

# Communication and using maths and stats

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# Communication

- ▶ There are many societal issues – e.g. climate change, artificial intelligence, disease modelling, and public health – which maths is vital to addressing.
- ▶ Many researchers in these areas are not mathematicians.
- ▶ These issues impact those outside the research community, so there is a need to engage and communicate with policymakers, mainstream media, and the wider public.
- ▶ Also to communicate the importance of curiosity-driven research.

# Statistics in science and social science

- ▶ Often the need arises around the role played by statistics in experimental research.
- ▶ Statistics is part of the process of formulating a research question and guiding experimental design.
- ▶ Data analysis is part of the methodology.
- ▶ This provides insights for drawing conclusions and making predictions, and also feed into discussion of uncertainty, limitations, and reliability of results.

# Who takes part?

- ▶ Ethical issues:

- ▶ Privacy and data protection issues.
- ▶ Is the research necessary and well designed?
- ▶ Will the participants' time/effort/inconvenience be effective in answering the research questions?

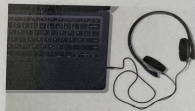
# Research with human participants

- ▶ Informed consent means the participants give their consent to take part and are well-informed about what they are agreeing to.
- ▶ Needs to communicate
  - ▶ clear, comprehensive information about the study, its purpose and how it will work;
  - ▶ potential risks of taking part;
  - ▶ potential benefits of taking part;
  - ▶ that participation is voluntary, with the option to withdraw at any time without penalty.

Are you interested in participating in  
**a simple online hearing test?**

*(Takes only 15-20 minutes)*

Volunteers aged 18-50  
with 'normal' or 'near-  
normal' hearing in both  
ears are invited.



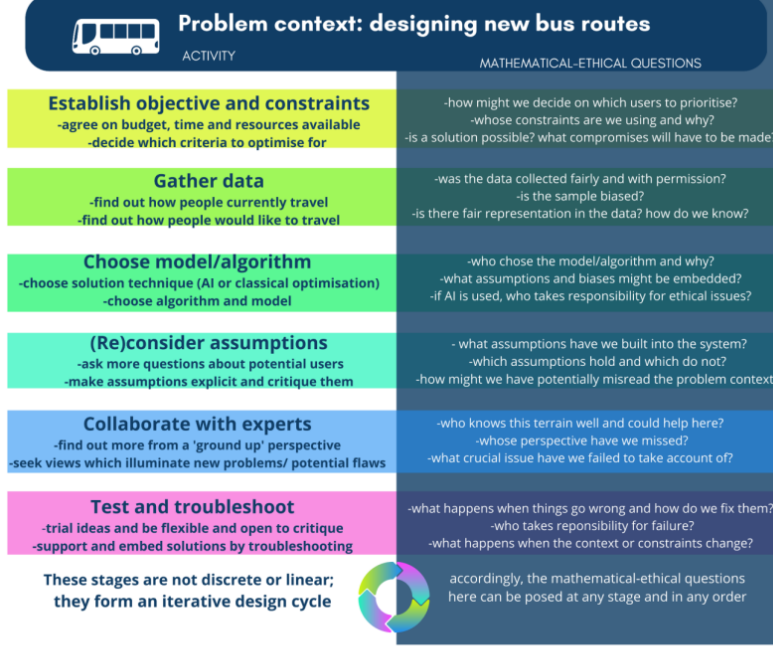
**To take part, please follow this link:**

You can perform the above experiment in a web browser on a PC, laptop, or tablet (using the above web-link) at home or in any quiet place where you feel comfortable and unlikely to be disturbed. You will require headphones or earphones for this test. I hope it will be fun!

If you have any questions, please drop me an e-mail  
to [redacted]

# Who is impacted?

- ▶ When models are developed and used to make policy and practical changes.
- ▶ Figure is from Rycroft-Smith et al. (2024)



# How are results communicated?

In order to shoot off one email per week for a year, ChatGPT would use up 27 liters of water, or about one-and-a-half jugs. . . . That means if one in 10 U.S. residents—16 million people—asked ChatGPT to write an email a week, it'd cost more than 435 million liters of water.

(Thier, 2025)



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- 27 litres is one and a half jugs? A jug of water holds 18 litres?
- The US population is about 340m, so "one in 10" is about 34 million people.

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- 27 litres is one and a half jugs? A jug of water holds 18 litres?
- The US population is about 340m, so "one in 10" is about 34 million people.

## ► Sense check:

- What is a U.S. resident's average water usage?
- What is the USA's total water usage?
- Essentially: is 435m litres a big number?
- The result might be horrifying, but the communication isn't helping get that across.

# Polling

- ▶ “One in five young Americans thinks the Holocaust is a myth” (*The Economist*, 2023).
- ▶ Based on a YouGov poll.

# Opt-in vs. random polling

- ▶ What are the incentives to participate?
- ▶ Pew Research Center used an online opt-in sample to ask opt-in respondents if they were licensed to operate a class SSGN (nuclear) submarine.
  - ▶ 12% of adults under 30 claimed this qualification, significantly higher than the share among older respondents.
  - ▶ In reality, the share of Americans with this type of submarine license rounds to 0%.

(Mercer, Kennedy and Keeter, 2024)

- ▶ Re-running the holocaust denial research as a mail-based poll with probability-based sampling, they found 3%, not 20%.

# How are results communicated?

- ▶ The output from mathematical and statistical modelling and analysis should be communicated clearly and accurately.
- ▶ Be aware that maths and stats can be used to mislead or confuse, or to give the impression of rigour where it does not exist.

# Mathiness

- ▶ Romer (2015) refers to misuse of mathematics in economics as “mathiness” – “he doesn’t mean that economics uses too much mathematics but that some economic theorists are pushing an ideological agenda and using fancy mathematics to disguise their intentions” (Harford, 2015).
  - ▶ “They can redefine familiar words to mean unfamiliar things.”
  - ▶ “They can make unrealistic assumptions.”
  - ▶ “They can take hypothetical conclusions and suggest they have practical significance.”
  - ▶ “And they can do all these things with little fear of detection, behind a smokescreen of equations.” (Harford, 2015)

# Mathiness

The antidote to mathiness isn't to stop using mathematics. It is to use better maths . . . Romer wants economists to use maths with “clarity, precision and rigour”. Statistical claims should be robust, match everyday language as much as possible, and be transparent about methods. . . .

Mathematics offers precision that English cannot. But it also offers a cloak for the muddle-headed and the unscrupulous. There is a profound difference between good maths and bad maths, between careful statistics and junk statistics. Alas, on the surface, the good and the bad can look very much the same.

(Harford, 2015)

# Example: US trade tariffs

- 2nd April 2025 (“Liberation Day”) the US instigated a number of protectionist import trade tariffs. (Guo, 2025)

## Basic Approach

Consider an environment in which the U.S. levies a tariff of rate  $\tau_i$  on country  $i$  and  $\Delta\tau_i$  reflects the change in the tariff rate. Let  $\varepsilon < 0$  represent the elasticity of imports with respect to import prices, let  $\varphi > 0$  represent the passthrough from tariffs to import prices, let  $m_i > 0$  represent total imports from country  $i$ , and let  $x_i > 0$  represent total exports. Then the decrease in imports due to a change in tariffs equals  $\Delta\tau_i * \varepsilon * \varphi * m_i < 0$ . Assuming that offsetting exchange rate and general equilibrium effects are small enough to be ignored, the reciprocal tariff that results in a bilateral trade balance of zero satisfies:

$$\Delta\tau_i = \frac{x_i - m_i}{\varepsilon * \varphi * m_i}.$$



In a comparison with four other major cities, Nottingham is ranked second for overall satisfaction with the way the authority runs things.\*

**Local Authority**

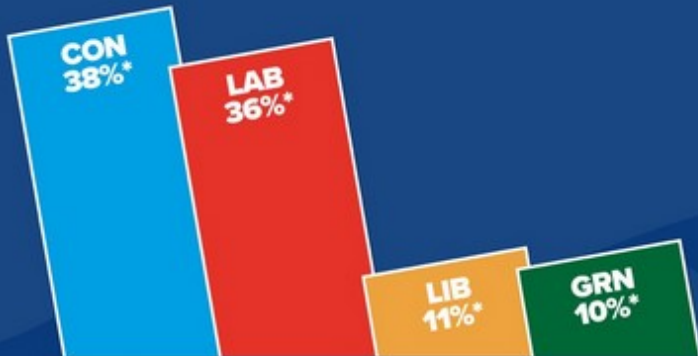
**Overall satisfaction with the way authority runs things**

Nottingham City Council 2012 .....	66%
Birmingham City Council 2009 .....	68%
Bristol City Council 2011 .....	36%
Newcastle City Council 2012 .....	57%
Sheffield City Council 2009 .....	45%

\*Methodology and sample size may vary between councils

[nottinghaminsight.org.uk/insight/library/citizens-survey.aspx](http://nottinghaminsight.org.uk/insight/library/citizens-survey.aspx)

5



**Only the Conservatives can seriously challenge  
Labour for control of Kirklees Council**

Promoted by Adam Gregg on behalf of Damian Brook, both of Colne Valley Conservatives, Cliffe End Business Park, Huddersfield, HD3 4TG. \*Kirklees wide vote share 2021 Local Elections

**ACCORDING TO THE LATEST DATA IT'S NECK AND NECK!**



**Vote Labour on Thursday**

Printed by South Essex Labour Party and presented by Michael Rogers on behalf of Mike Byatt, MP at 2012-13 Local Council Elections, South Essex, September 27th 2012.



**Colin Beveridge** ▶ **South Dorset Labour Party**

Wednesday at 07:54 · 🌐

I just received a flyer for Mike Byatt as part of your election campaign that included a graph without any numbers or source of data on it. Please can you clarify where the 'latest data' comes from?

Like · Comment



**Andy Blackwood** I suspect you have enough experience of the murky world of party politics and elections to know that this graph was "created" to get a specific message across to voters. If you like, the 'data' was based on the conversations I had with an unspecified number of the electorate during the campaign.

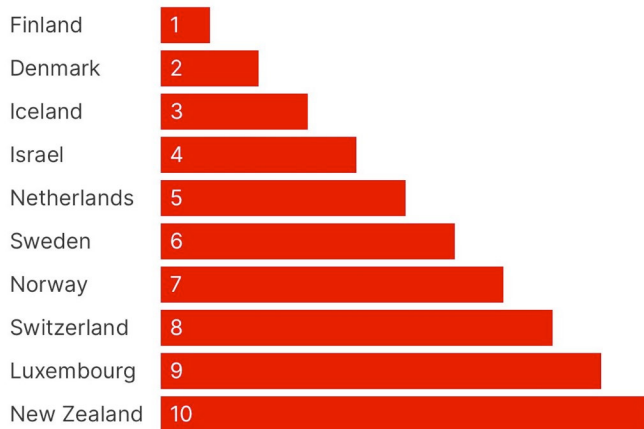
about an hour ago · Like

# Data visulisation

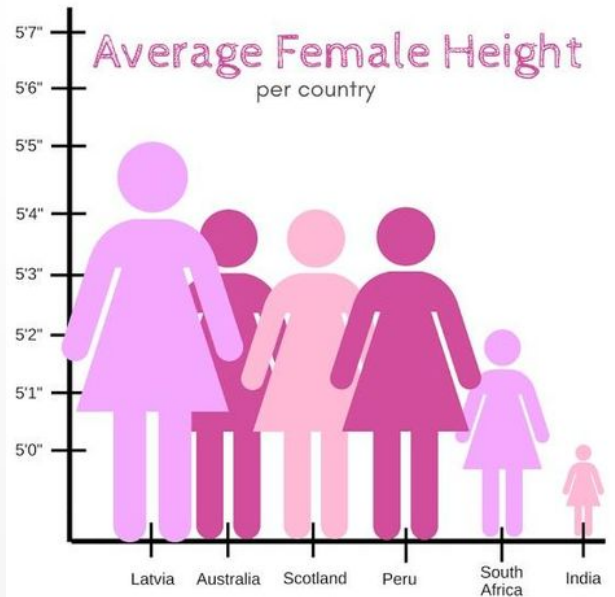
- ▶ Be aware it can be easy to mislead with bad graphs even when this is not intended.

# Top 10 Happiest Countries in 2023

This chart shows the top 10 happiest countries according to the 2023 World Happiness Report.

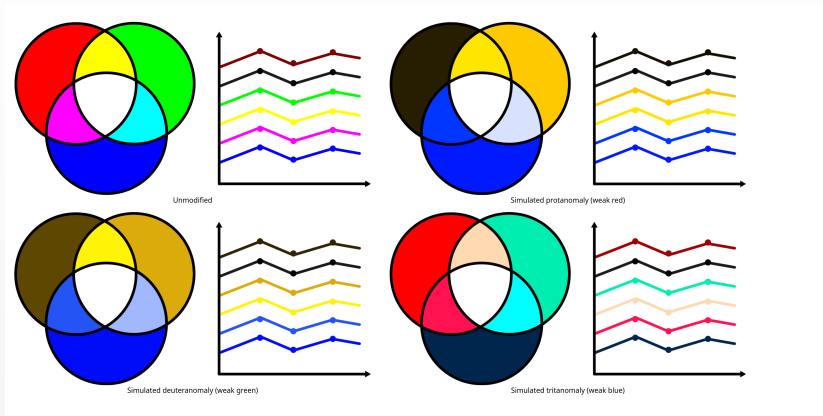


Kilde: [World Happiness Report](#)



# Colour-blindness

- One issue with presenting data is whether all readers will be able to access this.



<https://cvd-simulator.think.somethingorotherwhatever.com/>



# Weekly task

- ▶ You have now done ten weekly tasks.
- ▶ You should choose your best and do extra work this week to improve this, thinking about the feedback given across the ten pieces.
- ▶ If you feel you have not got a piece of work which reflects your best work, you may complete a new piece of research.

# References

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- ▶ Thier, J. (2025). California wildfires raise alarm on water-guzzling AI like ChatGPT. *Fortune*.  
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