

Statistics How To

Statistics for the rest of us!



[HOME](#) [TABLES](#) [PROBABILITY AND STATISTICS](#) [CALCULATORS](#) [MATRICES](#) [EXPERIMENTAL DESIGN](#)

[CALCULUS BASED STATISTICS](#) [THE PRACTICALLY CHEATING STATISTICS HANDBOOK](#)

Outliers: Finding Them in Data, Formula, Examples. Easy Steps and Video

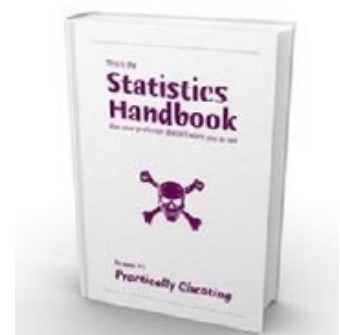
Share on

Outliers are stragglers — **extremely high or extremely low values** — in a data set that can throw off your stats. For example, if you were measuring children's nose length, your average value might be thrown off if Pinocchio was in the class.

Contents (Click to skip to the section):

1. What is an Outlier?
2. How to Find Outliers with the Interquartile Range.
3. How to Find Outliers with the Tukey Method and more advanced methods.

Find an article



Feel like "cheating" at Statistics?

^ out

Watch the video for the definition and how to find outliers with the IQR and Tukey's method:

How to Find Outliers (IQR and Tukey Method)



Can't see the video? [Click here.](#)

What is an outlier?

An outlier is a piece of data that is an abnormal distance from other points. In other words, it's data that lies **outside the other values** in the set. If you had Pinocchio in a class of children, the length of his nose compared to the other children would be an outlier.

In this set of random numbers, 1 and 201 are outliers:

1, 99, 100, 101, 103, 109, 110, 201

"1" is an extremely low value and "201" is an extremely high value.

Outliers aren't always that obvious. Let's say you received the following paychecks last month: \$225, \$250, \$25, \$235.

Your average paycheck is \$135. But that small paycheck (\$25) might be because you went on vacation, so a weekly paycheck average of \$135 isn't a true reflection of how much you earned. Your average is actually closer to \$237 if you take the outlier (\$25) out of the set.

Of course, trying to find outliers isn't always that simple. Your data set may look like this:

61, 10, 32, 19, 22, 29, 36, 14, 49, 3.

You could take a guess that 3 might be an outlier and perhaps 61. But you'd be wrong: 61 is the only outlier in this data set.

A **box and whiskers chart** (**boxplot**) often shows outliers:

[the grade-increasing book that's recommended reading at top universities!](#)

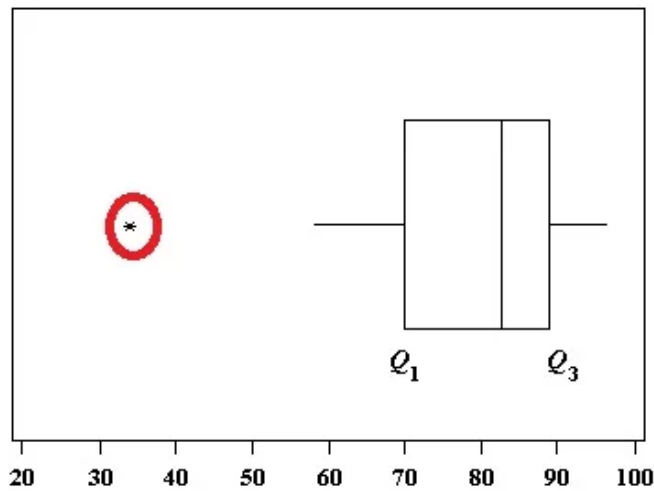


Statisticshowto.com
5,982 likes



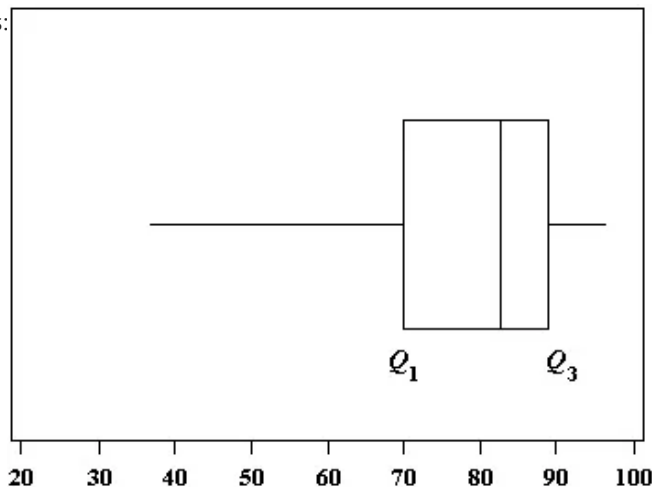
[NEED HELP NOW with a homework problem? CLICK HERE!](#)





The outlier on this boxplot is outside of the box and whiskers.

However, you may not have access to a box and whiskers chart. And even if you do, some boxplots may not show outliers. For example, this chart has whiskers that reach out to *include* outliers:



Probability and Statistics Topic Indexes

- Basic Statistics.
- Bayesian Statistics and Probability
- Descriptive Statistics: Charts, Graphs and Plots.
- Probability.
- Binomial Theorem.
- Definitions for Common Statistics Terms.
- Critical Values.
- Hypothesis Testing.
- Normal Distributions.
- T-Distributions.
- Central Limit Theorem.
- Confidence Intervals.
- Chebyshev's Theorem.
- Sampling and Finding Sample Sizes.
- Chi Square.
- Online Tables (z-table, chi-square, t-dist etc.).
- Regression Analysis / Linear Regression.
- Non Normal Distributions.

Therefore, *don't rely on finding outliers from a box and whiskers chart*. That said, box and whiskers charts can be a useful tool to display them *after* you have calculated what your outliers actually are. The most effective way to find all of your outliers is by using the [interquartile range](#) (IQR). The IQR contains the middle bulk of your data, so outliers can be



easily found once you know the IQR.

[Back to Top](#)

How to Find Outliers Using the Interquartile Range(IQR)

Need help with a homework question? [Check out our tutoring page!](#)

An outlier is defined as being any point of data that lies over 1.5 IQRs below the first quartile (Q_1) or above the third quartile (Q_3) in a data set.

$$\text{High} = (Q_3) + 1.5 \text{ IQR}$$

$$\text{Low} = (Q_1) - 1.5 \text{ IQR}$$

Example Question: Find the outliers for the following data set: 3, 10, 14, 22, 19, 29, 70, 49, 36, 32.

Step 1: Find the IQR, Q_1 (25th percentile) and Q_3 (75th percentile). Use our [online interquartile range calculator](#) to find the IQR or if you want to calculate it by hand, follow the steps in this article: [Interquartile Range in Statistics: How to find it.](#)

$$\text{IQR} = 22$$

$$Q_1 = 14$$

$$Q_3 = 36$$

Interquartile Range Calculator

Data set:

3, 10, 14, 19, 22, 29, 32, 36, 49, 70

Find the Interquartile Range!

Results

25th Percentile: 14

50th Percentile: 25.5

75th Percentile: 36

Interquartile Range: 22

IQR, Q_1 and Q_3 found using the online calculator (see link in this step).

Step 2: Multiply the IQR you found in Step 1 by 1.5:

$$\text{IQR} * 1.5 = 22 * 1.5 = 33.$$

Step 3: Add the amount you found in Step 2 to Q_3 from Step 1:

$$33 + 36 = 69.$$

This is your *upper limit*. Set this number aside for a moment.

Step 3: Subtract the amount you found in Step 2 from Q_1 from Step 1:

$$14 - 33 = -19.$$

This is your *lower limit*. Set this number aside for a moment.

Step 5: Put the numbers from your data set in order:

3, 10, 14, 19, 22, 29, 32, 36, 49, 70

Step 6: Insert your low and high values into your data set, in order:

-19, 3, 10, 14, 19, 22, 29, 32, 36, 49, 69, 70

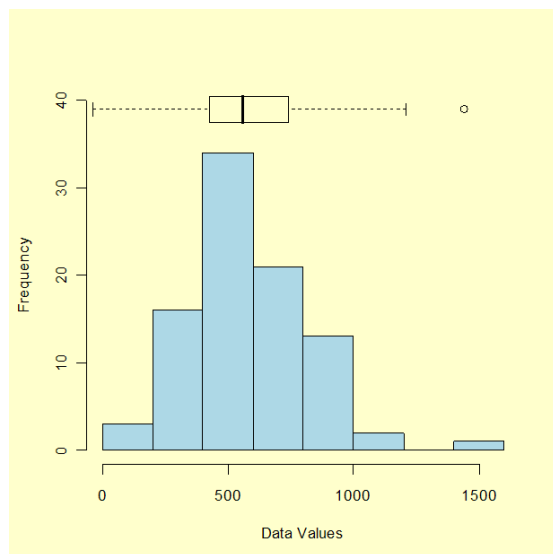
Step 6: Highlight any number below or above the numbers you inserted in Step 6:

-19, 3, 10, 14, 19, 22, 29, 32, 36, 49, 69, 70

That's it!

[Back to Top](#)

How to Find Outliers with the The Tukey Method



Frequency chart with boxplot at the top. The outliers are shown as dots outside the range of the whiskers.

The Tukey method for finding outliers uses the interquartile range to filter out very large or very small numbers. It's practically the same as the procedure above, but you might see the formulas written *slightly* differently and the terminology is a little different as well. For example, the Tukey method uses the concept of "fences".

The formulas are:

$$\text{Low outliers} = Q_1 - 1.5(Q_3 - Q_1) = Q_1 - 1.5(IQR)$$

$$\text{High outliers} = Q_3 + 1.5(Q_3 - Q_1) = Q_3 + 1.5(IQR)$$

Where:

Q_1 = first [quartile](#)



Q3 = third [quartile](#)

IQR = Interquartile range

These equations give you two values, or “[fences](#)”. You can think of them as a fence that cordons off the outliers from all of the values that are contained in the bulk of the data.

Sample question: Use Tukey’s method to find outliers for the following set of data:

1,2,5,6,7,9,12,15,18,19,38.

Step 1: Find the [Interquartile range](#):

1. Find the median: 1,2,5,6,7,**9**,12,15,18,19,38.
2. Place parentheses around the numbers above and below the median – it makes Q1 and Q3 easier to find.
(1,2,5,6,7),9,(12,15,18,19,38)
3. Find Q1 and Q3. Q1 can be thought of as a median in the lower half of the data. Q3 can be thought of as a median for the upper half of data.
(1,2,5,6,7), 9, (12,15,18,19,38). Q1=5 and Q3=18.
4. Subtract Q1 from Q3. $18 - 5 = 13$.

Step 2: Calculate $1.5 * IQR$:

$$1.5 * IQR = 1.5 * 13 = 19.5$$

Step 3: Subtract from Q1 to get your lower fence:

$$5 - 19.5 = -14.5$$

Step 4: Add to Q3 to get your upper fence:

$$18 + 19.5 = 37.5.$$

Step 5: Add your fences to your data to identify outliers:

(-14.5) 1,2,5,6,7,9,12,15,18,19,(37.5),38.

Anything outside of the fences is an outlier. For this data set, 38 is the only outlier.

That’s how to find outliers with the Tukey method!

[Back to Top](#)

How to Find Outliers with Advanced Methods

1. Generalized ESD
2. Grubbs’ test.
3. Dixon’s Q Test.
4. Modified Thompson Tau Test
5. Pierce’s Criterion

Next: [Modify Extreme Values with Winsorizations](#)

References

- Klein, G. (2013). [The Cartoon Introduction to Statistics](#). Hill & Wang.
- Kotz, S.; et al., eds. (2006), [Encyclopedia of Statistical Sciences](#), Wiley.
- Tukey, J. [Exploratory Data Analysis](#), Addison-Wesley, 1977, pp. 43-44.



Check out our [YouTube channel](#) for more stats tips and help!

CITE THIS AS:

Stephanie Glen. "Outliers: Finding Them in Data, Formula, Examples. Easy Steps and Video" From [StatisticsHowTo.com](https://www.statisticshowto.com/statistics-basics/find-outliers/): Elementary Statistics for the rest of us!
<https://www.statisticshowto.com/statistics-basics/find-outliers/>

Need help with a homework or test question? With [Chegg Study](#), you can get step-by-step solutions to your questions from an expert in the field. Your first 30 minutes with a Chegg tutor is free!

Comments? Need to post a correction? Please post a comment on our [Facebook page](#).