

# How to Find the Mode of a Histogram (With Example)?

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The mode of a statistical distribution represents a critical measure of central tendency: the value that occurs with the greatest frequency. While calculating the mode for discrete data is straightforward--simply counting the most repeated element in the data set--determining the mode when data is grouped, as in a histogram, requires a specialized estimation technique. A histogram graphically summarizes the distribution of a continuous variable by dividing the range of values into intervals, or bins, and displaying the frequency of observations falling into each bin using rectangular bars.

The core challenge in finding the mode from a histogram stems from the fact that the original data points are aggregated. We only know the frequency of a range of values, not the frequency of a single point within that range. Therefore, we cannot identify the exact mode. Instead, statisticians employ a reliable geometric method to estimate the mode, pinpointing where the peak of the underlying distribution curve is most likely to fall within the modal class. This comprehensive guide will detail the geometric estimation process, ensuring you can accurately determine the most representative value from any frequency distribution visualized as a histogram.

Understanding the mode's location is vital for interpreting the shape of the data distribution. Whether the distribution is unimodal (one mode), bimodal (two modes), or multimodal, the mode provides immediate insight into the most common outcome or measurement. When working with histograms, the first step is always to identify the modal class--the bin with the greatest height--which serves as the basis for our subsequent geometric calculation. This method, while graphical, provides an extremely close approximation to the true mode, particularly when the data is reasonably symmetrical or mildly skewed.

## Understanding the Modal Class in a Histogram

A histogram is constructed by plotting frequency on the vertical (Y) axis and the class intervals (bins) on the horizontal (X) axis. The bar that reaches the greatest height corresponds to the class interval with the highest frequency, which is officially termed the **modal class**. Although one might intuitively assume that the midpoint of this tallest bar is the mode, this simplification often proves inaccurate, especially in cases where the data distribution is significantly skewed. A more precise estimation is required to account for the influence of adjacent classes.

The goal of the geometric estimation technique is not just to find the center of the tallest bar, but to locate the specific point within that bar's range where the concentration of data points is highest, taking into account the frequencies of the classes immediately preceding and succeeding the modal class. These neighboring bars exert a pull on the true peak of the data. For instance, if the bar immediately following the modal class is significantly taller than the bar preceding it, the estimated mode will be pulled towards the higher values within the modal class range.

To accurately find the estimated mode, we utilize the relationship between the heights of the modal class bar and its immediate neighbors. This method, often taught in introductory statistics, relies on drawing simple diagonal lines that visually interpolate the peak of the data density within the modal interval. By carefully executing this drawing process, we achieve a high degree of precision in approximating the most frequent value in the grouped data set.

## The Geometric Estimation Method Overview

The technique for estimating the mode geometrically is designed to isolate the highest point of concentration within the modal class boundaries. This process involves four clear, sequential steps that utilize the corners of the bars representing the modal class and its two adjacent classes (the pre-modal and post-modal classes). This method ensures that the final estimate reflects the true asymmetry or symmetry of the data surrounding the peak frequency.

The method is procedural and demands careful drafting. The general approach involves drawing two specific diagonal lines: one line connects the corner of the modal bar to a corner of the preceding bar, and the second line connects the corner of the modal bar to a corner of the succeeding bar. The intersection of these two lines mathematically represents the most likely location of the mode. Once this intersection is found, projecting it down to the X-axis yields the estimated numerical value.

The **mode** of a dataset represents the value that occurs most often, derived through graphical interpolation when using a histogram.

To find the mode in a histogram using the geometric estimation method, we must follow these standardized steps:

Identify the **tallest bar**, which designates the modal class.

Draw a line from the top-left corner of the tallest bar to the top-left corner of the bar immediately following it (the post-modal class).

Draw a line from the top-right corner of the tallest bar to the top-right corner of the bar immediately preceding it (the pre-modal class).

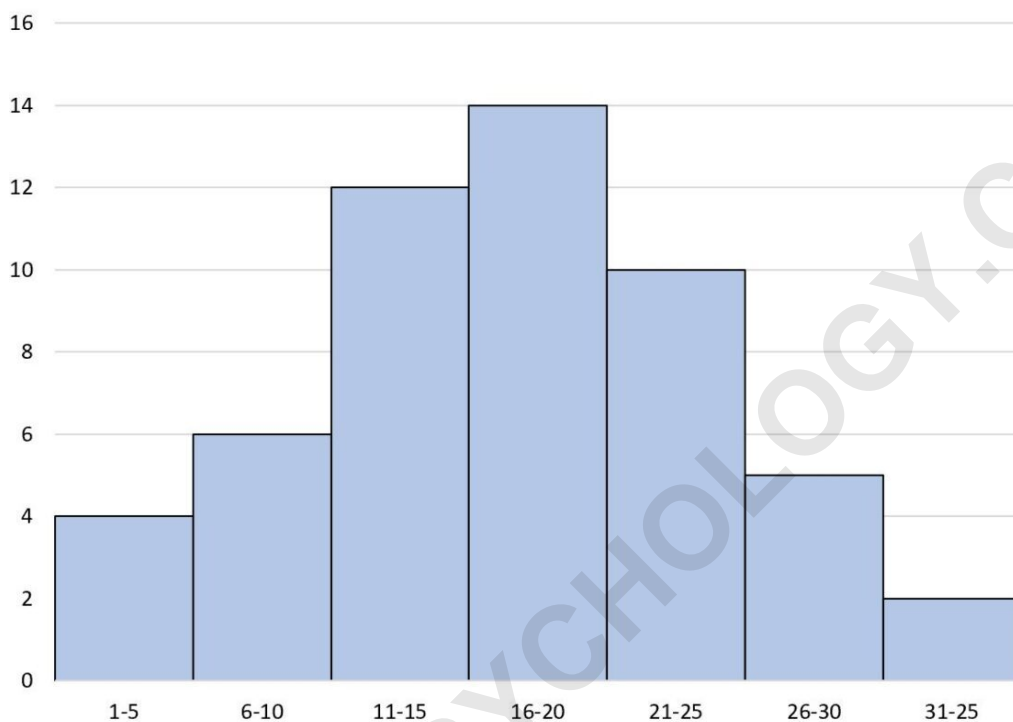
Identify the point where the two diagonal lines intersect. Then draw a vertical line straight down to the horizontal X-axis. The resulting intersection point on the X-axis is the estimated mode.

This process provides a visual derivation of the mode, complementing the analytic approach often used for continuous frequency distributions. We will now apply these steps rigorously to a practical example to solidify the technique.

## Example Walkthrough: Estimating the Mode

Consider the following histogram, which depicts a hypothetical frequency distribution. We will use this visual data representation to demonstrate the geometric mode estimation method precisely, following the steps outlined above. Observe the distribution of the bars and note the height of each respective class interval, which clearly illustrates a non-symmetrical distribution.

The following step-by-step example shows how to find the mode of the following histogram:



The visual inspection of this graph immediately reveals the primary concentration of data points. The technique we apply here is crucial for academic work and detailed statistical analysis where a simple midpoint approximation would introduce unacceptable error. Pay close attention to the coordinates used for drawing the diagonal lines, as the accuracy of the final estimate depends entirely on these starting points.

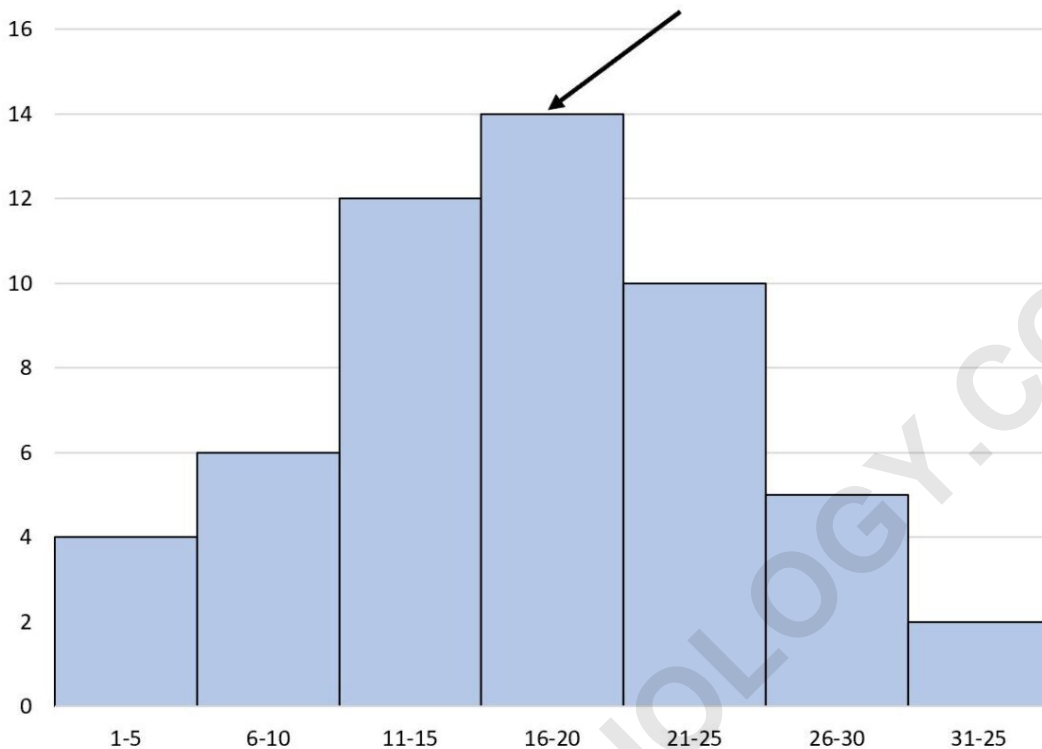
### Step 1: Identifying the Modal Class

The first critical action is to locate the bar that dominates the graph in terms of height. This tallest bar represents the class interval with the maximum frequency, hence defining the **modal class**. The identification of this bar is non-negotiable, as all subsequent geometric constructions are anchored to its boundaries.

First, we need to identify the tallest bar in the histogram.

In this specific example, the highest frequency occurs within the class interval ranging from 16 to

20. This interval, therefore, is designated as the modal class, serving as the foundation for our mode estimation:

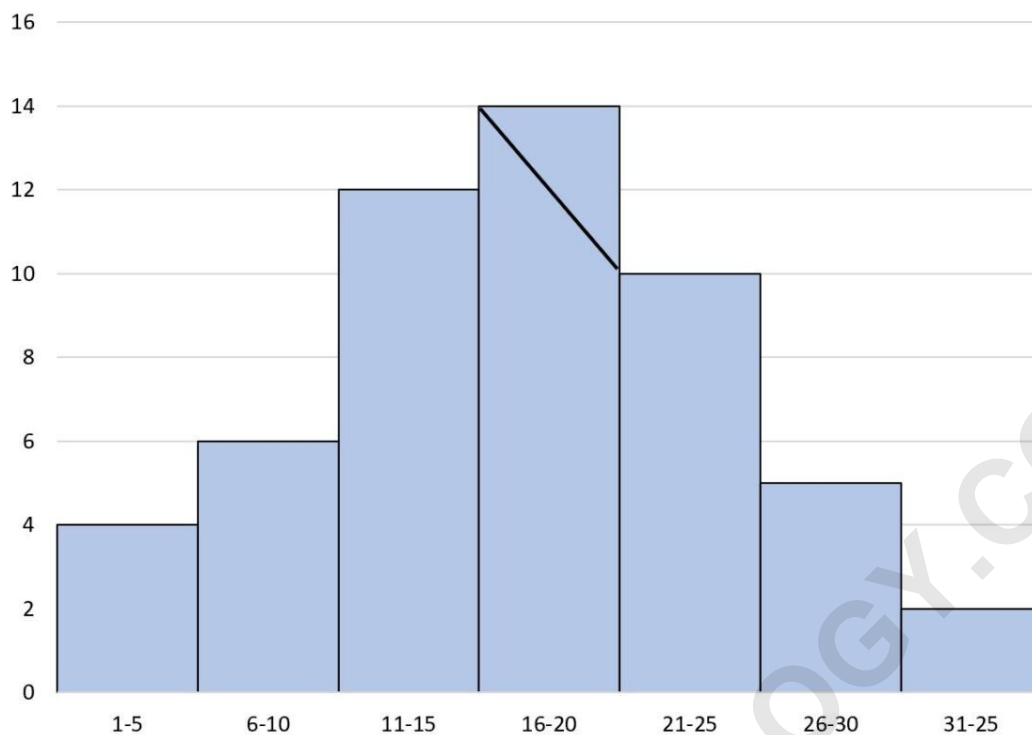


Note the frequencies of the surrounding bars. The class interval immediately before the modal class (the pre-modal class) and the class interval immediately after (the post-modal class) play an influential role in determining the exact location of the mode within the 16-20 range. If the distribution were perfectly symmetrical, the mode would simply be the midpoint (18). However, visual inspection suggests a slight skew, necessitating the geometric method for precision.

### Step 2: Drawing the First Auxiliary Line (Accounting for Post-Modal Frequency)

The next step involves drawing the first diagonal line, which incorporates the influence of the succeeding class interval. This line is drawn from the top-left corner of the modal class bar to the top-left corner of the bar immediately after it. This connection visually bridges the peak of the modal class with the data concentration of the higher values, helping to account for any potential skew relative to the center of the modal class.

Next, we need to draw a line from the top-left corner of the tallest bar to the top-left corner of the bar immediately after it. This line helps establish the downward slope of the density function as it moves into the higher class intervals:

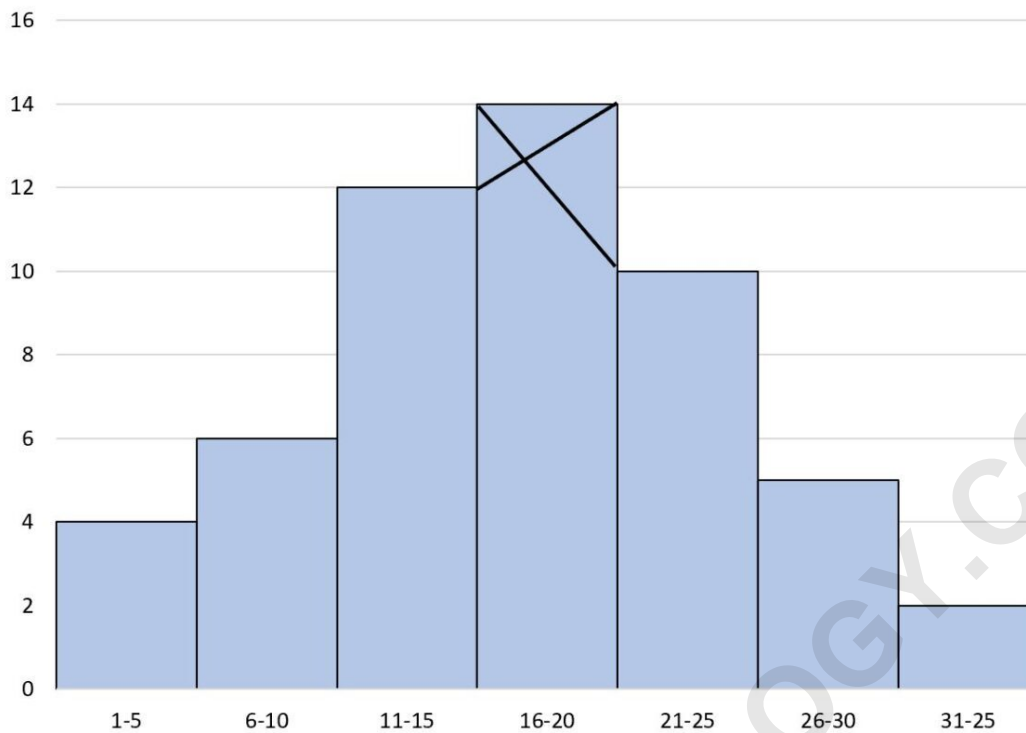


The starting and ending points for this line are crucial. If the subsequent bar (the post-modal class) were significantly shorter, this diagonal line would be much steeper, pulling the intersection point further to the left. Since the post-modal bar in this example still has a noticeable height, the influence it exerts ensures the mode estimate is carefully calculated relative to its frequency, contributing to the overall shape of the estimated frequency curve.

### Step 3: Drawing the Second Auxiliary Line (Accounting for Pre-Modal Frequency)

To complete the geometric construction, we must draw the second diagonal line, which accounts for the influence of the preceding class interval. This line is drawn from the top-right corner of the modal class bar to the top-right corner of the bar immediately before it. This connection essentially maps the upward slope of the data density as it culminates in the modal class, reflecting the overall rightward skew potential that might shift the mode away from the class midpoint.

Subsequently, we need to draw a line from the top-right corner of the tallest bar to the top-right corner of the bar immediately before it. This construction is vital for interpolating the exact peak:

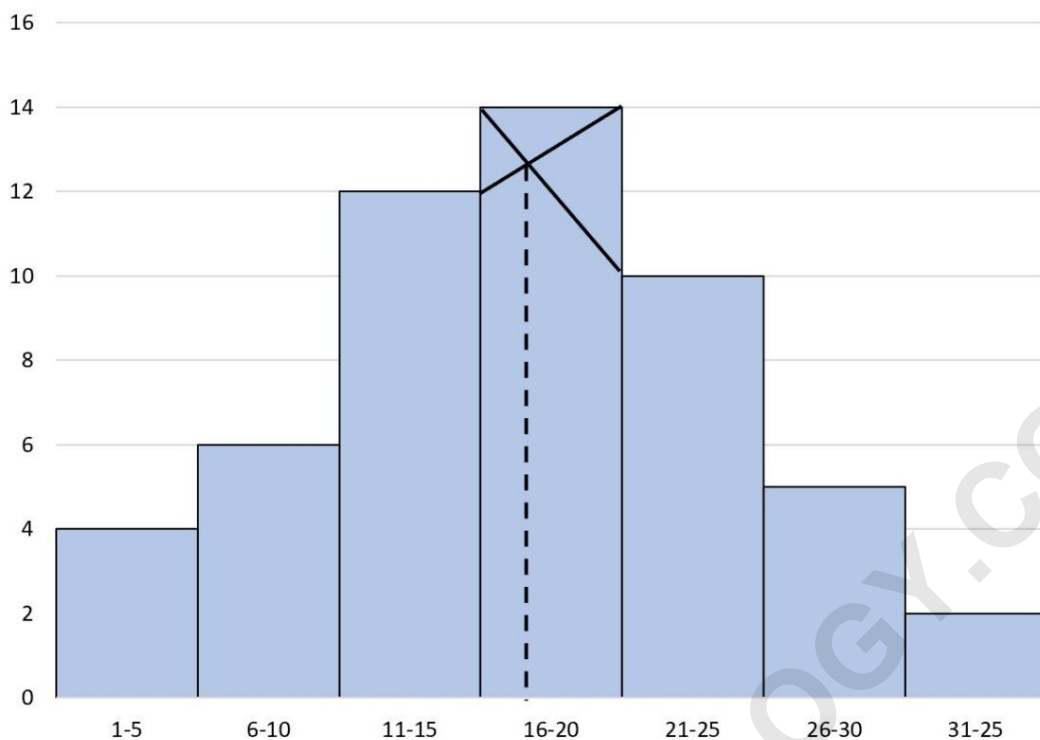


It is important to notice how the two diagonal lines cross. If the data were skewed sharply to the right (meaning the pre-modal class was much shorter than the post-modal class), the intersection point would shift towards the left boundary of the modal class (16). Conversely, the relative heights of the surrounding intervals in this scenario determine the precise point of intersection, highlighting the slight bias induced by the neighboring frequencies.

#### Step 4: Locating the Point of Intersection and Estimating the Mode

With both auxiliary lines drawn, the point where they cross represents the culmination of the geometric estimation process. This intersection point marks the coordinates (X, Y) corresponding to the highest likely concentration of data, given the grouped data set structure. To obtain the actual mode value, we only need the X-coordinate of this intersection.

Next, we need to identify the point where the two lines intersect. Then draw a vertical line straight down to the horizontal X-axis:



The point where the vertical line intersects the X-axis is our best estimate for the mode.

In this example, the resulting intersection point projects down to a value slightly below 18. Therefore, our best estimate for the mode is roughly **17**. This outcome confirms that while the modal class is 16-20, the highest density of values is concentrated toward the lower end of that interval, reflecting the influence of the relative frequencies of the adjoining bins.

### Limitations and Interpretation of the Estimated Mode

It is paramount to recognize that the value derived using the geometric method, while highly accurate, remains an **estimation**, not the exact mode. This inherent limitation arises because the underlying raw data is grouped into bins during the creation of the histogram. We lose the precision of individual data points when they are aggregated into class intervals, meaning the exact value with the highest frequency is obscured.

**Note:** Since the data in a histogram is grouped into bins, it's not possible to know the exact value of the mode. However, the geometric method employed here allows statisticians to make the most informed and accurate estimate possible based on the graphical representation of the frequency distribution.

For research applications requiring absolute certainty regarding the mode, the researcher must revert to the original, ungrouped data set. However, in many practical scenarios, such as

preliminary data visualization and reporting, this graphical estimation technique offers sufficient precision to interpret the central tendency and skewness characteristics of the data distribution efficiently.

### Alternative Calculation Method: Interpolation Formula

While the geometric method provides an excellent visual understanding, statisticians often use a corresponding algebraic interpolation formula for calculating the mode from a frequency distribution table, which mirrors the logic of the diagonal lines. This formula confirms the visual estimate and is essential for computer-based calculations, offering an analytical counterpoint to the graphical method.

The formula for the mode ( $M_o$ ) in grouped data is generally expressed as:

$$M_o = L + \frac{f_m - f_1}{f_m - f_1 + f_2} \cdot w$$

Where:

**L** is the lower boundary of the modal class.

**f<sub>m</sub>** is the frequency of the modal class.

**f<sub>1</sub>** is the frequency of the class preceding the modal class (pre-modal).

**f<sub>2</sub>** is the frequency of the class succeeding the modal class (post-modal).

**w** is the width of the modal class interval.

Both the geometric drawing technique and this analytical interpolation formula should yield essentially the same result. The geometric method is particularly valuable as it provides intuitive proof of the mode's dependence on the relative heights of the adjacent classes, confirming the robustness of the estimation method for determining the peak of the frequency density in grouped data.

### Further Resources on Histogram Analysis

Mastering the analysis of grouped data extends beyond finding the mode. Calculating the median and mean from histograms also requires specific estimation techniques due to the aggregation of the raw data. These methods are crucial for a complete statistical description of the data's central tendency.

The following tutorials explain how to perform other common tasks involving histograms, such as calculating the median or mean from grouped data tables: