

FIT3179 Data Visualisation

Week 03: Visualisation of Tables and Networks



Lecture Overview

- Forum Presentations
- Five Design Sheet Methodology
- Networks and Trees (Textbook chapter 9)
- Tables (Textbook chapter 7)

Presentations next Week!

Based on the Allocate+ tutorial class list, the students in the CLAYTON Lab 9 (Tuesday 6 pm–8 pm) and Lab 4 (Tuesday 10 am–12 pm) will present in Week 4.

All students: Read the instructions on the weekly forum and post your visualisation research and analysis there.

Due date: 1 hour before the lecture starts or the beginning of your weekly lab session, whichever is earlier.

Content: Table and network visualisation

Task for next Week!

Think about the **who**, **what** and **why** of your first visualisation project.

- **Who** are your target users?
- **What** are you showing?
- **Why** is it useful?

Come with a project idea (and if possible data) to the lab in week 4. We will apply the Five Design Sheet Methodology to explore the **how** of your project.

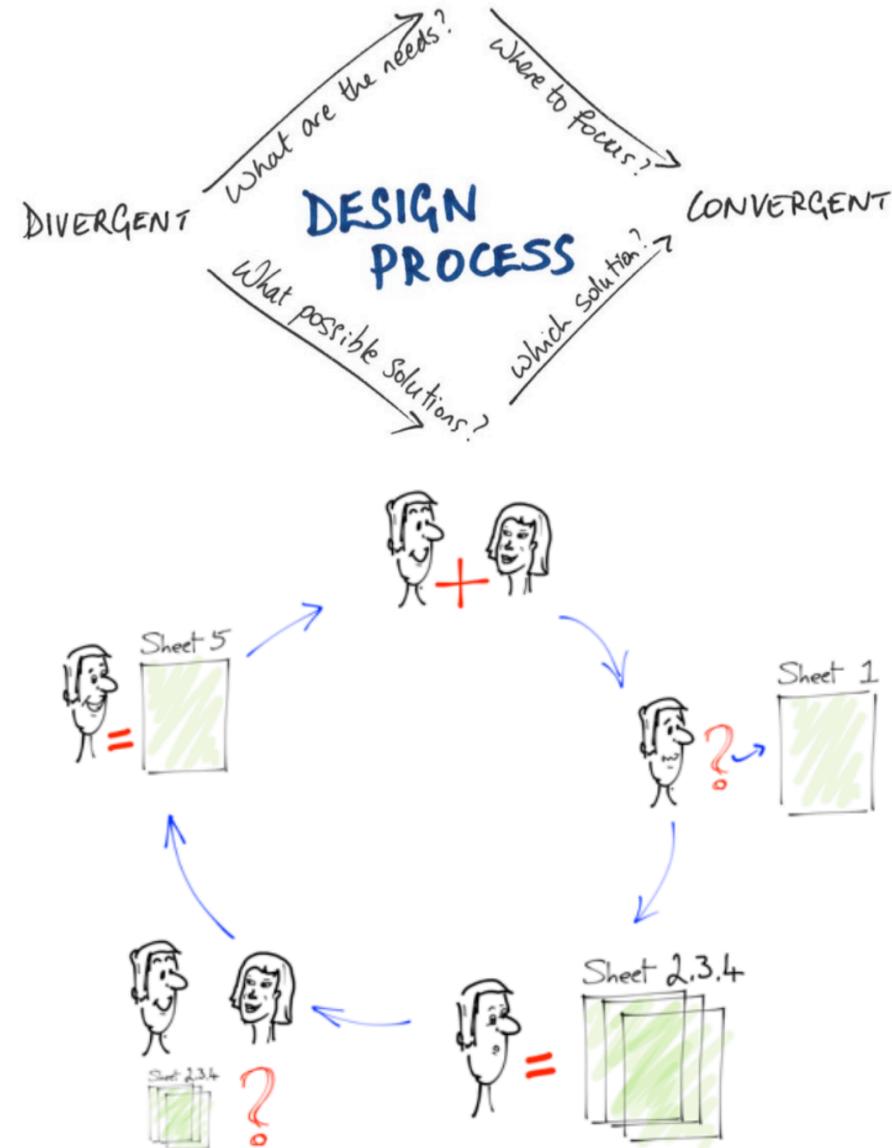
Student presentations

Five Design Sheet Methodology

Five Design Sheet Methodology Goals

- The FDS methodology helps us structure our approach to ideation.
- It encourages us to freely, yet systematically explore a design space before converging on a solution.

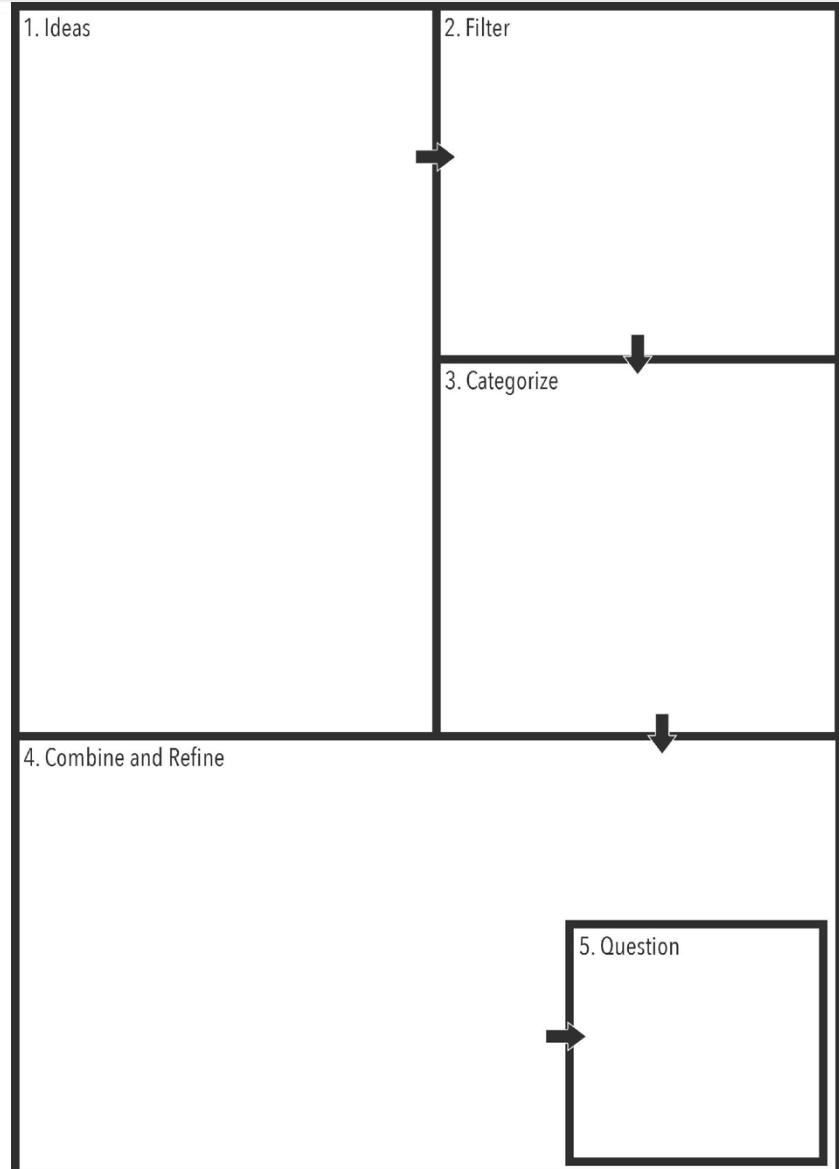
<http://fds.design>



Five Design Sheet Methodology

Sheet 1 - Brainstorm

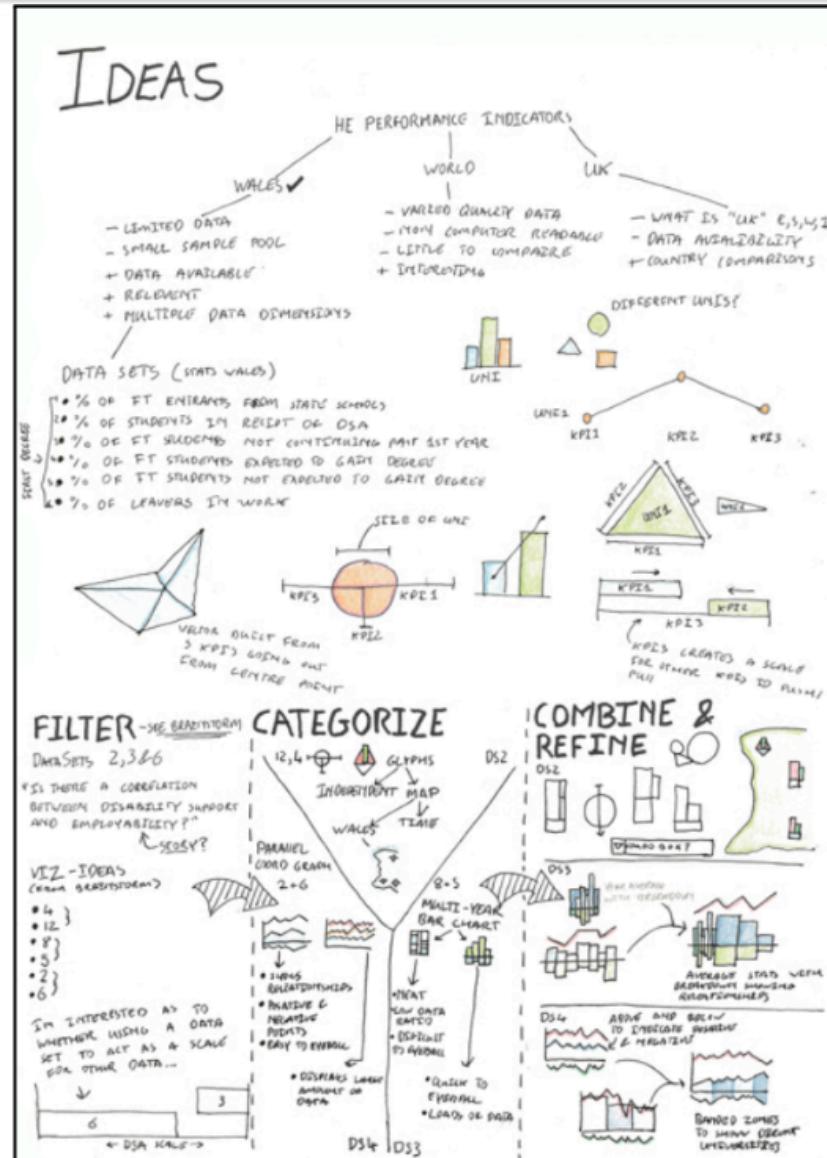
1. Sketch and draw as many ideas as you can think of
2. Remove duplication
3. Group similar ideas: sticky notes on a wall are helpful for this
4. Combine & Refine: From mini-ideas to bigger solutions... perhaps one system with multiple views?
5. Does this solution satisfy the *Why*?



Five Design Sheet Methodology

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Five Design Sheet Methodology

Sheets 2-4 - Brainstorm

Layout: e.g. sketched screen-shot

Focus: explanations of key/novel visualisation techniques

Operations: details of key interactions (e.g. a statechart)

Discussion: focus on advantages and disadvantages of the design

Meta-information: title/author, date, sheet-number, task

Layout	Title: Author: Date: Sheet: Task:
	Operations
Focus	Discussion

Five Design Sheet Methodology

Sheets 2-4 - Brainstorm

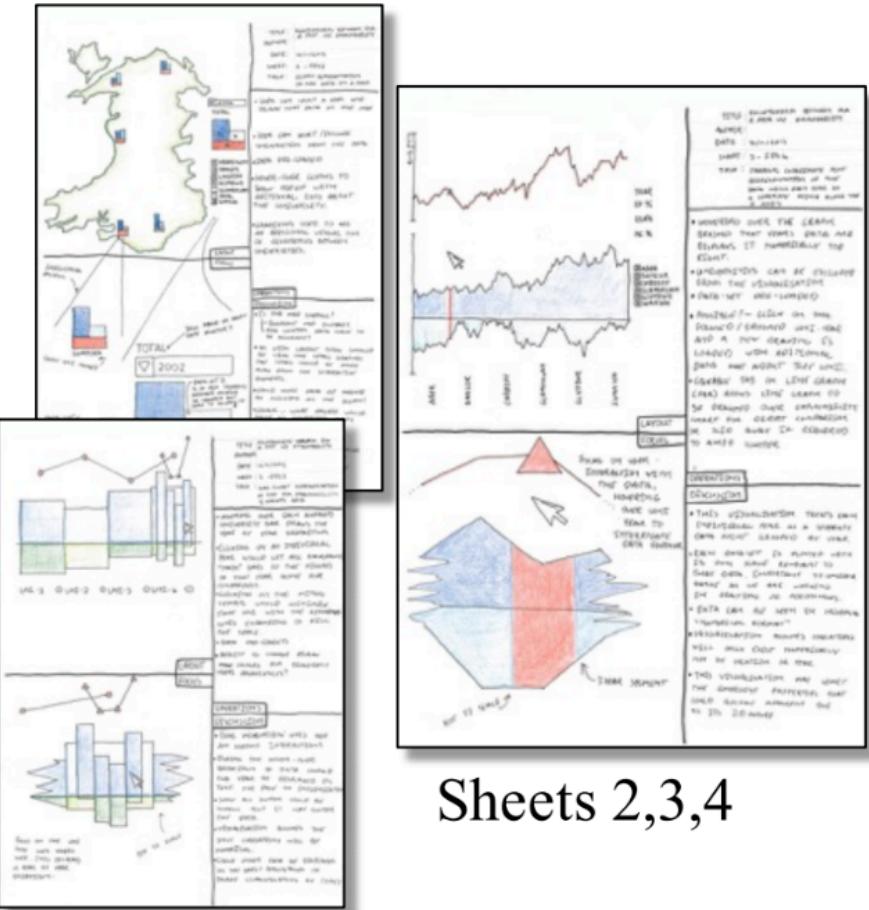
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Meta-information: title/author, date, sheet-number, task



Sheets 2,3,4

Five Design Sheet Methodology

Sheet 5 - Realisation

Take the best of the previous designs and explore in greater detail. Focus on:

1. Description of algorithms / techniques
 2. Dependencies: e.g. software libraries, compatibility, etc.
 3. Estimate time and effort to build the solution
 4. Specific requirements of materials, hardware (desktop, tablet, phone, etc.)



VAD chapter 7

Arrange Tables

Scatterplot, bar chart, line chart, stacked bar chart, area chart, pie chart

Visual vocabulary

Designing with data

There are so many ways to visualise data - how do we know which one to pick? Use the categories across the top to decide which data relationship is most important in your story, then look at the different types of chart within the category to form some initial ideas about what might work best. This list is not meant to be exhaustive, nor a wizard, but is a useful starting point for making informative and meaningful data visualisations.

FT graphic: Alan Smith; Chris Campbell; Jon Bert; Liz Fawcett; Graham Parish; Billy Ehrenberg; Paul McCallum; Harris Strake
Inspired by the Graphics Companion by Jon Schwabish and Steven Rizzo



ft.com/vocabulary

FT

Deviation

Emphasises variation from a reference point. Typical reference point can be zero but it can also be a target or a long-term average. Can also be used to show sentiment (positive/negative).

Example FT uses
Trade surplus/deficit, climate change

Correlation

Show the relationship between two or more variables. Be mindful that readers will tell them otherwise, many readers will assume the relationships they show to be causal (ie, one causes the other).

Example FT uses
Inflation & unemployment, income & life expectancy

Ranking

Used when one ranking is in an ordered list or more importance is given to it in more importance. It's absolute or relative value. Don't be afraid to highlight the points of interest.

Example FT uses
Wealth, deprivation, league tables, constituency election results

Distribution

Show values in a dataset and how often they occur. This type of 'view' of a distribution can be a memorable way of highlighting the lack of uniformity or equality in the data.

Example FT uses
Income distribution, population, age/gender distribution

Change over Time

Emphasises the changing trends. This can be short time data movements or extended series traversing decades or centuries. Changes in context period is important to provide suitable context for the reader.

Example FT uses
Share price movements, economic time series

Magnitude

Emphasise components. These can be relative or being able to see the target/budget or absolute need to see fine differences. Usually these show a magnitude-type chart (bars, line, dollars or people) rather than a calculated rate or per cent.

Example FT uses
Fiscal budgets, company structures, commodity production, market capitalisation

Part-to-whole

Show how a single entity can be broken down into its component parts. If the reader's interest is solely in the size of the components, consider a magnitude-type chart instead.

Example FT uses
Population density, natural resource locations, natural disaster risk/impact, catchment areas, variation in election results

Spatial

Avoid from using maps unless there is a clear location or geographical pattern in data are more important than reading anything else.

Example FT uses
Population density, natural resource locations, natural disaster risk/impact, catchment areas, variation in election results

Flow

Show the major sources/destinations or movement between two or more states or conditions. These might be logical sequences or geographical locations.

Example FT uses
Movements of funds, trade, migrants, lawsuits, information; relationship graphs.

Diverging bar

A simple standard bar chart that can handle negative values and positive magnitude values.

Diverging stacked bar

Perfect for presenting data series which involve sentiment (eg disagree/heural/agree).

Spine

Splits a single value into two contrasting components (male/female).

Surplus/deficit filled bar

The shaded area of the bar gives a clear balance to be shown – either against a baseline or between two series.

Column + line time

A good way of showing the relationship between 2 variables (and a rate/line).

Connected scatterplot

Usually used to show the relationship between 2 variables that have changed over time.

Dot strip plot

Good for showing individual values in a distribution, can be a dot matrix too, many dots have the same value.

XY heatmap

A good way of showing the patterns between 2 categories of data, less good at showing fine differences in amounts.

Lollipop

Lollipops draw more attention to the data points than a standard bar/column and can also share range and value effectively.

Bump

Effective for showing changing rankings across multiple dates.

For large datasets, consider using lines using colour.

Violin plot

Similar to a box plot but more effective with capturing continuous data (data that cannot be summarised with simple averages).

Population pyramid

A standard way for showing the age and sex breakdown of a population distribution, effectively back to back histograms.

Cumulative curve

A good way of showing how unequal a distribution is always cumulative frequency: x axis is always a measure.

Frequency polygon

For displaying multiple distributions of data. Like a regular line chart, best limited to a maximum of 3 or 4 datasets.

Circle timeline

Good for showing the sequence of varying time series across multiple categories (eg earthquakes by continent).

Vertical timeline

Presents time on the Y axis. Good for displaying detailed time series work especially well on mobile.

Seismogram

Another alternative to the circle timeline for situations where there are big variations in the data.

Dot scatterplot

The standard way to show the relationship between two or more variables, each of which has its own axis.

Ordered bar

Standard bar charts display the ranks of values in a dataset easily when sorted into order.

Dot plot

A simple way of showing the change or range (minimum) of data across multiple categories.

Dot strip plot

Good for showing individual values in a distribution, can be a dot matrix too, many dots have the same value.

Barcode plot

Like a dot strip plot, good for showing all the data in a table, they work best when highlighting individual values.

Slope

Perfect for showing how ranks have changed over time or vary between categories.

Boxplot

Summarises multiple distributions by showing the median (central) and range (the data).

Area chart

Used with care – these are good at showing changes to total, but showing the size of components can be very difficult.

Marimekko

A good way of showing the size and proportion of data at the same time – as long as the data are not too complicated.

Paired column

As per standard column but allows for comparing multiple series. Can be tricky to read with more than 2 series.

Paired bar

See above. Good when the data are not the same series and labels have long category names.

Paired line

A good way of showing the relationship over time between amount (columns) and a rate (line).

Slope

Good for showing change over time as long as the data can be simplified into 2 or 3 points without missing a key part of the story.

Area chart

Good for showing change over time as long as the data can be simplified into 2 or 3 points without missing a key part of the story.

Violin plot

Similar to a box plot but more effective with capturing continuous data (data that cannot be summarised with simple averages).

Candlestick

Usually focused on day-to-day volatility, showing open/closing and high/low points of each day.

Fan chart (projection)

Used to show the uncertainty in future projections – this grows the further forward to projection.

Connected scatterplot

A good way of showing changing rankings across multiple dates.

Calendar heatmap

A great way of showing the sequential nature of data (daily, weekly, monthly) – it shows the precision of quantity.

Priestley timeline

Great when date and duration are key elements of the story in the data.

Parallel coordinates

An alternative to order charts – again, the arrangement of the variables is important. Usually benefits from highlighting values.

Circle timeline

Good for showing the sequence of varying time series across multiple categories (eg earthquakes by continent).

Vertical timeline

Presents time on the Y axis. Good for displaying detailed time series work especially well on mobile.

Seismogram

Another alternative to the circle timeline for situations where there are big variations in the data.

Dot scatterplot

The standard way to show the relationship between two or more variables, each of which has its own axis.

Grouped symbol

An alternative to bar/column charts when being able to count data or highlight individual elements is useful.

Bullet

Good for showing a measurement against the amount of a target or performance range.

Grouped symbol

An alternative to bar/column charts when being able to count data or highlight individual elements is useful.

Vertical timeline

Presents time on the Y axis. Good for displaying detailed time series work especially well on mobile.

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Selection of an Idiom

Selection by attribute type and table layout

A project in beta by **ferdlio** FAMILY INPUT FUNCTION SHAPE

D	V
P	

X	Y ₁	Y ₂	
1	30	28	>
2	34	22	
3	38	26	
	▼		

A	2010	2015	
A	1	3	>
B	2	1	
C	3	2	
	▼		

A	60%
---	-----

X	Y
0-2	30
2-4	34
4-6	38
	▼

Event	Time
A	1-4-2015
B	10-4-2015
C	12-4-2015
	▼

Bump Chart

Stacked Ordered Area Chart

Do you have any feedback or suggestions for Data Viz Project? Let us know

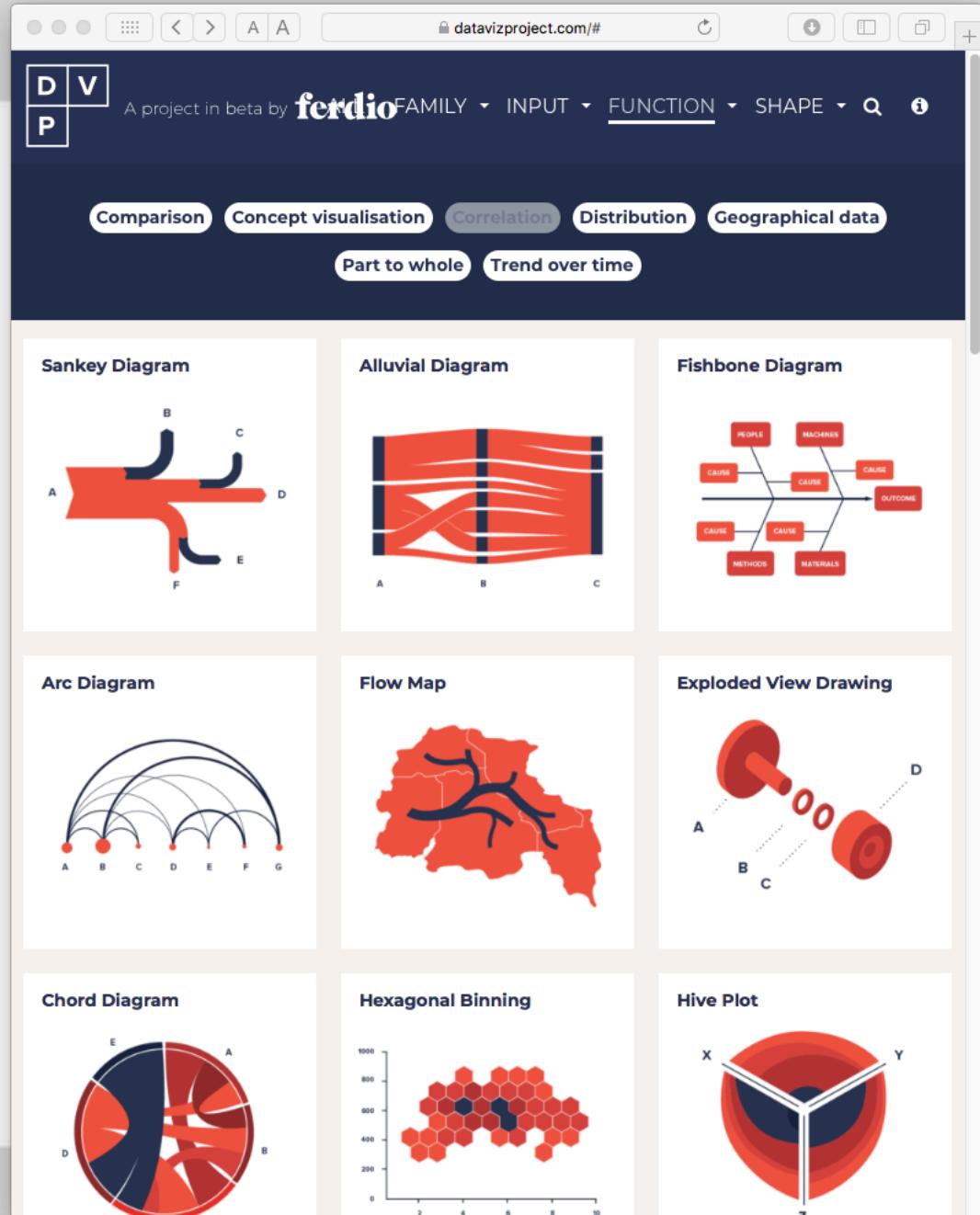
Selection of an Idiom

Selection by dataset type



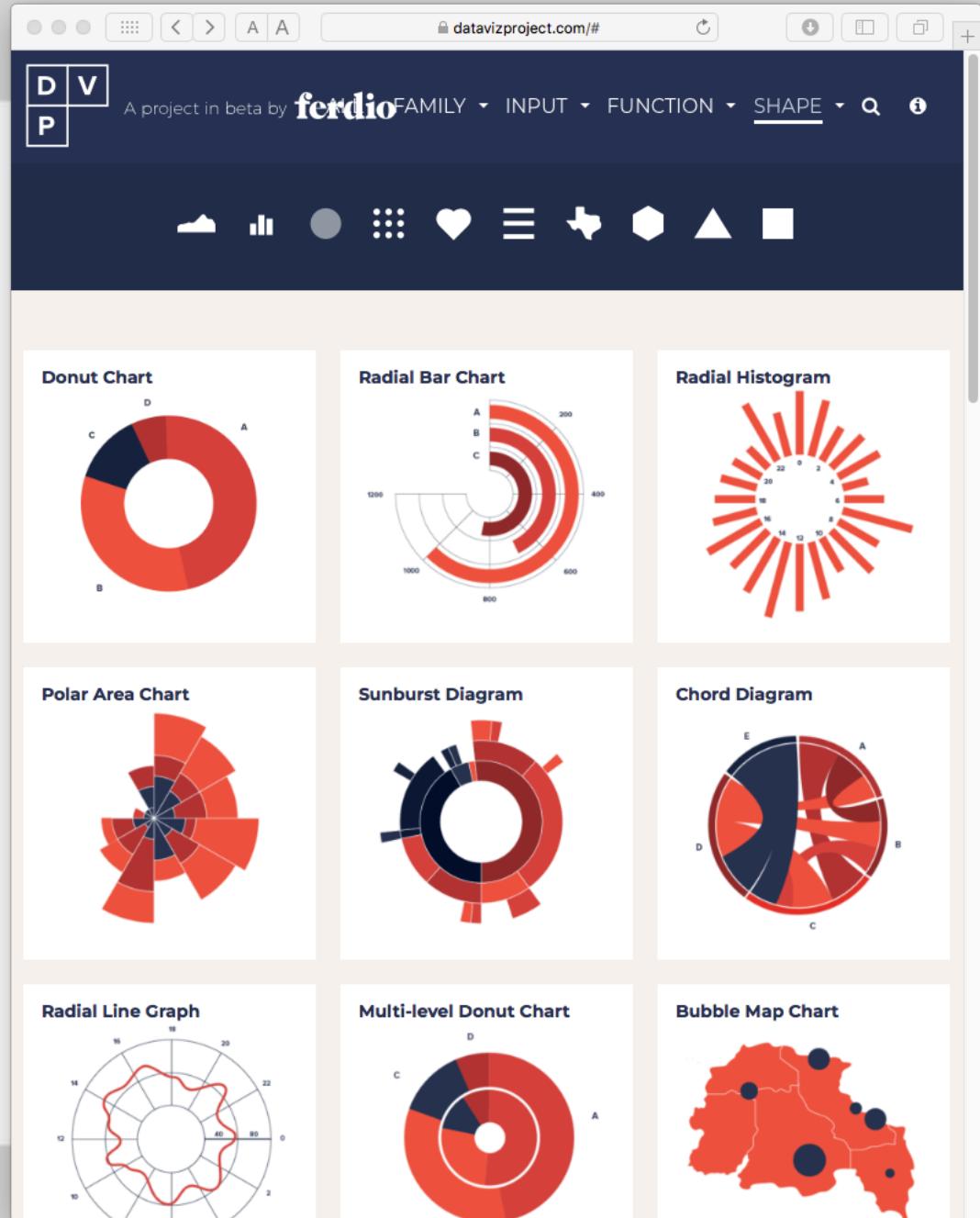
Selection of an Idiom

Selection by action
and target



Selection of an Idiom

Selection by shape



Selection of an Idiom

Vis catalogues

- <https://datavizproject.com>
- <https://datavizcatalogue.com>
- <https://ft.com/vocabulary>

What do you want to show?

Here you can find a list of charts categorised by their data visualization functions or by what you want a chart to communicate to an audience. While the allocation of each chart into specific functions isn't a perfect system, it still works as a useful guide for selecting chart based on your analysis or communication needs.



Comparisons



Proportions



Relationships



Hierarchy



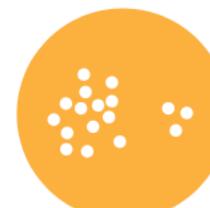
Concepts



Location



Part-to-a-whole



Distribution



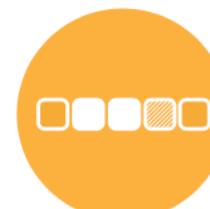
How things work



Processes & methods



Movement or flow



Patterns



Range



Data over time



Analysing text



Reference tool

Tableau Chart Catalog

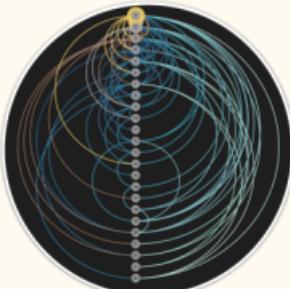
Examples Created in Tableau by the Tableau Community

This catalog provides a list of different chart types with links to actual visualizations built in Tableau and published on Tableau Public. This was developed as a resource for the Tableau community for inspiration and to assist in the understanding of how these chart types might be used in actual use cases. All visualizations on this page are being provided with the permission of the original author and are available for download from Tableau Public. Click on the image to open the actual visualization in a separate browser window. (Note: inclusion does not mean the chart is the best choice for the data represented. Also note that the originator of each chart may not necessarily be represented; these are simply examples).

For more information on chart type usage and blog posts on how to create these charts, please see the [Visual Vocabulary](#) by Andy Kriebel, the [Tableau Reference Guide](#) from Jeff Shaffer (Data Plus Science) and the [Tableau Cookbook](#) from Josh Weyburne.

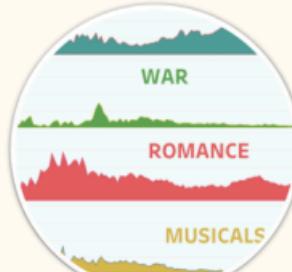


[Arc Diagram](#)



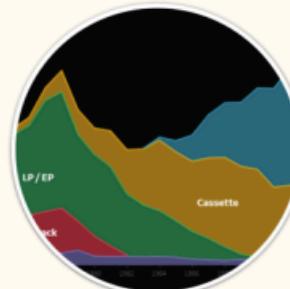
By James Smith

[Area Chart](#)



By Bo McCready

[Area Chart \(Stacked\)](#)



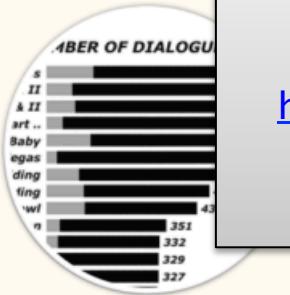
By Kevin Flerlage

[Bar Chart](#)



By Bridget Cogley

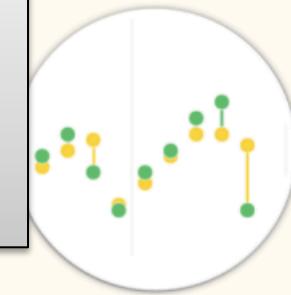
[Bar Chart \(Stacked\)](#)



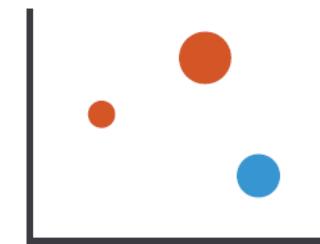
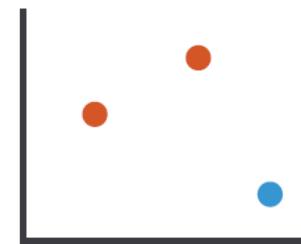
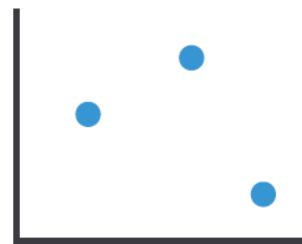
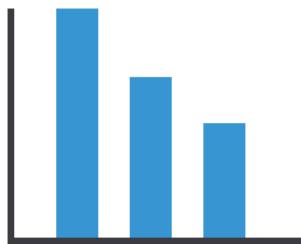
Have a look at the Tableau Chart Catalog!

<https://public.tableau.com/views/TheTableauChartCatalog/TableauChartExamples>

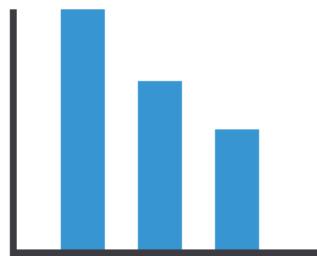
[Barbell Chart](#)



- Common data visualisations we see are *idioms*
- What can we say about the structure of these common idioms?

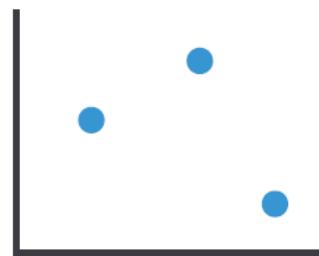


- Structure of common idioms
 - combinations of marks and channels



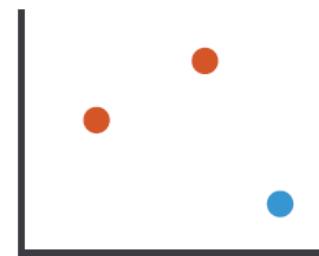
2:
vertical position
length

mark: line



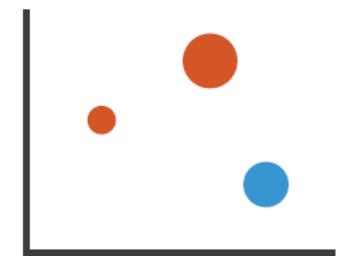
2:
vertical position
horizontal position

mark: point



3:
vertical position
horizontal position
color hue

mark: point



4:
vertical position
horizontal position
color hue
size (area)

mark: point

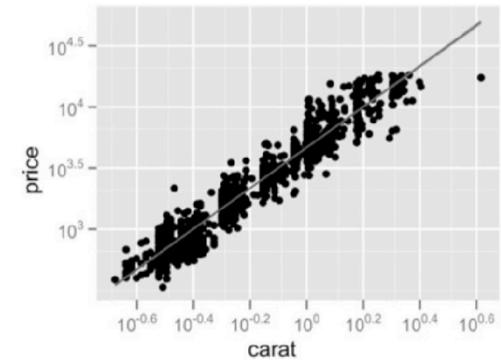
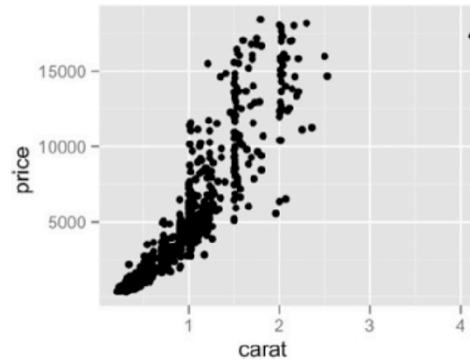
▪ What?

- Data: 2 quantitative attributes

▪ Why?

- Tasks:

- Find trends
- Outliers
- Distribution
- Correlation
- Clusters



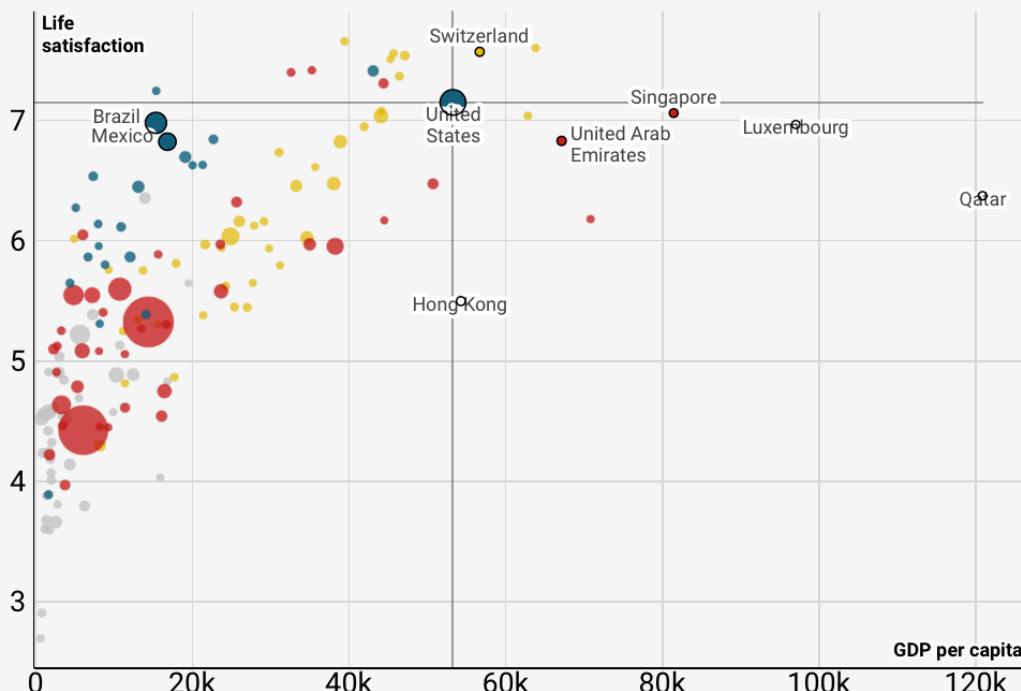
▪ How?

- Marks: points. Channels:
 - Horizontal position
 - Vertical position
- Scalability to hundreds of items
- Optional hue for additional nominal attribute
- Varying size = bubble plot

Idiom: Scatterplot (with multiple channels)

GDP per capita vs Self-reported Life Satisfaction

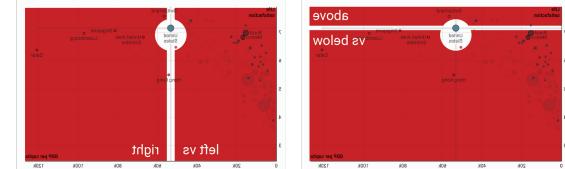
The vertical axis shows national average self-reported life satisfaction on a scale ranging from 0-10, where 10 is the highest possible life satisfaction. The horizontal axis shows GDP per capita based on purchasing power parity (i.e. GDP per head after adjusting for inflation and cross-country price differences). Numbers are from 2014-2016.



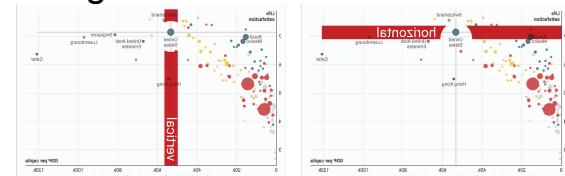
Source: Our World in Data, with data from Gallup World Poll surveys and World Bank • Get the data

Source: <https://blog.datawrapper.de/weekly-chart-lifesatisfaction/>

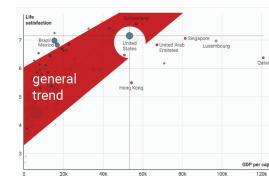
Compare with dots
• above and below
• left and right



- along vertical line
- along horizontal line



- on general trend

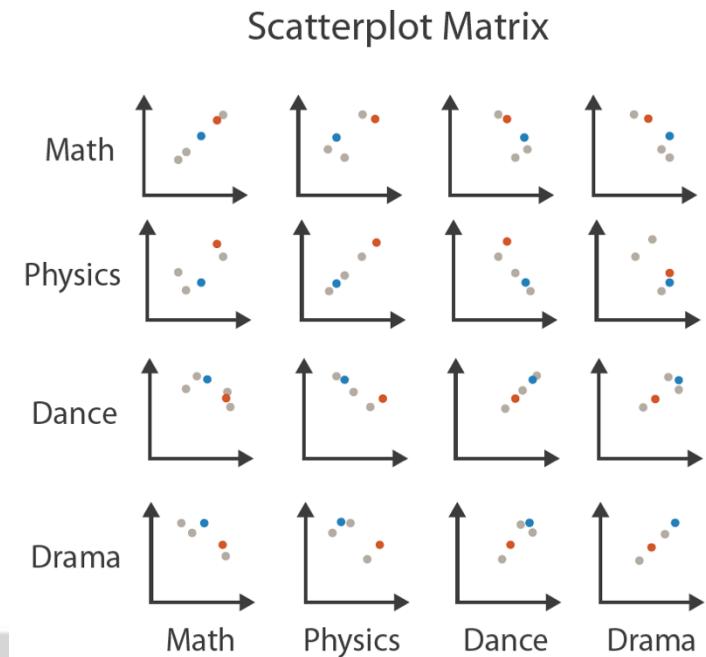


Idiom: Scatterplot matrix (SPLOM)

- **What?**
 - Table of quantitative attributes
- **Why?**
 - Task: find correlation, trends, outliers.
- **How?**
 - Scatterplots in 2D grid array (Matrix)
 - Scalability:
up to about a dozen attributes

Table

	Math	Physics	Dance	Drama
	85	95	70	65
	90	80	60	50
	65	50	90	90
	50	40	95	80
	40	60	80	90



Idiom: Bar chart

▪ What?

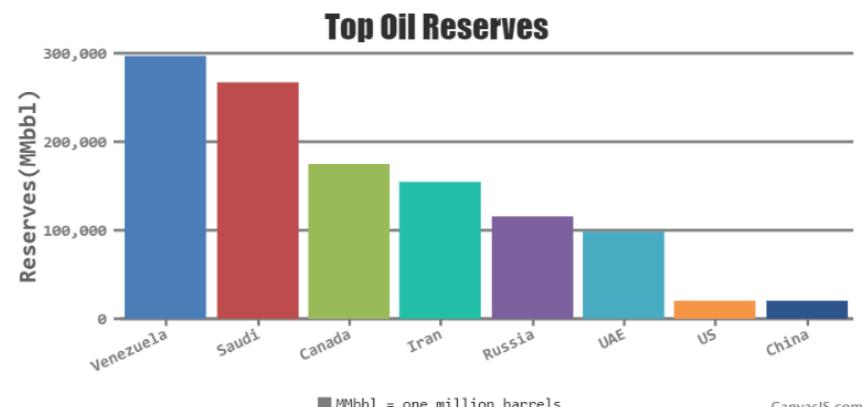
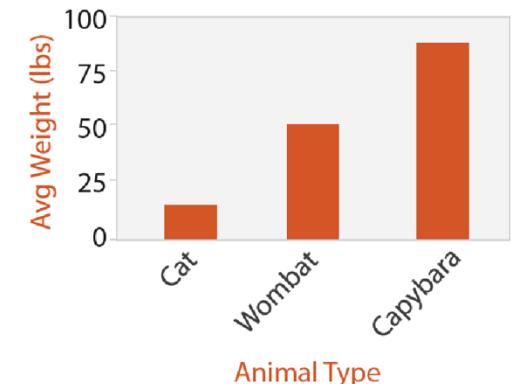
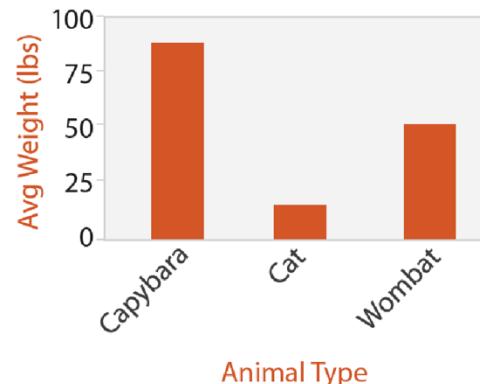
- Data: 1 key, one value
- 1 categ attrib, 1 quant attrib

▪ Why?

- Tasks:
 - Compare
 - Lookup values
 - Find biggest / smallest

▪ How?

- Marks: lines (bars)
- Channels:
 - Length to express quant value
 - Spatial regions: one per mark
 - Order by label or by value
- Scalability: dozens to hundreds of items



- **What?**

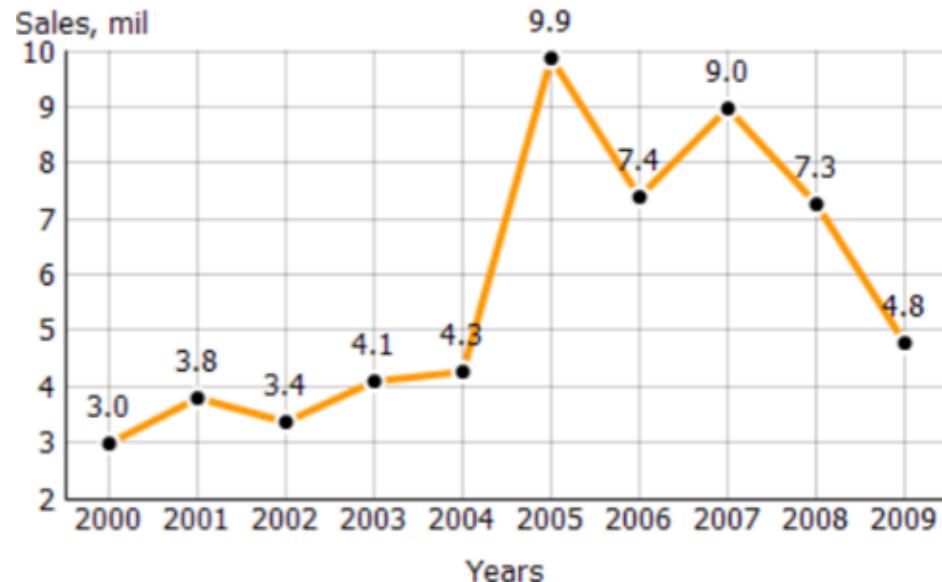
- Data:
 - 1 ordinal attribute (often time)
 - 1 quant attribute

- **Why?**

- Task: find trend, peaks, etc.

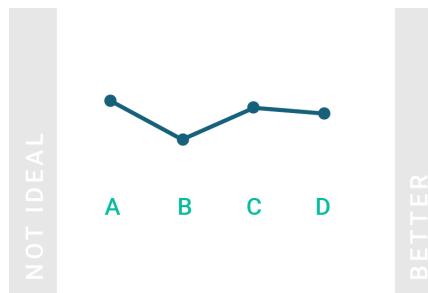
- **How?**

- Marks:
 - Points
 - Line connection
 - Channels:
 - Vertical positions express quantitative values
 - Line emphasises relationship between attributes
 - Scalability: depends on screen real-estate, zoomable interaction etc.



Choosing bar vs line charts

- Is the key attribute:
 - Categorical
 - bar charts
 - Ordered
 - line charts
- Use line charts to show how values develop over time.

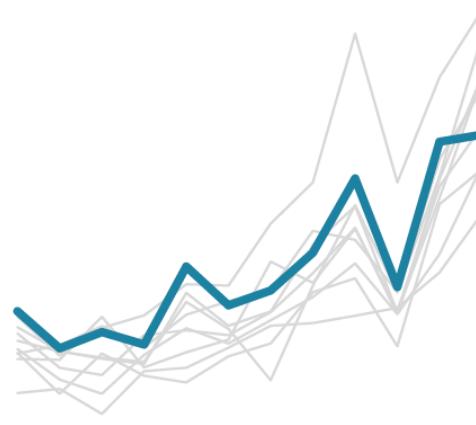


Designing line chart

NOT IDEAL



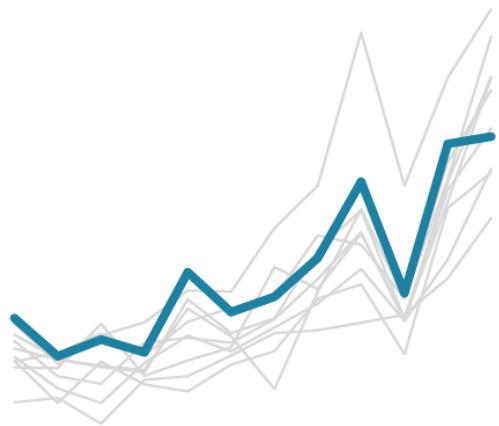
BETTER



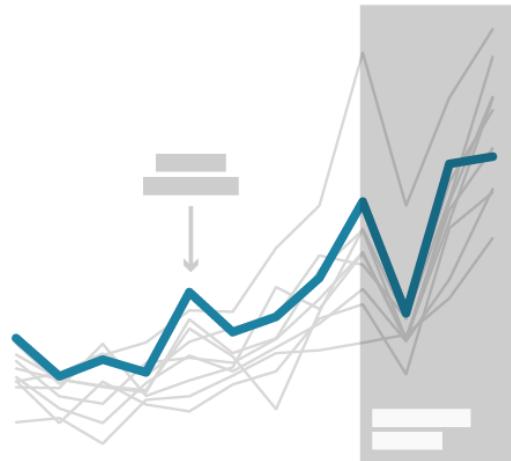
Source: Lisa Charlotte Rost, <https://blog.datawrapper.de/line-charts/>

Designing line chart

NOT IDEAL

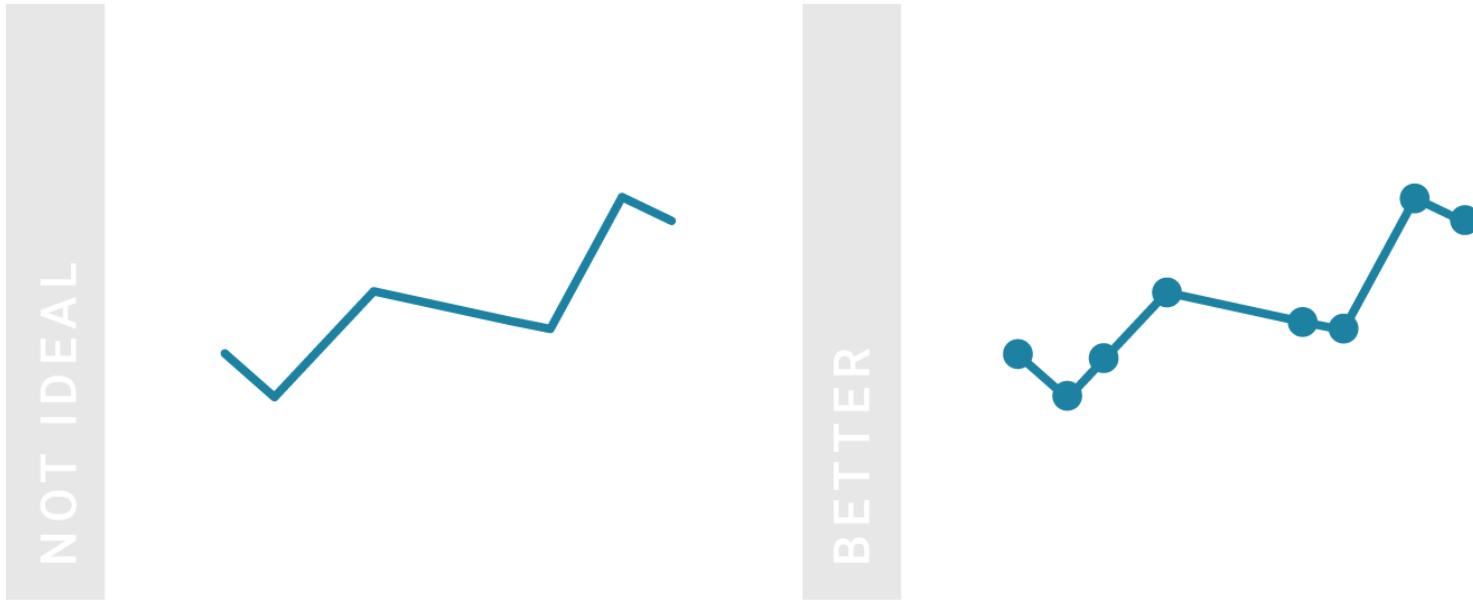


BETTER



Source: Lisa Charlotte Rost, <https://blog.datawrapper.de/line-charts/>

Designing line chart



Source: Lisa Charlotte Rost, <https://blog.datawrapper.de/line-charts/>

Designing line chart

NOT IDEAL



BETTER

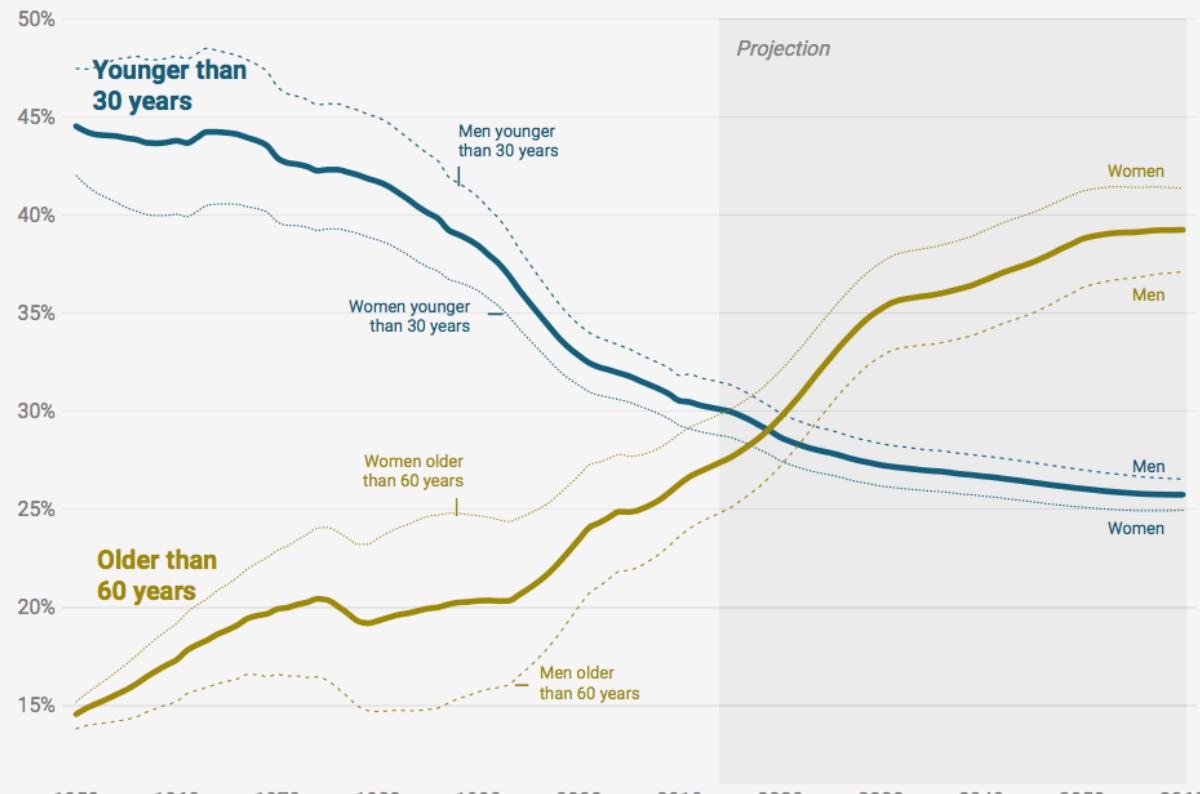


Source: Lisa Charlotte Rost, <https://blog.datawrapper.de/line-charts/>

Designing line chart

Starting in 2019, the number of Germans older than 60 will surpass those younger than 30. For women, that's already the case.

Share of Germans younger than 30 and older than 60 years.



Projections are from 2015

Chart: Lisa Charlotte Rost, Datawrapper • Source: Destatis, April 2015 • [Get the data](#)

Source: Lisa Charlotte Rost, <https://blog.datawrapper.de/line-charts/>

▪ What?

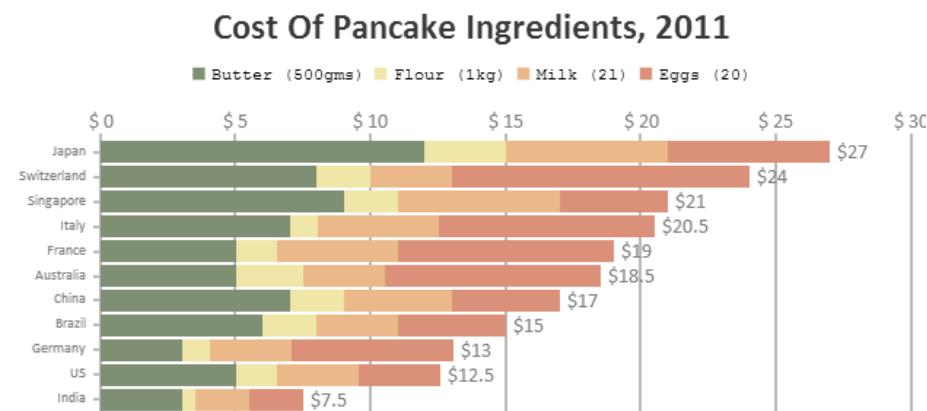
- Data: an extra key
- 2 categ attrib, 1 quant attrib

▪ Why?

- Tasks: Part to whole relationship

▪ How?

- Marks: stack of line marks
 - **Glyph:** composite object
- Channels:
 - Length to express quant value
 - Spatial regions: one per mark
 - Order by label or by value
- Scalability: several to dozens of levels of stacked attributes



<http://canvasjs.com/html5-javascript-bar-chart/>

Feb 13, 2018

by Lisa Charlotte
Rost

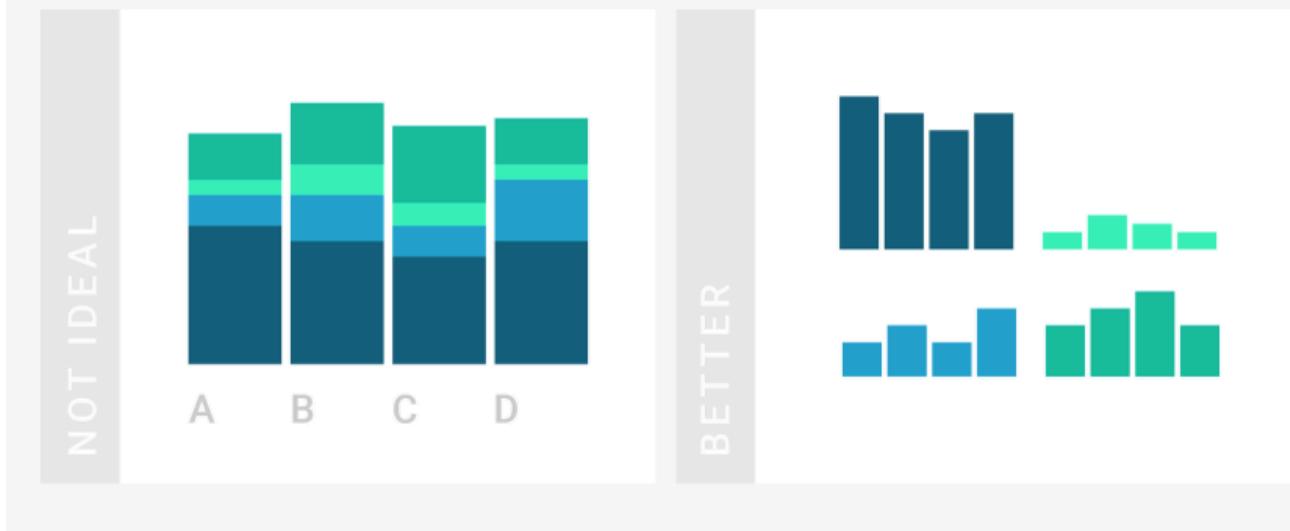
Thoughts & How To's

What to consider when creating stacked column charts

<https://blog.datawrapper.de/stacked-column-charts/>

When to use stacked bar charts?

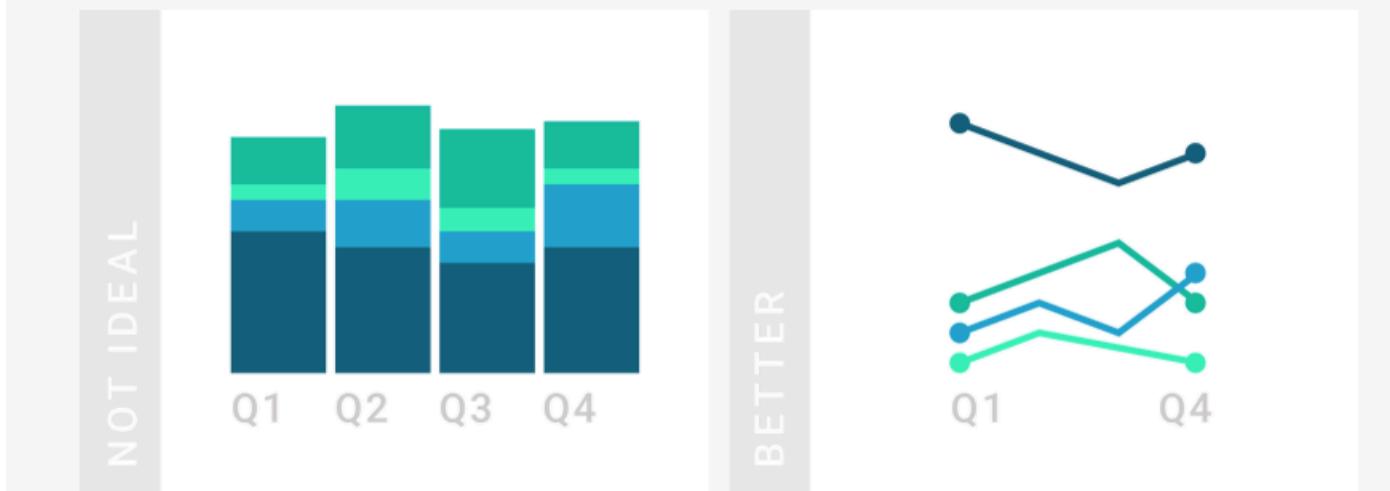
Stacked column charts work well when the focus of the chart is to compare the totals and one part of the totals. It's hard for readers to compare columns that don't start at the same baseline. If the focus of your chart is to compare multiple parts across all your totals with each other, consider split bars or small multiples instead.



Source: List Charlotte Rost, <https://blog.datawrapper.de/stacked-column-charts/>

When to use stacked bar charts?

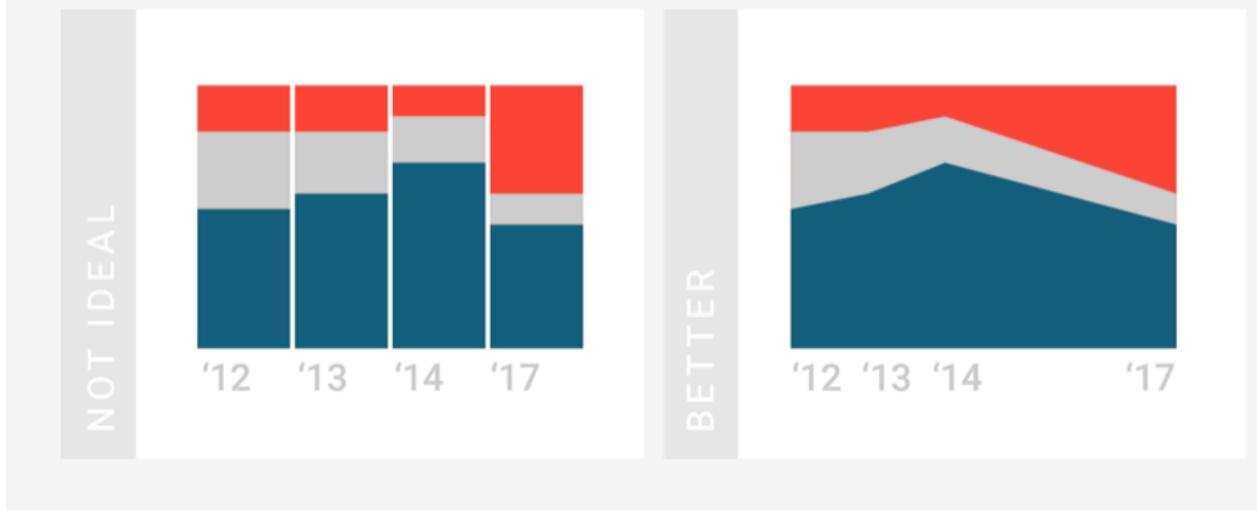
Stacked column chart can work well for dates, but should only be considered if the total of your parts is crucial. If the total of your parts is not important, a line chart is a better choice. It can be quicker decipherable by your readers.



Source: List Charlotte Rost, <https://blog.datawrapper.de/stacked-column-charts/>

When to use stacked bar charts?

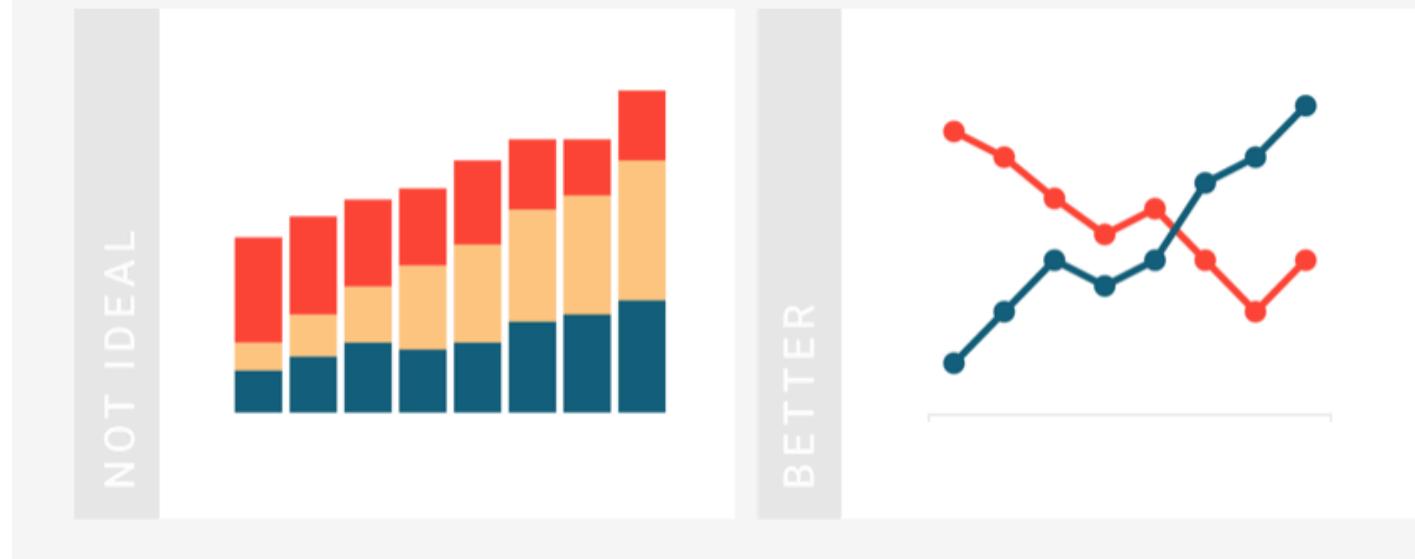
If you want to use stacked column charts for time data, make sure your dates have the same intervals. If you want to choose between area charts and stacked column charts, then the latter one is a better choice if you only have a few dates. Readers will be able to compare the parts of the totals better with each other than on an area chart. However, if the intervals between your dates are different, use an area chart (or line chart). They have x-axes with continuous scales that will show the date intervals correctly.



Source: List Charlotte Rost, <https://blog.datawrapper.de/stacked-column-charts/>

When to use stacked bar charts?

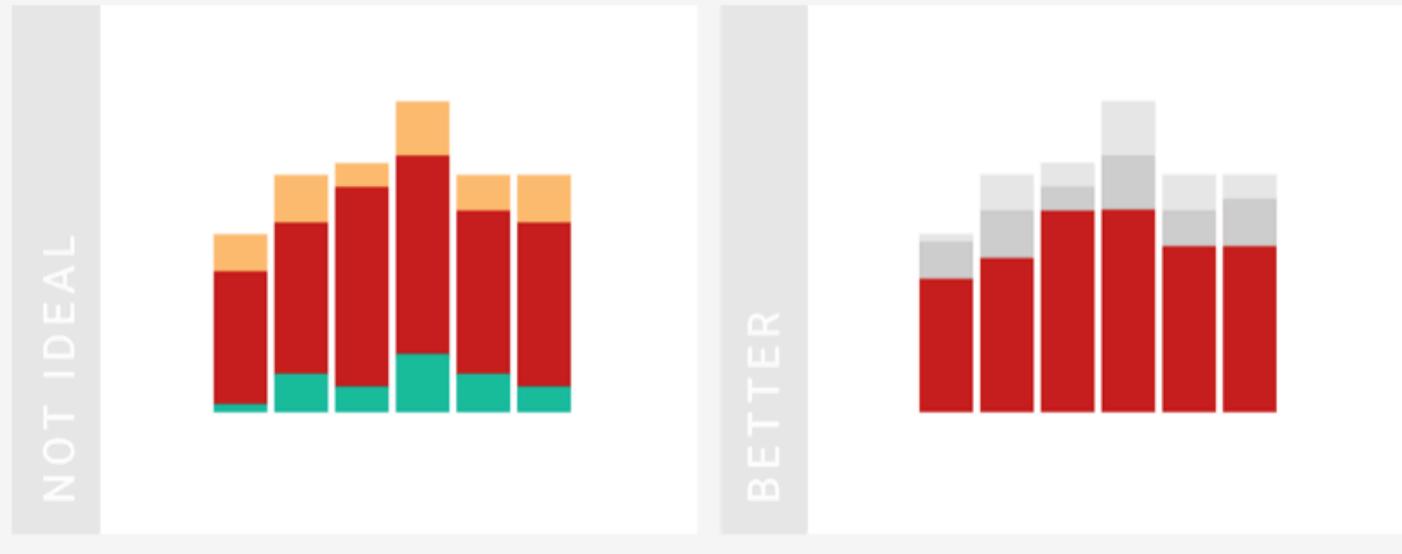
For time data, also consider a line chart if you want to show that one share overtook another one. Readers won't see intuitively that the chart is about parts of a total anymore. However, you will communicate your message more clearly and don't need to show all the shares of the total to do so.



Source: List Charlotte Rost, <https://blog.datawrapper.de/stacked-column-charts/>

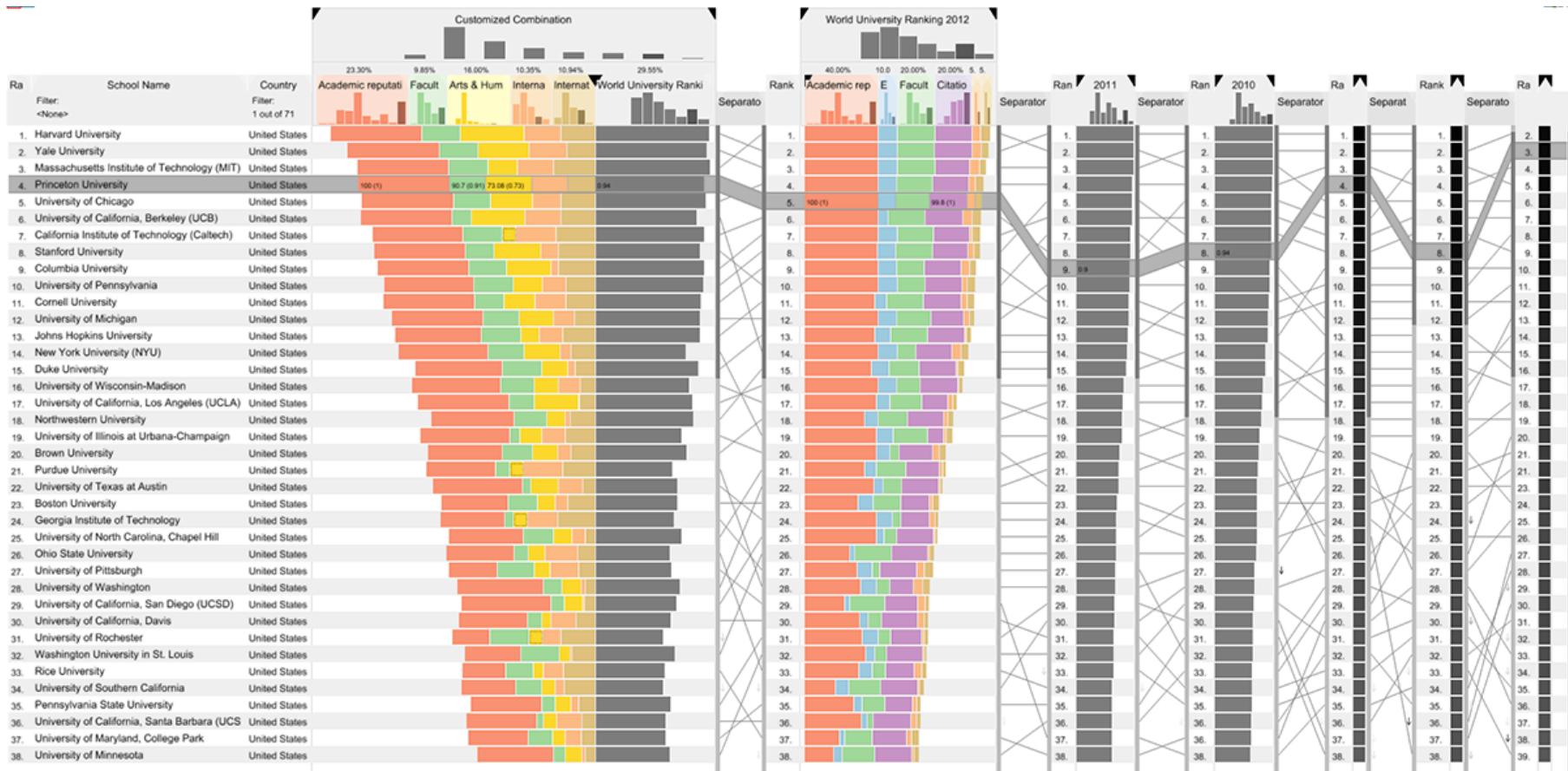
Designing stacked bar charts

Bring the most important value to the bottom of the chart and use color to make it stand out. Your readers can compare values easier with each other if they have the same baseline.



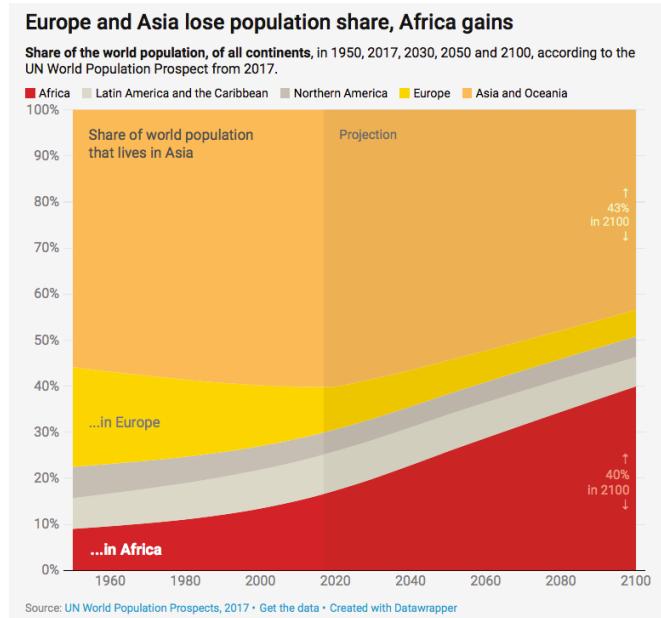
Source: List Charlotte Rost, <https://blog.datawrapper.de/stacked-column-charts/>

LineUp: Blurring the lines between tabular and visual representations



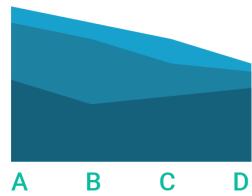
Demo: <http://caleydo.org/tools/lineup/>

- **What?**
 - Data:
 - 1 categ key attrib (continent)
 - 1 ordered key attrib (time)
 - 1 quant value attrib (population)
- **Why?**
 - Tasks:
 - Analyse trends over **time**
- **How?**
 - Marks: areas (polygons)
 - Channels:
 - Height of areas to express quant value
 - Hue: one per mark
 - For a relatively small number of items.



When to use area charts

NOT IDEAL



BETTER



For time only.

NOT IDEAL



BETTER

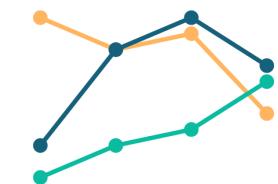


Not good for comparing shares.

NOT IDEAL



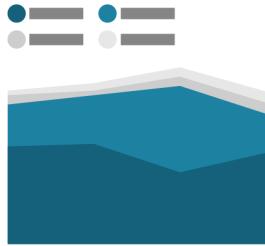
BETTER



Large differences required.

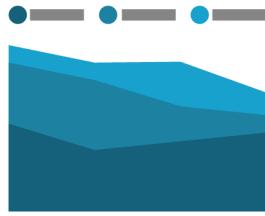
How to design area charts

NOT IDEAL



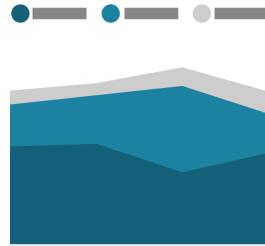
Group tiny values.

NOT IDEAL



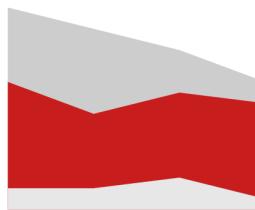
Place labels on chart.

BETTER



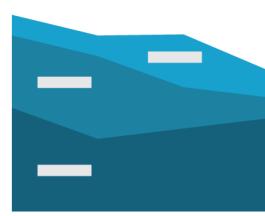
BETTER

NOT IDEAL



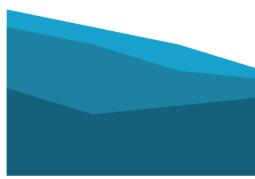
Most important at bottom and highlighted.

BETTER



BETTER

NOT IDEAL



Annotate and highlight ranges, mean values, current time, etc.

Source: Lisa Charlotte Rost,
<https://blog.datawrapper.de/area-charts/>

How to design area charts

Europe and Asia lose population share, Africa gains

Share of the world population, of all continents, in 1950, 2017, 2030, 2050 and 2100, according to the UN World Population Prospect from 2017.

■ Africa ■ Latin America and the Caribbean ■ Northern America ■ Europe ■ Asia and Oceania

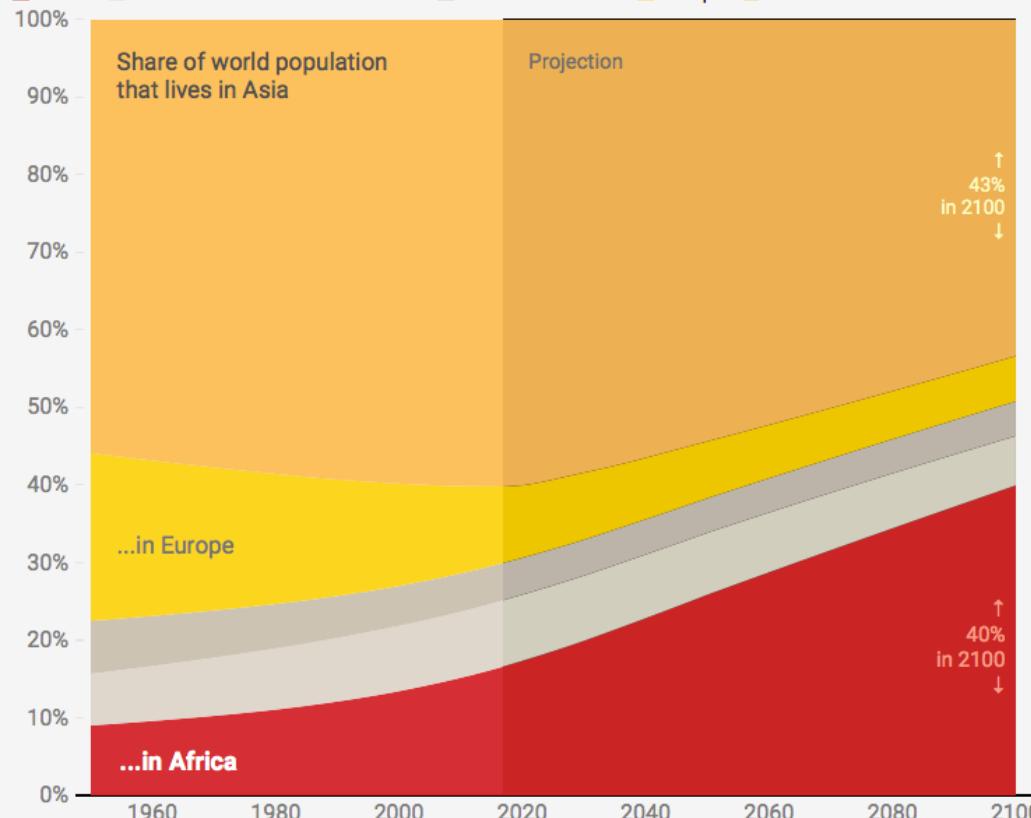


Chart: Lisa Charlotte Rost, Datawrapper • Source: [UN World Population Prospects, 2017](#) • [Get the data](#)

- **What?**
 - One quantitative attribute
 - One categorical attribute
- **Why?**
 - Part-whole relationship
- **How?**
 - Area and angle both encode relative quantity
 - Scalability:
a dozen categories



Internet meme: source unknown

Remove
to improve
the **pie chart** edition

When and how to use pie charts?



VAD chapter 9

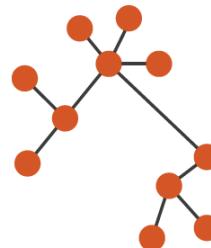
Arrange Networks and Trees

→ Node–Link Diagrams

Connection Marks

NETWORKS

TREES

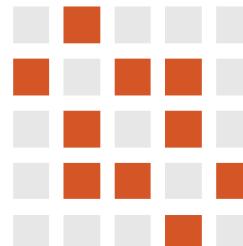


→ Adjacency Matrix

Derived Table

NETWORKS

TREES



→ Enclosure

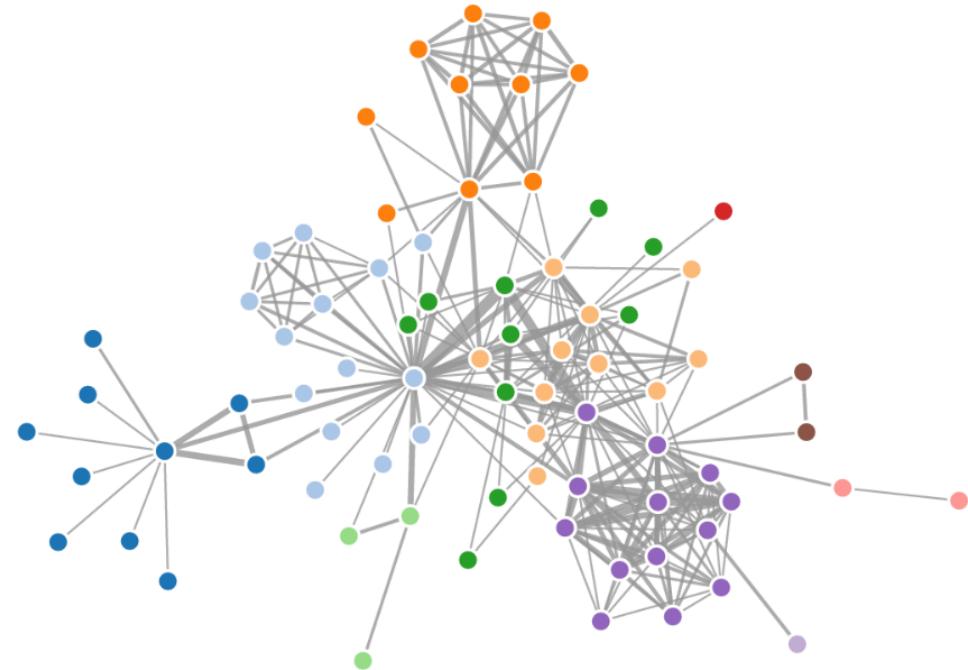
Containment Marks

NETWORKS

TREES



- **What?**
 - Graph / Network
 - Pairs of nodes define links
 - Links can be directed or undirected
- **Why?**
 - Task: Understand connectivity
- **How?**
 - Marks: labelled marks for nodes, lines for links
 - Scalability:
dozens of nodes,
relatively sparse links



<http://marvl.infotech.monash.edu/webcola>

Adjacency Matrix

▪ What?

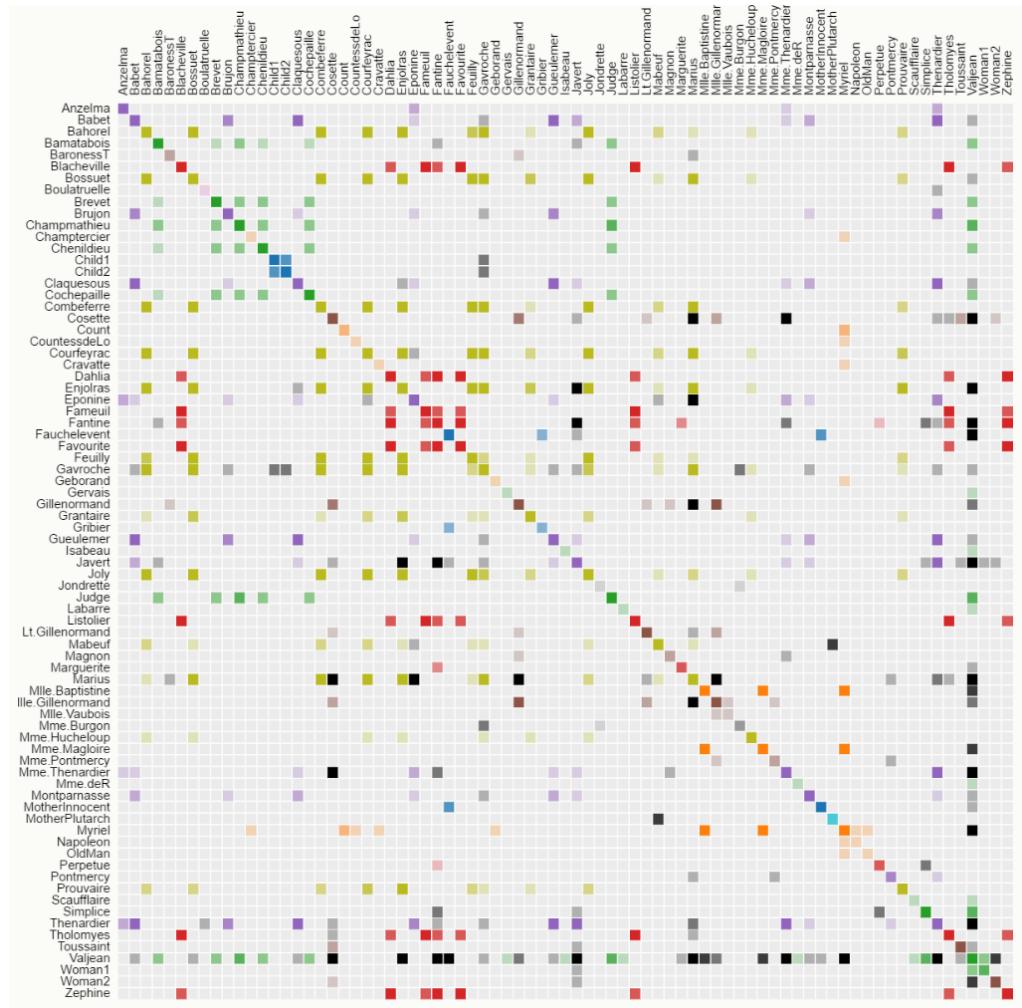
- Graph / Network
- Pairs of nodes define links
- Links can be directed or undirected

▪ Why?

- Task: Understand connectivity

▪ How?

- Marks:
 - Each node is both a column and a row
 - filled cells indicate a link
- Scalability: dozens of nodes, dense connectivity can be shown



<http://bl.ocks.org/jdfekete/raw/a8828c88060a1883b3f4/>

▪ What?

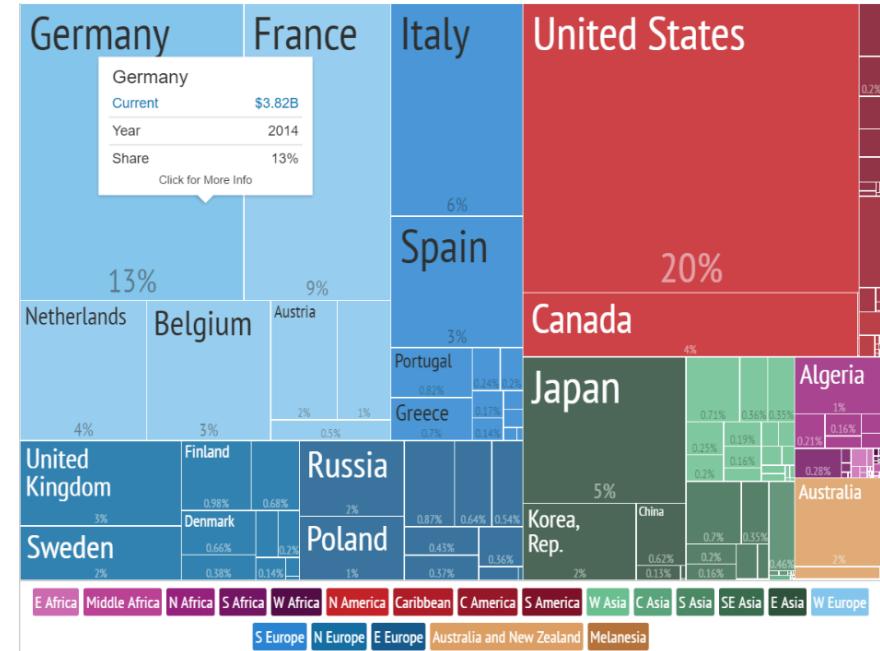
- Hierarchical (tree) structure over categories or items
- Quantitative attributes associated with nodes/items

▪ Why?

- Task: Understand distribution of quantities throughout the hierarchy

▪ How?

- Marks:
 - Areas proportional to quantitative attribute
- Scalability: without [interactivity](#) only larger regions have clearly visible labels



http://atlas.cid.harvard.edu/explore/tree_map/import/show/all/0901/2014/