Statistics Calculator

A Guide for Lorenz and Year 6

English

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In this guide you will learn everything you need for the Statistics Calculator: mean, median, quartiles, percentiles and sorted datasets.

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What is Statistics?

Statistics is the art of drawing clever conclusions from lots of numbers and data. If you roll a dice 100 times, for example, you might ask:

- Which number came up most often?
- What was the average of all rolls?
- How many rolls were in the lower half?

The Statistics Calculator helps you find exactly that — with colourful charts and clear numbers!

! Tip

Start the calculator by opening the file `statistik_lorenz.html` in your browser. You don't need internet access!

The Calculator — Overview

The calculator has three areas, which you can select using the buttons at the top:

[C]
Coin tossing
Heads or tails? How often does each come up?

[D]
Dice rolling
How often does each number appear?

[K]
School class
Height, weight, hair colour …

Slider and Input Field

In every area you can set the number of rolls or pupils — either with the **slider** or by typing a number directly.

Example: Example

Set the slider to **10** and toss the coin. Then set it to **1000** and compare! What do you notice?

Key Terms Explained

Dataset

A **dataset** is a collection of measured values or observations.

Example: Example

You roll the dice 8 times and get: $3, 1, 4, 1, 5, 9, 2, 6$
These are your 8 **data values** — together they form your **dataset**.

Sorted Dataset

In a **sorted dataset** you arrange all values from smallest to largest. This makes it much easier to find the middle or split the data in half!

Example: Example

Unsorted: $3, 1, 4, 1, 5, 9, 2, 6$
Sorted: $\underbrace{1, 1, 2, 3}_{\text{lower half}}, \underbrace{4, 5, 6, 9}_{\text{upper half}}$

In the calculator you can see the sorted dataset as **coloured circles** and as a **bar chart** — sorted from smallest to largest, in four different colours.

Mean (Average)

» Mean

The **mean** is the average of all values. You add up all the numbers and divide by how many there are.

$$\bar{x} = \frac{\text{sum of all values}}{\text{number of values}}$$

Example: Example

Rolls: $1, 3, 5, 2, 4$
Sum: $1 + 3 + 5 + 2 + 4 = 15$
Count: 5
Mean: $\bar{x} = \frac{15}{5} = 3$

*** Remember!**

For a normal dice the theoretical mean is always **3.5** — $(1+2+3+4+5+6) \div 6 = 3.5$.
The more often you roll, the closer your result gets to 3.5!

Median (Middle Value)

» Median

The **median** is the *middle* value in the sorted dataset. Exactly half of all values lie below it and the other half above it.

How to calculate the median:

1. Sort all values from smallest to largest.
2. If there is an **odd** number of values: take the middle value.
3. If there is an **even** number of values: take the average of the two middle values.

Example: Example

Odd count (5 values): $1, 2, \mathbf{3}, 4, 5$ Median $= 3$

Even count (6 values): $1, 2, \mathbf{3}, \mathbf{4}, 5, 6$ Median $= \frac{3+4}{2} = 3.5$

! Tip

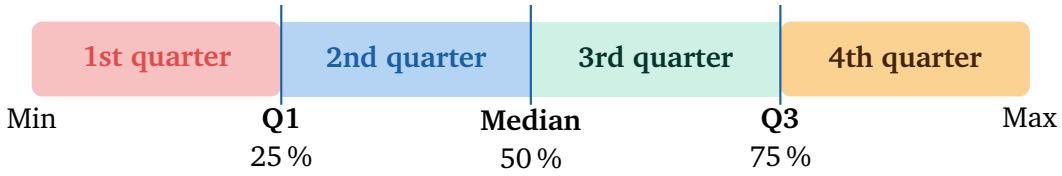
The median is often *more robust* than the mean: a single very large or very small value barely changes the median — but it can shift the mean a lot!

Quartiles — The Four Quarters

» Quartiles

Quartiles divide the sorted dataset into *four equal parts*.

- **Q1** (1st quartile, 25 %): one quarter of values lie below it
- **Q2** (median, 50 %): half of the values lie below it
- **Q3** (3rd quartile, 75 %): three quarters of values lie below it



Example: Example

Heights in a class (sorted, 8 pupils):

$$\underbrace{142,\ 145}_{\text{1st quarter}},\ \underbrace{149,\ 152}_{\text{2nd quarter}},\ \underbrace{155,\ 158}_{\text{3rd quarter}},\ \underbrace{163,\ 170}_{\text{4th quarter}}$$

$$\begin{aligned}
\text{Q1 (25 \%)} &= \frac{145 + 149}{2} = 147 \text{ cm} \\
\text{Median (50 \%)} &= \frac{152 + 155}{2} = 153.5 \text{ cm} \\
\text{Q3 (75 \%)} &= \frac{158 + 163}{2} = 160.5 \text{ cm}
\end{aligned}$$

In the calculator you can see the four quarters as **coloured bars** and **coloured circles**:

Colour	Region	Meaning
	Light red	1st quartile (lowest 25 %)
	Red	2nd quartile (25 % to median)
	Blue	Median (middle)
	Green	3rd quartile (median to 75 %)
	Orange	4th quartile (highest 25 %)

Quantile

» Quantile

A **quantile** is the general term for all such dividing points. The p-quantile is the value below which exactly $p \cdot 100\,\%$ of the data lie.

- The 0.25-quantile = Q1 = 25th percentile
- The 0.50-quantile = Median = 50th percentile
- The 0.75-quantile = Q3 = 75th percentile

*** Remember!**

Quartiles are special quantiles: they always divide the data into **four equal parts** (25 % each).

Percentile

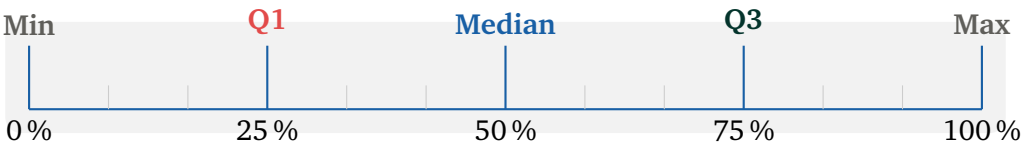
» Percentile

A **percentile** tells you what percentage of values are less than or equal to a given value. There are 99 percentiles, dividing the dataset into 100 equal parts.

Example: Example

Emma is 155 cm tall. The 60th percentile in her class is 155 cm.
This means: **60 % of pupils** are the same height as Emma or shorter.
40 % of pupils are taller than Emma.

Relationship between percentile and quartile:



In the calculator you will find a percentile slider in the **School class** area. Set it to 25 — and you get exactly Q1!

Percentile	Name	Meaning
0	Minimum	smallest value
25	Q1 / 1st quartile	upper boundary of the 1st quarter
50	Median	middle of the dataset
75	Q3 / 3rd quartile	upper boundary of the 3rd quarter
100	Maximum	largest value

The Three Areas of the Calculator

[C] Coin Tossing

Here you can toss a coin as many times as you like — from 1 to 1000 times. The calculator counts how often **heads** and how often **tails** appear.



*** Remember!**

Law of Large Numbers: If you toss many times (e.g. 1000 times), heads and tails will come up almost equally often — each roughly **50 %**. With only 10 tosses the result can still be quite uneven. That is perfectly normal!

! Tip

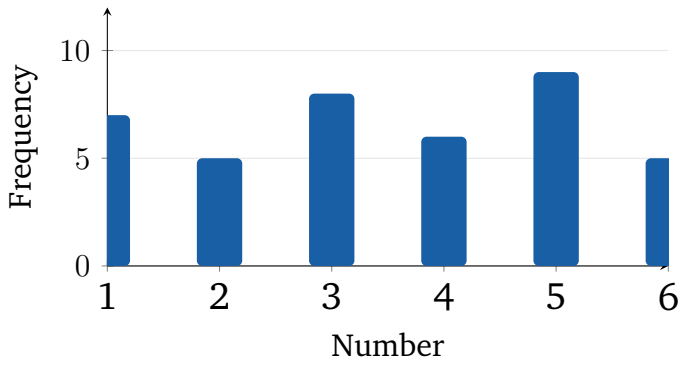
The chart always shows you the **frequencies** — how often each result occurred. The small circles at the top show the first outcomes (H = Heads, T = Tails).

[D] Dice Rolling

Here you roll a normal 6-sided dice as many times as you like. The calculator shows you:

- The **frequency** of each number (1 to 6)
- The **mean** of all rolls
- Minimum and maximum
- A **frequency table** with count and proportion

Example: 40 rolls



! Tip

The dice pictures show only the **first 30 rolls**. The chart, however, summarises *all* rolls — even if you roll 1000 times!

[K] School Class

This is the richest area. The calculator generates a random class with up to 40 pupils. Each person has:

Characteristic	Type	Possible values
Name	Text	random names
Height	**numerical**	140 – 175 cm
Weight	**numerical**	32 – 60 kg
Hair colour	categorical	brown, blonde, black, red
Favourite subject	categorical	Maths, PE, Music, Art, ...

Numerical characteristics (height, weight) display:

- Statistics cards: Min, Q1, Median, Q3, Max, Mean
- Coloured quartile bar
- Histogram
- Sorted dataset as circles *and* as a bar chart
- Percentile slider

Categorical characteristics (hair colour, favourite subject) display:

- Bar chart of frequencies
- Sorted dataset by frequency (most common first)

Step by Step: Exploring the School Class

Step 1. Create the class
Set the number of pupils (e.g. 25) and click *"Create class!"*. The class is generated randomly.

Step 2. Look at height
The Height tab is selected automatically. You will see:

- The 6 statistics cards at the top (Min, Q1, Median, Q3, Max, Mean)
- The coloured quartile bar
- The histogram: how many pupils fall into each height range?

Step 3. Read the sorted dataset
Scroll down a little. You will see the heights as coloured circles — from the smallest on the left to the tallest on the right. Below that is the bar chart: each bar represents one pupil, coloured by quartile.

Step 4. Try out the percentile slider
Set the slider to different values:

Value	What you see
25	exactly Q1 (upper boundary of the 1st quarter)
50	the median
75	Q3 (upper boundary of the 3rd quarter)
90	the value that only 10 % exceed

Step 5. Look at other characteristics
Click on Hair colour or Favourite subject — now you can see the distribution of the class. Which hair colour appears most often?

Step 6. Look at the class table
Scroll all the way to the bottom: there you will find a complete table of all pupils with all their characteristics.

Summary of Terms

Term	Meaning in simple words
Dataset	A collection of measured values, e.g. all the heights in a class.
Sorted dataset	All values arranged from smallest to largest.
Mean $\bar{x}$	Add up all values and divide by how many there are. The “average”.
Median	The middle value in the sorted dataset. Half lie below it, half above it. Also: 50th percentile = Q2.
Quartile	One of the three dividing points Q1, Q2, Q3 that split the dataset into four equal quarters.
Q1 (1st quartile)	The value below which 25 % of the data lie. Upper boundary of the first quarter.
Q3 (3rd quartile)	The value below which 75 % of the data lie. Lower boundary of the last quarter.
Quantile	The general term for all such dividing points. The p-quantile splits the data so that $p \cdot 100\,\%$ of values lie below it.
Percentile	Like a quantile, but expressed as a percentage. The 25th percentile = Q1, the 50th percentile = Median, the 75th percentile = Q3.
Frequency	How often a particular value occurs.
Histogram	A bar chart showing how many values fall into certain ranges (e.g. 140–145 cm).

:-) Have fun exploring!

Statistics is fun — especially when you can do your own experiments!

Try lots of different settings and see what changes.
Every random class is different!