

# A colourful journey!

## MVE080/MMG640 Lecture 3

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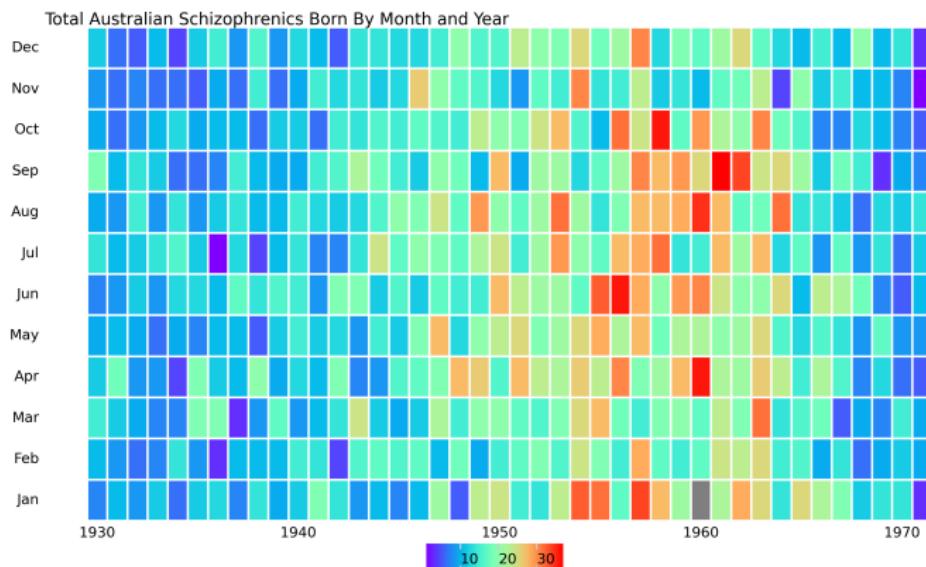
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November 8, 2022

# Colours

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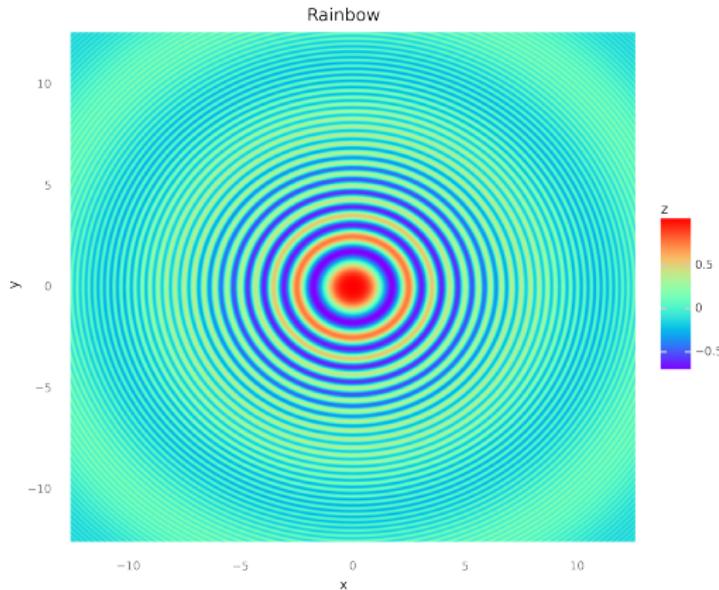
# From last lecture ...

- ▶ Why is this a bad colormap?



# When visualising amounts with colors we want to

1. Extract features/patterns
2. Rapidly identify what corresponds to small/medium/large values



# Lets compare four different colormaps

- ▶ From which maps do you think we can;
  1. Extract features/patterns?
  2. Rapidly identify what corresponds to small/medium/large values?

Blues



Viridis



Jet

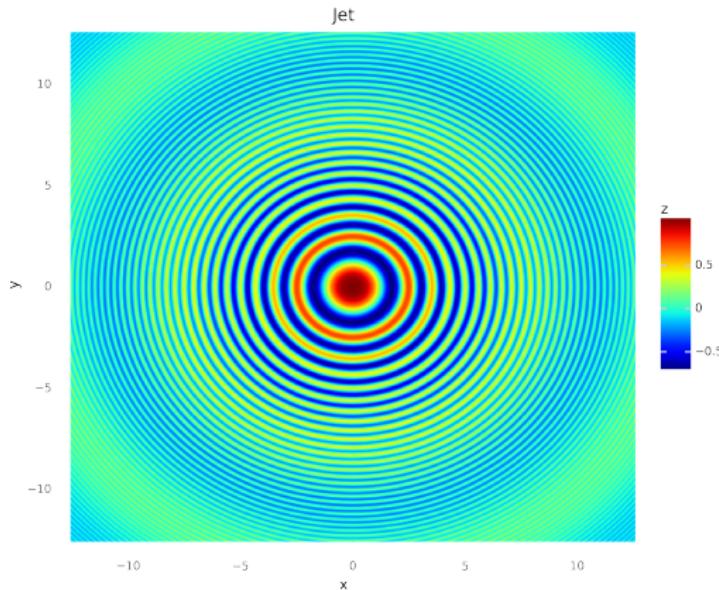


Rainbow desaturated



# Jet - old default in Matlab

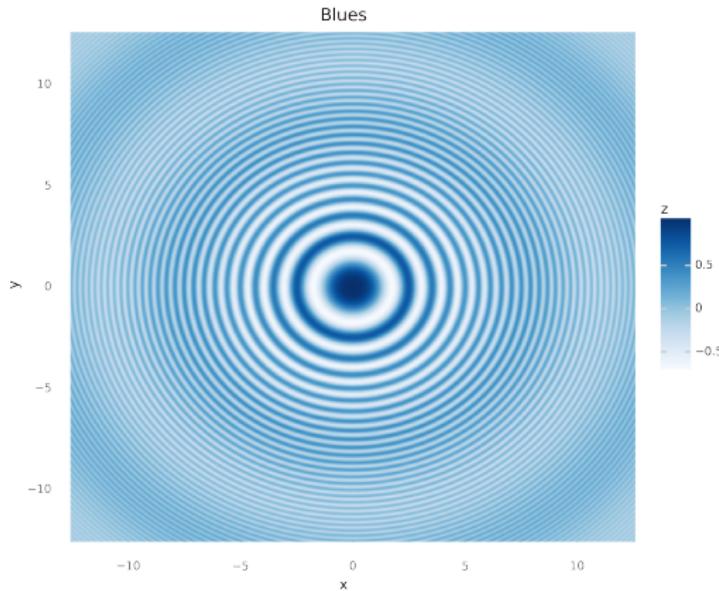
- ▶ Relatively good feature extraction
- ▶ Mapping does not make quantitative sense



# Blues - a tale as old as time

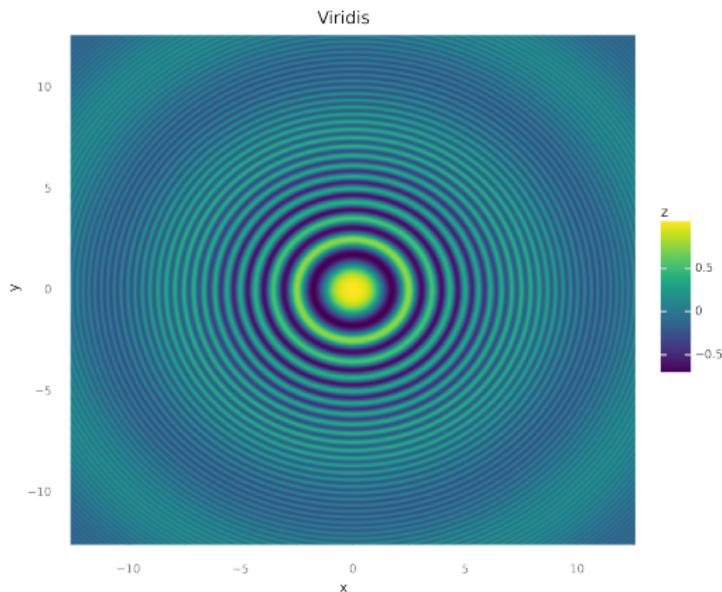
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- ▶ Better feature extraction
- ▶ Mapping make quantitative sense



# Viridis - The triumph of Matplotlib<sup>1</sup>

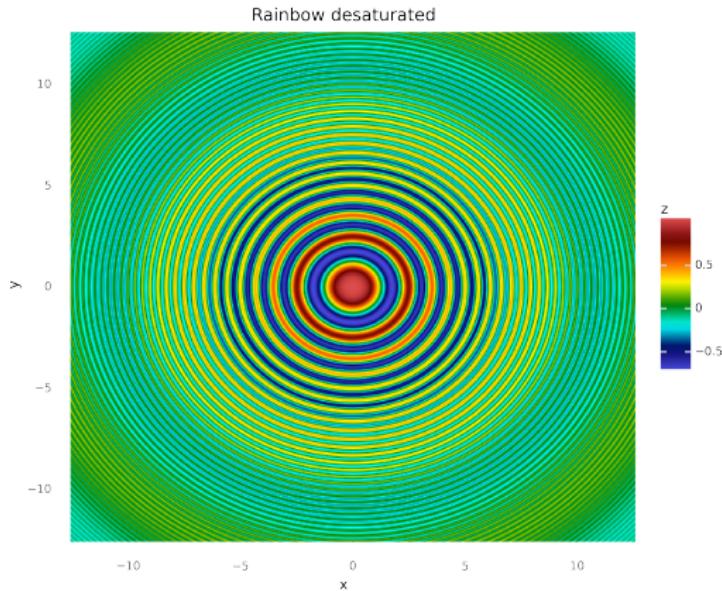
- ▶ Good feature extraction
- ▶ Mapping make quantitative sense



<sup>1</sup><https://www.youtube.com/watch?v=xAoIjeRJ3lU>

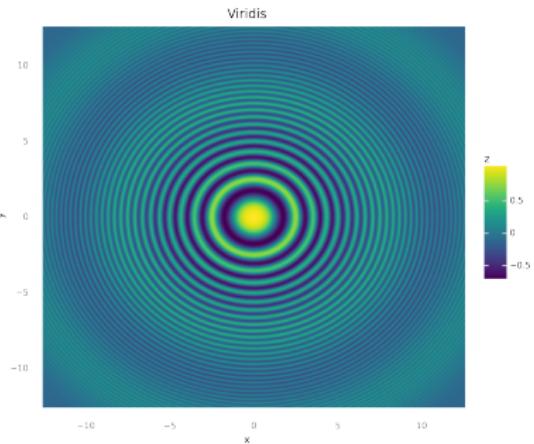
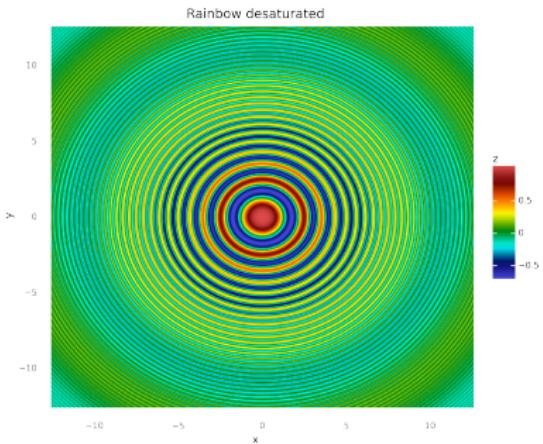
# Rainbow destatured - a better rainbow palette?

- ▶ Great feature extraction
- ▶ Mapping does not make quantitative sense



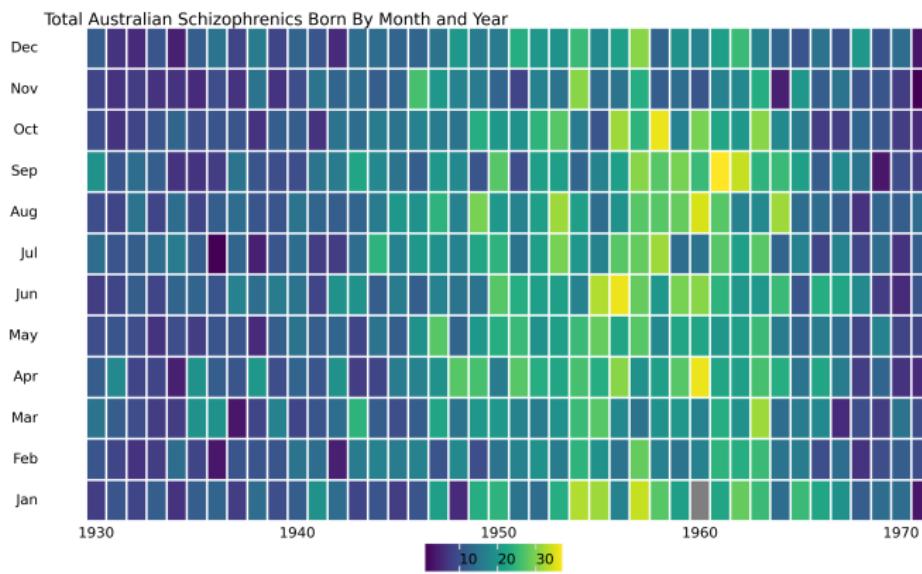
# Luminance is key

- ▶ Luminance = light emitted per unit area
  - ▶ For feature extraction - go from low to high luminance several times (Rainbow desaturated)
  - ▶ For quantification - go from low to high luminance across entire colormap (Viridis)



# Lets fix our first example

- More kids than usual were born as Schizophrenics between 1950 to 1960



# The Viridis family

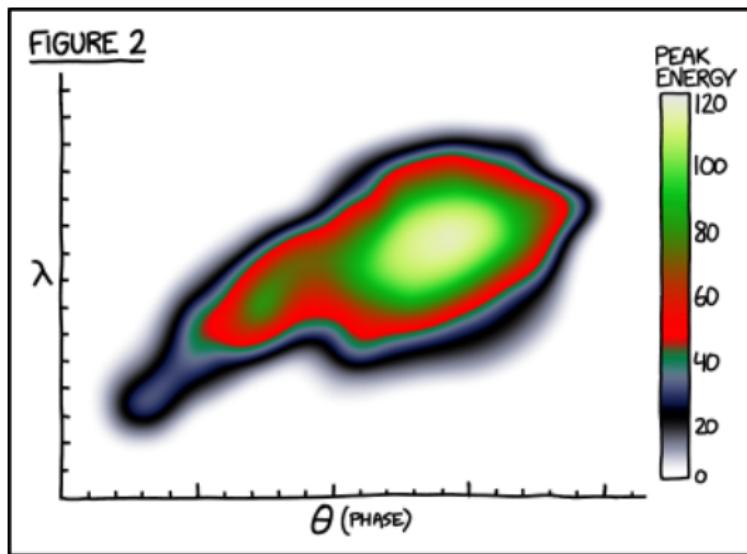
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Set of colormaps that are perceptually uniform; A *color space is perceptually uniform if a change of length in any direction X of the color space is perceived by a human as the same change.* The maps are also colorblind friendly.



# However ...

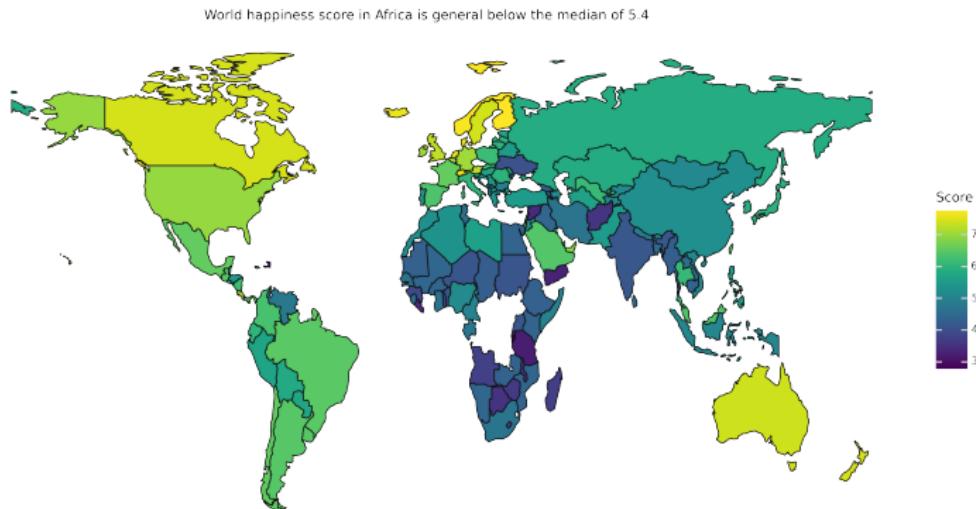
If you use the advice in this lecture you will never win the painbow award



EVERY YEAR, DISGRUNTLED SCIENTISTS COMPETE  
FOR THE PAINBOW AWARD FOR WORST COLOR SCALE.

# What if we want to compare around a baseline?

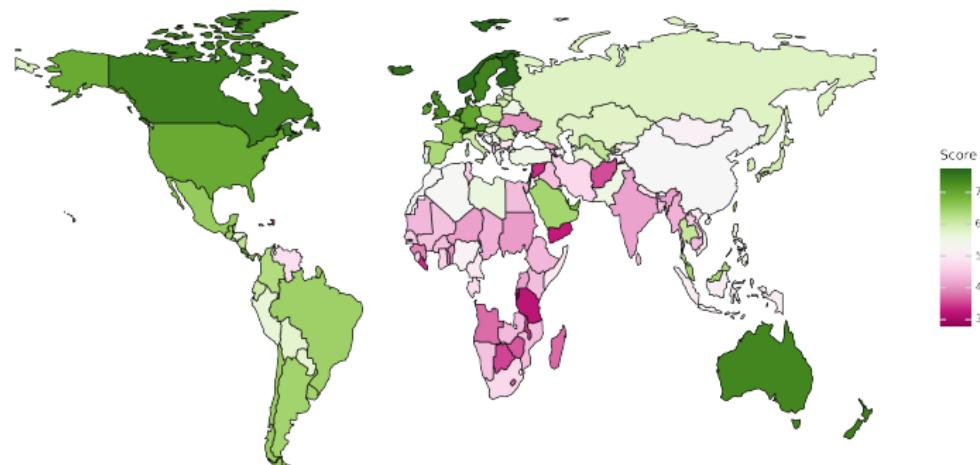
- ▶ Which parts of the world have a below median life-happiness score?



# What if we want to compare around a baseline?

- ▶ Use divergent colormaps<sup>2</sup>!
- ▶ Which parts of the world have a below median life-happiness score?

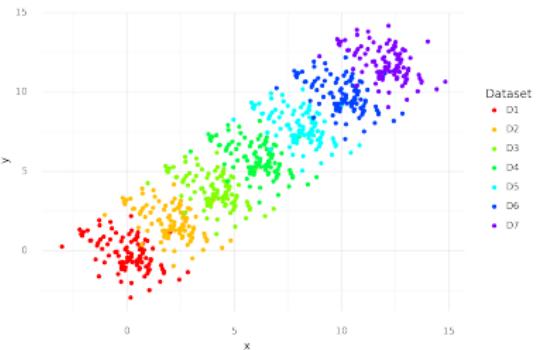
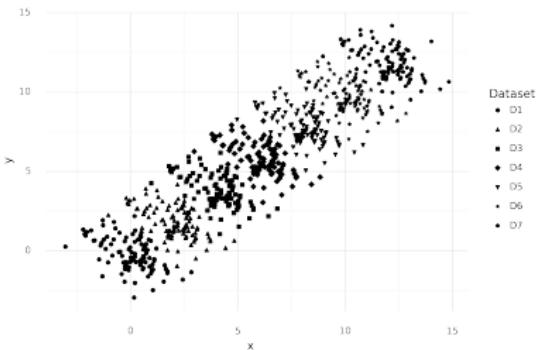
World happiness score in Africa is general below the median of 5.4



<sup>2</sup><https://matplotlib.org/stable/tutorials/colors/colormaps.html#diverging>

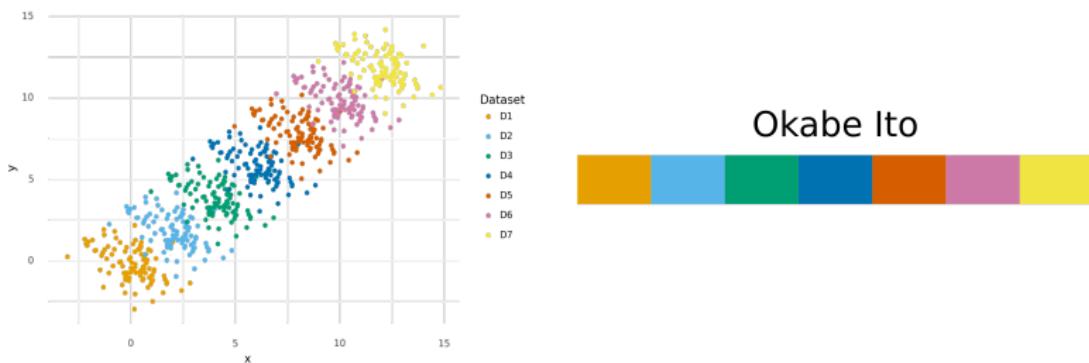
# How should we visualise categories?

- ▶ Often data contain categories (e.g companies etc...)
- ▶ Visualising them often relevant
- ▶ Colours are better than symbols
  - ▶ What are the problems with the palette?



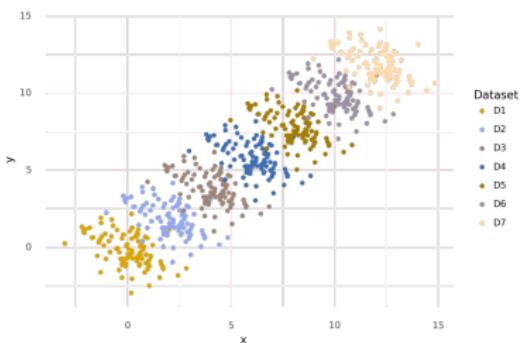
# For a categorical palette we want

1. Colours sufficiently distinct to rapidly be matched against a legend.
2. Color blindness friendly
3. Colours which are easy to name.



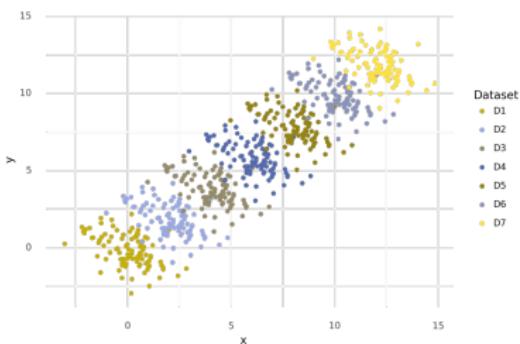
# Colour blindness - Deuteranopia

- ▶ Red-green colour blindness
- ▶ 8% men and 0.5% women



# Colour blindness - Protan

- ▶ Type of red-green colour blindness
- ▶ 2% men



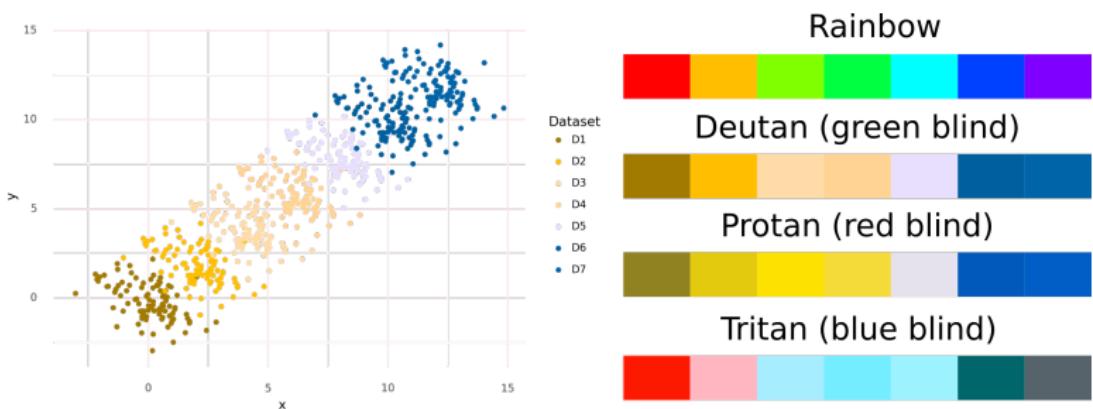
# Colour blindness - Tritan

- ▶ Yellow-blue blindness
- ▶  $\leq 0.01\%$  all individuals



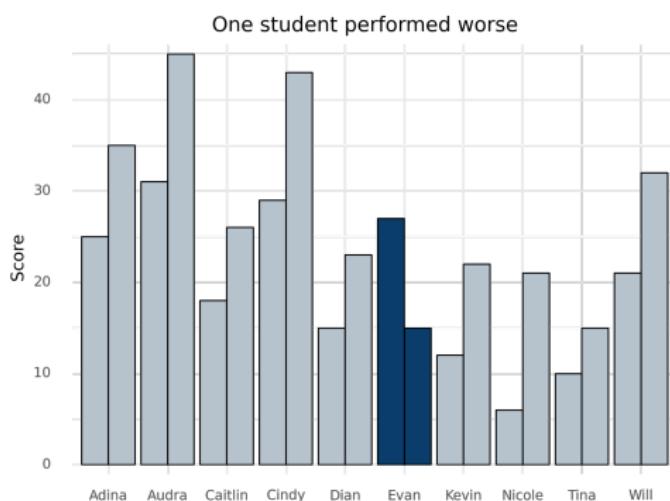
# Colour blindness - Rainbow palette

The rainbow palette is not a good choice for colour blindness (graph Deutan)

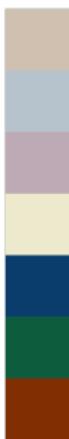


# If we want to highlight something?

- ▶ Use colour palette where a few colours stand out against
- ▶ Accent palette - mix of strong (darker/saturated) colours and subdued colours

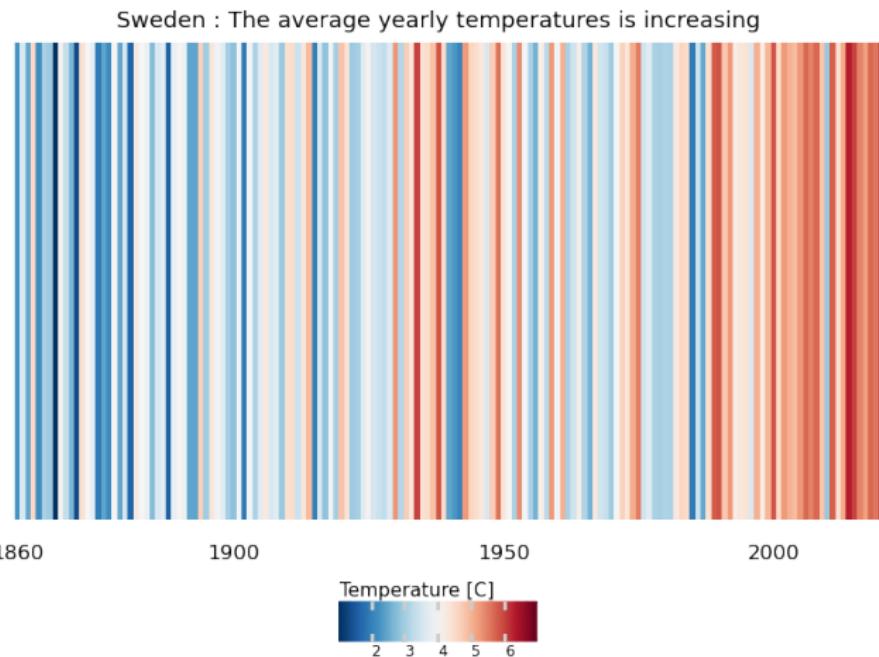


Okabe Ito Accent



# There are several guidelines regarding colours but ...

- Focus is always to truthfully present a message<sup>3</sup>



<sup>3</sup>Economist climate issue

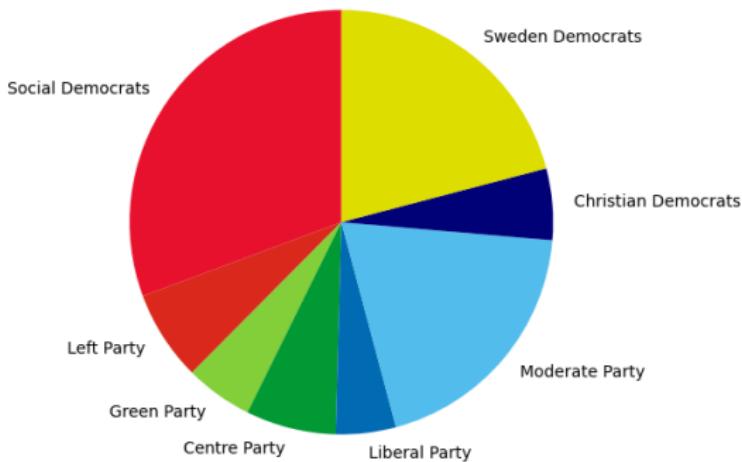
# Proportions

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# Pie-charts are great for election data

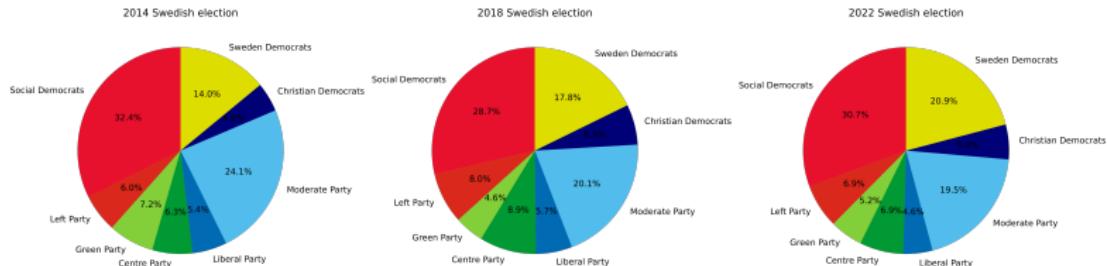
- ▶ Quantification via angles
  - ▶ Which is the biggest party?
  - ▶ Does S + V + MP + C have majority?

2022 : M, L, SD, and KD have a majority



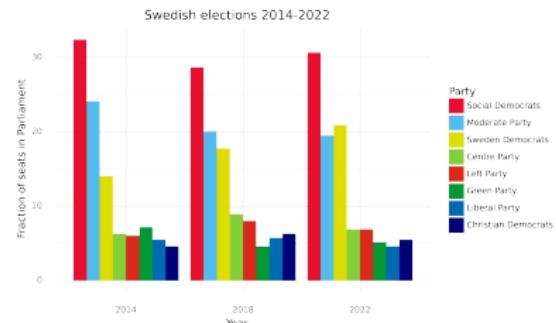
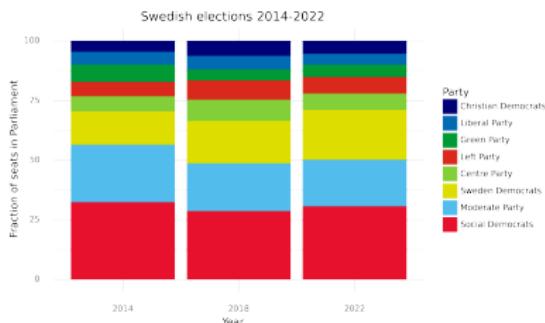
# Typically pie-charts are not a good idea

- ▶ Second best year for the Moderate party?
- ▶ We are bad at seeing amount via angles
  - ▶ Must complement with numbers - why then use a chart?



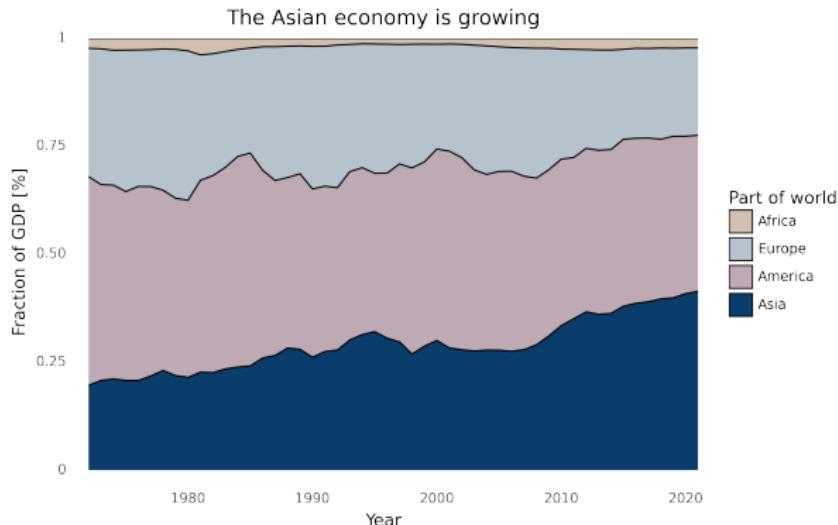
# Typically pie-charts are not a good idea

- ▶ Second best year for the Moderate party?
  - ▶ Stacked bar-chart?
  - ▶ Often normal bar-chart is best
  - ▶ A strong case can be made for line-plot (homework)



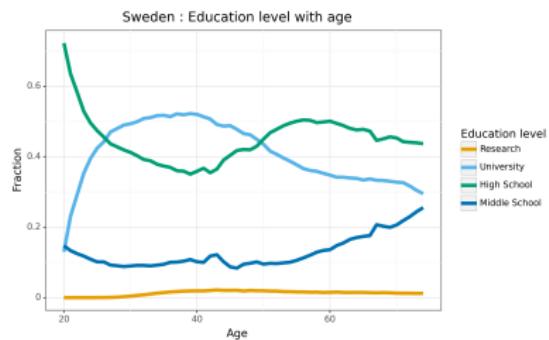
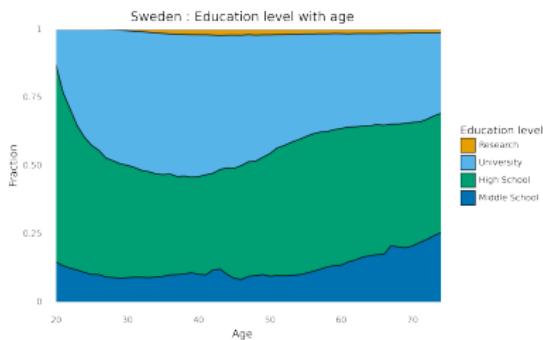
# The case for stacked graphs

- ▶ When does a stacked graph work?
  - ▶ When focus is on bottom category
  - ▶ Main message - Asia's economy is growing



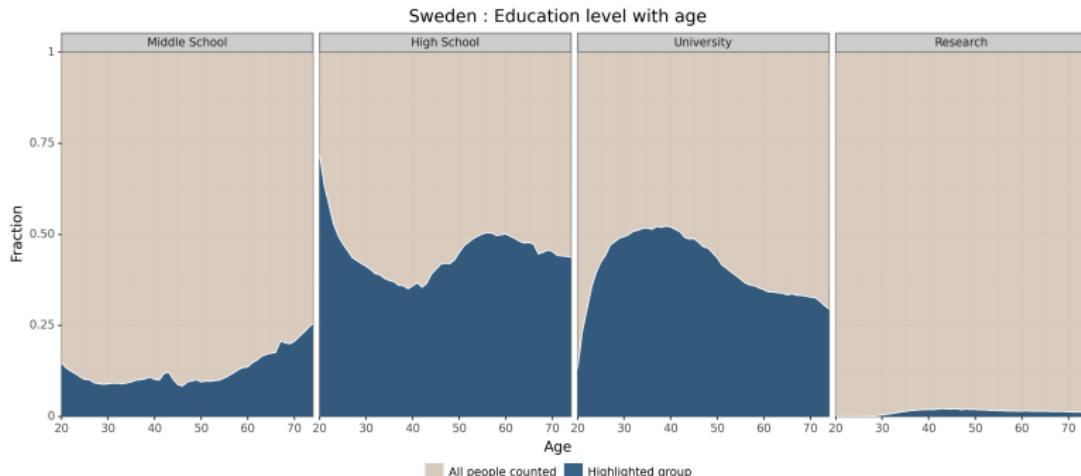
# If interested in components - plot them

- ▶ Which age has largest fraction of university graduates?
- ▶ Are there any other ways we can visualise the components?



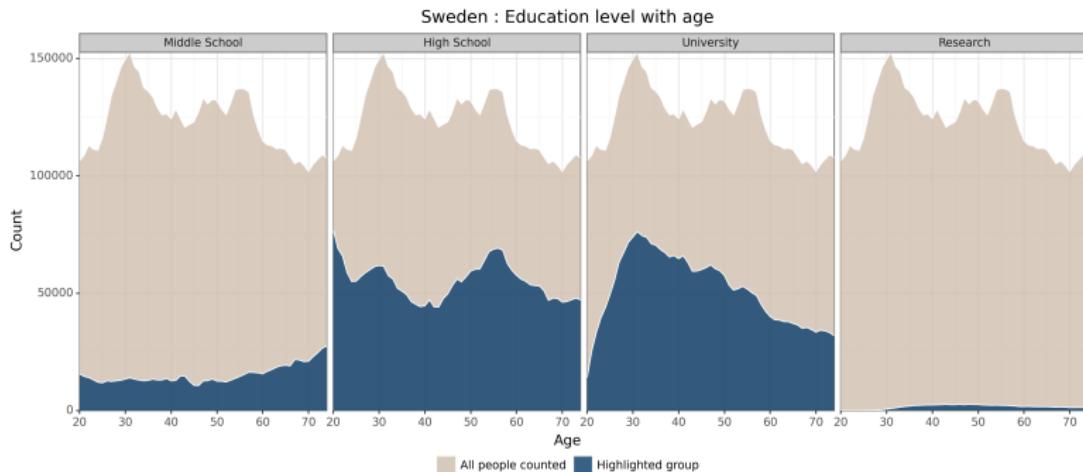
# Facets - use several plots

- ▶ Instead of colors an efficient way to compare categories is by putting each category into a separate plot
- ▶ Any drawbacks with plotting proportions?



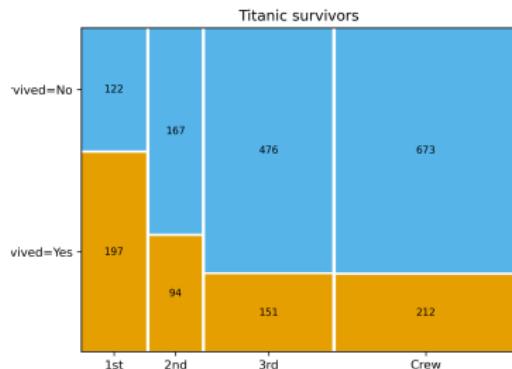
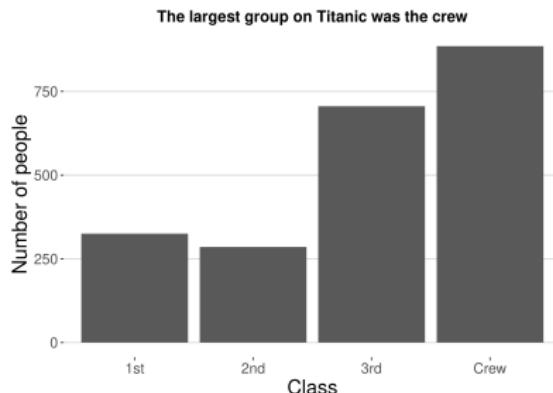
# Facets allows us to visualise total sample size

- ▶ Proportions are summary statistics
  - ▶ Strongly depend on sample size



# Nested proportions

- ▶ What if we have two categories?
- ▶ Which group had the most people on Titanic?
- ▶ In which group did most survive?
  - ▶ Mosaic plots for two categories



# Take home messages

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- ▶ For quantitative data Viridis is often a good colormap
- ▶ We best distinguish categories by color
  - ▶ A categorical colour palette should i) have sufficiently distinct colours, ii) nameable colours and iii) be colour blind friendly
- ▶ Which kind of visual to use for proportions depends on the context
  - ▶ Often pie-charts do not work (we do not perceive angles well)
  - ▶ Splitting into several subplots allows us to plot both proportions and total amount

# For next lecture...

Why is this plot published in Jul 2013 a bad visual?

