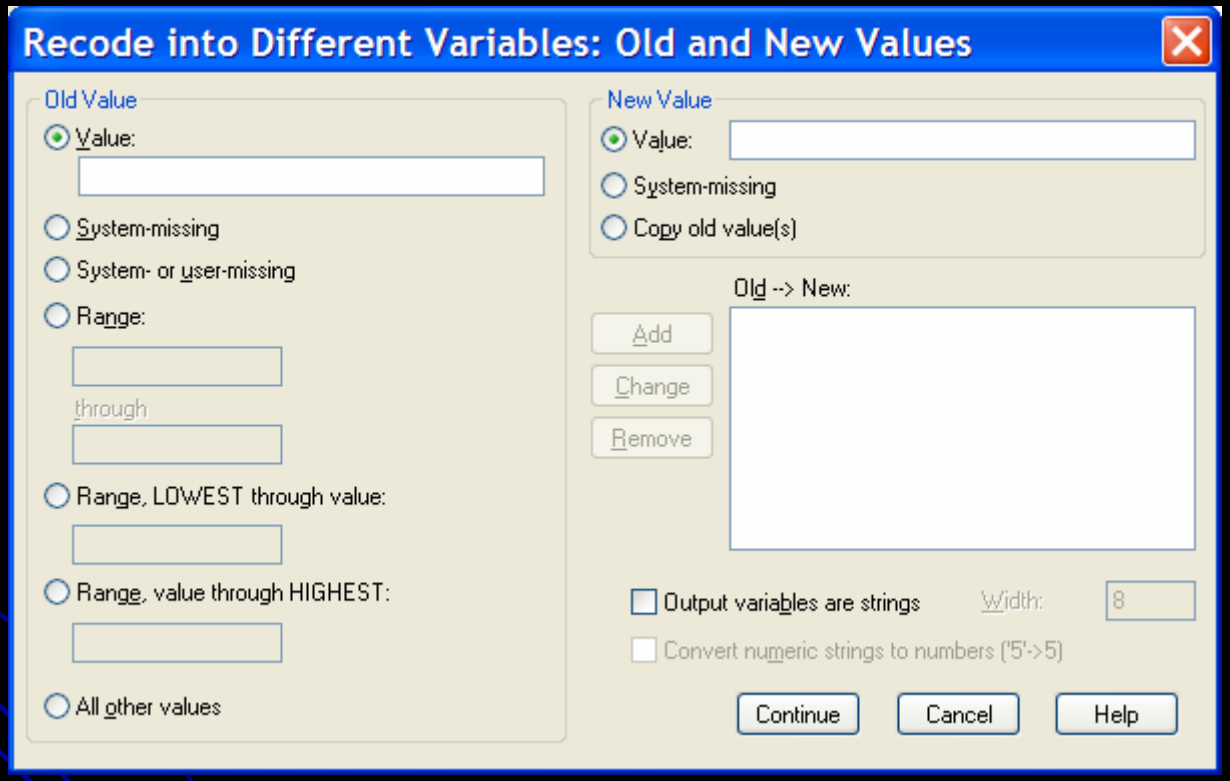
Αλλαγή Κωδικοποίησης (3)



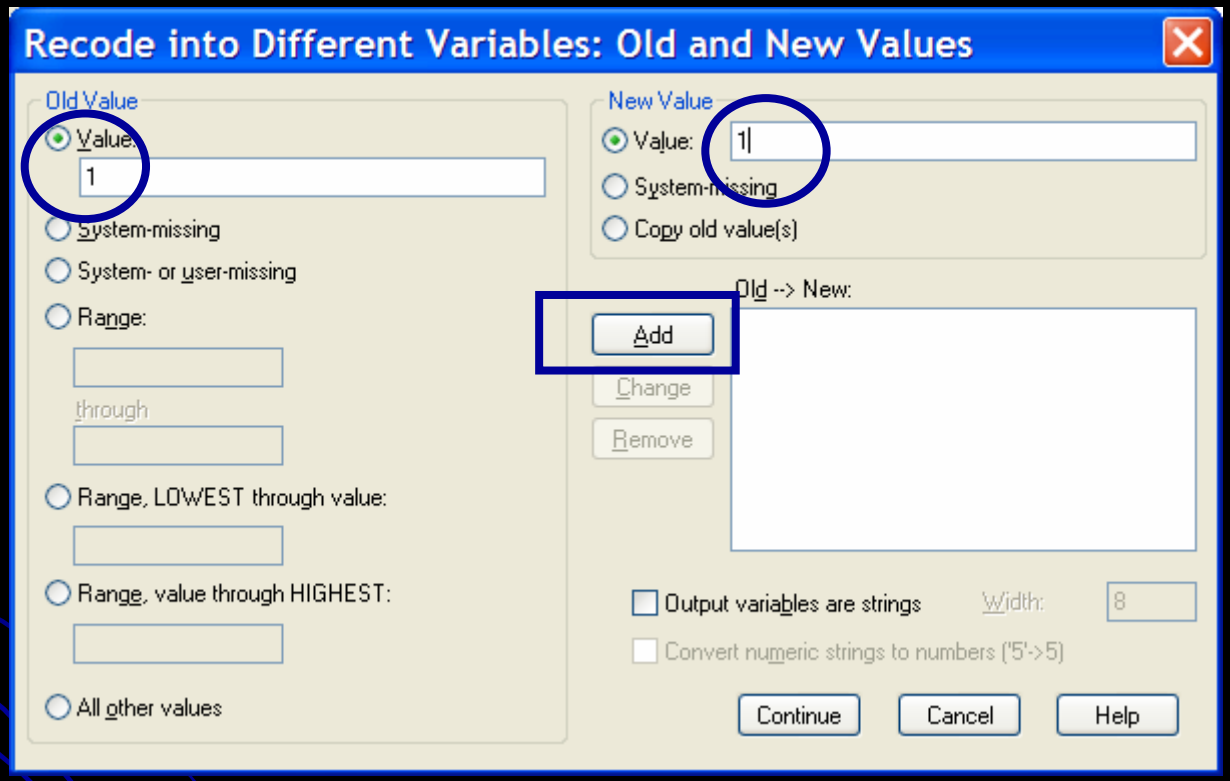
Αλλαγή Κωδικοποίησης (4)



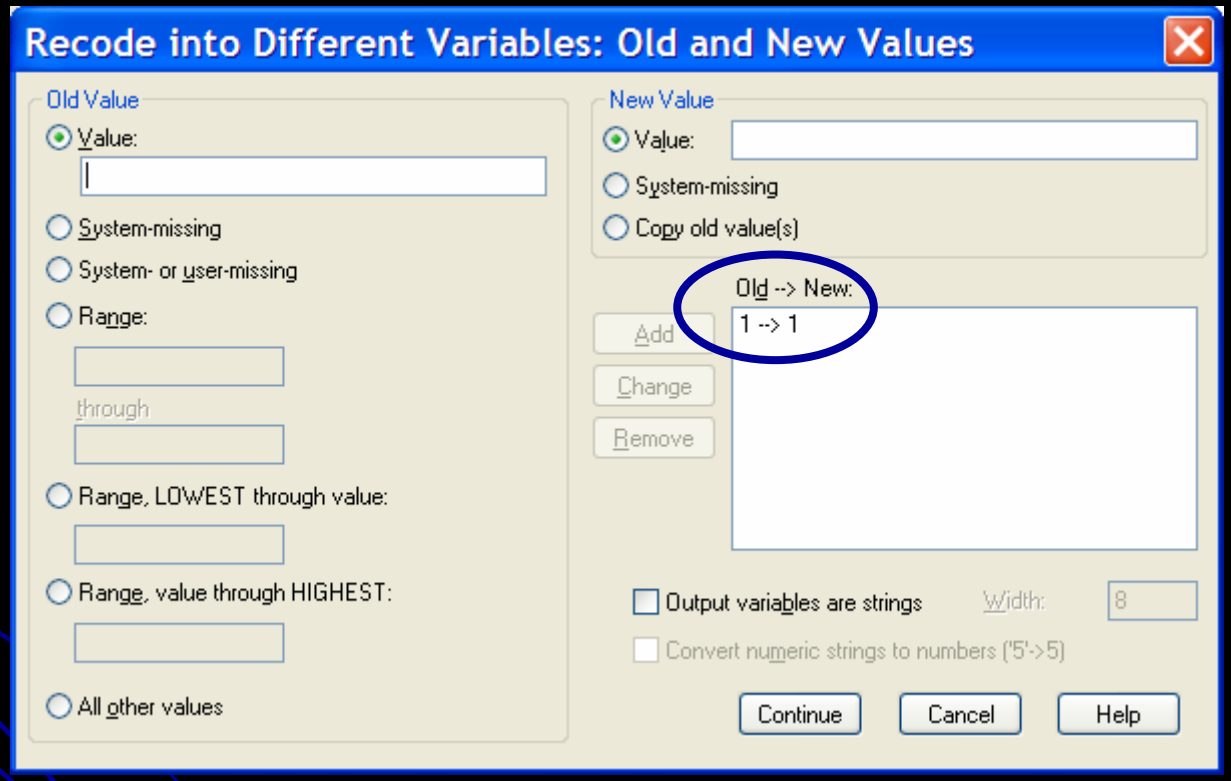
Αλλαγή Κωδικοποίησης (5)



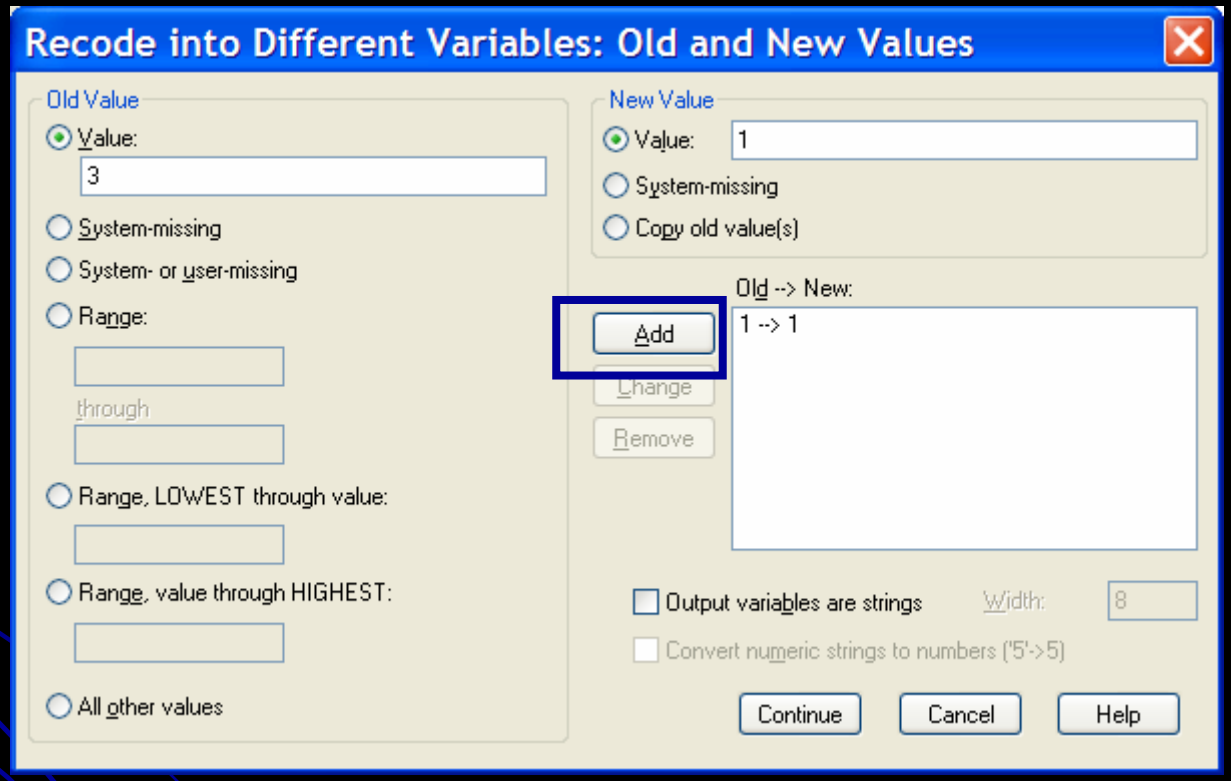
Αλλαγή Κωδικοποίησης (6)



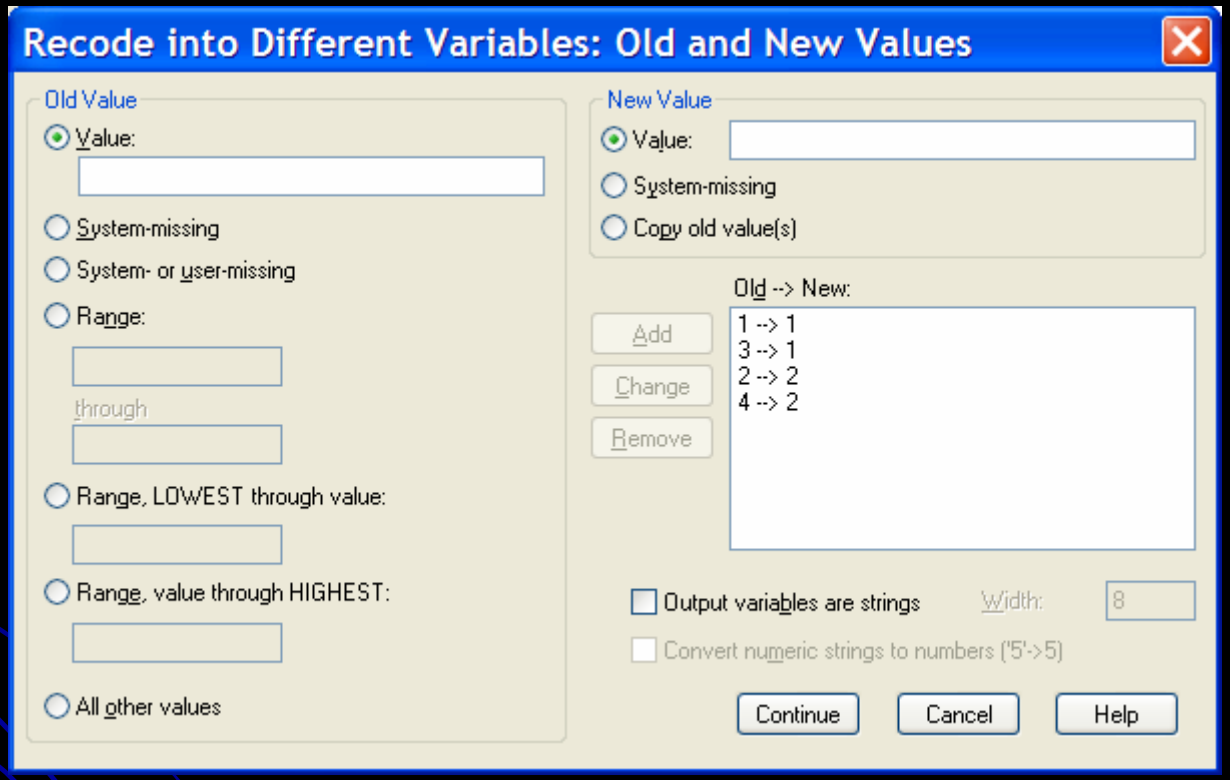
Αλλαγή Κωδικοποίησης (7)



Αλλαγή Κωδικοποίησης (8)



Αλλαγή Κωδικοποίησης (9)



Δημιουργία της μεταβλητής Groups

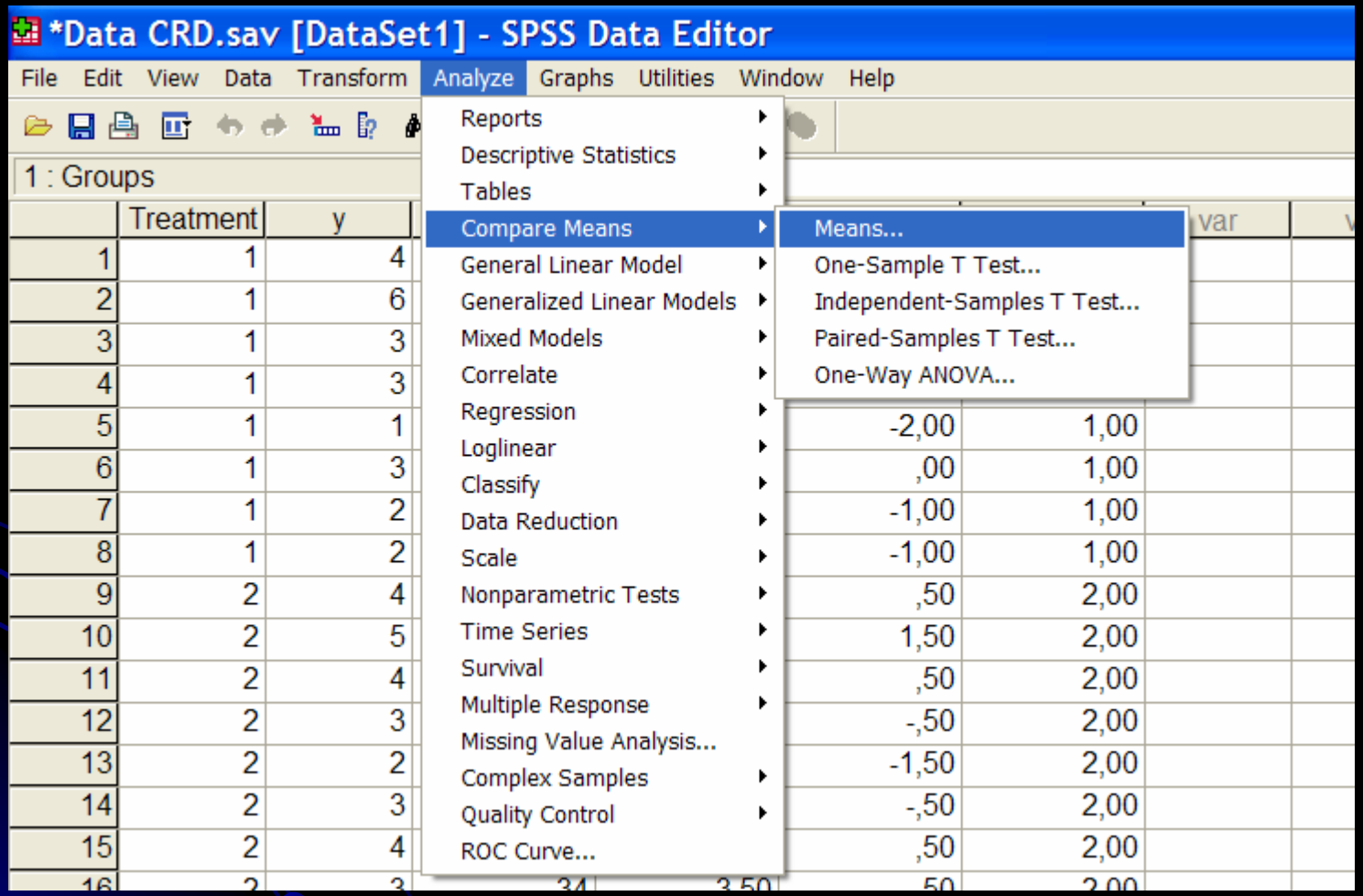
*Data CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

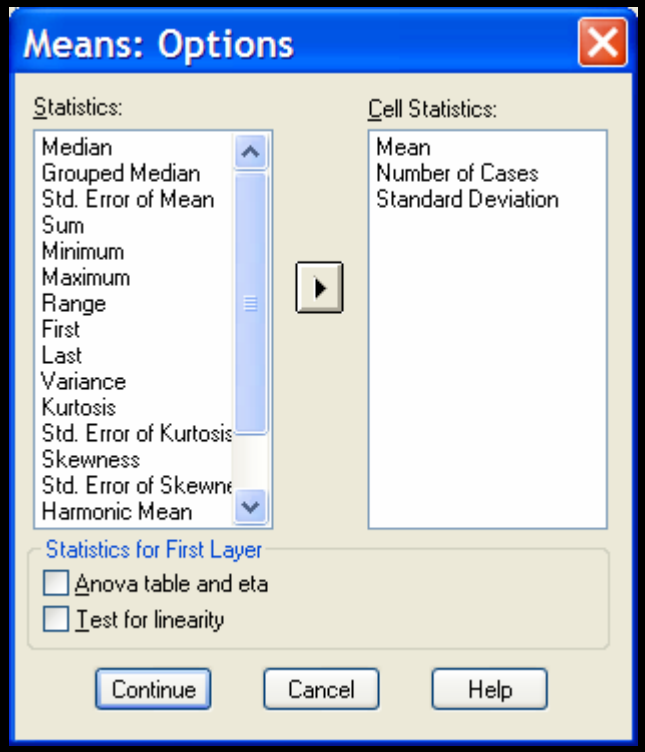
1 : Groups 1

	Treatment	y	ZRE_1	PRE_1	RES_1	Groups	var
1	1	4	,68	3,00	1,00	1,00	
2	1	6	2,03	3,00	3,00	1,00	
3	1	3	,00	3,00	,00	1,00	
4	1	3	,00	3,00	,00	1,00	
5	1	1	-1,36	3,00	-2,00	1,00	
6	1	3	,00	3,00	,00	1,00	
7	1	2	-,68	3,00	-1,00	1,00	
8	1	2	-,68	3,00	-1,00	1,00	
9	2	4	,34	3,50	,50	2,00	
10	2	5	1,02	3,50	1,50	2,00	
11	2	4	,34	3,50	,50	2,00	
12	2	3	-,34	3,50	-,50	2,00	
13	2	2	-1,02	3,50	-1,50	2,00	
14	2	3	-,34	3,50	-,50	2,00	
15	2	4	,34	3,50	,50	2,00	
16	2	3	,34	3,50	,50	2,00	

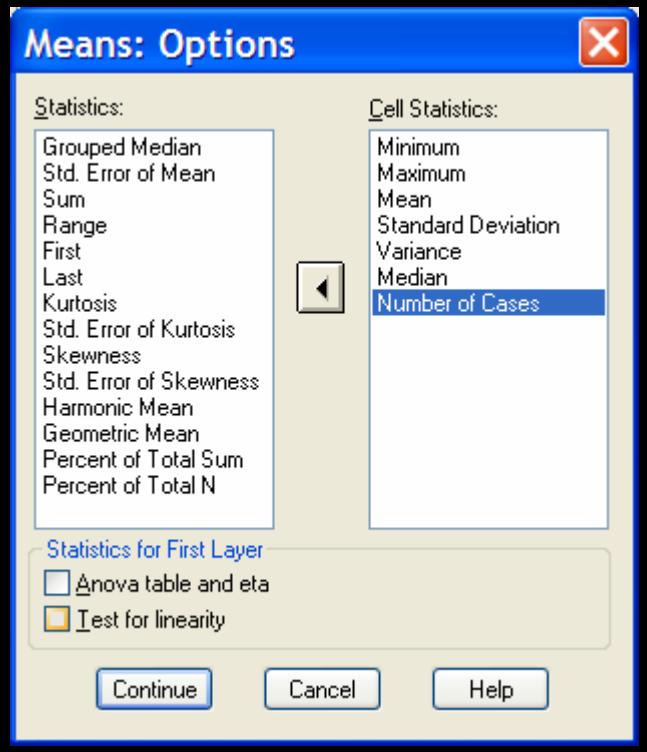
Επιλογή Στατιστικής Διαδικασίας



Εντολές και Ρυθμίσεις (1)



Εντολές και Ρυθμίσεις (2)



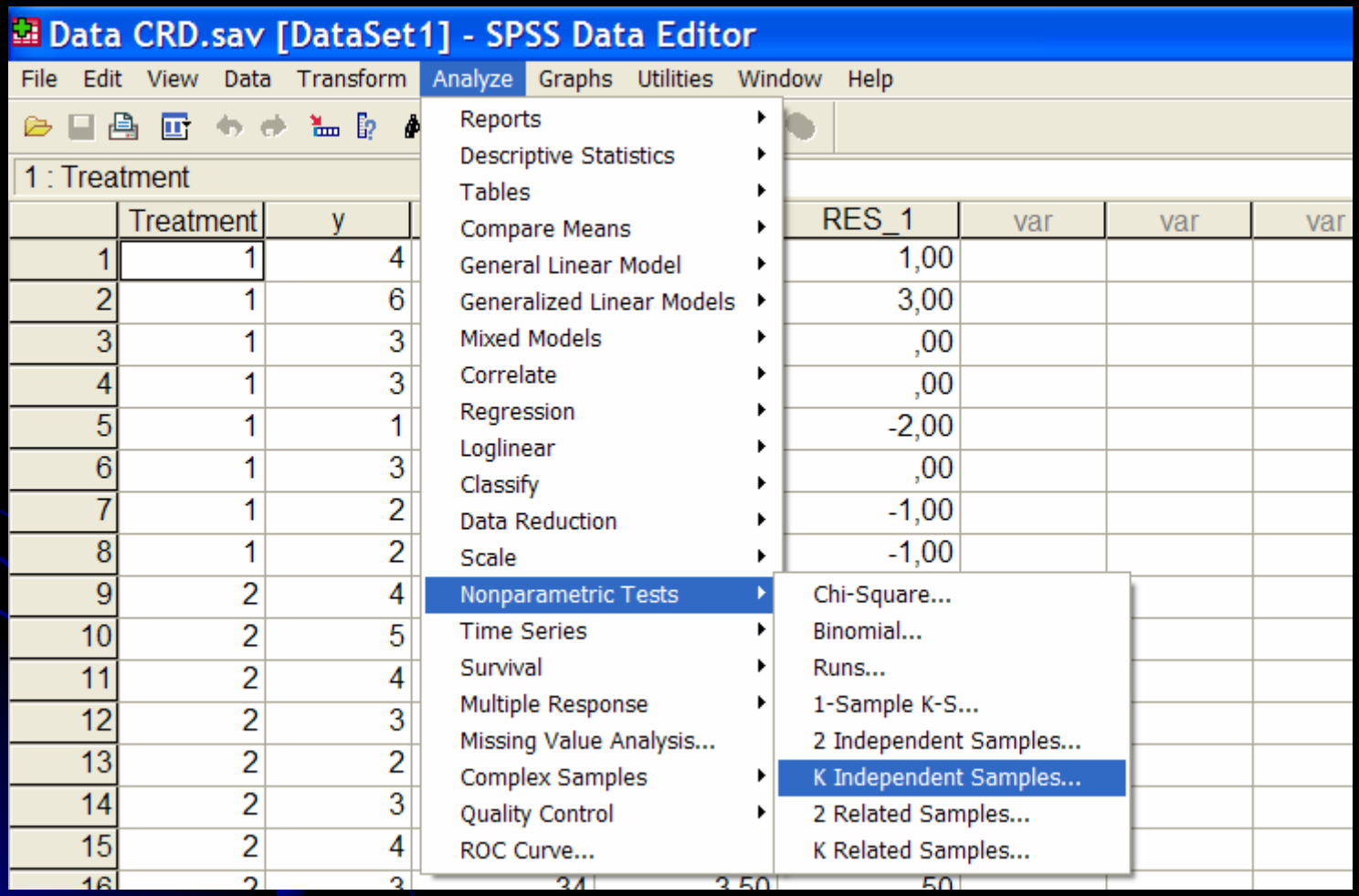
Αποτελέσματα SPSS

Report

y

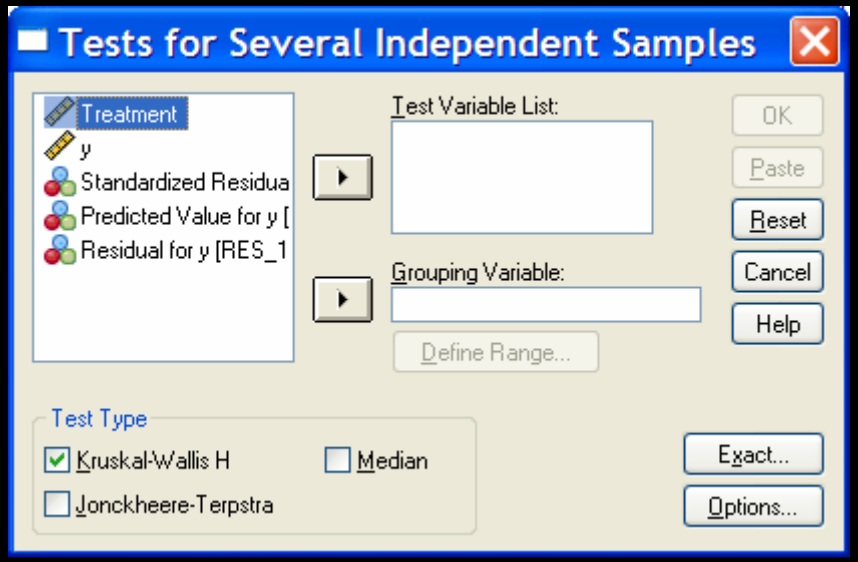
Groups	Minimum	Maximum	Mean	Std. Deviation	Variance	Median	N
1,00	1	6	3,63	1,408	1,983	3,50	16
2,00	2	10	4,88	2,125	4,517	4,50	16
Total	1	10	4,25	1,884	3,548	4,00	32

Μη Παραμετρική Προσέγγιση

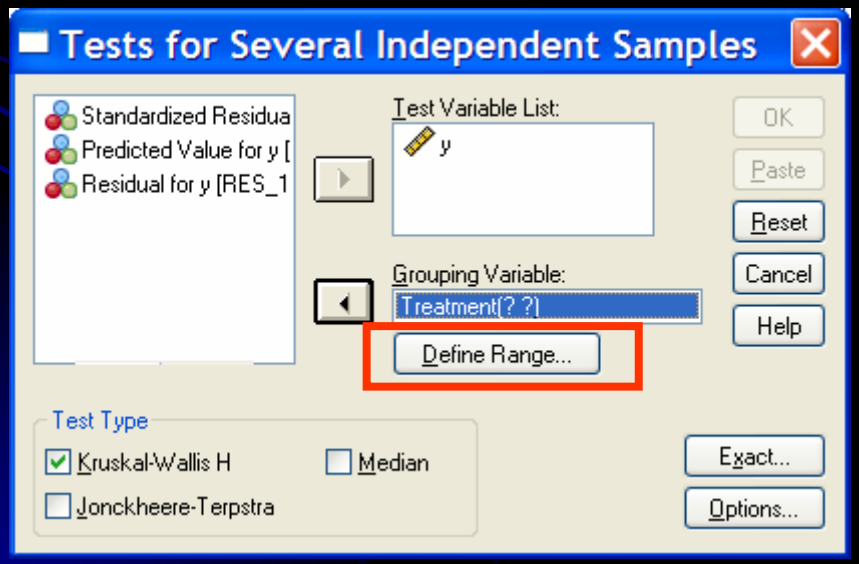


Εντολές και Ρυθμίσεις

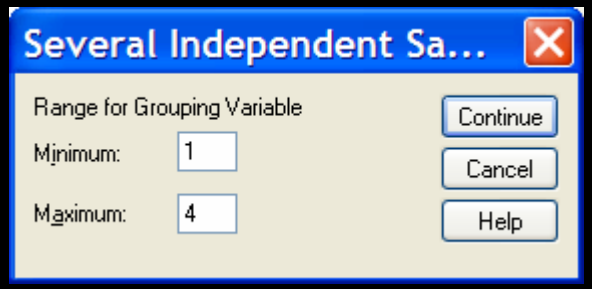
1



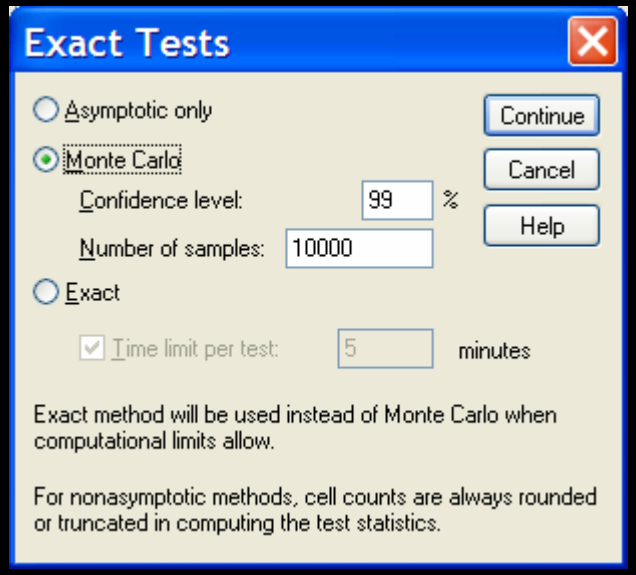
2



3



4



Αποτελέσματα SPSS

Ranks

	Treatment	N	Mean Rank
y	1	8	9,81
	2	8	13,00
	3	8	17,81
	4	8	25,38
	Total	32	

Test Statistics[b,c]

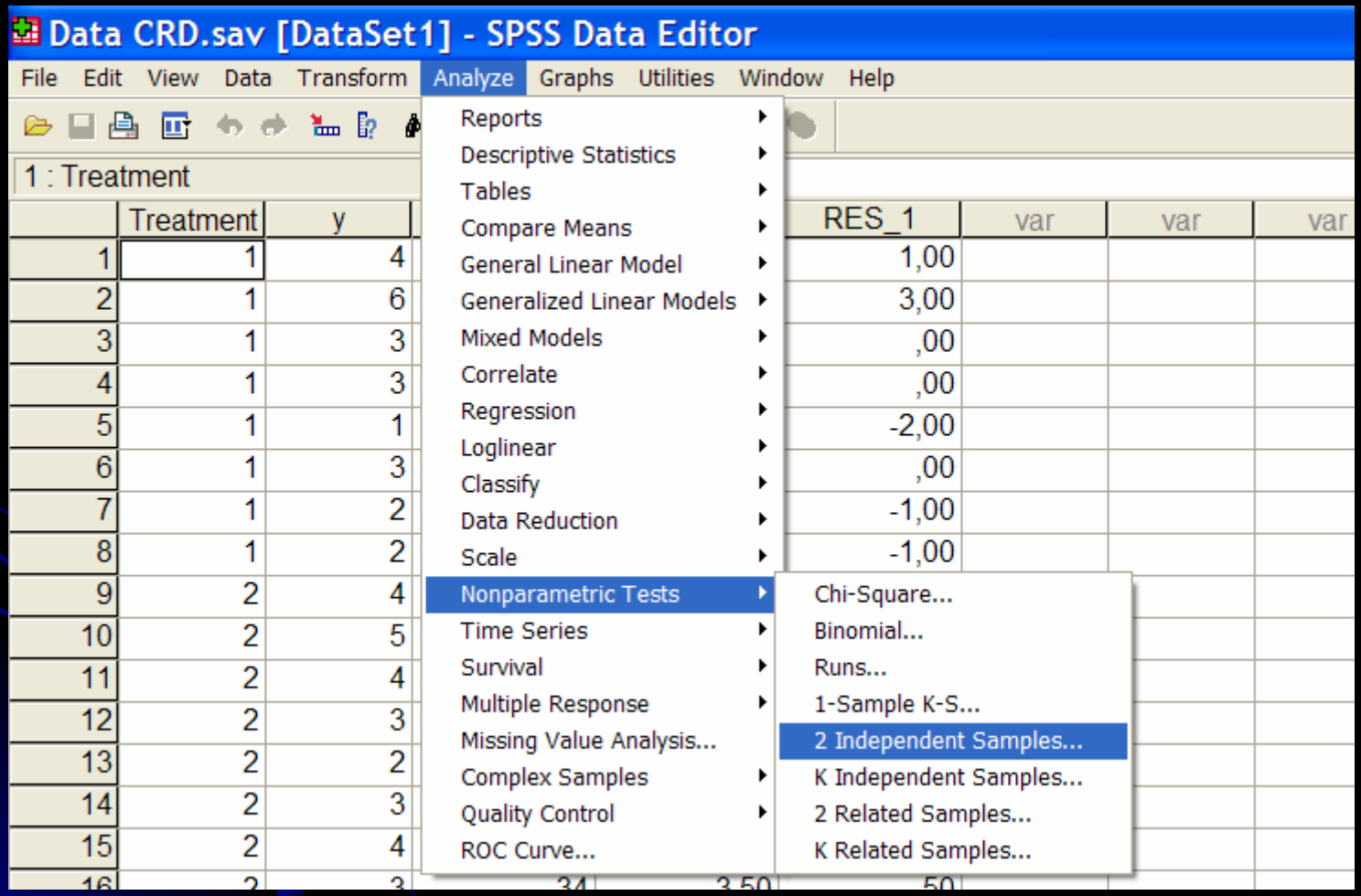
			y
Chi-Square			12,997
df			3
Asymp. Sig.			,005
Monte Carlo Sig.	Sig.		,002[a]
	99% Confidence Interval	Lower Bound	,001
		Upper Bound	,003

a. Based on 10000 sampled tables with starting seed 2000000.

b. Kruskal Wallis Test

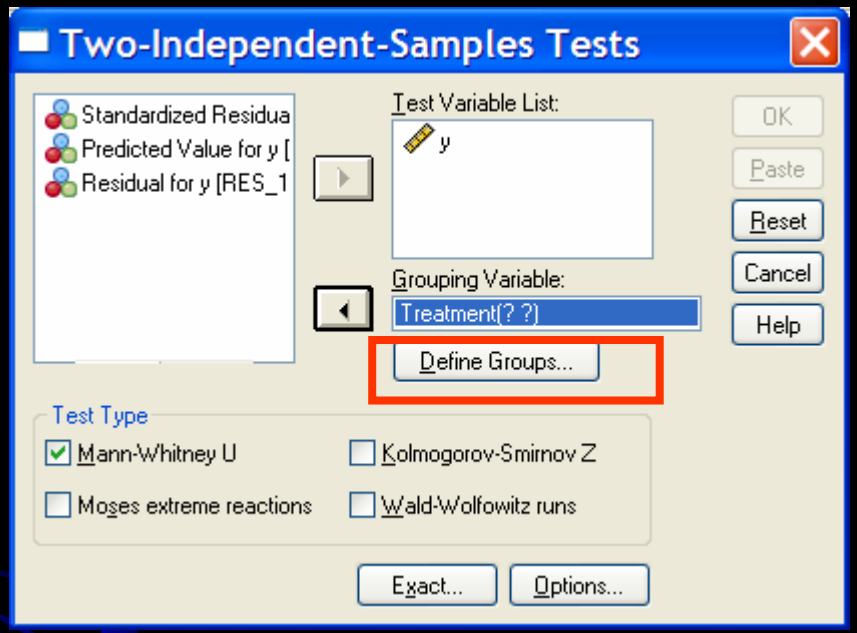
c. Grouping Variable: Treatment

Επιλογή Στατιστικής Διαδικασίας

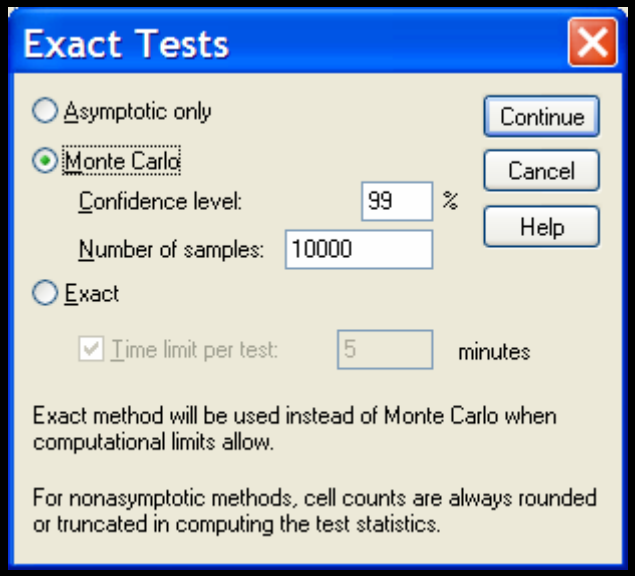


Εντολές και Ρυθμίσεις (1)

1



2



3

Αποτελέσματα SPSS

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
y	1	8	7,25	58,00
	2	8	9,75	78,00
	Total	16		

Test Statistics[c]

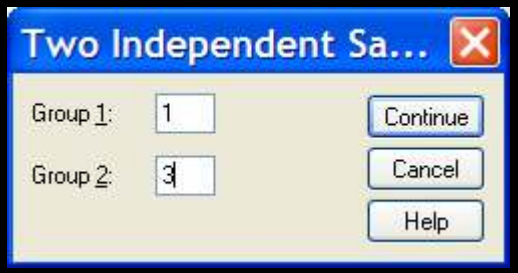
			y
Mann-Whitney U			22,000
Wilcoxon W			58,000
Z			-1,090
Asymp. Sig. (2-tailed)			,276
Exact Sig. [2*(1-tailed Sig.)]			,328[a]
Monte Carlo Sig. (2-tailed)	Sig.		,302[b]
	99% Confidence Interval	Lower Bound	,290
		Upper Bound	,314
Monte Carlo Sig. (1-tailed)	Sig.		,153[b]
	99% Confidence Interval	Lower Bound	,144
		Upper Bound	,162

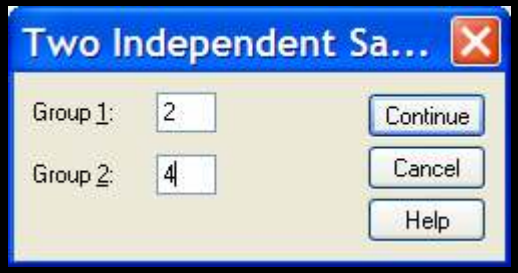
a. Not corrected for ties.

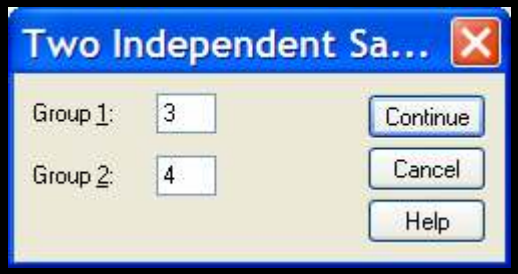
b. Based on 10000 sampled tables with starting seed 299883525.

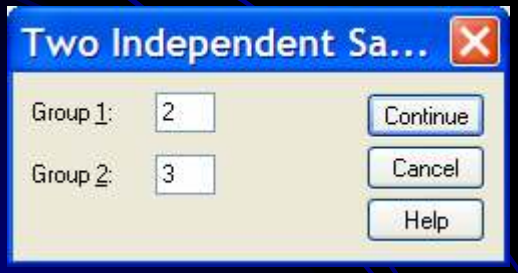
c. Grouping Variable: Treatment

Εντολές και Ρυθμίσεις (2)









Αν τα Treatments είναι περισσότερα από 3 τότε θα πρέπει να γίνει διόρθωση κατά Bonferroni στο επίπεδο σημαντικότητας των ελέγχων Mann-Whitney

Αποτελέσματα SPSS (1)

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
y	1	8	6,25	50,00
	3	8	10,75	86,00
	Total	16		

Test Statistics[c]

			y
Mann-Whitney U			14,000
Wilcoxon W			50,000
Z			-1,938
Asymp. Sig. (2-tailed)			,053
Exact Sig. [2*(1-tailed Sig.)]			,065[a]
Monte Carlo Sig. (2-tailed)	Sig.		,063[b]
	99% Confidence Interval	Lower Bound	,057
		Upper Bound	,070
Monte Carlo Sig. (1-tailed)	Sig.		,029[b]
	99% Confidence Interval	Lower Bound	,025
		Upper Bound	,034

a. Not corrected for ties.

b. Based on 10000 sampled tables with starting seed 926214481.

c. Grouping Variable: Treatment

Διόρθωση Bonferroni
α=(0,05/6)=0,0083

Αποτελέσματα SPSS (2)

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
y	1	8	5,31	42,50
	4	8	11,69	93,50
	Total	16		

Test Statistics[c]

			y
Mann-Whitney U			6,500
Wilcoxon W			42,500
Z			-2,710
Asymp. Sig. (2-tailed)			,007
Exact Sig. [2*(1-tailed Sig.)]			,005[a]
Monte Carlo Sig. (2-tailed)	Sig.		,005[b]
	99% Confidence Interval	Lower Bound	,003
		Upper Bound	,007
Monte Carlo Sig. (1-tailed)	Sig.		,003[b]
	99% Confidence Interval	Lower Bound	,001
		Upper Bound	,004

a. Not corrected for ties.

b. Based on 10000 sampled tables with starting seed 1314643744.

c. Grouping Variable: Treatment

Αποτελέσματα SPSS (3)

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
y	2	8	6,94	55,50
	3	8	10,06	80,50
	Total	16		

Test Statistics[c]

			y
Mann-Whitney U			19,500
Wilcoxon W			55,500
Z			-1,374
Asymp. Sig. (2-tailed)			,170
Exact Sig. [2*(1-tailed Sig.)]			,195[a]
Monte Carlo Sig. (2-tailed)	Sig.		,223[b]
	99% Confidence Interval	Lower Bound	,213
		Upper Bound	,234
Monte Carlo Sig. (1-tailed)	Sig.		,114[b]
	99% Confidence Interval	Lower Bound	,106
		Upper Bound	,122

a. Not corrected for ties.

b. Based on 10000 sampled tables with starting seed 624387341.

c. Grouping Variable: Treatment

Αποτελέσματα SPSS (4)

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
y	2	8	5,31	42,50
	4	8	11,69	93,50
	Total	16		

Test Statistics[c]

			y
Mann-Whitney U			6,500
Wilcoxon W			42,500
Z			-2,716
Asymp. Sig. (2-tailed)			,007
Exact Sig. [2*(1-tailed Sig.)]			,005[a]
Monte Carlo Sig. (2-tailed)	Sig.		,004[b]
	99% Confidence Interval	Lower Bound	,003
		Upper Bound	,006
Monte Carlo Sig. (1-tailed)	Sig.		,002[b]
	99% Confidence Interval	Lower Bound	,001
		Upper Bound	,003

a. Not corrected for ties.

b. Based on 10000 sampled tables with starting seed 334431365.

c. Grouping Variable: Treatment

Αποτελέσματα SPSS (5)

Ranks

	Treatment	N	Mean Rank	Sum of Ranks
y	3	8	6,00	48,00
	4	8	11,00	88,00
	Total	16		

Test Statistics[c]

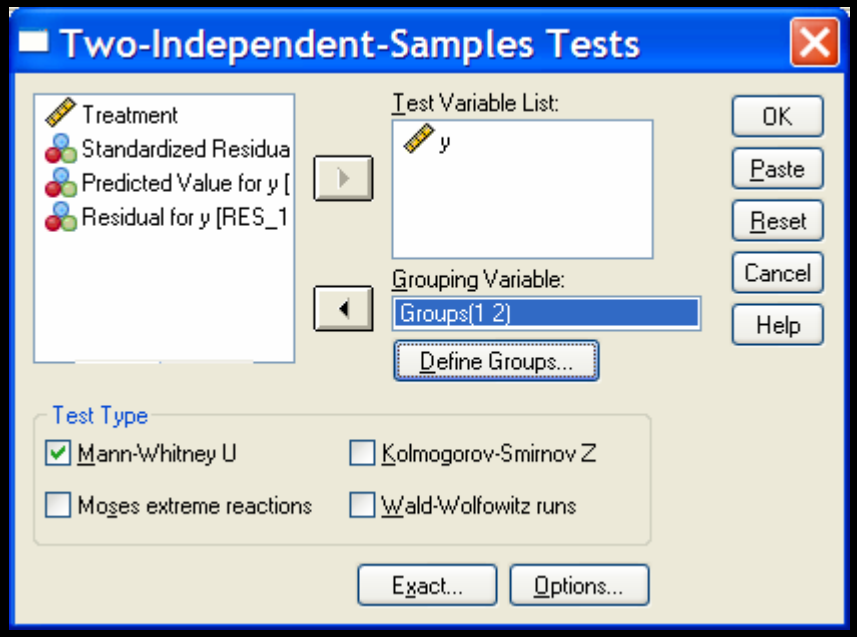
			y
Mann-Whitney U			12,000
Wilcoxon W			48,000
Z			-2,135
Asymp. Sig. (2-tailed)			,033
Exact Sig. [2*(1-tailed Sig.)]			,038[a]
Monte Carlo Sig. (2-tailed)	Sig.		,033[b]
	99% Confidence Interval	Lower Bound	,029
		Upper Bound	,038
Monte Carlo Sig. (1-tailed)	Sig.		,016[b]
	99% Confidence Interval	Lower Bound	,013
		Upper Bound	,019

a. Not corrected for ties.

b. Based on 10000 sampled tables with starting seed 1502173562.

c. Grouping Variable: Treatment

Σύγκριση Ομάδων Μέσων Όρων



Αποτελέσματα SPSS

Ranks

	Groups	N	Mean Rank	Sum of Ranks
y	1,00	16	13,81	221,00
	2,00	16	19,19	307,00
	Total	32		

Test Statistics[c]

			y
Mann-Whitney U			85,000
Wilcoxon W			221,000
Z			-1,653
Asymp. Sig. (2-tailed)			,098
Exact Sig. [2*(1-tailed Sig.)]			,110[a]
Monte Carlo Sig. (2-tailed)	Sig.		,103[b]
	99% Confidence Interval	Lower Bound	,095
		Upper Bound	,111
Monte Carlo Sig. (1-tailed)	Sig.		,051[b]
	99% Confidence Interval	Lower Bound	,045
		Upper Bound	,057

a. Not corrected for ties.

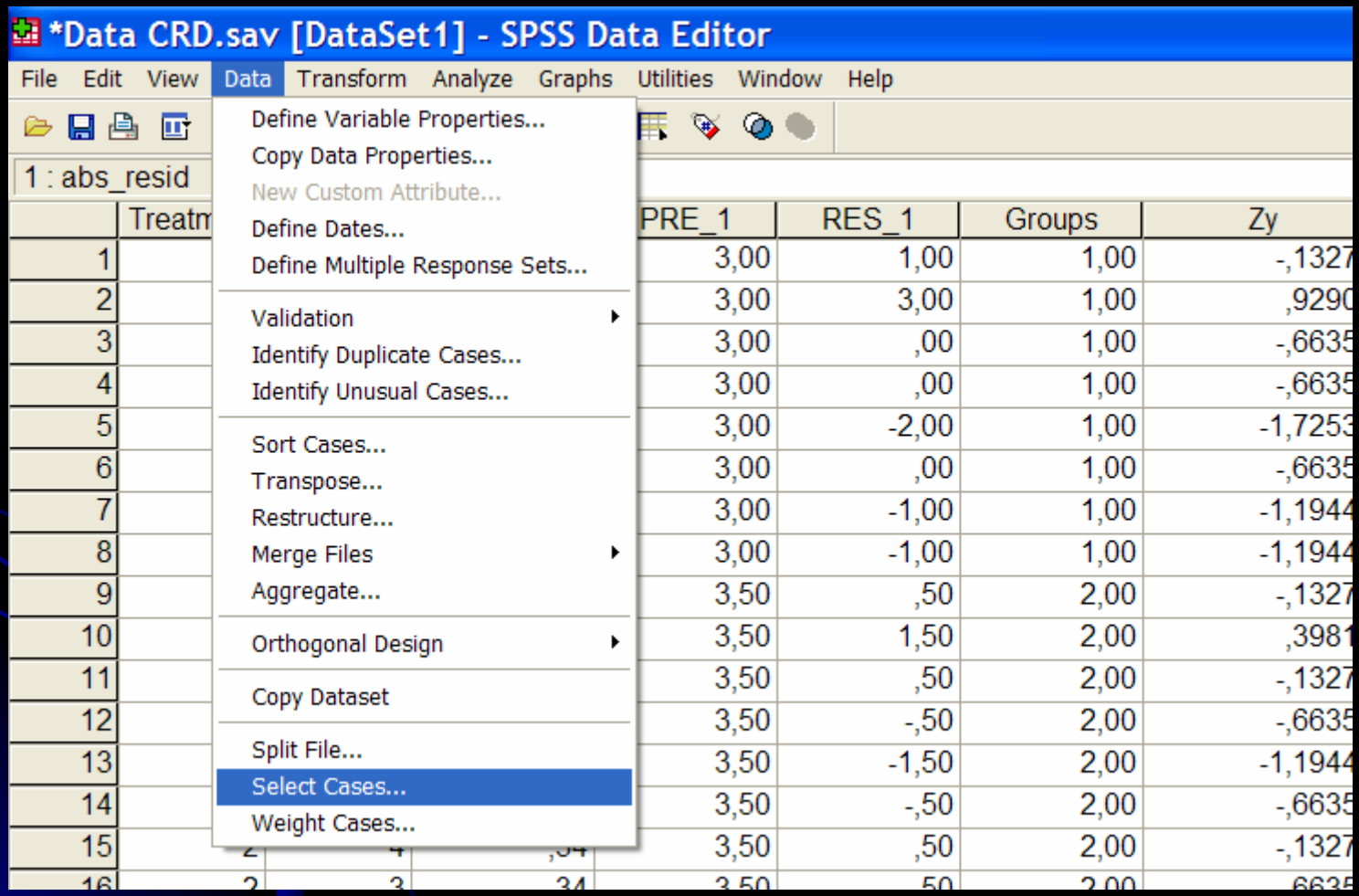
b. Based on 10000 sampled tables with starting seed 743671174.

c. Grouping Variable: Groups

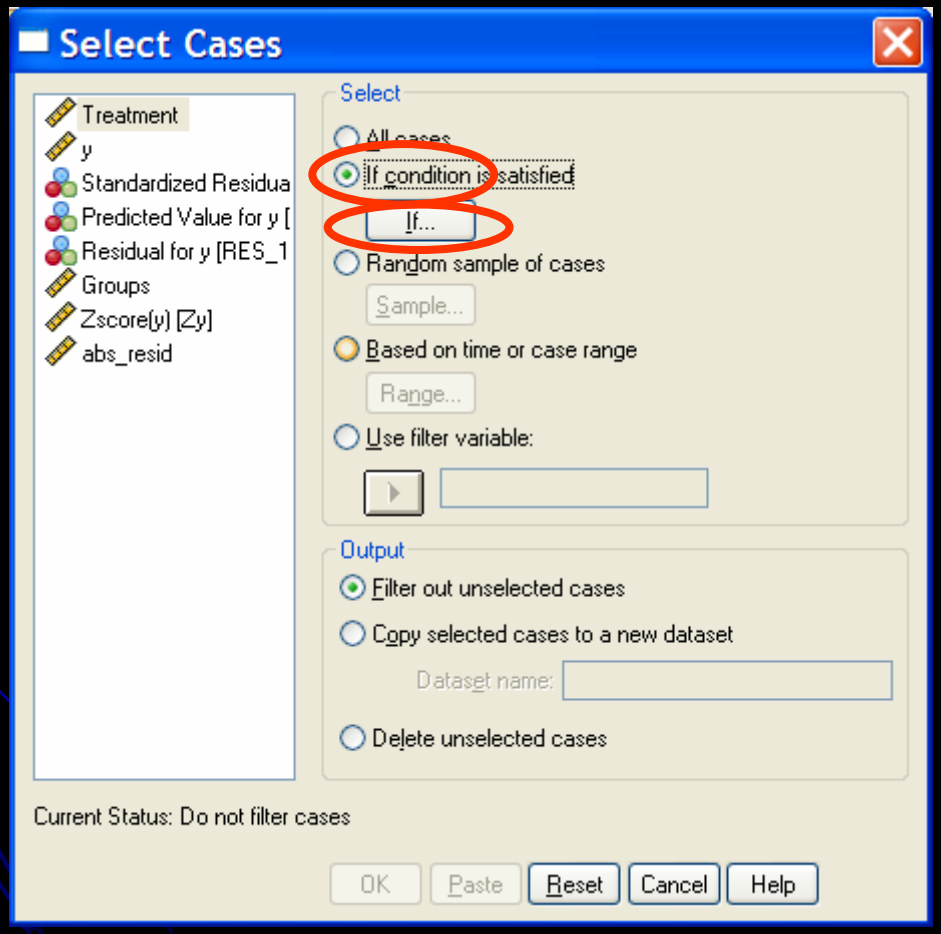
Ειδική Περίπτωση Γ

- Θέλουμε να εξαιρέσουμε την επέμβαση Δ από τις αναλύσεις.

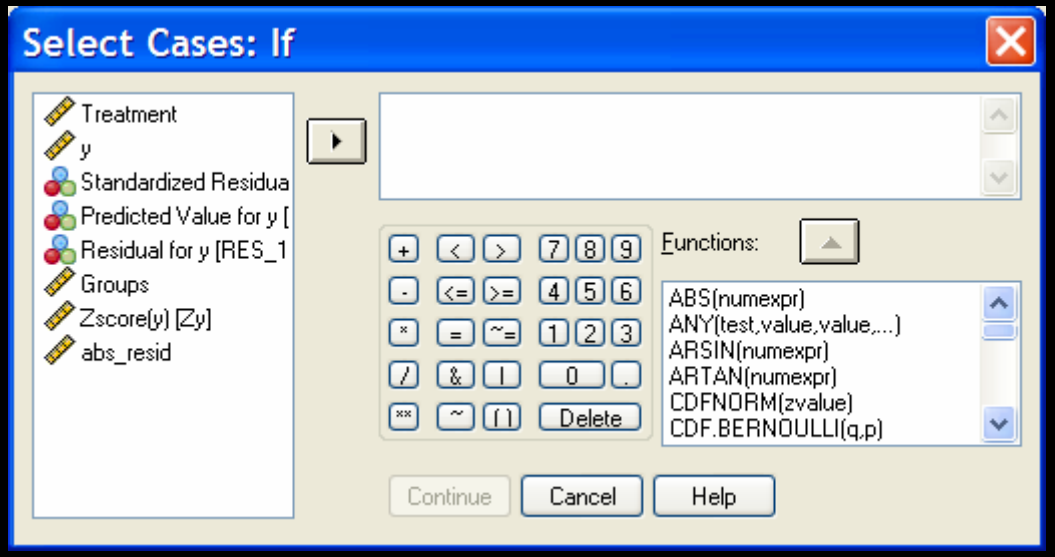
Εντολές και Ρυθμίσεις (1)



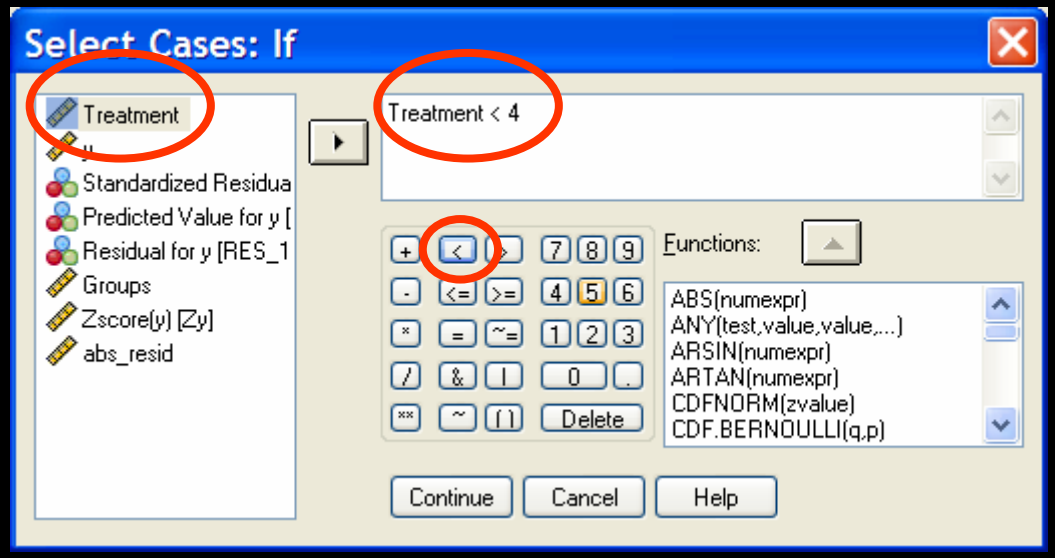
Εντολές και Ρυθμίσεις (2)



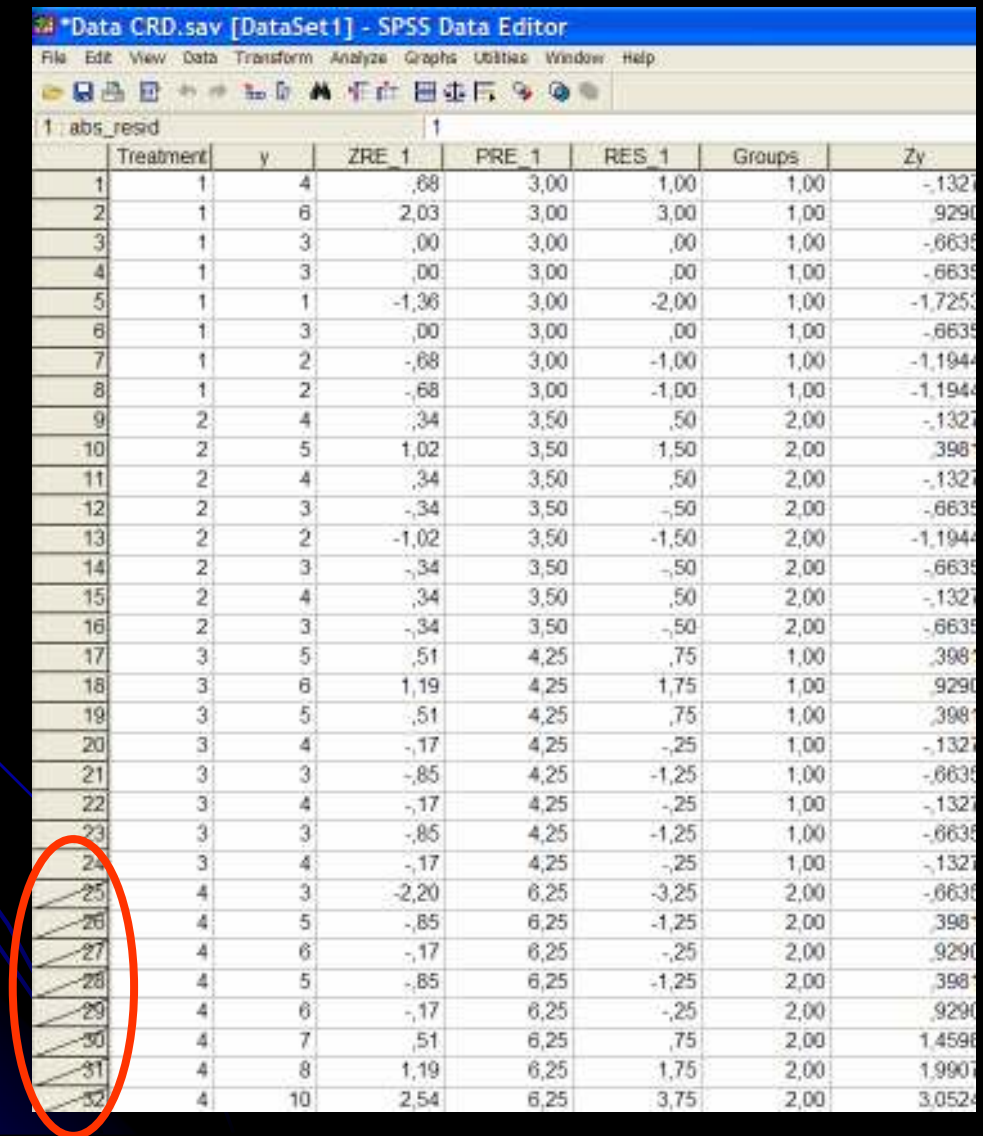
Εντολές και Ρυθμίσεις (3)



Εντολές και Ρυθμίσεις (4)



Επιλογή Γραμμών



	Treatment	y	ZRE_1	PRE_1	RES_1	Groups	Zy
1	1	4	,68	3,00	1,00	1,00	-,1327
2	1	6	2,03	3,00	3,00	1,00	,9290
3	1	3	,00	3,00	,00	1,00	-,6635
4	1	3	,00	3,00	,00	1,00	-,6635
5	1	1	-1,36	3,00	-2,00	1,00	-1,7253
6	1	3	,00	3,00	,00	1,00	-,6635
7	1	2	-,68	3,00	-1,00	1,00	-1,1944
8	1	2	-,68	3,00	-1,00	1,00	-1,1944
9	2	4	,34	3,50	,50	2,00	-,1327
10	2	5	1,02	3,50	1,50	2,00	,3981
11	2	4	,34	3,50	,50	2,00	-,1327
12	2	3	-,34	3,50	-,50	2,00	-,6635
13	2	2	-1,02	3,50	-1,50	2,00	-1,1944
14	2	3	-,34	3,50	-,50	2,00	-,6635
15	2	4	,34	3,50	,50	2,00	-,1327
16	2	3	-,34	3,50	-,50	2,00	-,6635
17	3	5	,51	4,25	,75	1,00	,3981
18	3	6	1,19	4,25	1,75	1,00	,9290
19	3	5	,51	4,25	,75	1,00	,3981
20	3	4	-,17	4,25	-,25	1,00	-,1327
21	3	3	-,85	4,25	-1,25	1,00	-,6635
22	3	4	-,17	4,25	-,25	1,00	-,1327
23	3	3	-,85	4,25	-1,25	1,00	-,6635
24	3	4	-,17	4,25	-,25	1,00	-,1327
25	4	3	-2,20	6,25	-3,25	2,00	-,6635
26	4	5	-,85	6,25	-1,25	2,00	,3981
27	4	6	-,17	6,25	-,25	2,00	,9290
28	4	5	-,85	6,25	-1,25	2,00	,3981
29	4	6	-,17	6,25	-,25	2,00	,9290
30	4	7	,51	6,25	,75	2,00	1,4598
31	4	8	1,19	6,25	1,75	2,00	1,9907
32	4	10	2,54	6,25	3,75	2,00	3,0524

Αυτόματη Δημιουργία Φίλτρου

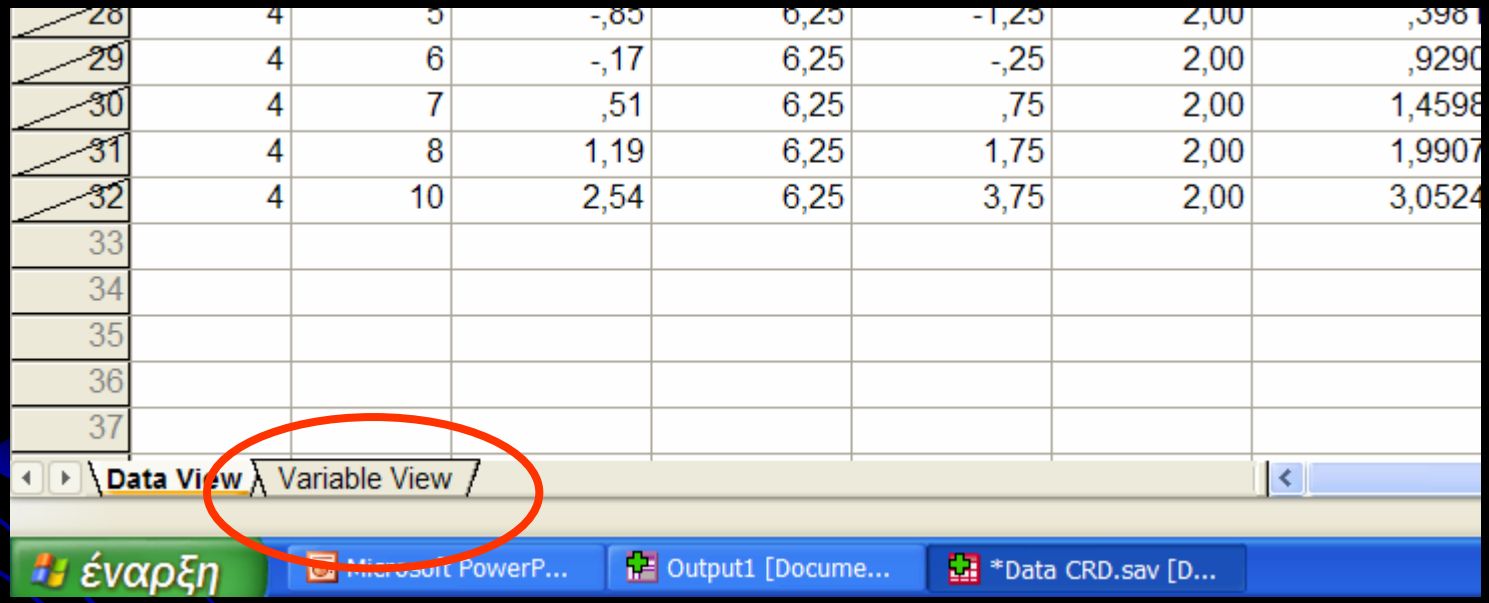
*Data CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

1 : abs_resid 1

	Treatment	y	ZRE_1	PRE_1	RES_1	Groups	Zy	abs_resi	filter_$
1	1	4	,68	3,00	1,00	1,00	-,13272	1,00	1
2	1	6	2,03	3,00	3,00	1,00	,92901	3,00	1
3	1	3	,00	3,00	,00	1,00	-,66358	,00	1
4	1	3	,00	3,00	,00	1,00	-,66358	,00	1
5	1	1	-1,36	3,00	-2,00	1,00	-1,72531	2,00	1
6	1	3	,00	3,00	,00	1,00	-,66358	,00	1
7	1	2	-,68	3,00	-1,00	1,00	-1,19445	1,00	1
8	1	2	-,68	3,00	-1,00	1,00	-1,19445	1,00	1
9	2	4	,34	3,50	,50	2,00	-,13272	,50	1
10	2	5	1,02	3,50	1,50	2,00	,39815	1,50	1
11	2	4	,34	3,50	,50	2,00	-,13272	,50	1
12	2	3	-,34	3,50	-,50	2,00	-,66358	,50	1
13	2	2	-1,02	3,50	-1,50	2,00	-1,19445	1,50	1
14	2	3	-,34	3,50	-,50	2,00	-,66358	,50	1
15	2	4	,34	3,50	,50	2,00	-,13272	,50	1
16	2	3	-,34	3,50	-,50	2,00	-,66358	,50	1
17	3	5	,51	4,25	,75	1,00	,39815	,75	1
18	3	6	1,19	4,25	1,75	1,00	,92901	1,75	1
19	3	5	,51	4,25	,75	1,00	,39815	,75	1
20	3	4	-,17	4,25	-,25	1,00	-,13272	,25	1
21	3	3	-,85	4,25	-1,25	1,00	-,66358	1,25	1
22	3	4	-,17	4,25	-,25	1,00	-,13272	,25	1
23	3	3	-,85	4,25	-1,25	1,00	-,66358	1,25	1
24	3	4	-,17	4,25	-,25	1,00	-,13272	,25	1
25	4	3	-2,20	6,25	-3,25	2,00	-,66358	3,25	0
26	4	5	-,85	6,25	-1,25	2,00	,39815	1,25	0
27	4	6	-,17	6,25	-,25	2,00	,92901	,25	0
28	4	5	-,85	6,25	-1,25	2,00	,39815	1,25	0
29	4	6	-,17	6,25	-,25	2,00	,92901	,25	0
30	4	7	,51	6,25	,75	2,00	1,45988	,75	0
31	4	8	1,19	6,25	1,75	2,00	1,99075	1,75	0
32	4	10	2,54	6,25	3,75	2,00	3,05248	3,75	0

Διατήρηση Μεταβλητής Φίλτρου



28	4	5	-,85	6,25	-1,25	2,00	,398
29	4	6	-,17	6,25	-,25	2,00	,9290
30	4	7	,51	6,25	,75	2,00	1,4598
31	4	8	1,19	6,25	1,75	2,00	1,9907
32	4	10	2,54	6,25	3,75	2,00	3,0524
33							
34							
35							
36							
37							

Εντολές και Ρυθμίσεις (1)

*Data CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Colu
1	Treatment	Numeric	8	0		None	None	8
2	y	Numeric	8	0		None	None	8
3	ZRE_1	Numeric	8	2	Standardized	None	None	10
4	PRE_1	Numeric	8	2	Predicted Val	None	None	10
5	RES_1	Numeric	8	2	Residual for y	None	None	10
6	Groups	Numeric	8	2		None	None	10
7	Zy	Numeric	11	5	Zscore(y)	None	None	13
8	abs_resid	Numeric	8	2		None	None	11
9	filter_$	Numeric	1	0	Treatment <=	{0, Not Select	None	10
10								
11								
12								
13								
14								
15								
16								

Εντολές και Ρυθμίσεις (2)

*Data CRD.sav [DataSet1] - SPSS Data Editor

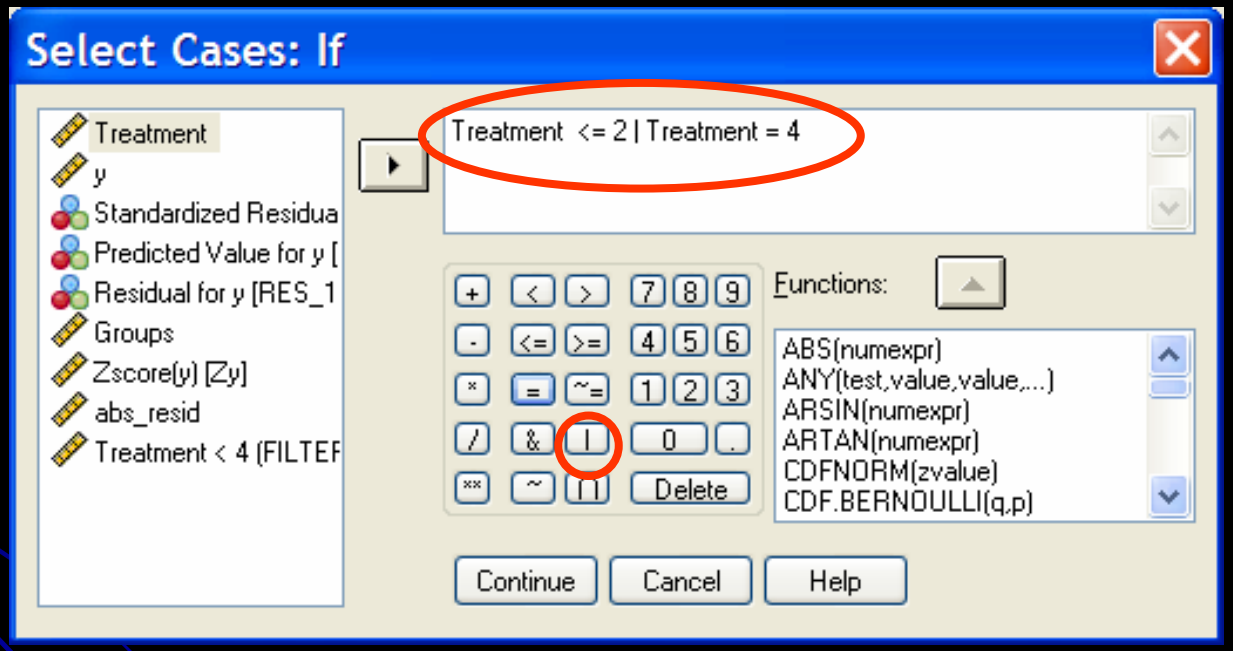
File Edit View Data Transform Analyze Graphs Utilities Window Help

	Name	Type	Width	Decimals	Label	Values	Missing	Colu
1	Treatment	Numeric	8	0		None	None	8
2	y	Numeric	8	0		None	None	8
3	ZRE_1	Numeric	8	2	Standardized	None	None	10
4	PRE_1	Numeric	8	2	Predicted Val	None	None	10
5	RES_1	Numeric	8	2	Residual for y	None	None	10
6	Groups	Numeric	8	2		None	None	10
7	Zy	Numeric	11	5	Zscore(y)	None	None	13
8	abs_resid	Numeric	8	2		None	None	11
9	Myfilter1	Numeric	1	0	Treatment <=	{0, Not Select	None	10
10								
11								
12								
13								
14								
15								
16								

Ειδική περίπτωση Δ

- Θέλουμε να εξαιρέσουμε την επέμβαση Γ από τις αναλύσεις.

Εντολές και Ρυθμίσεις



Επιλογή Γραμμών

*Data CRD.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

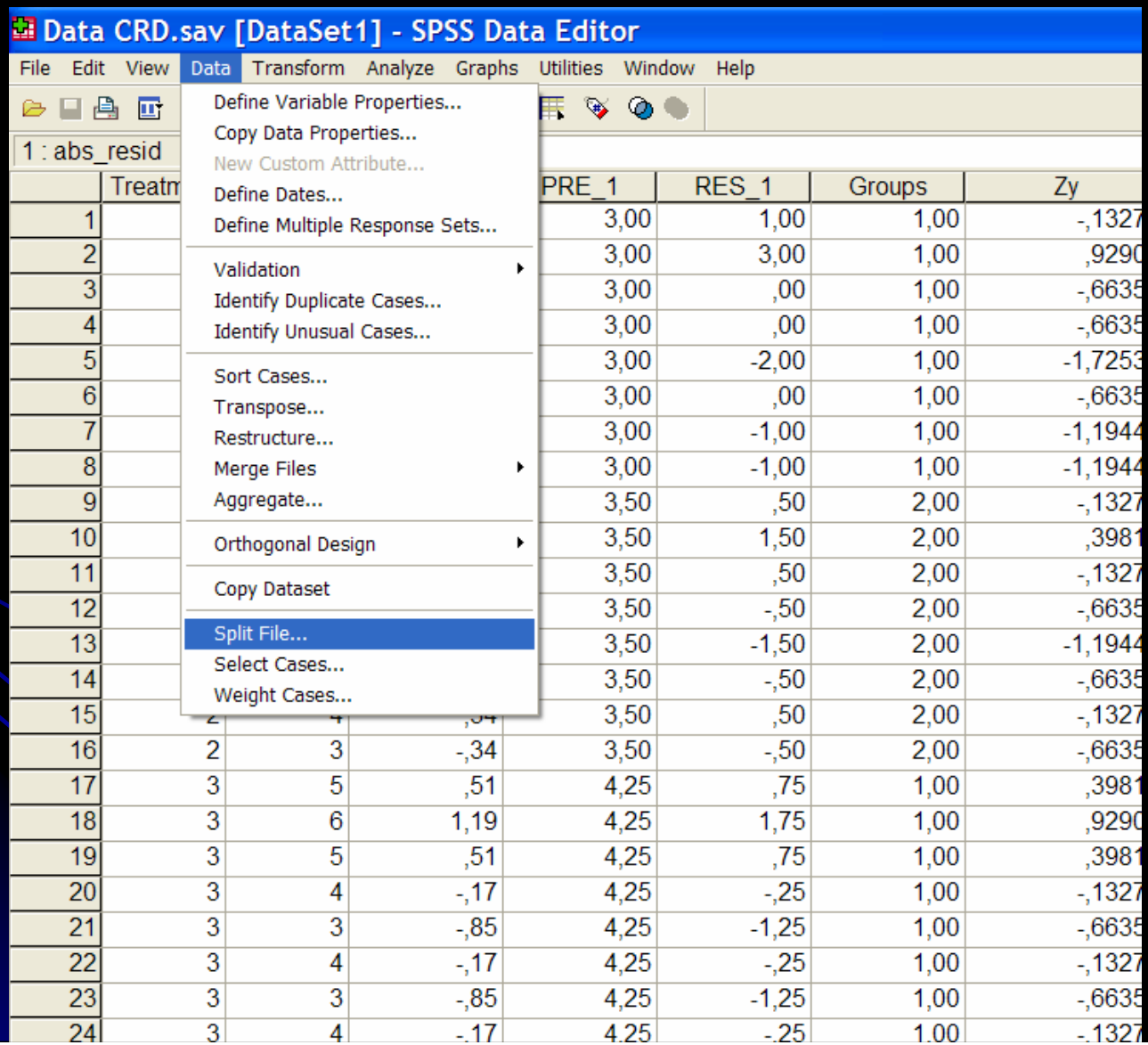
1 : abs_resid 1

	Treatment	y	ZRE_1	PRE_1	RES_1	Groups	Zy
1	1	4	,68	3,00	1,00	1,00	-,1327
2	1	6	2,03	3,00	3,00	1,00	,9290
3	1	3	,00	3,00	,00	1,00	-,6635
4	1	3	,00	3,00	,00	1,00	-,6635
5	1	1	-1,36	3,00	-2,00	1,00	-1,7253
6	1	3	,00	3,00	,00	1,00	-,6635
7	1	2	-,68	3,00	-1,00	1,00	-1,1944
8	1	2	-,68	3,00	-1,00	1,00	-1,1944
9	2	4	,34	3,50	,50	2,00	-,1327
10	2	5	1,02	3,50	1,50	2,00	,3981
11	2	4	,34	3,50	,50	2,00	-,1327
12	2	3	-,34	3,50	-,50	2,00	-,6635
13	2	2	-1,02	3,50	-1,50	2,00	-1,1944
14	2	3	-,34	3,50	-,50	2,00	-,6635
15	2	4	,34	3,50	,50	2,00	-,1327
16	2	3	-,34	3,50	-,50	2,00	-,6635
17	3	5	,51	4,25	,75	1,00	,3981
18	3	6	1,19	4,25	1,75	1,00	,9290
19	3	5	,51	4,25	,75	1,00	,3981
20	3	4	-,17	4,25	-,25	1,00	-,1327
21	3	3	-,85	4,25	-1,25	1,00	-,6635
22	3	4	-,17	4,25	-,25	1,00	-,1327
23	3	3	-,85	4,25	-1,25	1,00	-,6635
24	3	4	-,17	4,25	-,25	1,00	-,1327
25	4	3	-2,20	6,25	-3,25	2,00	-,6635
26	4	5	-,85	6,25	-1,25	2,00	,3981
27	4	6	-,17	6,25	-,25	2,00	,9290
28	4	5	-,85	6,25	-1,25	2,00	,3981
29	4	6	-,17	6,25	-,25	2,00	,9290
30	4	7	,51	6,25	,75	2,00	1,4598
31	4	8	1,19	6,25	1,75	2,00	1,9907
32	4	10	2,54	6,25	3,75	2,00	3,0524

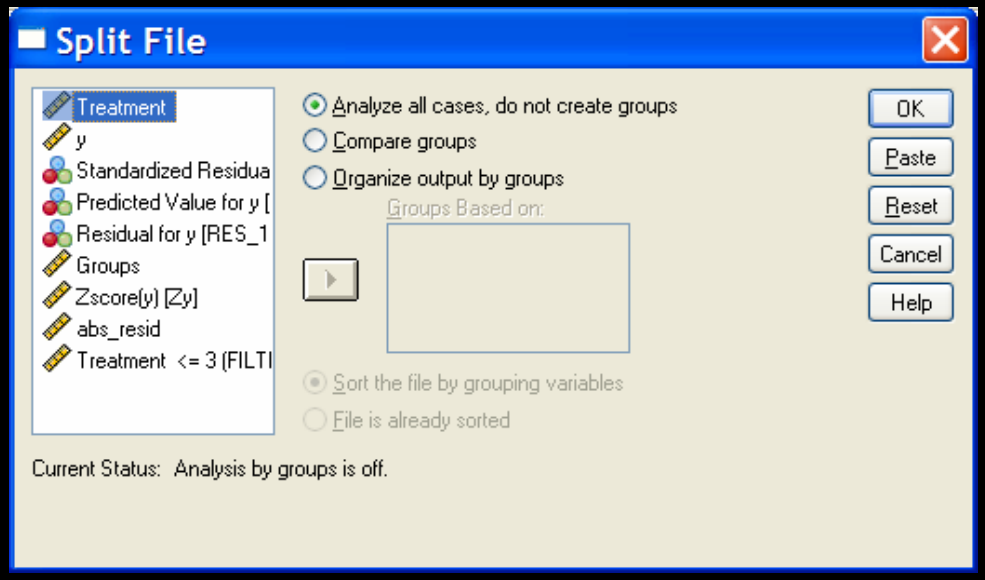
Ειδική Περίπτωση Ε

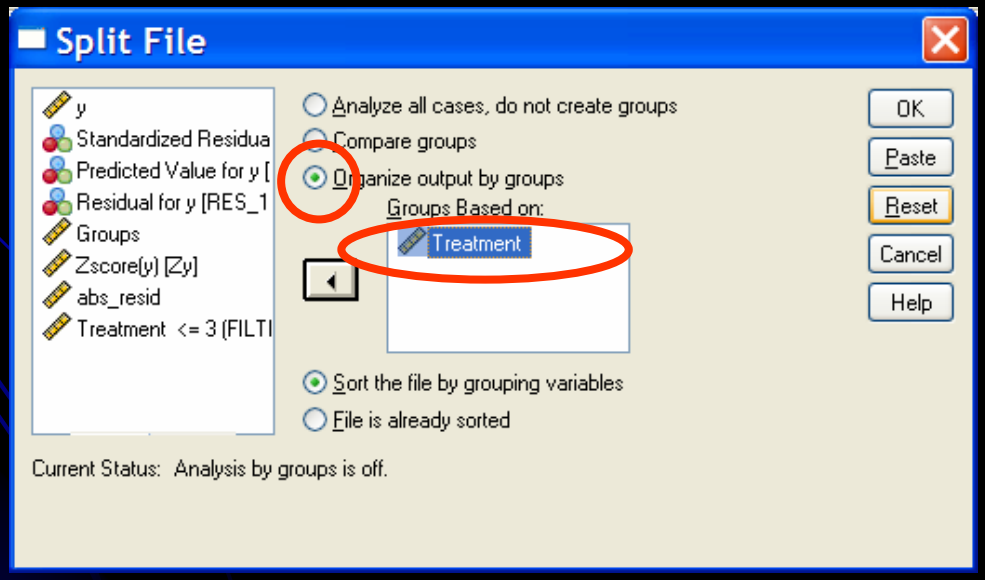
- Θέλουμε να εφαρμόσουμε τις ίδιες αναλύσεις σε υποομάδες των δεδομένων

Εντολές και Ρυθμίσεις (1)

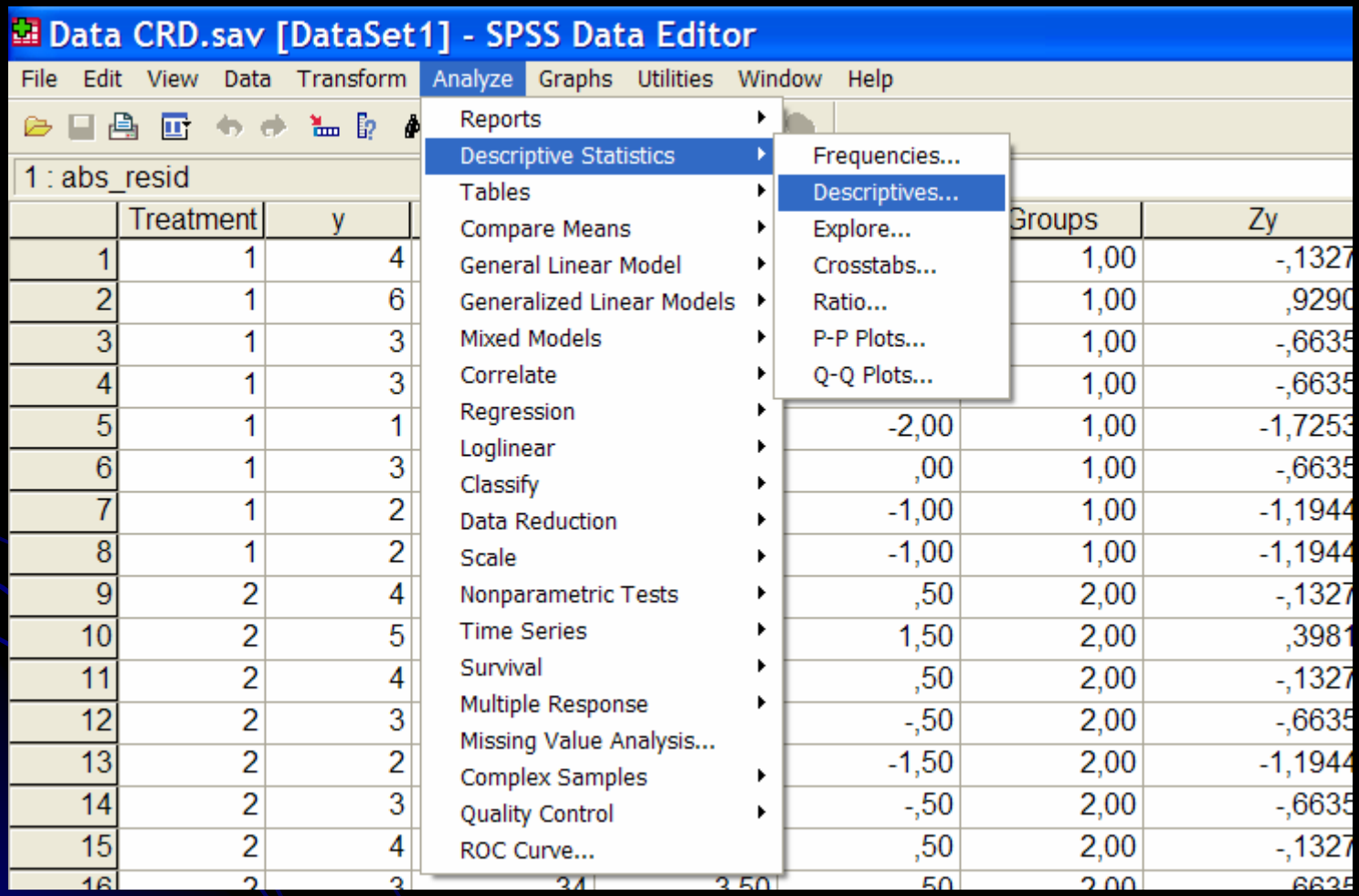


Εντολές και Ρυθμίσεις (2)

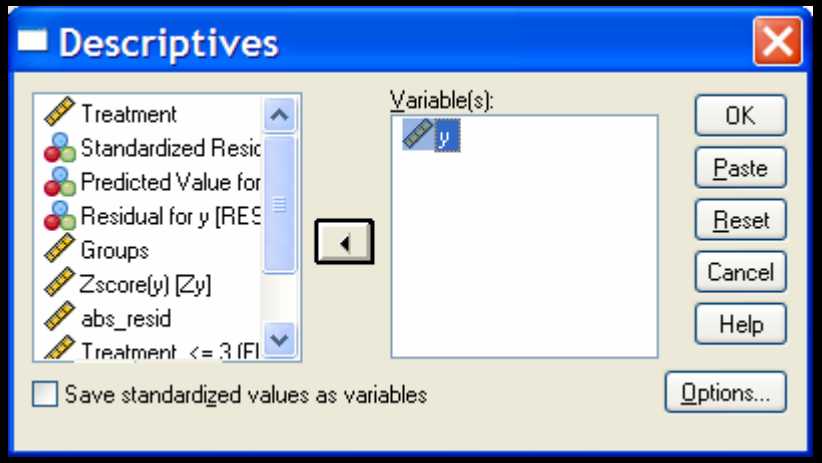


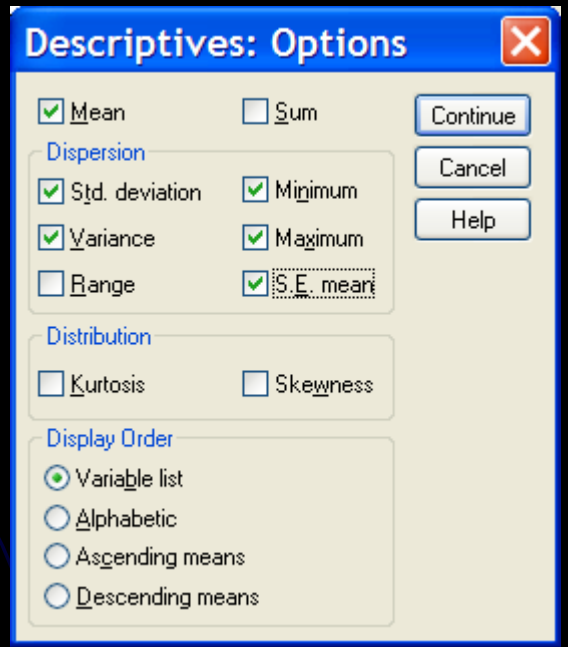


Εντολές και Ρυθμίσεις (3)

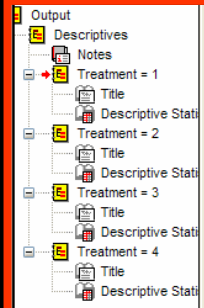


Εντολές και Ρυθμίσεις (4)





Αποτελέσματα SPSS



Treatment = 1

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean		Std.	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
y	8	1	6	3,00	,535	1,512	2,286
Valid N (listwise)	8						

a. Treatment = 1

Treatment = 2

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean		Std.	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
y	8	2	5	3,50	,327	,926	,857
Valid N (listwise)	8						

a. Treatment = 2

Treatment = 3

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean		Std.	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
y	8	3	6	4,25	,366	1,035	1,071
Valid N (listwise)	8						

a. Treatment = 3

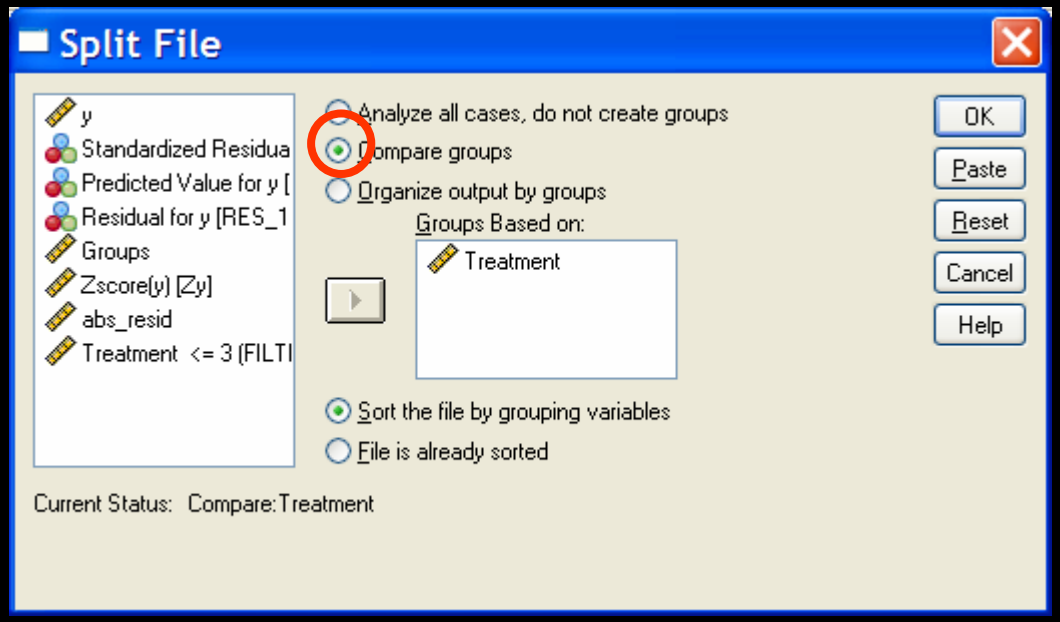
Treatment = 4

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean		Std.	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
y	8	3	10	6,25	,750	2,121	4,500
Valid N (listwise)	8						

a. Treatment = 4

Εναλλακτικά…

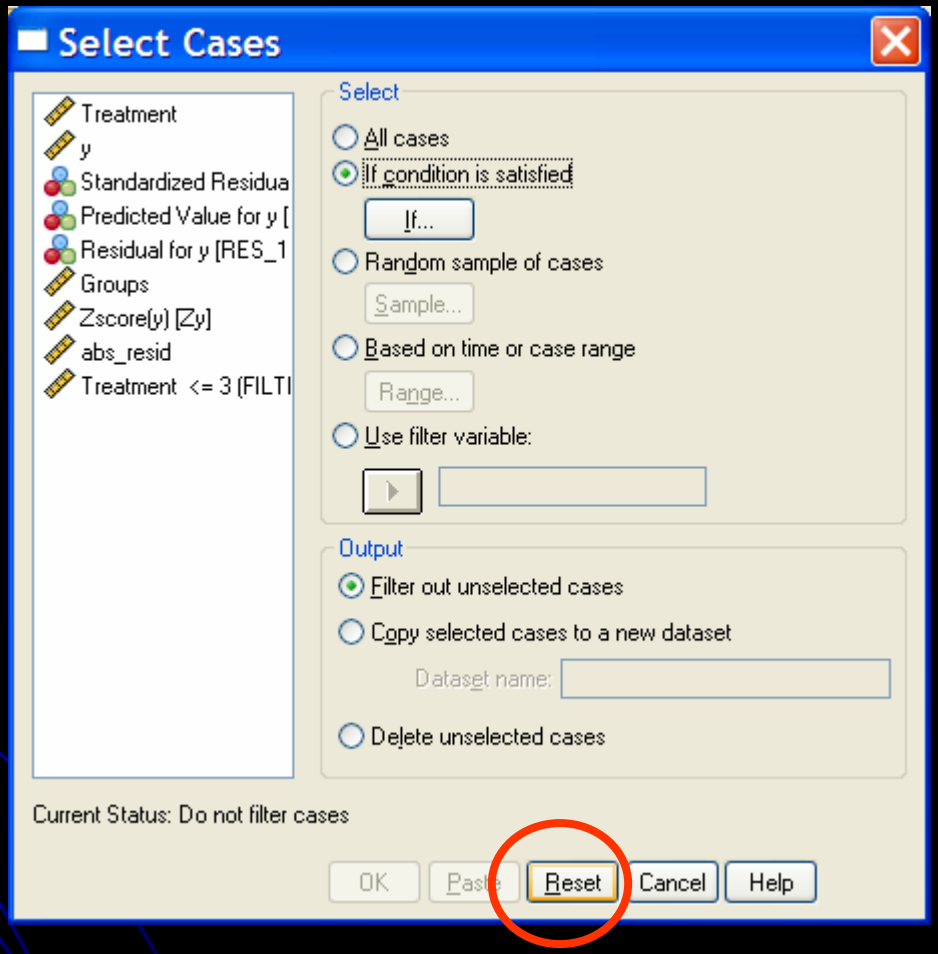


Αποτελέσματα SPSS

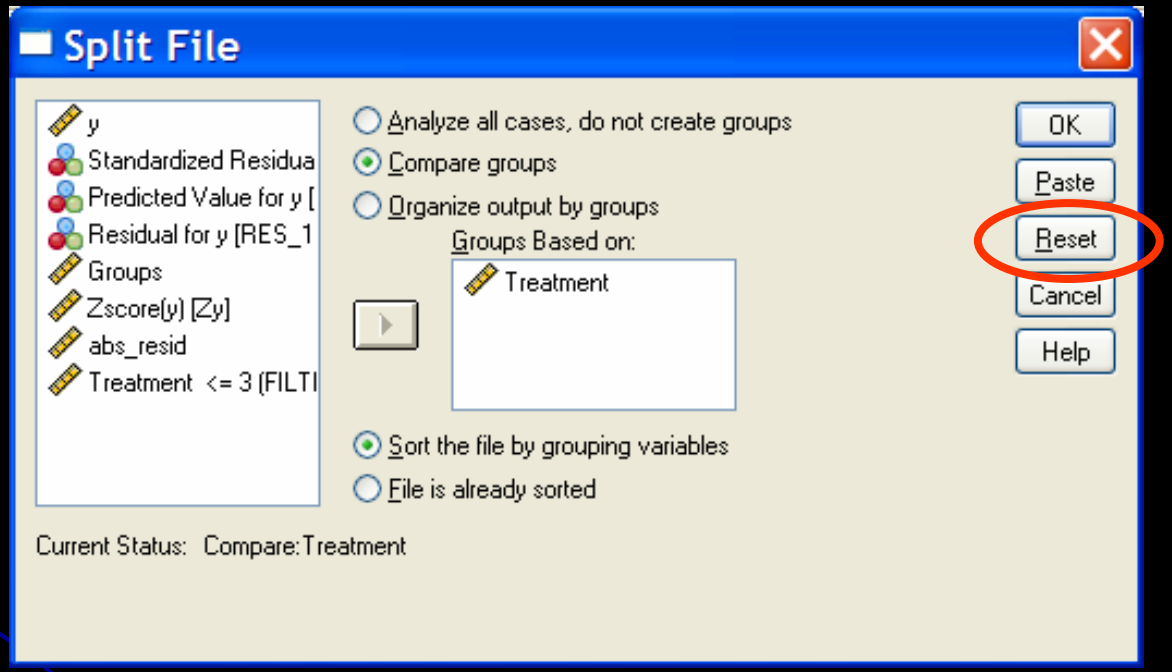
Descriptive Statistics

Treatment		N	Minimum	Maximum	Mean		Std.	Variance
		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
1	y	8	1	6	3,00	,535	1,512	2,286
	Valid N (listwise)	8						
2	y	8	2	5	3,50	,327	,926	,857
	Valid N (listwise)	8						
3	y	8	3	6	4,25	,366	1,035	1,071
	Valid N (listwise)	8						
4	y	8	3	10	6,25	,750	2,121	4,500
	Valid N (listwise)	8						

Επαναφορά Αρχικών Ρυθμίσεων (1)



Επαναφορά Αρχικών Ρυθμίσεων (2)



Ειδική περίπτωση ΣΤ

α) Σύγκριση δύο επεμβάσεων: CRD με 2 μόνο επεμβάσεις. Δείγματα ανεξάρτητα.

β) Σύγκριση δύο επεμβάσεων. Δείγματα εξαρτημένα-ζευγαρωτές παρατηρήσεις.

Εισαγωγή Δεδομένων (α)

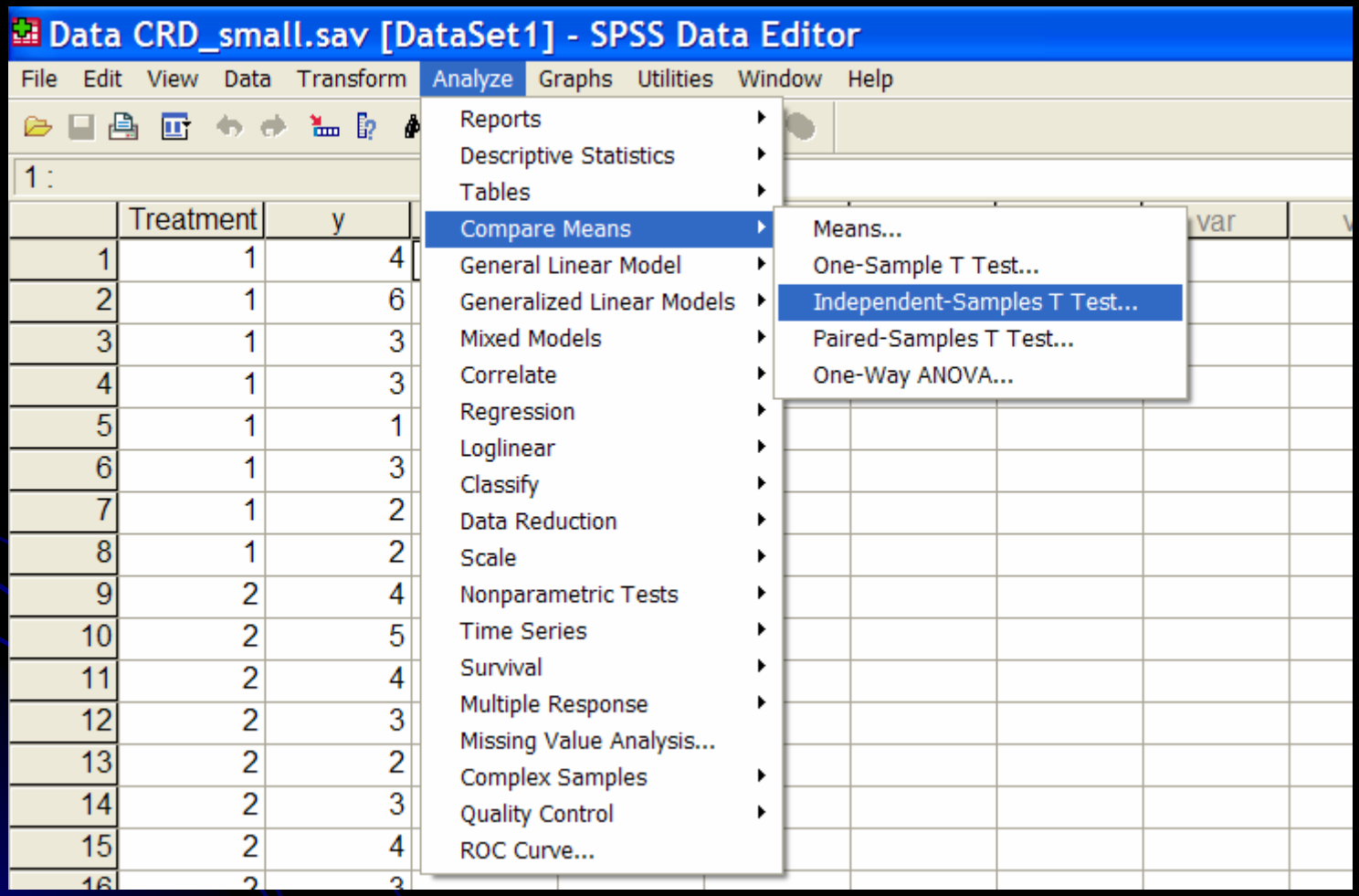
Data CRD_small.sav [DataSet1] - SPSS Data Editor

File Edit View Data Transform Analyze Graphs Utilities Window Help

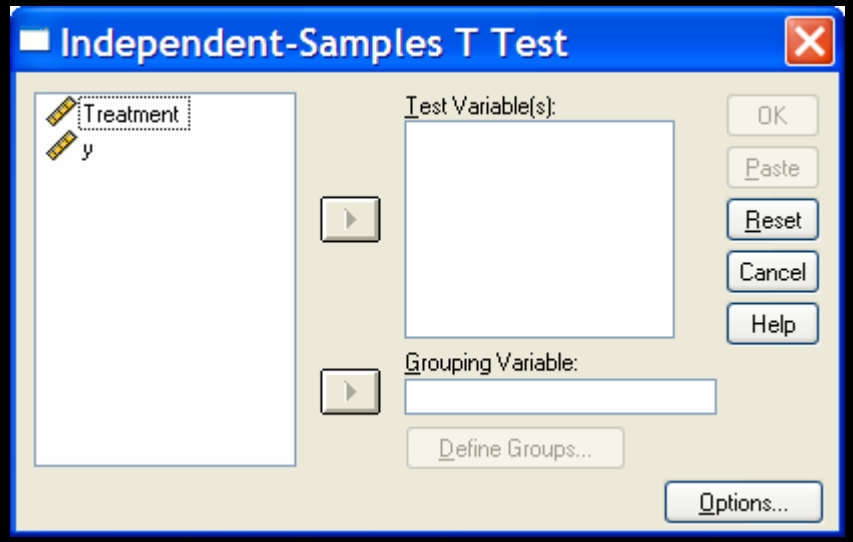
1 :

	Treatment	y	var	var	var	var	var	var	var
1	1	4							
2	1	6							
3	1	3							
4	1	3							
5	1	1							
6	1	3							
7	1	2							
8	1	2							
9	2	4							
10	2	5							
11	2	4							
12	2	3							
13	2	2							
14	2	3							
15	2	4							
16	2	3							
17									

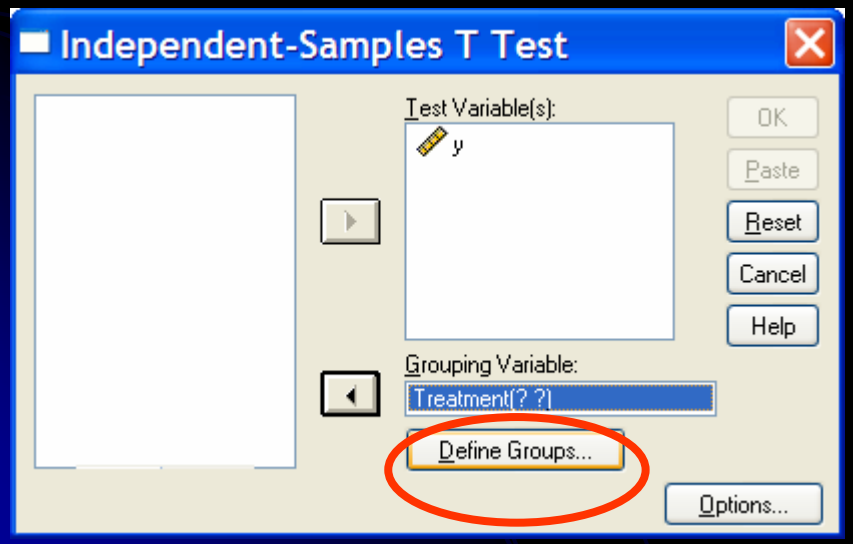
Επιλογή Στατιστικής Διαδικασίας (α)



Εντολές και Ρυθμίσεις (α)



1



2

3

Αποτελέσματα SPSS (α)

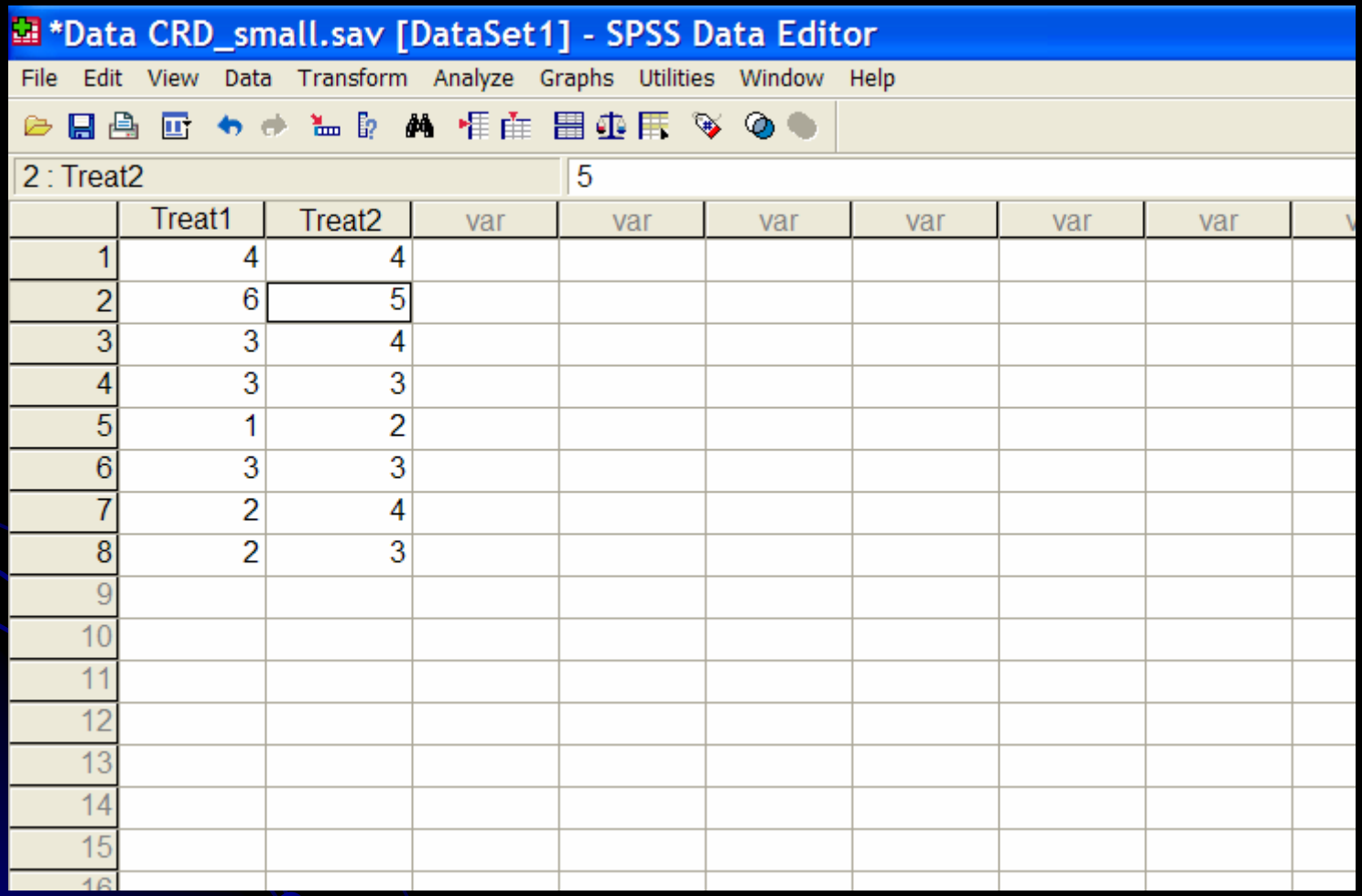
Group Statistics

	Treatment	N	Mean	Std. Deviation	Std. Error Mean
y	1	8	3,00	1,512	,535
	2	8	3,50	,926	,327

Independent Samples Test

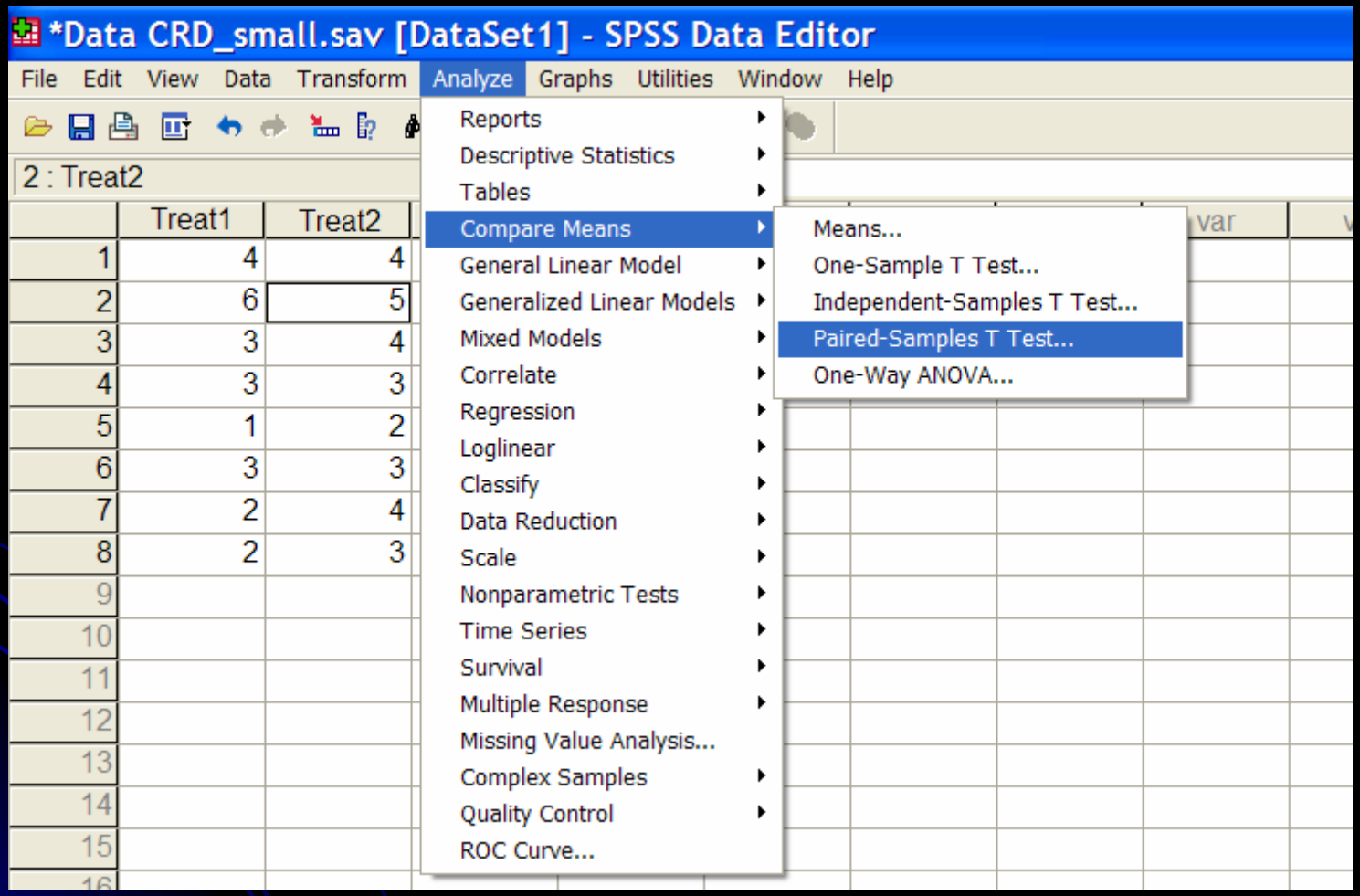
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
y	Equal variances assumed	,368	,554	-,798	14	,438	-,500	,627	-1,844	,844
	Equal variances not assumed			-,798	11,603	,441	-,500	,627	-1,871	,871

Εισαγωγή Δεδομένων (β)



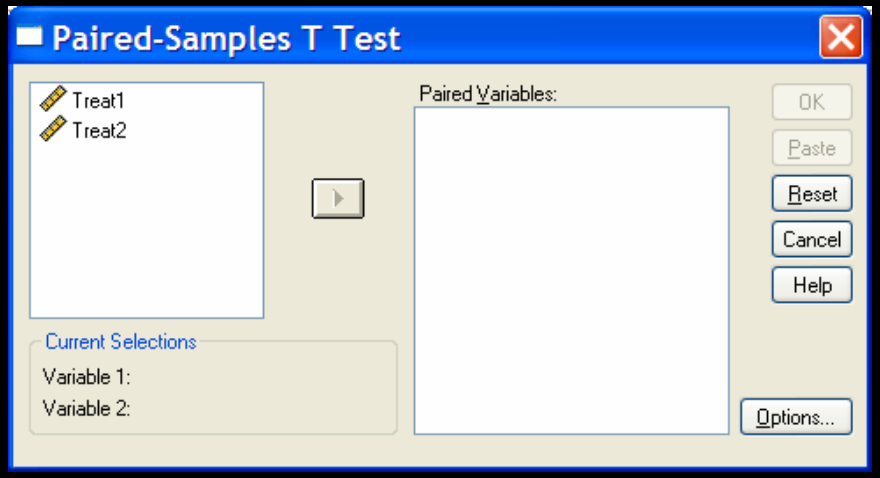
	Treat1	Treat2	var	var	var	var	var	var
1	4	4						
2	6	5						
3	3	4						
4	3	3						
5	1	2						
6	3	3						
7	2	4						
8	2	3						
9								
10								
11								
12								
13								
14								
15								

Επιλογή Στατιστικής Διαδικασίας (β)

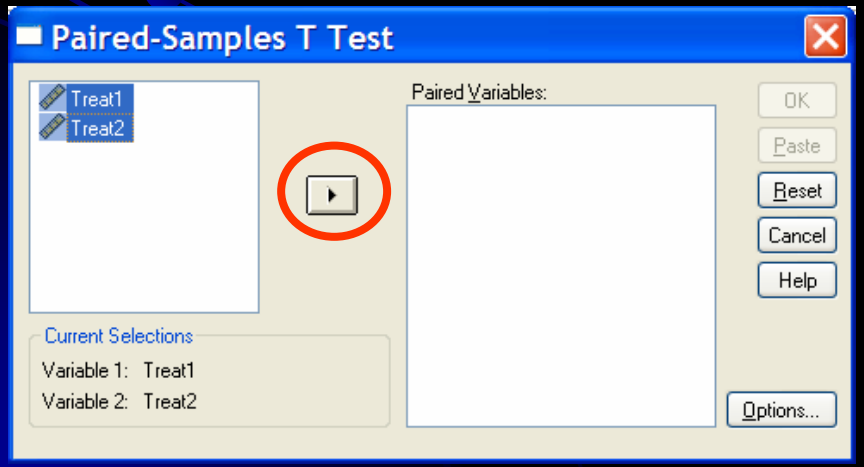


Εντολές και Ρυθμίσεις (β)

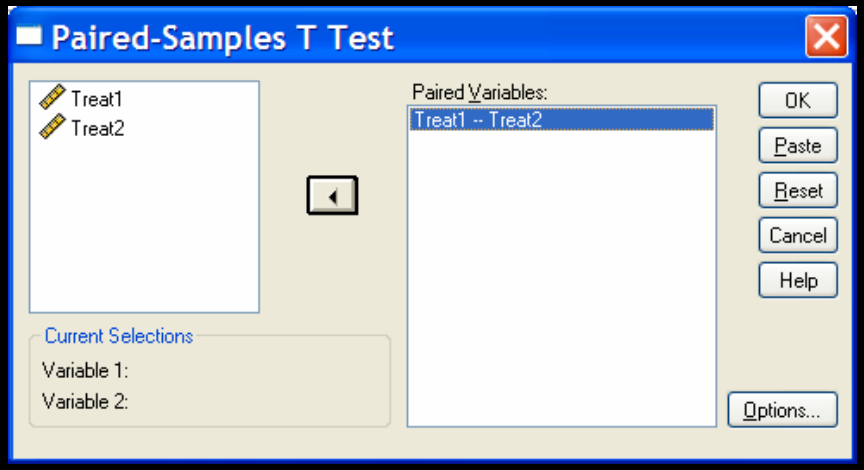
1



2



3



Αποτελέσματα SPSS (β)

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Treat1	3,00	8	1,512	,535
	Treat2	3,50	8	,926	,327

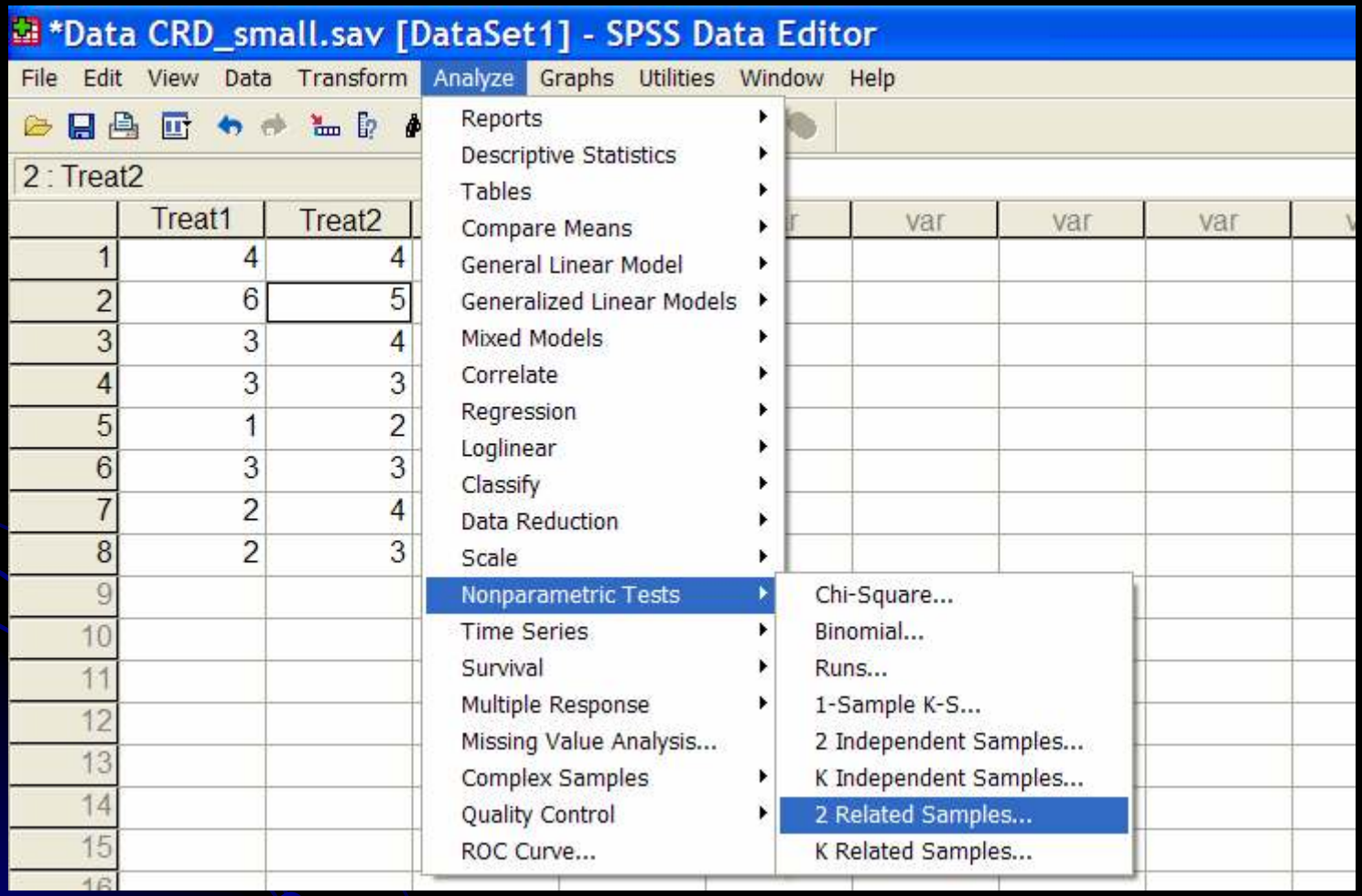
Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Treat1 & Treat2	8	,816	,013

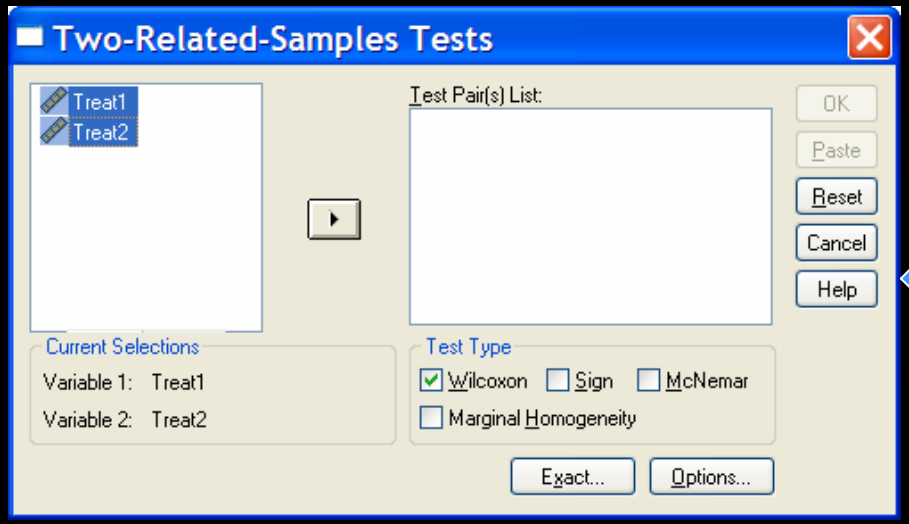
Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Treat1 - Treat2	-,500	,926	,327	-1,274	,274	-1,528	7	,170

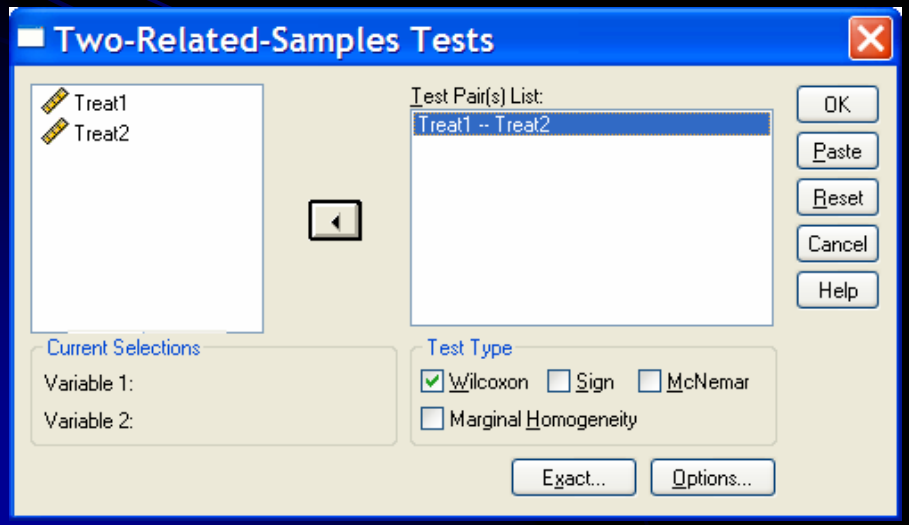
Μη Παραμετρική Προσέγγιση (β)



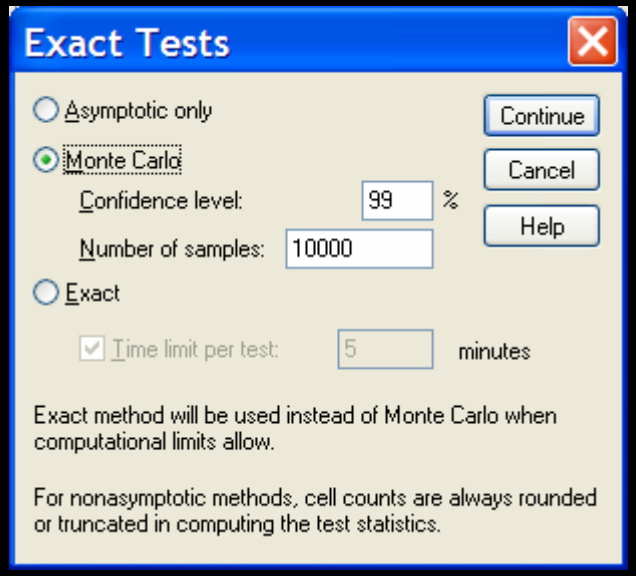
Εντολές και Ρυθμίσεις (β)



1



2



3

Αποτελέσματα SPSS (β)

Ranks

		N	Mean Rank	Sum of Ranks
Treat2 - Treat1	Negative Ranks	1[a]	2,50	2,50
	Positive Ranks	4[b]	3,13	12,50
	Ties	3[c]		
	Total	8		

a. Treat2 < Treat1

b. Treat2 > Treat1

c. Treat2 = Treat1

Test Statistics[b,c]

			Treat2 - Treat1
Z			-1,414[a]
Asymp. Sig. (2-tailed)			,157
Monte Carlo Sig. (2-tailed)	Sig.		,314
	99% Confidence Interval	Lower Bound	,302
		Upper Bound	,326
Monte Carlo Sig. (1-tailed)	Sig.		,157
	99% Confidence Interval	Lower Bound	,147
		Upper Bound	,166

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

c. Based on 10000 sampled tables with starting seed 2000000.

Σας ευχαριστώ για την προσοχή σας