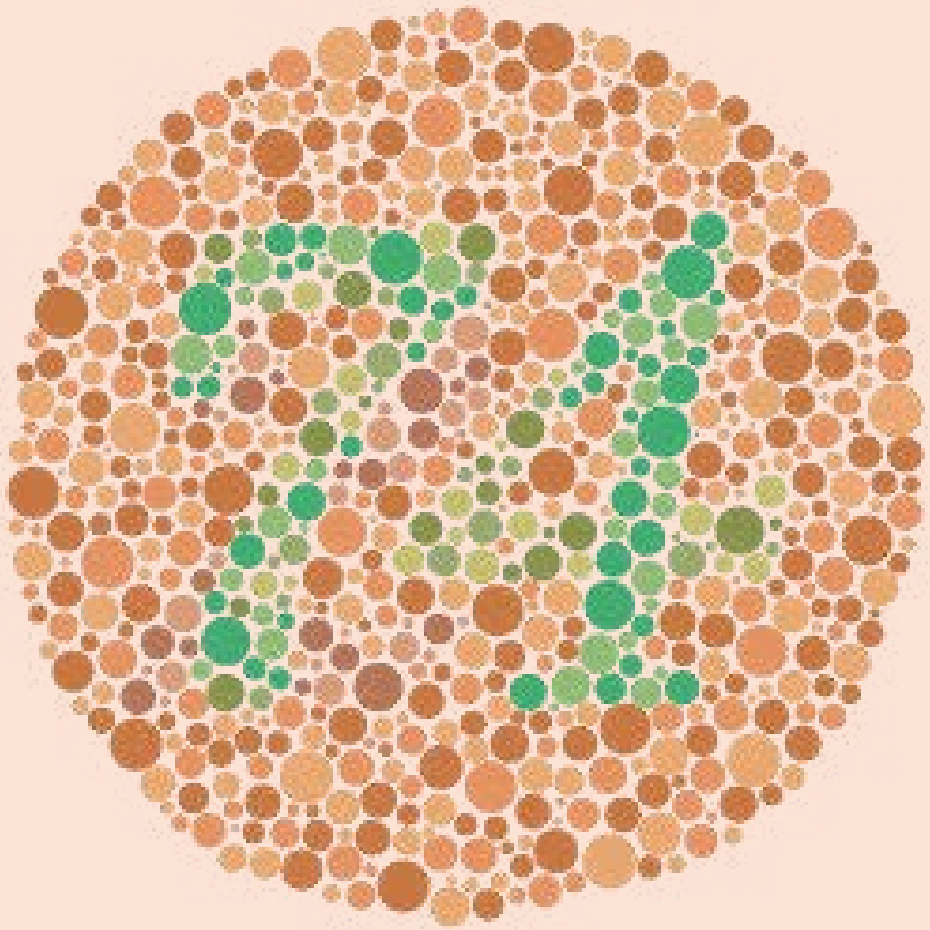
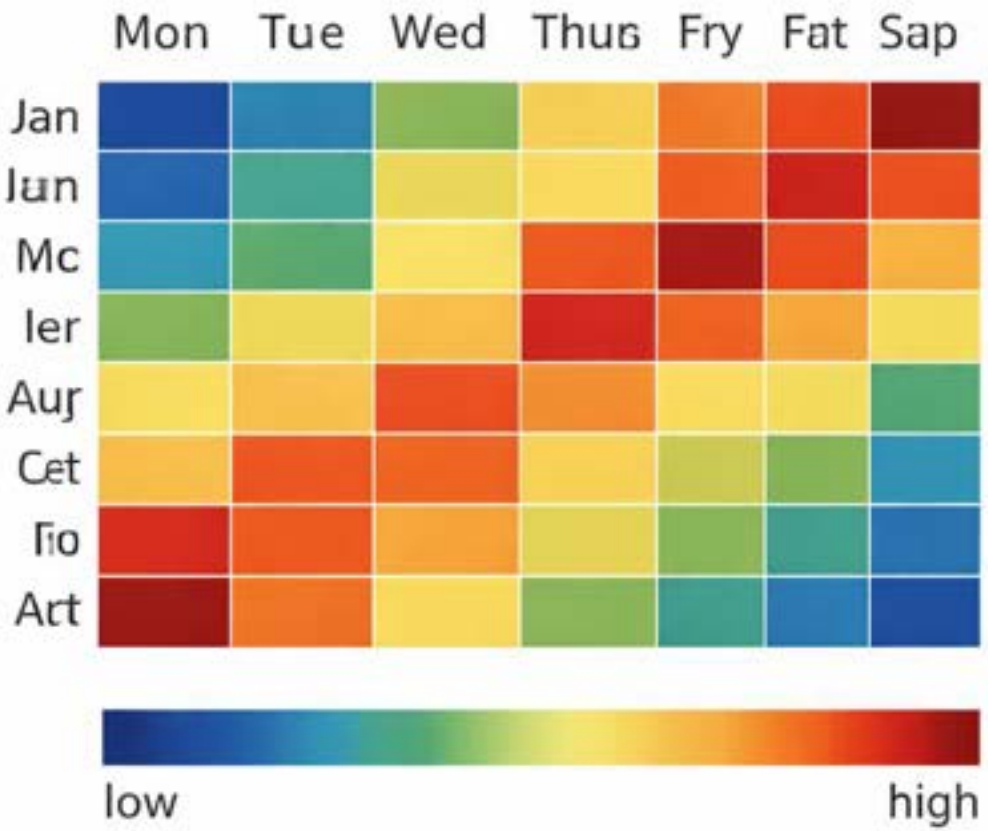

Charts

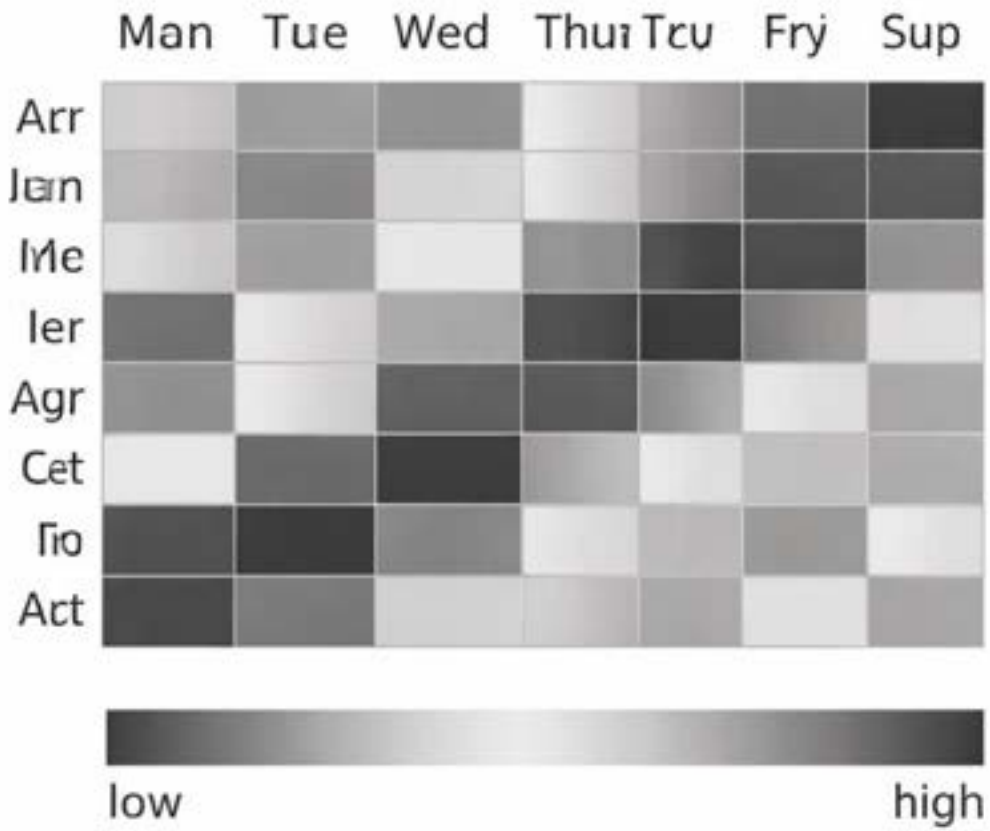
Excursion: Data Visualization & visual impairments



Charts may fail when color is lost

Heatmaps

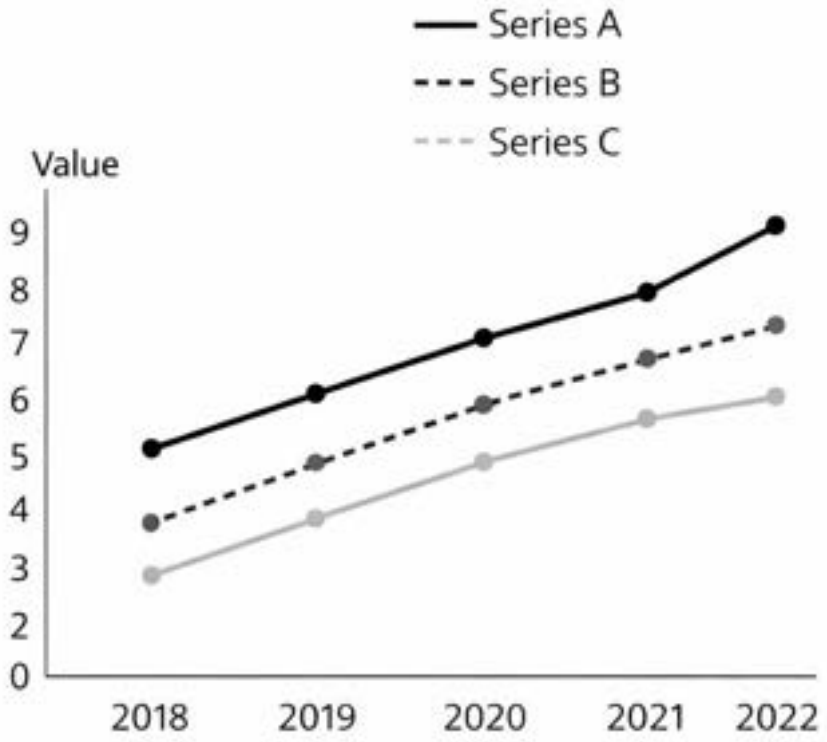


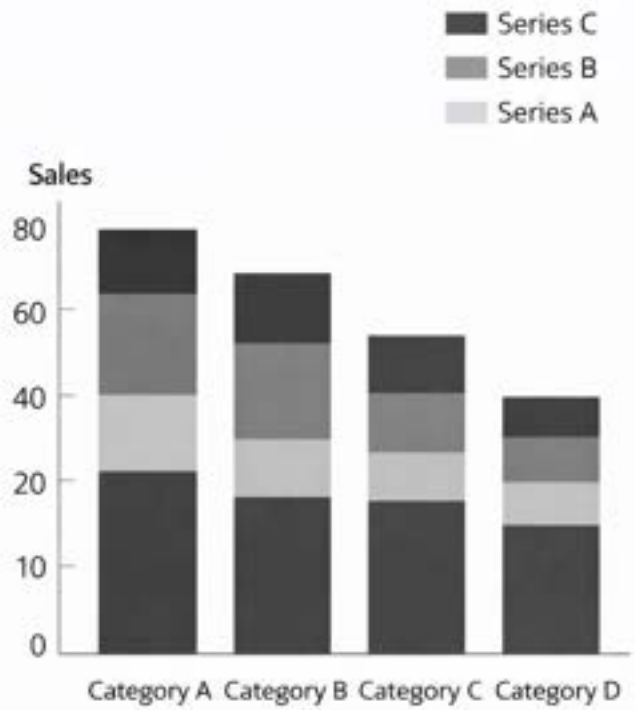


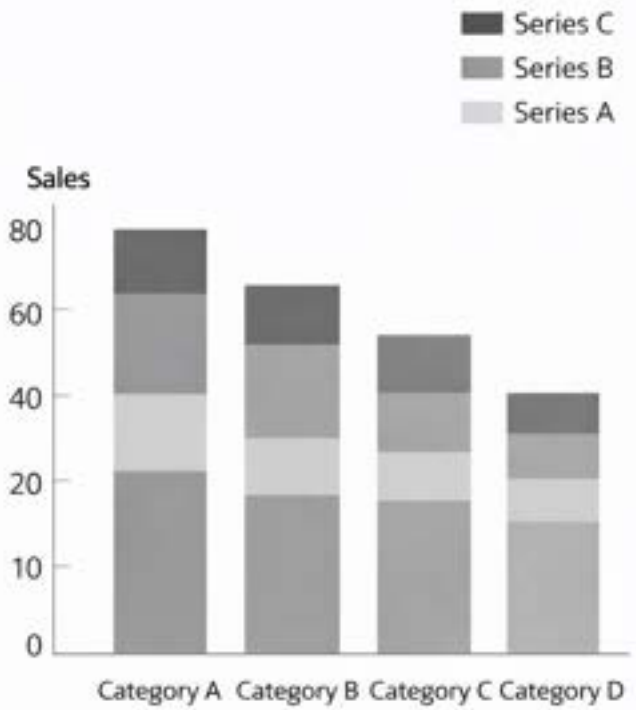
Charts may fail when color is lost

Pie Charts

Charts may fail when color is lost



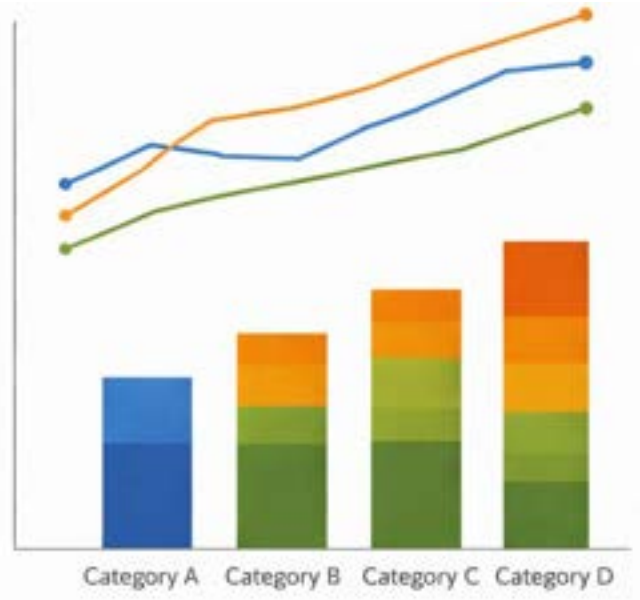


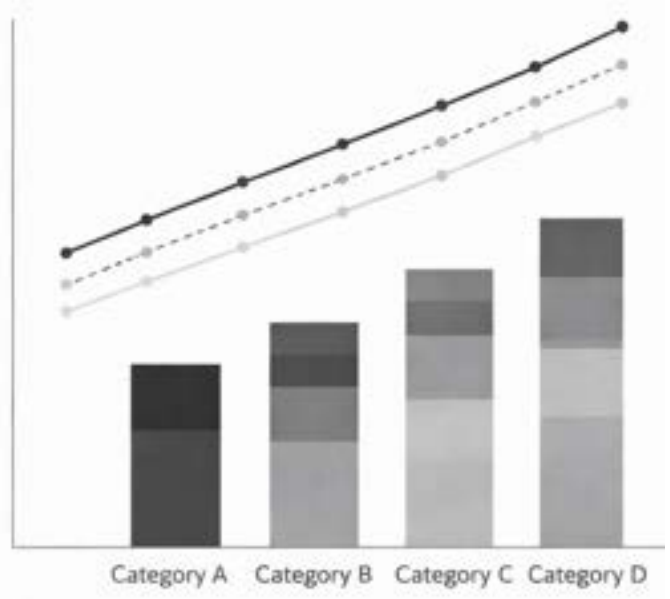


Line charts and bar charts are the safest options

Best practices

- Color should **not** be the **only carrier** of **information**
- Color **emphasizes** — it should not **explain**
- **Contrast** beats aesthetics
- Contrasting visuals **improve robustness**

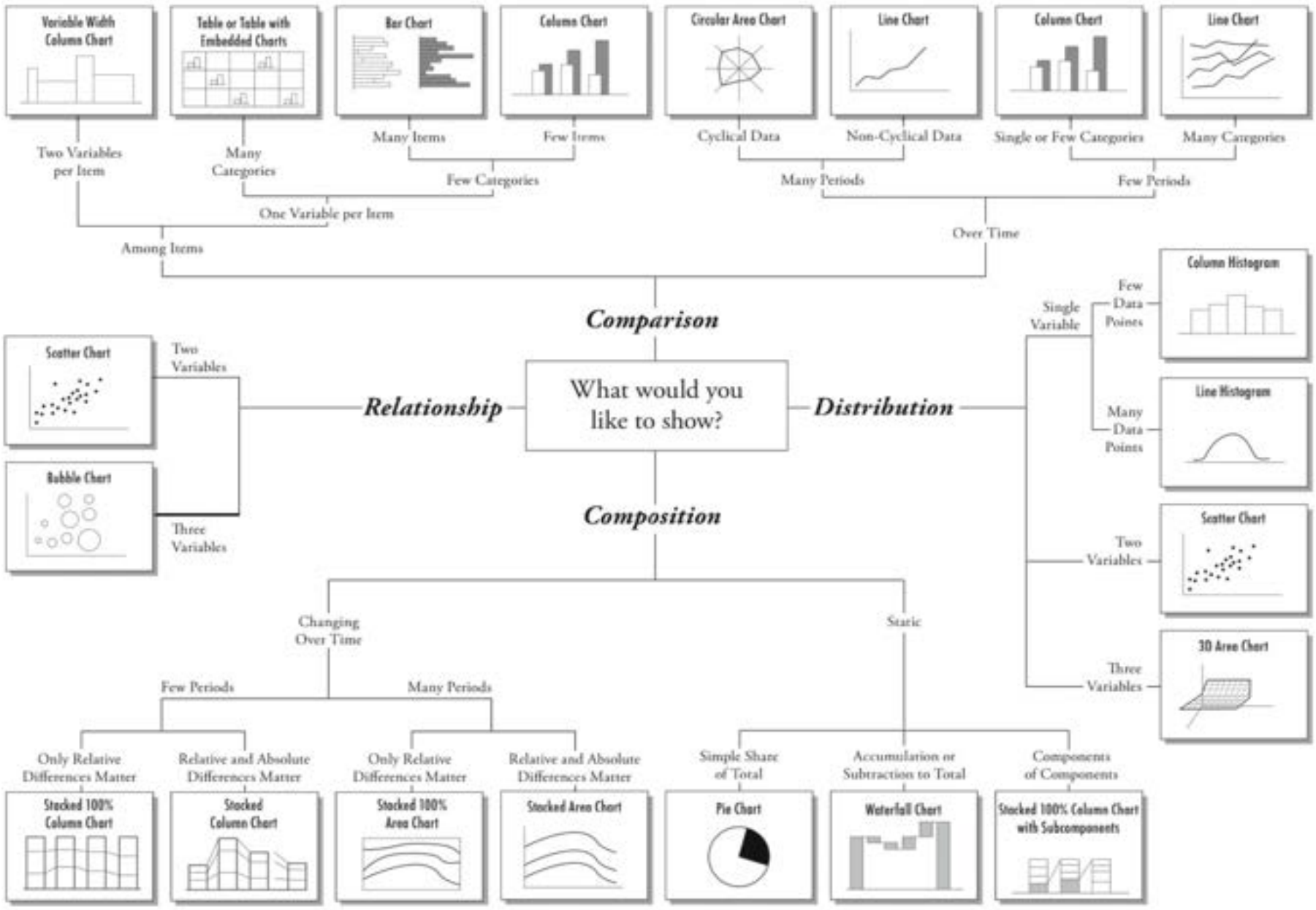




How do you pick the right chart or graph for your data?

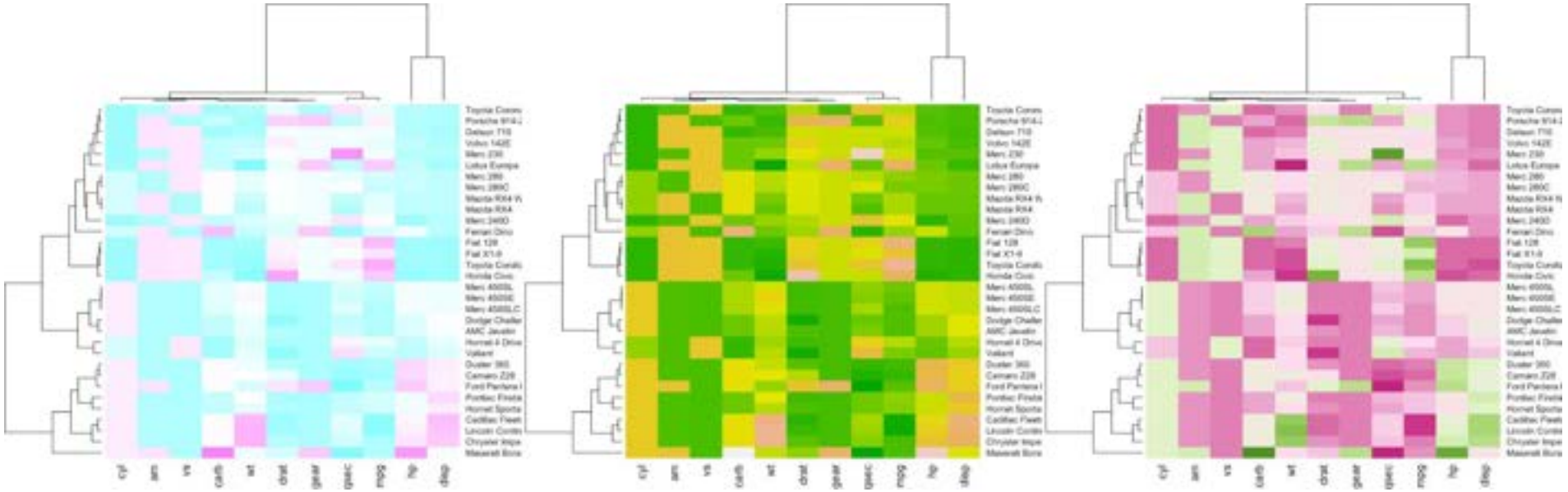
- Before making a chart it's important to understand why you need one.
- Charts help people understand complicated data, find patterns, identify trends, and tell a story.
- Think about the message you want to share with your audience.
  - How many variables do you want to show?
  - How many data points you want to display?
  - How you want to scale your axis?

Chart Suggestions – A Thought Starter



Heat Map

A heatmap is a graphical representation of data where the individual values contained in a matrix are represented as colors.



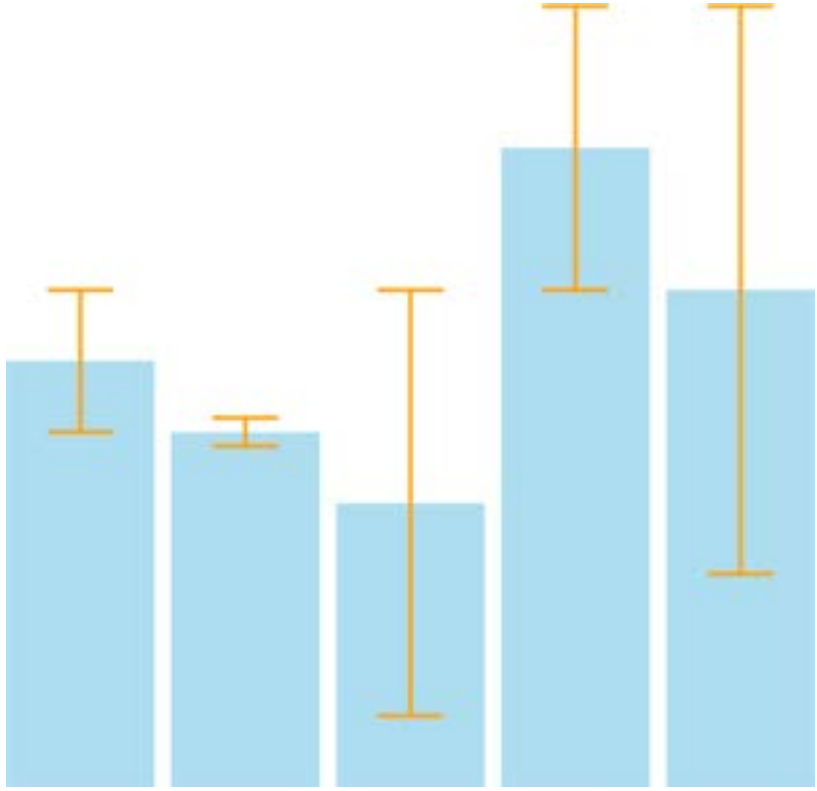
Heatmaps are built thanks to the `heatmap()` function, natively provided in R.

Bar plot

One of the most common types of graphic. It shows the relationship between a numeric and a categoric variable.

`ggplot2` allows to build barplot thanks to the `geom_bar()` function

Basic R can build quality barplots thans to the `barplot()` function



```r
# Most basic error bar
ggplot(data) +
    geom_bar( aes(x=name, y=value), stat="identity", fill="skyblue", alpha=0.7) +
    geom_errorbar( aes(x=name, ymin=value-sd, ymax=value+sd), width=0.4, colour="orange", alpha=0.9, size=1.3)
```

For a better visualization, barplots can be replaced by…

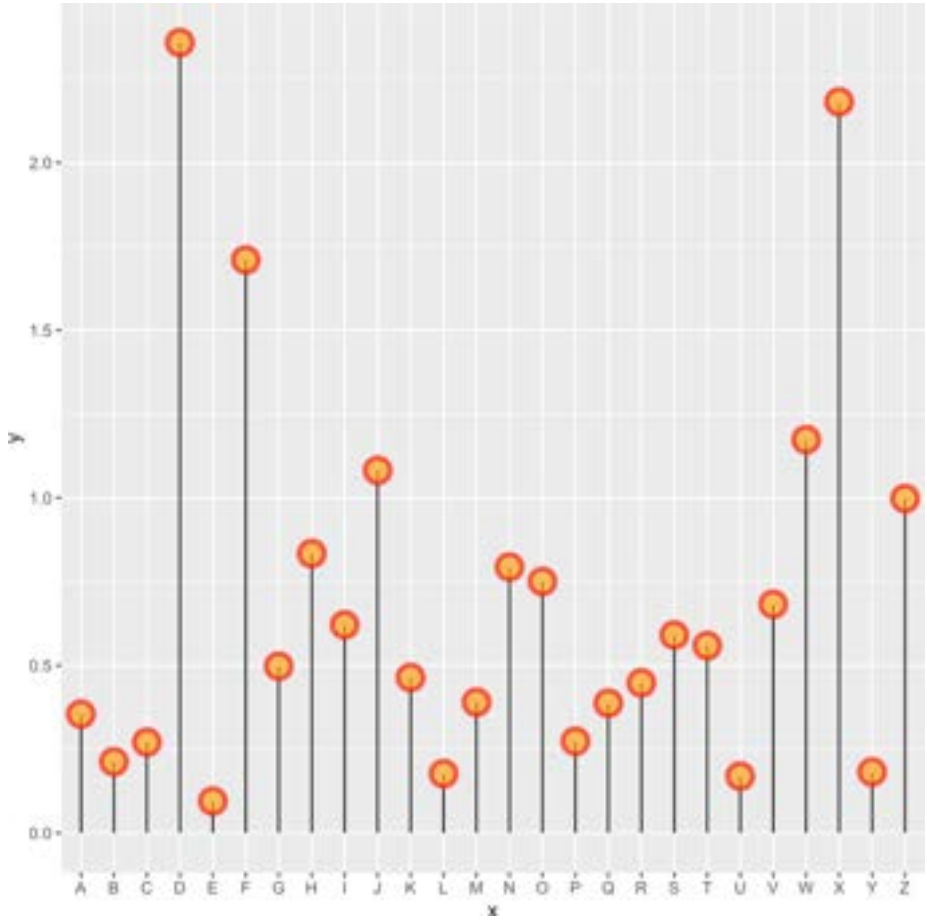
- Lollipop plot that replaces the bars with a segment and a dot.

```r
# Plot
ggplot(data, aes(x=x, y=y)) +
  geom_point() +
  geom_segment( aes(x=x, xend=x, y=0, yend=y))
```

```r
# Library
library(tidyverse)

# Create data
data <- data.frame(
  x=LETTERS[1:26],
  y=abs(rnorm(26))
)

# plot
ggplot(data, aes(x=x, y=y)) +
  geom_segment( aes(x=x, xend=x, y=0, yend=y)) +
  geom_point( size=5, color="red", fill=alpha("orange", 0.3), alpha=0.7, shape=21, stroke=2)
```

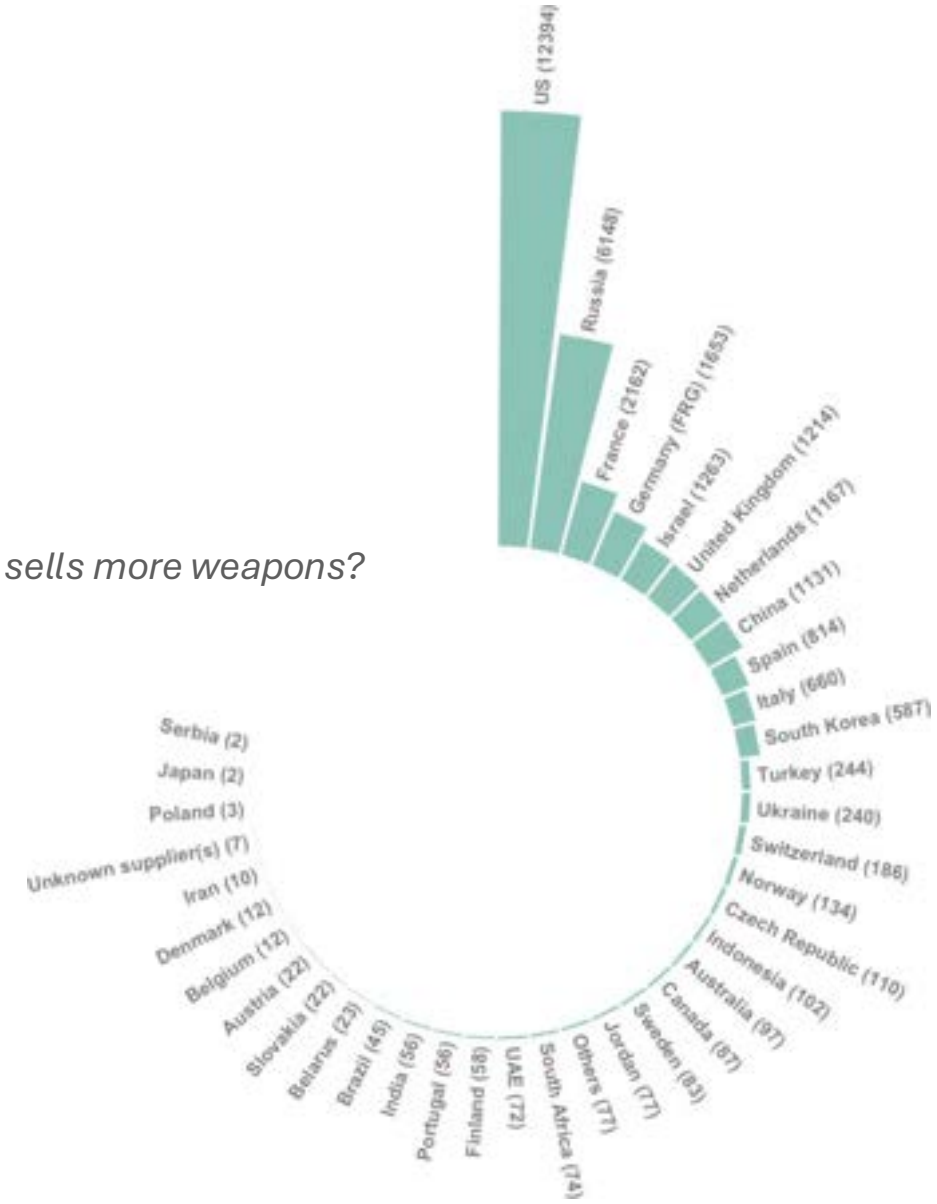


Circular barplot can also be considered if you have many groups.

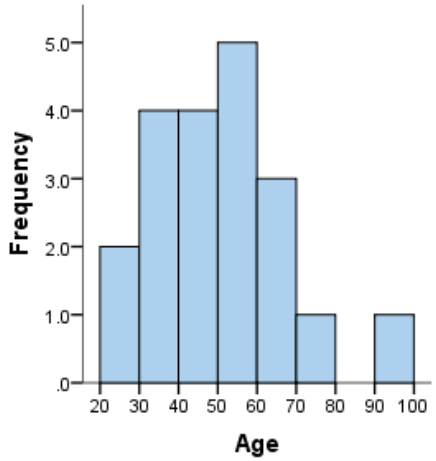
The group comparison is less accurate; thus, this option must be selected if there is an obvious pattern to show in the data.

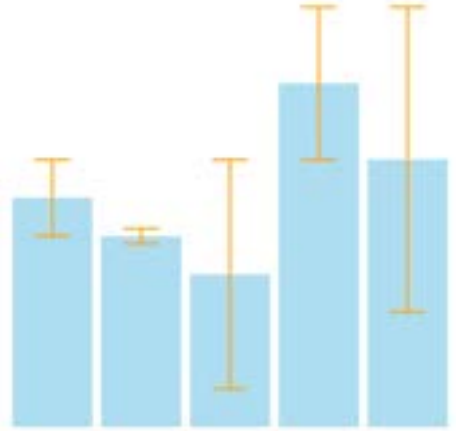
`coord_polar()`

Who sells more weapons?

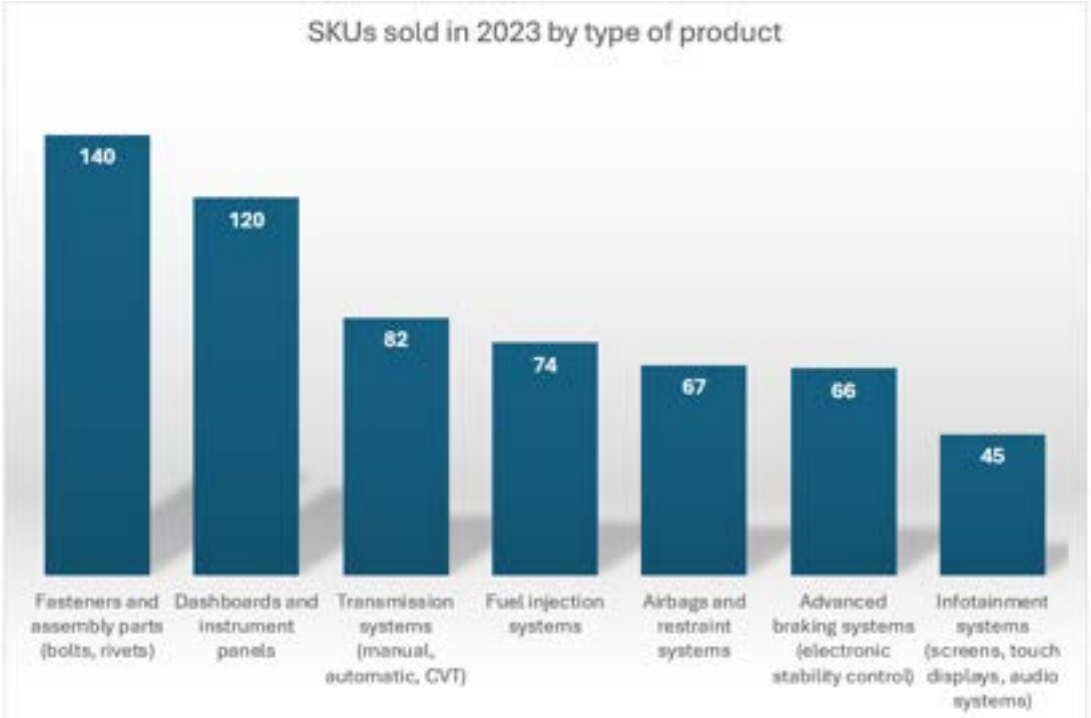


Common mistakes: Barplots

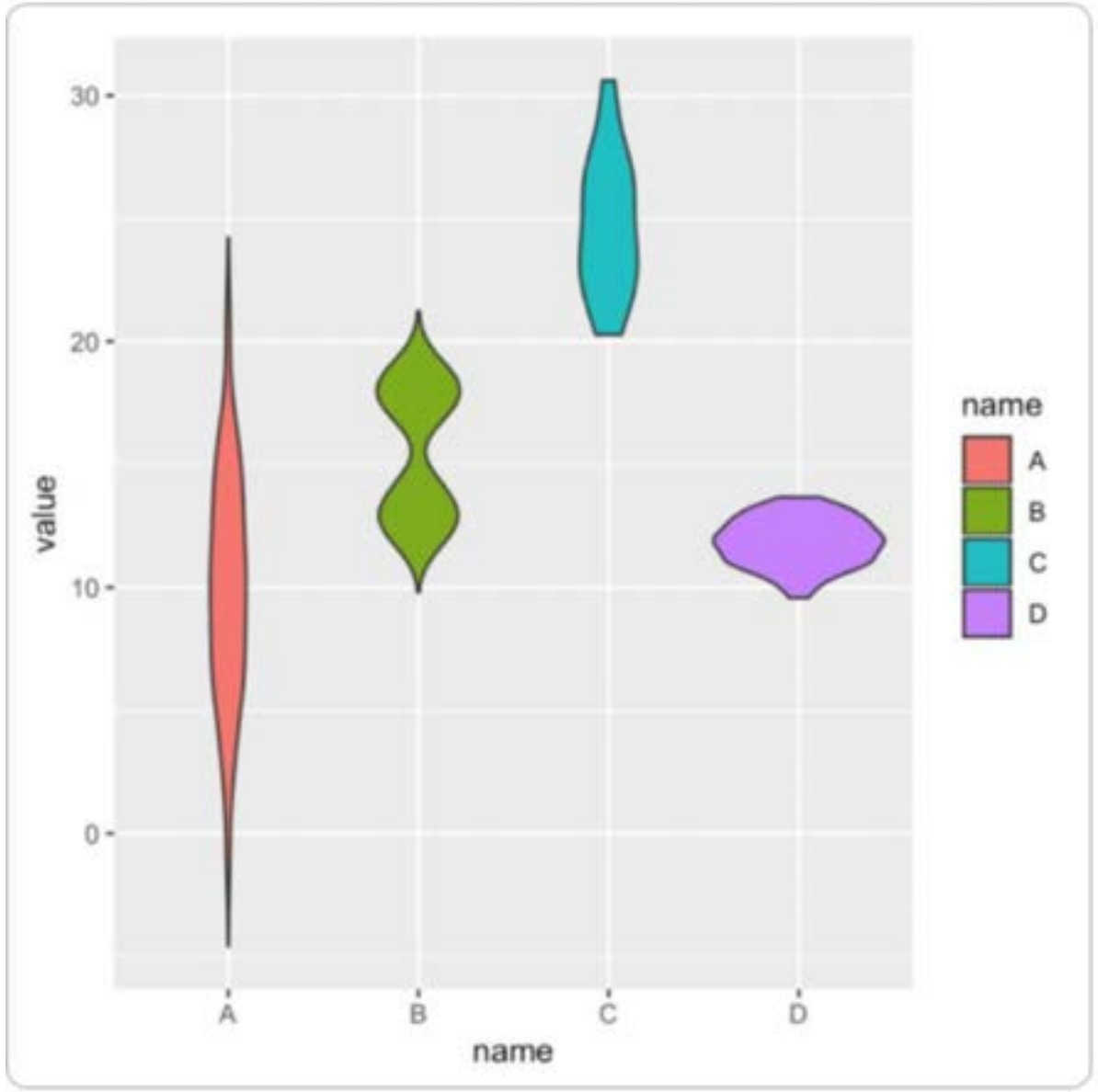




- Do not confound bar chart with histogram. A histogram has only a numeric variable as input and shows its distribution.
- Order your bars. If the levels of your categoric variable have no obvious order, order the bars following their values.
- Several values per group? Don't use a barplot.



Use it when the amount of data is vast and showing individual observations gets impossible.

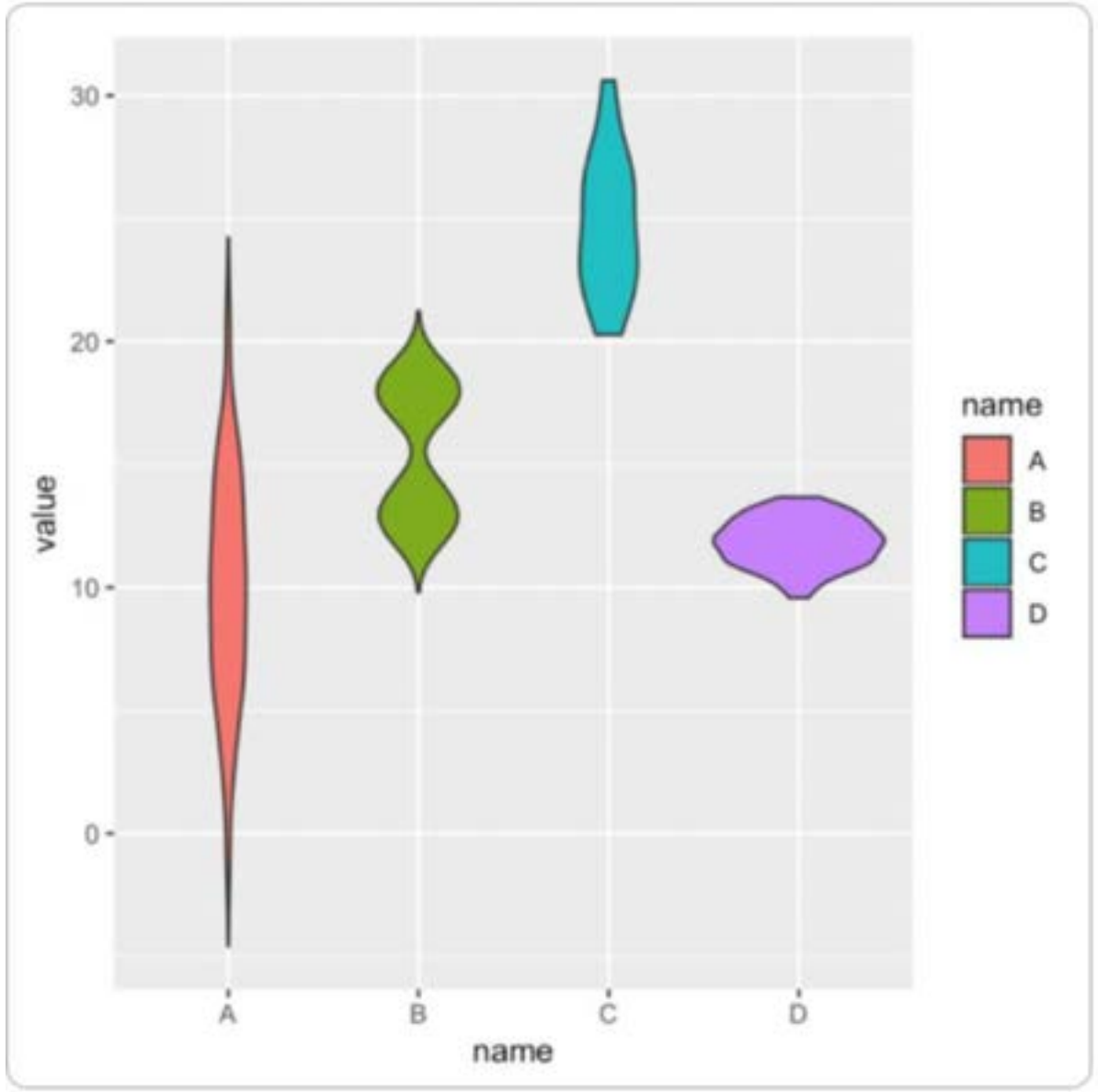


Allows to visualize the distribution of a numeric variable for one or several groups.

Each ‘violin’ represents a group or a variable.

The shape = the density estimate of the variable: the more data points in a specific range, the larger the violin is for that range

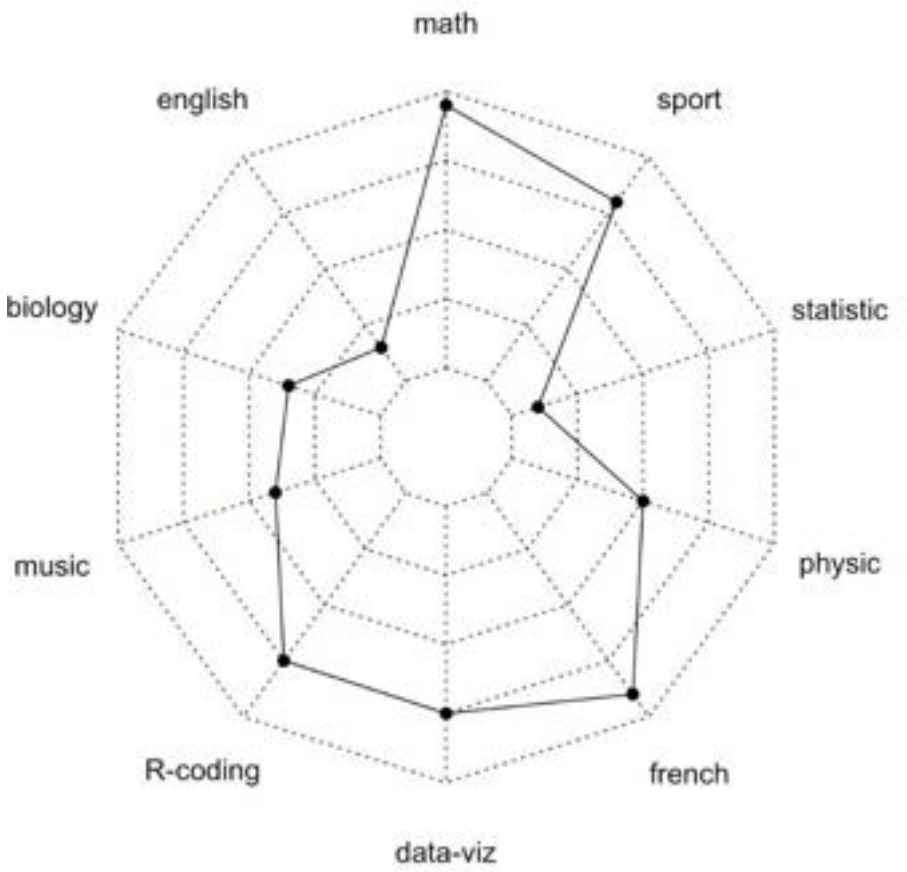
Violin charts can be produced with `ggplot2` thanks to the `geom_violin()` function



Radar plot

A radar or spider or web chart is a two-dimensional chart type designed to plot one or more series of values over multiple quantitative variables.

The package `fmsb` allows to build radar charts in R `radarchart(data)`

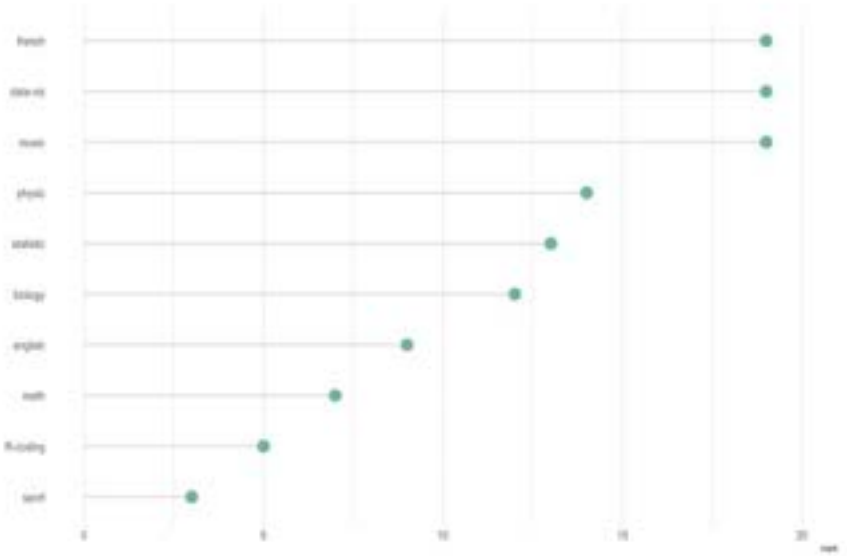


Common mistakes

Radar plots

- *Circular layout = harder to read. Quantitative values are much easier to compare when they are laid out along a* single vertical or horizontal axis. This is a general weakness made of circular layouts.

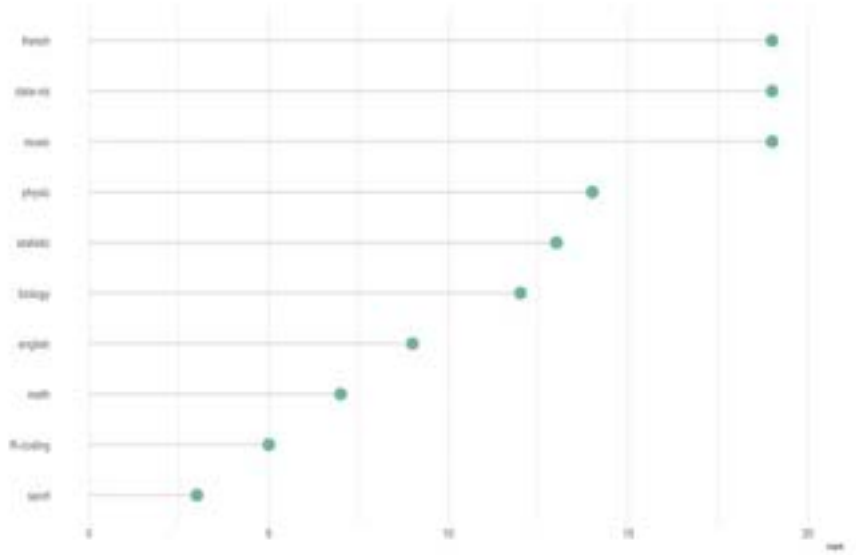
- *Supporting the ranking* - The lollipop plot is ordered in the above example. It allows you to see instantly which topic had the best mark and what the ranking of each topic was.



Common mistakes

Radar plots

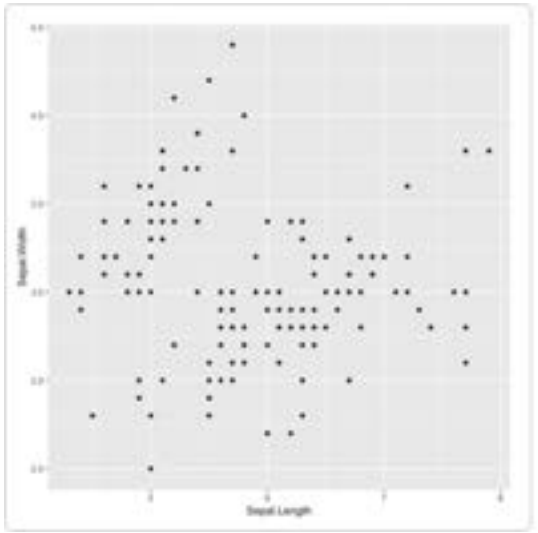
- *Category order has a huge impact* - Radar chart readers will probably focus on the shape observed. This can be misleading since this shape highly depends on the ordering of categories around the plot.

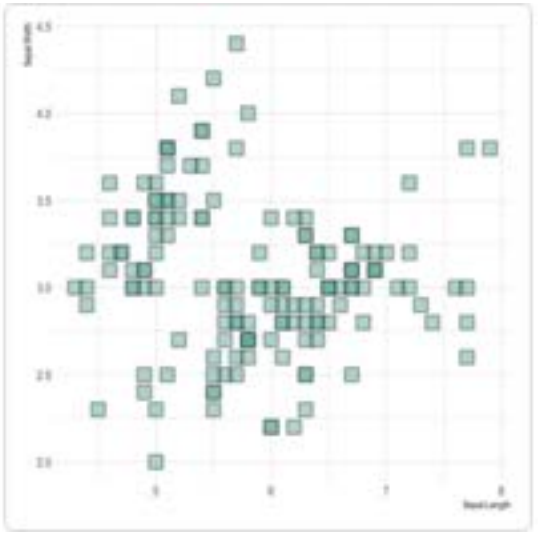


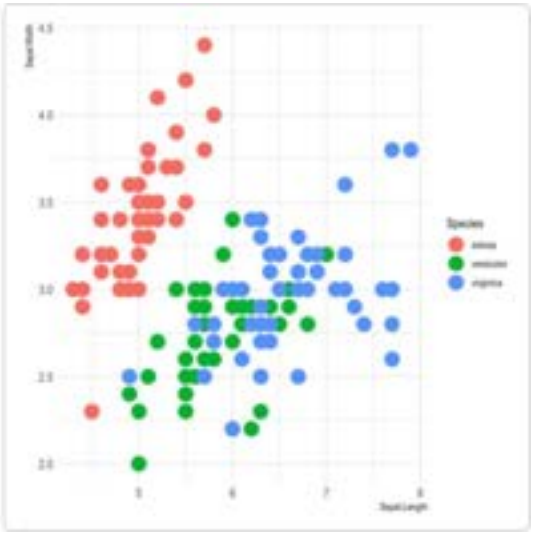
Scatter

A Scatterplot displays the relationship between 2 numeric variables. Each dot represents an observation. Their position on the X (horizontal) and Y (vertical) axis represents the values of the 2 variables.

Using ggplot2, scatterplots are built thanks to the `geom_point` function.



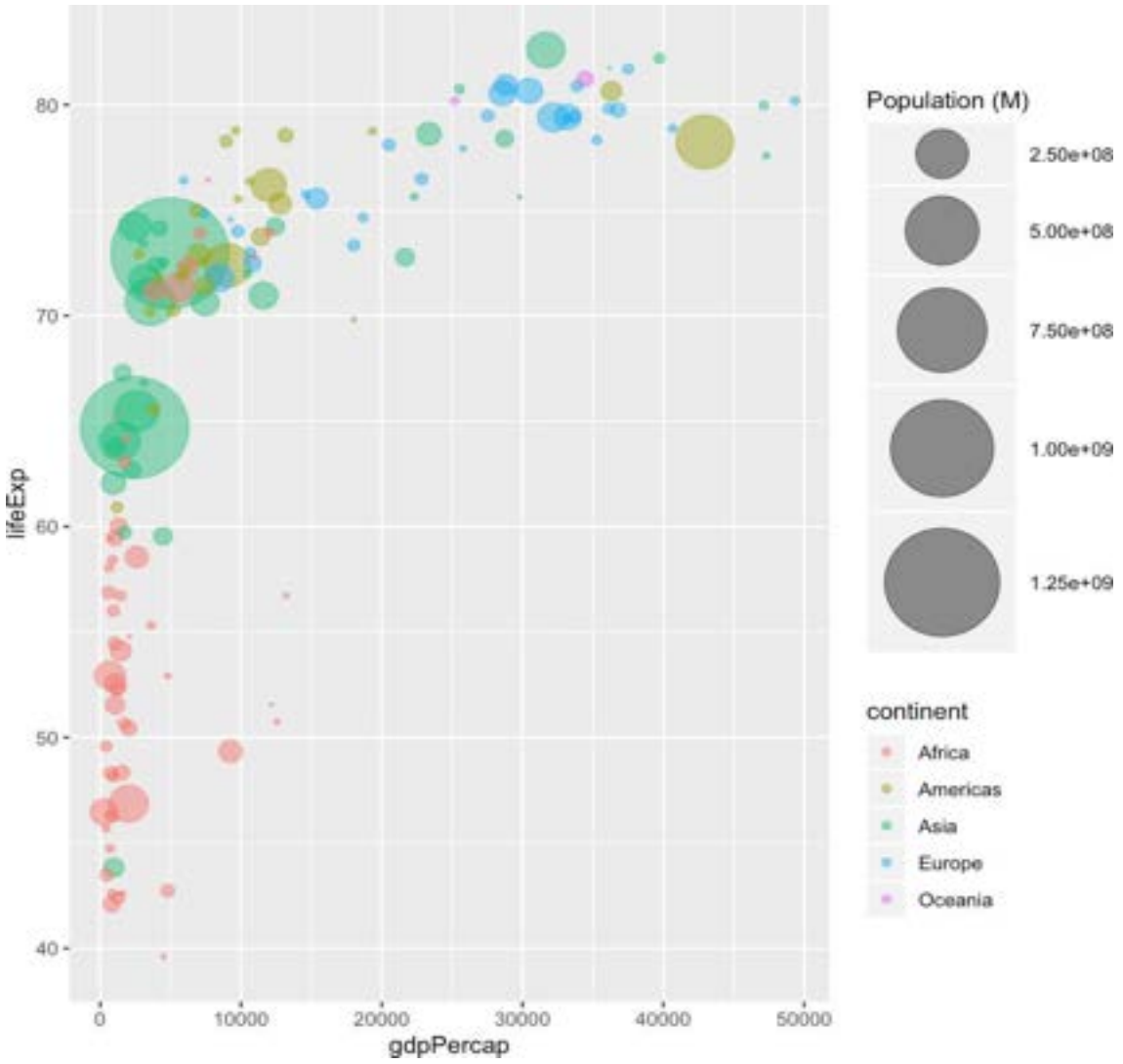




Bubble Plot

A **bubble plot** is a scatter plot with a third numerical variable used for circle **size**.

Ggplot2: geom_point()

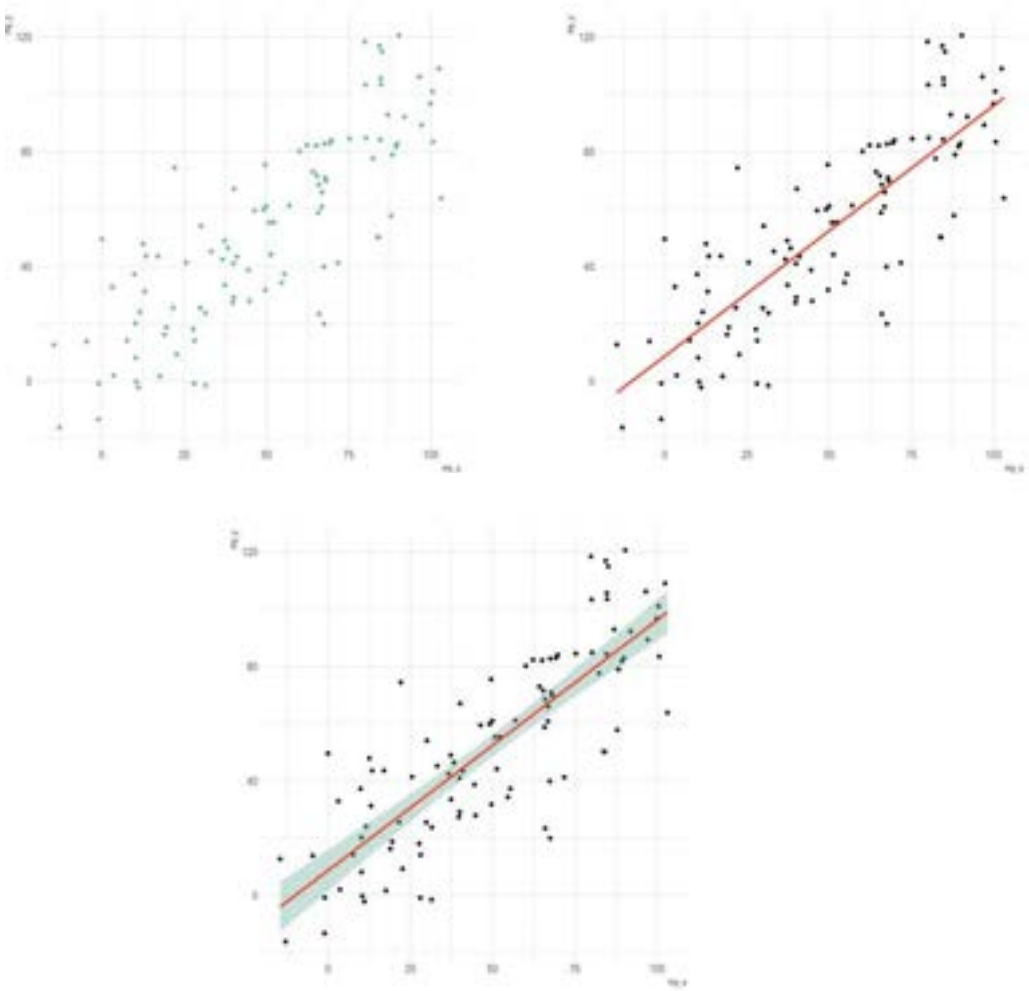


Linear Trend with Scatter plot

Adding a linear trend to a scatterplot helps the reader in seeing patterns.

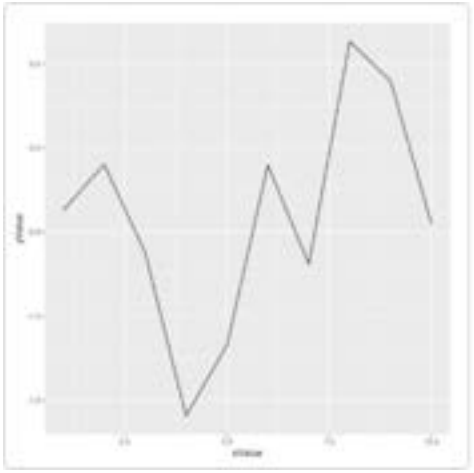
`ggplot2` provides `geom_smooth()` function.

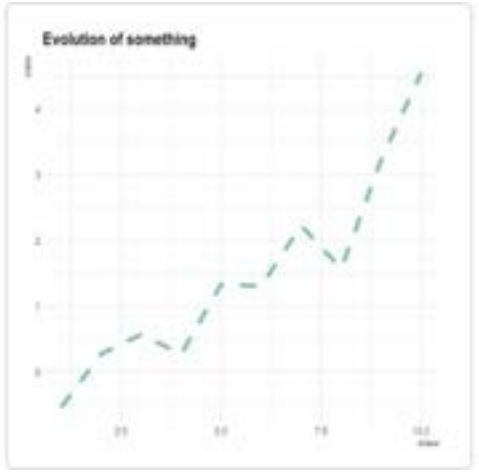
Allows to add the linear trend and the confidence interval around it if needed (option `se=TRUE`).

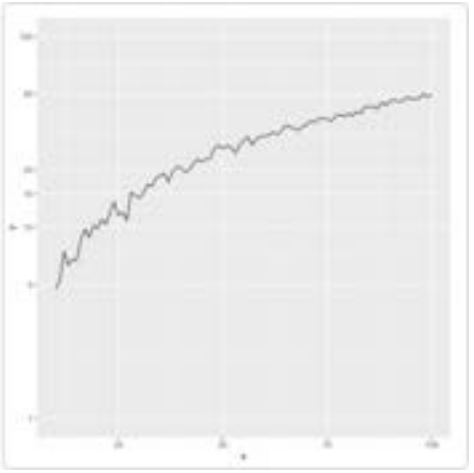


Line Chart

A **line chart** is often used to visualize a trend in data over intervals of time – a time series – thus the line is often drawn chronologically.







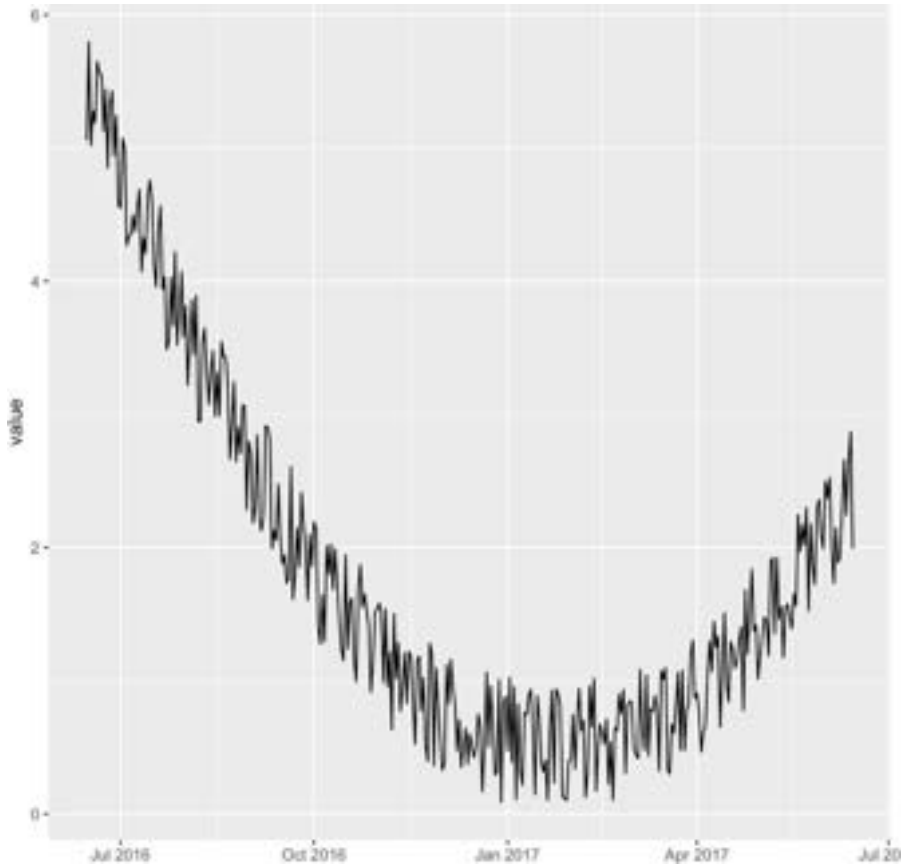
`ggplot` allows to draw line charts thanks to the `geom_line()` function. It expects as input a data frame with 2 numeric variables, one displayed on each axis.

Time Series

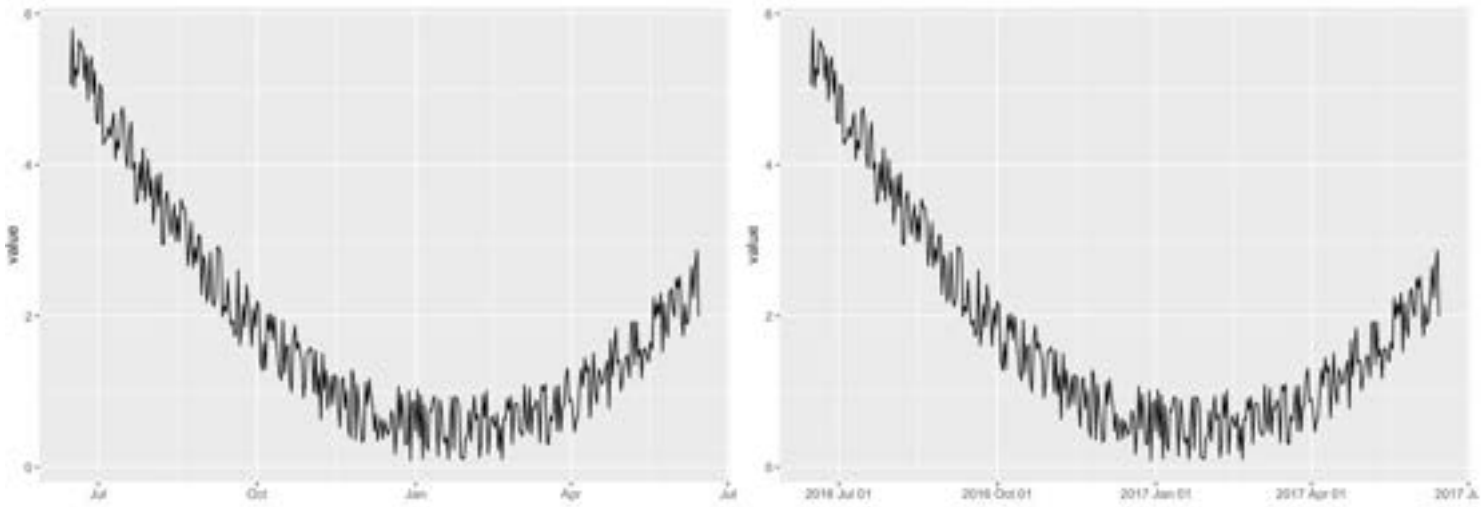
The `ggplot2` package recognizes `date` format and automatically uses a specific type of X axis.
If the time variable isn't at the `date` format, this won't work.

Always check with `str(data)` how variables are understood by R. If not read as a date, use lubridate to convert it.

The `date` format will be recognized automatically, resulting in neat X-axis labels.



Time Series



As soon as the time variable is recognized as a date, you can use the scale_x_date() function to choose the format displayed on the X axis.

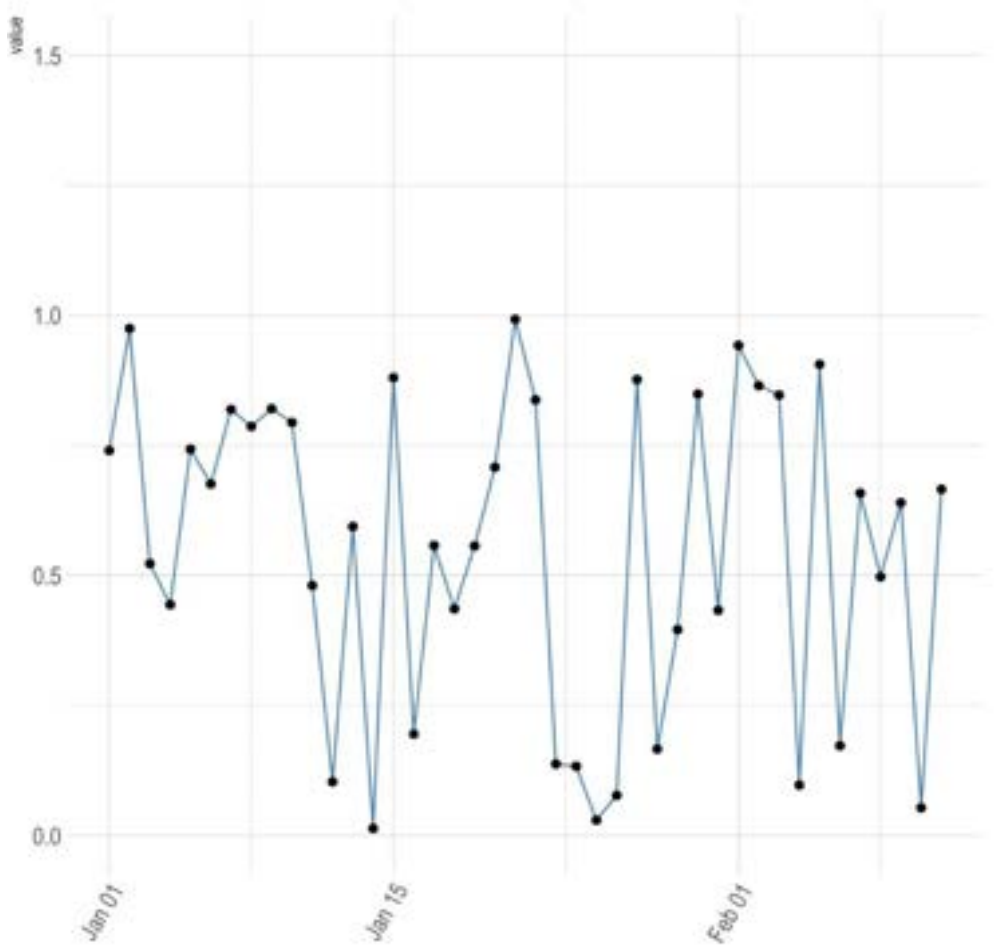
```
p+scale_x_date(date_labels = "%b")
p+scale_x_date(date_labels = "%Y %b %d")
p+scale_x_date(date_labels = "%W")
p+scale_x_date(date_labels = "%m-%Y")
```

Symbol	Meaning	Example
%d	day as a number (0-31)	01-31
%a %A	abbreviated weekday unabbreviated weekday	Mon Monday
%m	month (00-12)	00-12
%b %B	abbreviated month unabbreviated month	Jan January
%y %Y	2-digit year 4-digit year	07 2007

Select time frame

Use the `limit` option of the `scale_x_date()` function to select a time frame in the data:

```
p <- ggplot(data, aes(x=day, y=value)) +
  geom_line( color="steelblue") +
  geom_point() +
  xlab("") +
  theme_ipsum() +
  theme(axis.text.x=element_text(angle=60, hjust=1)) +
  scale_x_date(limit=c(as.Date("2017-01-01"),as.Date("2017-02-11"))) +
  ylim(0,1.5)
```

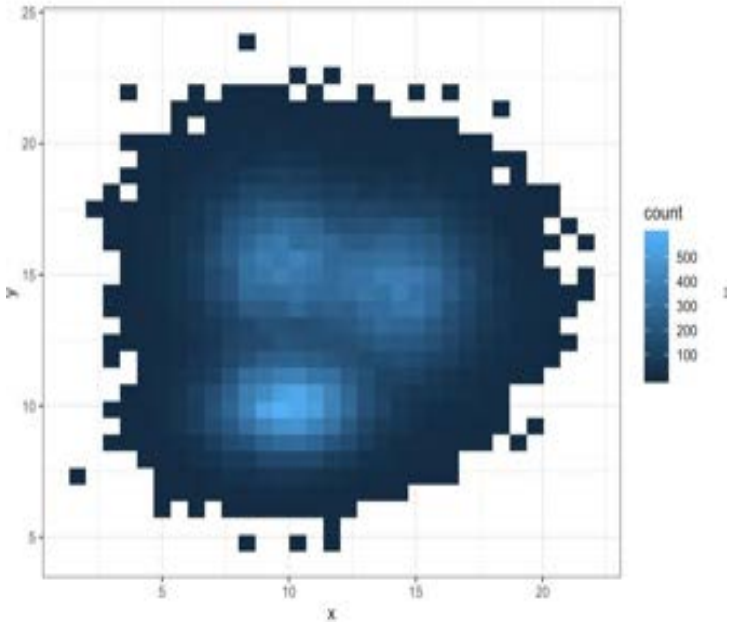


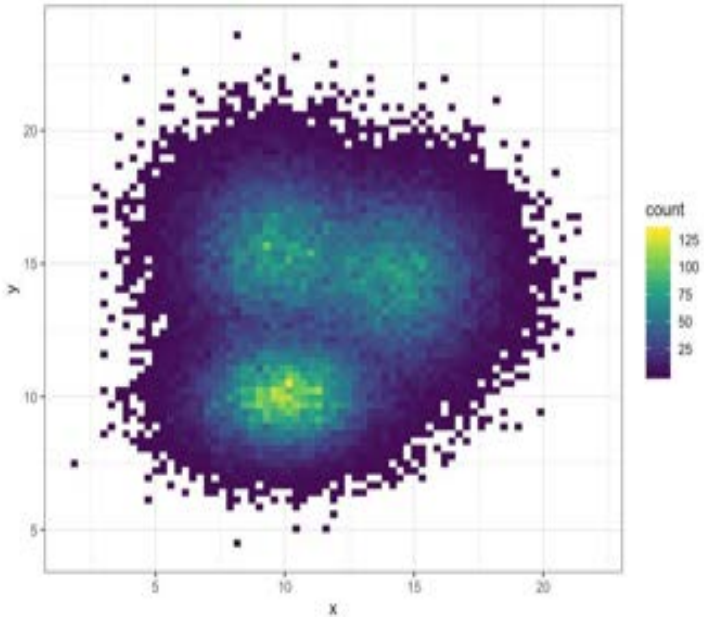
2d Histogram

The plot area is divided in a multitude of squares

Use the `geom_bin_2d()` function. This function offers a `bins` argument that controls the number of bins you want to display.

```
# Bin size control + color palette
ggplot(data, aes(x=x, y=y) ) +
  geom_bin2d(bins = 70) +
  scale_fill_continuous(type = "viridis") +
  theme_bw()
```

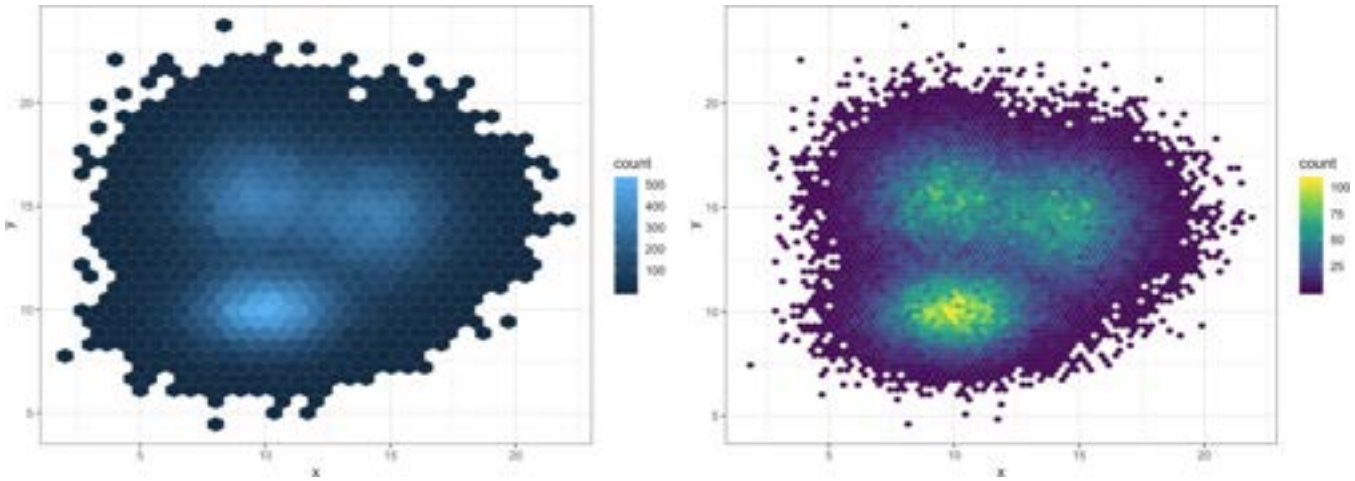




Hexbin chart

Another alternative is to divide the plot area in a multitude of hexagons: it is thus called a hexbin chart, and is made using the `geom_hex()` function.

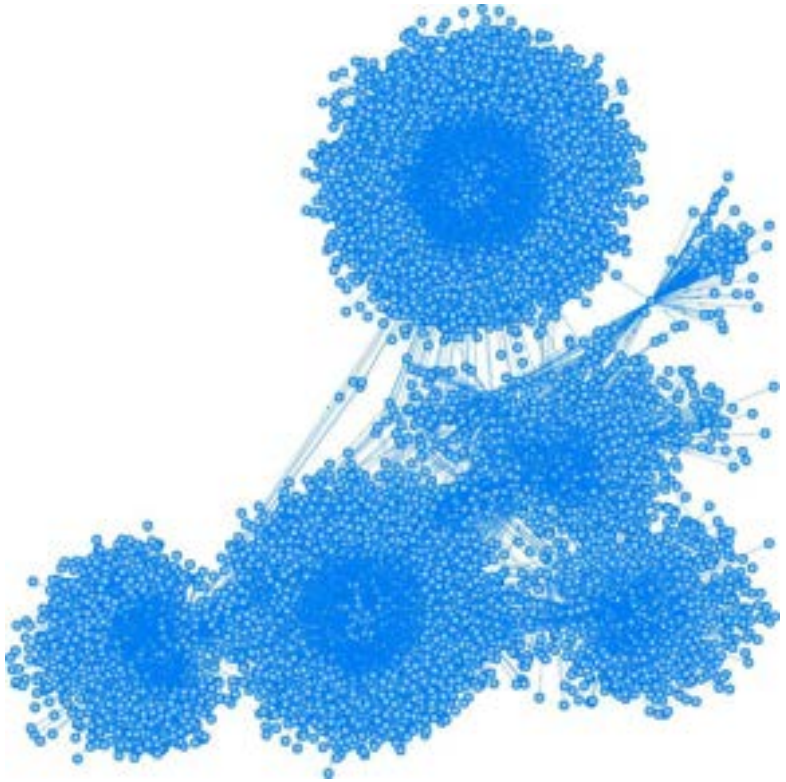
Provides the `bins` argument as well, to control the number of division per axis.



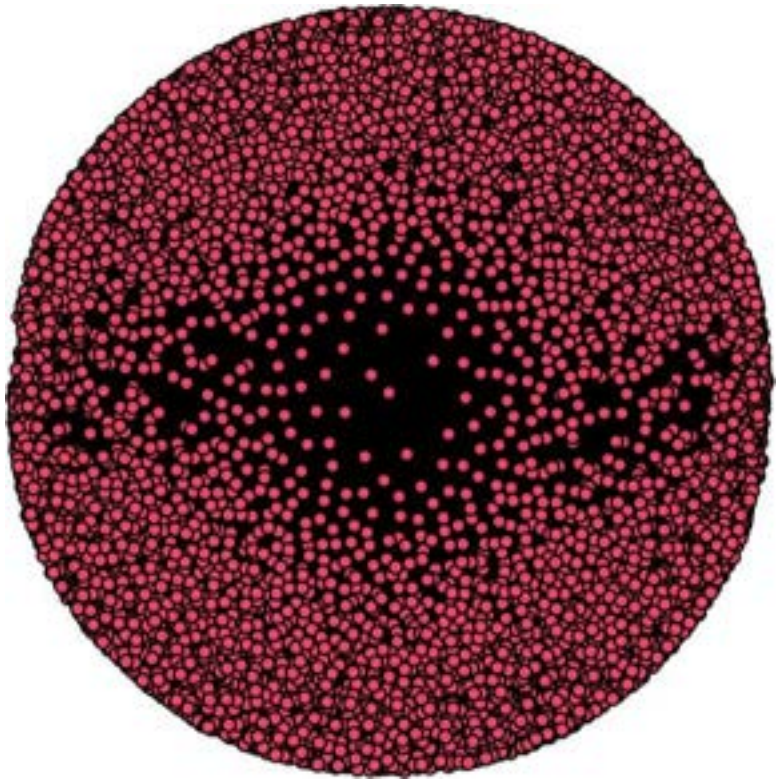
```
# Bin size control + color palette
ggplot(data, aes(x=x, y=y) ) +
  geom_hex(bins = 70) +
  scale_fill_continuous(type = "viridis") +
  theme_bw()
```

Social Network - Entities are represented as nodes, and the relationships between entities are represented as lines that are called links.

library(visNetwork)



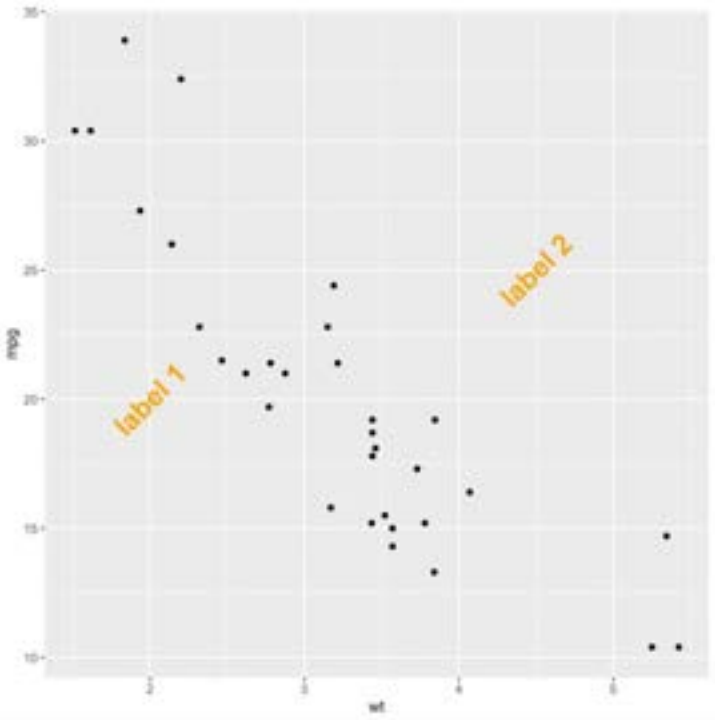
library(Network)

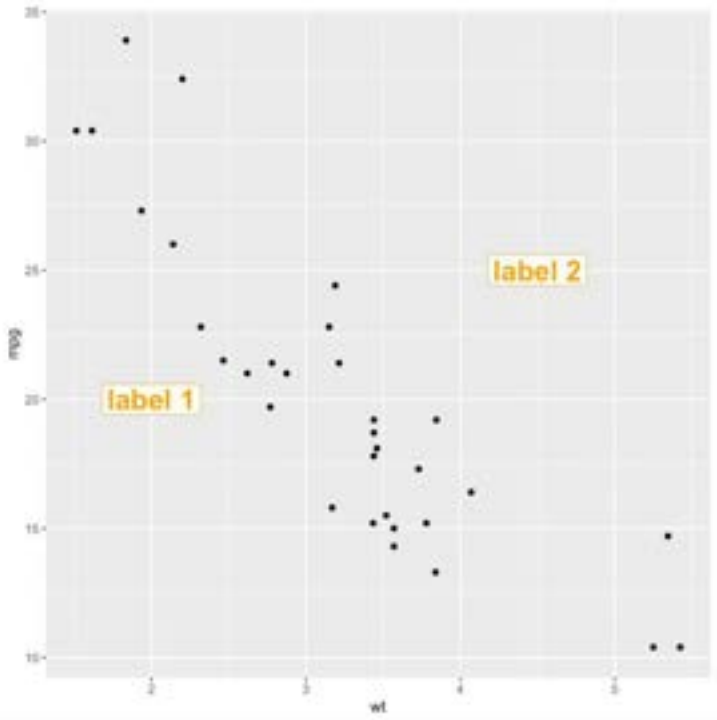


Annotation with `geom_text()` or `geom_label()`

Text is the most common kind of annotation. It allows to give more information on the most important part of the chart.

Using `ggplot2` , 2 main functions are available for that kind of annotation:



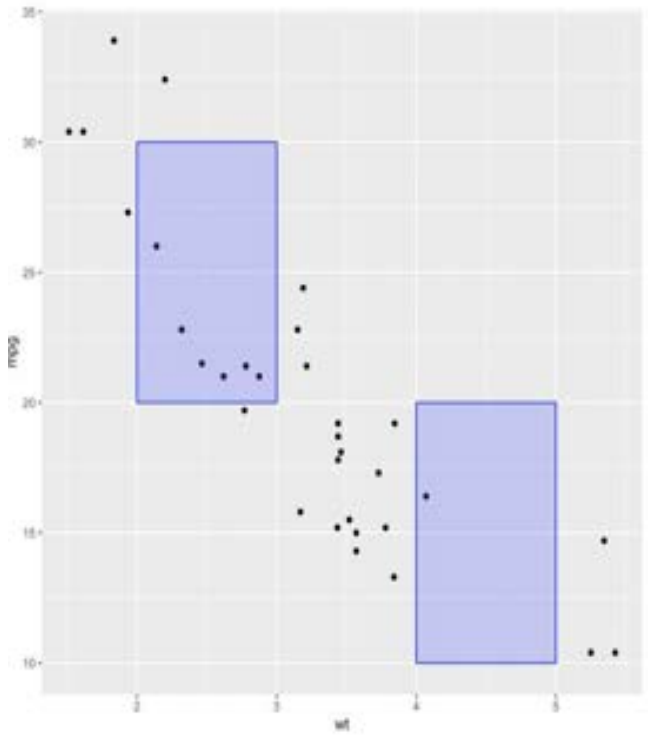


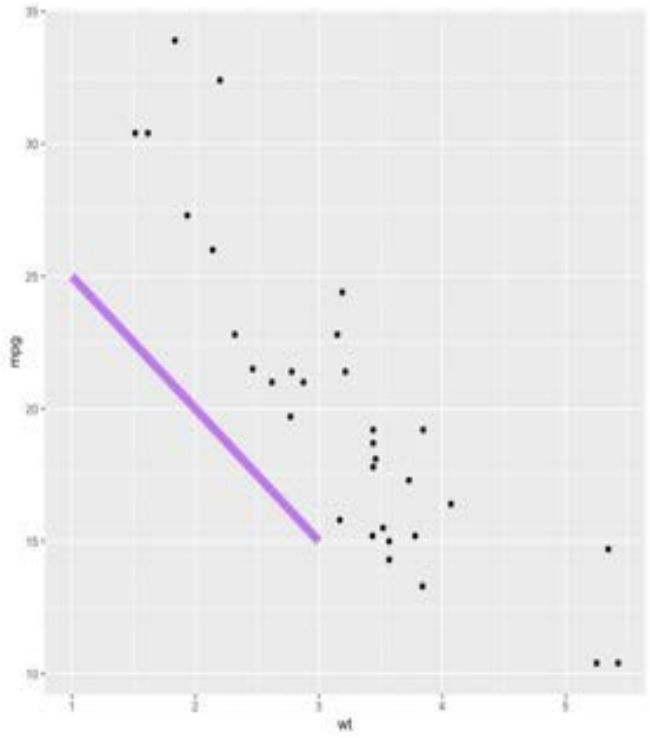
`geom_te` to add a simple piece of text

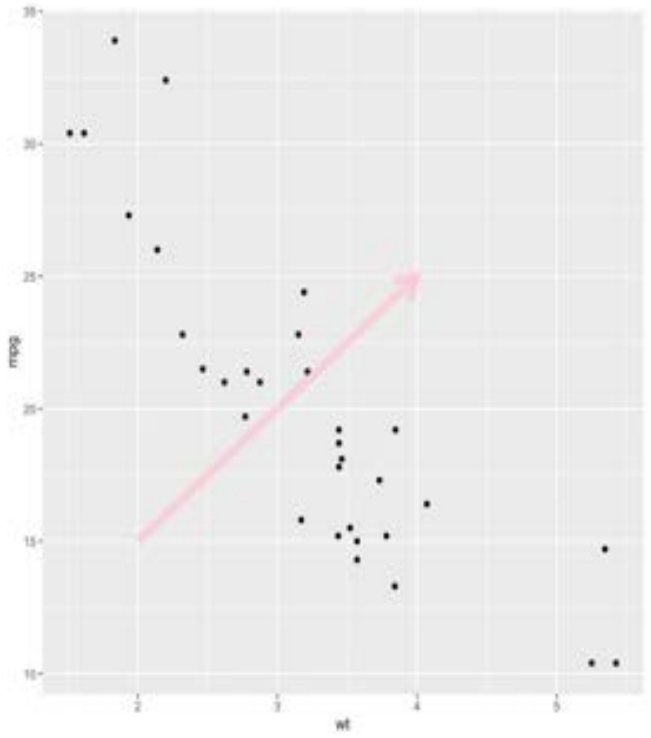
`geom_lab el` to add a label: framed text

Adding text with `geom_text()` or `geom_label()`

Add shapes with `annotate()`







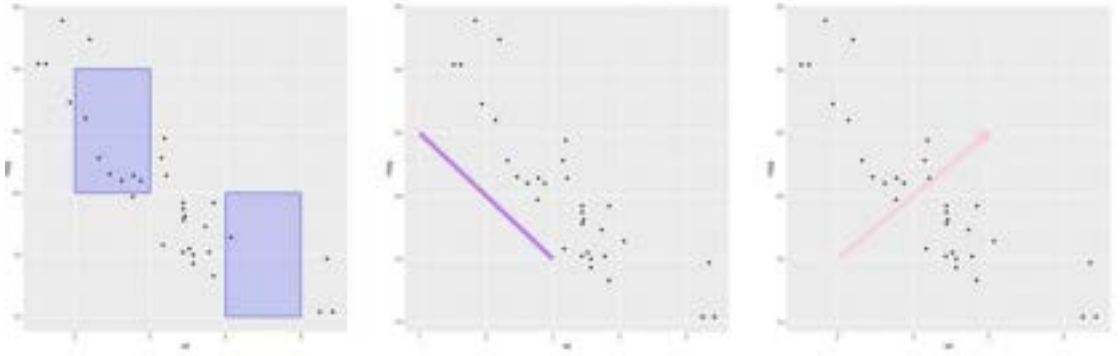
Adding text with geom_text() or geom_label()

Add shapes with annotate()

```
# Add rectangles
p + annotate("rect", xmin=c(2,4), xmax=c(3,5), ymin=c(20,10) , ymax=c(30,20), alpha=0.2, color="blue", fill="blue")

# Add segments
p + annotate("segment", x = 1, xend = 3, y = 25, yend = 15, colour = "purple", size=3, alpha=0.6)

# Add arrow
p + annotate("segment", x = 2, xend = 4, y = 15, yend = 25, colour = "pink", size=3, alpha=0.6, arrow=arrow())
```



dataviz resources

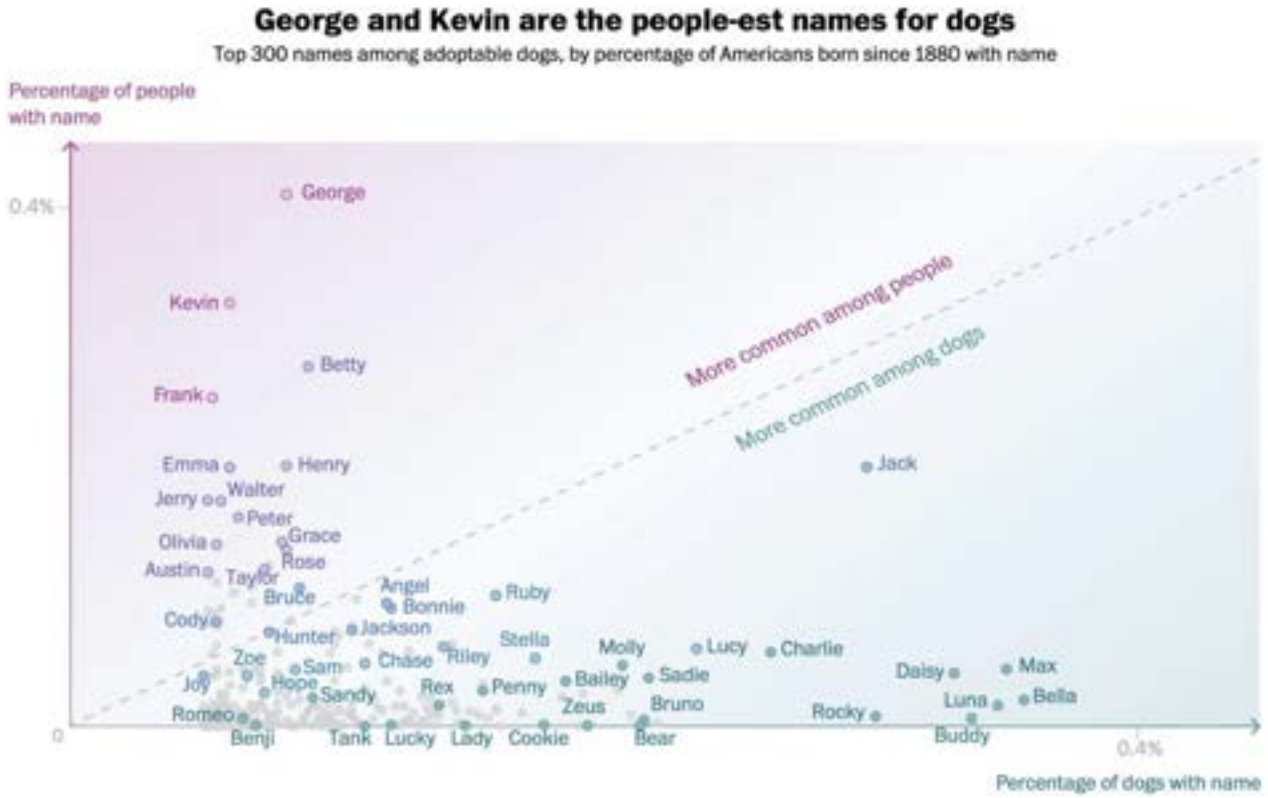
Data Visualization Tools

Our world data mission: “research and data to make progress against the world’s largest problems”.

https://ourworldindata.org/

Data Visualization Tools

Names that are more dog or more human



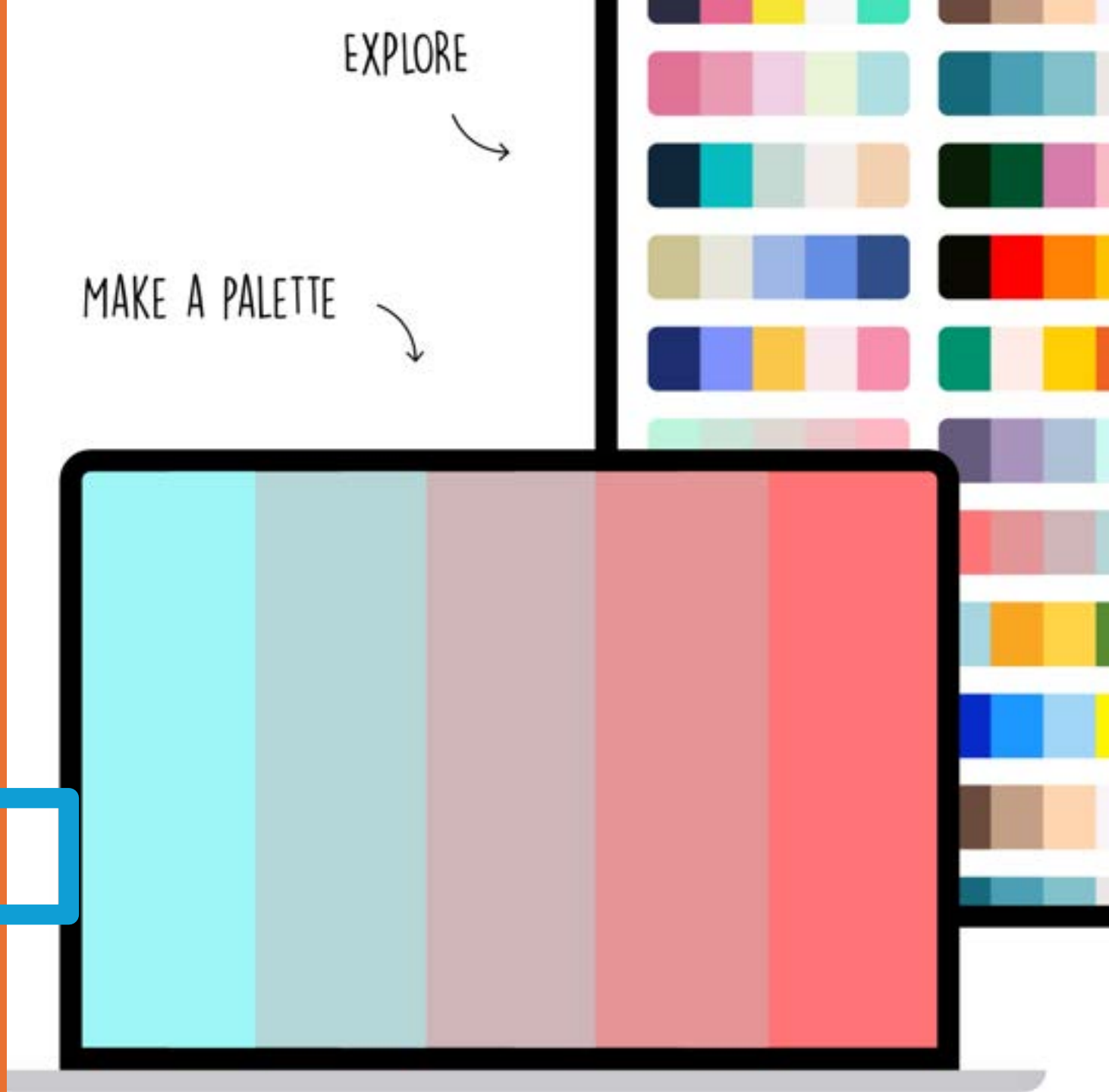
https://flowingdata.com/

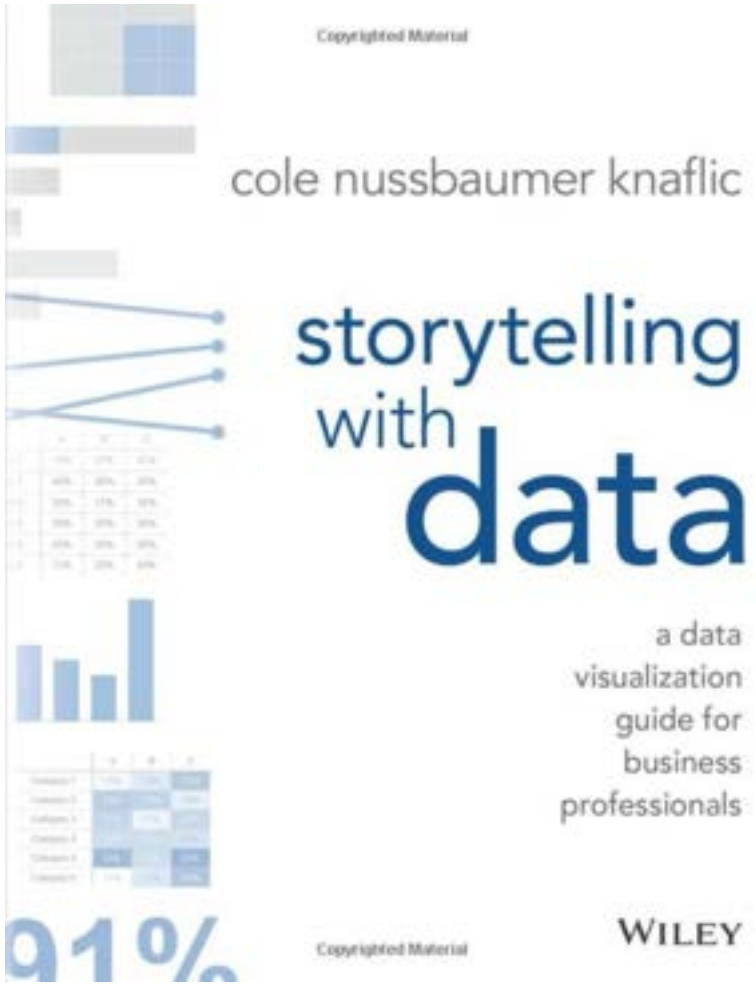
Flowing Data explores how statisticians, designers, data scientists, and others use analysis, visualization, and exploration to understand data.

Color Tools

Generate cool pallets, get inspiration!

https://coolors.co/
color.adobe.com

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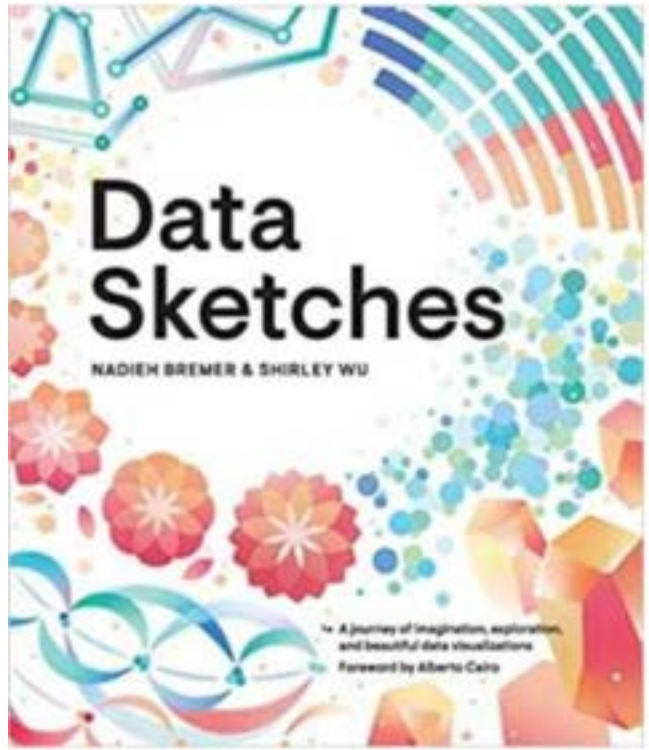
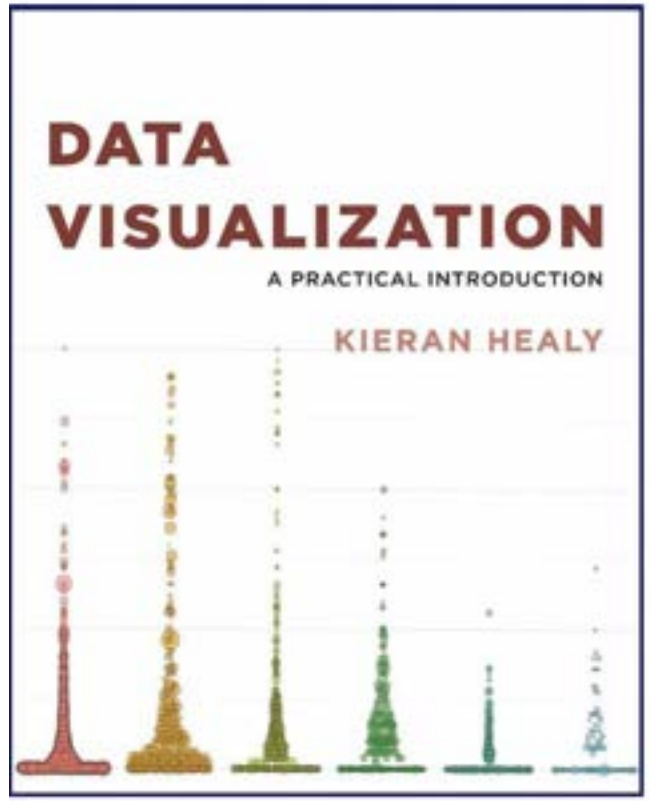

Data Sketches
NADIEH BREMER & SHIRLEY WU
A journey of imagination, exploration, and beautiful data visualizations
Foreword by Alberto Cairo


DATA VISUALIZATION
A PRACTICAL INTRODUCTION
KIERAN HEALY

What is used in industry?

The Best Data Visualization Software of 2024

- **Microsoft Power BI:** Best for business intelligence (BI)
- **Tableau:** Best for interactive charts
- **Qlik Sense:** Best for artificial intelligence (AI)
- **Klipfolio:** Best for custom dashboards
- **Looker:** Best for visualization options
- **Zoho Analytics:** Best for Zoho users
- **Domo:** Best for custom apps

Microsoft Power BI

BEST FOR BUSINESS INTELLIGENCE

Microsoft Power BI

4.5 Forbes ADVISOR

Software Integrations	Real-Time Analytics	Trend Analysis
Yes	Yes	Yes

Why We Picked It

Microsoft Power BI is a business intelligence platform that enables users to collaborate with data and track goals. It provides real-time analytics and trend analysis to help users make confident decisions. Microsoft Power BI integrates with many Microsoft products and cloud services, making it a versatile solution for businesses.

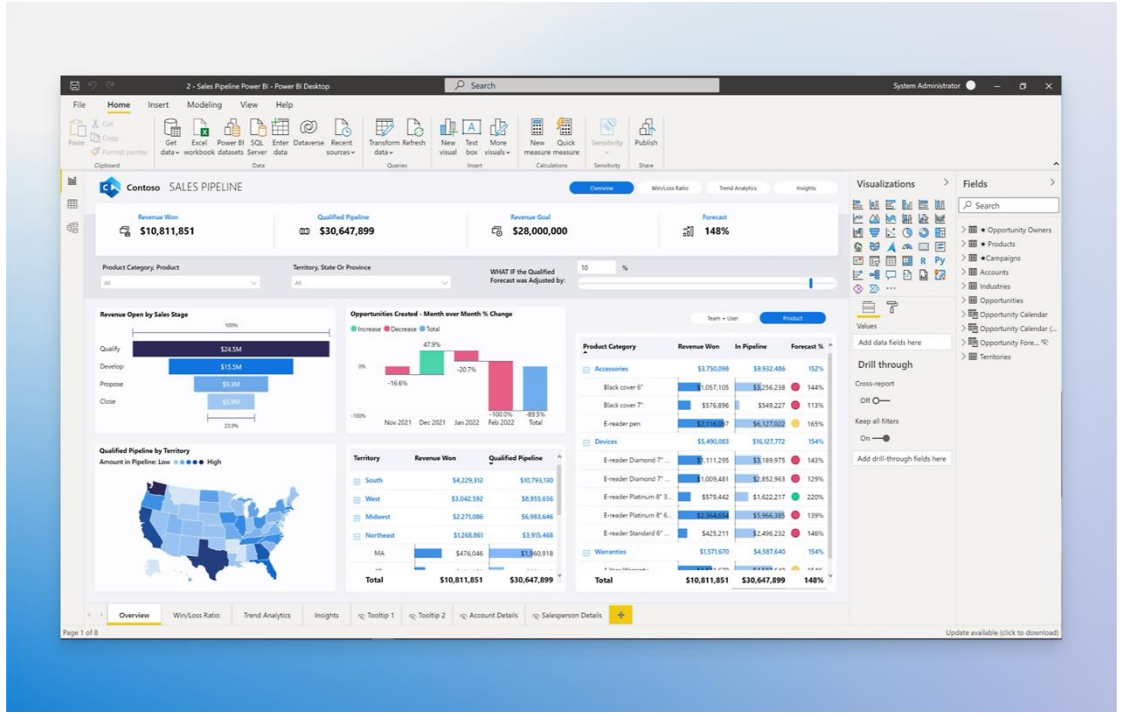
It offers data security features to protect user data. Microsoft Power BI is a powerful platform for building engaging, immersive dashboards and reports that allow you to take action.

Who should use it:

Businesses that use Microsoft products and services and need a business intelligence solution.

Pros & Cons

- ✓ Has a mobile app
- ✓ Competitive pricing
- ✓ If you know how to use Excel, you'll have an easy time learning this
- ✗ Heavy CPU usage
- ✗ Desktop version not compatible with Mac



Tableau

BEST FOR INTERACTIVE CHARTS

Tableau

4.4 Forbes Advisor

Software Integrations	Real-Time Analytics	Trend Analysis
Yes	Yes	Yes

Why We Picked It

Tableau is a data visualization and analytics platform that enables users to explore data and share insights. Data exploration is simple for anyone thanks to Tableau's flexibility and power. Users can build visualizations with drag and drop, employ AI-driven statistical modeling with a few clicks and ask questions using natural language.

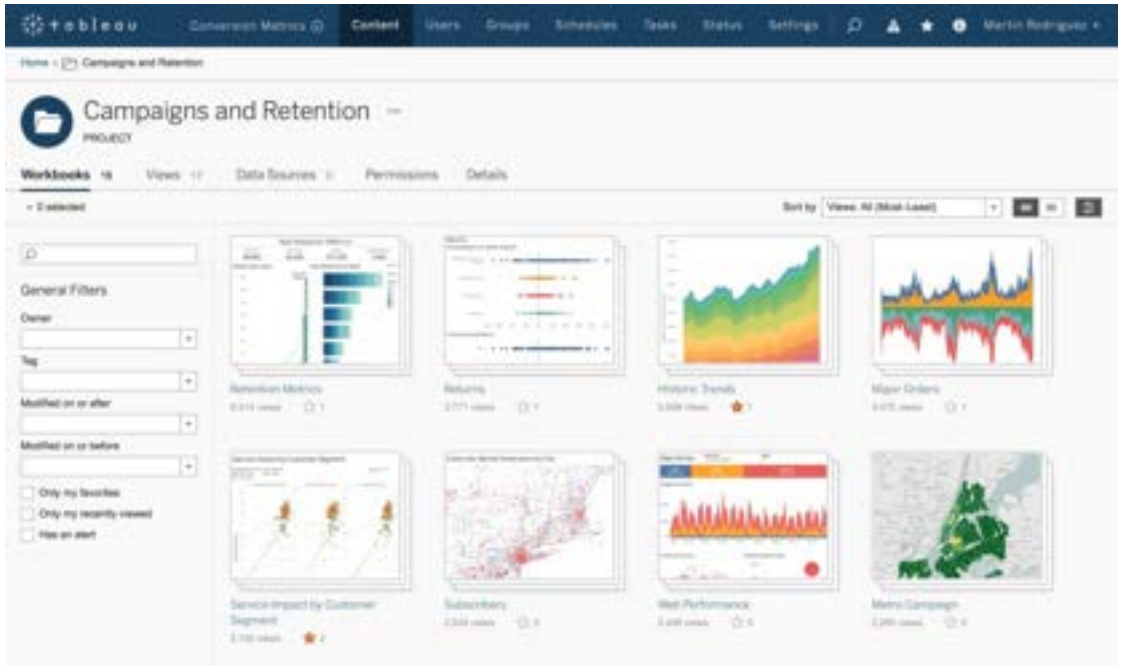
Tableau saves time and money by allowing for greater scale in the areas of governance, security, compliance, maintenance and support. Users also receive more than just an analytics tool–they get the knowledge and support they need to achieve greater scale.

Who should use it:

Businesses that need data visualization and analytics capabilities to scale their data operations.

Pros & Cons

- ✓ Storytelling dashboards
- ✓ It's backed by Salesforce
- ✓ Integrates with Slack
- ✗ Steep learning curve
- ✗ Prices are higher compared to similar products



Qlik Q

BEST FOR ARTIFICIAL INTELLIGENCE

Qlik

Qlik Sense

4.4

Software Integrations	Real-Time Analytics	Trend Analysis
Yes	Yes	Yes

Why We Picked It

Qlik Sense is a data visualization tool that uses artificial intelligence (AI) to help users understand and use data more effectively. It offers deeper interactivity and broader context than other data visualization tools, as well as lightning-fast calculations and the ability to connect and combine data from hundreds of data sources.

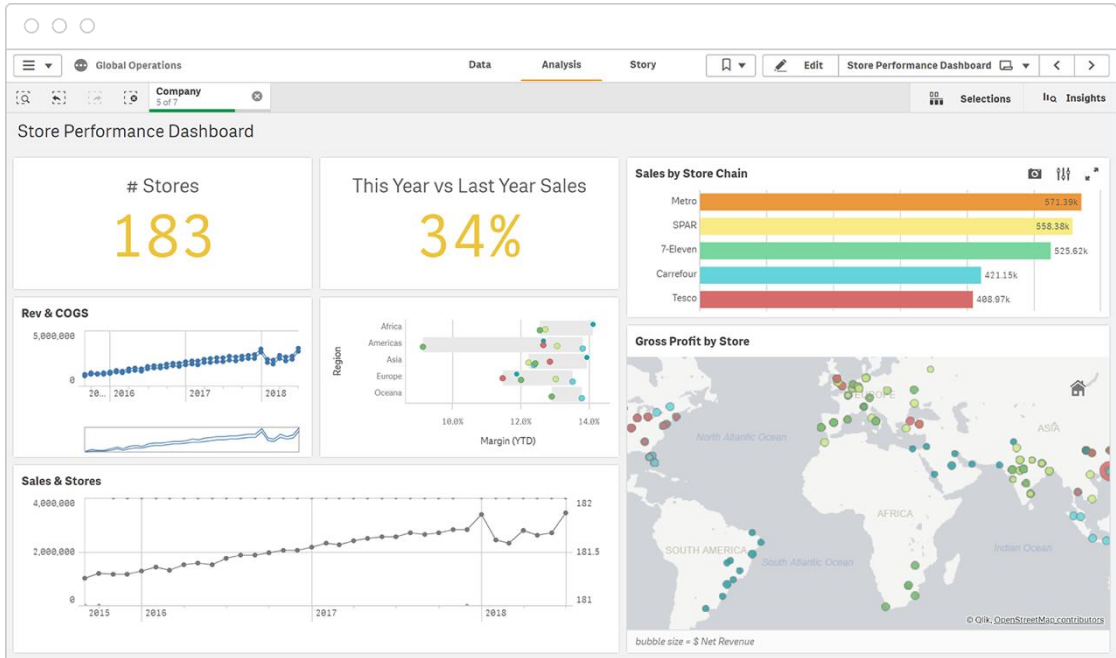
Qlik Sense is a part of the Qlik Active Intelligence Platform, which offers analytics performance and scalability to businesses of all sizes. Additionally, it's available as a software-as-a-service (SaaS) solution or as a hybrid service that extends SaaS analytics to on-premises data.

Who should use it:

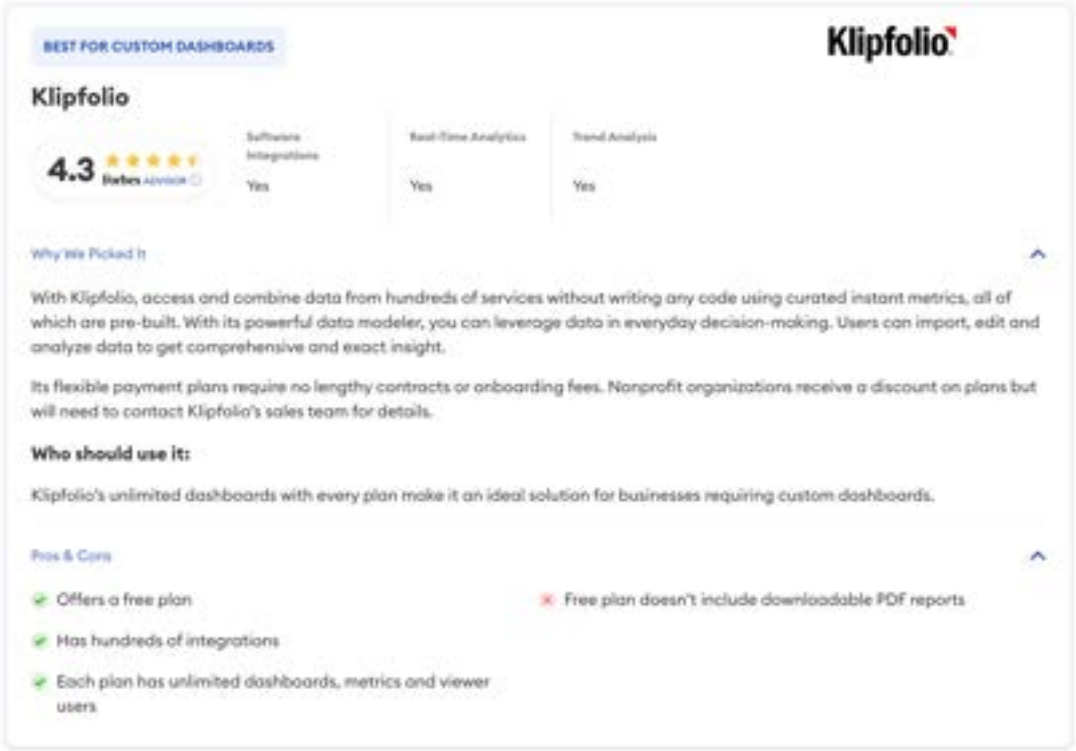
Businesses that need artificial intelligence capabilities to scale their data operations.

Pros & Cons

- Automated action triggers
- AI insights
- Drag-and-drop interface
- User interface needs work

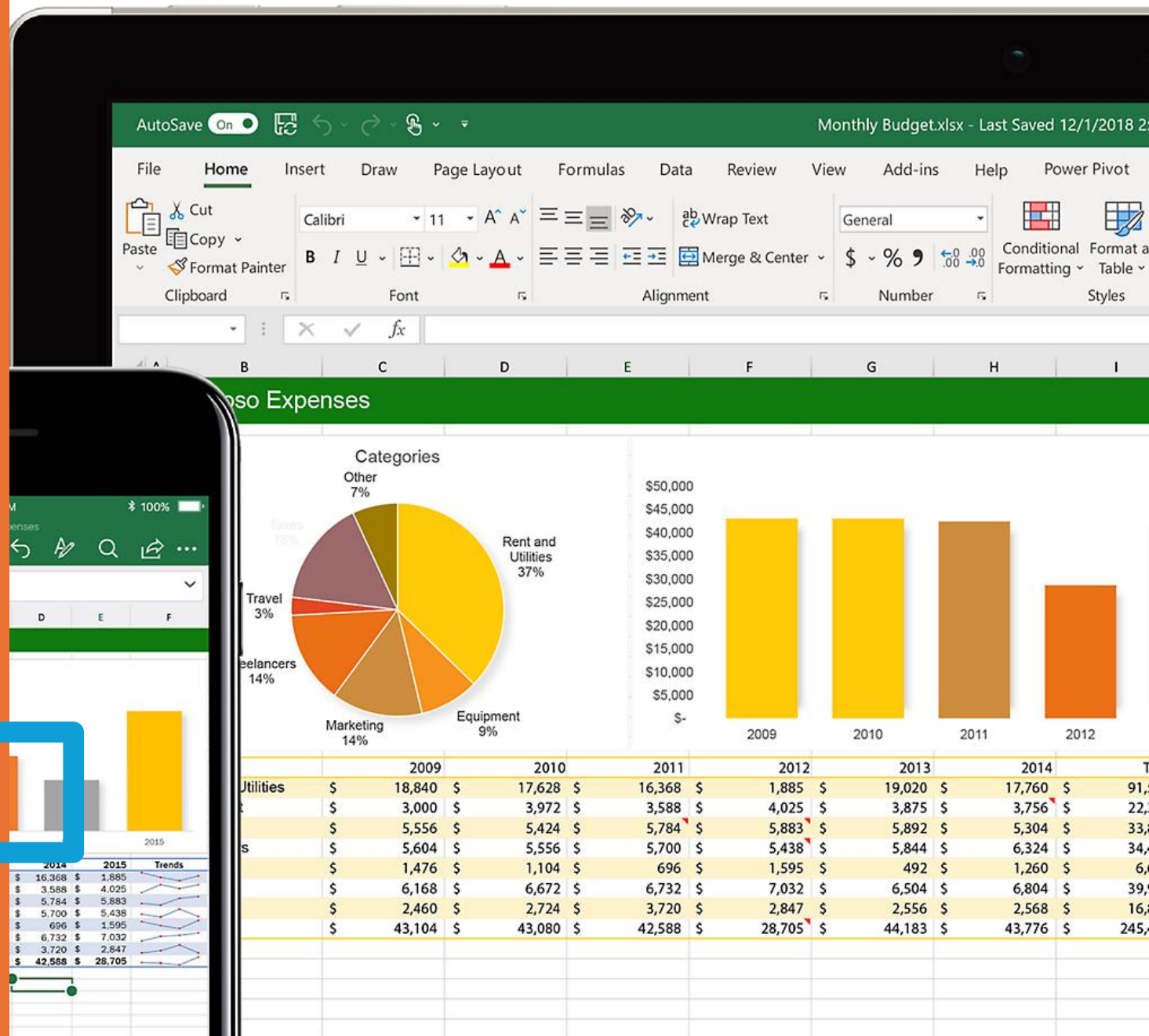


Klipfolio



https://www.klipfolio.com

Personal Reports:

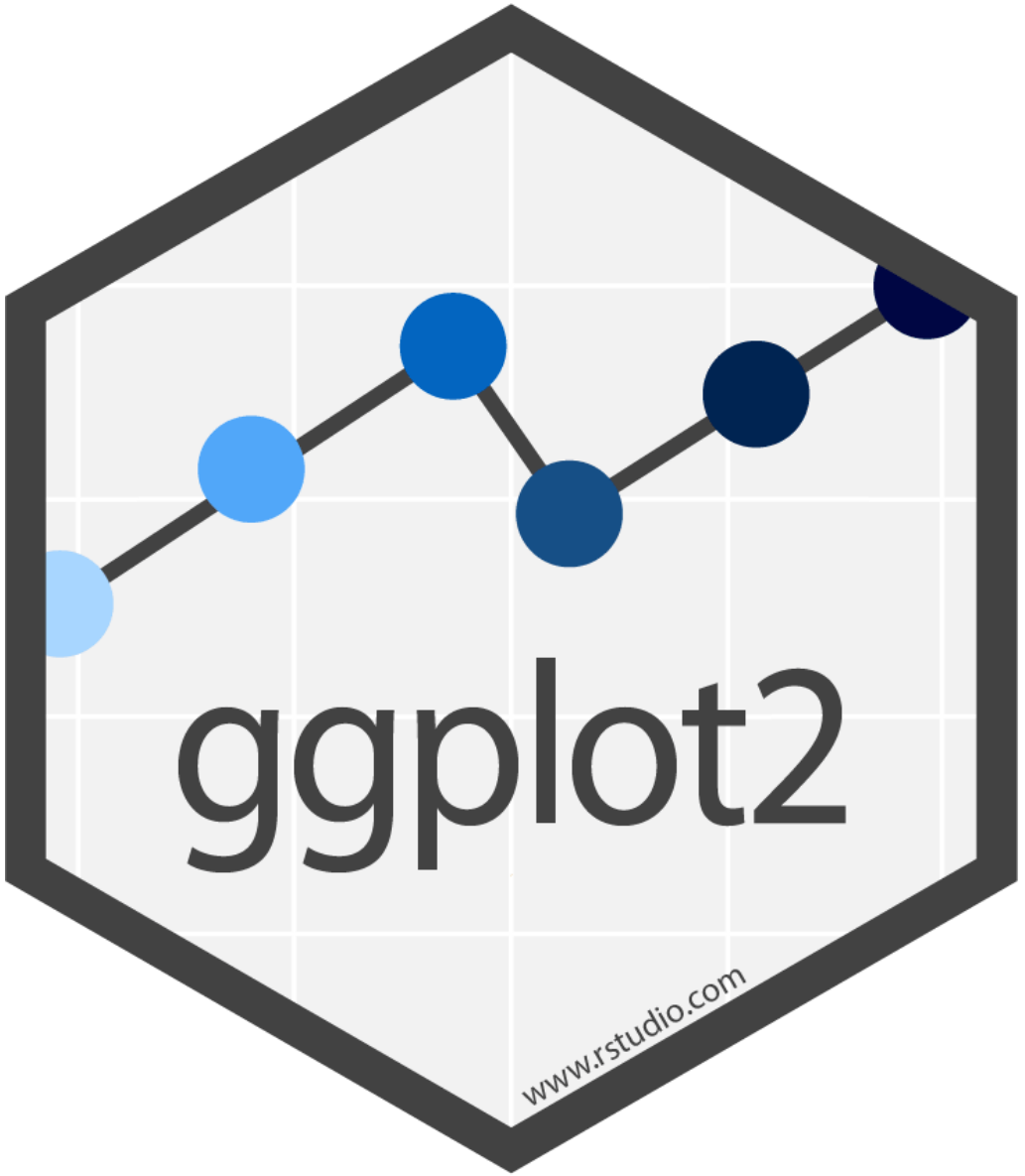


Google Sheets

https://www.datawrapper.de/

Great Personal and Commercial Options

We will learn this next time




https://multimedia.journalism.berkeley.edu/blog/free-data-visualization-tools/

Tableau Example

https://public.tableau.com/

+ableau

In-Class Exercise

- Objectives
  - Explore ”zero-code” software
  - See required elements of various graphs
  - Learn an online software as a comparison to R

- Instructions
  - https://public.tableau.com/ and create a free account
    - They have a web version or public desktop version you can download
  - Find and load sample data
    - https://www.kaggle.com/datasets
    - https://www.tableau.com/learn/articles/free-public-data-sets
    - Google “free data”, there is a ton out there
  - Create an interesting graph

- **On Slack, channel and post you graph(s) in the data-visualization channel, explaining what it is.**