

# Understanding Quartile Calculation Methods in Excel: QUARTILE.EXC vs. QUARTILE.INC

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## Understanding the Role of Quartiles in Data Analysis

The calculation of [quartiles](#) is fundamental to descriptive statistics, offering essential insights into the distribution, spread, and central tendency of any given [dataset](#). Quartiles are specific positional values that effectively partition an ordered dataset into four sections, each representing 25% of the total observations. Conventionally, the first quartile (Q1) corresponds to the 25th percentile, the second quartile (Q2) defines the [median](#) (the 50th percentile), and the third quartile (Q3) isolates the 75th percentile.

Accurate quartile calculation is critical for various statistical applications, including the construction of informative box plots, the systematic detection of statistical outliers, and comprehensive understanding of overall data distribution shape. However, determining the precise position or index used to locate these quartiles--especially when dealing with datasets containing an odd number of observations--can vary significantly. It is this methodological variation that causes different software packages, notably [Microsoft Excel](#), to offer specialized functions.

To address the divergence in statistical standards, Excel provides distinct functions designed to accommodate the two most widely accepted methodologies for quartile calculation: the inclusive method and the exclusive method. Understanding which method is being applied is paramount for maintaining consistency and comparability in statistical reporting.

## The Three Quartile Functions in Excel

Excel currently offers three primary functions for determining [quartiles](#) within a range of data. While one function is maintained solely for legacy compatibility, modern statistical practice in Excel focuses predominantly on the explicit `.EXC`` and `.INC`` versions, which clearly delineate the statistical approach employed for positioning the quartiles.

These three functions are:

**1. QUARTILE.EXC:** This function is based on the exclusive method, a traditional counting approach where the central observation, specifically the overall [median](#) (Q2), is systematically excluded when establishing the lower and upper subsets used for calculating the subsequent Q1 and Q3 positions.

The procedure first identifies the overall [median](#) of the dataset to define the initial split into two halves.

Q1 is then calculated as the [median](#) value of the lower half of the data, and Q3 is calculated as the [median](#) of the upper half. It is essential to remember that the central [median](#) observation of the entire dataset must be **excluded** when partitioning the data into these lower and upper subsets for Q1 and Q3 calculation.

**2. QUARTILE.INC:** This function implements the inclusive method. This approach ensures that the central observation (Q2) is included within both the lower and upper data subsets used for the calculation of Q1 and Q3, especially when the dataset contains an odd number of elements. This method often relies on interpolation techniques and is widely adopted as the standard practice in many contemporary statistical software packages.

The dataset is initially segmented based on its overall [median](#) position.

Q1 is determined as the [median](#) value found within the lower half, and Q3 is determined as the [median](#) value found within the upper half. Crucially, the overall [median](#) of the dataset must be **included** when defining the subsets used for the Q1 and Q3 calculations.

**3. QUARTILE:** This is a legacy function that remains solely for the purpose of backward compatibility with older Excel files and versions. Functionally, it performs the exact same calculation as the modern **QUARTILE.INC** function. For all new analyses and statistical work, utilizing the explicit **QUARTILE.INC** function is strongly recommended to ensure methodological clarity.

## Deep Dive into Calculation Differences

The practical distinction between the inclusive and exclusive calculation methodologies becomes most apparent when applied to a specific [dataset](#), particularly one that contains an odd number of observations. The core decision--whether to include or exclude the central median observation--fundamentally alters the index position utilized for subsequent calculations or interpolation, thereby leading to differing final results for Q1 and Q3.

To illustrate this variance, let us analyze the following ordered dataset, which consists of N=15 observations. In this set, the overall median (Q2) is clearly 17.

Dataset: 4, 6, 6, 7, 8, 12, 15, 17, 20, 21, 21, 23, 24, 27, 28

### QUARTILE.EXC: The Exclusive Method

The **QUARTILE.EXC** function dictates that the overall median (17) must be removed from consideration before calculating the lower quartile (Q1) and the upper quartile (Q3). This action effectively splits the remaining dataset into two precisely equal halves, each containing 7 distinct observations.

Q1 Calculation (Lower Half): We find the median of the subset 4, 6, 6, 7, 8, 12, 15. Since this subset has an odd number of elements (N=7), the median is the 4th value, which is **7**.

Q3 Calculation (Upper Half): We find the median of the subset 20, 21, 21, 23, 24, 27, 28. Similarly, the median is the 4th value, which is **23**.

Following the exclusive methodology, the resulting quartiles are  $Q1 = 7$  and  $Q3 = 23$ .

### **QUARTILE.INC: The Inclusive Method**

Conversely, the **QUARTILE.INC** function requires that the overall median (17) be included in both the lower and upper subsets of the data. This inclusion results in two larger subsets, each containing 8 observations.

**Q1 Calculation (Lower Half):** We find the median of the subset 4, 6, 6, 7, 8, 12, 15, 17. Since this subset has an even number of elements ( $N=8$ ), the median is calculated as the average of the two central values (the 4th value, 7, and the 5th value, 8). The result is  $(7 + 8) / 2$ , or **7.5**.

**Q3 Calculation (Upper Half):** We find the median of the subset 17, 20, 21, 21, 23, 24, 27, 28. The median is the average of the two central values (the 4th value, 21, and the 5th value, 23). The result is  $(21 + 23) / 2$ , or **22**.

Using the inclusive methodology, the resulting quartiles are  $Q1 = 7.5$  and  $Q3 = 22$ .

### **Example: Visualizing QUARTILE.EXC vs. QUARTILE.INC in Excel**

To fully grasp how these functional differences translate in a practical setting, we can apply these functions within [Excel](#), using the numerical [dataset](#) referenced above, entered into a single column:

Below is the arrangement of our sample dataset within the Excel spreadsheet:

	A	B	C	D	E	F	G
1	<b>Data</b>						
2	4						
3	6						
4	6						
5	7						
6	8						
7	12						
8	15						
9	17						
10	20						
11	21						
12	21						
13	23						
14	24						
15	27						
16	28						
17							
18							
19							
20							
21							
22							

When the specific quartile functions are applied to this range, the resulting calculations immediately confirm the differences that arise from the inclusion or exclusion of the central median value, illustrating the divergence in statistical outcome:

	A	B	C	D	E	F	G
1	<b>Data</b>			<b>Q1</b>	<b>Q3</b>	Formulas Used	
2	4		<b>QUARTILE</b>	7.5	22	=QUARTILE(A2:A16, 1)	=QUARTILE(A2:A16, 3)
3	6		<b>QUARTILE.INC</b>	7.5	22	=QUARTILE.INC(A2:A16, 1)	=QUARTILE.INC(A2:A16, 3)
4	6		<b>QUARTILE.EXC</b>	7	23	=QUARTILE.EXC(A2:A16, 1)	=QUARTILE.EXC(A2:A16, 3)
5	7						
6	8						
7	12						
8	15						
9	17						
10	20						
11	21						
12	21						
13	23						
14	24						
15	27						
16	28						
17							
18							
19							
20							
21							
22							
23							

When utilizing the **QUARTILE** (legacy) or **QUARTILE.INC** functions, which strictly adhere to the inclusive method, the resulting lower and upper [quartiles](#) are calculated as:

**Q1:** 7.5

**Q3:** 22

Conversely, when using the **QUARTILE.EXC** function, which implements the exclusive method defined by traditional counting rules, the resulting lower and upper [quartiles](#) are distinct:

**Q1:** 7

**Q3:** 23

## When to Use QUARTILE.EXC vs. QUARTILE.INC

The selection between **QUARTILE.EXC** and **QUARTILE.INC** is primarily a decision rooted in adhering to a specific statistical convention or interpolation standard, rather than identifying one method as universally mathematically correct. It is essential to recognize that neither method possesses inherent superiority; they simply align with different interpolation formulas and counting standards commonly taught across various academic disciplines and utilized by disparate computational tools.

Because different statistical softwares often employ different default formulas for calculating [quartiles](#) (sometimes referred to as quantile types), Excel strategically provides both options. Understanding these external defaults is crucial for analysts seeking cross-platform compatibility and accurate result replication:

The [R programming language](#), when employing its standard Type 7 algorithm for quantile calculations, typically produces results that match those generated by **QUARTILE.INC**.

The [Python programming language](#) (particularly when leveraging popular statistical libraries such as NumPy or Pandas) often defaults to an interpolation method that shows strong alignment with **QUARTILE.INC** results.

Many traditional graphing calculators, such as models like the TI-84, frequently use a specific counting rule that corresponds precisely to the results returned by **QUARTILE.EXC**.

In summary, if the objective is to replicate or benchmark results against output from modern, standardized statistical computing environments, **QUARTILE.INC** is generally the most reliable choice. Conversely, if the analysis requires comparison against methodologies found in older statistics textbooks or verification against results produced by specific graphing calculators, **QUARTILE.EXC** may be necessary to ensure consistency.

## Convergence and Practical Impact

A reassuring point for practical data analysis is that in the vast majority of real-world scenarios, particularly when analysts are working with significantly large [datasets](#), the numerical difference between the values calculated by **QUARTILE.INC** and **QUARTILE.EXC** tends to be statistically negligible. As the sample size (N) increases substantially, the influence exerted by the single central observation (the median) on the subsequent quartile calculations diminishes greatly, causing the two results to converge.

For academic reporting or any form of rigorous statistical analysis where methodological transparency is a core requirement, it is essential practice to always explicitly document and specify which Excel function was utilized. In non-critical business analysis or general exploratory data visualization, using either function is typically acceptable, as the resulting statistical insights--such as the interquartile range or measures of skewness--will remain extremely similar and support the same conclusions.

Furthermore, depending entirely on the unique sequence and size of the numbers within a specific dataset, the two functions will occasionally return the exact same numerical values, which underscores the fact that the difference between the two methods is often marginal rather than fundamentally substantial.

## **Additional Resources**

For those requiring a deeper comprehension of quantile methods and the precise algorithms (such as Type 7 and Type 6) that govern these complex calculations across various statistical software platforms, focused research into formal statistical methodologies and interpolation techniques is highly recommended.