

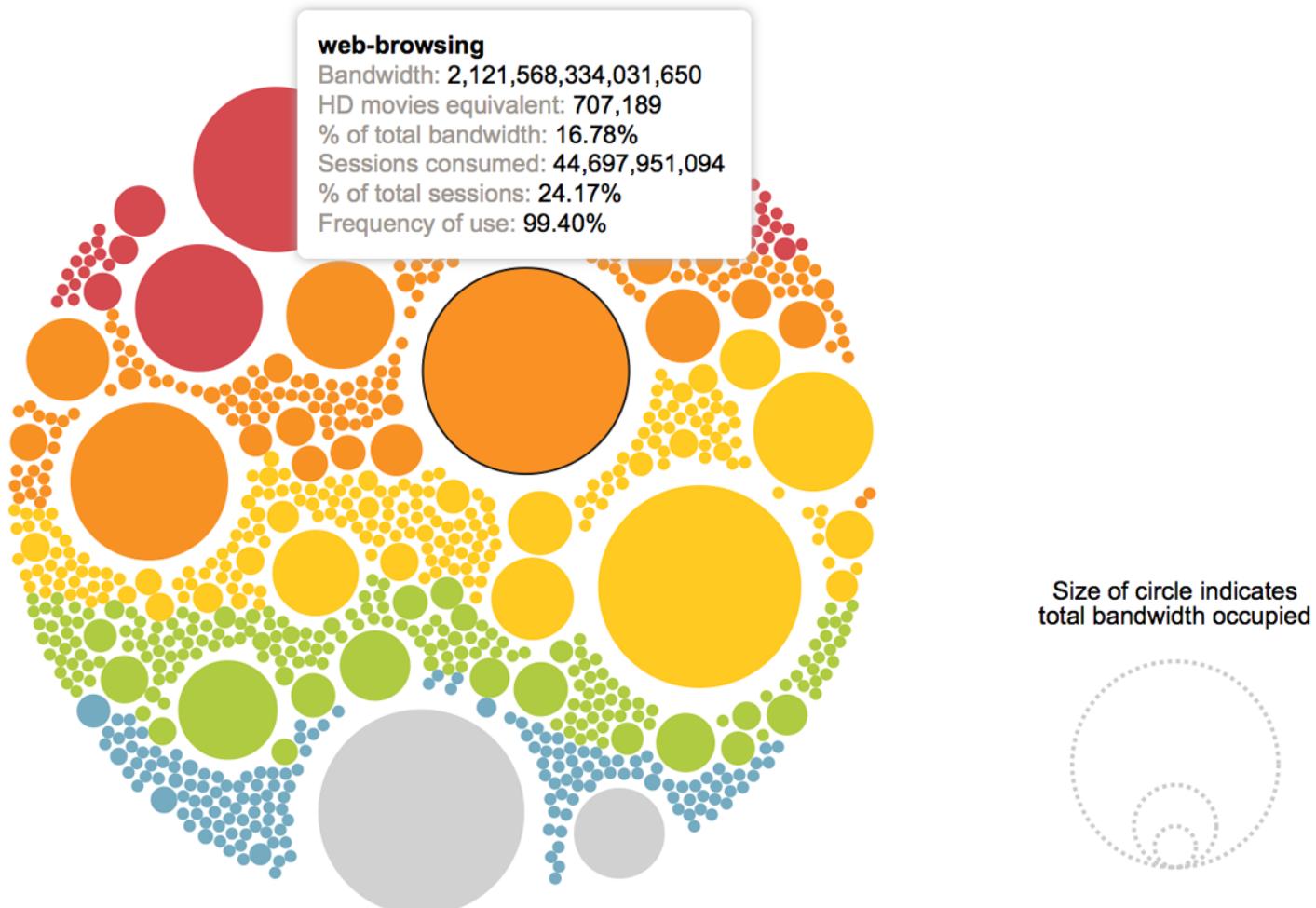


Data Visualization

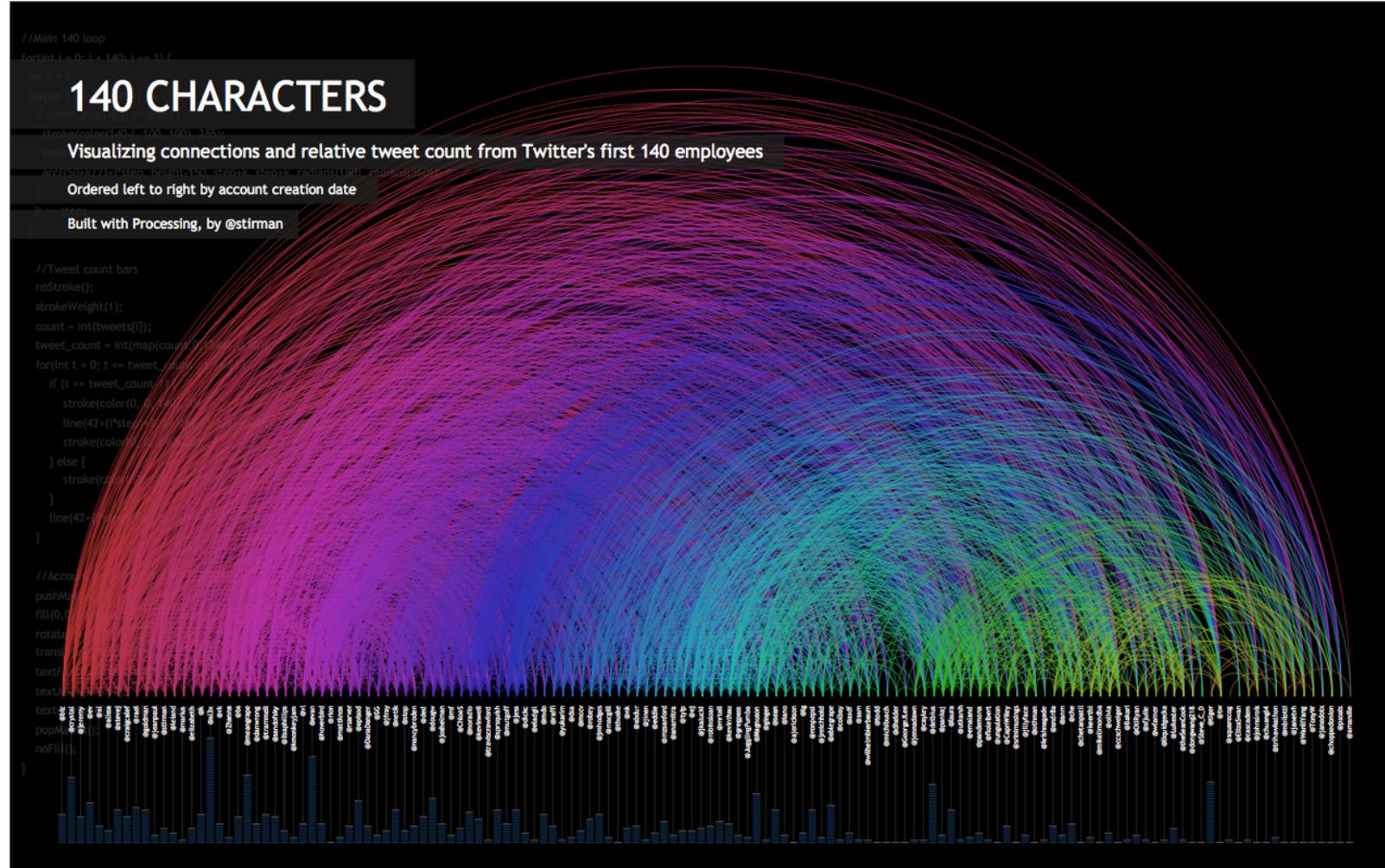
Katelina Boykova

10 November 2016

Example: Network traffic



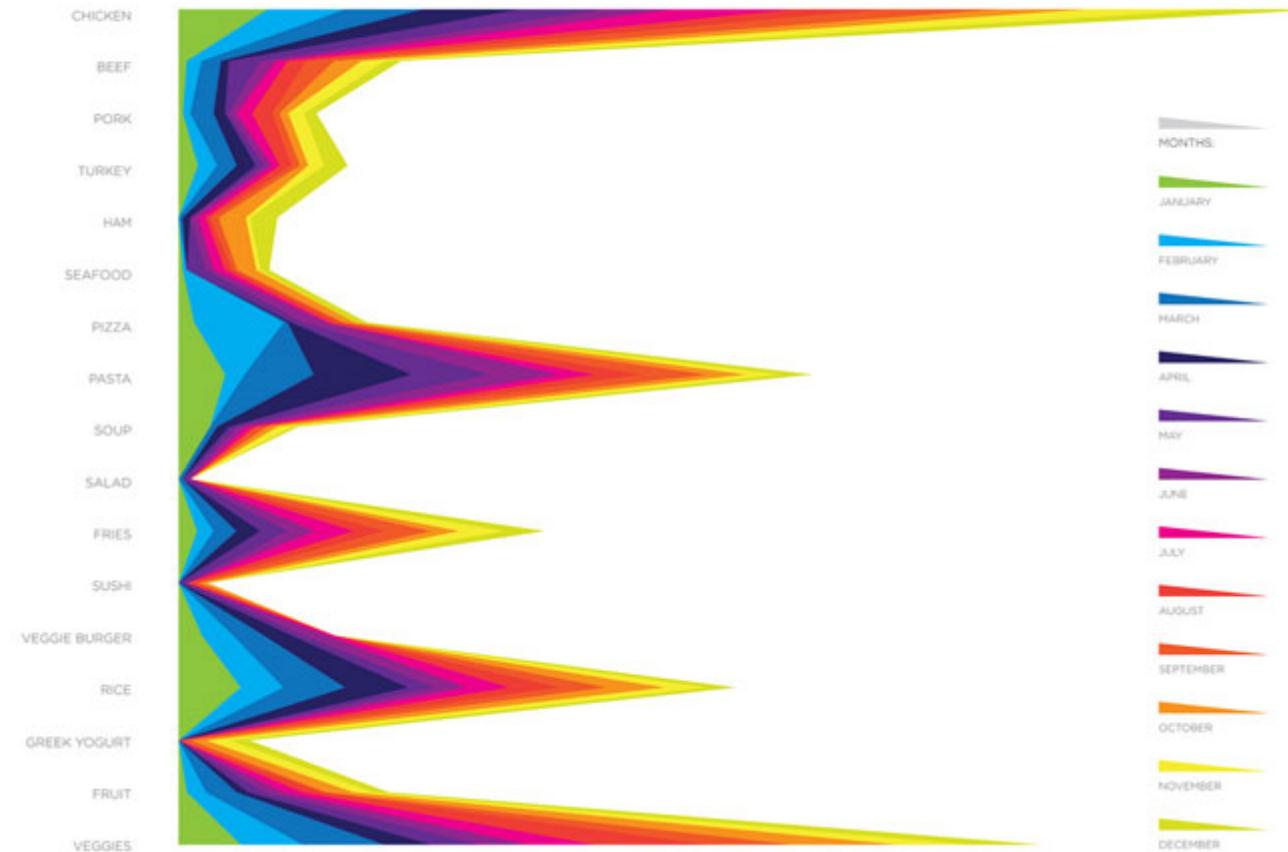
Example: Tweets representation



Example: Food consumption

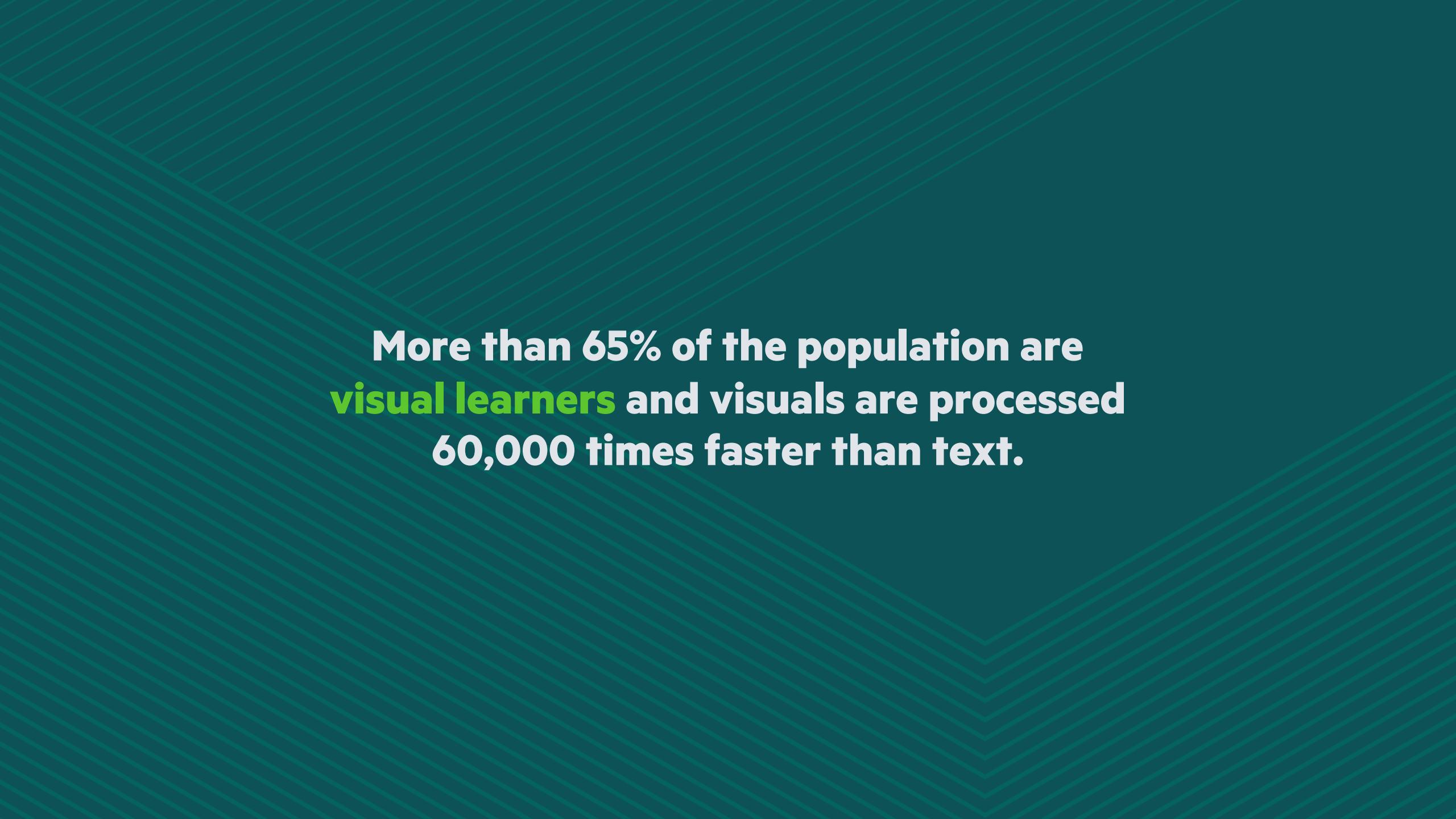
TOTAL FOOD CONSUMPTION BY MONTH

IN 2010





**Articles that contain images get
94% more views
than articles that don't.**



**More than 65% of the population are
visual learners and visuals are processed
60,000 times faster than text.**

What is Data visualization?

Overview

Data visualization is the presentation of data or information by encoding it as visual objects (e.g., points, lines or bars) contained in graphics.

Goal

To communicate information clearly and effectively, thus to make complex data more accessible, understandable and usable.



Another (delicious) point of view

Data



Information



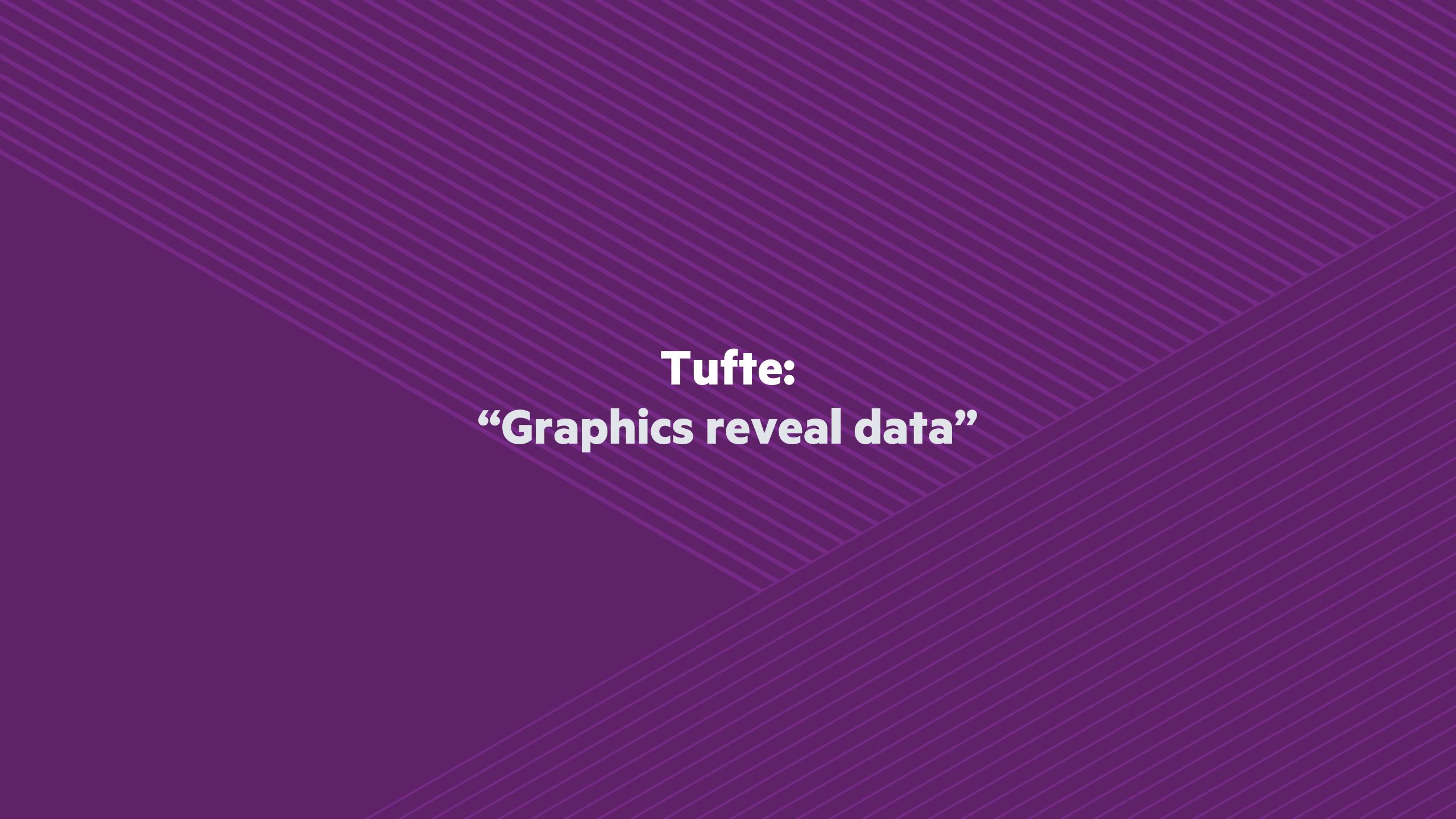
Presentation



Knowledge



EpicGraphic.com



**Tufte:
“Graphics reveal data”**

Graphics essentials

Excellence in statistical graphics consists of complex ideas communicated with clarity, precision and efficiency.

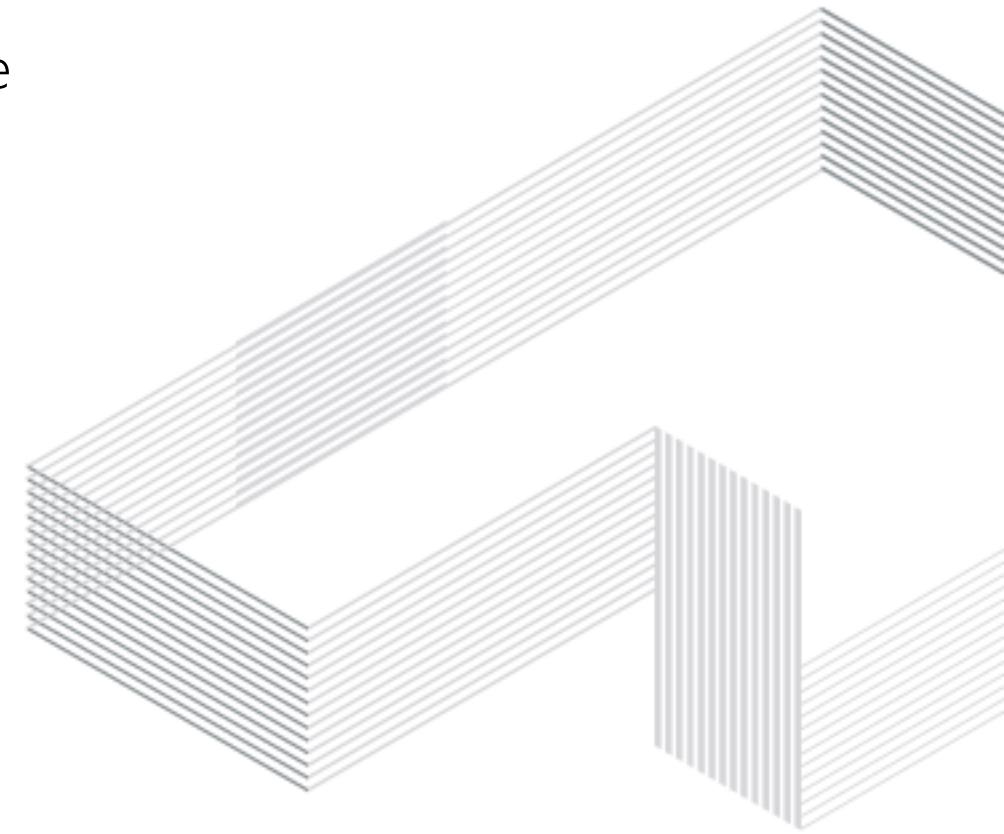
Graphical displays should:

- show the data
- present many numbers in a small space
- make large data sets coherent
- encourage the eye to compare different pieces of data
- reveal the data at several levels of detail, from a broad overview to the fine structure
- reveal relationships between data.



Why is data visualization important?

- Data visualization help people see things that were not obvious to them before.
- Data visualization makes interpretation easier.
- Data visualization simplifies the data, instantly clarifying the important KPIs, factors, trends, etc.



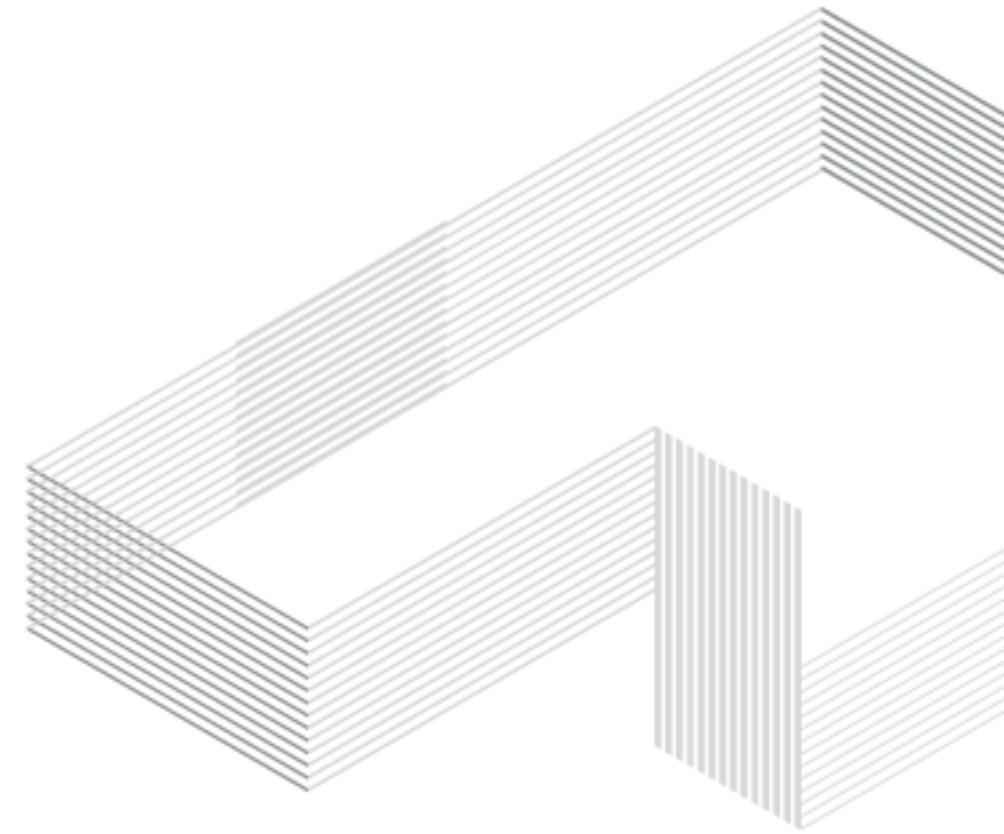
Primary types of displaying information

Table

A table contains quantitative data organized into rows and columns with categorical labels. It is primarily used to look up specific values.

Graph

A graph is primarily used to show relationships among data and portrays values encoded as visual objects (e.g., lines, bars, or points). Numerical values are displayed within an area delineated by one or more axes. These axes provide scales (quantitative and categorical) used to label and assign values to the visual objects. Many graphs are also referred to as charts.



The power of visual perception

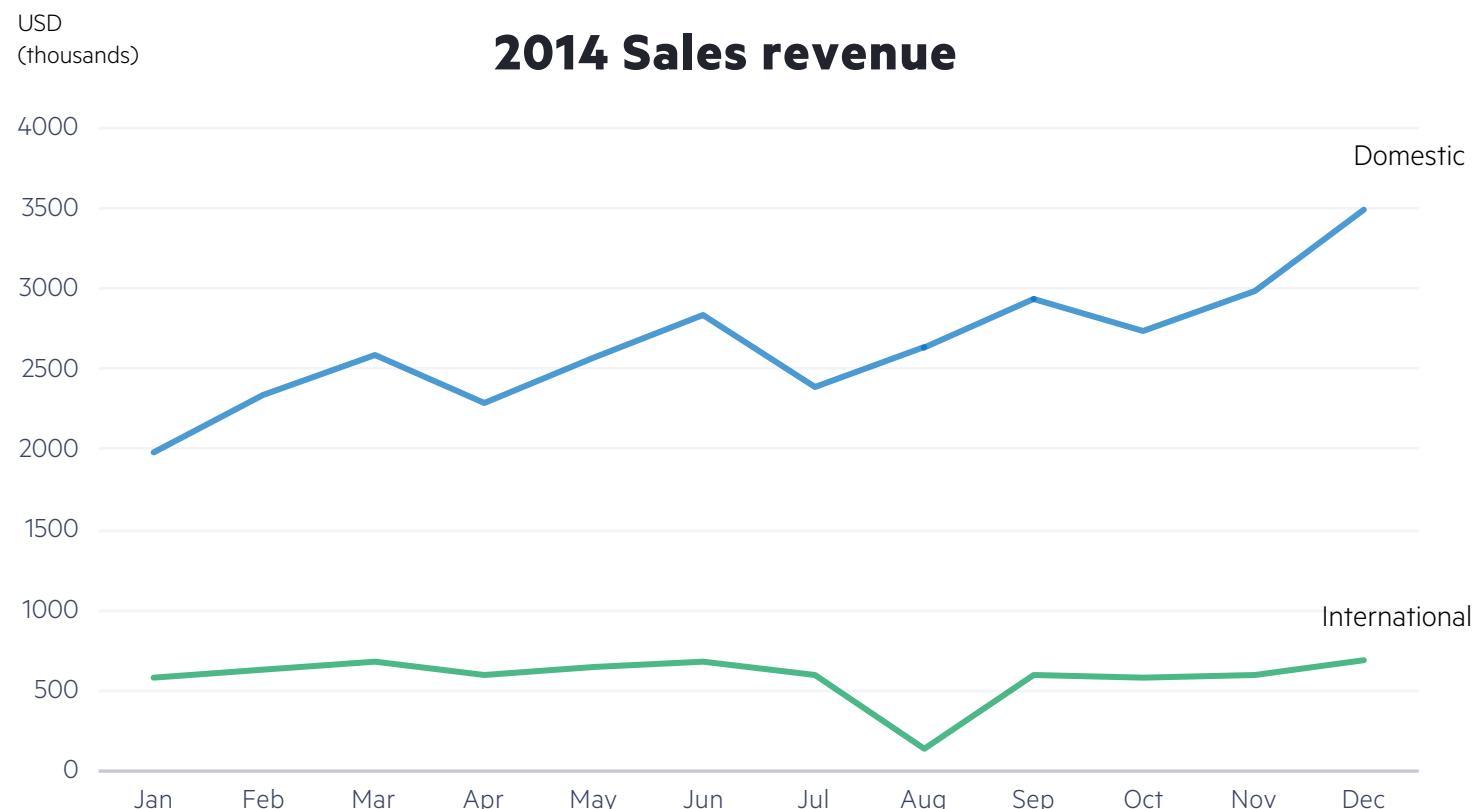
2014 Sales revenue

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Domestic	\$1,983	\$2,343	\$2,593	\$2,283	\$2,574	\$2,838	\$2,382	\$2,634	\$2,938	\$2,739	\$2,983	\$3,493
International	\$574	\$636	\$673	\$593	\$644	\$679	\$593	\$139	\$599	\$583	\$602	\$690
	\$2,557	\$2,979	\$3,266	\$2,876	\$3,218	\$3,517	\$2,975	\$2,773	\$3,537	\$3,322	\$3,585	\$4,183

- Shows precise values
- Shows individual values
- No trends, exceptions, relationships, or patterns

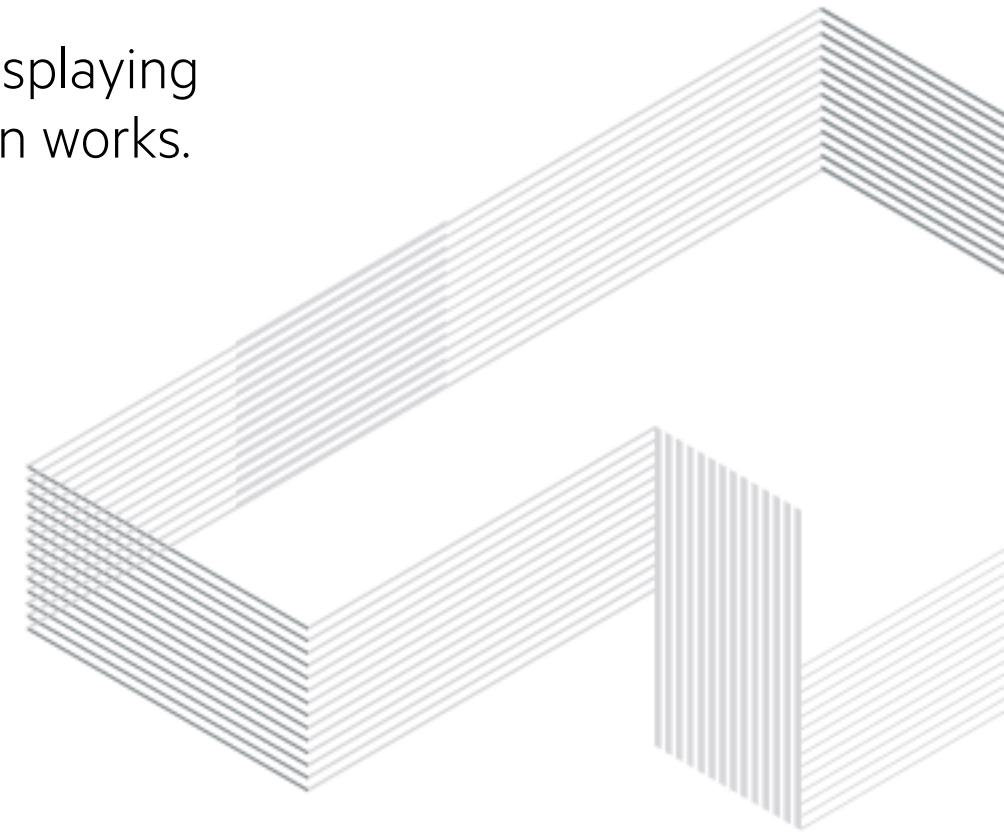
The power of visual perception

- Domestic sales were much higher
- Domestic sales trended upward
- August was an exception
- Domestic sales exhibited a monthly pattern – up, up, down (“hockey stick”)



Thinking with our eyes

- Seeing and thinking collaborate closely to make sense of the world.
- The human visual system is a pattern seeker. When data is presented in certain ways, the patterns can be easily seen.
- To use visualization effectively, it takes more than simply displaying data graphically. We must understand how visual perception works.



Pre-attentive attributes

A human can distinguish differences in line length, shape orientation, and color (hue) readily without significant processing effort.

987349790275647902894728624092406037070570279072
803208029007302501270237008374082078720272007083
247802602703793775709707377970667462097094702780
927979709723097230979592750927279798734972608027

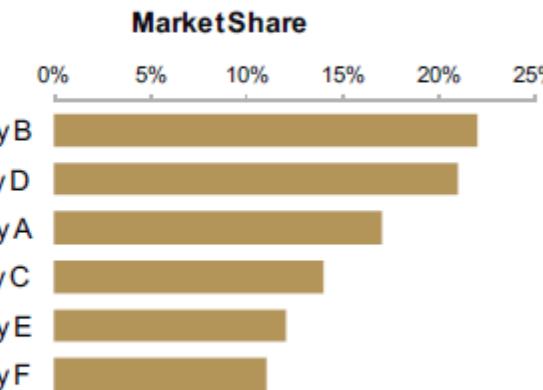
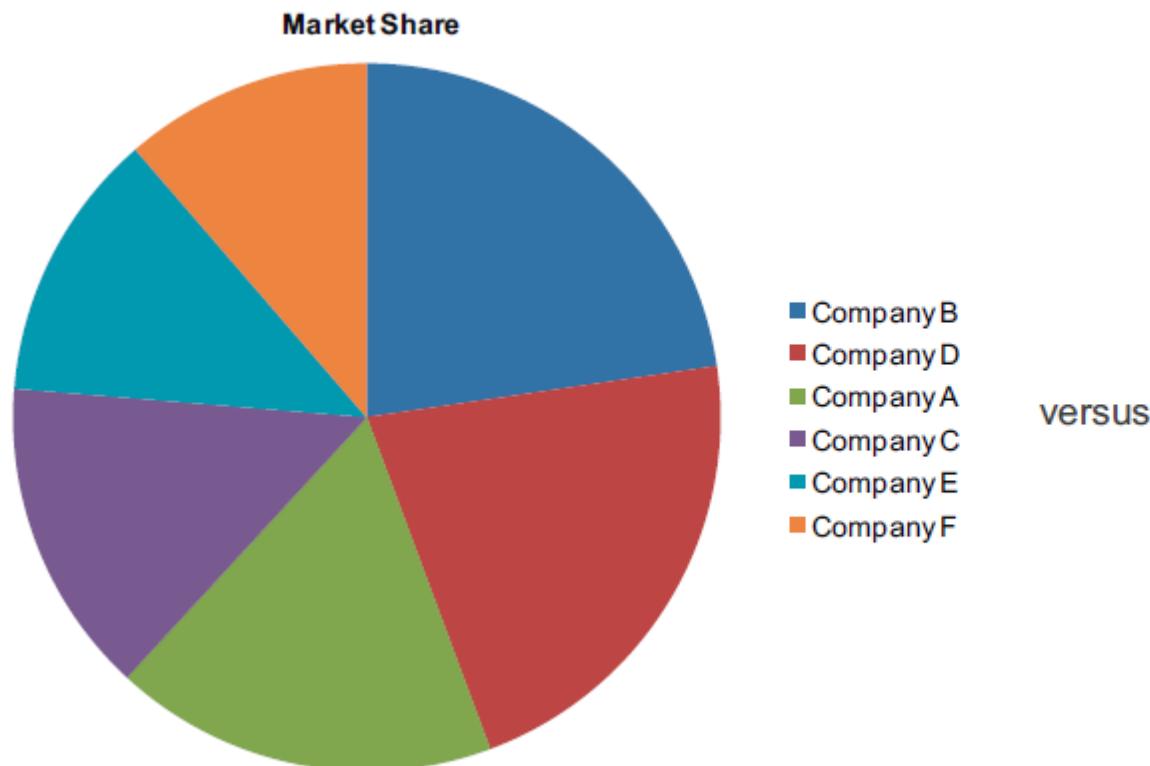
Pre-attentive attributes

A human can distinguish differences in line length, shape orientation, and color (hue) readily without significant processing effort.

98734979027**5**647902894728624092406037070**5**70279072
803208029007302**5**01270237008374082078720272007083
24780260270379377**5**709707377970667462097094702780
927979709723097230979**5**927**5**0927279798734972608027

Pre-attentive attributes

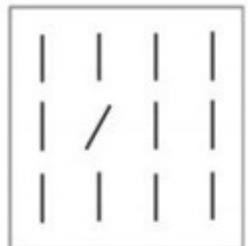
Effective graphics take advantage of pre-attentive processing and attributes and the relative strength of these attributes.



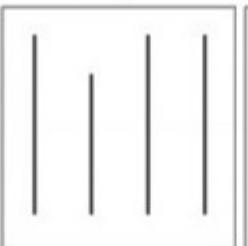
Pre-attentive attributes used in visual displays of data

Form

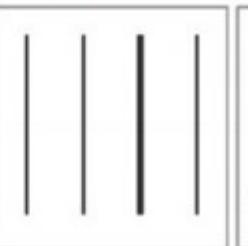
Orientation



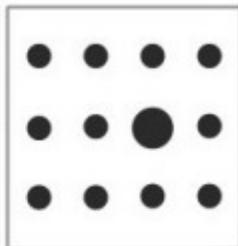
Line Length



Line Width

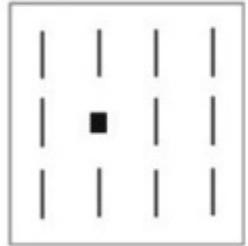


Size

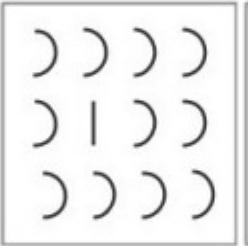


Each of these pre-attentive attributes can be used for one or more information visualization purposes.

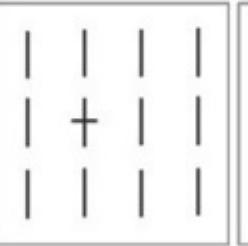
Shape



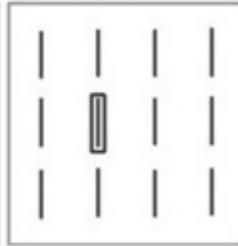
Curvature



Added Marks

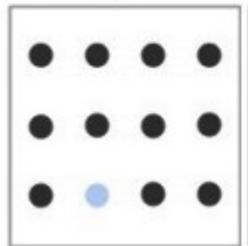


Enclosure

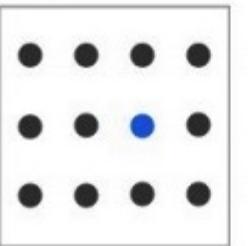


Color

Intensity

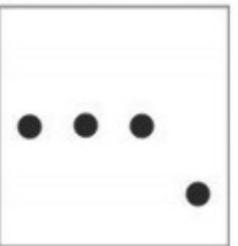


Hue

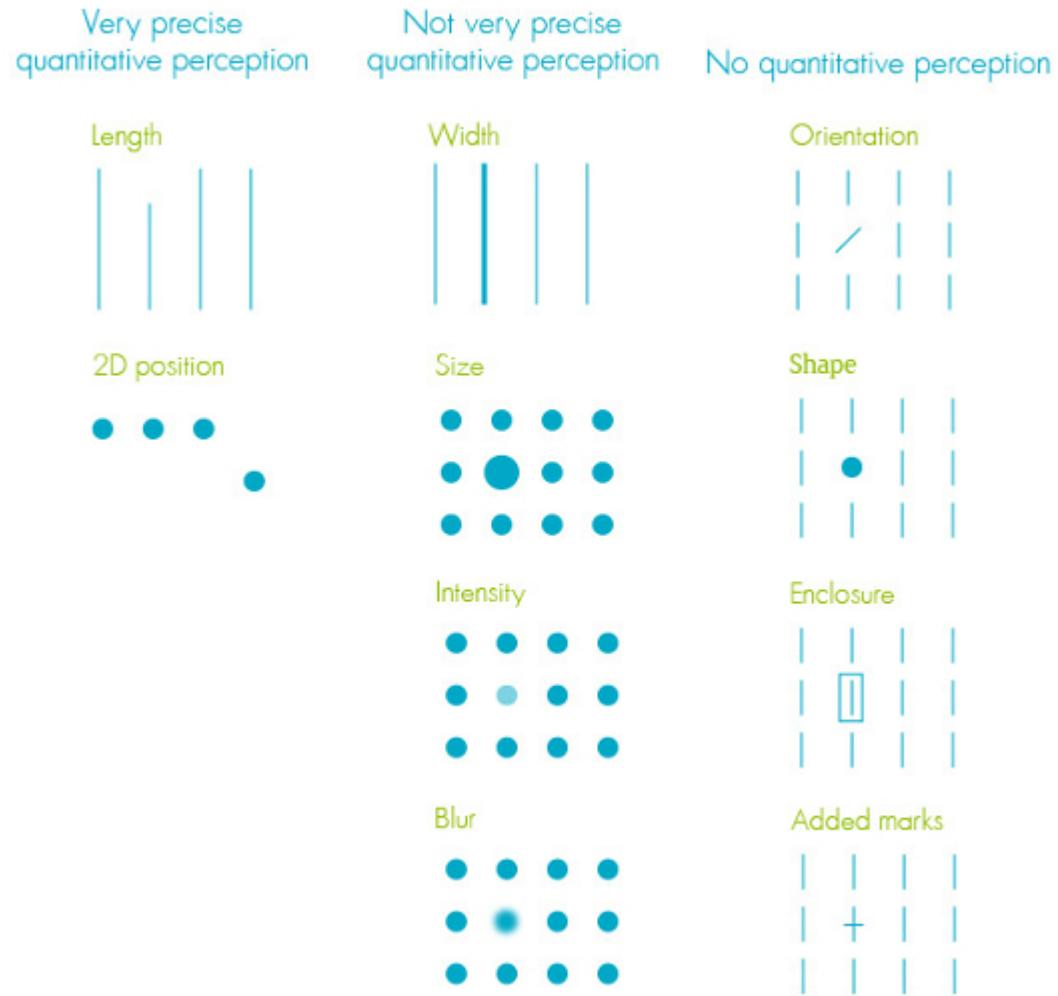


Spatial Position

2-D Position



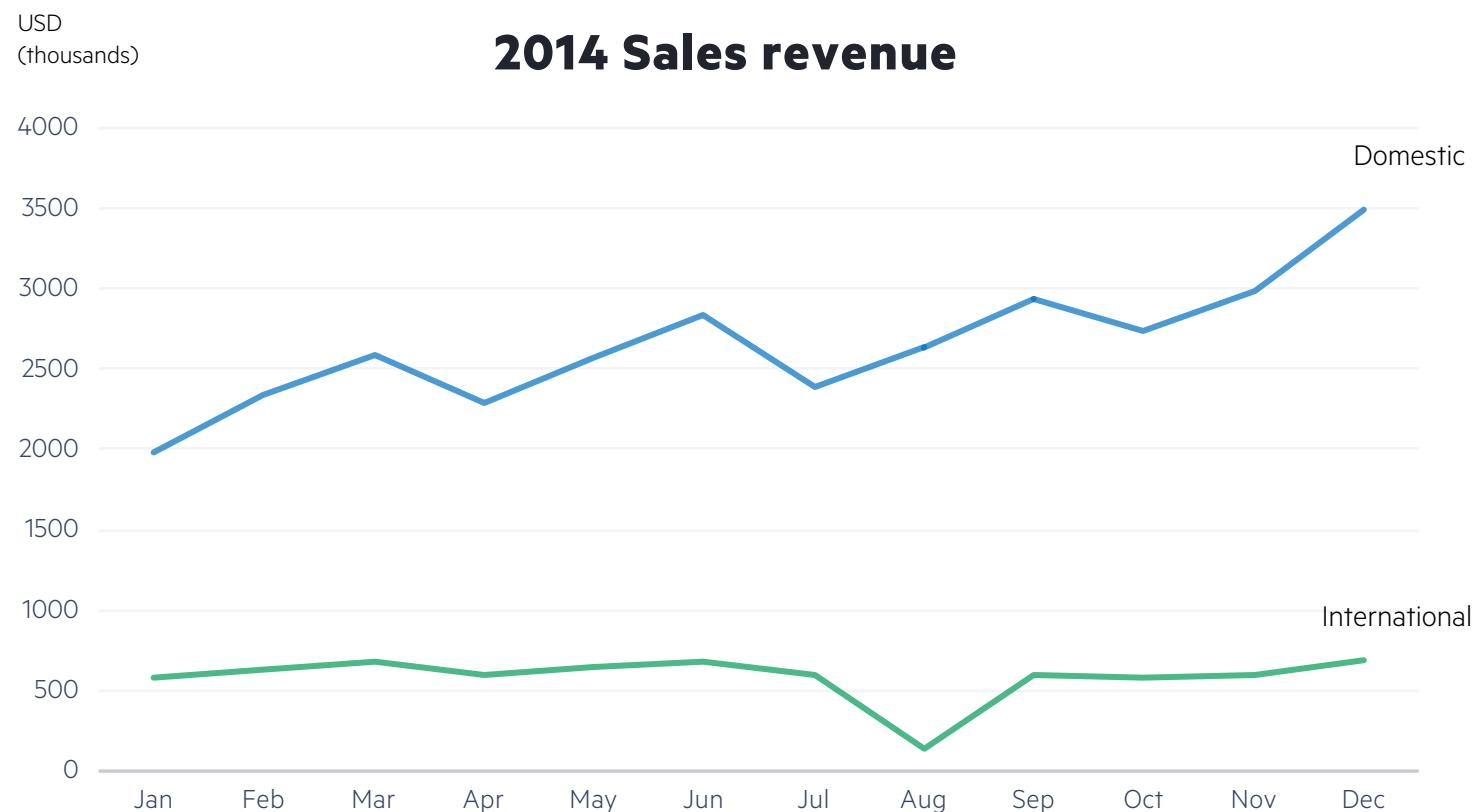
Pre-attentive attributes used in visual displays of data



- Some of these pre-attentive attributes are perceptually stronger than others.
- Some of these pre-attentive attributes can be perceived quantitatively and can therefore be used to encode numeric values.
- Color intensity (grayscale for example) can be quantitatively perceived to a degree, showing that one value is greater than another.
- An object's size in 2-D area (simultaneous perception of both length and width) can be perceived quantitatively, in that we can tell that one object is bigger than another. However, it's difficult to determine by how much they differ.

Chart elements

- Title
- Plot area
- Axes
- Gridlines, Striplines
- Series
- Labels
- Point marks
- Legend
- Animations



Decision time

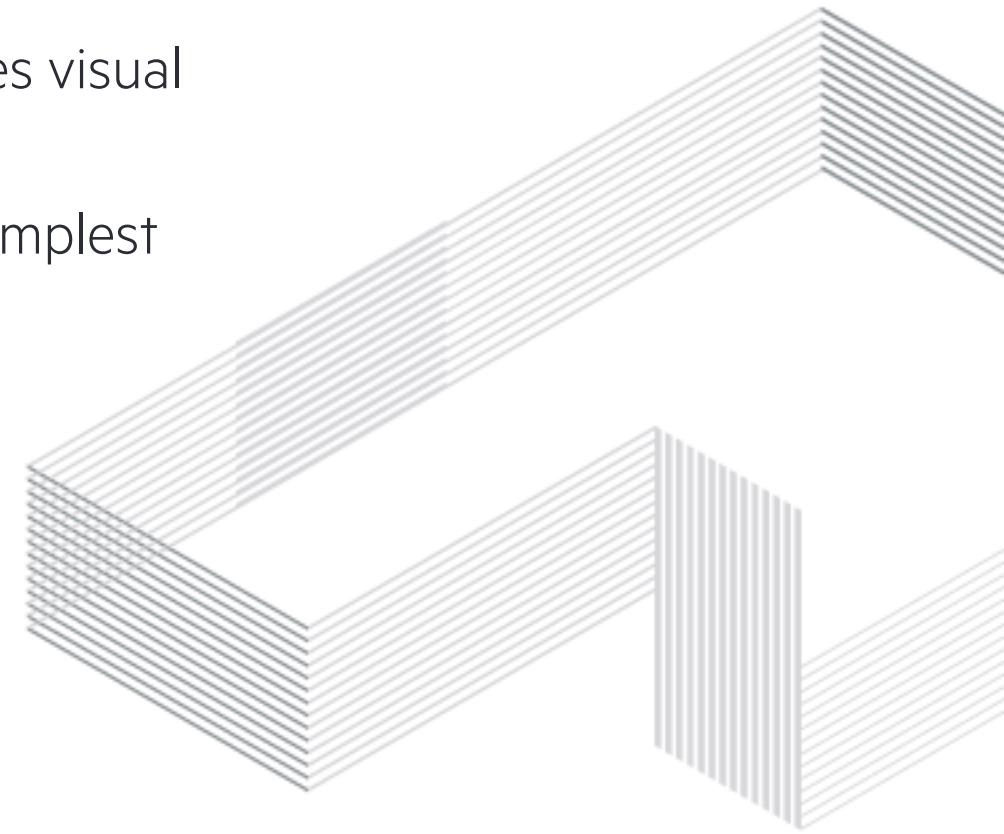
“ There is virtually unlimited freedom in how we represent data. The difficult question is how best to represent it.”

William Wright

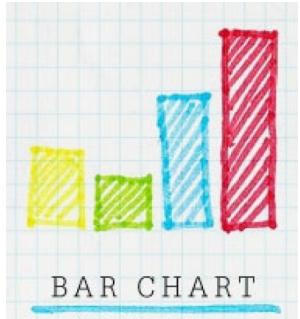


How to design the best visual for my data?

- Understand the data you are trying to visualize, and its size.
- Determine what you are trying to visualize and what kind of information you want to communicate.
- Get to know your audience and understand how it processes visual information.
- Use a visual that conveys the information in the best and simplest form for your audience.

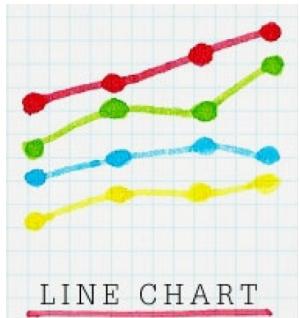


Types of charts



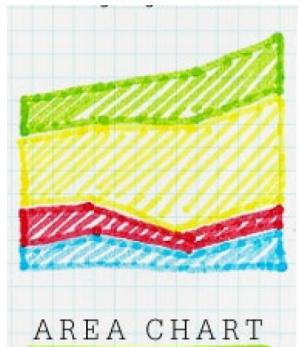
Presents data with rectangular bars with lengths proportional to the values that they represent.

Bar charts provide a visual presentation of categorical data. Grouped bar charts and stacked bar charts can also be used for more complex comparisons of data.



Displays information as a series of data points called 'markers' connected by straight line segments.

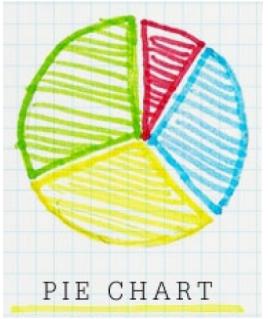
A line chart is often used to visualize a trend in data over intervals of time.



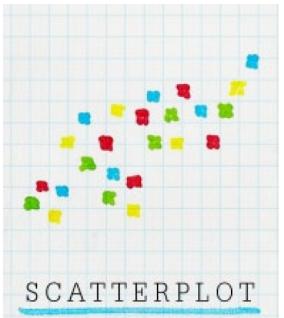
Displays graphically quantitative data. It is based on the line chart.

Area charts are used to represent cumulated totals using numbers or percentages (stacked area charts in this case) over time. Can be used for showing trends over time among related attributes.

Types of charts

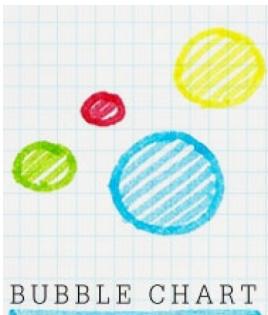


A circular statistical graphic, which is divided into slices to illustrate numerical proportion. In a pie chart, the arc length of each slice (and consequently its central angle and area), is proportional to the quantity it represents.



Displays a collection of points, each having the value of one variable determining the position on the horizontal axis and the value of the other variable determining the position on the vertical axis.

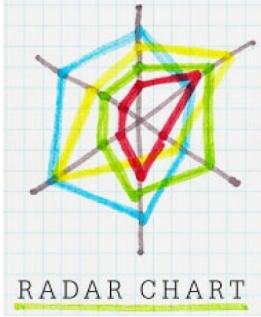
Scatter plot can be used either when one continuous variable is under the control of the experimenter and the other depends on it or when both variables are independent.



Displays three dimensions of data (the third through its size). Bubble charts can be considered a variation of the scatter plot, in which the data points are replaced with bubbles.

Bubble charts can facilitate the understanding of social, economical, medical, and other scientific relationships.

Types of charts



Displays multivariate data in the form of a two-dimensional chart of three or more quantitative variables represented on axes starting from the same point.

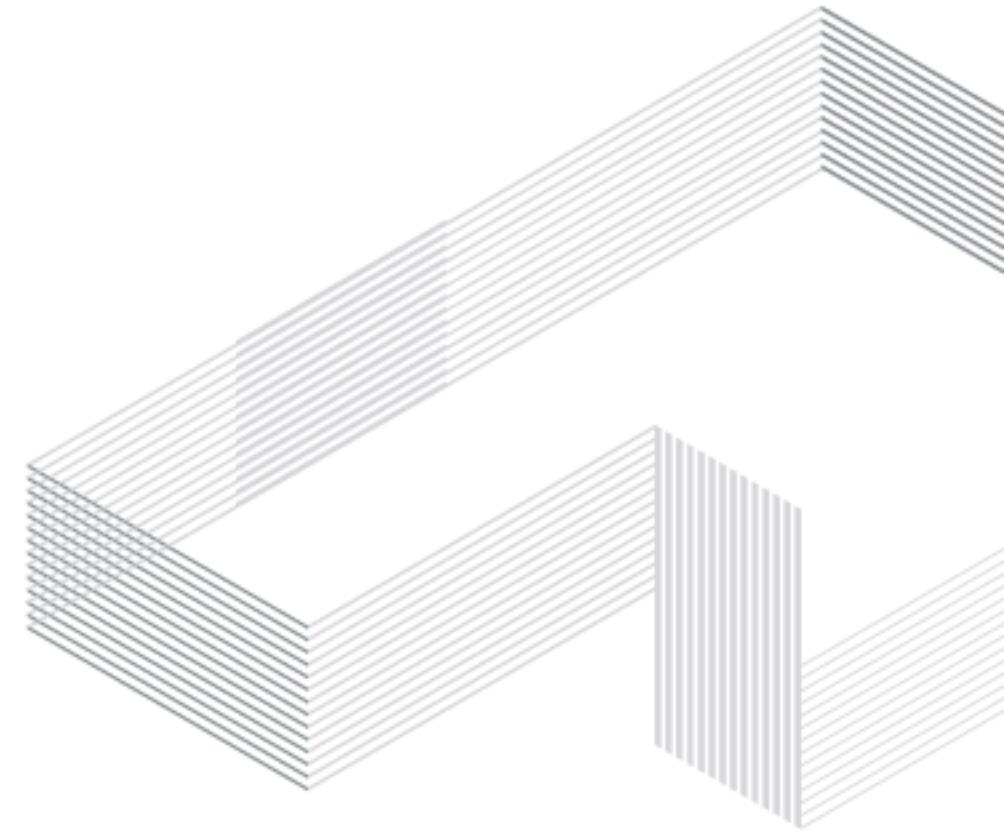
Radar charts are a useful way to display multivariate observations with an arbitrary number of variables. Each star represents a single observation. They are also used in sports to chart players' strengths and weaknesses, where they are usually called spider charts.

Stock series (Candlestick and OHLC)

Polar chart

Range chart

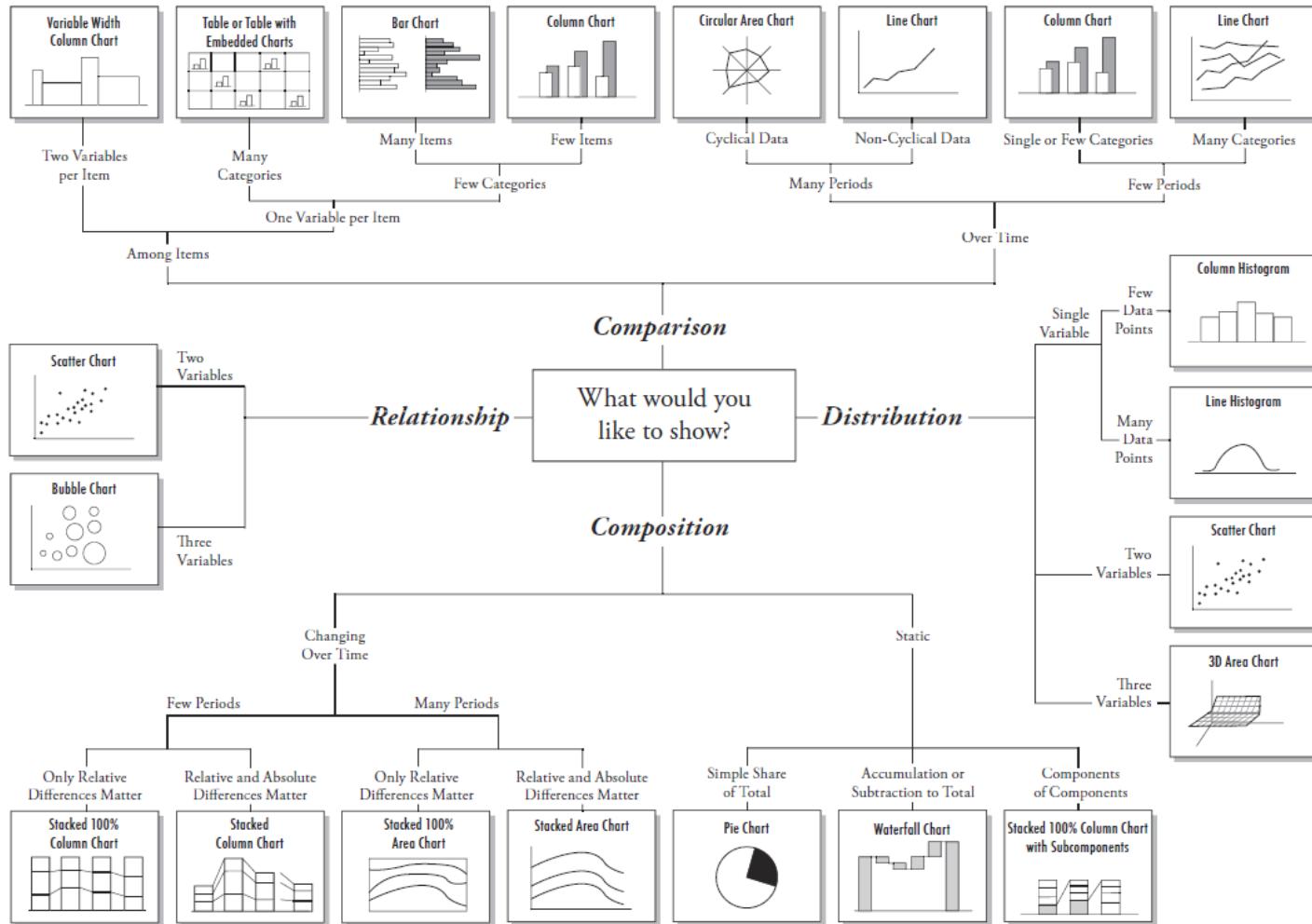
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How to design the best visual for my data?

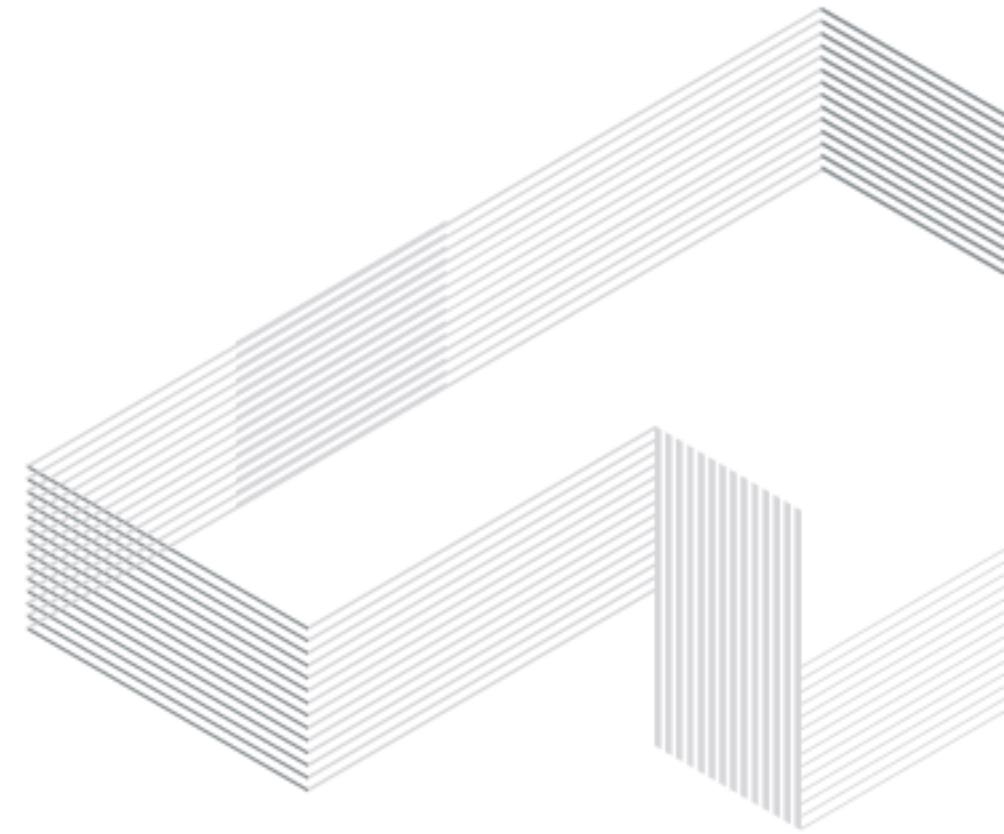
A	Comparison
B	Distribution
C	Composition
D	Relationship

How to design the best visual for my data?



Tips & Tricks

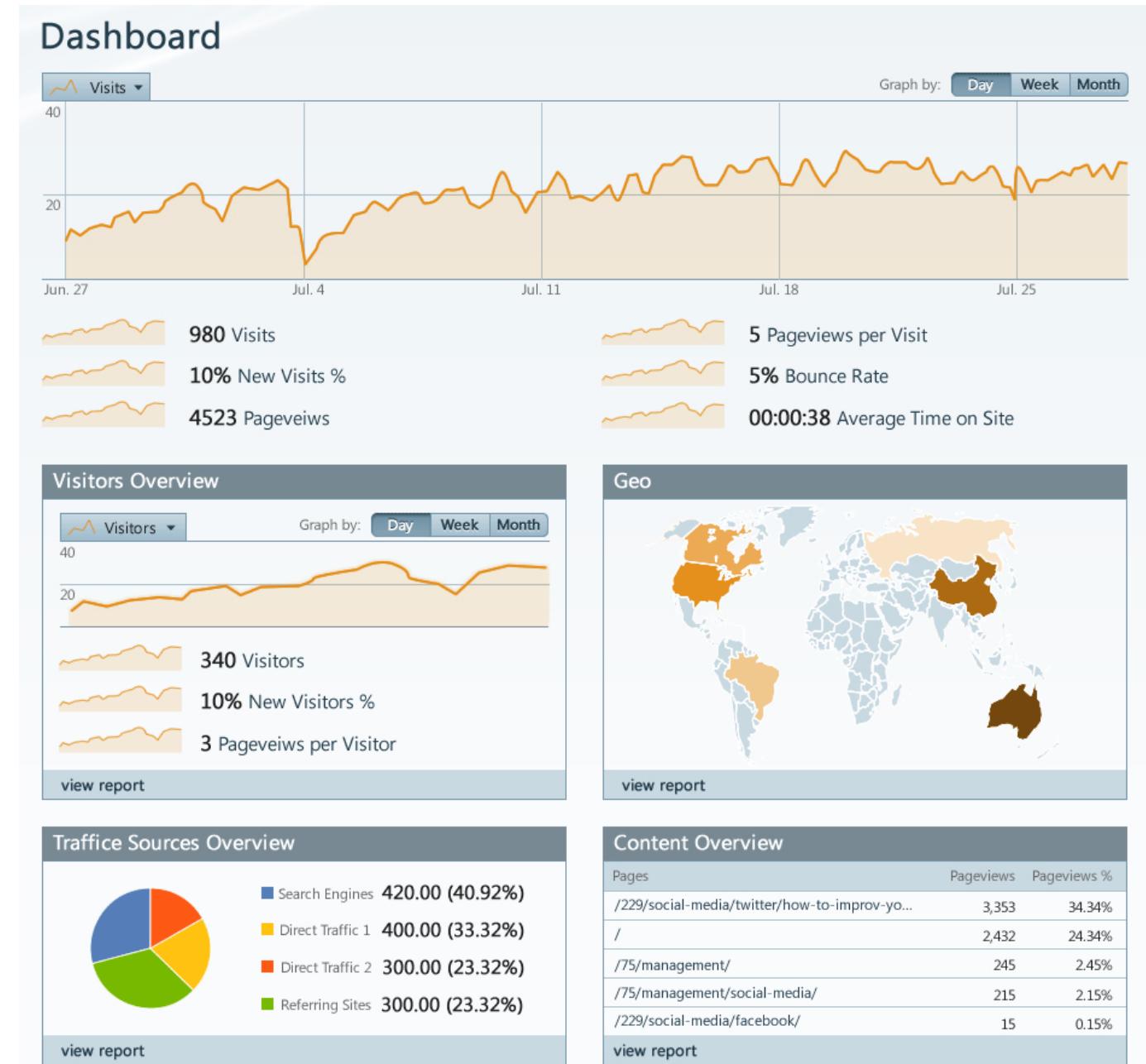
- Do you really need a chart?
- Use wireframes - focus on structure, not design elements
- Color your chart carefully
- Remove all unnecessary elements
- Use interactions when needed
- Avoid 3D charts
- Avoid meaningless chart variety



Dashboards

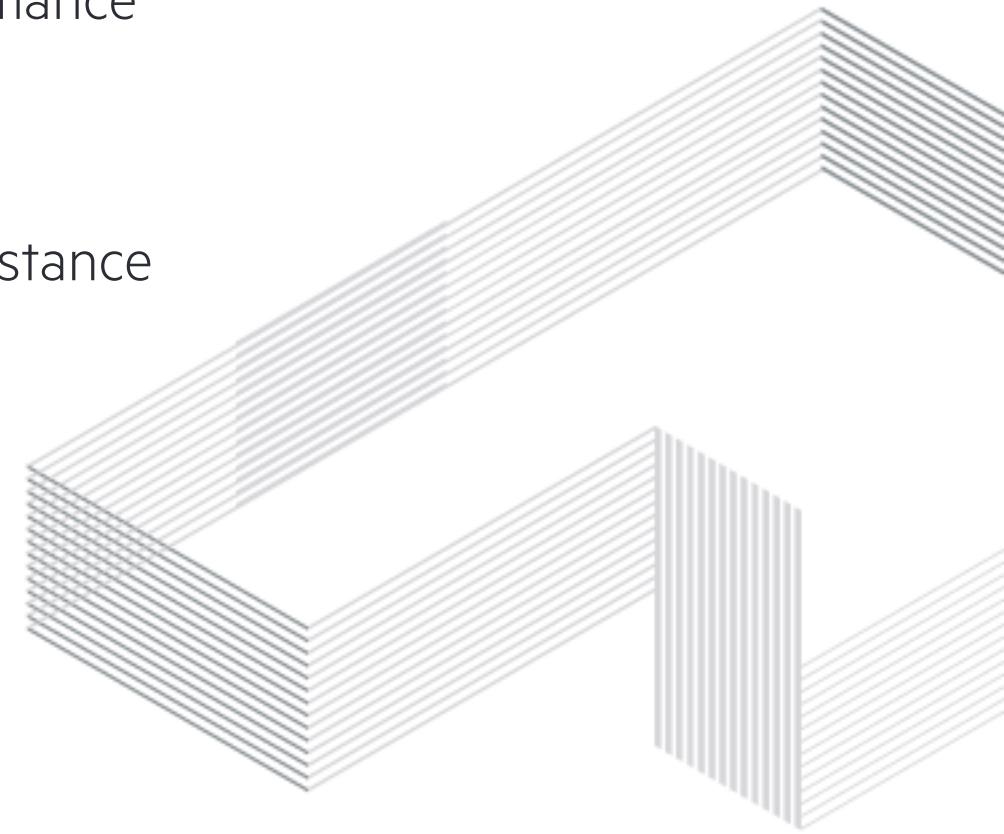
“ A dashboard is a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance.

Stephen Few

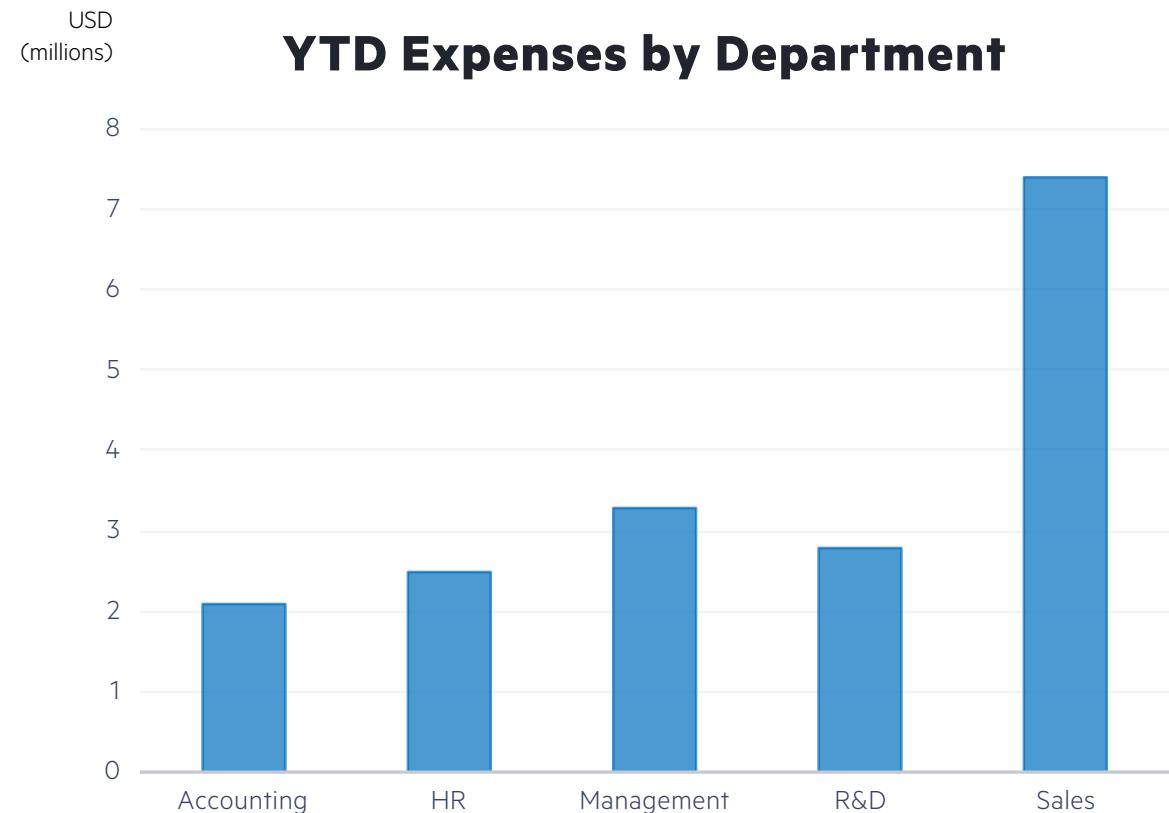
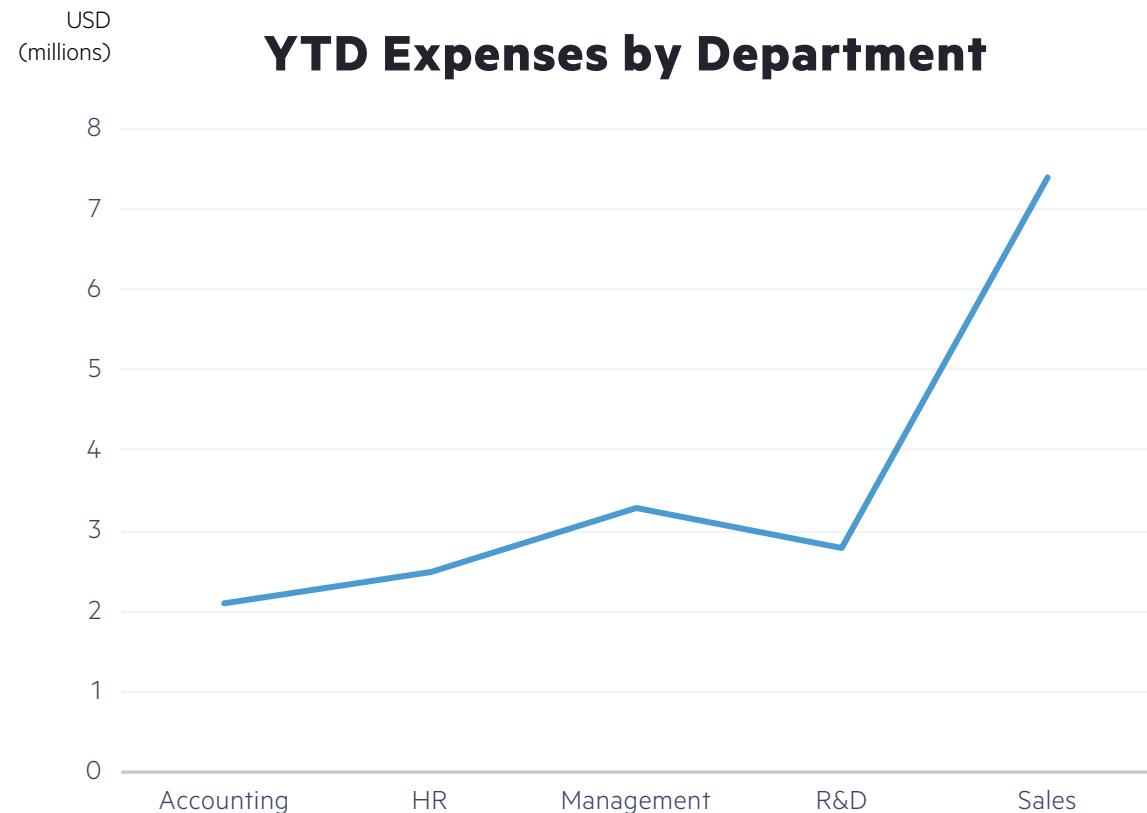


Key characteristics

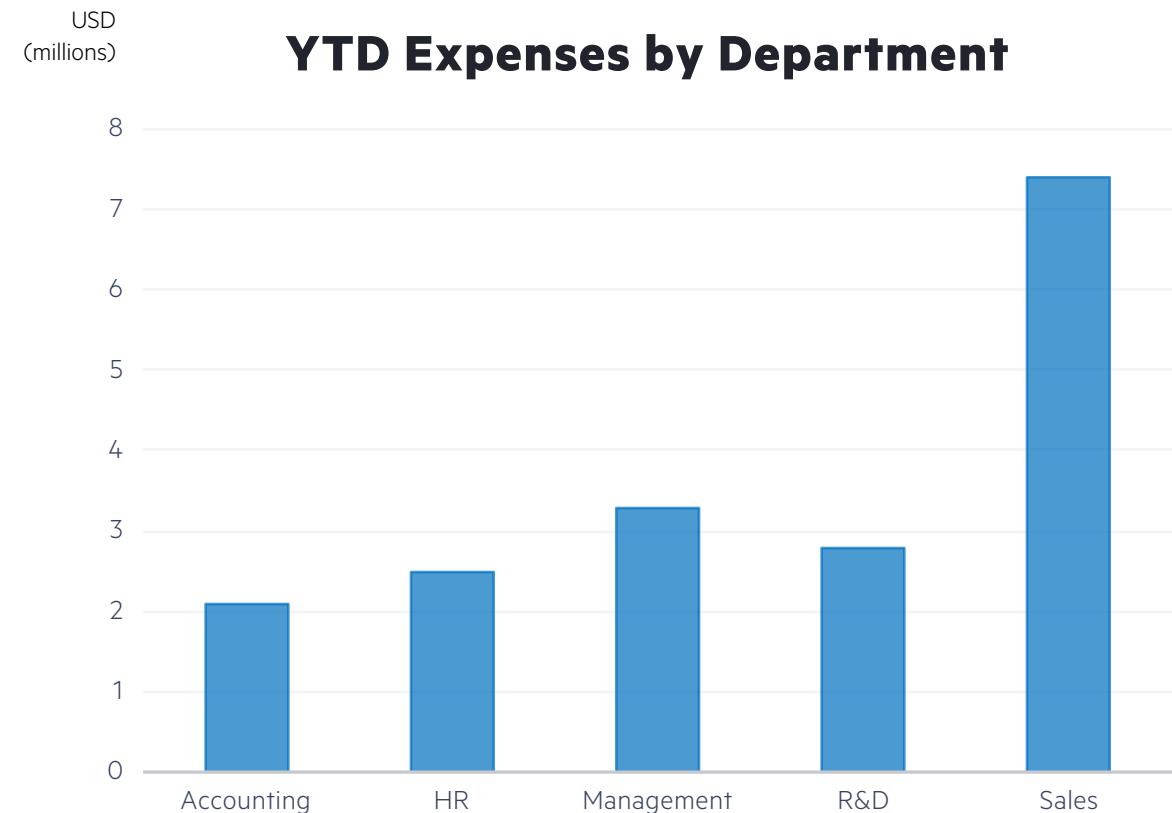
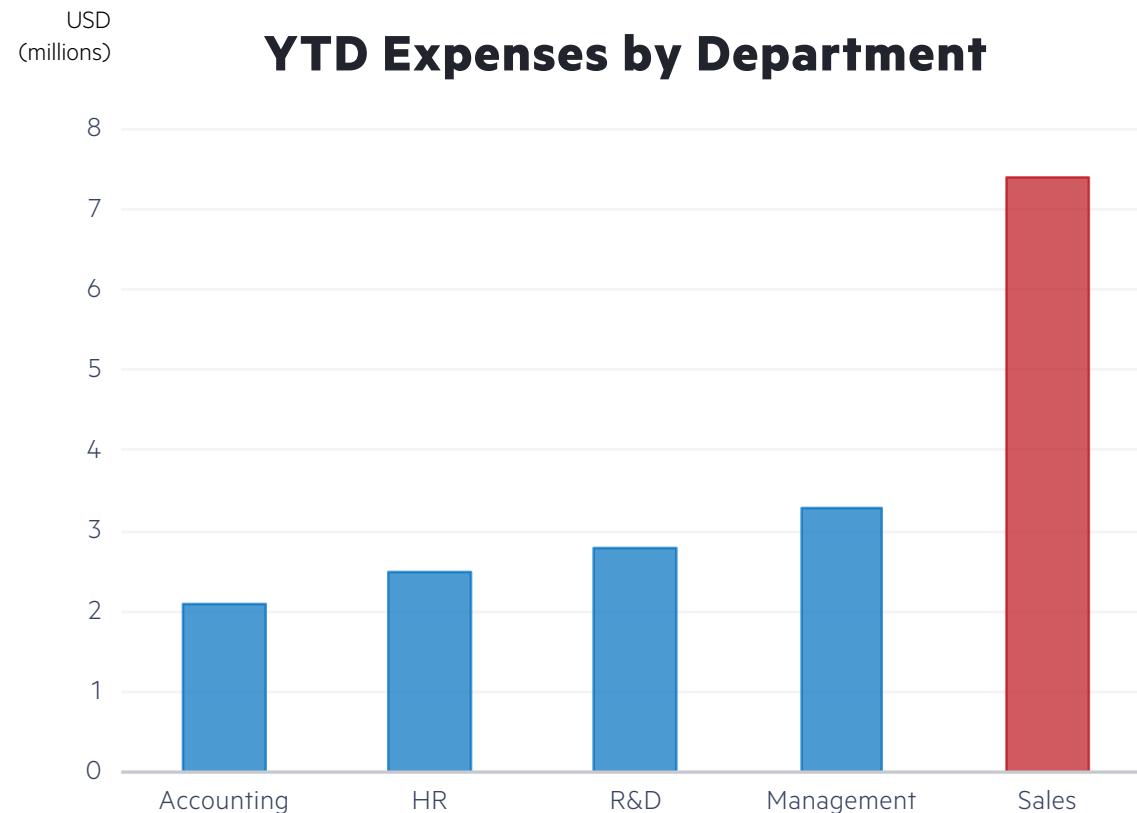
- All the visualizations fit on a single computer screen
- Effective and easy to understand and use
- Shows the most important performance indicators / performance measures to be monitored
- May use interactivity such as filtering and drill-down
- Updates the displayed data automatically updated any assistance from the user.



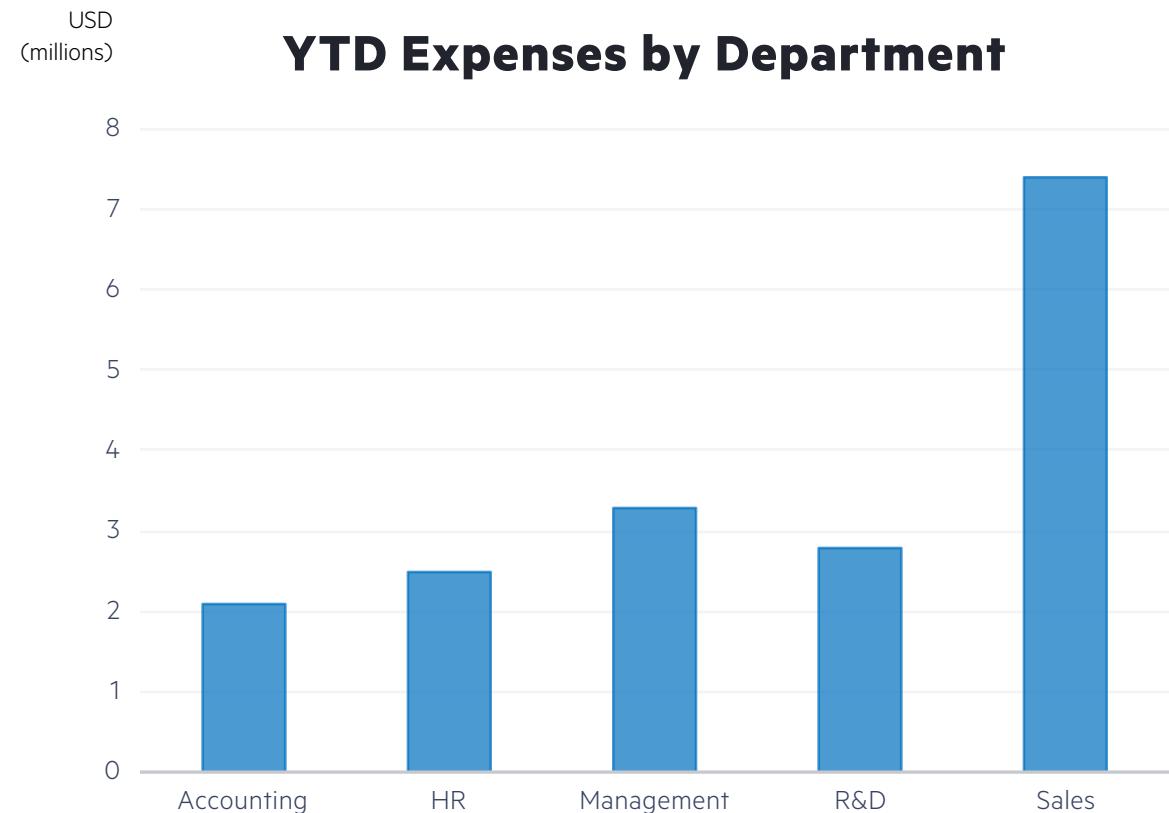
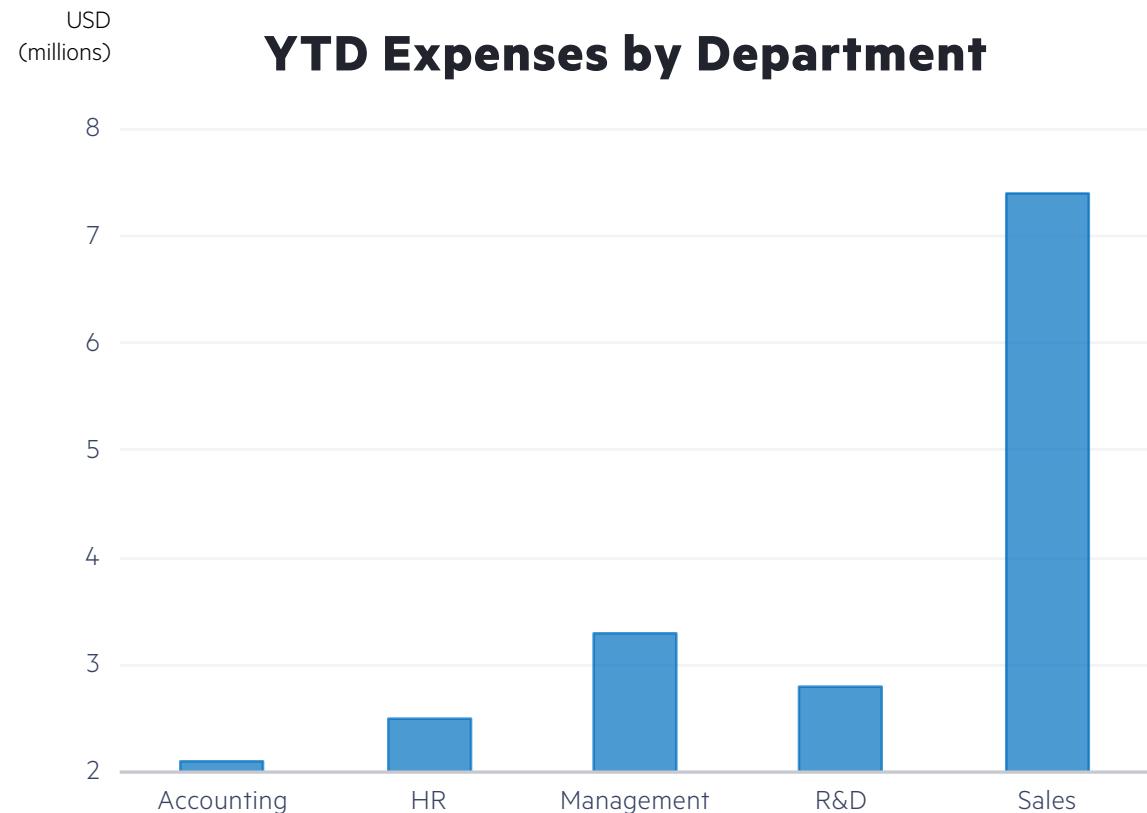
Wrong or Right?



Wrong or Right?

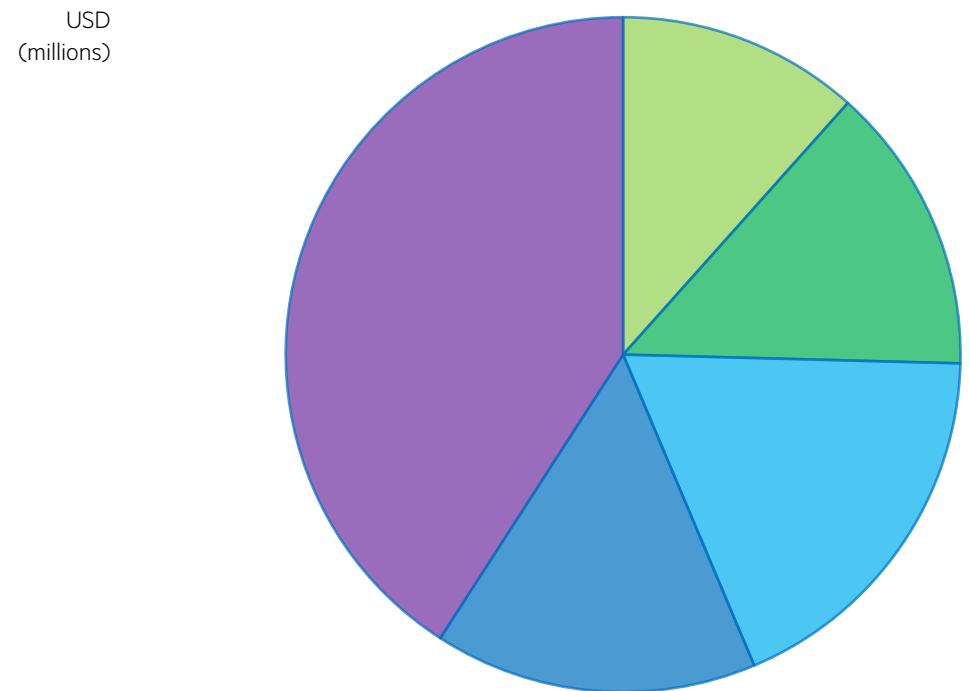


Wrong or Right?



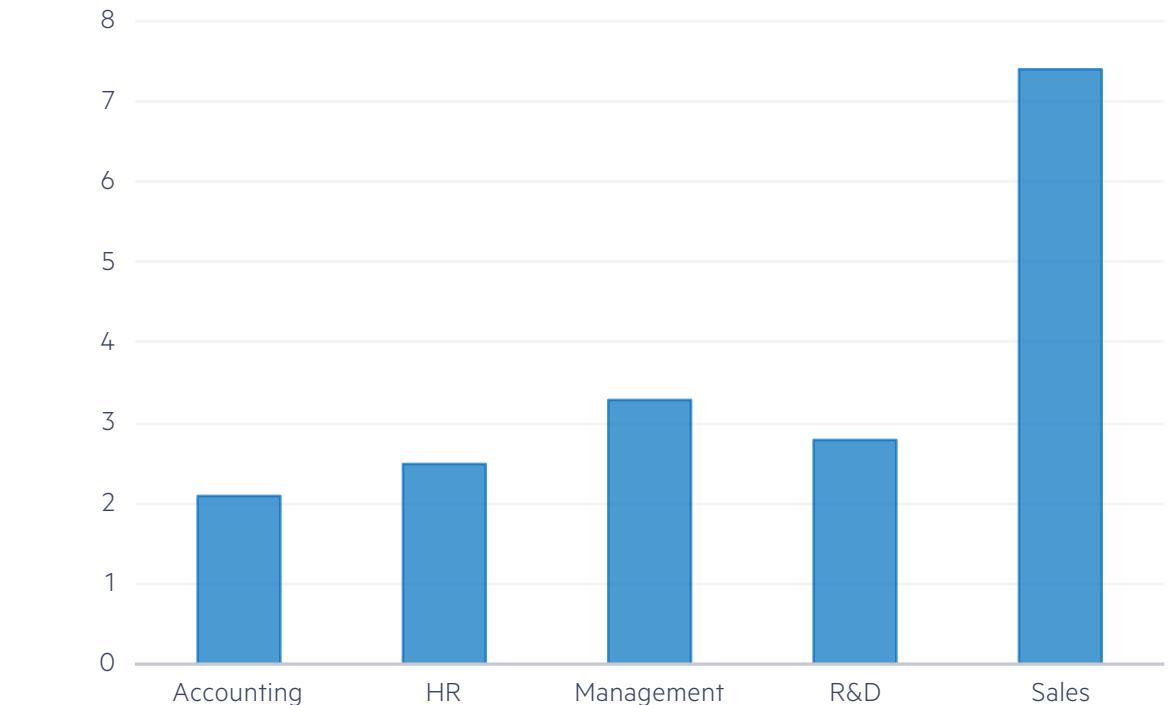
Wrong or Right?

YTD Expenses by Department



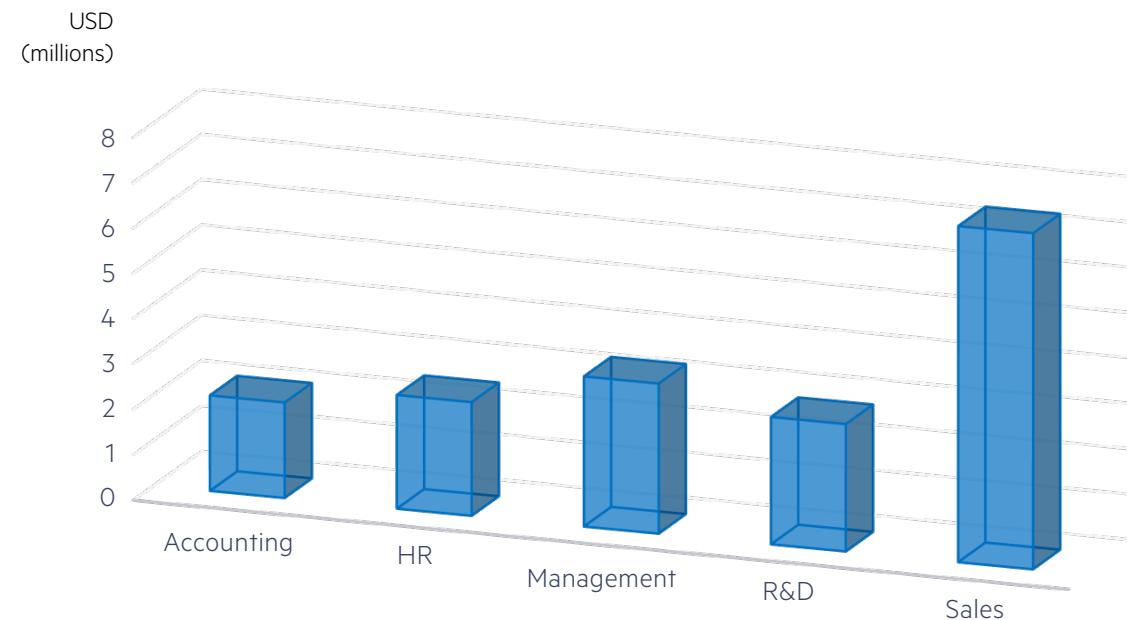
USD
(millions)

YTD Expenses by Department

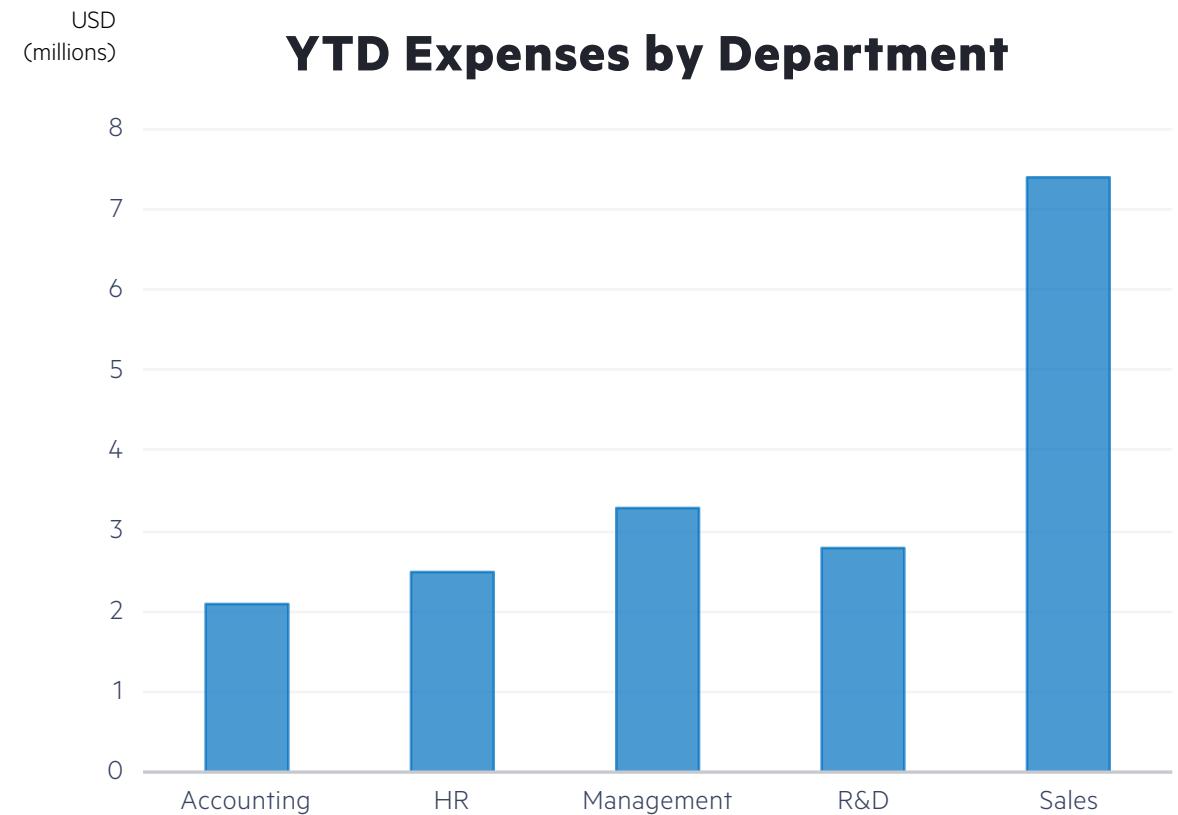


Wrong or Right?

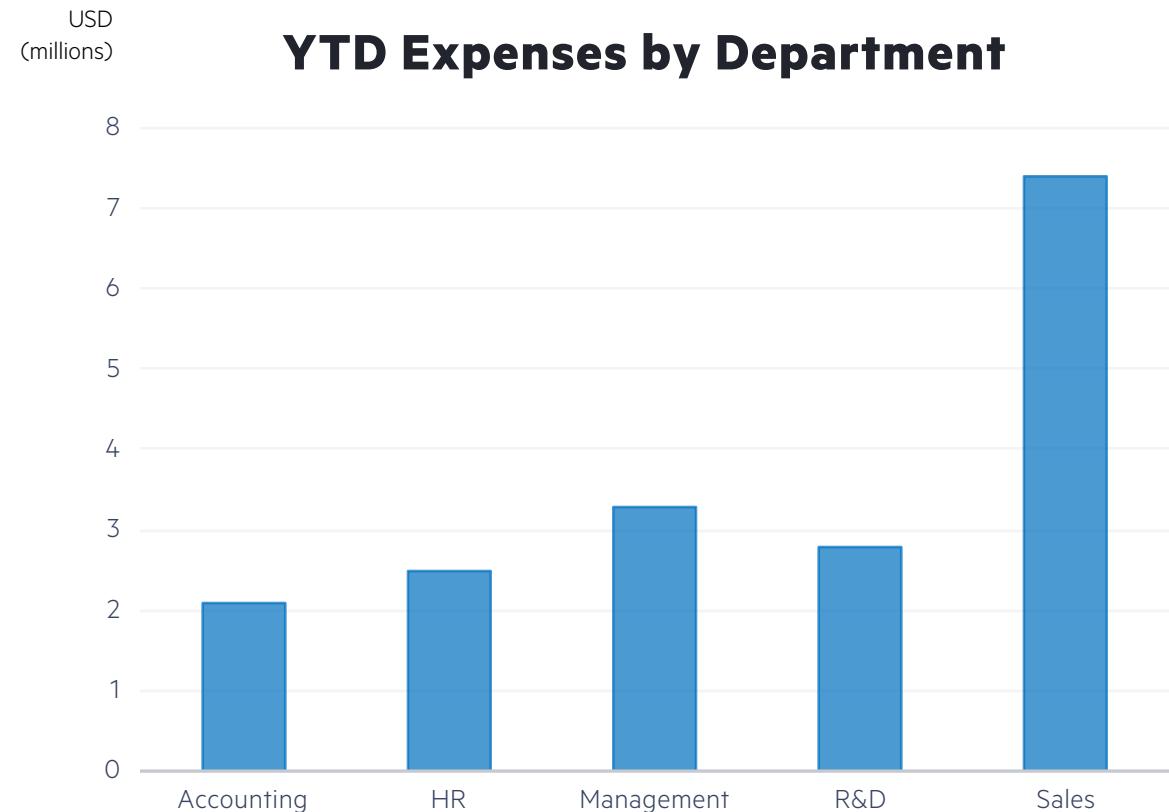
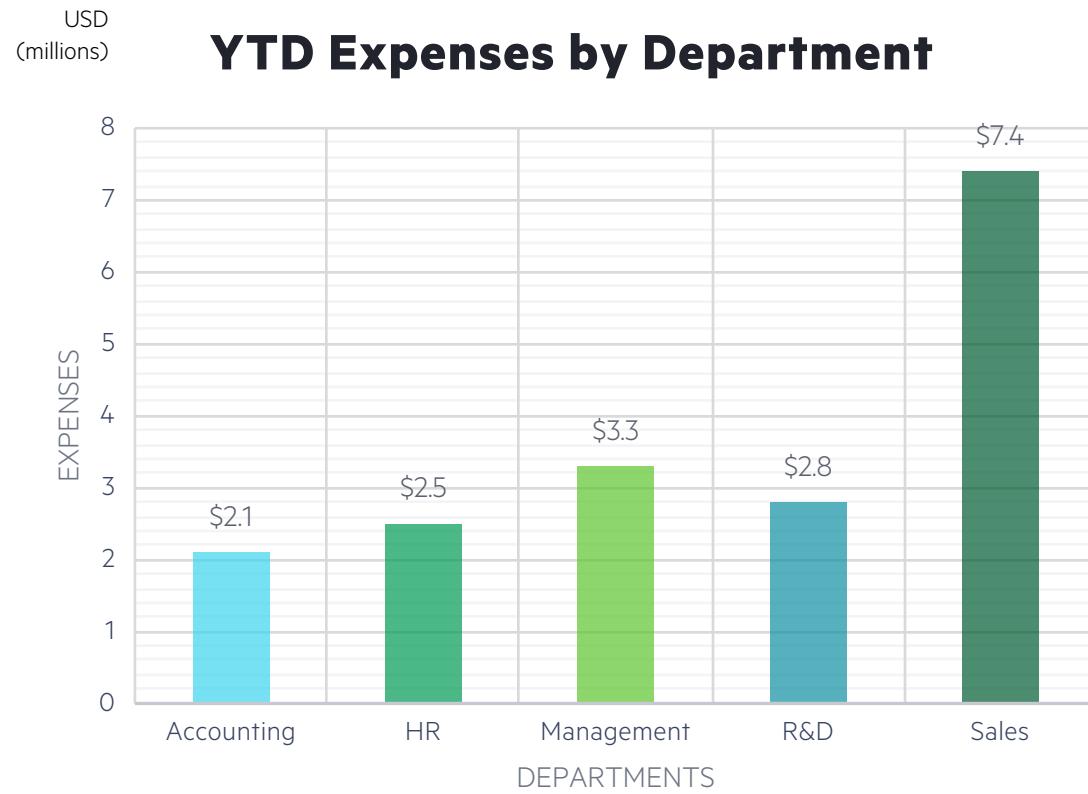
YTD Expenses by Department



YTD Expenses by Department



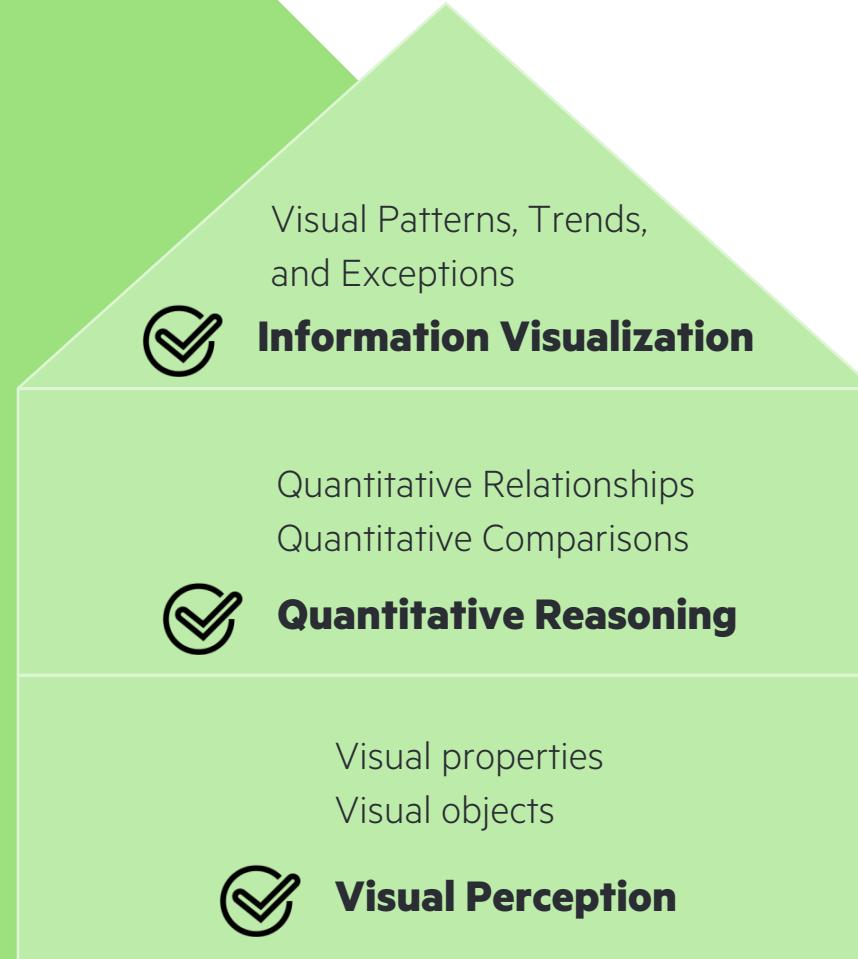
Wrong or Right?

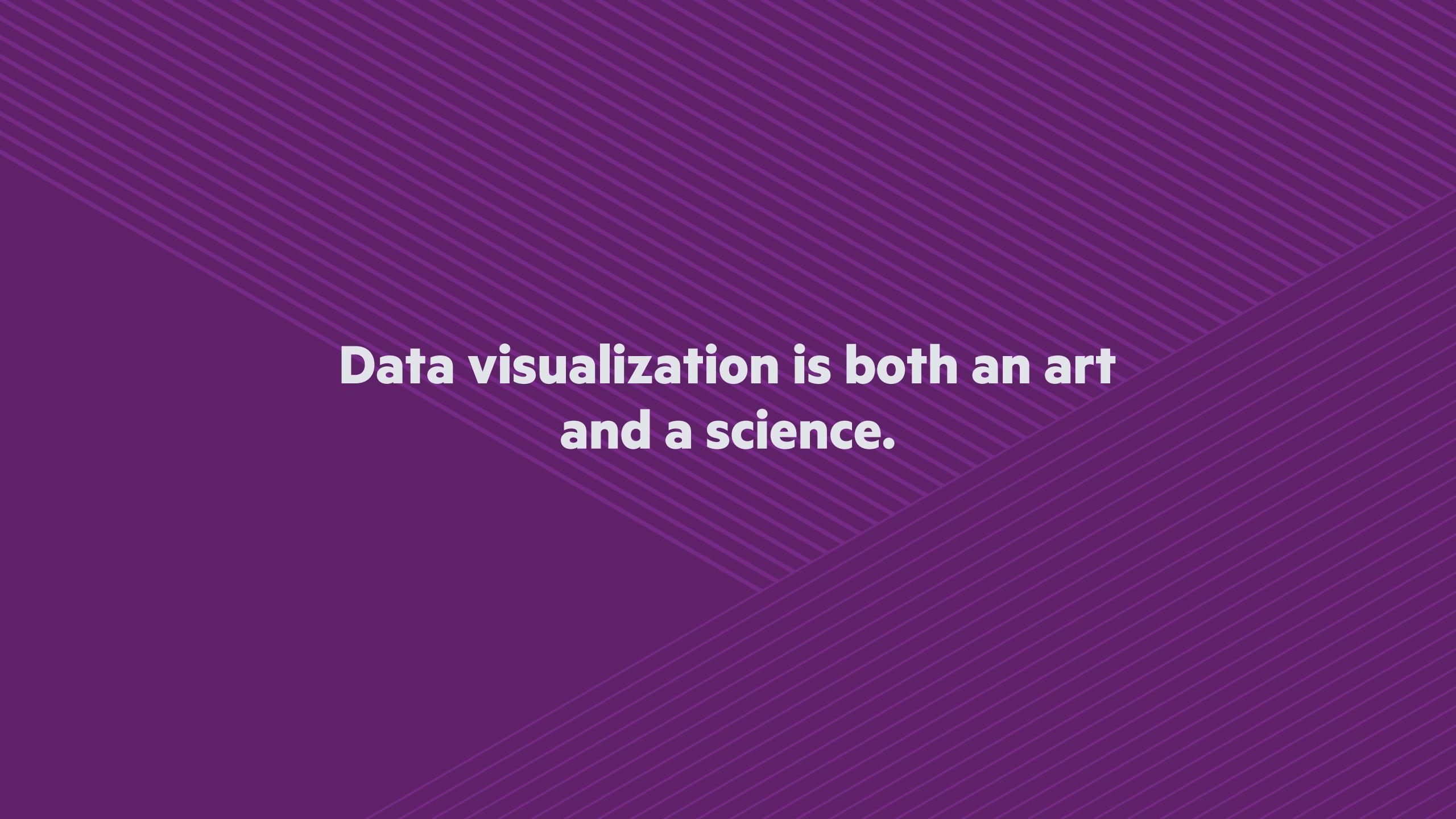


Building blocks of Information Visualization

“Information visualization is all about gaining understanding, so we can make good decisions.”

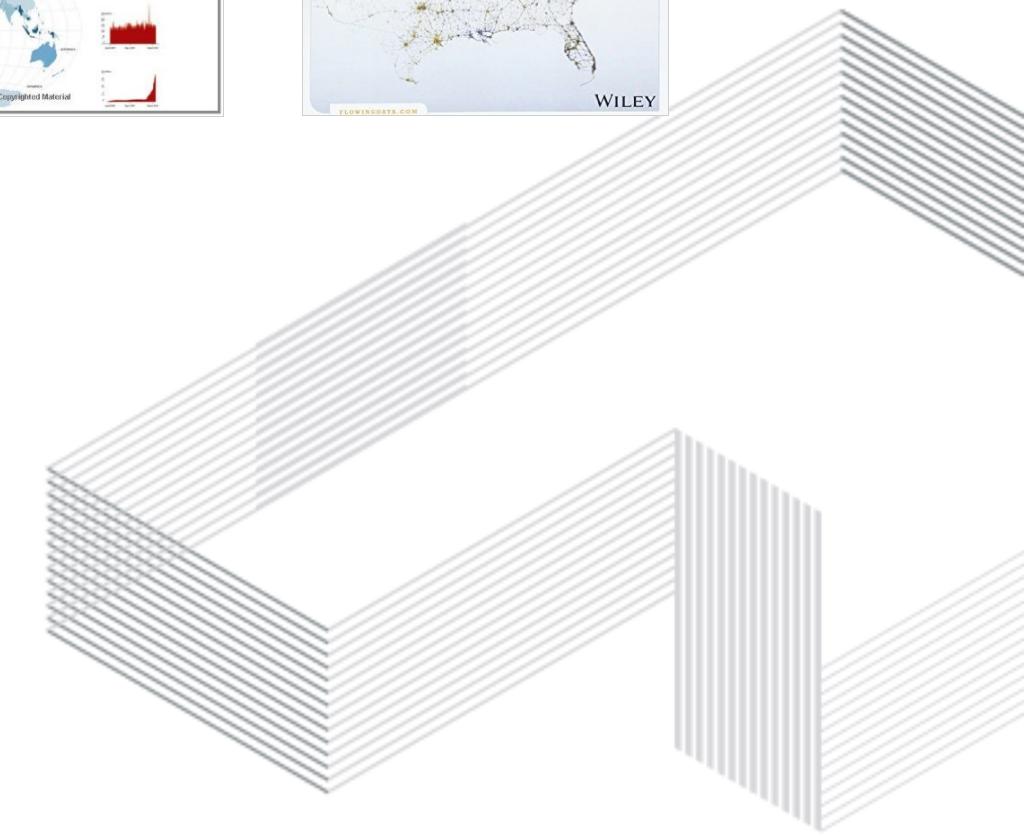
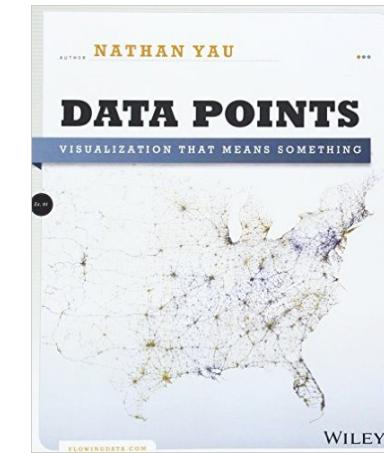
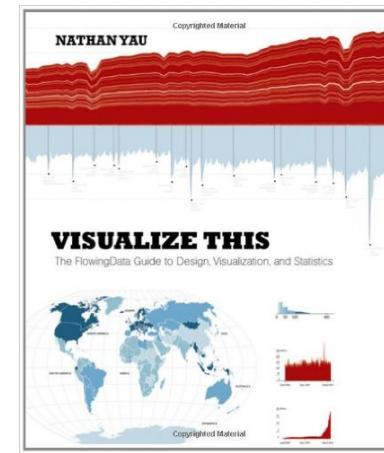
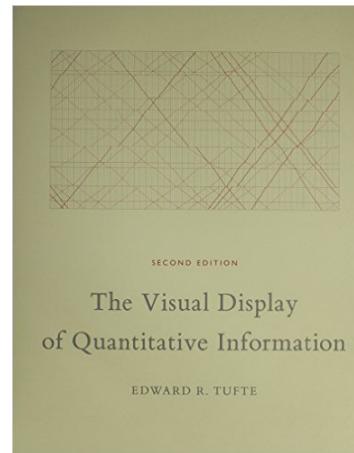
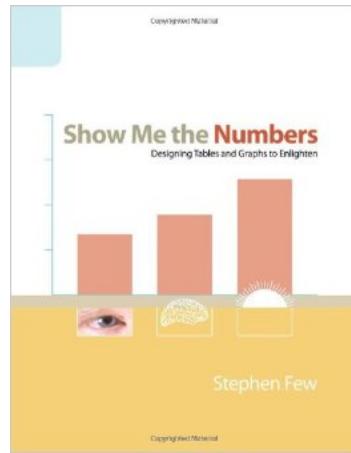
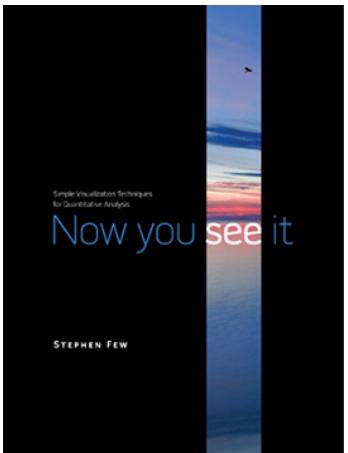
Stephen Few





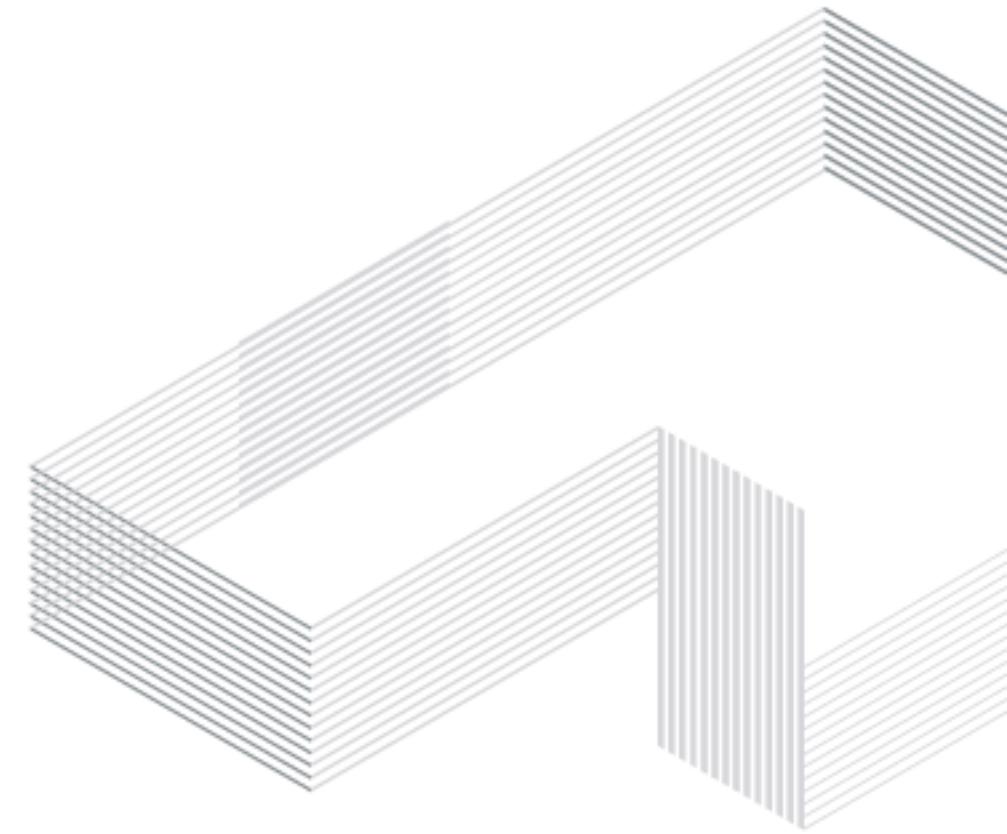
**Data visualization is both an art
and a science.**

Books



Useful links

- www.theguardian.com/data
- www.businessinsider.com/category/chart-of-the-day
- flowingdata.com
- www.perceptualedge.com
- www.informationisbeautiful.net
- junkcharts.typepad.com/junk_charts
- www.storytellingwithdata.com
- www.visualisingdata.com



Thank you.

