tableau®
SOFTWARE

# VISUAL ANALYTICS

# BEST PRACTICES

Sasha Pasulka
Senior Manager, Product Marketing

Slightly adapted by Marc van Kreveld

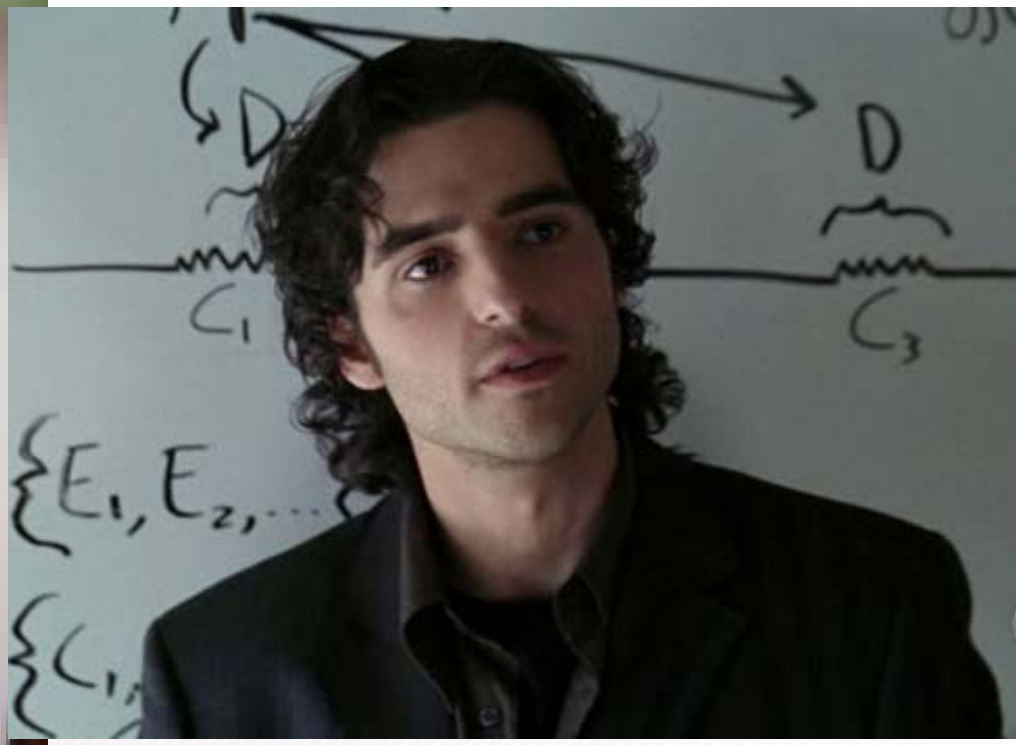
# Visual Analytics

- Aiding the human expert to understand data by exploration and seeing patterns
- When you don't really know what you are looking for
- When you are searching for research questions

- Help the expert by providing visual help in any form

3 3 0 3 0 1 8 7 6 8 2 1 4 0 3 8 3 7 7 2 0 5 2 3 2 7 0 2 0
7 1 4 6 0 2 1 3 2 7 6 0 2 5 6 3 2 5 7 6 3 3 0 2 0 3 0 7 2
8 7 5 7 2 8 3 8 7 7 8 2 0 7 7 5 2 3 1 1 5 6 3 8 4 7 8 2 0
0 5 0 5 1 6 1 7 5 6 8 0 4 4 6 7 4 7 1 4 0 0 8 4 4 3 0 3 2
2 4 3 1 3 5 4 9 5 0 7 6 0 7 4 3 1 8 2 7 3 4 6 0 2 4 8 2 3
8 6 2 2 6 5 4 6 7 0 7 6 0 0 3 9 0 2 4 7 1 7 2 3 3 5 8 7 0
0 8 4 5 1 3 1 7 6 4 5 4 1 2 4 5 3 3 5 4 9 6 7 7 6 3 4 2 5
4 7 7 0 2 2 0 1 1 7 7 7 0 2 6 6 4 7 5 8 6 1 4 3 7 8 5 4 6
4 3 6 6 4 6 6 2 8 4 8 5 3 7 8 8 1 3 8 5 4 5 7 4 0 3 2 8 4
5 5 0 3 5 3 5 3 8 3 2 3 8 2 3 1 6 2 7 2 4 6 3 6 4 4 3 2 5
4 4 0 2 1 7 2 4 4 7 4 1 9 2 4 5 2 5 0 4 0 0 5 3 6 3 3 6 7
7 4 6 6 8 7 5 7 9 2 0 2 8 8 8 8 3 2 4 2 6 4 0 4 6 3 7 2 1
0 1 7 1 5 9 1 4 2 8 7 3 7 1 4 5 1 8 7 8 0 5 1 7 0 5 8 8 1
2 8 5 2 1 2 8 7 7 6 2 5 6 2 6 4 1 5 1 6 1 2 1 1 0 5 6 4 0
2 1 1 7 7 2 0 0 1 8 7 0 2 9 0 2 8 5 7 8 4 6 0 6 5 0 7 1 2
0 5 2 4 1 5 3 3 1 5 5 1 4 0 1 6 4 3 3 9 8 8 3 4 6 8 4 8 6
7 3 7 5 2 4 0 2 7 6 3 8 5 5 4 5 8 8 7 5 5 6 5 6 7 9 7 7 4
0 3 2 8 1 4 4 6 0 8 2 3 0 1 3 4 6 2 0 5 7 7 3 6 1 8 7 3 5
4 4 8 3 3 3 5 0 1 0 3 8 6 3 2 0 5 0 6 1 3 3 4 3 6 1 5 8 6
1 0 2 2 7 6 3 3 0 8 8 0 3 1 8 8 1 2 1 7 5 2 9 3 5 8 3 2 5

# The power of human pattern recognition



# Evidence board

# What is

# VISUAL ANALYTICS?

"Visual analytics is the representation and presentation of data that EXPLOITS OUR VISUAL PERCEPTION ABILITIES in order to AMPLIFY COGNITION."

- Andy Kirk, author of "Data Visualization: a successful design process"

# Let's look at some data

| I | | II | | III | | IV | |
|---|---|---|---|---|---|---|---|
| x | y | x | y | x | y | x | y |
| 10 | 8.04 | 10 | 9.14 | 10 | 7.46 | 8 | 6.58 |
| 8 | 6.95 | 8 | 8.14 | 8 | 6.77 | 8 | 5.76 |
| 13 | 7.58 | 13 | 8.74 | 13 | 12.74 | 8 | 7.71 |
| 9 | 8.81 | 9 | 8.77 | 9 | 7.11 | 8 | 8.84 |
| 11 | 8.33 | 11 | 9.26 | 11 | 7.81 | 8 | 8.47 |
| 14 | 9.96 | 14 | 8.1 | 14 | 8.84 | 8 | 7.04 |
| 6 | 7.24 | 6 | 6.13 | 6 | 6.08 | 8 | 5.25 |
| 4 | 4.26 | 4 | 3.1 | 4 | 5.39 | 19 | 12.5 |
| 12 | 10.84 | 12 | 9.13 | 12 | 8.15 | 8 | 5.56 |
| 7 | 4.82 | 7 | 7.26 | 7 | 6.42 | 8 | 7.91 |
| 5 | 5.68 | 5 | 4.74 | 5 | 5.73 | 8 | 6.89 |

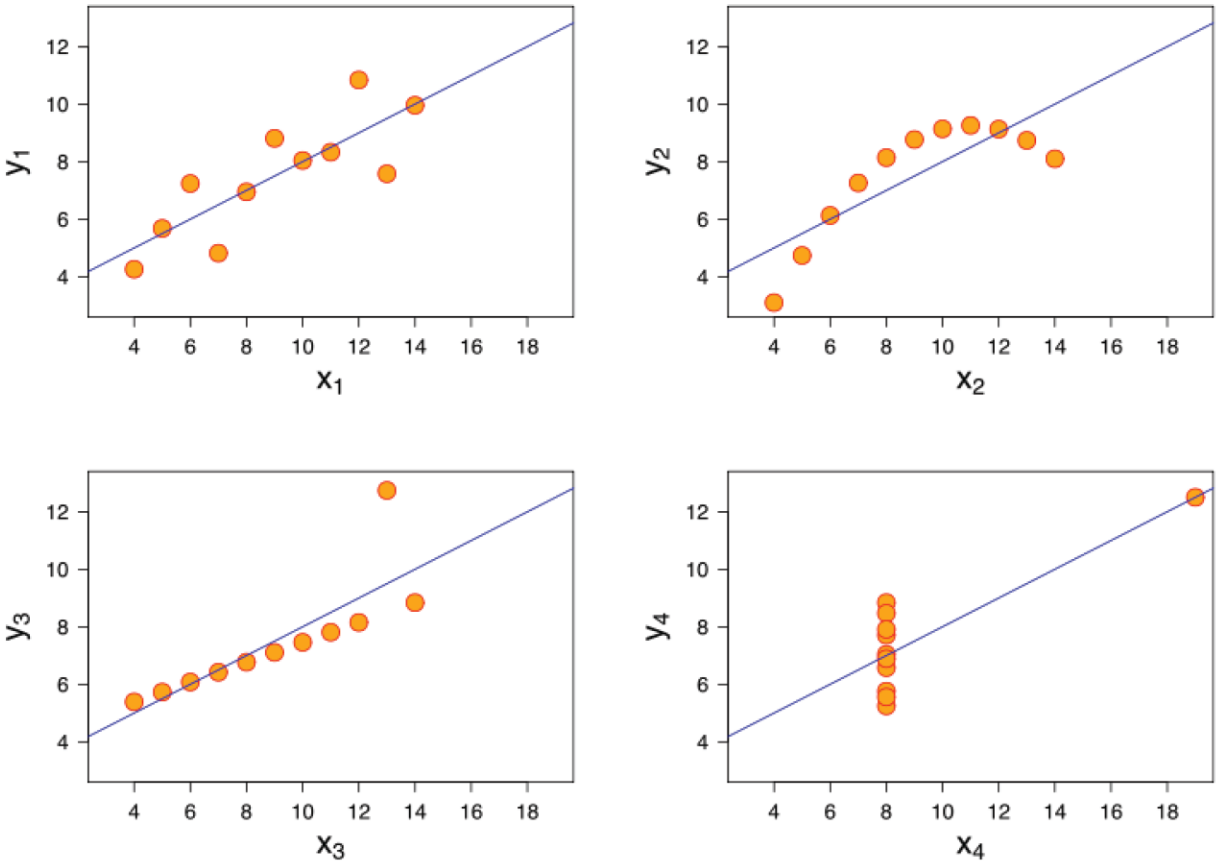
# Let's look at some data

| I | | II | | III | | IV | |
|---|---|---|---|---|---|---|---|
| x | y | x | y | x | y | x | y |
| 10 | 8.04 | 10 | 9.14 | 10 | 7.46 | 8 | 6.58 |
| 8 | 6.95 | 8 | 8.14 | 8 | 6.77 | 8 | 5.76 |
| 13 | 7.58 | 13 | 8.74 | 13 | 12.74 | 8 | 7.71 |
| 9 | 8.81 | 9 | 8.77 | | | | |
| 11 | 8.33 | 11 | 9.26 | | | | |
| 14 | 9.96 | 14 | 8.1 | | | | |
| 6 | 7.24 | 6 | 6.13 | | | | |
| 4 | 4.26 | 4 | 3.1 | | | | |
| 12 | 10.84 | 12 | 9.13 | | | | |
| 7 | 4.82 | 7 | 7.26 | | | | |
| 5 | 5.68 | 5 | 4.74 | | | | |

| Property | Value |
|---|---|
| Mean of x in each case | 9 (exact) |
| Variance of x in each case | 11 (exact) |
| Mean of y in each case | 7.50 (to 2 decimal places) |
| Variance of y in each case | 4.122 or 4.127 (to 3 decimal places) |
| Correlation between x and y in each case | 0.816 (to 3 decimal places) |
| Linear regression line in each case | y = 3.00 + 0.500x (to 2 and 3 decimal places, respectively) |

# Let's look at some data

## VISUALLY




"Anscombe's Quartet" Source: Wikipedia

# AGENDA

1. Human Perception and Cognition
2. Visual Analysis Cycle
3. Visualization Best Practices

# Human perception and cognition

# Humans are slow at math

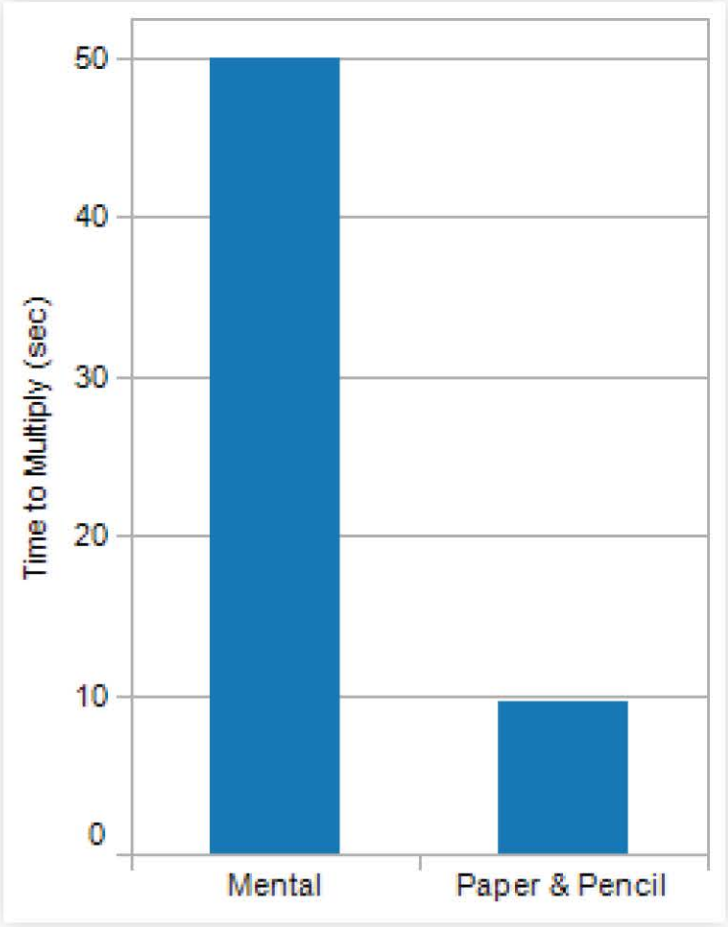
$$\begin{array}{r} 34 \\ \times\ 72 \\ \hline \end{array}$$

# We're Faster When We Use the World

$$
\begin{array}{r}
34 \\
\times\ 72 \\
\hline
68 \\
23^{1}80 \\
\hline
2448
\end{array}
$$

# Much faster

$$\begin{array}{r} 34 \\ \times\ 72 \\ \hline 68 \\ 23^{1}80 \\ \hline 2448 \end{array}$$



# We're faster when we can

## SEE DATA

| | | Customer Segment | | | |
|---|---|---|---|---|---|
| Category | Sub-Category (group) | Consumer | Corporate | Home Office | Small Business |
| Furniture | Bookcases | -63.02 | -9,305.76 | -16,610.95 | -7,602.40 |
| | Chairs & Chairmats | 42,942.97 | 39,370.10 | 41,686.28 | 25,650.38 |
| | Office Furnishings | 12,099.80 | 27,374.47 | 42,196.25 | 18,757.40 |
| | Tables | -12,251.51 | -35,430.73 | -43,292.40 | -8,087.89 |
| Office Supplies | Appliances | 15,501.48 | 50,095.94 | 25,343.06 | 6,217.58 |
| | Binders and Binder Ac.. | 48,035.27 | 125,811.27 | 71,674.19 | 61,892.69 |
| | Envelopes, Labels, Pa.. | 16,907.52 | 31,230.67 | 25,508.13 | 33,476.65 |
| | Pens & Art Supplies | 2,621.68 | 1,670.40 | 1,580.82 | 1,691.88 |
| | Rubber Bands | 271.85 | -353.54 | -93.12 | 72.14 |
| | Scissors, Rulers and .. | -558.10 | -3,330.62 | -2,844.06 | -1,066.47 |
| | Storage & Organization | 5,752.65 | -2,086.83 | -23.24 | 3,021.57 |
| Technology | Computer Peripherals | 14,152.79 | 45,092.93 | 17,771.05 | 17,270.71 |
| | Copiers and Fax | 41,310.35 | 28,654.48 | 29,283.14 | 68,113.50 |
| | Office Machines | 51,454.78 | 180,356.22 | 39,386.23 | 36,515.70 |
| | Telephones and Com.. | 49,781.48 | 120,596.92 | 86,788.72 | 59,784.52 |

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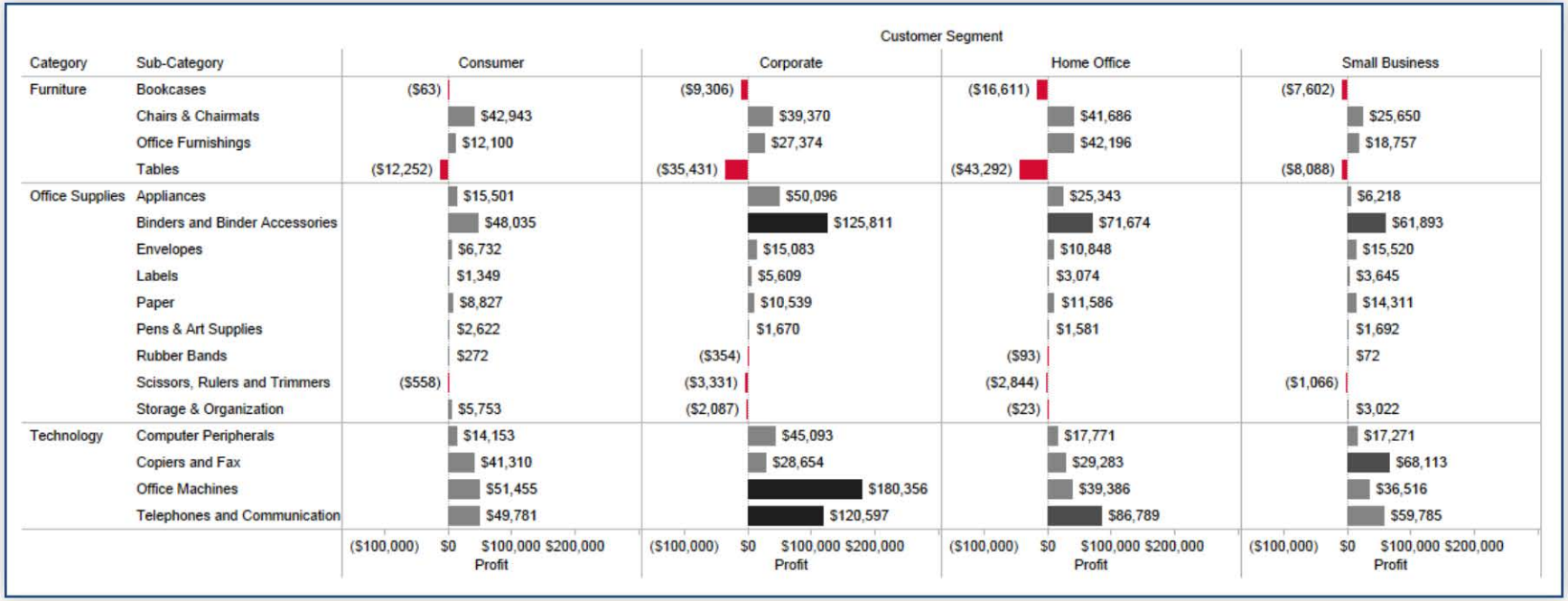
# We're faster when we can

## SEE DATA



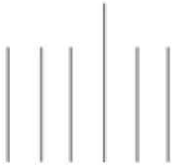
Customer Segment

| Category | Sub-Category | Consumer | Corporate | Home Office | Small Business |
|---|---|---|---|---|---|
| Furniture | Bookcases | ($63) | ($9,306) | ($16,611) | ($7,602) |
| | Chairs & Chairmats | $42,943 | $39,370 | $41,686 | $25,650 |
| | Office Furnishings | $12,100 | $27,374 | $42,196 | $18,757 |
| | Tables | ($12,252) | ($35,431) | ($43,292) | ($8,088) |
| Office Supplies | Appliances | $15,501 | $50,096 | $25,343 | $6,218 |
| | Binders and Binder Accessories | $48,035 | $125,811 | $71,674 | $61,893 |
| | Envelopes | $6,732 | $15,083 | $10,848 | $15,520 |
| | Labels | $1,349 | $5,609 | $3,074 | $3,645 |
| | Paper | $8,827 | $10,539 | $11,586 | $14,311 |
| | Pens & Art Supplies | $2,622 | $1,670 | $1,581 | $1,692 |
| | Rubber Bands | $272 | ($354) | ($93) | $72 |
| | Scissors, Rulers and Trimmers | ($558) | ($3,331) | ($2,844) | ($1,066) |
| | Storage & Organization | $5,753 | ($2,087) | ($23) | $3,022 |
| Technology | Computer Peripherals | $14,153 | $45,093 | $17,771 | $17,271 |
| | Copiers and Fax | $41,310 | $28,654 | $29,283 | $68,113 |
| | Office Machines | $51,455 | $180,356 | $39,386 | $36,516 |
| | Telephones and Communication | $49,781 | $120,597 | $86,789 | $59,785 |

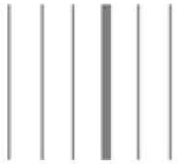
($100,000) $0 $100,000 $200,000
Profit

# Pre-attentive visual attributes

Length

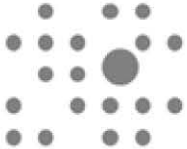


Width

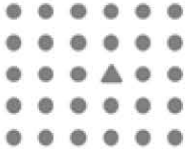


Orientation

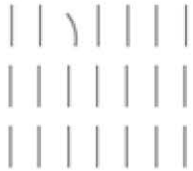
Size



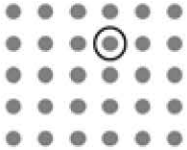
Shape



Curvature



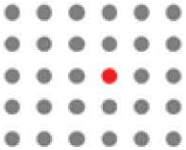
Enclosure



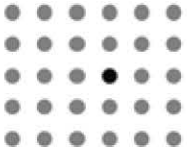
2-D Position

Spatial Grouping

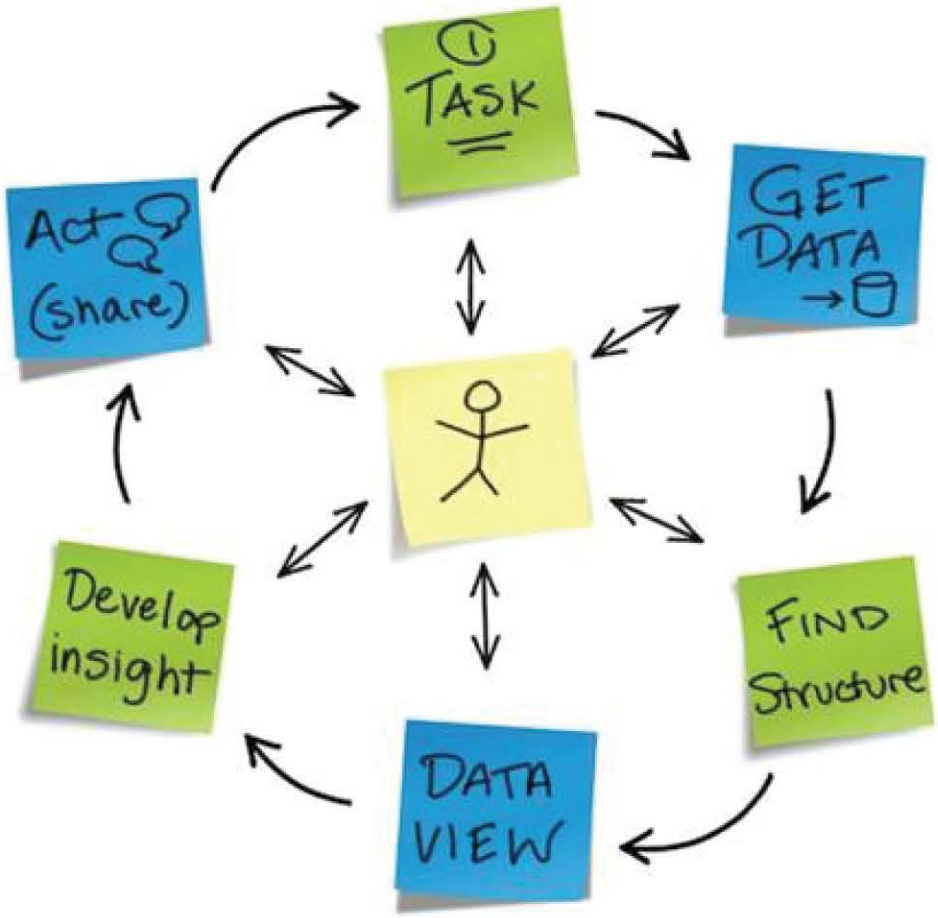
Color (Hue)



Color (Intensity)



# The cycle of visual analysis



# Supporting the cycle

Incremental: allow people to easily and incrementally CHANGE THE DATA and how they are looking at it

Expressive: there is NO SINGLE VIEW for all tasks and all data

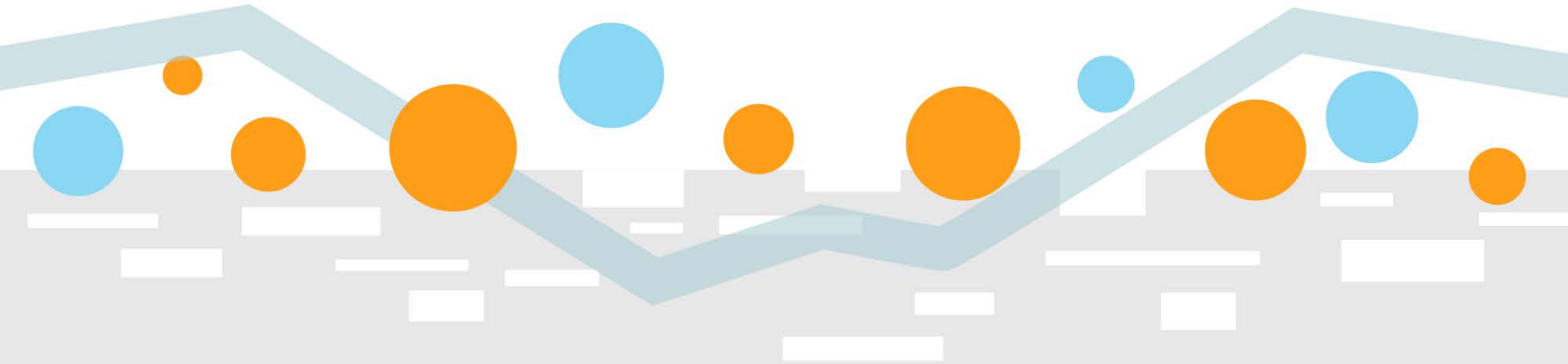
# Visual Information Seeking Mantra

Overview first,
zoom and filter,
then details-on-demand

Ben Shneiderman

freshspectrum.com

# Visualization best practices



# Best practices overview

1. Representing data for humans
2. Color
3. Maps
4. Creating dashboards
5. The viz review

# Types of data

- Qualitative (nominal)

  Arizona, New York, Texas
  Sarah, John, Maria
  Coors, Bud Light, Stella Artois

- Qualitative (ordinal)

  Gold, silver, bronze
  Excellent health, good health, poor health
  Love it, like it, hate it

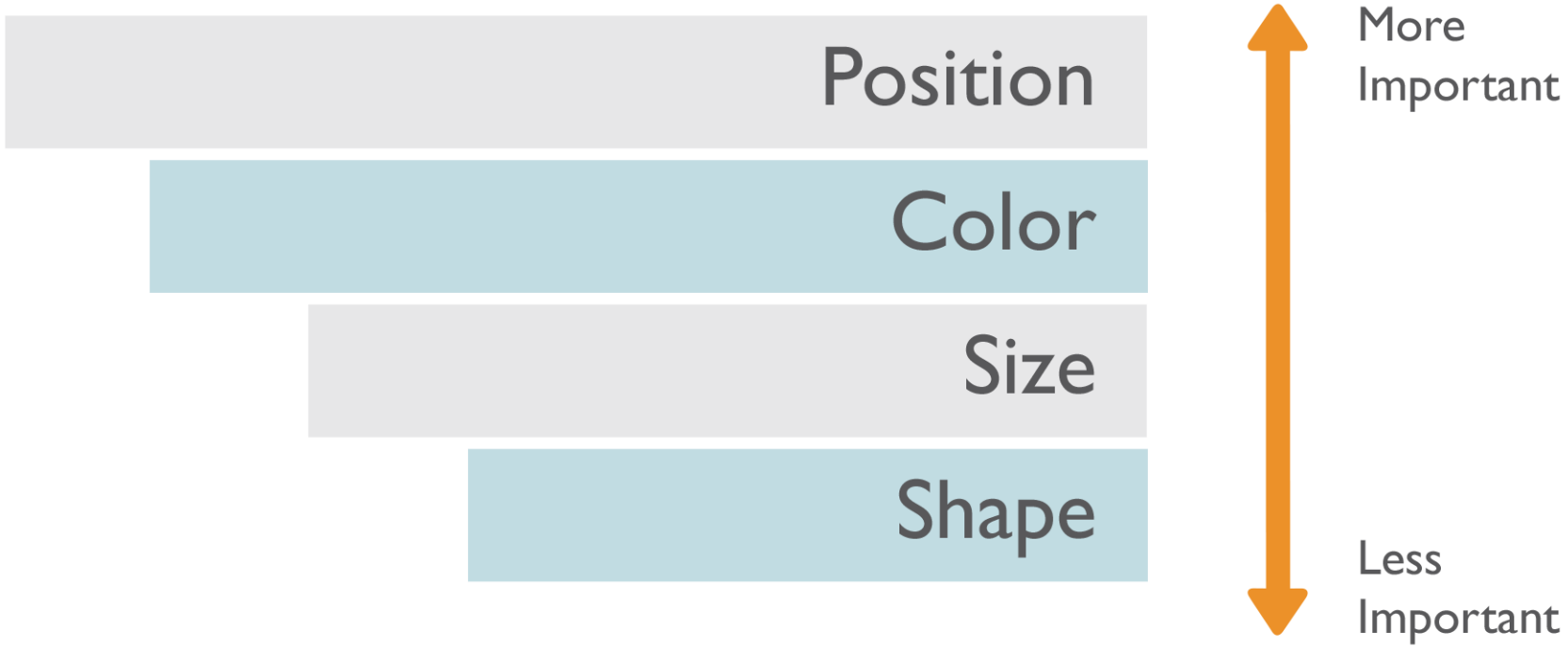
- Quantitative

  Weight (10 lbs, 20 lbs, 5000 lbs)
  Cost ($50, $100, $0.05)
  Discount (5%, 10%, 12.8%)

# How do humans like their data?

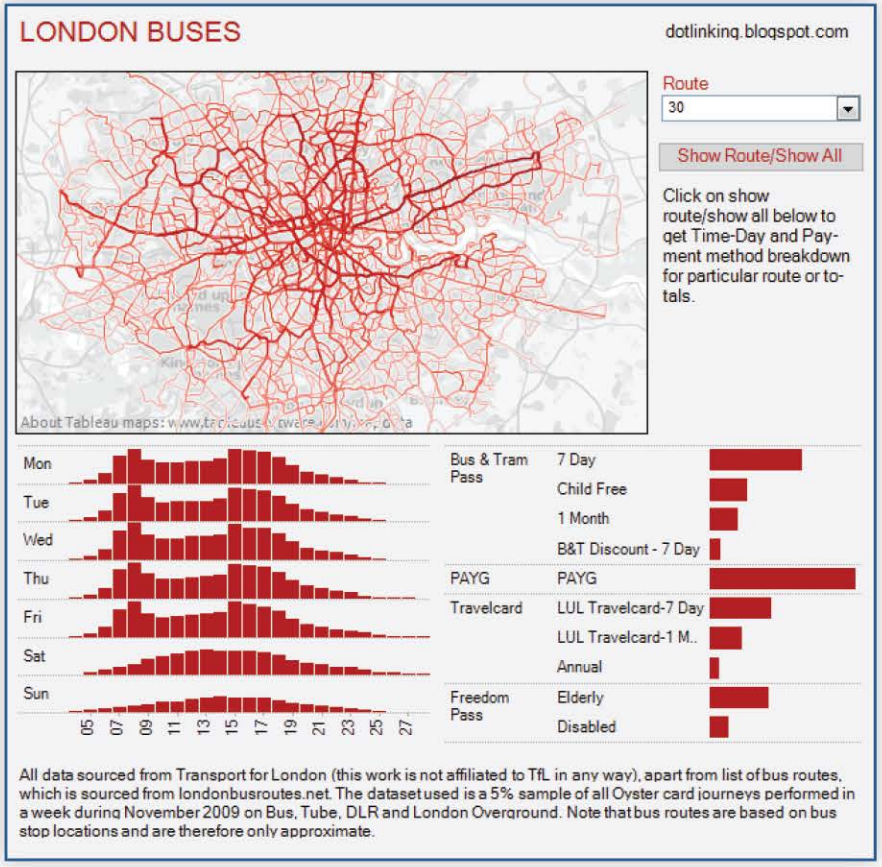
| QUANTITIVE | ORDINAL | CATEGORICAL |
| --- | --- | --- |
| Position | Position | Position |
| Length | Size | Shape |
| Size | Color Intensity | Different Colors |
| Color Intensity | Different Colors | |
| | Shape | |

# How do humans like their data?



# How do humans like their data?

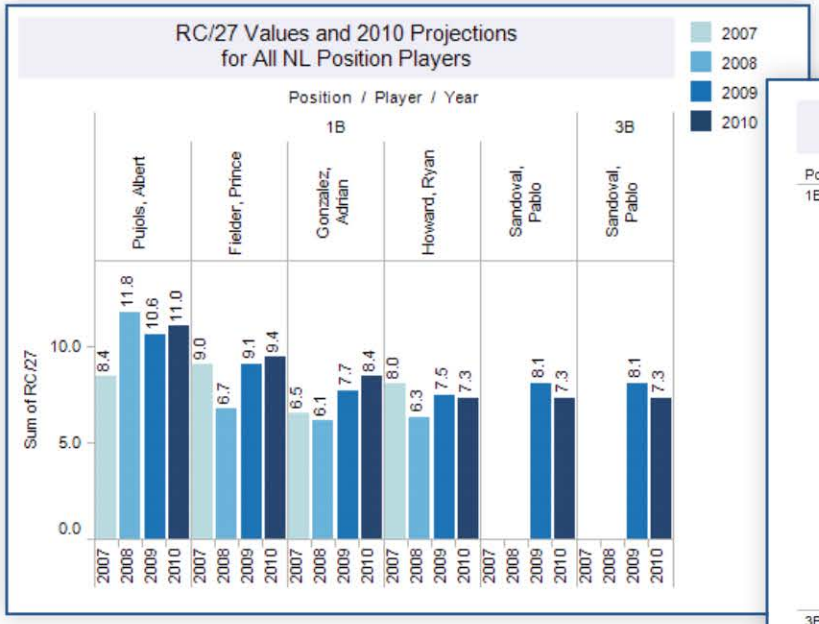
- Time: on an x-axis
- Location: on a map
- Comparing values:
  bar chart
- Exploring relationships:
  scatter plot
- Relative proportions:
  treemap



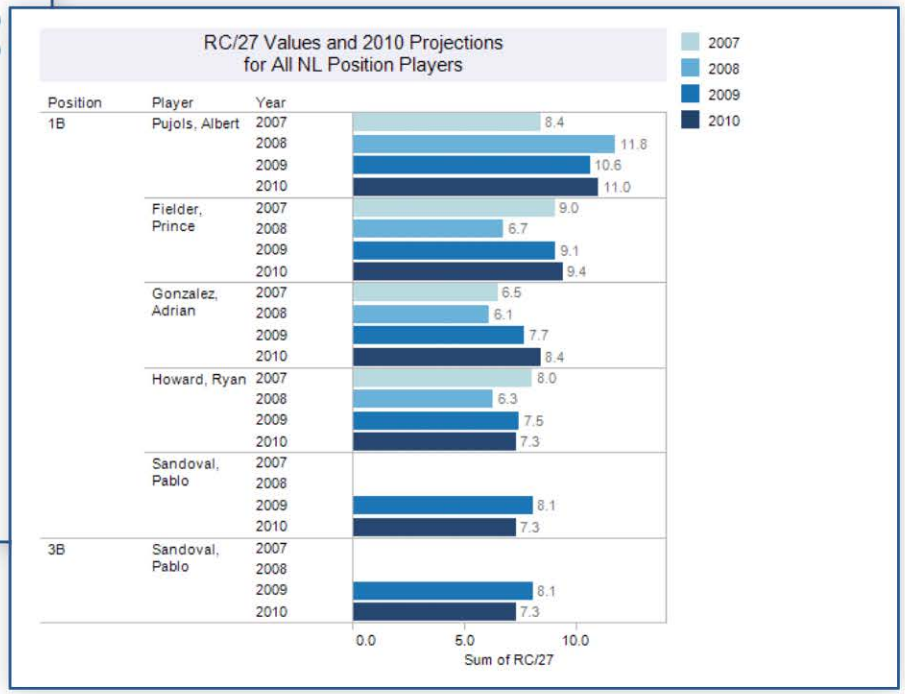
# How do humans like their data?

## Orient data so people can read it easily

Good

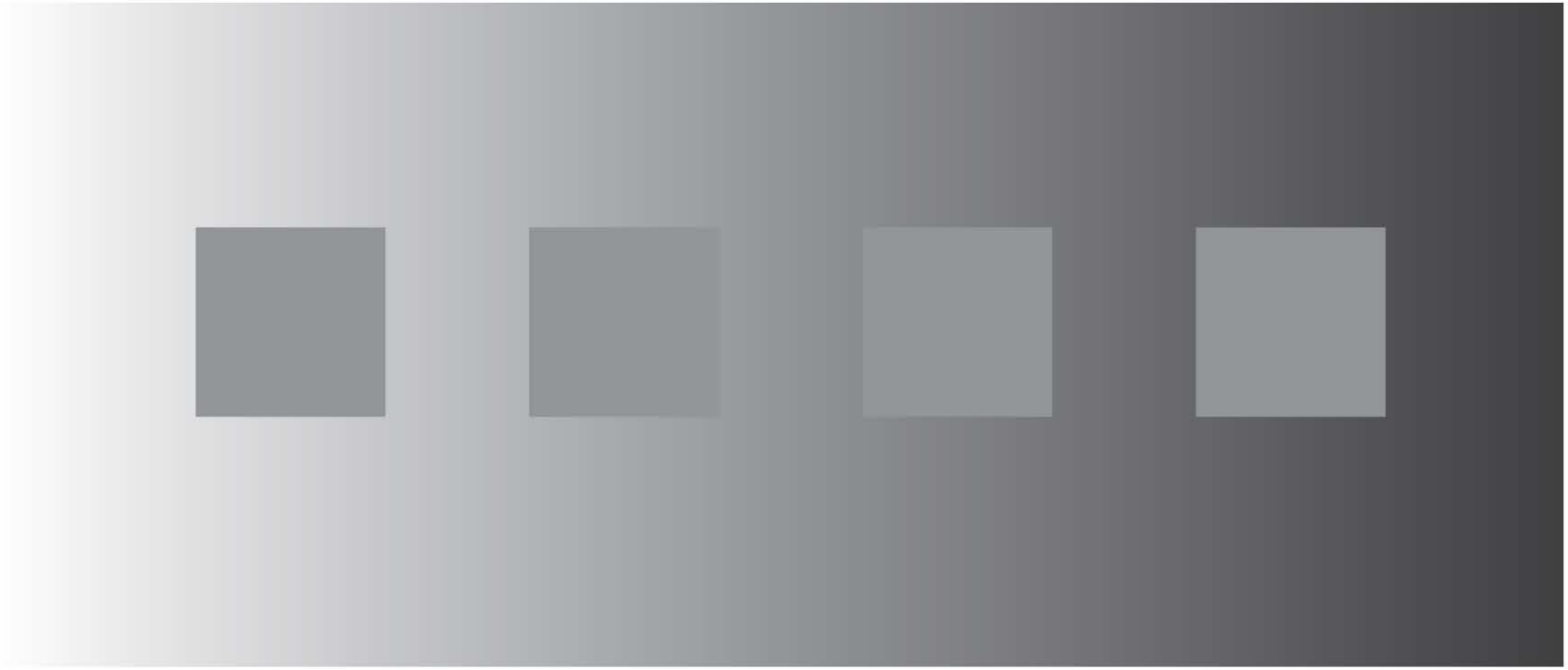



Better



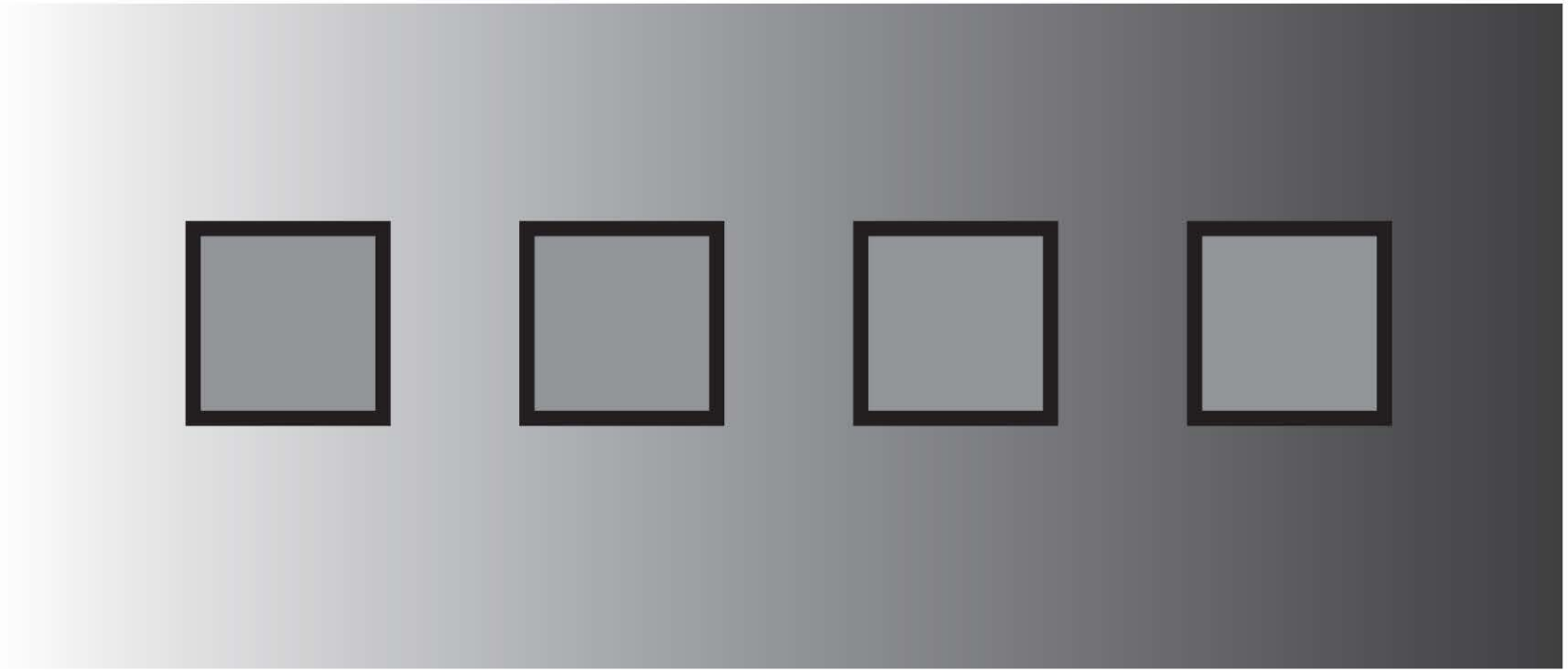
# Color me impressed

## Color perception is relative, not absolute



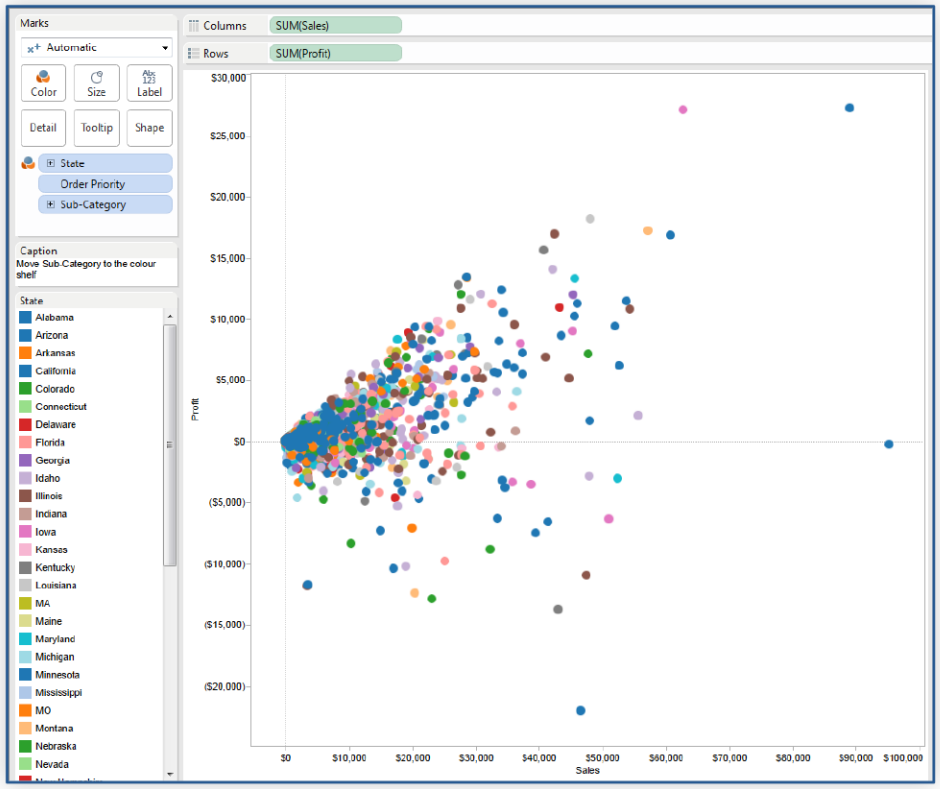
# Color me impressed

## Provide a consistent background



# Color me impressed

## Humans can only distinguish ~8 colors




This is not helpful.

# Color me impressed

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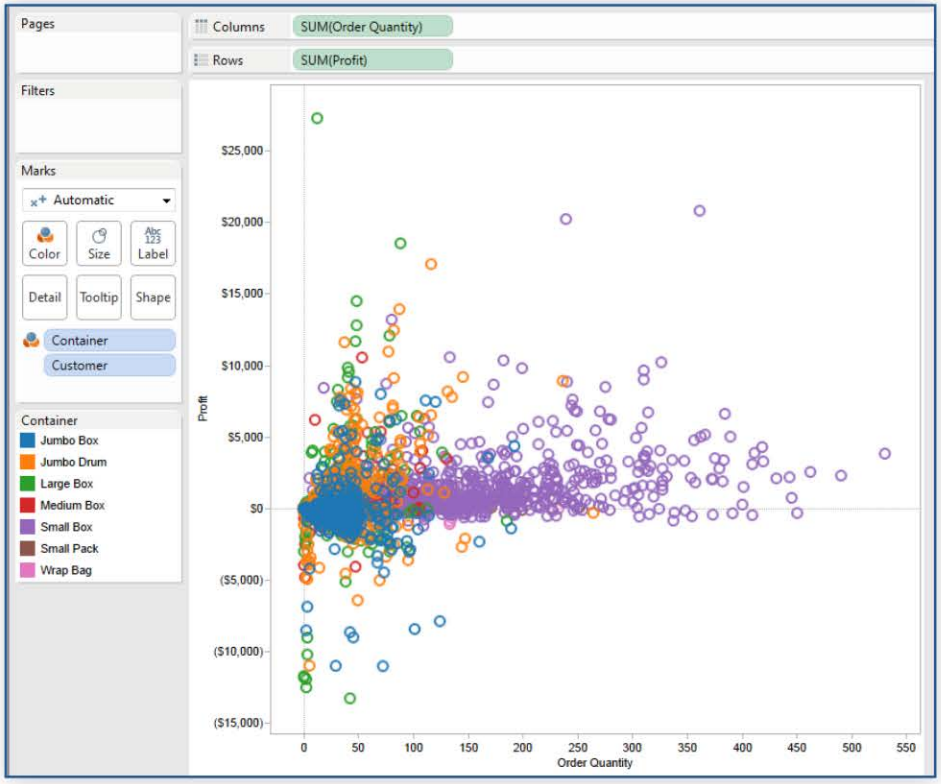


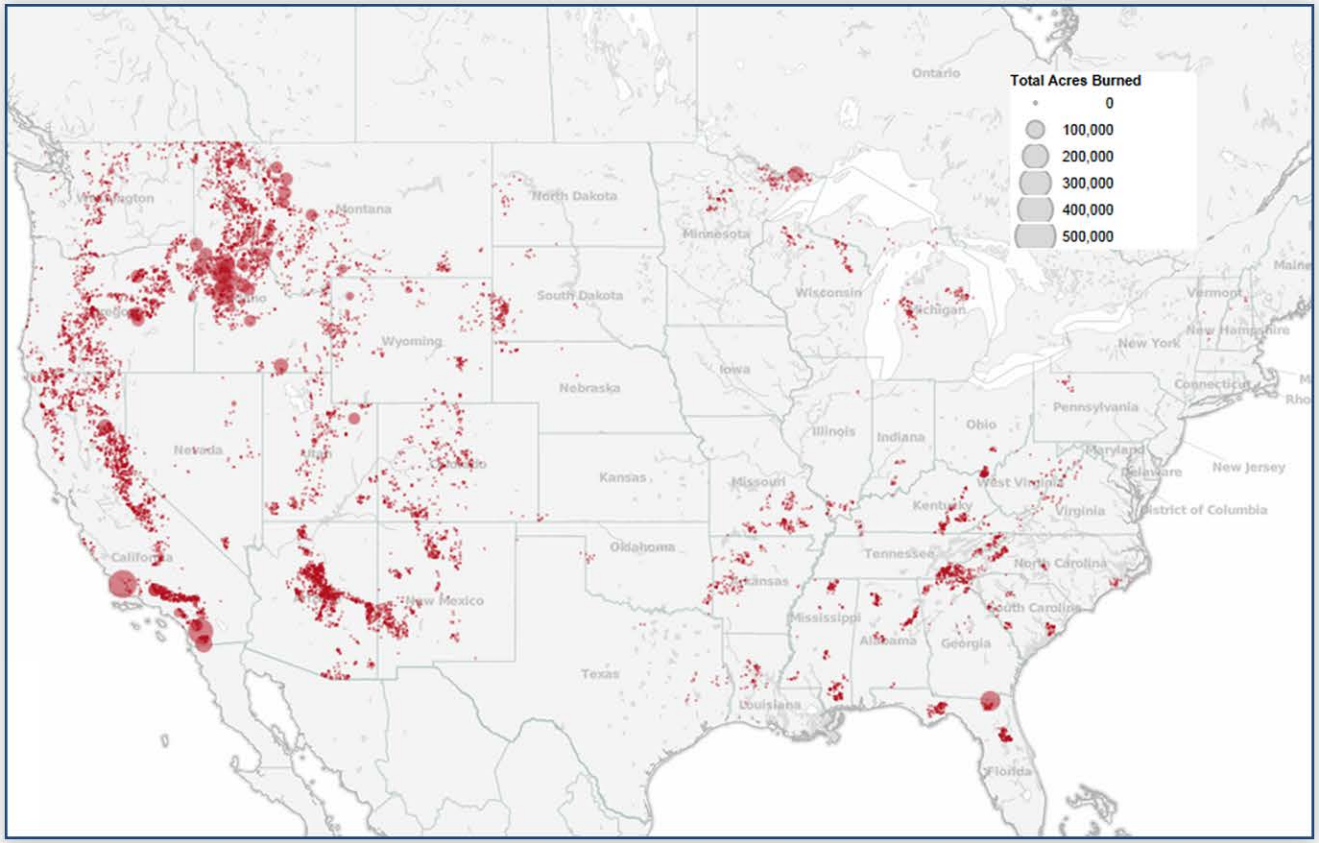

This is helpful.

# Color me impressed

## For quantitative data, color intensity and divergent color palettes work well

# Mapping to insight

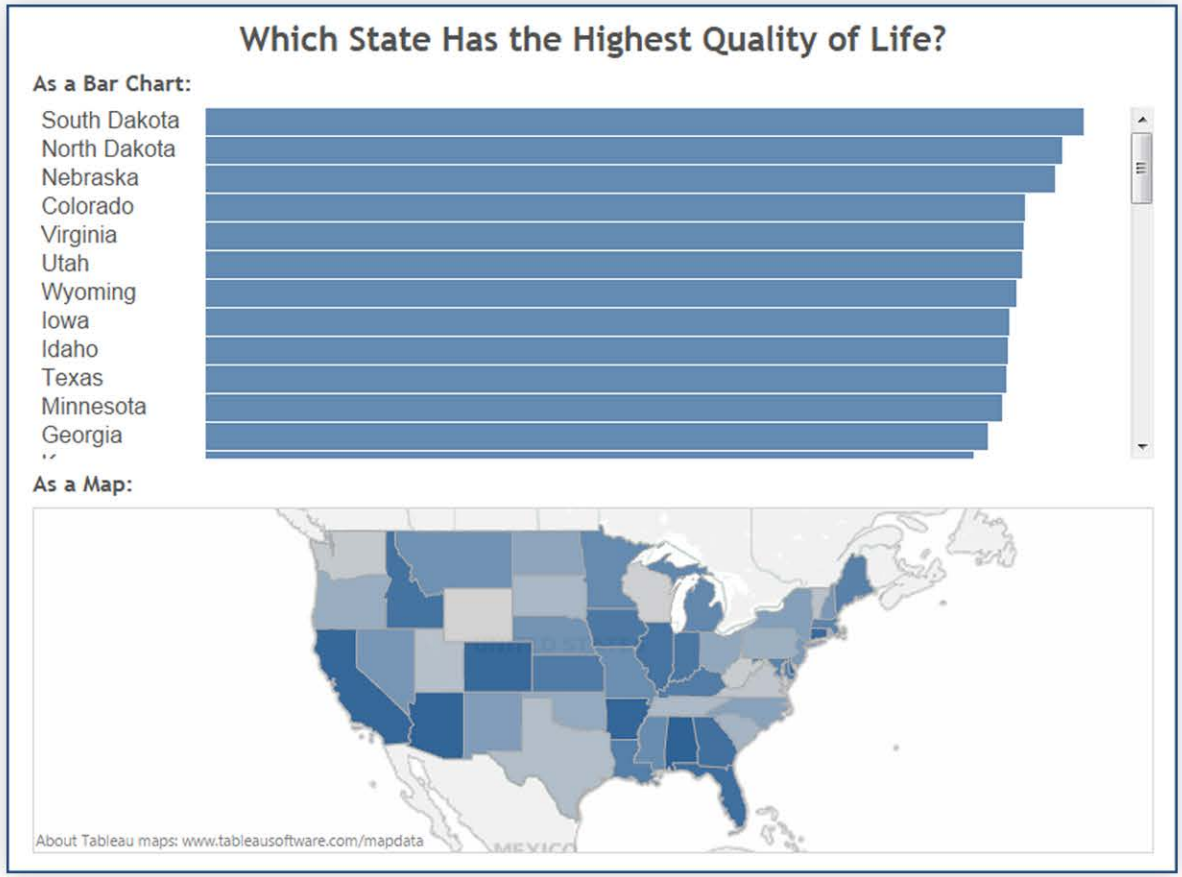
## Use maps when location is relevant




Where do forest fires occur?

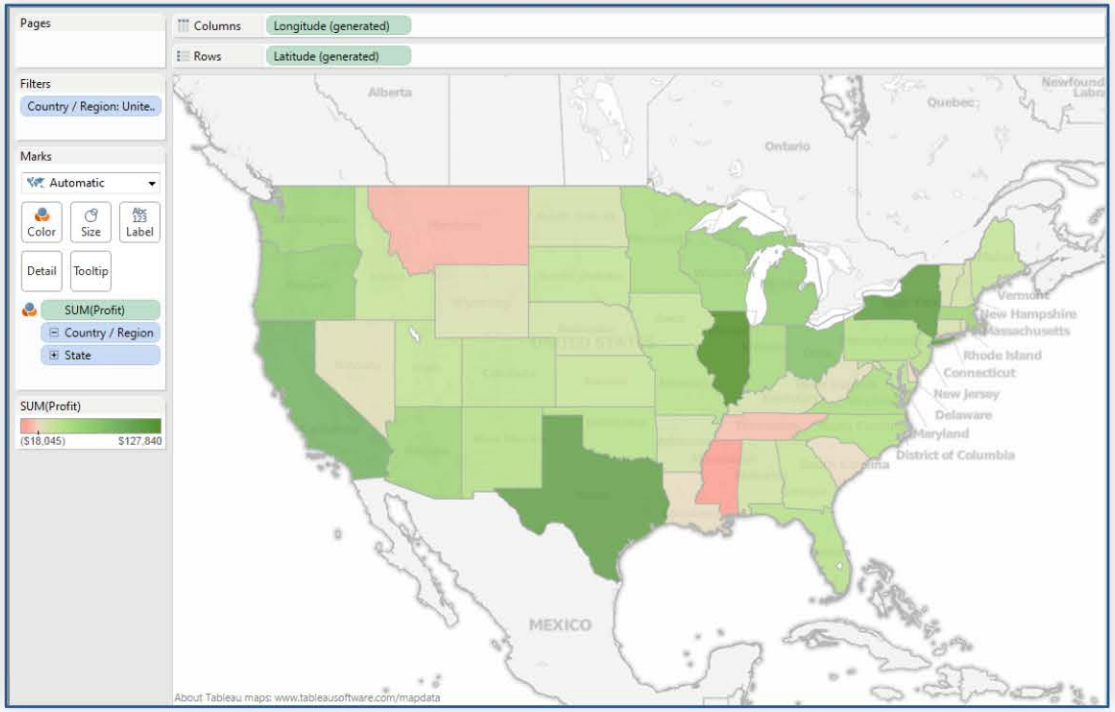
# Mapping to insight

## Don’t use maps just because you can



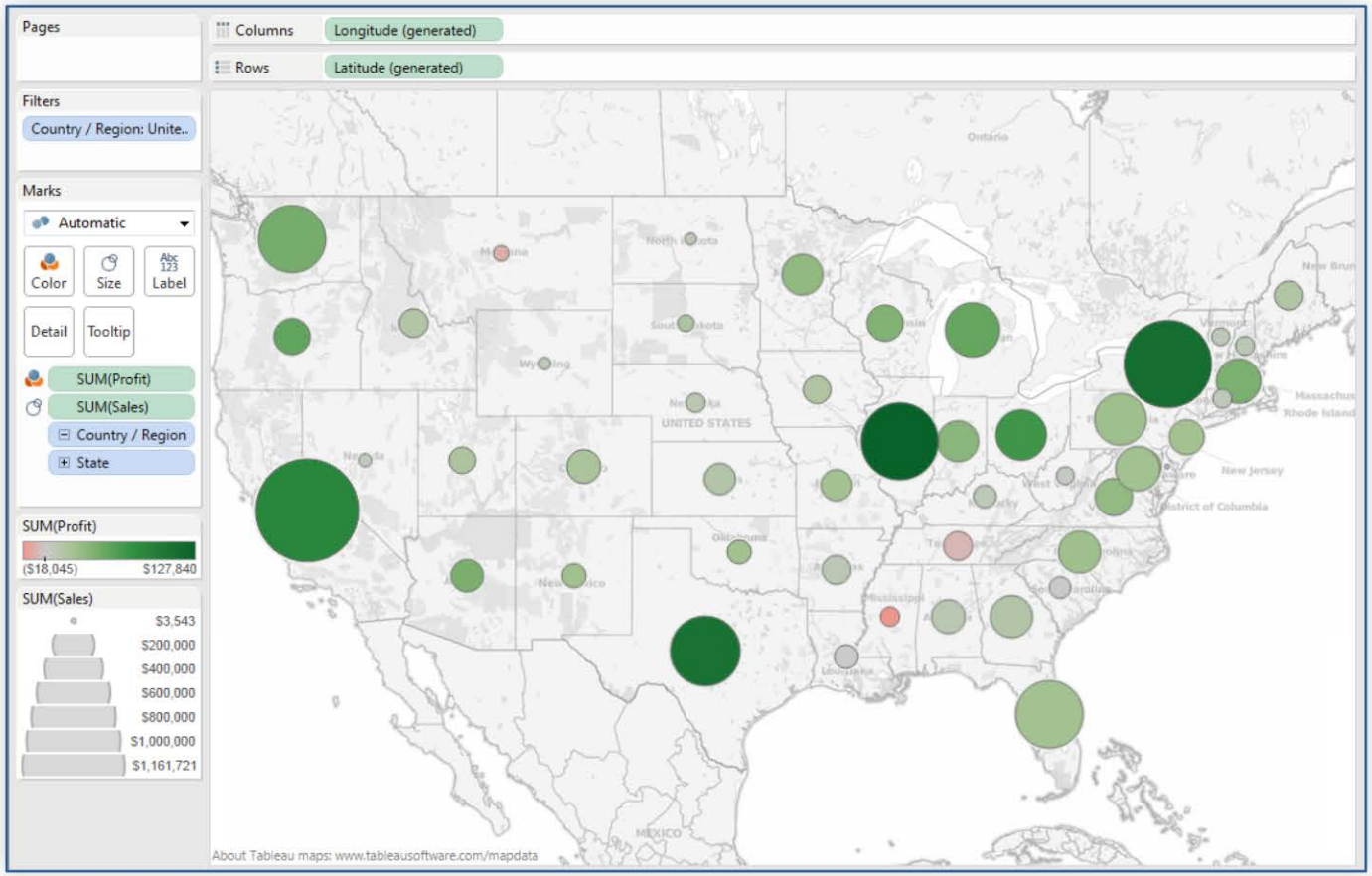
# Mapping to insight

## Use filled maps (”choropleths”) for defined areas and only ONE measure



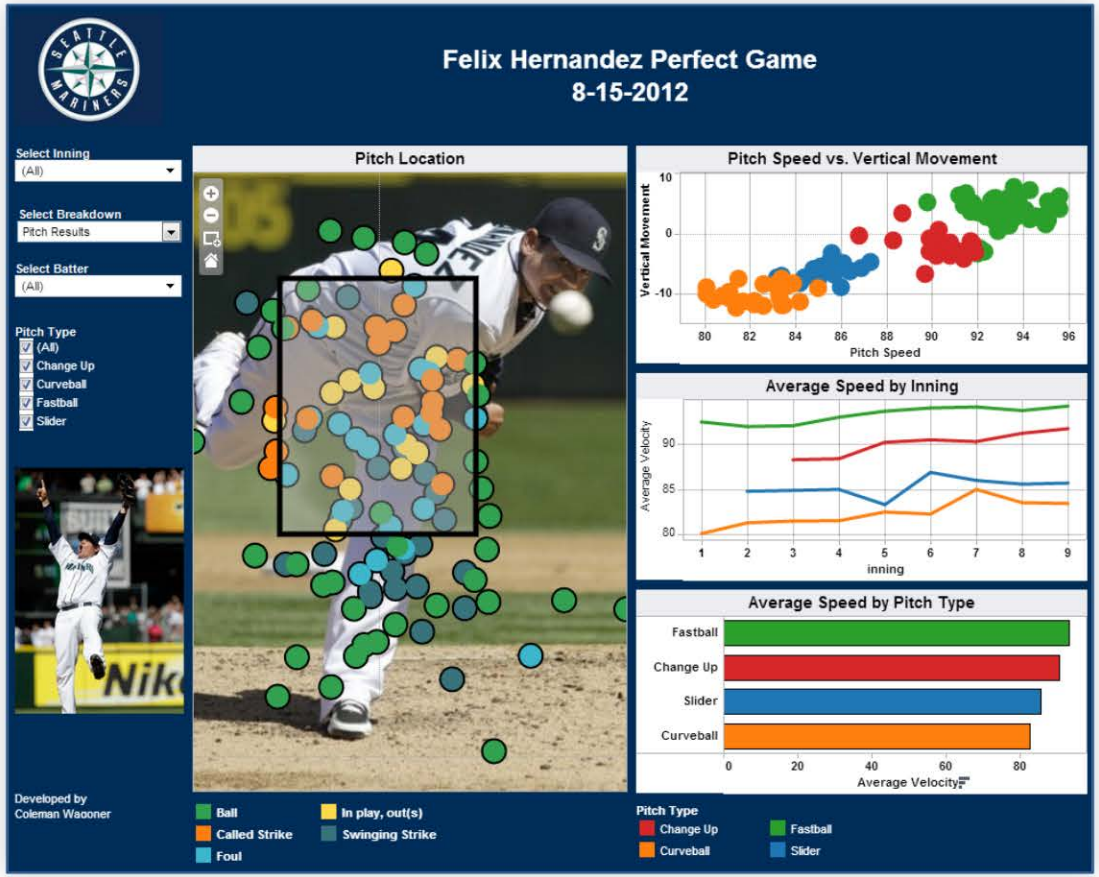
# Mapping to insight

## Filled maps won't work for multiple measures



# Mapping to insight

## Maps don't have to be geographic



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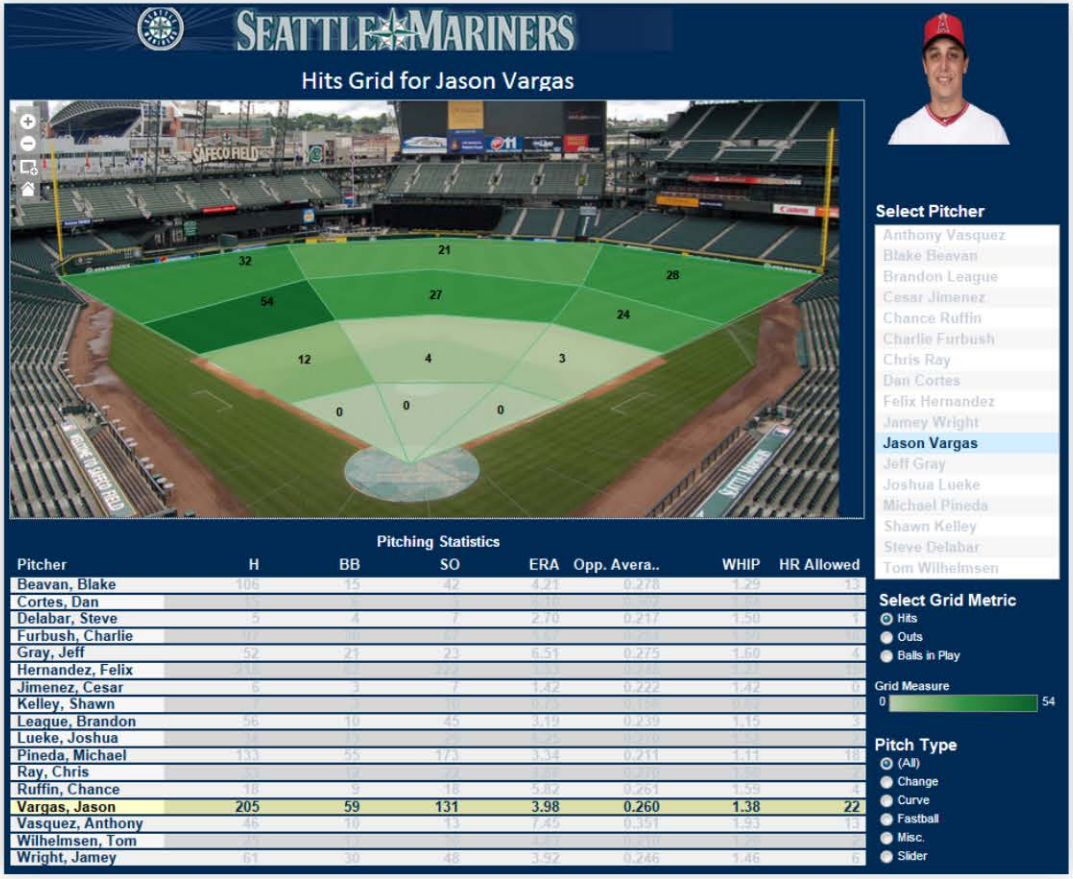
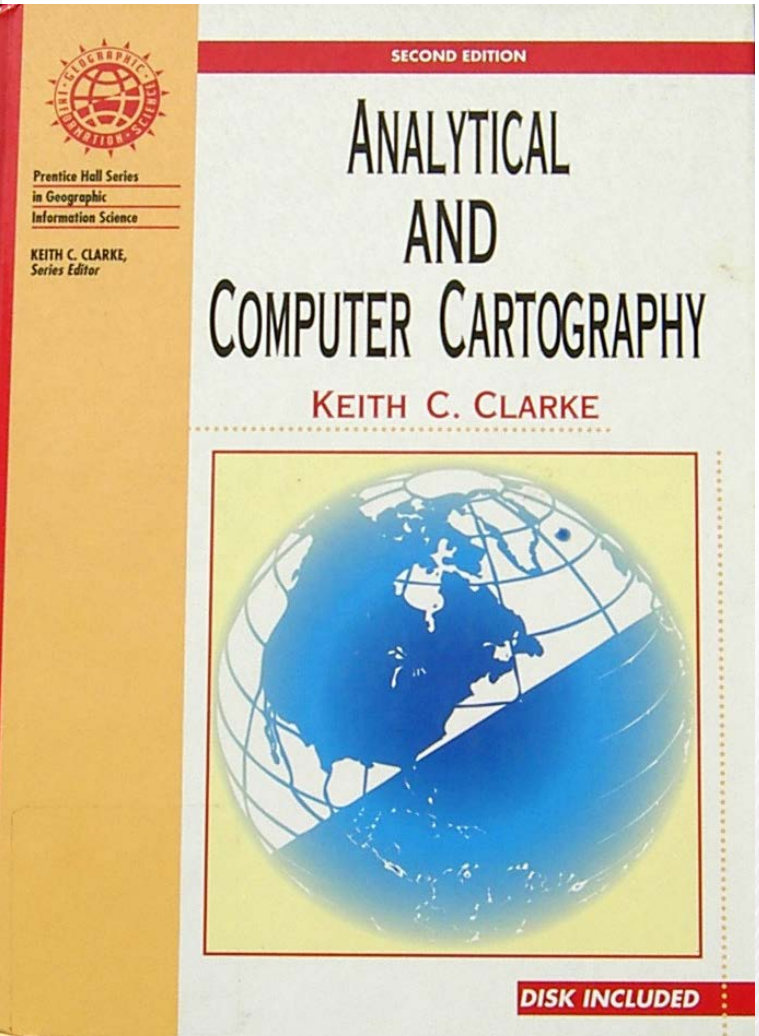



Pitching Statistics

| Pitcher | H | BB | SO | ERA | Opp. Avera.. | WHIP | HR Allowed |
|---|---|---|---|---|---|---|---|
| Beavan, Blake | 106 | 15 | 42 | 4.21 | 0.278 | 1.29 | 13 |
| Cortes, Dan | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Delabar, Steve | 5 | 4 | 7 | 2.70 | 0.217 | 1.50 | 1 |
| Furbush, Charlie | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Gray, Jeff | 52 | 21 | 23 | 6.51 | 0.275 | 1.60 | 4 |
| Hernandez, Felix | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Jimenez, Cesar | 6 | 3 | 7 | 1.42 | 0.222 | 1.42 | 0 |
| Kelley, Shawn | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| League, Brandon | 56 | 10 | 45 | 3.19 | 0.239 | 1.15 | 3 |
| Lueke, Joshua | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Pineda, Michael | 133 | 55 | 173 | 3.34 | 0.211 | 1.11 | 18 |
| Ray, Chris | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Ruffin, Chance | 18 | 9 | 18 | 5.82 | 0.261 | 1.59 | 4 |
| Vargas, Jason | 205 | 59 | 131 | 3.98 | 0.260 | 1.38 | 22 |
| Vasquez, Anthony | 46 | 10 | 13 | 7.45 | 0.351 | 1.93 | 13 |
| Wilhelmsen, Tom | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| Wright, Jamey | 61 | 30 | 48 | 3.52 | 0.246 | 1.46 | 6 |



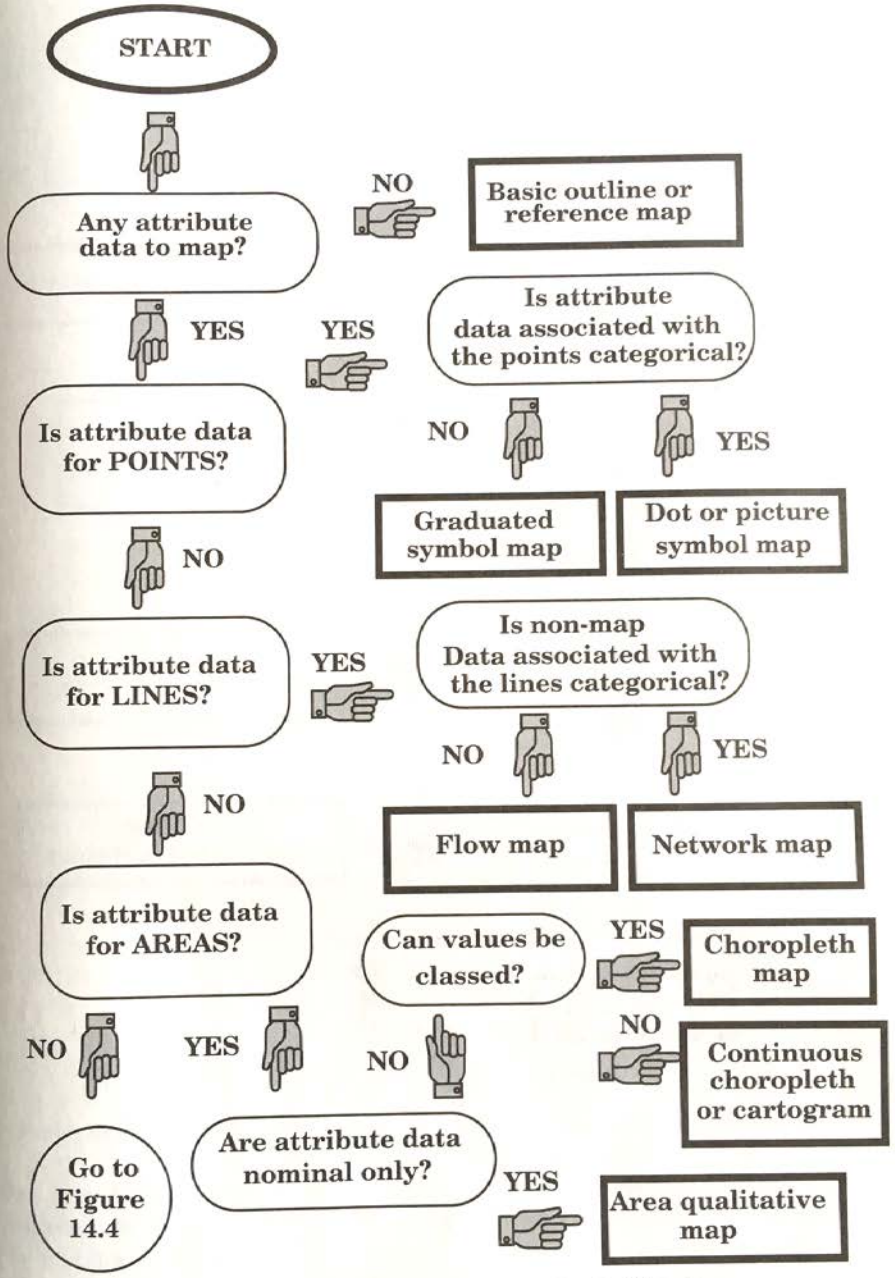




**Figure 14.3** Guide to selecting a representational method (Part 1).

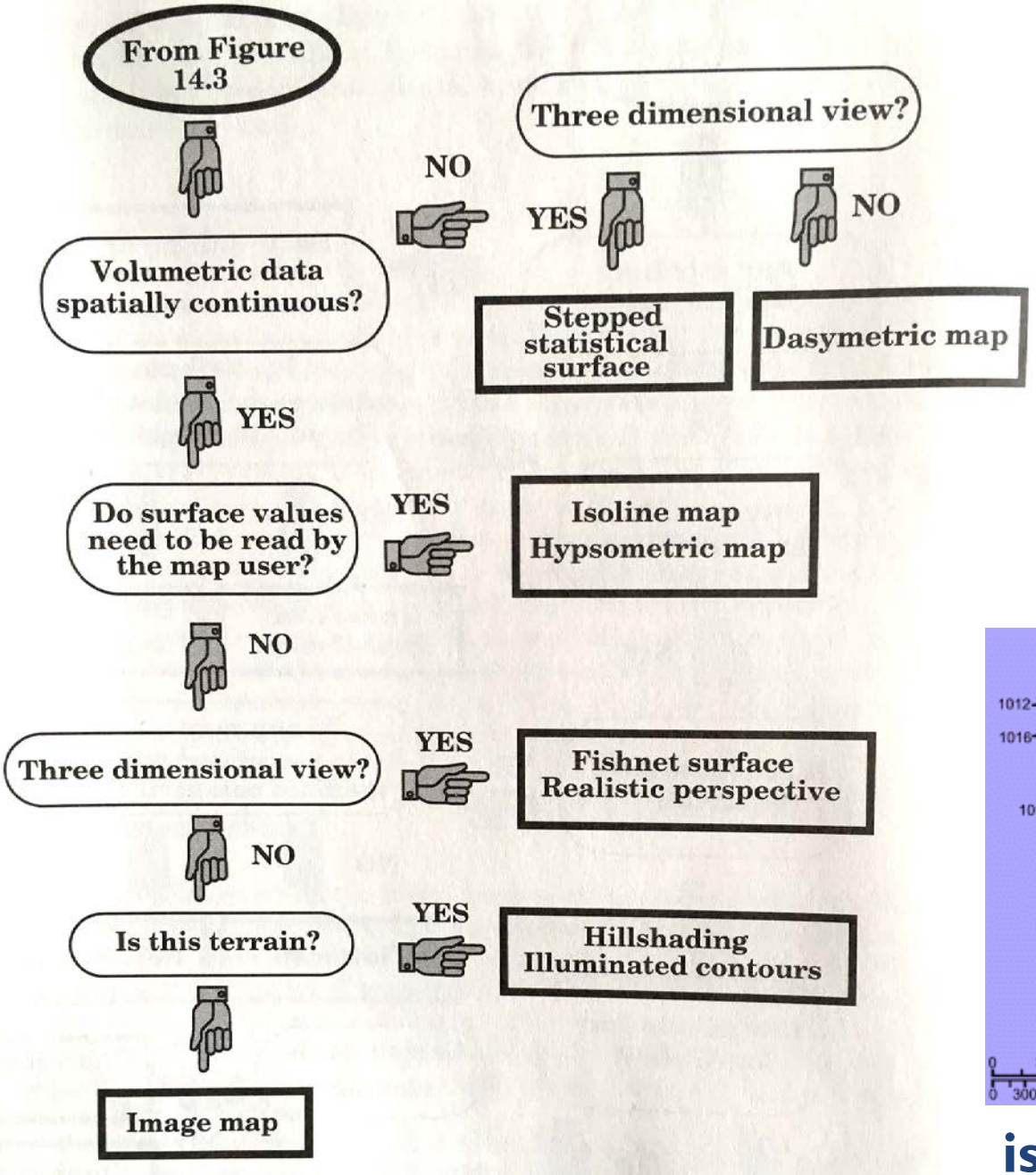
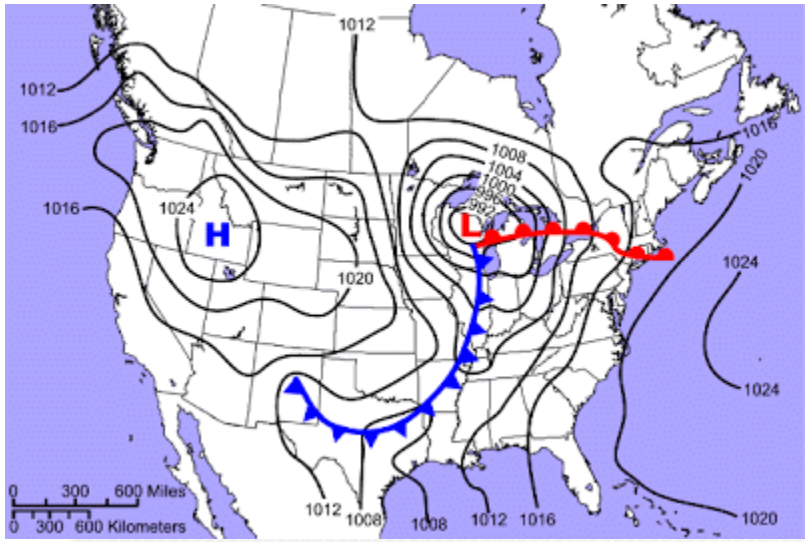


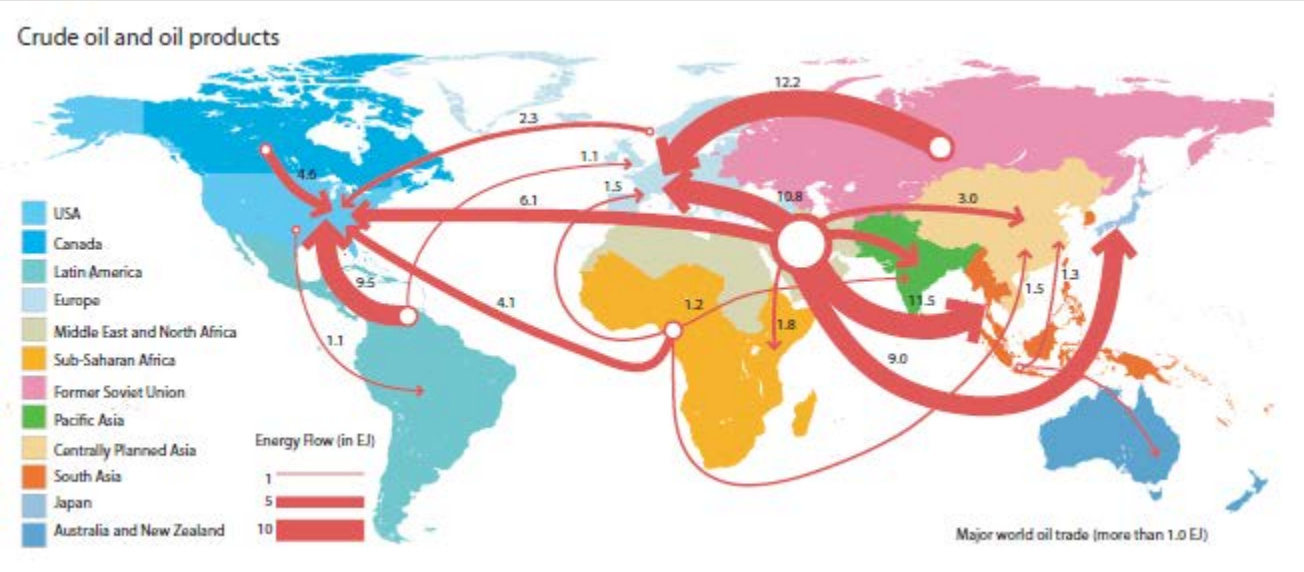

**Figure 14.4** Guide to selecting a representational method (Part 2).

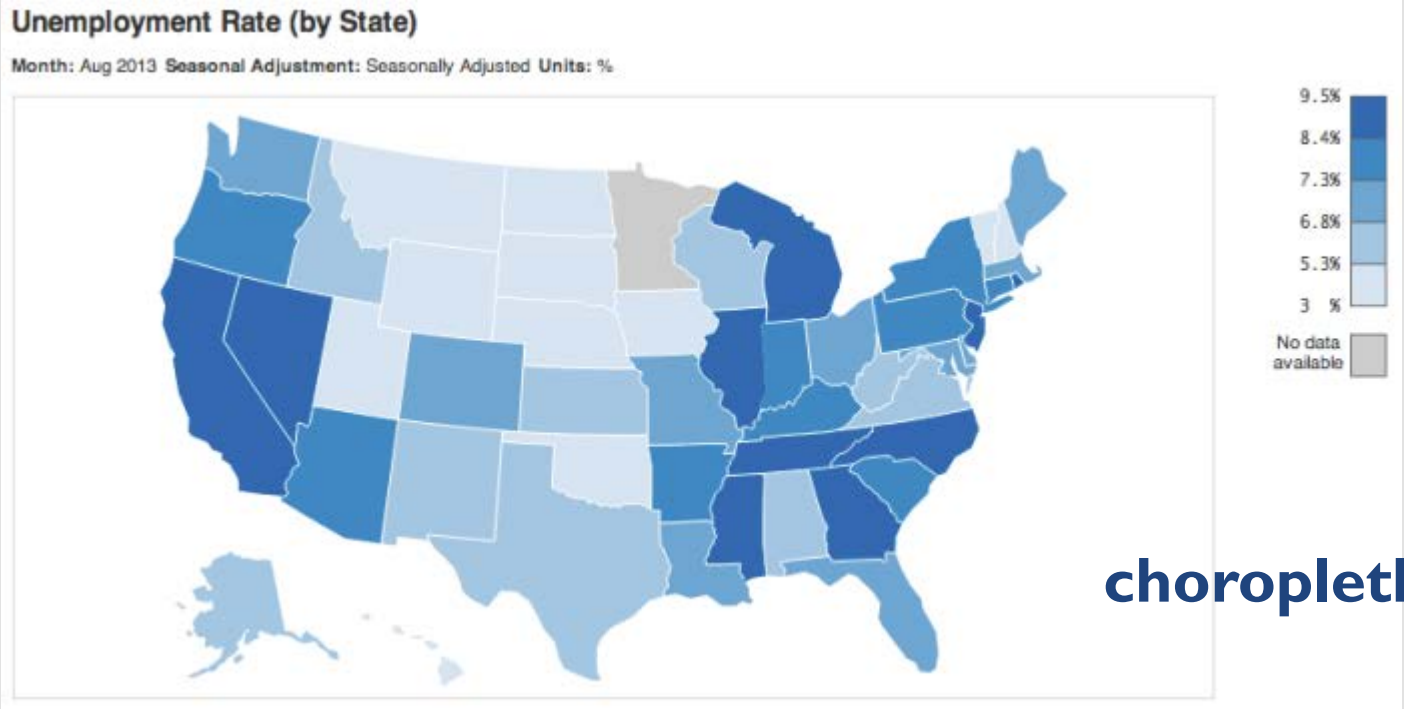
hypsometric map



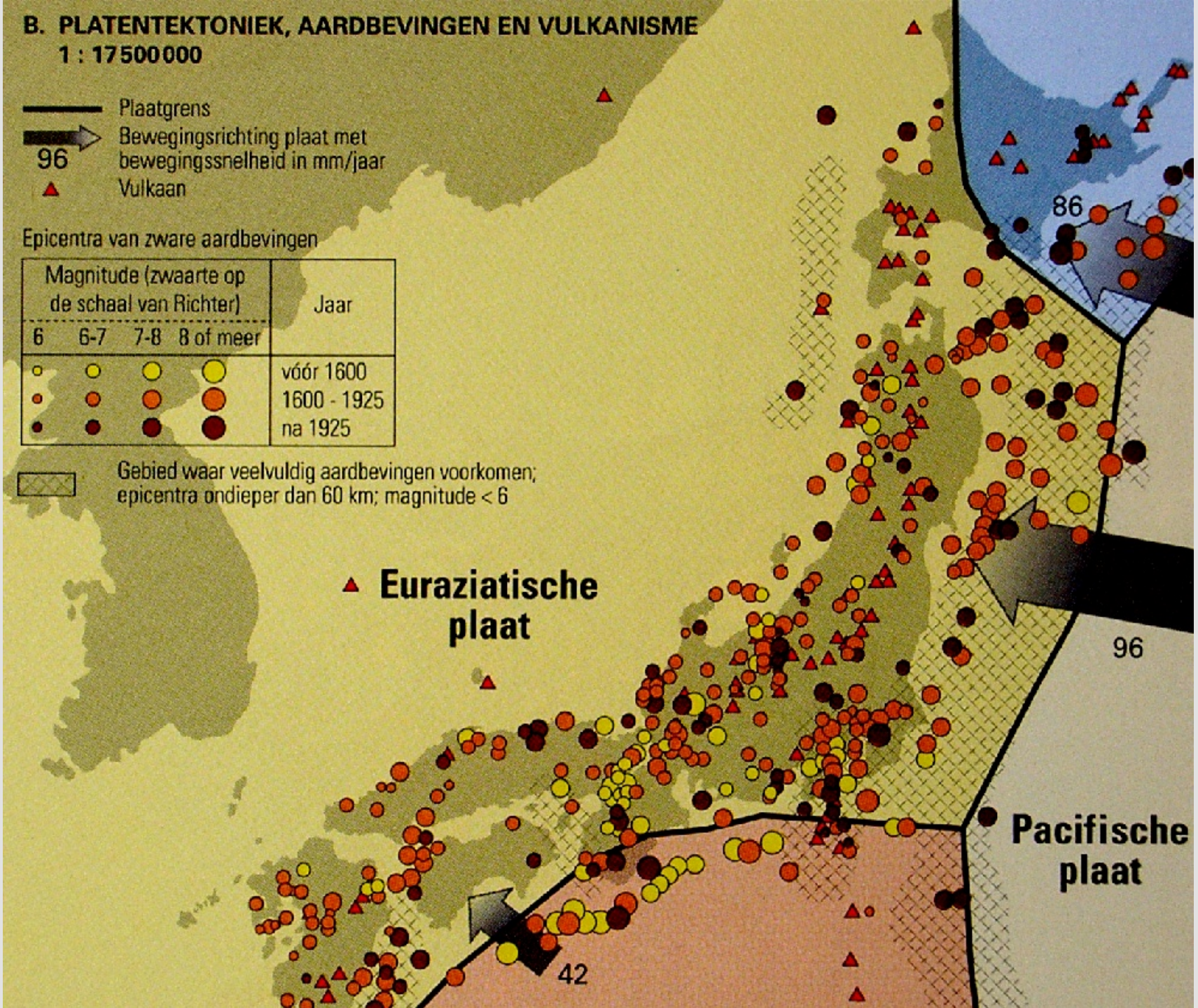

isoline map

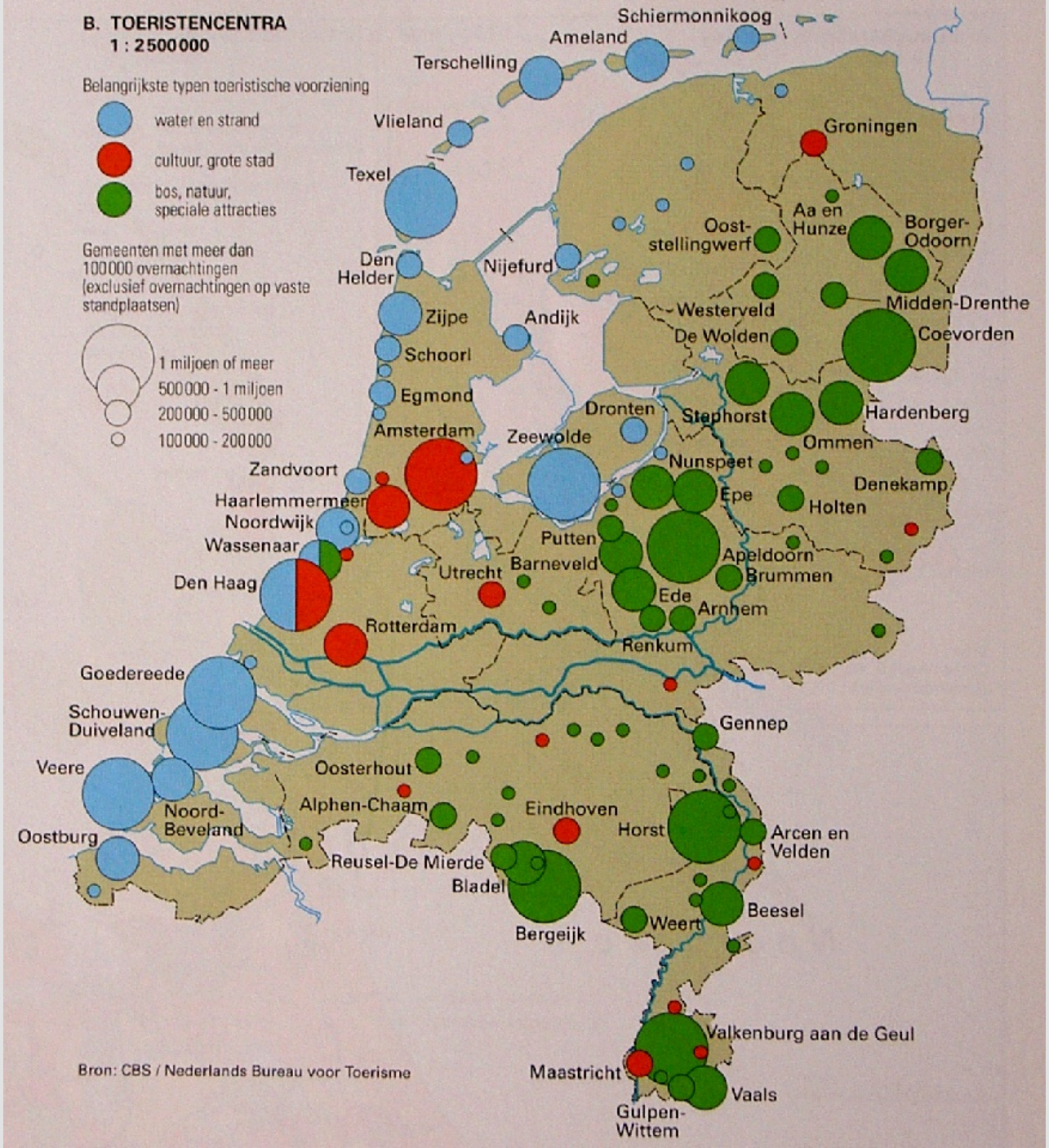
## flow map



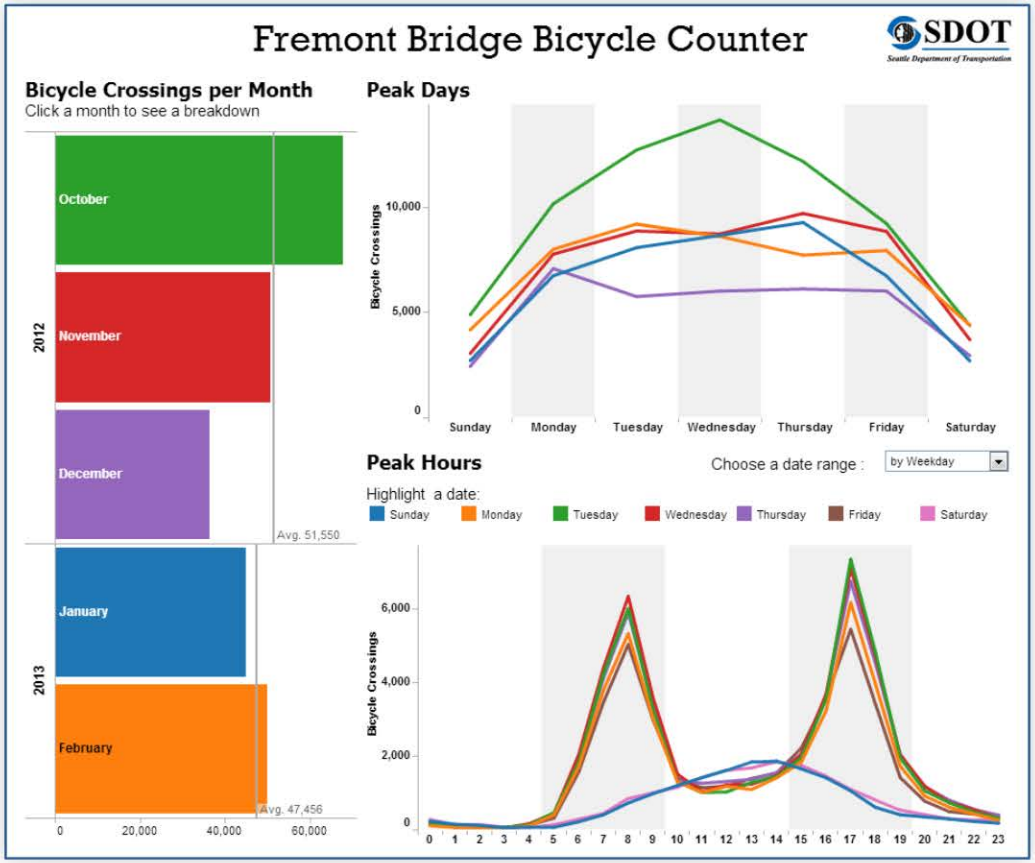

## choropleth map


B. PLATENTEKTONIEK, AARDBEVINGEN EN VULKANISME
1 : 17 500 000
Plaatgrens
96
Bewegingsrichting plaat met bewegingssnelheid in mm/jaar
Vulkaan
Epicentra van zware aardbevingen
Magnitude (zwaarte op de schaal van Richter)
6
6-7
7-8
8 of meer
Jaar
vóór 1600
1600 - 1925
na 1925
Gebied waar veelvuldig aardbevingen voorkomen; epicentra ondieper dan 60 km; magnitude < 6
Euraziatische plaat
86
96
Pacifische plaat
42


B. TOERISTENCENTRA
1 : 2500000
Belangrijkste typen toeristische voorziening
water en strand
cultuur, grote stad
bos, natuur, speciale attracties
Gemeenten met meer dan 100000 overnachtingen (exclusief overnachtingen op vaste standplaatsen)
1 miljoen of meer
500000 - 1 miljoen
200000 - 500000
100000 - 200000
Schiermonnikoog
Ameland
Terschelling
Vlieland
Texel
Den Helder
Nijefurd
Zijpe
Andijk
Schoorl
Egmond
Amsterdam
Zeewolde
Zandvoort
Haarlemmermeer
Noordwijk
Wassenaar
Den Haag
Rotterdam
Utrecht
Barneveld
Putten
Dronten
Nunspeet
Epe
Ede
Arnhem
Renkum
Apeldoorn
Brummen
Holten
Ommen
Stephorst
Hardenberg
Denekamp
Coevorden
Westerveld
De Wolden
Midden-Drenthe
Oost-stellingwerf
Aa en Hunze
Borger-Odoorn
Groningen
Goedereede
Schouwen-Duiveland
Veere
Oostburg
Noord-Beveland
Oosterhout
Alphen-Chaam
Reusel-De Mierde
Eindhoven
Bladel
Bergeijk
Horst
Arcen en Velden
Beesel
Weert
Gennep
Valkenburg aan de Geul
Maastricht
Vaals
Gulpen-Wittem
Bron: CBS / Nederlands Bureau voor Toerisme

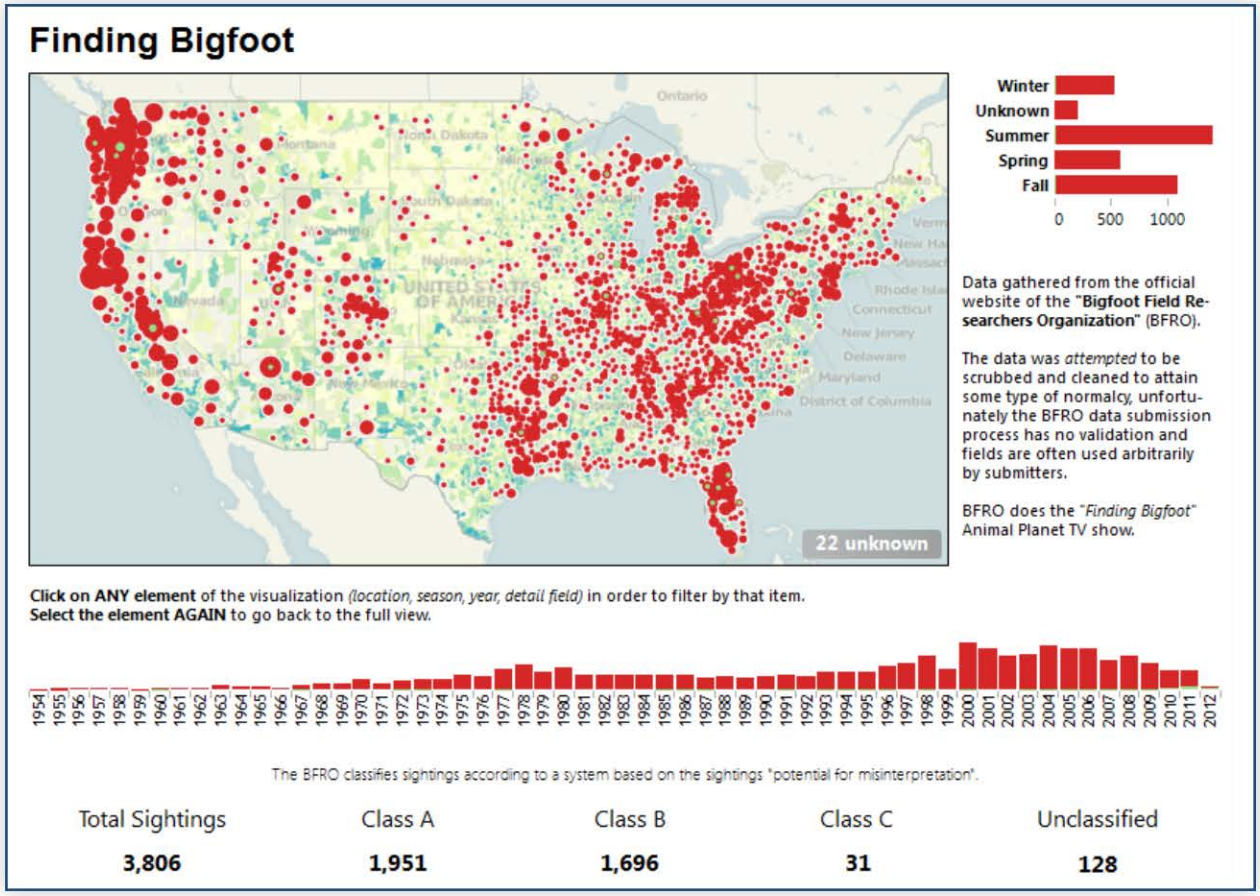
# Dashboards

## Dashboards bring together multiple views



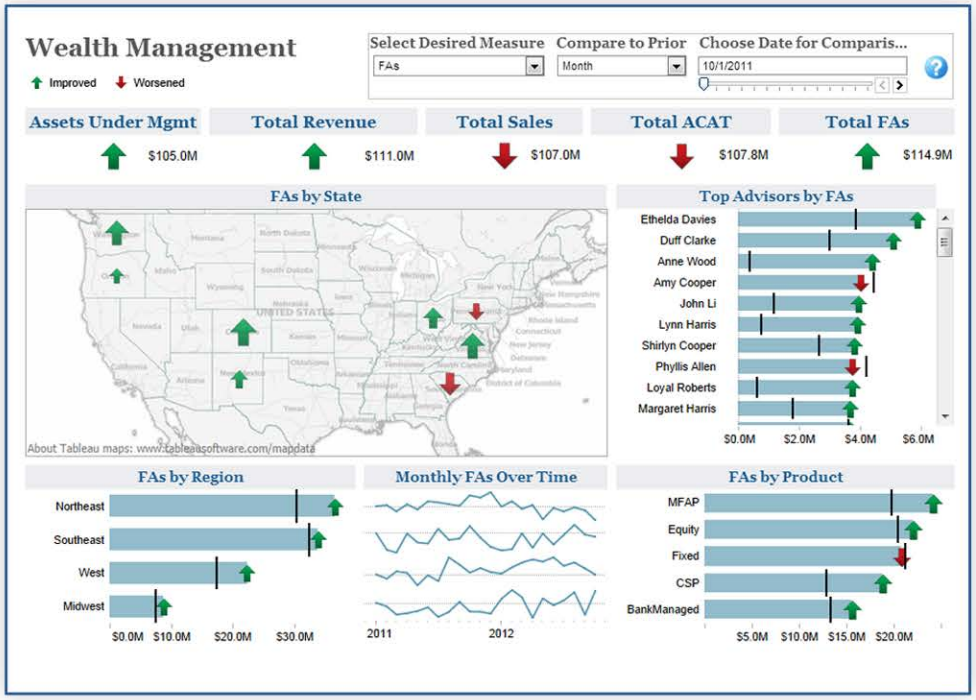
# Dashboards

## Dashboards should pass the 5-second test



# Dashboarding for the 5-second test

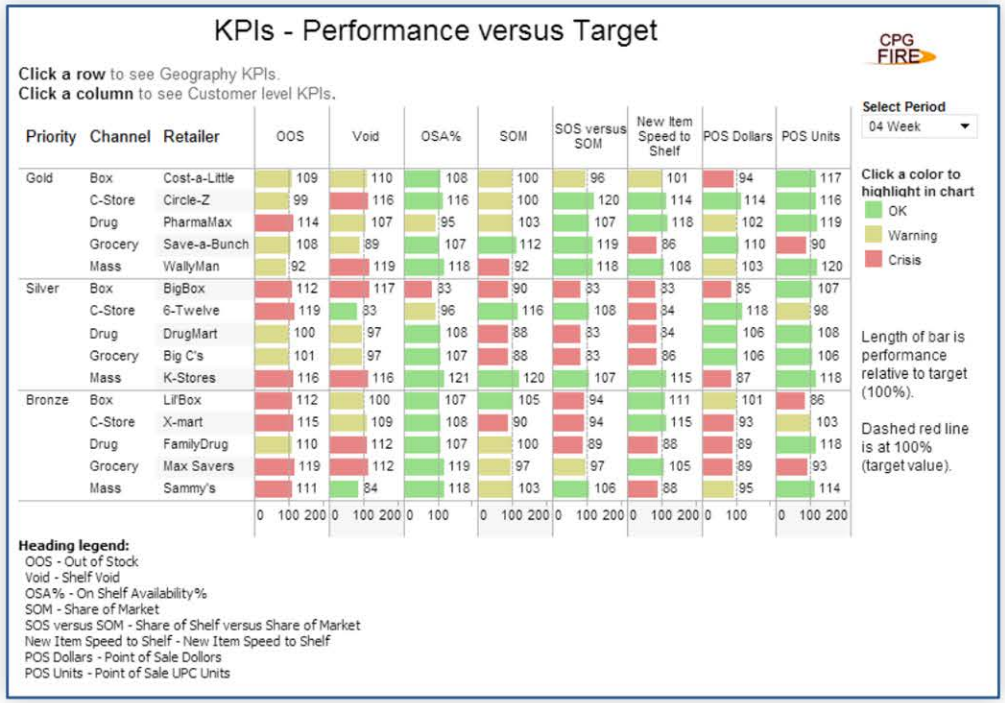
- Most important view goes on top or top-left
- Legends go near their views
- Avoid using multiple color schemes on a single dashboard
- Provide interactivity



# Dashboarding for the 5-second test

## Use your words!

- Titles
- Axes
- Key facts and figures
- Units
- Remove extra digits in numbers
- Great tooltips

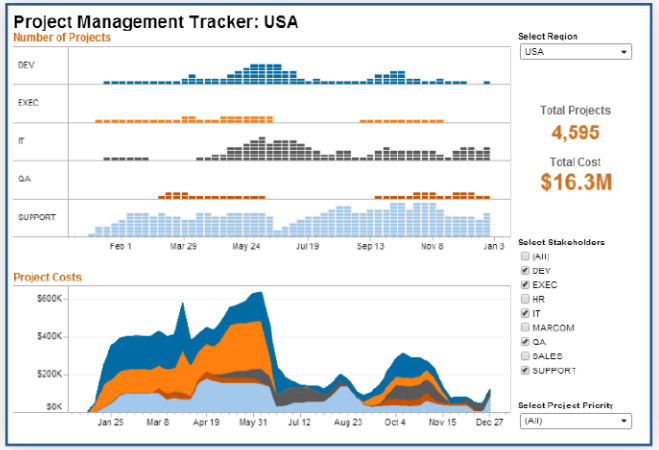



| Priority | Channel | Retailer | OOS | Void | OSA% | SOM | SOS versus SOM | New Item Speed to Shelf | POS Dollars | POS Units |
|---|---|---|---|---|---|---|---|---|---|---|
| Gold | Box | Cost-a-Little | 109 | 110 | 108 | 100 | 96 | 101 | 94 | 117 |
| | C-Store | Circle-Z | 99 | 116 | 116 | 100 | 120 | 114 | 114 | 116 |
| | Drug | PharmaMax | 114 | 107 | 95 | 103 | 107 | 118 | 102 | 119 |
| | Grocery | Save-a-Bunch | 108 | 89 | 107 | 112 | 119 | 86 | 110 | 90 |
| | Mass | WallyMan | 92 | 119 | 118 | 92 | 118 | 108 | 103 | 120 |
| Silver | Box | BigBox | 112 | 117 | 83 | 90 | 83 | 83 | 85 | 107 |
| | C-Store | 6-Twelve | 119 | 83 | 96 | 116 | 108 | 84 | 118 | 98 |
| | Drug | DrugMart | 100 | 97 | 108 | 88 | 83 | 84 | 106 | 108 |
| | Grocery | Big C's | 101 | 97 | 107 | 88 | 83 | 86 | 106 | 106 |
| | Mass | K-Stores | 116 | 116 | 121 | 120 | 107 | 115 | 87 | 118 |
| Bronze | Box | LilBox | 112 | 100 | 107 | 105 | 94 | 111 | 101 | 86 |
| | C-Store | X-mart | 115 | 109 | 108 | 90 | 94 | 115 | 93 | 103 |
| | Drug | FamilyDrug | 110 | 112 | 107 | 100 | 89 | 88 | 89 | 118 |
| | Grocery | Max Savers | 119 | 112 | 119 | 97 | 97 | 105 | 89 | 93 |
| | Mass | Sammy's | 111 | 84 | 118 | 103 | 106 | 88 | 95 | 114 |
| | | | 0 100 200 | 0 100 200 | 0 100 | 0 100 200 | 0 100 200 | 0 100 200 | 0 100 | 0 100 200 |

# The "Viz" review

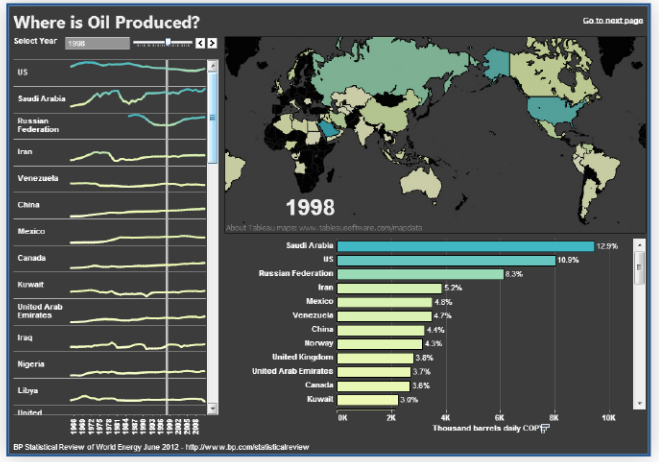
## Why?

- Maintain standards and accountability
- Ongoing learning and skill refinement
- Get input from multiple stakeholders




## How?

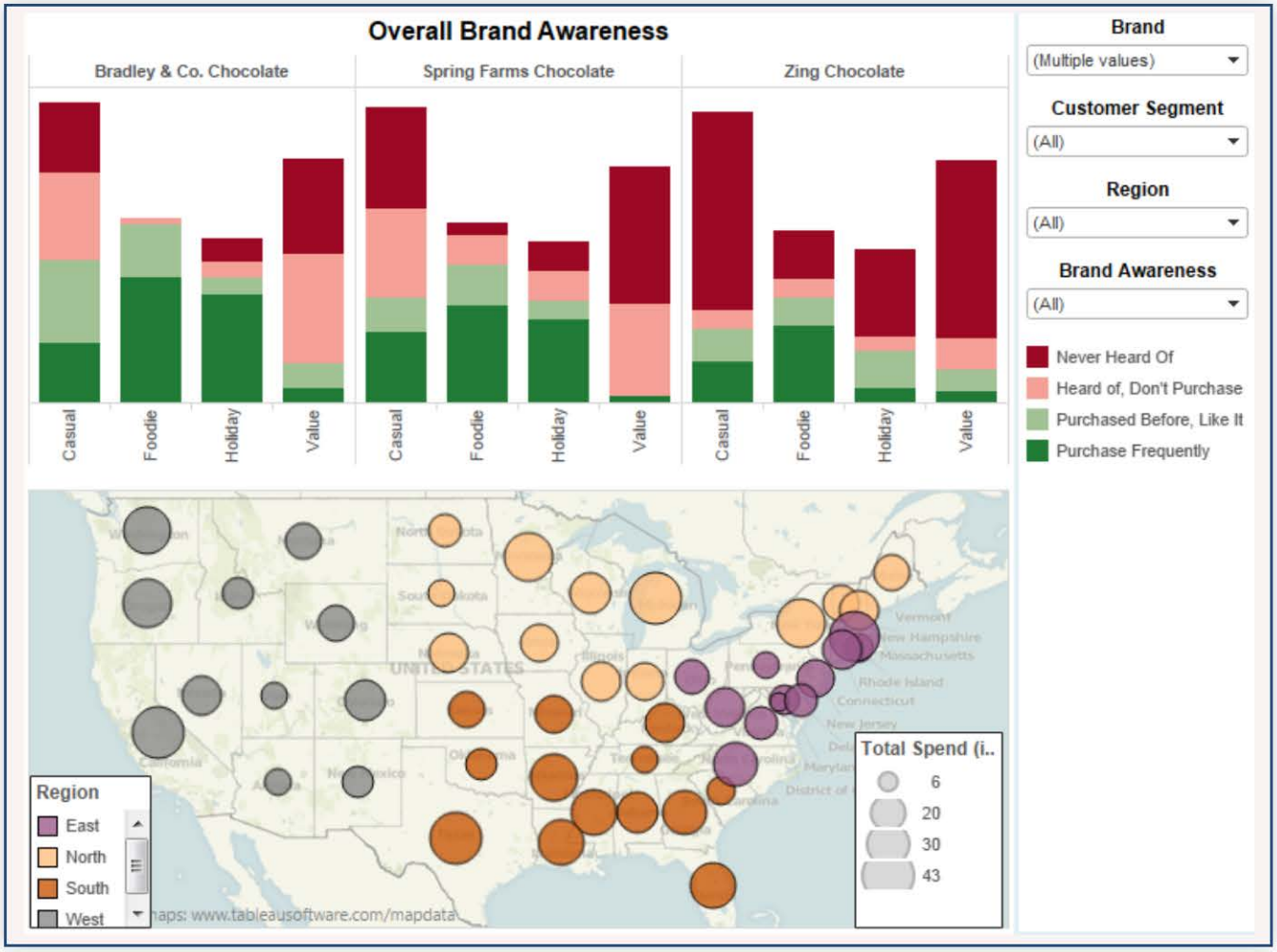
- Allow 30 minutes for each dashboard
- Invite 3+ colleagues and stakeholders
- Send the dashboards for review ahead of time
- Test recommendations during the meeting



# Questions to ask in a viz review

- What question does this answer?
- Is this the best way to answer this question?
- Does everything on the dashboard add value?
- Is there functional interactivity?
- Are labels, titles and legends effective?
- Does this viz apply visual best practices?
- Is this viz right for its audience?

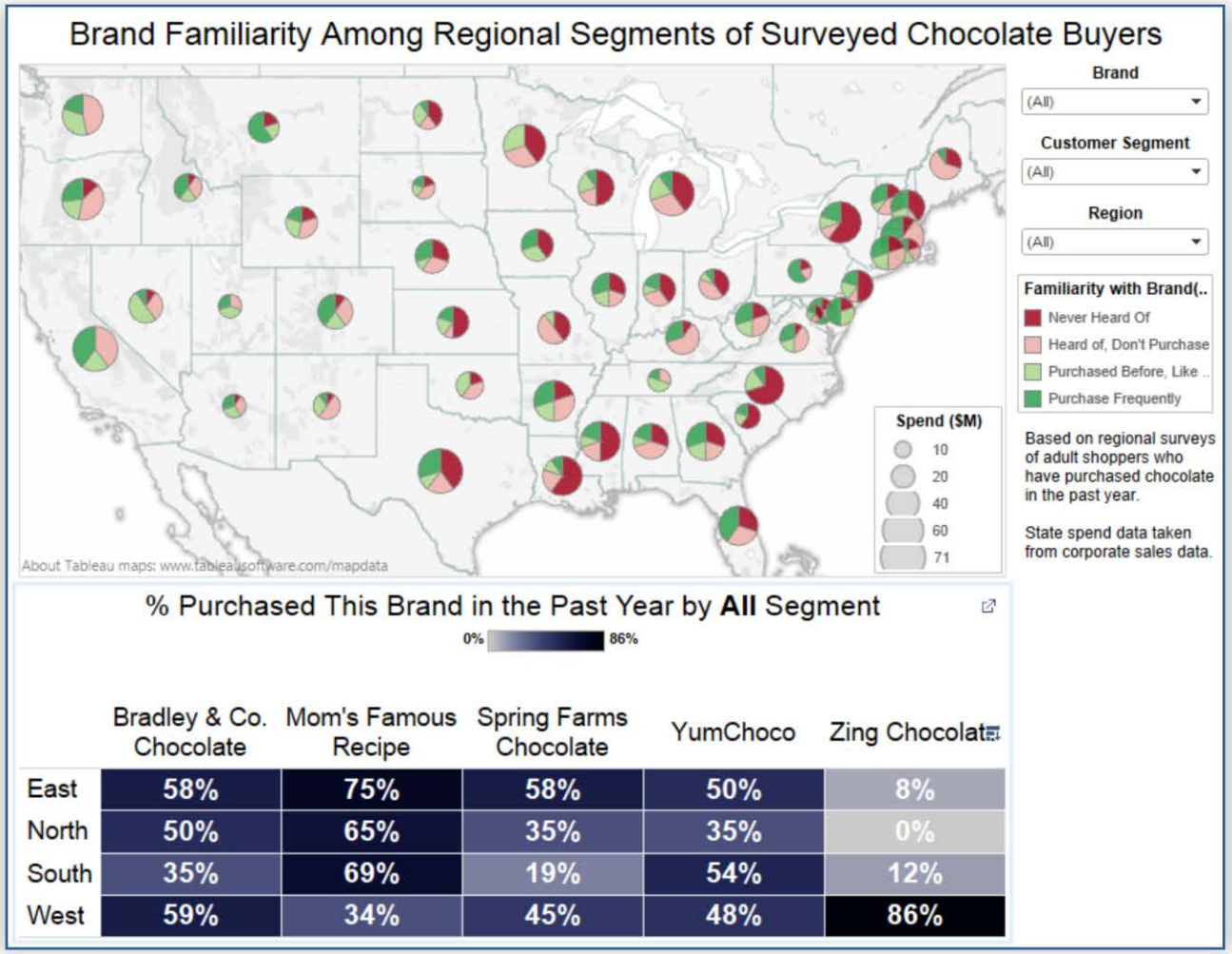
# Viz review: Before




## Concerns

- Question isn't clear
- Color palettes compete
- Is it important that region be encoded using color?
- Interactivity edge cases don't have value
- No units on y-axis
- Not clear that viz presents survey results

# Viz review: After




| | Bradley & Co. Chocolate | Mom's Famous Recipe | Spring Farms Chocolate | YumChoco | Zing Chocolate |
|---|---|---|---|---|---|
| East | 58% | 75% | 58% | 50% | 8% |
| North | 50% | 65% | 35% | 35% | 0% |
| South | 35% | 69% | 19% | 54% | 12% |
| West | 59% | 34% | 45% | 48% | 86% |

## What's changed?

- Titles and supporting text clarify subject
- Pie charts on map display total spend and regional brand awareness in one view
- Table calc written to create crosstab below
- Color palettes don't compete
- Interactivity edge cases produce meaningful results

# More dashboards

ACCESS The Foundation for Social Investment

## Quarterly Dashboard to 30 June 2019: GROWTH FUND

COMMUNITY FUND · BIG SOCIETY CAPITAL · Delivered by ACCESS The Foundation for Social Investment

### Social investments made by investors into charities and social enterprises

**INVESTMENTS MADE**
at 30th Jun 2019 - totalling **£21m**


CLICK HERE to view interactive map

Of the **335** investments made into charities and social enterprises by the social investors to date...

**£63k**
Average investment

**48 months**
Average loan term

**5 FTE**
Median investee employees

**7.34%**
Average interest rate

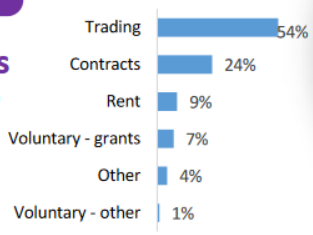
**£223k**
Median turnover of recipients

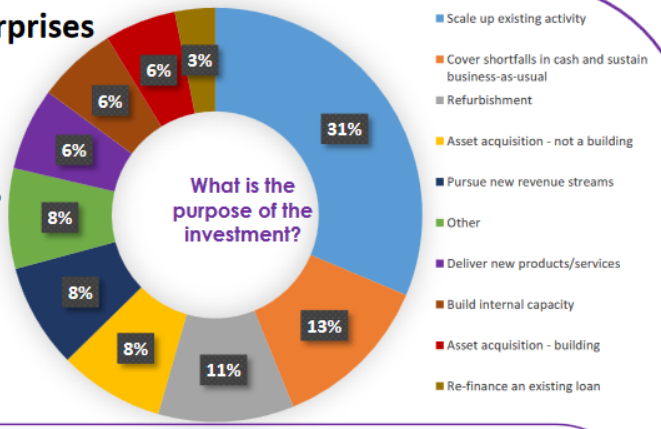
**58%**
Loan recipients also received a Growth Fund grant

**29%**
Borrowers that received Reach Fund or other capacity building support

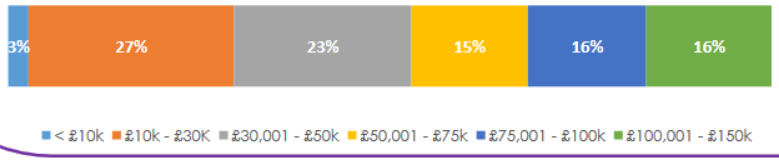
**13%**
Of total investment given as grant

**What is the primary source of income of investees?**



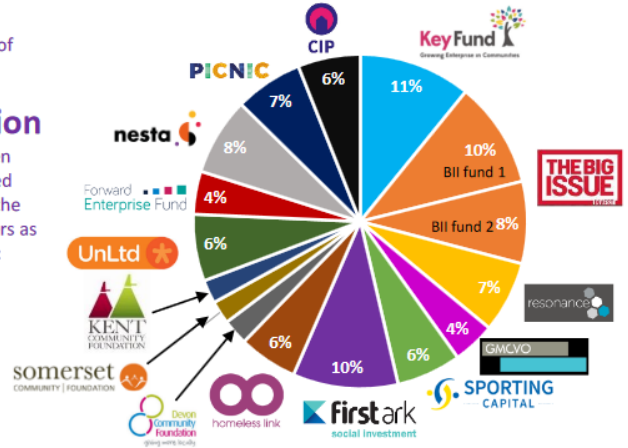




**What is the spread of investment size?**




### The social investors delivering the Growth Fund

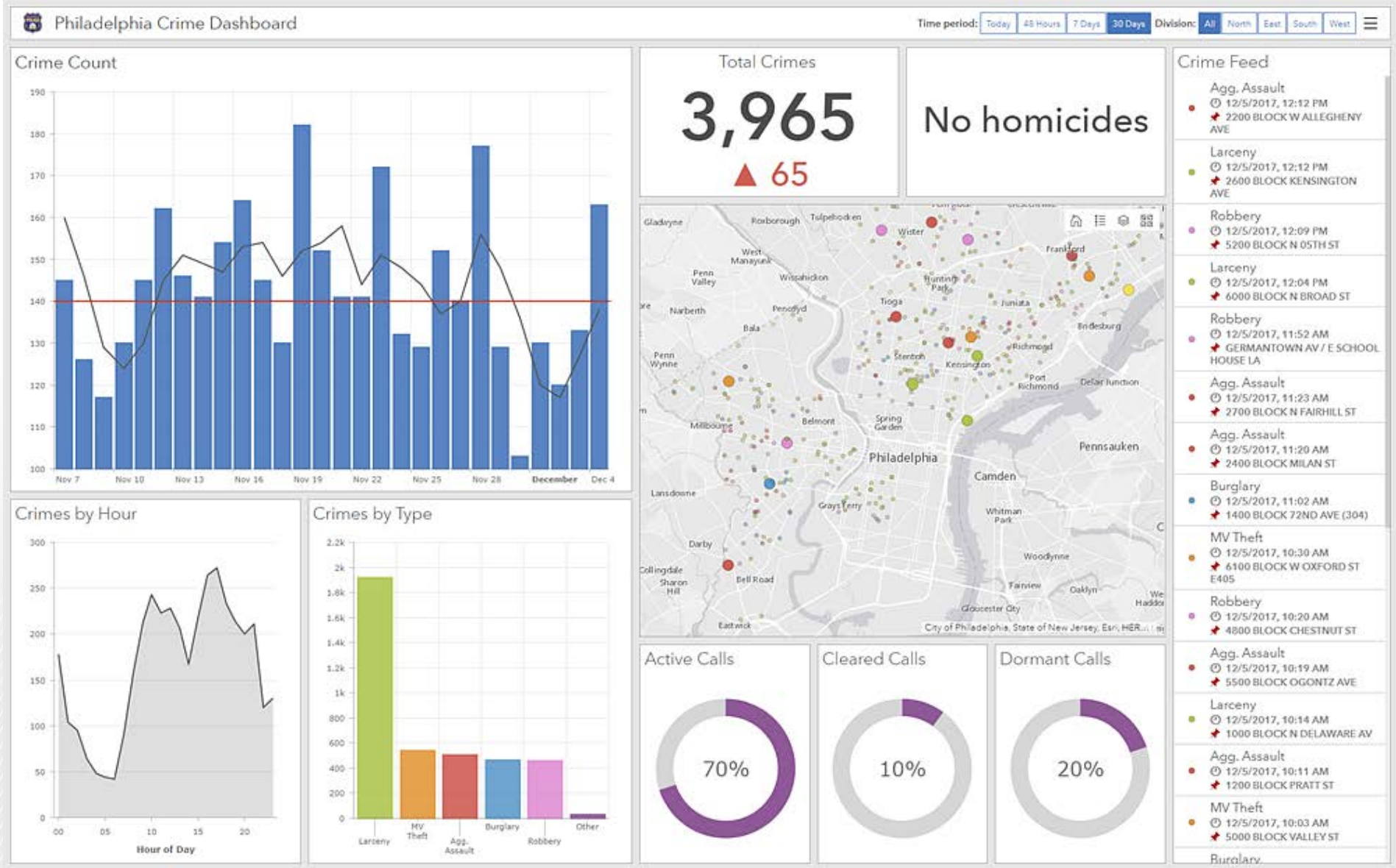
A total of **£47 million** has been allocated across the providers as follows:




For more information on the Growth Fund and how it works see our website here

Read our latest Growth Fund blogs here

# More dashboards



# QUESTIONS?