

4.4: Inequalities and Midpoints

Learning Objectives

- Write out an inequality from words.
- Go from a midpoint and error to an inequality.
- Go from inequality to a midpoint and error.

Inequalities are an essential component of statistics. One very important use of inequalities is when we have found a mean or proportion from a sample and want to write out an inequality that gives where the population mean or proportion is likely to lie. Another application is in probability where we want to find the probability of a value being more than a number, less than a number, or between two numbers.

Converting Words to Inequalities

Example 4.4.1

You want to find the probability that it will a patient will "take at least three hours to wake up after surgery". Write an inequality for this situation.

Solution

The key words here are "at least". These words can be written symbolically as " \geq ". Therefore we can write "take at least three hours to wake up after surgery" as:

$$x \geq 3$$

Example 4.4.2

Suppose you want to find the probability that a relationship will last "more than 1 week and at most 8 weeks". Write an inequality for this situation.

Solution

Let's first translate the words "more than". This is equivalent to " $>$ ". Next translate the words "at most". This is equivalent to " \leq ". Now we can put this together to get:

$$1 < x \leq 8$$

Midpoints and Inequalities

There are two ways of thinking about an interval. The first is that x is greater than the lower bound and less than the upper bound. The second is that the center or midpoint of the interval is a given value and the interval goes no more than a certain distance from that value. In statistics, this is important when we look at confidence intervals. Both ways of presenting the interval are commonly used, so we need to be able to go from one way to the other.

Example 4.4.3

A researcher observed 45 startup companies to find a 95% confidence interval for the population mean amount of time it takes to make a profit. The sample mean was 14 months and the margin of error was plus or minus 8 months. In symbols the confidence interval can be written as:

$$14 \pm 8$$

Express this as a trilinear inequality.

Solution

We first find the lower bound by subtracting:

$$14 - 8 = 6$$

Next, we find the upper bound by adding:

$$14 + 8 = 22$$

We can now put this together as a trilinear inequality:

$$6 \leq x \leq 22$$

Example 4.4.4

A researcher interviewed 1000 Americans to asking them if they thought abortion should be against the law. The following 95% confidence interval was given for the population proportion of all Americans who are against abortion:

$$(0.41, 0.47)$$

Find the midpoint and the margin or error. That is write this interval in the form:

$$a \pm b \tag{4.4.1}$$

Solution

Let's first find the midpoint. This is the average of the left and right endpoints:

$$a = \frac{0.41 + 0.47}{2} = 0.44$$

Next, find the distance from the midpoint to either boundary:

$$b = 0.47 - 0.44 = 0.03$$

Finally we can put these two together to get:

$$0.44 \pm 0.03$$

Exercise 4.4.1

A study was done to see how many years longer it takes low income students to finish college compared to high income students. The confidence interval for the population mean difference was found to be:

$$[0.67, 0.84]$$

Find the midpoint and the margin of error. That is write this interval as in the form:

$$a \pm b$$

[Converting an Inequality from Interval Notation to Midpoint and Error Notation \(Links to an external site.\)](#)

[Writing Equations and Inequalities for Scenarios](#)

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