

CHI-SQUARE AND FISHER'S EXACT TEST ON SPSS

Chi-Square Test (χ^2)

- Hypothesis;
 - Comparing two or more proportion
 - $H_0: P_1 = P_2$
- Assumption
 - Random samples
 - Observations are independent
 - The number of cells with **Expected Count (EC)** less than 5, must be less than 20% of the total number of cells.
 - The smallest EC must be at least 2.

The chi-square test for independence, also called Pearson's chi-square test or the chi-square test of association, is used to discover if there is a relationship between two categorical variables.

Based on study design & method

Calculate expected count for each cell (SPSS will do it)

Example Chi-Square Test (χ^2) – (1)

- Hypothesis;
 - Association between gender and Knowledge on Nutrition (KoN)
 - Comparing the proportion of Low KoN between gender
 - $H_0 : P(\text{KoN})_{\text{male}} = P(\text{KoN})_{\text{female}}$
- Assumption
 - Random samples [✓]
 - Observations are independent [✓]
 - The number of cells with **Expected Count (EC)** less than 5, must be less than 20% of the total number of cells
 - The smallest EC must be at least 2

Calculated by SPSS

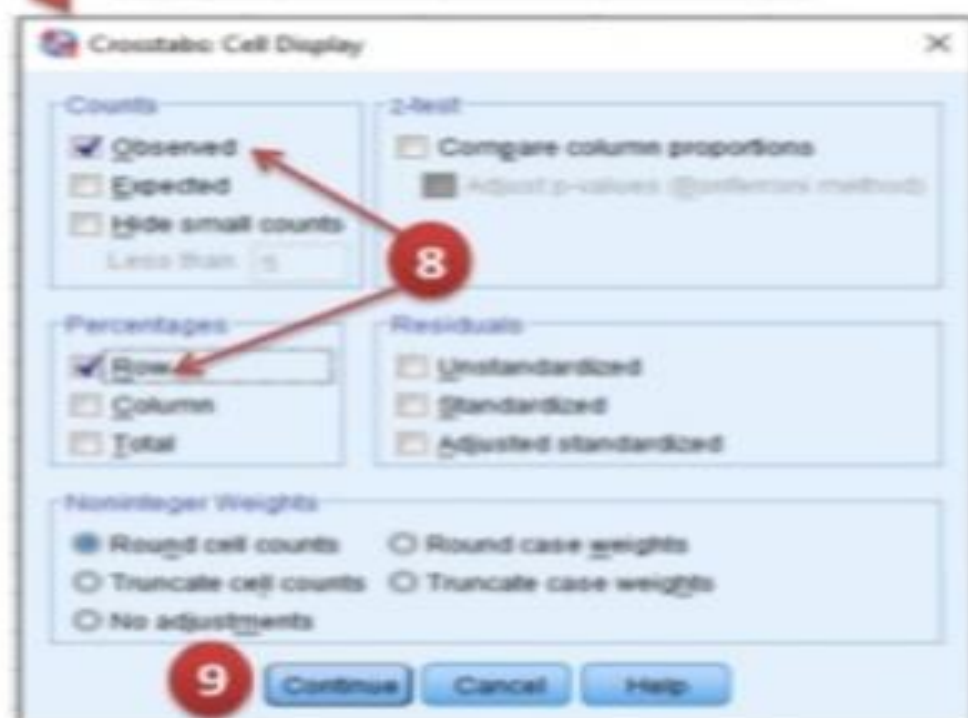
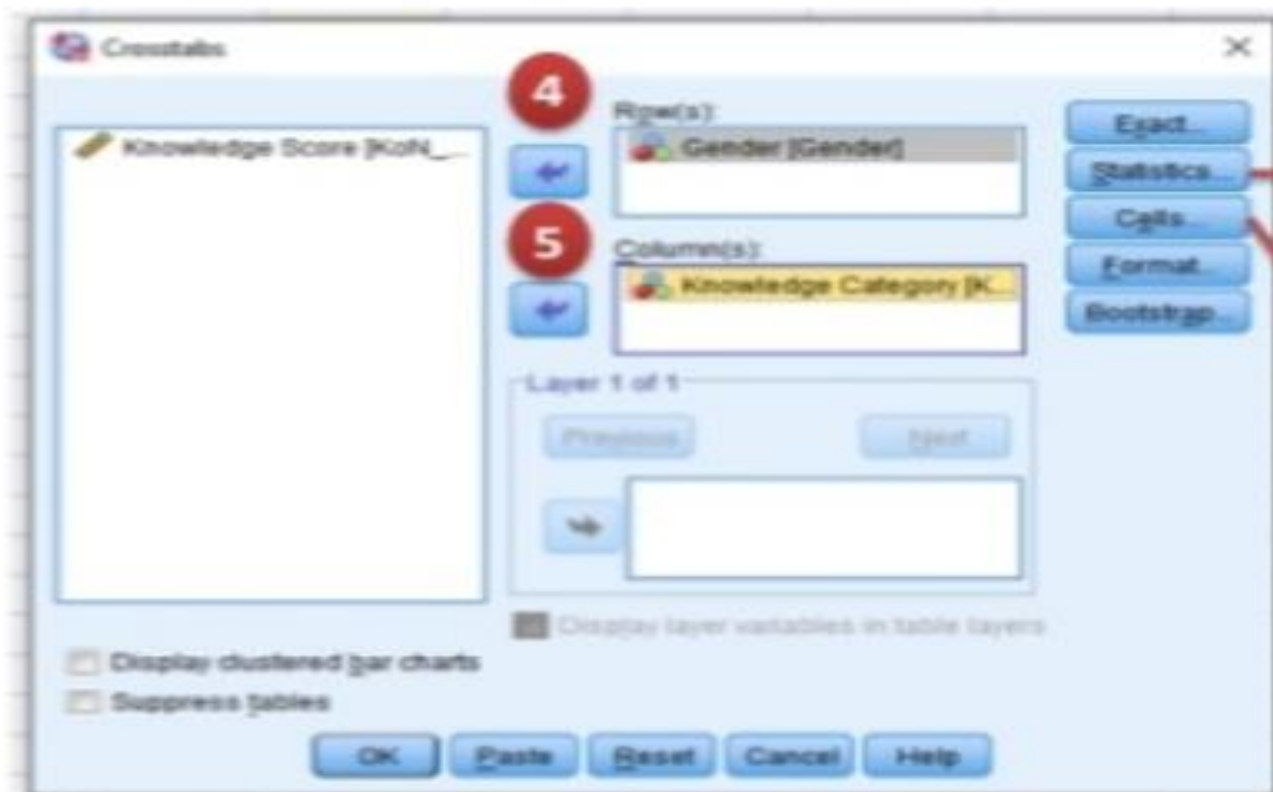
Chi-square using SPSS - procedure:

*Untitled2 [DataSet2] - IBM SPSS Statistics Data Editor

The screenshot shows the IBM SPSS Statistics Data Editor interface. The menu bar includes File, Edit, View, Data, Transform, Analyze, Direct Marketing, Graphs, Utilities, Add-ons, and Window. The Analyze menu is open, showing options like Reports, Descriptive Statistics, Tables, Compare Means, General Linear Model, Generalized Linear Models, Mixed Models, Correlate, Regression, and Loglinear. The Descriptive Statistics sub-menu is also open, showing options like Frequencies..., Descriptives..., Explore..., Crosstabs..., Ratio..., P-P Plots..., and Q-Q Plots... The Crosstabs... option is highlighted. A data table is visible in the background with columns Gender and KoN_Score.

	Gender	KoN_Score
1	Female	
2	Female	
3	Female	
4	Female	
5	Female	
6	Female	
7	Female	

Chi-square using SPSS - procedure:



Chi-square using SPSS - Output:

Descriptive statistics for each group

Gender * Knowledge Category Crosstabulation

			Knowledge Category		Total
			High	Low	
Gender	Female	Count	20	14	34
		% within Gender	58.8%	41.2%	100.0%
	Male	Count	20	19	39
		% within Gender	51.3%	48.7%	100.0%
Total		Count	40	33	73
		% within Gender	54.8%	45.2%	100.0%

Chi-square statistic = 0.417
df = 1; P-value = 0.518

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.417 ^a	1	.518		
Continuity Correction ^b	.168	1	.682		
Likelihood Ratio	.418	1	.518		
Fisher's Exact Test				.638	.341
Linear-by-Linear Association	.411	1	.521		
N of Valid Cases	73				

Must be ≥ 2

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.37

b. Computed only for a 2x2 table

Must be $< 20\%$

2 EC assumptions is met

Chi-square using SPSS – Table and Interpretation:

Table 1: Factors (categorical variable) associated with Knowledge on Nutrition

Variable	n	Low KoN Freq (%)	High KoN Freq (%)	χ^2 statistics ^a (df)	P-value
Gender					
Male	39	19 (48.7)	20 (51.3)	0.417 (1)	0.518
Female	34	14 (41.2)	20 (58.8)		
Ethnicity					
Malay					
Others					
Education Level					
Low					
High					

The prevalence (proportion) of Low Knowledge on Nutrition between male and female is not significantly different ($P = 0.518$). Therefore, there is no significant association between gender and Knowledge on Nutrition.

^a Chi-square test for independence

What if assumptions **were not met?**

- **Combine** adjacent columns or/and rows to increase the EC if possible.
- If still did not meet expected cell assumption, **Fisher's exact (FE) test** can be applied (only for 2 x 2 table in SPSS).

Fisher Exact Test

- **Fisher's Exact Test** is a test for independence in a 2 X 2 table.
- It is most useful when the total sample size and the expected values are small.
 - Useful when $E(\text{cell counts}) < 5$.
- The output consists of more than one p-values:
 - **Choose Exact Sig. (2-sided)**

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.072 ^a	1	.788		
Continuity Correction ^b	.001	1	.976		
Likelihood Ratio	.072	1	.788		
Fisher's Exact Test				.816	.489
Linear-by-Linear Association	.071	1	.790		
N of Valid Cases	73				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 13.56.

b. Computed only for a 2x2 table