How to Perform a Chi-Square Goodness of Fit Test in SPSS: A Step-by-Step Guide

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March 15, 2026

RECOMMENDED CITATION

stats writer (2026). *How to Perform a Chi-Square Goodness of Fit Test in SPSS: A Step-by-Step Guide*. PSYCHOLOGICAL SCALES. Retrieved from https://scales.arabpsychology.com/?p=135842

The **Chi-Square Goodness of Fit Test** is a fundamental statistical procedure utilized by researchers to ascertain whether an observed distribution of **categorical data** differs significantly from a hypothesized or expected distribution. In essence, this test allows analysts to compare the **frequencies** of occurrences across different groups to see if the data "fits" a specific theoretical model. By calculating a **test statistic** based on the squared differences between observed and expected values, the test provides a rigorous way to determine if variations in the data are due to random chance or represent a meaningful departure from the expected pattern.

Performing this analysis within the **SPSS** software environment involves a structured series of steps designed to handle frequency data efficiently. To begin, a researcher must ensure that their dataset is correctly formatted, typically using a weighting system if the data is summarized in counts rather than raw individual cases. Once the data is prepared, the user navigates through the **nonparametric tests** menu to execute the procedure. This test is highly versatile and is widely employed in various professional fields, including **market research** for consumer behavior analysis, the **social sciences** for demographic studies, and **medical research** for examining the prevalence of clinical outcomes across diverse populations.

The ultimate goal of the **Chi-Square Goodness of Fit Test** is to produce interpretable results, specifically the **Chi-Square value**, the **degrees of freedom**, and the **p-value**. These metrics collectively allow the researcher to either reject or fail to reject the **null hypothesis**. In most scenarios, the null hypothesis posits that there is no significant difference between the observed and expected distributions. By following the precise steps outlined in this tutorial, users can gain a deeper understanding of their categorical datasets and make evidence-based decisions based on their **statistical findings**.

Perform a Chi-Square Goodness of Fit Test in SPSS

Theoretical Foundations of the Goodness of Fit Analysis

The **Chi-Square Goodness of Fit Test** is primarily employed to determine whether a **categorical variable** adheres to a specific, hypothesized **probability distribution**. This analysis is particularly useful when a researcher has a theoretical expectation of how data points should be distributed across various categories--such as equal distribution across days of the week or specific percentages based on historical census data--and needs to verify if the actual collected data mirrors that theory. By examining the **observed frequencies** against the **expected frequencies**, the test quantifies the magnitude of the discrepancy, providing a statistical basis for drawing conclusions about the population from which the sample was drawn.

Within the framework of **hypothesis testing**, the **null hypothesis** for this test generally states that the observed data follows the specified distribution. Conversely, the alternative hypothesis suggests that the observed data does not follow the hypothesized distribution. The **Chi-Square** statistic itself is calculated by summing the squared differences between observed and expected counts, divided by the expected counts for each category. This ensures that larger deviations are given more weight and that the scale of the categories does not disproportionately bias the result, allowing for a standardized comparison across different types of **categorical data**.

It is important to note that the **Chi-Square Goodness of Fit Test** is a **nonparametric test**, meaning it does not require the assumption of normality within the data distribution. However, it does require that the data be **nominal** or ordinal in nature and that the categories are mutually exclusive. Furthermore, for the results to be valid, most statisticians recommend that the **expected frequency** in each cell should be at least five. This tutorial provides a comprehensive guide on how to navigate the **SPSS** interface to perform this test accurately, ensuring your findings are both statistically sound and relevant to your research objectives.

Practical Example: Shop Visitor Distribution Hypothesis

To illustrate the application of the **Chi-Square Goodness of Fit Test** in a real-world scenario, consider a shop owner who makes a specific claim regarding his business operations. He asserts that his shop attracts an approximately equal number of customers every weekday, suggesting a uniform distribution of foot traffic from Monday through Friday. To objectively evaluate this claim, a researcher decides to collect empirical data by recording the actual number of customers who enter the shop during a standard work week. This type of **observational study** generates the **observed frequencies** necessary to perform a rigorous **statistical analysis**.

The data collected by the researcher for the week is summarized as follows:

Monday: 50 customers
Tuesday: 60 customers
Wednesday: 40 customers
Thursday: 47 customers
Friday: 53 customers

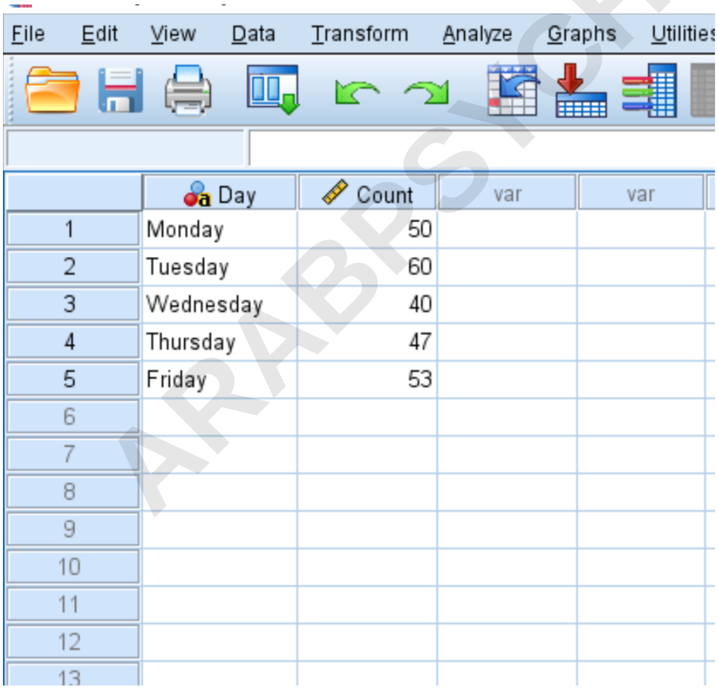
By examining these raw numbers, one can see there is some variation; however, a simple visual inspection is insufficient to determine if this variation is **statistically significant** or merely the result of typical day-to-day fluctuations. The **Chi-Square Goodness of Fit Test** will allow us to mathematically test the shop owner's hypothesis. We will use **SPSS** to determine if the **p-value** associated with these differences is low enough to suggest that the "equal distribution" claim is likely false, or if the differences are small enough that we can attribute them to random variation.

In the following sections, we will walk through the exact steps required to input this data into **SPSS** and run the appropriate **nonparametric test**. This process will include preparing the data variables, applying necessary weights to the counts, and interpreting the final output tables. By the end of this exercise, you will understand how to transform raw frequency counts into actionable **statistical insights** using one of the most powerful software tools available to researchers today.

Step 1: Data Entry and Variable Definition

The initial phase of any analysis in **SPSS** involves the careful entry of data into the **Data Editor**. For a **Chi-Square Goodness of Fit Test**, you typically need two columns: one representing the categories of your **categorical variable** and another representing the frequency or count for each of those categories. In our example, the first variable will be "Day" (representing the days of the week) and the second will be "Count" (representing the number of customers). It is critical to ensure that "Day" is defined as a numeric variable with **value labels** assigned to each number (e.g., 1 for Monday, 2 for Tuesday, etc.) to maintain clarity during the analysis.

To enter the data, open **SPSS** and navigate to the **Data View** tab. Input the values corresponding to each day and its respective customer count. Ensuring the precision of this data entry is paramount, as any errors at this stage will propagate through the entire analysis, leading to incorrect **p-values** and potentially flawed conclusions. Below is a visual representation of how your **SPSS** data sheet should look once the information has been correctly entered.



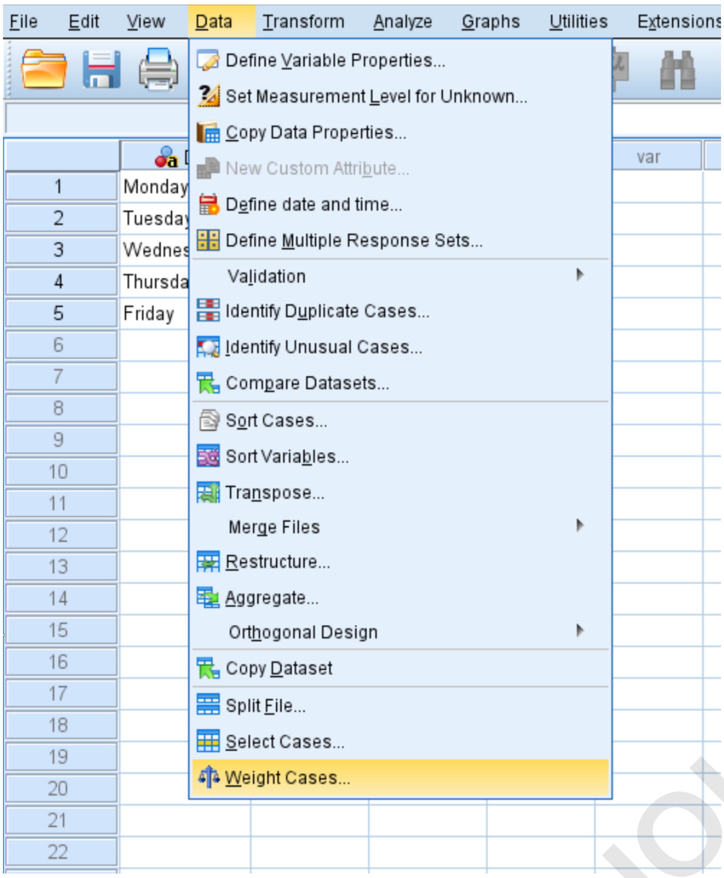
	Day	Count	var	var
1	Monday	50		
2	Tuesday	60		
3	Wednesday	40		
4	Thursday	47		
5	Friday	53		
6				
7				
8				
9				
10				
11				
12				
13				

After the data is entered, it is a **best practice** to visit the **Variable View** tab to confirm the measurement levels. The "Day" variable should be set to **Nominal**, reflecting its role as a categorical identifier, while the "Count" variable should be set to **Scale**, as it represents quantitative frequency data. Properly defining these parameters ensures that **SPSS** interprets the data correctly when performing complex mathematical operations later in the workflow. With the data correctly staged, we can proceed to the weighting process, which is essential for frequency-based datasets.

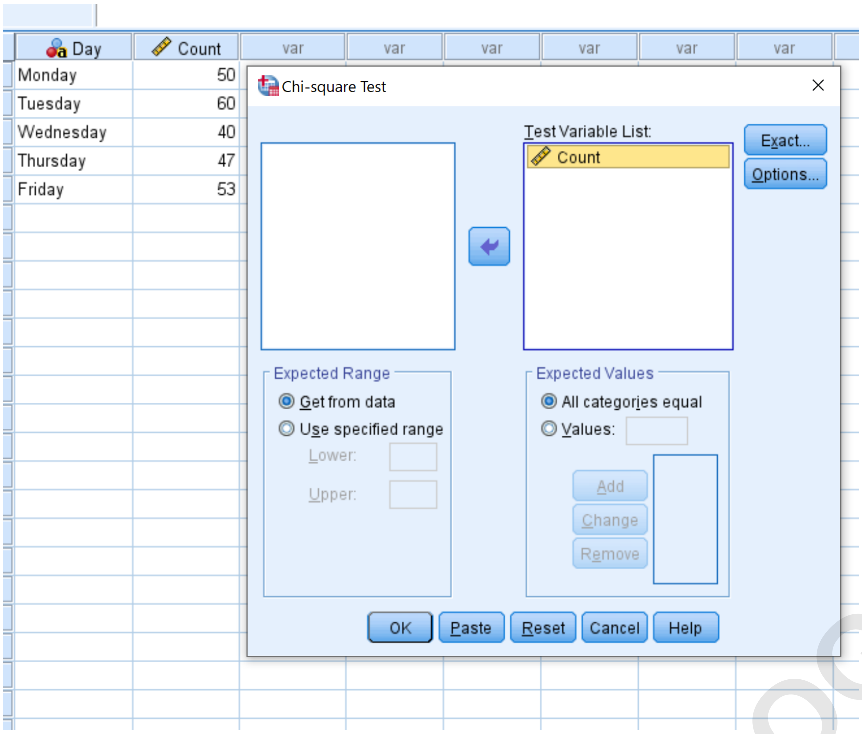
Step 2: Implementing Case Weighting in SPSS

One of the most common mistakes when performing a **Chi-Square** analysis with summarized data is forgetting to weight the cases. By default, **SPSS** treats every row in the **Data View** as a single observation. In our dataset, however, each row represents a group of customers (e.g., the row for Monday represents 50 individual people). To rectify this, we must instruct **SPSS** to treat the "Count" variable as the **frequency** weight for each category. This ensures the **degrees of freedom** and the total sample size are calculated correctly based on the actual number of customers rather than the number of rows.

To apply this setting, click on the **Data** menu at the top of the screen and select the **Weight Cases** option from the dropdown list. This action will open a new dialogue box where you can specify how **SPSS** should handle the observations in your dataset. Weighting is a powerful feature in **inferential statistics** that allows researchers to analyze aggregated data without needing to enter hundreds of individual case rows manually.



In the **Weight Cases** dialogue box, select the radio button labeled **Weight cases by**. Next, highlight the "Count" variable from the list on the left and move it into the field labeled **Frequency Variable**. Once you click **OK**, you will notice "Weight On" appearing in the status bar at the bottom right of the **SPSS** interface. This indicates that all subsequent **statistical tests** will now account for the full volume of your data, allowing for an accurate **Chi-Square Goodness of Fit Test** execution.



Day	Count	var	var	var	var	var	var
Monday	50						
Tuesday	60						
Wednesday	40						
Thursday	47						
Friday	53						

Chi-square Test

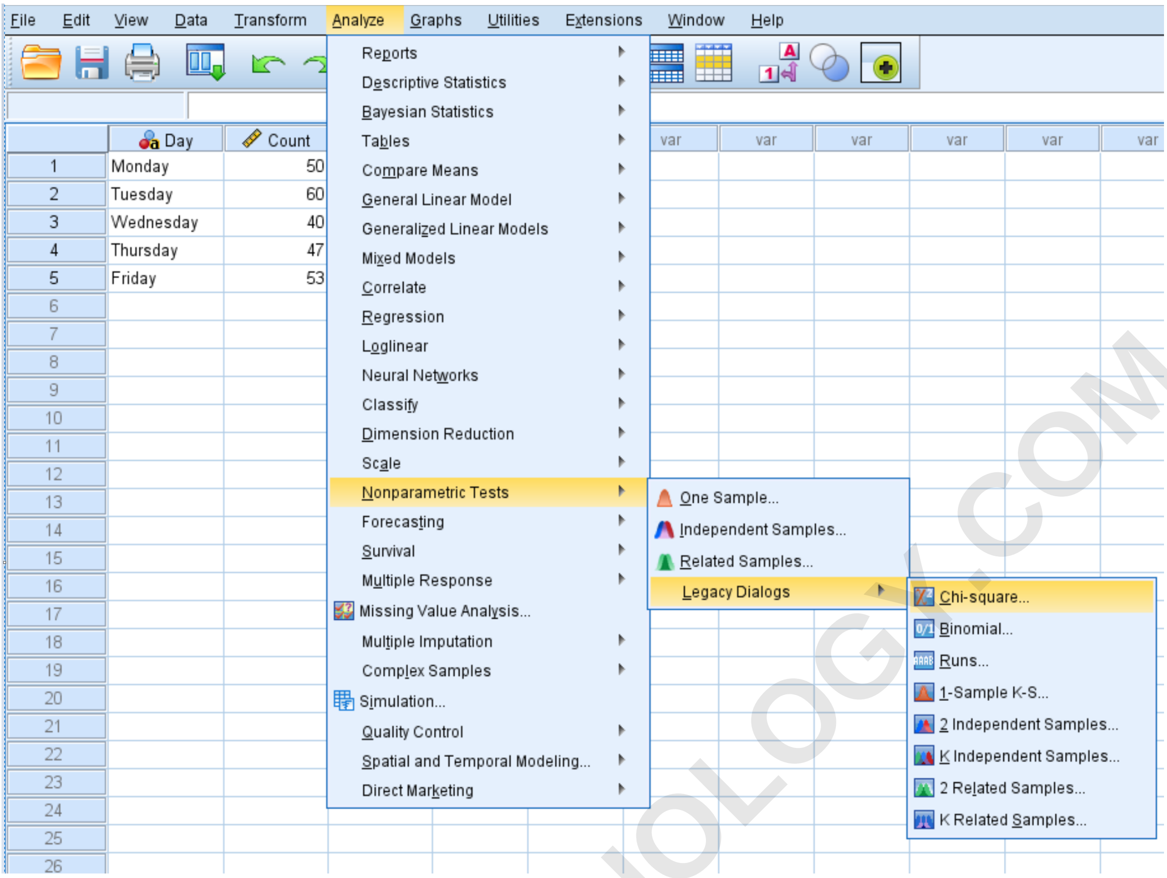
Test Variable List: Count

Expected Range
● Get from data
○ Use specified range
Lower:
Upper:

Expected Values
● All categories equal
○ Values:

Step 3: Navigating to the Chi-Square Test Dialog

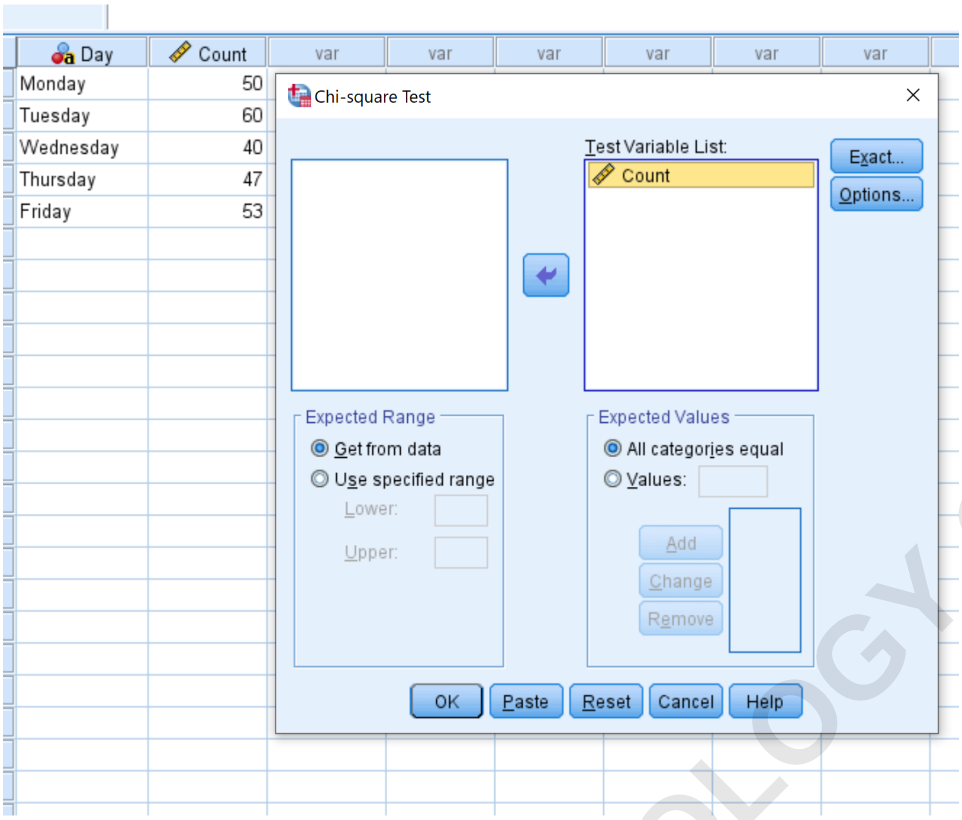
With the weighting active, the next phase is to initiate the actual **Chi-Square Goodness of Fit Test**. Within **SPSS**, this procedure is categorized under the **nonparametric tests** suite. These tests are essential when you are not making assumptions about the specific parameters of the population distribution. To find the correct menu, navigate to the **Analyze** tab, hover over **Nonparametric Tests**, select **Legacy Dialogs**, and then click on **Chi-Square**. Using the **Legacy Dialogs** path is often preferred by researchers for its straightforward, classic interface which provides clear control over test variables.



	Day	Count
1	Monday	50
2	Tuesday	60
3	Wednesday	40
4	Thursday	47
5	Friday	53

Once the **Chi-Square Test** dialogue box appears, your primary task is to identify which **categorical variable** you wish to analyze. In this specific case study, you will select the "Day" variable (which represents our days of the week) and move it into the **Test Variable List** box. This tells **SPSS** that "Day" is the variable for which we want to compare the observed frequencies against the expected ones. It is important to ensure that only the categorical variable is placed here, as the "Count" variable is already acting as the weight for the analysis.

The dialogue box also contains a section for **Expected Values**. By default, **SPSS** selects **All categories equal**. This setting is perfect for our current example because the shop owner's claim is that the number of customers is the same for every day of the week. However, if you were testing against a distribution where you expected different percentages for each category (e.g., 20% on Monday, 30% on Tuesday, etc.), you would select the **Values** option and enter those specific **expected frequencies** manually. For now, leave the default setting checked and click **OK** to run the test.



Day	Count
Monday	50
Tuesday	60
Wednesday	40
Thursday	47
Friday	53

Chi-square Test

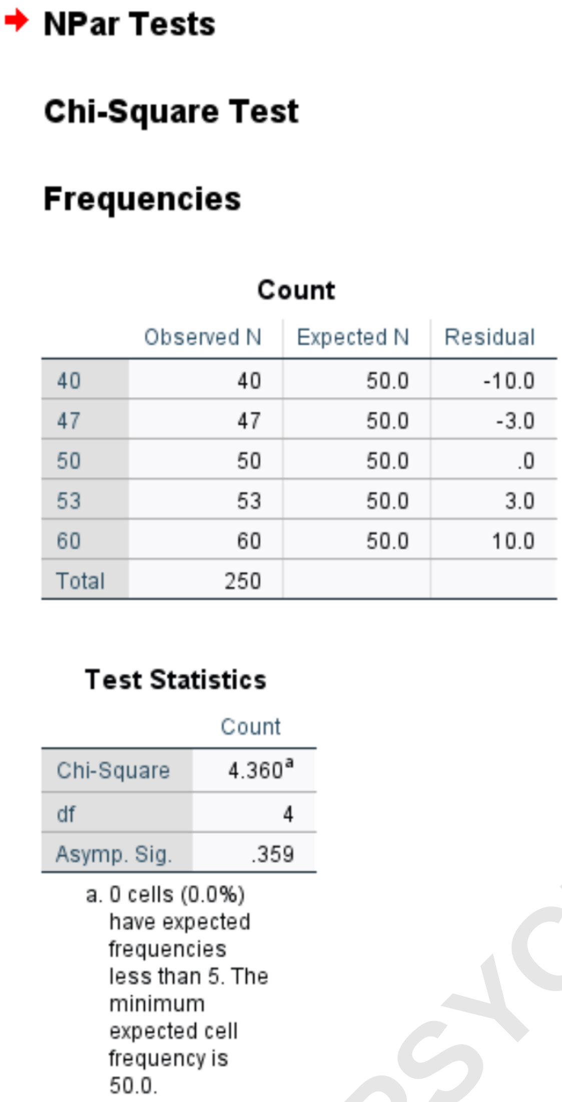
Test Variable List: Count

Expected Range: ● Get from data ○ Use specified range

Expected Values: ● All categories equal ○ Values:

Step 4: Interpreting the Frequencies and Residuals Table

Upon clicking **OK**, **SPSS** will generate an **Output Viewer** window containing the results of your analysis. The first table you should examine is the **Frequencies** table. This table provides a side-by-side comparison of the **Observed N** (the actual counts you entered) and the **Expected N** (the counts **SPSS** calculated based on your hypothesis of equal distribution). In our example, with a total of 250 customers across 5 days, the **Expected N** for each day is exactly 50. This table is vital for a preliminary **descriptive analysis** of where the data deviates most from the theory.



NPar Tests

Chi-Square Test

Frequencies

Count

	Observed N	Expected N	Residual
40	40	50.0	-10.0
47	47	50.0	-3.0
50	50	50.0	.0
53	53	50.0	3.0
60	60	50.0	10.0
Total	250		

Test Statistics

	Count
Chi-Square	4.360[a]
df	4
Asymp. Sig.	.359

a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 50.0.

A key column in this table is the **Residual**. The **residual** is simply the difference between the **Observed N** and the **Expected N**. For instance, on Tuesday, the observed count was 60 while the expected was 50, resulting in a positive residual of 10. Conversely, on Wednesday, the observed was 40, resulting in a negative residual of -10. These residuals provide an immediate visual cue regarding which categories are over-performing or under-performing relative to the shop owner's claim, offering more context than the **test statistic** alone.

Analyzing the residuals is a critical part of **data interpretation**. If all residuals are near zero, the observed data fits the expected distribution very closely. As the absolute values of the residuals increase, the **Chi-Square** statistic also increases, leading toward **statistical significance**. By understanding the direction and magnitude of these residuals, researchers can go beyond merely rejecting a **null hypothesis** and actually describe the nature of the divergence in the population behavior.

Step 5: Analyzing Test Statistics and P-Values

The second table in the **SPSS** output is the **Test Statistics** table, which contains the mathematical core of your **Chi-Square Goodness of Fit Test**. The first value to note is the **Chi-Square** value itself, which in our example is 4.360. This number represents the aggregate measure of how much the **observed frequencies** deviate from the **expected frequencies** across all categories. While the **Chi-Square** value is important, it cannot be interpreted in isolation; it must be considered alongside the **degrees of freedom** (df).

The **degrees of freedom** for this test are calculated as the number of categories minus one (k - 1). In our shop visitor example, there are 5 categories (Monday through Friday), so the **df** is 4. This value is crucial because it determines the shape of the **Chi-Square distribution** used to calculate the **p-value**. **SPSS** automates this calculation, providing the **Asymp. Sig.** (asymptotic significance), which is the **p-value**. For our test, the **p-value** is reported as .359, which is the primary metric used to decide the outcome of the **hypothesis test**.

In standard **scientific research**, a **p-value** threshold (alpha) of 0.05 is typically used to determine **statistical significance**. Since our calculated **p-value** of .359 is significantly greater than 0.05, we **fail to reject the null hypothesis**. This indicates that the differences between the observed customer counts and the expected equal distribution are not large enough to be considered statistically significant. Therefore, based on this specific sample, we do not have enough evidence to contradict the shop owner's claim that customer traffic is equally distributed across the weekdays.

Step 6: Drawing Conclusions and Reporting Results

The final stage of the **Chi-Square Goodness of Fit Test** is the synthesis of the findings into a clear, academic conclusion. Failing to reject the **null hypothesis** does not necessarily prove the shop owner is correct, but rather that the **empirical evidence** collected during that week is consistent with his claim. When reporting these results in a formal paper or business report, you should include the **Chi-Square** statistic, the **degrees of freedom**, and the **p-value** to allow readers to verify your analysis.

For instance, an **APA-style** report of these findings might read: "A **Chi-Square Goodness of Fit Test** was conducted to determine if the number of customers was equally distributed across the five weekdays. The results indicated that there was no significant difference between the **observed frequencies** and the expected equal distribution, $\chi 2(4) = 4.36$, p = .359." Such a statement provides a concise yet comprehensive summary of the **statistical analysis**, adhering to professional standards for data transparency and reporting.

Understanding how to perform and interpret the **Chi-Square Goodness of Fit Test** in **SPSS** empowers researchers to validate theoretical assumptions with **real-world data**. Whether you are checking if a **random sample** matches a known population demographic or testing a specific business hypothesis like our shop owner example, this test provides a robust framework for **categorical data analysis**. By mastering these steps, you ensure that your **data-driven decisions** are backed by rigorous **statistical methodology** and clear, objective evidence.