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F08 Data Visualisation as a Powerful Means of Communication

Examples from the IFoA Working Party

Rob Black (Standard Life) and Julian Ellacott (Just Group)

23 November 2018



Data Visualisation

Today's talk

- What is data visualisation?
- Who are we?
- Background to working party and our vision
- Non-actuarial examples
- Our blog – <https://dataviz-wp.blogspot.com>
- Actuarial examples
- Next steps and getting involved
- Questions



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What is Data Visualisation?

- The main goal of data visualisation is to **communicate information clearly and effectively through graphical means** (Friedman)
- Important stories live in our data and data visualisation is **a powerful means to discover and understand these stories, and then to present them to others** (Few)
- Data visualisation **gives you answers to questions you didn't know you had** (Shneiderman)



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Who are we?

- | | |
|---------------------|---------------------------------|
| • Rob Black (Chair) | Standard Life |
| • Aidan Smith | Government Actuary's Department |
| • Anees Aslam | BUPA |
| • Florian Gomez | Partner Re |
| • Julian Ellacott | Just Group |
| • Lloyd Richards | Crowe (crowe.com) |
| • Martin Cairns | Aviva |
| • Paul Tegg | Bank of England/PRA |
| • Will Mirams | EY |

<https://www.actuaries.org.uk/practice-areas/risk-management/risk-management-research-working-parties/data-visualisation>



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Background to Working Party

The working party

- Builds on SIAS paper, *A Practical Guide to Data Visualisation* (Ellacott and Tegg, 2014)

Further examples in:

Data Visualisation for Business Insight (Ellacott and Tegg, 2013)

- <https://www.actuaries.org.uk/documents/c2-data-visualisation-business-insight>



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Data Visualisation – Our Vision

We have in mind a picture of an actuary at their desk with some data and asking themselves how best to summarise and present it.

Our vision is that, through the work of the working party, the actuary should have:

- A modern library of different visualisation techniques
- An understanding of which visualisations work well for different purposes (eg, data investigation vs reporting to management)
- Domain-specific examples of helpful practice (eg, pensions, investment, life or general insurance)
- An understanding of how to produce the visualisations, including tools and techniques (not just Excel)
- An understanding of the principles of developing and improving data visualisations
- Awareness of caveats that should be associated with data visualisations

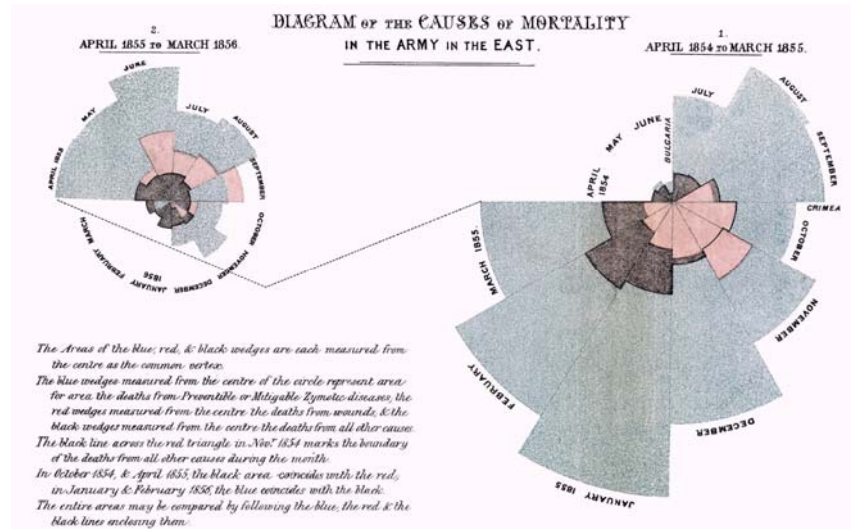


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Florence Nightingale (1855) – Coxcomb chart

Source: <https://commons.wikimedia.org/>



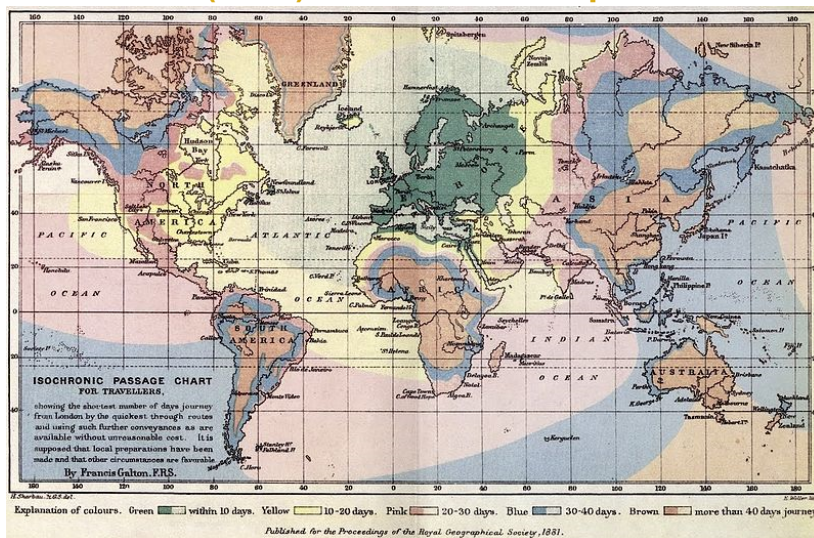
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Francis Galton (1881) – Isochronic map

Source: https://en.wikipedia.org/wiki/Isochrone_map



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London Tube Map – Harry Beck (1931)

Source: <https://londonist.com/>



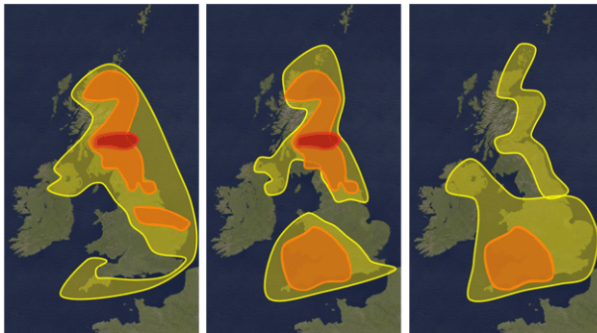
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“Beast from the East” – BBC (2018)

Snow warnings for the UK

- Severe weather possible
- Potential risk to life and property
- Risk to life likely



Wednesday
28 February

Thursday
1 March

Friday
2 March

Source: Met Office

BBC

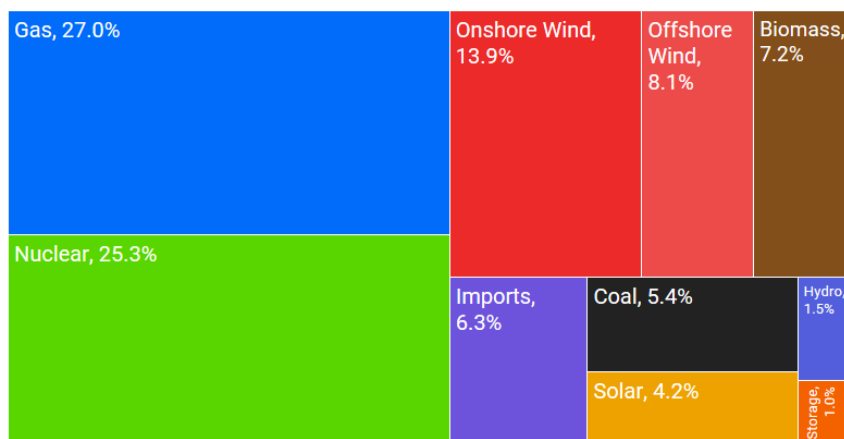


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Daily source of electricity generation in the UK (2018)

GB electricity generation over 48 hours from Sat 15 September 2018 to Mon 17 September 2018



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Source: <https://www.mygridgb.co.uk/last-48-hours>

<https://dataviz-wp.blogspot.com>



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Data Visualisation

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Tuesday, 28 August 2018

Display a Large Number of Client Recommendations

1 Problem Statement

A large number of recommendations (e.g., in a consultancy report) can immediately appear overwhelming. Ranking recommendations by impact and importance, as well as grouping by area to which the recommendation applies (e.g., validation function, finance function), allows for focus on the "quick wins", recommendations that have maximum impact for minimum effort.

2 Suggested Approach

We suggest a hybrid of the following techniques – see example overleaf:


- An overall heatmap plotting numbered recommendations by impact and importance, split into High/Medium/Low sections
- A coloured background to ease identification of relative importance, particularly enabling a user to rapidly identify "quick wins" – recommendations that are low effort and high impact
- Pre-requisites plotted graphically to identify dependencies between recommendations
- Separately, a collection of bar charts show the number of recommendations corresponding to High/Medium/Low impact and effort, and grouped by area to which the recommendation applies, to


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 - [Display a Large Number of Client Recommendations](#)
 - Jul 2018 (1)

Contributors

-  [Aidan Smith](#)


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General approach

For each data visualisation example

- Problem statement
- Suggested approach
- Rationale and commentary
- Applicability and alternatives
- Implementation
- Resources
- + Comments from others

Example: Correlation Matrix

Problem Statement

Correlation matrices are often large, complex and visually off-putting. The objectives of the visualisation are to:

- Present a correlation matrix in a way which is straightforward to engage with
- Make it easy to locate the material assumptions
- Make it easy to identify possible inconsistencies between correlation assumptions



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Example: Correlation Matrix – Before

		Equity returns	Credit spreads	Interest rates – parallel shifts	Interest rates – twists	Interest rates – curvature	Property returns	Corporate bond default / migr	Other counterparty	Mortality/longevity	Morbidity	Lapse	Motor	Home	Legal	Travel	Liability	Current expenses	Expense inflation	Internal fraud
Market risk	Equity returns	1.00	-0.75	-0.25	0.25	0.00	-0.50	-0.50	-0.25	0.00	0.00	-0.50	0.00	0.00	0.00	0.00	0.00	0.25	-0.25	-0.25
	Credit spreads	-0.75	1.00	0.50	-0.25	0.00	-0.50	0.50	0.25	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	-0.25	-0.25	0.25
	Interest rates – parallel shifts	-0.25	0.50	1.00	0.10	0.10	-0.25	0.50	0.50	0.00	0.00	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Interest rates – twists	0.25	-0.25	0.10	1.00	0.10	0.25	0.25	0.25	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Interest rates – curvature	0.00	0.00	0.10	0.10	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Credit risk	Property returns	0.50	-0.50	-0.25	0.25	0.00	1.00	-0.50	-0.25	0.00	0.00	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Corporate bond default / migration	-0.50	0.50	0.50	0.25	0.00	-0.50	1.00	0.25	0.00	0.00	-0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
Life insurance risk	Other counterparty	-0.25	0.25	0.50	0.25	0.00	-0.25	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25
	Mortality/longevity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Morbidity	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Non-life insurance risk	Lapse	-0.50	0.50	-0.25	0.10	0.00	-0.50	-0.50	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.00
	Motor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.25	0.25	0.25	0.25	0.00	0.00	0.00
	Home	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	1.00	0.25	0.25	0.25	0.25	0.00	0.00	0.00
	Legal	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	1.00	0.25	0.25	0.25	0.00	0.00	0.00
	Travel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	1.00	0.25	0.25	0.00	0.00	0.00
Expense risk	Liability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.25	1.00	0.00	0.00	0.00	0.00
	Current expenses	0.25	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	1.00	0.25	0.25
	Expense inflation	0.25	-0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.25	1.00	0.25
Operational risk	Internal fraud	-0.25	0.25	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	1.00
	External fraud	-0.25	0.25	0.00	0.00	0.00	0.00	0.25	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.50
	Employment Practices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.50
	Business Practice	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.50
	Physical Asset Damage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.50
	System Failures	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.50



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Example: Correlation Matrix

Suggested Approach: We suggest a hybrid of the following techniques:

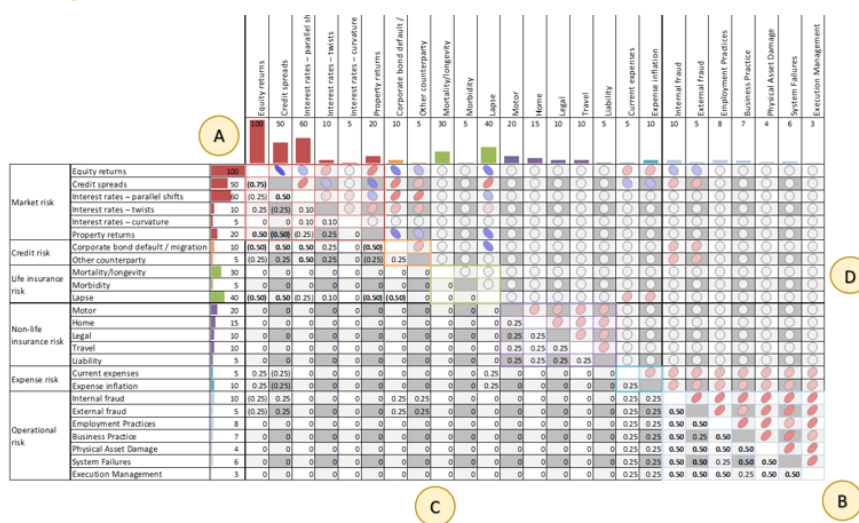
- **Bar charts to illustrate the materiality of individual risks**, measured by undiversified capital requirements. Colour is used to collate risks into categories.
- **Shading of alternate rows and columns** to lead the eye to the row and column headings, and borders around correlations within each category that align to the bar charts.
- **A table of values to show the correlation assumptions** – this can be triangular because the matrix is symmetric, and the values of 1.0 on the diagonal are omitted. The typography is designed to emphasise visual differences between zero, positive and negative values.
- **Ellipses to visualise the sign and magnitude of each correlation**, in the space created by restricting the numerical assumptions to a triangle. These help with seeing patterns



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Example: Correlation Matrix – After



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Example: Display a Large Number of Client Recommendations

Problem Statement

- A large number of recommendations (eg, in a consultancy report) can immediately appear overwhelming.
- Ranking recommendations by impact and importance, as well as grouping by area to which the recommendation applies (eg, validation function, finance function), allows for focus on the “quick wins”; recommendations that have maximum impact for minimum effort.



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Example: Display a Large Number of Client Recommendations

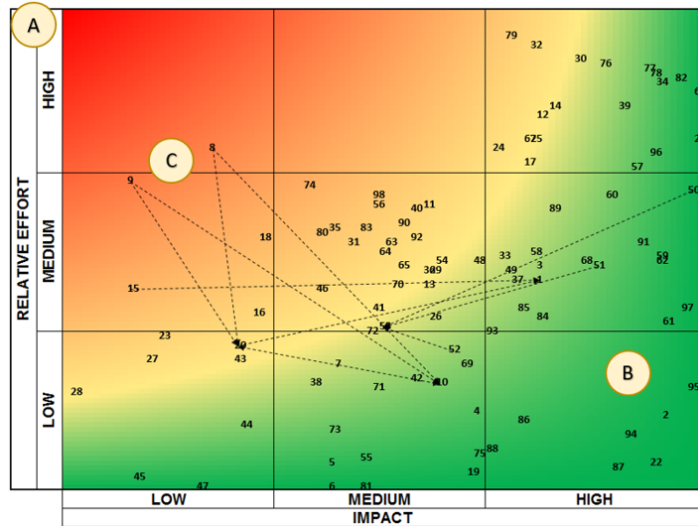
Suggested Approach: We suggest a hybrid of the following techniques:

- **An overall heatmap** plotting numbered recommendations by impact and importance, split into High/Medium/Low sections
- **A coloured background** to ease identification of relative importance, particularly enabling a user to rapidly identify “quick wins” – recommendations that are low effort and high impact
- **Pre-requisites plotted graphically** to identify dependencies between recommendations
- Separately, **a collection of bar charts** show the number of recommendations corresponding to High/Medium/Low impact and effort, and grouped by area to which the recommendation applies, to enable a high level view on where to focus resources



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Example: Display a Large Number of Client Recommendations



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Example: Visualise Daily Incidences

Problem Statement

- A large number of incidences occurring over a long timeframe can make it challenging to spot trends.
- The example shown is for daily incidence reporting over a year, but is adaptable to other timeframes



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Example: Visualise Daily Incidences

Suggested Approach: We suggest a hybrid of the following techniques:

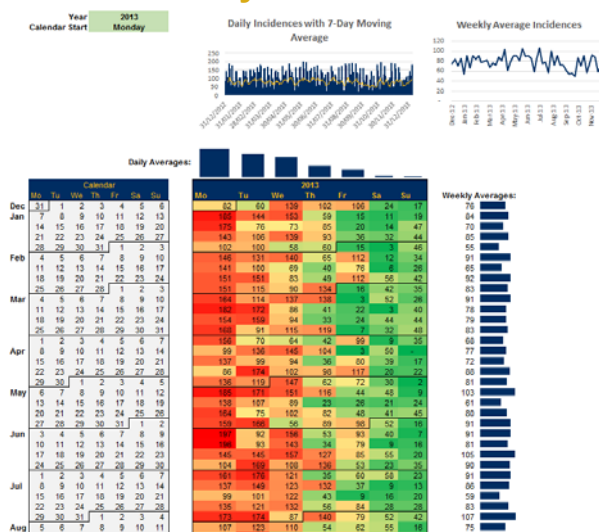
- **Listing the number of incidences each day**, with days arranged in a calendar format (conditional formatting is used to identify at a glance relatively better/worse days)
- **A calendar is included** alongside to enable quick reference to specific dates
- **Daily/weekly averages** are shown above/beside the calendar listing
- **Daily/weekly average charts** are shown at the top



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Example: Visualise Daily Incidences



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Data Visualisation: A Checklist

- **Does the information within the visualisation answer the initial question posed by your audience?**
- **Can your audience understand and interpret the visualisation within 15 seconds?** If not, then it's possible that your graph is too complicated
- **Have you chosen the right type of visualisation?** There is nothing wrong with a simple pie chart or bar chart!
- **Will the user asks a subsequent question after viewing your visualisation?** If so, then do we need some supplementary visualisations, eg a separate graph or overlaid line graph?
- **Would your visualisation benefit from any form or data grouping?** For example, would plotting cash flows in annual buckets be clearer than monthly buckets?
- **Does the visualisation make due consideration** to all your users, eg a visualisation with lots of different colours may not be received well be individuals who are colour blind
- **Is the style and design of your visualisations sufficient future-proof**, or may it change next month? Users get used to seeing certain types of information. If the visualisation changes month-on-month then the communication may be weaker

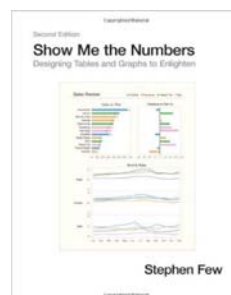
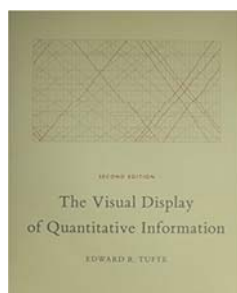


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Resources that have helped us

Books



Websites

- <https://flowingdata.com/>
- <https://informationisbeautiful.net/>
- <http://economist.com/blogs/graphicdetail>
- <http://www.jmoon.co.uk/>



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Next steps and getting involved

- Please visit our blog – <https://dataviz-wp.blogspot.com>
- **Registered users** can submit full blog posts of your own
- **Anyone** can comment on the site in general, via “Give us feedback” page, or specific visualisations



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Questions

Comments

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