Good Graphs, Bad Graphs

Kate Baldwin

K8Baldwin.com

Bastille Day, 2025

Kate Baldwin

- PhD in 2013:

  Cellular & Molecular Biology

- Freelance
- Also part-time:

  Sustainability Research Hub
  Nelson Institute for Environmental Studies and the Office of Sustainability

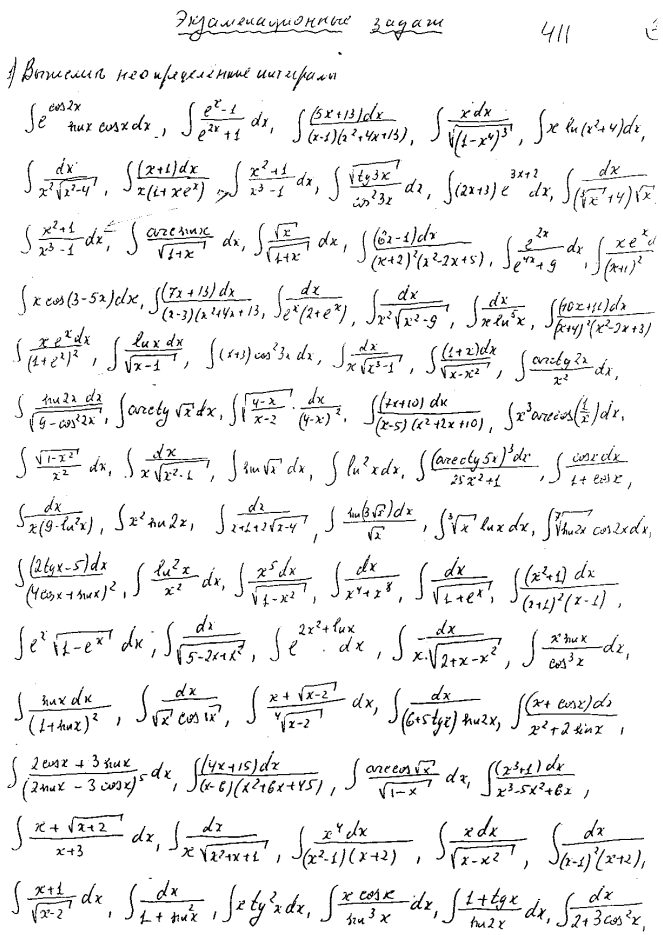
  - Publications
  - Grant proposals
  - Science books
  - Infographics

Visual Animals

~9% caloric intake fuels vision

30-50% of cortical real estate → vision

Calculus

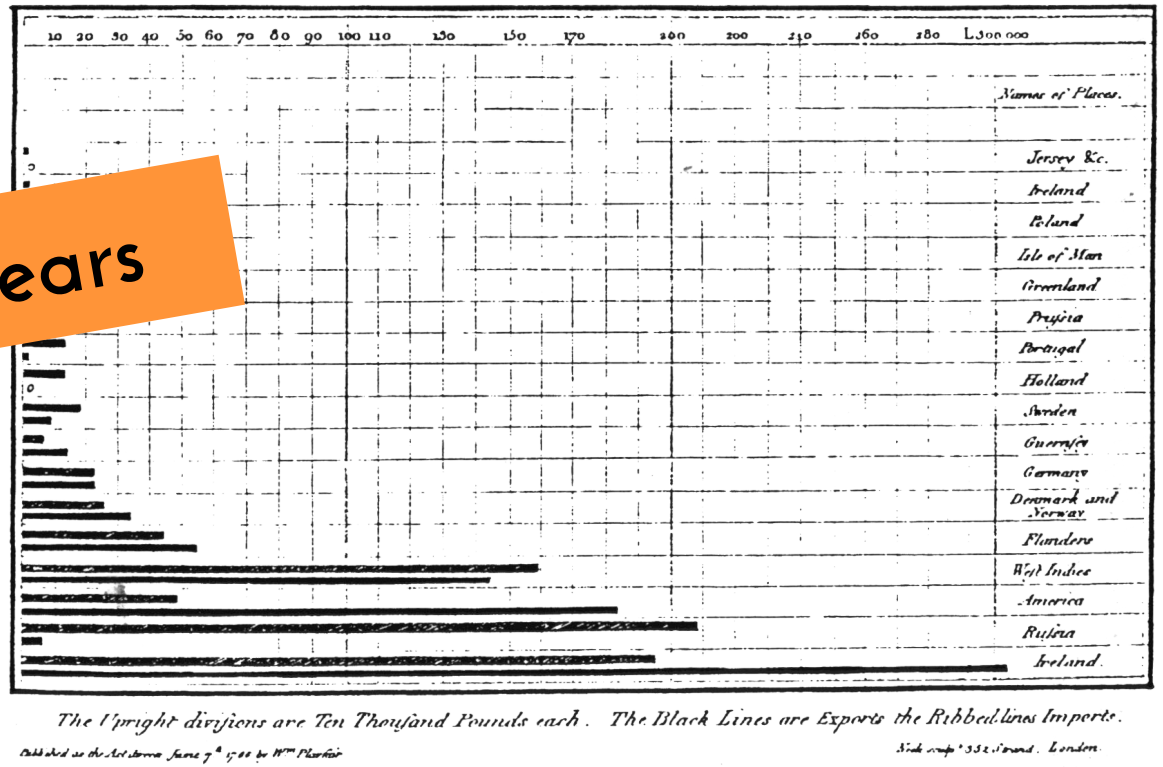


1670

Newton & Leibniz

>100 years

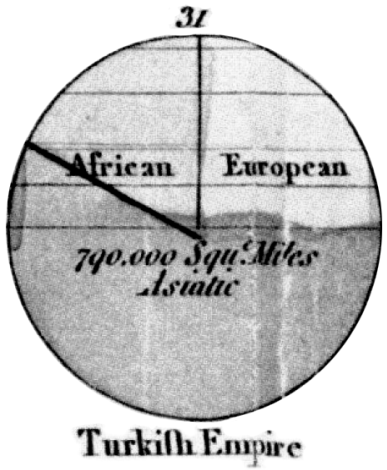
Bar Charts



1790

Playfair

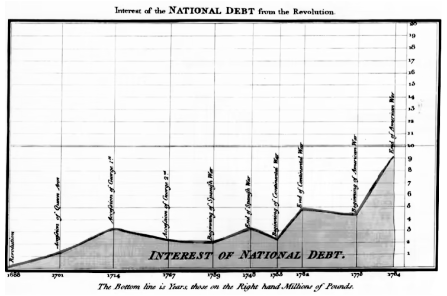
Pie Charts



1790

Playfair

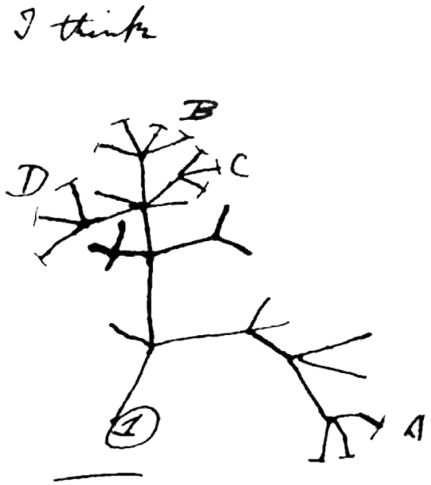
Line Graph



1800

Playfair

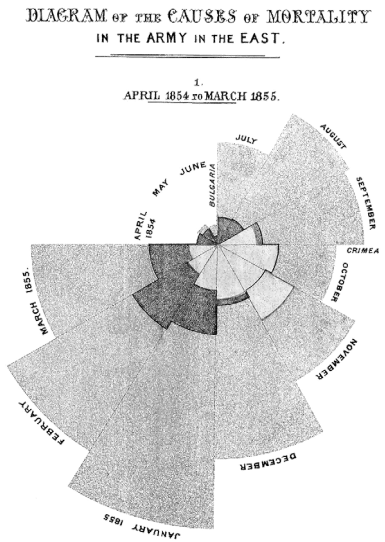
Tree



1840

Darwin

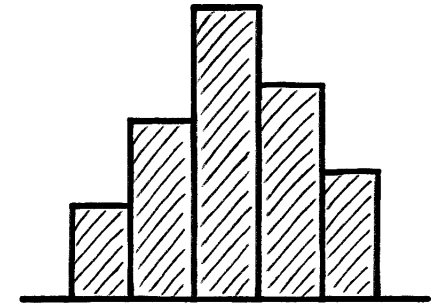
Coxcomb



1880

Nightengale

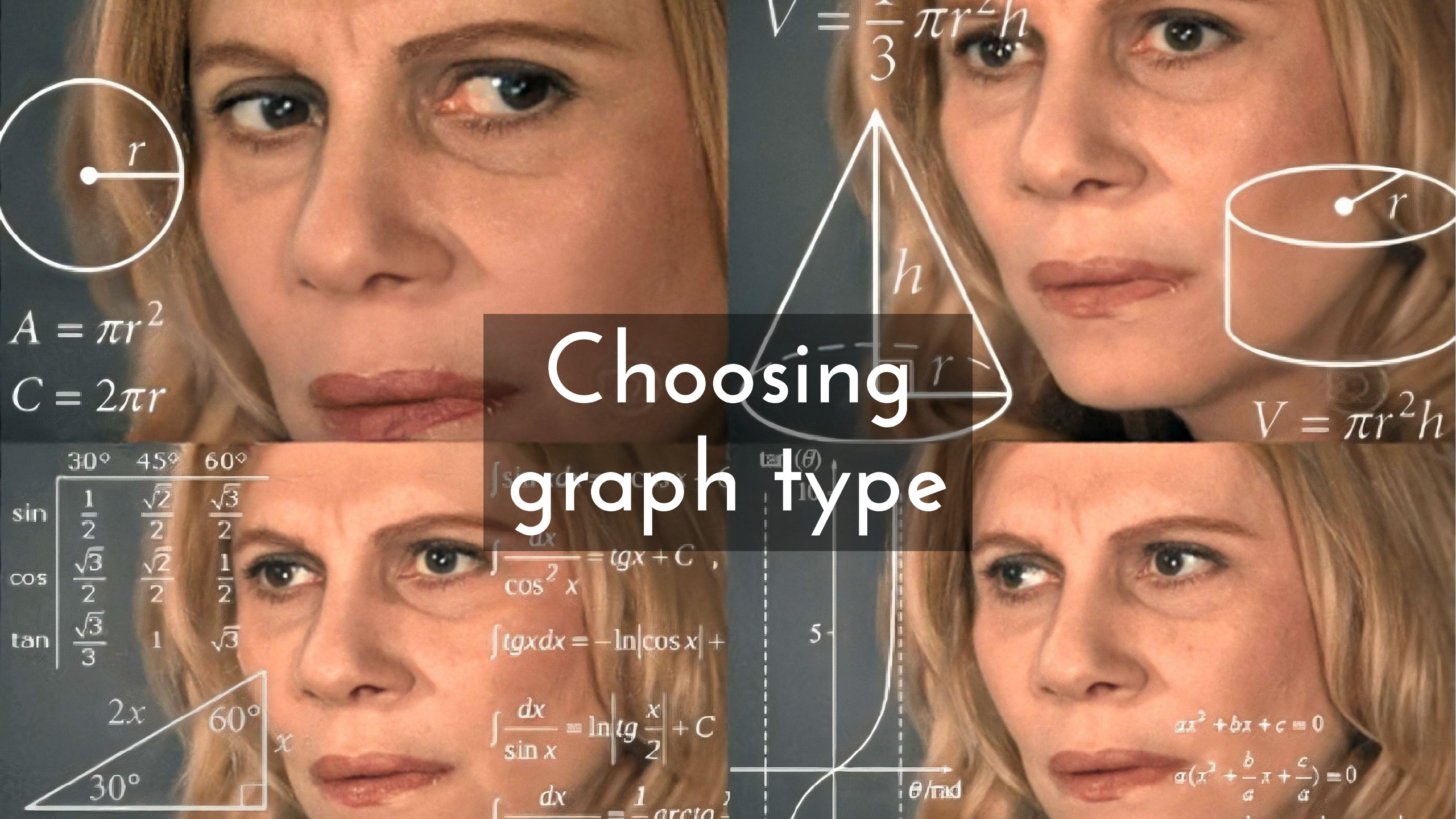
Histogram



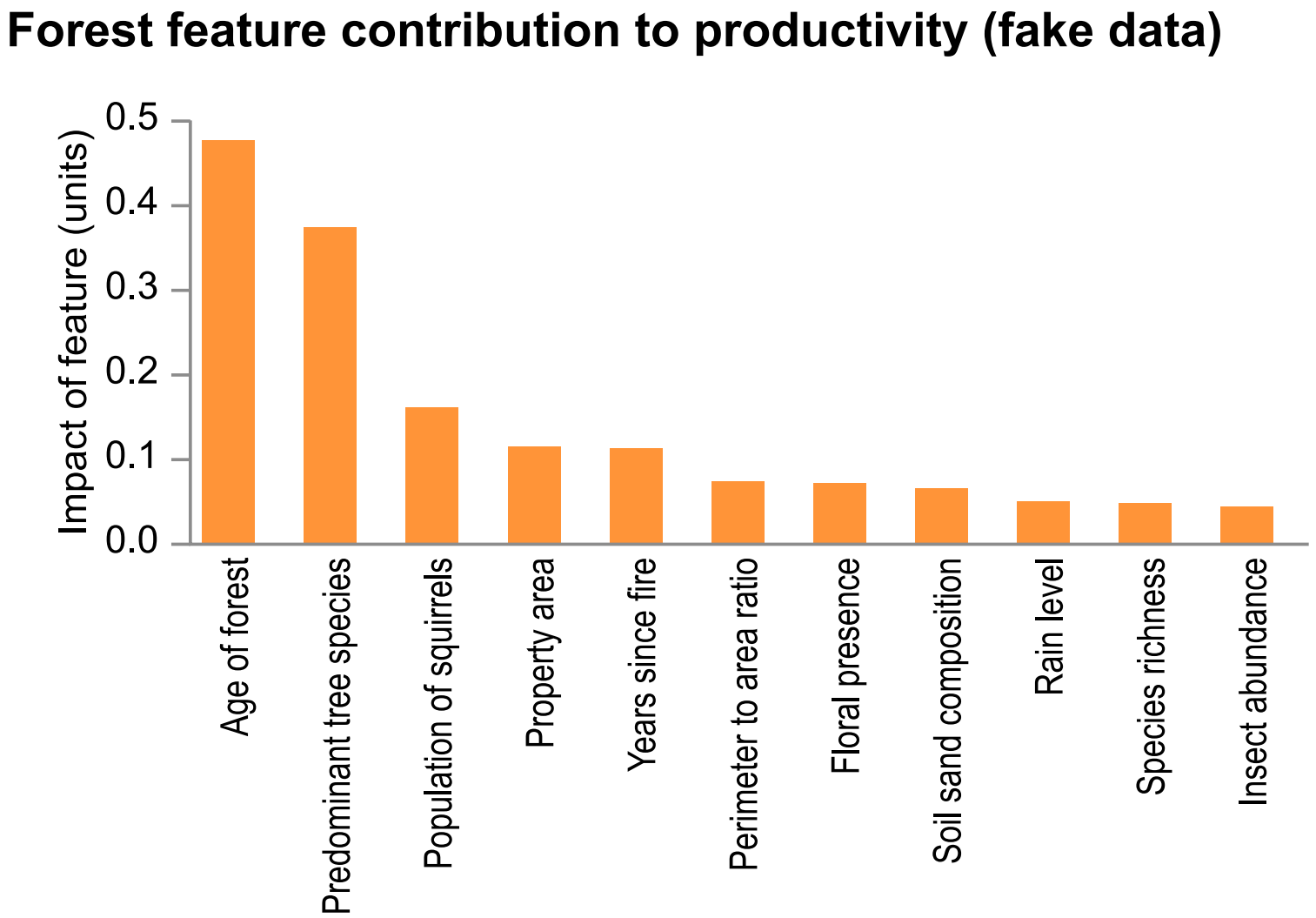
1900

Pearson

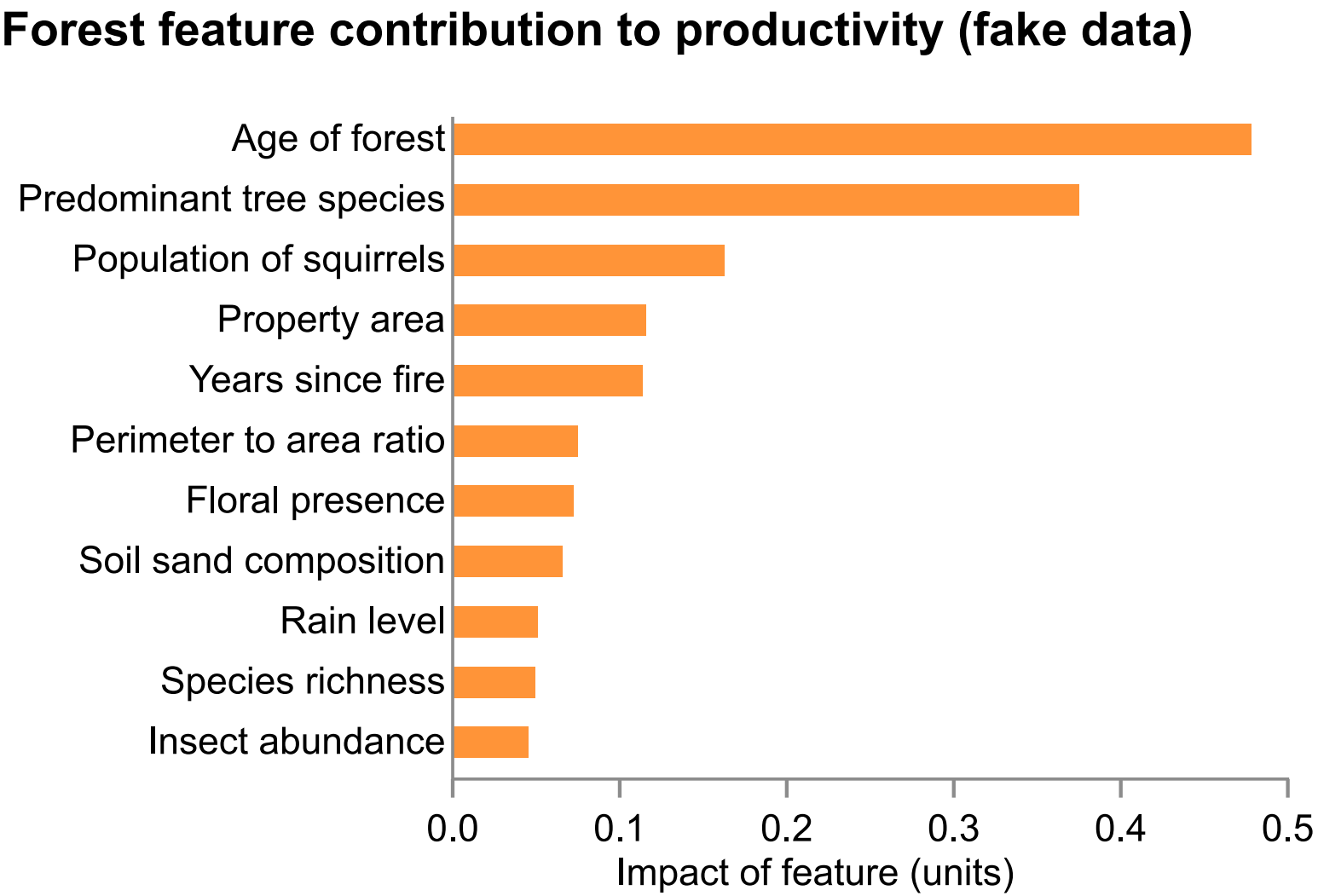
2010: Kelleher & Wagener
2007: Ben Fry


Choosing
graph type

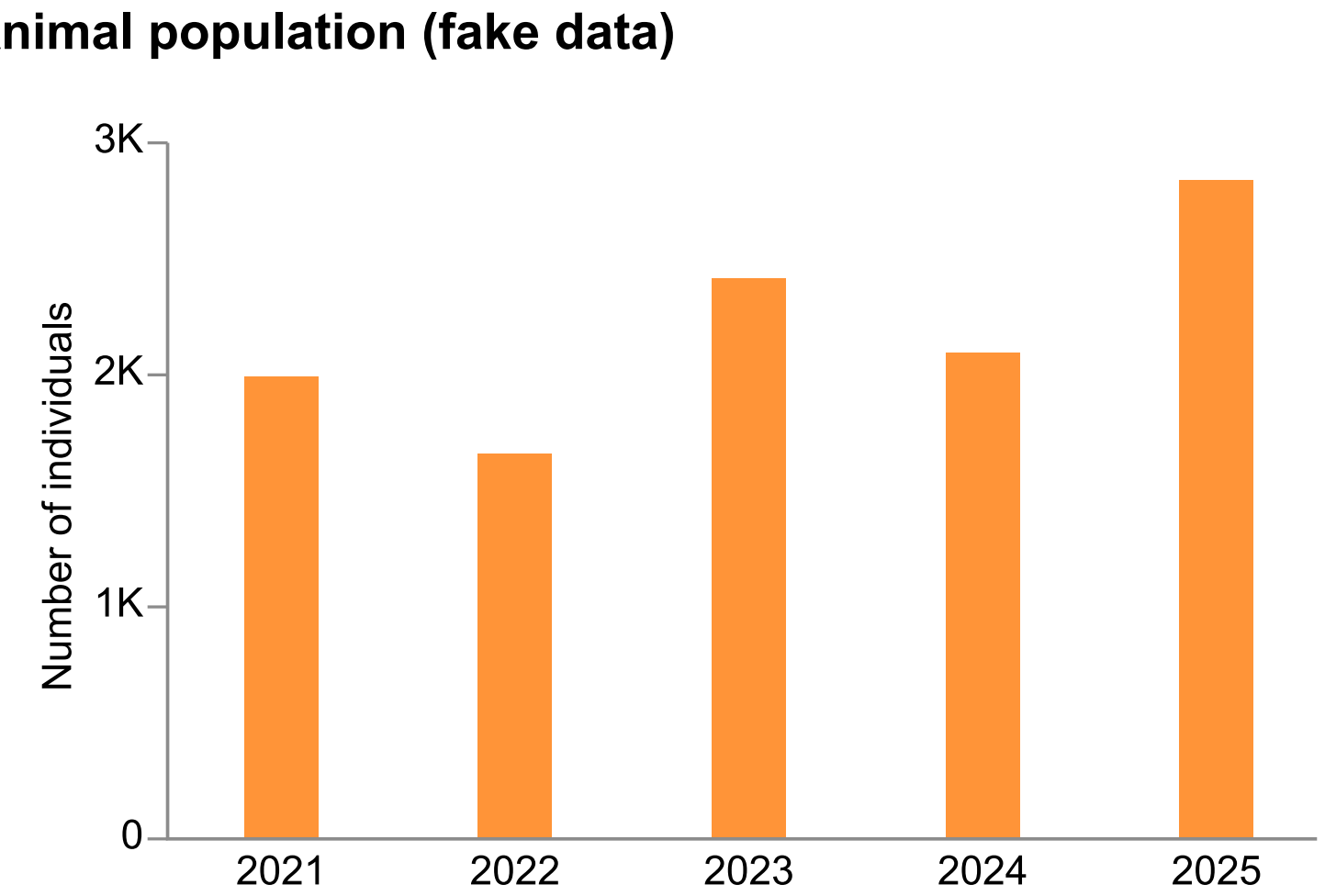
Try to keep text in normal orientation



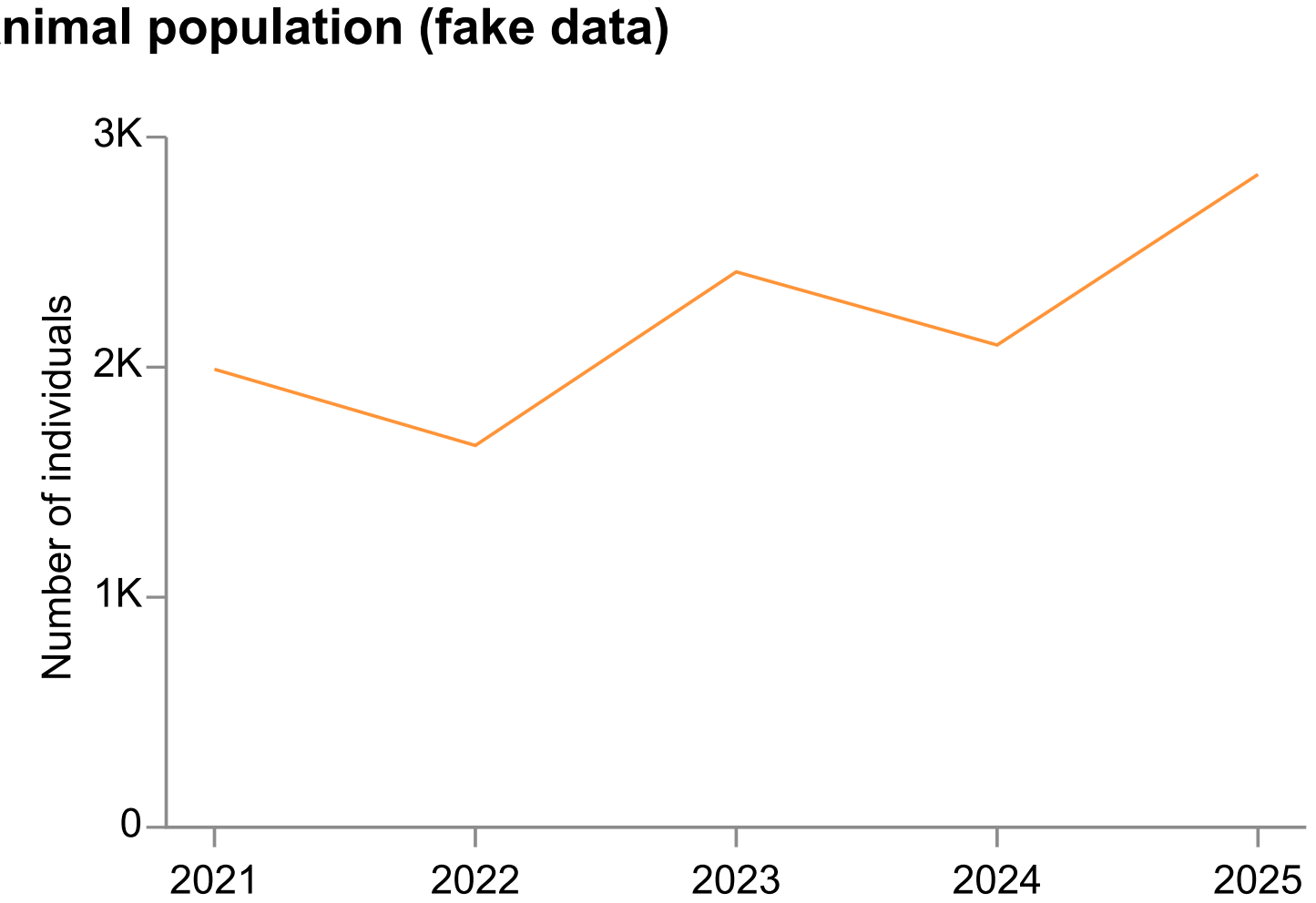
Try to keep text in normal orientation

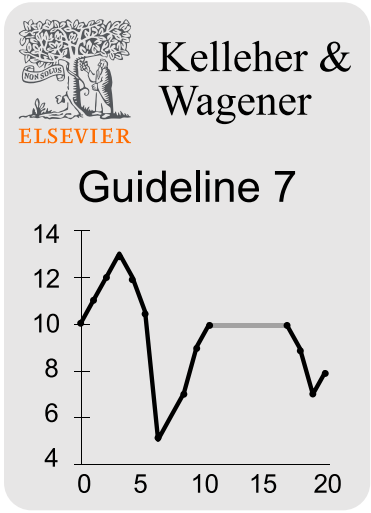


Continuous data: Line charts

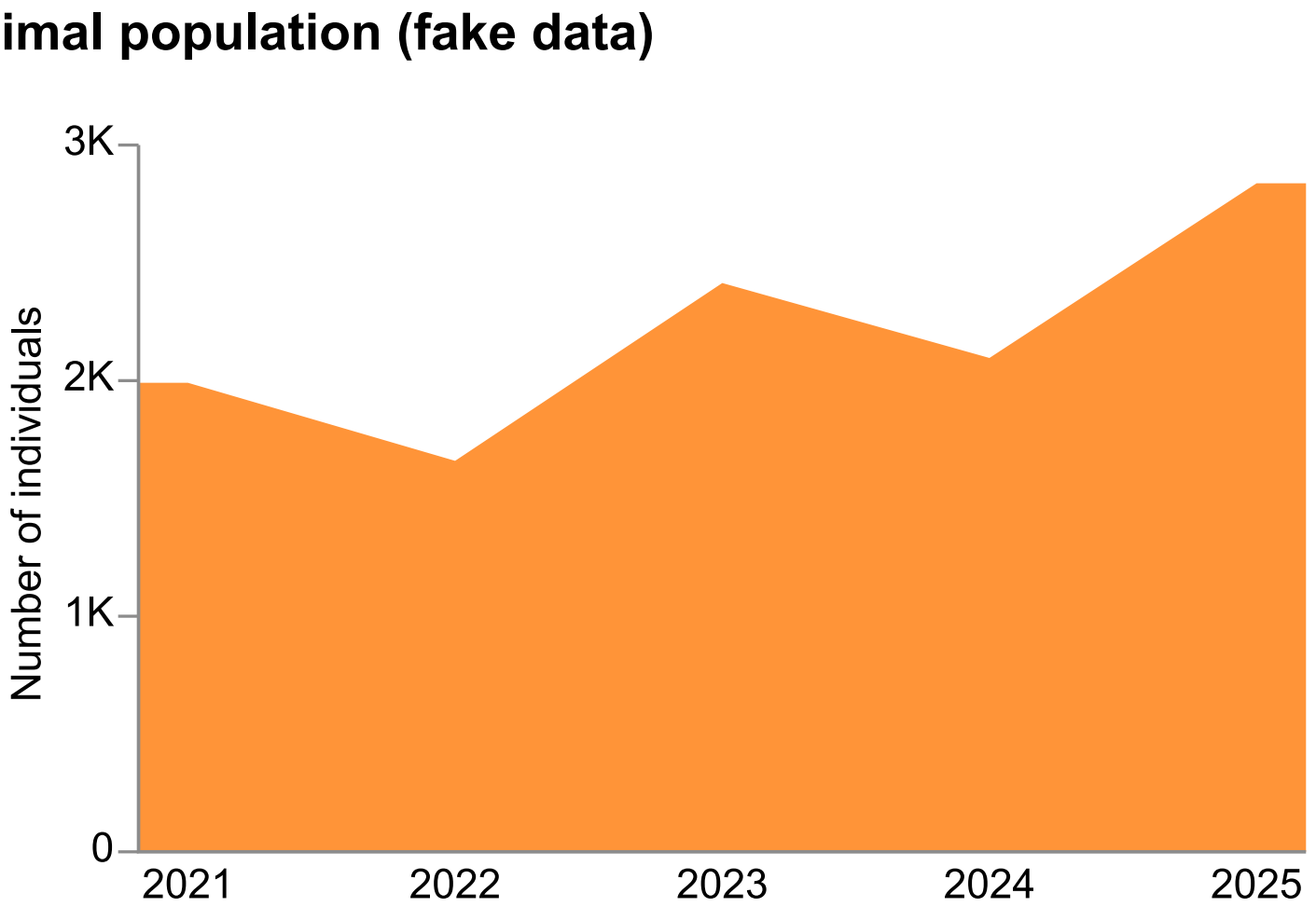


Continuous data: Line charts

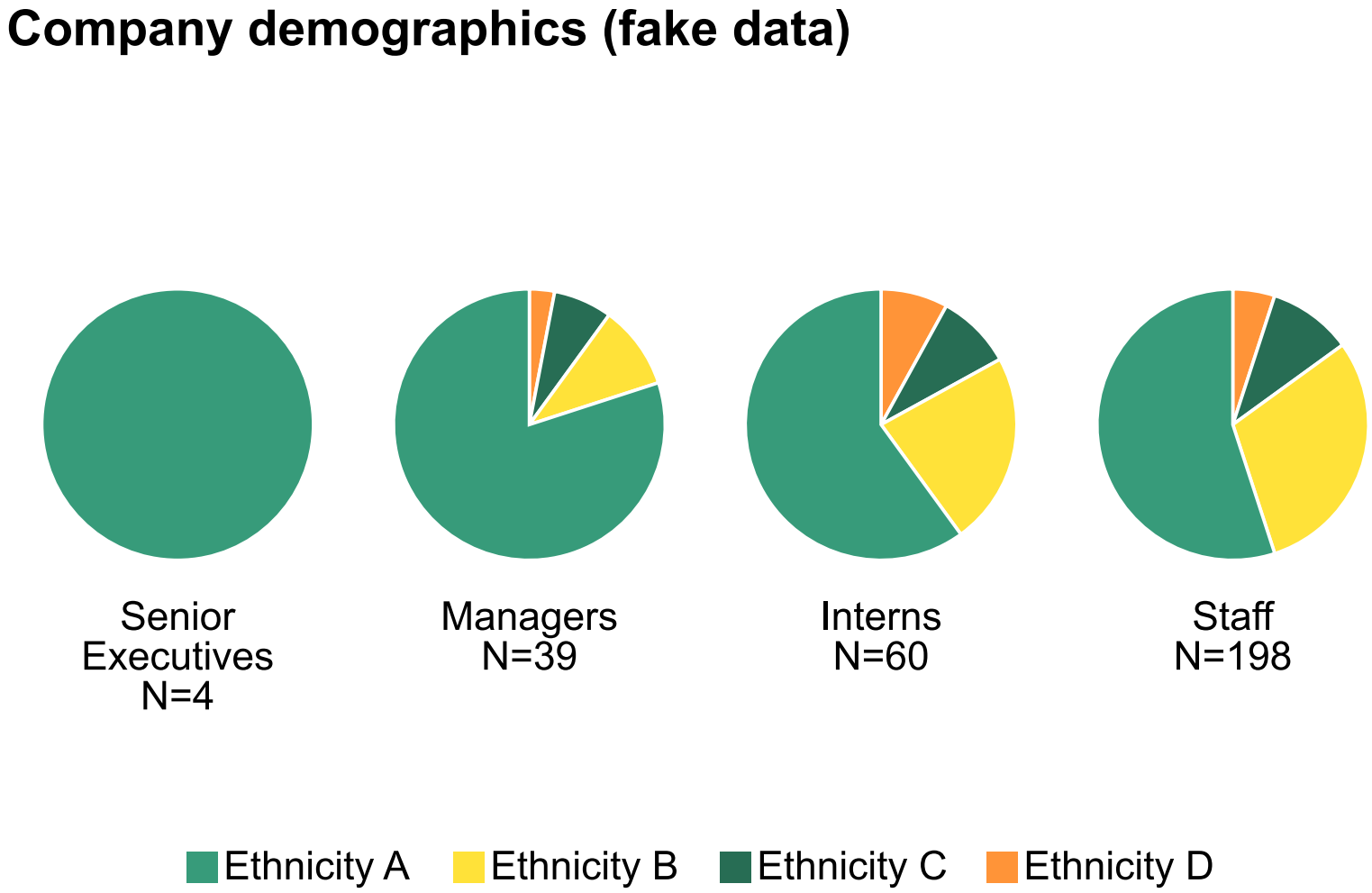




Continuous data: Line charts



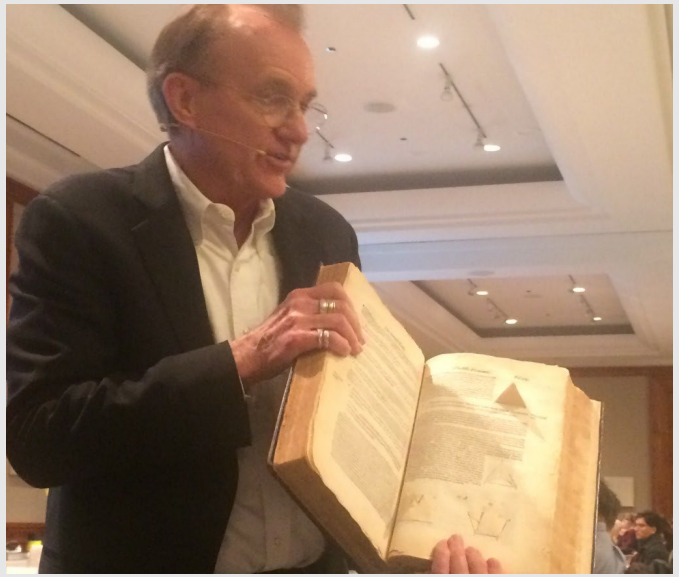
Pie charts: Hard to cross compare



Pie charts: Hard to cross compare

"The only thing worse than a pie chart is several of them"

-Edward Tufte



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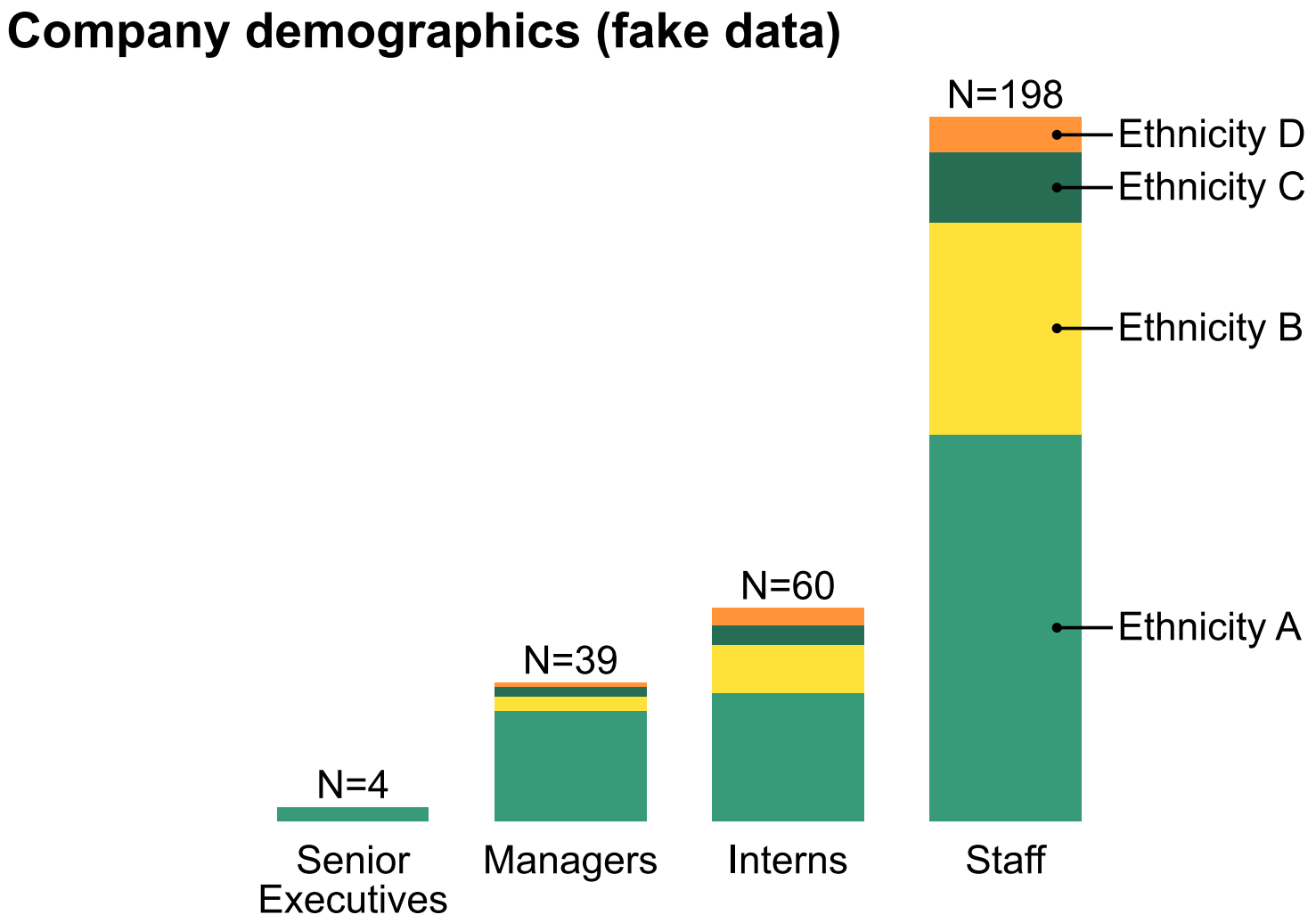
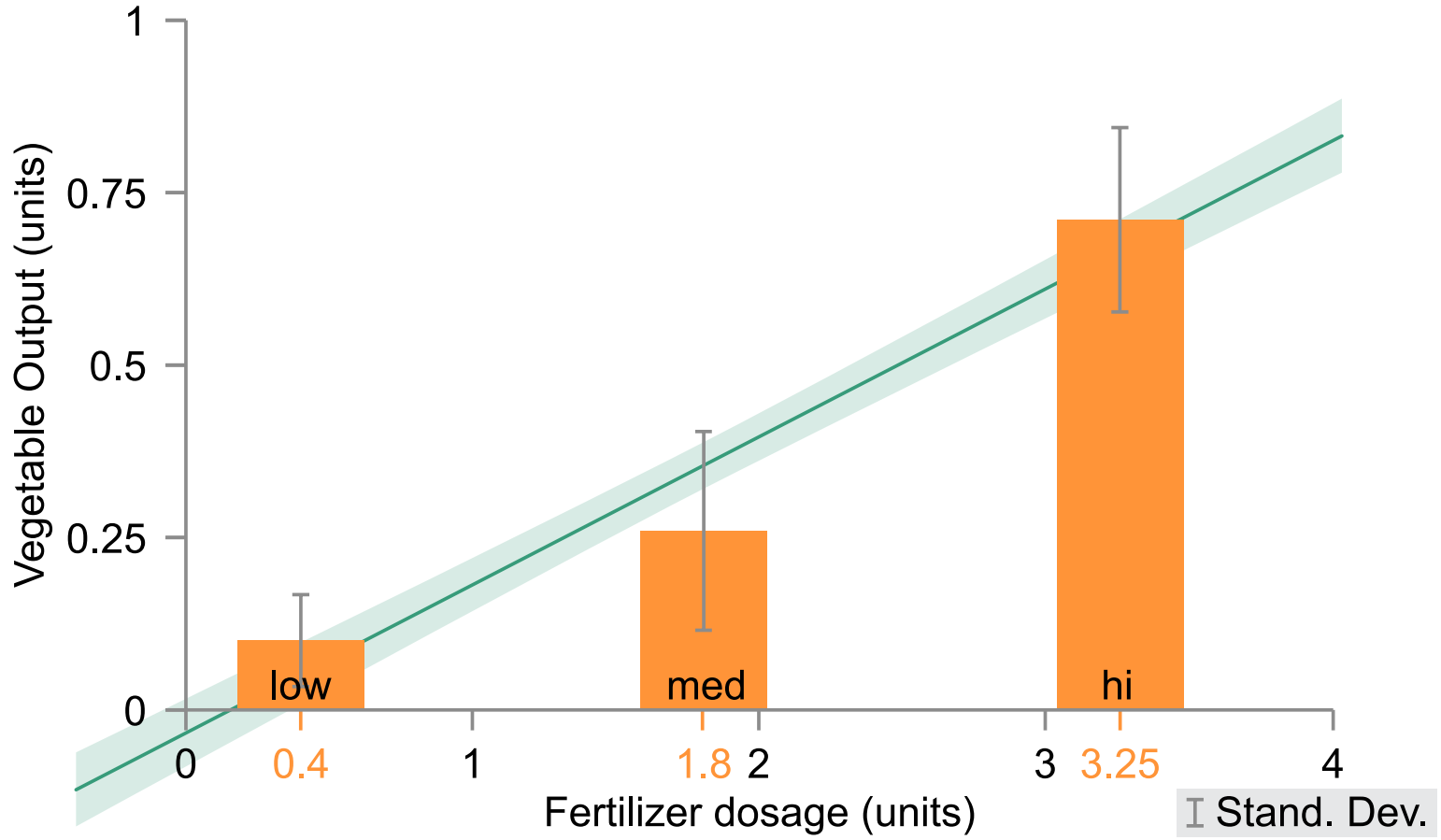


Dealing with density

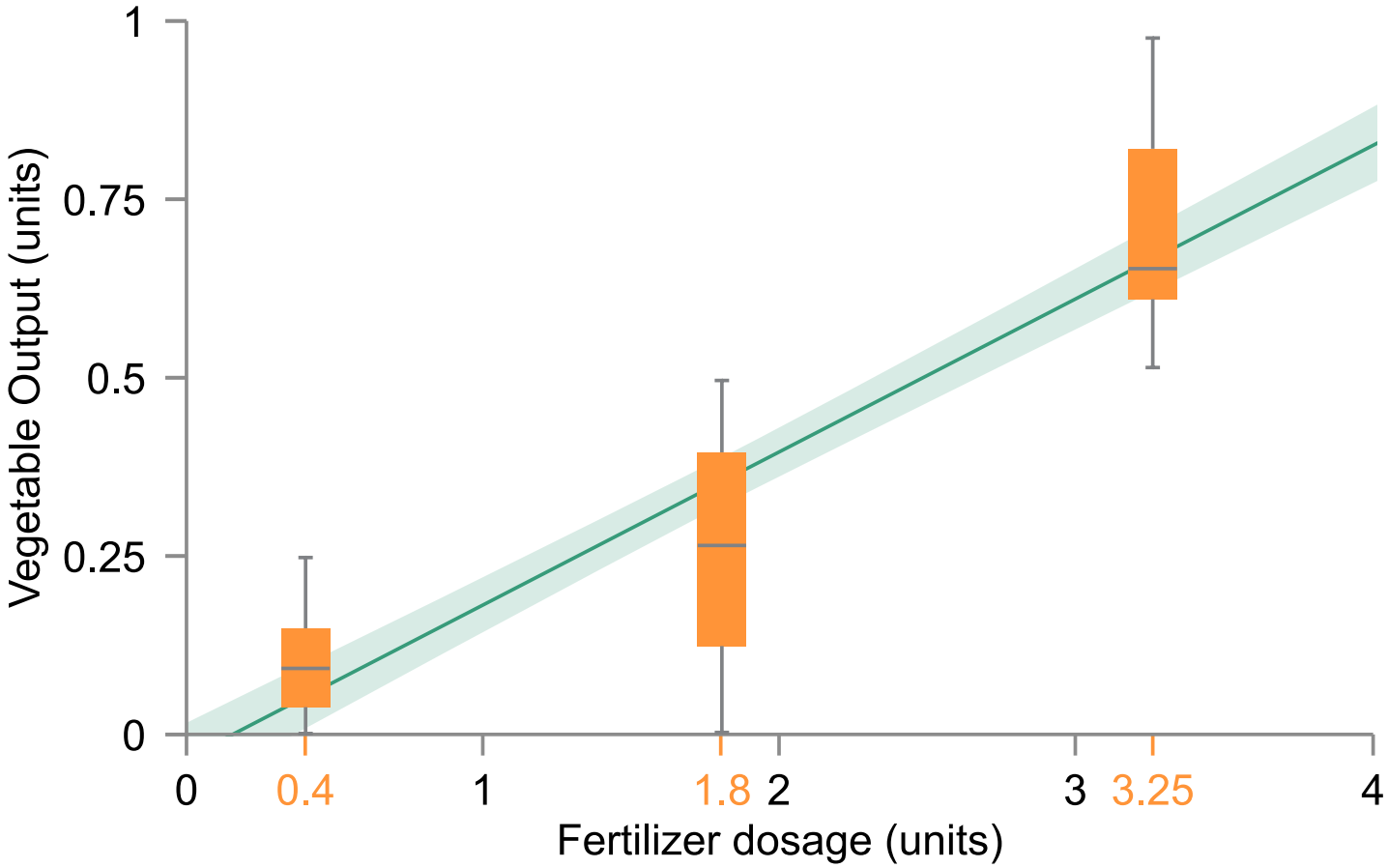
Output from fields with different fertilizers (fake data)



Kelleher & Wagener

Dealing with density

Output from fields with different fertilizers (fake data)



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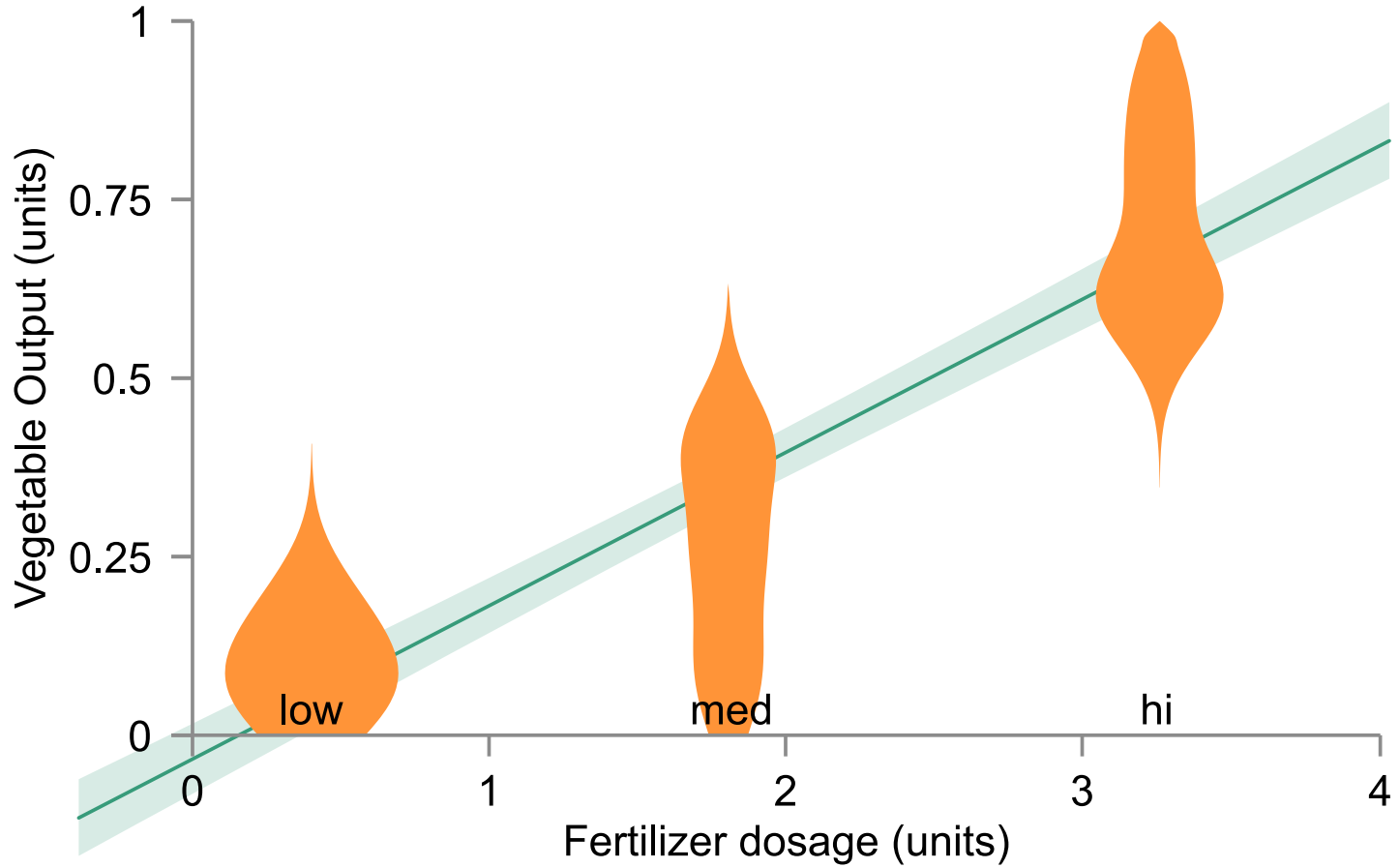
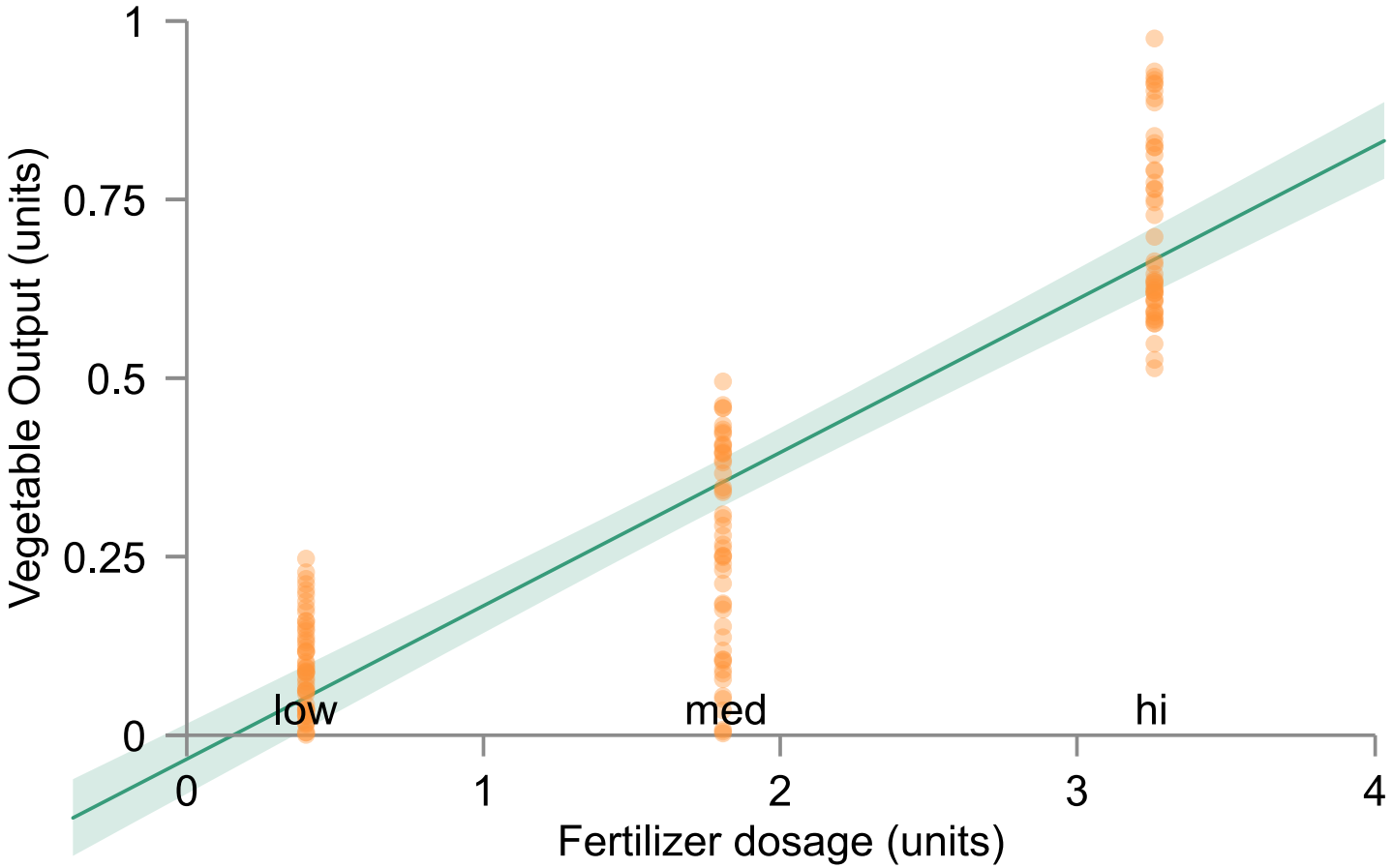


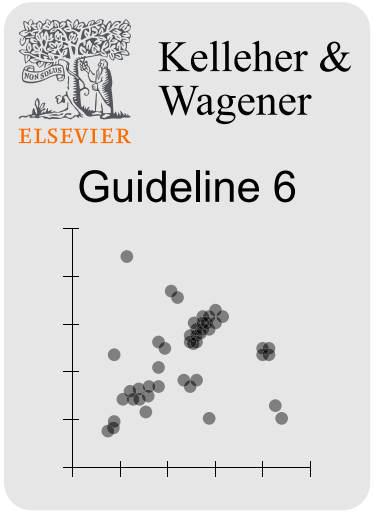
- Violin's not a part of ggplot until 2012
- Still not easily doable in excel

✳Flourish

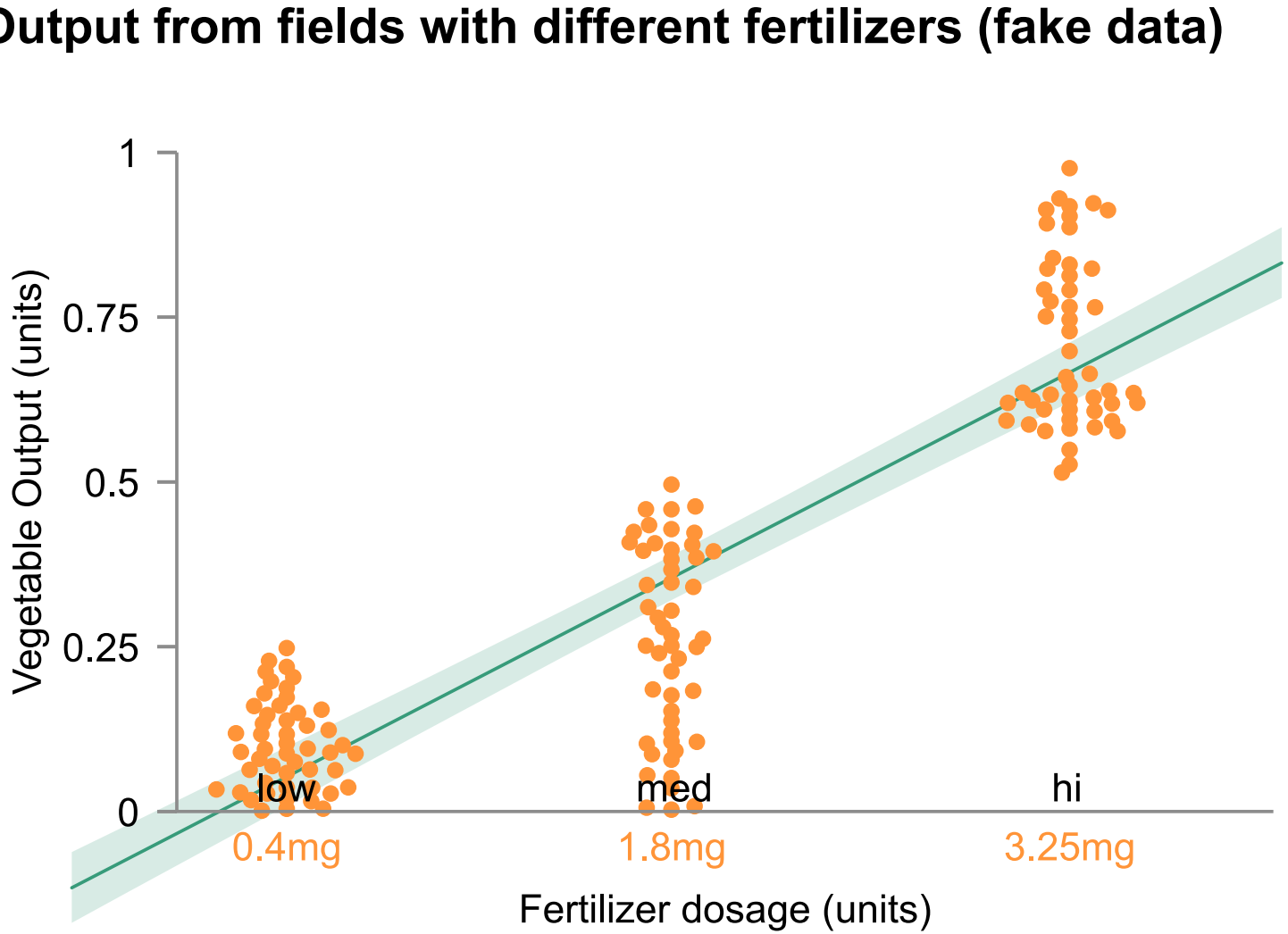
Dealing with density

Output from fields with different fertilizers (fake data)





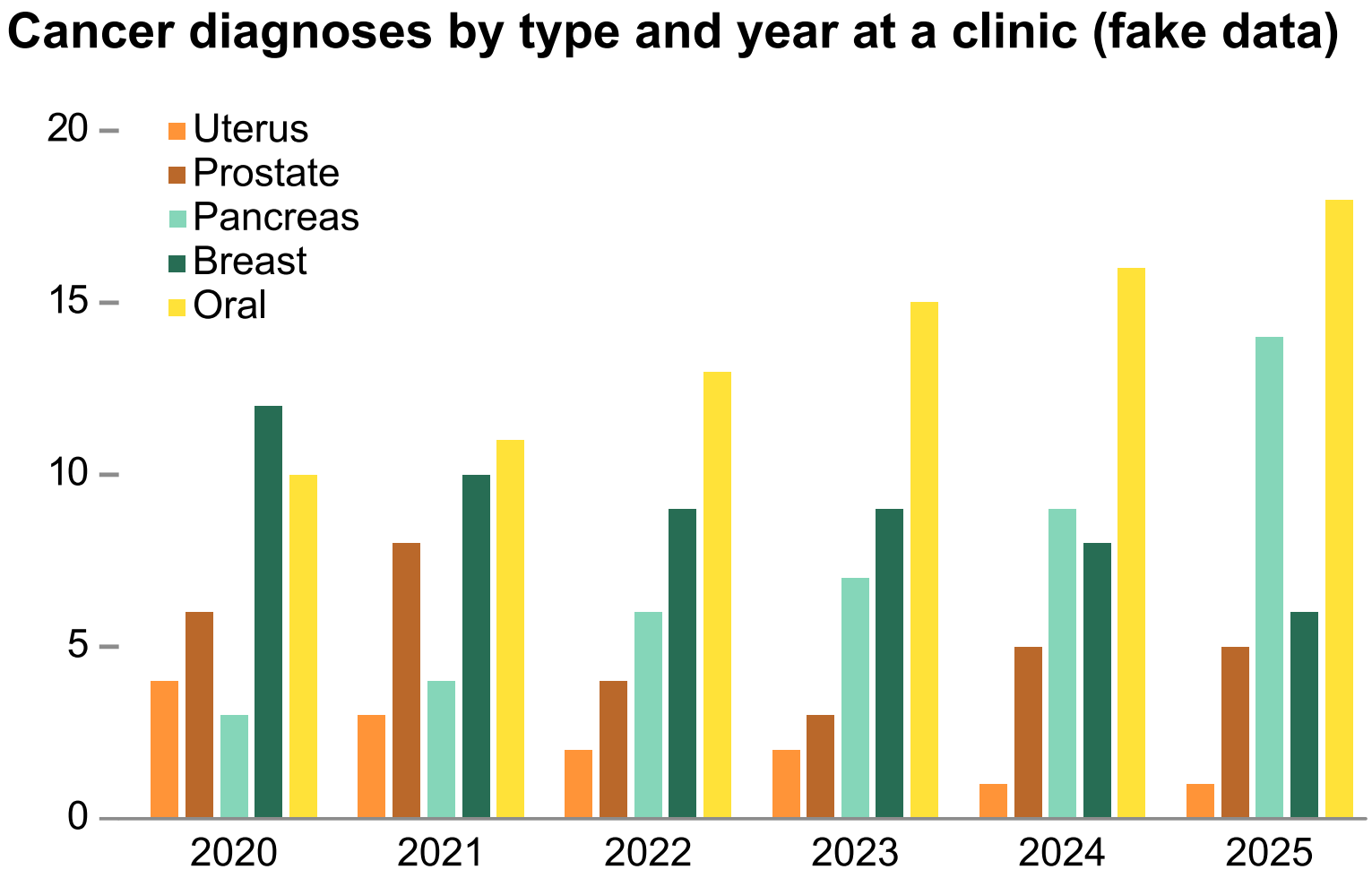
Dealing with density



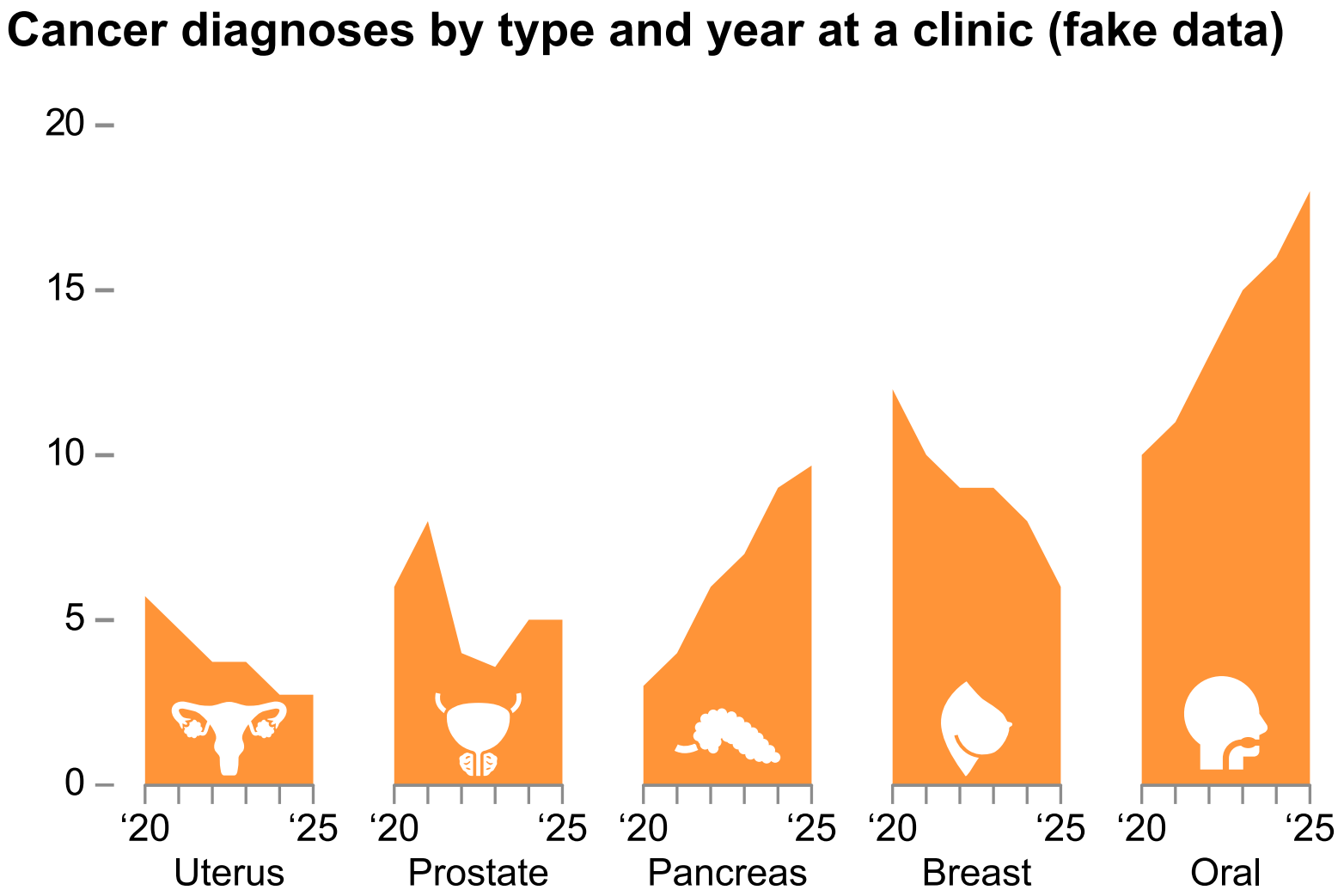
- Swarms not a part of common R packages until late 2010s
- Still not easily doable in excel

✳Flourish

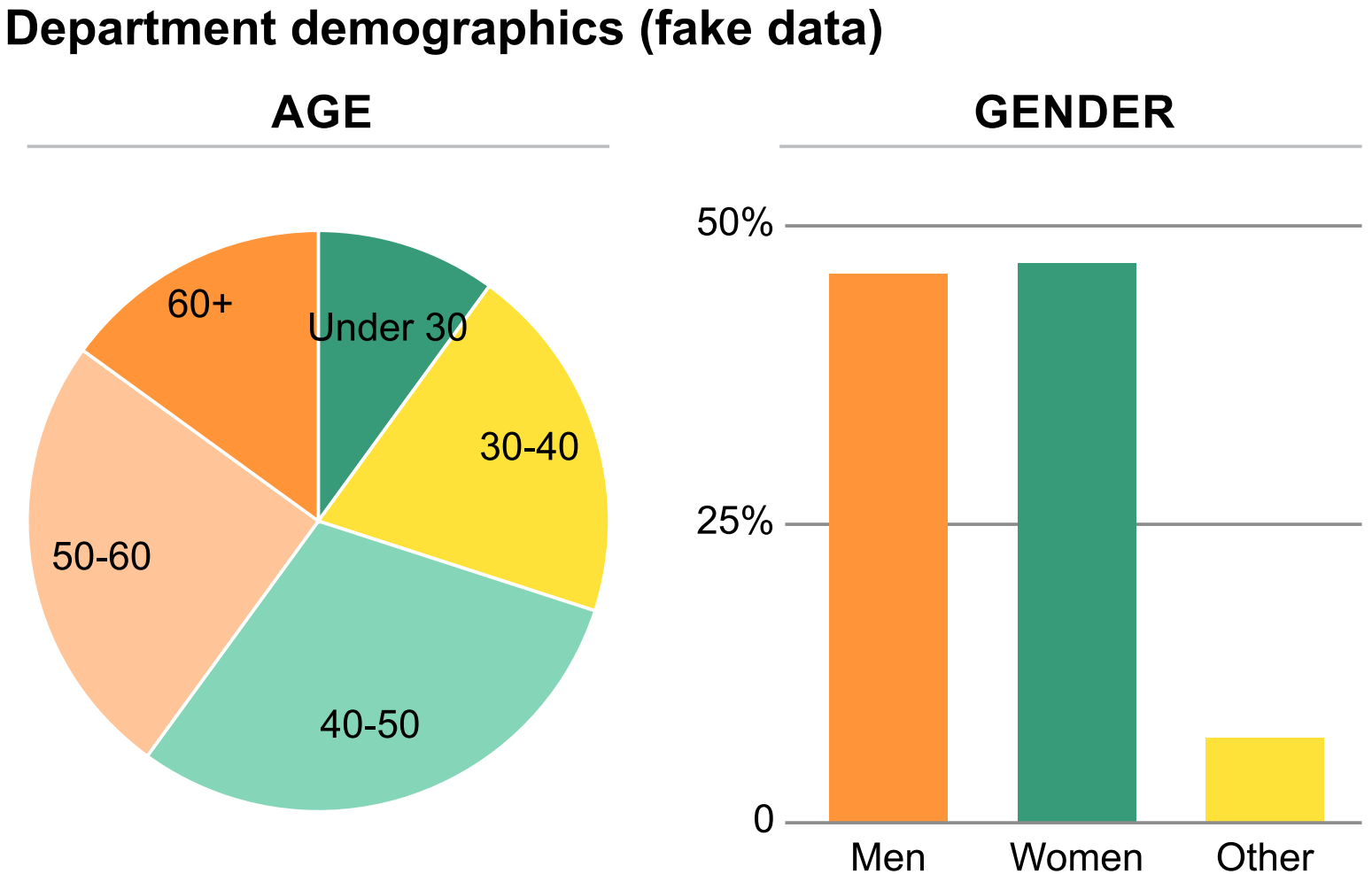
Complex series of bars is rarely best choice



Complex series of bars is rarely best choice



Sometimes there is a more elegant solution



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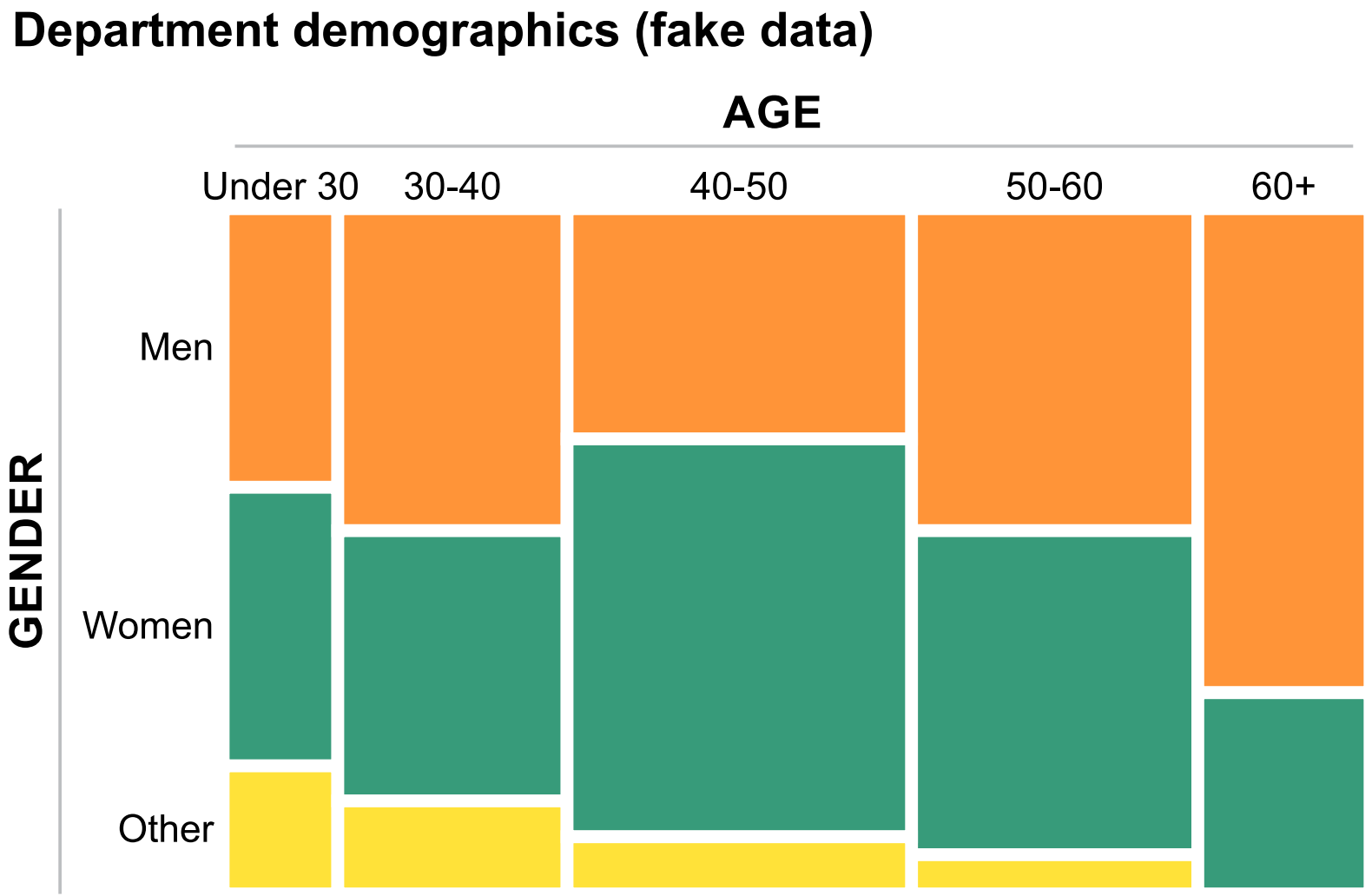
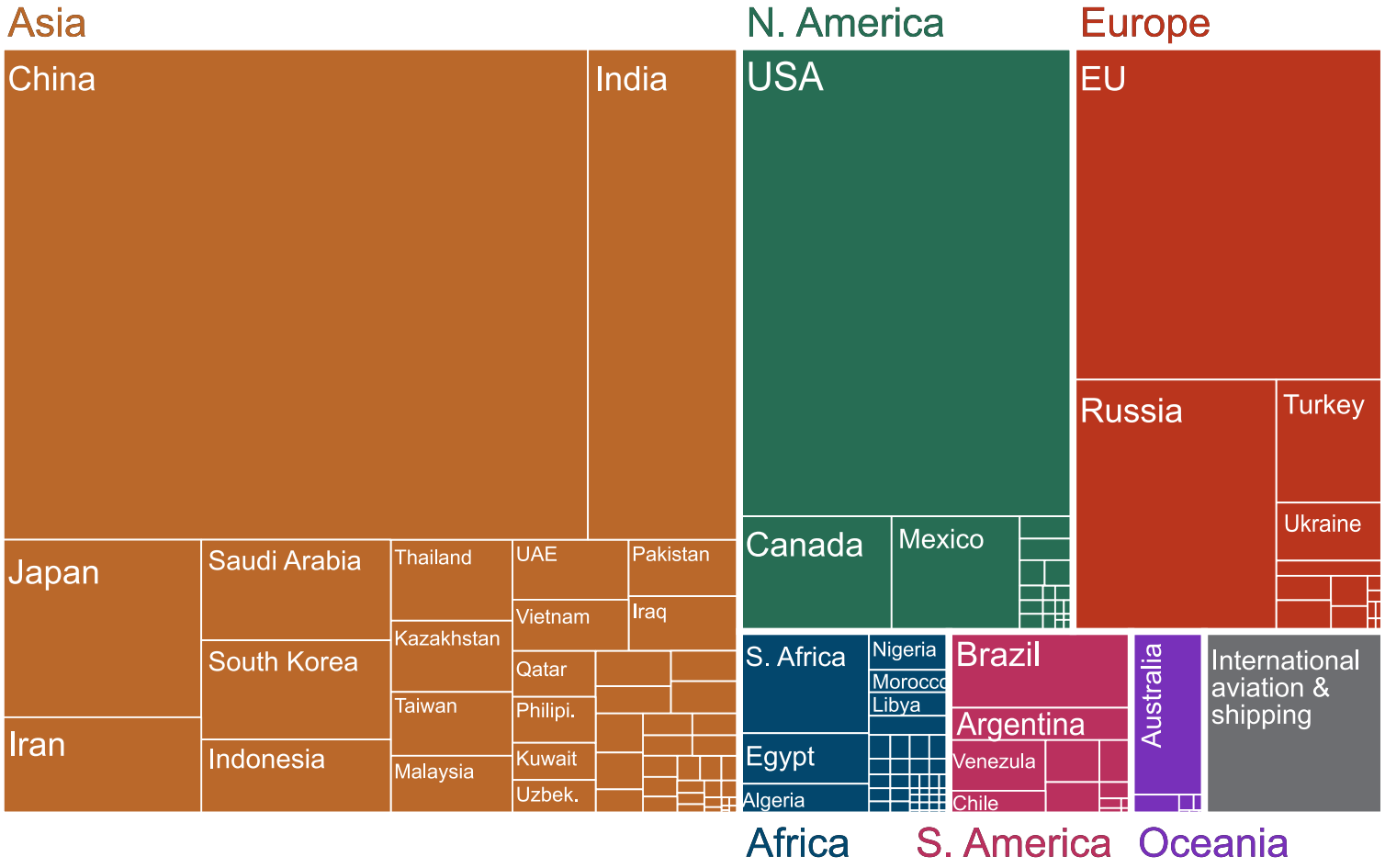


- Mosaic, Marimekko, or Mekko graph
- Invented in 1981
- Not easy to make and mainstream until 2010s
- Still not easily doable in excel

✳Flourish

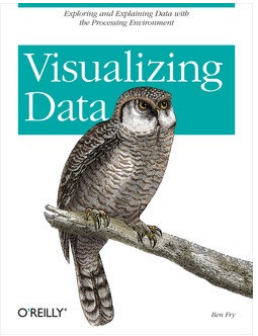
Love a tree map!

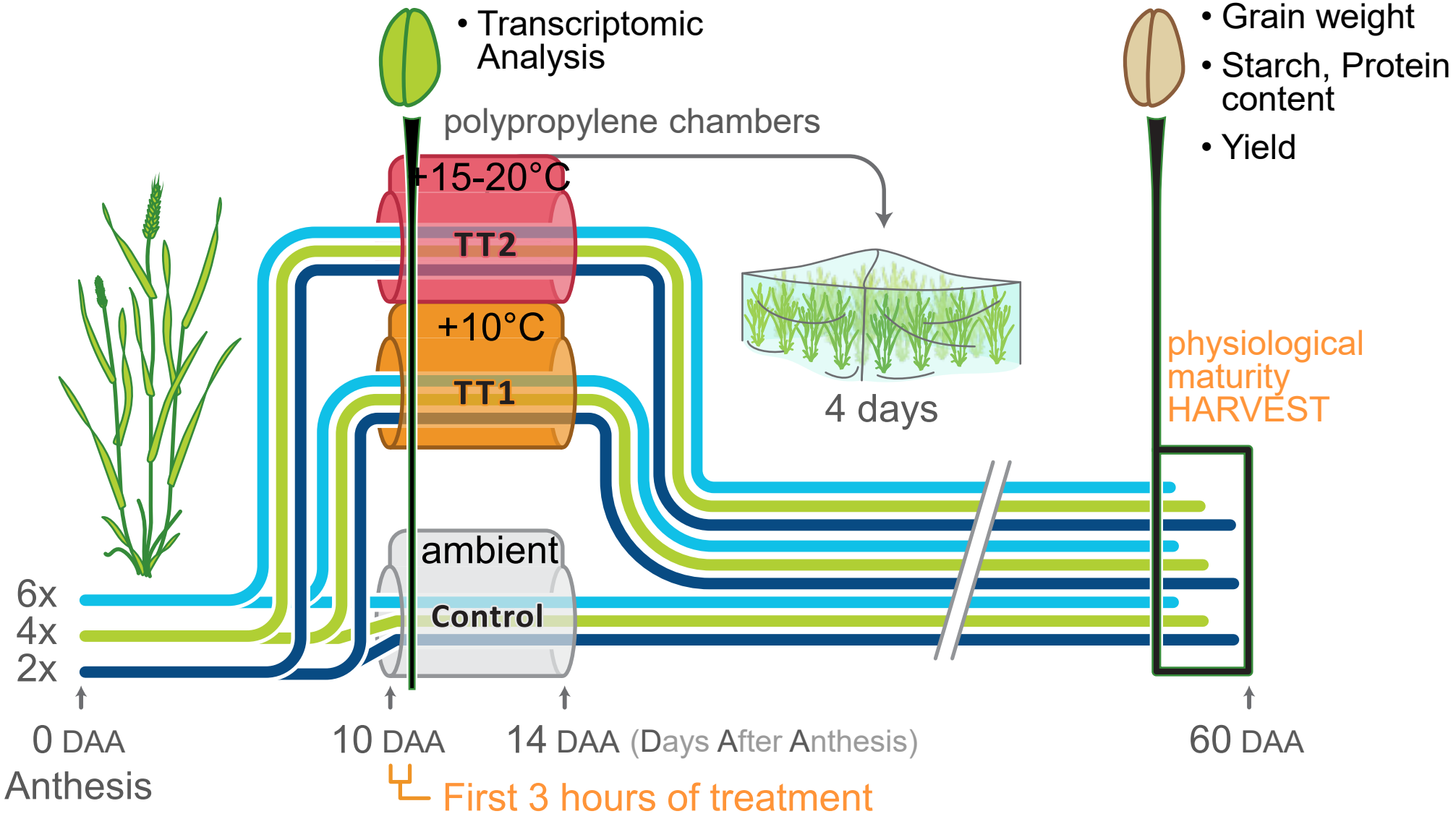
CO_2 emmisions



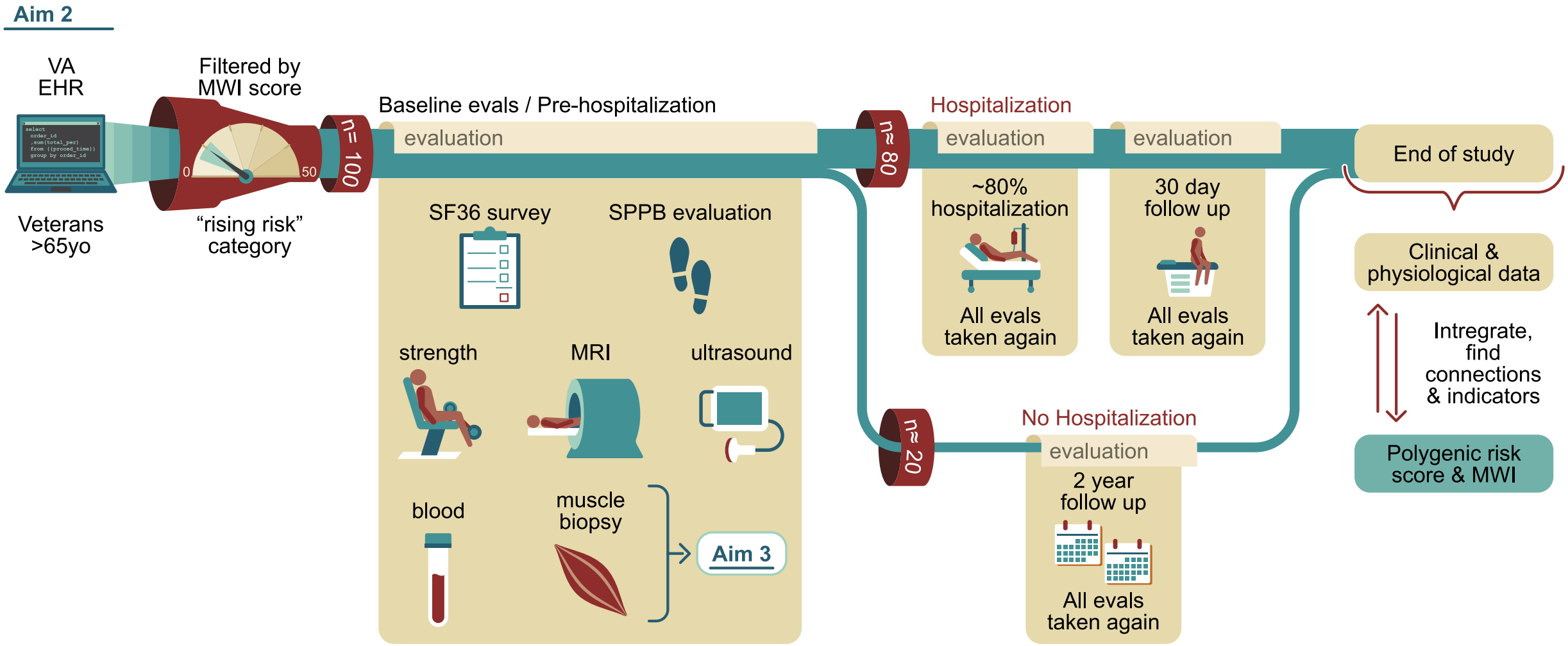
- Excel can do these

Subway diagrams

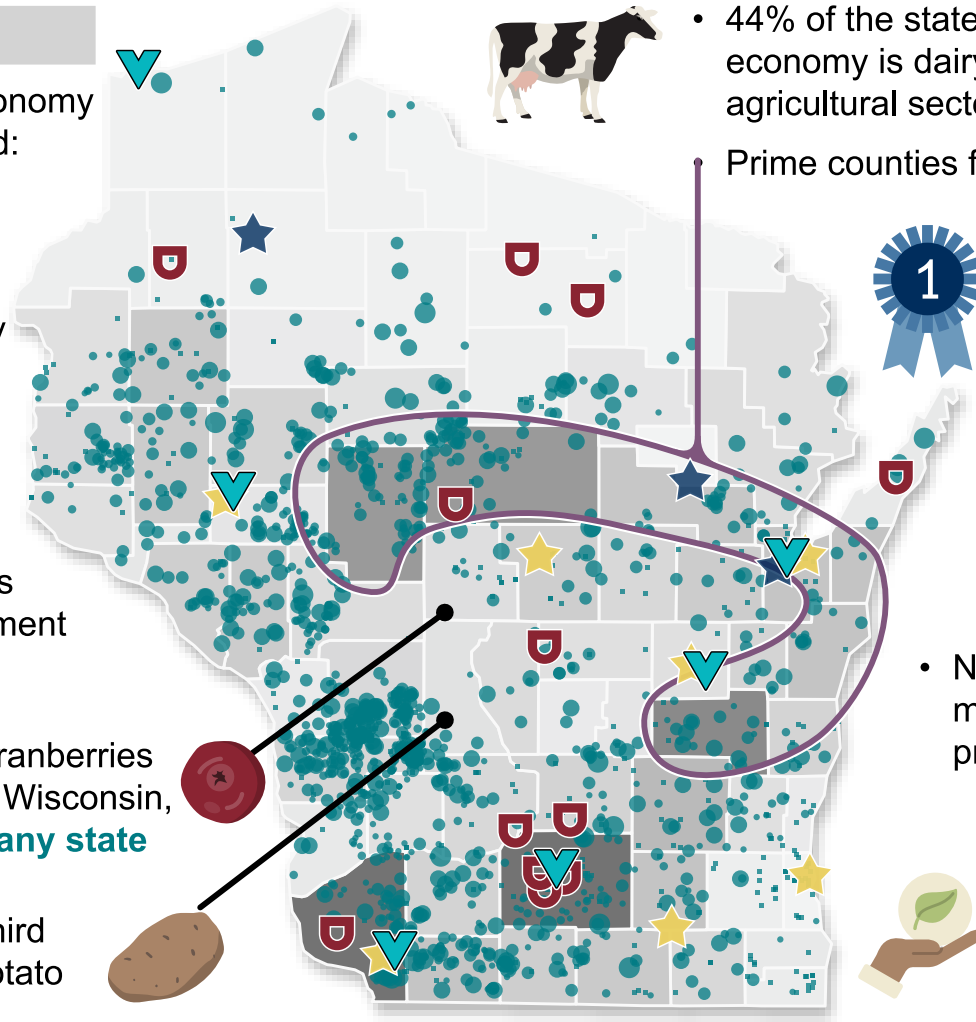




Subway diagrams



Maps integrated into diagrams



31%

- ⅓ of Wisconsin economy is agriculture-based: $105 billion
- This includes $83 billion in food processing, notably making cheese

- Agriculture provides **12%** of WI employment

1

- 62% of US cranberries are grown in Wisconsin, the **most of any state**

- Wisconsin is the third largest state for potato production

- 44% of the state's agriculture economy is dairy, our largest agricultural sector

Prime counties for dairy cows

1

Wisconsin is the **number one state**[1] for:

- Specialty cheeses
- Ginseng roots
- Prepared meats
- Green beans
- Milk goats
- Silage Corn

- Number 4 state in maple syrup production

- Wisconsin is second only to California for the number of certified organic farms

Existing agrisystem infrastructure locations:

- Established Venture Home locations
- UW ag exp stations
- UW system uni
- Tribal colleges

Organic Food

- Non-farm (processing)
- 1-20 acre farm
- 1,001+ acre farm

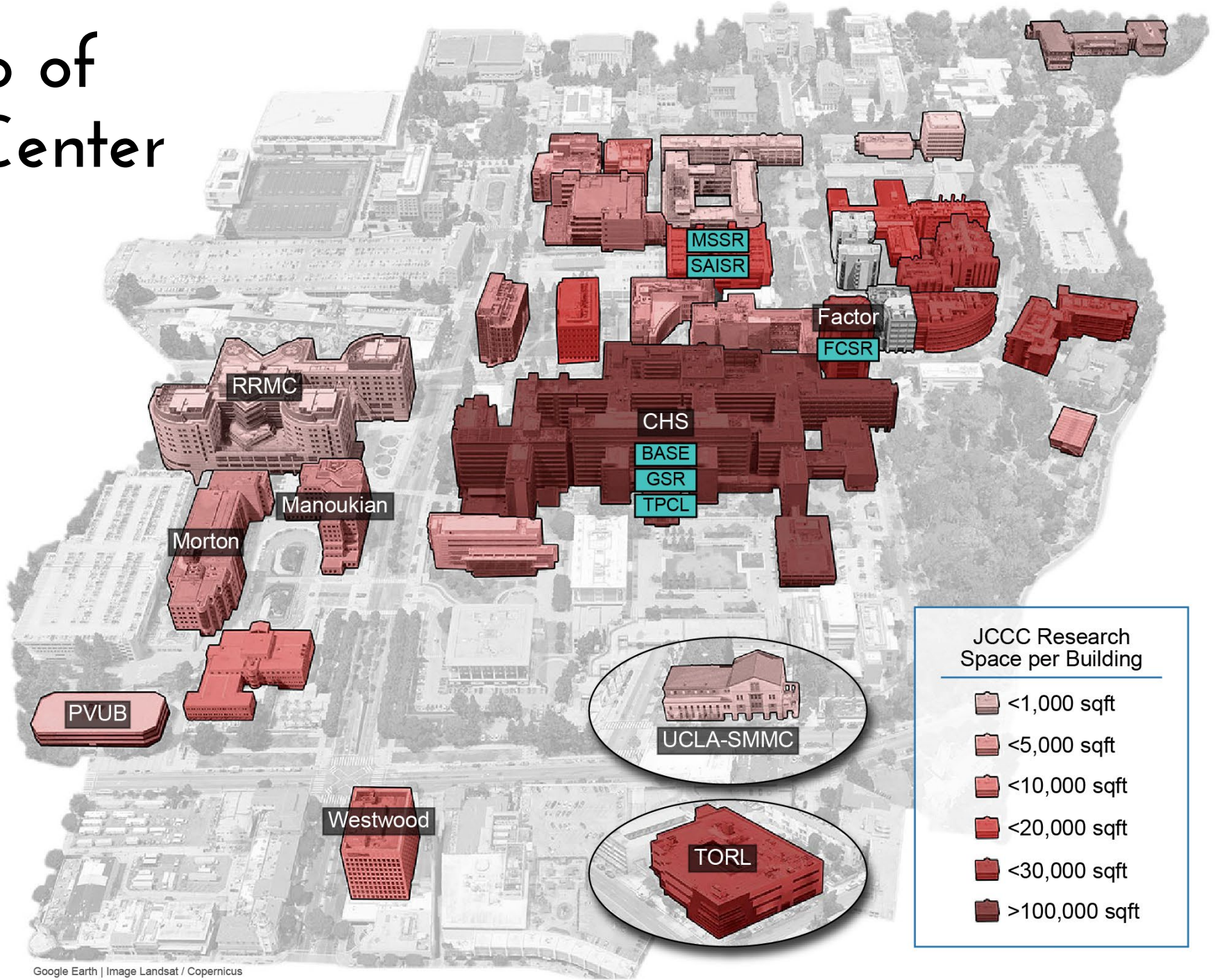
Market value of agricultural products sold by county

$3.5 M

$300 M

$650 M

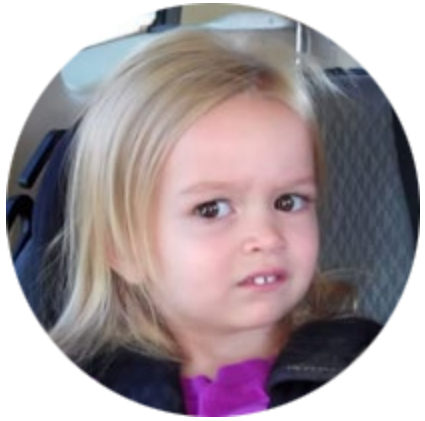
Choropleth Map of UCLA Cancer Center

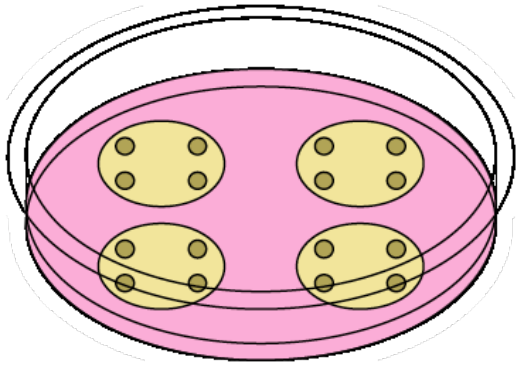



Practical
graphing
checklist

Get feedback from other human subjects

Get feedback from other human subjects





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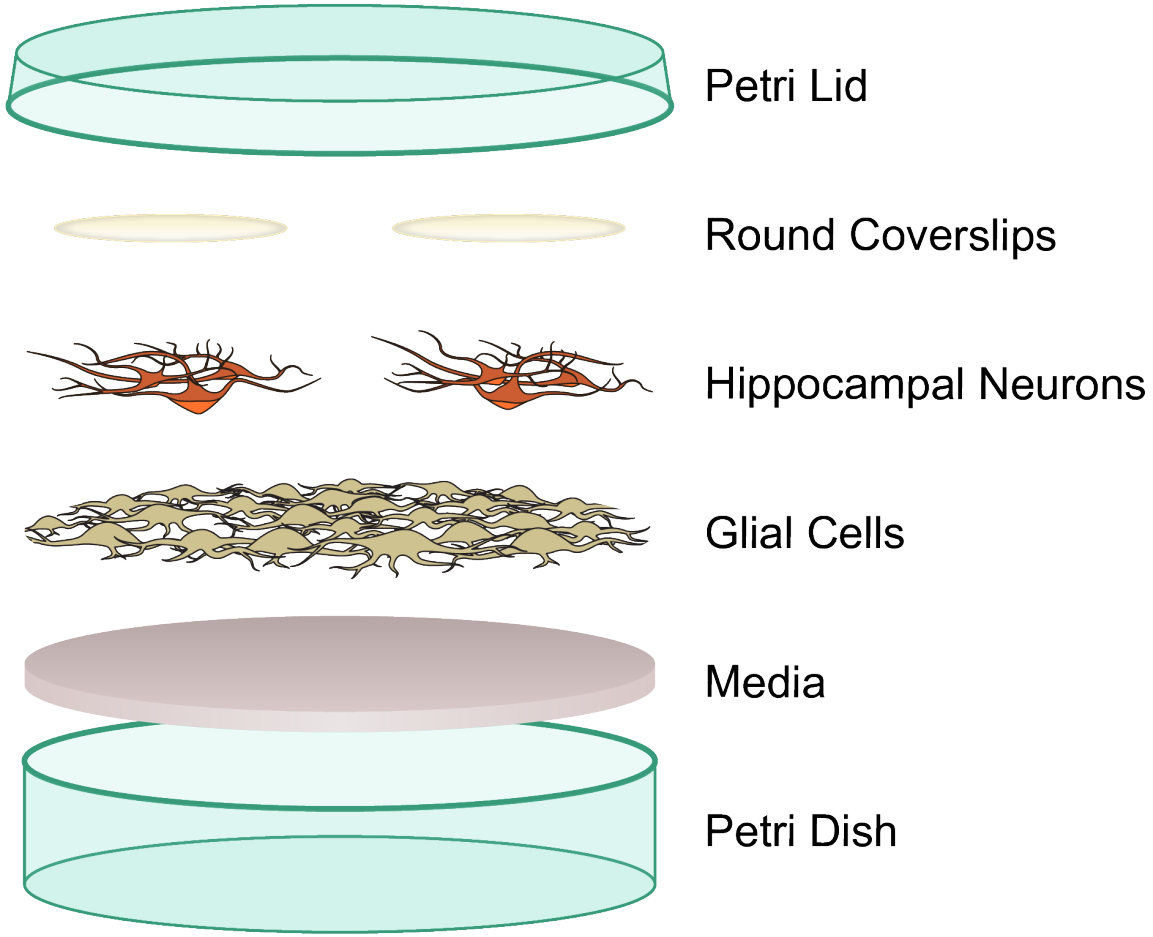
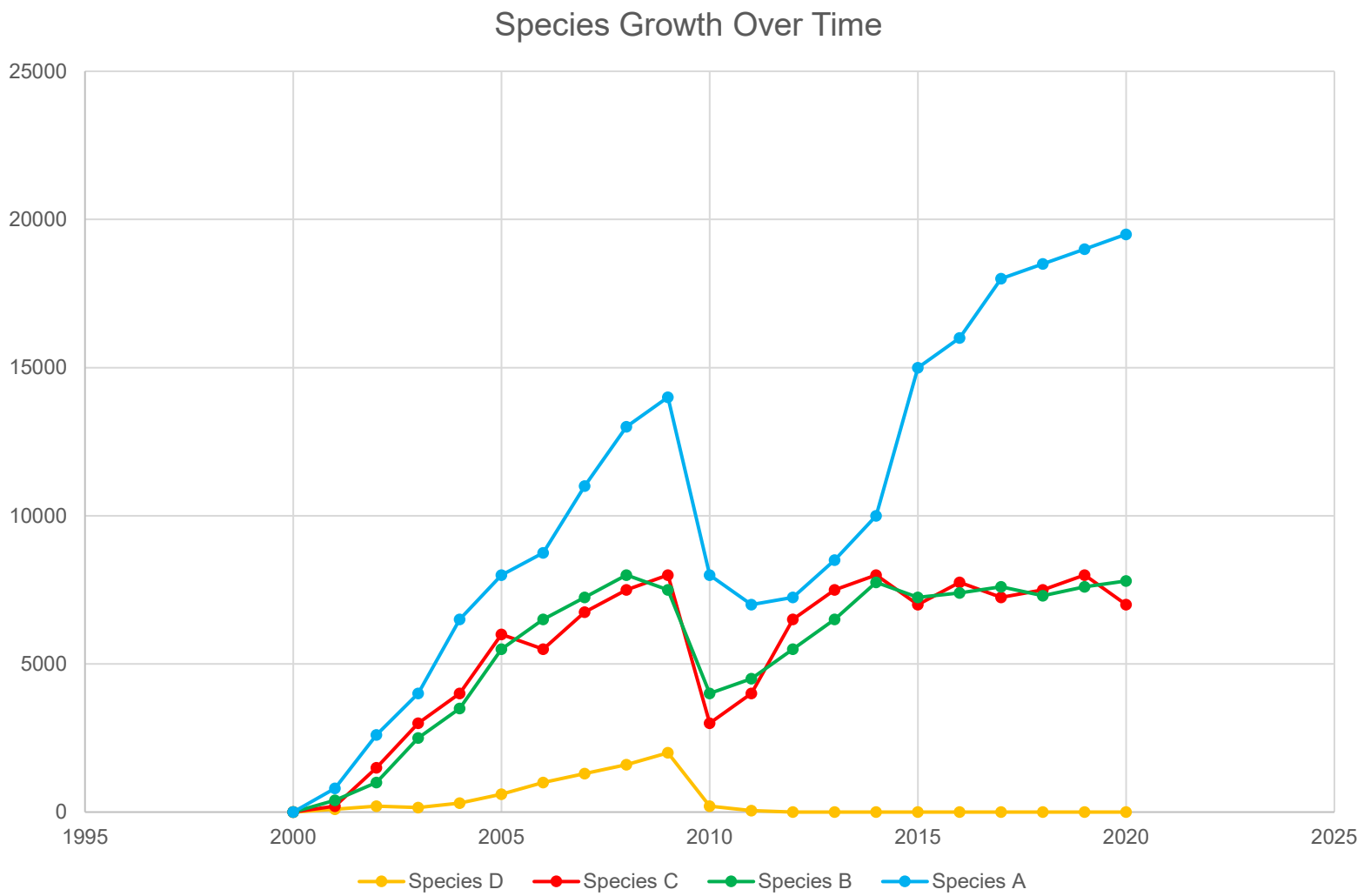


*Cells and Coverslip shown enlarged

Don't just do the defaults



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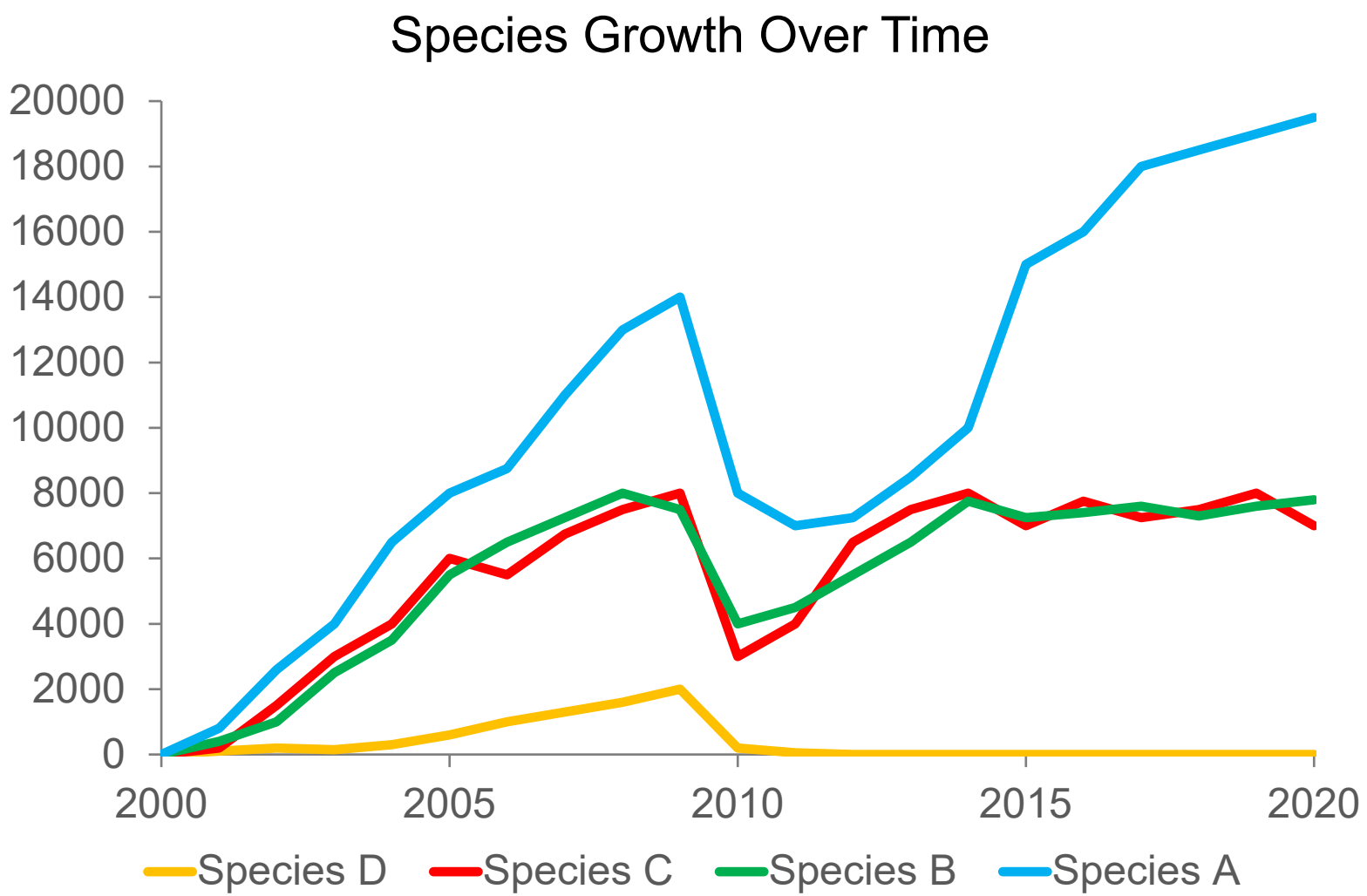
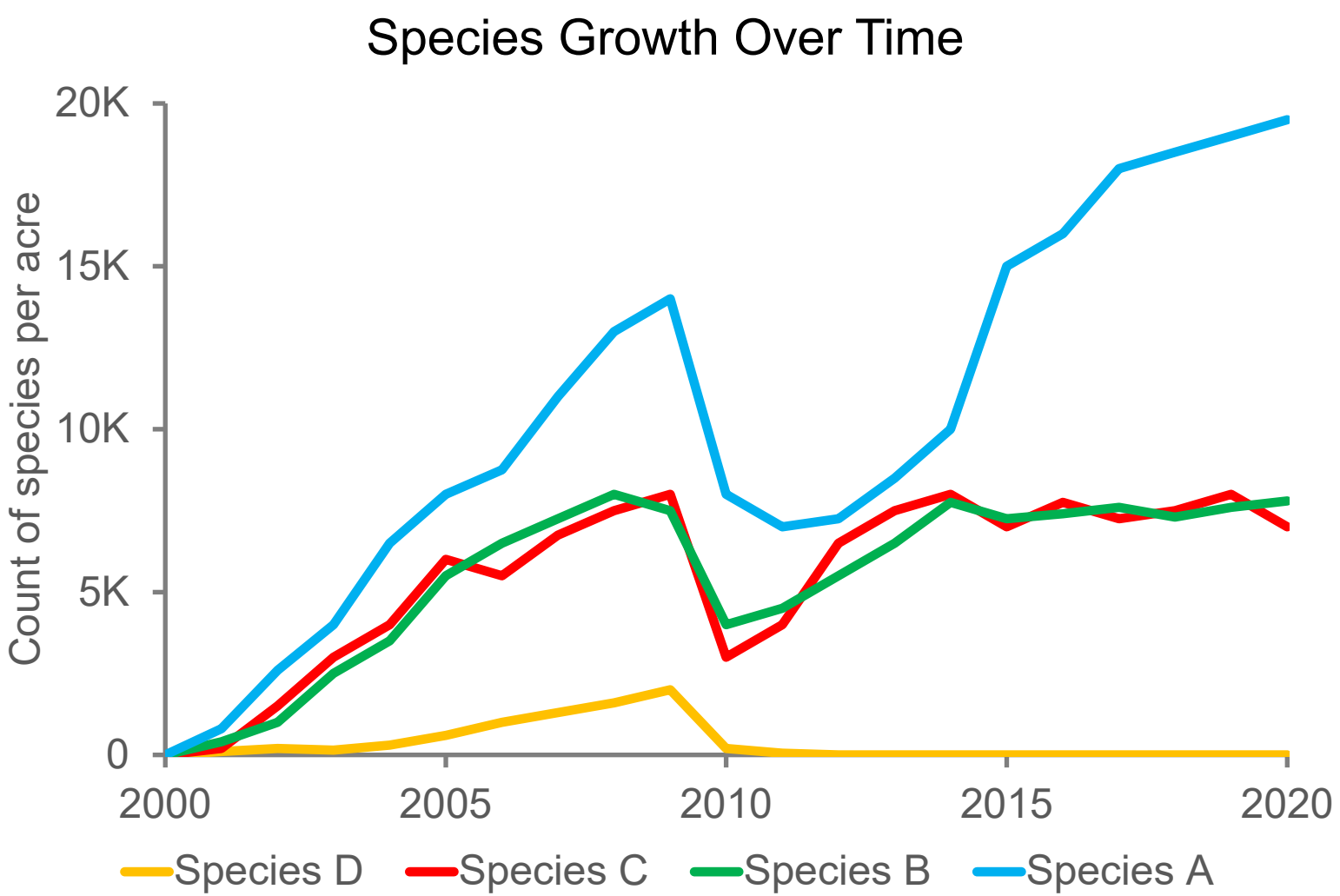


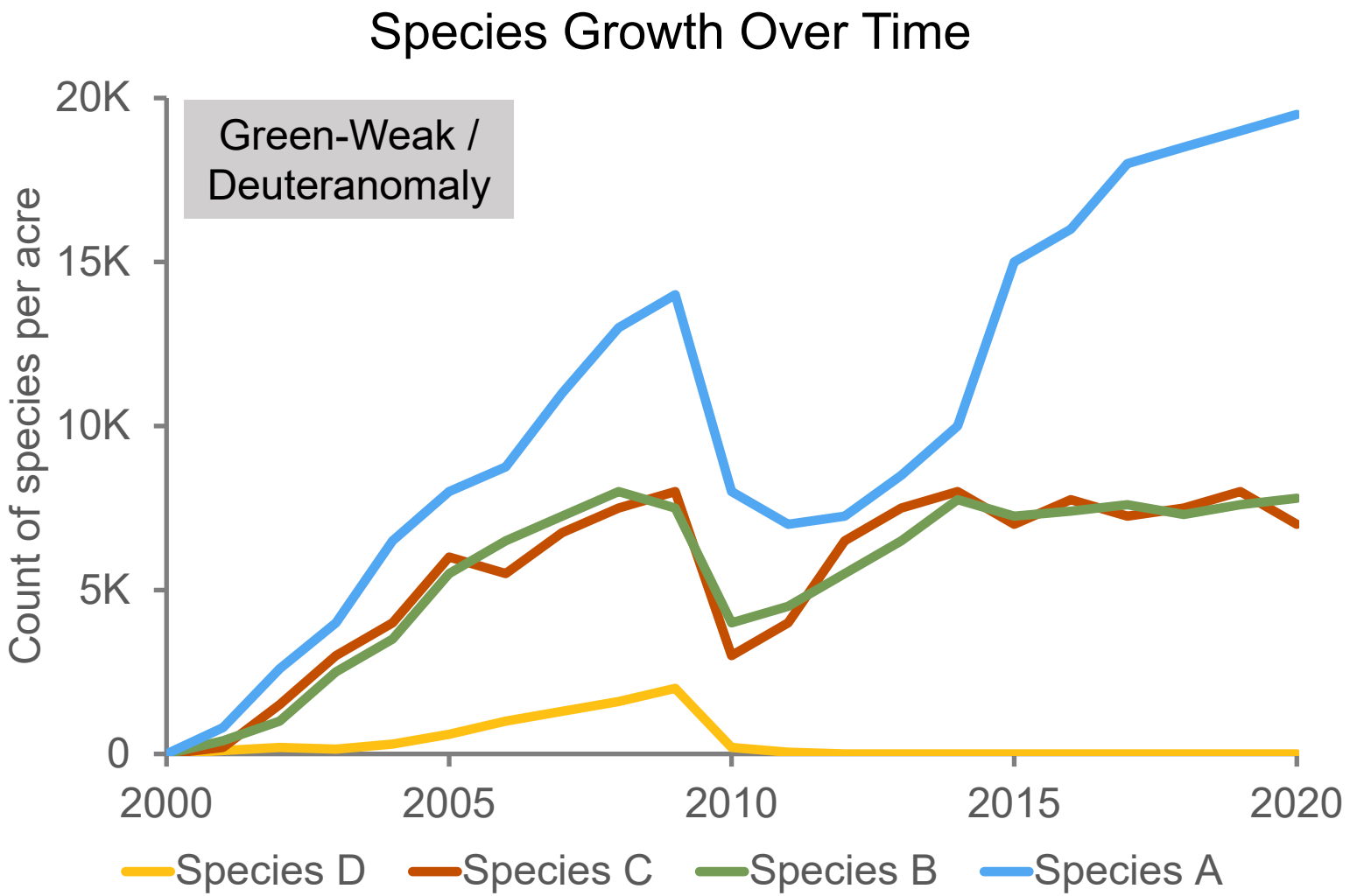
- Font size!
- Axis min & max
- Grid & ticks

Label the axes!

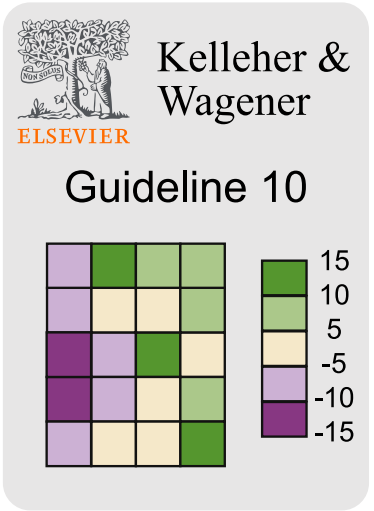


- No more than ~3 digits in numbers!
- Use K and M
- Increments
- Title the axis with units unless painfully obvious, like 2010, etc

Avoid relying solely on color



- 1 in 4 people have a monochrome printer
- 1 in 30 men have red/green color blindness
- Minimum contrast levels



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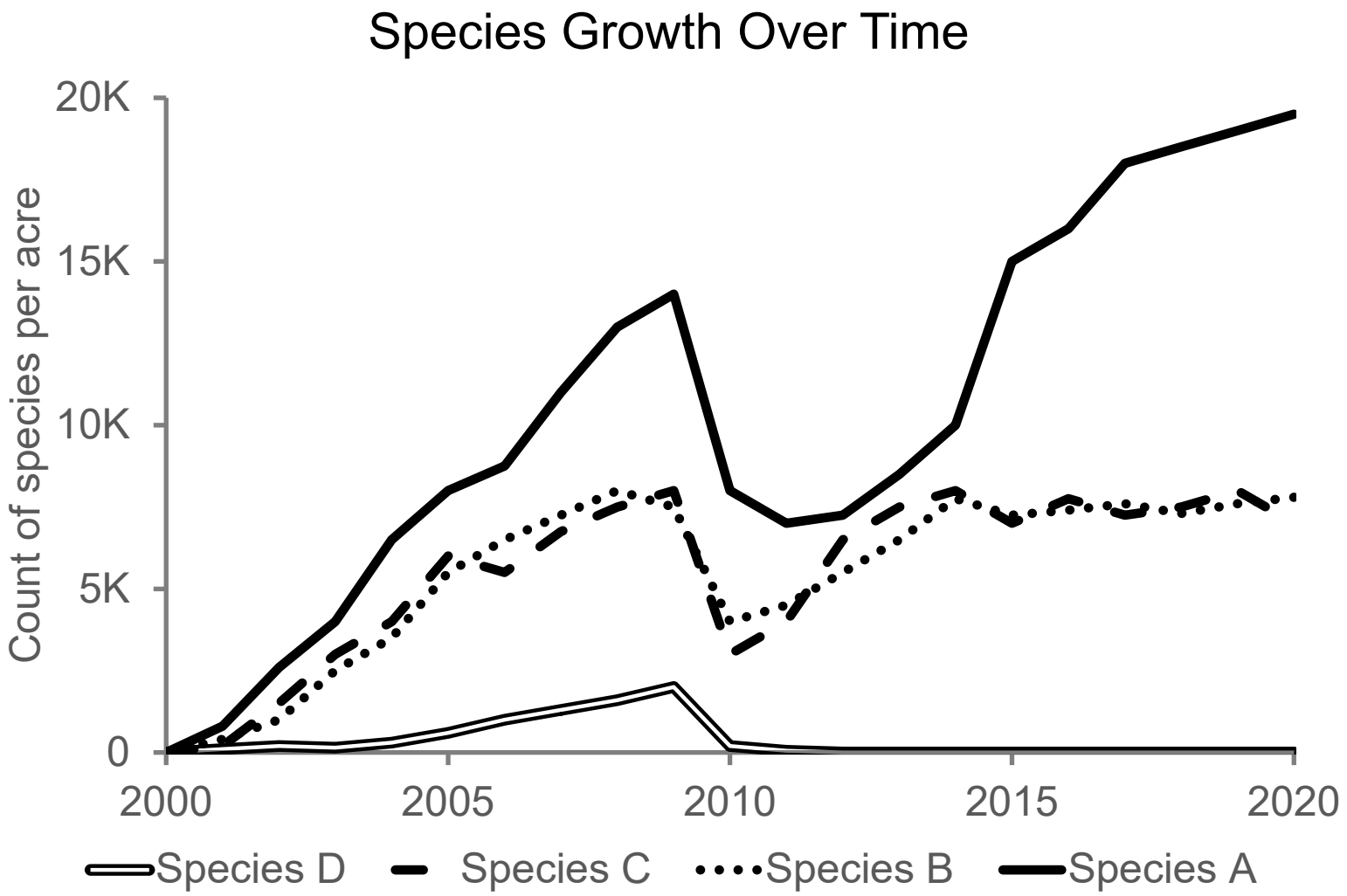
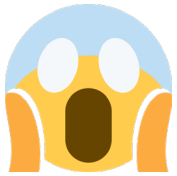
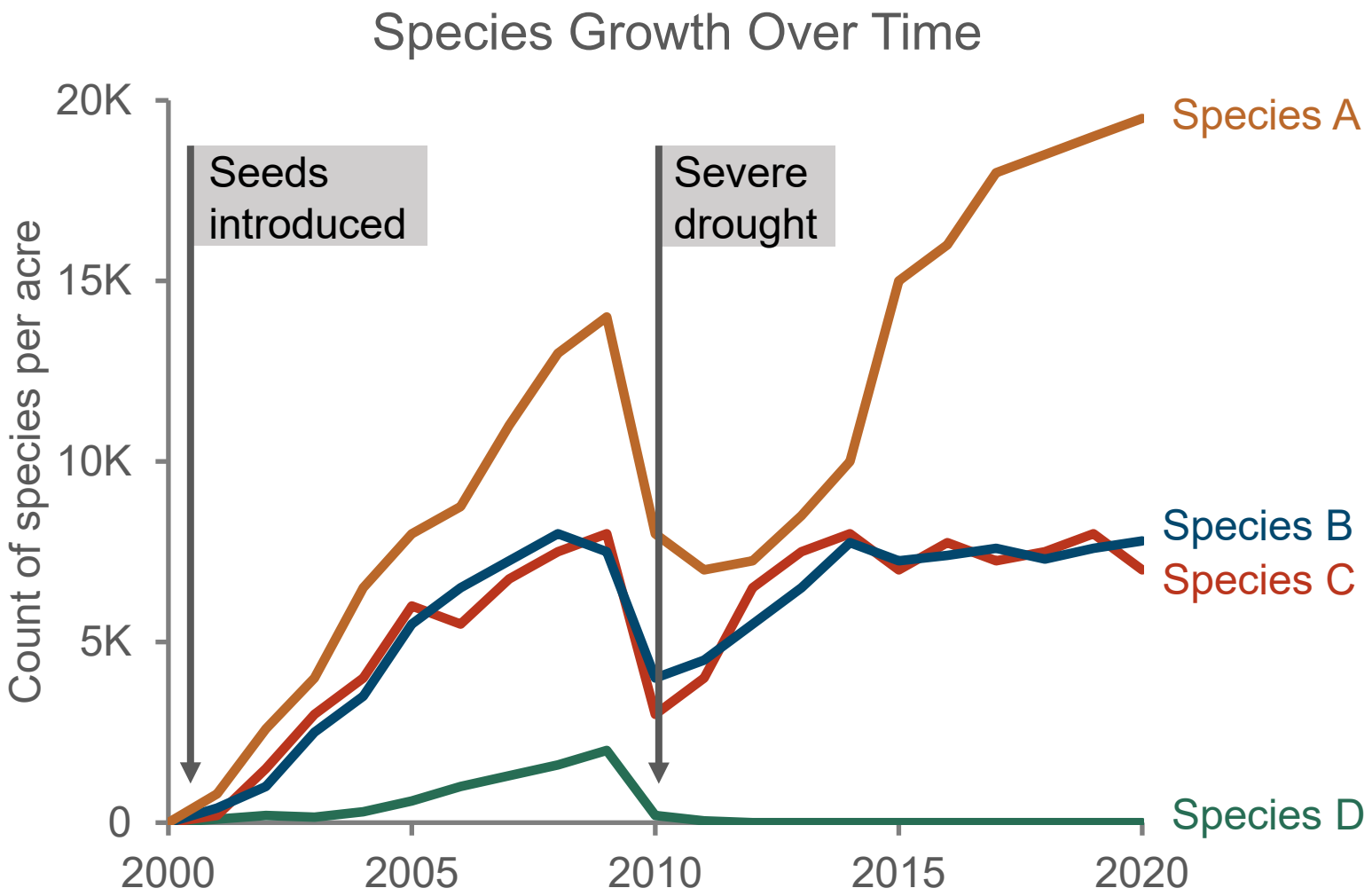


- There are better options than making a puzzle!

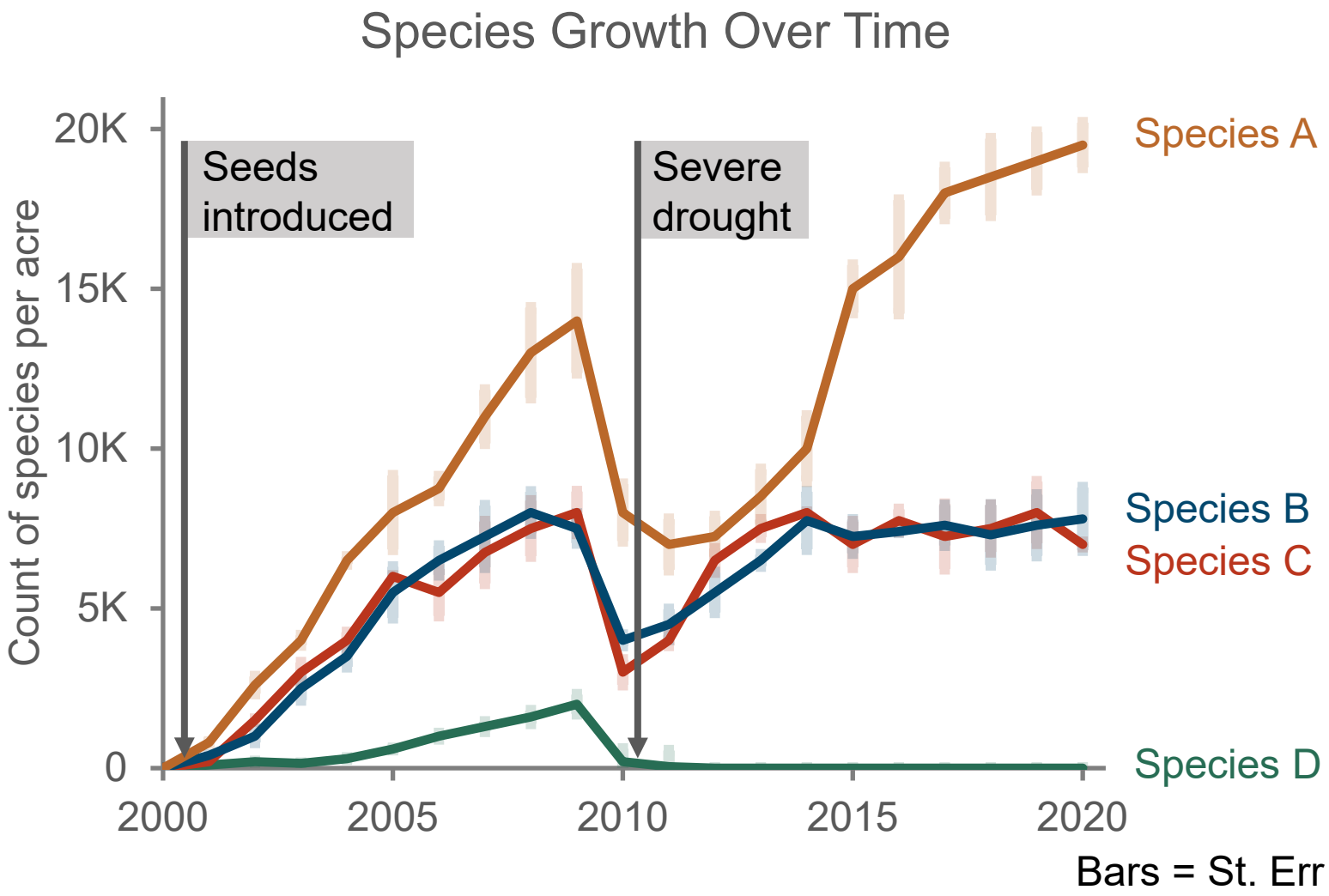


Directly label features



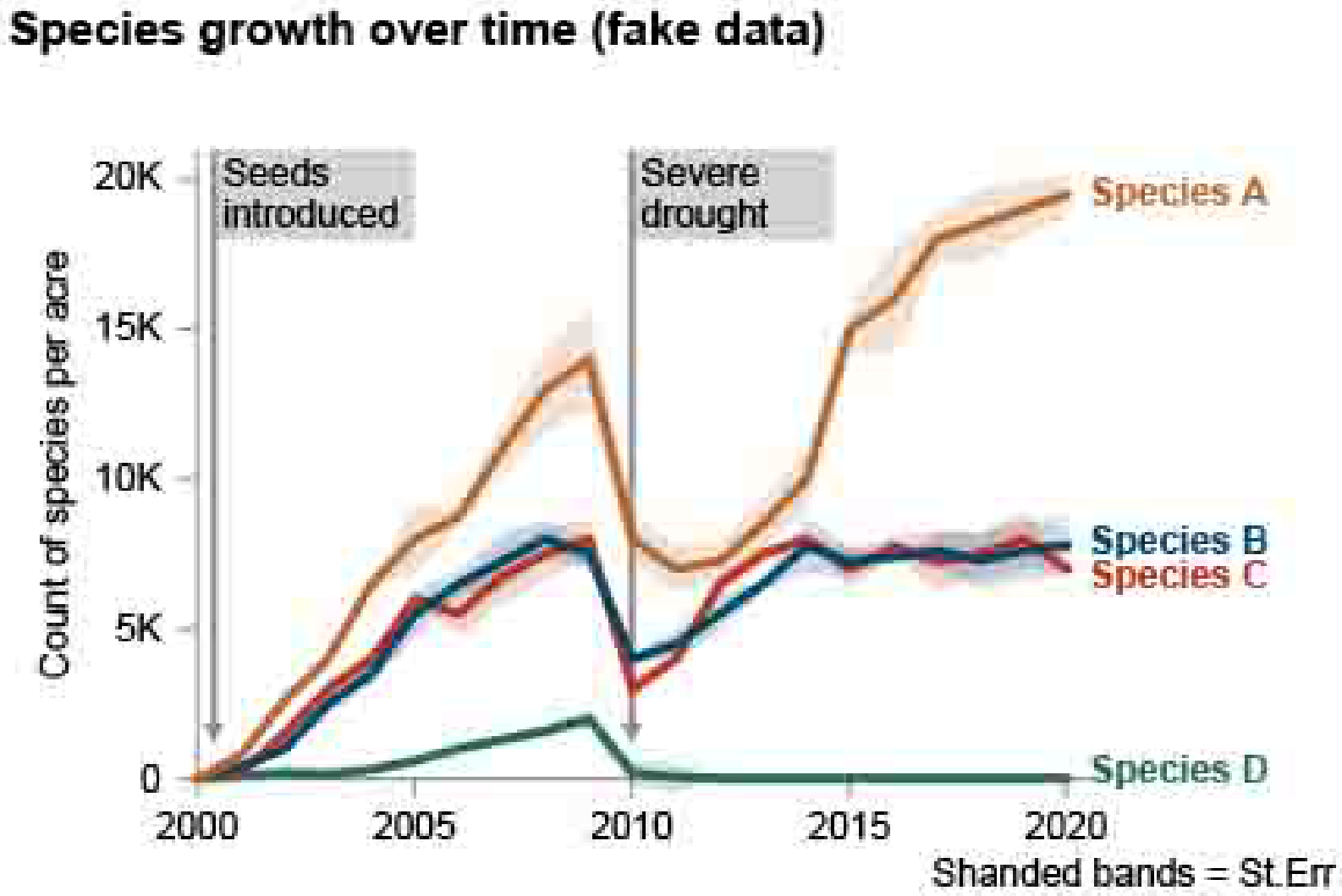
- Everyone benefits
- Legends/keys require back-and-forth looking

Show error and label it



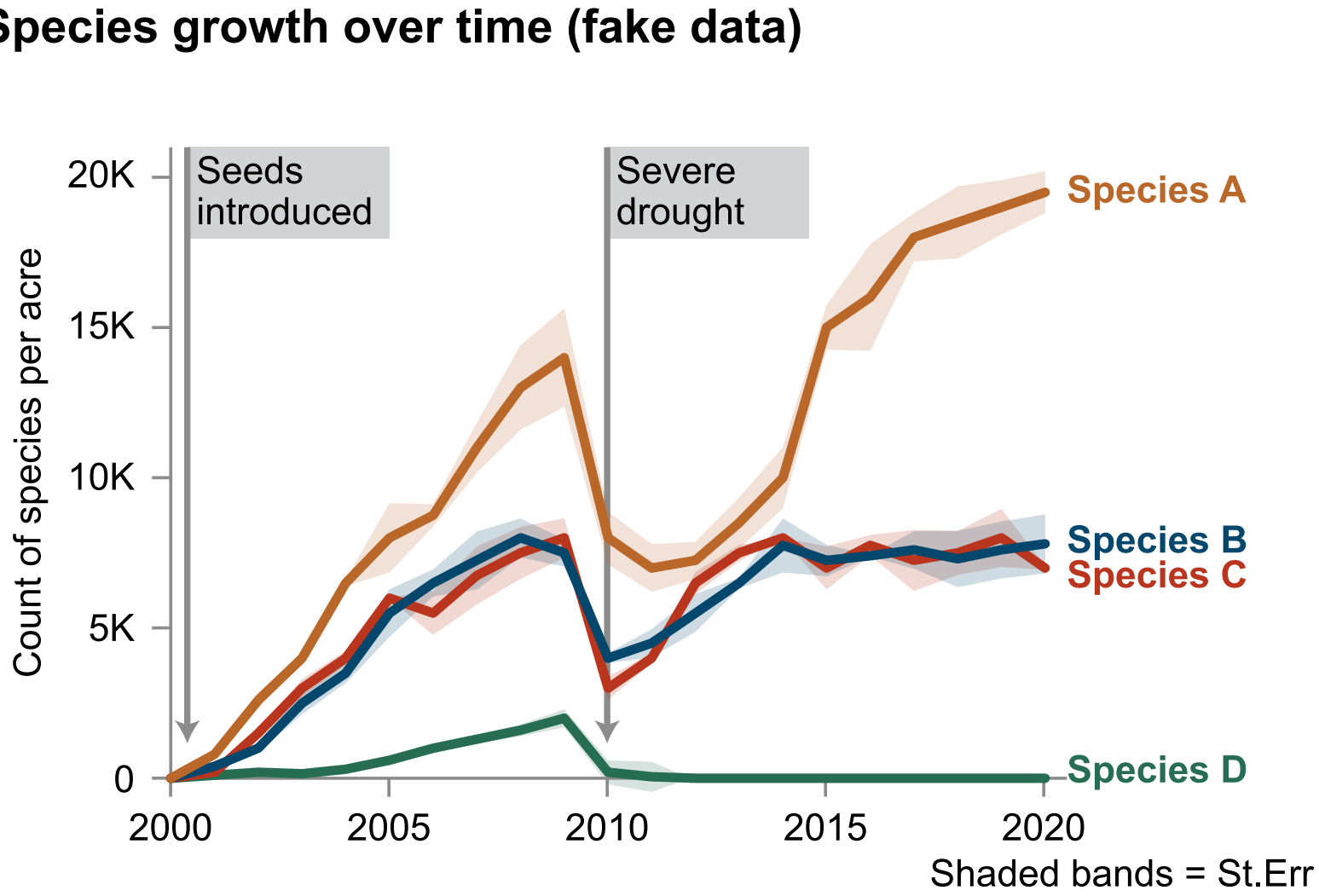
- Somewhere say what the error bars are
- eg. Standard Error

Make sure it's crisp!

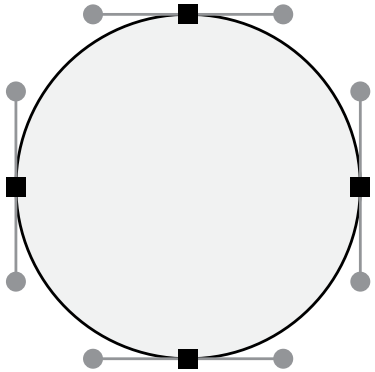


- Vector formats are PERFECT for graphs
- Choose **SVG** or **PDF**
- If you *have to* use a PNG/JPEG
  - Hi Res
  - Hi Quality

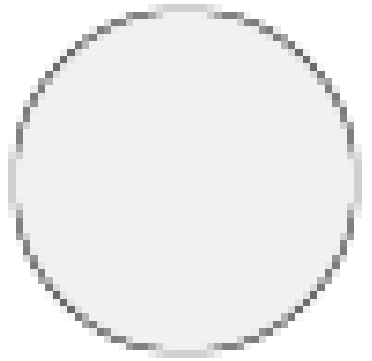
Make sure it's crisp!



- Vector based



- Pixel based

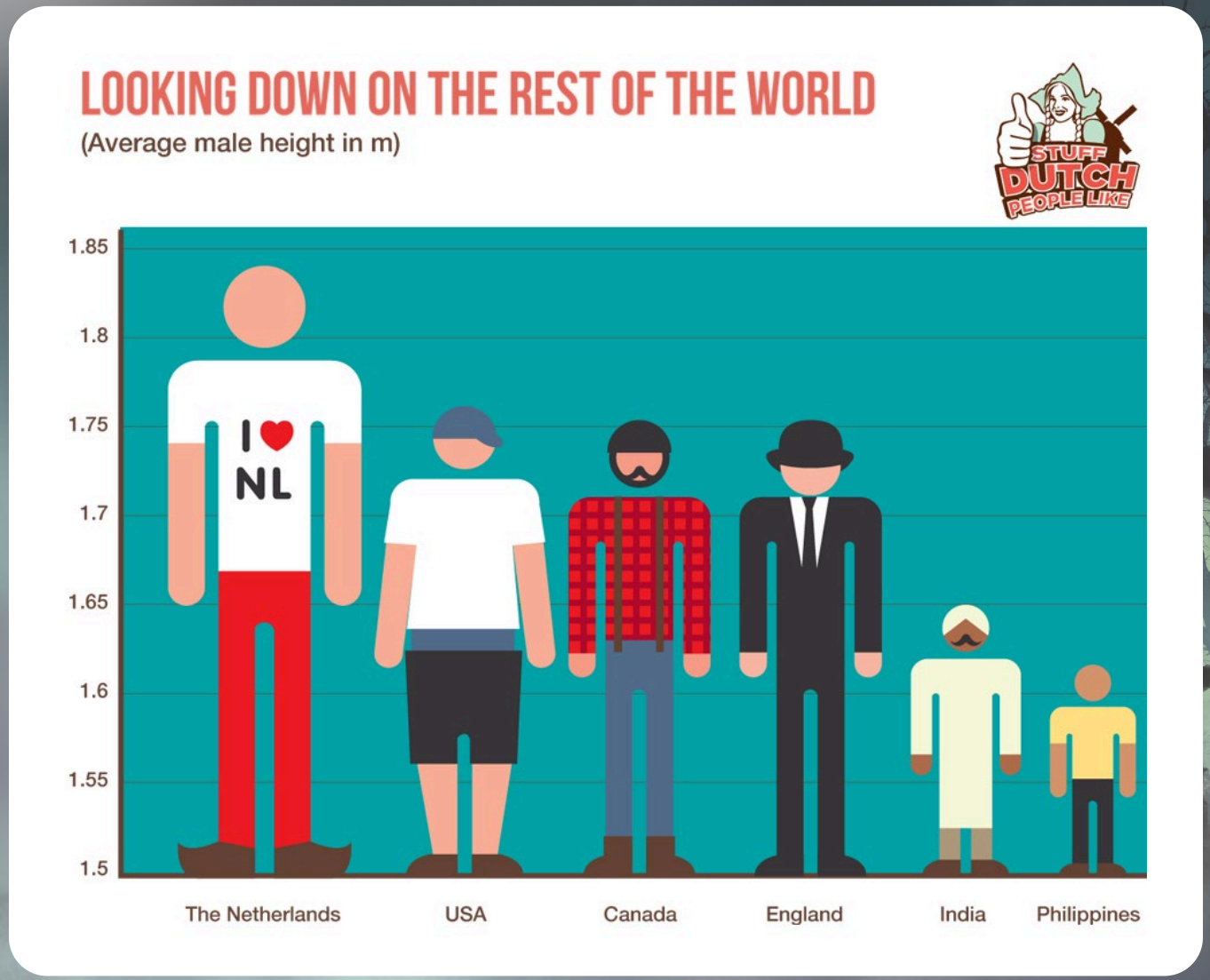



Graph Graveyard

Non-zero baseline

Normally Zero Baseline:

- Length
- Area
- Duration time
- Cost
- Percents
- Counts

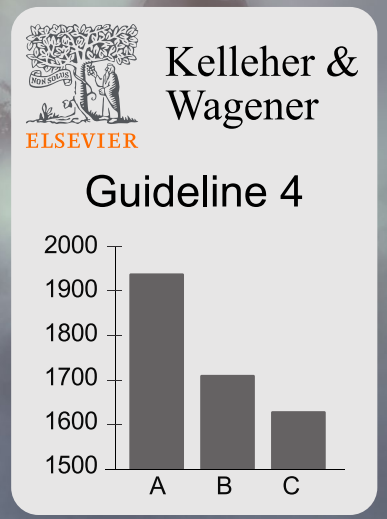


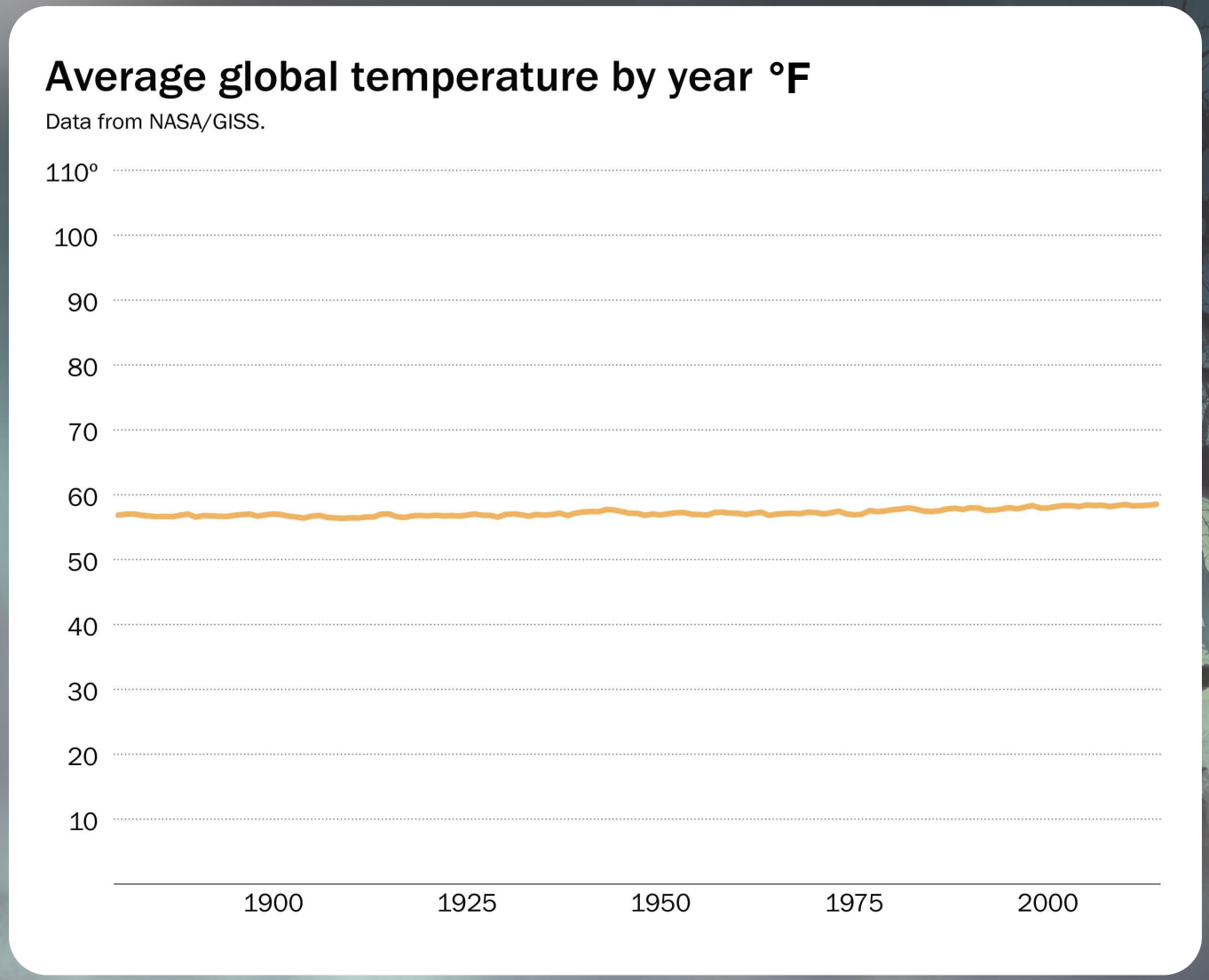
stuffdutchpeoplelike.com

Zero baseline

Normally NOT Zero Baseline:

- Temperature
- Heart rate
- Visible light wavelength
- Stock prices
- pH

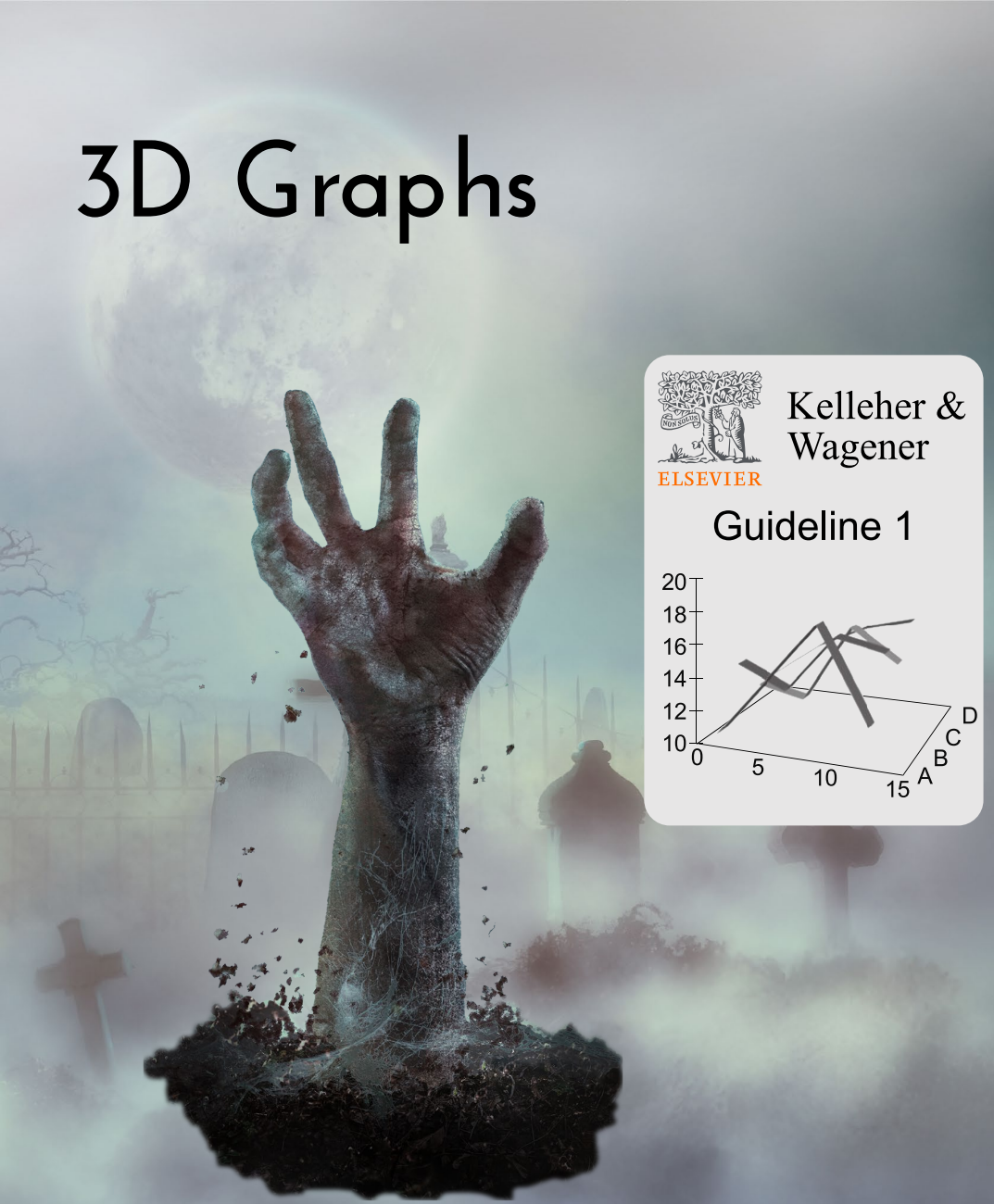


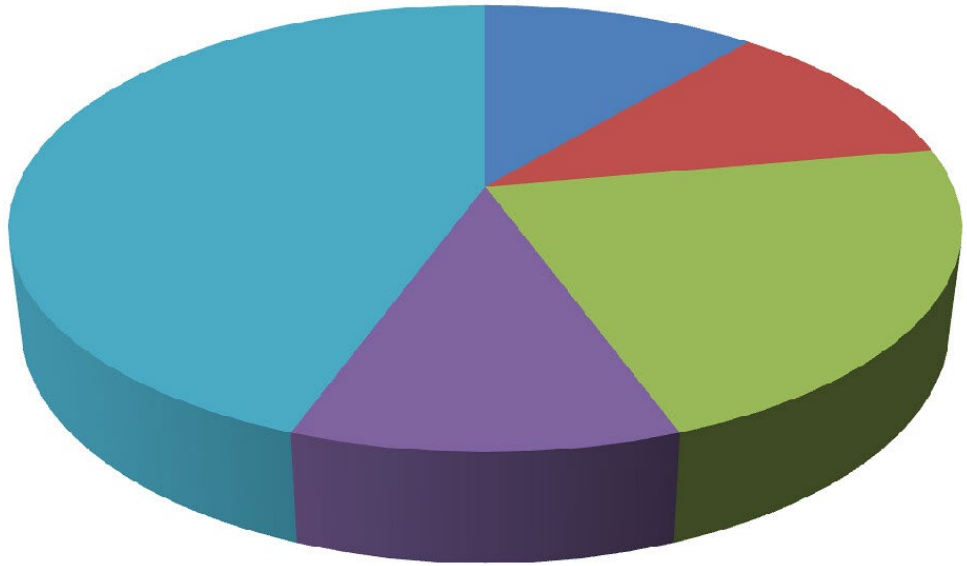


Good data viz article by Philip Bump at Washington Post

washingtonpost.com/news/the-fix/wp/2015/12/14/why-the-national-reviews-global-temperature-graph-is-so-misleading/

3D Graphs





LoveStats Blog

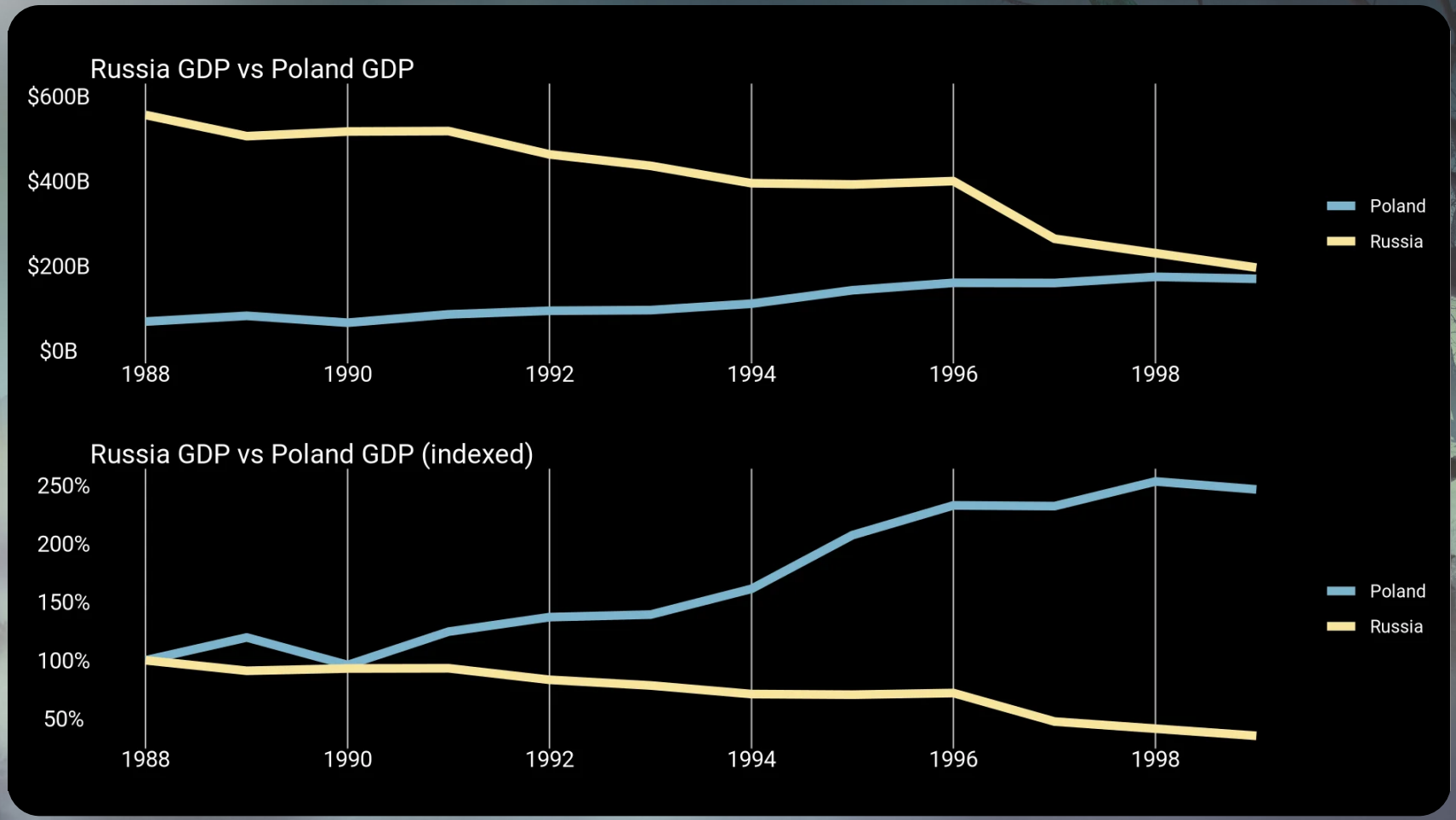
https://lovestats.wordpress.com/2009/03/11/pie-charts-our-evil-friend/

BEWARE! of 2-Y-axes

r/dataisugly, originally from Last Week Tonight

https://www.reddit.com/r/dataisugly/comments/1gd6yxx/two_y_axis_i_got_tricked/

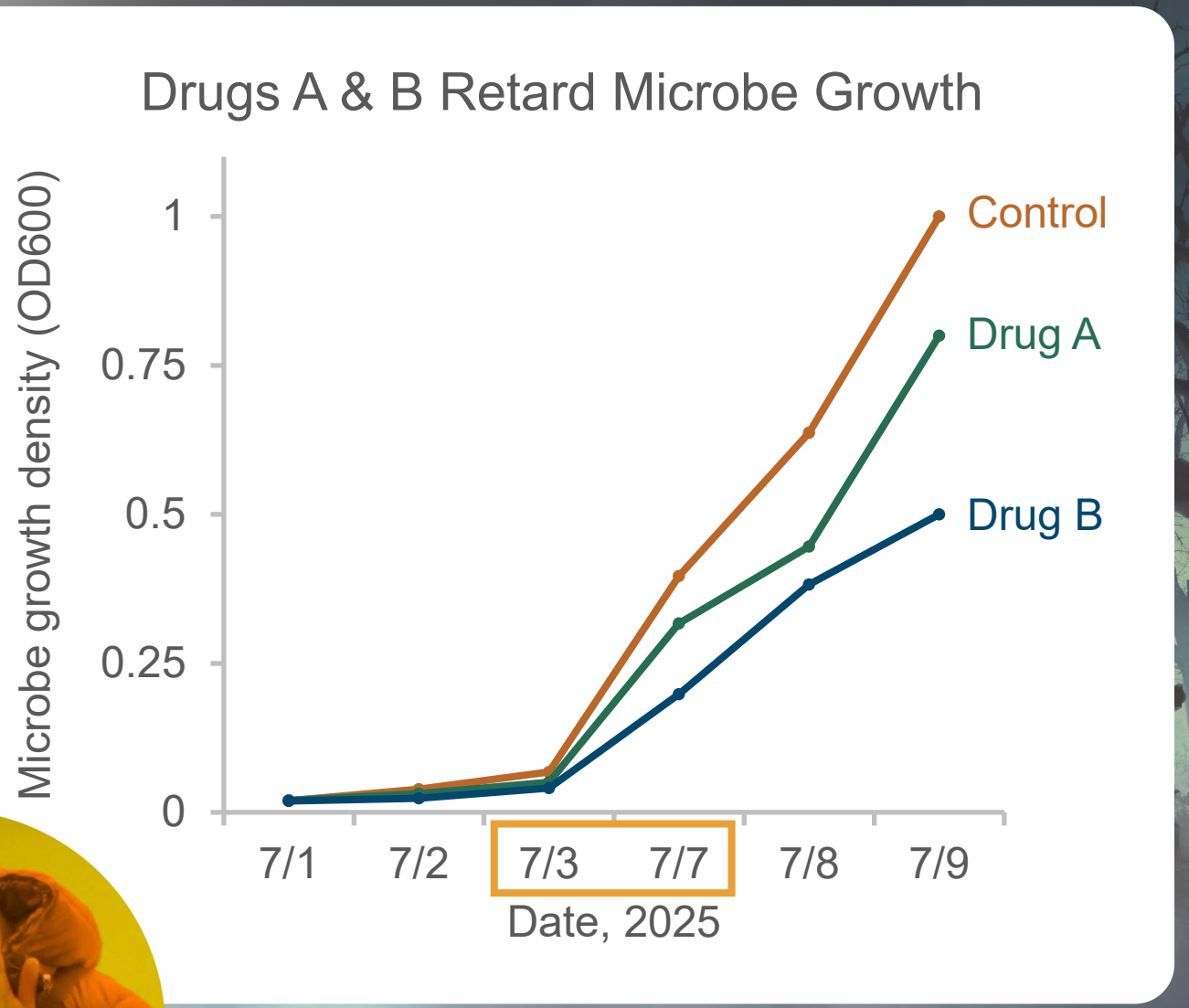
BEWARE! of 2-Y-axes



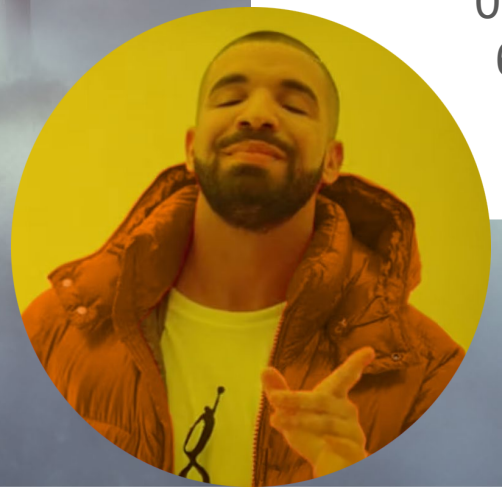
Redit: r/dataisugly, u/TheMegaDTGT48 & u/mduvekot

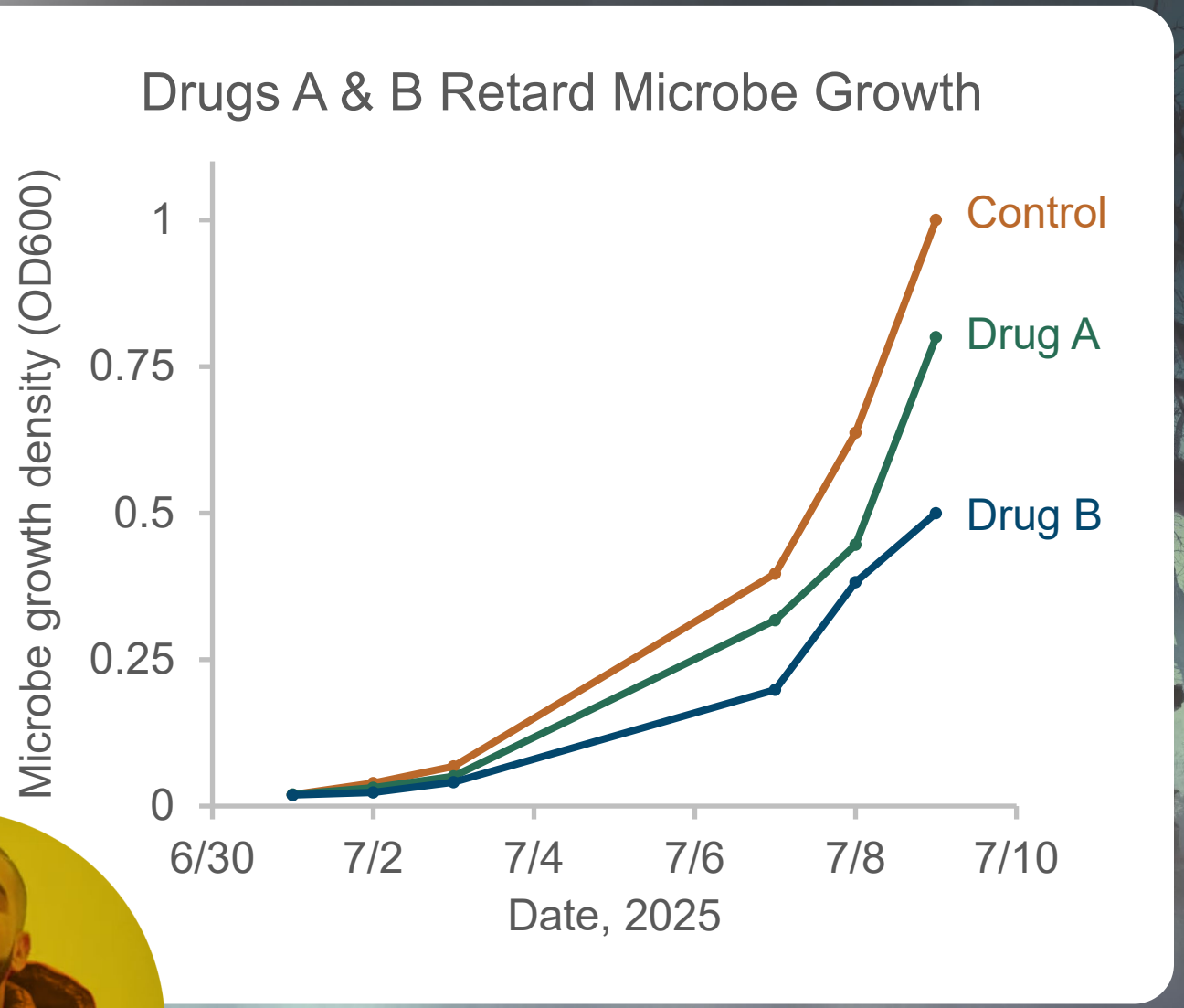
https://www.reddit.com/r/dataisugly/comments/1gd6yxx/two_y_axis_i_got_tricked/

Excel "line" graph



Excel "scatter" graph



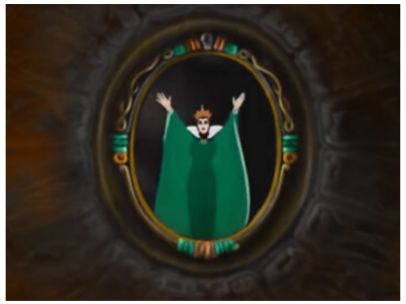


Resources

K8Baldwin.com/ES950

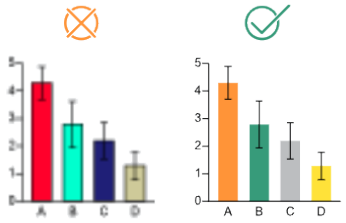
Vector vs Pixel

The differences between Vector-Based and Pixel-Based images.



Figures in Proposals

How to have the most beautiful and professional scientific grant application of them all!

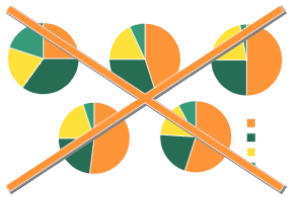


Grant figures conceptual tips

Dos and Do Nots of proposal figures.

Color Themes for Diagrams & Graphs

Ready-to-use color schemes with aspects pointed out that are useful for analytical figures.



Consider the Graph

Choosing the right graph type is the most important choice you'll make.

Graph Check List

A very practical checklist for your everyday graphs.

LinkedIn Learning

Adobe Illustrator

Flourish