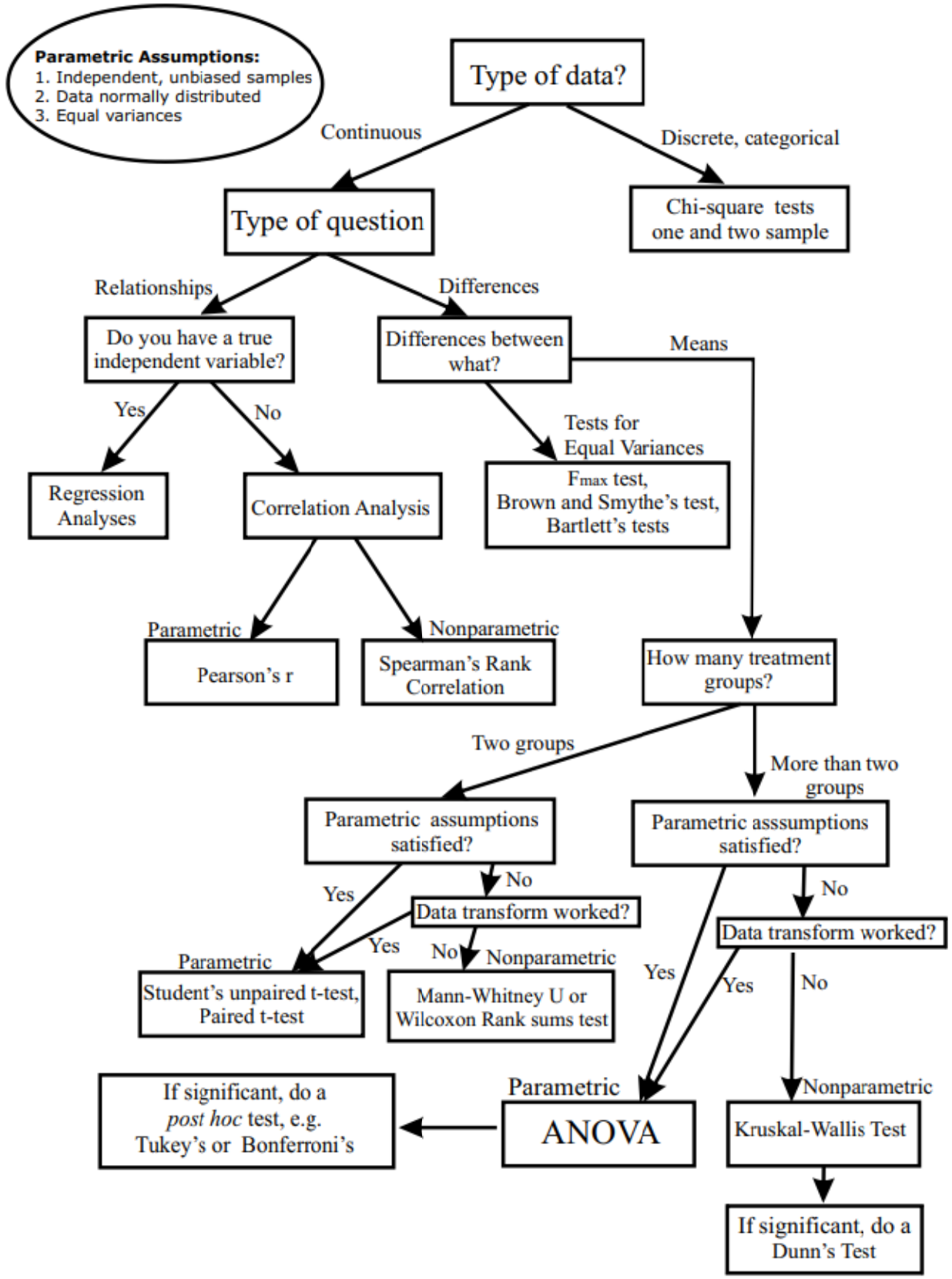
LESSON 4: SPSS TEST SELECTION

Flow Chart for Selecting Commonly Used Statistical Tests



Let's start by one of the most common tests in your field of study (TEFL), the Chi-Square Test.

TEST 01: CHI-SQUARE

The Chi-square /ˌkaɪ ˈskweə/test is a statistical test used to determine whether there is an association or relationship between two categorical variables. It is commonly used in the following scenarios:

Quick Reminder: A categorical variable, also known as a nominal variable, is a type of variable used in statistics and research that represents data categories or groups rather than numerical values. Categorical variables can take on values that are names, labels, or different categories, and they are used to classify or categorize data into distinct groups based on specific characteristics or attributes. There are two main types of categorical variables:

Nominal Variables: These variables represent categories or groups with no inherent order or ranking. For example, the colors of cars (e.g., red, blue, green) or types of fruits (e.g., apple, banana, orange) are nominal variables. The order in which these categories are listed doesn't matter, as there's no inherent hierarchy.

Ordinal Variables: Ordinal variables also represent categories, but they have a specific order or ranking. While the categories themselves are distinct, they can be ordered based on a meaningful sequence or hierarchy. For example, educational levels (e.g., high school, bachelor's degree, master's degree, Ph.D.) are ordinal variables because they have an inherent order.

1. **Goodness of Fit Test:** This is used when you want to compare observed frequencies of categorical data to the expected frequencies based on a theoretical distribution or hypothesis.

Scenario: You want to assess whether the observed distribution of language proficiency levels among your students matches the expected distribution based on national language proficiency standards. You have four categories for language proficiency: Beginner, Intermediate, Advanced, and Expert.

Research Question: Does the distribution of language proficiency levels among our students align with the expected distribution based on national language proficiency standards?

2. **Independence Test (Chi-Square Test of Independence):** This test is used when you want to determine if there is a **significant association** between two categorical variables. It's often used in survey research to assess if there's a relationship between two categorical variables. For instance, you might investigate if there's a relationship between gender and preferred mode of transportation.

Scenario: You are conducting a study to explore whether students' preferred learning mediums are associated with their gender. You have two categorical variables: "Learning Mediums" (Books, Online) and "Gender" (Male, Female).

Research Question: Is there a significant association between students' preferred learning style and their choice of English language learning resources?

3. **Homogeneity Test:** This test helps assess whether the distribution of one categorical variable is similar across different groups of another categorical variable. It's often used when you want to compare whether proportions or percentages are consistent across subgroups. For

instance, you might use it to check if the preferences for different types of smartphones are similar across different age groups.

Scenario: In a TEFL program, you are interested in examining whether the preferences for teaching materials differ among teachers with varying years of teaching experience. You have two groups of teachers: "Novice Teachers" (0-2 years of experience) and "Experienced Teachers" (5+ years of experience), and three categories of preferred teaching materials: "Textbooks," "Online Resources," and "In-class Activities."

Research Question: Are there differences in the preferred teaching materials among novice and experienced TEFL teachers, or are the preferences homogenous across the two groups?

In summary, the chi-square test is used to analyze categorical data and to determine whether observed frequencies or proportions differ significantly from expected frequencies or whether two categorical variables are independent or related. It's a valuable tool for analyzing data in various fields, including social sciences, market research, biology, and more.

Now let's take the scenario from the Independence Chi-Square Test and go through the procedure

Test Procedure in SPSS Statistics

The 13 steps below show you how to analyse your data using a chi-square test for independence in SPSS Statistics. At the end of these 13 steps, I show you how to interpret the results from your chi-square test for independence.

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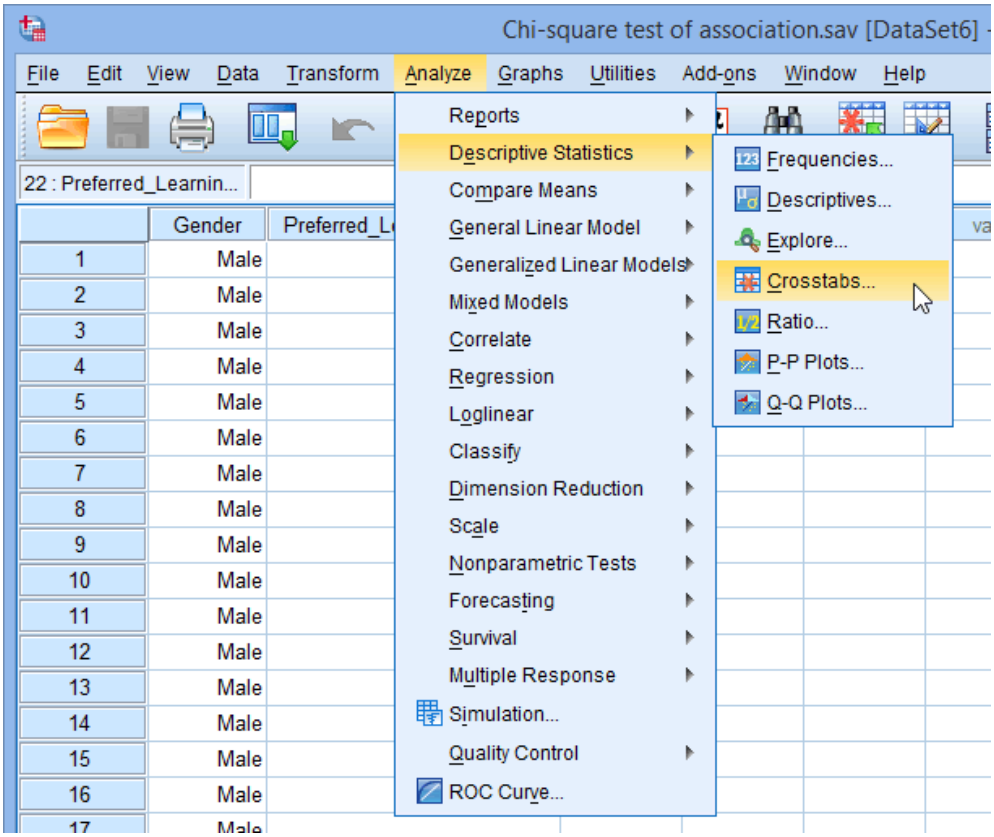
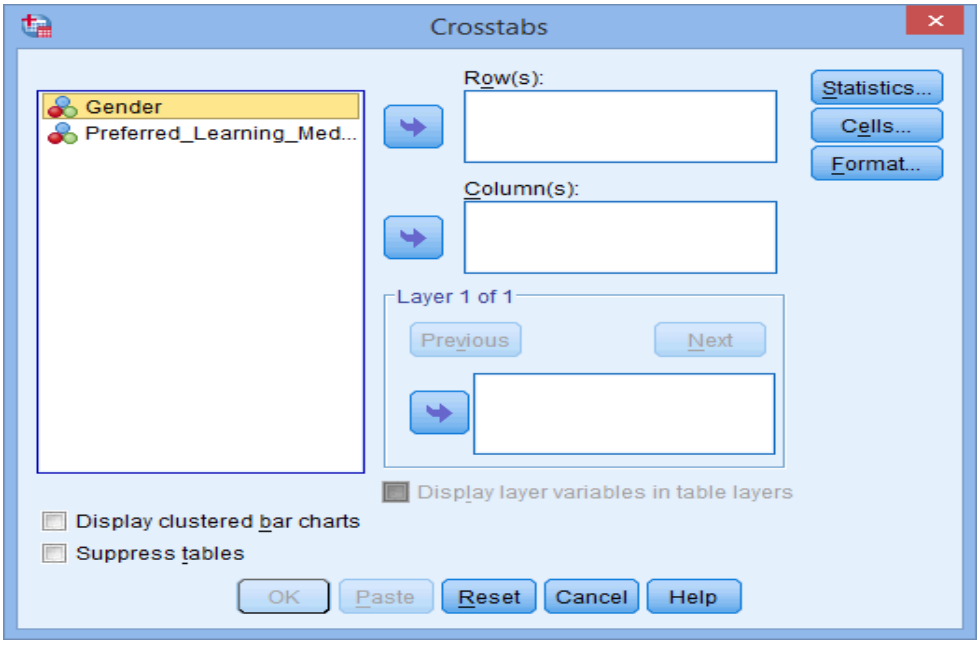
1. Click **Analyze > Descriptives Statistics > Crosstabs...** on the top menu, as shown below:

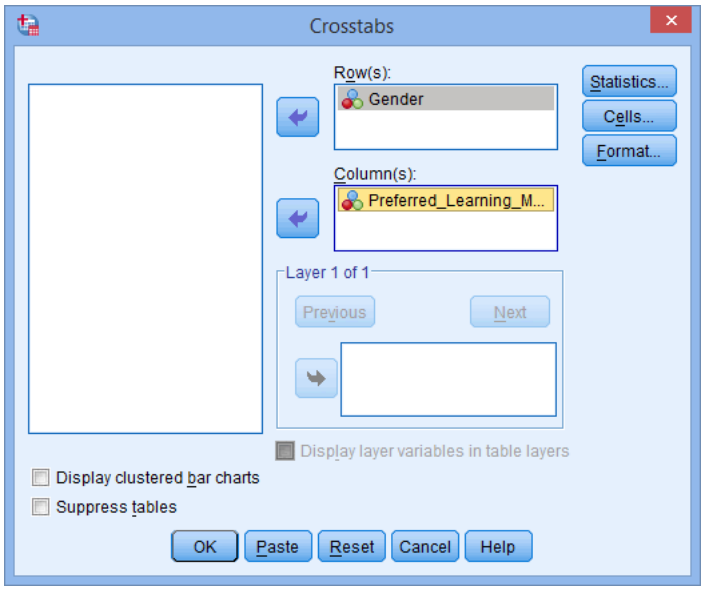


2. You will be presented with the following **Crosstabs** dialogue box:

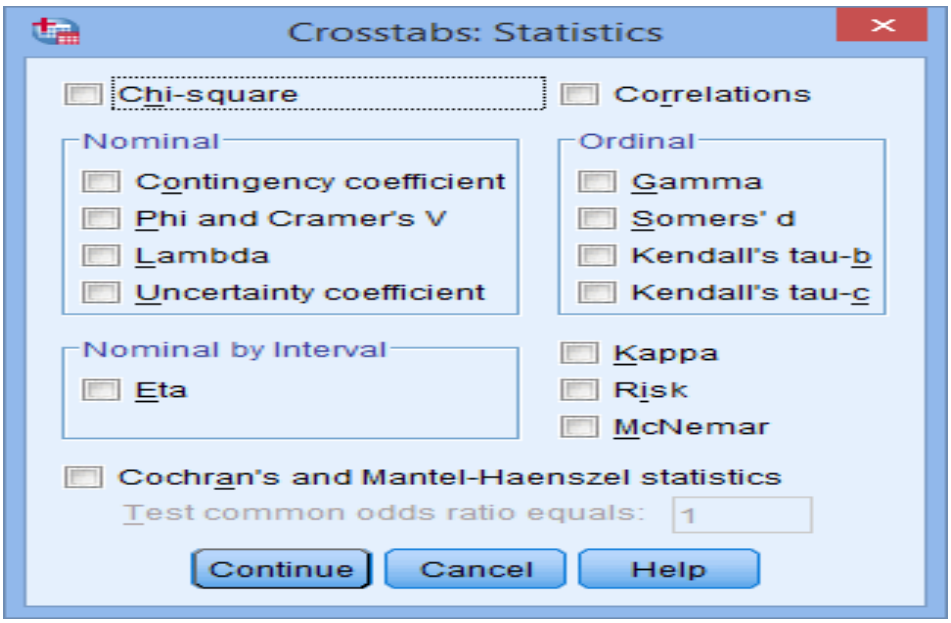


3. Transfer one of the variables into the Row(s): box and the other variable into the Column(s): box. In our example, we will transfer the Gender variable into the Row(s): box and Preferred_Learning_Medium into the Column(s): box. There are two ways to do this.

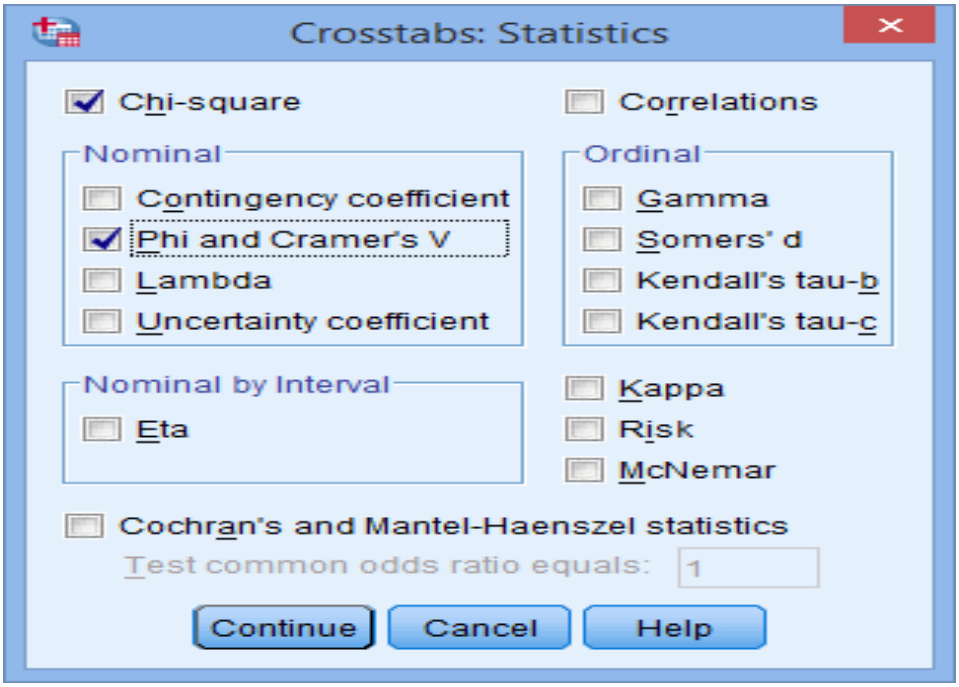
   You can either: (1) highlight the variable with your mouse and then use the relevant  buttons to transfer the variables; or (2) drag-and-drop the variables. How do you know which variable goes in the row or column box? There is no right or wrong way. It will depend on how you want to present your data.
   If you want to display clustered bar charts (recommended), make sure that Display clustered bar charts checkbox is ticked.
   You will end up with a screen similar to the one below:



4. Click on the Statistics... button. You will be presented with the following **Crosstabs: Statistics** dialogue box:

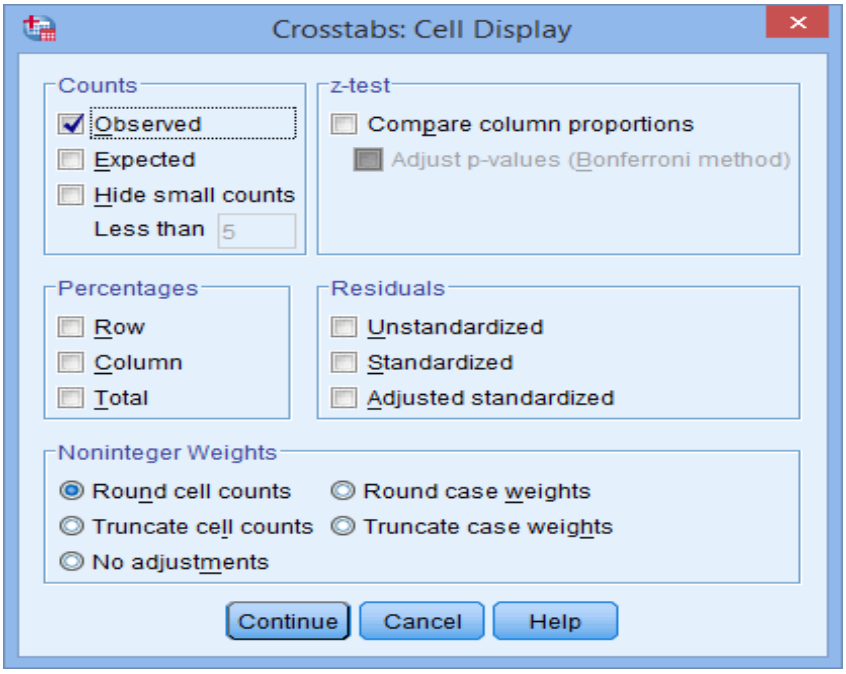


5. Select the Chi-square and Phi and Cramer's V options, as shown below:

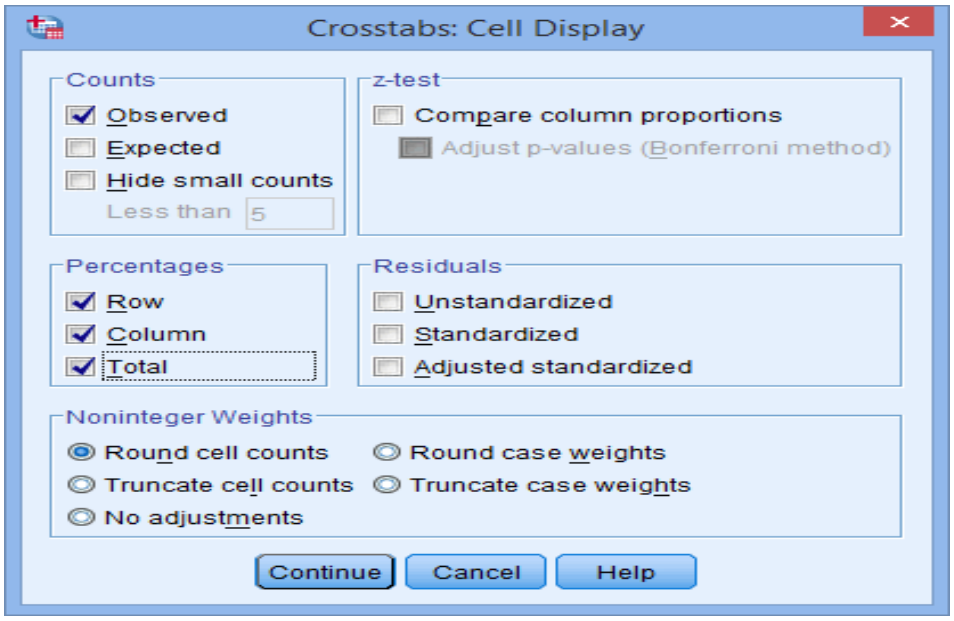


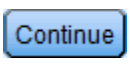
Click on the Continue button.

6. Click on the Cells... button. You will be presented with the following **Crosstabs: Cell Display** dialogue box:

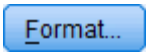


7. Select Observed from the –Counts– area, and Row, Column and Total from the –Percentages– area, as shown below:



8. Click on the 

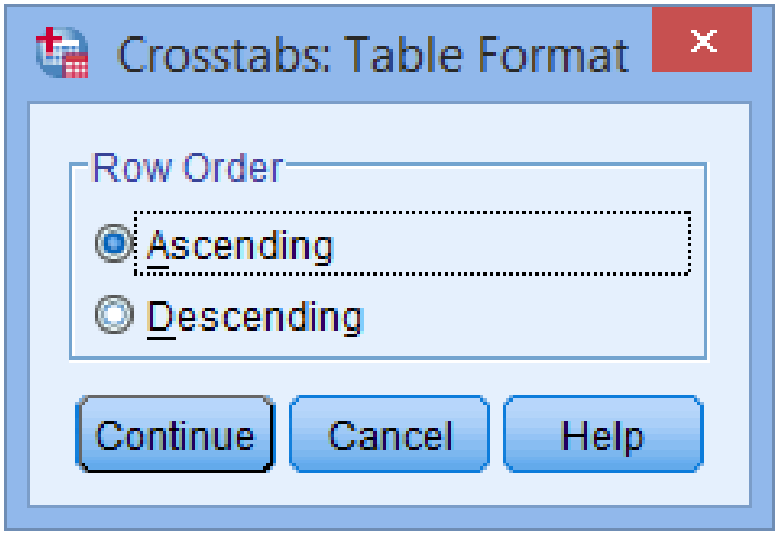
button.

9. Click on the 

button.

Note: This next option is only really useful if you have more than two categories in one of your variables, but we will show it here in case you have. If you don't, you can skip to STEP 12.

10. You will be presented with the following:



This option allows you to change the order of the values to either ascending or descending.

11. Once you have made your choice, click on the Continue button.

12. Click on the OK button to generate your output.

Output:

You will be presented with some tables in the Output Viewer under the title "Crosstabs". The tables of note are presented below:

The Crosstabulation Table (Gender*Preferred Learning Medium Crosstabulation)

Gender * Preferred Learning Medium Crosstabulation

			Preferred Learning Medium		
			Books	Online	Total
Gender	Male	Count	16	24	40
		% within Gender	40.0%	60.0%	100.0%
		% within Preferred Learning Medium	55.2%	47.1%	50.0%
		% of Total	20.0%	30.0%	50.0%
	Female	Count	13	27	40
		% within Gender	32.5%	67.5%	100.0%
		% within Preferred Learning Medium	44.8%	52.9%	50.0%
		% of Total	16.3%	33.8%	50.0%
Total		Count	29	51	80
		% within Gender	36.3%	63.8%	100.0%
		% within Preferred Learning Medium	100.0%	100.0%	100.0%
		% of Total	36.3%	63.8%	100.0%

This table allows us to understand that both males and females prefer to learn using online materials versus books.

Now let's read the test result. But, before we read the table; let's remember some concepts

What are degrees of freedom in statistics?

Degrees of freedom are the number of independent values that a statistical analysis can estimate. You can also think of it as the number of values that are free to vary as you estimate parameters. DF encompasses the notion that the amount of independent information you have limits the number of parameters that you can estimate. Typically, the degrees of freedom equals your sample size minus the number of parameters you need to calculate during an analysis. It is usually a positive whole number.

For the **Chi-square test**, $df = (r - 1)*(c - 1)$; where r is the number of rows (groups of one variable) and c is the number of columns (groups of the other variable) in the contingency table

The Chi-Square Tests Table

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.487[a]	1	.485		
Continuity Correction[b]	.216	1	.642		
Likelihood Ratio	.487	1	.485		
Fisher's Exact Test				.642	.321
Linear-by-Linear Association	.481	1	.488		
N of Valid Cases	80				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.50.

b. Computed only for a 2x2 table

Two-Sided Hypothesis Tests

Two-sided hypothesis tests are also known as nondirectional and two-tailed tests because you can test for effects in both directions. When you perform a two-sided test, you split the significance level percentage between both sides of the distribution.

One-Sided Hypothesis Tests

One- sided hypothesis tests are also known as directional and one- tailed tests because you can test for effects in only one direction. When you perform a one-sided test, the entire significance level percentage goes into the extreme end of one side of the distribution.

This means, if your research involves a directional hypothesis, i.e., you have made a prediction about the outcome; you will read the table from the one-sided sig value column. If no prediction has been made, you consider the two-sided column.

When reading this table we are interested in the results of the "**Pearson Chi-Square**" row. We can see here that $\chi(1) = 0.487$, $p = .485$. This tells us that there is no statistically significant association between Gender and Preferred Learning Medium; that is, both Males and Females equally prefer online learning versus books.

The Symmetric Measures Table

Symmetric Measures

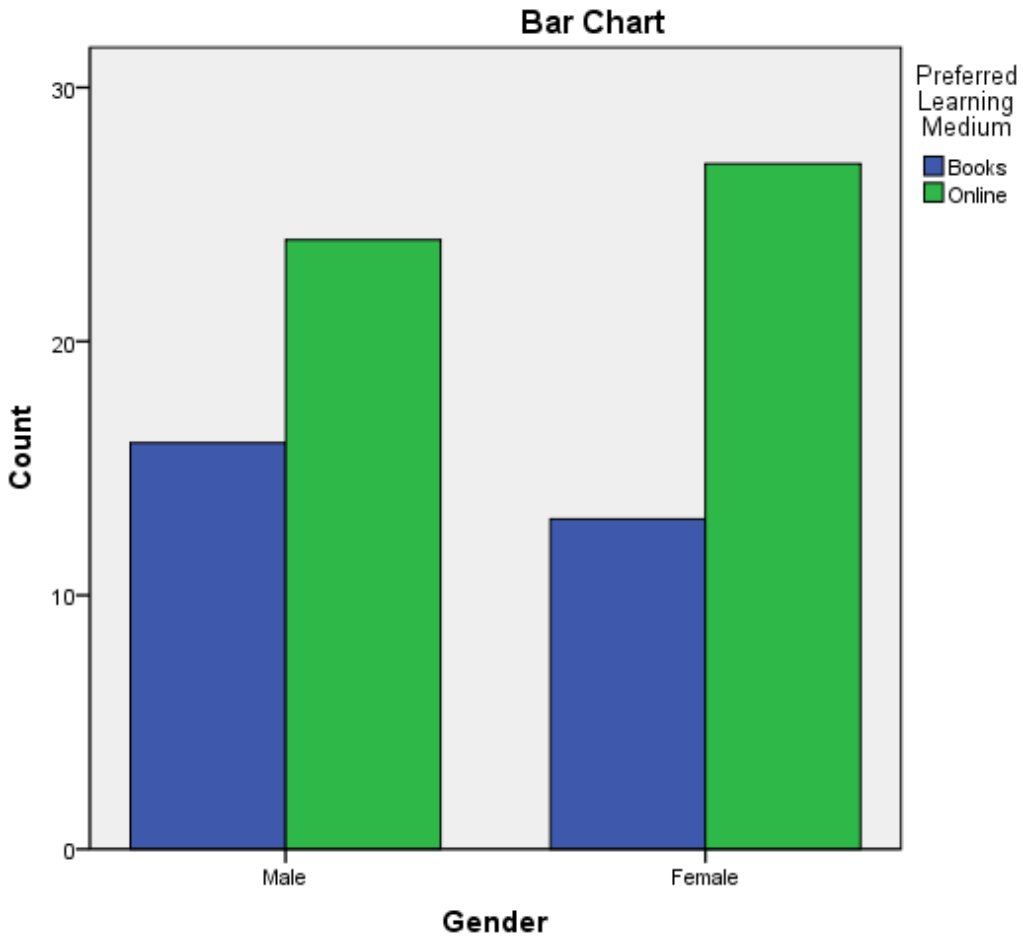
		Value	Approx. Sig.
Nominal by Nominal	Phi	.078	.485
	Cramer's V	.078	.485
N of Valid Cases		80	

Phi and Cramer's V are both tests of the strength of association. We can see that the strength of association between the variables is very weak.

In other scenarios where the test could have been significant, the 'Approx sig' would have shown values lesser than (.05). The strength of the association between the variables would be considered according to the following values:

0 < value < .2	**weak association**
.2 < value < .3	**moderate association**
Value > .3	**strong association**

Bar chart



It can be easier to visualize data than read tables. The clustered bar chart option allows a relevant graph to be produced that highlights the group categories and the frequency of counts in these groups.