

How to Calculate the Interquartile Range (IQR) in SPSS: A Step-by-Step Guide

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Calculate Interquartile Range in SPSS

Understanding the Interquartile Range (IQR)

The Interquartile Range (IQR) is a fundamental measure of statistical variability, often utilized to quantify the dispersion of data points around the central tendency. Unlike the total range, which simply measures the distance between the maximum and minimum values, the IQR focuses specifically on the middle 50% of the dataset, offering a far more robust assessment of spread. This concentration on the central distribution makes the IQR largely insensitive to extreme outliers, which can significantly skew measures like the standard deviation or variance, thereby providing a more reliable picture of typical data dispersion.

Formally, the IQR is calculated as the difference between the third quartile (Q3) and the first quartile (Q1). The first quartile (Q1) marks the 25th percentile of the data, meaning 25% of the observations fall below this value. Conversely, the third quartile (Q3) represents the 75th percentile, indicating that 75% of the observations fall below it. The median (Q2) lies exactly at the 50th percentile. By isolating the distance between Q3 and Q1, the IQR effectively captures the range over which the majority of the data points cluster, minimizing the influence of potential data entry errors or unusual observations residing in the tails of the distribution.

In practical terms, a small IQR suggests that the central 50% of the data are tightly clustered, indicating low variability and high consistency within the sample. Conversely, a large IQR signifies a greater spread among the central observations. Understanding this measure is crucial for preliminary data screening, especially when dealing with variables exhibiting non-normal distributions or when constructing visual aids such as box plots, where the IQR forms the central box, vividly illustrating the structure of the data spread.

Why Utilize the Interquartile Range in Data Analysis?

The choice of an appropriate measure of dispersion often depends heavily on the underlying characteristics of the dataset, particularly its distribution. While the standard deviation is the preferred measure for datasets that follow a normal distribution, the IQR is the superior statistic when dealing with skewed distributions or datasets where the presence of outliers is a concern. Since the calculation of the IQR relies on positional values (quartiles) rather than the exact magnitude of every score, it is classified as a non-parametric statistic, making it highly suitable for data that violate assumptions of normality required for parametric analyses.

Furthermore, the IQR plays an integral role in identifying potential outliers using the standard '1.5 times the IQR' rule. Observations that fall below $Q1 - (1.5 \text{ times IQR})$ or above $Q3 + (1.5 \text{ times IQR})$ are typically flagged as potential outliers. This systematic method allows researchers to

objectively assess and potentially manage extreme values before proceeding with advanced modeling techniques, ensuring the integrity and reliability of subsequent statistical inferences. This utility extends beyond basic reporting into critical data cleaning phases of research methodology.

In summary, whenever a researcher encounters data measured on at least an ordinal scale, and especially when the data distribution is known to be asymmetrical or contains high-leverage points, the IQR should be employed alongside the median to provide a comprehensive and resistant summary of the data's central tendency and spread. Its reliance on robust percentiles rather than means makes it indispensable in domains ranging from finance and economics to psychological and social sciences where data rarely conform perfectly to the Gaussian model.

Prerequisites and Initial Steps in SPSS

Before commencing the calculation of the IQR within SPSS Statistics, the dataset must be correctly loaded and the variable of interest must be defined with an appropriate measurement scale--specifically, the variable should be defined as either Scale (interval/ratio) or Ordinal data, as calculating quartiles for nominal data lacks statistical meaning. Once the data file is open, the calculation process begins by accessing the primary analysis menus, leading to the highly versatile Explore procedure.

The established and most efficient method for obtaining quartiles in SPSS involves navigating through the main menu bar. You must click on **Analyze**, which opens the gateway to all statistical procedures. From the resulting dropdown menu, hover over **Descriptive Statistics**. This submenu contains several useful tools for summarizing data, including Frequencies and Descriptives. However, to reliably obtain the quartiles needed for the IQR, the required option is **Explore**. This procedure is specifically designed not only to generate basic descriptive summaries but also to assess data distribution, detect outliers, and, crucially, calculate comprehensive percentile information.

Step-by-Step Guide: Configuring the Explore Function

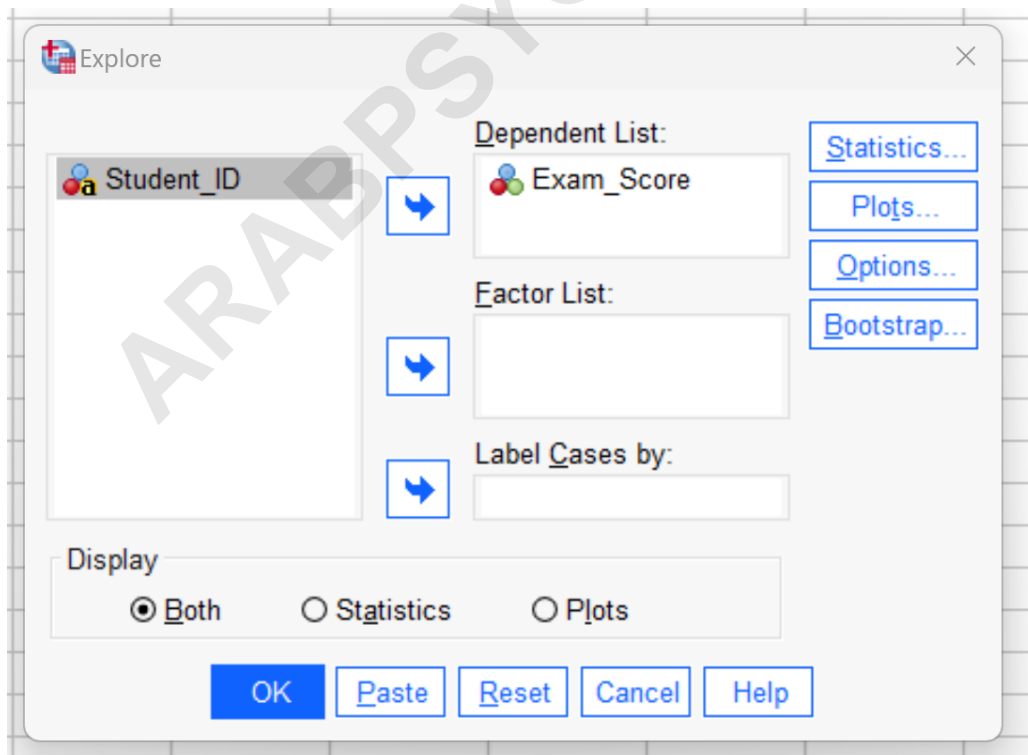
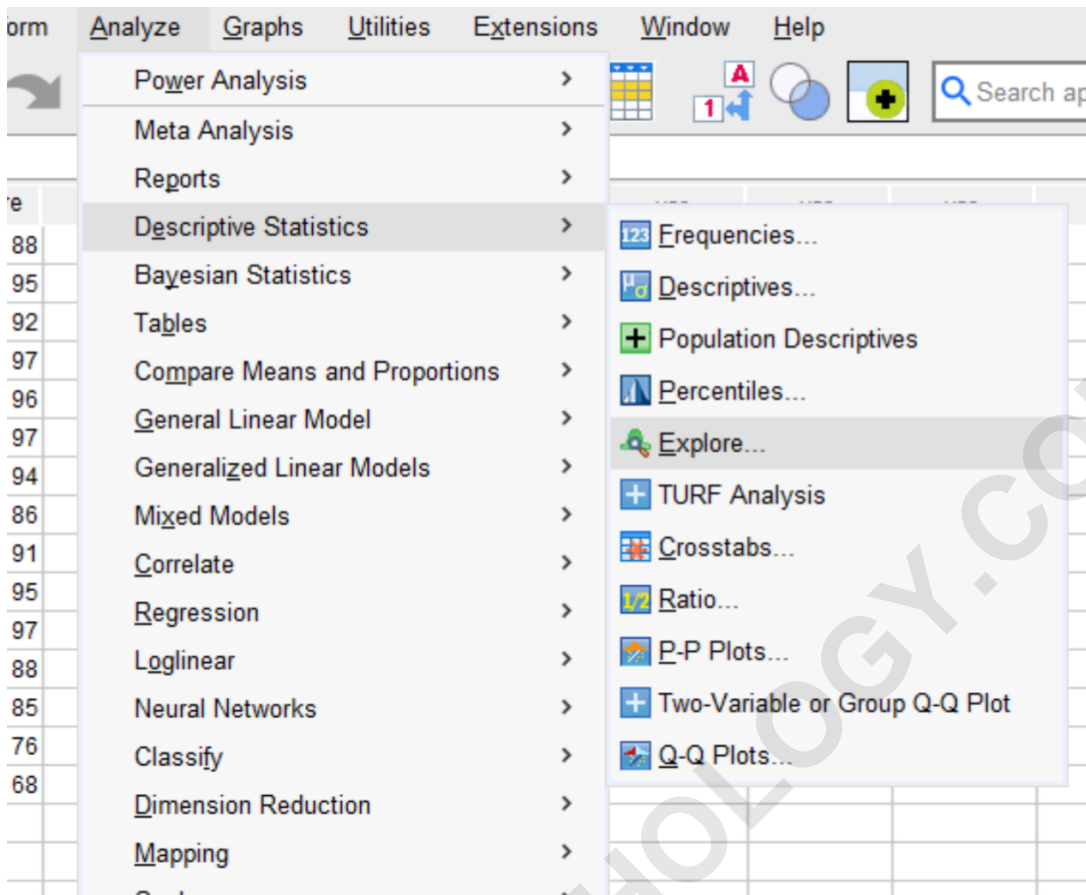
To demonstrate this process, we utilize a sample dataset that records exam scores from a class of students. This variable, labeled 'Exam_Score', is numerical and measured on a Scale level, making it suitable for quartile analysis. The goal is to determine the IQR for these scores to understand the typical spread of student performance.

Suppose we have the following dataset in SPSS that shows the exam scores received by various students in some class:

	Student_ID	Exam_Score	var	var	
1	1	88			
2	2	95			
3	3	92			
4	4	97			
5	5	96			
6	6	97			
7	7	94			
8	8	86			
9	9	91			
10	10	95			
11	11	97			
12	12	88			
13	13	85			
14	14	76			
15	15	68			
16					
17					
18					
19					

To initiate the analysis for the exam scores, the researcher must carefully follow the path: Click the **Analyze** tab, then click **Descriptive Statistics**, and finally click **Explore**. This sequence opens the primary Explore dialog box, which is necessary for defining the variables and specifying the required output statistics.

Upon opening the Explore dialog box, the core task is to identify the variable for analysis. In this new window, the variable **Exam_Score** must be selected from the variable list on the left and then dragged or moved into the **Dependent List** panel on the right. The Dependent List is reserved for the variables whose distribution and summary statistics are to be examined. For a simple IQR calculation, the 'Factor List' and 'Label Cases by' fields can typically be left empty, unless a separate analysis of the IQR is needed across different groups.

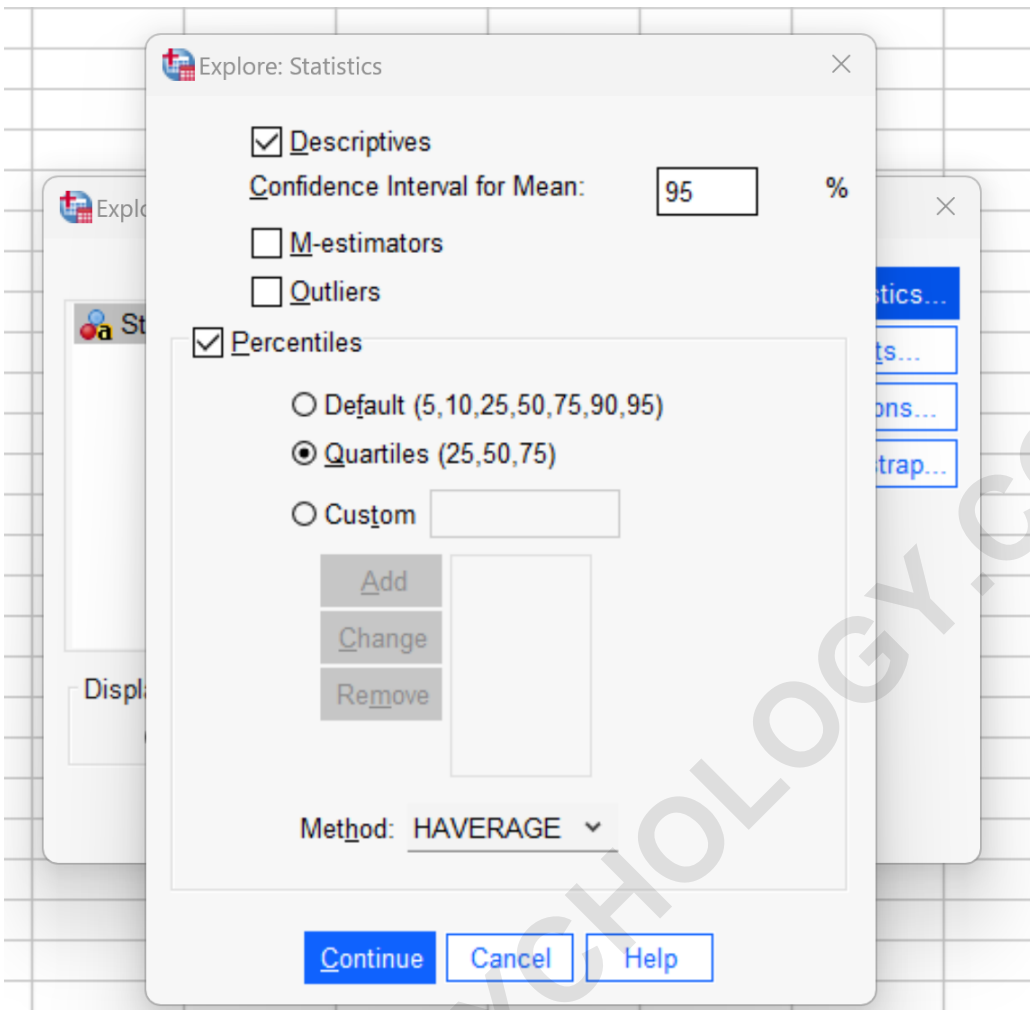


Configuring Options and Generating Output

After placing the variable in the Dependent List, the default output settings in **SPSS** do not automatically include quartiles, necessitating manual configuration. The next critical step is to click the **Statistics** button located on the right side of the Explore dialog box. This action opens a subsidiary window dedicated to selecting specific numerical summaries.

Within the Statistics dialog box, the default setting typically includes only "Descriptives." To obtain the necessary quartiles (Q1 and Q3), the researcher must check the box next to **Percentiles**. Crucially, while there are options for custom percentiles, the standard quartiles (25th, 50th, 75th) are generated by ensuring the button next to **Quartiles** is selected under the Percentiles section. It is worth noting that SPSS offers different methods for calculating percentiles (Weighted Average vs. Empirical definitions); however, for standard **IQR** calculations, the default settings usually suffice and align with standard statistical practice.

Once the **Percentiles** box is checked and **Quartiles** is selected, click **Continue** to return to the main Explore dialog box. Before clicking **OK** to run the procedure, the researcher should briefly check the 'Plots' option. While not strictly necessary for the IQR calculation, ensuring that 'Boxplots' are selected is highly recommended, as the visual output provides immediate confirmation of the quartiles and the overall data variability. Finally, click **OK** to execute the command and generate the statistical output in the SPSS Viewer window.



Interpreting the SPSS Percentiles Output

The execution of the Explore command generates several tables, including Case Processing Summaries and basic Descriptives. The most important table for calculating the IQR is the **Percentiles** table. This output table organizes the calculated percentile values, typically categorized under different methods (e.g., Weighted Average or Tukey's Hinges), though the primary "Weighted Average (Definition 1)" row usually provides the necessary Q1 and Q3 values for textbook IQR calculation.

Reviewing the Percentiles table in the output, the researcher needs to locate the rows corresponding to the 25th percentile (Q1) and the 75th percentile (Q3). For our example dataset of 'Exam_Score', the output will present the specific scores that demarcate these cutoff points. The value listed under the 25th percentile column represents Q1--the score below which 25% of students performed. Similarly, the value under the 75th percentile column represents Q3--the score below which 75% of students performed.

The following output will appear:

→ **Explore**

Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Exam_Score	15	100.0%	0	0.0%	15	100.0%

Descriptives

		Statistic	Std. Error
Exam_Score	Mean	89.67	2.162
95% Confidence Interval for Mean	Lower Bound	85.03	
	Upper Bound	94.30	
5% Trimmed Mean		90.46	
Median		92.00	
Variance		70.095	
Std. Deviation		8.372	
Minimum		68	
Maximum		97	
Range		29	
Interquartile Range		10	
Skewness		-1.551	.580
Kurtosis		2.230	1.121

Percentiles

		Percentiles		
		25	50	75
Weighted Average (Definition 1)	Exam_Score	86.00	92.00	96.00
Tukey's Hinges	Exam_Score	87.00	92.00	95.50

In the **Percentiles** table, specifically utilizing the values derived from the "Weighted Average (Definition 1)" method, we can see that the value at the 25th percentile (Q1) is **86**, and the value at the 75th percentile (Q3) is **96**. These two critical figures provide all the necessary information to finalize the calculation of the interquartile range for the exam scores dataset.

The Final Calculation and Significance of the Result

Once the first and third quartiles have been extracted from the SPSS output, the final step is

straightforward arithmetic. The Interquartile Range (IQR) is determined by subtracting the value of the first quartile (Q1) from the value of the third quartile (Q3). This calculation quantifies the exact range of scores spanned by the middle half of the distribution.

Applying this formula to our example scores, where Q3 is 96 and Q1 is 86, the calculation yields a specific value:

$$\text{IQR} = 75\text{th percentile (Q3)} - 25\text{th percentile (Q1)}$$

$$\text{IQR} = 96 - 86$$

$$\text{IQR} = \mathbf{10}$$

The resulting IQR of 10 signifies that the central 50% of the students scored within a 10-point range (between 86 and 96). This figure offers valuable insight into the concentration of performance. If the scores had been tightly grouped, the IQR would be smaller, suggesting high consistency. Conversely, a larger IQR would imply significant variability among the typical performers. Thus, the IQR serves as an essential descriptive statistic, providing a robust, outlier-resistant measure of spread crucial for robust data interpretation, especially when preparing data for more complex statistical modeling.

The following tutorials explain how to perform other common tasks in SPSS: