

SPSS

Advanced Level



Presented by:

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Sirjan Faculty of Medical Sciences

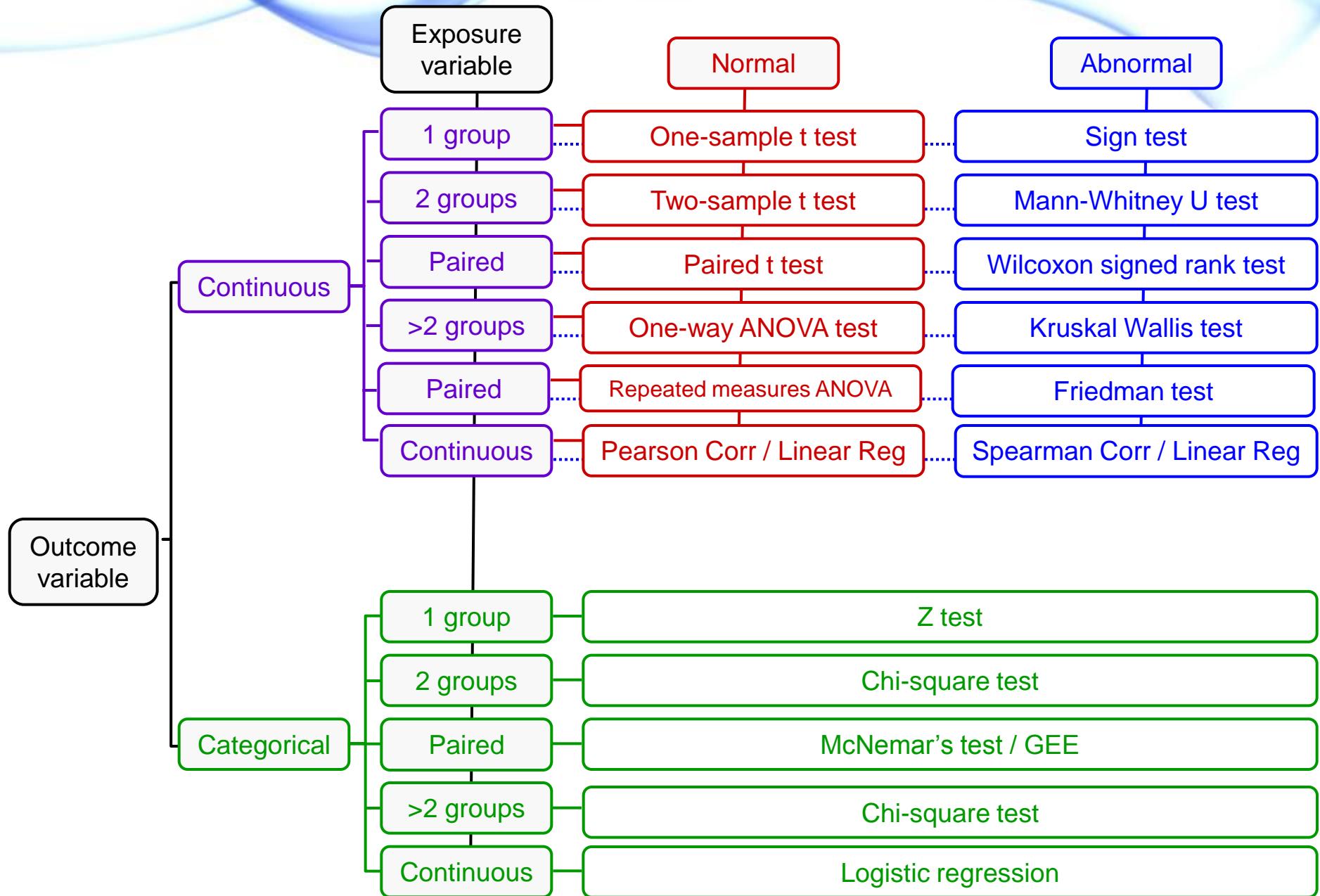
June 2021

Objectives

- Investigating the Normality and Variance Homogeneity
- Parametric and Non-Parametric Tests
- Correlation and Regression

رئوس مطالب

- آزمون ها و روش های بررسی نرمالیتی
- آزمون همگنی واریانس
- آزمون های میانگین
 - پارامتری
 - ناپارامتری
- آزمون متغیر کیفی
- همبستگی و رگرسیون
- رسم نمودار میله ای



Normality Assumption

- Tests
 - Kolmogorov–Smirnov
 - Shapiro-Wilk
- Graphs
 - Histogram
 - PP plot
 - QQ plot
 - Stem and Leaf

Normality Assumption

*data2.sav [DataSet13] - IBM SPSS Statistics Data Editor

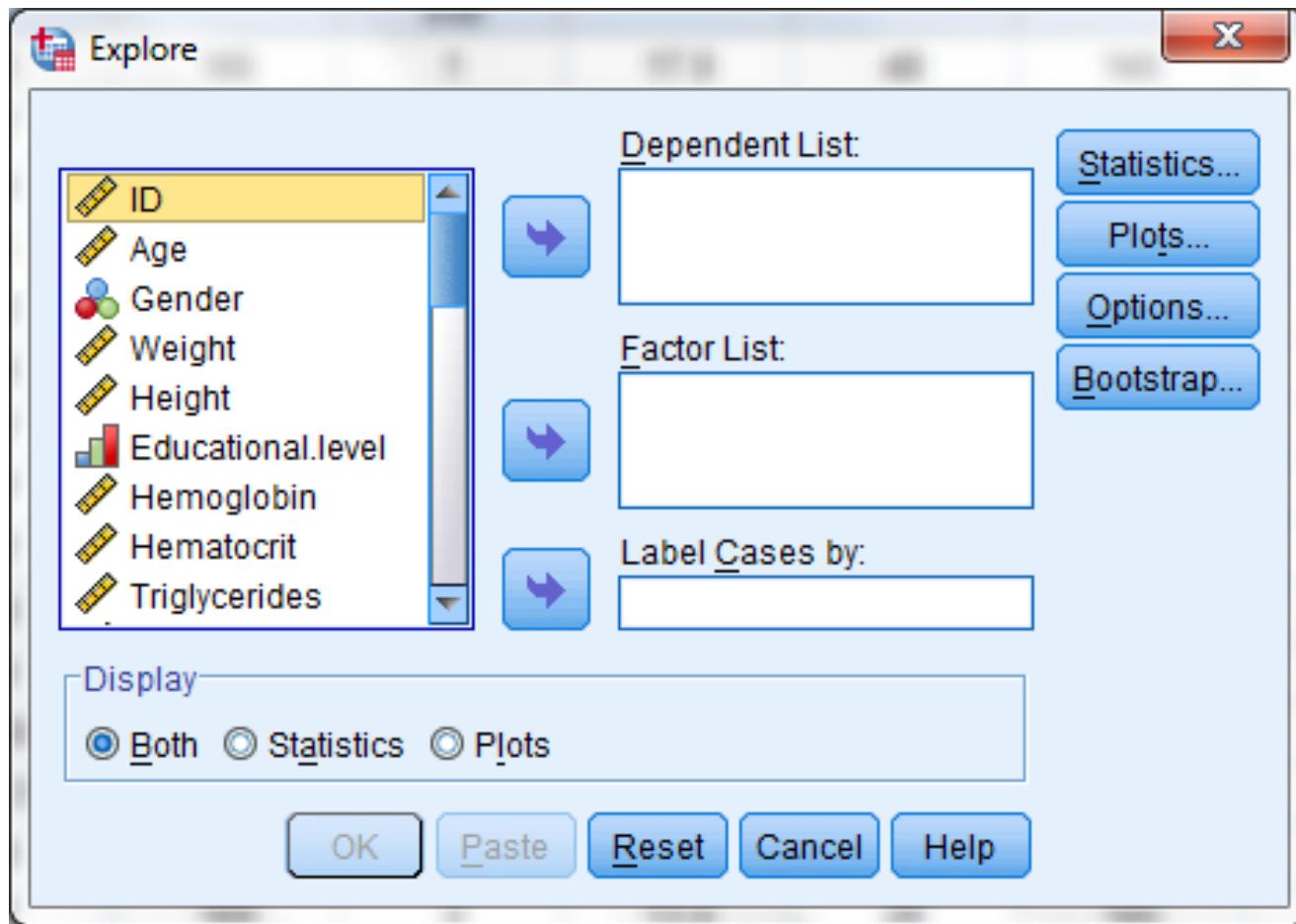
File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Windows

Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale

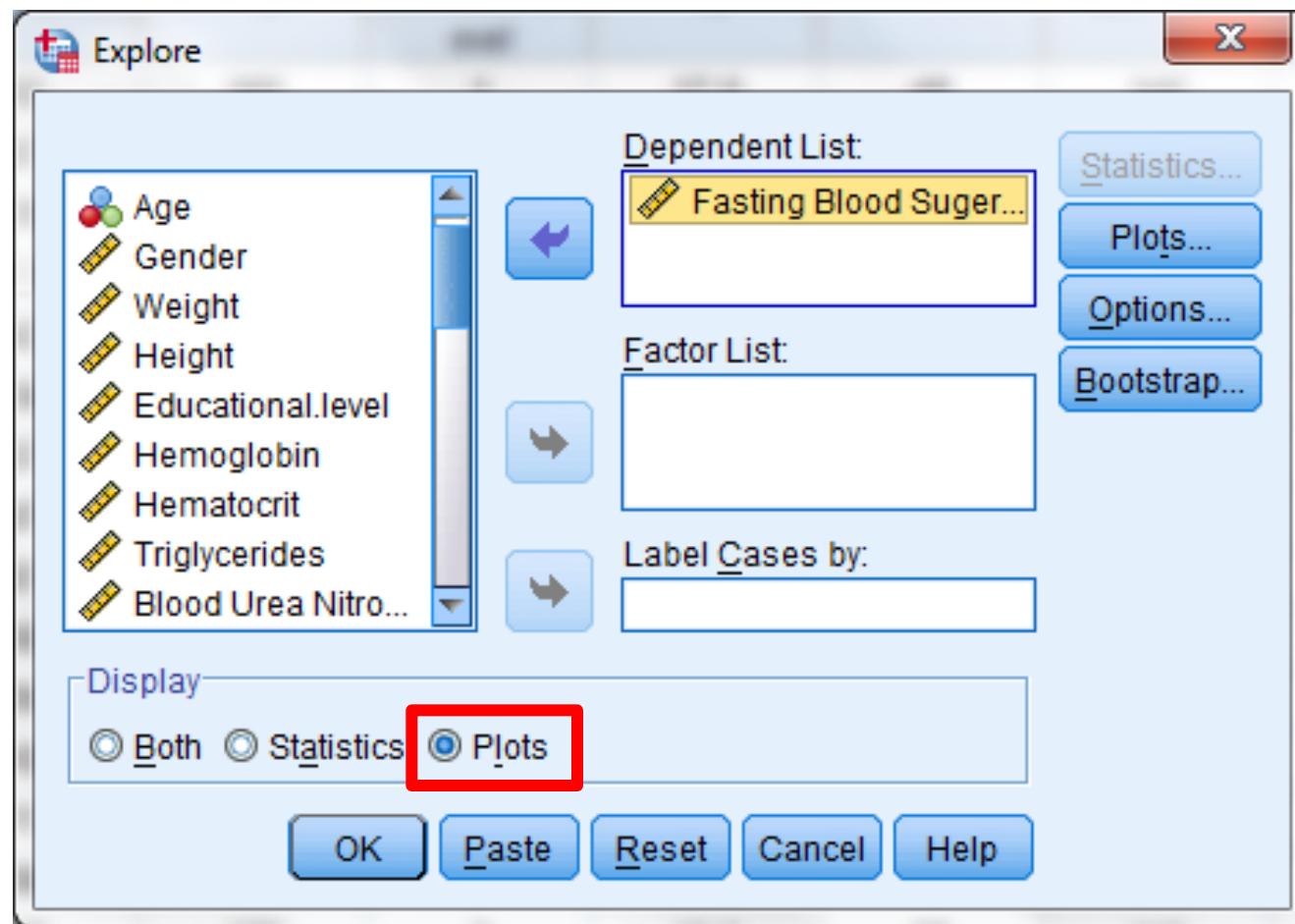
Frequencies... Descriptives... Explore... Crosstabs... Ratio... P-P Plots... Q-Q Plots...

ID	Age
1	60
2	79
3	82
4	66
5	52
6	58
7	50
8	83
9	46
10	54

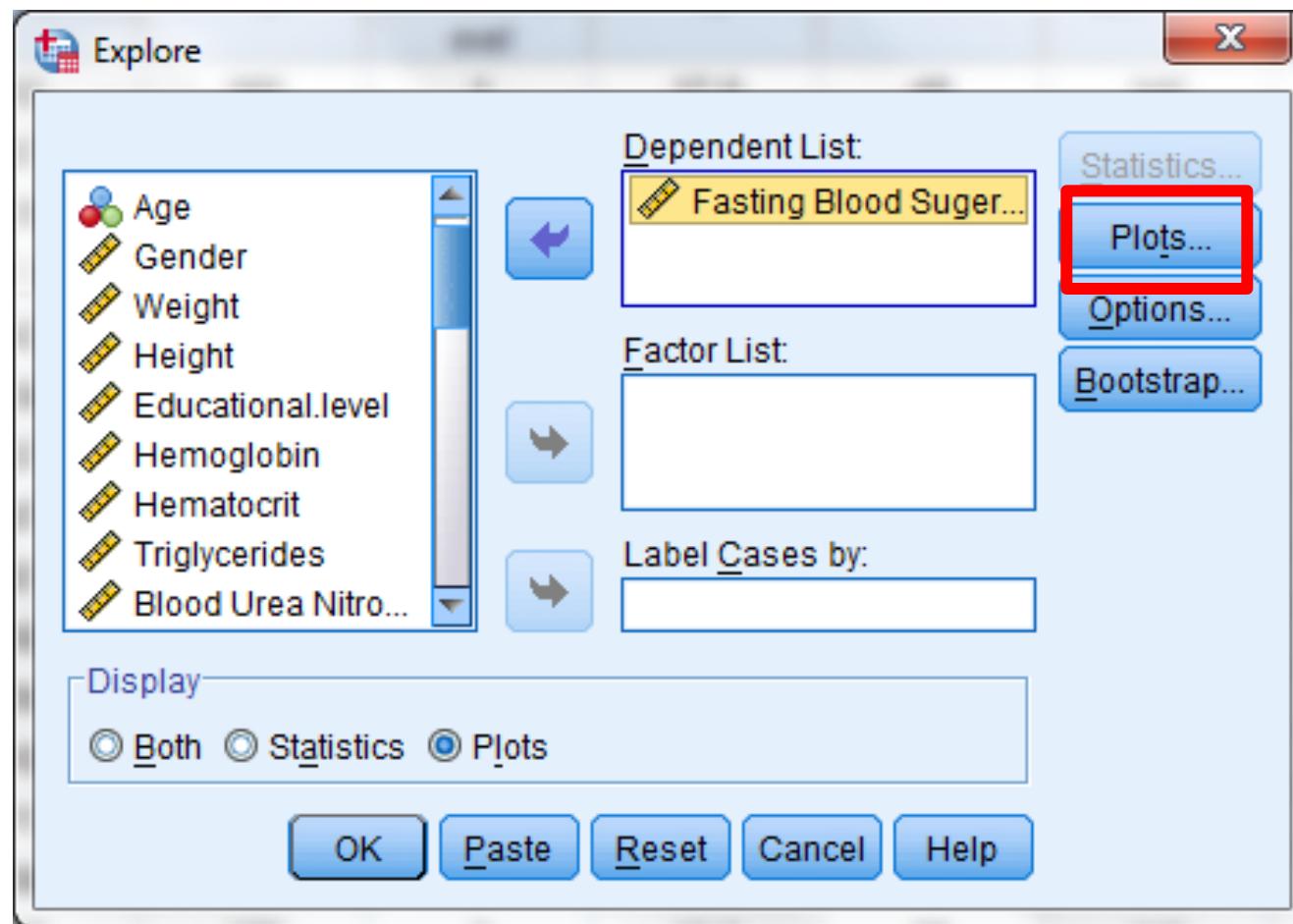
Normality Assumption



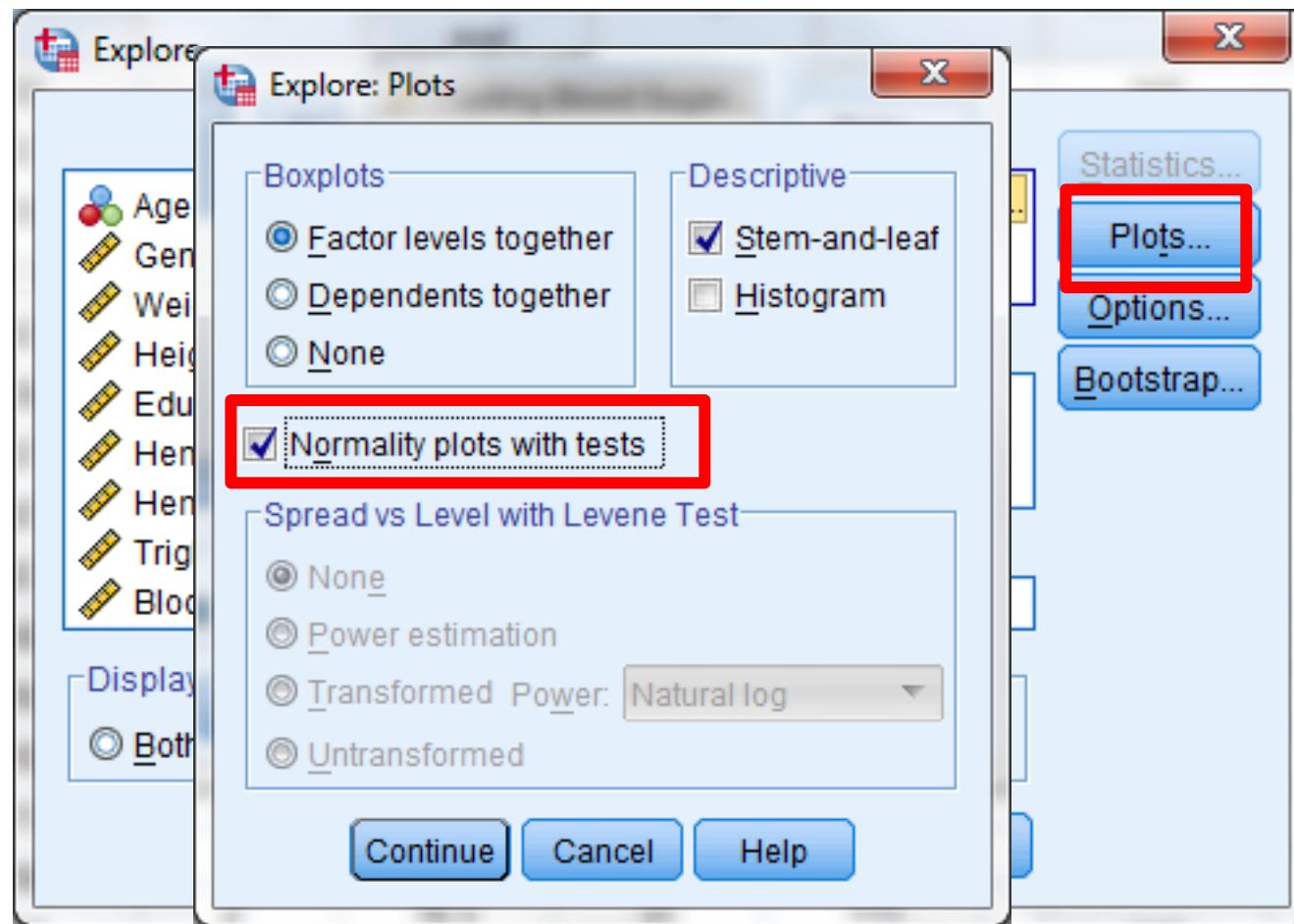
Normality Assumption



Normality Assumption



Normality Assumption



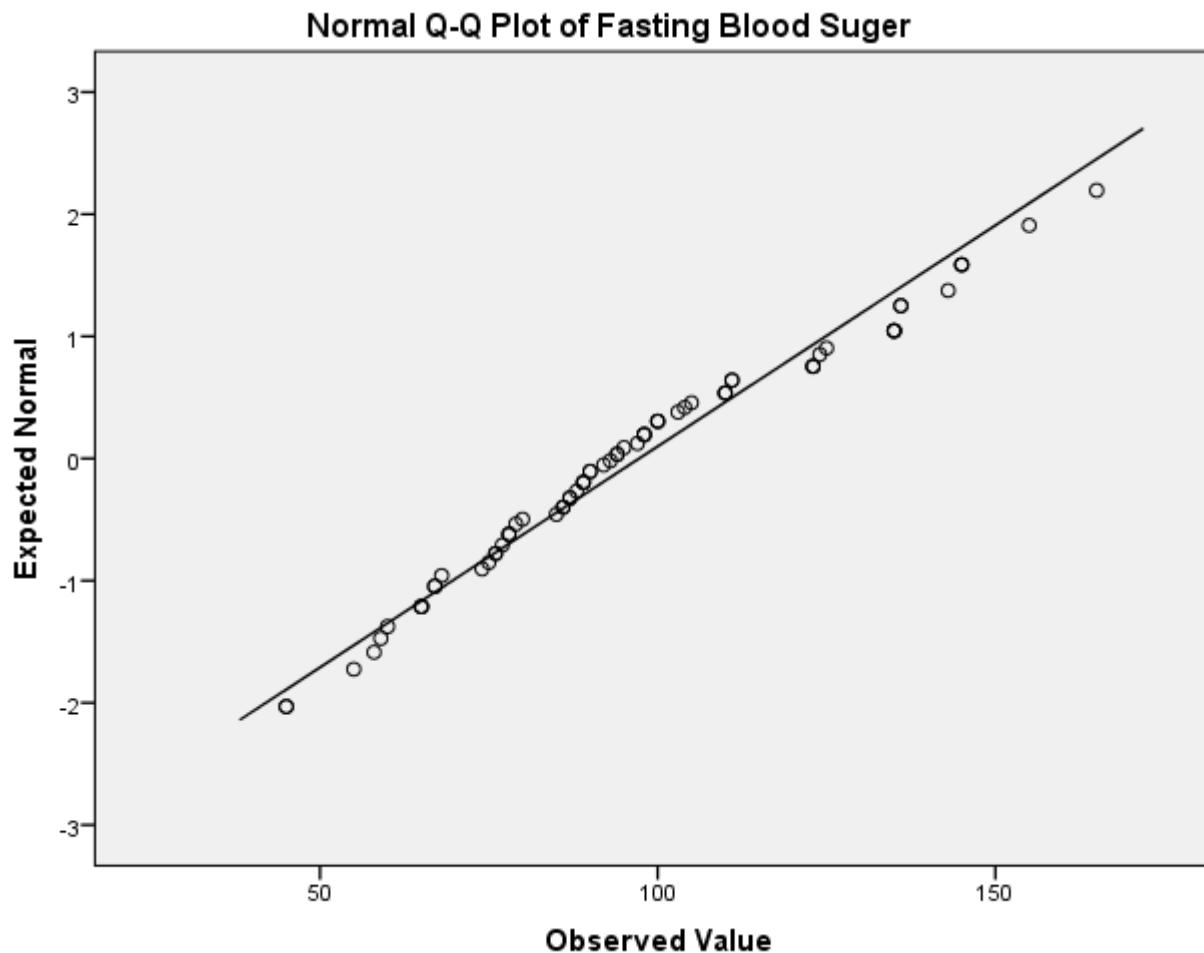
Normality Assumption

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Fasting Blood Suger	.103	70	.062	.971	70	.104

a. Lilliefors Significance Correction

Normality Assumption



Normality Assumption

data2.sav [DataSet2] - IBM SPSS Statistics Data Editor

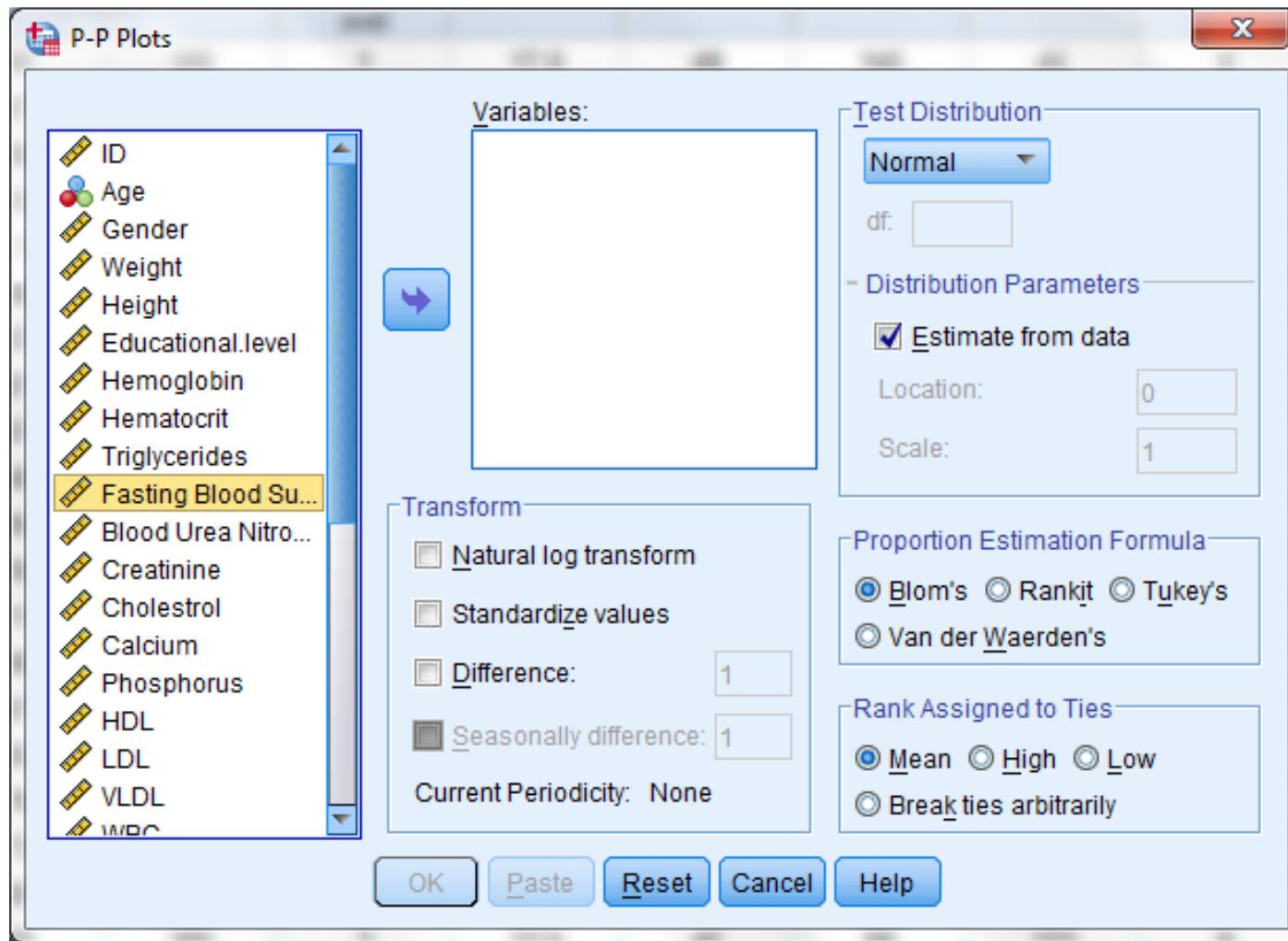
File Edit View Data Transform Analyze Direct_Marketing Graphs Utilities Add-ons Window Help

Reports
Descriptive Statistics
Tables
Compare Means
General Linear Model
Generalized Linear Models
Mixed Models
Correlate
Regression
Loglinear
Neural Networks
Classify
Dimension Reduction
Scale
Nonparametric Tests
Forecasting
Survival
Multiple Response

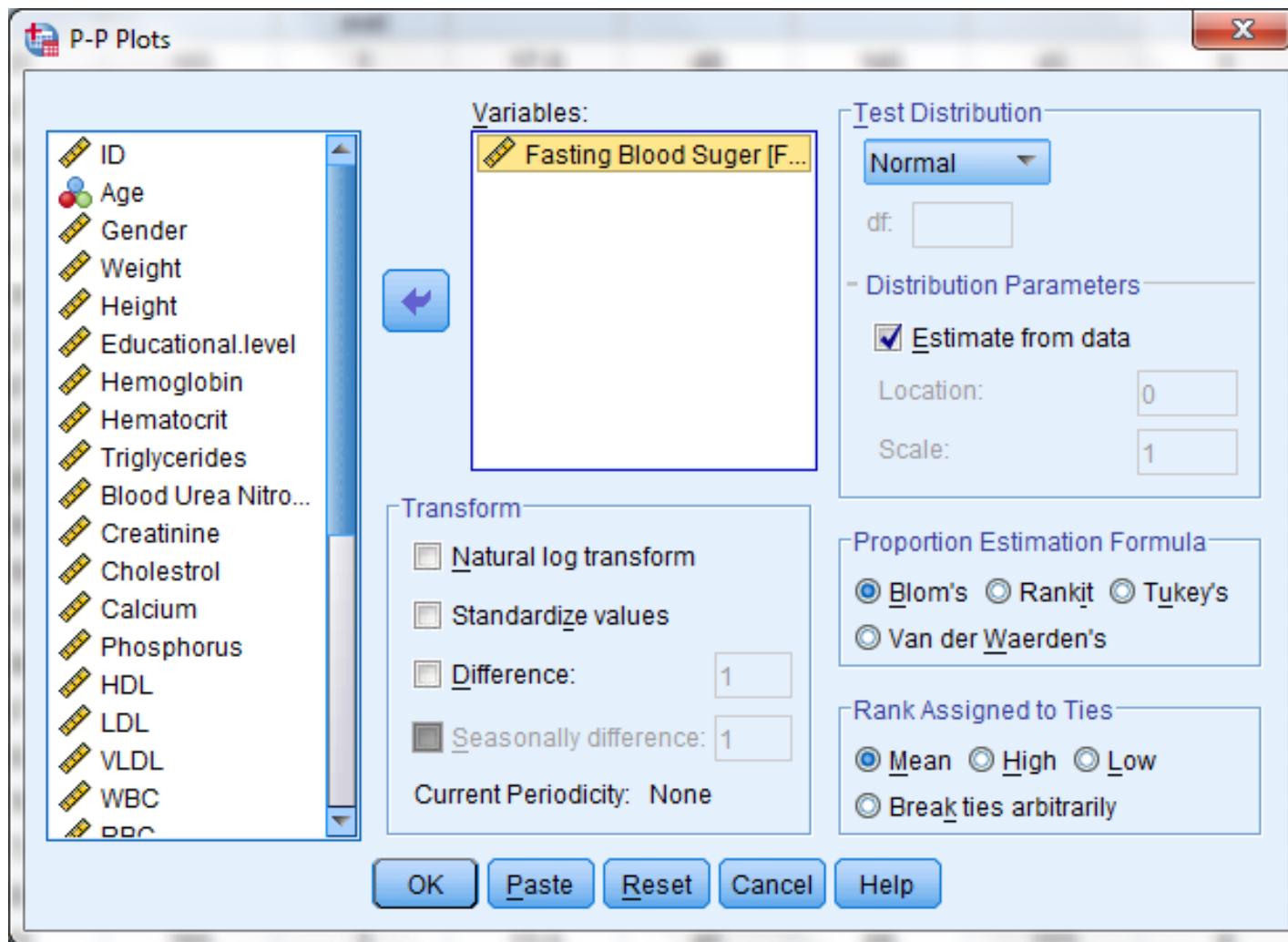
Frequencies...
Descriptives...
Explore...
Crosstabs...
Ratio...
P-P Plots...
Q-Q Plots...

ID	Age	Hemoglobin
1	60	17.0
2	79	16.0
3	82	17.0
4	66	16.5
5	52	16.5
6	58	14.5
7	50	15.3
8	83	16.8
9	46	16.5
10	54	23.5
11	67	15.2
12	54	16.3
13	63	17.2
14	44	22.0

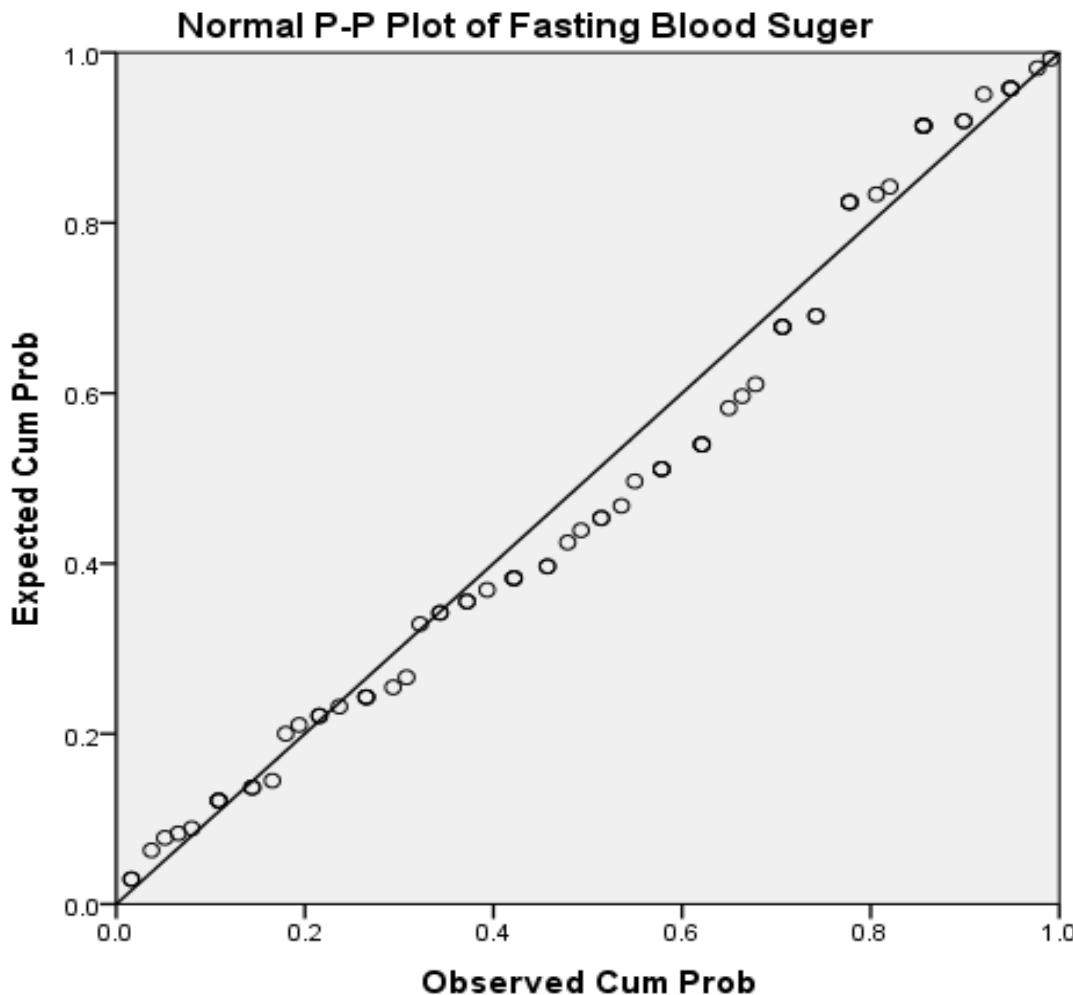
Normality Assumption



Normality Assumption



Normality Assumption



Normality Assumption

SPSS menu bar showing Analyze selected.

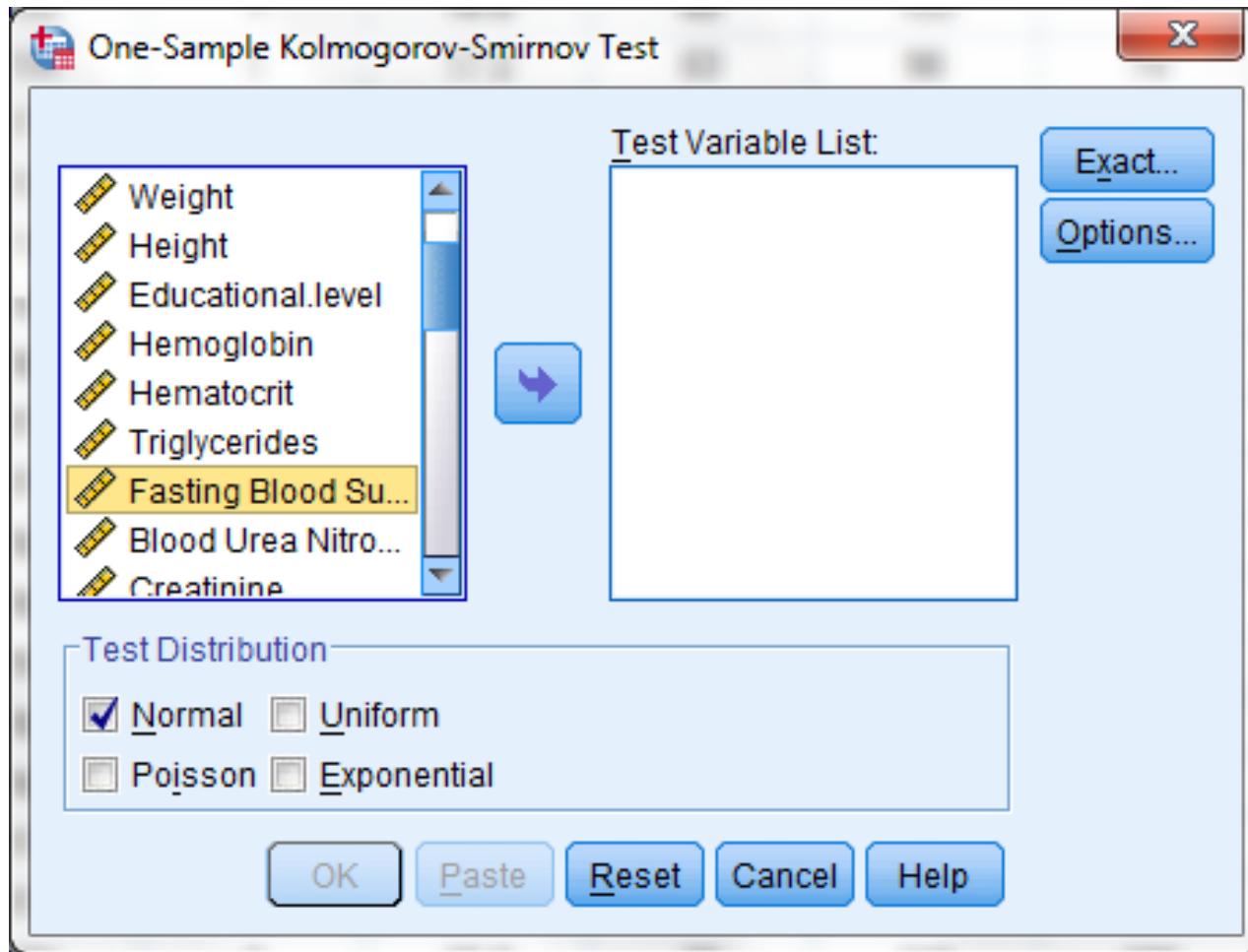
Data View:

	Age
1	60
2	79
3	82
4	66
5	52
6	58
7	50
8	83
9	46
10	54
11	67
12	54
13	63
14	44
15	60
16	49
17	41
18	39
19	65
20	45
21	57
22	47

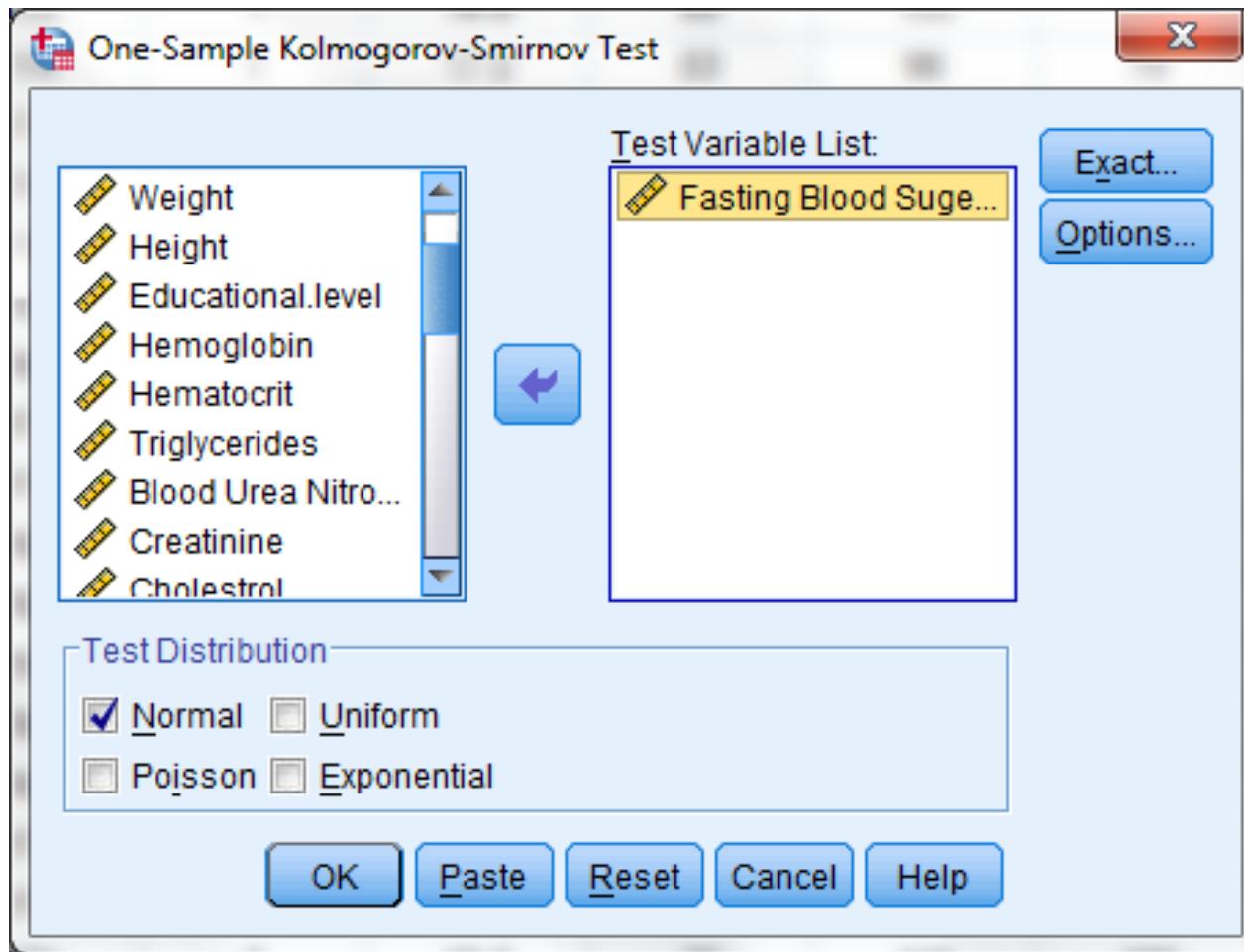
Analyze menu path:

- Nonparametric Tests
 - One Sample...
 - Independent Samples...
 - Related Samples...
- Legacy Dialogs
 - Chi-square...
 - Binomial...
 - Runs...
 - 1-Sample K-S...
 - 2 Independent Samples...
 - K Independent Samples...
 - 2 Related Samples...
 - K Related Samples...

Normality Assumption



Normality Assumption



Normality Assumption

One-Sample Kolmogorov-Smirnov Test

		Fasting Blood Sugar
N		70
Normal Parameters ^{a,b}	Mean	97.24
	Std. Deviation	27.631
Most Extreme Differences	Absolute	.103
	Positive	.103
	Negative	-.086
Kolmogorov-Smirnov Z		.863
Asymp. Sig. (2-tailed)		.446

a. Test distribution is Normal.

b. Calculated from data.

Normality Assumption

Tests of Normality

	Kolmogorov-Smirnov ^a		
	Statistic	df	Sig.
Fasting Blood Suger	.103	70	.062

a. Lilliefors Significance Correction

One-Sample Kolmogorov-Smirnov Test

		Fasting Blood Suger
N		70
Normal Parameters ^{a,b}	Mean	97.24
	Std. Deviation	27.631
Most Extreme Differences	Absolute	.103
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Normality Assumption

Tests of Normality

	Kolmogorov-Smirnov ^a		
	Statistic	df	Sig.
Fasting Blood Suger	.103	70	.062

a Lilliefors Significance Correction

One-Sample Kolmogorov-Smirnov Test

		Fasting Blood Suger
N		70
Normal Parameters ^{a,b}	Mean	97.24
	Std. Deviation	27.631
Most Extreme Differences	Absolute	.103
	Positive	.103
	Negative	-.086
Kolmogorov-Smirnov Z		.863
Asymp. Sig. (2-tailed)		.446

a. Test distribution is Normal.

b. Calculated from data.

Normality Assumption

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
systolic blood pressure	.174	46	.001	.921	46	.004

a. Lilliefors Significance Correction

One-Sample Kolmogorov-Smirnov Test

		systolic blood pressure
N		46
Normal Parameters ^{a,b}	Mean	123.22
	Std. Deviation	19.458
Most Extreme Differences	Absolute	.174
	Positive	.174
	Negative	-.118
Kolmogorov-Smirnov Z		1.183
Asymp. Sig. (2-tailed)		.122

a. Test distribution is Normal.

b. Calculated from data.

Normality Assumption

- در صورتی که میانگین و واریانس جامعه را نداشته باشیم از پنجره برای آزمون نرمالیتی استفاده خواهیم کرد.

Homogeneity of Variances

- Leven's test
 - Two independent t-test
 - One-Way ANOVA

Mean Parametric Tests

- One group
 - One Sample t-test
- Two groups
 - Two Independent Sample t-test
 - Paired Sample t-test
- More than two groups
 - One Way ANOVA

One-Sample t-test

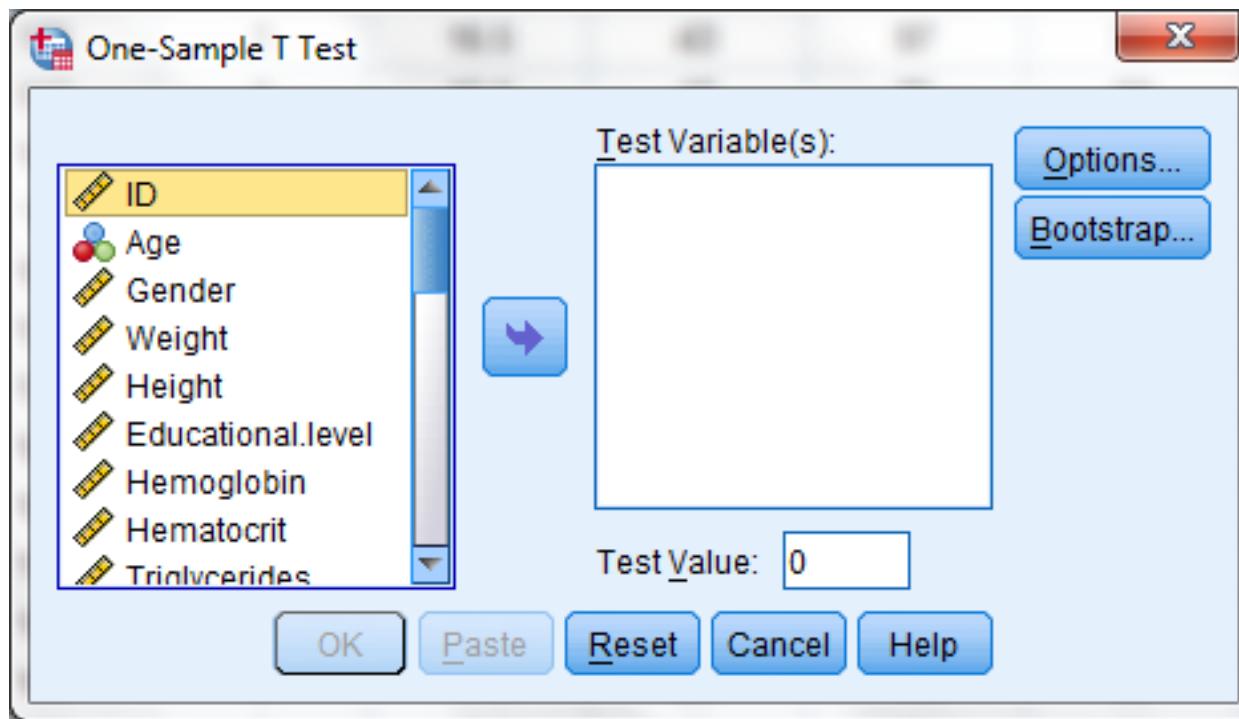
data2.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

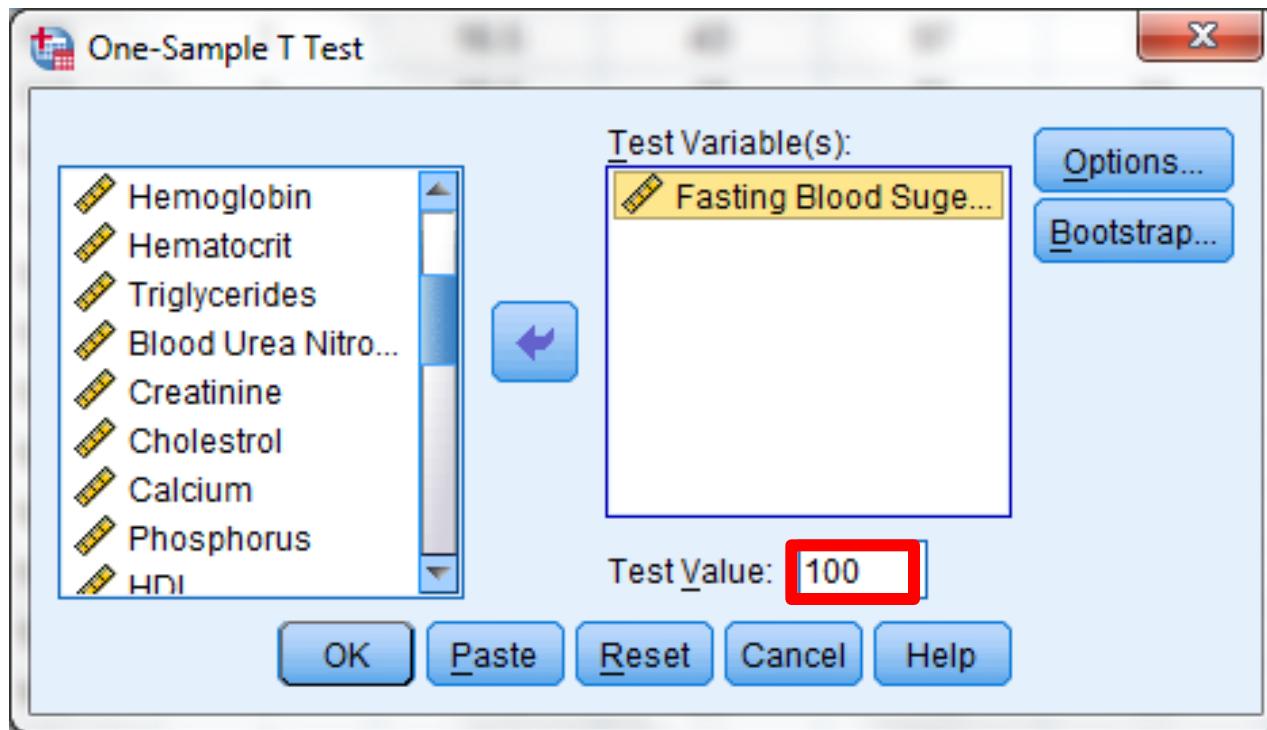
Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve...

	ID	Age
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4	4	66
5	5	52
6	6	58
7	7	50
8	8	83
9	9	46
10	10	54
11	11	67
12	12	54
13	13	63
14	14	44
15	15	60
16	16	49
17	17	41
18	18	39
19	19	65
20	20	45
21	21	57
22	22	47

One-Sample t-test



One-Sample t-test



One-Sample t-test

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Fasting Blood Suger	70	97.24	27.631	3.303

One-Sample Test

	Test Value = 100					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Fasting Blood Suger	-.835	69	.407	-2.757	-9.35	3.83

Two independent Samples t-test

data2.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

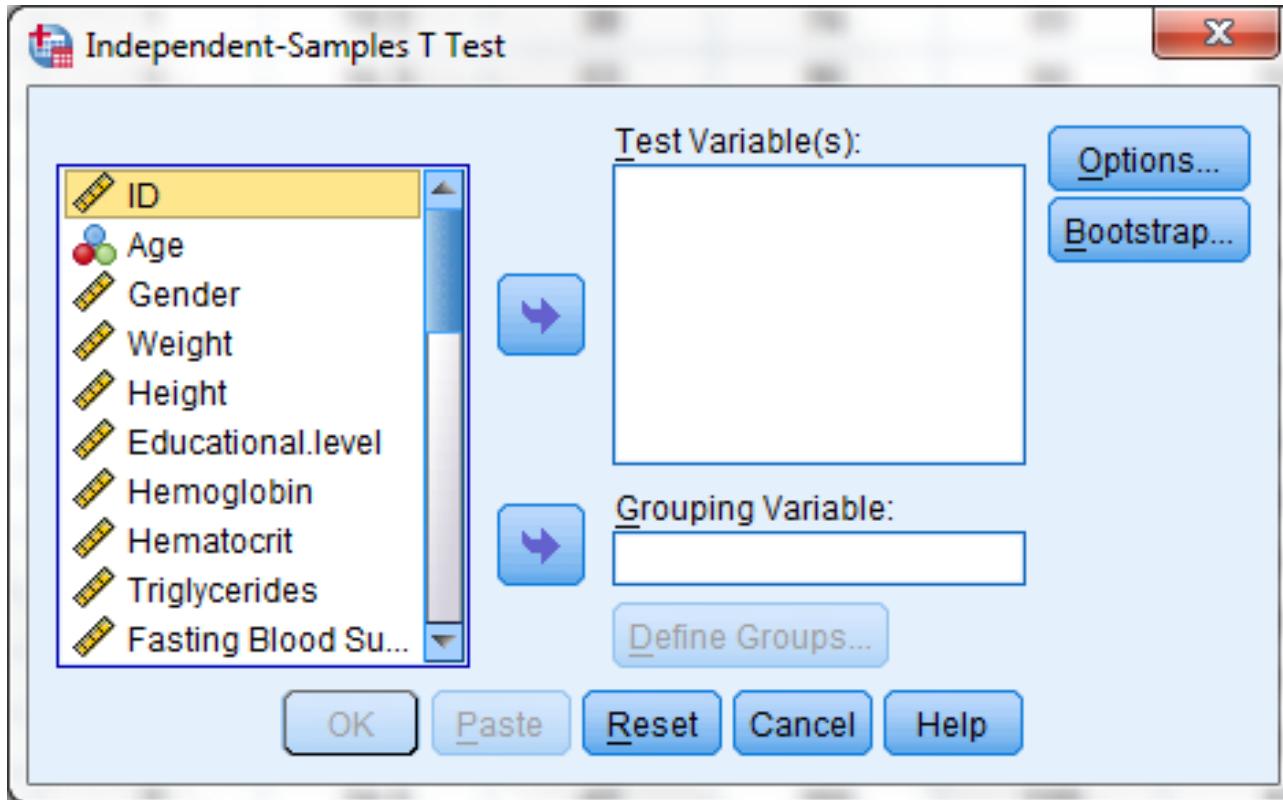
Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve...

Means... One-Sample T Test... Independent-Samples T Test... Paired-Samples T Test... One-Way ANOVA...

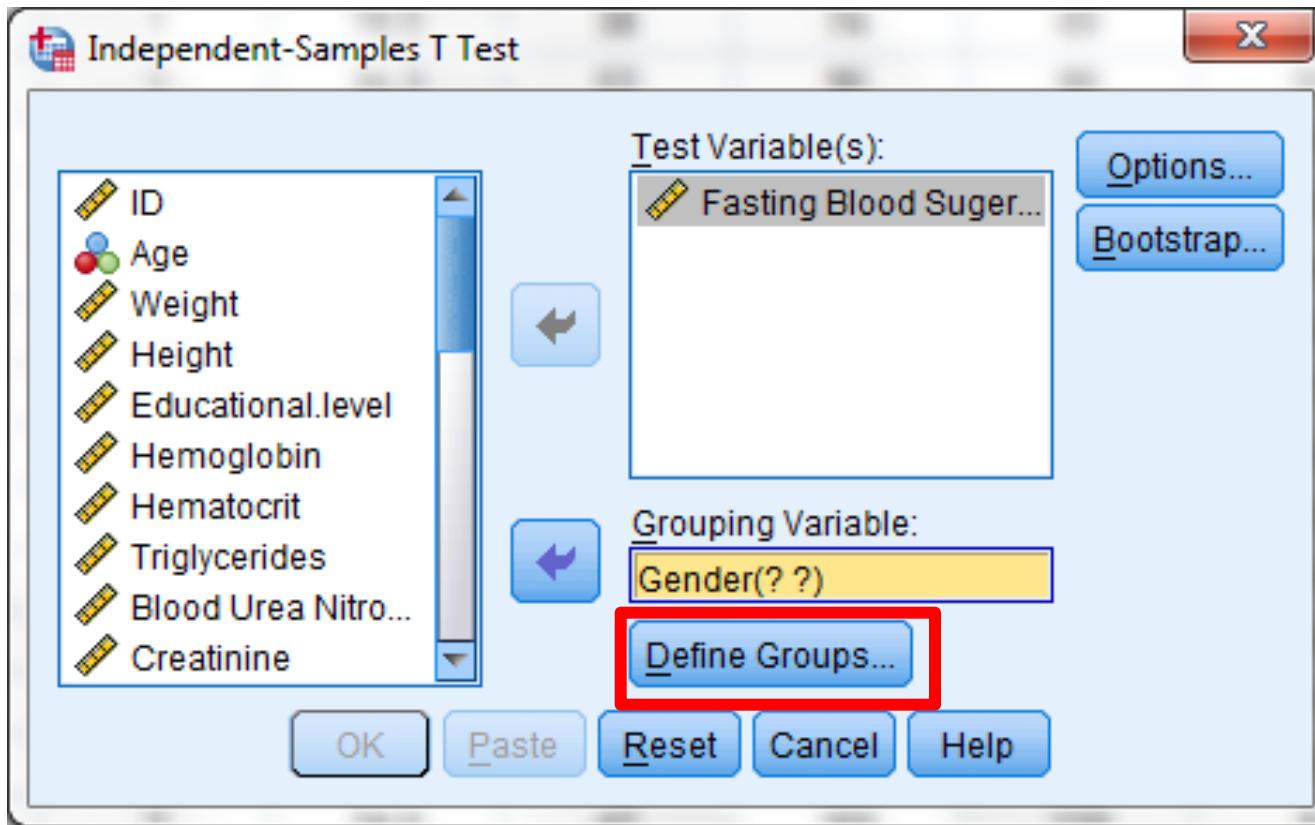
	ID	Age
1	1	60
2	2	79
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5	5	52
6	6	58
7	7	50
8	8	83
9	9	46
10	10	54
11	11	67
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15	15	60
16	16	49
17	17	41
18	18	39
19	19	65
20	20	45
21	21	57
22	22	47

1 96 200 3 18.6 42

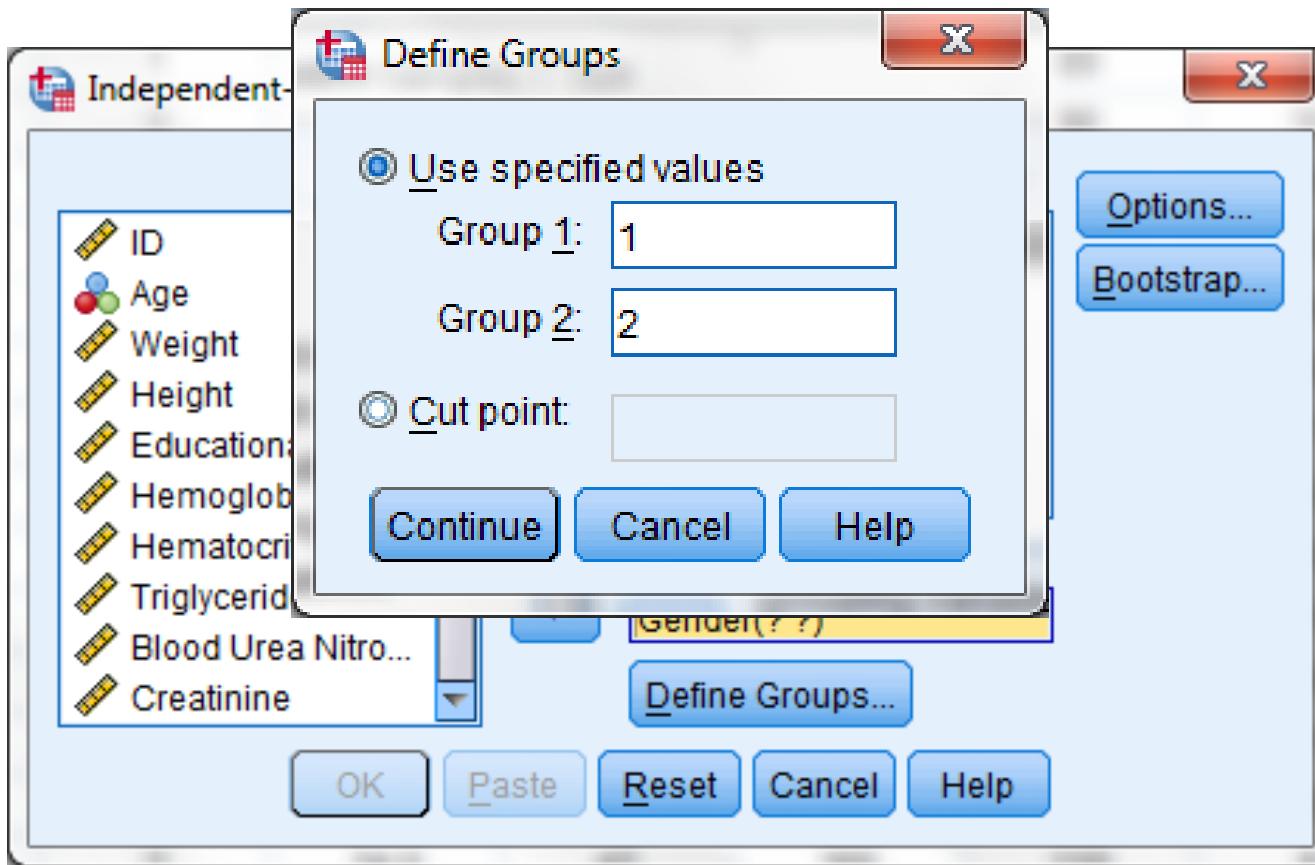
Two independent Samples t-test



Two independent Samples t-test



Two independent Samples t-test



Two independent Samples t-test

Group Statistics

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Fasting Blood Suger	Male	35	96.71	30.373	5.134
	Female	35	97.77	25.026	4.230

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
Fasting Blood Suger	Equal variances assumed	1.426	.237	-.159	68	.874	-1.057	6.652	-14.331	12.217
	Equal variances not assumed			-.159	65.601	.874	-1.057	6.652	-14.340	12.226

Two independent Samples t-test

Group Statistics

	gender groups	N	Mean	Std. Deviation	Std. Error Mean
creatinin	male	29	1.5279	.76461	.14198
	female	19	1.1316	.57740	.13246

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
creatinin	Equal variances assumed	2.039	.160	1.926	46	.060	.39635	.20583	-.01796	.81066
	Equal variances not assumed			2.041	44.965	.047	.39635	.19418	.00524	.78746

Paired Samples t-test

data2.sav [DataSet1] - IBM SPSS Statistics Data Editor

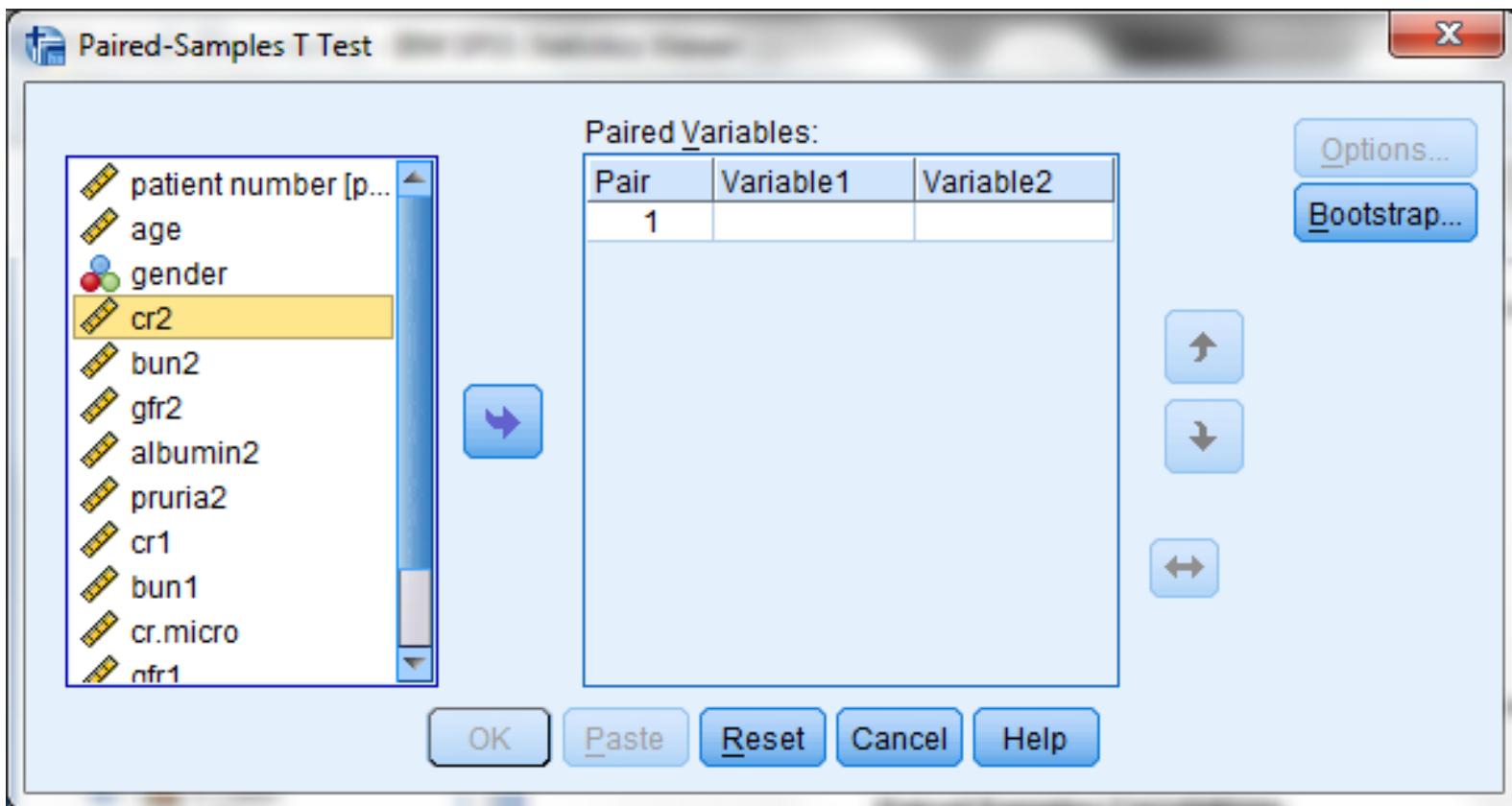
File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve...

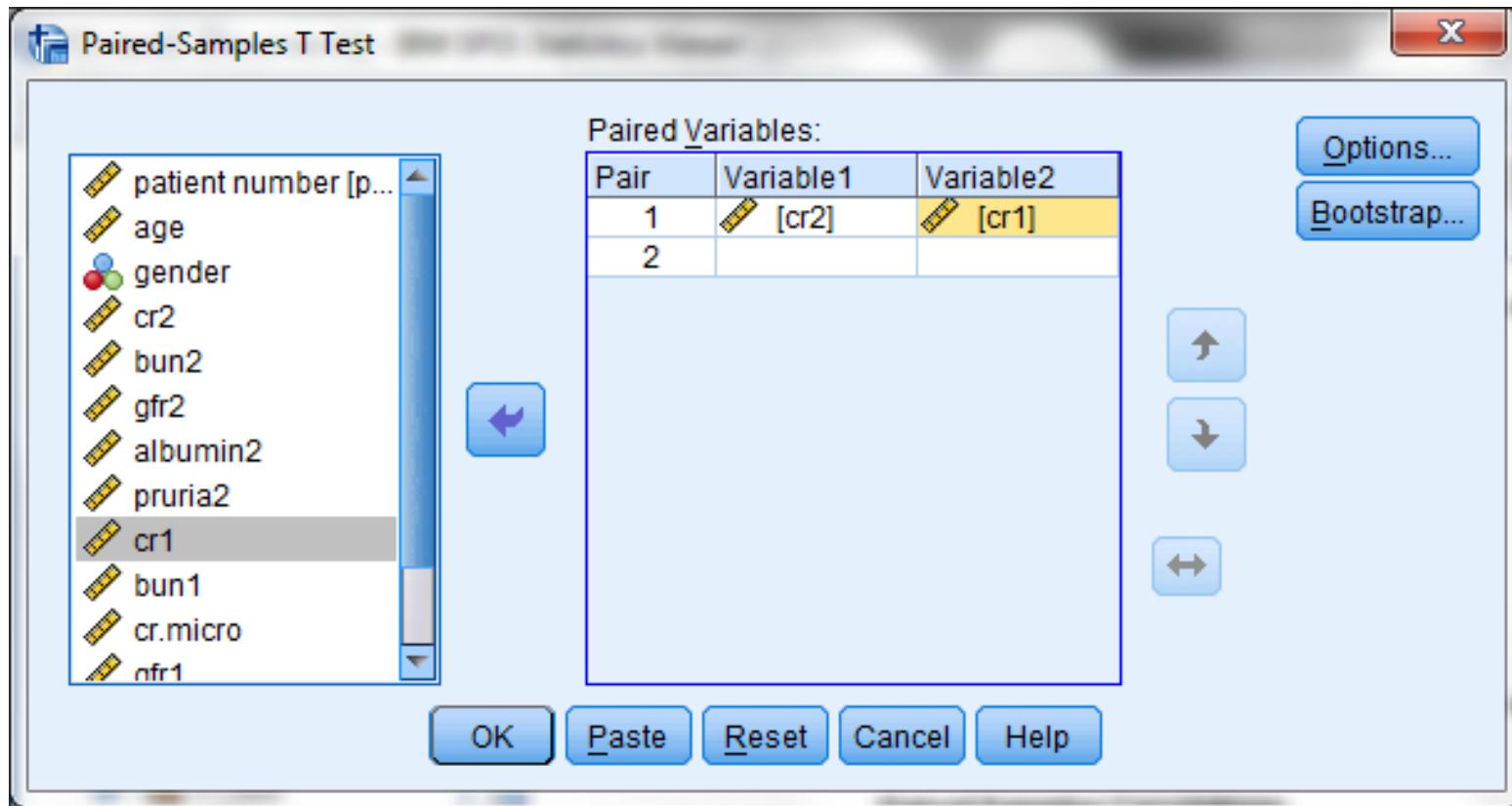
ID	Age
1	60
2	79
3	82
4	66
5	52
6	58
7	50
8	83
9	46
10	54
11	67
12	54
13	63
14	44
15	60
16	49
17	41
18	39
19	65
20	45
21	57
22	47

1 96 200 3 18.6 42

Paired Samples t-test



Paired Samples t-test



Paired Samples t-test

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Pair 1	cr2	1.3691	45	.73347
	cr1	1.2359	45	.69283
				.10934
				.10328

Paired Samples Correlations

	N	Correlation	Sig.
Pair 1	cr2 & cr1	45	-.026
			.864

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	cr2 - cr1	.13323	1.02213	.15237	-.17385	.44032	.874	.44	.387		

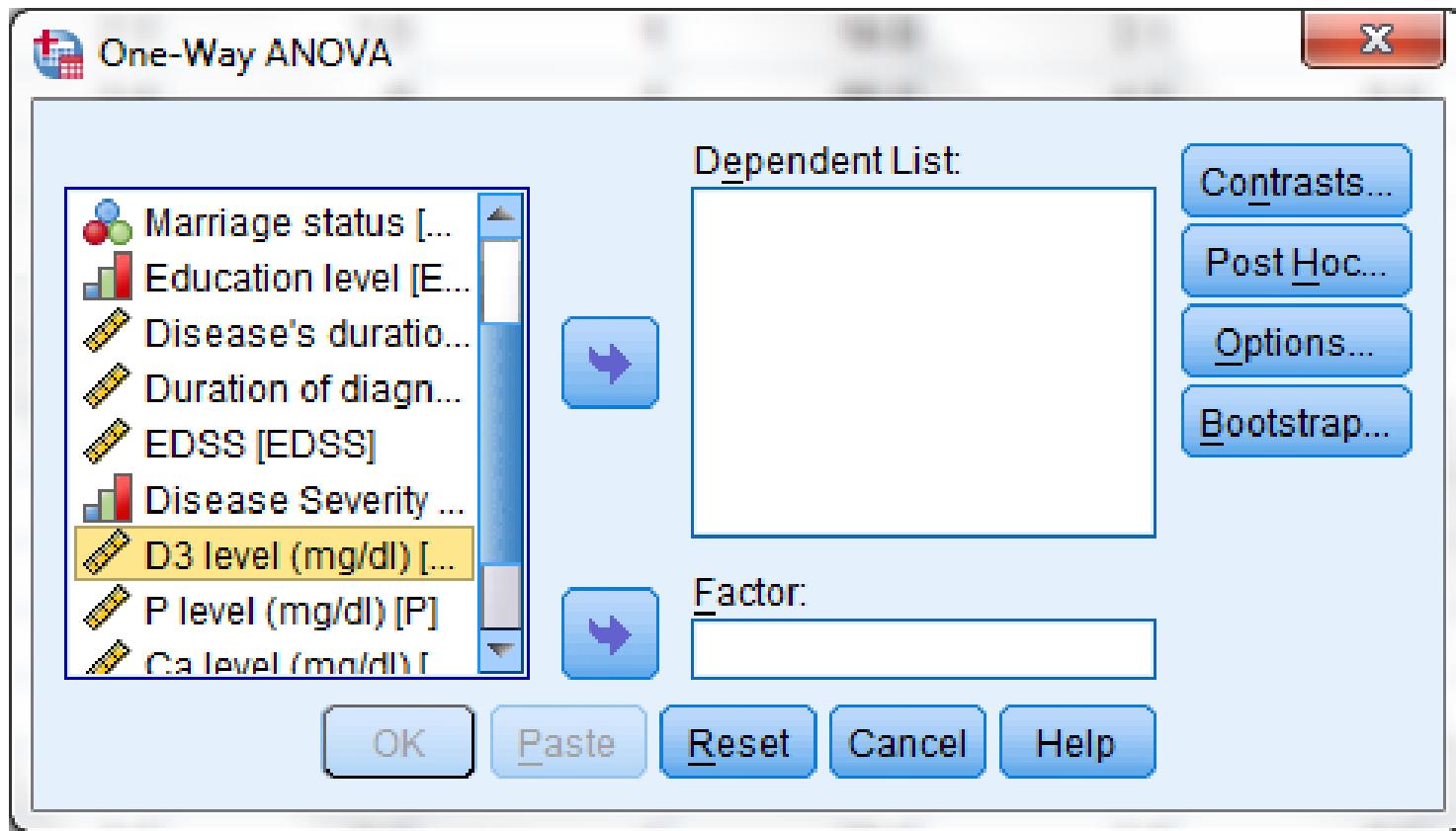
One-Way ANOVA

data2.sav [DataSet1] - IBM SPSS Statistics Data Editor

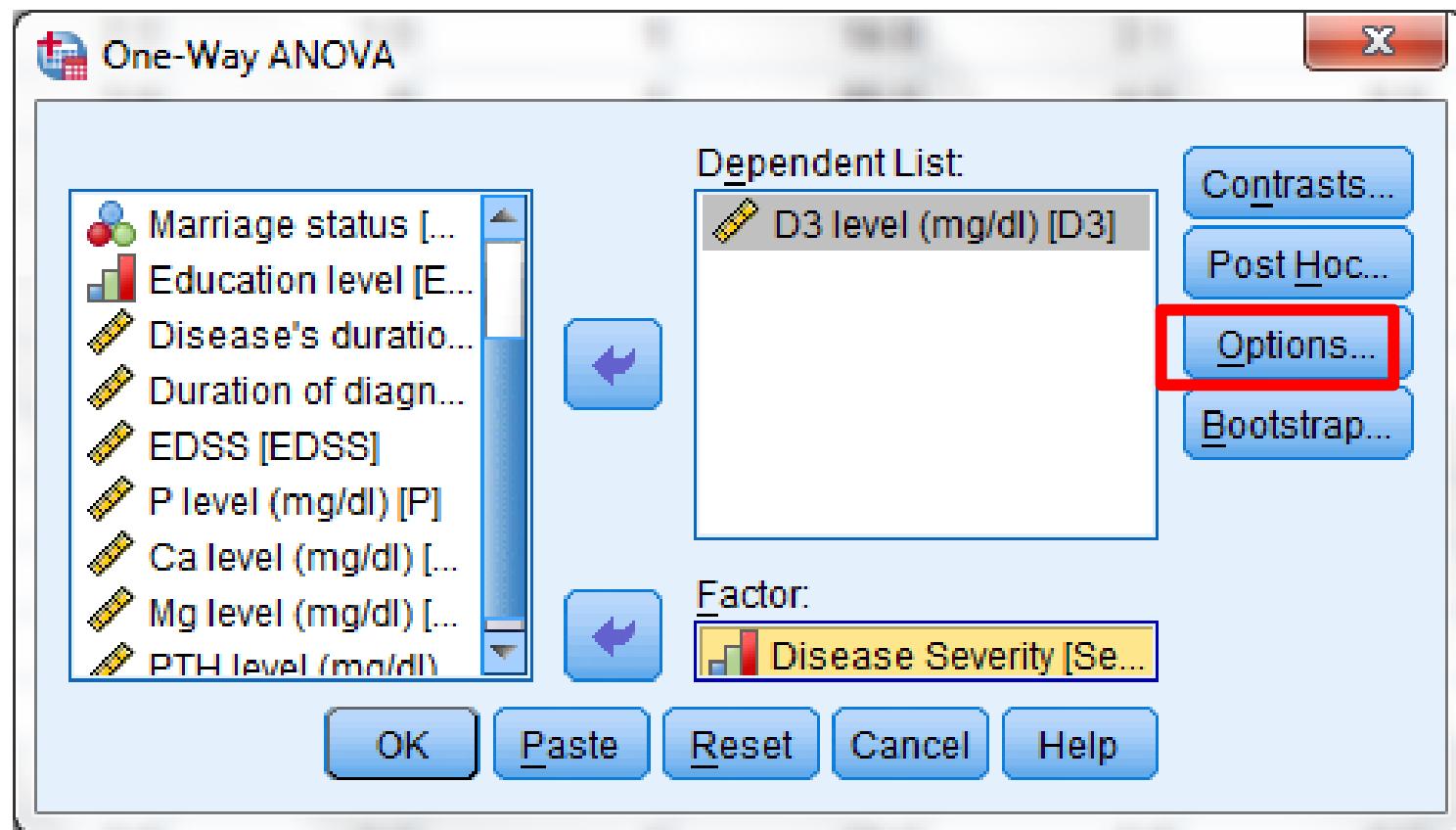
The screenshot shows the IBM SPSS Statistics Data Editor interface. The menu bar is visible at the top, with 'Analyze' being the active tab. A sub-menu for 'Compare Means' is open, and 'One-Way ANOVA...' is highlighted. To the left of the menu, a data table is displayed with columns labeled 'ID' and 'Age'. The data consists of 22 rows of age values ranging from 47 to 83. The bottom of the screen shows the status bar with values 1, 96, 200, 3, 1, and 42.

	ID	Age
1	1	60
2	2	79
3	3	82
4	4	66
5	5	52
6	6	58
7	7	50
8	8	83
9	9	46
10	10	54
11	11	67
12	12	54
13	13	63
14	14	44
15	15	60
16	16	49
17	17	41
18	18	39
19	19	65
20	20	45
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22	22	47

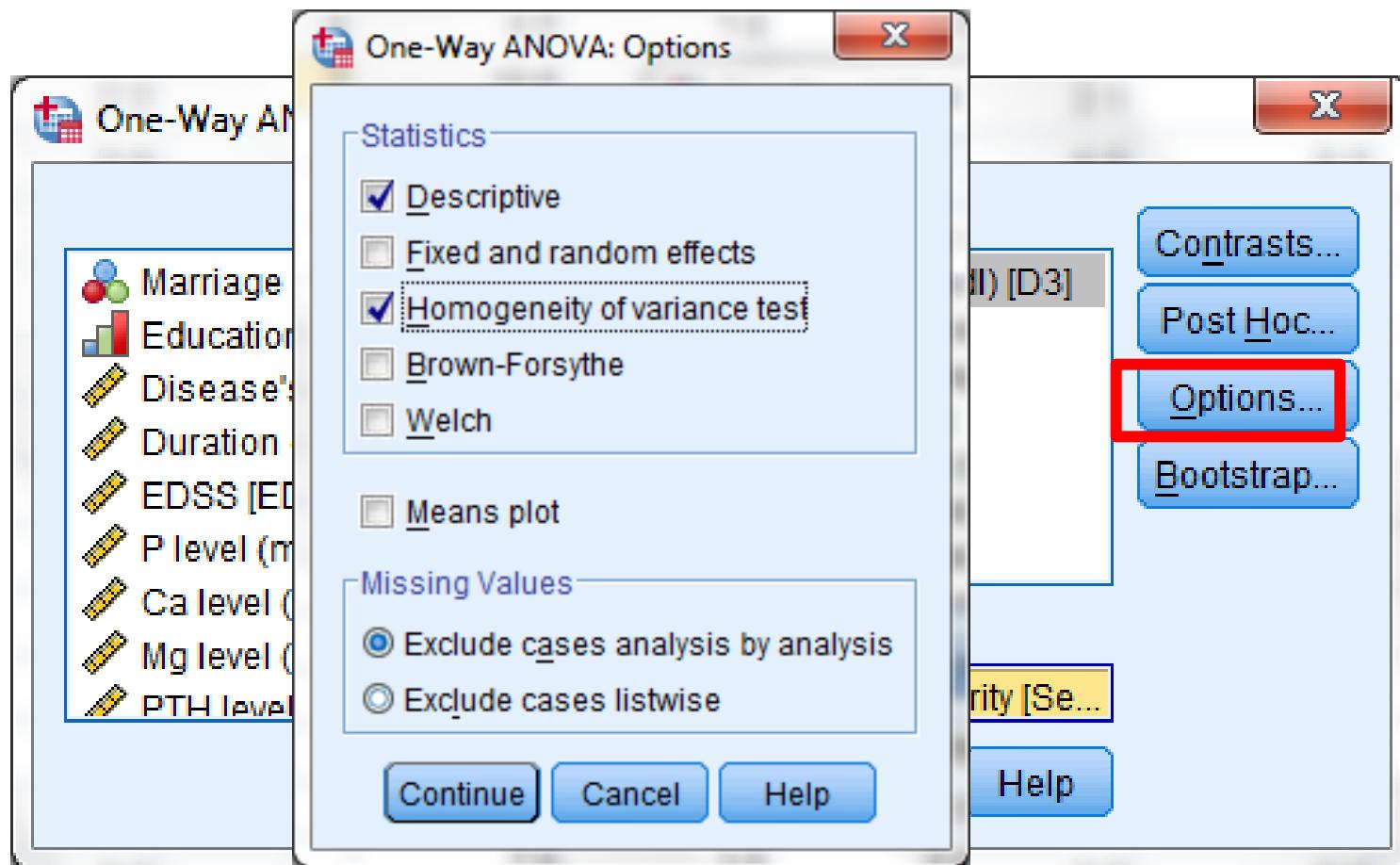
One-Way ANOVA



One-Way ANOVA



One-Way ANOVA



One-Way ANOVA

Descriptives

D3 level (mg/dl)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Mild	47	36.657	35.4597	5.1723	26.246	47.069	4.7	149.0
Moderate	11	52.382	45.1186	13.6038	22.071	82.693	4.9	170.0
Severe	10	29.230	37.3468	11.8101	2.514	55.946	2.0	105.0
Total	68	38.109	37.4322	4.5393	29.048	47.169	2.0	170.0

Test of Homogeneity of Variances

D3 level (mg/dl)

Levene Statistic	df1	df2	Sig.
.098	2	65	.907

ANOVA

D3 level (mg/dl)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3128.242	2	1564.121	1.120	.332
Within Groups	90750.052	65	1396.155		
Total	93878.295	67			

One-Way ANOVA

Descriptives

Ca level (mg/dl)

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Mild	47	9.489	.5313	.0775	9.333	9.645	8.2	10.6
Moderate	11	9.427	.4860	.1465	9.101	9.754	8.7	10.1
Severe	10	8.570	2.0364	.6440	7.113	10.027	2.8	9.6
Total	68	9.344	.9442	.1145	9.116	9.573	2.8	10.6

Test of Homogeneity of Variances

Ca level (mg/dl)

Levene Statistic	df1	df2	Sig.
5.090	2	65	.009

ANOVA

Ca level (mg/dl)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7.060	2	3.530	4.357	.017
Within Groups	52.667	65	.810		
Total	59.728	67			

One-Way ANOVA

Kruskal-Wallis Test

Ranks

Disease Severity	N	Mean Rank
Ca level (mg/dl) Mild	47	36.68
Moderate	11	35.05
Severe	10	23.65
Total	68	

Test Statistics^{a,b}

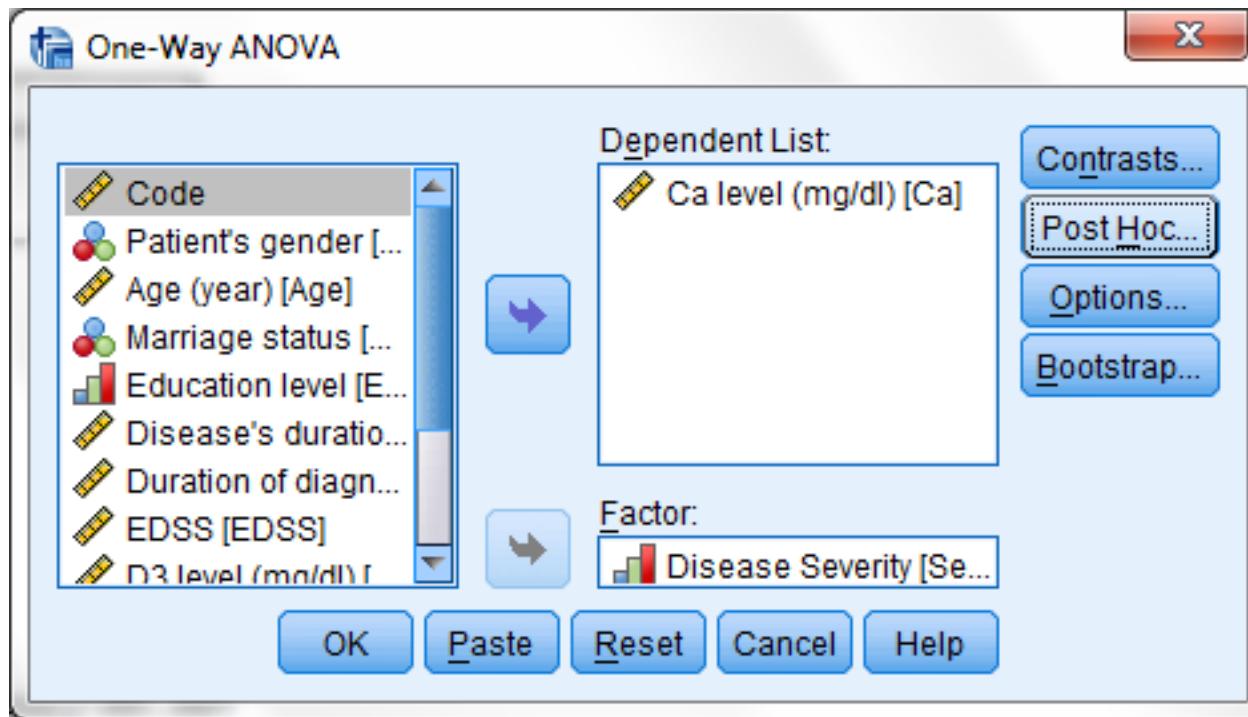
	Ca level (mg/dl)
Chi-Square	3.616
df	2
Asymp. Sig.	.164

a. Kruskal Wallis Test

b. Grouping Variable:
Disease Severity

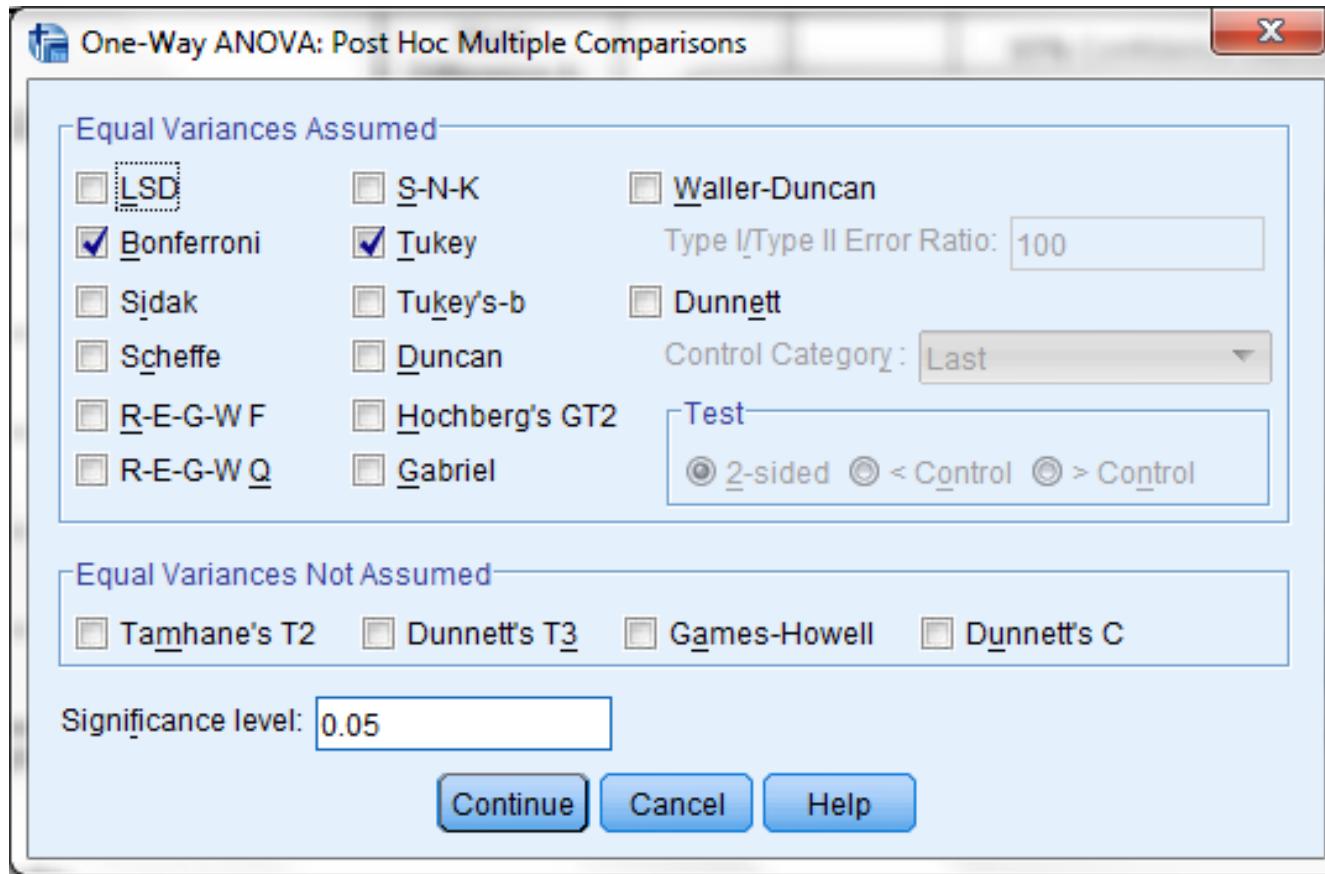
One-Way ANOVA

- Post Hoc multiple comparisons



One-Way ANOVA

- Post Hoc multiple comparisons



One-Way ANOVA

- Post Hoc multiple comparisons

Multiple Comparisons

Dependent Variable: Ca level (mg/dl)

	(I) Disease Severity	(J) Disease Severity	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD	Mild	Moderate	.0621	.3015	.977	-.661	.785
		Severe	.9194*	.3135	.013	.167	1.671
	Moderate	Mild	-.0621	.3015	.977	-.785	.661
		Severe	.8573	.3933	.082	-.086	1.801
	Severe	Mild	-.9194*	.3135	.013	-1.671	-.167
		Moderate	-.8573	.3933	.082	-1.801	.086
Bonferroni	Mild	Moderate	.0621	.3015	1.000	-.679	.803
		Severe	.9194*	.3135	.014	.149	1.690
	Moderate	Mild	-.0621	.3015	1.000	-.803	.679
		Severe	.8573	.3933	.099	-.109	1.824
	Severe	Mild	-.9194*	.3135	.014	-1.690	-.149
		Moderate	-.8573	.3933	.099	-1.824	.109

*. The mean difference is significant at the 0.05 level.

Mean Non-Parametric Tests

- One group
 - Sign test
- Two groups
 - Mann-Whitney U test
 - Wilcoxon test
- More than two groups
 - Kruskal-Wallis test
 - Friedman test

Sign test

data1.sav [DataSet9] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Independent Samples... Related Samples... Legacy Dialogs

	pn	age
1	1	28.00
2	2	34.00
3	3	56.00
4	4	47.00
5	5	73.00
6	7	19.00
7	8	27.00
8	9	23.00
9	10	23.00
10	11	26.00
11	12	43.00
12	13	54.00
13	14	36.00
14	15	73.00
15	16	54.00
16	17	34.00
17	18	21.00
18	19	30.00
19	21	42.00
20	22	47.00

	dbp	cr	bun
90	.90	14.00	
75	1.00	14.95	
70	1.00	20.00	
85	1.40	13.55	
70	3.60	33.64	
80	1.90	17.28	
80	1.80	16.82	
80	.80	11.00	
70	1.10	16.00	
70	1.20	29.00	
90	.50	17.00	
80	3.50	21.96	
80	1.00	14.00	
80	1.00	27.00	
75	1.10	12.00	
80	.90	17.00	

52

Sign test

One-Sample Nonparametric Tests X

Objective **Fields** **Settings**

Identifies differences in single fields using one or more nonparametric tests. Nonparametric tests do not assume your data follow the normal distribution.

What is your objective?

Each objective corresponds to a distinct default configuration on the Settings Tab that you can further customize, if desired.

Automatically compare observed data to hypothesized
 Test sequence for randomness
 Customize analysis

Description

'Customize analysis' allows you fine-grained control over the tests performed and their options. The Wilcoxon Signed-Rank test is also available on the Settings tab.

Run **Paste** **Reset** **Cancel** **Help**

Sign test

One-Sample Nonparametric Tests

Use predefined roles
 Use custom field assignments

Fields:

Sort: None

Test Fields:

- ID
- Age
- Gender
- Weight
- Height
- Educational.level
- Hemoglobin
- Hematocrit
- Triglycerides
- Fasting Blood Suger
- Blood Urea Nitrogen
- Creatinine
- Cholestral
- Calcium
- Phosphorus
- HDL

All  

Run Paste Reset Cancel Help

Sign test

One-Sample Nonparametric Tests

Use predefined roles
 Use custom field assignments

Fields:

Sort: None

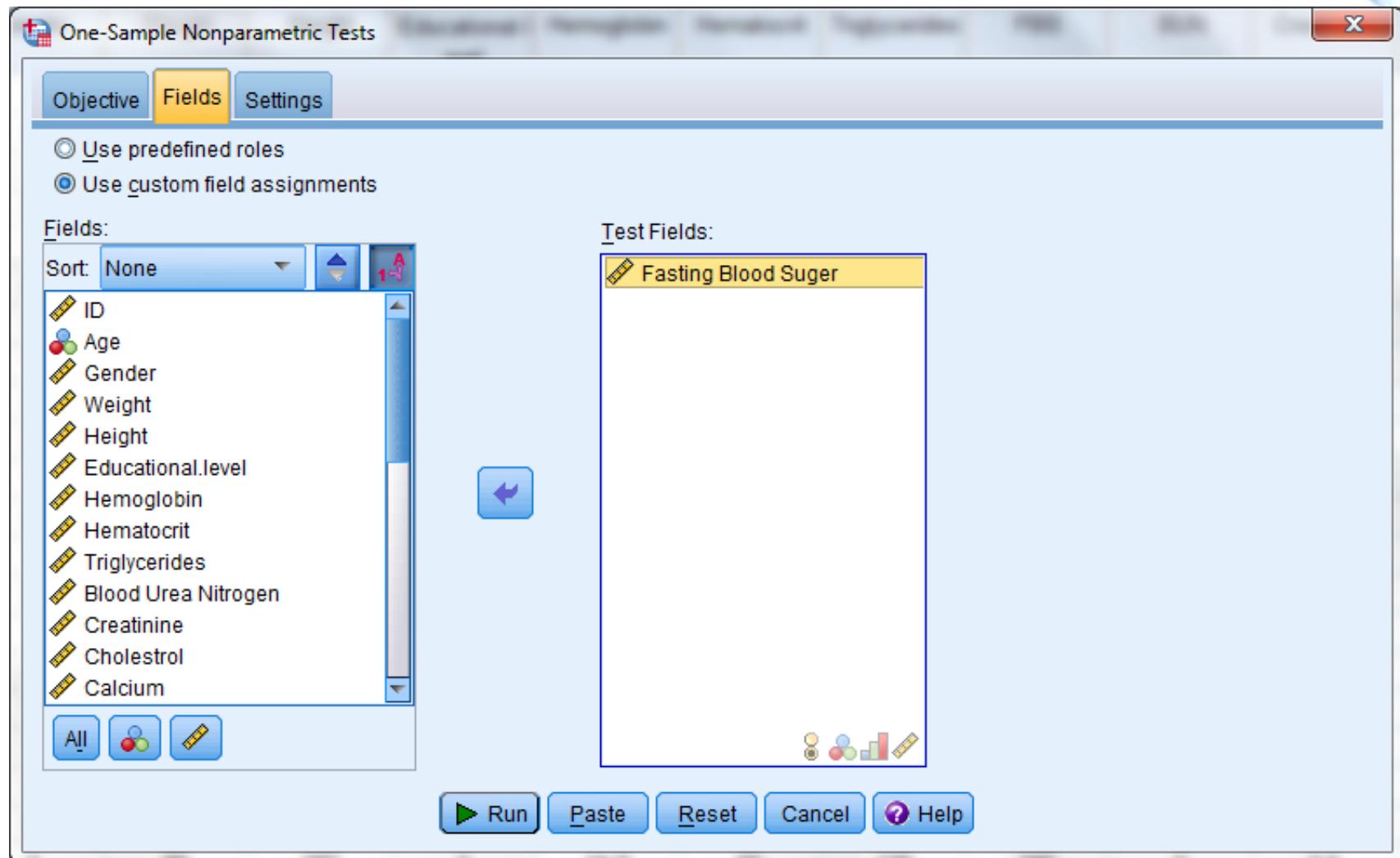
- ID
- Age
- Gender
- Weight
- Height
- Educational.level
- Hemoglobin
- Hematocrit
- Triglycerides
- Blood Urea Nitrogen
- Creatinine
- Cholesterol
- Calcium

Test Fields:

Fasting Blood Suger

All Age Gender

Run Paste Reset Cancel Help



Sign test

One-Sample Nonparametric Tests

Objectives Fields Settings

Select an item:

Choose Tests

Test Options

User-Missing Values

Automatically choose the tests based on the data

Customize tests

Compare observed binary probability to hypothesized (Binomial test)
Options...

Compare observed probabilities to hypothesized (Chi-Square test)
Options...

Test observed distribution against hypothesized (Kolmogorov-Smirnov test)
Options...

Compare median to hypothesized (Wilcoxon signed-rank test)
Hypothesized median:
Options...

Test sequence for randomness (Runs test)
Options...

Run Paste Reset Cancel Help

Sign test

One-Sample Nonparametric Tests

Objective Fields Settings

Select an item:

Choose Tests Test Options User-Missing Values

Automatically choose the tests based on the data
 Customize tests

Compare observed binary probability to hypothesized (Binomial test)
Options...

Compare observed probabilities to hypothesized (Chi-Square test)
Options...

Test observed distribution against hypothesized (Kolmogorov-Smirnov test)
Options...

Compare median to hypothesized (Wilcoxon signed-rank test)
Hypothesized median:
Options...

Test sequence for randomness (Runs test)
Options...

Run Paste Reset Cancel Help

Sign test

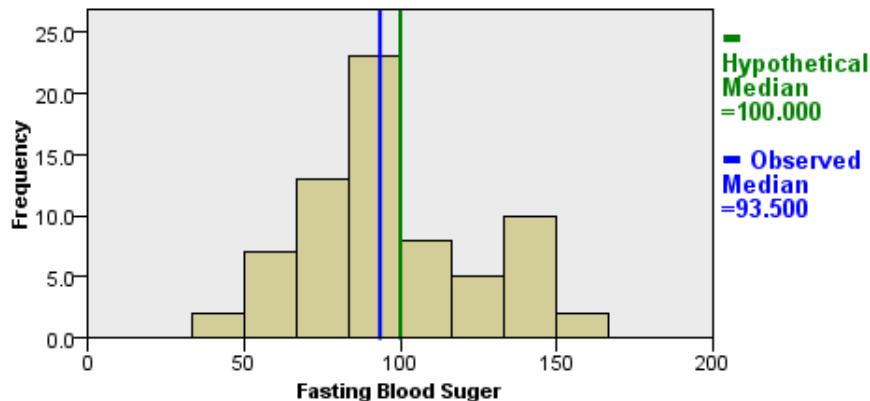
Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The median of Fasting Blood Suger equals 100.000.	One-Sample Wilcoxon Signed Rank Test	.304	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Sign test

One-Sample Wilcoxon Signed Rank Test



Total N	70
Test Statistic	974.500
Standard Error	160.031
Standardized Test Statistic	-1.028
Asymptotic Sig. (2-sided test)	.304

Mann-Whitney U test

data1.sav [DataSet9] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

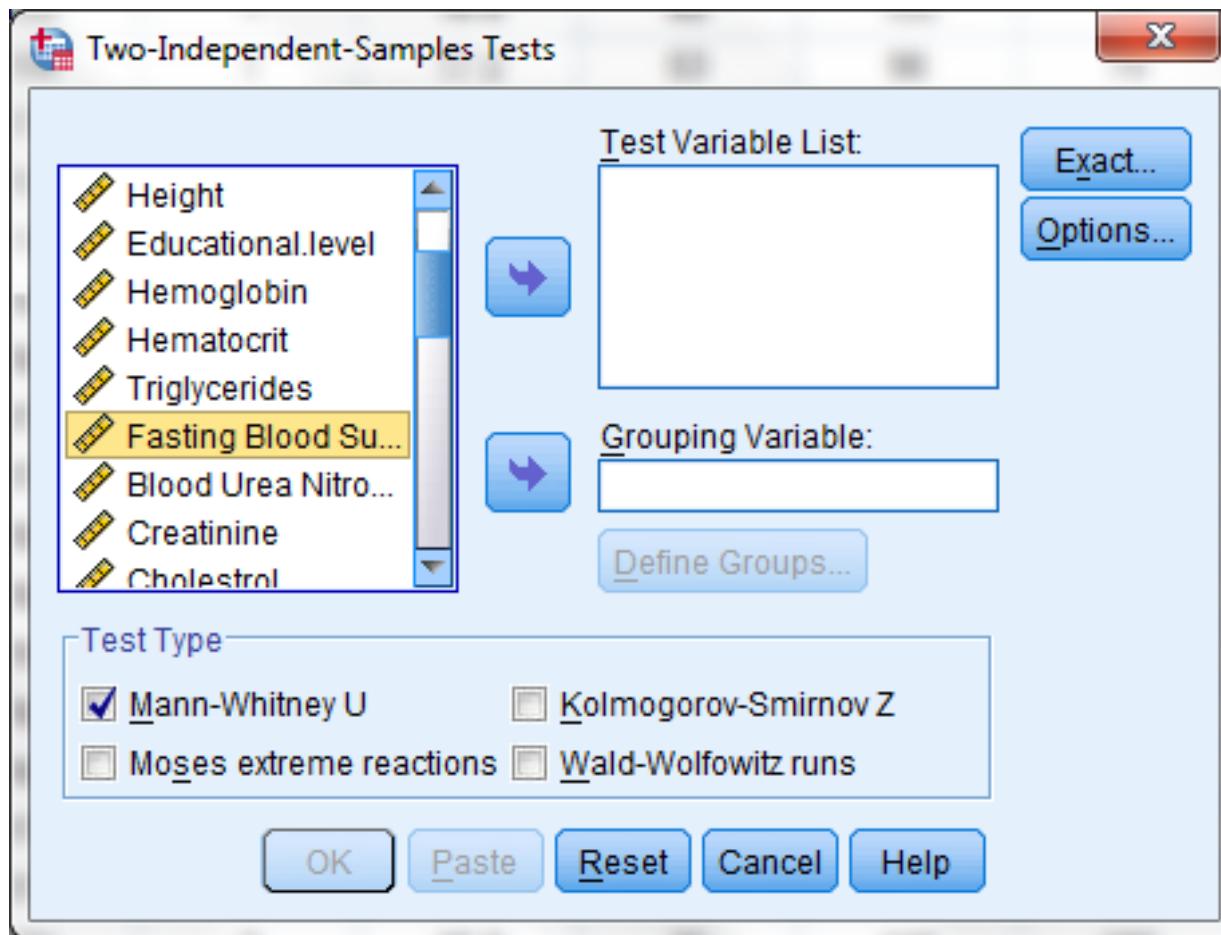
Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve... IBM SPSS Amos...

dbp cr bun albumin proteinuria

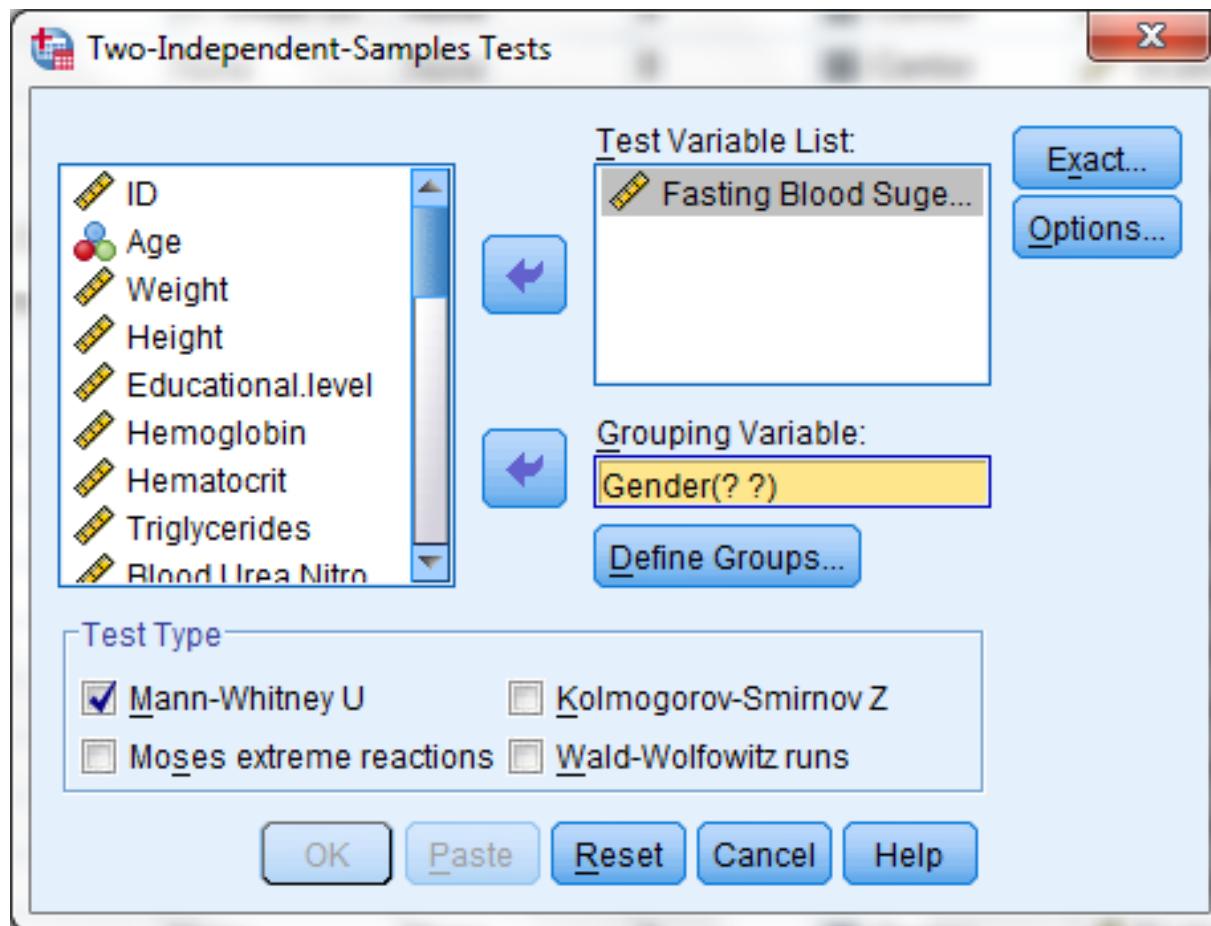
	pn	age	dbp	cr	bun	albumin	proteinuria
1	1	28.00	90	.90	14.00	.	143
2	2	34.00	75	1.00	14.95	.	510
3	3	56.00	70	1.00	20.00	4.00	210
4	4	47.00	85	1.40	13.55	.	600
5	5	73.00	70	3.60	33.64	3.30	3300
6	7	19.00	80	1.90	17.28	4.80	60
7	8	27.00	80	1.80	16.82	2.70	2239
8	9	23.00	80	.80	11.00	.	86
9	10	23.00	70	1.10	16.00	4.00	3600
10	11	26.00	70	1.20	29.00	3.20	720
11	12	43.00	90	.50	17.00	3.20	1260
12	13	54.00				.	3000
13	14	36.00				.	250
14	15	73.00				4.40	600
15	16	54.00	80	3.50	21.96		
16	17	34.00	80	1.00	14.00		
17	18	21.00	80	1.00	27.00		
18	19	30.00	75	1.10	12.00		
19	21	42.00	80	.90	17.00		
20	22	47.00	80	.90	12.00		
21	23	33.00	80	1.20	16.00		
22	24	26.00	80	1.40	23.36		
23	25	29.00					

One Sample... Independent Samples... Related Samples... Chi-square... Binomial... Runs... 1-Sample K-S... 2 Independent Samples... K Independent Samples... 2 Related Samples... K Related Samples...

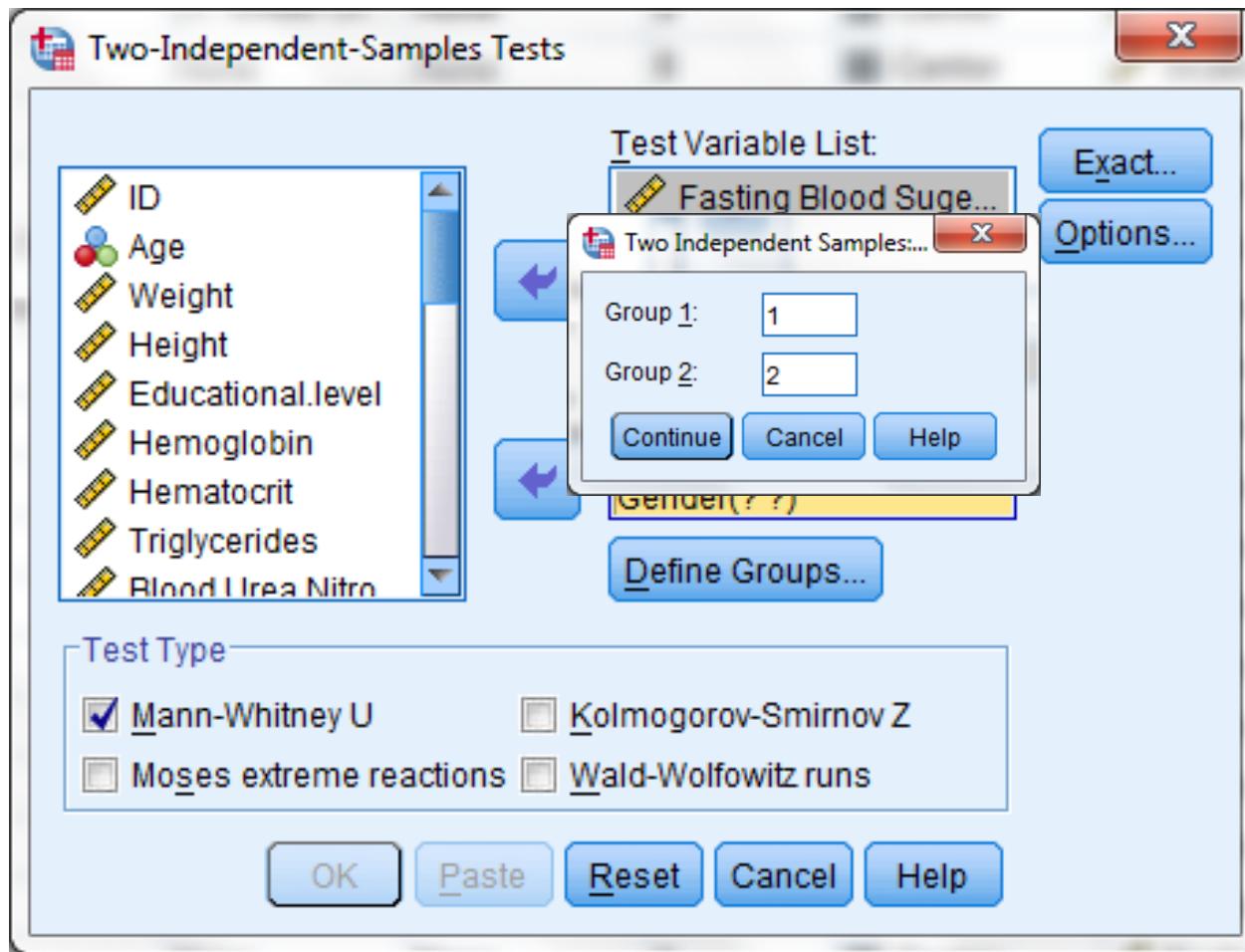
Mann-Whitney U test



Mann-Whitney U test



Mann-Whitney U test



Mann-Whitney U test

Mann-Whitney Test

Ranks

	Gender	N	Mean Rank	Sum of Ranks
Fasting Blood Suger	Male	35	35.14	1230.00
	Female	35	35.86	1255.00
	Total	70		

Test Statistics^a

	Fasting Blood Suger
Mann-Whitney U	600.000
Wilcoxon W	1230.000
Z	-.147
Asymp. Sig. (2-tailed)	.883

a. Grouping Variable: Gender

Wilcoxon test

data1.sav [DataSet9] - IBM SPSS Statistics Data Editor

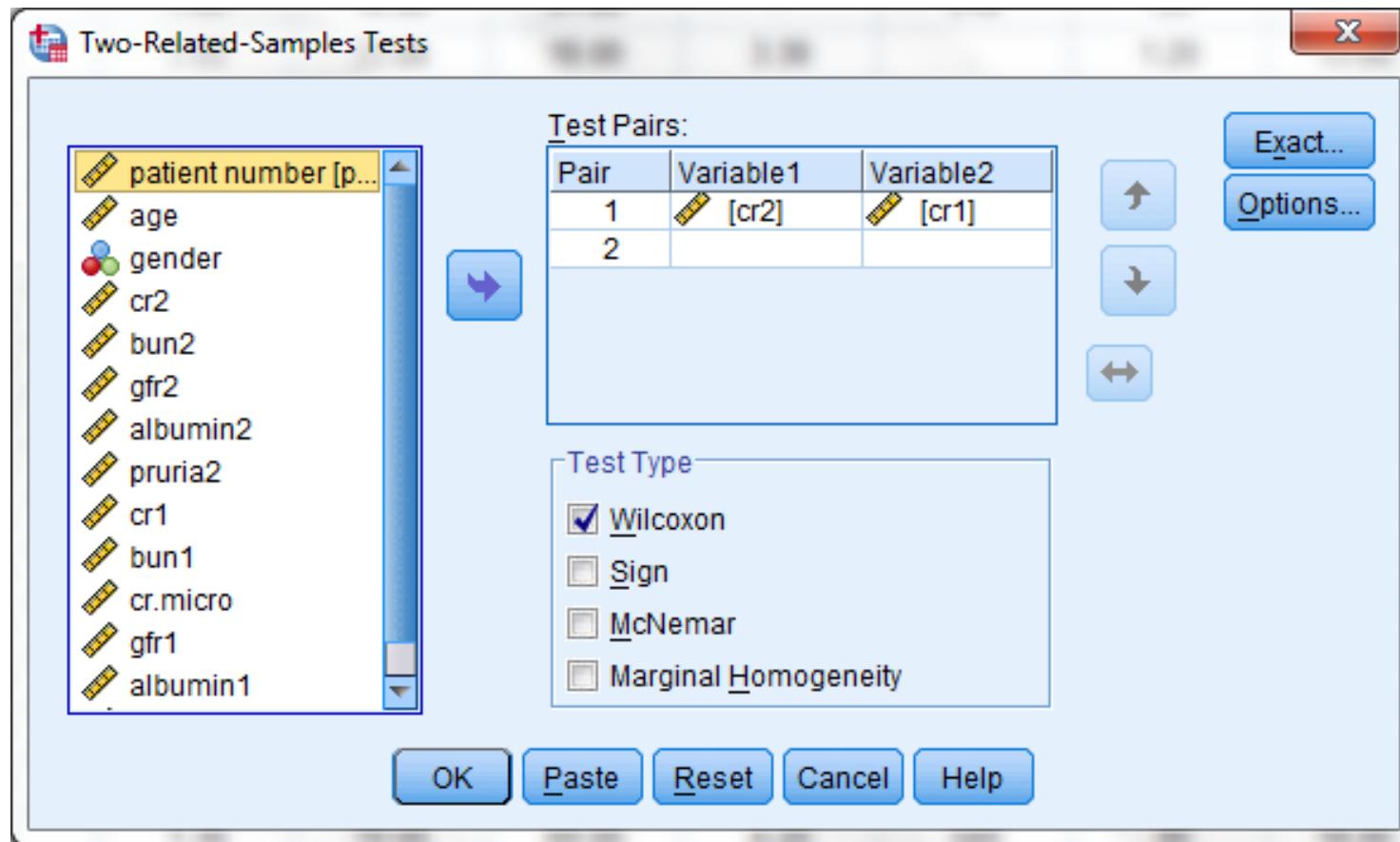
File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve... IBM SPSS Amos...

One Sample... Independent Samples... Related Samples... Legacy Dialogs Chi-square... Binomial... Runs... 1-Sample K-S... 2 Independent Samples... K Independent Samples... 2 Related Samples... K Related Samples...

	pn	age	dbp	cr	bun	albumin	proteinuria	...
1	1	28.00	90	.90	14.00	.	143	
2	2	34.00	75	1.00	14.95	.	510	
3	3	56.00	70	1.00	20.00	4.00	210	
4	4	47.00	85	1.40	13.55	.	600	
5	5	73.00	70	3.60	33.64	3.30	3300	
6	7	19.00	80	1.90	17.28	4.80	60	
7	8	27.00	80	1.80	16.82	2.70	2239	
8	9	23.00	80	.80	11.00	.	86	
9	10	23.00	70	1.10	16.00	4.00	3600	
10	11	26.00	70	1.20	29.00	3.20	720	
11	12	43.00	90	.50	17.00	3.20	1260	
12	13	54.00				.	3000	
13	14	36.00				.	250	
14	15	73.00				4.40	600	
15	16	54.00						
16	17	34.00						
17	18	21.00						
18	19	30.00						
19	21	42.00						
20	22	47.00						
21	23	33.00						
22	24	26.00						
23	25	29.00						

Wilcoxon test



Wilcoxon test

Test Statistics^a

	cr1 - cr2
Z	-.920 ^b
Asymp. Sig. (2-tailed)	.358

a. Wilcoxon Signed Ranks
Test

b. Based on positive ranks.

Kruskal-Wallis test

data1.sav [DataSet9] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

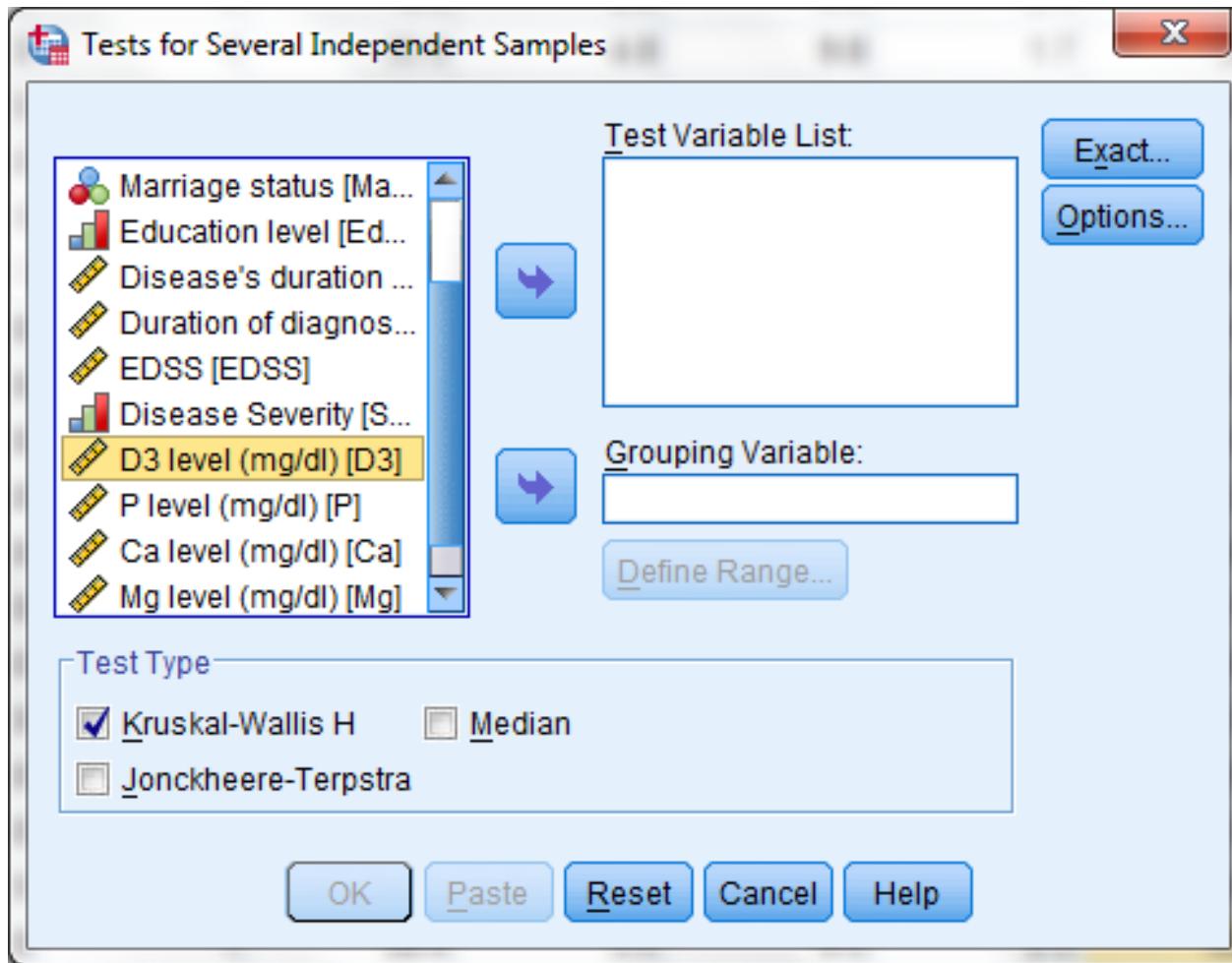
Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve... IBM SPSS Amos...

dbp cr bun albumin proteinuria

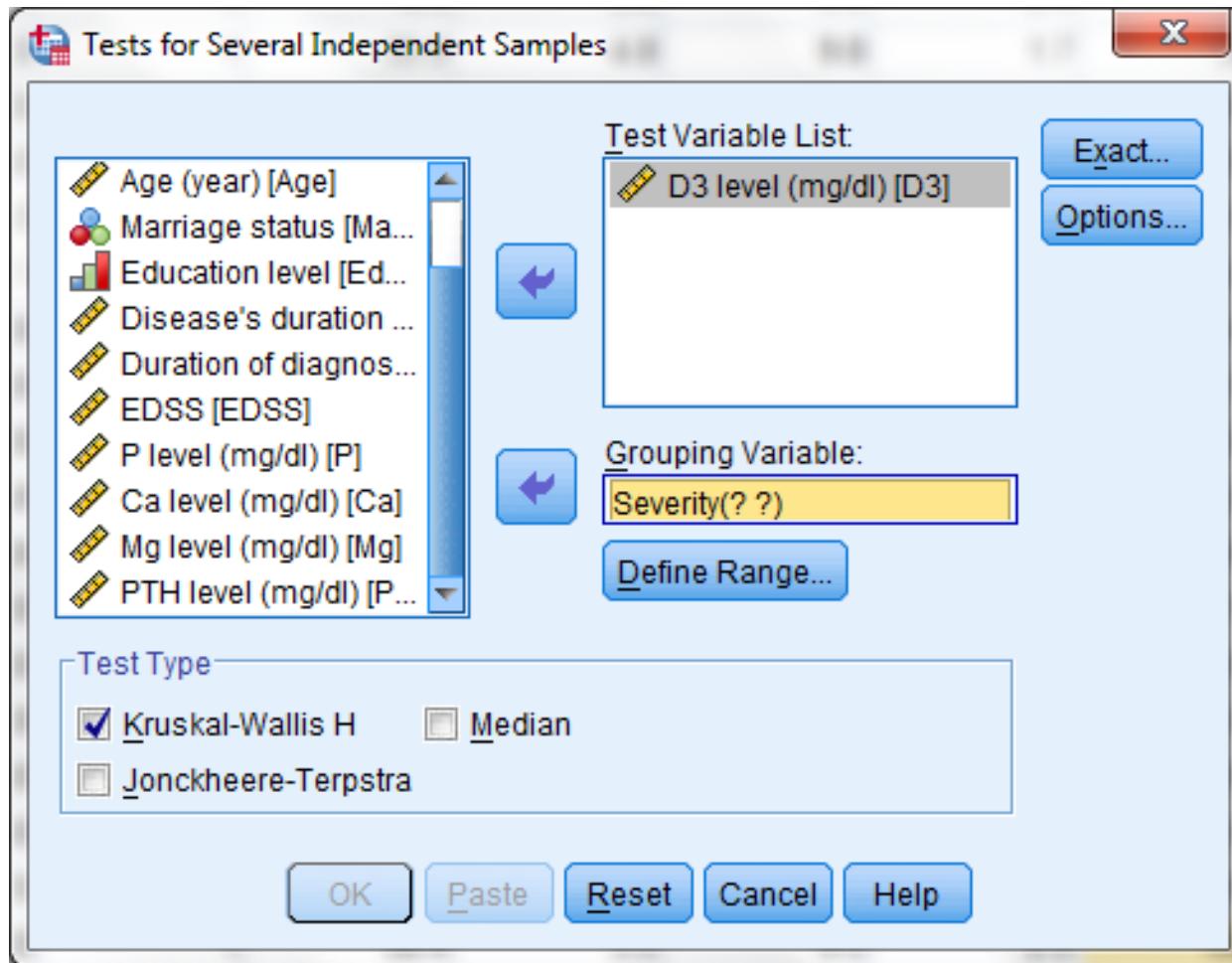
	pn	age	dbp	cr	bun	albumin	proteinuria
1	1	28.00	90	.90	14.00	.	143
2	2	34.00	75	1.00	14.95	.	510
3	3	56.00	70	1.00	20.00	4.00	210
4	4	47.00	85	1.40	13.55	.	600
5	5	73.00	70	3.60	33.64	3.30	3300
6	7	19.00	80	1.90	17.28	4.80	60
7	8	27.00	80	1.80	16.82	2.70	2239
8	9	23.00	80	.80	11.00	.	86
9	10	23.00	70	1.10	16.00	4.00	3600
10	11	26.00	70	1.20	29.00	3.20	720
11	12	43.00	90	.50	17.00	3.20	1260
12	13	54.00				.	3000
13	14	36.00				.	250
14	15	73.00				4.40	600
15	16	54.00					
16	17	34.00					
17	18	21.00					
18	19	30.00					
19	21	42.00					
20	22	47.00					
21	23	33.00					
22	24	26.00					
23	25	29.00					

One Sample... Independent Samples... Related Samples... Chi-square... Binomial... Runs... 1-Sample K-S... 2 Independent Samples... K Independent Samples... 2 Related Samples... K Related Samples...

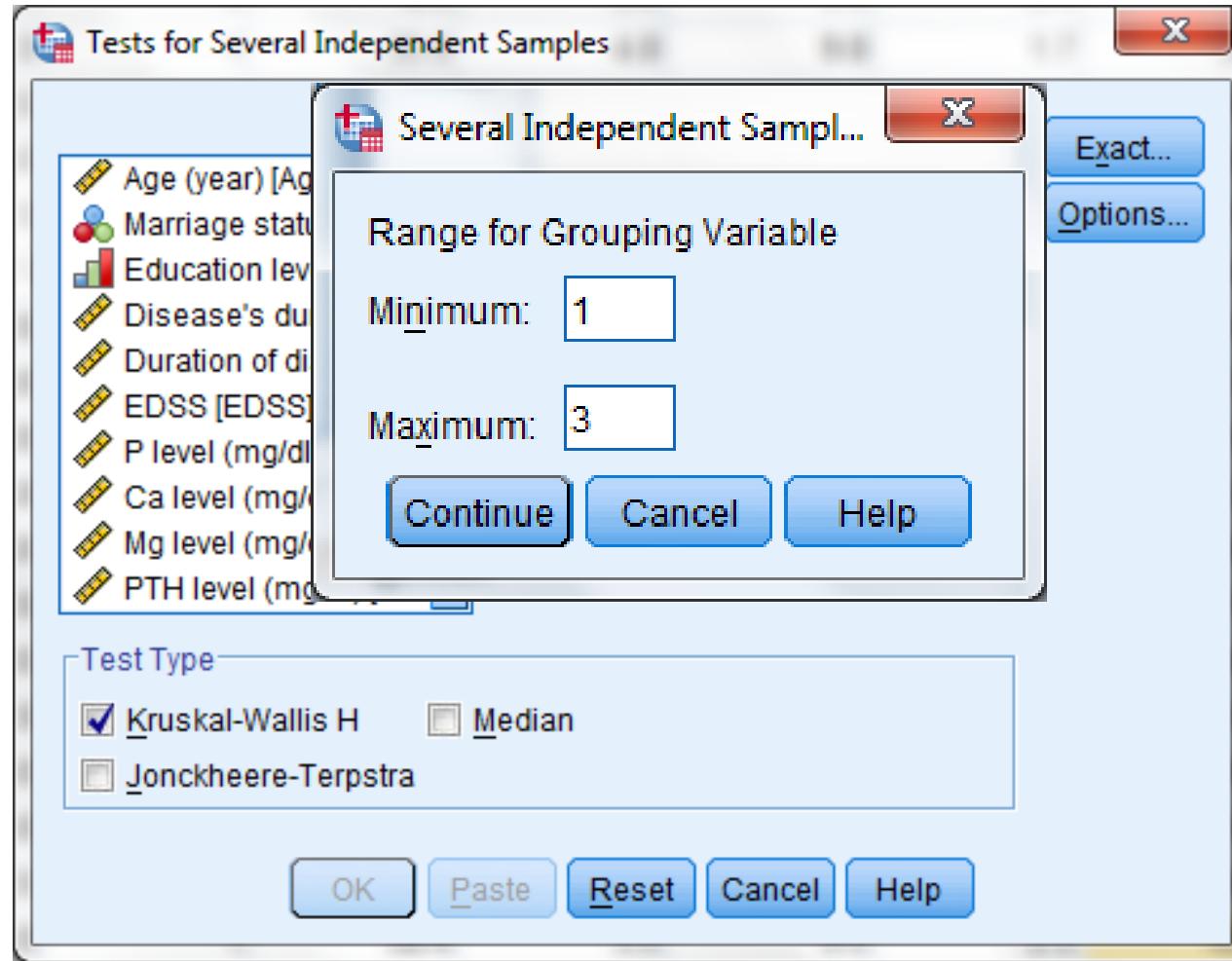
Kruskal-Wallis test



Kruskal-Wallis test



Kruskal-Wallis test



Kruskal-Wallis test

Kruskal-Wallis Test

Ranks

Disease Severity	N	Mean Rank
D3 level (mg/dl)		
Mild	47	34.37
Moderate	11	42.86
Severe	10	25.90
Total	68	

Test Statistics^{a,b}

	D3 level (mg/dl)
Chi-Square	3.862
df	2
Asymp. Sig.	.145

a. Kruskal Wallis Test

b. Grouping Variable:
Disease Severity

Kruskal-Wallis test

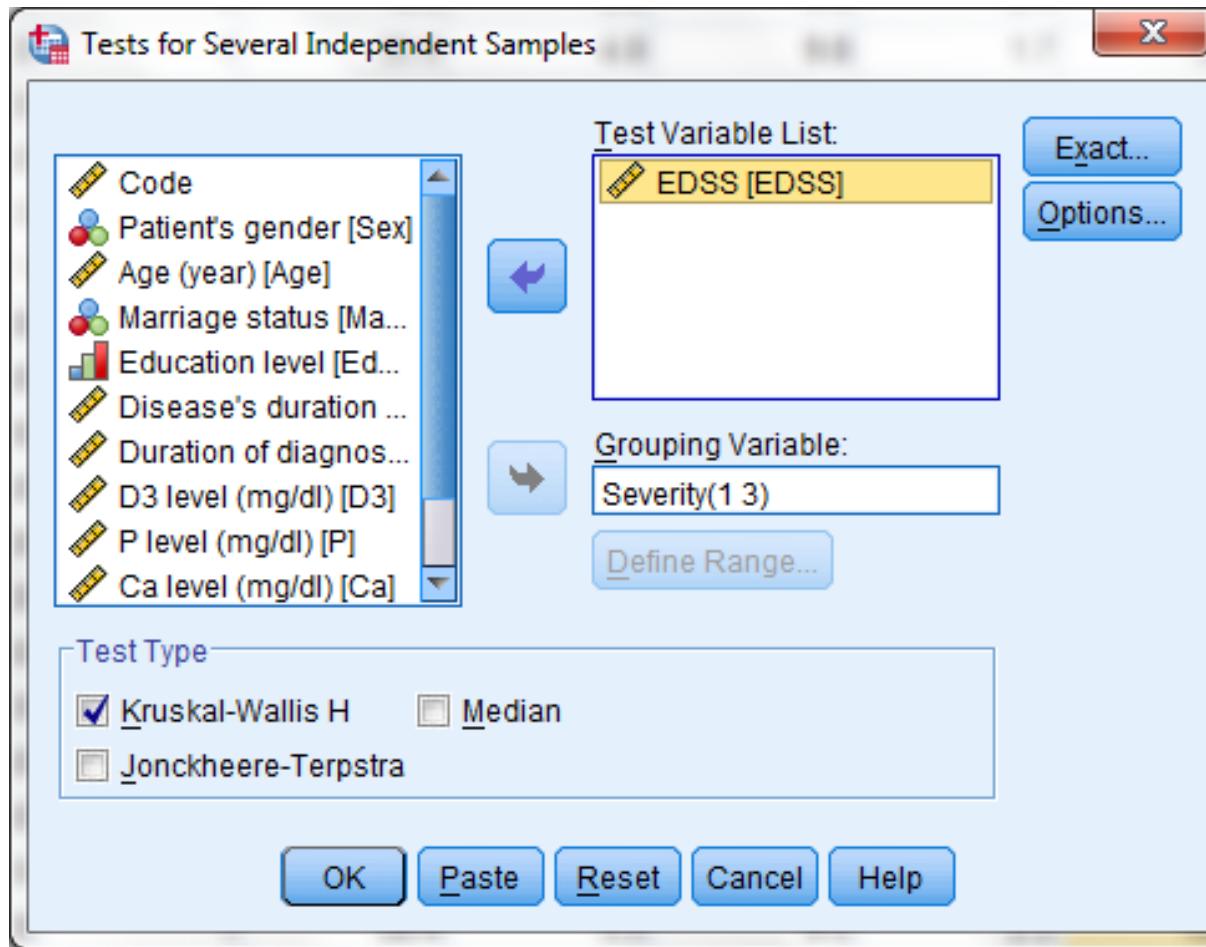
مثال: مقایسه EDSS در شدت بیماری های مختلف.

Test of Homogeneity of Variances

EDSS

Levene Statistic	df1	df2	Sig.
6.789	2	65	.002

Kruskal-Wallis test



Kruskal-Wallis test

Kruskal-Wallis Test

Ranks

Disease Severity		N	Mean Rank
EDSS	Mild	47	24.00
	Moderate	11	53.00
	Severe	10	63.50
	Total	68	

Test Statistics^{a,b}

	EDSS
Chi-Square	45.455
df	2
Asymp. Sig.	.000

a. Kruskal Wallis
Test

b. Grouping
Variable:
Disease
Severity

Kruskal-Wallis test

The screenshot shows the IBM SPSS Statistics Data Editor interface. The menu bar is visible at the top, with "Analyze" being the active tab. A sub-menu for "Nonparametric Tests" is currently displayed, containing options like One Sample..., Independent Samples..., Related Samples..., and Legacy Dialogs. To the left of the menu, there is a data view showing a table with columns labeled "Action" and "Duration". On the right side of the screen, there is another data view showing a table with columns labeled "Severity", "D3", and "P".

Kruskal-Wallis test

 Nonparametric Tests: Two or More Independent Samples X

Objective **Fields** **Settings**

Identifies differences between two or more groups using nonparametric tests. Nonparametric tests do not assume your data follow the normal distribution.

What is your objective?

Each objective corresponds to a distinct default configuration on the Settings Tab that you can further customize, if desired.

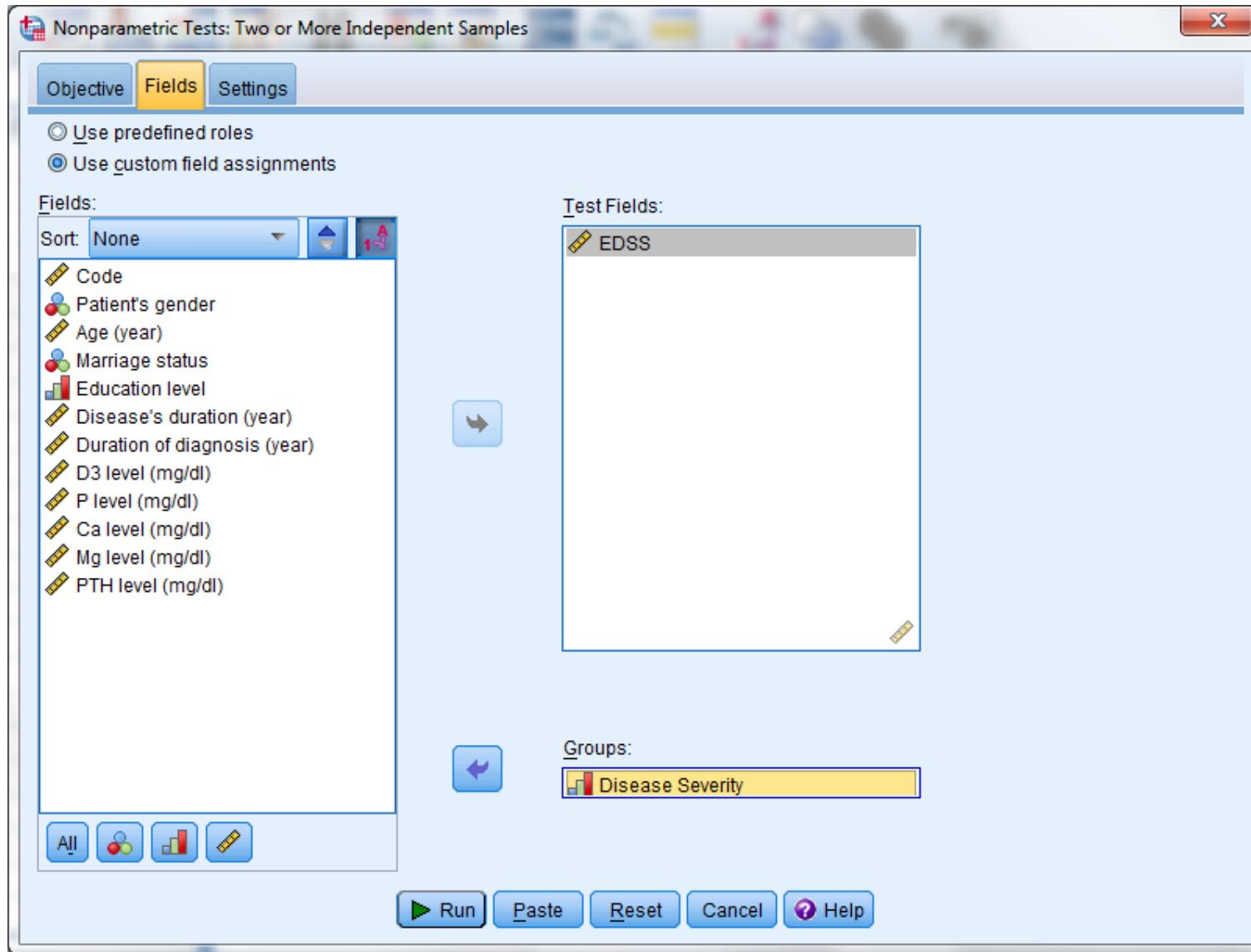
Automatically compare distributions across groups
 Compare medians across groups
 Customize analysis

Description

Customize analysis allows you fine-grained control over the tests performed and their options. Other tests available on the Settings tab are the Kolmogorov-Smirnov, Moses extreme reaction, and Wald-Wolfowitz for 2 samples, and the Jonckheere-Terpstra for k samples. An optional confidence interval (Hodges-Lehman estimate) is also available for 2 samples.

 Run  Paste  Reset  Cancel  Help

Kruskal-Wallis test



Kruskal-Wallis test

Nonparametric Tests: Two or More Independent Samples

Objective Fields Settings

Select an item:

Choose Tests Automatically choose the tests based on the data
 Customize tests

Test Options

User-Missing Values

Compare Distributions across Groups

Mann-Whitney U (2 samples) Kruskal-Wallis 1-way ANOVA (k samples)
Multiple comparisons: All pairwise

Kolmogorov-Smirnov (2 samples)

Test sequence for randomness (Wald-Wolfowitz for 2 samples)

Test for ordered alternatives (Jonckheere-Terpstra for k samples)
Hypothesis order: Smallest to largest
Multiple comparisons: All pairwise

Compare Ranges across Groups

Moses extreme reaction (2 samples)
 Compute outliers from sample
 Custom number of outliers
Outliers: 1

Compare Medians across Groups

Median test (k samples)
 Pooled sample median
 Custom
Median: 0
Multiple comparisons: All pairwise

Estimate Confidence Interval across Groups

Hodges-Lehman estimate (2 samples)

Run Paste Reset Cancel Help

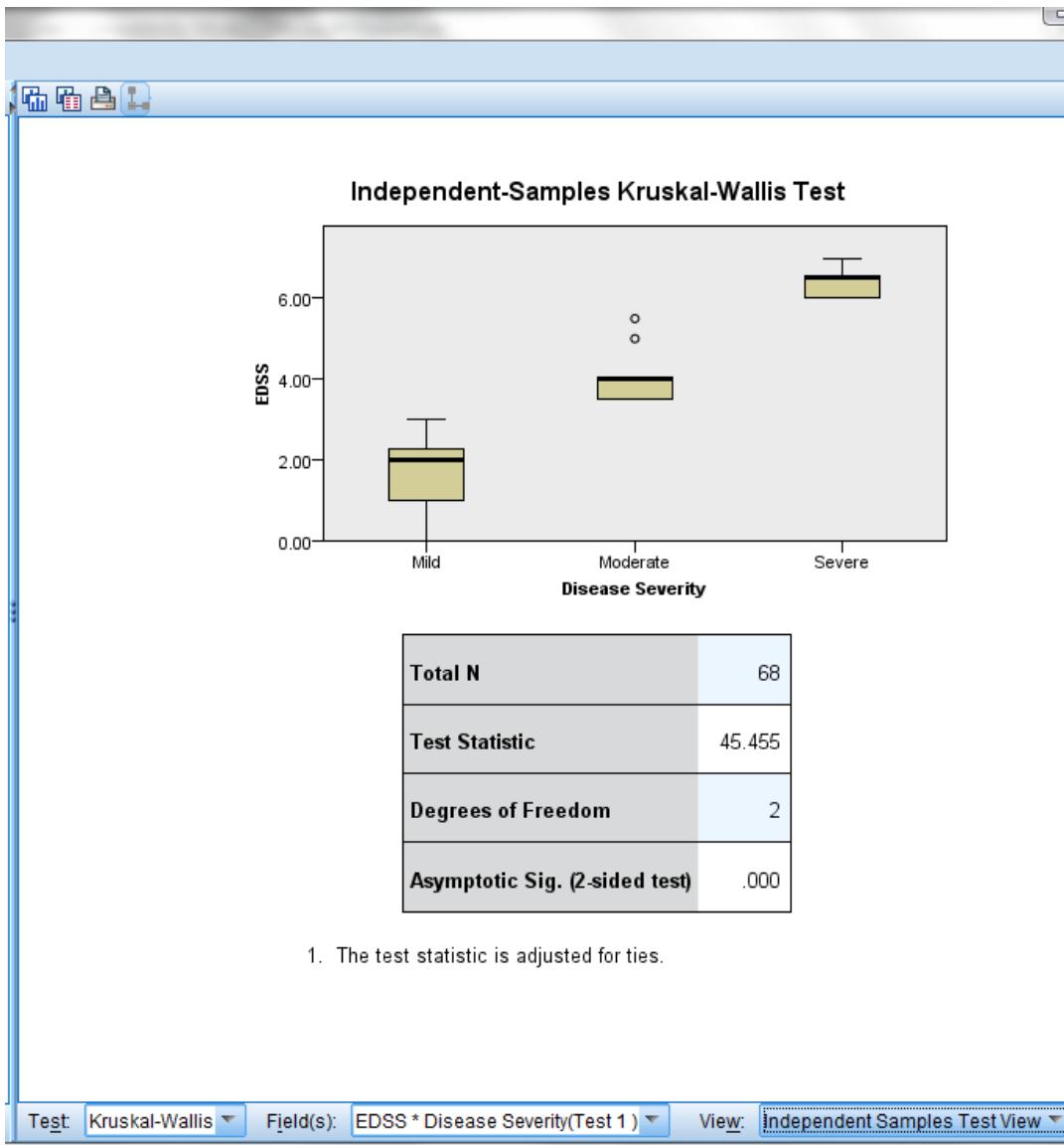
Kruskal-Wallis test

Hypothesis Test Summary

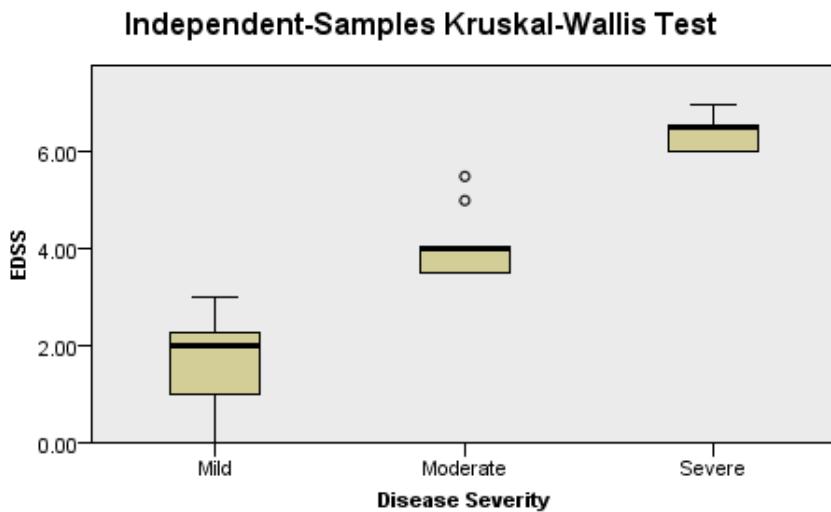
	Null Hypothesis	Test	Sig.	Decision
1	The distribution of EDSS is the same across categories of Disease Severity.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Kruskal-Wallis test



Kruskal-Wallis test



Total N	68
Test Statistic	45.455
Degrees of Freedom	2
Asymptotic Sig. (2-sided test)	.000

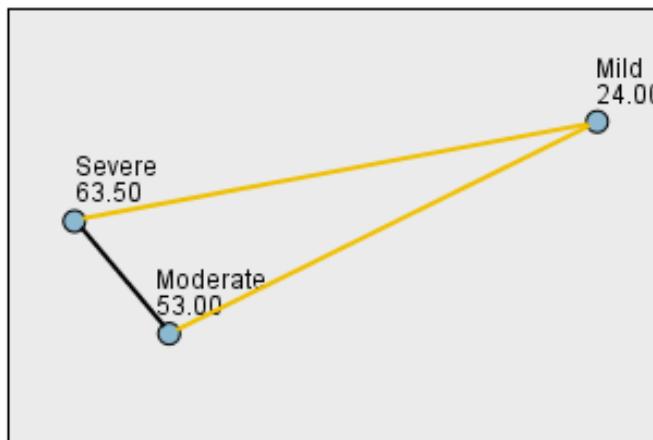
1. The test statistic is adjusted for ties.

Independent Samples Test View
Categorical Field Information
Continuous Field Information
Pairwise Comparisons

Field(s): EDSS * Disease Severity(Test 1) View: Independent Samples Test View

Kruskal-Wallis test

Pairwise Comparisons of Disease Severity



Each node shows the sample average rank of Disease Severity.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Mild-Moderate	-29.000	6.545	-4.431	.000	.000
Mild-Severe	-39.500	6.805	-5.805	.000	.000
Moderate-Severe	-10.500	8.538	-1.230	.219	.656

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is .05.

Correlation and Regression

برای بررسی ارتباط بین دو متغیر کمی از **همبستگی** و **رگرسیون خطی** می توان استفاده نمود.

Correlation

- Pearson Correlation
- Spearman Correlation

Size of Correlation	Interpretation
.90 to 1.00 (-.90 to -1.00)	Very high positive (negative) correlation
.70 to .90 (-.70 to -.90)	High positive (negative) correlation
.50 to .70 (-.50 to -.70)	Moderate positive (negative) correlation
.30 to .50 (-.30 to -.50)	Low positive (negative) correlation
.00 to .30 (.00 to -.30)	negligible correlation

Pearson Correlation

*data2.sav [DataSet3] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons

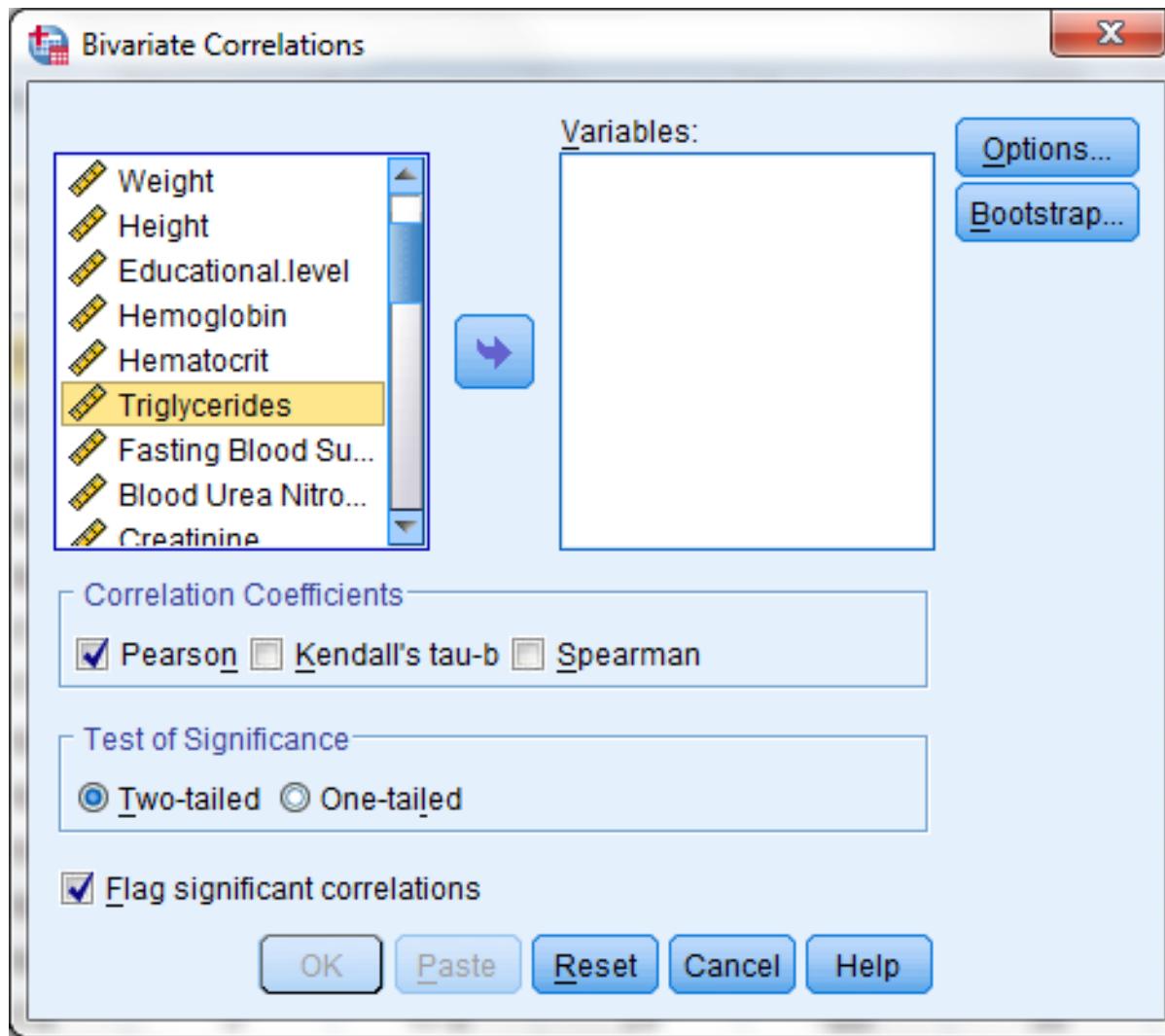
ID Age Height Educational Level

	ID	Age	Height	Educational Level
1	1	60	165	1
2	2	79	150	1
3	3	82	156	1
4	4	66	163	1
5	5	52	180	5
6	6	58	179	2
7	7	50	176	2
8	8	83	189	5
9	9	46	180	2
10	10	54	190	2
11	11	67	180	5
12	12	54	169	3
13	13	63		
14	14	44		
15	15	60		

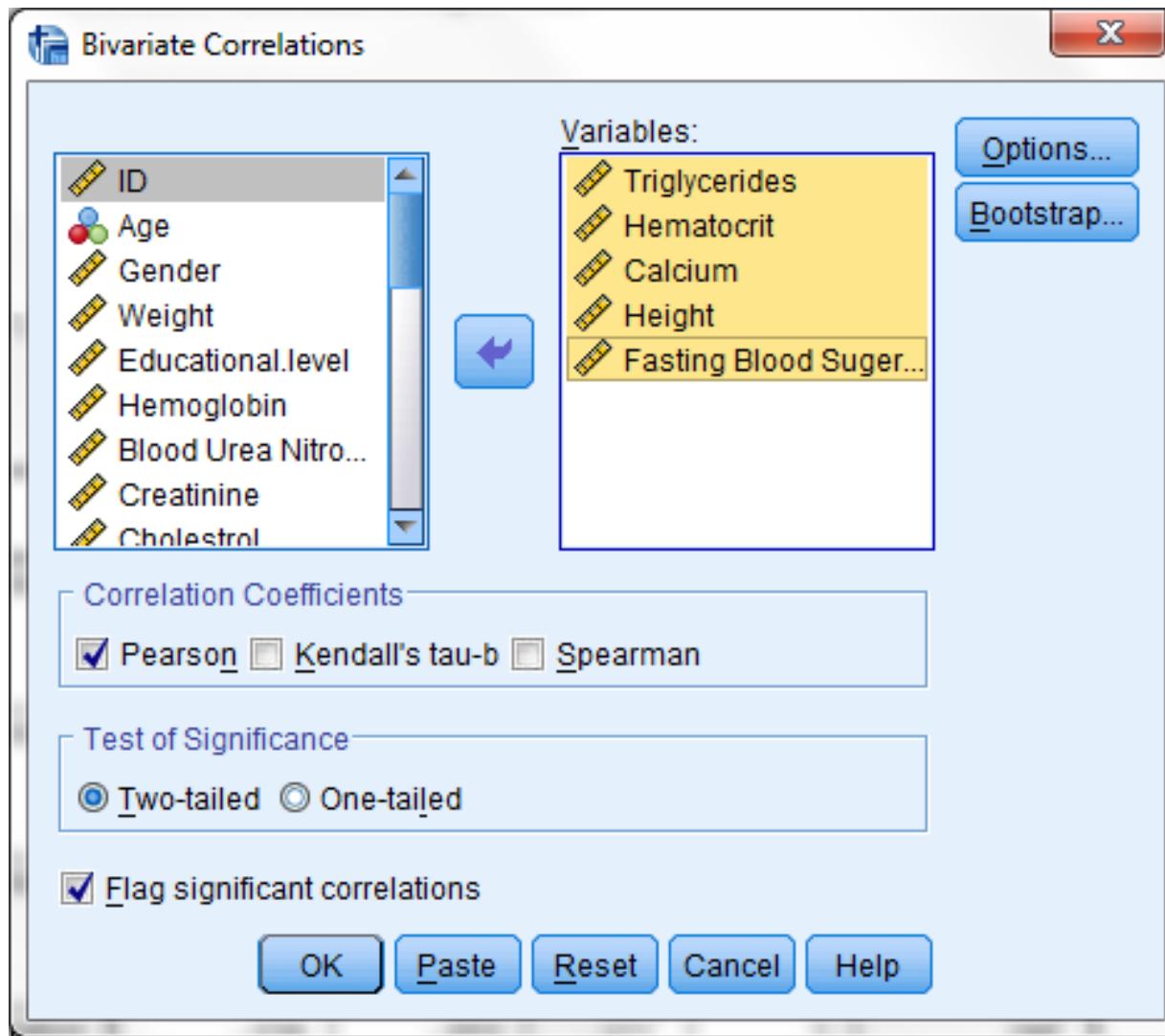
Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis...

Bivariate... Partial... Distances...

Pearson Correlation



Pearson Correlation



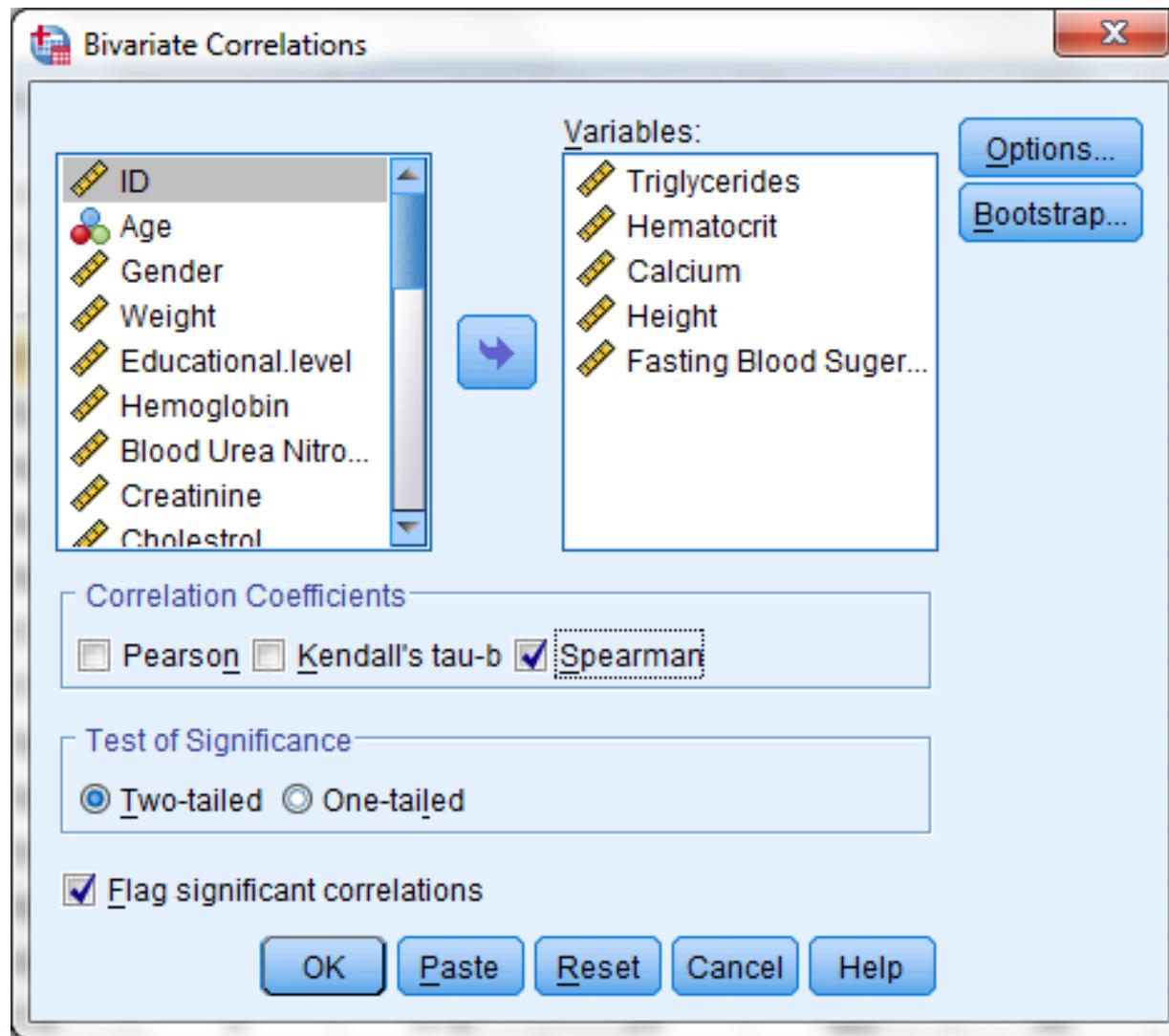
Pearson Correlation

Correlations

		Triglycerides	Hematocrit	Calcium	Height	Fasting Blood Suger
Triglycerides	Pearson Correlation	1	.247*	-.248*	-.036	-.039
	Sig. (2-tailed)		.040	.039	.769	.747
	N	70	70	70	70	70
Hematocrit	Pearson Correlation	.247*	1	-.283*	-.053	.128
	Sig. (2-tailed)	.040		.017	.660	.290
	N	70	70	70	70	70
Calcium	Pearson Correlation	-.248*	-.283*	1	.271*	-.035
	Sig. (2-tailed)	.039	.017		.023	.774
	N	70	70	70	70	70
Height	Pearson Correlation	-.036	-.053	.271*	1	.248*
	Sig. (2-tailed)	.769	.660	.023		.039
	N	70	70	70	70	70
Fasting Blood Suger	Pearson Correlation	-.039	.128	-.035	.248*	1
	Sig. (2-tailed)	.747	.290	.774	.039	
	N	70	70	70	70	70

*. Correlation is significant at the 0.05 level (2-tailed).

Spearman Correlation



Spearman Correlation

Correlations

		Triglycerides	Hematocrit	Calcium	Height	Fasting Blood Suger
Spearman's rho	Triglycerides	Correlation Coefficient	1.000	.275*	-.259*	.022
		Sig. (2-tailed)		.021	.030	.854
	N		70	70	70	70
	Hematocrit	Correlation Coefficient	.275*	1.000	-.278*	-.073
		Sig. (2-tailed)	.021		.020	.546
	N		70	70	70	70
	Calcium	Correlation Coefficient	-.259*	-.278*	1.000	.263*
		Sig. (2-tailed)	.030	.020		.028
	N		70	70	70	70
	Height	Correlation Coefficient	.022	-.073	.263*	1.000
		Sig. (2-tailed)	.854	.546	.028	
	N		70	70	70	70
	Fasting Blood Suger	Correlation Coefficient	-.080	.121	-.020	.159
		Sig. (2-tailed)	.512	.319	.867	.189
	N		70	70	70	70

*. Correlation is significant at the 0.05 level (2-tailed).

Linear Regression

Screenshot of the SPSS software interface showing the Analyze menu open with the Regression option selected.

The menu bar includes: File, Edit, View, Data, Transform, Analyze, Direct Marketing, Graphs, Utilities, Add-ons, Window, Help.

The Data view shows a dataset titled "6 : Cholesterol" with 248 rows and columns ID and Age.

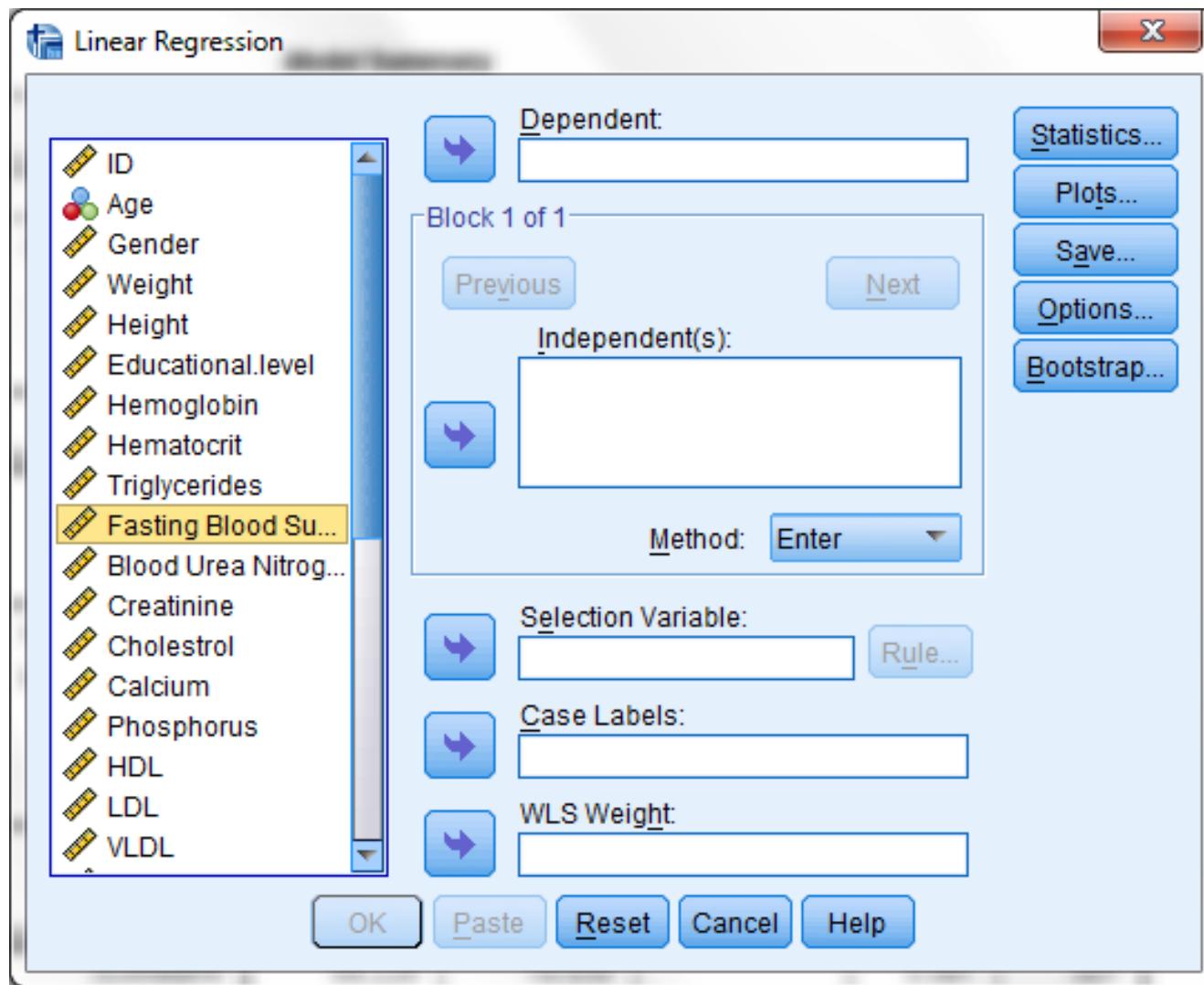
The Analyze menu is expanded, showing:

- Reports
- Descriptive Statistics
- Tables
- Compare Means
- General Linear Model
- Generalized Linear Models
- Mixed Models
- Correlate
- Regression
- Loglinear
- Neural Networks
- Classify
- Dimension Reduction
- Scale
- Nonparametric Tests
- Forecasting
- Survival
- Multiple Response
- Missing Value Analysis...
- Multiple Imputation
- Complex Samples

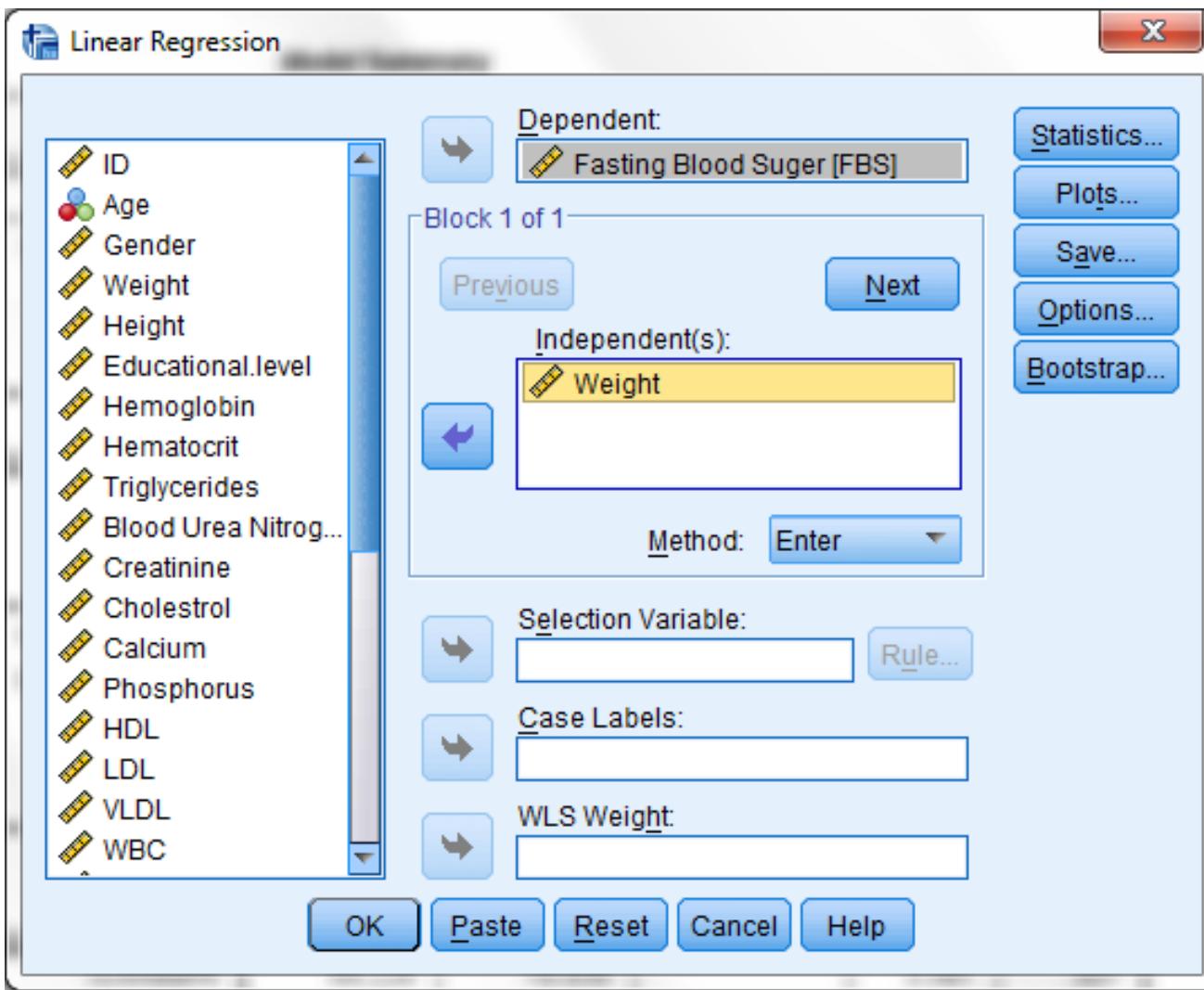
The "Regression" option is highlighted. Under "Regression", the "Linear..." option is also highlighted.

	ID	Age	Height	Educational level	Hemoglobin	...
1	1	60	165	1	17.0	
2	2	79	150	1	16.0	
3	3	82	156	1	17.0	
4	4	66	176	1	16.5	
5	5	52				
6	6	58				
7	7	50				
8	8	83				
9	9	46				
10	10	54				
11	11	67				
12	12	54				
13	13	63				
14	14	44				
15	15	60				
16	16	49				
17	17	41				
18	18	39				

Linear Regression



Linear Regression



Linear Regression

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	2319.157	1	2319.157	3.132	.081 ^b
Residual	50359.715	68	740.584		
Total	52678.871	69			

a. Dependent Variable: Fasting Blood Suger

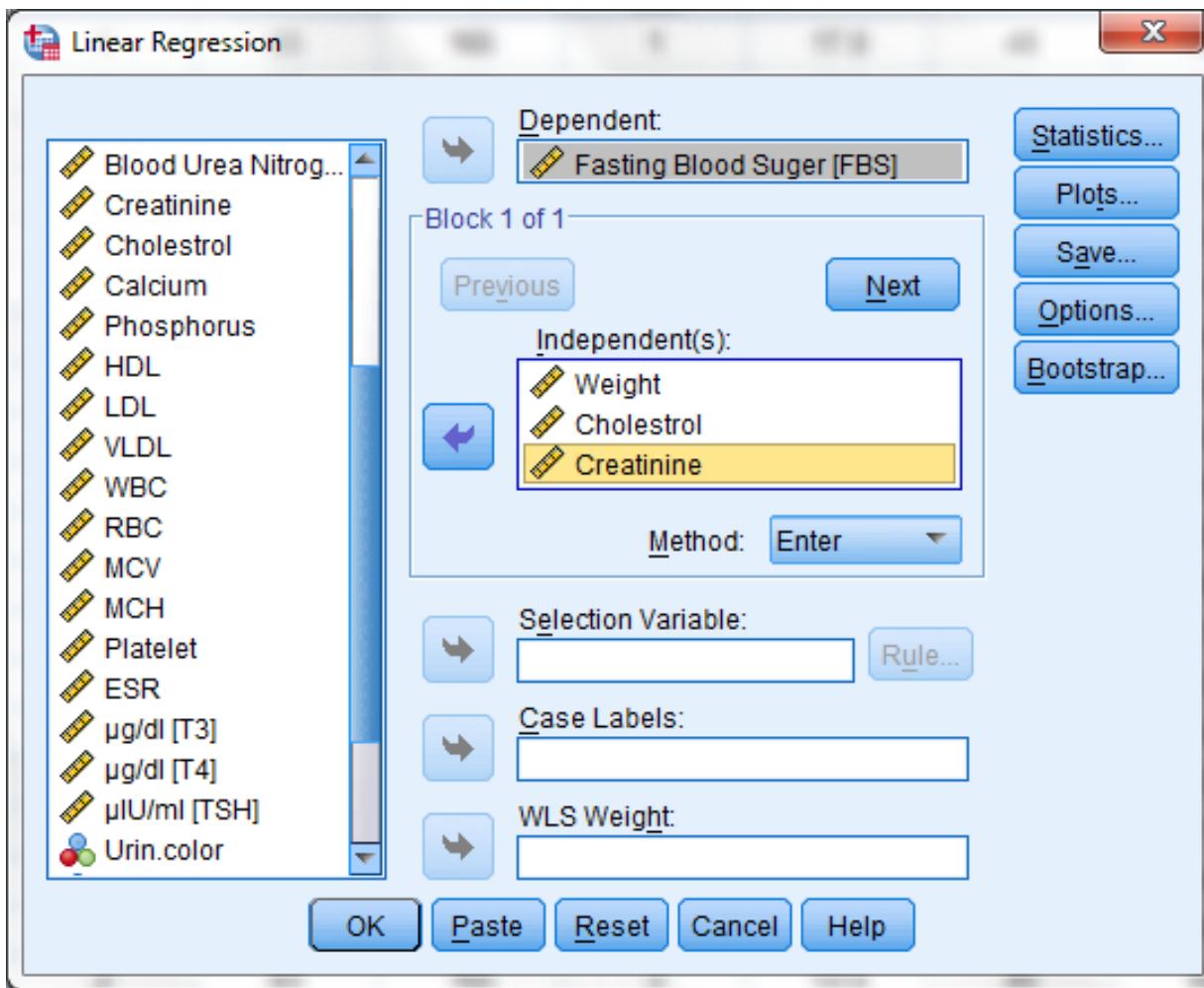
b. Predictors: (Constant), Weight

Coefficients^a

Model	Unstandardized Coefficients		Beta	t	Sig.
	B	Std. Error			
1 (Constant)	64.226	18.939		3.391	.001
	.438	.247	.210	1.770	.081

a. Dependent Variable: Fasting Blood Suger

Linear Regression



Linear Regression

ANOVA^a

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	1759.087	3	586.362	.760	.521 ^b
Residual	50919.785	66	771.512		
Total	52678.871	69			

a. Dependent Variable: Fasting Blood Sugar

b. Predictors: (Constant), Hematocrit, Cholesterol, Creatinine

Coefficients^a

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error			
1 (Constant)	77.138	24.860		3.103	.003
Cholesterol	.057	.082	.084	.691	.492
Creatinine	-6.883	8.098	-.103	-.850	.398
Hematocrit	.332	.321	.125	1.035	.304

a. Dependent Variable: Fasting Blood Sugar

Proportion Tests

- One group
 - Binomial test
- Two groups
 - Chi-square test (Z-test have been not provided in SPSS)
- More than two groups
 - Chi-square test
- Logistic Regression

Binomial test

MS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

18 : PTH 100.0

	Code	Sex
1	1	
2	2	
3	7	
4	10	
5	12	
6	16	
7	17	
8	19	
9	20	
10	21	
11	25	
12	26	
13	28	
14	31	
15	34	
16	37	
17	41	
18	42	
19	43	
20	46	
21	49	
22	51	

Reports Descriptive Statistics Tables Compare Means General Linear Model Generalized Linear Models Mixed Models Correlate Regression Loglinear Neural Networks Classify Dimension Reduction Scale Nonparametric Tests Forecasting Survival Multiple Response Missing Value Analysis... Multiple Imputation Complex Samples Simulation... Quality Control ROC Curve... IBM SPSS Amos...

Education Duration Dur.Diag EDSS Severe

6 8.0 4.0 6.5

6 1.0 1.0 .0

5 4.0 1.0 2.0

2 12.0 2.0 3.0

4 2.0 2.0 .0

5 5.0 4.0 2.0

3 10.0 5.0 2.0

5 12.0 4.0 3.0

3 4.0 3.0 2.0

4 6.0 6.0 4.0

12.0 2.0 4.0

0 1.0 2.0

0 4.0 3.0

0 2.0 1.0

Legacy Dialogs Chi-square... Binomial... Runs... 1-Sample K-S... 2 Independent Samples... K Independent Samples... 2 Related Samples...

6 3.0

2 4.0

. 7.0

5 1.0

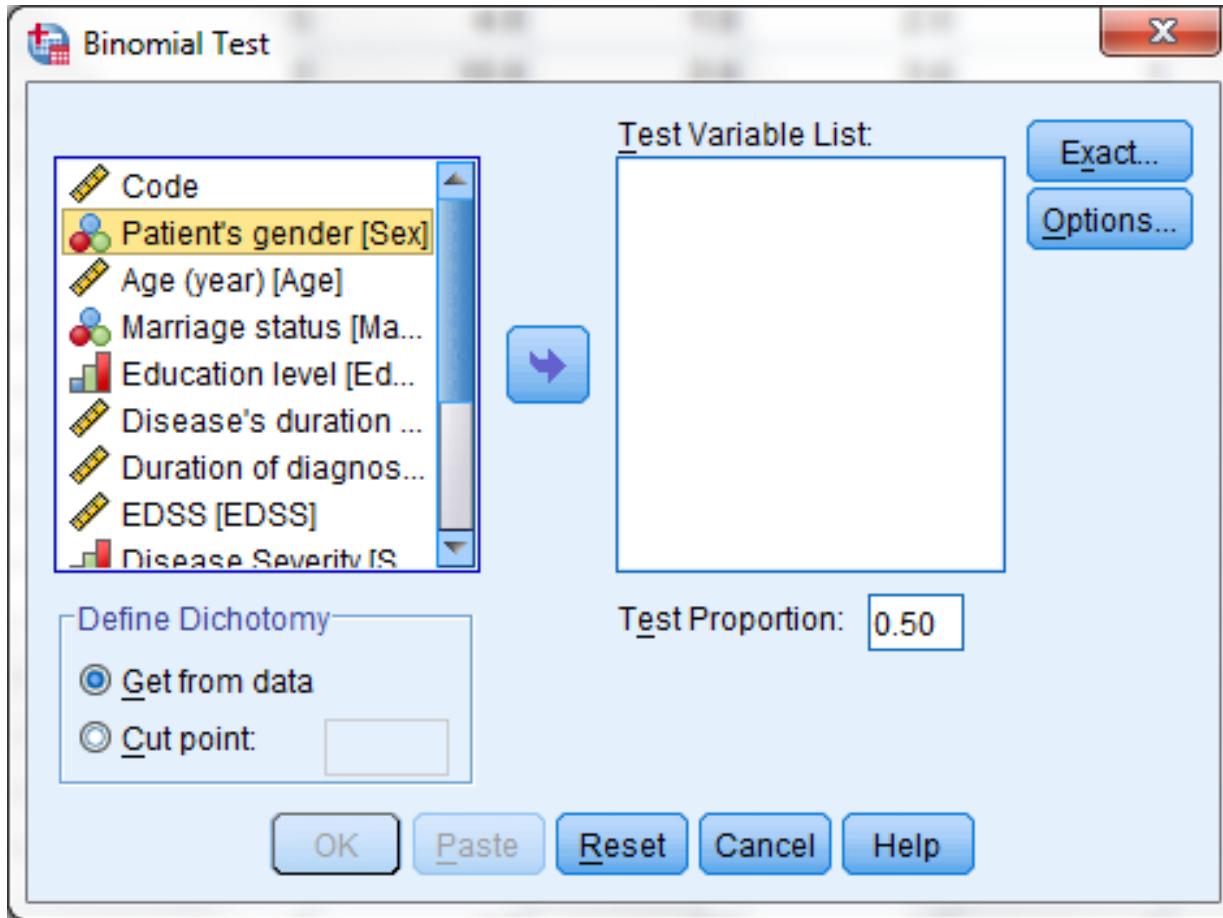
5 4.0

4 12.0

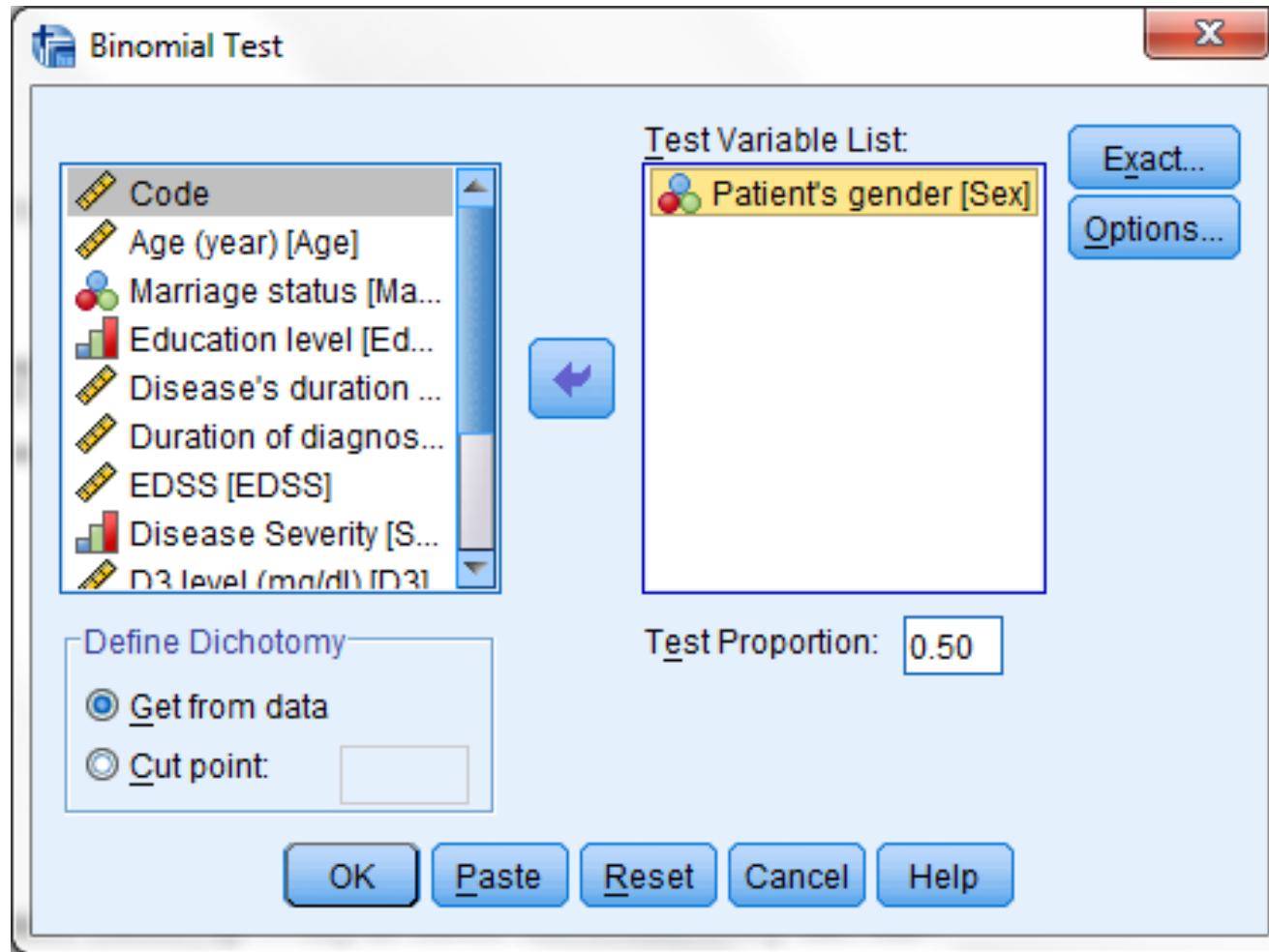
. 6.0

99

Binomial test



Binomial test

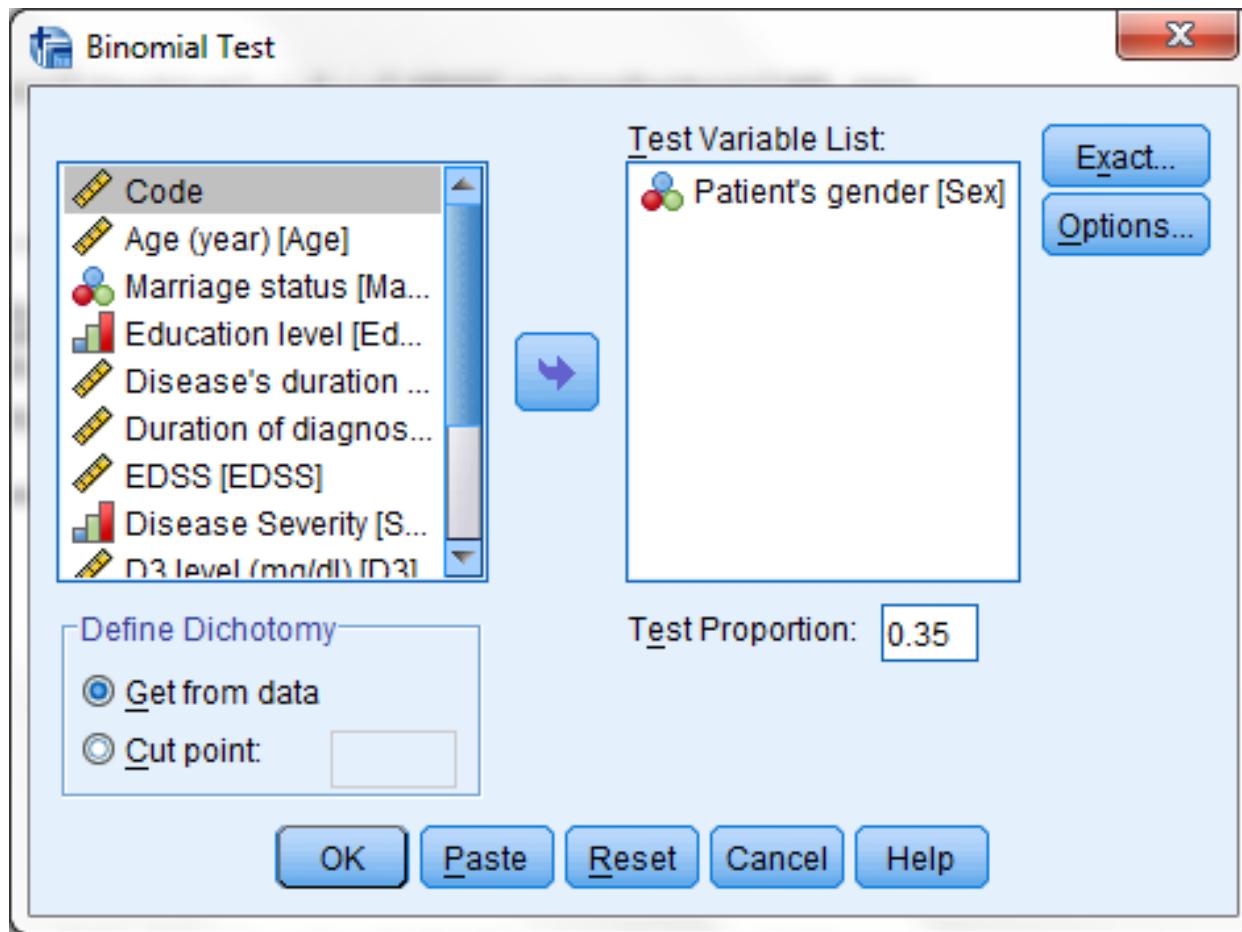


Binomial test

Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Patient's gender	Group 1	Male	19	.28	.50	.000
	Group 2	Female	49	.72		
	Total		68	1.00		

Binomial test



Chi-Square test

*data2.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons W

Reports

Descriptive Statistics

Tables

Compare Means

General Linear Model

Generalized Linear Models

Mixed Models

Correlate

Regression

Loglinear

Neural Networks

Classify

Dimension Reduction

Scale

Nonparametric Tests

Forecasting

Survival

Multiple Response

Missing Value Analysis...

Multiple Imputation

Complex Samples

Quality Control

Crosstabs...

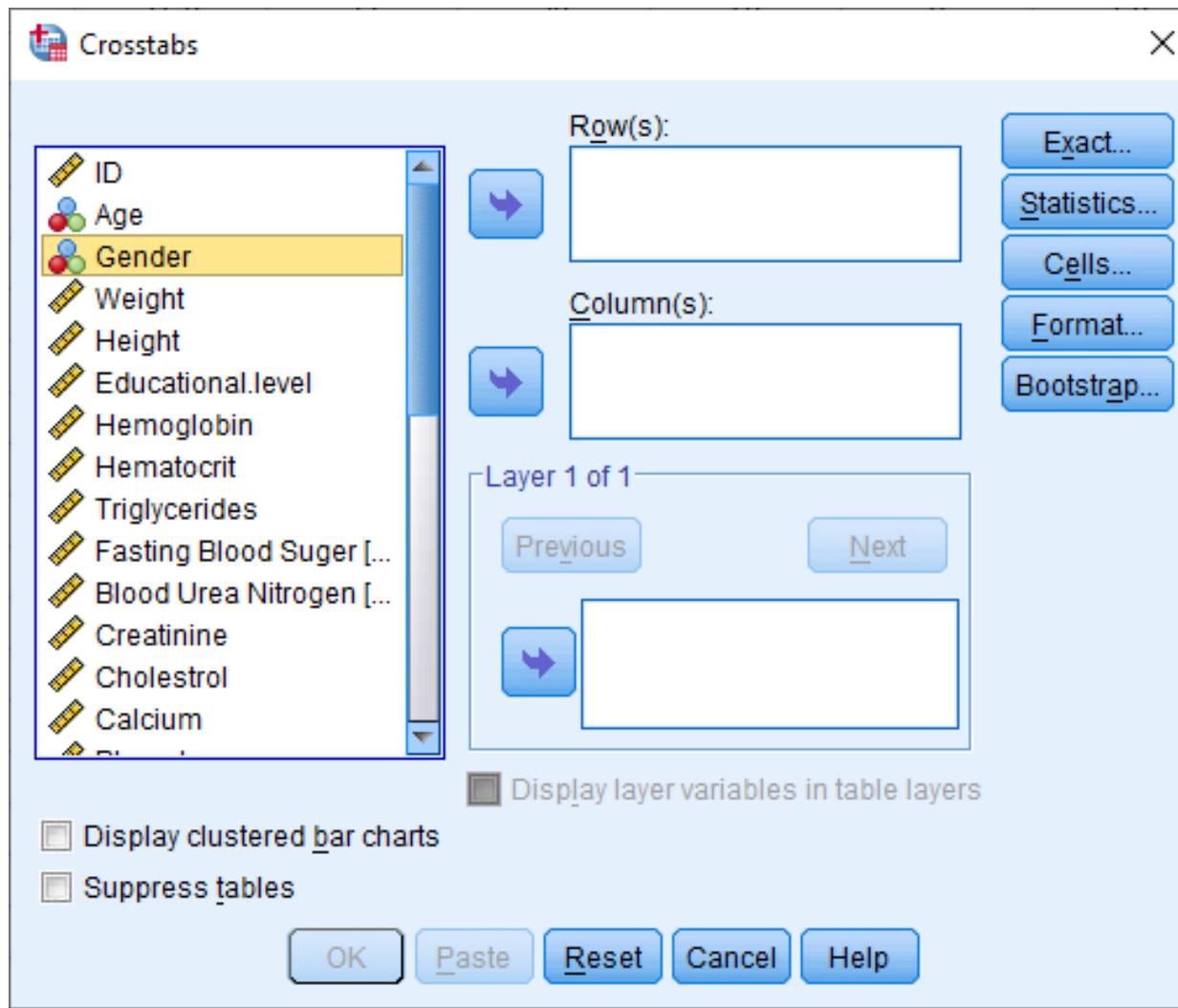
Ratio...

P-P Plots...

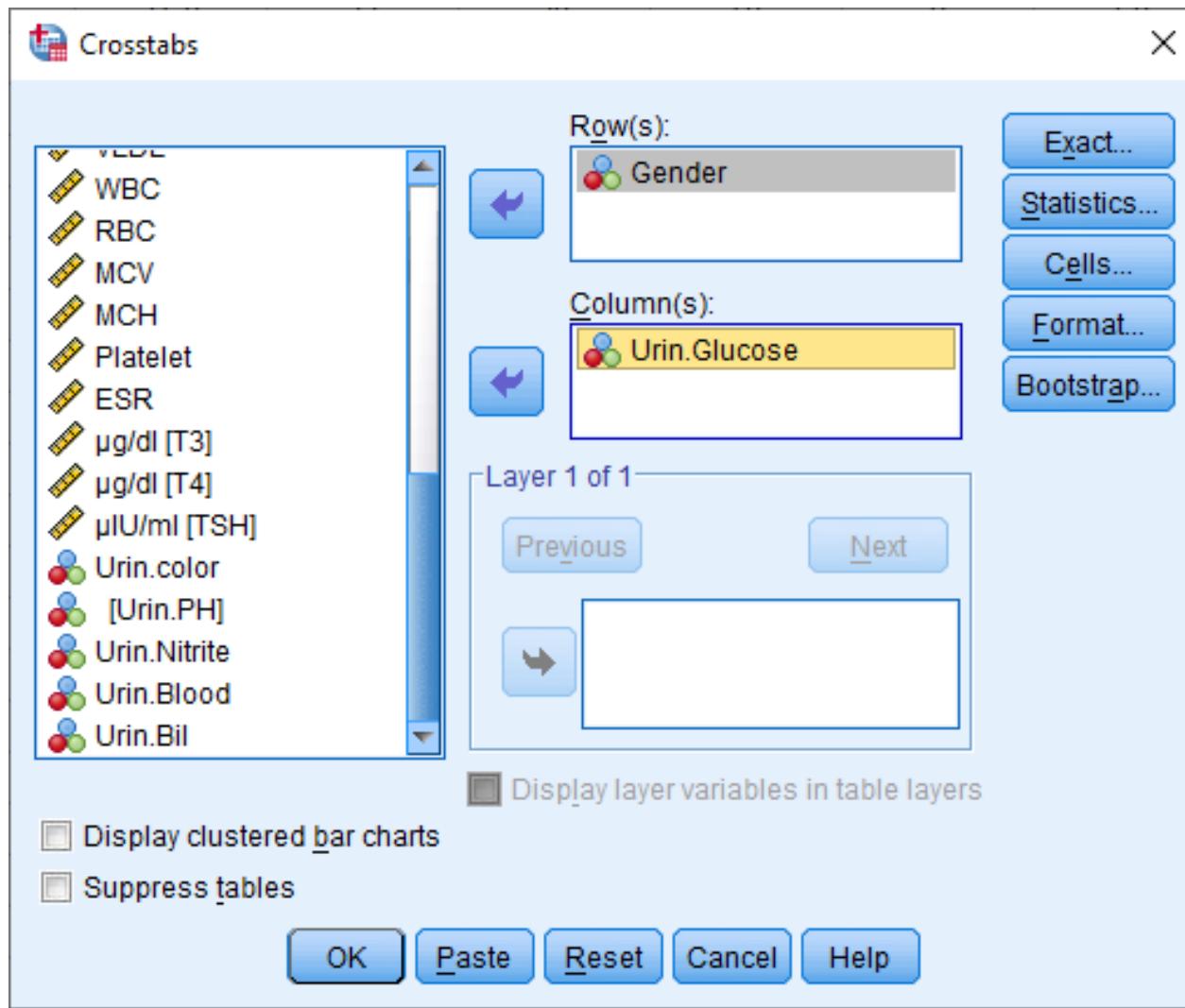
Q-Q Plots...

	ID	Age
1	1	60
2	2	79
3	3	82
4	4	66
5	5	52
6	6	58
7	7	50
8	8	83
9	9	46
10	10	54
11	11	67
12	12	54
13	13	63
14	14	44
15	15	60
16	16	49
17	17	41
18	18	39
19	19	65
20	20	45

Chi-Square test



Chi-Square test



Chi-Square test

Crosstabs

WBC
RBC
MCV
MCH
Platelet
ESR
 $\mu\text{g/dl}$ [T3]
 $\mu\text{g/dl}$ [T4]
 $\mu\text{IU/ml}$ [TSH]
Urin.color
[Urin.PH]
Urin.Nitrite
Urin.Blood
Urin.Bil

Crosstabs: Statistics

Chi-square Correlations

Nominal

Contingency coefficient
 Phi and Cramer's V
 Lambda
 Uncertainty coefficient

Nominal by Interval

Eta

Ordinal

Gamma
 Somers' d
 Kendall's tau-b
 Kendall's tau-c

Kappa
 Risk
 McNemar

Cochran's and Mantel-Haenszel statistics
Test common odds ratio equals:

Exact...
Statistics...
Cells...
Format...
Bootstrap...

Display layer variables in table layers

Display clustered bar charts
 Suppress tables

OK Paste Reset Cancel Help

Chi-Square test

Gender * Urin.Glucose Crosstabulation

Count

		Urin.Glucose		Total
		Negative	Positive	
Gender	Male	14	21	35
	Female	19	16	35
Total		33	37	70

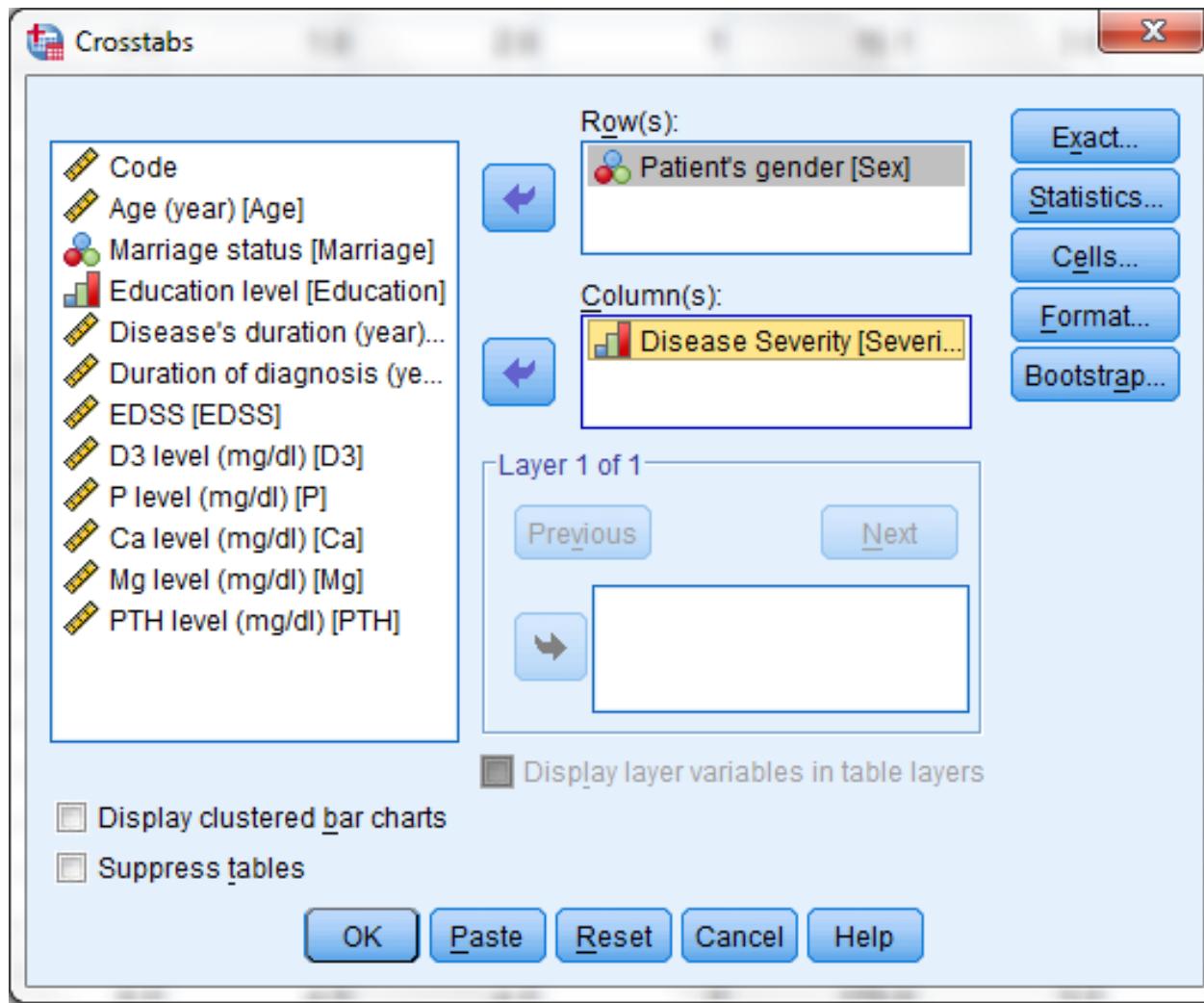
Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	1.433 ^a	1	.231		
Continuity Correction ^b	.917	1	.338		
Likelihood Ratio	1.438	1	.230		
Fisher's Exact Test				.338	.169
Linear-by-Linear Association	1.413	1	.235		
N of Valid Cases	70				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.50.

b. Computed only for a 2x2 table

Chi-Square test



Chi-Square test

Patient's gender * Disease Severity Crosstabulation

Count

	Patient's gender	Disease Severity			Total
		Mild	Moderate	Severe	
Female	Female	38	7	4	49
		9	4	6	19
Total		47	11	10	68

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.297 ^a	2	.026
Likelihood Ratio	6.778	2	.034
Linear-by-Linear Association	7.148	1	.008
N of Valid Cases	68		

a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 2.79.

Logistic Regression

MS.sav [DataSet1] - IBM SPSS Statistics Data Editor

File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

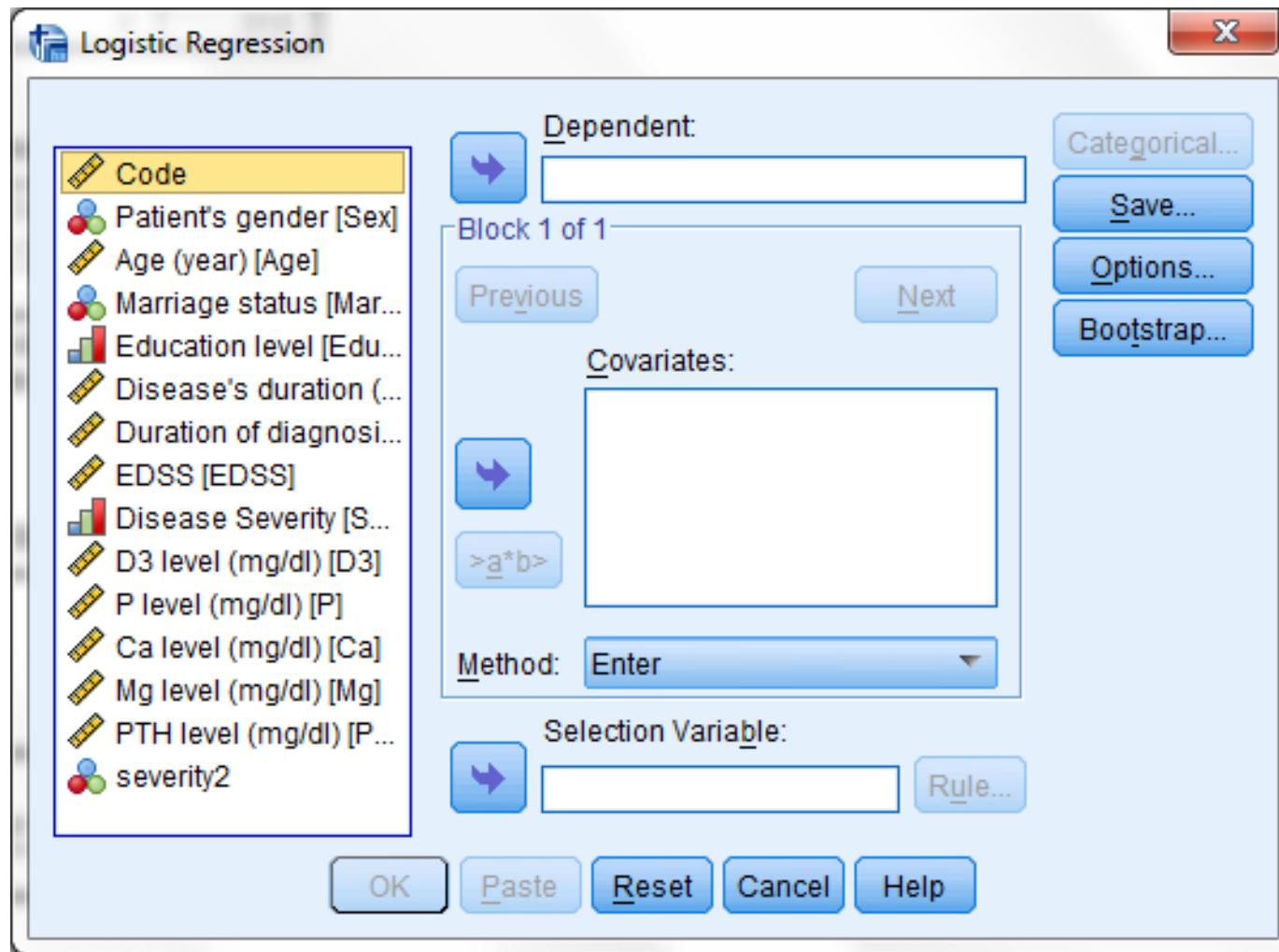
Reports
Descriptive Statistics
Tables
Compare Means
General Linear Model
Generalized Linear Models
Mixed Models
Correlate
Regression
Loglinear
Neural Networks
Classify
Dimension Reduction
Scale
Nonparametric Tests
Forecasting
Survival
Multiple Response
Missing Value Analysis...
Multiple Imputation
Complex Samples

Education Duration

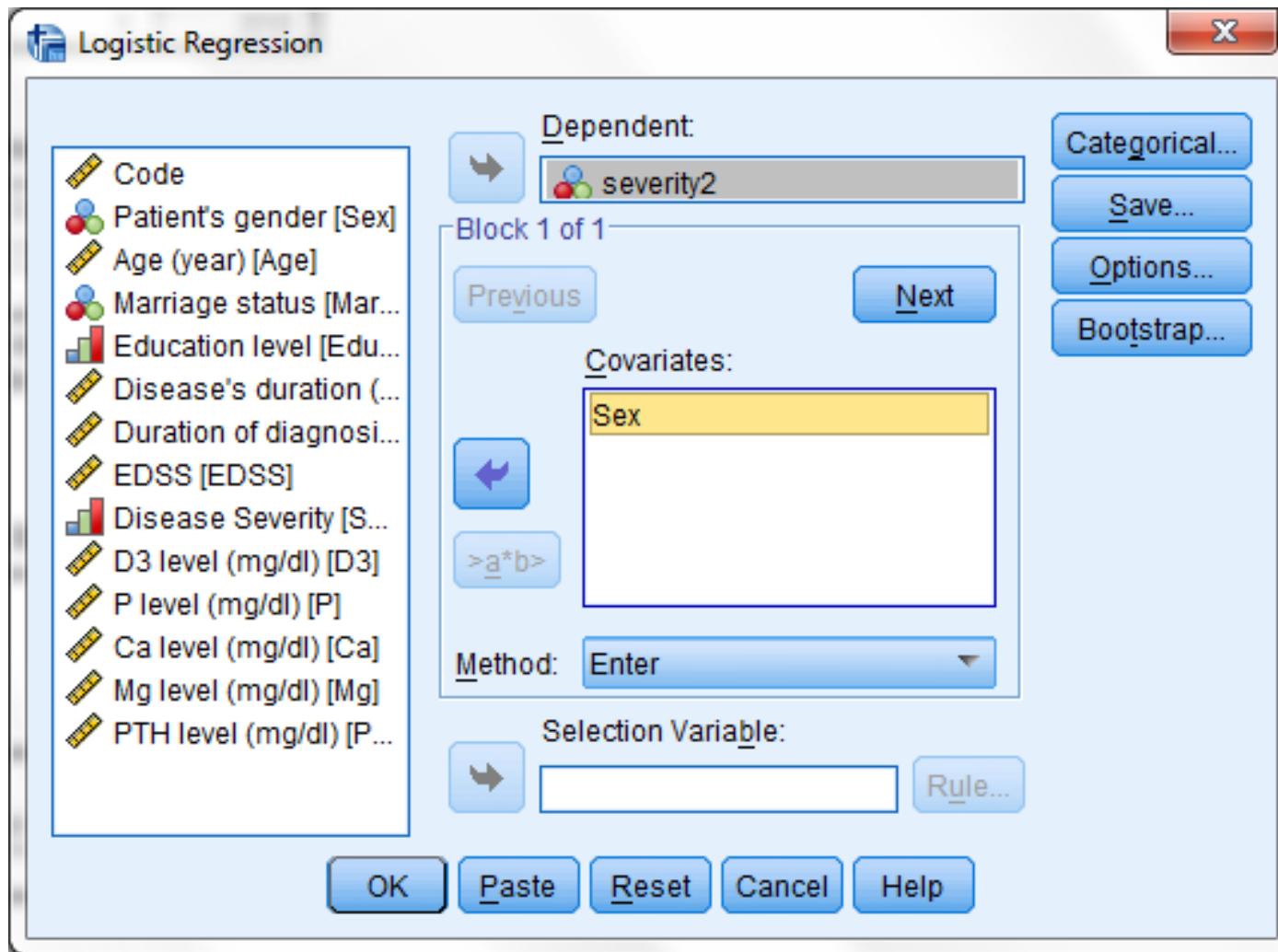
1	1	6	8.0
2	2	6	1.0
3	7	5	4.0
4	10	2	12.0
5	12		
6	16		
7	17		
8	19		
9	20		
10	21		
11	25		
12	26		
13	28		
14	31		
15	34		
16	37		
17	41		
18	42		

Automatic Linear Modeling...
Linear...
Curve Estimation...
Partial Least Squares...
Binary Logistic...
Multinomial Logistic...
Ordinal...
Probit...
Nonlinear...
Weight Estimation...
2-Stage Least Squares...
Optimal Scaling (CATREG)...

Logistic Regression



Logistic Regression



Logistic Regression

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp(B)
Step 1 ^a	Sex	1.345	.573	5.510	1	.019
	Constant	-1.240	.342	13.110	1	.000

a. Variable(s) entered on step 1: Sex.

Bar Chart

MS.sav [DataSet1] - IBM SPSS Statistics Data Editor

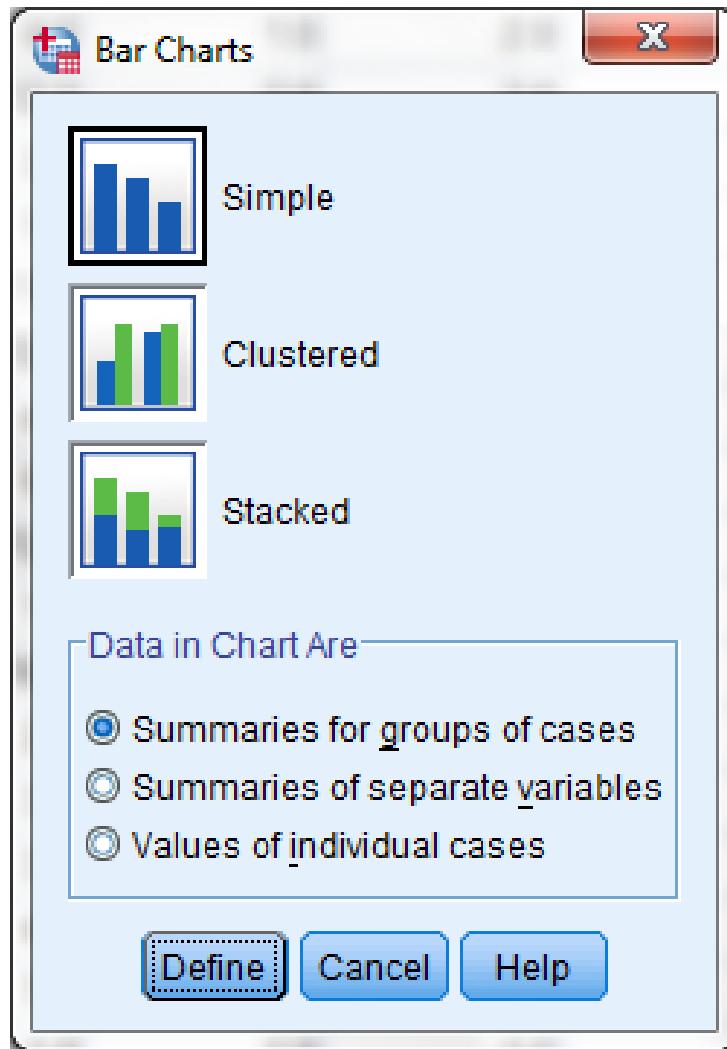
File Edit View Data Transform Analyze Direct Marketing Graphs Utilities Add-ons Window Help

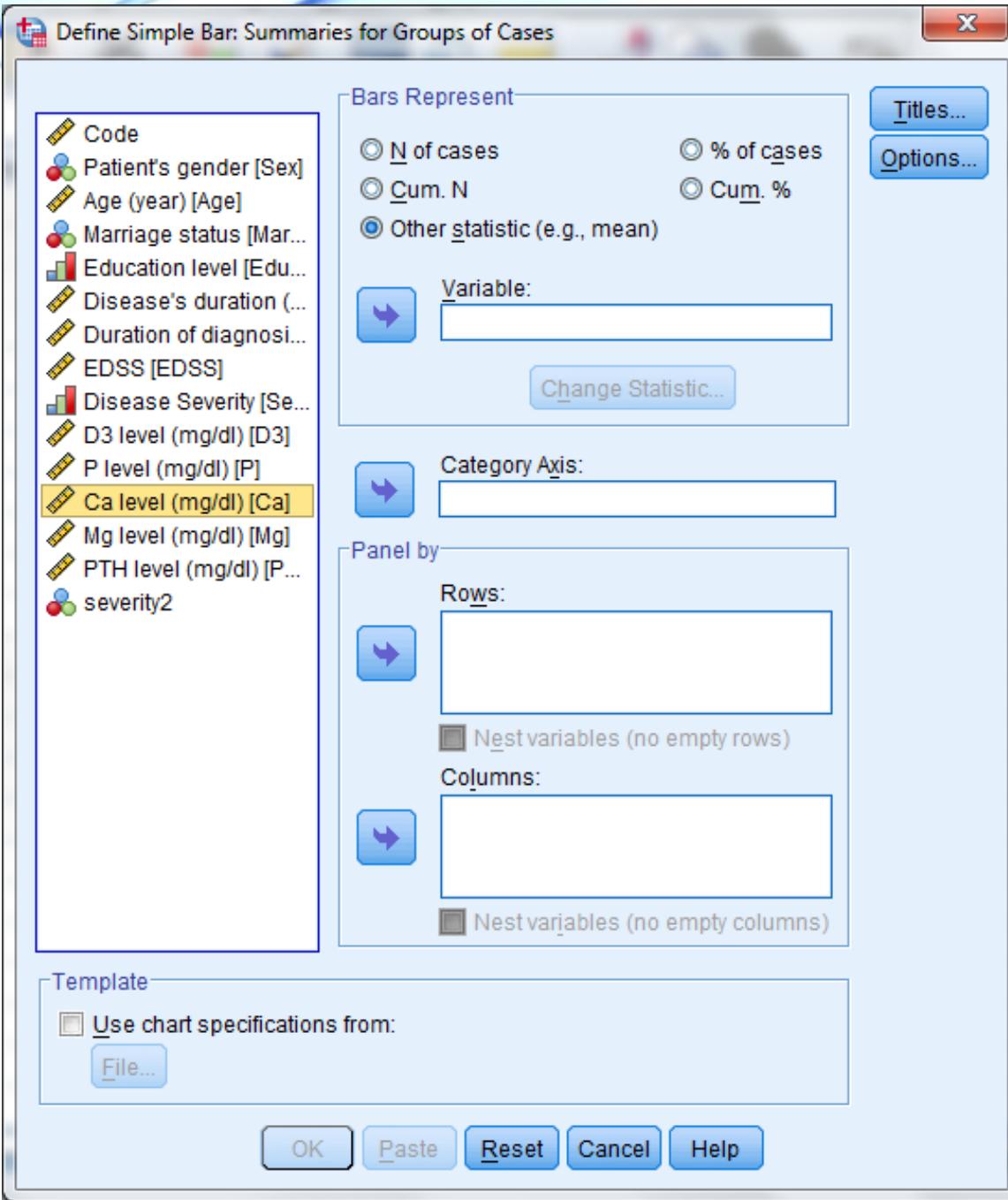
20 : severity2 1.00

	Sex	Age	Marriage	Education	Duration	DUR.Dia
1	1	37	2		6	8.0
2	2	29	1		6	1.0
3	7	32	2		5	4.0
4	10	57	2		2	12.0
5	12	17	1		4	2.0
6	16	31	2		5	5.0
7	17	39	2		3	10.0
8	19	30	2		5	12.0
9	20	36	2		3	4.0
10	21	42	2		4	6.0
11	25	43	2		.	12.0

Chart Builder...
Graphboard Template Chooser...
Legacy Dialogs ▾
Bar...
3-D Bar...
Line...
Area...
Pie...
High-Low...
Boxplot...
Error Bar...
Population Pyramid...
Scatter/Dot...
Histogram...

Bar Chart







Define Simple Bar: Summaries for Groups of Cases



- Code
- Patient's gender [Sex]
 - Age (year) [Age]
 - Marriage status [Mar...]
 - Education level [Edu...]
 - Disease's duration (...)
 - Duration of diagnosis...
 - D3 level (mg/dl) [D3]
 - P level (mg/dl) [P]
 - Ca level (mg/dl) [Ca]
 - Mg level (mg/dl) [Mg]
 - PTH level (mg/dl) [P...]
 - severity2

Bars Represent

- N of cases % of cases
 Cum. N Cum. %
 Other statistic (e.g., mean)

[Titles...](#)[Options...](#)

Variable:

[Change Statistic...](#)

Category Axis:

Panel by

Rows:

 Nest variables (no empty rows)

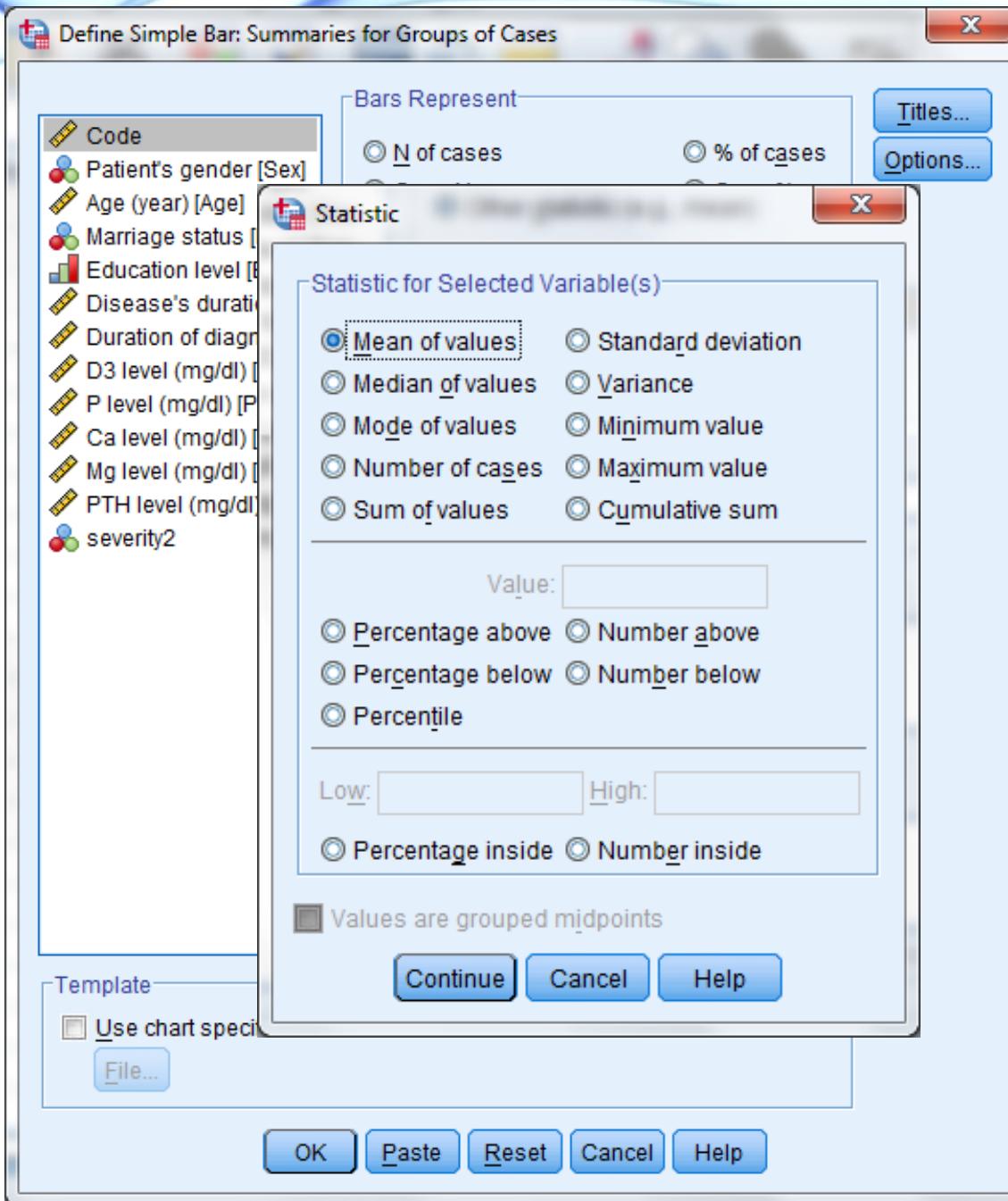
Columns:

 Nest variables (no empty columns)

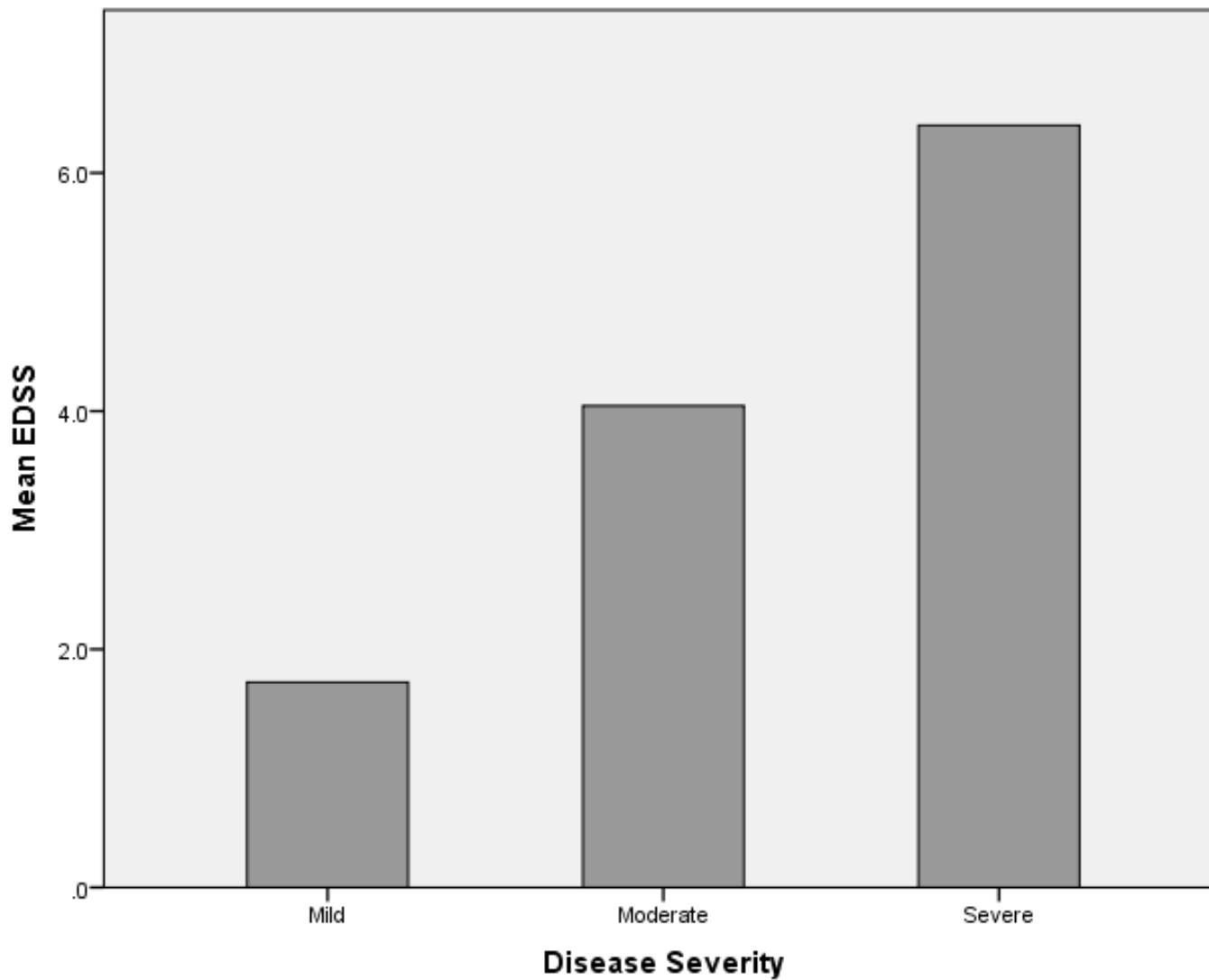
Template

- Use chart specifications from:

[File...](#)[OK](#)[Paste](#)[Reset](#)[Cancel](#)[Help](#)



Bar Chart





Define Simple Bar: Summaries for Groups of Cases



- Code
- Patient's gender [Sex]
 - Age (year) [Age]
 - Marriage status [Mar...]
 - Education level [Edu...]
 - Disease's duration (...)
 - Duration of diagnosis...
 - D3 level (mg/dl) [D3]
 - P level (mg/dl) [P]
 - Ca level (mg/dl) [Ca]
 - Mg level (mg/dl) [Mg]
 - PTH level (mg/dl) [P...]
 - severity2

Bars Represent

- N of cases % of cases
 Cum. N Cum. %
 Other statistic (e.g., mean)

[Titles...](#)[Options...](#)

Variable:

[Change Statistic...](#)

Category Axis:

Panel by

Rows:

 Nest variables (no empty rows)

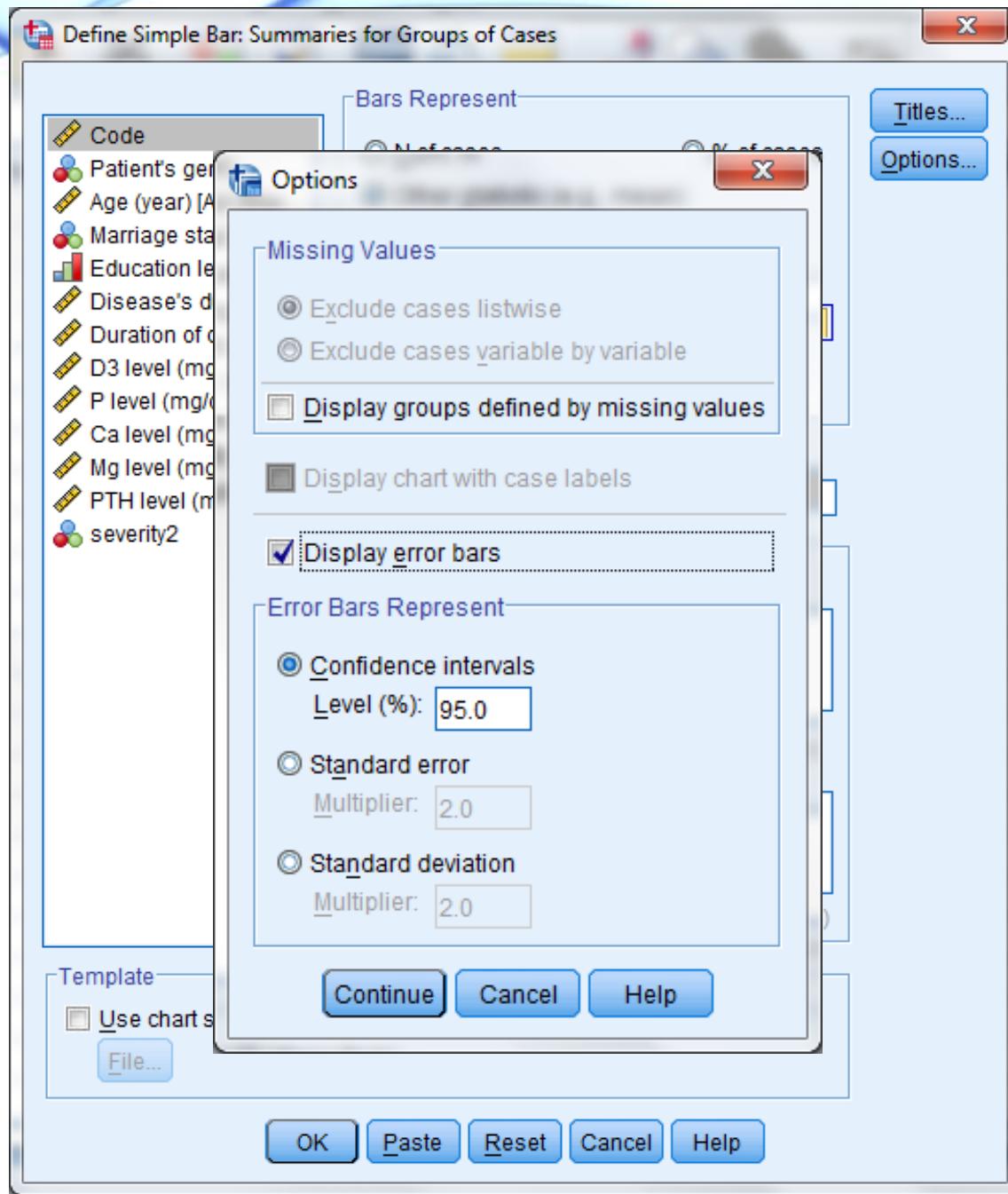
Columns:

 Nest variables (no empty columns)

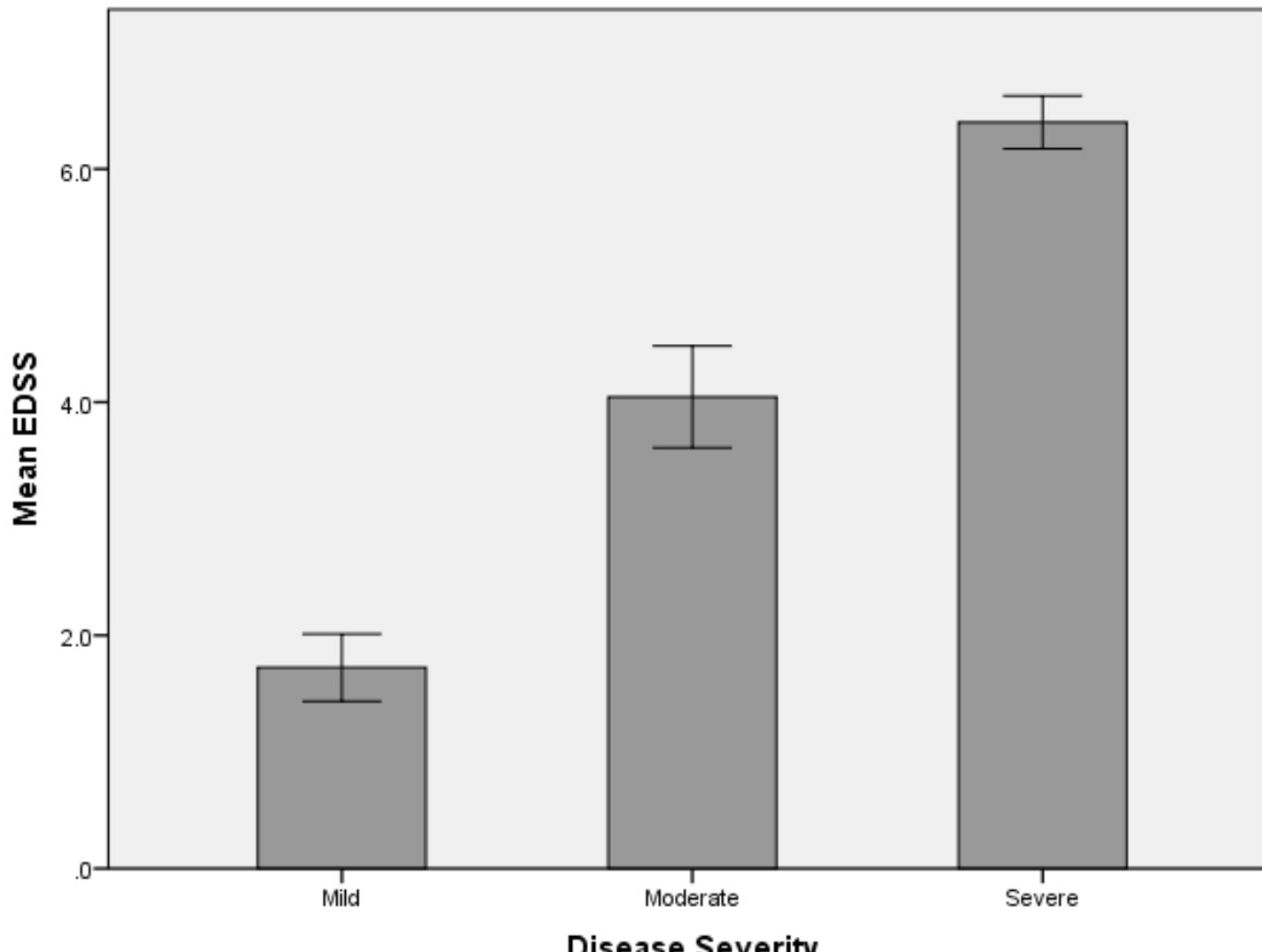
Template

- Use chart specifications from:

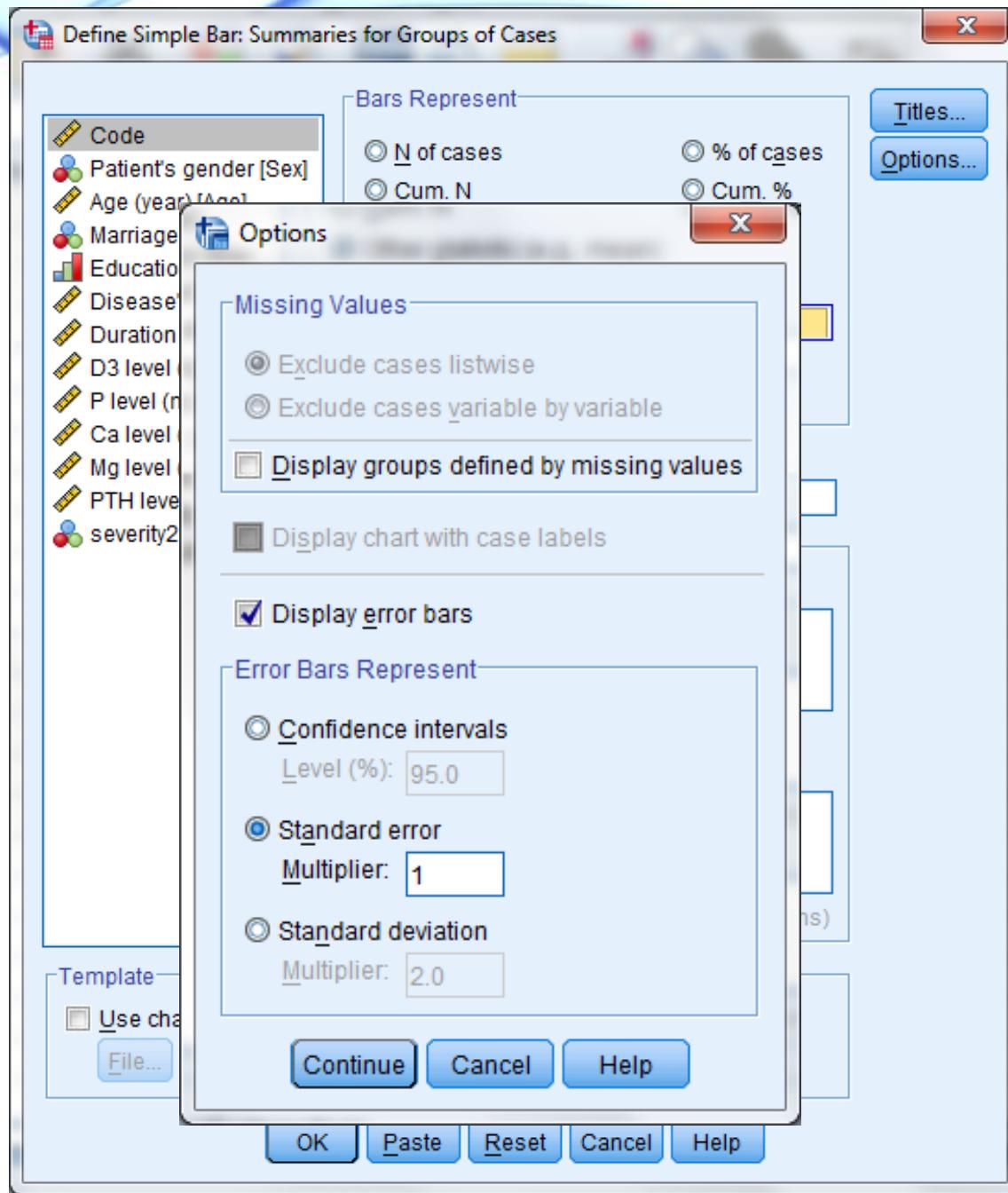
[File...](#)[OK](#)[Paste](#)[Reset](#)[Cancel](#)[Help](#)



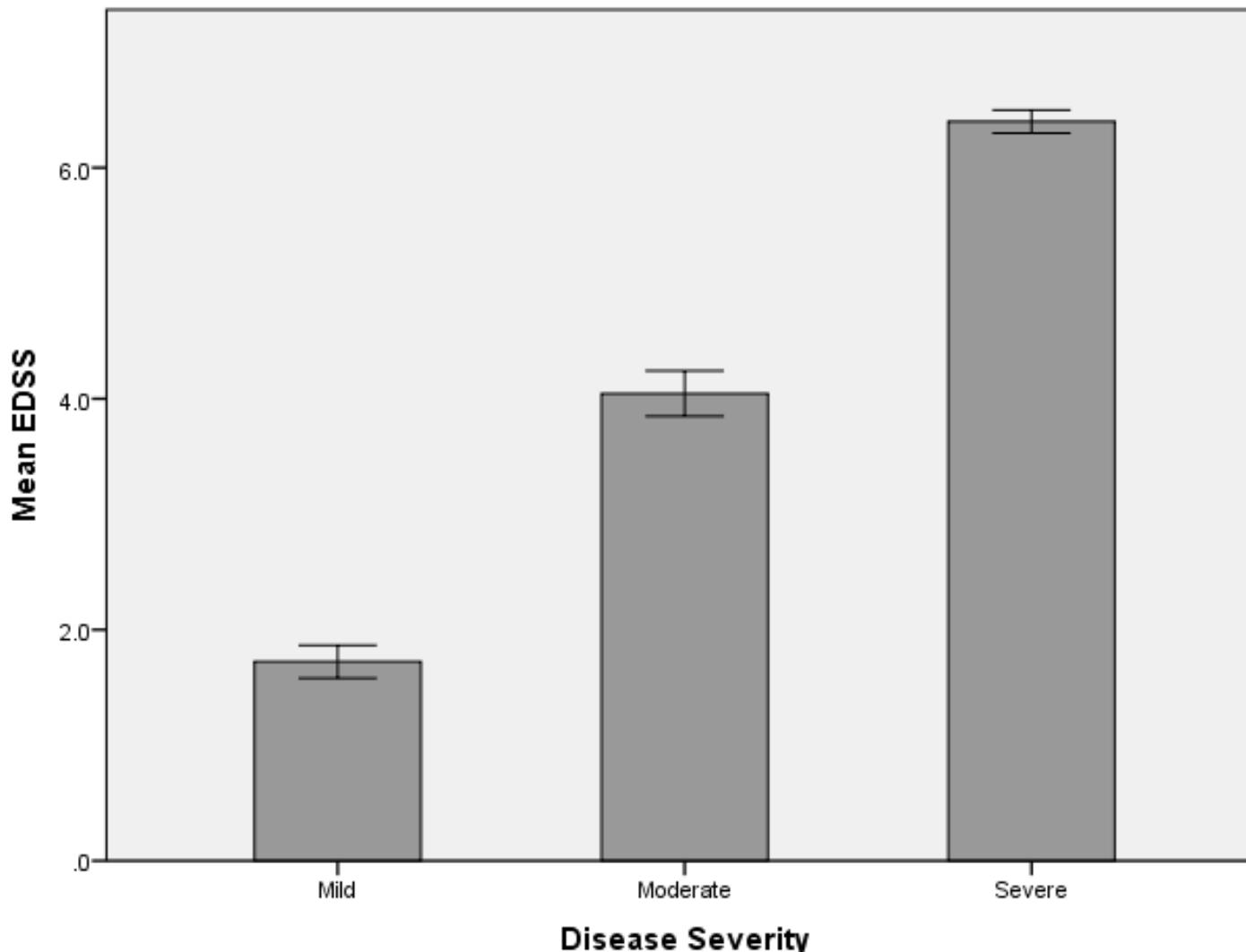
Bar Chart



Error bars: 95% CI

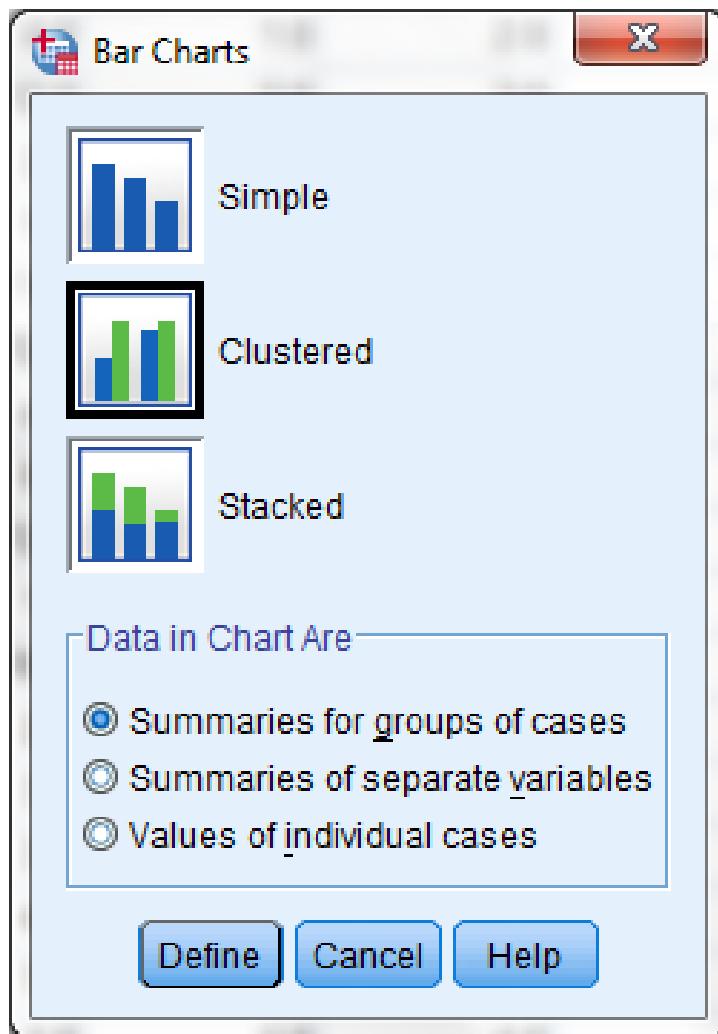


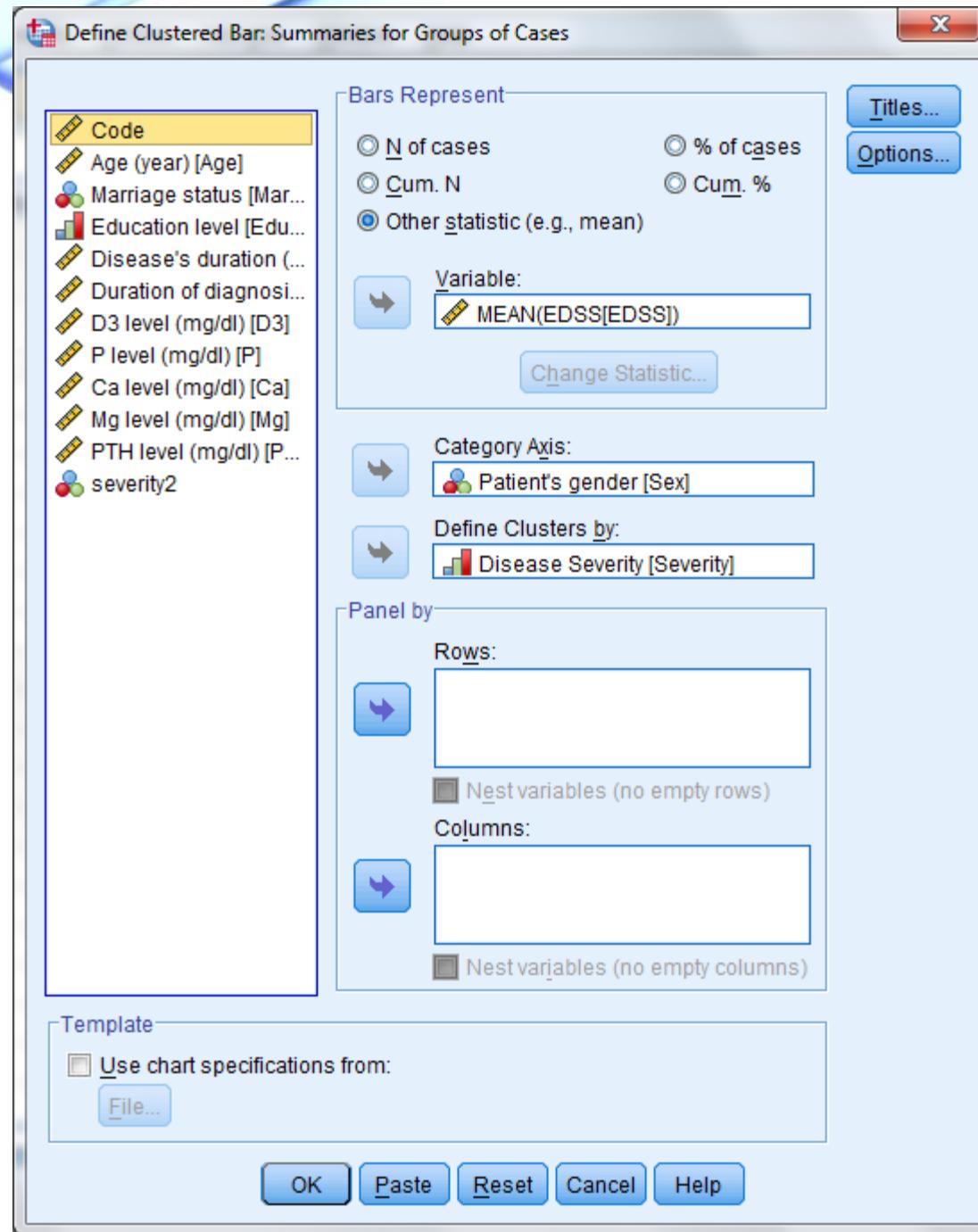
Bar Chart



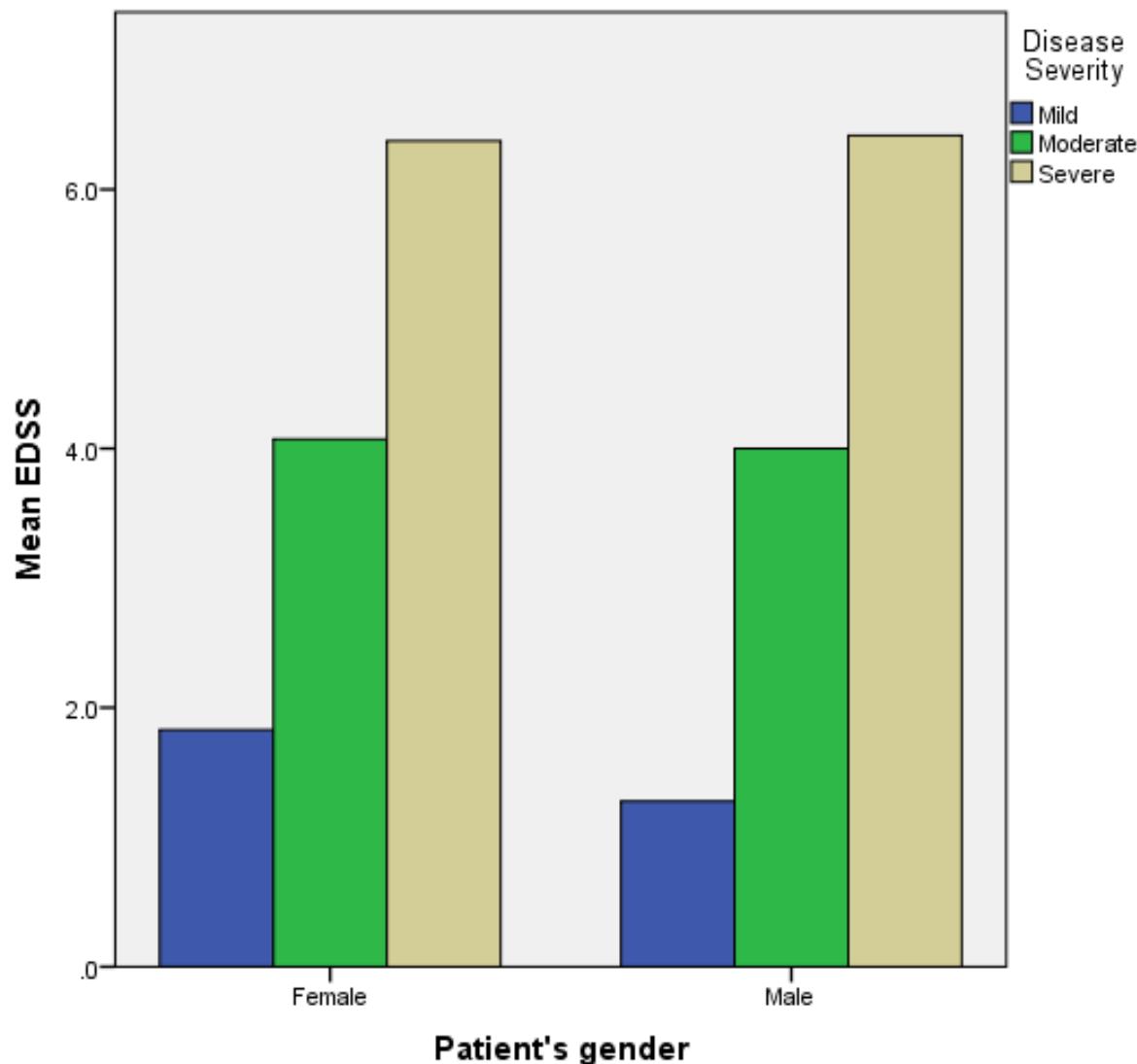
Error bars: +/- 1 SE

Bar Chart





Bar Chart



Thank You