



M. F. Gilmullin, "Percentages and Their Companions: %, Percentage Points and Basis Points," *Mathematics with Mansur*, Nov. 5, 2024. [Online]. Available: <https://history-math.org/publications/hm-tt-1220bac36def-en/>.

ESSAY

Percentages and Their Companions: %, Percentage Points and Basis Points

Percentages, percentage points and basis points measure different kinds of change; practical examples show how to distinguish them.

Mansur Gilmullin · 05.11.2024 · EN

[Read this article on the journal website](https://history-math.org/publications/hm-tt-1220bac36def-en/)



· [Source](#)

Let us begin with an old joke on the subject.

An elderly mathematics teacher meets a former pupil.

"How are you getting on these days, Vovochka?"

"Everything's fine, Marya Ivanovna! I'm in business — buying and selling."

"How on earth do you manage that? You couldn't even understand percentages at school!"

"What's there to understand? I buy a carton of American cigarettes for 18 dollars and sell it for 20. I live on that two percent!"



Well... Vovochka isn't quite the boy he used to be! :) · [Source](#)

Much has been written about percentages. They are studied at school and tested in Russia's OGE and EGE examinations. Nevertheless, there is now so much information noise around the subject, and so many complications that are confusing to the ordinary person. Many people mix up the terms and concepts, especially those connected with percentages in finance.

The percentage is one of mathematics' basic theoretical and applied concepts. Students learn to solve the principal percentage problems in secondary school. They seem straightforward enough.

A percent is one hundredth of a number. Percentages often measure changes in indicators that themselves are expressed in other units.

The whole, expressed in some units as z , is 100%. A part, expressed in the same units as x , is $p\%$ of that whole.

The proportion $x / z = p / 100$ gives the solutions to all the familiar percentage problems:

$$p = 100 \times (x/z), z = 100 \times (x/p), x = zp/100$$

Then economists and financiers enter the picture with their "tricks". They begin to measure changes in percentages themselves.

New units — percentage points, abbreviated p.p., and basis points, abbreviated b.p. — are often used in finance to measure changes in interest rates in bond, lending, currency and other financial markets, as well as changes in inflation.

Changes in indicators that are themselves expressed as percentages, such as a central bank's policy rate, are said to be expressed in percentage points rather than as percentages of the initial value. A percentage point measures the difference between the new and old percentage values. If the central bank rate was 10% and becomes 12%, it is said to rise by 2 percentage points. If it becomes 9%, it

falls by 1 percentage point. The explanation for using this unit is that expressing interest-rate changes in percentage points eliminates ambiguity between different interpretations of percentage calculations.

What has actually happened to the initial value of the indicator itself? A rise of 2 percentage points means a 20% increase in the old rate, since $(2 / 10) \times 100 = 20$, by the rules of percentage calculation.

Similarly, a fall of 1 percentage point in our example means a 10% decrease relative to the initial rate of 10%.

Thus, to calculate the actual percentage change in the original quantity, use the basic formula:

Percentage change = $((\text{Final value} - \text{Initial value}) / \text{Initial value}) \times 100$.

A negative result means that the initial quantity has decreased.

The same formula calculates percentage changes in any quantity. For example, if sales at the beginning of the year were 500 thousand roubles, and by the end of the first quarter had increased to 525 thousand roubles, the actual increase was $((525 - 500) / 500) \times 100 = 5\%$.

For more detailed changes, involving tenths and hundredths of a change in an indicator, the unit “basis point” is used. One basis point is one hundredth of a percentage point, 0,01 p.p. Basis points are often used to measure macroeconomic indicators.

For example, a bank’s mortgage rate falls from 11% to 9,5% per year. It has decreased by 1,5 percentage points, or 150 basis points.

Examples

Let us illustrate all this with practical problems from everyday life.

Example 1

Suppose the annual return on shares was 16% in 2021 and 20% in 2022. The return increased by 4 percentage points, or $(4 / 16) \times 100 = 25\%$.

Example 2

Take the same number, 20%, and increase it by the same value, 50, expressed in different units: percent, percentage points and basis points.

Percent. As we have seen, an increase of 1% means an increase of one hundredth. Since this example involves an increase of 50%, or 50 hundredths, the calculation is:

$$20\% + 20\% \times 0,50 = 30\%$$

Percentage point. An increase of 50 percentage points means increasing the percentage value by 50 units: increasing 20% by 50 percentage points gives 70%.

Basis point. Here we must convert basis points to percentage points: 50 b.p. = 0,5 p.p.

Increasing 20% by 50 basis points is the same as increasing it by 0,5 percentage points, giving 20,5%.

Example 3

How does percentage growth relate to multiplication?

Growth of 100% means doubling. Growth of 50% means multiplying by 1,5; growth of 200% means tripling; growth of 300% means multiplying by four. This follows from the definition of a percentage.

Example 4

Similarly, a fall of 50% means halving, and a fall of 25% means decreasing by one quarter. If something becomes 75% cheaper, its price has fallen to one quarter of the original. A decrease of more than 100% is impossible.