

Learn How to Apply the 68-95-99.7 Rule (Empirical Rule) in Excel

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Understanding the Empirical Rule and its Significance

The [Empirical Rule](#), famously known as the 68-95-99.7 rule, is a cornerstone concept in statistical theory. Its application is strictly limited to datasets that demonstrate a [normal distribution](#), often visualized as a bell curve. This powerful statistical guideline offers a rapid yet remarkably accurate method for estimating the proportion of data points that cluster around the central tendency, specifically the [mean](#). For anyone involved in data analysis or statistical interpretation, a solid grasp of this rule is fundamental to assessing variability and drawing meaningful conclusions from population samples.

The structure of the rule relies entirely on intervals defined by the [standard deviation](#) of the dataset. Unlike analyses of raw or irregularly distributed data, the inherent properties of the normal distribution allow us to make definitive, probability-based statements simply by knowing the mean and the standard deviation. The rule establishes specific percentages of data expected to fall within integer multiples of the standard deviation away from the mean:

68% of all data values will fall within **one standard deviation** (± 1 SD) of the mean.

95% of all data values will fall within **two standard deviations** (± 2 SD) of the mean.

99.7% of all data values will fall within **three standard deviations** (± 3 SD) of the mean.

This guideline is invaluable for quickly characterizing a dataset's spread, identifying potential anomalies, and setting crucial benchmarks. In the following tutorial, we will provide a comprehensive, step-by-step methodology for applying the [Empirical Rule](#) using Microsoft Excel, demonstrating precisely how to calculate and interpret these vital ranges for any appropriate dataset.

Preparing the Spreadsheet for Empirical Rule Calculations

To illustrate the practical and straightforward application of the Empirical Rule within a spreadsheet environment, we will commence with a simple, hypothetical scenario. Assume we are analyzing a dataset that has been definitively confirmed to adhere to a [normal distribution](#). For our initial demonstration, let us establish that this dataset possesses a known [mean](#) of **7** and a [standard deviation](#) of **2.2**. Our primary objective is to define the exact quantitative boundaries corresponding to the 68%, 95%, and 99.7% confidence intervals, which are crucial for subsequent analysis.

The process of determining these boundaries in Excel is exceptionally streamlined, relying solely on fundamental arithmetic operations: addition and subtraction. For any specified interval percentage (e.g., 68%), the lower boundary is calculated by taking the mean and subtracting the product of the standard deviation and the sigma level (which is 1, 2, or 3). Conversely, the upper boundary is found by adding that same product to the mean. This clear, systematic approach allows us to precisely establish the expected ranges for the vast majority of the data points.

Detailed Calculation Example: Mean = 7, SD = 2.2

The visual aid below depicts the ideal structure for calculating these critical values within Excel. We recommend placing the key statistical inputs--the mean and the standard deviation--in dedicated input cells (C2 and C3 in this specific template). This setup facilitates the subsequent calculation of the boundaries for the ± 1 , ± 2 , and ± 3 standard deviation ranges. The screenshot provides immediate visual confirmation of the calculated ranges, offering instant insight into the expected spread of the data based on the established parameters.

	A	B	C	D	E	F	G
1							
2		mean	7				
3		standard deviation	2.2				
4							
5							
6		68% of data falls between:	4.8	9.2		= $\$C\$2 - \$C\3	= $\$C\$2 + \$C\3
7		95% of data falls between:	2.6	11.4		= $\$C\$2 - 2* \$C\3	= $\$C\$2 + 2* \$C\3
8		99.7% of data falls between:	0.4	13.6		= $\$C\$2 - 3* \$C\3	= $\$C\$2 + 3* \$C\3
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							

By analyzing the numerical results derived from the formulas entered in columns *F* and *G*, we can make the following definitive statements regarding the characteristics of this particular normally distributed dataset:

68% of the data is contained within the interval spanning **4.8** and **9.2** (Mean ± 1 * SD).

95% of the data is contained within the interval spanning **2.6** and **11.4** (Mean ± 2 * SD).

99.7% of the data is contained within the interval spanning **0.4** and **13.6** (Mean ± 3 * SD).

It is essential to recognize that the Excel formulas employed in columns *F* and *G* are direct mathematical translations of the [Empirical Rule](#) definition itself. Specifically, the fundamental calculation for the lower bound is expressed as **Mean - (N * Standard Deviation)**, and the upper bound is calculated as **Mean + (N * Standard Deviation)**, where N is the sigma level (1, 2, or 3)

corresponding to the desired confidence percentage.

Scalability: Applying the Rule to Diverse Datasets

The primary advantage of establishing this initial, structured Excel template is its inherent flexibility and automation capability. To apply the [Empirical Rule](#) to an entirely new dataset, the analyst is only required to update the input values for the mean and the standard deviation (specifically in cells C2 and C3, following our structured template). Upon inputting the new figures, all calculated boundaries for the 68%, 95%, and 99.7% intervals immediately refresh and update. This feature significantly streamlines the statistical analysis workflow, making it fast and repeatable across numerous data sources.

Consider a new business intelligence scenario where the population parameters are significantly different. For instance, imagine a dataset characterized by a [mean](#) of **40** and a standard deviation of **3.75**. By simply updating the input cells, Excel instantaneously recalculates the precise expected ranges, as clearly demonstrated in the visual output below. This powerful automation underscores how readily scalable this method is for analyzing diverse distributions, provided they rigorously adhere to the characteristic bell-shaped curve of a [normal distribution](#).

	A	B	C	D	E	F	G
1							
2		mean	40				
3		standard deviation	3.75				
4							
5							
6		68% of data falls between:	36.25	43.75		= \$C\$2 - \$C\$3	= \$C\$2 + \$C\$3
7		95% of data falls between:	32.5	47.5		= \$C\$2 - 2*\$C\$3	= \$C\$2 + 2*\$C\$3
8		99.7% of data falls between:	28.75	51.25		= \$C\$2 - 3*\$C\$3	= \$C\$2 + 3*\$C\$3
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							

Based on this second output, the distribution boundaries are now defined as follows:

68% of the data falls between **36.25** and **43.75**.

95% of the data falls between **32.5** and **47.5**.

99.7% of the data falls between **28.75** and **51.25**.

Case Study: Standardized Distribution Analysis (Mean = 100, SD = 5)

For our concluding demonstration using the Empirical Rule approximation, we will examine a standardized dataset commonly encountered in fields like psychological testing, educational assessments, or industrial quality control. This distribution features a mean of **100** and a standard deviation of **5**. The consistent and immediate application of the Empirical Rule quickly yields clear, perfectly symmetrical boundaries around the central tendency. These boundaries are immediately valuable for establishing reliable performance benchmarks and efficiently identifying potential statistical outliers.

	A	B	C	D	E	F	G
1							
2		mean	100				
3		standard deviation	5				
4							
5							
6		68% of data falls between:	95	105		= \$C\$2 - \$C\$3	= \$C\$2 + \$C\$3
7		95% of data falls between:	90	110		= \$C\$2 - 2*\$C\$3	= \$C\$2 + 2*\$C\$3
8		99.7% of data falls between:	85	115		= \$C\$2 - 3*\$C\$3	= \$C\$2 + 3*\$C\$3
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							

For this standardized distribution, the calculated ranges are highly intuitive:

68% of the data falls between **95** and **105**.

95% of the data falls between **90** and **110**.

99.7% of the data falls between **85** and **115**.

Achieving Precision: Calculating Probabilities for Non-Standard Intervals

While the Empirical Rule offers robust, quick approximations for intervals defined by 1, 2, and 3 standard deviations, advanced statistical analysis frequently demands the calculation of the exact percentage of data falling between two arbitrary, non-standard values. This necessity moves us beyond simple arithmetic and requires the use of specialized functions within Excel designed for precise probability calculation under the assumption of a [normal distribution](#).

Let us revisit the parameters established in the previous Example 3, where the mean was 100 and the standard deviation was 5. Instead of relying on the standard 68% interval (95 to 105), suppose we now need to determine the exact proportion of data points that specifically fall between the values of **99** and **105**. To solve this common analytical challenge, we must leverage Excel's powerful built-in statistical tool: the **NORM.DIST()** function.

Understanding and Utilizing the NORM.DIST() Function

The [NORM.DIST\(\)](#) function is specifically engineered to return the normal cumulative distribution for a given value, based on a specified mean and standard deviation. Crucially, calculating the probability (or area) between any two points (Point A and Point B) requires a subtraction technique: we must subtract the cumulative probability up to the lower bound (A) from the cumulative probability up to the upper bound (B). This method is indispensable for accurately determining the precise area under the normal curve that corresponds to the desired interval.

The syntax of the NORM.DIST() function requires the definition of four arguments, which must be correctly supplied for the calculation to be executed:

NORM.DIST(x, mean, standard_dev, cumulative)

These arguments are defined as follows:

x: This represents the specific data value or boundary point within the distribution for which the cumulative probability is sought.

mean: The central tendency, or arithmetic average, of the specified distribution.

standard_dev: The measure of data variability, or the degree of dispersion/spread.

cumulative: A logical input where using "TRUE" returns the value of the [cumulative distribution function \(CDF\)](#). The CDF represents the total probability that a random variable will be less than or equal to x. For interval calculations, using **TRUE** is mandatory.

To find the exact percentage of data between 99 and 105 for our example distribution, the required Excel formula is constructed as: **=NORM.DIST(105, 100, 5, TRUE) - NORM.DIST(99, 100, 5, TRUE)**. The subsequent screenshot verifies this exact operation performed within Excel,

confirming the precisely calculated area between these two points on the normal distribution curve.

	A	B	C	D	E	F	G
1							
2							
3							
4							
5		=NORM.DIST(105, 100, 5, TRUE) - NORM.DIST(99, 100, 5, TRUE)					
6		42.1%					
7							
8							
9							
10							
11							
12							
13							
14							
...							

The final result clearly indicates that **42.1%** of the data falls within the specific range bounded by the values 99 and 105 for this particular distribution. By mastering the **NORM.DIST()** function, you significantly elevate your capability to perform sophisticated, precise statistical analysis, moving well beyond the general approximations offered by the Empirical Rule alone.

Further Resources for Statistical Practice

To solidify your understanding of the core concepts related to the Empirical Rule, the normal distribution, and practical Excel applications, we highly recommend utilizing these supplementary tools and detailed practice materials:

[Empirical Rule Calculator](#)

[Empirical Rule \(Practice Problems\)](#)