

Situation: Power of the average

Average and mean - two INCREDIBLE quantities from our everyday life?

In many statistics, newspaper articles, survey results, in reports or studies, we often come across the average or the indication of an average. They are meant to help us understand important information and perhaps make decisions in this world that is flooded with data and information.

The average is like a compass, it allows us to have an idea of average salaries, average grades, average times - it gives us a clue as to how something compares to others.

But the average can also be deceptive. What if a handful of exceptional salaries, grades or times distort the picture? It's like a detective uncovering the mysteries of the data. So with a compass and detective skills, we set out into our modern world with its information.

Overview "Die Macht des Durchschnitts"

What is really behind
the mean and average
data?

Context
everyday life
(work-related)
citizenship
(finances)

Cognitive processes
Analysing situations
Processing information
Reasoning
Problem solving
Critical thinking

Target group (incl. necessary prior skills and competences)

adults with basic information about statistics and their presentation are willing to deal with less explicit mathematical information in known contexts.

Y1-Y2

Outcomes and results

Adults understand headings and statistics dealing average and mean value; they perform low-threshold transfer activities.

Dispositions
self-confidence
collaboration
math anxiety
math difficulties

Content
quantity and number
pattern, relationship
data and change
using a calculator
using digital skills

Main information	
Content	<p>Understanding of quantity and numbers: know what numbers mean and how to compare them, an understanding (revision) of fractions is helpful</p> <p>Pattern, relationship, data and change: understand, question and interpret data and results. Learners should be able to analyze and understand the mean and average in a given everyday life context.</p>
Target group	Adults with basic information about statistics and their presentation are willing to deal with less explicit mathematical information in known contexts. They recognise and understand more complex quantitative representations and use the information to analyse data and sources and to make decisions.
Learning intention	<p>What is the intention of adults to face this problem?</p> <ul style="list-style-type: none"> – Numeracy for personal and private purposes – Numeracy to understand society
Duration	Approx. 3 lessons
Material and resources	<ul style="list-style-type: none"> • Newspaper articles with information on average / mean data in headings or statistic representations • data (e.g. collection of group data on shoe size)
Group size	Range from 8 to 15 learners
Problem statement	What is really behind the mean and average data?
Working questions	<p>Where in our everyday (or professional) life do we find information about average and mean?</p> <p>Why is the average important in different contexts?</p> <p>How can average and mean be applied in different contexts?</p> <p>How can learners use the mean to analyze information and draw conclusions?</p> <p>How can learners compare different averages?</p> <p>Optional: How can the mean help identify misconceptions or biases in data?</p> <p>Optional: What impact does "extreme" data (outliers) have on the mean?</p>

<p>Learning outcomes and results</p>	<p>Learners identify data and representations of average and mean in concrete situations, e.g., salary statistics, population data, product ratings, or sports statistics. Learners apply the calculation of average / mean value in simple situations close to everyday life. Learners analyze and compare different averages, e.g. average income in different countries. Learners develop awareness of the influence of outliers on the mean.</p>
<p>Reference to National Qualification Frame</p>	<p>Optional (country's decision)</p>



Working plan

Time (lessons)	Description of content/activities	Material	Methodical and didactic information ¹
15 minutes	<p>Activation: Place learners in the situation by letting them discover the terms “average” or “mean value” in news headlines, respective charts and graphs or short newspaper articles.</p>	authentic and actual material that meets the learners everyday life or working life realities (see appendix 1)	HITS cognitive activation
25 minutes	<p>Mathematical dialogue: Activating learners' prior knowledge and experience in a mathematical dialogue. The following questions may play a role:</p> <ul style="list-style-type: none"> • Are you familiar with the term average / mean? • Where do we encounter those terms in everyday life? • What basis of data do you think this value could have? • How (with which mathematical methods) could one determine this value? <p>This phase of questioning can be done in plenum, but also in small groups or pairs – depending on the group size and on how much the learners are used to working independently on this kind of open tasks.</p>	optional: working and discussion questions for group or pair work	HITS questioning collaborative learning hands on learning
15 minutes	<p>Compilation and further processing The results of the mathematical dialogue or group work above are repeated, discussed, and summarized. It may be necessary that the teacher clarifies and redefines the concept or the terminology to some of the learners. So, we make sure that all learners are familiar with how to calculate the average and understand that this calculation helps us understand the overall “average” or “typical” value in a dataset.</p>		HTS metacognitive strategies differentiated teaching

¹ for description and explanation of kinds of tasks, HITs and other background information please consult the teachers' guide



25 minutes	<p>Provide an example The teacher presents a simple example (or more examples with different levels of difficulty, depending on the learners' needs). The teacher (or a learner) demonstrates how to add up all the numbers and then divide the sum by the total number of values.</p> <p>Reinforce with additional examples and walk the learners through the calculation process if necessary, but encourage them to follow along, participate and work independently if possible.</p>	Data for example(s) for demo task(s), prepared or spontaneously, e.g. age of group members / a small set of arbitrary numbers / kids per group member / ...	worked examples differentiated teaching
40 minutes	<p>Transfer and practical application Connect the concept to real-life scenarios. Discuss situations where average or mean value are commonly used, such as finding the average test score in a class or calculating the mean income of a group of people. Reinforce that these calculations help us understand typical values and make comparisons.</p> <p>Practice exercises Work out (maybe together with the learners) examples for practical application within their everyday-life realities. Make sure to start with simple sets and gradually increase the complexity as learners gain confidence. Offer guidance and feedback as they work through the problems and situations.</p>	the material presented in appendix 1 can be used here as well Collections of data (see appendix 2 for inspiration)	questioning hands on learning collaborative learning
10 minutes	<p>Recap and summary Conclude by summarizing the key points and highlighting the steps involved in calculating the average or mean value. Encourage students to ask questions or give feedback.</p>		feedback metacognitive strategies
20 minutes+	<p>Optional: the influence of outlier data Help the learners develop awareness of the influence of outliers on the mean value by giving / describing a situation or a set of data and discussing on it.</p>	situation or set of data with outlier data (see appendix 3 for inspiration)	metacognitive strategies

Suggestions for the teacher

The example presented here should be considered as exemplary and inspirational material presenting a guideline with a high range of possibilities of adapting those suggestions to a specific group of learners or an individual learner with his or her very personal requirements.

In concrete terms, the example “The power of the average” could be adapted these ways:

- Duration and level of difficulty: As described in the working plan, students with developed metacognitive strategies can be confronted with the influence of outliers on the mean value (optional step in the working plan) which of course has impact on the duration of this example. The level of difficulty always needs to be adapted to the group of learners (or the various initial learning situations within one group). It is therefore recommended to start with worked tasks on a simple set of data and then provide tasks that gradually increase the complexity or – for skilled learners – require more independence and abilities.
- Further or additional material: Make sure to use authentic and up-to-date material that meets the learners’ realities. We also consider important to be aware of the learners’ backgrounds and biographies when choosing respective material in order not to put them in discussions about situations they feel uncomfortable with, e.g. focusing on income averages with low-income / long-term unemployed learners; or calculating the average age of the group members if learners don’t want to reveal their age.

Our educational activities aim at numeracy skills being not only memorized, but first of all being practiced and functionally used by the learners in daily life or/and vocational situations. It is therefore recommended to implement the idea of HITS² (higher impacts of teaching skills) as far and often as possible: ...

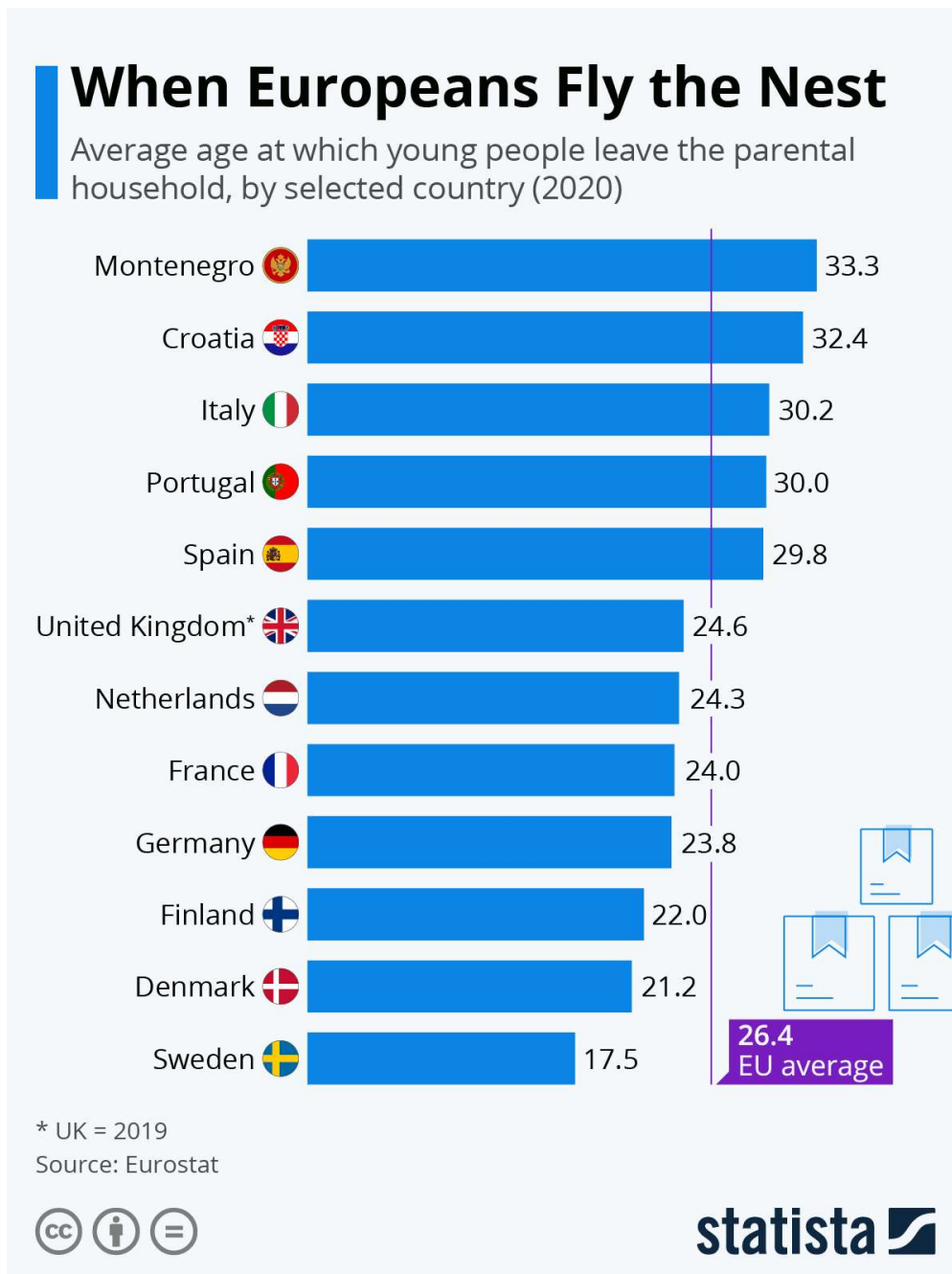
- ... work with concrete and authentic material that learners will recognize from everyday life situations.
- ... ask the learners questions and let them raise questions themselves. It can be crucial to discuss numeracy themes, contexts, and numbers.
- ... think of possible ways of transfer: In this concrete example we propose to work with data to be collected within the group of learners. Once again, we want to underline the importance of being sensitive with group specifics and the learners’ social and emotional backgrounds. When in doubt, it could be better to work with innocuous data sets, such as the average temperature in the city they live in.

² For general information and explanation on HITS please see the teacher’s guide



Appendix 1

Authentic material (articles, diagrams or news headlines) to let the learners discover average / mean data



Source: <https://www.weforum.org/agenda/2021/08/young-people-europeans-home-work/>
[30.06.2023]



PANORAMA | CHRONIK

Durchschnittsalter in Österreich liegt bei 43,2 Jahren

Von nachrichten.at/apa, 28. April 2023, 10:27 Uhr



Source : <https://www.nachrichten.at/panorama/chronik> [30.06.2023]

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Women in the EU are having their first child later

24 February 2021 



The [mean age](#) of women in the [EU](#) on giving birth to their first child is gradually increasing and stood at 29.4 years in 2019. The mean age has increased in all EU Member States over this period, though to varying degrees.

The largest change was in Estonia, where the mean age increased by 1 year, from 27.2 years in 2015 to 28.2 years in 2019, followed by Lithuania and Luxembourg (both +0.9 years). Over the same period, the smallest changes were recorded in Slovakia (+0.1 years) and Slovenia (+0.2).

This information comes from Eurostat data on births and fertility published today. The indicator presented in this article shows only a small part of the large amount of [data](#) related to [demography](#), covering areas such as population, fertility, marriages and divorces.

Age of women at the first childbirth ranges from 26.3 in Bulgaria to 31.3 in Italy

In 2019, the mother's age at the first childbirth was above 31 in three EU Member States: Italy (31.3 years), Spain and Luxembourg (both 31.1 years).

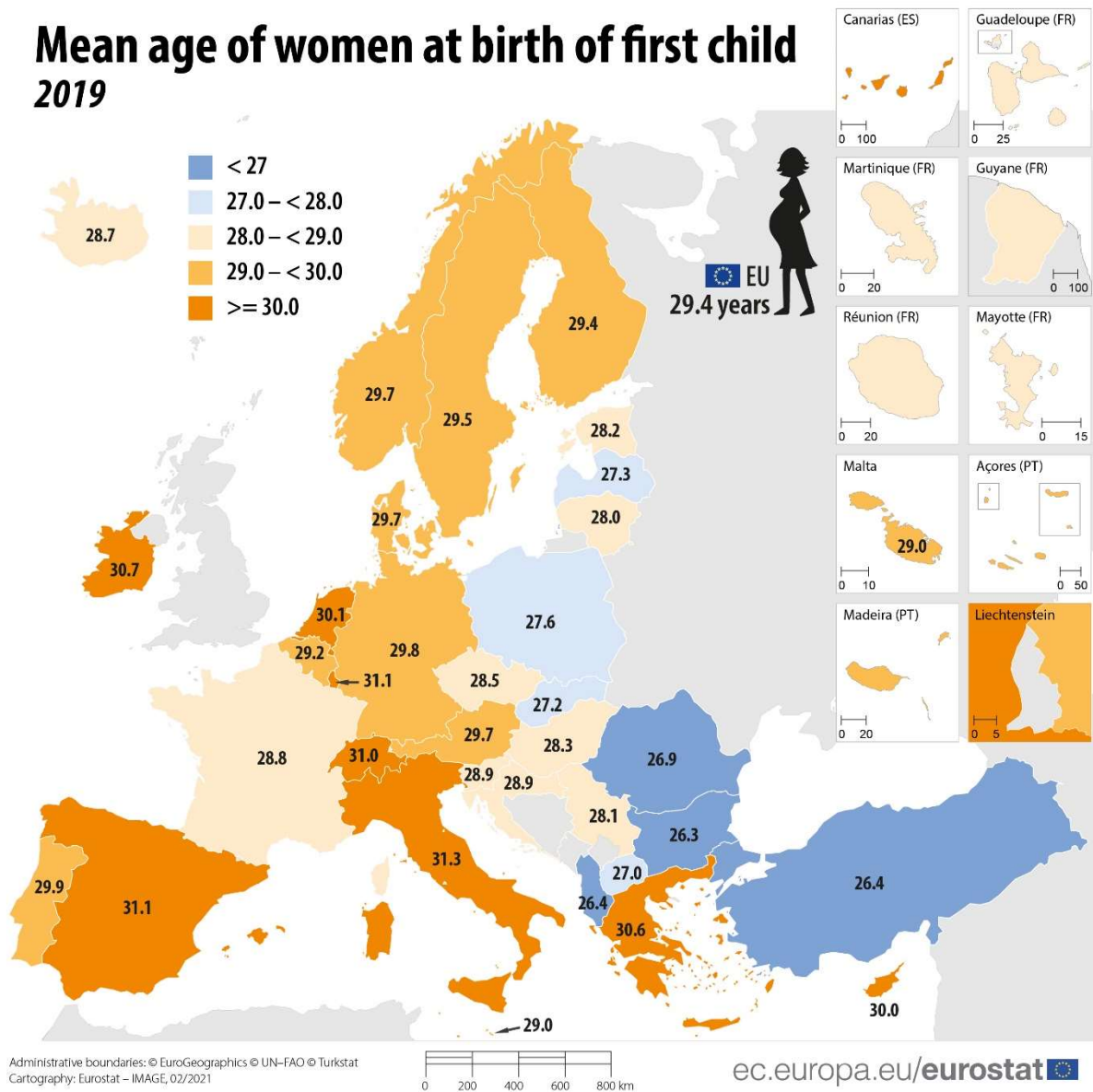
In contrast, in two Member States the mean ages at which women had their first child were below 27 years: Bulgaria (26.3 years) and Romania (26.9 years).

Average age of women giving birth to first child in EU

Source: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210224-1> [30.06.2023]



Mean age of women at birth of first child 2019



Source: <https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20210224-1> [30.06.2023]



The screenshot shows a news article from SchengenVisa.com. The article title is "Eurostat: Average Annual Salary in EU Stood at €33,500 in 2021", dated December 20, 2022. The article is categorized under "EU/Schengen" and "Migration". The page includes a navigation menu with categories like "Latest", "EU/Schengen", "Borders & Security", "Policy", "Statistics", "Migration", "Tourism", "Air Travel", and "Education". There are social media sharing icons for Facebook, Twitter, LinkedIn, and others.

Source : <https://www.schengenvisainfo.com/news/eurostat-average-annual-salary-in-eu-stood-at-e33500-in-2021/> [30.06.2023]

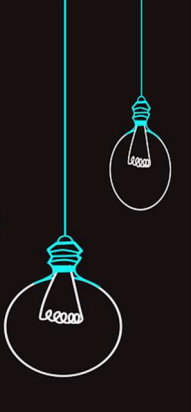


Source : <https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20221219-3> [30.06.2023]



Appendix 2

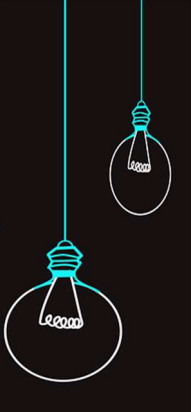
Collections of data for practical applications



Class survey

We want to determine the average shoe size within our group. We need to...

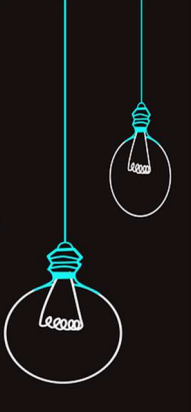
- collect the data
- calculate the mean shoe size
- analyse (and visualize) the result



Class survey

We want to determine the average age of the learners within our group. We need to...

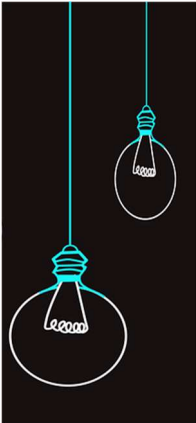
- collect the data
- calculate the mean age of the learners
- analyse (and visualize) the result



It's hot in the city

We want to determine the average temperature of the last ten days in our city. We need to...

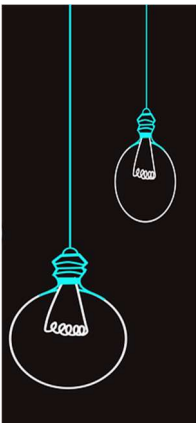
- collect the data
- calculate the mean temperature of the last ten days
- analyse how the temperature has changed



The winner takes it all

You want to know the average score of your favourite sports team over a series of games. You need to...

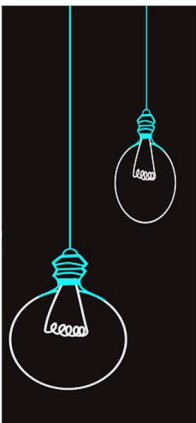
- collect the data
- calculate the average score of your favourite sports team
- analyse (and visualize) the result



Class survey

We want to determine the average time it takes the learners within our group to come to class in the morning. We need to...

- collect the data
- calculate the average time it takes the group to come to class
- discuss on the result (consider possible outlier data)



Fitness in figures

You want to determine the average time you spent on fitness, workout and sports within the last two weeks. You need to...

- collect the data
- calculate the average time you spend on fitness every day
- analyse how the temperature has changed

Appendix 3

Working with the influence of outlier data



Be careful!

The average can sometimes be deceiving.

Imagine...

... you're looking for an apartment and see an ad for an "average" rental rate in a particular area. But what does that really mean? Where does the data come from? What is the range of values? What kind of apartments are there to be found in the neighbourhood of this particular area? Is there maybe a small villa district around?

... you're confronted with the average monthly salaries of all employees within a company that counts 500 employees in a wide variety of positions and field of activity. Could there be salaries that are extremely higher or lower than the others? What is the distribution of the employees across the different positions?

... you want to find the average body height of your family over several generations. Your great-grandfather measured 2 meters 9 centimeters, whereas your paternal aunt is no taller than 1.55 meters. How will those outliers affect the overall average?

... your favourite soccer team nearly never wins. This season, out of 15 games, the team won only two, two ended in a draw, and the rest of the games were lost. Still, one of the two games won ended with a record score of 9 to 1.

