Άσκηση two way anova

Άντρες και γυναίκες φοιτητές εξετάστηκαν κάτω από τρία διαφορετικά επίπεδα θορύβου. Για κάθε επίπεδο θορύβου και για κάθε φύλλο επιλέχτηκαν τυχαία 4 φοιτητές. Οι βαθμολογίες τους δίνονται παρακάτω.

Φοιτητές	Χαμηλό θόρυβο	Μεσαίο θόρυβο	Υψηλό θόρυβο
Άντρες	10 12 11 9	7 9 8 12	4 5 6 5
Γυναίκες	12 13 10 13	13 15 12 12	6 6 4 4

Έχει ο θόρυβος επίδραση στις επιδόσεις των φοιτητών;
Έχει επίδραση το φύλλο στις επιδόσεις;
Το φύλλο επιδρά στο πως ένας φοιτητής αντιδρά στο θόρυβο;

H_0

Φοιτητές	Χ.Θ	Μ.Θ	Υ.Θ	Σύνολο
Άντρες	10 12 11 9	7 9 8 12	4 5 6 5	$R_1=98$
Γυναίκες	12 13 10 13	13 15 12 12	6 6 4 4	$R_2=120$
Σύνολο	$S_1=90$	$S_2=88$	$S_3=40$	$S_x=60$

(1) $\frac{(S_x)^2}{24} = 1980$

$SST = \Sigma x^2 - 1980 = (10^2+12^2+\dots+4^2) - 1980 = 274$

$$SSA = \frac{\sum_{i=1}^{3} S_i^2}{8} - 1980 = \frac{90^2 + 88^2 + 40^2}{8} = 200$$

$$SS_B = \frac{\sum_{i=1}^{2} R_i^2}{12} - 1980 = 2$$

$$SS_{AB} = \frac{(42^2 + 48^2 + \quad + 20^2)}{6} - 1980 - 200 - 20$$

$$= 16,33$$

$$SSE = SST - SS_A - SS_B - SS_{AB} = 37$$

Πίνακας ANOVA

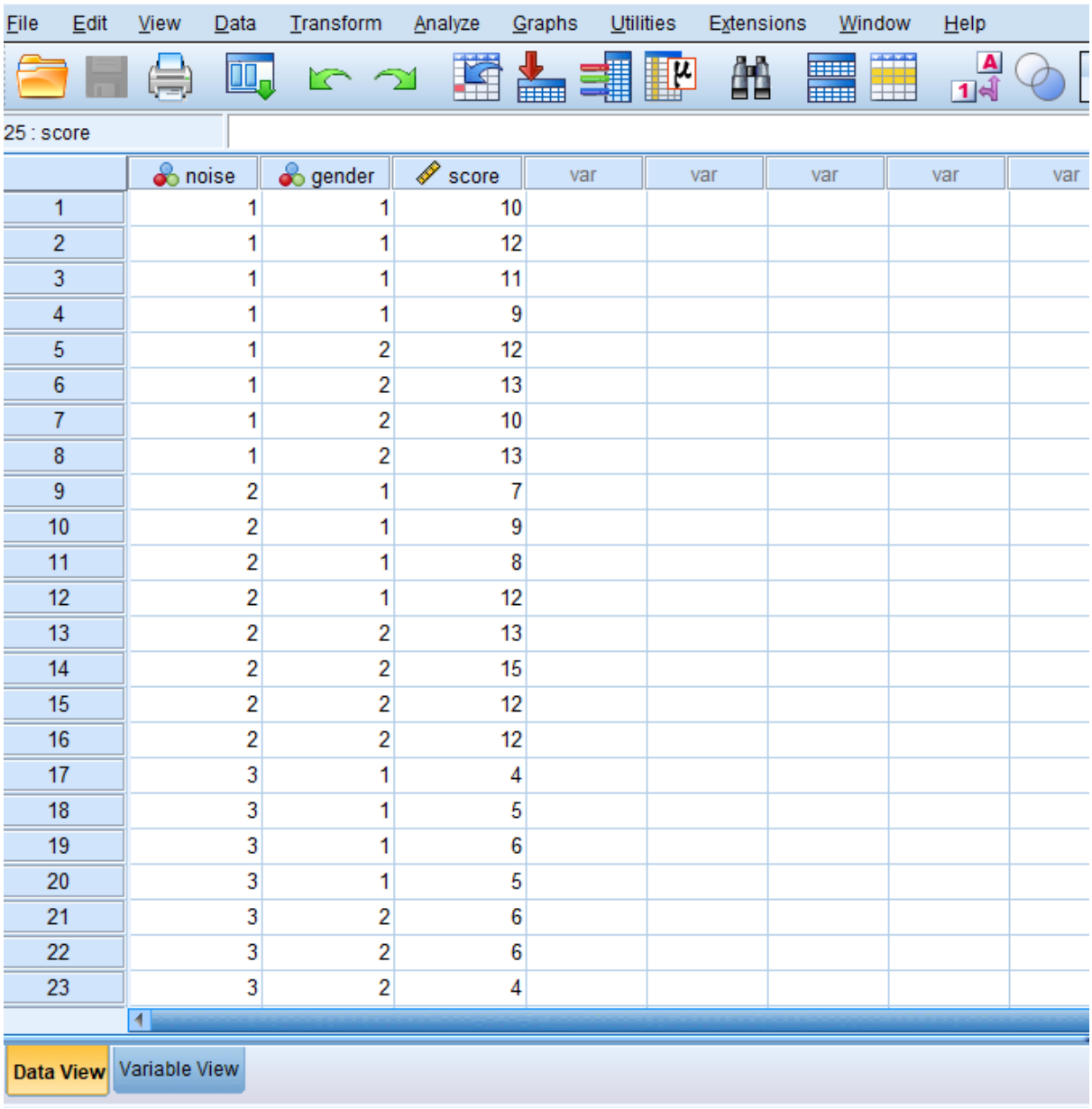
Πηγή	B.E	SS	MS	F	Fcritical
A	C−1=2	200	100	48,73	$F_{2,18}$ = 3,55
B	R−1=1	20	20	9,81	$F_{1,18}$ = 4,41
AB	(C−1)×(R−1) = 2	16.33	8,167	3,97	$F_{2,18}$ = 3,55
Σφάλμα	C×R×(n−1) = 18	37	2,06		
Σύνολο	N−1=23	59.25			

C: αριθμός στηλών
R: αριθμός γραμμών
N: συνολικός αριθμός φοιτητών
n: αριθμός φοιτητών ανά group

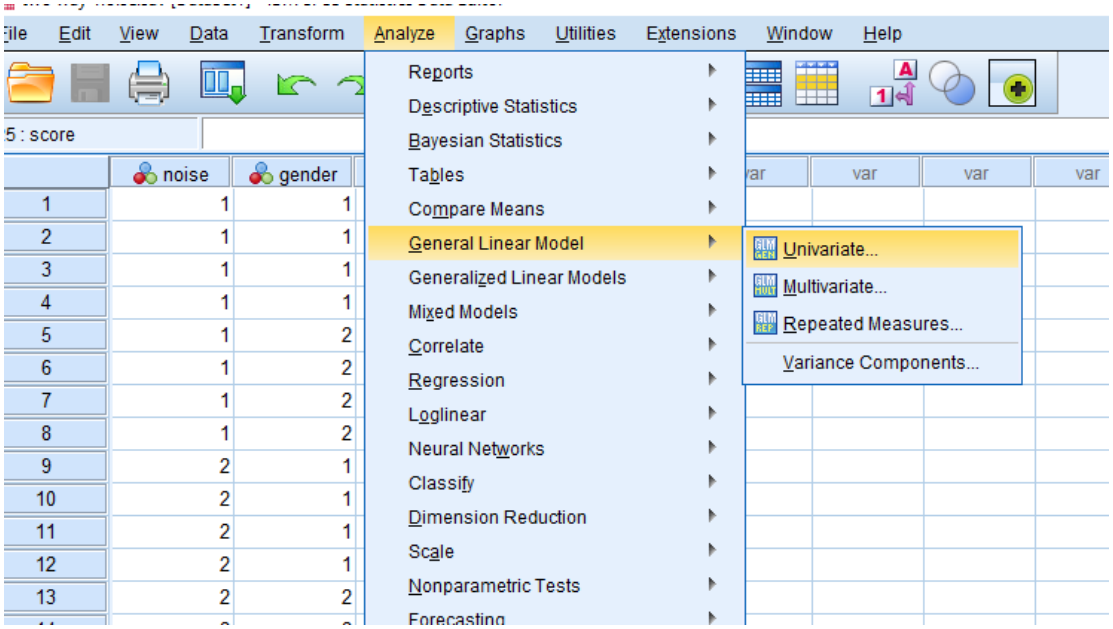
Συμπεράσματα

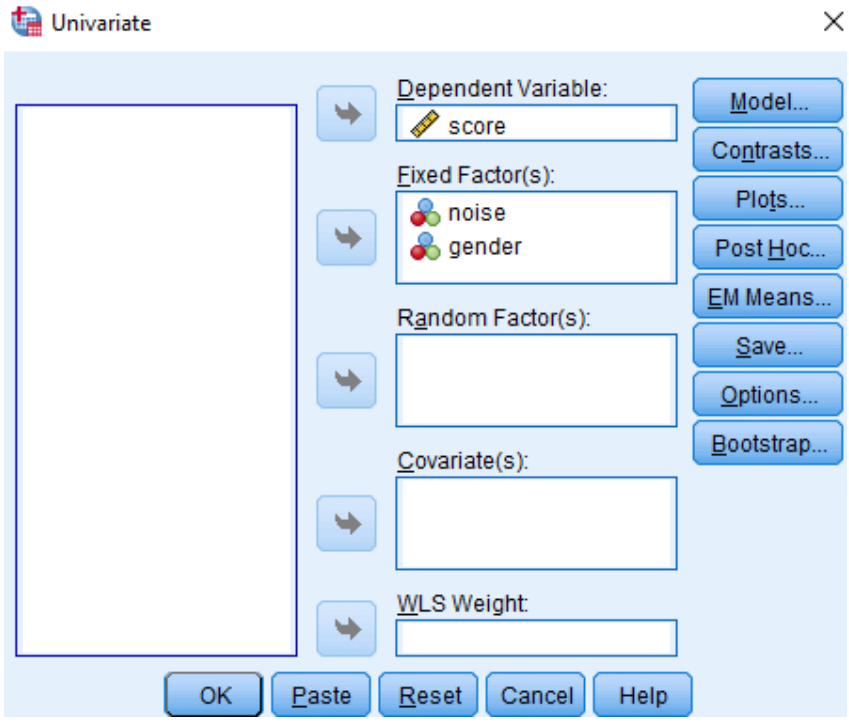
→ Ο θόρυβος είναι σ.σ και έχει επίδραση στη βαθμολογία των φοιτητών
→ Το φύλλο έχει σημαντική επίδραση στην επίδοση των φοιτητών
→ Καθε φύλλο αντιδρά διαφορετικά στον θόρυβο.

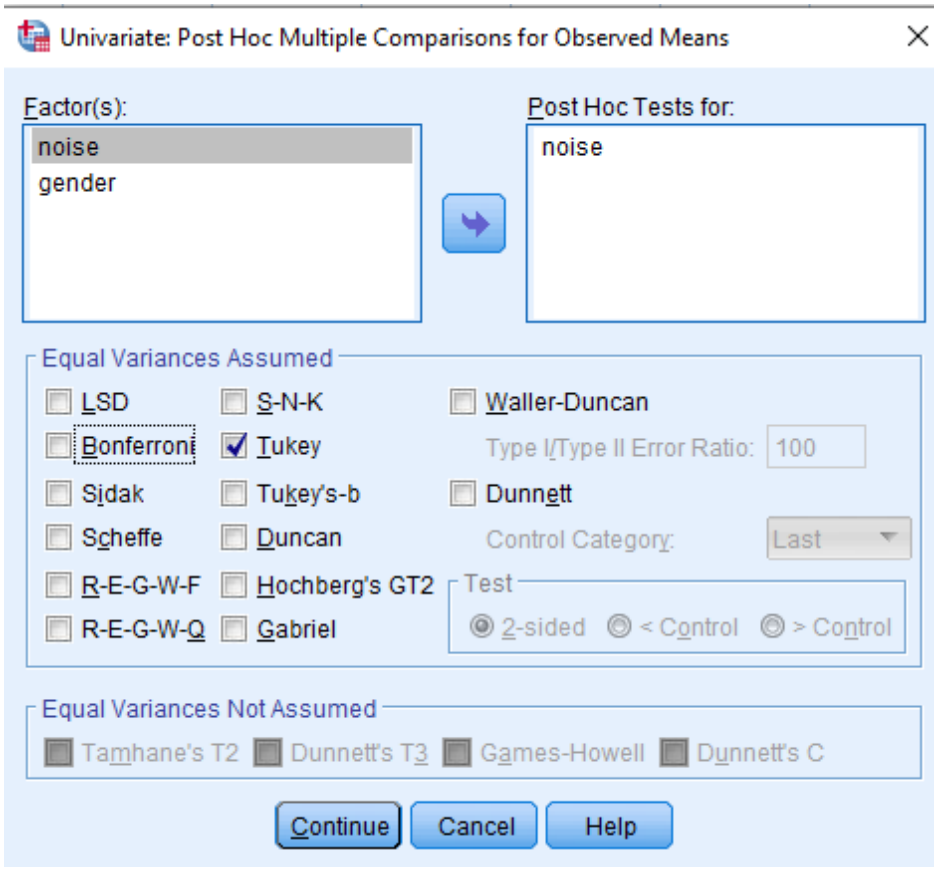
Ασκηση two-way anova

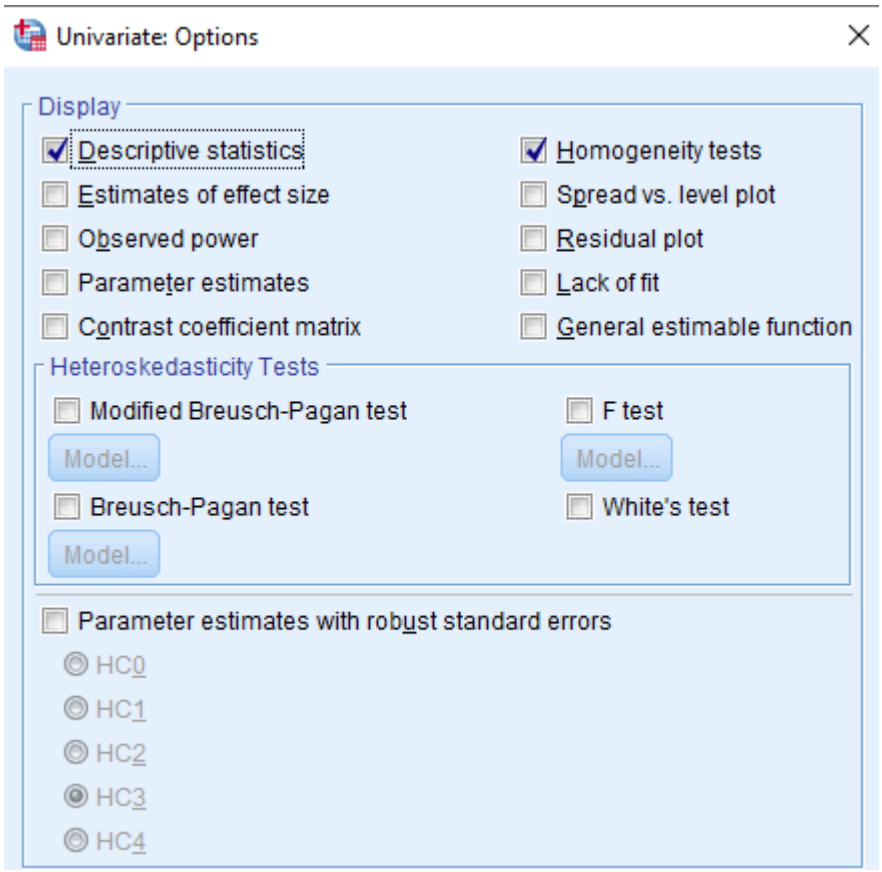


	noise	gender	score	var	var	var	var	var
1	1	1	10					
2	1	1	12					
3	1	1	11					
4	1	1	9					
5	1	2	12					
6	1	2	13					
7	1	2	10					
8	1	2	13					
9	2	1	7					
10	2	1	9					
11	2	1	8					
12	2	1	12					
13	2	2	13					
14	2	2	15					
15	2	2	12					
16	2	2	12					
17	3	1	4					
18	3	1	5					
19	3	1	6					
20	3	1	5					
21	3	2	6					
22	3	2	6					
23	3	2	4					


File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help
Reports
Descriptive Statistics
Bayesian Statistics
Tables
Compare Means
General Linear Model
Generalized Linear Models
Mixed Models
Correlate
Regression
Loglinear
Neural Networks
Classify
Dimension Reduction
Scale
Nonparametric Tests
Forecasting
Univariate...
Multivariate...
Repeated Measures...
Variance Components...
5 : score
noise
gender
var
1 1 1
2 1 1
3 1 1
4 1 1
5 1 2
6 1 2
7 1 2
8 1 2
9 2 1
10 2 1
11 2 1
12 2 1
13 2 2


Univariate
Dependent Variable:
score
Fixed Factor(s):
noise
gender
Random Factor(s):
Covariate(s):
WLS Weight:
Model...
Contrasts...
Plots...
Post Hoc...
EM Means...
Save...
Options...
Bootstrap...
OK
Paste
Reset
Cancel
Help


Univariate: Post Hoc Multiple Comparisons for Observed Means
Factor(s):
noise
gender
Post Hoc Tests for:
noise
Equal Variances Assumed
LSD
S-N-K
Waller-Duncan
Bonferroni
Tukey
Type I/Type II Error Ratio: 100
Sidak
Tukey's-b
Dunnett
Scheffe
Duncan
Control Category: Last
R-E-G-W-F
Hochberg's GT2
Test
2-sided
< Control
> Control
R-E-G-W-Q
Gabriel
Equal Variances Not Assumed
Tamhane's T2
Dunnett's T3
Games-Howell
Dunnett's C
Continue
Cancel
Help


Univariate: Options
Display
Descriptive statistics
Homogeneity tests
Estimates of effect size
Spread vs. level plot
Observed power
Residual plot
Parameter estimates
Lack of fit
Contrast coefficient matrix
General estimable function
Heteroskedasticity Tests
Modified Breusch-Pagan test
F test
Model...
Model...
Breusch-Pagan test
White's test
Model...
Parameter estimates with robust standard errors
HC0
HC1
HC2
HC3
HC4

Between-Subjects Factors

		Value Label	N
noise	1	low	8
	2	medium	8
	3	high	8
gender	1	men	12
	2	women	12

Descriptive Statistics

Dependent Variable: score

noise	gender	Mean	Std. Deviation	N
low	men	10,50	1,291	4
	women	12,00	1,414	4
	Total	11,25	1,488	8
medium	men	9,00	2,160	4
	women	13,00	1,414	4
	Total	11,00	2,726	8
high	men	5,00	,816	4
	women	5,00	1,155	4
	Total	5,00	,926	8
Total	men	8,17	2,791	12
	women	10,00	3,908	12
	Total	9,08	3,450	24

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

		Levene Statistic	df1	df2	Sig.
score	Based on Mean	,655	5	18	,662
	Based on Median	,514	5	18	,762
	Based on Median and with adjusted df	,514	5	10,500	,760
	Based on trimmed mean	,652	5	18	,664

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

a. Dependent variable: score

b. Design: Intercept + noise + gender + noise * gender

Tests of Between-Subjects Effects

Dependent Variable: score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	236,833[a]	5	47,367	23,043	,000
Intercept	1980,167	1	1980,167	963,324	,000
noise	200,333	2	100,167	48,730	,000
gender	20,167	1	20,167	9,811	,006
noise * gender	16,333	2	8,167	3,973	,037
Error	37,000	18	2,056		
Total	2254,000	24			
Corrected Total	273,833	23			

a. R Squared = ,865 (Adjusted R Squared = ,827)

Post Hoc Tests

noise

Multiple Comparisons

Dependent Variable: score

Tukey HSD

(I) noise	(J) noise	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
low	medium	,25	,717	,935	-1,58	2,08
	high	6,25*	,717	,000	4,42	8,08
medium	low	-,25	,717	,935	-2,08	1,58
	high	6,00*	,717	,000	4,17	7,83
high	low	-6,25*	,717	,000	-8,08	-4,42
	medium	-6,00*	,717	,000	-7,83	-4,17

Based on observed means.
The error term is Mean Square(Error) = 2,056.

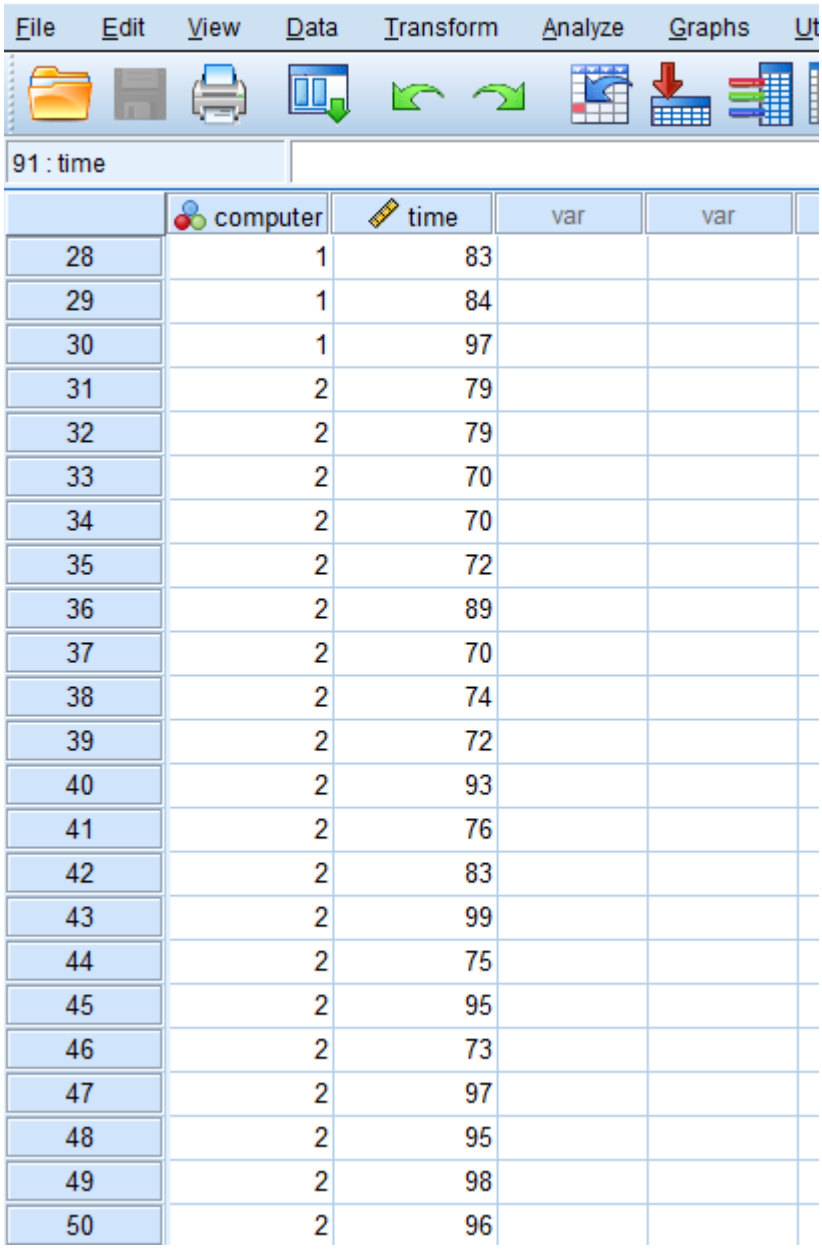
*. The mean difference is significant at the ,05 level.

ONE WAY RANDOM EFFECTS

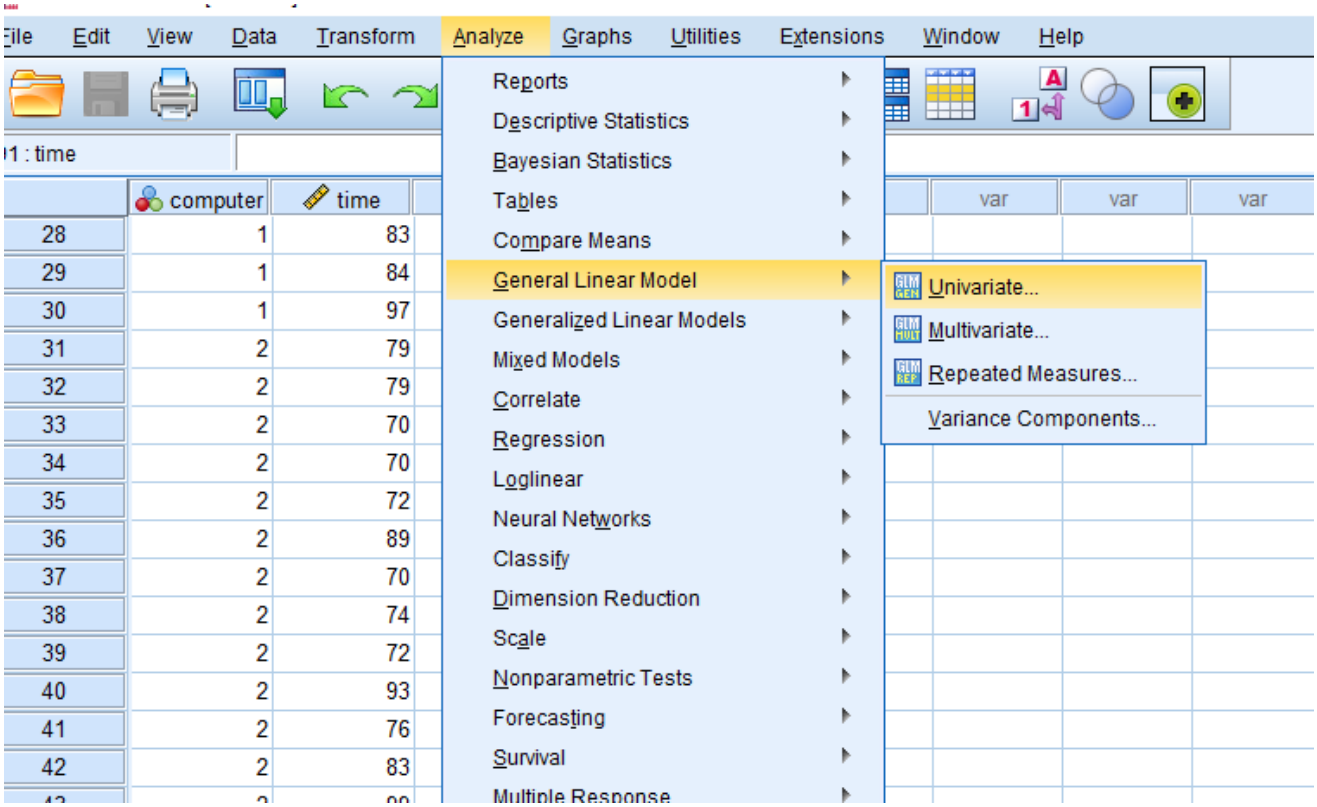
Τρεις υπολογιστές επιλέγονται τυχαία από ένα εργαστήριο υπολογιστών και οι χρόνοι υπολογισμού για μια εργασία συλλέγονται 30 φορές και για τους τρεις υπολογιστές.

Το μοντέλο τυχαίων επίδρασεων είναι κατάλληλο για το ερευνητικό ερώτημα «εάν υπάρχει σημαντική μεταβλητότητα μεταξύ των υπολογιστών»

Η διαδικασία ανάλυσης για ένα μοντέλο τυχαίων επιδράσεων χρησιμοποιώντας SPSS



	computer	time	var	var
28	1	83		
29	1	84		
30	1	97		
31	2	79		
32	2	79		
33	2	70		
34	2	70		
35	2	72		
36	2	89		
37	2	70		
38	2	74		
39	2	72		
40	2	93		
41	2	76		
42	2	83		
43	2	99		
44	2	75		
45	2	95		
46	2	73		
47	2	97		
48	2	95		
49	2	98		
50	2	96		


File Edit View Data Transform Analyze Graphs Utilities Extensions Window Help
1 : time
computer
time
var
var
var
28 1 83
29 1 84
30 1 97
31 2 79
32 2 79
33 2 70
34 2 70
35 2 72
36 2 89
37 2 70
38 2 74
39 2 72
40 2 93
41 2 76
42 2 83
Reports
Descriptive Statistics
Bayesian Statistics
Tables
Compare Means
General Linear Model
Generalized Linear Models
Mixed Models
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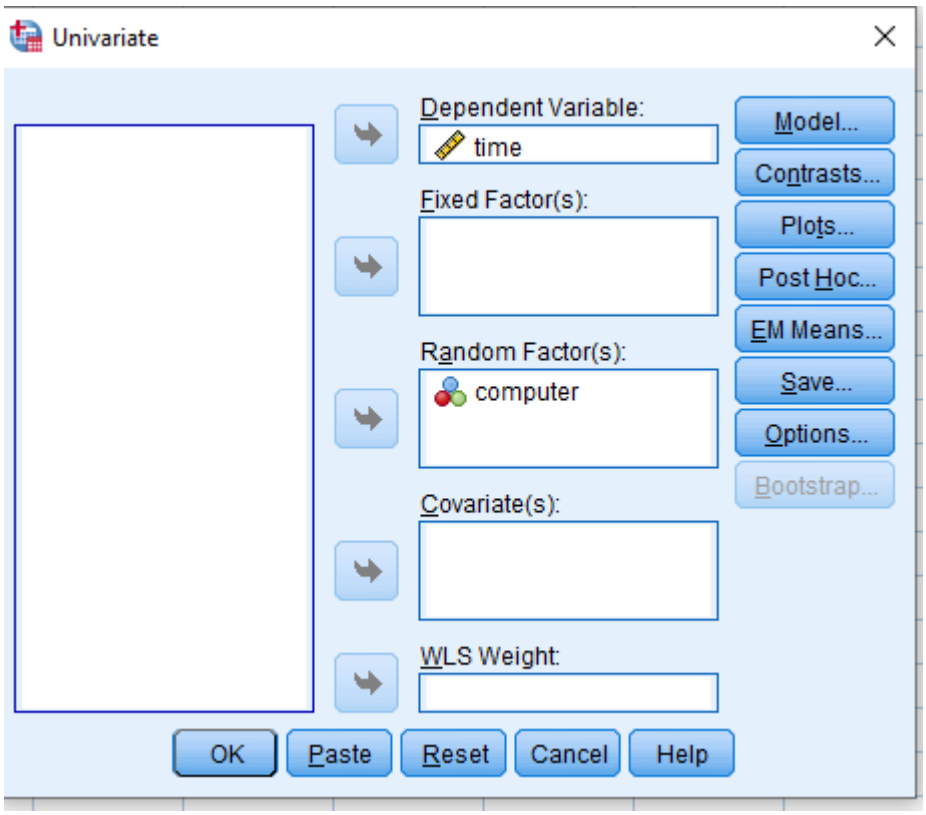
Multiple Response
Univariate...
Multivariate...
Repeated Measures...
Variance Components...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Fixed Factor(s):
Random Factor(s):
computer
Covariate(s):
WLS Weight:
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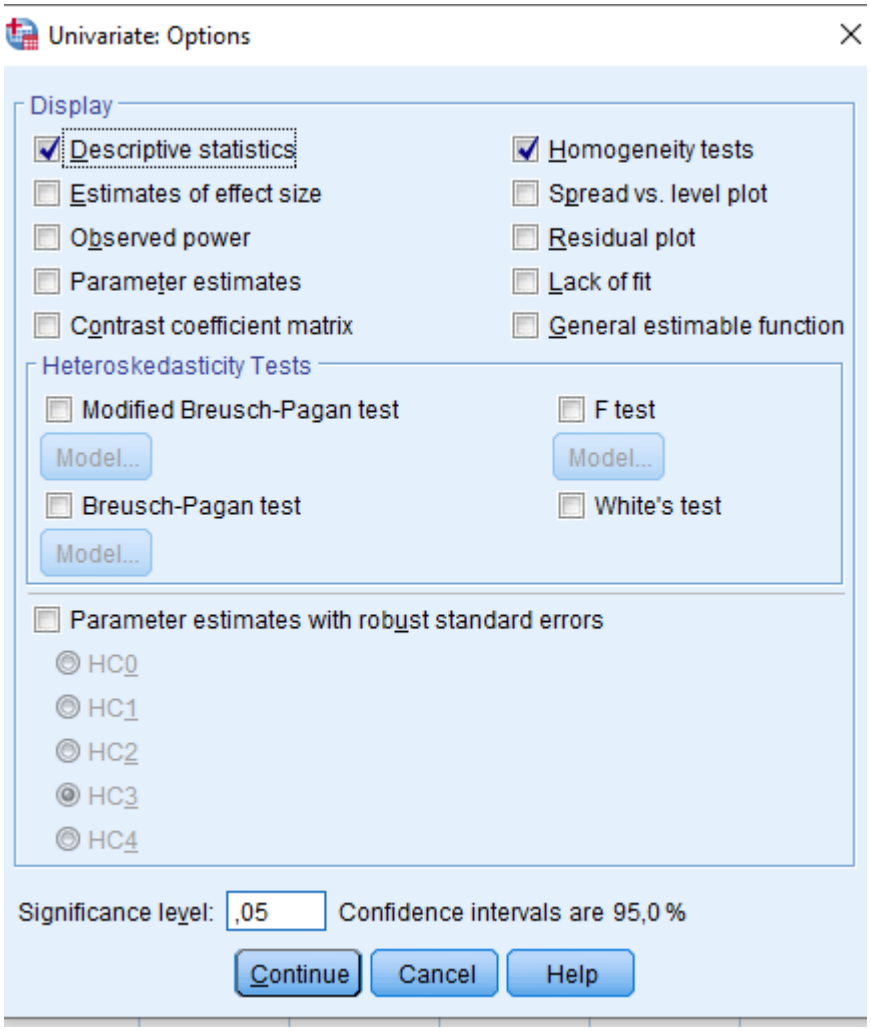
Plots...
Post Hoc...
EM Means...
Save...
Options...
Bootstrap...
OK
Paste
Reset
Cancel
Help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Estimates of effect size
Observed power
Parameter estimates
Contrast coefficient matrix
Homogeneity tests
Spread vs. level plot
Residual plot
Lack of fit
General estimable function
Heteroskedasticity Tests
Modified Breusch-Pagan test
Model...
Breusch-Pagan test
Model...
F test
Model...
White's test
Parameter estimates with robust standard errors
HC0
HC1
HC2
HC3
HC4
Significance level: ,05
Confidence intervals are 95,0 %
Continue
Cancel
Help

Univariate Analysis of Variance

Between-Subjects Factors

		N
computer	1	30
	2	30
	3	30

Descriptive Statistics

Dependent Variable: time

computer	Mean	Std. Deviation	N
1	84,70	8,906	30
2	84,80	10,522	30
3	83,87	10,683	30
Total	84,46	9,964	90

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

		Levene Statistic	df1	df2	Sig.
time	Based on Mean	2,287	2	87	,108
	Based on Median	2,149	2	87	,123
	Based on Median and with adjusted df	2,149	2	84,693	,123
	Based on trimmed mean	2,305	2	87	,106

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

Tests of Between-Subjects Effects

Dependent Variable: time

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	Hypothesis	641946,678	1	641946,678	81488,295	,000
	Error	15,756	2	7,878[a]		
computer	Hypothesis	15,756	2	7,878	,078	,925
	Error	8820,567	87	101,386[b]		

a. MS(computer)

b. MS(Error)