King Saud University

College of Business Administration

Department of Quantitative Analysis

PSPP applications on Business Statistics (QUA 107 +QUA207)

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Introduction

(Variable & Data View / The data coding / The data Entering)

PSPP is a program for statistical analysis of sampled data. It is a free as in replacement for the proprietary program SPSS, and appears very similar to it with a few exceptions. (https://www.techopedia.com/definition/21531/pspp)

Opening PSPP

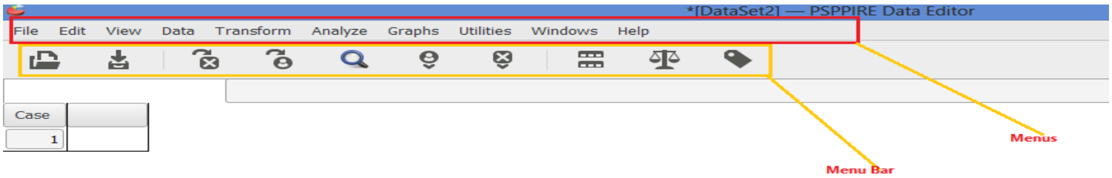
Start → All Programs → PSPP

Preparation of Data Files

Before analysis can commence, the data must be loaded into PSPP and arranged such that both PSPP and humans can understand what the data represents. There are two aspects of data:

The variables: these are the parameters of a quantity, which has been measured or estimated in some way. For example: height, weight and geographic location are all variables.

The observations (also called 'cases') of the variables — each observation represents an instance when the variables were measured or observed.



The following is a brief explanation of the main menus in the program.

- **File** includes most of the options you typically use in other programs such as open, save, create new files ...etc.
- **Edit** includes the cut, copy, and paste, go to variable or case and other Options...etc.
- **View** allows you to select which toolbars you want to show, select font size, add or remove the gridlines that separate each piece of data, and to select whether or not to display your raw data or the data labels.
- **Data** allows you to select several options ranging from displaying data that is sorted by a specific variable to selecting certain cases or weight cases for subsequent analyses.
- **Transform** includes several options to change current variables. For example: change the coding, compute new variables... etc.

- **Analyze** includes most of the commands to carry out statistical analyses. Much of this summary will focus on using commands located in this menu.
- **Graphs** includes the commands to create various types of graphs including histograms, scatterplot, and bar chart.
- **Utilities** allows you to list file information which is a list of all variables,   there labels, values, locations in the data file, and type.
- **Window** can be used to select which window you want to view (i.e., Data Editor, Output Viewer, or Syntax
- **Help** has many useful options including a link to the SPSS homepage, a statistics coach, and a syntax guide. This is an excellent tool and can be used to troubleshoot most problems.

The Icons directly under the Menus provide shortcuts to many common commands that are available in specific menus.

When you open PSPP, you should be faced with the following screen:

1. Data view   2. Variable view

Variable View window (Defining Variables)

This window contains information about the variables set that is used; each row will provide information for each variable.

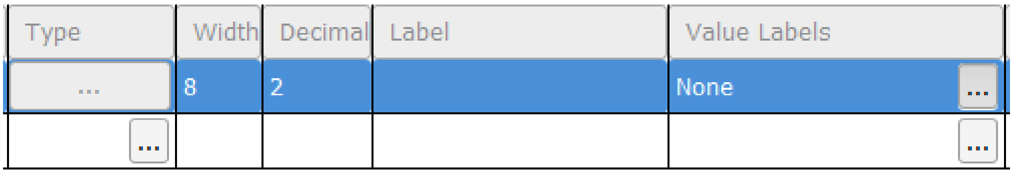
- **Name:**

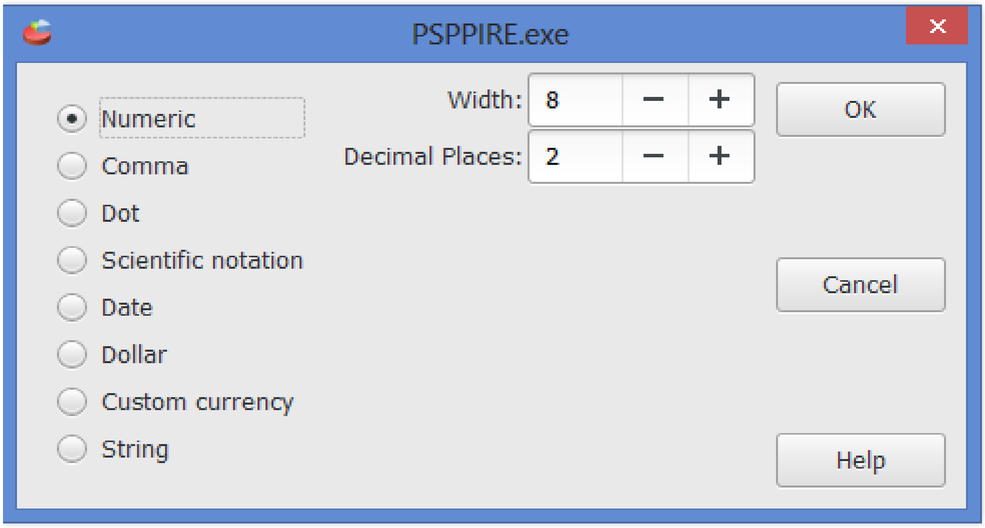
PSPP has a number of rules for naming variables:

- ❖ An identifier, up to 64 bytes long. However, you should keep the variable name as short and succinct as possible.
- ❖ The name must begin with a letter. The remaining characters can be any letter, any digit, a full stop or the symbols @, #, _ or $.
- ❖ Variable names cannot contain spaces or end with a full stop.
- ❖ Each variable name must be unique: duplication is not allowed.
- ❖ Reserved keywords cannot be used as variable names. Reserved keywords are : ALL, AND, BY, EQ, GE, GT, LE, LT, NE, NOT, OR, TO, WITH.

- **Type:**

The most common choice is **“numeric,”** which means the variable has a numeric value. The other common choice is **“string,”** which means the variable is in text format. Below is a table showing the data types:





This column enables you to specify the type of variable.

Type	Example
Numeric	23456789
Comma	23,456,789
Dot	23.456.789
Scientific	34567 >>>3E+004 12000>>> 1E+004
Date	01-Feb-2000
Dollar	$12,345,678 ,
Custom currency	SR 12,345
String	A, B, C …

- **Width**

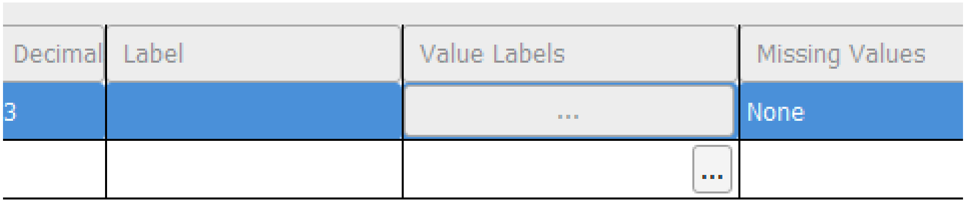
Width allows you to determine the number of characters PSPP will allow to be entered for the variable

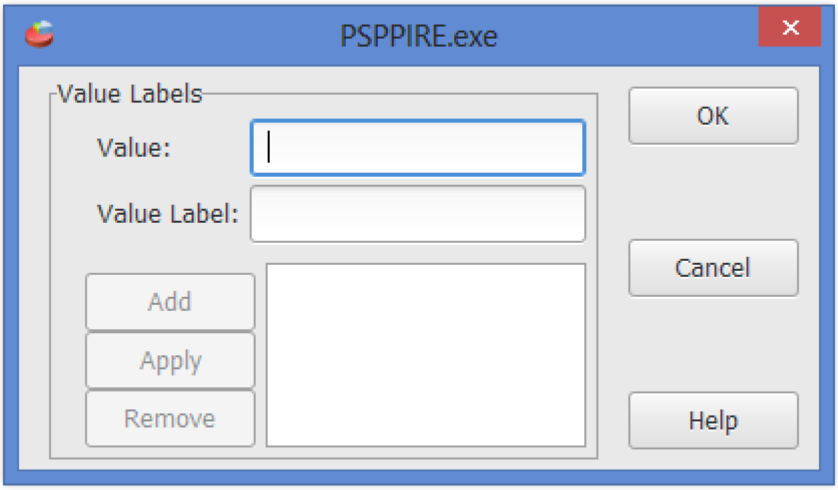
- **Decimals**

  PSPP defaults to two decimal places. Since our data does not require decimal places we can simply click in the Decimals cell and click the up or down arrows to adjust decimal places needed for that particular variable.
- **Label**

  The Label column allows you to provide a longer description of your variable, which will be shown in the output produced by PSPP.
- **Values**

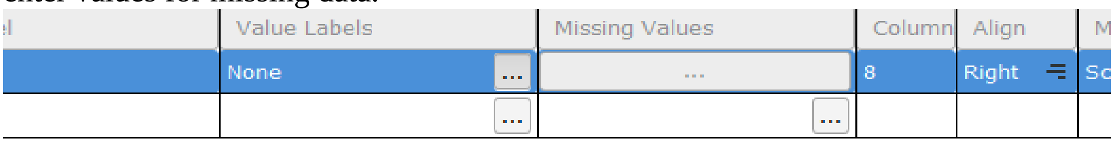
Values are code (number or letter) assigned to categories for nominal/ordinal variables, for example (male = 1 and female = 2).

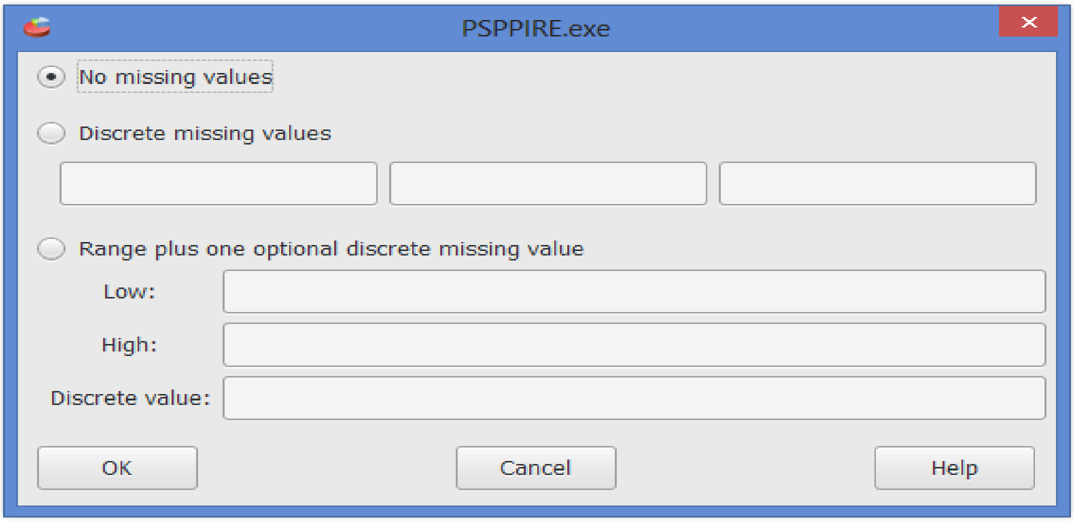




- **Missing value**

Sometimes it is useful to assign specific values to indicate different reasons for missing data. However, PSPP recognizes any blank cell as missing data and excludes it from any calculations, so if you intend to leave the cell blank there is no need to enter values for missing data.

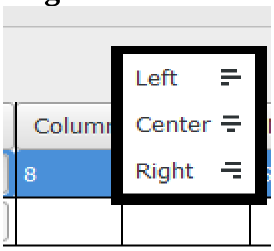




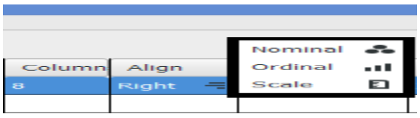
- **Columns**

You can change the column width to reduce the space it takes on the screen. However, you need to allow enough space for variable names, so the default of eight is usually OK.

- **Align :**



- **Measure :**



- ❖ **Scale:** For numeric values on an interval or ratio scale: age, sessions, satisfaction.
- ❖ **Nominal:** For values that represent categories with no intrinsic order: patient, sex, counsellor.
- ❖ **Ordinal:** For values with some intrinsic order (e.g., low, medium, high; first, second , third)

Entering Data into PSPP

- Switch from variable view to data view - Establish that all labels are evident across the top row of the data view window. - Once this has been established it is possible to begin inputting data.

Definition of variables & Data entry

Example (1):

For creating a database for a company, a questionnaire was distributed to a sample of 20 workers. The following questions are part of the questionnaire.

Q1- Gender Male 1 Female 0

Q2 - Age………… Year

Q3 - Marital status: Married 1 Not Married 0

Q4- Years of Experience: < 5 1 5 -10 2 >10 3

Q5 - Educational level:
Graduate G University U Secondary S Primary P

Q6 - Monthly income: …..........SR

Q7 - Monthly expenditure: ……………..SR

Definition of variables:

File Edit View Data Transform Analyze Graphs Utilities Windows Help

Variabl	Name	Type	Width	Decimal	Label	Value Labels	Missing Values	Column	Align	Measure	Role
1	Gender	Numeric	1	0	Gender	{0, Female}...	None	6	Right	Nominal	Input
2	Age	Numeric	2	0	Age	None	None	8	Right	Scale	Input
3	Status	Numeric	6	0	Marital status	{0, Not Married}...	None	12	Right	Nominal	Input
4	Experience	Numeric	8	0	Years of Experience	{1, < 5}...	None	8	Right	Ordinal	Input
5	Education	String	1		Educational level	{G, Graduate}...	None	10	Right	Ordinal	Input
6	Income	Numeric	5	0	Monthly income	None	None	8	Right	Scale	Input
7	Expenditure	Numeric	5	0	Monthly expenditure	None	None	8	Right	Scale	Input

Data entry

Case	Gender	Age	Status	Experienc	Education	Income	Expenditu
1	1	24	0	1	U	3500	3500
2	0	34	1	2	P	5000	4000
3	0	25	0	3	U	5500	4500
4	1	26	0	1	U	6000	5530
5	1	36	1	3	G	12300	12000
6	0	44	1	3	S	15000	15300
7	1	56	1	3	S	17500	20500
8	0	45	1	3	P	12000	11500
9	1	29	1	2	U	7000	6500
10	0	38	0	3	G	14000	14000
11	0	43	1	3	P	14750	13000
12	1	55	1	3	S	17000	15000
13	1	50	1	3	U	15450	14400
14	0	43	1	3	S	15000	15000
15	1	28	1	2	U	7000	6500
16	0	53	1	3	S	19000	17000
17	1	28	0	1	U	6200	7000
18	0	31	0	2	G	8500	8000
19	1	39	0	3	U	12500	12000

PSPP applications on Principles of Statistics QUA 107

Chapter (3) & (4)

Organizing Variables / Numerical Descriptive Measures

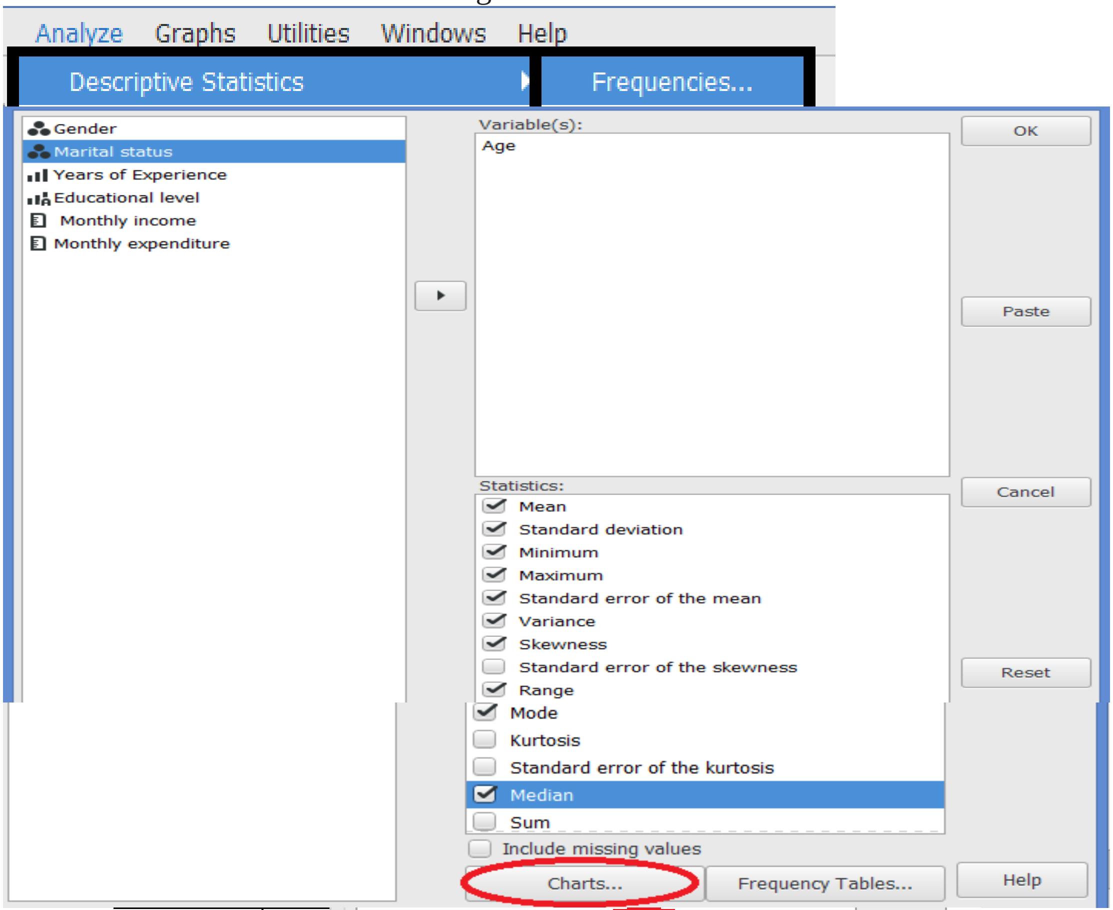
Example (2): Refer to example (1):

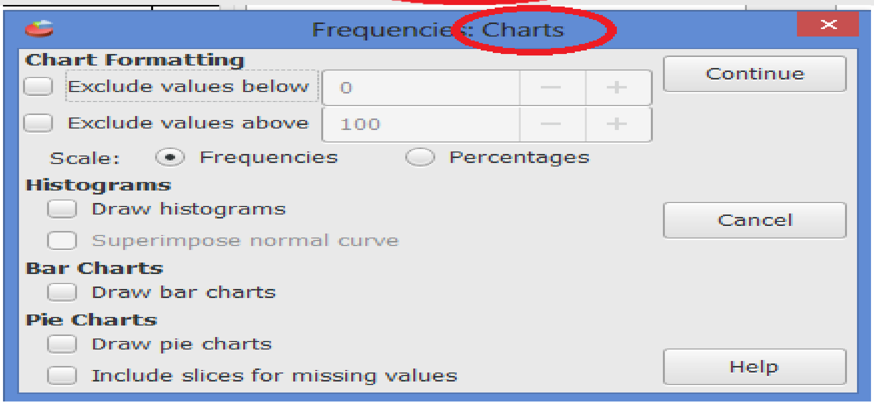
Construct a frequency table and calculate the numerical measures for the following variables: Gender, Marital status, Age

Solation:

1) Descriptive statistics … Frequencies

This option calculates the measures of dispersion and central tendency of quantitative variables and related drawings.





The output:

Age

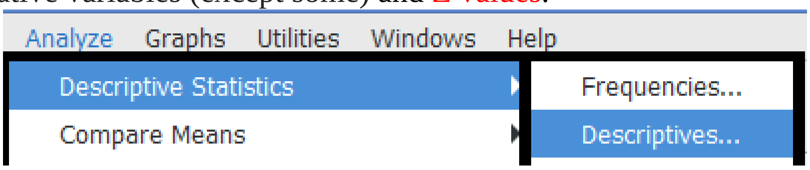
Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
	24	1	5.00	5.00	5.00
	25	1	5.00	5.00	10.00
	26	1	5.00	5.00	15.00
	28	2	10.00	10.00	25.00
	29	1	5.00	5.00	30.00
	31	1	5.00	5.00	35.00
	34	1	5.00	5.00	40.00
	36	1	5.00	5.00	45.00
	38	1	5.00	5.00	50.00
	39	1	5.00	5.00	55.00
	42	1	5.00	5.00	60.00
	43	2	10.00	10.00	70.00
	44	1	5.00	5.00	75.00
	45	1	5.00	5.00	80.00
	50	1	5.00	5.00	85.00
	53	1	5.00	5.00	90.00
	55	1	5.00	5.00	95.00
	56	1	5.00	5.00	100.00
	Total	20	100.0	100.0	

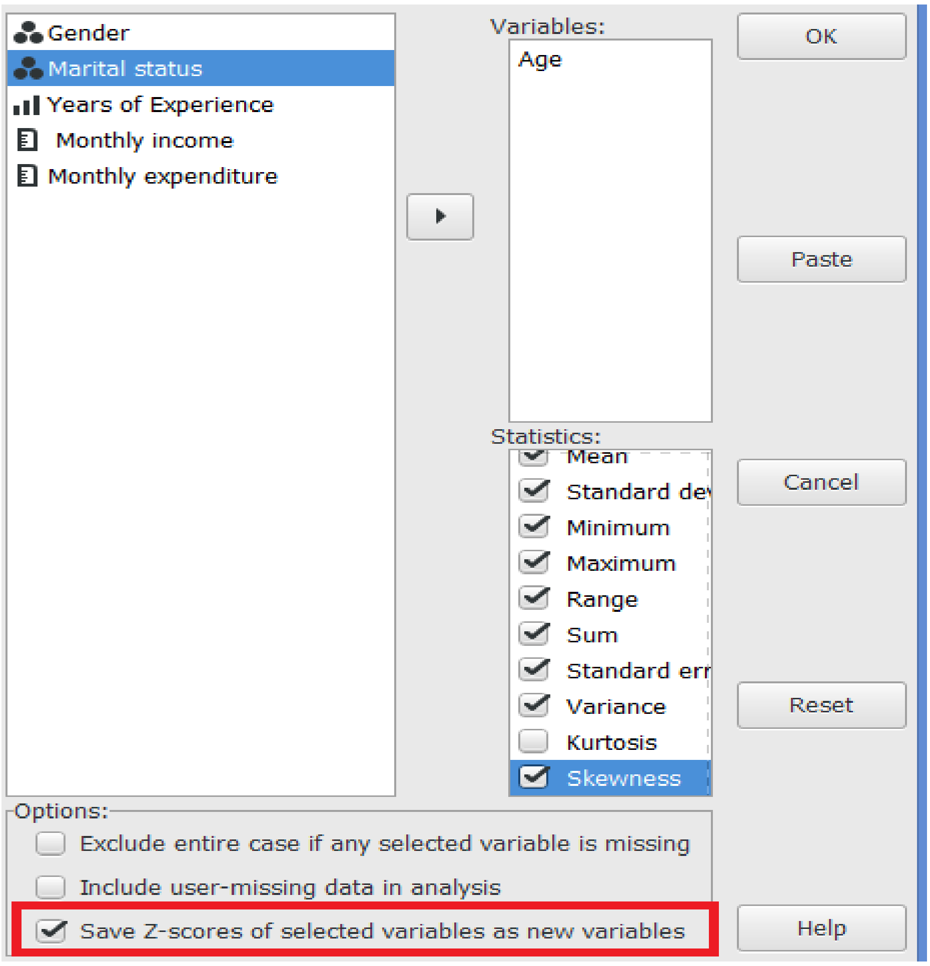
Age

N	*Valid*	20
	Missing	0
Mean		38.42
S.E. Mean		2.30
Mode		.
Std Dev		10.27
Variance		105.45
Skewness		.22
Range		32.50
Minimum		23.50
Maximum		56.00
Percentiles	50 (Median)	39

2) Descriptive statistics … Descriptive

This option calculates the measures of dispersion and central tendency of quantitative variables (except some) and Z values.





The output:

Mapping of variables to corresponding Z-scores.

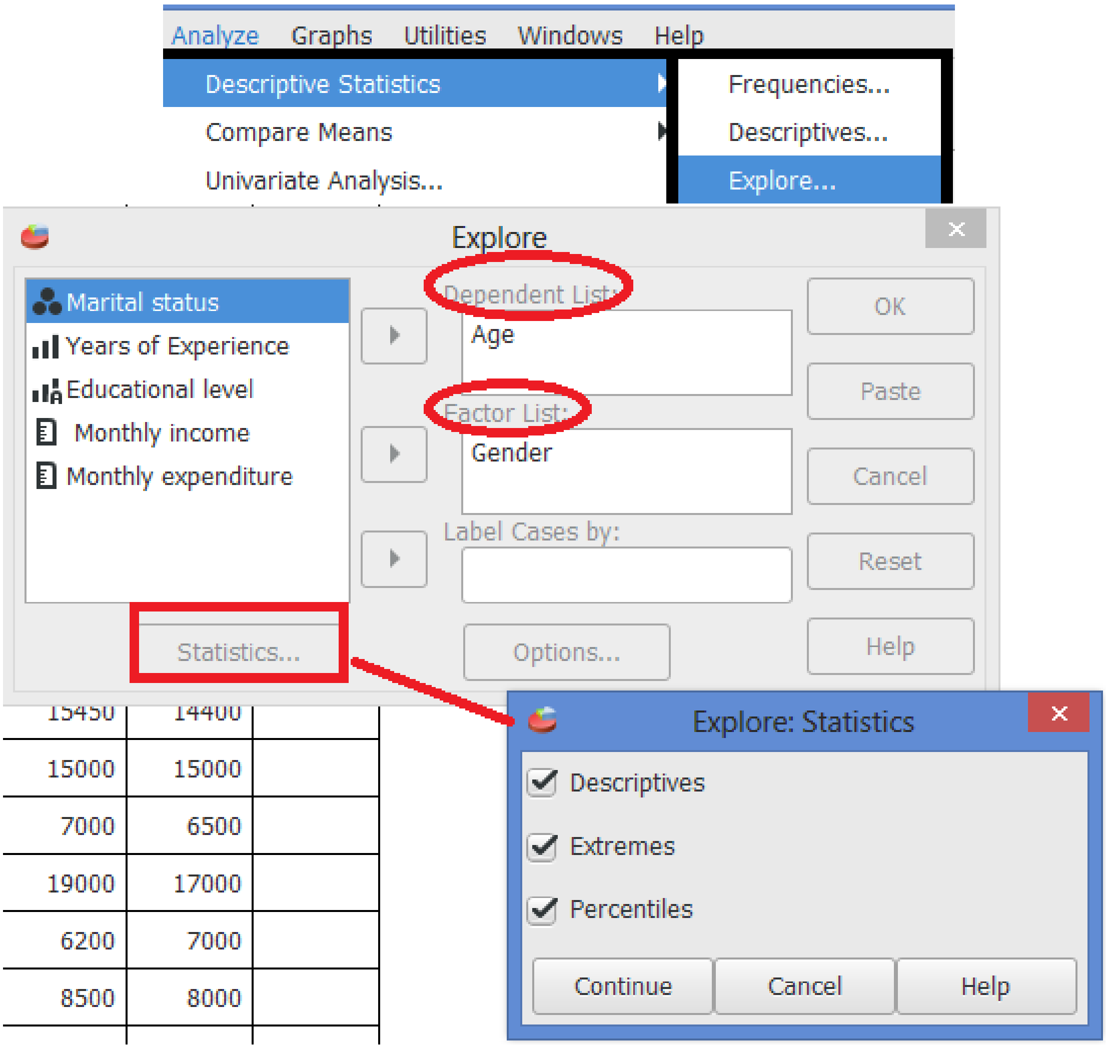
Source	*Target*
Age	ZAge

Valid cases = 20; cases with missing value(s) = 0.

Variable	*N*	*Mean*	*S.E. Mean*	*Std Dev*	*Variance*	*Skewness*	*S.E. Skew*	*Range*	*Minimum*	*Maximum*	*Sum*
Age	20	38.42	2.30	10.27	105.45	.22	.51	32.50	23.50	56.00	768.50

Case	Gender	Age	Status	Experienc	Education	Income	Expenditu	ZAge
1	1	24	0	1	U	3500	3500	-1.45
2	0	34	1	2	P	5000	4000	-.43
3	0	25	0	3	U	5500	4500	-1.31
4	1	26	0	1	U	6000	5530	-1.21
5	1	36	1	3	G	12300	12000	-.24
6	0	44	1	3	S	15000	15300	.54
7	1	56	1	3	S	17500	20500	1.71
8	0	45	1	3	P	12000	11500	.64
9	1	29	1	2	U	7000	6500	-.92

3) Descriptive statistics … Explore



Outputs by Quantitative Variable (Age)

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Age	20	100%	0	0%	20	100%

Extreme Values

			Case Number	Value
Age	Highest	1	7	56
		2	12	55
		3	16	53
		4	13	50
		5	8	45
	Lowest	1	1	24
		2	3	25
		3	4	26
		4	15	28
		5	17	28

Percentiles

		Percentiles						
		5	10	25	50	75	90	95
Age	HAverage	23.57	25.10	28.25	38.50	44.75	54.80	55.95
	Tukey's Hinges			28.50	38.50	44.50		

Descriptives

			Statistic	Std. Error
Age	Mean		38.42	2.30
	95% Confidence Interval for Mean	Lower Bound	33.62	
		Upper Bound	43.23	
	5% Trimmed Mean		38.28	
	Median		38.50	
	Variance		105.45	
	Std. Deviation		10.27	
	Minimum		23.50	
	Maximum		56.00	
	Range		32.50	
	Interquartile Range		16.50	
	Skewness		.22	.51
	Kurtosis		-1.08	.99

Outputs by qualitative variable (Age & Gender)

Case Processing Summary

	Gender	Valid N	Valid Percent	Missing N	Missing Percent	Total N	Total Percent
Age	Female	9	100%	0	0%	9	100%
	male	11	100%	0	0%	11	100%

Extreme Values

	Gender			Case Number	Value
Age	Female	Highest	1	16	53
			2	8	45
			3	6	44
			4	14	43
			5	11	43
		Lowest	1	3	25
			2	18	31
			3	2	34
			4	10	38
			5	11	43
	male	Highest	1	7	56
			2	12	55
			3	13	50
			4	20	42
			5	19	39
		Lowest	1	1	24
			2	4	26
			3	15	28
			4	17	28
			5	9	29

Percentiles

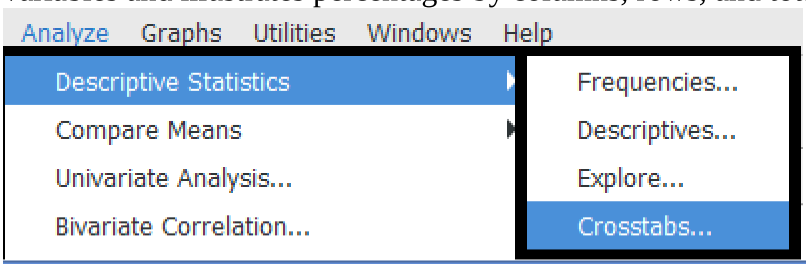
	Gender		5	10	25	50	75	90	95
Age	Female	HAverage	12.50	25.00	32.50	43.00	44.50	53.00	53.00
		Tukey's Hinges			34.00	43.00	44.00		
	male	HAverage	14.10	24.00	28.00	36.00	50.00	55.80	56.00
		Tukey's Hinges			28.00	36.00	46.00		

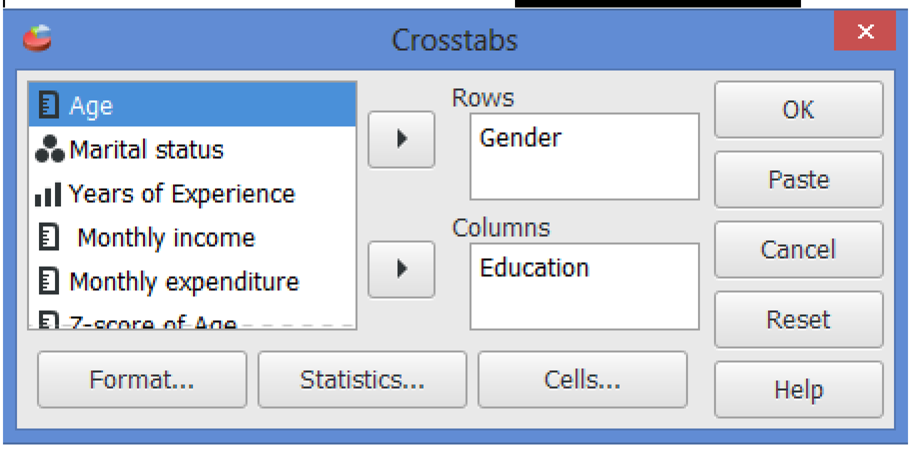
Descriptives

	Gender			Statistic	Std. Error
Age	Female	Mean		39.56	2.82
		95% Confidence Interval for Mean	Lower Bound	33.05	
			Upper Bound	46.06	
		5% Trimmed Mean		39.62	
		Median		43.00	
		Variance		71.53	
		Std. Deviation		8.46	
		Minimum		25.00	
		Maximum		53.00	
		Range		28.00	
		Interquartile Range		12.00	
		Skewness		-.30	.72
		Kurtosis		-.10	1.40
	male	Mean		37.50	3.58
		95% Confidence Interval for Mean	Lower Bound	29.52	
			Upper Bound	45.48	
		5% Trimmed Mean		37.25	
		Median		36.00	
		Variance		141.05	
		Std. Deviation		11.88	
		Minimum		23.50	
		Maximum		56.00	
		Range		32.50	
		Interquartile Range		22.00	
		Skewness		.52	.66
		Kurtosis		-1.28	1.28

4) Descriptive statistics … Crosstabs

This option is for designing intersecting tables (contingency tables) of qualitative variables and illustrates percentages by columns, rows, and totals and chi square test.





Summary.

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Gender * Educational level	20	100.0%	0	0.0%	20	100.0%

Gender * Educational level [count, row %, column %, total %].

	Educational level				
Gender	Graduate	Primary	Secondary	University	Total
Female	2.00	3.00	3.00	1.00	9.00
	22.22%	33.33%	33.33%	11.11%	100.00%
	66.67%	100.00%	60.00%	11.11%	45.00%
	10.00%	15.00%	15.00%	5.00%	45.00%
male	1.00	.00	2.00	8.00	11.00
	9.09%	.00%	18.18%	72.73%	100.00%
	33.33%	.00%	40.00%	88.89%	55.00%
	5.00%	.00%	10.00%	40.00%	55.00%
Total	3.00	3.00	5.00	9.00	20.00
	15.00%	15.00%	25.00%	45.00%	100.00%
	100.00%	100.00%	100.00%	100.00%	100.00%
	15.00%	15.00%	25.00%	45.00%	100.00%

Chi-square tests.

Statistic	*Value*	*df*	*Asymp. Sig. (2-tailed)*
Pearson Chi-Square	8.87	3	.031
Likelihood Ratio	10.70	3	.013
N of Valid Cases	20		

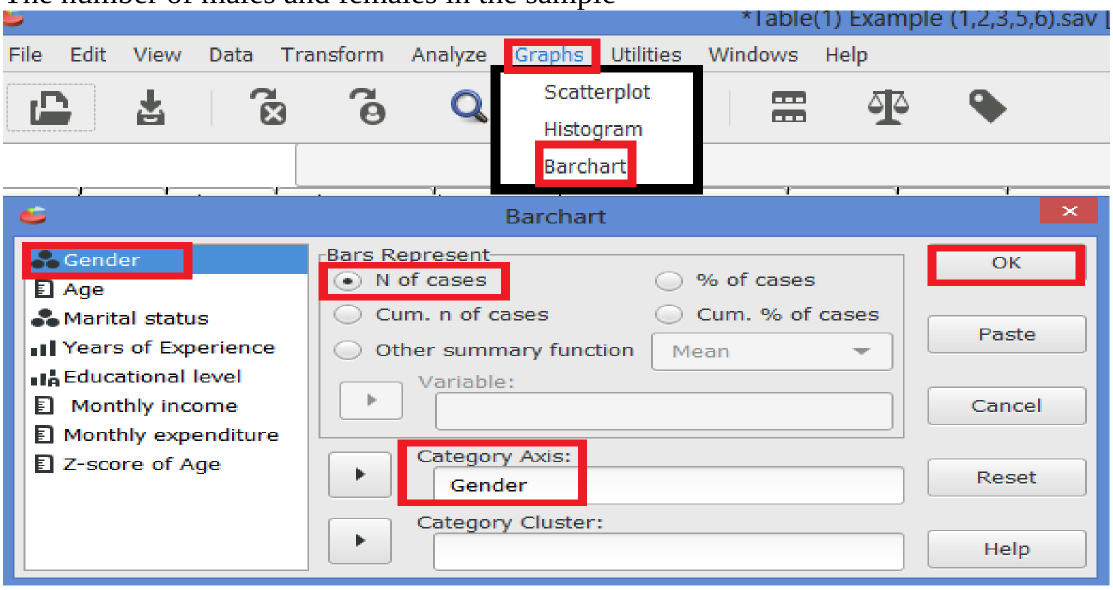
Example (3): Refer to example (1):

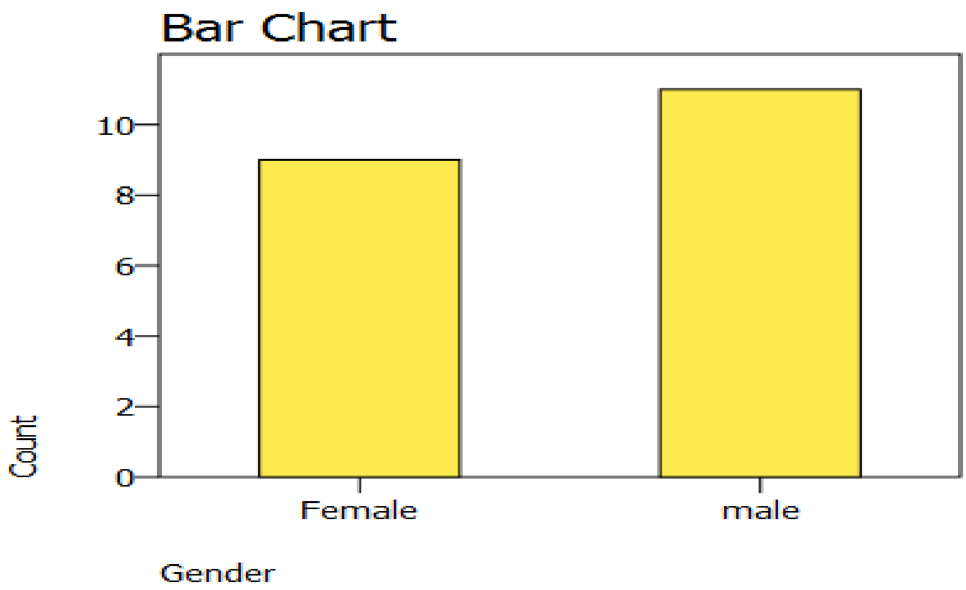
Draw a bar chart to the following:

1. The number of males and females in the sample
2. Average monthly income by level of education.
3. Average monthly expenditure by level of education and Marital status

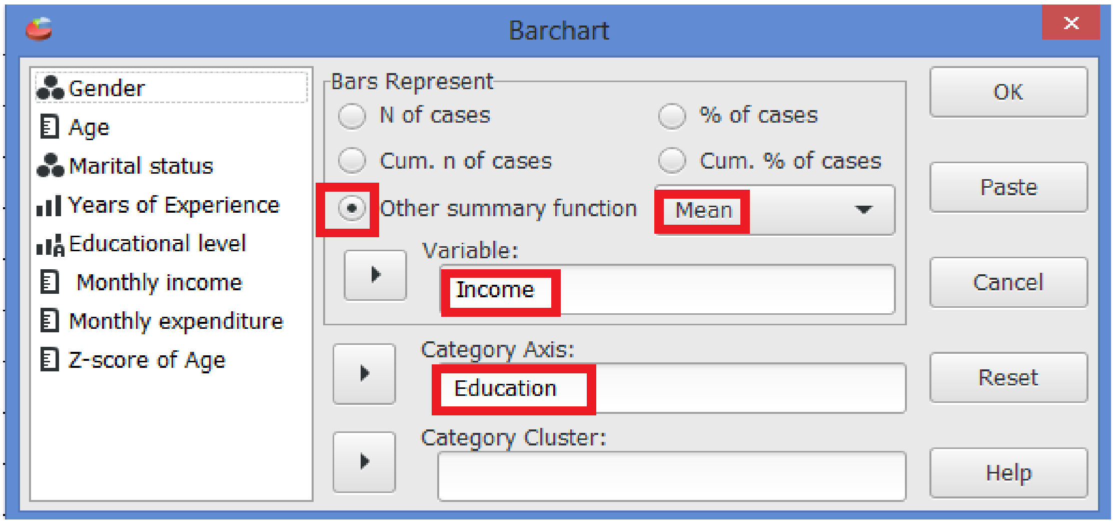
Solation:

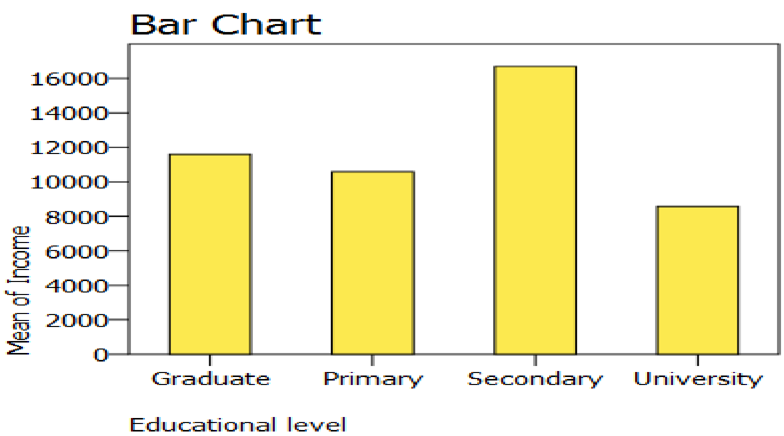
The number of males and females in the sample



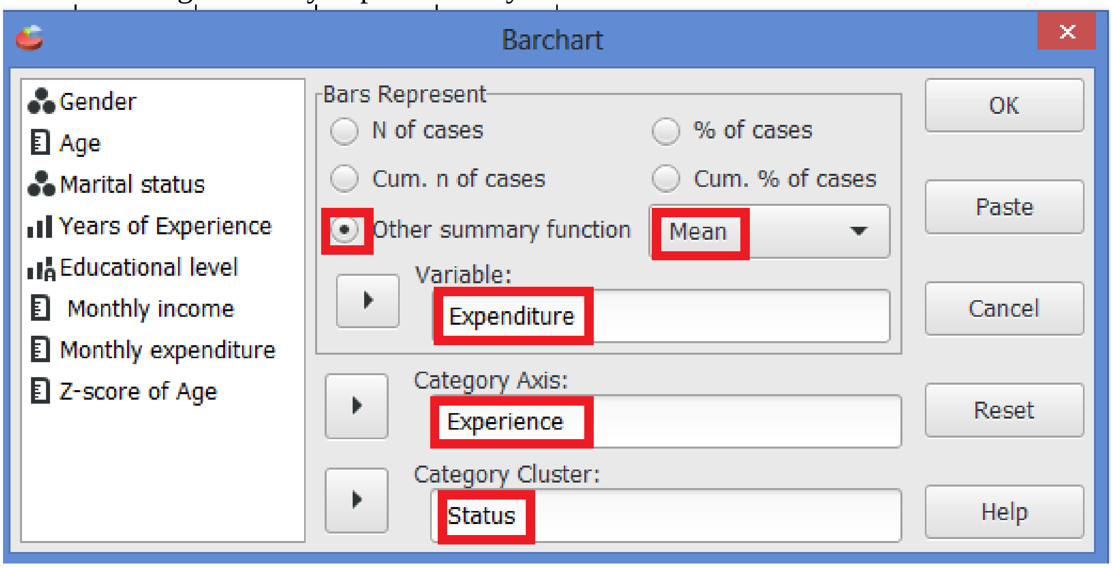


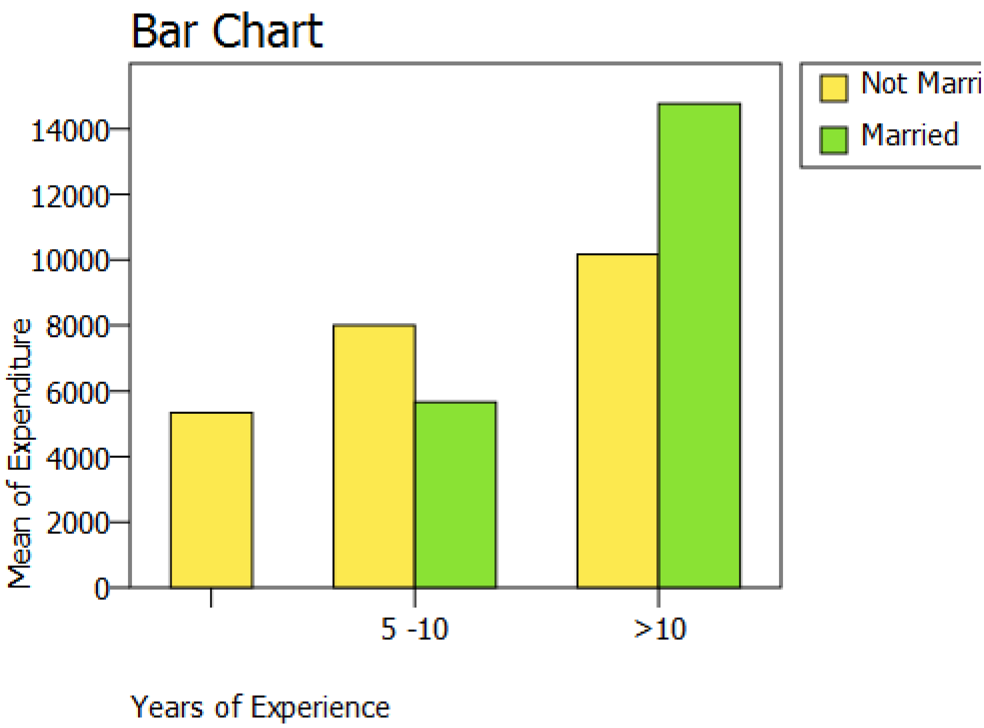
Average monthly income by level of education.



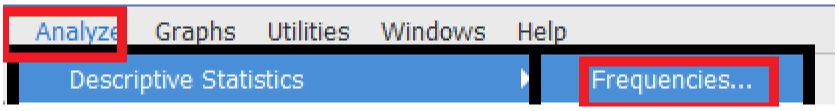


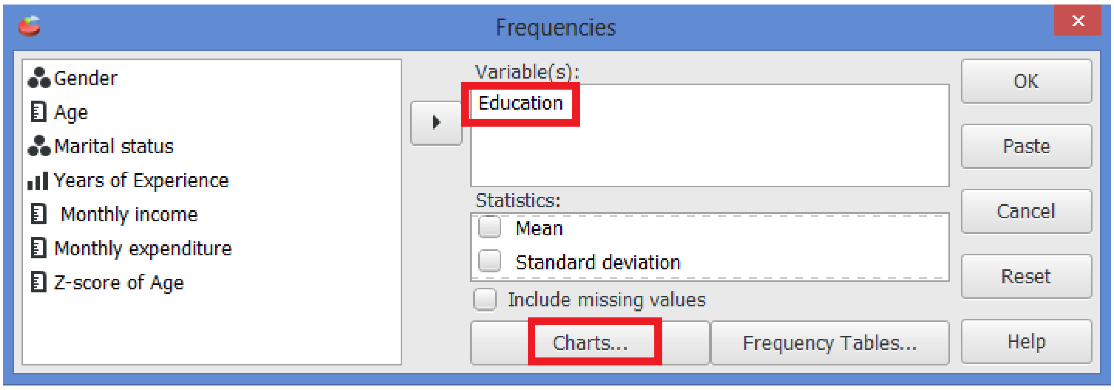
3. Average monthly expenditure by level of education and Marital status

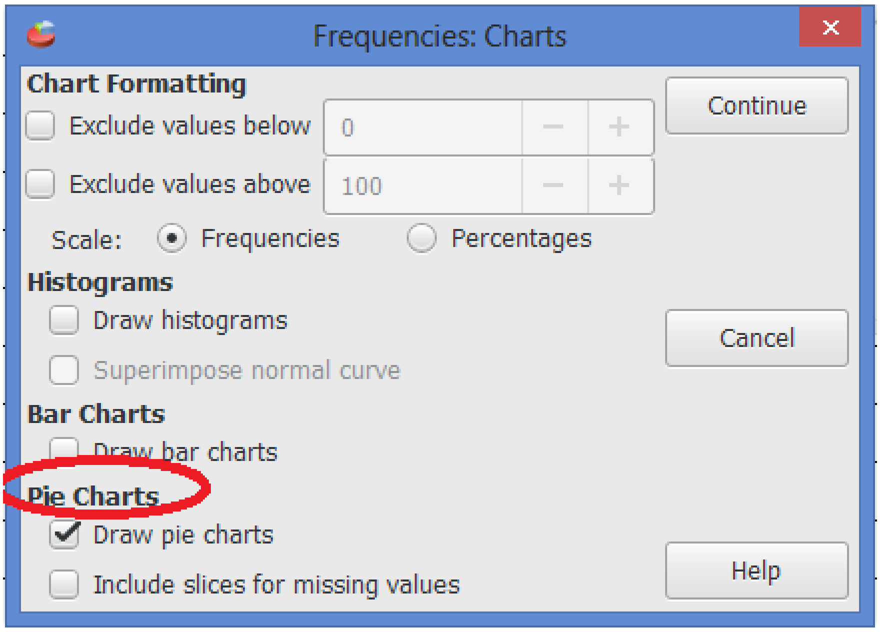




Example (4): Refer to example (1):
Draw a pie chart to the education level variable



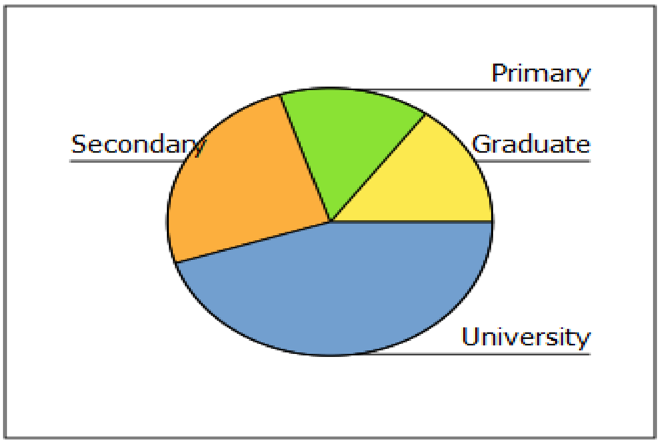




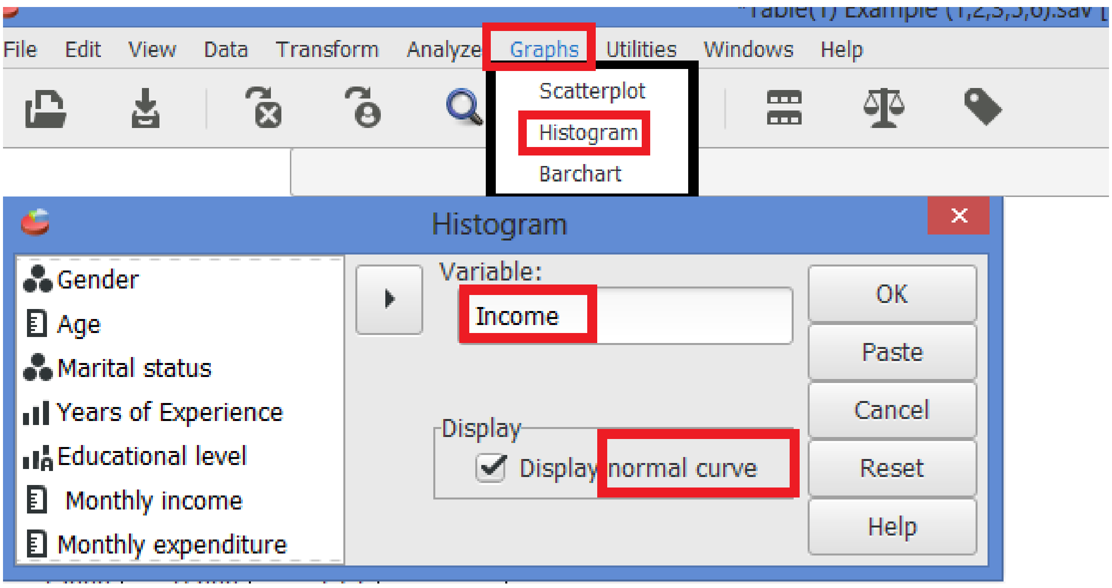
Educational level

Value Label	Value	Frequency	Percent	Valid Percent	Cum Percent
Graduate	G	3	15.00	15.00	15.00
Primary	P	3	15.00	15.00	30.00
Secondary	S	5	25.00	25.00	55.00
University	U	9	45.00	45.00	100.00
	Total	20	100.0	100.0	

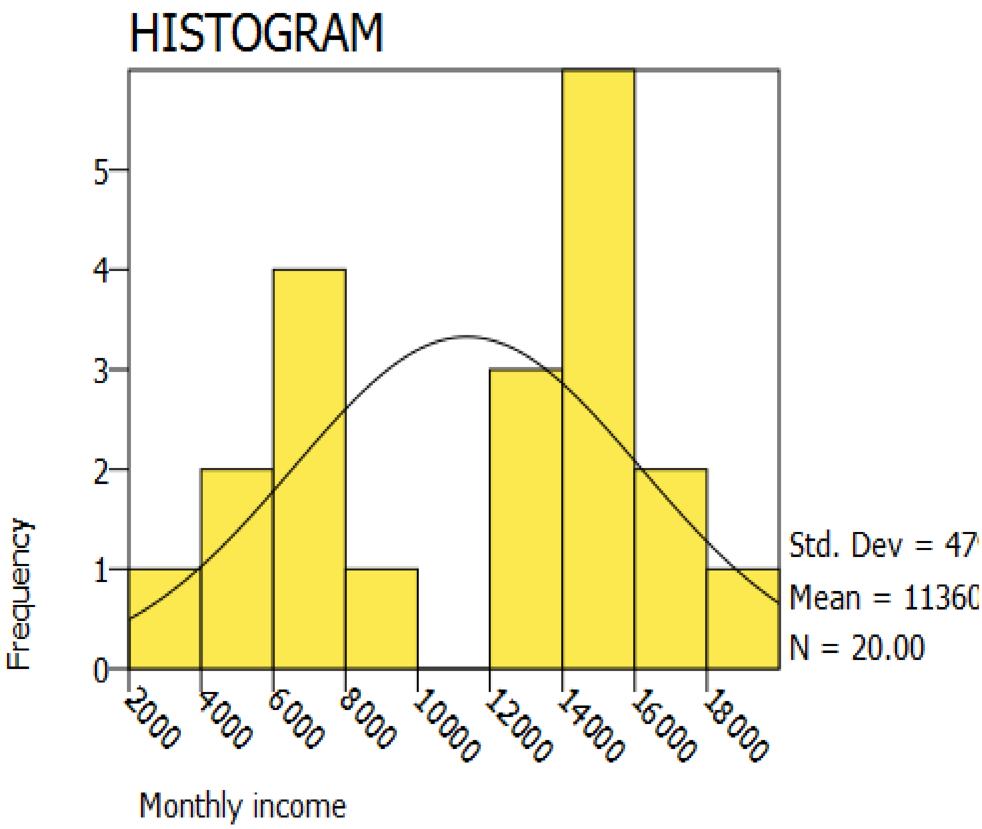
Educational level



Example (5): Refer to example (1): Draw histogram to the income



GRAPH /HISTOGRAM (NORMAL) = Income.



PSPP applications on statistical tests hypotheses & Confidence Interval 207 QUA

Dr. Manahil Kamal M. Eltayeb

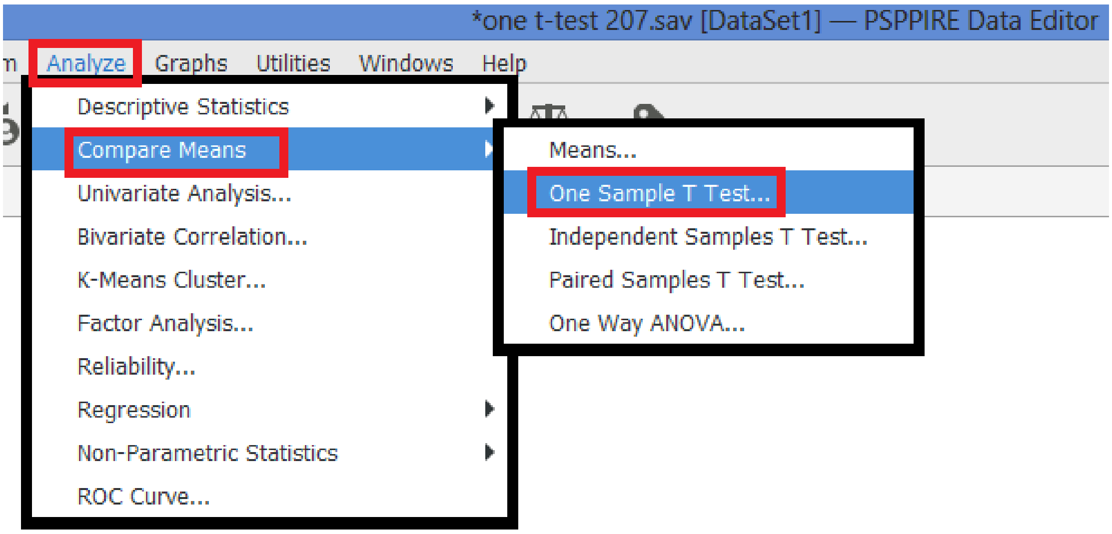
Hypothesis Tests for one mean
One sample T- test

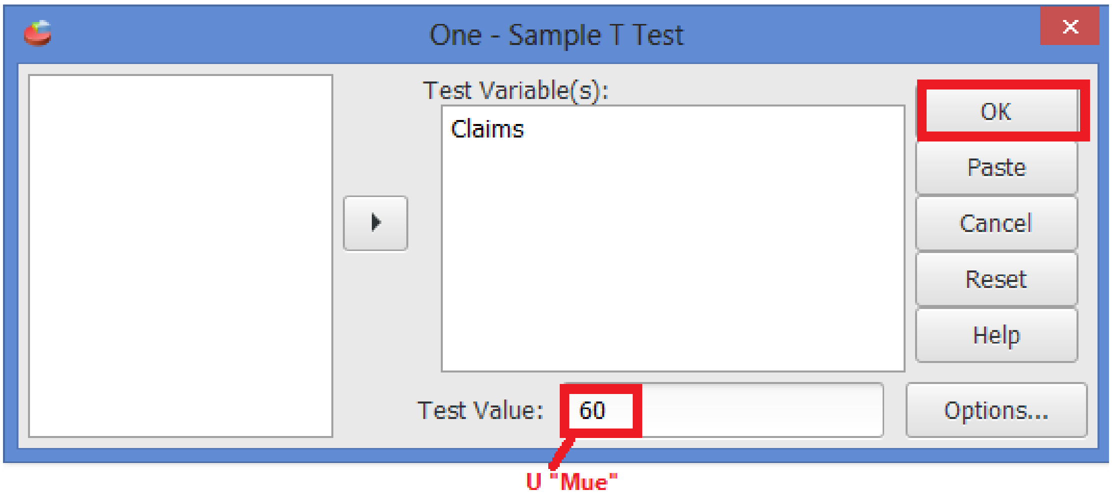
Example (1):
The McFarland Insurance Company Claims Department reports the mean cost to process a claim is $60. An industry comparison showed this amount to be larger than most other insurance companies, so the company instituted cost-cutting measures. To evaluate the effect of the cost-cutting measures, the Supervisor of the Claims Department selected a random sample of 26 claims processed last month. The sample information is reported below.

No	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Mean Cost (Claims) $	45	49	62	40	43	61	48	53	67	63	78	64	48
No	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
Mean Cost (Claims) $	54	51	56	63	69	58	51	58	59	56	57	38	76

- Determine the 95 percent confidence interval for the population mean.
- Calculate the mean and standard error of mean.
- At the .05 significance level, is it reasonable a claim is now less than $60?

Solution:





X-Bar SE(X-Bar)

One-Sample Statistics

	N	Mean	Std. Deviation	S.E. Mean
The mean cost to process a claim ($)	26	56.42	10.04	1.97

One-Sample Test

	Test Value = 60.000000					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
The mean cost to process a claim ($)	-1.82	25	.081	-3.58	-7.63	.48

t-statistic P-value

$$H_0: \quad \mu \geq \$\ 60 \qquad H_1: \ \mu < \$\ 60$$

P-value (0.081/2) > 0.01 Accept the null hypotheses

We have not demonstrated that the cost-cutting measures reduced the mean cost per claim to less than \$60. The difference of \$3.58 (\$56.42 - \$60) between the sample mean and the population mean could be due to sampling error.

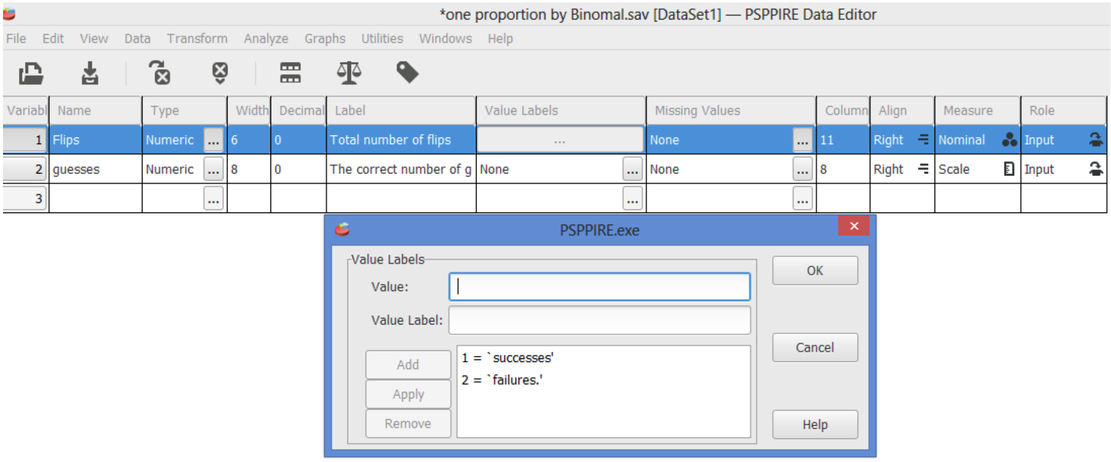
Accept the null hypothesis and conclude there is not sufficient evidence that the cost-cutting measures reduced the mean cost per claim to less than \$60.

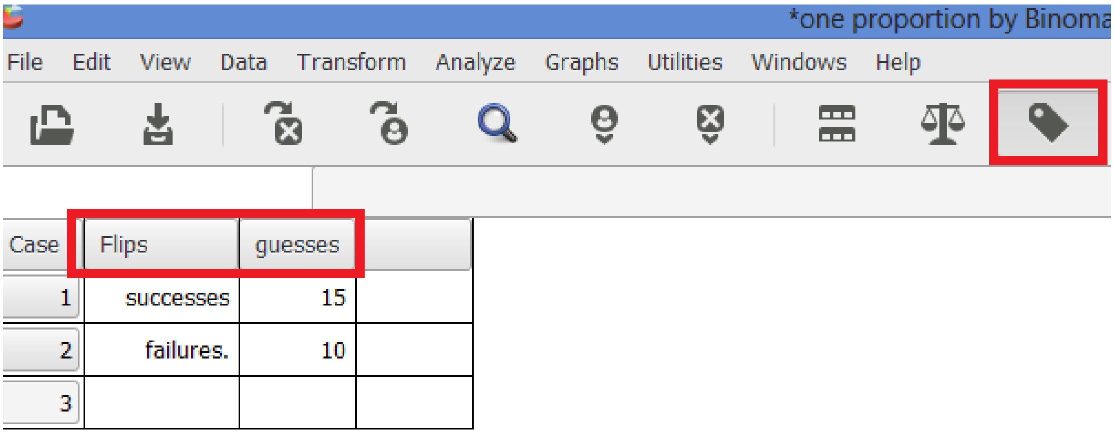
Hypothesis Tests for one Proportion

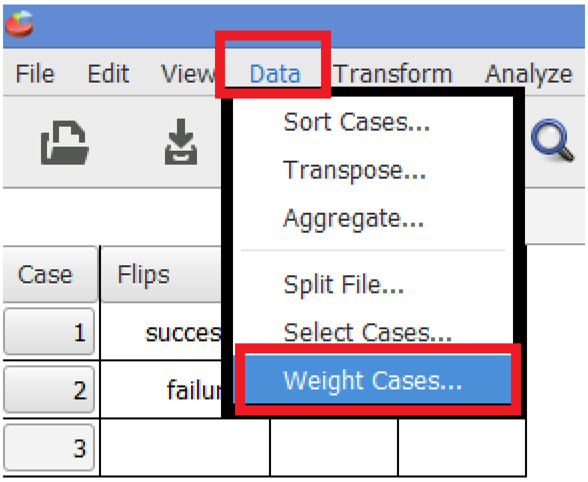
First method (Binomial test)

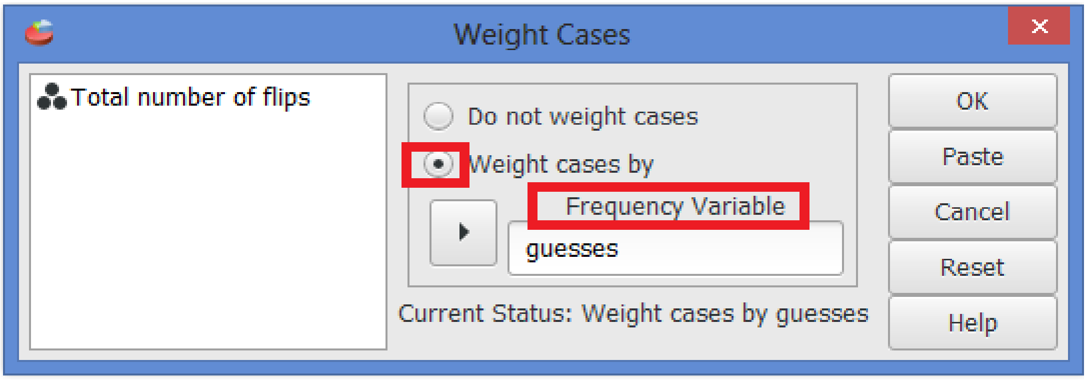
Example (2)

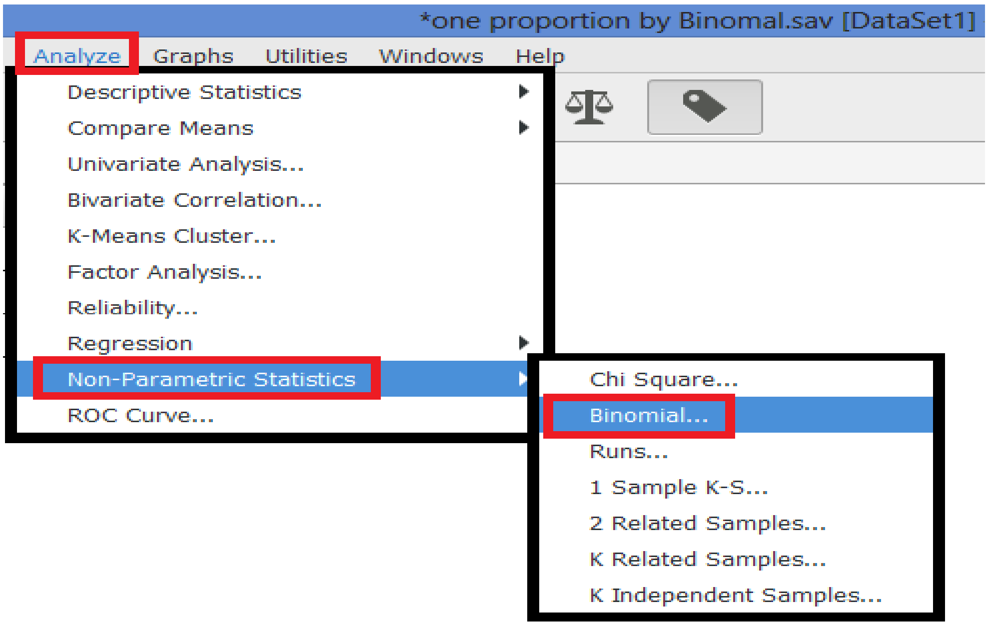
A person who claims to possess extrasensory perception (ESP) says she can guess more often than not the outcome of a flip of a fair coin. Out of 25 flips, she guesses correctly 15 times. Would you conclude that she truly has ESP?

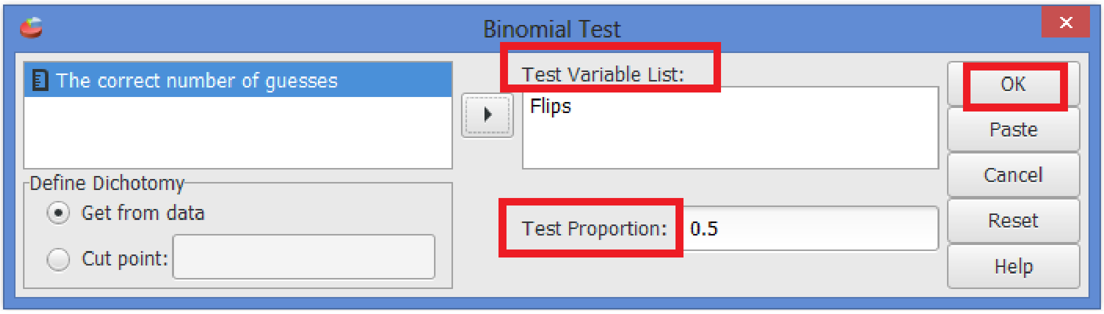












Binomial Test

		Category	N	Observed Prop.	Test Prop.	Exact Sig. (2-tailed)
Total number of flips	Group1	successes	15	.60	.50	.424
	Group2	failures.	10	.40		
	Total		25	1.00		

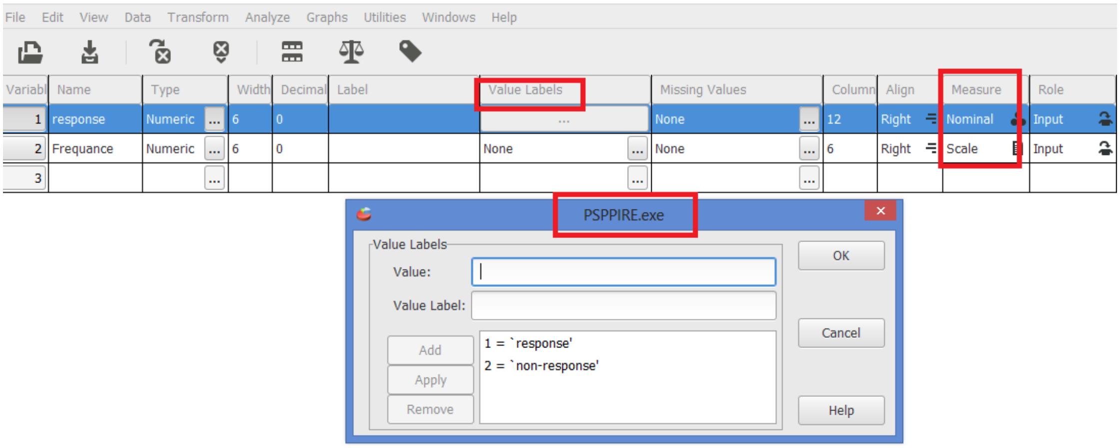
P-value

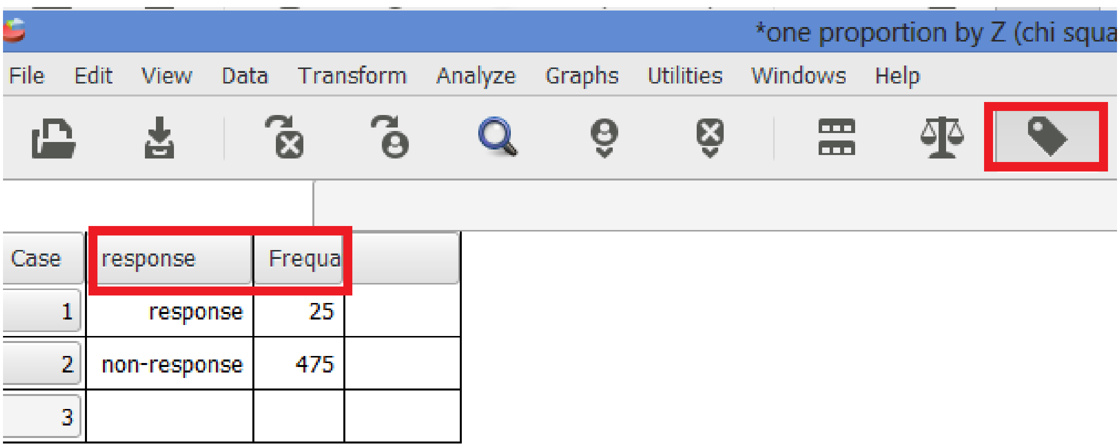
The p-value of .424, which is the value for a two-tailed test. The appropriate p-value for the test we are conducting is half of .424, or p = .212

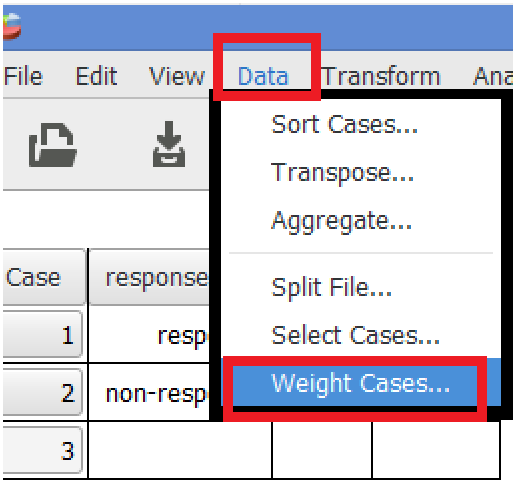
Note that SPSS uses a method based on the binomial distribution, which may not exactly match the values from the other calculation methods. However, these results will still lead to the appropriate decision to fail to reject the null hypothesis

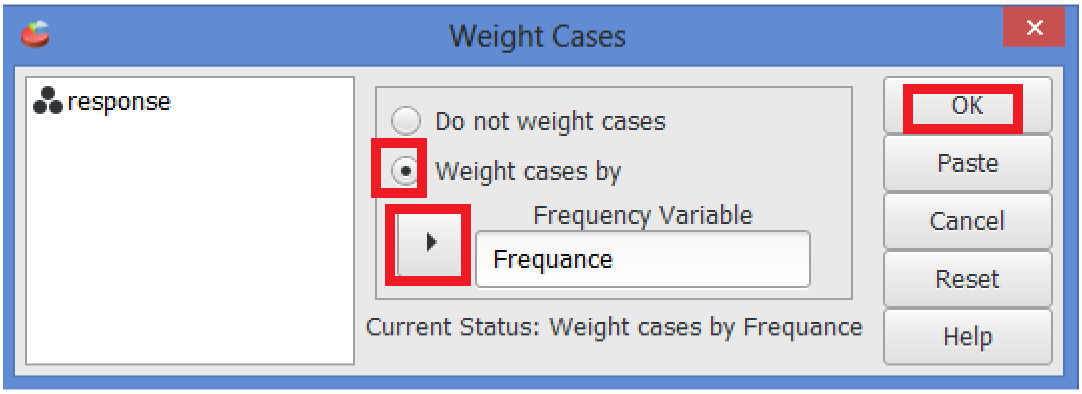
Second method (Chi-square/Z-test)
Example (3)
A marketing company claims that it receives 8% responses from its mailing. To test this claim, a random sample of 500 were surveyed with 25 responses. Test at the α = 0.05 significance level.

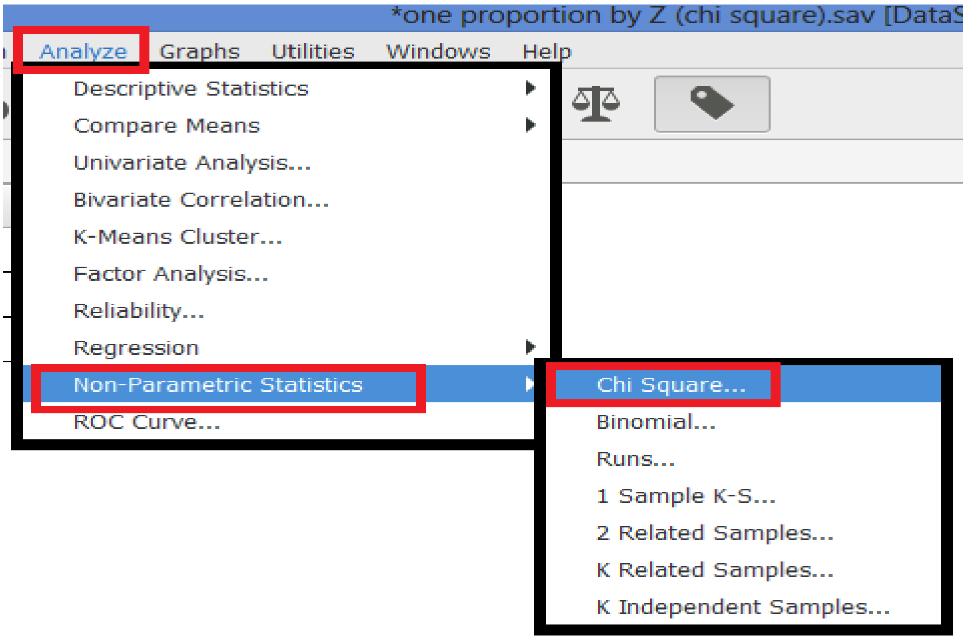
H_0: $\pi = 0.08$ $\qquad\qquad$ H_1: $\pi \neq 0.08$











response

	Observed N	Expected N	Residual
response	25	40.00	-15.00
non-response	475	460.00	15.00
Total	500		

Test Statistics

	response
Chi-Square	6.11
df	1
Asymp. Sig.	.013

P-value

Z-test

Rejection Region: Reject the null hypothesis if p-value ≤ 0.05.

Test Statistic: $Z = \sqrt{\chi^2} = \sqrt{6.11} = 2.47$

P-value = Asymp. Sig. (2-tailed) = 0.013

P-value (0.013) < 0.05 (Reject H_0)

There is sufficient evidence to reject the company's claim of 8% response rate.

Chapter 10 & 11: Two-Samples Tests, One-Way ANOVA and Chi -square

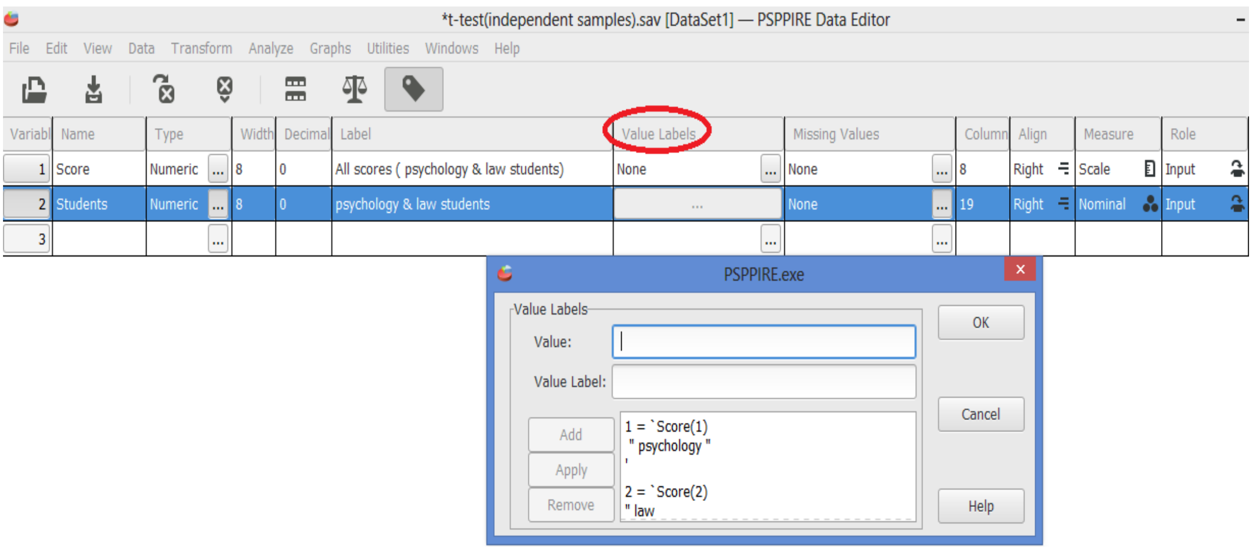
Difference between Two Means
Independent Samples
"T-Test"

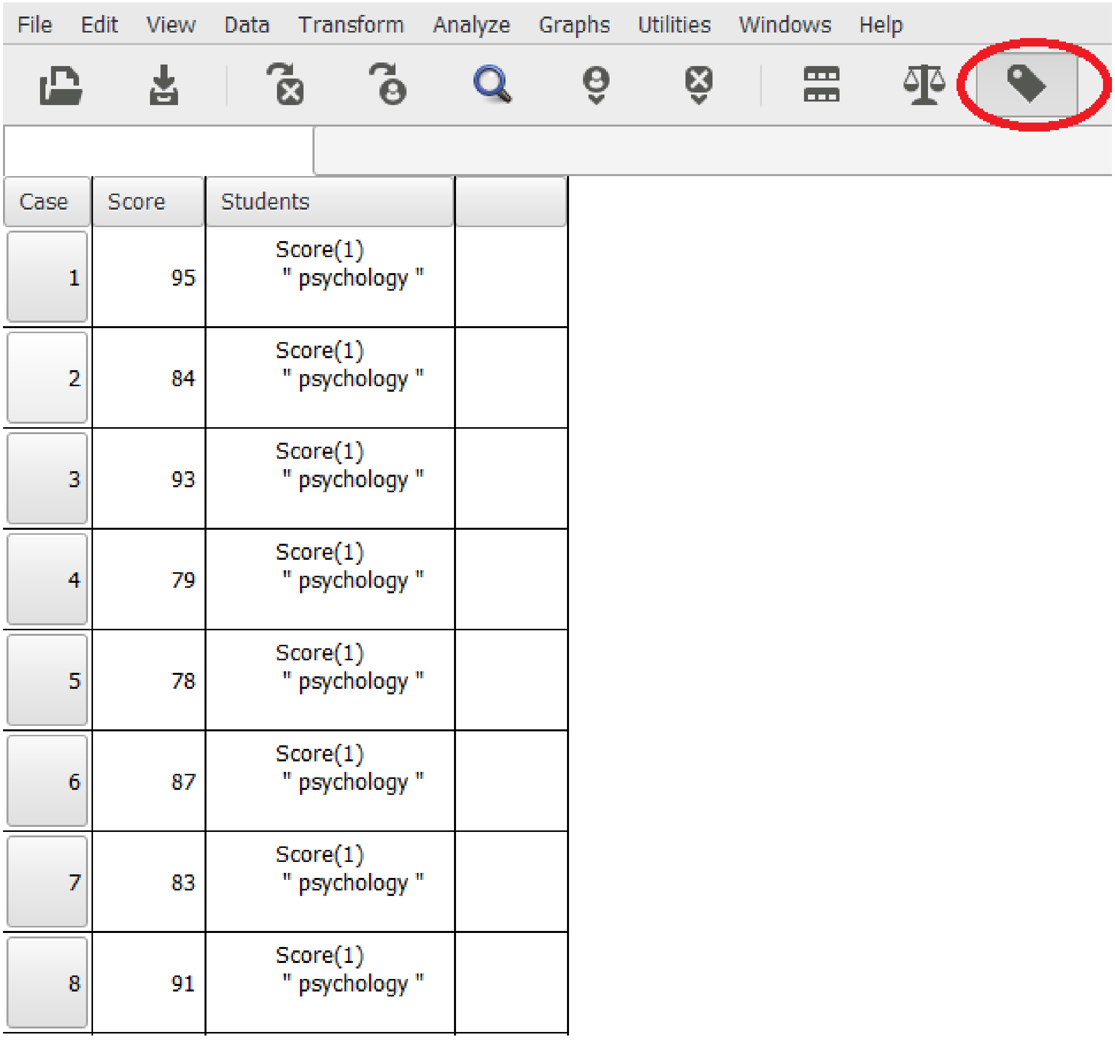
Example (1)

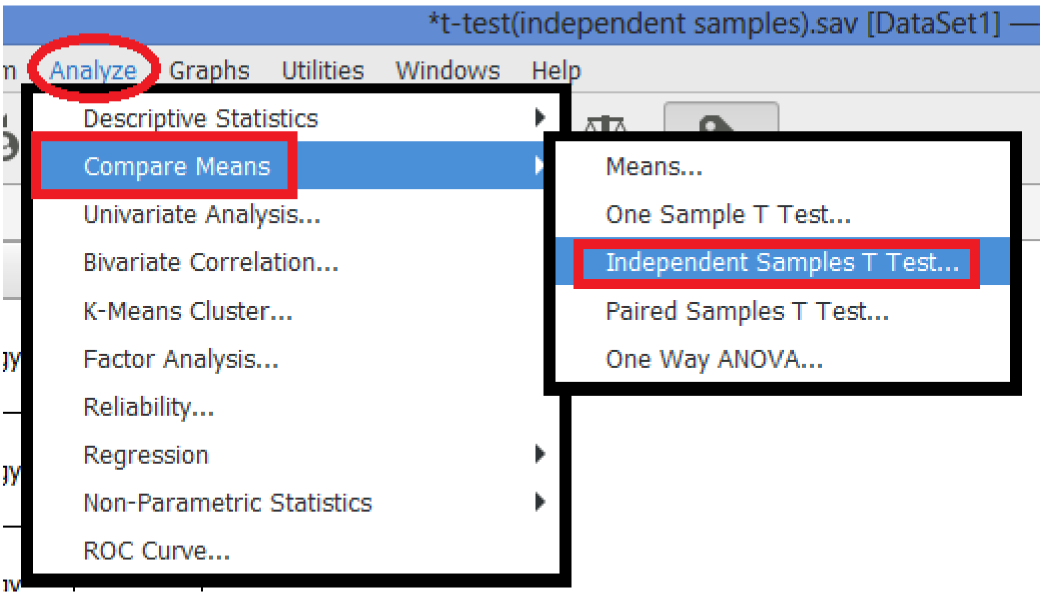
We have the following data, which represents the statistic test scores for the two groups .Assuming both populations are approximately normal, is there a difference in the mean scores in a statistics test between psychology students and law students ($\alpha = 0.05$)?

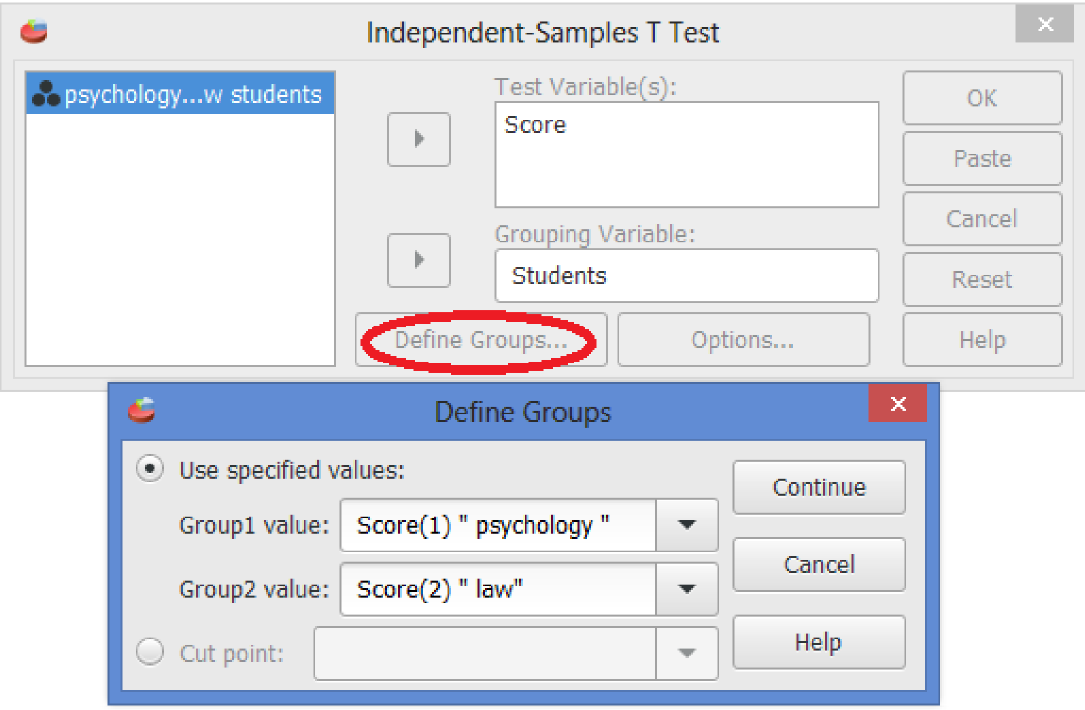
Score(1) " psychology students"	Score(2) " law students"
95	72
84	69
93	65
79	73
78	75
87	80
83	85
91	68
78	
89	
91	
93	

$$H_0: \mu_1 - \mu_2 = 0 \quad VS \quad H_1: \mu_1 - \mu_2 \neq 0$$




File Edit View Data Transform Analyze Graphs Utilities Windows Help
Case
Score
Students
1 95 Score(1) " psychology "
2 84 Score(1) " psychology "
3 93 Score(1) " psychology "
4 79 Score(1) " psychology "
5 78 Score(1) " psychology "
6 87 Score(1) " psychology "
7 83 Score(1) " psychology "
8 91 Score(1) " psychology "


*t-test(independent samples).sav [DataSet1]
Analyze Graphs Utilities Windows Help
Descriptive Statistics
Compare Means
Univariate Analysis...
Bivariate Correlation...
K-Means Cluster...
Factor Analysis...
Reliability...
Regression
Non-Parametric Statistics
ROC Curve...
Means...
One Sample T Test...
Independent Samples T Test...
Paired Samples T Test...
One Way ANOVA...



The output

X-Bar (1 & 2)

Group Statistics

	psychology & law students	N	Mean	Std. Deviation	S.E. Mean
All scores (psychology & law students)	Score(1) " psychology	12	86.75	6.20	1.79
	Score(2) " law"	8	73.38	6.57	2.32

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
All scores (psychology & law students)	Equal variances assumed	.05	.830	4.62	18.00	.000	13.38	2.90	7.29	19.46
	Equal variances not assumed			4.56	14.52	.000	13.38	2.93	7.11	19.64

A B

Here, you see there are two results from two different t-tests :

- Equal variance assumed (**Pooled-Variance t test.)**
- Equal variance not assumed (**Separate-variance t test**)

The choice of the result depends on the Levene's test.
Since from A, the p-value of Levene's test is $0.83 > \alpha\ (0.05)$ we can assume that the variances of two groups are the equal. (If the p-value of Levene's test is < 0.05, we have to use the "Equal variance not assumed" result.
From B, since the p-value of t-test is $0.000 < \alpha\ (0.05)$ we reject the null hypothesis and conclude that there is difference between the mean score of psychology students and law students at 5% significance level.

95% Confidence Interval for $\mu_1 - \mu_2$ = (7.29 – 19.46)

Difference between Two Means
Related Populations
the Paired Difference t-Test

Example (2)

For answering the question: Does a treatment reduce the level of anxiety? A sample of 7 people was taken and anxiety levels were measured before and after treatment. Is there a change in the result?

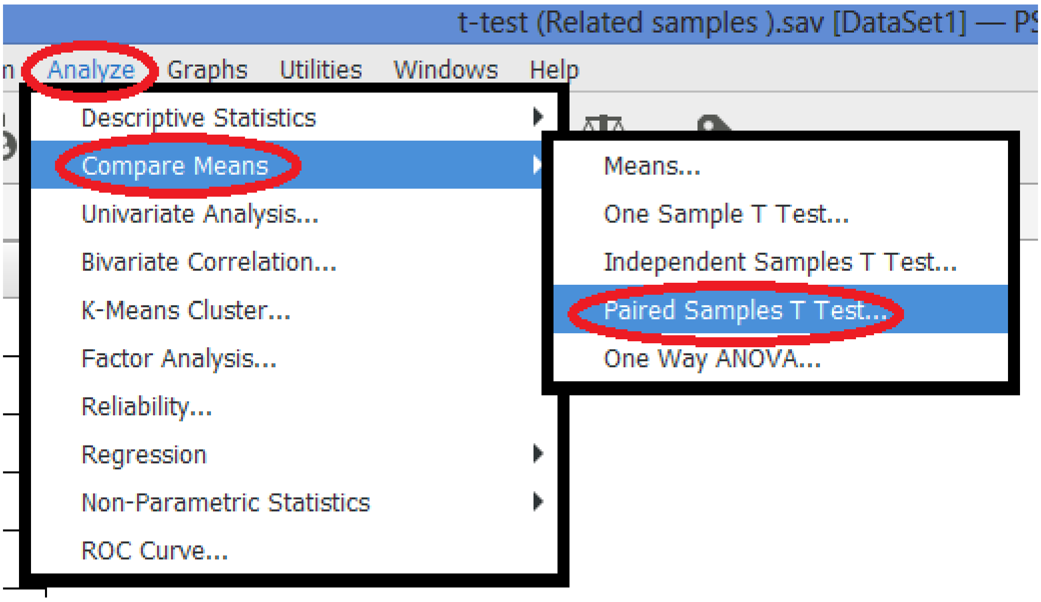
Patient	Before	After
1	40	24
2	42	30
3	36	37
4	31	21
5	55	32
6	45	40
7	46	47

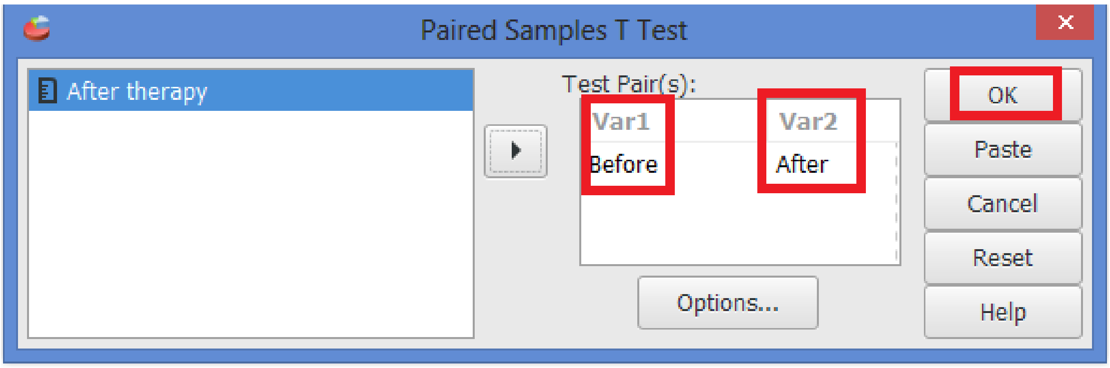
$$H_0: \mu_D = 0 \quad VS \quad H_1: \mu_D \neq 0$$

Variabl	Name	Type	Width	Decimal	Label	Value Labels	Missing Values	Column	Align	Measure	Role
1	Before	Numeric ...	8	0	Before therapy	None ...	None ...	8	Right	Scale	Input
2	After	Numeric ...	8	0	After therapy	None ...	None ...	8	Right	Scale	Input

File Edit View Data Tr

Case	Before	After
1	40	24
2	42	30
3	36	37
4	31	21
5	55	32
6	45	40
7	46	47
8		





Paired Sample Statistics

X-Bar

		Mean	N	Std. Deviation	S.E. Mean
Pair 1	Before therapy	42.14	7	7.69	2.91
	After therapy	33.00	7	9.09	3.44

Paired Samples Correlations

r

		N	Correlation	Sig.
Pair 1	Before therapy & After therapy	7	.45	.308

Paired Samples Test

P-value

		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Before therapy - After therapy	9.14	8.86	3.35	.95	17.34	2.73	6	.034

D-Bar SE(D)

P-value (0.034) < α (0.05) (reject null hypotheses)
The confidence interval for μ_D is : (0.95 – 17.34)

Difference between two proportions

Example (3)

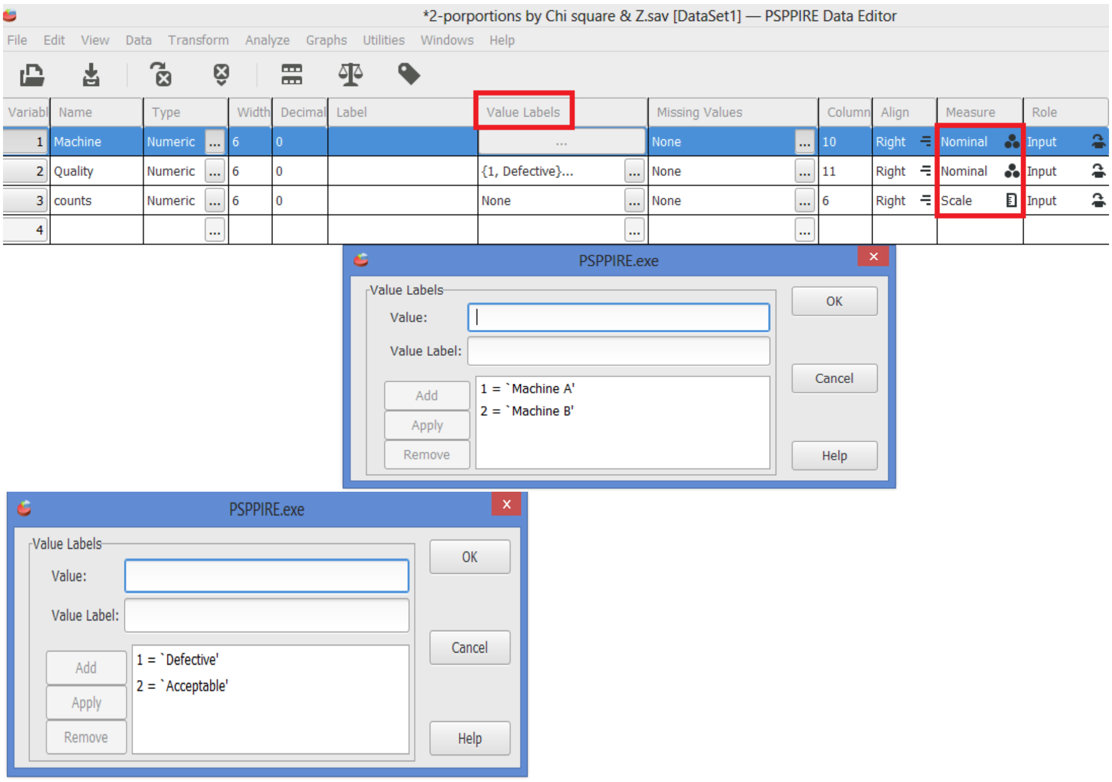
In a test of the reliability of products produced by two machines, machine a produced 15 defective parts in a run of 280, while machine B produced 10 defective parts in a run of 200. Do these results imply a difference in the reliability of these two machines? (Use α = 0.05.)

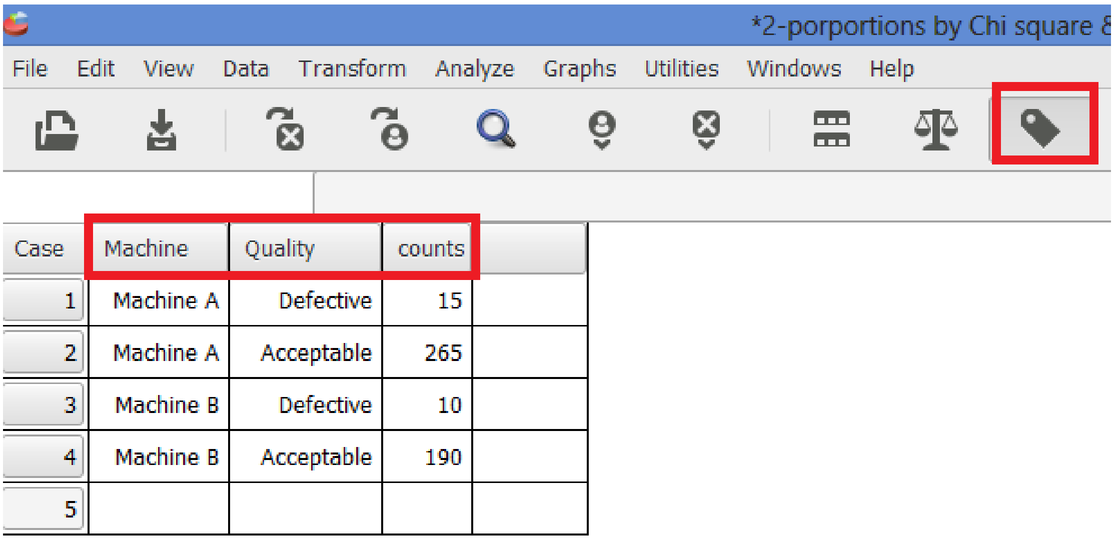
Solution:

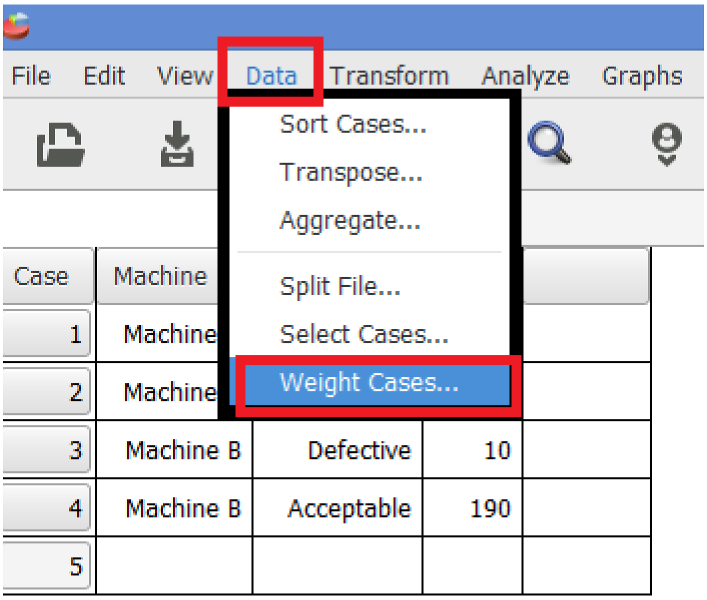
Enter the group values (Machine: 1 = Machine A, 2=Machine B) into one variable, the quality values (Quality: 1=Defective, 2=Acceptable) into another variable, and the observed counts into a third variable.

$H_0: \pi_1 - \pi_2 = 0$ (The two proportions are equal)

$H_1: \pi_1 - \pi_2 \neq 0$ (There is a significant difference between proportions)




*2-porportions by Chi square &
File Edit View Data Transform Analyze Graphs Utilities Windows Help
Case Machine Quality counts
1 Machine A Defective 15
2 Machine A Acceptable 265
3 Machine B Defective 10
4 Machine B Acceptable 190
5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Transpose...
Aggregate...
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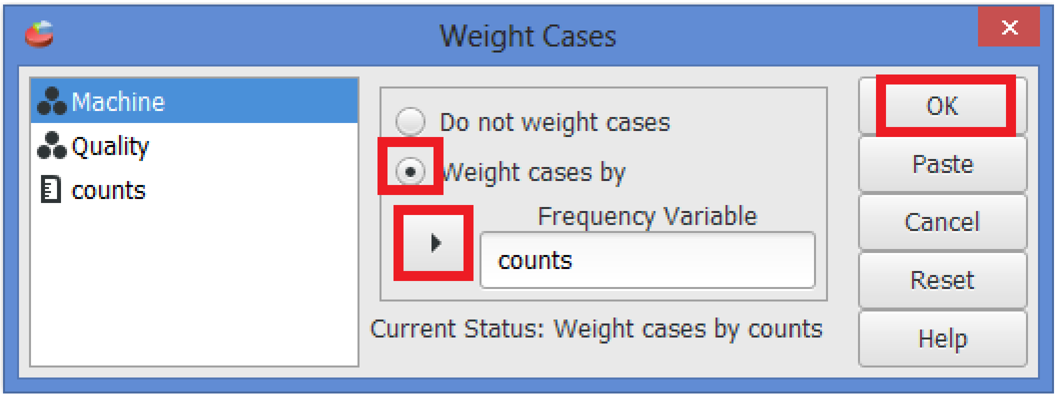
Select Cases...
Weight Cases...
Case Machine
1 Machine
2 Machine
3 Machine B Defective 10
4 Machine B Acceptable 190
5


Weight Cases
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Do not weight cases
Weight cases by
Frequency Variable
counts
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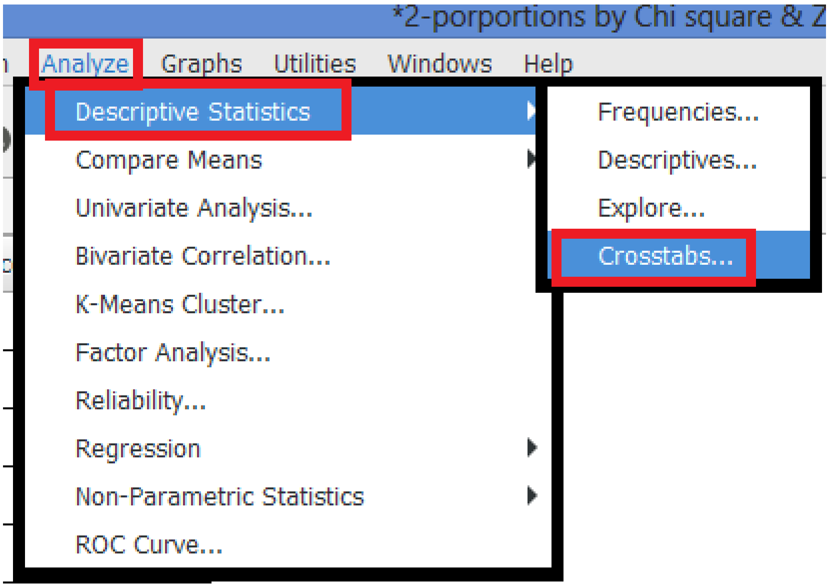
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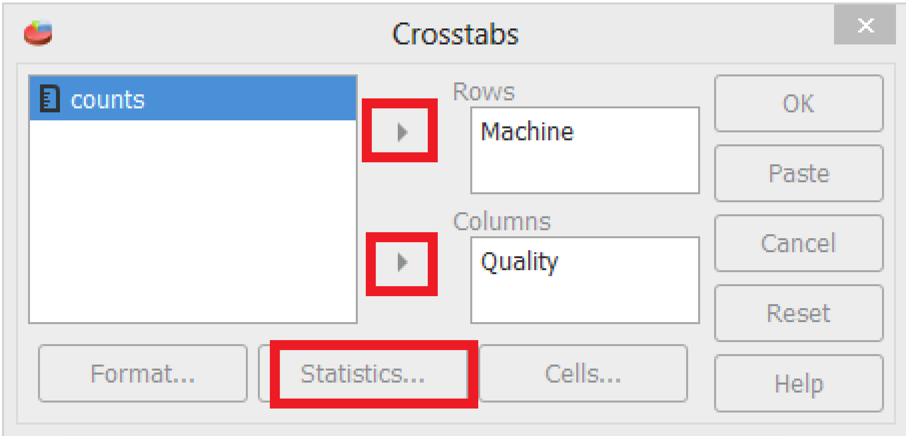
Compare Means
Univariate Analysis...
Bivariate Correlation...
K-Means Cluster...
Factor Analysis...
Reliability...
Regression
Non-Parametric Statistics
ROC Curve...
Frequencies...
Descriptives...
Explore...
Crosstabs...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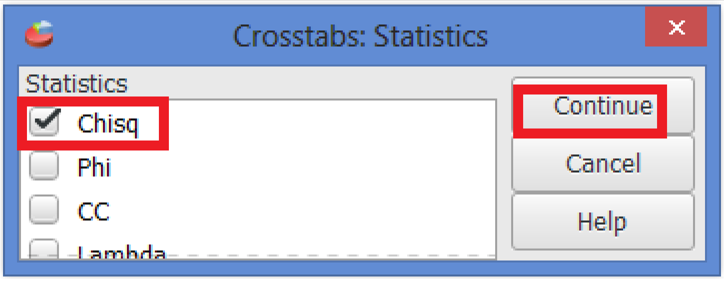
Crosstabs: Statistics
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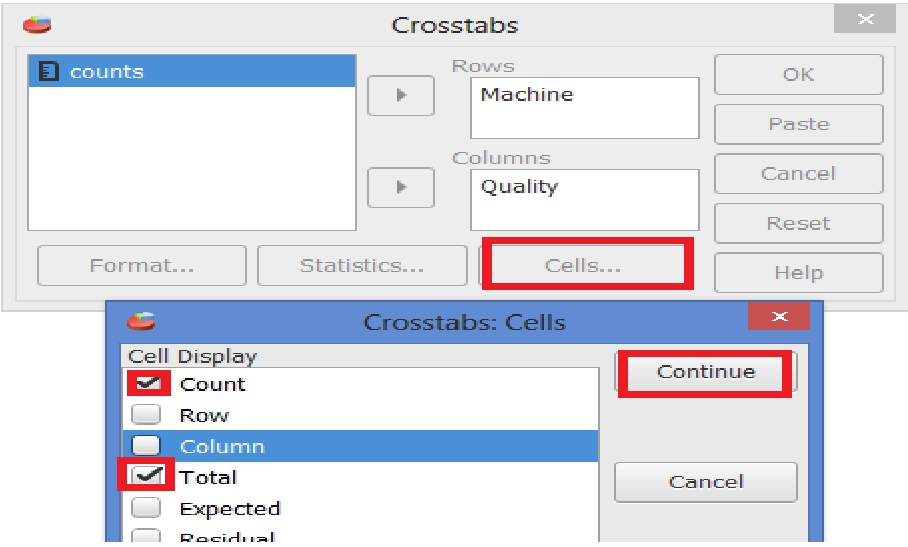


Summary.

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Machine * Quality	480	100.0%	0	0.0%	480	100.0%

Machine * Quality [count, total %].

	Quality		
Machine	Defective	Acceptable	Total
Machine A	15.00	265.00	280.00
	3.13%	55.21%	58.33%
Machine B	10.00	190.00	200.00
	2.08%	39.58%	41.67%
Total	25.00	455.00	480.00
	5.21%	94.79%	100.00%

Chi-square tests. chi -stat P-value

Statistic	*Value*	*df*	*Asymp. Sig. (2-tailed)*	*Exact Sig. (2-tailed)*	*Exact Sig. (1-tailed)*
Pearson Chi-Square	.03	1	.862		
Likelihood Ratio	.03	1	.862		
Fisher's Exact Test				1.000	.518
Continuity Correction	.00	1	1.000		
Linear-by-Linear Association	.03	1	.862		
N of Valid Cases	480				

You should use the output information in the following manner to answer the question:

Rejection Region: Reject the null hypothesis if p-value ≤ 0.05.

P-value = Asymp. Sig. (2-tailed) = 0.862

Since p-value (0.8622) > α (0.05), we fail to reject the null hypothesis.

At the = 0.05 level of significance, there is not enough evidence to conclude that there is a difference in the reliability of the two machines.

Note: If you used the Z-test:

Test Statistic: $Z = \sqrt{\chi^2} = \sqrt{0.030} = 0.1735$

If the test were one-tailed, the p-value would be 1/2 (Asymp. Sig. (2-tailed)).

Analysis of variance
One –way ANOVA

Example (4)

A manufacturer suspects that the batches of raw material furnished by her supplier differ significantly in calcium content. There is a large number of batches currently in the warehouse. Five of these are randomly selected for study. A chemist makes five determinations on each batch and obtains the following data.

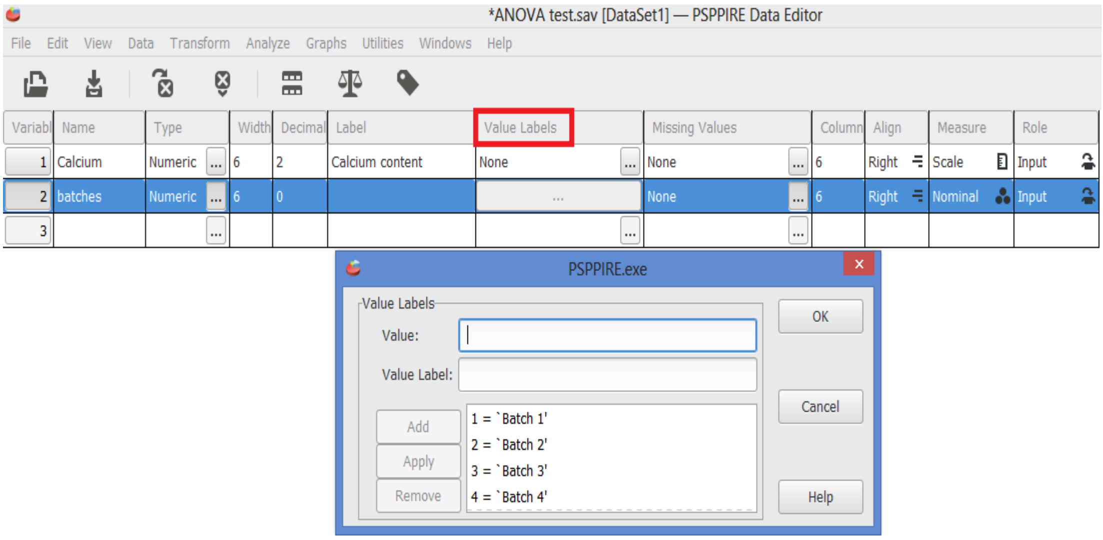
Batch 1	Batch 2	Batch 3	Batch 4	Batch 5
23.46	23.59	23.51	23.28	23.29
23.48	23.46	23.64	23.40	23.46
23.56	23.42	23.46	23.37	23.37
23.39	23.49	23.52	23.46	23.32
23.40	23.50	23.49	23.39	23.38

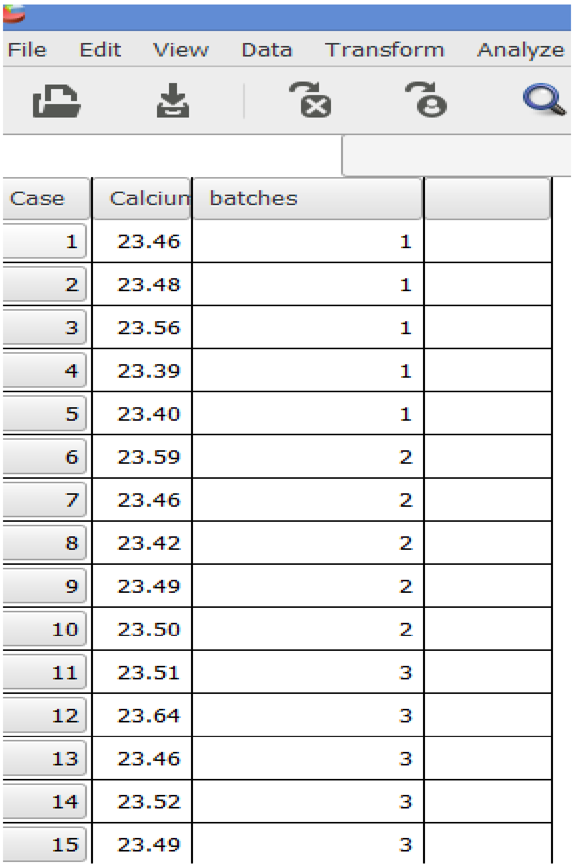
Is there a significant variation in calcium content from batch to batch? Use $\alpha = 0.05$.

Solution:

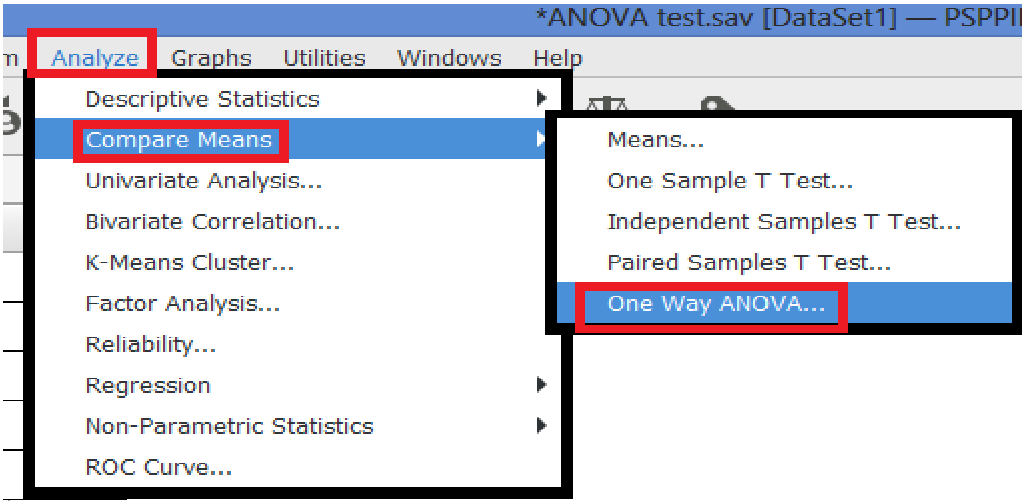
$$H_o: \mu_1 = \mu_2 = \mu_3 = \mu_4$$

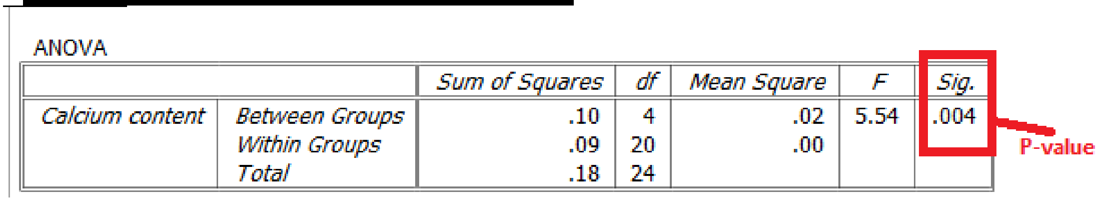
H_1: Not all of the population means are equal





Case	Calcium	batches
1	23.46	1
2	23.48	1
3	23.56	1
4	23.39	1
5	23.40	1
6	23.59	2
7	23.46	2
8	23.42	2
9	23.49	2
10	23.50	2
11	23.51	3
12	23.64	3
13	23.46	3
14	23.52	3
15	23.49	3





ANOVA

		Sum of Squares	*df*	*Mean Square*	*F*	*Sig.*
Calcium content	*Between Groups*	.10	4	.02	5.54	.004
	Within Groups	.09	20	.00		
	Total	.18	24			

Since the *p*-value (Sig) (0.004) < α (0.05) , one can reject the null hypothesis that all means are equal. Thus, there is a significant variation in calcium content from batch to batch, for α = 0.05.

(Chapter 12) Simple Linear Regression and correlation

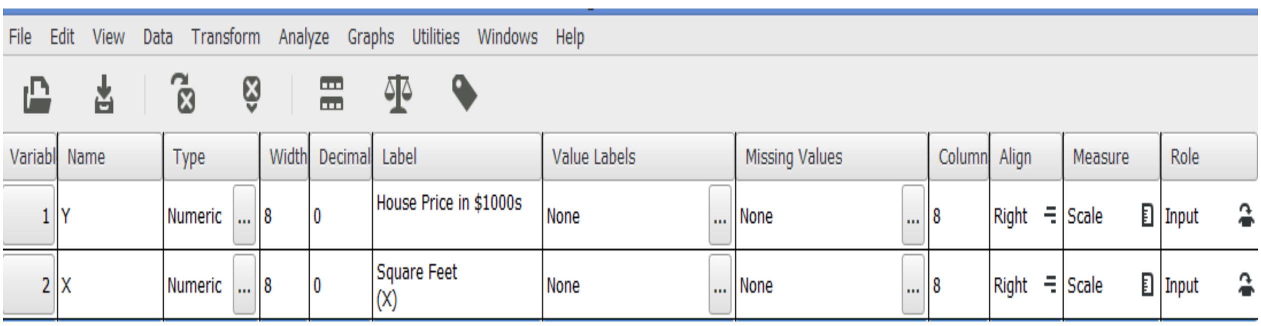
Example (1)

A real estate agent wishes to examine the relationship between the selling price of a home and its size (measured in square feet) .A random sample of 10 houses is selected (Dependent variable (Y) = house price in $1000s , Independent variable (X) = square feet).

Find:

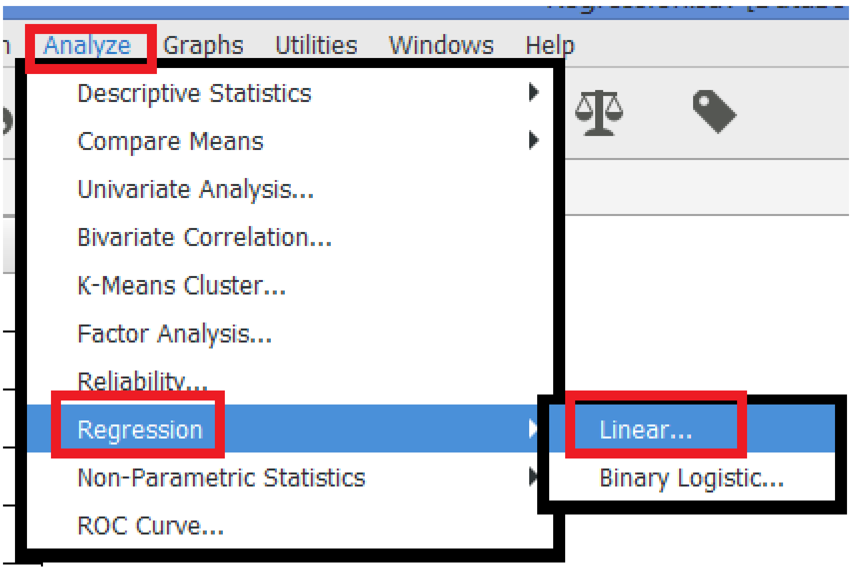
1) The estimate regression equation (prediction line) , and Interpret the slope and intercept of this problem.
2) Sum of square of regression (SSR) and Error sum of square (SSE).
3) Coefficient of Determination (R^2) and Interpret it.
4) Standard error of the estimate.
5) Is there a linear relationship between X and Y? (Use t-test)
6) Construct ANOVA table for regression to test that there is no significance relationship between X and Y by using F-ratio and t test.
7) Find $\hat{Y}$
8) The correlation between X and Y.

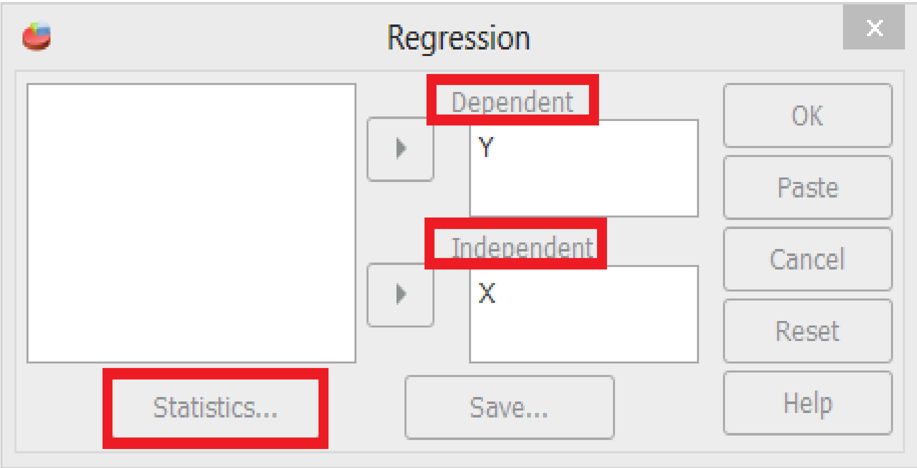
House Price in $1000s (Y)	Square Feet (X)
245	1400
312	1600
279	1700
308	1875
199	1100
219	1550
405	2350
324	2450
319	1425
255	1700

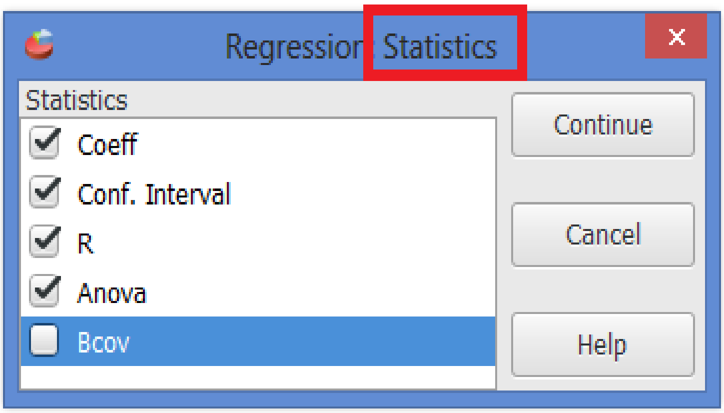


10 cases × 1 variable

Case	Y	X
1	245	1400
2	312	1600
3	279	1700
4	308	1875
5	199	1100
6	219	1550
7	405	2350
8	324	2450
9	319	1425
10	255	1700




Regression
Dependent
Y
Independent
X
Statistics...
Save...
OK
Paste
Cancel
Reset
Help


Regression Statistics
Statistics
Coeff
Conf. Interval
R
Anova
Bcov
Continue
Cancel
Help

Model Summary

Model	R	R Square (**Coefficient of Determination**)	Adjusted R Square	Std. Error of the Estimate **S_{YX}**
1	.762[a]	.581	.528	41.330

NOVA[a]						
Model		Sum of Squares	df degrees of freedom	Mean Square	F (F-Stat)	Sig. P-value
1	Regression	SSR 18934.935	k =1	18934.935	11.085	.010[b]
	Residual	SSE 13665.565	(n – k - 1) = 8	1708.196		
	Total	SST 32600.500	n-1 = 9			

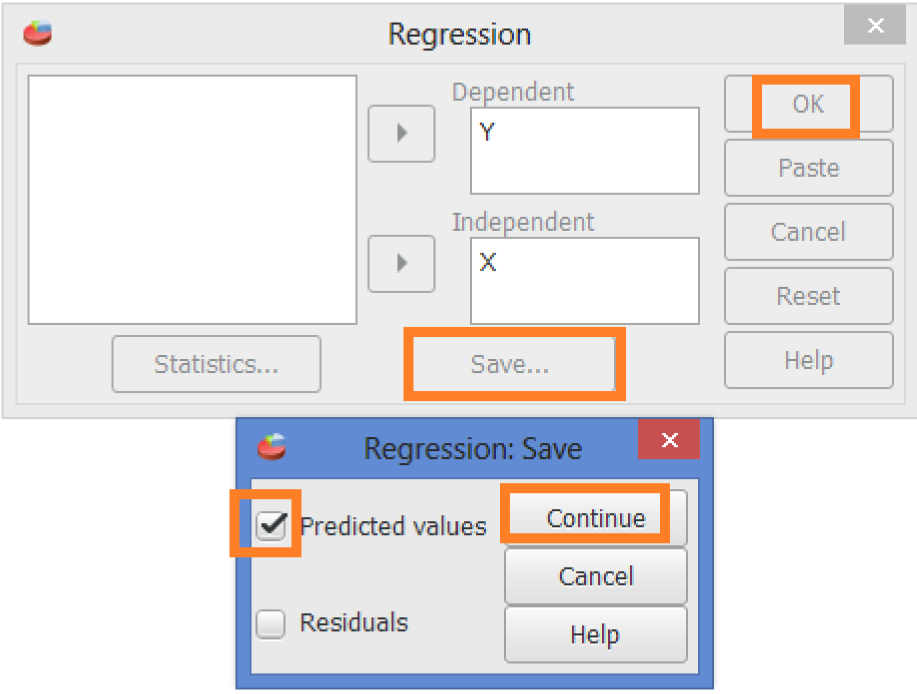
Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t - Stat	Sig. P-value
1	(Constant)	t (b0) 98.248	58.033		1.693	.129
	Square Feet (X)	Slope(b1) .110	S_{b1} .033	.762	3.329	.010

$$\hat{Y} = 98.25 + 0.1098X$$

House price =98.25 + 0.1098 (sq.ft)

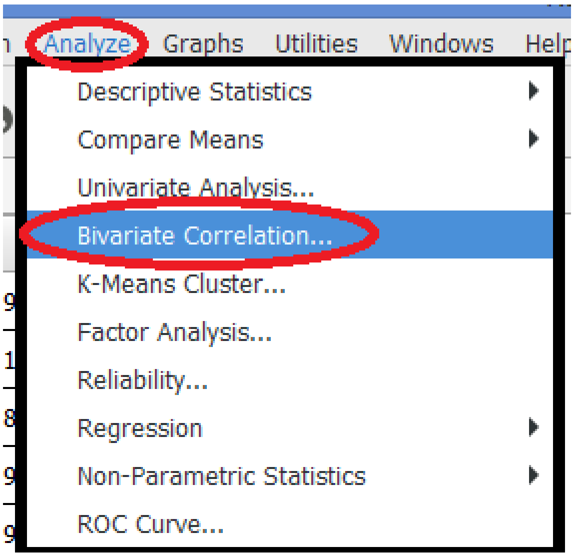
7) Find $\hat{Y}$

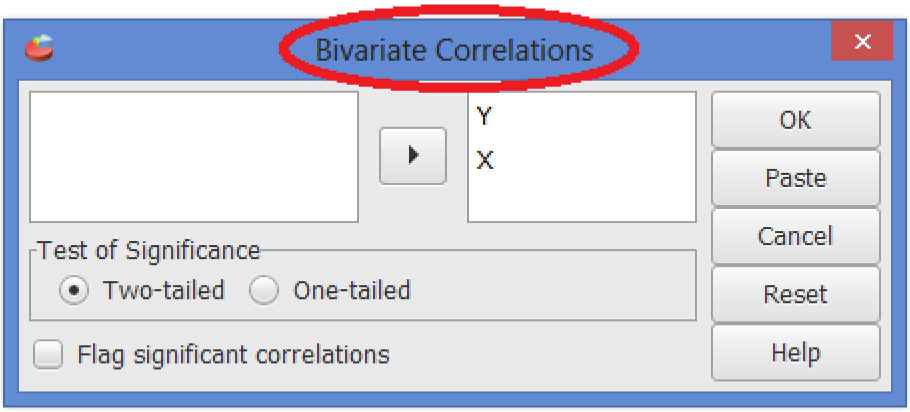


Case	Y	X	PRED1	
1	245	1400	251.92	
2	312	1600	273.88	
3	279	1700	284.85	
4	308	1875	304.06	
5	199	1100	218.99	
6	219	1550	268.39	
7	405	2350	356.20	
8	324	2450	367.18	
9	319	1425	254.67	
10	255	1700	284.85	
11				

Y^

The correlation between X and Y.





Correlations

		House Price in $1000s	Square Feet (X)
House Price in $1000s	Pearson Correlation	1.00	.76
	Sig. (2-tailed)		.010
	N	10	10
Square Feet (X)	Pearson Correlation	.76	1.00
	Sig. (2-tailed)	.010	
	N	10	10

There is a relatively strong positive linear relationship between XY