

How to Perform Fisher's Exact Test in SPSS: A Step-by-Step Guide

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Introduction to Fisher's Exact Test in Statistical Analysis

The **Fisher's Exact Test** is a fundamental **nonparametric test** used primarily to determine if there are non-random associations between two **categorical variables**. Named after the eminent statistician Sir Ronald Fisher, this method provides an exact calculation of the probability of observing a distribution as extreme as, or more extreme than, the one found in the sample data, assuming the **null hypothesis** of independence is true. Unlike other tests that rely on large-sample approximations, this procedure is mathematically precise, making it an indispensable tool for researchers working with limited datasets or rare occurrences.

In the realm of modern data science and social research, **SPSS** (Statistical Package for the Social Sciences) serves as a robust platform for executing these complex calculations. While many researchers initially gravitate toward the **Chi-square test** of independence, the **Fisher's Exact Test** serves as a critical alternative when the sample size is small. The precision of this test allows for high-confidence conclusions even when the data does not meet the distributional requirements of more common parametric or asymptotic tests, ensuring that the validity of the statistical inference remains intact regardless of the volume of observations.

Understanding the underlying mechanics of this test is essential for any researcher. It operates by calculating the probability of the specific **contingency table** observed, given the marginal totals. Because it calculates an exact **p-value** rather than relying on a distribution curve like the Chi-square distribution, it eliminates the errors that can occur when the expected frequency in any cell of the table is low. This guide will provide a comprehensive walkthrough of performing this analysis within the **SPSS** environment, ensuring that your results are both accurate and professionally presented.

Determining When to Use Fisher's Exact Test Over Chi-Square

One of the most frequent dilemmas in **statistics** is choosing between the Pearson **Chi-square test** and the **Fisher's Exact Test**. The general rule of thumb, often referred to as Cochran's requirement, suggests that the Chi-square test is valid only if at least 80% of the cells in a **contingency table** have an expected frequency of 5 or more, and no cell has an expected frequency of less than 1. When these assumptions are violated--typically in small pilot studies or clinical trials involving rare outcomes--the Chi-square test becomes unreliable, potentially leading to Type I or Type II errors.

The **Fisher's Exact Test** is specifically designed to handle these small-sample scenarios. While it was originally developed for 2x2 tables, modern iterations and computational power in **SPSS** allow for its application in larger tables through the **Monte Carlo method**. By using this test, researchers can maintain the integrity of their **statistical significance** findings without needing to artificially

inflate their sample sizes or combine categories in a way that might obscure the actual data patterns.

Furthermore, the choice of test impacts the interpretation of the **p-value**. In a **Chi-square test**, the p-value is an estimate based on the area under a curve. In the **Fisher's Exact Test**, the p-value is the actual sum of probabilities of all tables that are as extreme as the one observed. This level of detail is particularly valuable in high-stakes environments, such as medical research or legal settings, where the exact probability of an association can significantly influence the conclusions drawn from the evidence.

Understanding the Data Structure for Categorical Variables

Before initiating the analysis in **SPSS**, it is vital to ensure that your data is correctly structured. In the context of the **Fisher's Exact Test**, you are typically looking at two **categorical variables**, which may be nominal or ordinal. For instance, you might be investigating the relationship between gender (male vs. female) and a specific preference or outcome (e.g., political affiliation or success rate). Each participant in your study must be represented by a single row in the data editor, with separate columns for each variable being tested.

In **SPSS**, these variables should be coded numerically. For example, "Female" might be coded as 1 and "Male" as 2, while "Democrat" could be coded as 1 and "Republican" as 2. Using the "Variable View" tab in **SPSS** to define these values is a best practice, as it allows the software to generate readable output while performing calculations on the numerical codes. This structured approach prevents errors during the analysis phase and ensures that the **contingency table** generated by the software accurately reflects the real-world data.

To illustrate the process, consider a research scenario where we want to investigate if gender influences political party preference. We have a small sample of 25 students. This sample size is inherently small, which immediately suggests that a **Fisher's Exact Test** will be more appropriate than a standard **Chi-square test**. The relationship between these two **categorical variables** will be analyzed through a 2×2 table, which is the most common format for this particular statistical procedure.

Example Scenario: Gender and Political Preference

Let us define the parameters of our example to provide clarity. Suppose we randomly poll 25 students to determine if there is a significant association between their gender and their political party preference. The collected data is summarized in the following **contingency table**:

	Democrat	Republican

Female	8	4
Male	4	9

In this table, we can observe that the distribution of Democrats and Republicans appears to differ between females and males. However, visual inspection is not enough to determine if this difference is due to chance or a genuine underlying association. Given that the total sample size is only 25, some of the expected cell counts will likely fall below the threshold of 5, which is the primary justification for utilizing the **Fisher's Exact Test** in **SPSS**.

The goal of our analysis is to test the **null hypothesis**, which states that gender and political party preference are independent of each other in the population. If the **p-value** resulting from our test is below a predetermined threshold (usually 0.05), we will reject this **null hypothesis** and conclude that a statistically significant association exists between the two variables. This process provides a rigorous framework for making objective decisions based on empirical data.

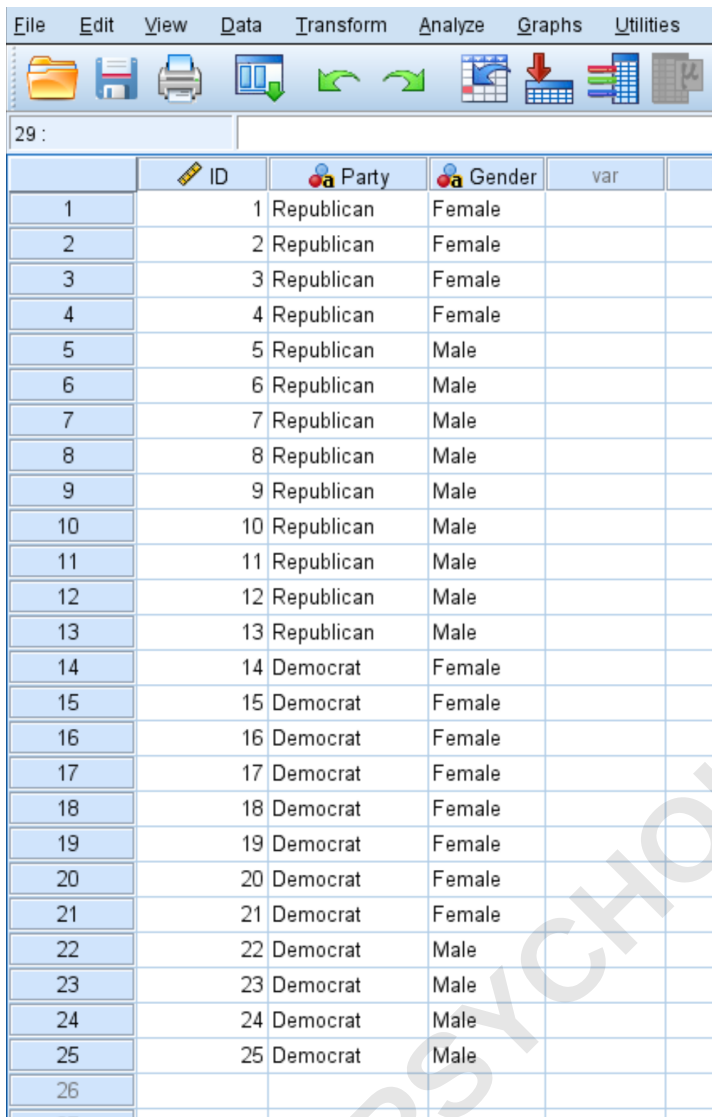
Step 1: Data Entry and Preparation in SPSS

The first practical step in our guide involves entering the raw data into the **SPSS** Data Editor. Each student in our poll must be entered as an individual case. You should create three columns: one for a unique identifier (ID), one for the **categorical variable** "Gender," and one for the **categorical variable** "Party." This raw data format is essential for **SPSS** to process the variables and generate the necessary **contingency table** automatically during the analysis phase.

Ensure that the "Measure" type in the Variable View is set to "Nominal" for both "Gender" and "Party." This informs **SPSS** that the numbers represent categories rather than quantities on a scale. While the software can still perform the test if this is not perfectly set, correct metadata management is a hallmark of professional **statistical analysis** and prevents confusion when interpreting the output or sharing the dataset with colleagues.

Once the data is entered, your spreadsheet should resemble the structure shown in the image below. Each row represents a single individual's response, providing a clear and organized foundation for the **Fisher's Exact Test** procedure:

Each row shows an individual's ID, their political party preference, and their gender.



	ID	Party	Gender	var	v
1	1	Republican	Female		
2	2	Republican	Female		
3	3	Republican	Female		
4	4	Republican	Female		
5	5	Republican	Male		
6	6	Republican	Male		
7	7	Republican	Male		
8	8	Republican	Male		
9	9	Republican	Male		
10	10	Republican	Male		
11	11	Republican	Male		
12	12	Republican	Male		
13	13	Republican	Male		
14	14	Democrat	Female		
15	15	Democrat	Female		
16	16	Democrat	Female		
17	17	Democrat	Female		
18	18	Democrat	Female		
19	19	Democrat	Female		
20	20	Democrat	Female		
21	21	Democrat	Female		
22	22	Democrat	Male		
23	23	Democrat	Male		
24	24	Democrat	Male		
25	25	Democrat	Male		
26					
27					

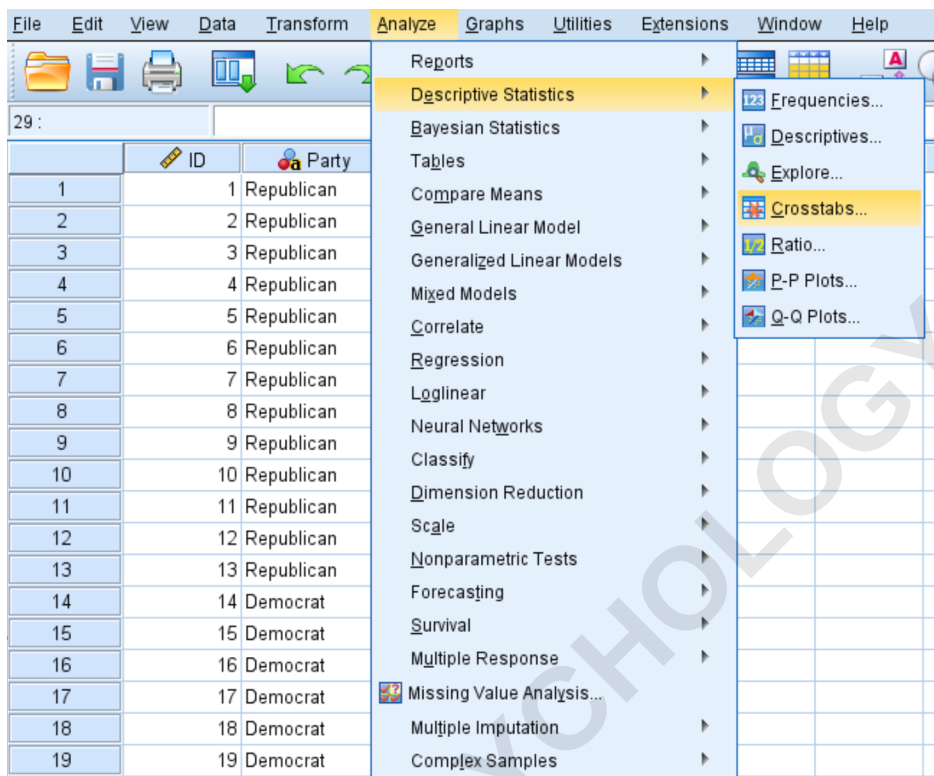
Step 2: Navigating the SPSS Crosstabs Menu

With the data properly prepared, the next phase is to navigate the **SPSS** menu system to locate the Crosstabs procedure. This is the primary gateway for generating association tests for **categorical variables**. To begin, click on the **Analyze** tab in the top navigation bar. From the resulting drop-down menu, hover over **Descriptive Statistics** and then select **Crosstabs...** from the secondary list.

The Crosstabs dialog box is where you define the relationship you wish to study. You will see a list of your variables on the left. In our example, you should drag the variable **Gender** into the box labeled **Rows** and the variable **Party** into the box labeled **Columns**. This arrangement determines how the **contingency table** will be displayed in your output. While the statistical results remain the same regardless of which variable is in the row or column, it is standard practice to place the

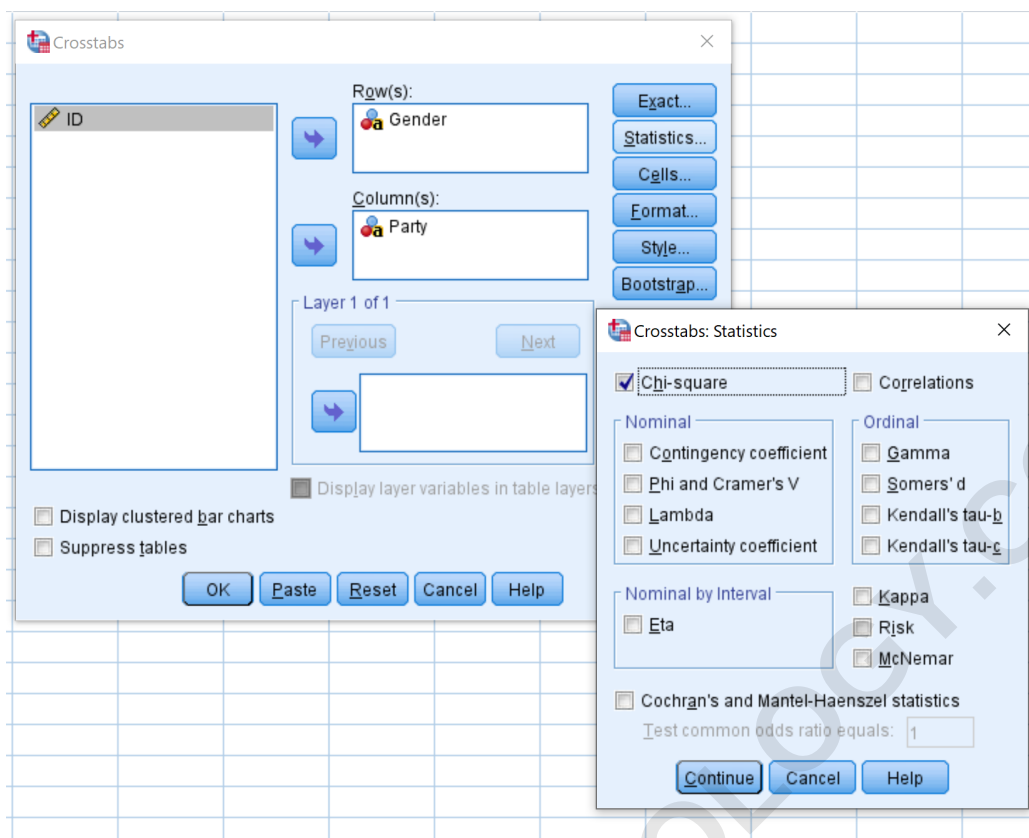
independent variable in the rows and the dependent variable in the columns.

The following visual illustrates the correct menu path and the initial configuration of the Crosstabs dialog box. It is important to proceed carefully through these menus to ensure all relevant sub-options are selected in the subsequent steps of the **Fisher's Exact Test** setup:

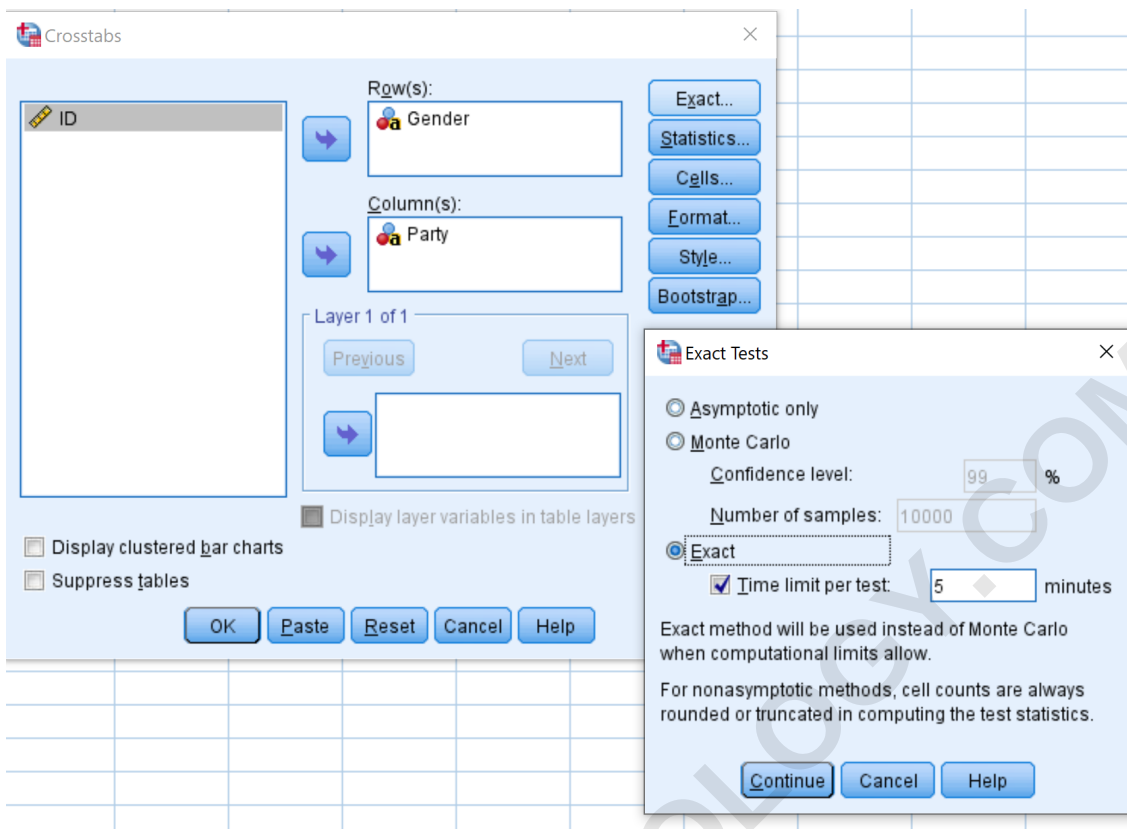


Step 3: Configuring Statistics and Exact Test Options

Once you have assigned your variables, you must tell **SPSS** which specific **statistics** to calculate. Click the **Statistics** button on the right side of the Crosstabs dialog box. In the new window that appears, ensure that the checkbox next to **Chi-square** is selected. Even though we are specifically seeking the **Fisher's Exact Test**, **SPSS** bundles this within the Chi-square output options. Click **Continue** to return to the main dialog.



The most crucial step for ensuring an exact calculation is the **Exact** button. By default, **SPSS** uses "Asymptotic only" methods, which are based on large-sample approximations (like the standard Chi-square). To perform the **Fisher's Exact Test**, click the **Exact** button and select the radio button labeled **Exact**. You can also specify a time limit for the calculation, though for a 2×2 table with a small sample, the computation will be instantaneous. Click **Continue** and then click **OK** in the main dialog to execute the analysis.



Step 4: Interpreting the SPSS Output Tables

After clicking **OK**, **SPSS** will generate an output viewer window containing several tables. The first table, the **Case Processing Summary**, is a quality control check. It confirms the number of valid cases used in the analysis and identifies if any data points were excluded due to missing values. In our example, it shows 25 valid cases and 0 missing cases, indicating that our dataset was processed in its entirety without issue.

The second table is the **Gender * Party Crosstabulation**. This table provides the actual counts for each category combination, mirroring the data we initially conceptualized. It is helpful to review this table to ensure that the data was entered and categorized as intended. Seeing the counts (8, 4, 4, 9) laid out clearly helps provide context for the **statistical significance** results that follow in the third table.

The final and most important table is the **Chi-Square Tests** table. This table includes the results for the Pearson Chi-Square, the Continuity Correction, and, most importantly, the **Fisher's Exact Test**. You should look specifically for the row labeled "Fisher's Exact Test" and identify the "Exact Sig. (2-sided)" and "Exact Sig. (1-sided)" values. These are the **p-values** that will determine the outcome of your research inquiry.

➔ Crosstabs

Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Gender * Party	25	100.0%	0	0.0%	25	100.0%

Gender * Party Crosstabulation

Count

		Party		Total
		Democrat	Republican	
Gender	Female	8	4	12
	Male	4	9	13
Total		12	13	25

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.222 ^a	1	.073	.115	.081
Continuity Correction ^b	1.944	1	.163		
Likelihood Ratio	3.293	1	.070	.115	.081
Fisher's Exact Test				.115	.081
N of Valid Cases	25				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.76.

b. Computed only for a 2x2 table

Step 5: Analyzing the P-Values and Hypothesis Testing

To conclude our analysis, we must interpret the **p-values** provided in the **Fisher's Exact Test** row. In our specific example, **SPSS** has reported the following results:

Two-sided p-value: .115

One-sided p-value: .081

The **null hypothesis** for the **Fisher's Exact Test** states that there is no association between the variables (they are independent). Since we did not have a prior directional hypothesis (e.g., we didn't specifically predict that females would be more likely to be Democrats), the **two-sided p-value** of 0.115 is the appropriate metric to use. In statistical practice, a p-value must typically be less than 0.05 to be considered significant.

Because our **p-value** of 0.115 is greater than the 0.05 threshold, we fail to reject the **null hypothesis**. This means that, based on our sample of 25 students, we do not have sufficient evidence to conclude that there is a statistically significant association between gender and political party preference. The differences observed in our **contingency table** are likely due to random sampling variation rather than a systematic relationship in the broader population.

Conclusion and Practical Implications of the Test

The **Fisher's Exact Test** is a powerful tool for researchers dealing with small datasets, providing a level of mathematical certainty that asymptotic tests cannot match. By following the steps outlined in this guide--from careful data entry in **SPSS** to the precise configuration of the Crosstabs procedure--you can ensure that your **statistical significance** testing is performed correctly. This method protects against the inaccuracies that arise when cell counts are low, offering a reliable path to valid scientific conclusions.

It is important to remember that while the test tells us about the significance of an association, it does not describe the strength of that association. For that, researchers might look to other measures such as Phi or Cramér's V. However, as a first step in analyzing **categorical variables**, the **Fisher's Exact Test** remains the gold standard for small-sample research. Its implementation in **SPSS** is intuitive and efficient, making it accessible to students and professional researchers alike.

In summary, performing the **Fisher's Exact Test** in **SPSS** involves identifying the need for an exact test, organizing data into a **contingency table** format, and selecting the "Exact" option within the Crosstabs menu. By mastering this process, you enhance the rigor of your data analysis and ensure that your findings are supported by the most appropriate statistical methods available. Whether you are conducting academic research or professional data analysis, this test is a vital component of your analytical toolkit.