Study: Large Value Ranges in Time Series

Welcome and thank you for your interest in participating in this study!

The aim of the study is to compare different visualization types for displaying time series, including data with large value ranges (e.g. from 10^0 to 10^4).

There are 137 questions in this survey.

General Information about yourself.

Please remove any environmental factors that may interfere with participation, e.g. please close all other applications and browser windows.

By the fact that the response-time is also measured, it is important that you answer as quick as possible, but without losing carefulness.

You can stop the study at an time at your request. In this case, your data will be deleted and not included in the evaluation.

Please write your answer here:

The visualizations used in this study require sufficient screen space of 13" or more. It is therefore recommended that you conduct the study on a sufficiently large display.

Please also disable the dark mode of your device if used.

Have you followed the instructions? *

Please choose **only one** of the following:

○ yes

○ no

○ partial

Please specify your gender. *

Please choose **only one** of the following:

○ male

○ female

○ diverse

○ prefer not to say

How much experience do you have with visualizations of time series? *
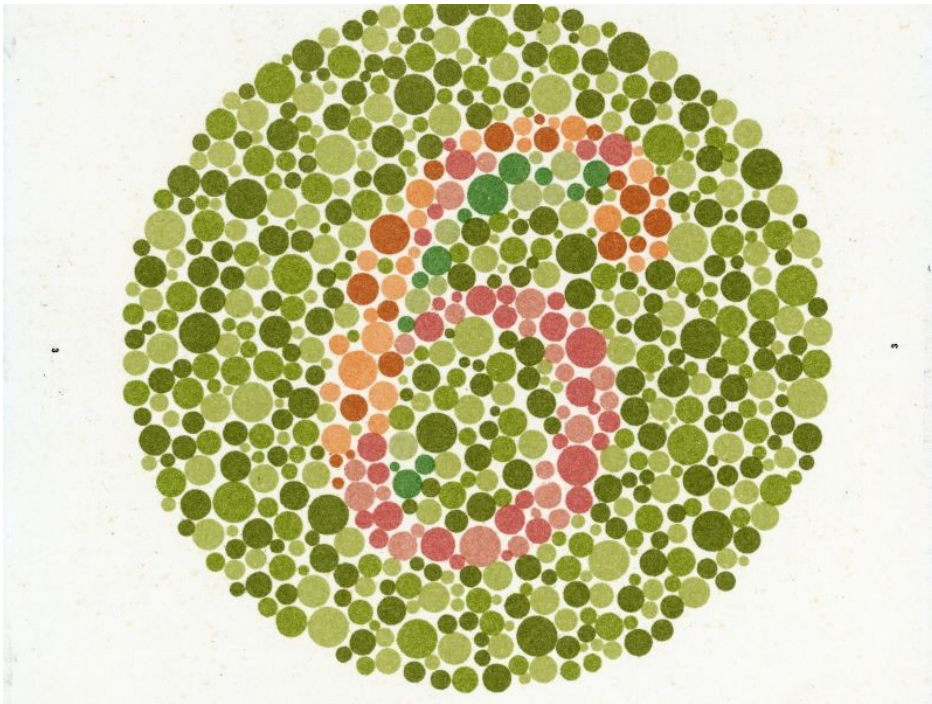
Please choose **only one** of the following:

○ 1- none

○ 2 - little

○ 3 - some

○ 4 - much

○ 5 - very much

How old are you? *

Please choose **only one** of the following:

- ○ <20
- ○ 20-30
- ○ 30-40
- ○ 40-50
- ○ 50-60
- ○ >60
- ○ prefer not to say
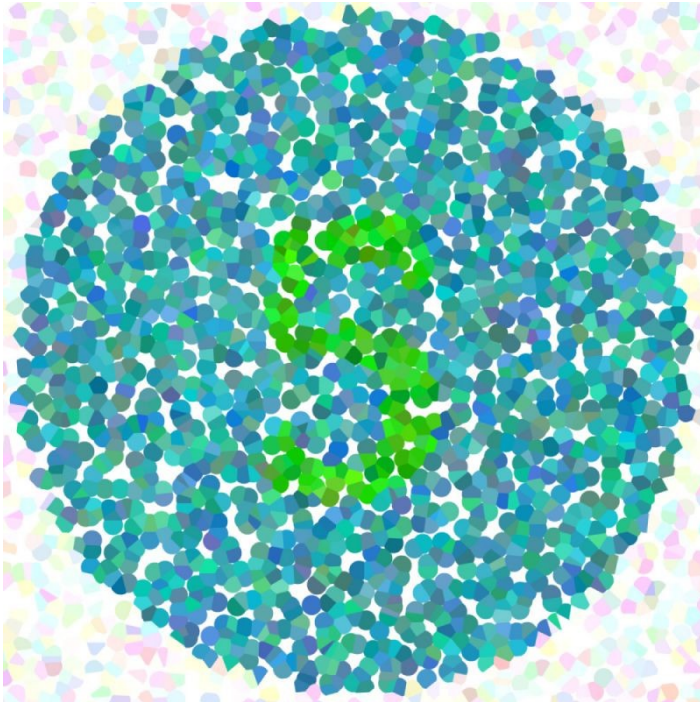
Which number do you see in the following picture?

*

❗ Choose one of the following answers

Please choose **only one** of the following:

- ○ 0
- ○ 1
- ○ 2
- ○ 3
- ○ 4
- ○ 5
- ○ 6
- ○ 7
- ○ 8
- ○ 9

Which number do you see in the following picture?

*

❶ Choose one of the following answers
Please choose **only one** of the following:

○ 0
○ 1
○ 2
○ 3
○ 4
○ 5
○ 6
○ 7
○ 8
○ 9

Study Introduction and Training

On the following pages an example is shown for each task type of the study.

For these examples normal line graphs with linear scaling are used, which will not be tested in the later tasks.

Since there is no time tracking here yet, you can take your time to familiarize yourself with the task types and input options.

The data visualized in the study are time series. These are represented by different types of visualization.

The graphs show values between 1 and 100,000 over 100 time points.

There will be four different type of tasks:

- Reading of values
- Comparison of values
- Estimation of value differences
- Determination of the trend in the data

An example for each of these task types follows so that you can familiarize yourself with the questions.

Since the data contain large ranges of values, the logarithmic notation is briefly revised here.

In the notation, a distinction is made between **exponent** (or **order of magnitude**) and **mantissa**.

The mantissa is always a number between 1 and 10 ans is marked in red In the following example number. The exponent, or magnitude, is highlighted in blue.
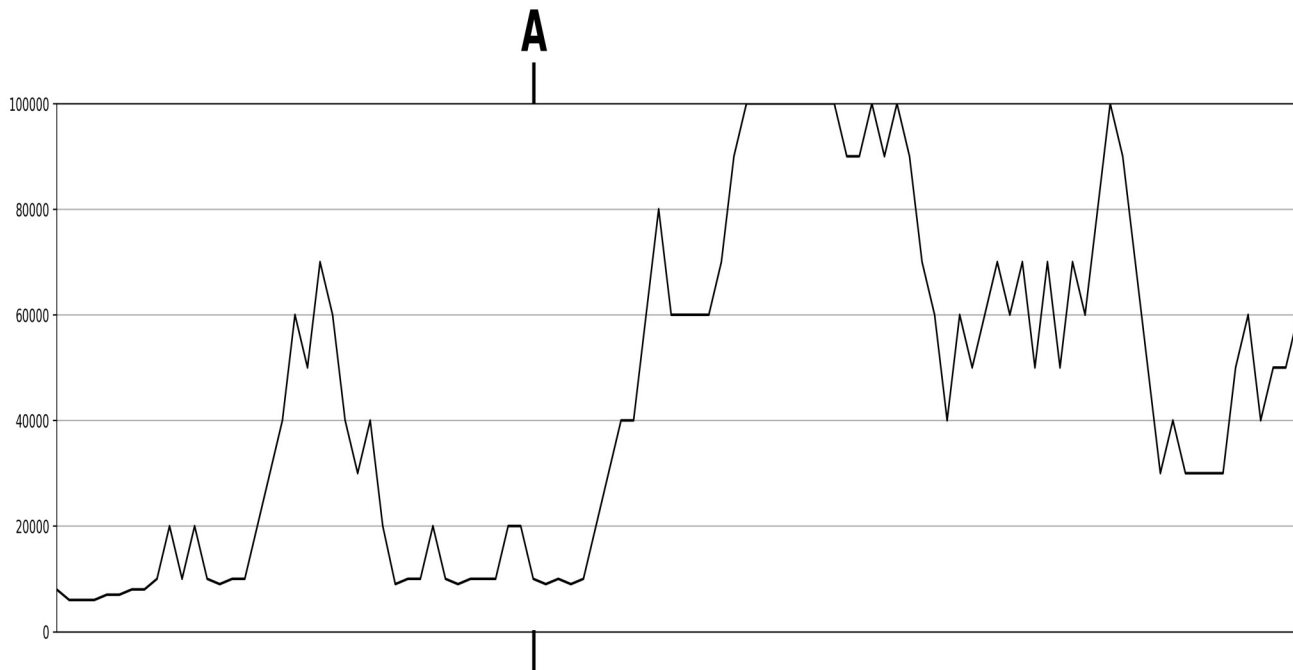
Only data with integer mantissa are used for this study!

$$5 \cdot 10^3 = 5 \cdot 1000 = 5000$$

The identification tasks are about reading individual values.

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**

A

The correct answer in this case would be *10000*. As confidence, one of the values between 1 and 5 should be chosen..
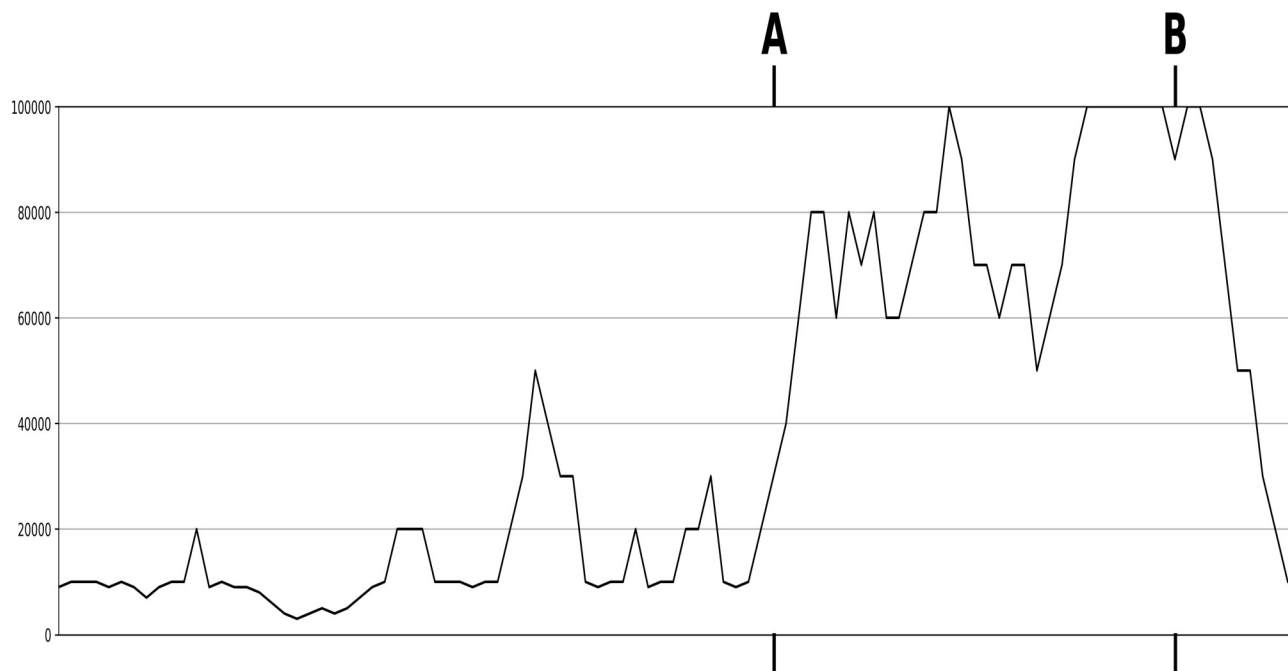
*

	Value	Confidence
Answer		

In the comparison tasks, two values in one time series are to be compared.

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

The correct answer here would be *B*. And as a confidence, a value from *1, 2, 3, 4* or *5* should be chosen again.

*

	Letter	Confidence
Answer		

In the estimation tasks, the absolute difference of the two marked values is to be determined.

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
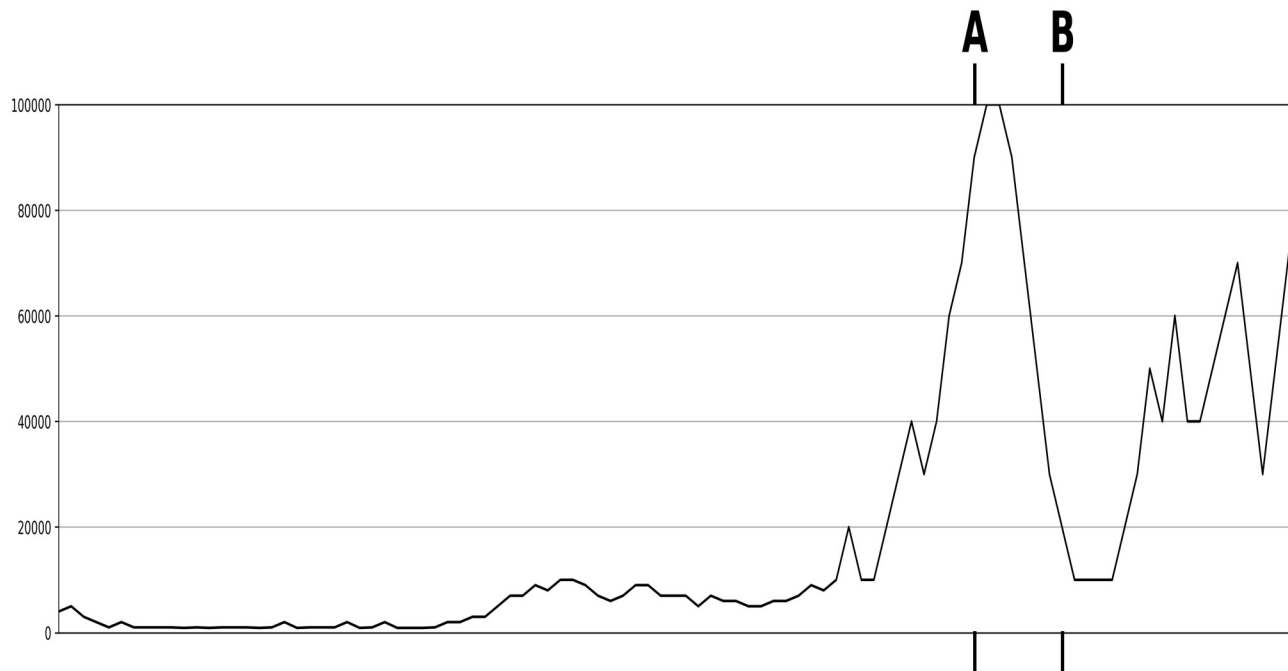
In this example, the correct answer is (90000-20000=) *70000*. The confidence should be specified as in the previous tasks.
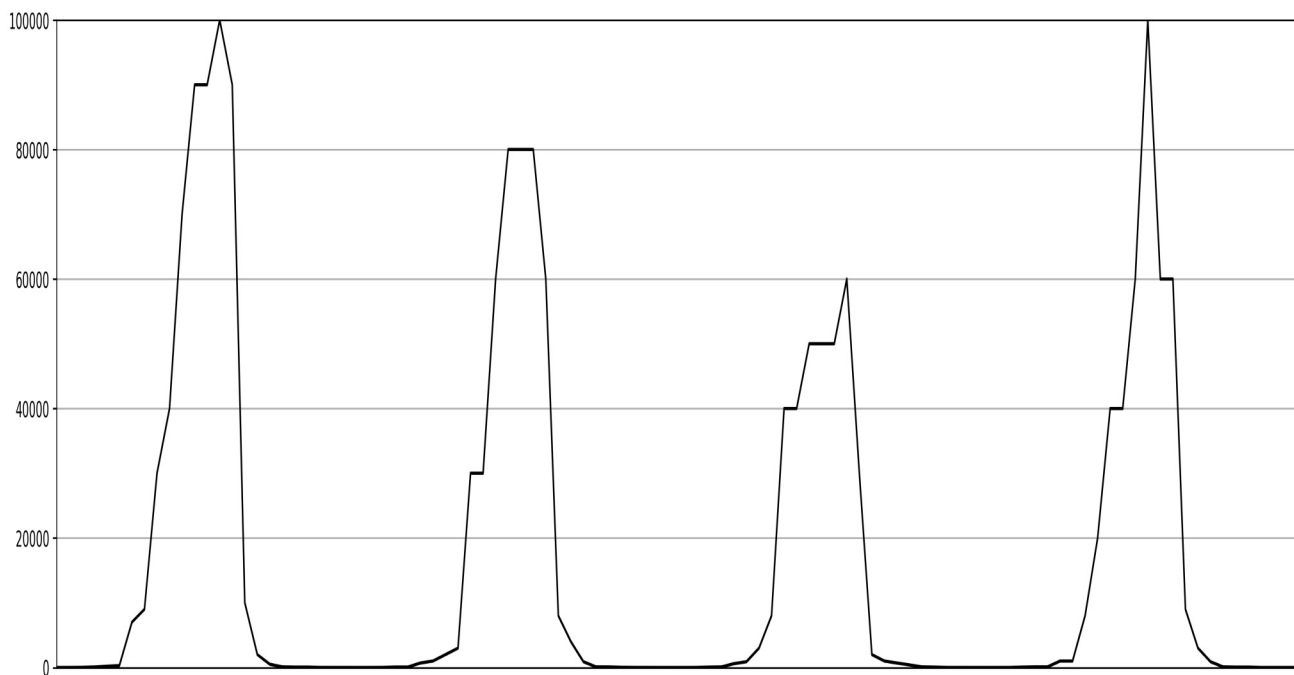
*

	Difference	Confidence
Answer		

In the trend tasks, the trend type in the data is to be determined. The following types are available for selection:

- linear
- exponential
- periodic
- none

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

Periodic is the correct answer in this case.
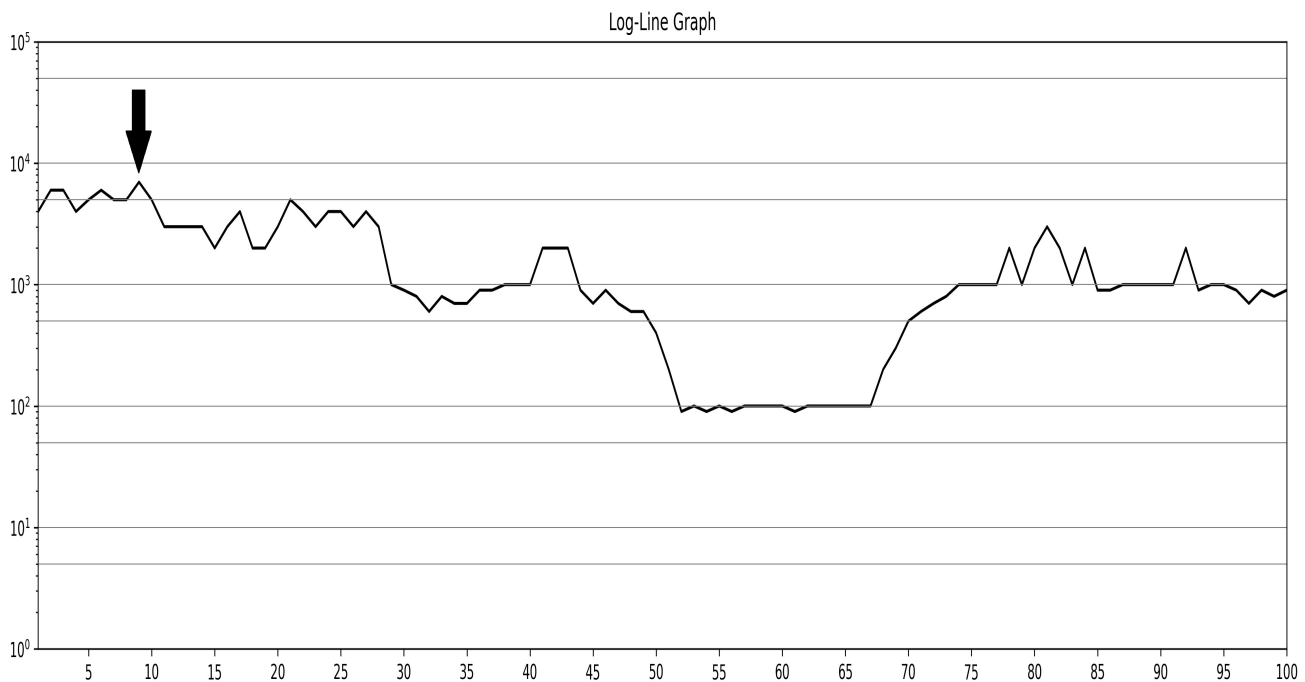
*

	Trend	Confidence
Answer		

{SAVEDID-5*floor(SAVEDID/5)} *

Log-Line Chart

The visualization technique Log-Line Chart is a line chart with a logarithmic scaling.

This example should help to read the visualization correctly.

The mantissa of the marked value is 7 and the exponent 3 (--> value 7*1000 = 7000).
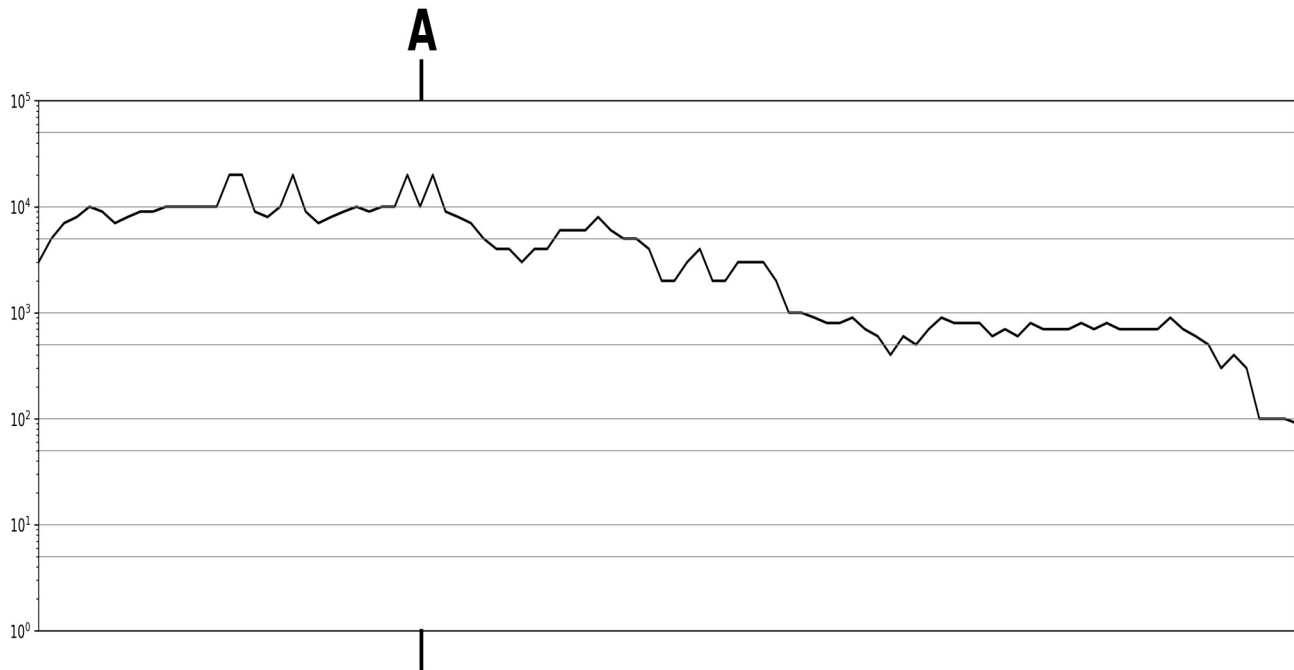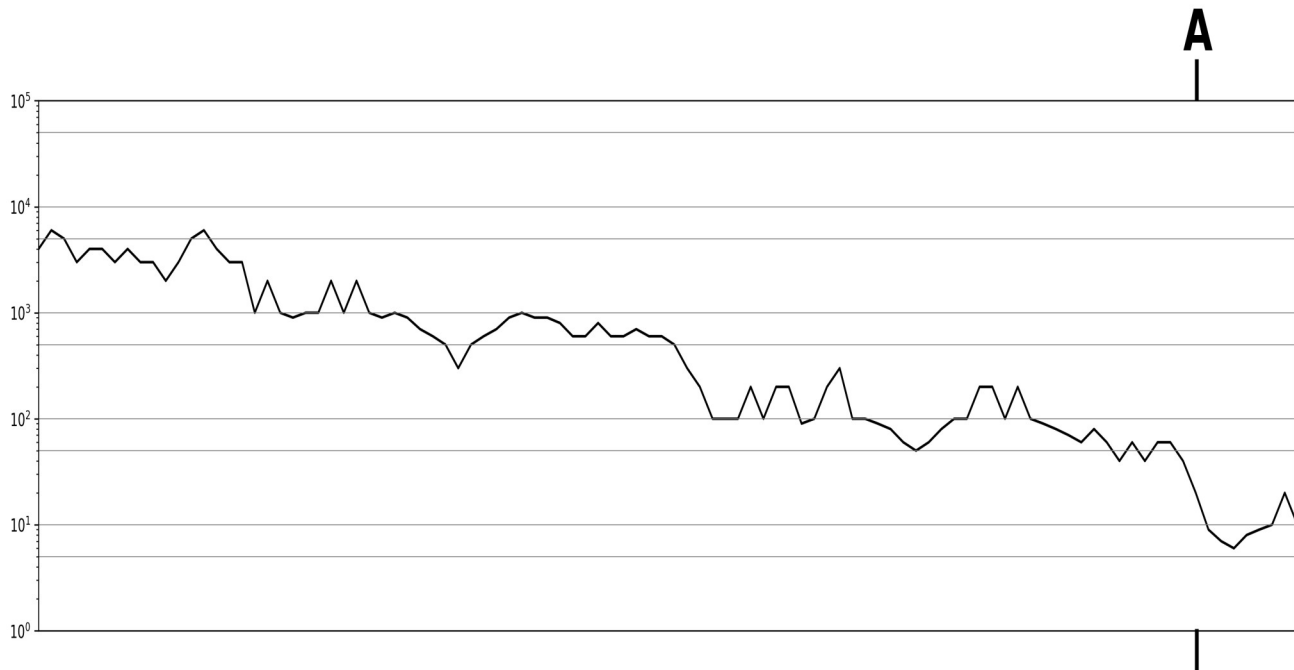

Log-Line Graph

The training is over now.

The actual study, including time measurement, begins on the next page.

Reminder: Only data with integer mantissa are used for this study!

The following questions are about identifying individual values.

Name the marked value.

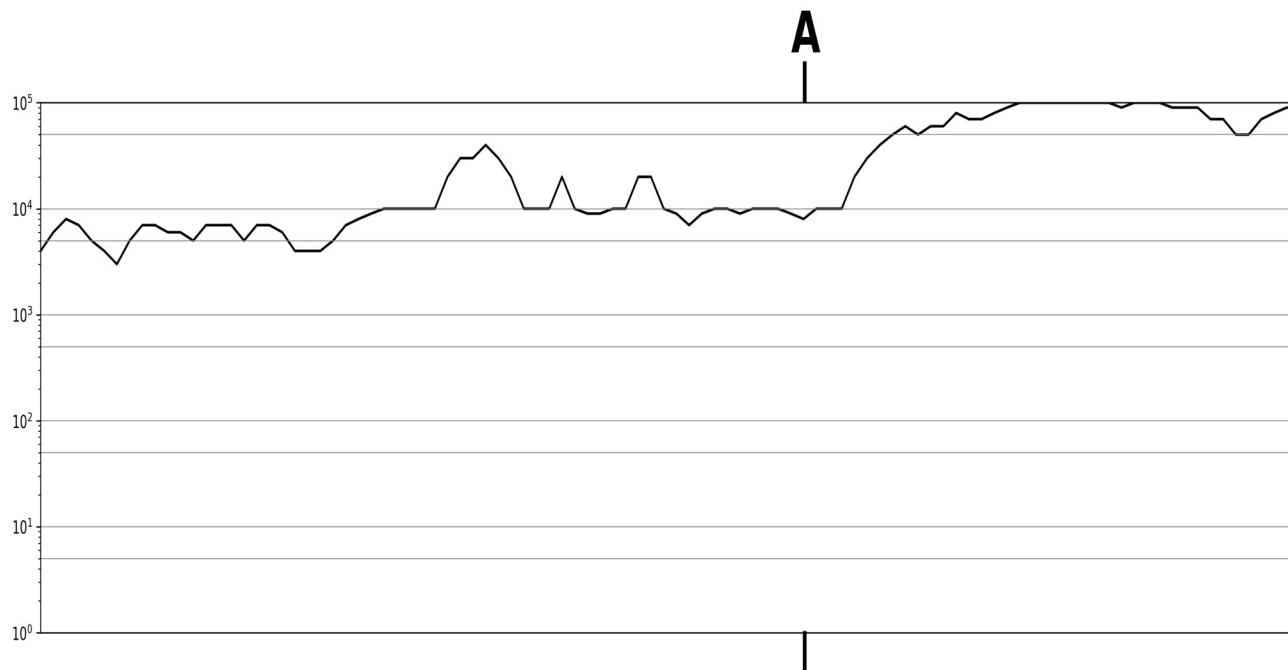And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

A

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *

Please choose **only one** of the following:

○ 0

○ 10000

○ 1000

The following questions compare two marked values.

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
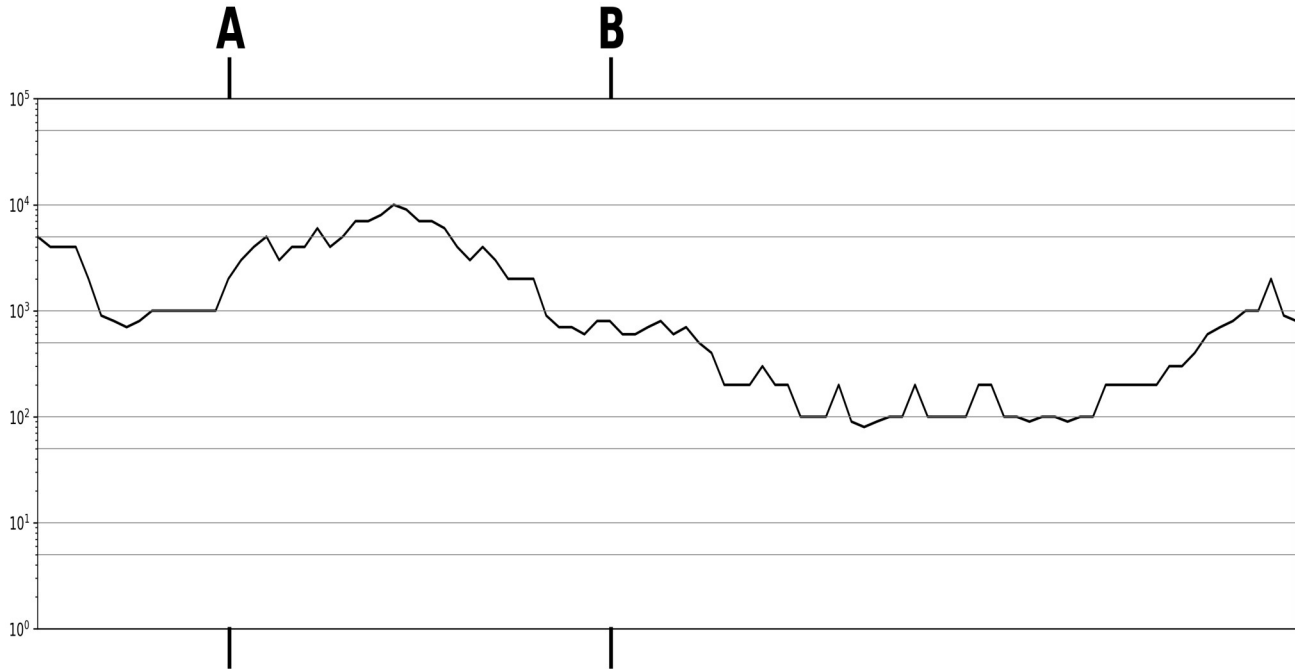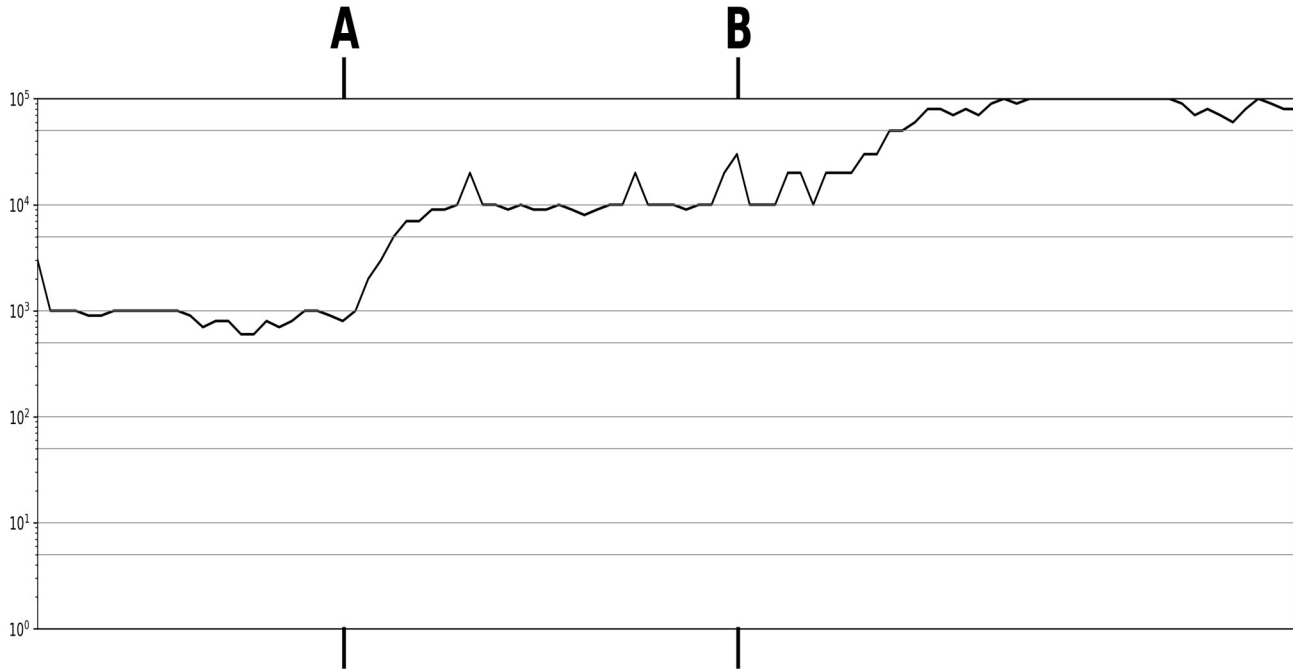

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.
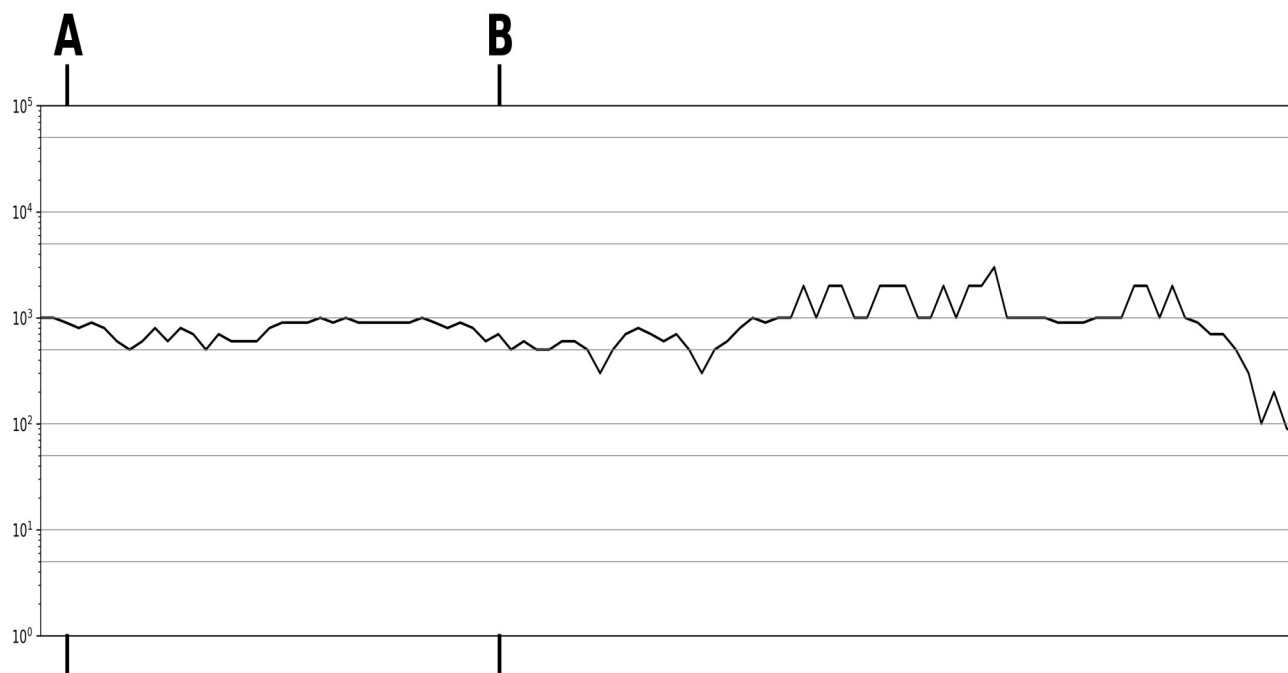
Which number is the greatest? *

Please choose **only one** of the following:

○ 0

○ 2*10^3

○ 5*10^4

In the following tasks the absolute difference between two marked values has to be estimated.

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
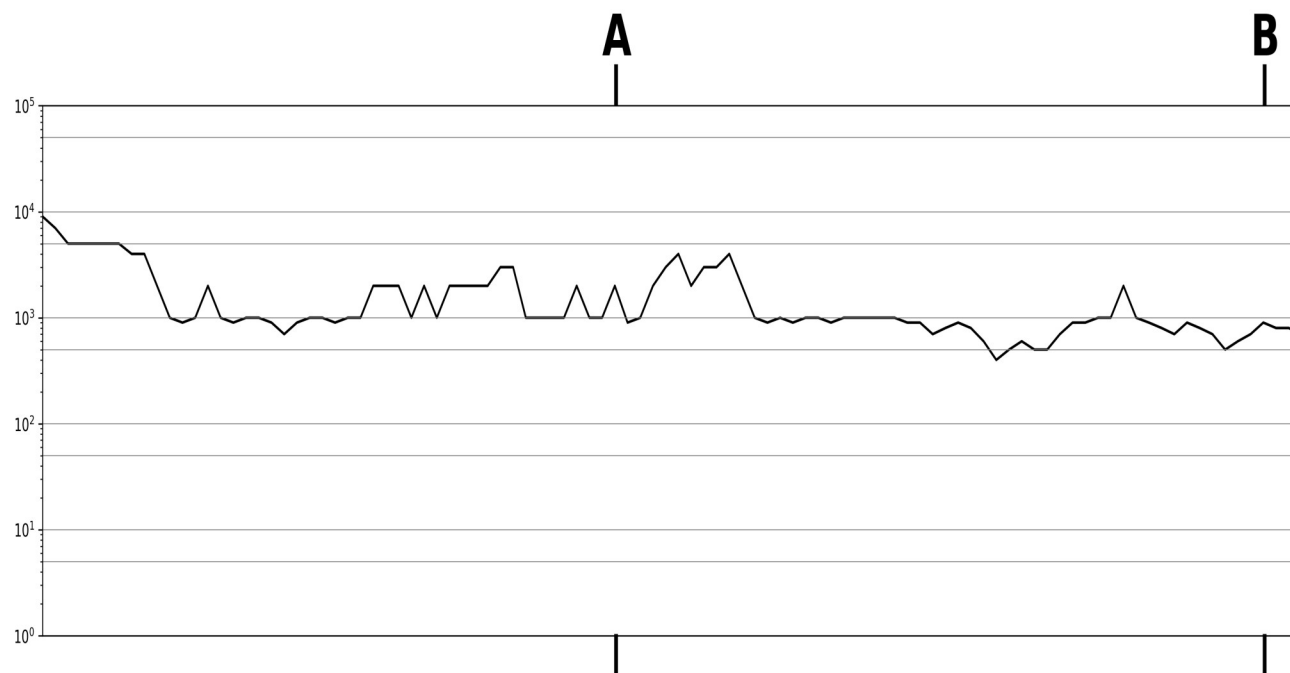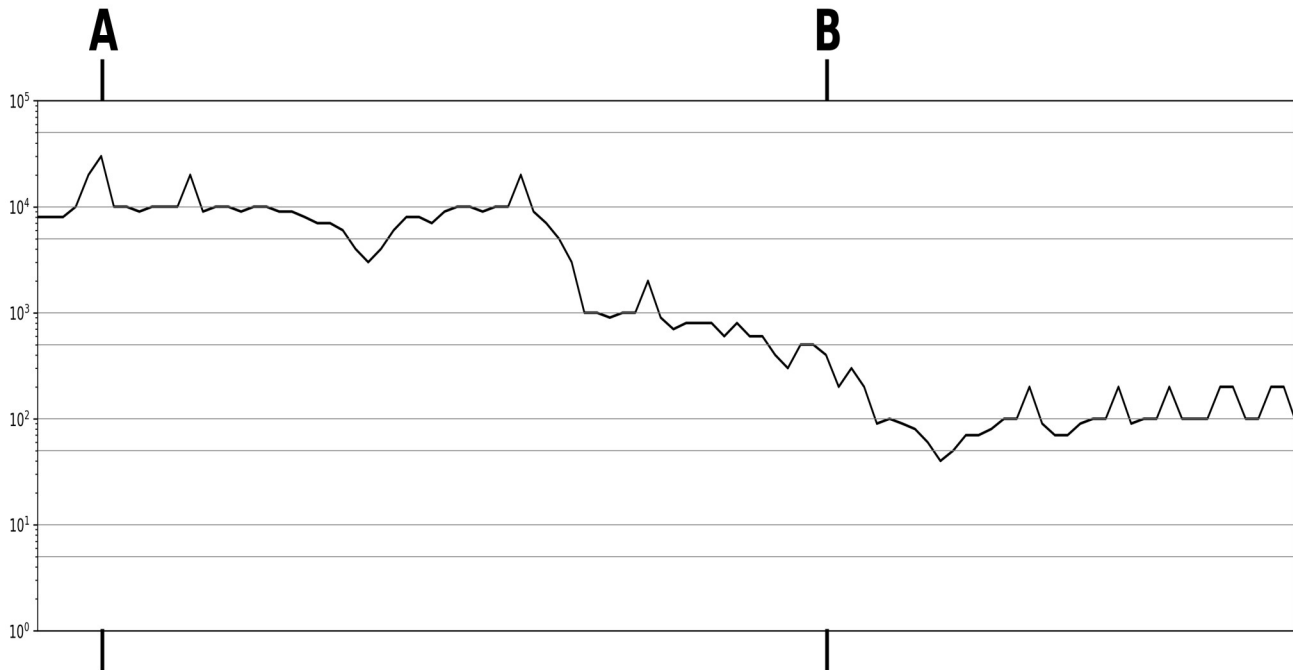

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the smallest? *

Please choose **only one** of the following:

○ 0

○ 10

○ 100

The last task type is to determine the trend in the data.

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
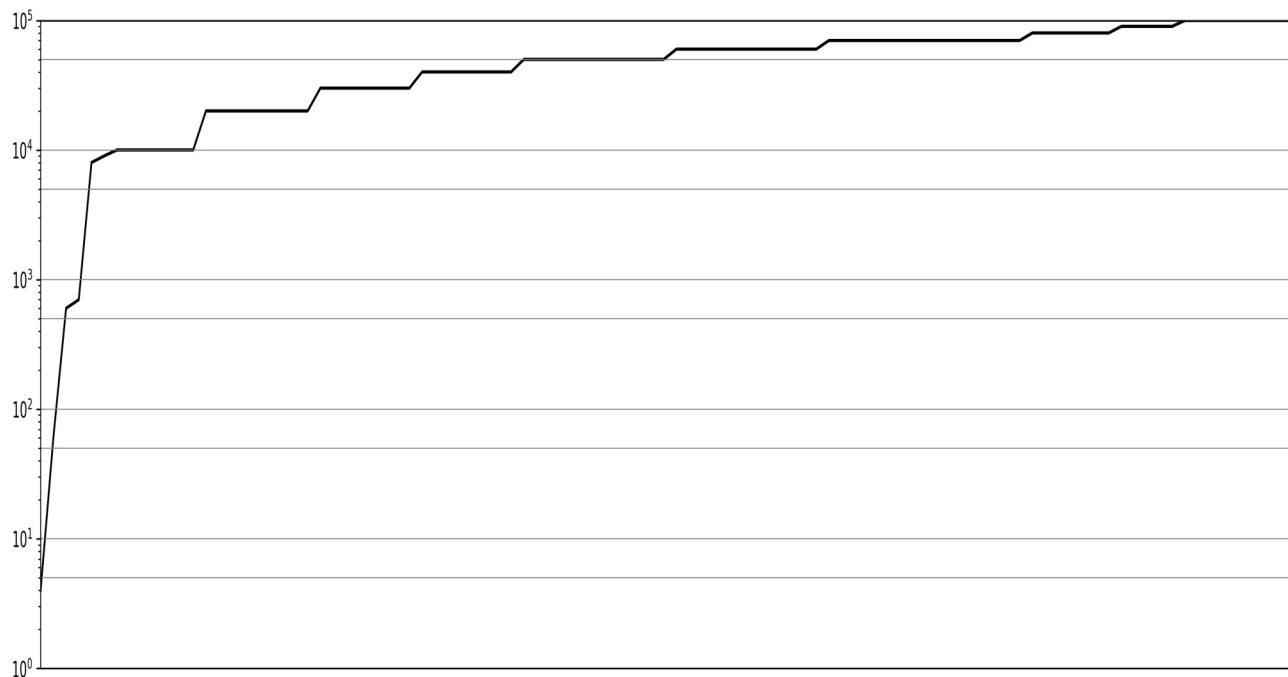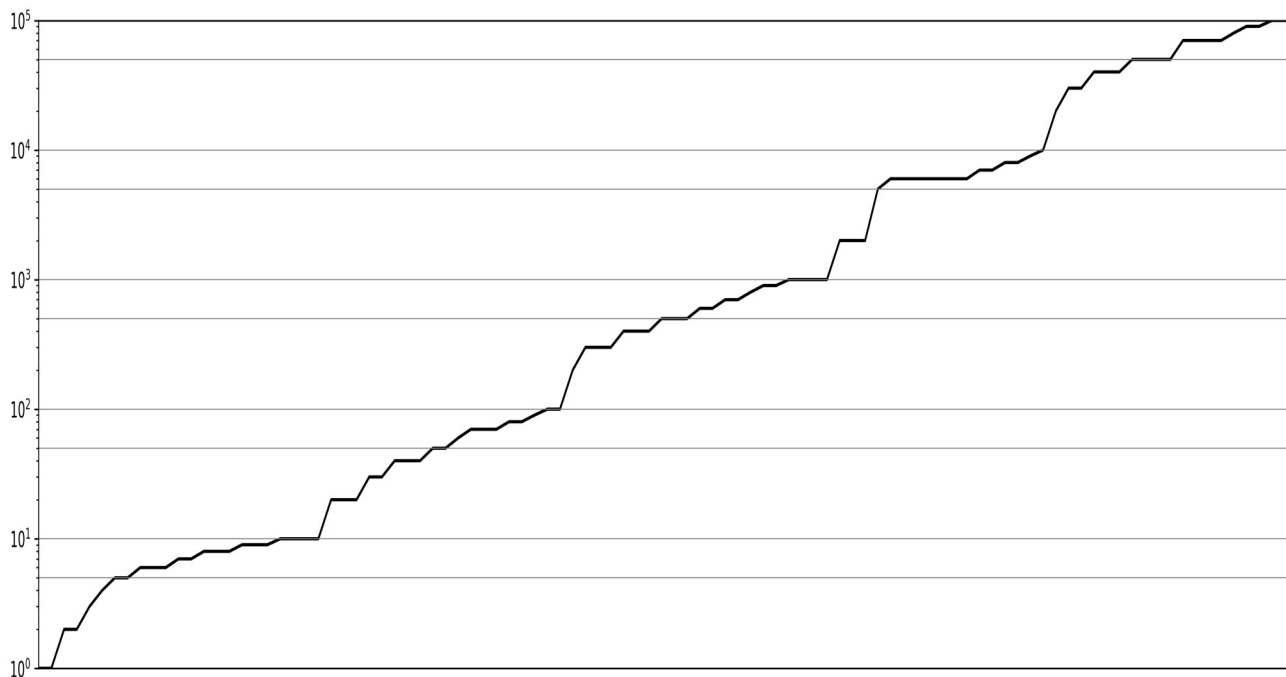

*

	Trend	**Confidence**
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Trend	Confidence
Answer		

Order of Magnitude Line

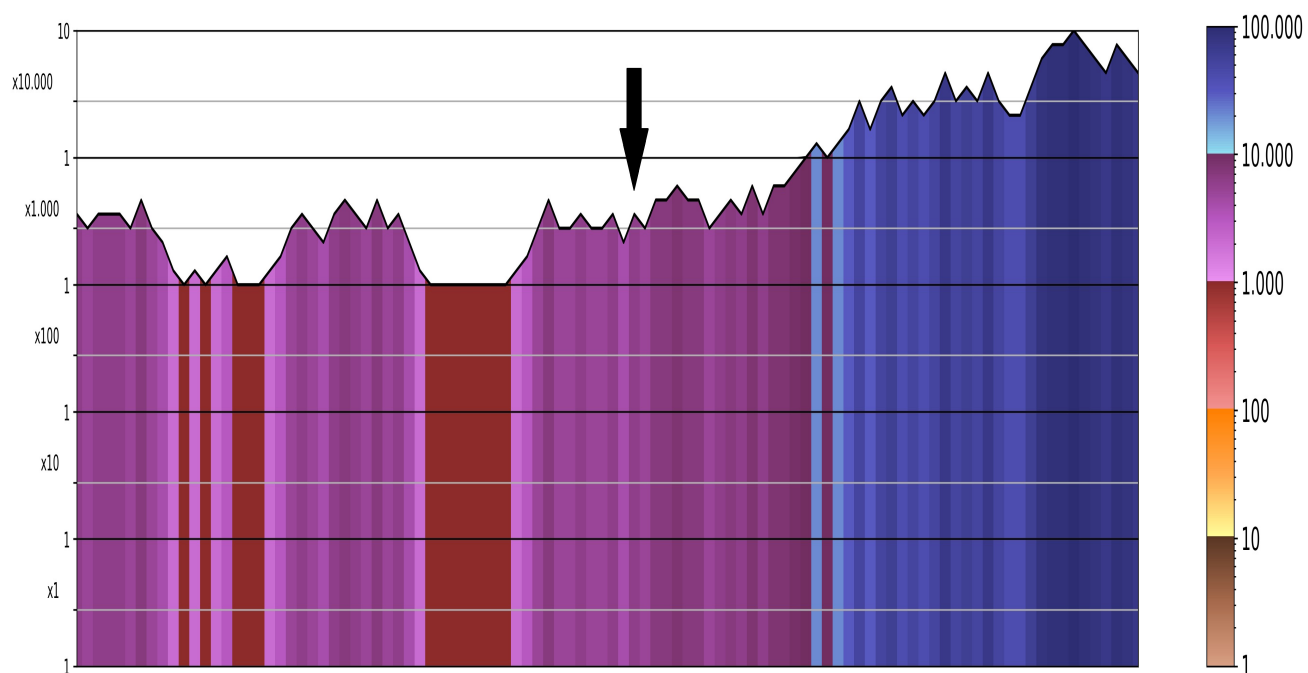The visualization technique Order of Magnitude Line is a variation of the logarithmic scaled line graph.

I.e., the mantissa read on the y-axis within the magnitude must be multiplied by the corresponding magnitude.

Here, the scaling of the y-axis within each exponent is linear from 1 to 10 (the grey lines mark the mantissa 5).

In addition, each value is given a vertical bar that is encoded using a separate (logarithmic scaled) color scale.

This example should help to read the visualization correctly.

The marked point has the value 6*1000 = 6000.

The training is over now.

The actual study, including time measurement, begins on the next page.

The following questions are about identifying individual values.

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
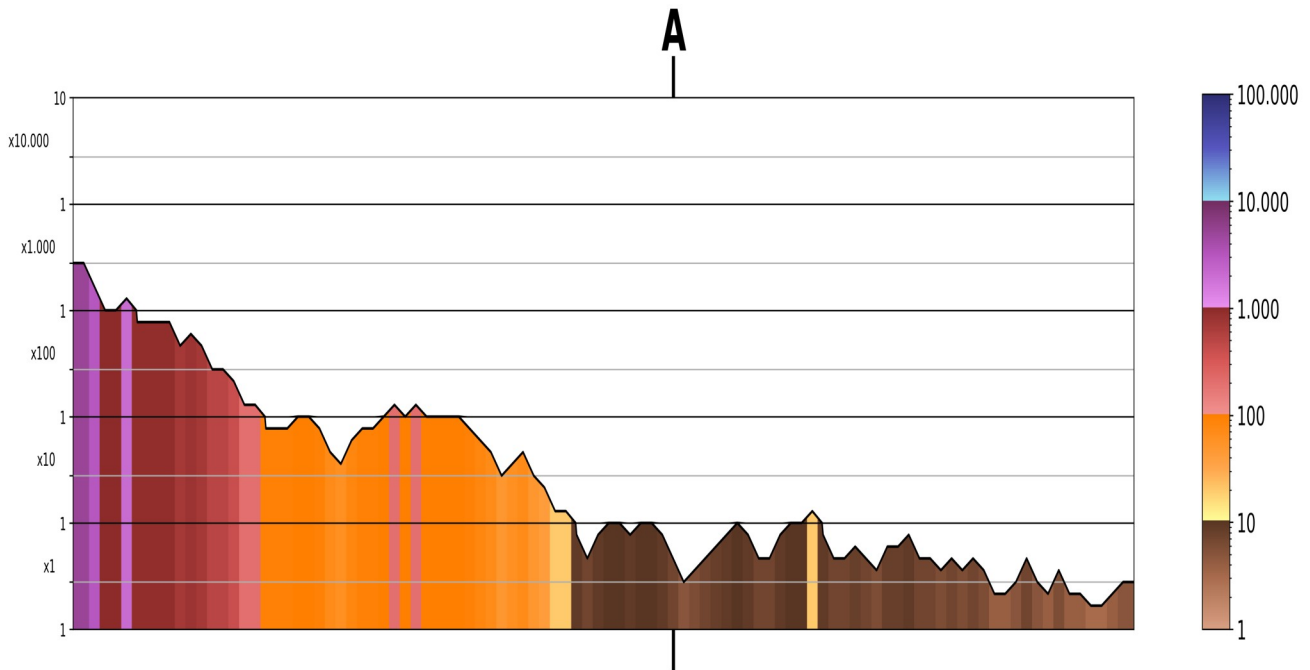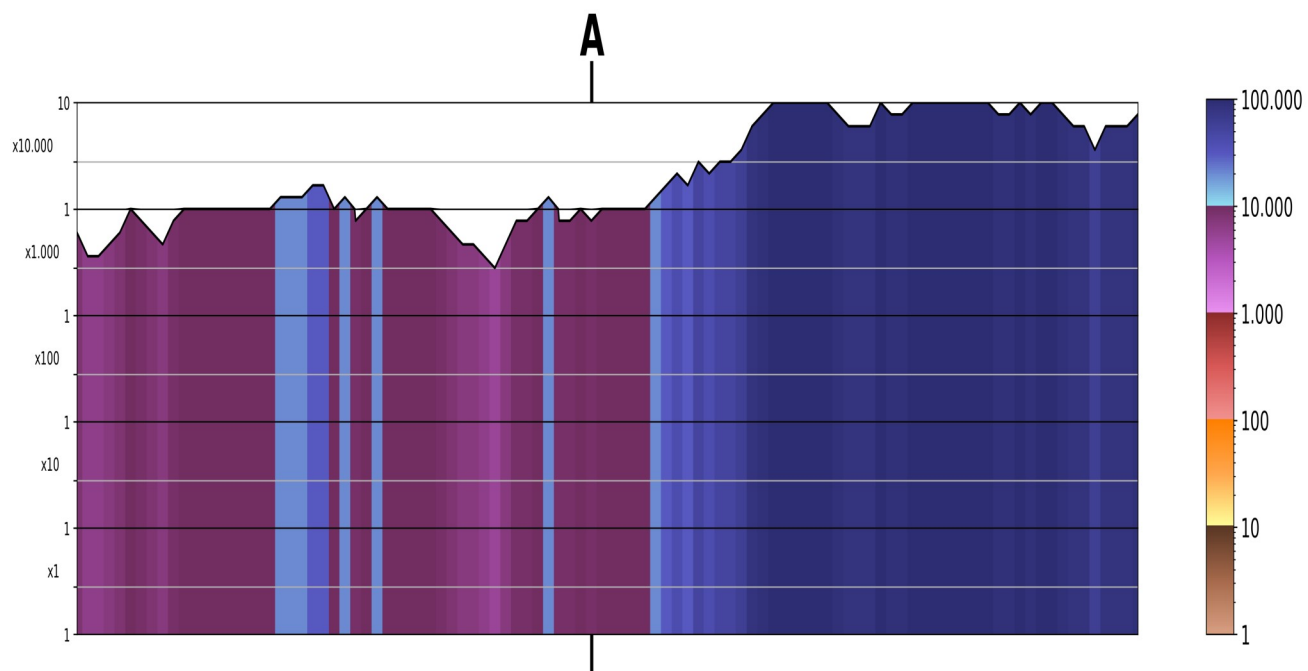

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.
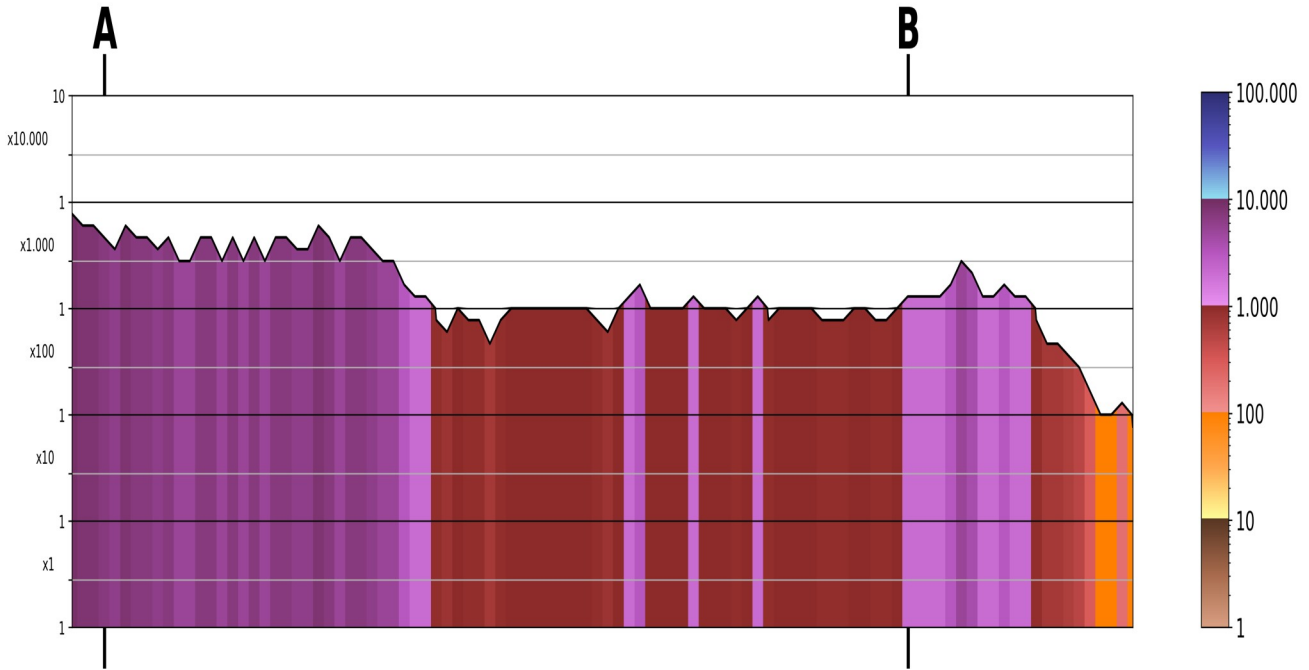
Which number is the greatest? *

Please choose **only one** of the following:

○ 0

○ 10000

○ 1000

The following questions compare two marked values.

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
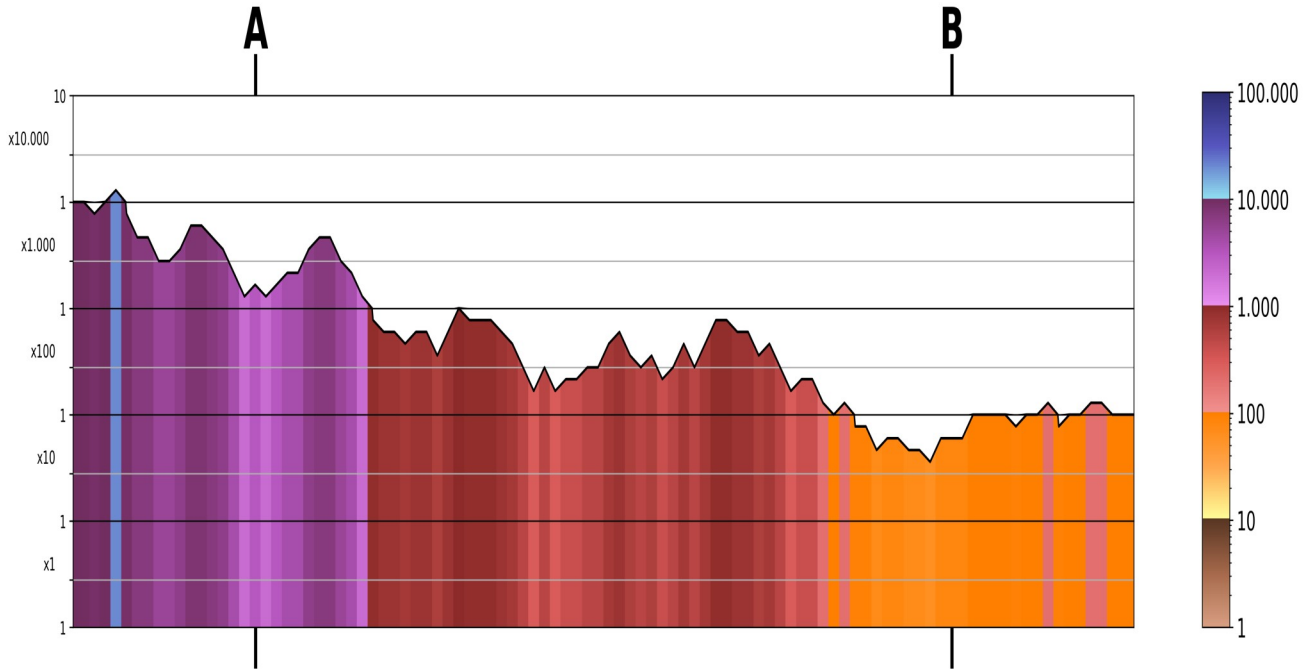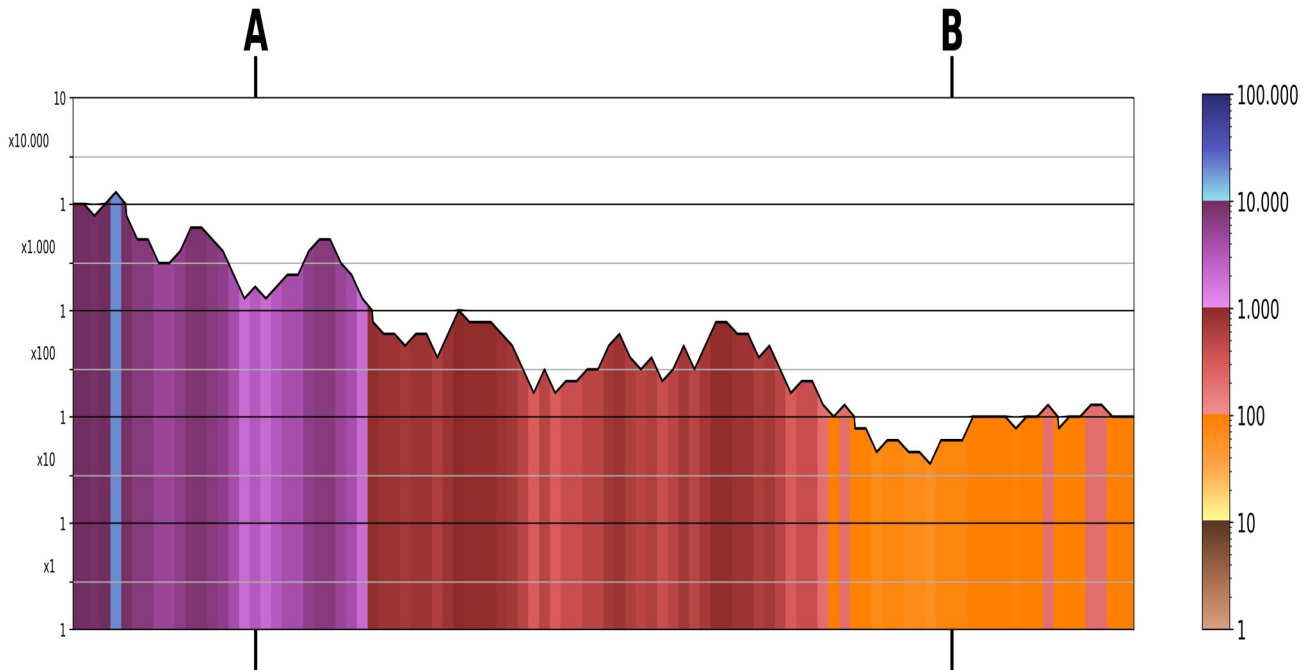

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.
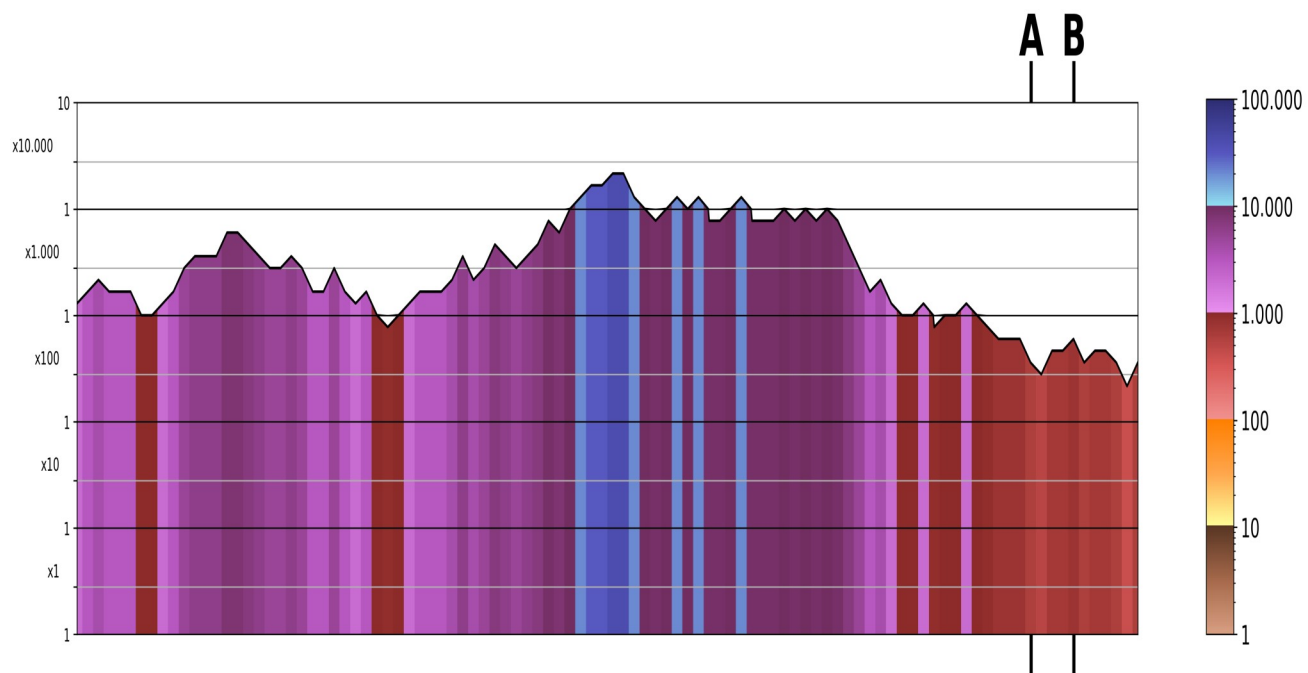
Which number is the greatest? *

Please choose **only one** of the following:

○ 0

○ 2*10^3

○ 5*10^4

In the following tasks the absolute difference between two marked values has to be estimated.

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
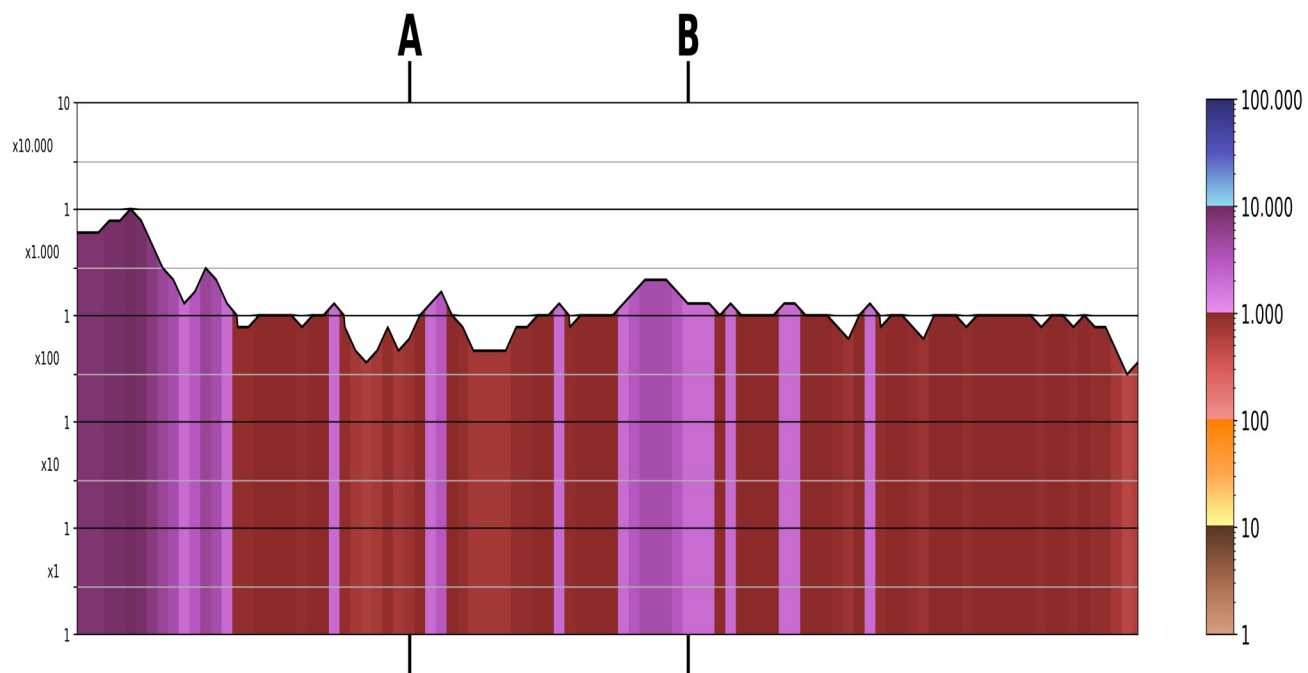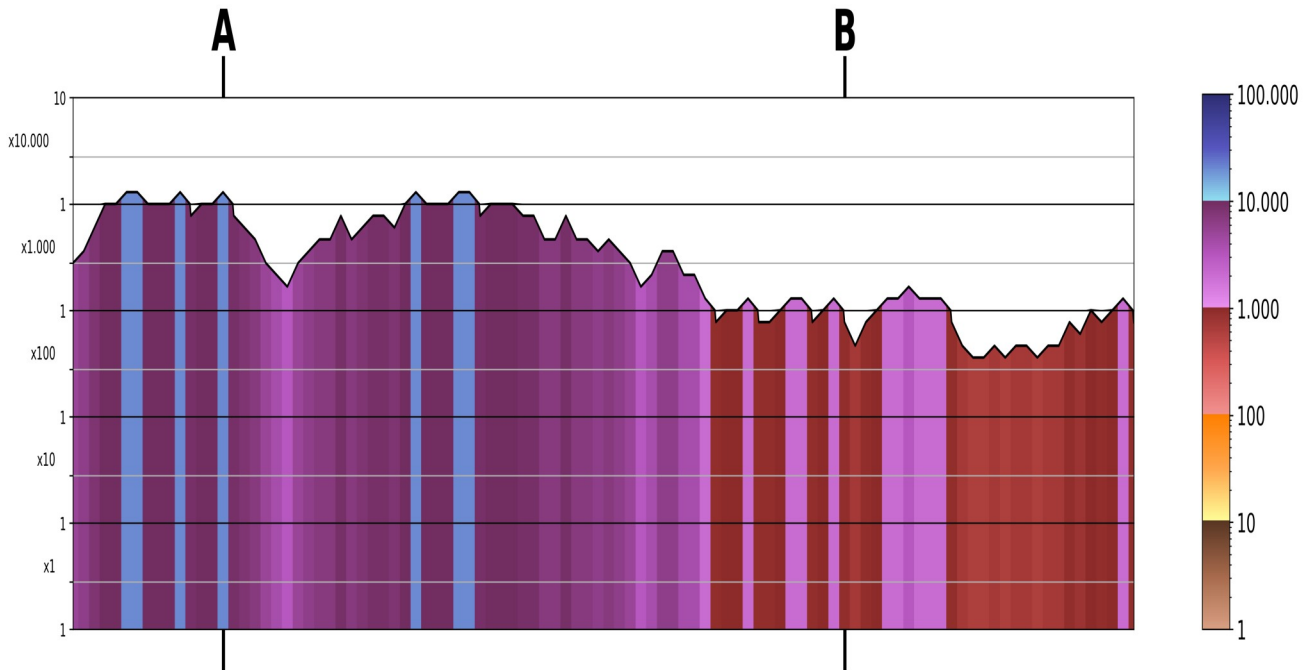

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the smallest? *

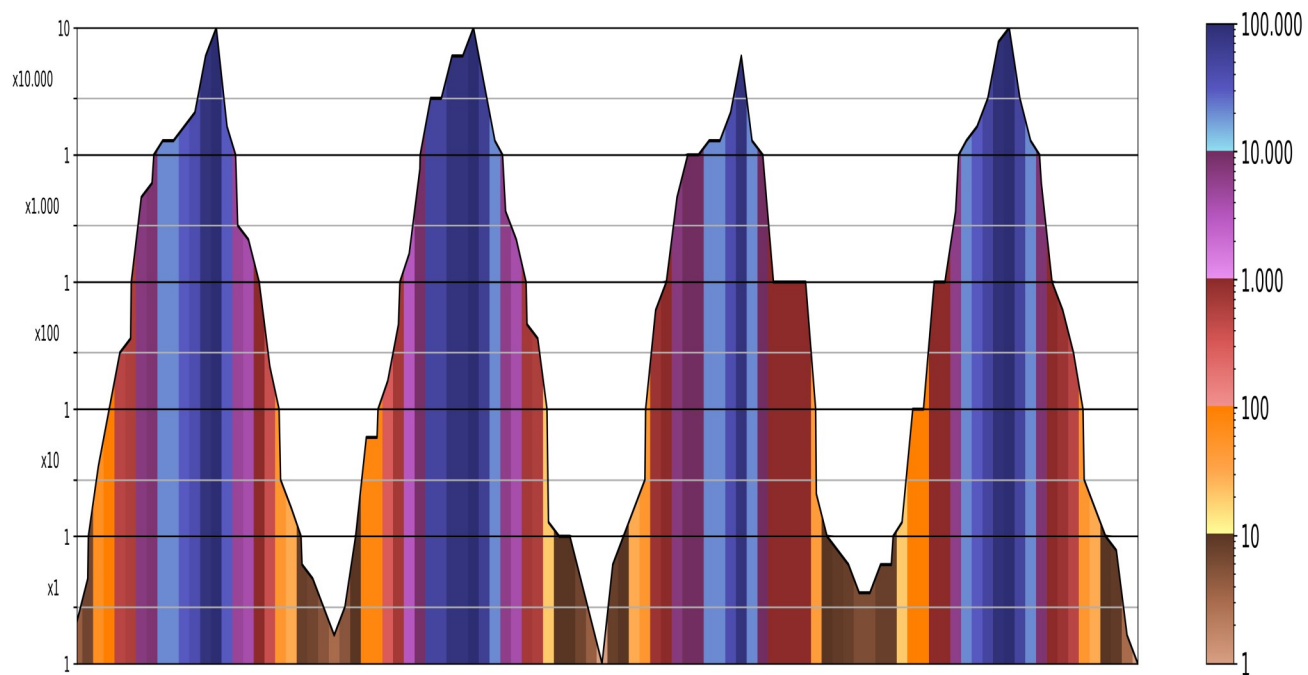Please choose **only one** of the following:

○ 0

○ 10

○ 100

The last task type is to determine the trend in the data.

What trend do the data presented in the visualization describe?

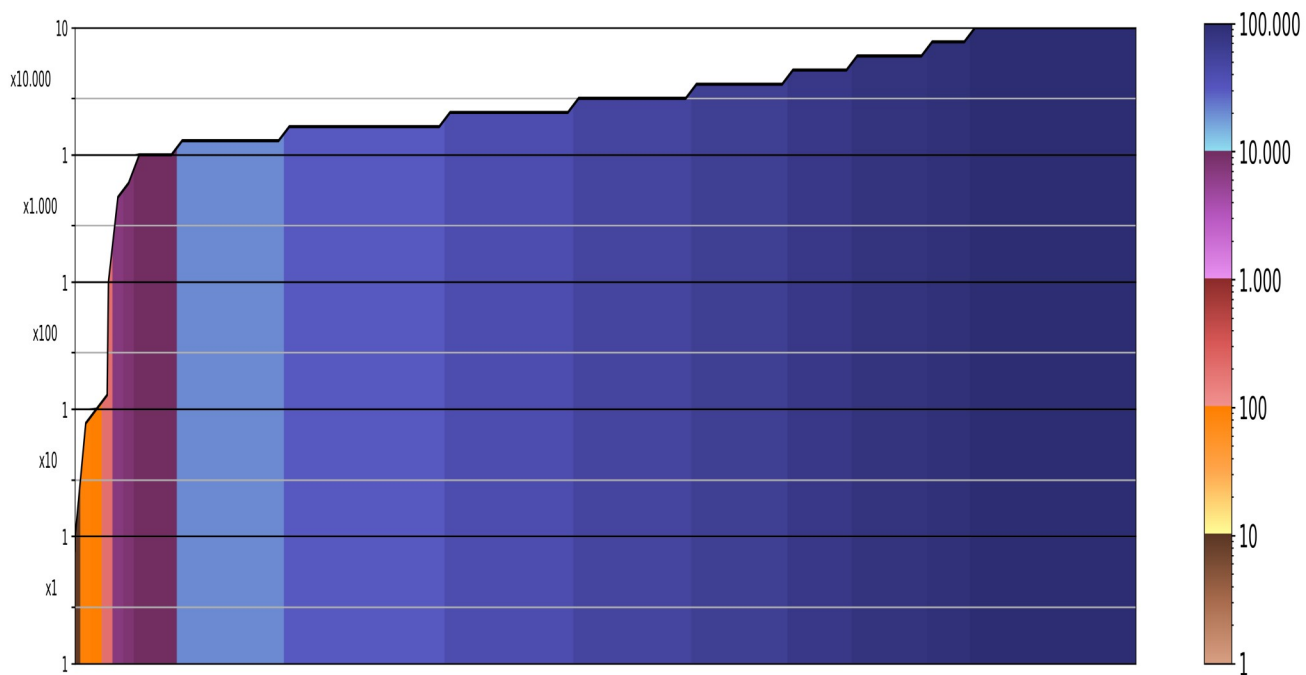And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
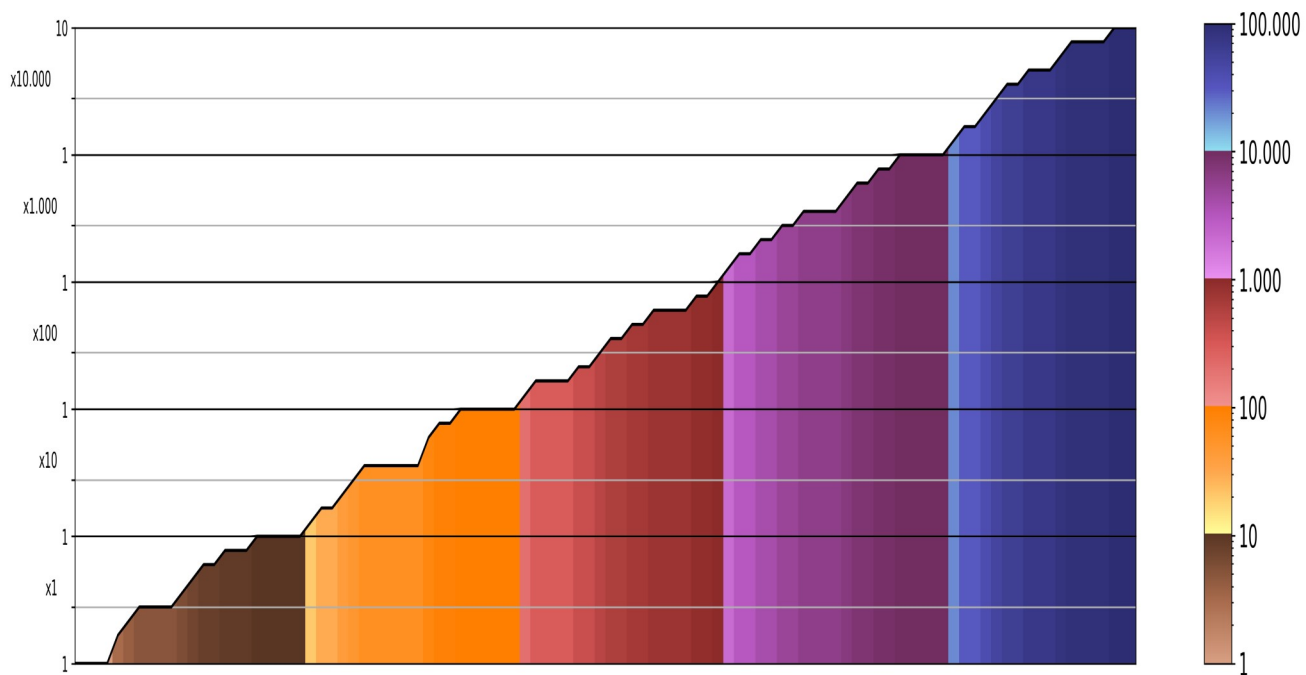

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
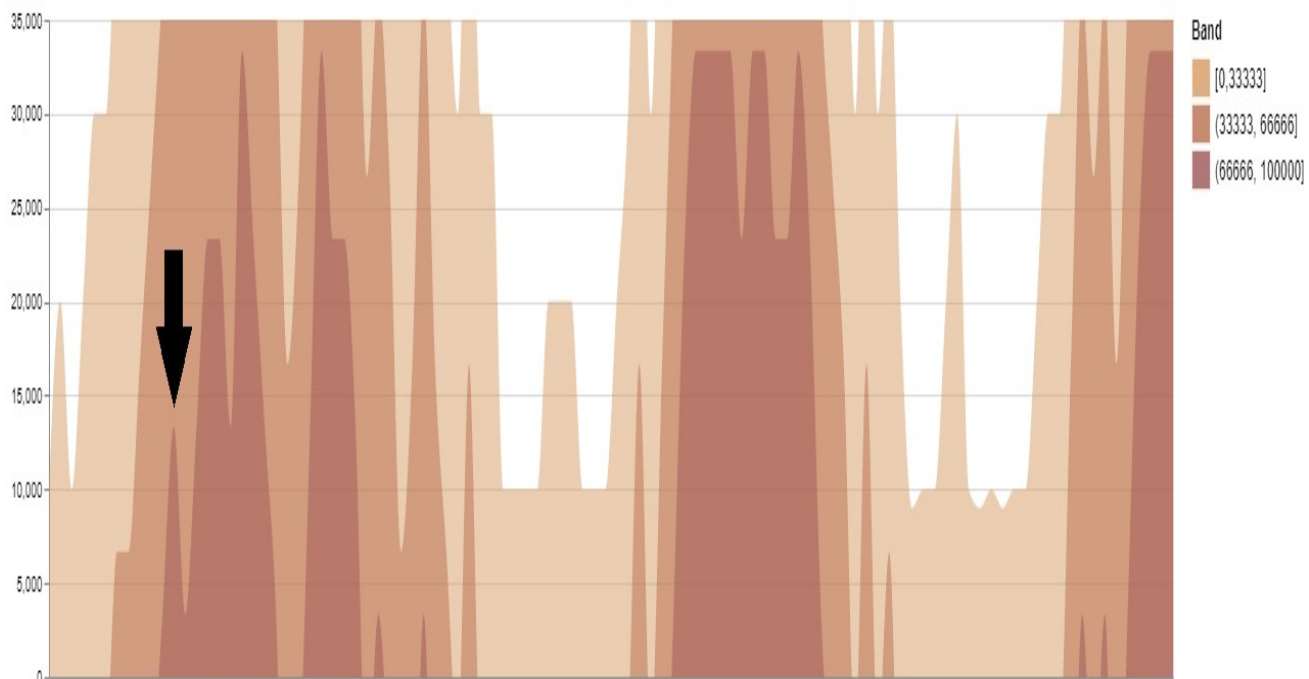

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Trend	Confidence
Answer		

Horizon Plot

In a horizon plot, the range of values is divided into 3 parts. Each of these ranges has a size of 33333.

The three ranges are displayed in different colors as superimposed areas. For example, if a value is in the second range, the area for this range is superimposed over that of the first. To the value that can be read from the area of the second range, the 33333 of the first ranged must be added.

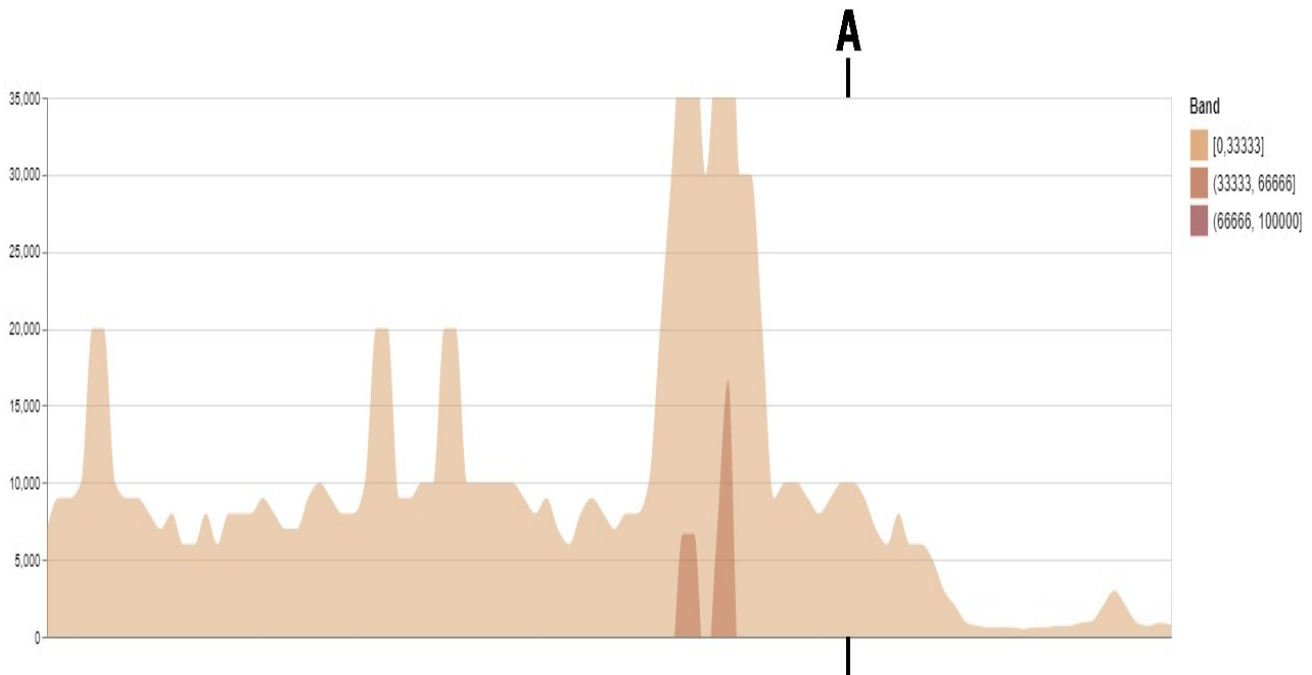*The marked data point has the value 66666 + 13334 = 80000.*

The training is over now.

The actual study, including time measurement, begins on the next page.

The following questions are about identifying individual values.

Name the marked value.

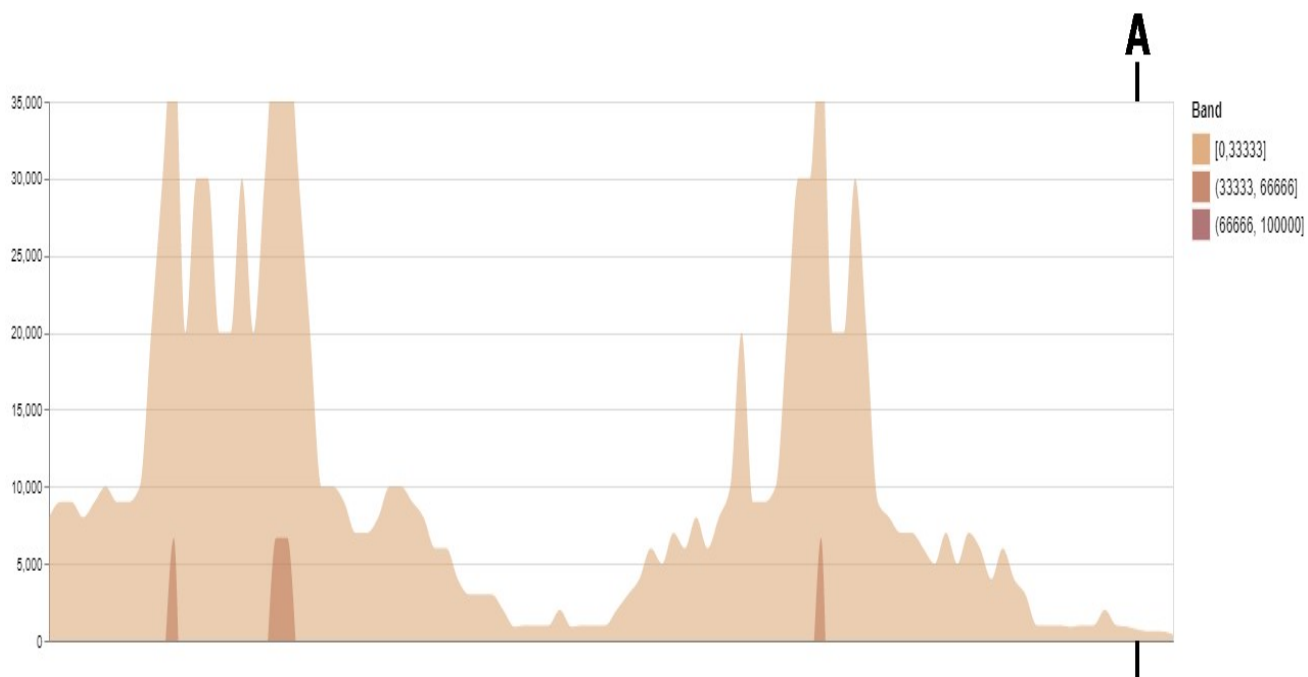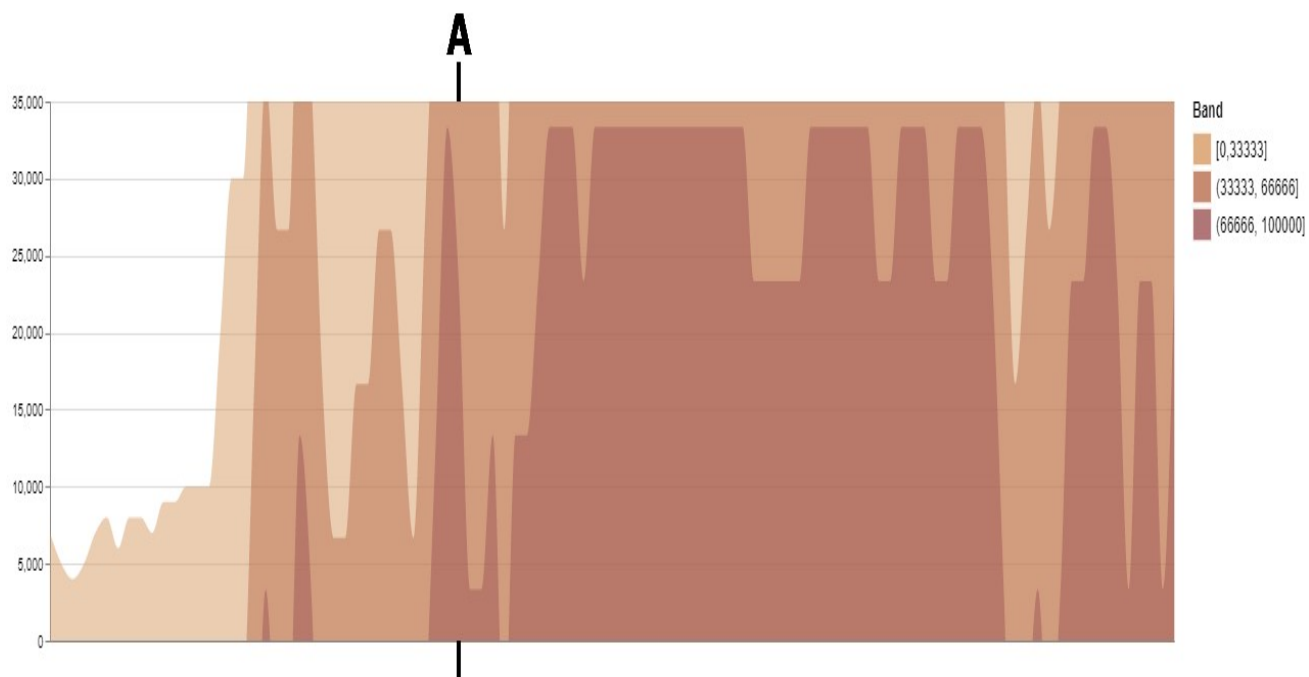And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

A

Band	
	[0,33333]
	(33333, 66666]
	(66666, 100000]

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *
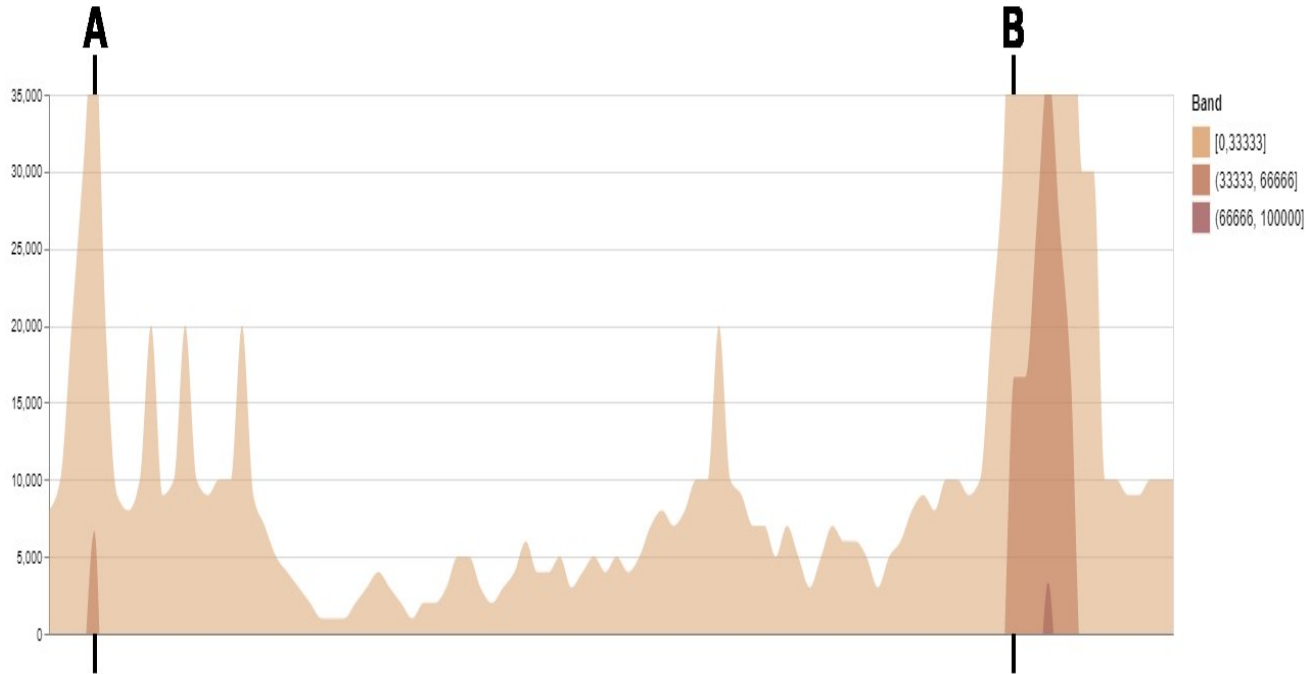
Please choose **only one** of the following:

○ 0

○ 10000

○ 1000

The following questions compare two marked values.

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
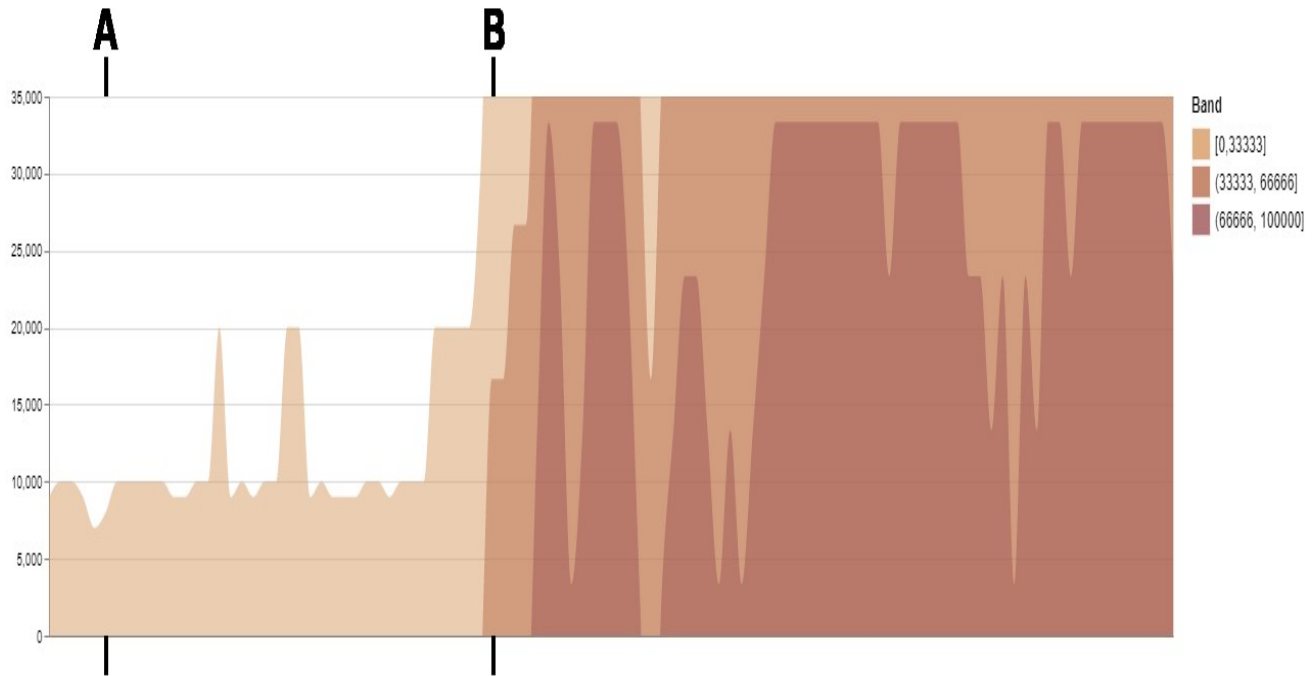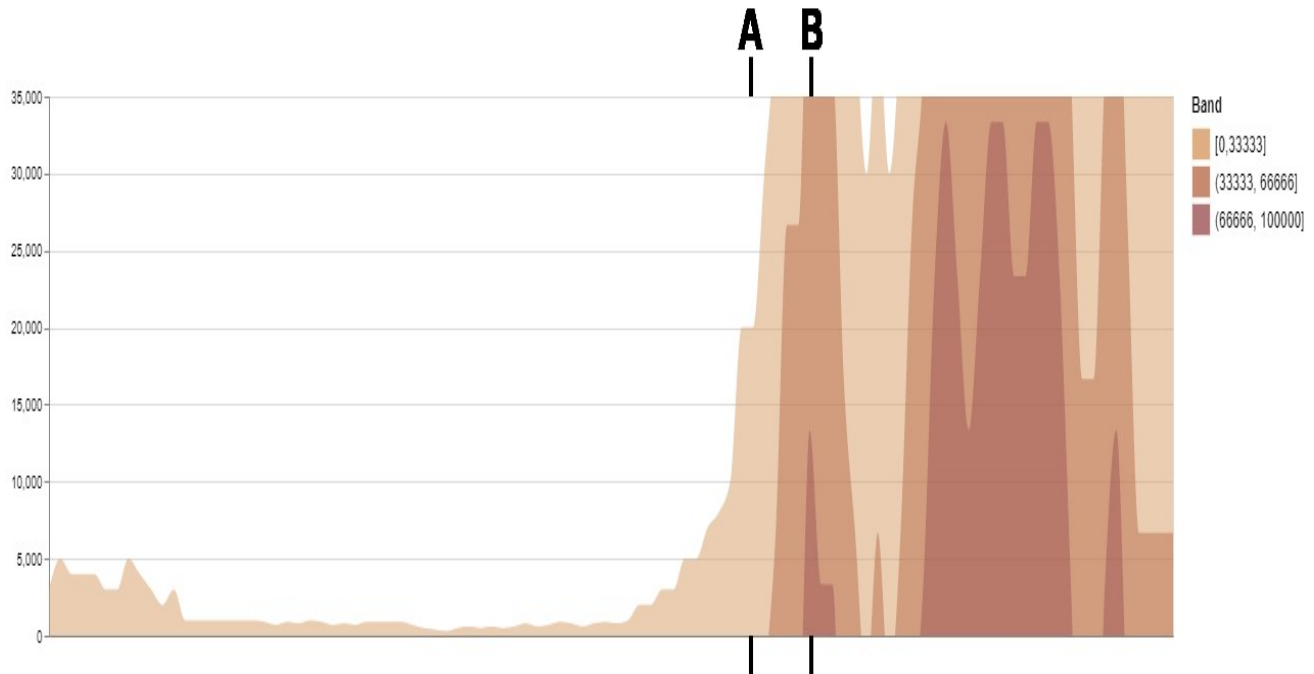

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *

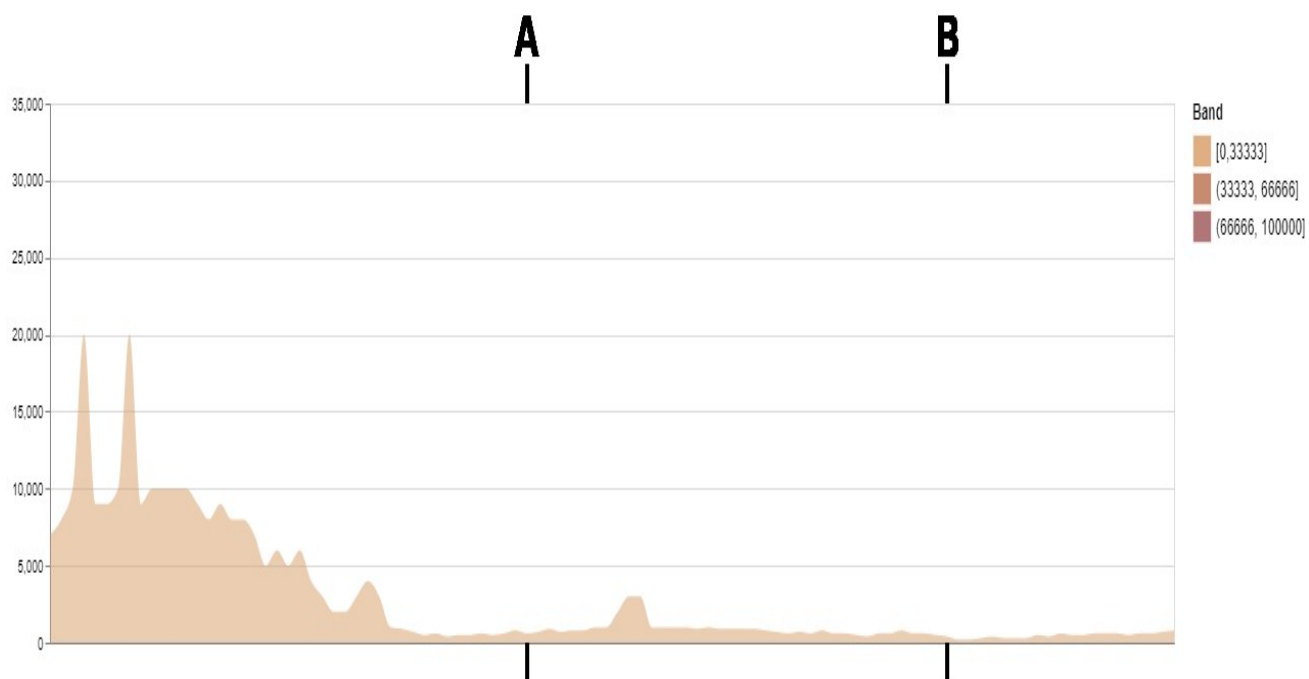Please choose **only one** of the following:

○ 0

○ 2*10^3

○ 5*10^4

In the following tasks the absolute difference between two marked values has to be estimated.

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
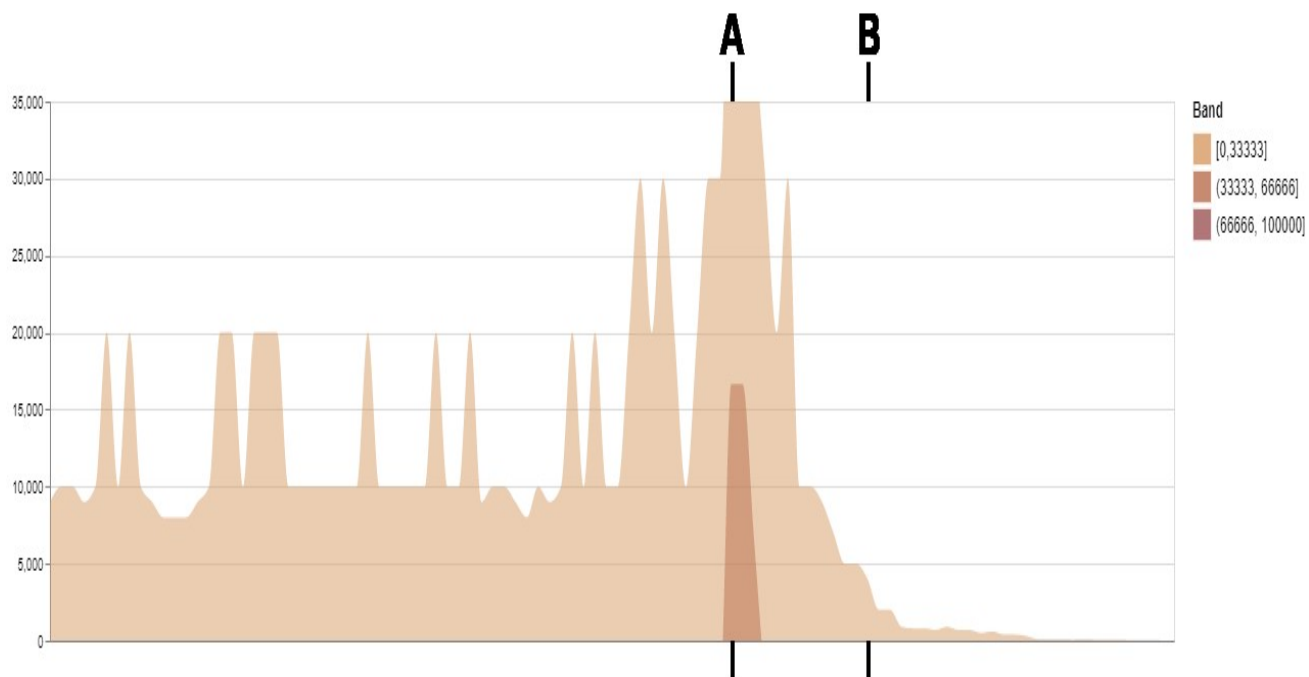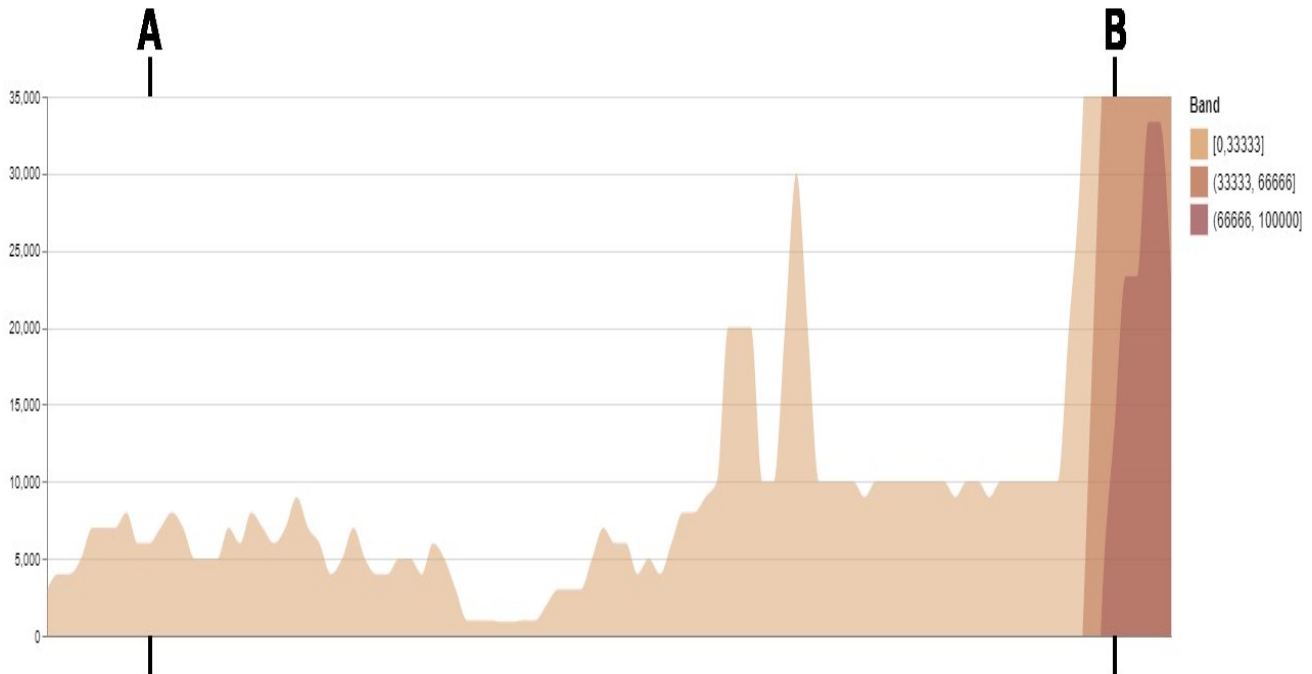

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the smallest? *

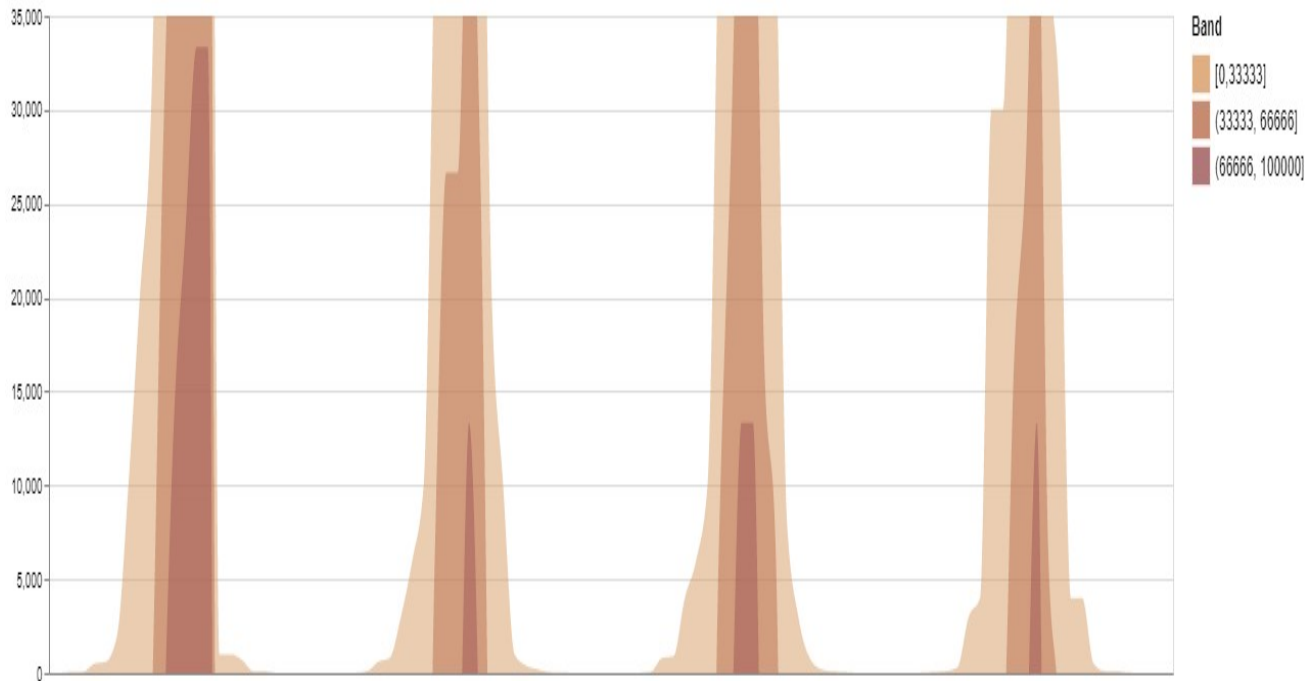Please choose **only one** of the following:

- ○ 0
- ○ 10
- ○ 100

The last task type is to determine the trend in the data.

What trend do the data presented in the visualization describe?

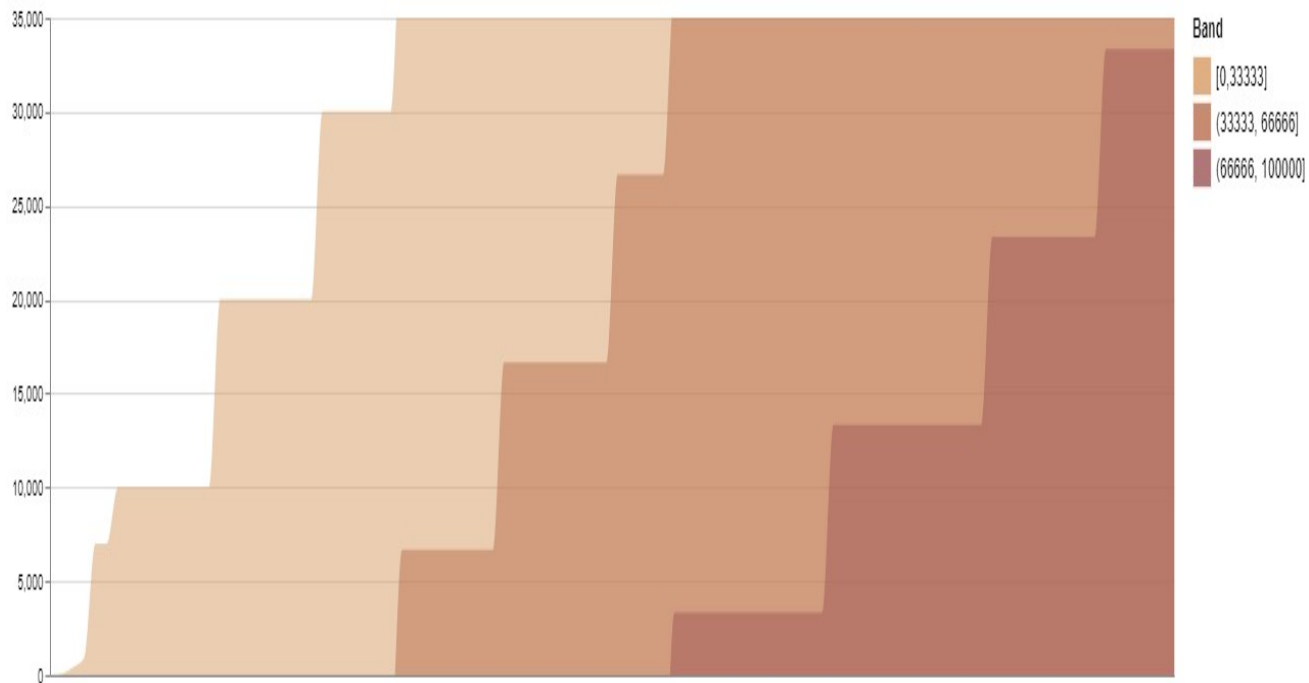And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
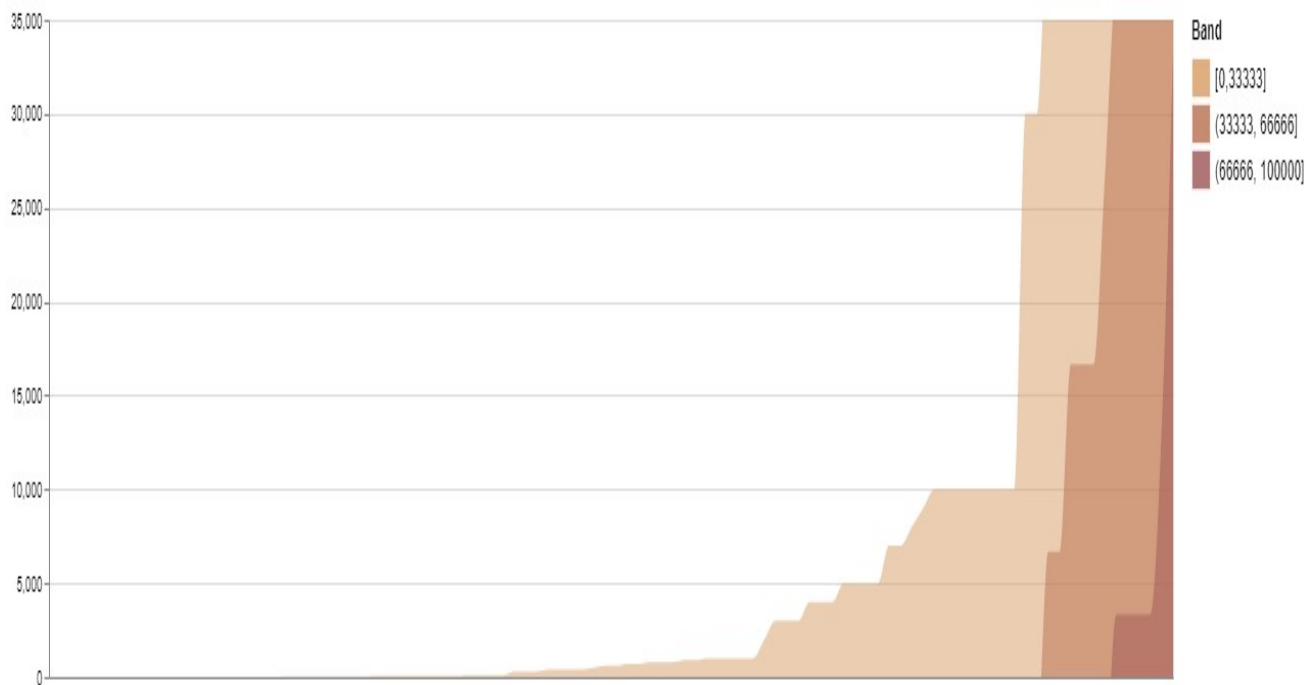

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Trend	Confidence
Answer		

Order of Magnitude Horizon

In the Order of Magnitude Horizon visualization technique, the different magnitudes are displayed in different colors as superimposed areas. The height of the area at a certain position represents the mantissa.

To determine a value, the read mantissa of the area that is in the foreground must be multiplied by the corresponding magnitude.

This example should help to read the visualization correctly.

*The mantissa of the marked value is 6 and the magitude 1000 (--> value 6*1000 = 6000).*

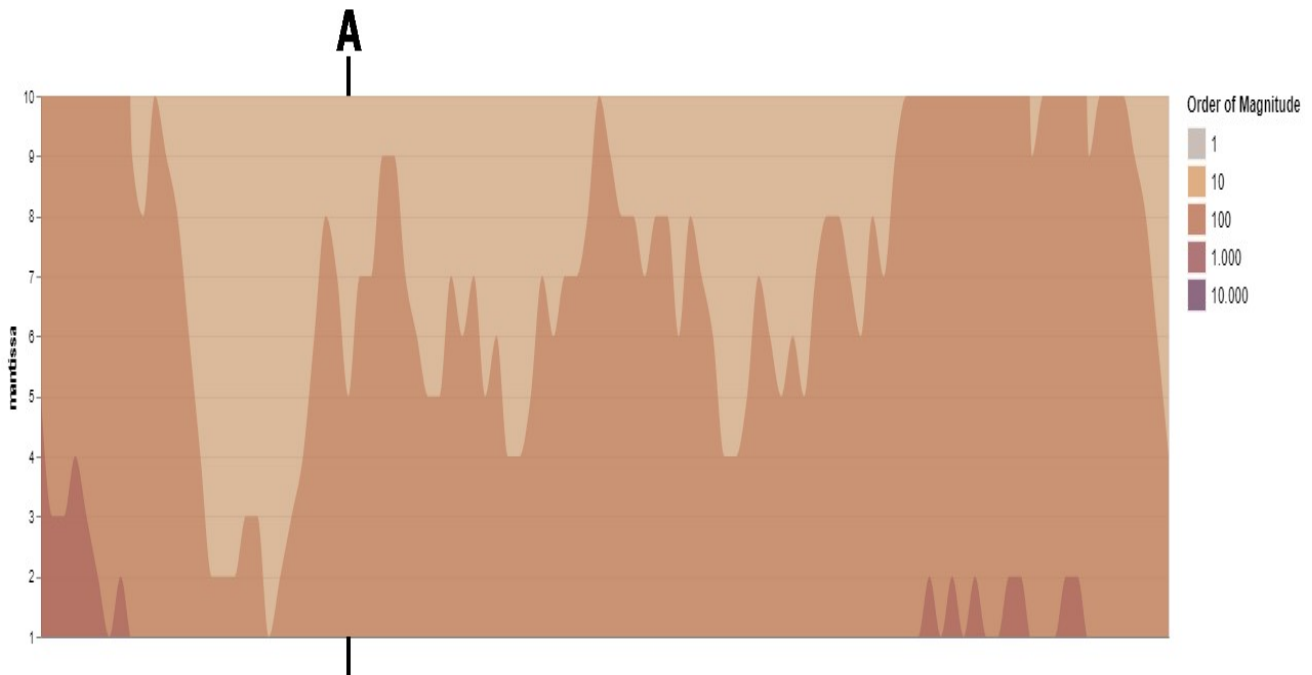**The training is over now.**

The actual study, including time measurement, begins on the next page.

The following questions are about identifying individual values.

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
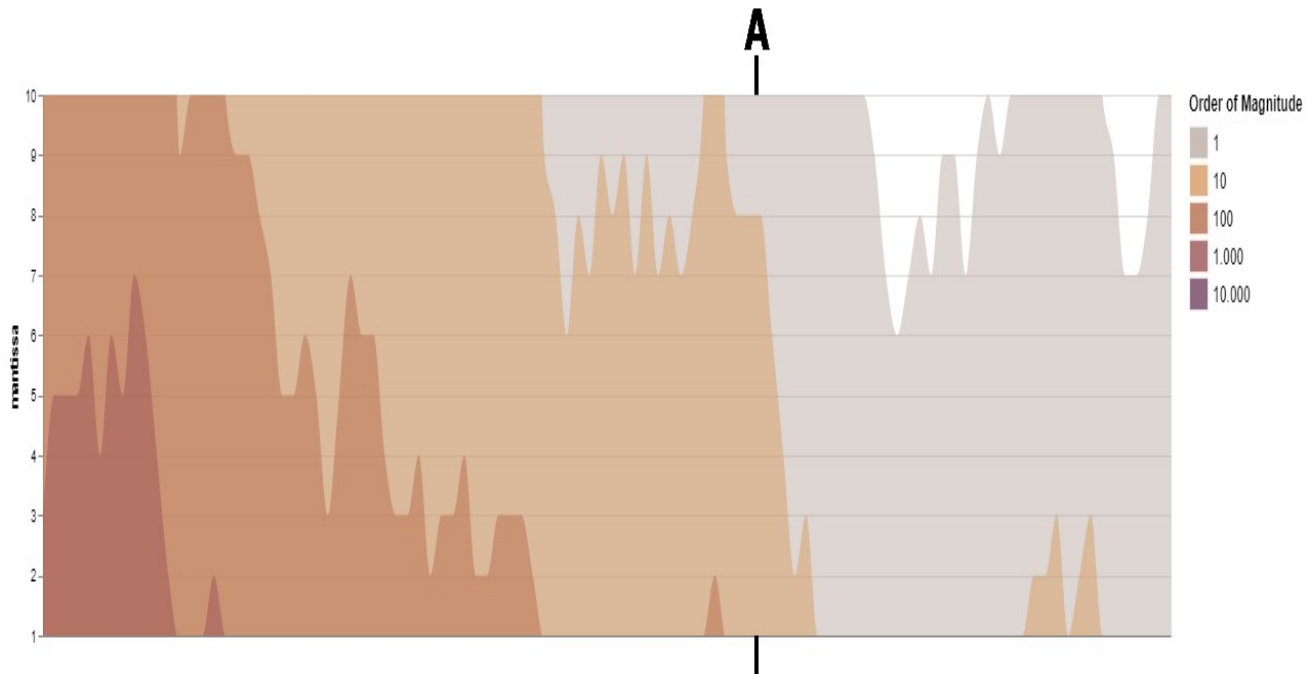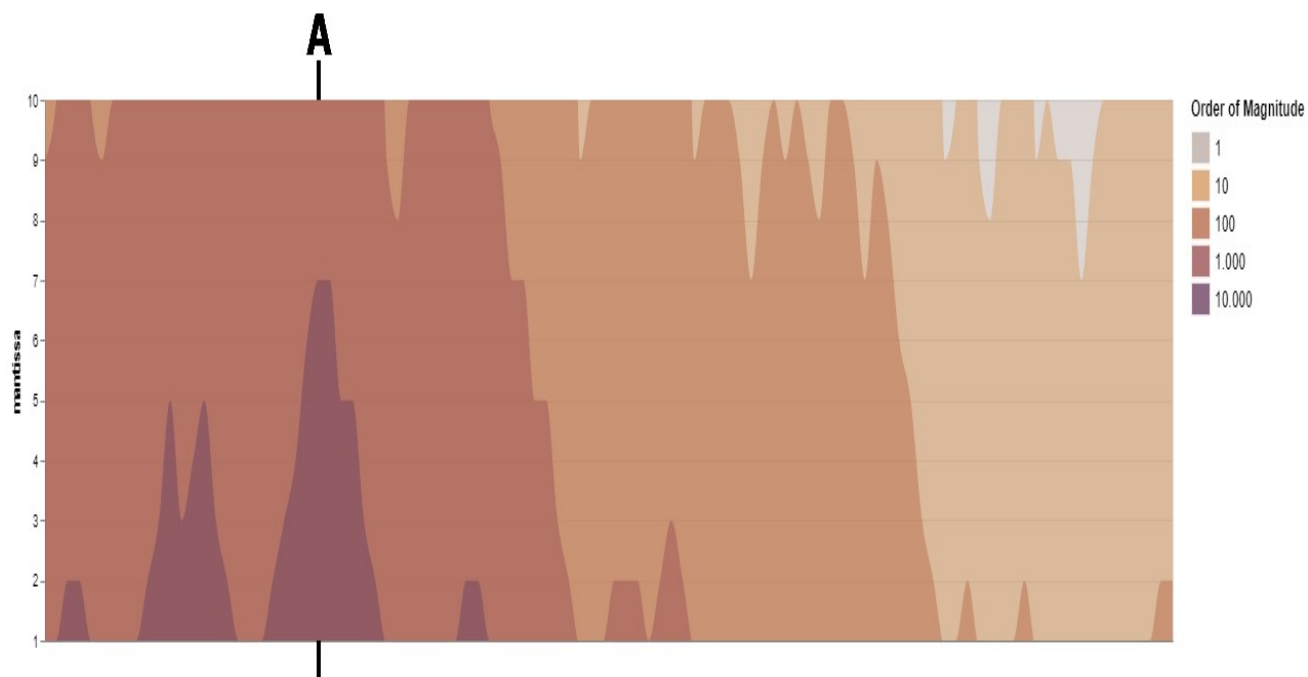

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *
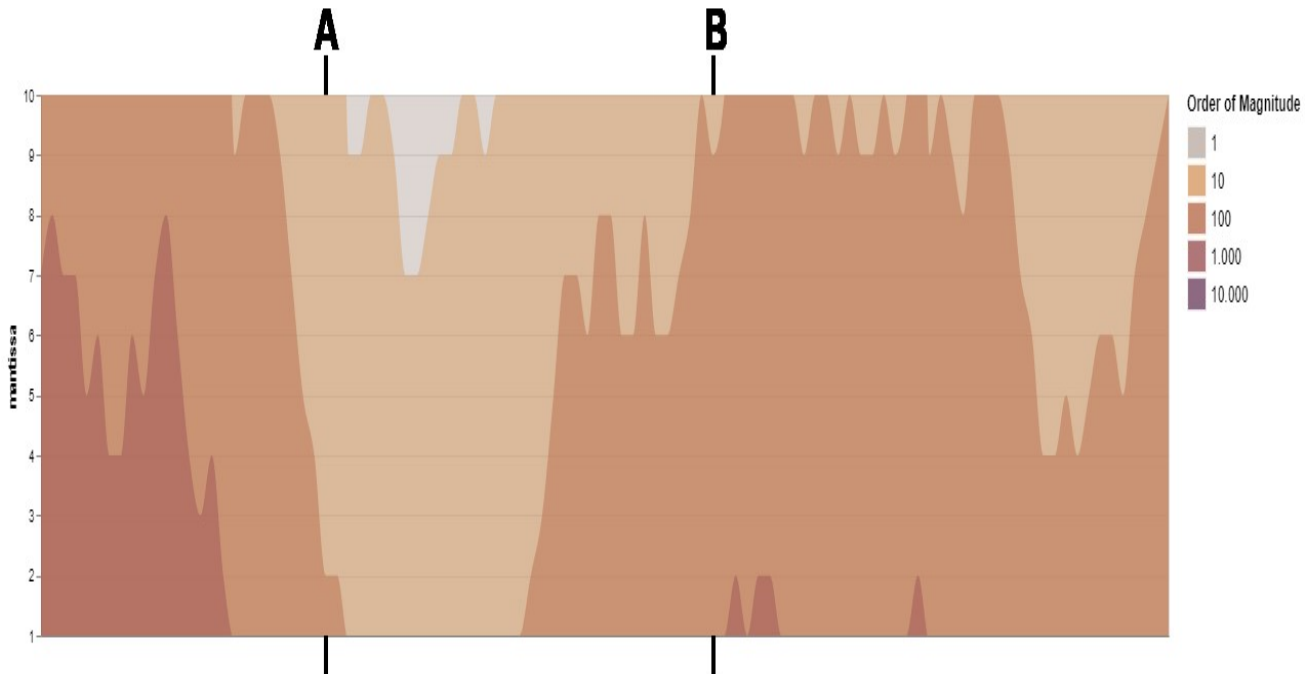
Please choose **only one** of the following:

- ○ 0
- ○ 10000
- ○ 1000

The following questions compare two marked values.

Which of the marked values is greater?

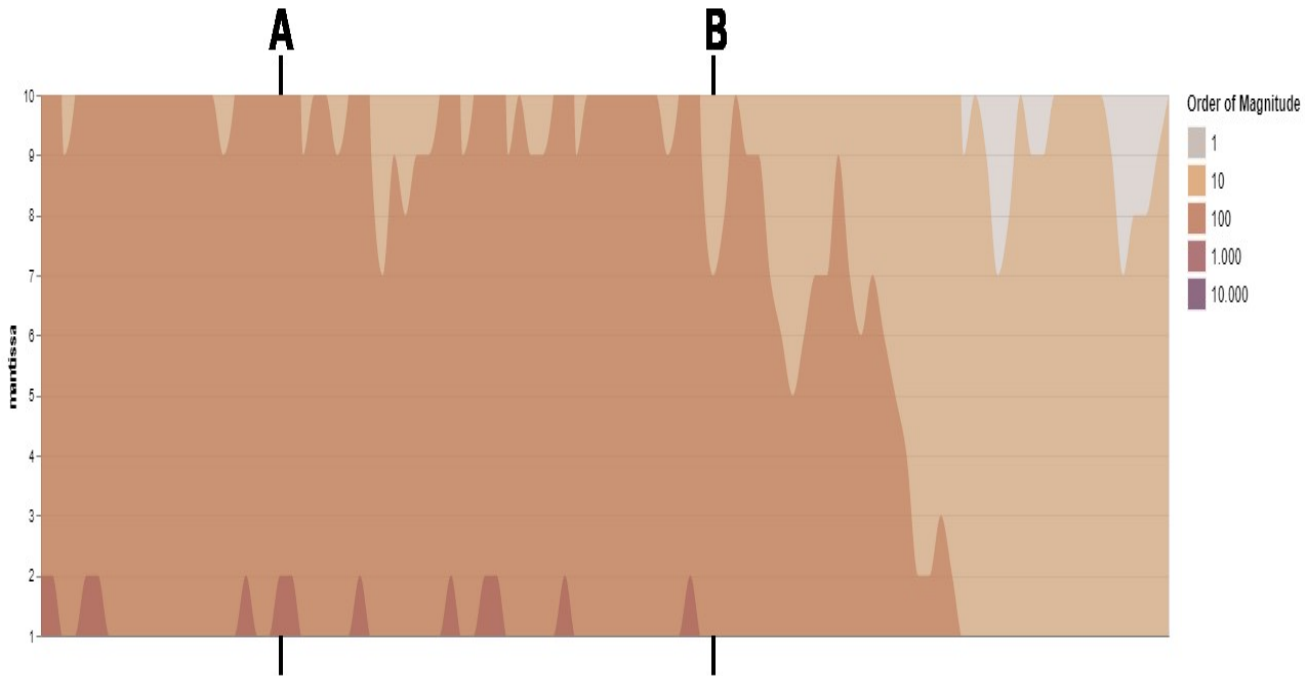And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
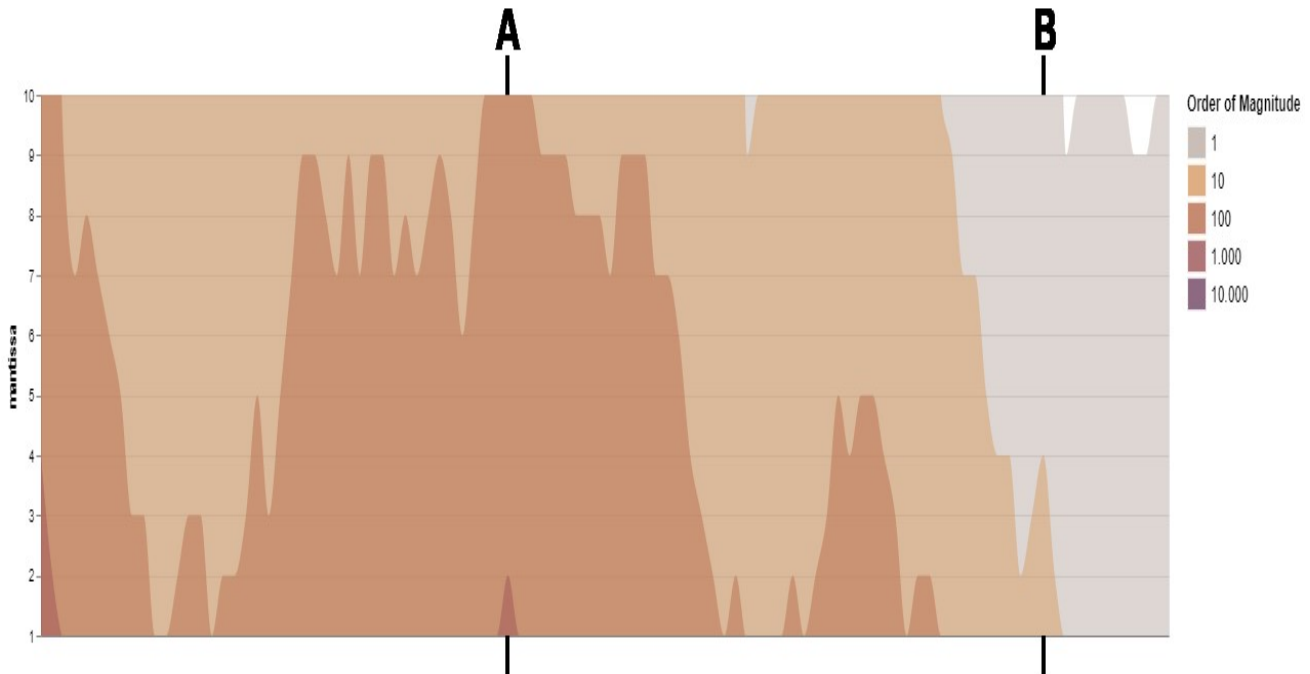

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *

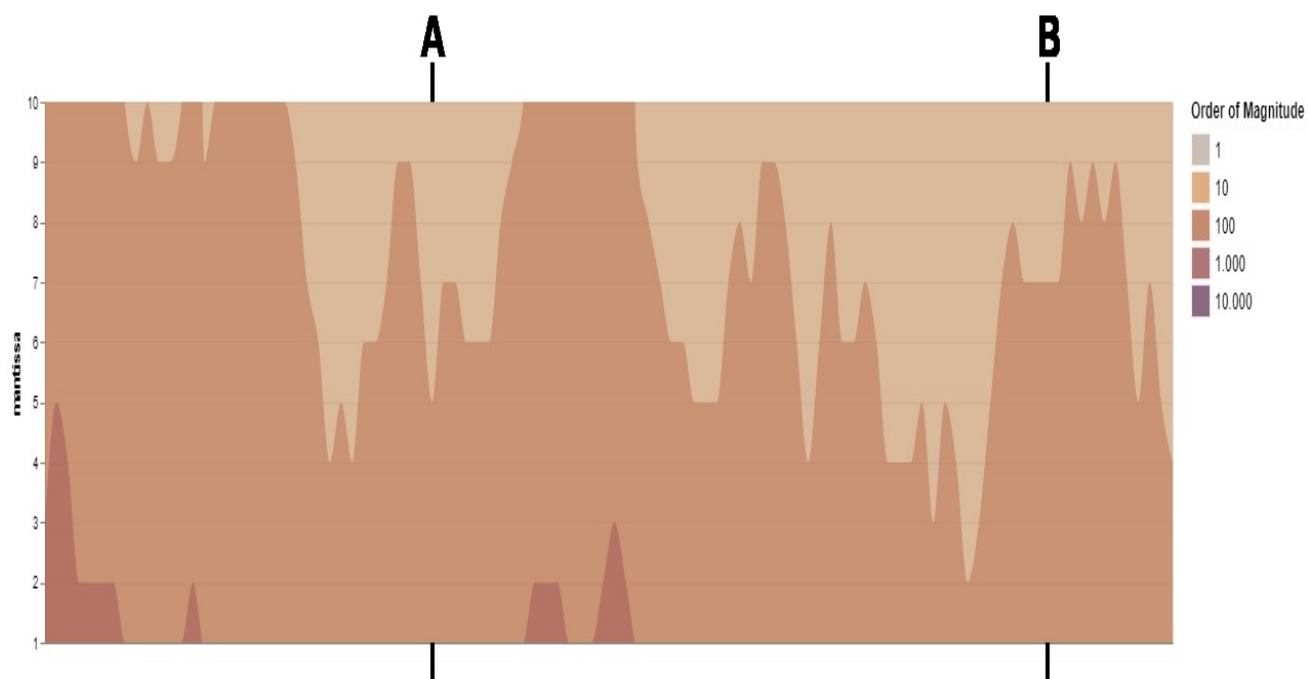Please choose **only one** of the following:

○ 0

○ 2*10^3

○ 5*10^4

In the following tasks the absolute difference between two marked values has to be estimated.

What is the absolute difference of the two marked values?

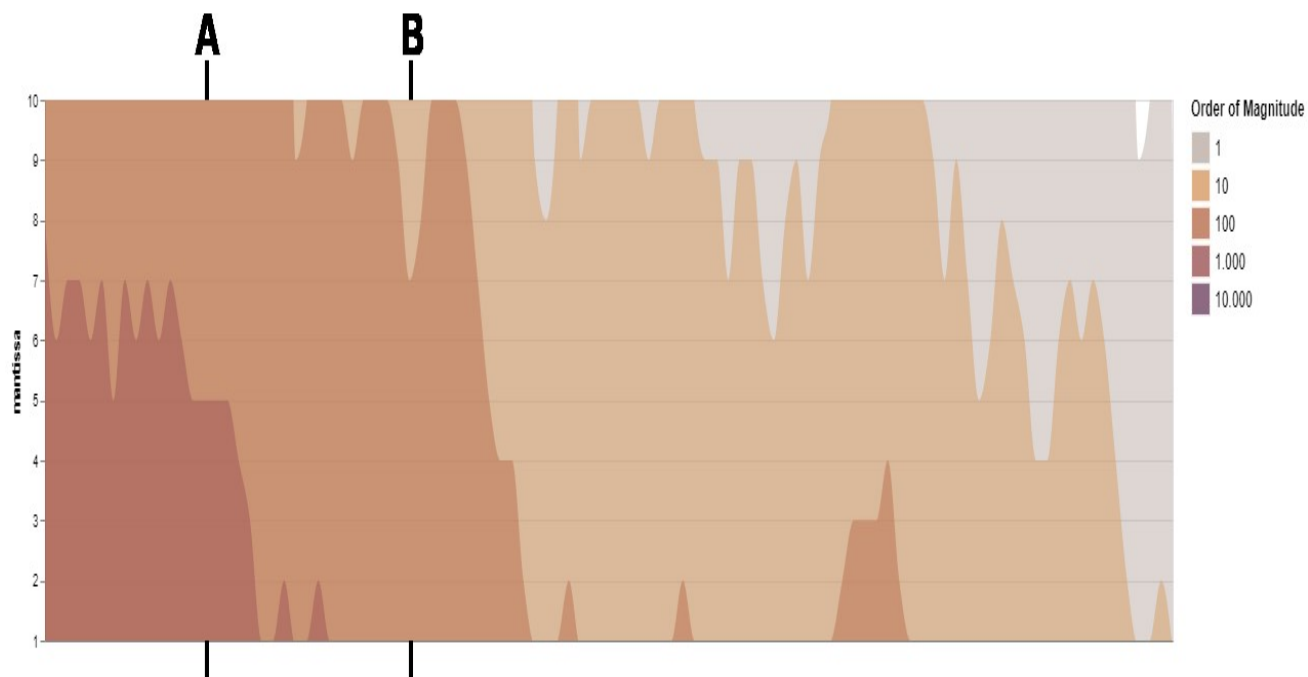And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
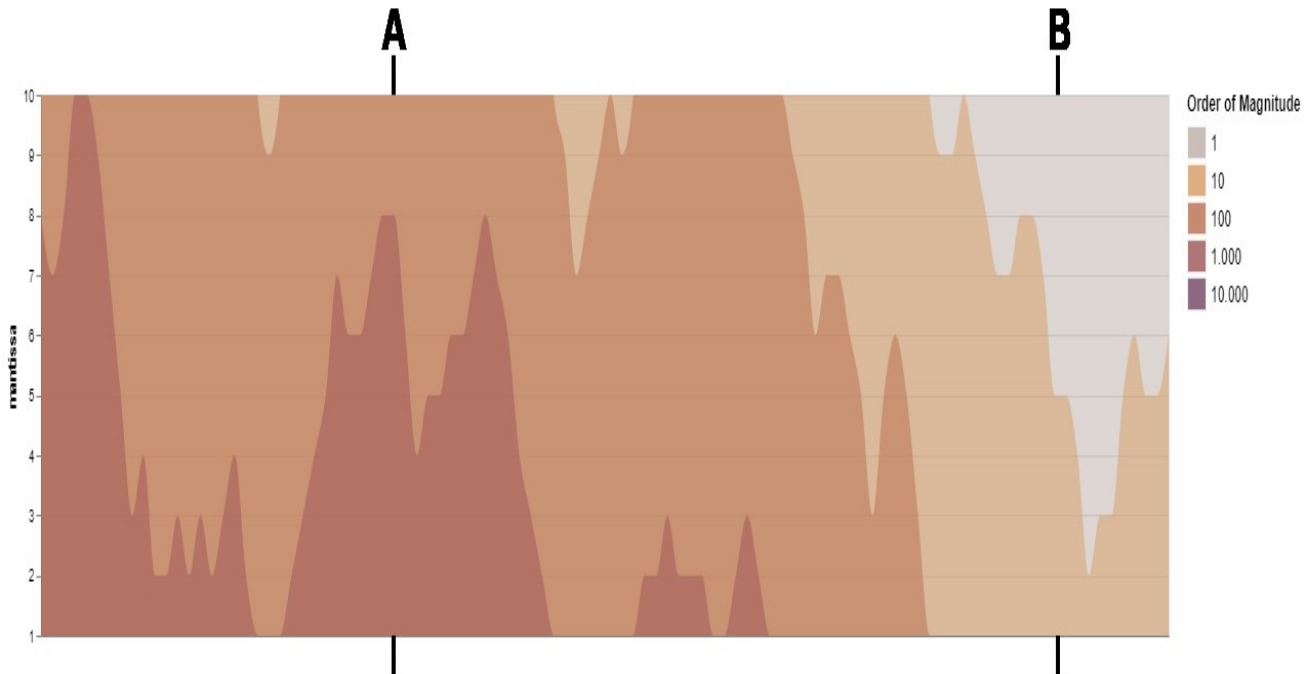

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the smallest? *

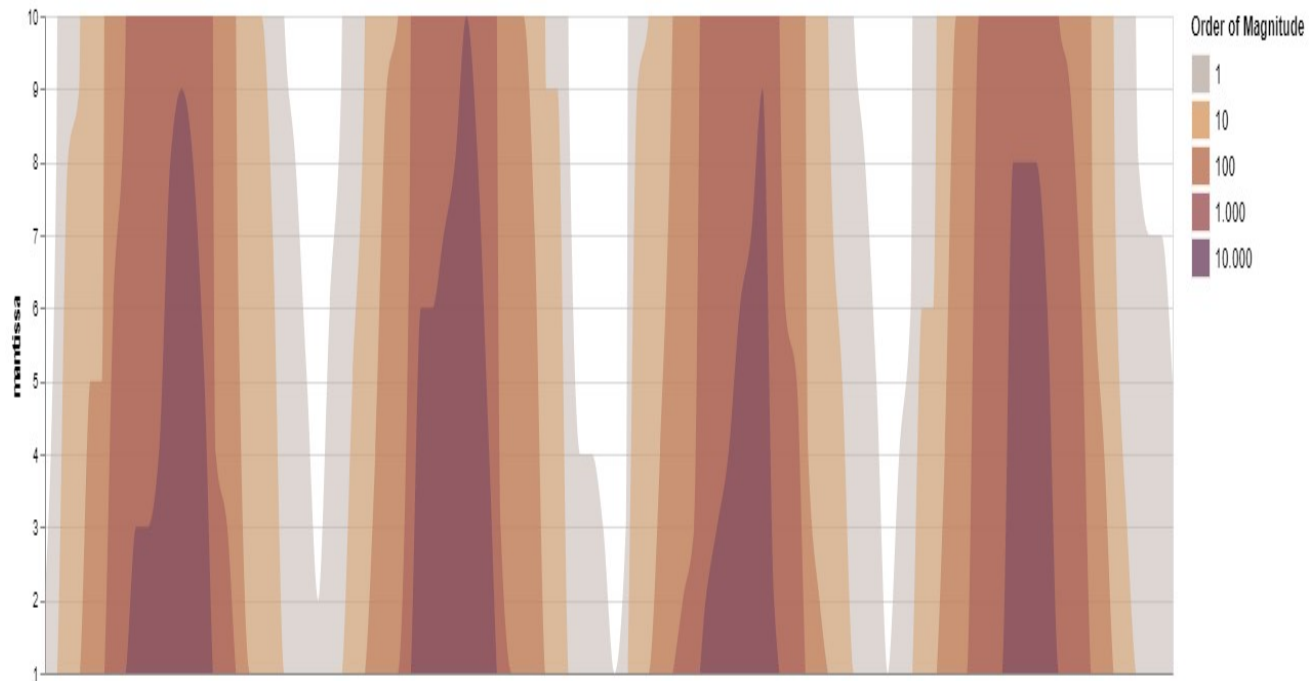Please choose **only one** of the following:

○ 0

○ 10

○ 100

The last task type is to determine the trend in the data.

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
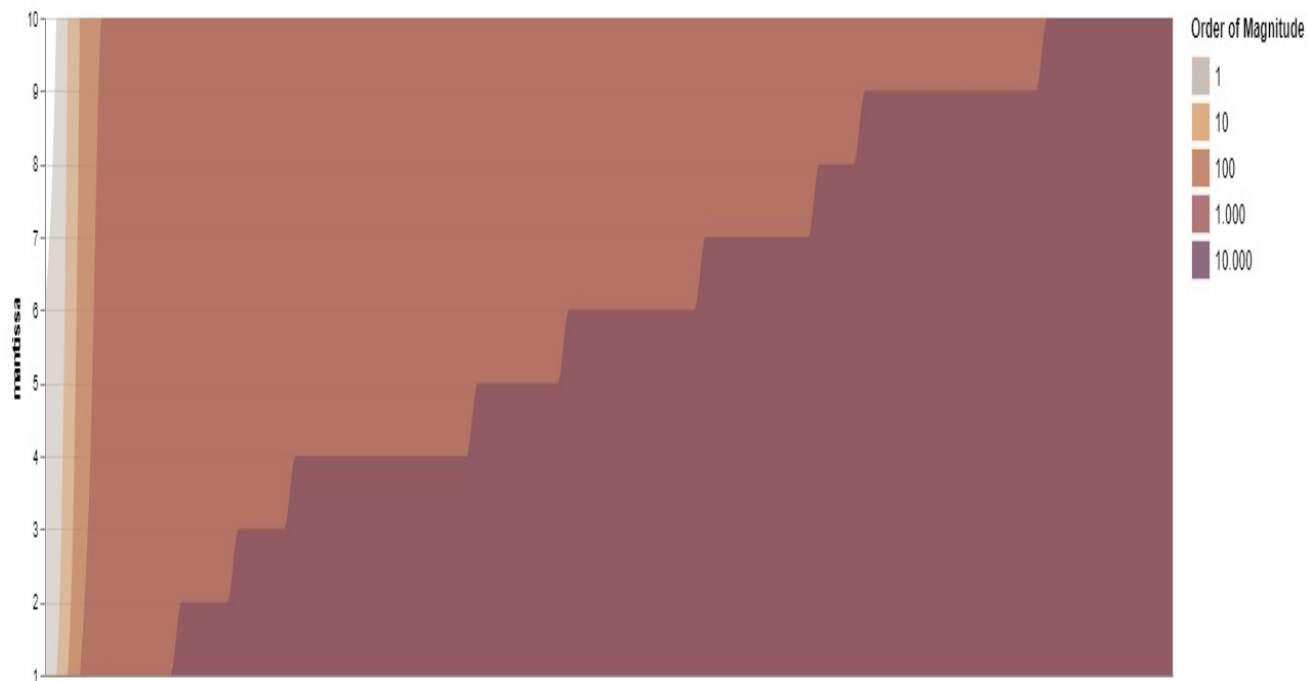

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
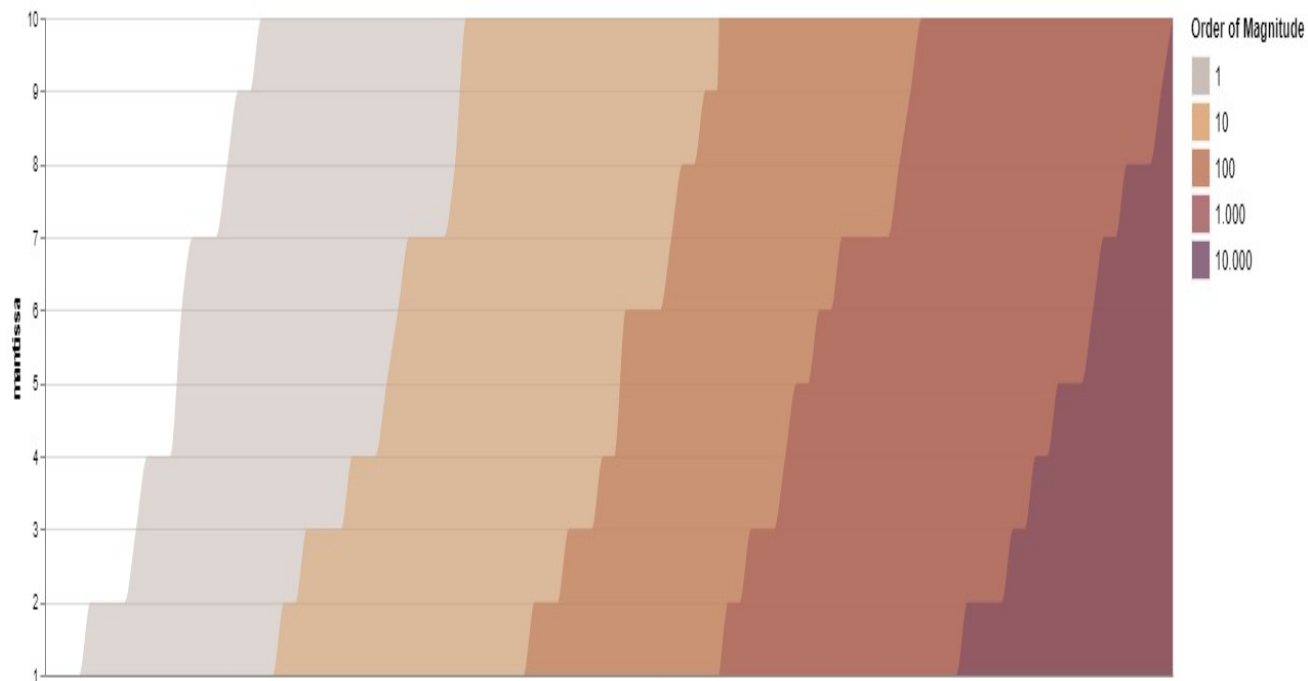

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

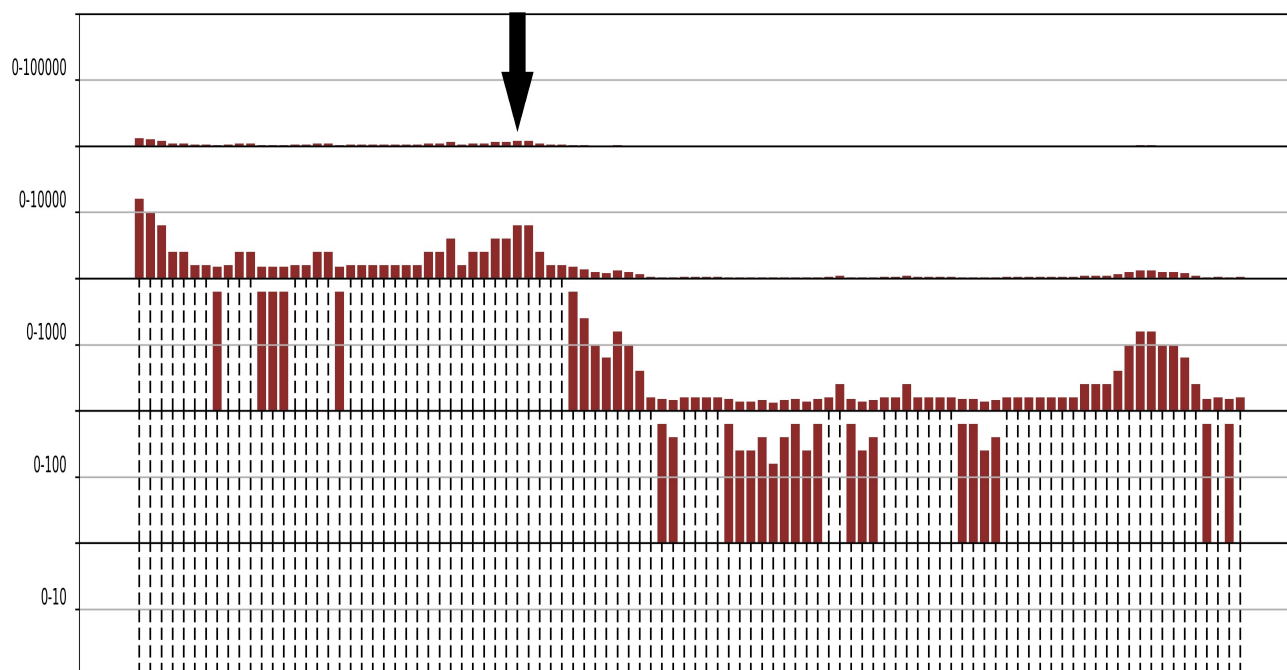|	Trend	Confidence
Answer		

Scale-Stacked Bar Chart

The Scale Stacked Bar Chart visualization technique represents different parts of the value range. While the top section of the visualization shows the entire value range, the sections below it show increasingly smaller sub-ranges.

The individual sections are linearly scaled. A dashed line through a section means that the value at that point exceeds that range of values.

This example should help to read the visualization correctly.

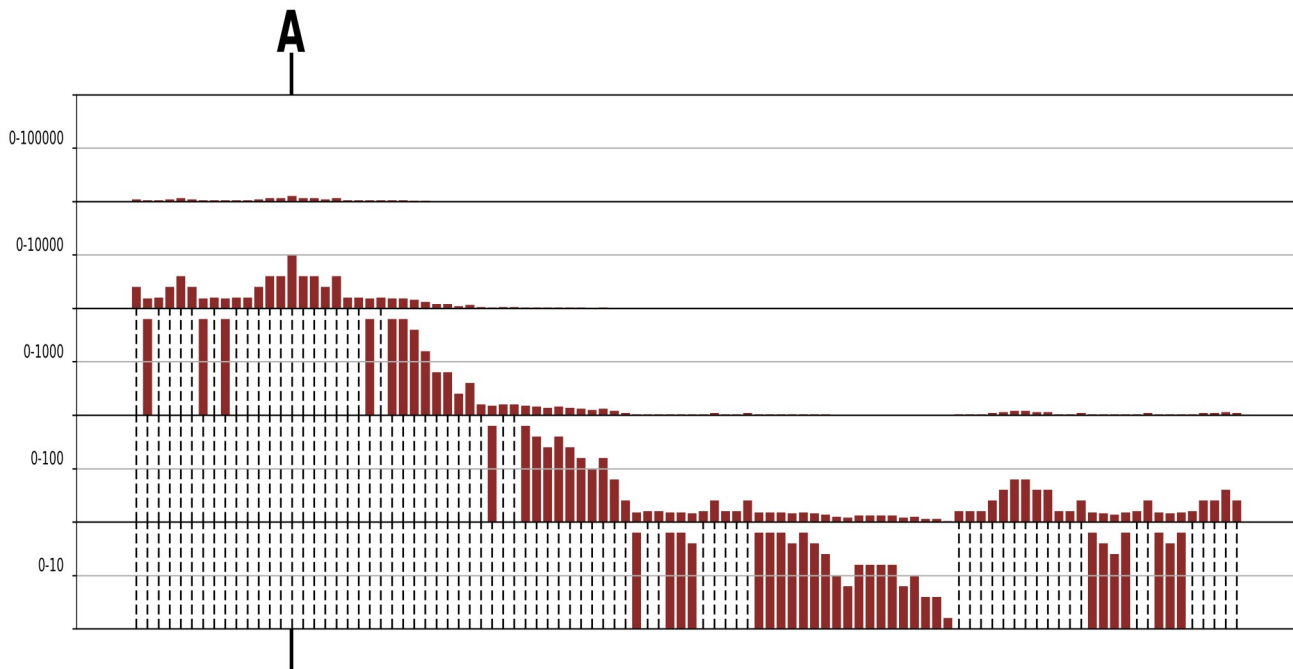*The marked data point has the value 4000.*

The training is over now.

The actual study, including time measurement, begins on the next page.

The following questions are about identifying individual values.

Name the marked value.

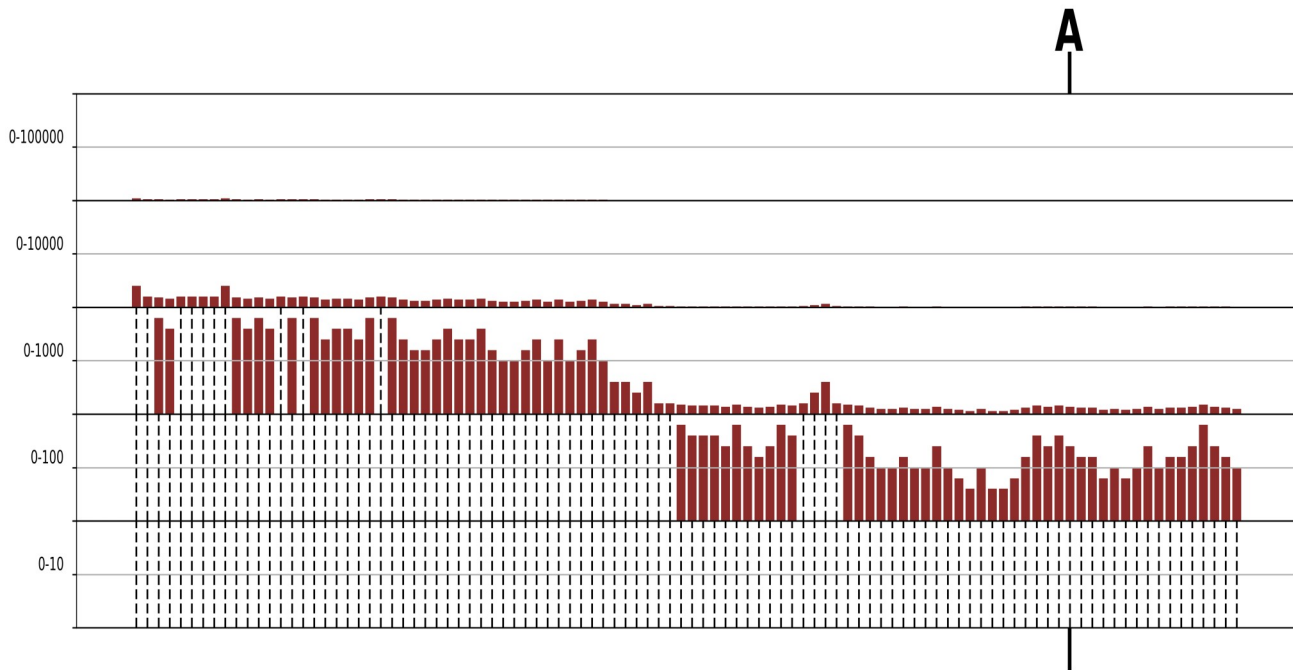And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

Name the marked value.

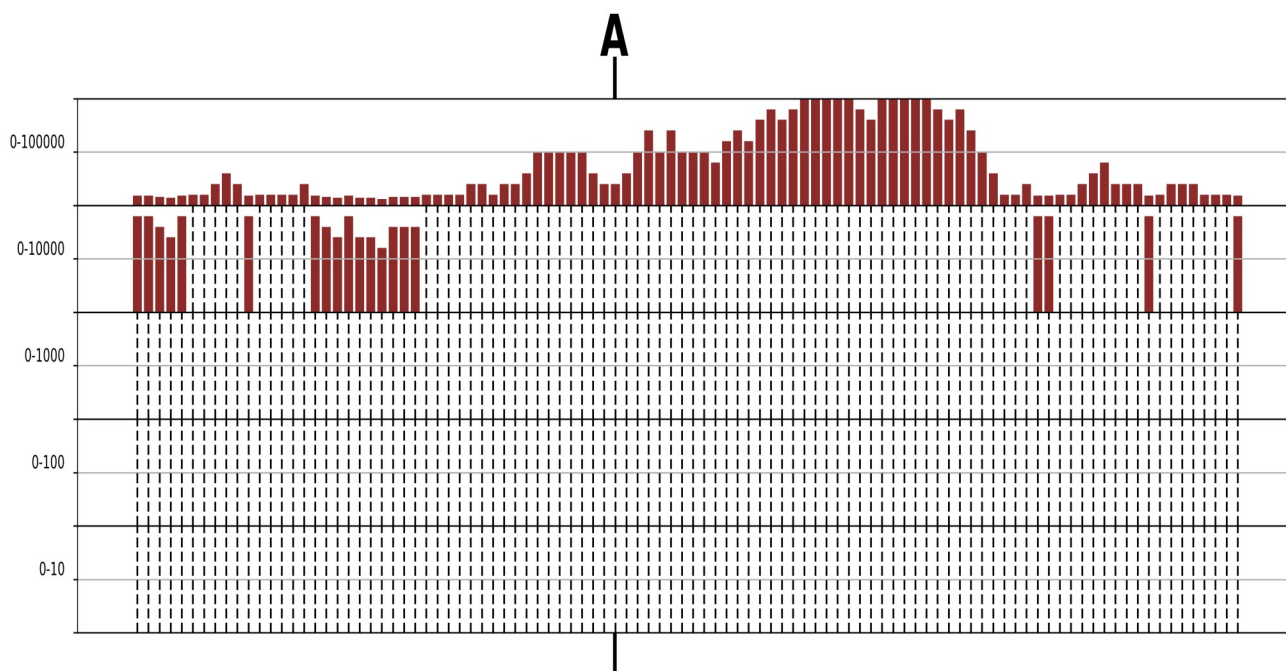And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

Name the marked value.

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Value	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *
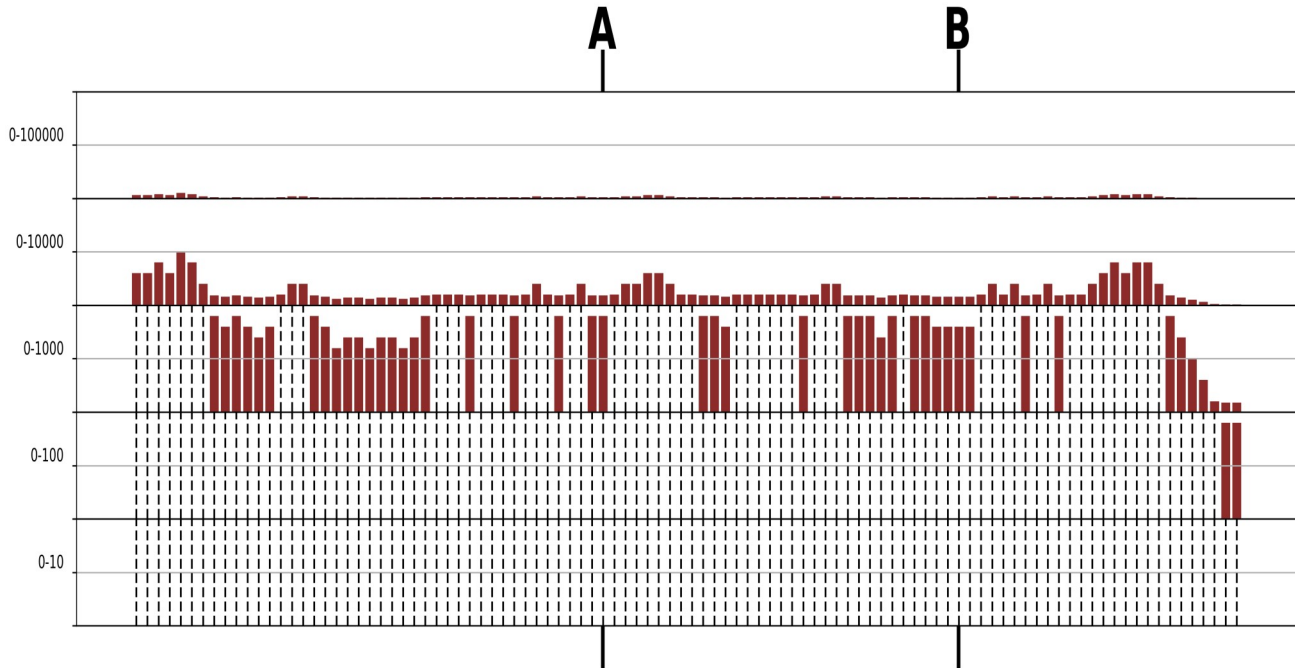
Please choose **only one** of the following:

- ○ 0
- ○ 10000
- ○ 1000

The following questions compare two marked values.

Which of the marked values is greater?

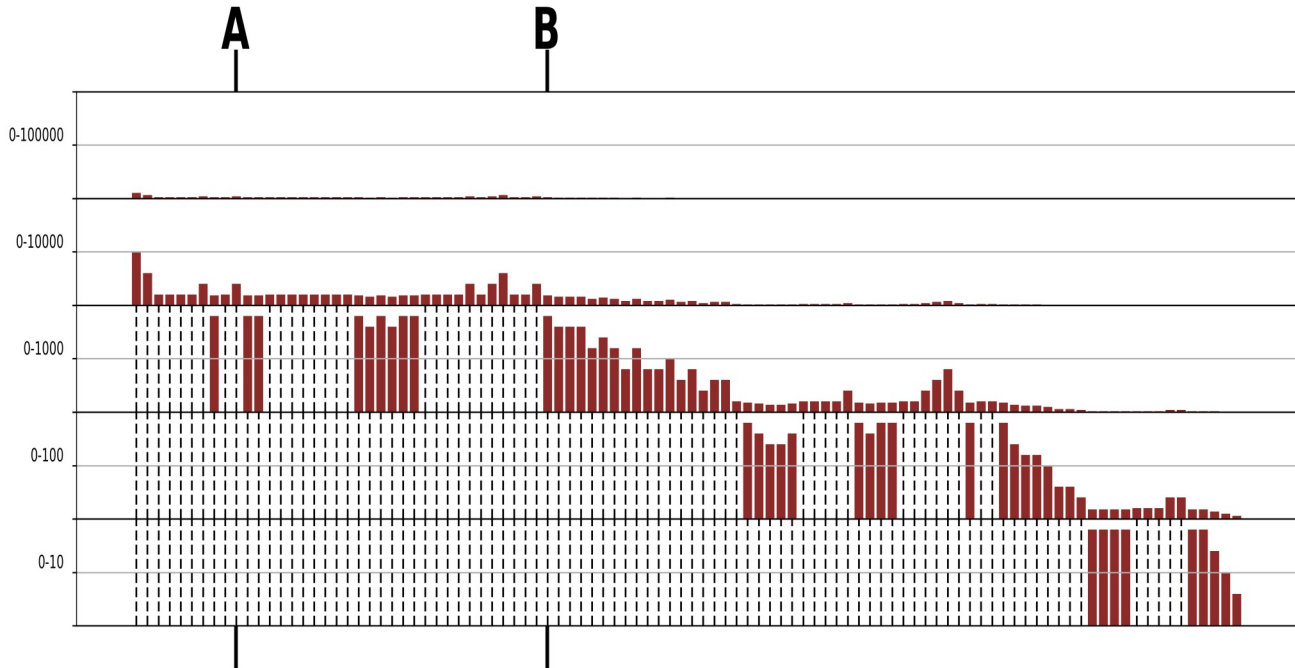And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
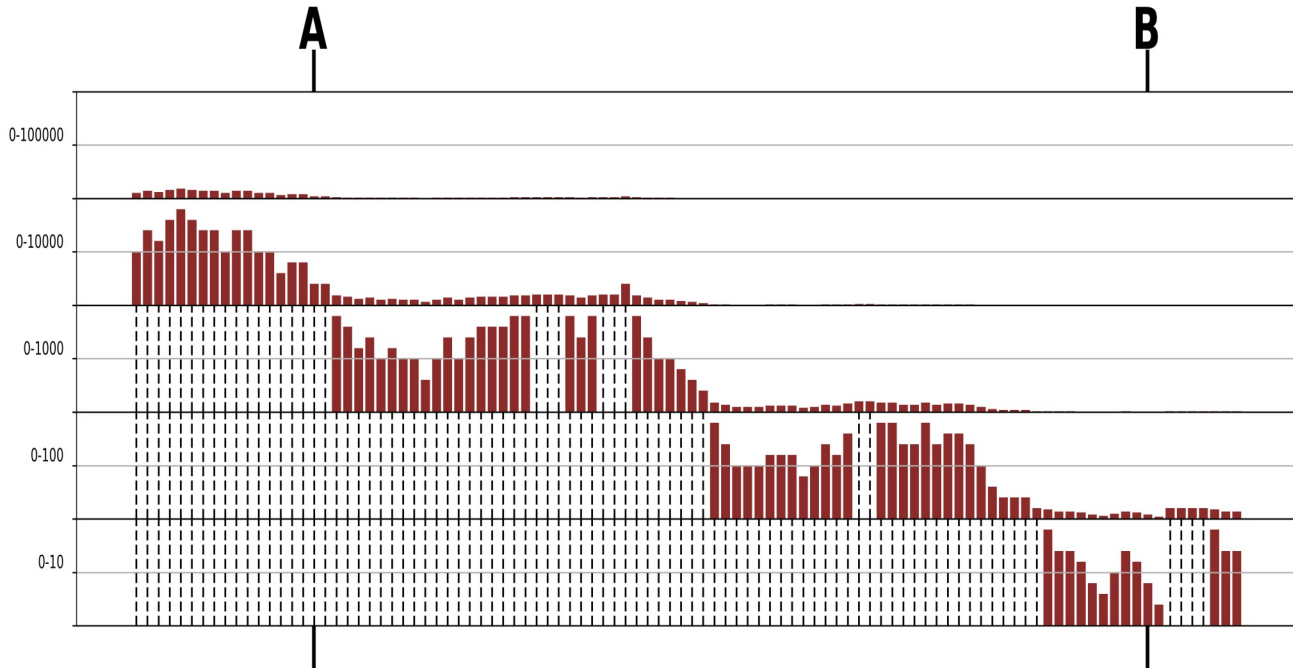

*

	Letter	Confidence
Answer		

Which of the marked values is greater?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Letter	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the greatest? *

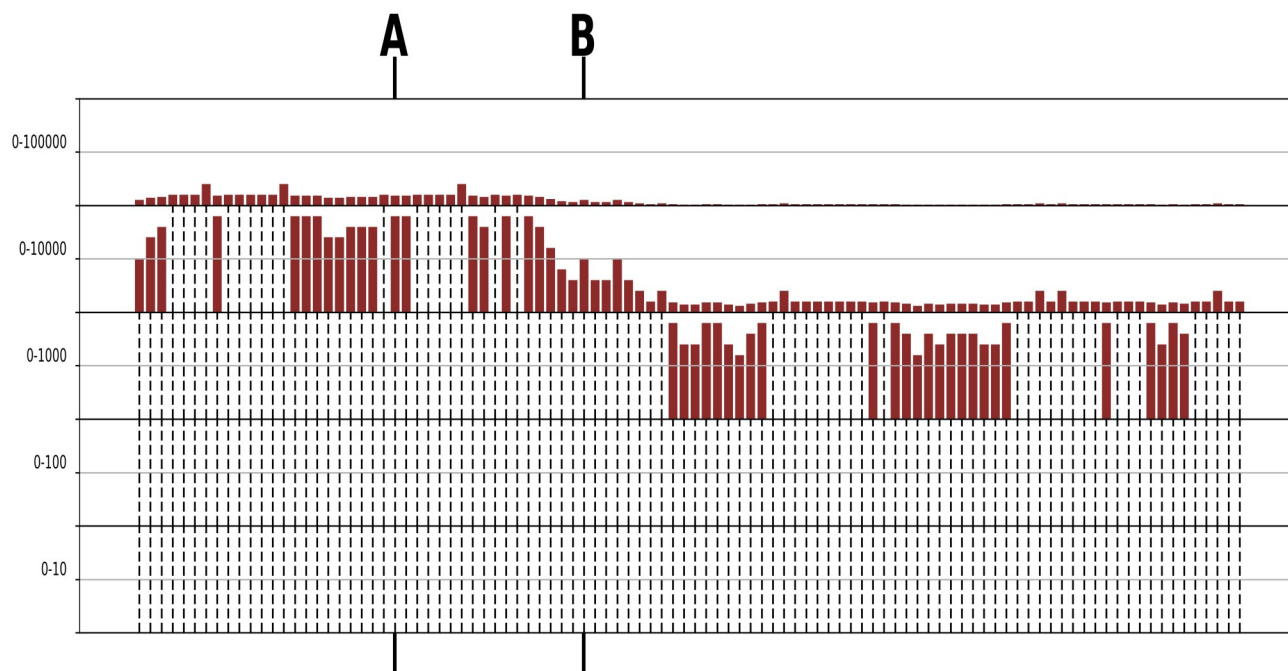Please choose **only one** of the following:

◯ 0

◯ 2*10^3

◯ 5*10^4

In the following tasks the absolute difference between two marked values has to be estimated.

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
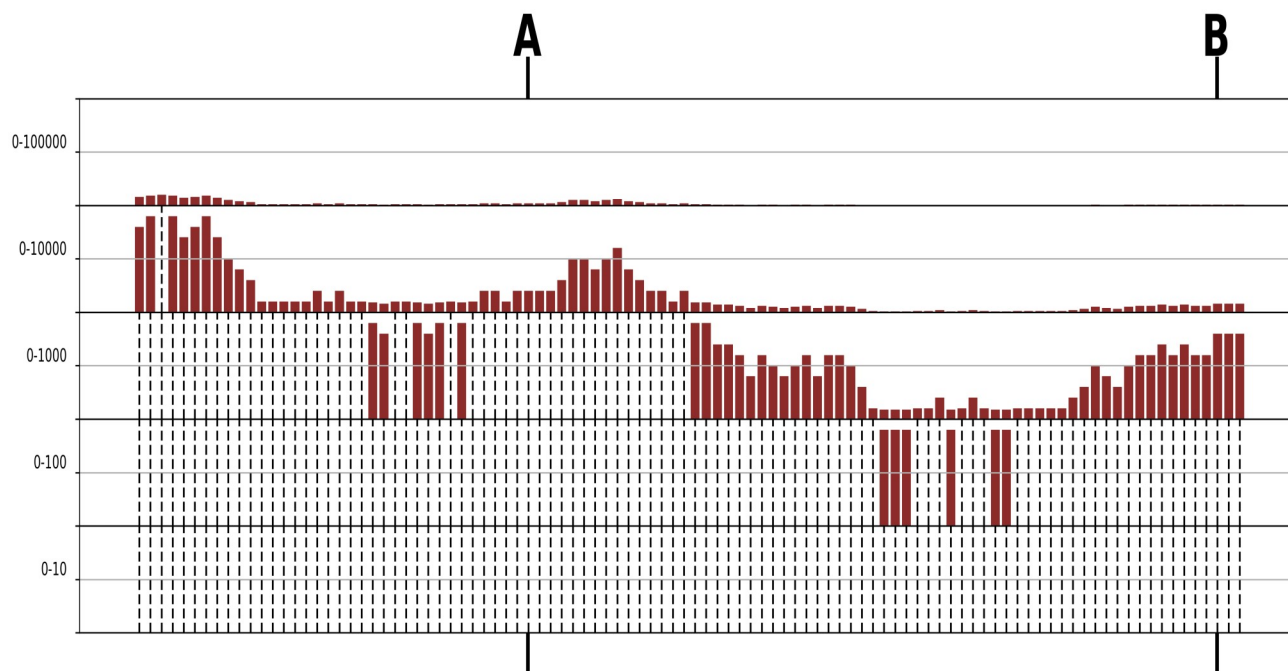

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
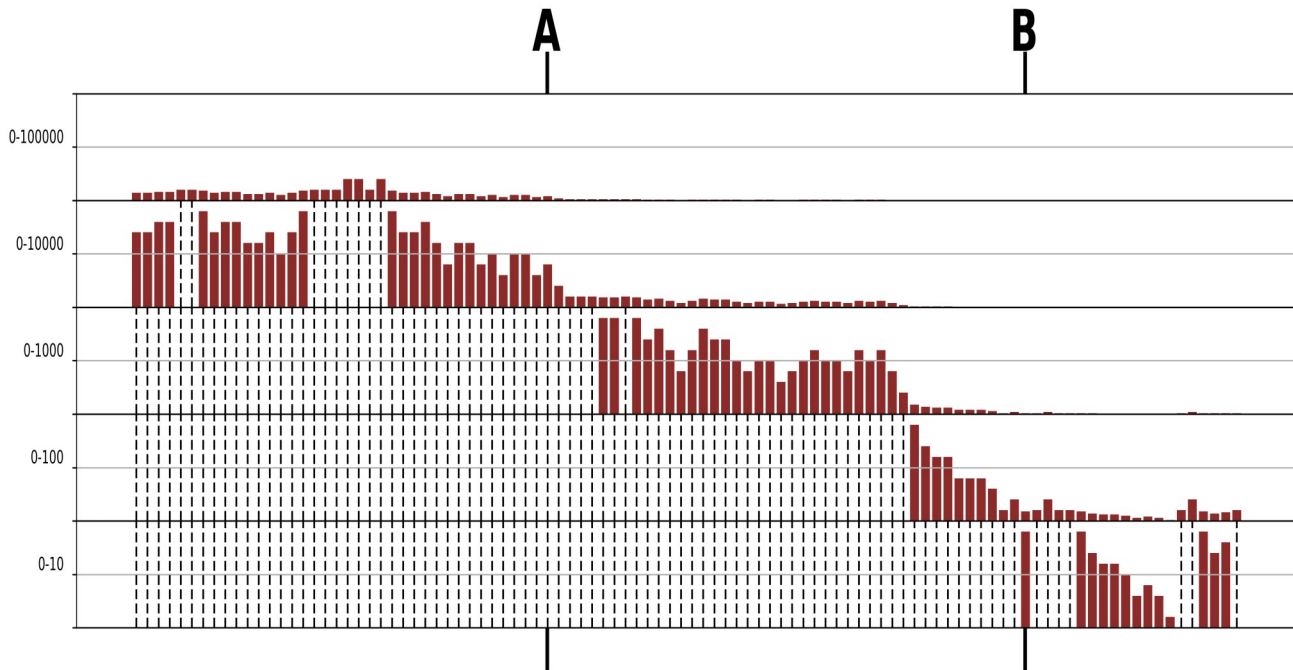

*

	Difference	Confidence
Answer		

What is the absolute difference of the two marked values?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?

*

	Difference	Confidence
Answer		

This is a short break. Take a moment to relax and after the time has expired, please answer the question on the following page.

You will be automatically redirected to the next page after the time has expired.

Which number is the smallest? *

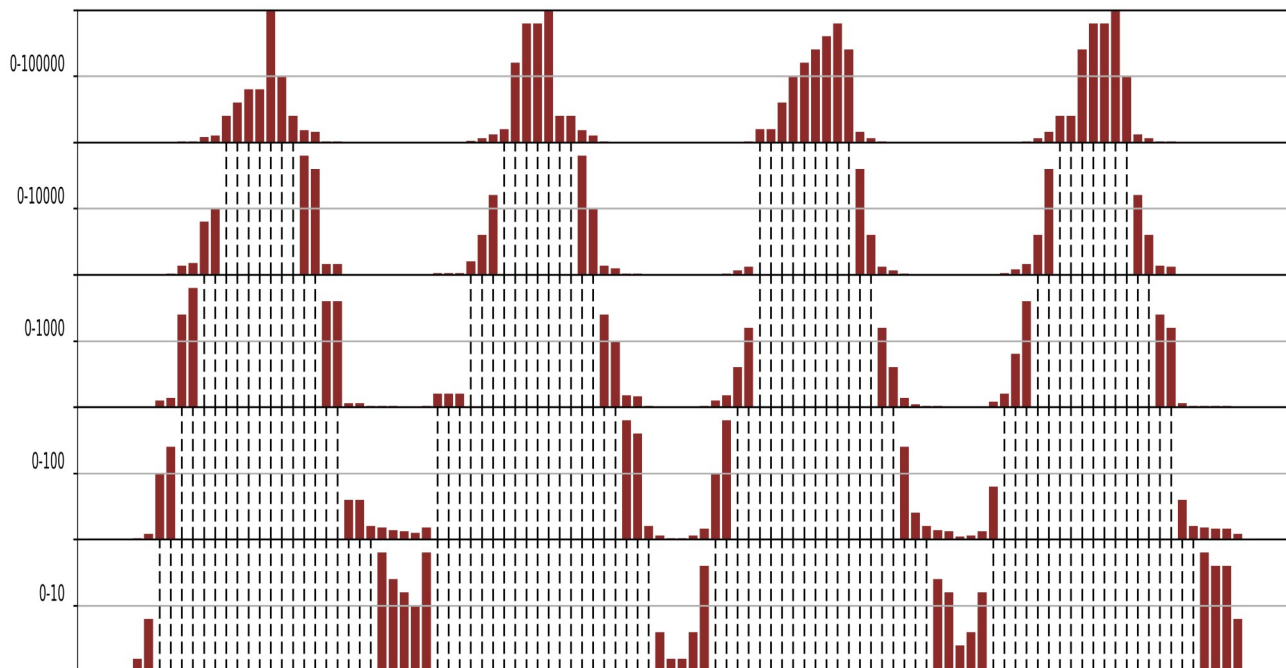Please choose **only one** of the following:

○ 0

○ 10

○ 100

The last task type is to determine the trend in the data.

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
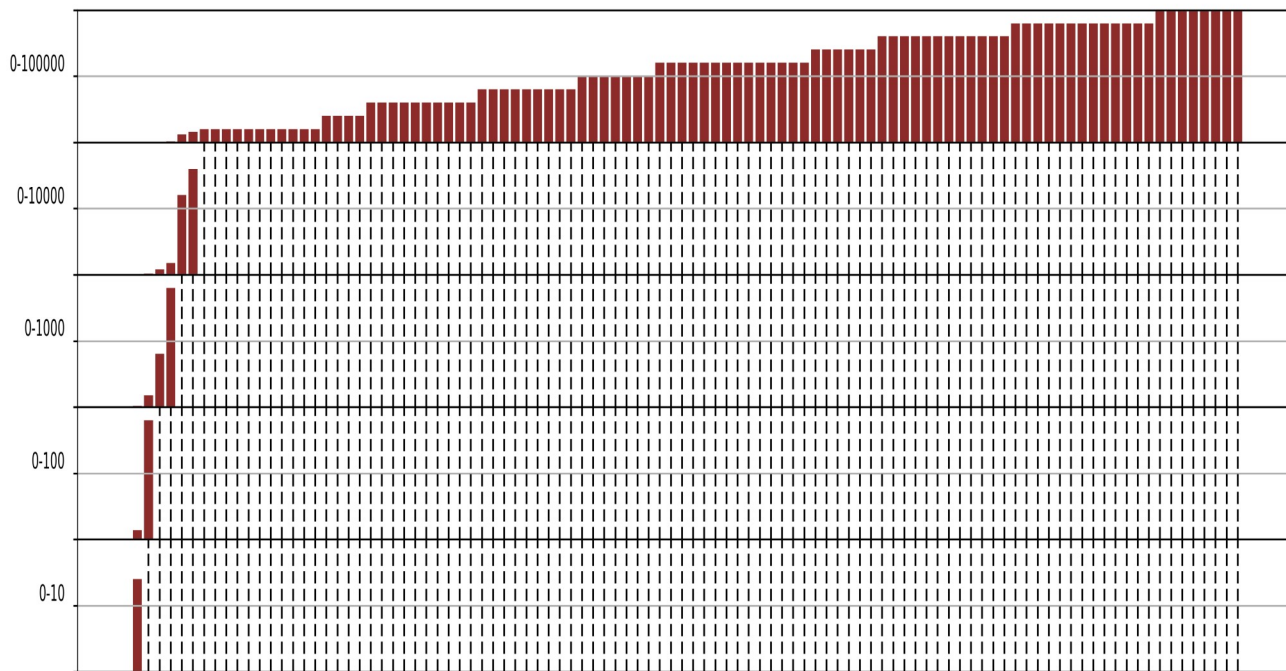

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
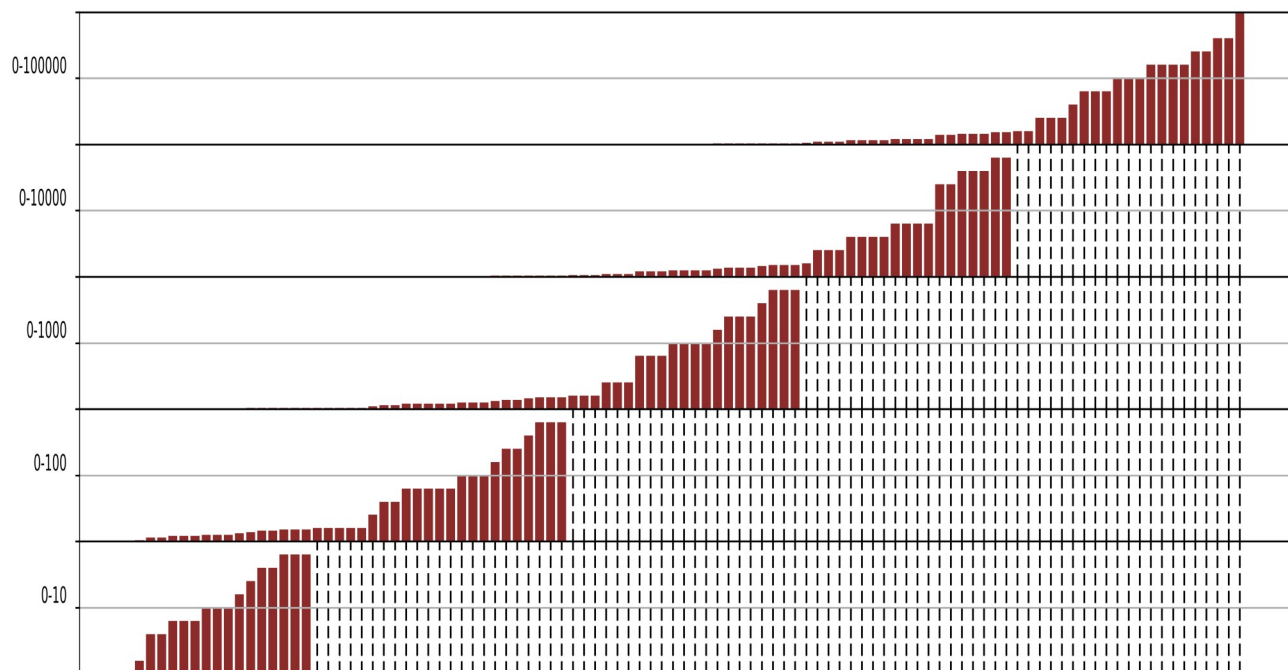

*

	Trend	Confidence
Answer		

What trend do the data presented in the visualization describe?

And how confident are you about your answer on a scale from **1 (very unconfident)** to **5 (very confident)**?
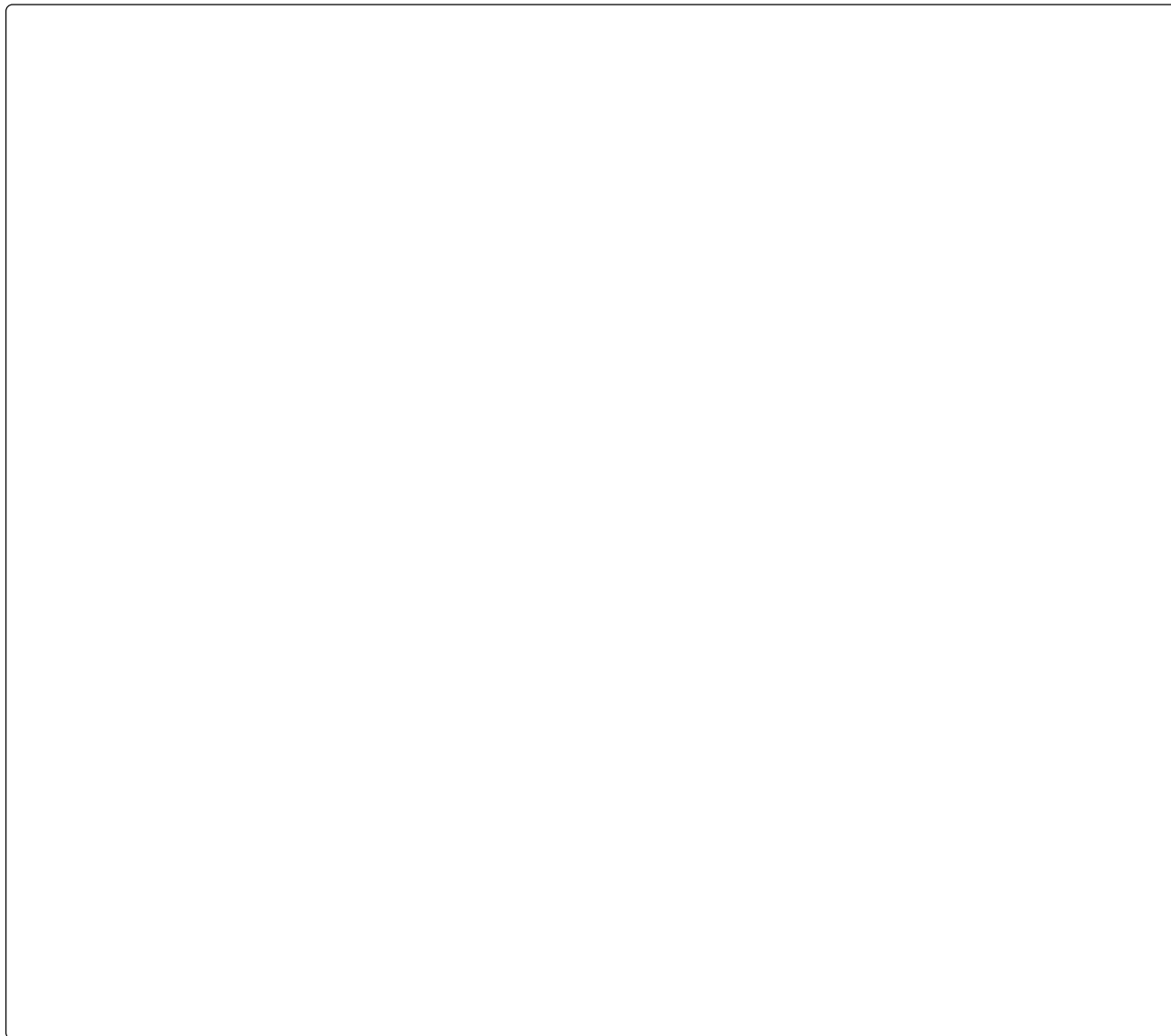

*

	Trend	**Confidence**
Answer		

Feedback

Personal opinion.

If you have any feedback or comments about the study, we would appreciate it if you would share them with us here.

Please write your answer here:

Were there any questions or other things in the study that you had particular difficulties with?

Please write your answer here:

Thank you for participating in this study!

Submit your survey.

Thank you for completing this survey.