

How to Find Class Boundaries?

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Understanding Frequency Distributions and Class Limits

When analyzing large sets of statistical data, organizing raw observations into meaningful groups is essential for clear interpretation. A frequency distribution is a powerful descriptive statistical tool that summarizes data by showing how often various values or ranges of values occur. This organizational method involves grouping the data into defined intervals known as classes.

Each class within a distribution is formally defined by two numerical markers: the lower class limit and the upper class limit. These limits state the smallest and largest actual data values that can belong to that specific class, respectively. However, in most raw data sets, classes are often separated by tiny gaps or discontinuities. For example, if one class ends at a value of 19 and the very next class begins at 20, there is a visible gap between these two measured intervals. This inherent discontinuity often necessitates an adjustment, which is where the concept of boundary values becomes critically important for achieving statistical continuity.

The core challenge with utilizing only class limits is that they do not inherently account for the potential continuity in the underlying measurement scale. If the variable being measured is theoretically continuous (even if the measurements are reported discretely), these gaps can lead to ambiguity regarding where an observation should truly be placed, particularly when constructing continuous visualizations like histograms. To address this mathematical gap and ensure a smooth, continuous display of data, statisticians use class boundaries. These boundaries are the precise, shared points that mathematically separate adjacent classes without any overlap or intervening space, ensuring that every possible numerical value falls definitively into exactly one class.

The Purpose of Calculating Class Boundaries

Class boundaries serve the vital statistical purpose of transforming discrete class limits--which often have visible gaps--into a continuous scale. When data is presented with limits like 10-19 and 20-29, the interval between 19 and 20 is not explicitly accounted for by either class. While this might be acceptable for truly discrete count data, it is problematic when the underlying variable is continuous. This small discontinuity prevents the construction of continuous graphical representations of the data, such as histograms, which require the bars to touch to indicate the flow of continuous data.

By calculating the exact numerical midpoint between the upper limit of one class and the lower limit of the subsequent class, we establish the true boundary point. This resulting boundary value is then used to slightly decrease the lower class limit and slightly increase the upper class limit for every interval. This crucial adjustment eliminates the gaps and ensures that the upper boundary of one class is mathematically identical to the lower boundary of the next class, thus making the data set continuous.

In essence, establishing accurate class boundaries is a prerequisite for generating statistically valid visual aids and for performing certain types of advanced statistical analysis that rely on the assumption of a continuous variable. It standardizes the measurement scale, guaranteeing that the statistical representation truly reflects the continuous nature of the variable being measured, even if the raw collection of statistical data initially appeared discrete due to rounding or reporting conventions.

The Three-Step Procedure for Determining Boundaries

Calculating class boundaries from existing class limits is a highly systematic and straightforward three-step arithmetic procedure designed to precisely quantify and bridge the gap between adjacent classes. This methodology is universally applied regardless of whether the initial data is based on whole numbers or highly precise decimal values. The result of this simple process is a set of precise, continuous class intervals ready for statistical analysis and graphing.

Here are the systematic steps we follow to calculate the class boundaries in any given frequency distribution:

Determine the Gap (The Difference): Select two adjacent classes. Subtract the upper class limit for the first class from the lower class limit for the second class. This difference reveals the precise magnitude of the discontinuity or space existing between the two intervals.

Calculate the Adjustment Factor (The Correction): Divide the gap determined in the previous step by two. This resulting value, often called the correction factor or adjustment factor, represents the exact amount by which we must extend or contract the original limits so that they meet perfectly in the middle of the gap.

Apply the Adjustment (The Transformation): Subtract this adjustment factor from the lower class limit of every single class, and simultaneously add the identical adjustment factor to the upper class limit of every class. This action effectively shifts the limits outward, eliminating all gaps and establishing the final, continuous class boundaries.

Mastering this three-step procedure is essential for accurately handling grouped data. The following examples will illustrate precisely how these steps are implemented in practice, first using integer data and then demonstrating the process with decimal data, highlighting that the core logic remains constant.

Example 1: Calculating Boundaries with Integer Data

Let us analyze a common scenario involving grouped data based on integer measurements. Suppose we have compiled a frequency distribution that represents the number of wins

accumulated by various professional basketball teams during a season. This data set uses integer class limits, creating typical discrete measurements where a one-unit gap exists between the upper limit of one class and the lower limit of the next.

The initial data summary is presented in the following table, where the class intervals are 26-30, 31-35, 36-40, and so on. Notice the clear one-unit discontinuity between 30 (the upper limit of the first class) and 31 (the lower limit of the second class).

Wins	Frequency
26 - 30	2
31 - 35	3
36 - 40	7
41 - 45	8
46 - 50	4
51 - 55	3
56 - 60	2
61 - 65	1

Our goal is to meticulously apply the three-step method to convert these limits into precise, continuous class boundaries. This process ensures that if any measurement fell exactly between the reported limits (e.g., 30.5), it would fall precisely on the established dividing line between the two adjacent classes, removing any ambiguity.

Step-by-Step Calculation for Example 1

The first requirement is to quantify the exact gap existing between the adjacent classes. We use the first two classes for this measurement. The upper class limit for the first class (26-30) is 30, and the lower class limit for the second class (31-35) is 31.

Step 1: Determine the Gap. We calculate the difference between these adjacent limits: 31 minus 30 equals 1. This signifies a full unit of separation, which must be corrected.

$$31 - 30 = 1$$

Wins	Frequency
26 - 30	2
31 - 35	3
36 - 40	7
41 - 45	8
46 - 50	4
51 - 55	3
56 - 60	2
61 - 65	1

Step 2: Calculate the Adjustment Factor. The adjustment factor is always half of the calculated gap. We divide the result from Step 1 by two: $1 / 2$ equals **0.5**. This value of 0.5 is the precise correction needed to close the gap when applied equally to the limits on both sides of the class interval.

Step 3: Apply the Adjustment. The final step involves applying the 0.5 correction factor universally. We subtract 0.5 from every lower class limit (e.g., $26 - 0.5 = 25.5$) and add 0.5 to every upper class limit (e.g., $30 + 0.5 = 30.5$). This action successfully establishes the new, continuous class boundaries, as shown in the table below.

Wins	Frequency	Class Boundaries
26 - 30	2	25.5 - 30.5
31 - 35	3	30.5 - 35.5
36 - 40	7	35.5 - 40.5
41 - 45	8	40.5 - 45.5
46 - 50	4	45.5 - 50.5
51 - 55	3	50.5 - 55.5
56 - 60	2	55.5 - 60.5
61 - 65	1	60.5 - 65.5

Interpreting the Results of Boundary Calculation (Example 1)

Following the successful application of the correction factor (0.5), the original discrete limits have been mathematically transformed into continuous class boundaries. This final structure is visually evident in the table, where the upper boundary of any given class interval perfectly matches the lower boundary of the next adjacent class.

We interpret these adjusted classes, now defined by their true boundaries, as follows:

The first class, originally 26-30, now ranges continuously from a lower class boundary of **25.5** up to an upper class boundary of **30.5**.

The second class, originally 31-35, immediately follows, beginning precisely at the shared boundary point of **30.5** and extending up to an upper class boundary of **35.5**.

The third class, initially 36-40, maintains the established continuous pattern, starting at **35.5** and concluding at **40.5**.

This revised, continuous definition is essential for constructing a statistically correct histogram, where the bars representing these intervals must touch exactly at the boundary points (e.g., 30.5, 35.5), satisfying the requirement for visualizing continuous statistical data.

Example 2: Calculating Boundaries with Decimal Data

The procedure for finding class boundaries remains mathematically identical even when the data is measured and reported to one or more decimal places. The only difference is the scale of the gap we must identify and correct. Data involving precise scientific measurements, such as weights, temperatures, or reaction times, frequently utilize decimal class limits, creating smaller, yet equally important, gaps between intervals.

Consider the following frequency distribution, which features limits defined to one decimal place, such as 56.0-60.9 and 61.0-65.9.

Heights	Frequency
56 - 60.9	13
61 - 65.9	17
66 - 70.9	19
71 - 75.9	14
76 - 80.9	8

In this example, the gap between the end of the first class (60.9) and the start of the second class (61.0) is only 0.1 units--a much smaller discontinuity than in the integer example. However, the exact same three-step method is applied to correct it. We must handle the decimal points carefully throughout the calculation to achieve the required level of accuracy for this set of data.

Step-by-Step Calculation for Example 2 (Decimal Data)

As per the standard procedure, we begin by determining the discontinuity between the classes using adjacent limits. The first class has an upper class limit of 60.9, and the second class has a lower class limit of 61.0.

Step 1: Determine the Gap. Subtracting the upper limit of the first class from the lower limit of the second class yields the gap: 61.0 minus 60.9 equals **0.1**.

$$61 - 60.9 = 0.1$$

Heights	Frequency
56 - 60.9	13
61 - 65.9	17
66 - 70.9	19
71 - 75.9	14
76 - 80.9	8

Step 2: Calculate the Adjustment Factor. We divide this small gap by two to find the necessary correction factor: 0.1 divided by 2 equals **0.05**. This is the precise amount needed to adjust the limits. Importantly, since the original data had one decimal place, the boundary adjustment factor

now utilizes two decimal places to ensure exact correction.

Step 3: Apply the Adjustment. We subtract 0.05 from all lower class limits and add 0.05 to all upper class limits to achieve perfect continuity. For the first class (56.0-60.9), the lower boundary becomes $56.0 - 0.05 = 55.95$, and the upper boundary becomes $60.9 + 0.05 = 60.95$.

Heights	Frequency	Class Boundaries
56 - 60.9	13	55.95 - 60.95
61 - 65.9	17	60.95 - 65.95
66 - 70.9	19	65.95 - 70.95
71 - 75.9	14	70.95 - 75.95
76 - 80.9	8	75.95 - 80.95

Final Interpretation and Summary

The successful application of the three-step method results in new class ranges that are contiguous; that is, they touch without overlapping. This contiguity is fundamental for accurate representation and analysis of continuous variables in statistics.

The final class boundaries established for Example 2 are interpreted as follows:

The first class now runs continuously from a lower class boundary of **55.95** to an upper class boundary of **60.95**.

The second class immediately picks up at the shared boundary point, starting at a lower class boundary of **60.95** and extending to an upper class boundary of **65.95**.

The third class continues this mathematically defined pattern, starting at **65.95** and concluding at **70.95**.

In summary, regardless of the precision of the raw data--whether measured in integers or decimals--the process of finding class boundaries ensures statistical accuracy. It transforms class limits, which define the scope of the raw data collection, into mathematically continuous boundaries that are necessary for advanced statistical graphing and rigorous comparison. Mastering this calculation is a fundamental skill in summarizing and presenting grouped statistical data effectively.