Challenges in Developing Data Visualization Applications

Dušanka Bošković
University of Sarajevo

Content

○ Motivation

○ Data Visualization: what it is and why we need it?

○ Some fun with graphs

Motivation

- HCI course – assessing student projects
- Some of frequently identified problems:
  - visualizations irrelevant to the task*
  - data presented in an inappropriate way*
  - undocumented graphs
- Introduced a new lecture „Visualization" in 2014-2015
- Two students working on master theses in 2015-2016
  - Visualization Techniques for Quantitative Analysis of Complex Data
  - Application for Economic Indicators Visualization
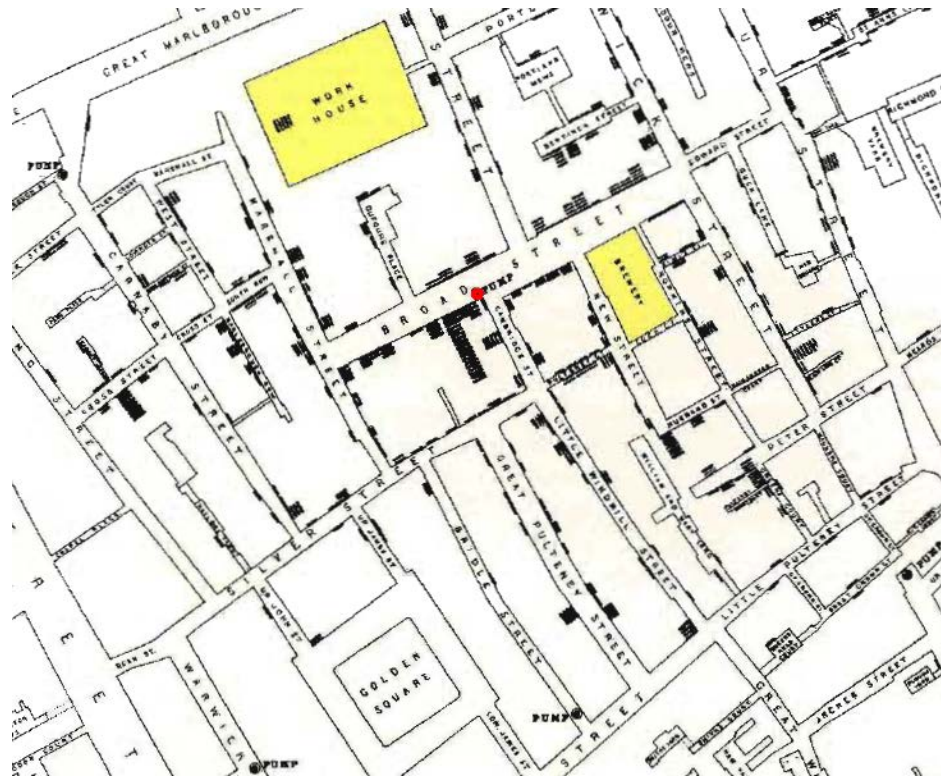
Motivation

- Tufte „Beautiful Evidence" (2006):

Data graphics are data graphics because they have *scales of measurement*. Viewers should be told about measurements. Many modern graphics are undocumented: in 13 computer-science books on technical visualizations, only 20% of the published images had complete scales and labels, 60% had *no* scales or labeled dimensions at all.[9] Even in real science, images sometimes forget about measurement scales: the astronomical pictures from the Hubble Space Telescope are usually published without indications of distance, size, or location. In business and financial displays, the common errors and lies involve corrupt measurement scales: absence of labels, undefined or imprecise measurements, tendentiously chosen base-years, excessively short time-series, inflated rather than inflation-adjusted monetary units, and time-shifting of data (such as the notorious premature revenue recognition).

Motivation

- Tufte: Display of Evidence for Making Decisions, Example of Cholera Epidemic in London 1854 (John Snow)

Motivation

- Vast amounts of available data
- Visualization – hand in hand with Data Analytics

Definition

- .. in definitions, there are many references to gaining insight, or likewise phrases such as amplifying cognition, seeing the unseen, unveiling structure, answering questions, solving problems, and so forth.
  [Chen, Floridi, Borgo, *What is Visualization Really for?*, 2013]

- „Visualization is solely a human cognitive activity and has nothing to do with computers"
  [Spence, *Information Visualization: Design for Interaction*, 2007]

Definition

Visualization ... facilitate **visual representations** of abstract data to amplify **cognition**.

Challenge

[Card, Mackinlay, and Shneiderman, *Readings in Information Visualization: Using Vision to Think*, 1999]

Challenges

- The ability to present quantitative information effectively is not **intuitive**; it requires visual communication skills that must be **learned**. [Stephen Few, Show Me the Numbers, 2004]

- Do we have time to learn new skills?

- We should know at least main **principles**!

Principle of Analytic Graphic (Tufte)

- Principle 1 : Show comparisons.
- Principle 2 : Show causality, mechanism, explanation.
- Principle 3 : Show multivariate data.
- Principle 4 : Integrate multiple modes of evidence.
- Principle 5 : Describe and document the evidence.
- Principle 6 : Content is king.

- Edward Tufte: "Good *content reasoners* and *presenters* are *rare*, *designers are not.*"

Principle of Analytic Graphic (Tufte)

- Principle 1 :
- Principle 2 :
- Principle 3 :
- Principle 4 :
- Principle 5 :
- Principle 6 :

- It is all about **data**, data **relations**, and **evidence**.

Epicycles of Data Analytics

- 1. Stating and refining the question
- 2. **Exploring the data**
- 3. Building formal statistical models
- 4. Interpreting the results
- 5. **Communicating the results**
  [Peng and Matsui, Art of Data Science, 2015]

Visualisation
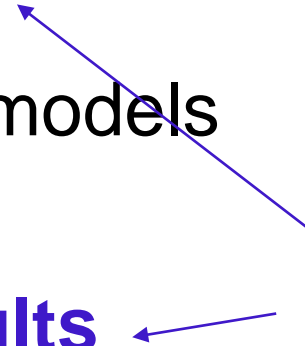
Mapping Data to Graphs

- Conclusion: Know your data!

- But also: Know your graphs!

- Books:
  - Show Me the Numbers, Few
  - The Grammar of Graphics, Wilkinson

Fun with Graphs
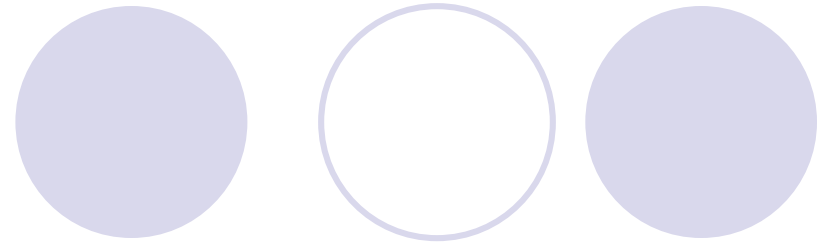
- Poincare graph (Scatter plot)
- Visualisation of Heart Rate Variability (HRV), RR – duration of heart cycle
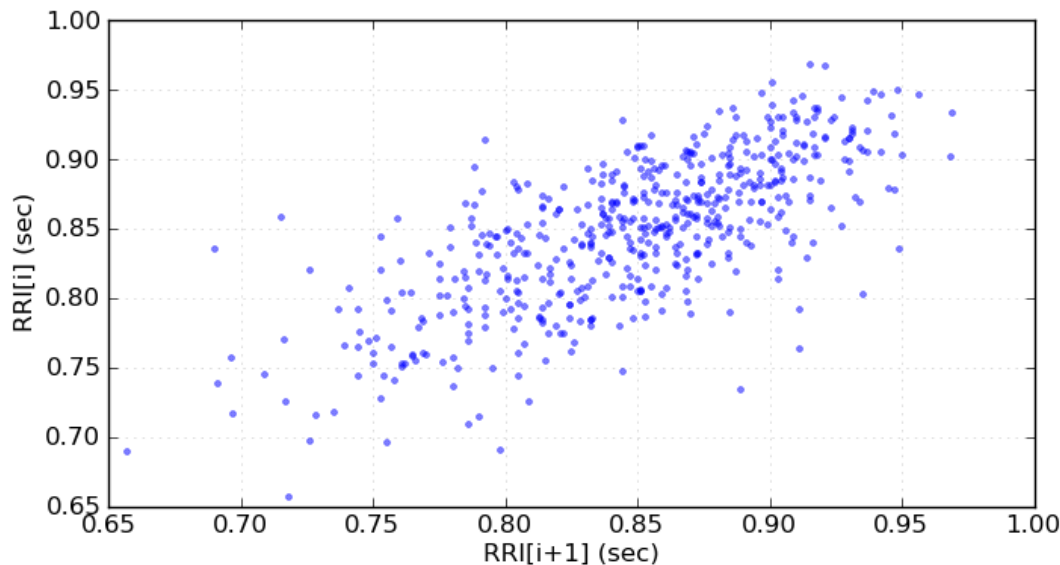
Fun with Graphs

- Poincare graph (Scatter plot): Visualisation of Heart Rate Variability (HRV)
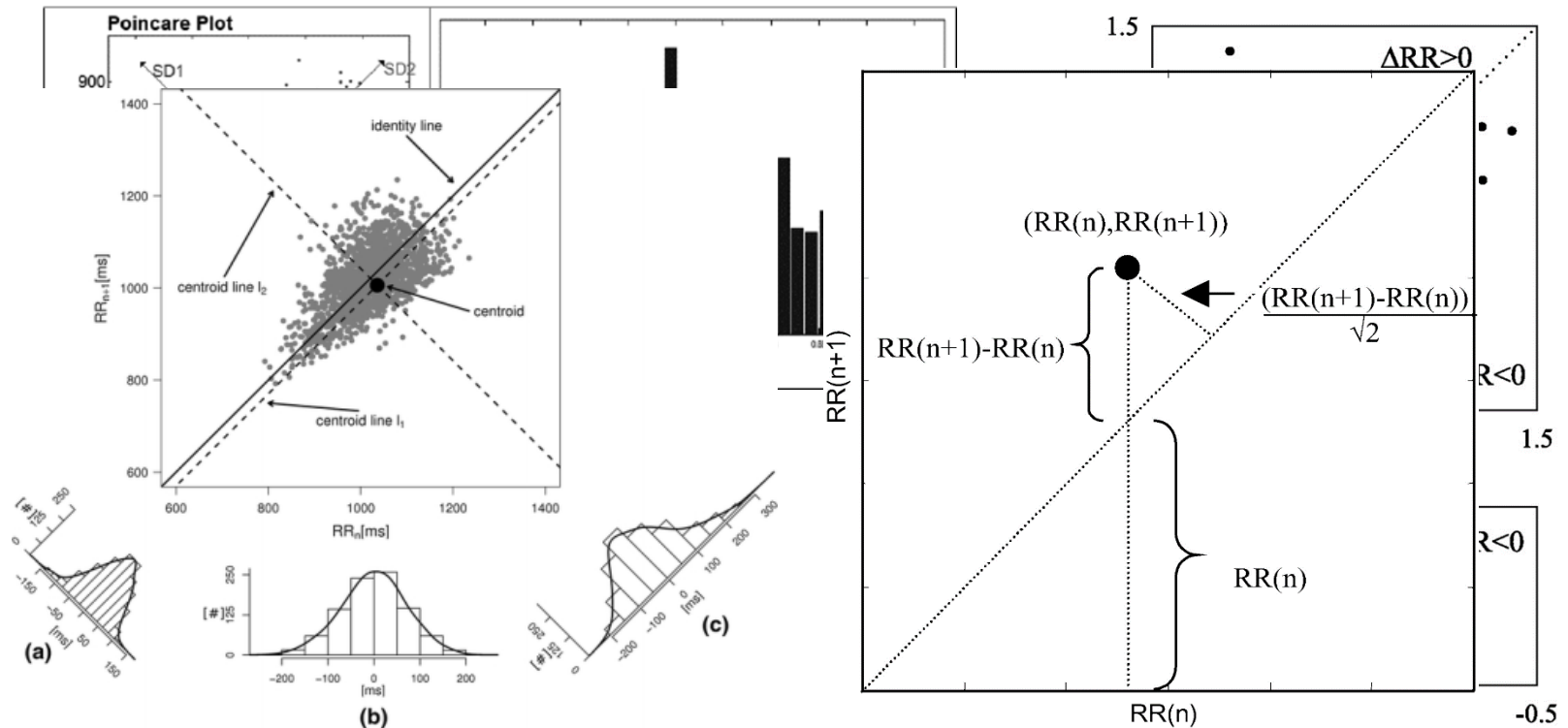
Fun with Graphs
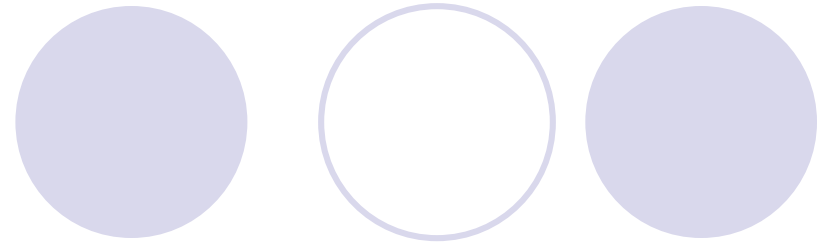
- Scatter plot vs Histogram (white American married couples)
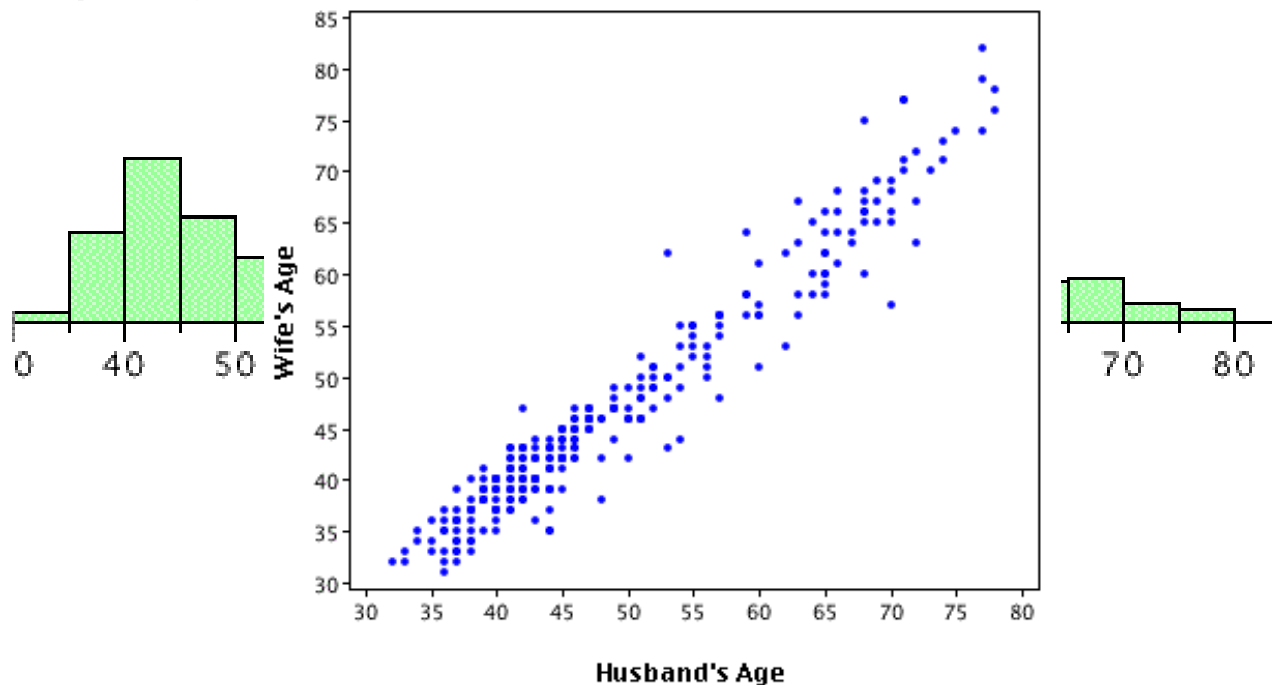
Online Statistics Education: An Interactive Multimedia Course of Study, D.Lane

Fun with Graphs
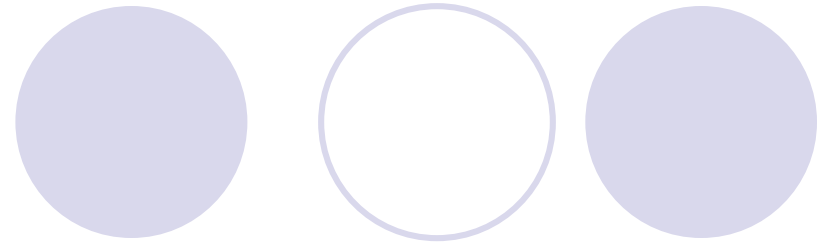
● Pie or Bar?
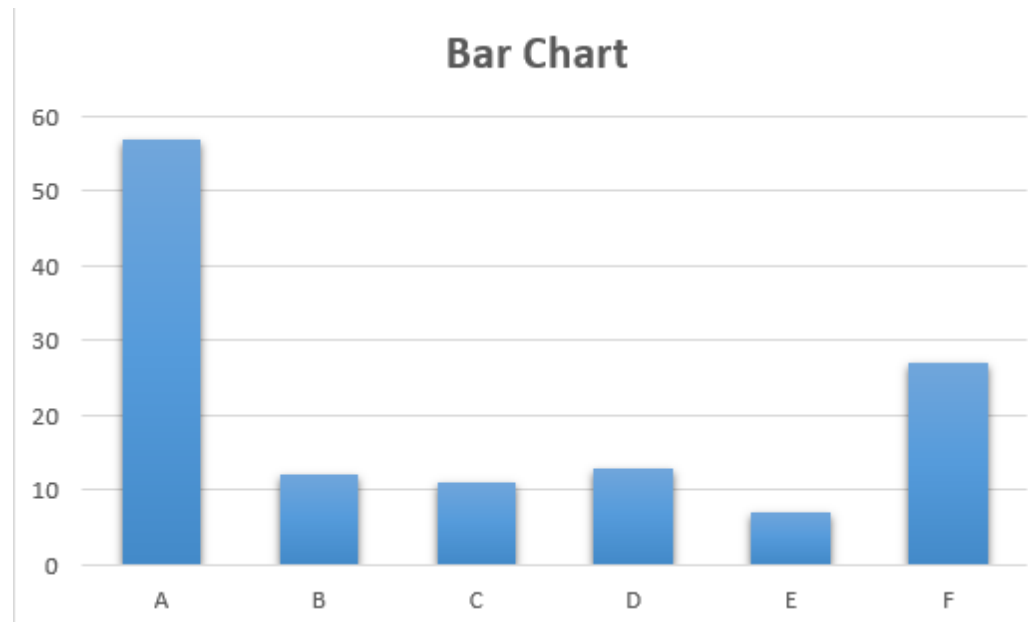
Hierarchy Tree Map

- BBC: World 500 Super computer chart (2010)
- Speed ~ Country
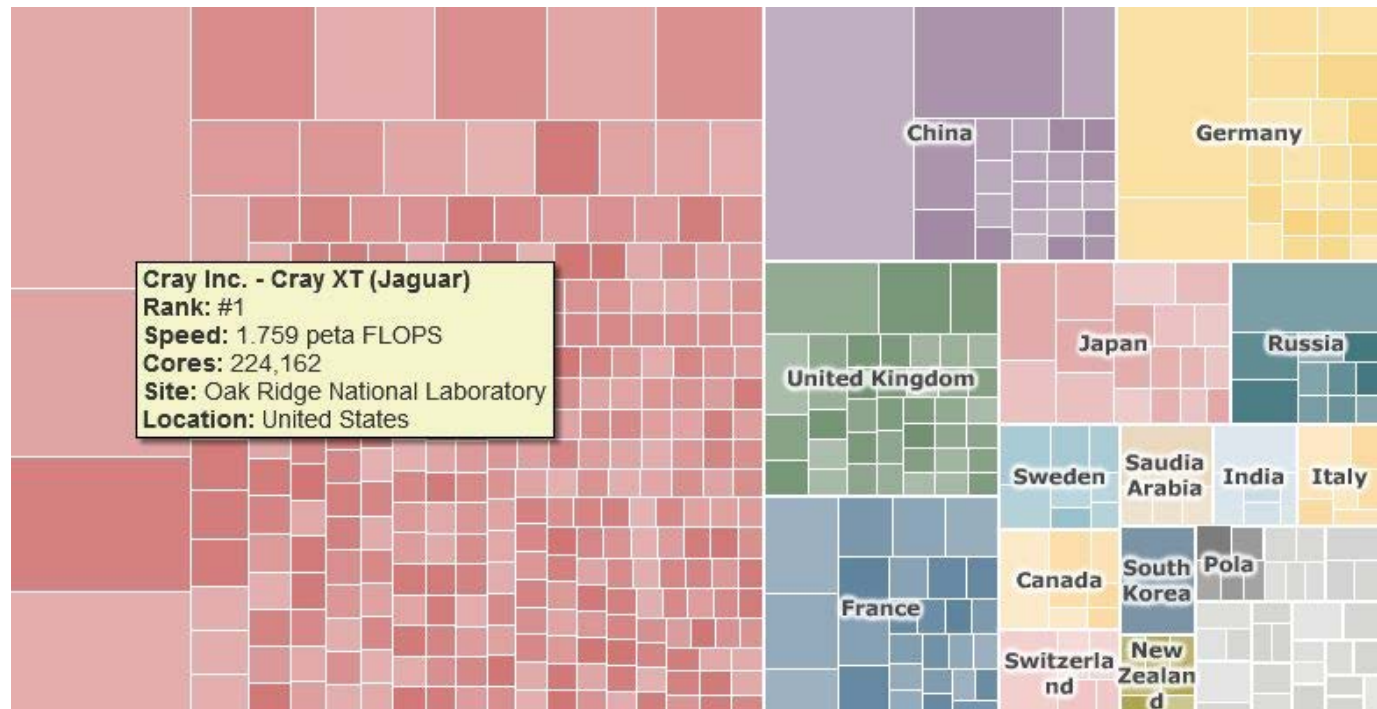
Radar/Spider Chart
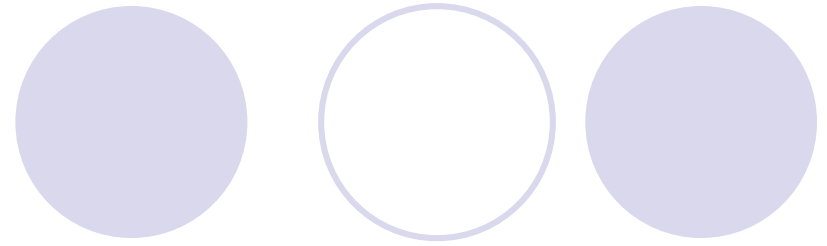
- Graphical profiles
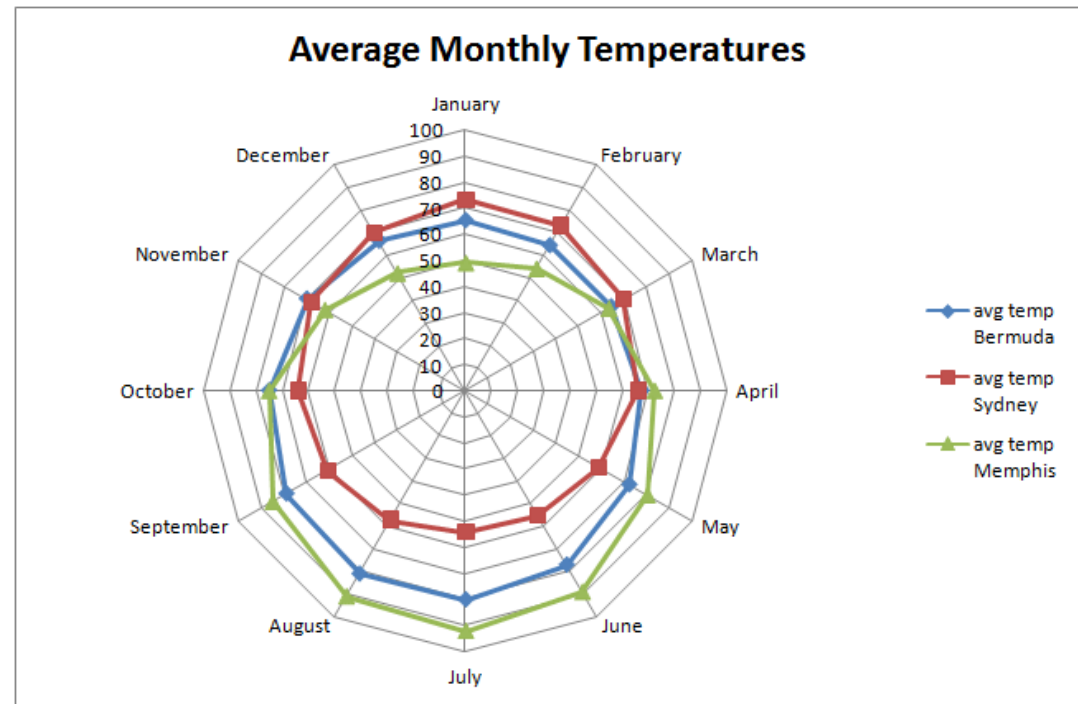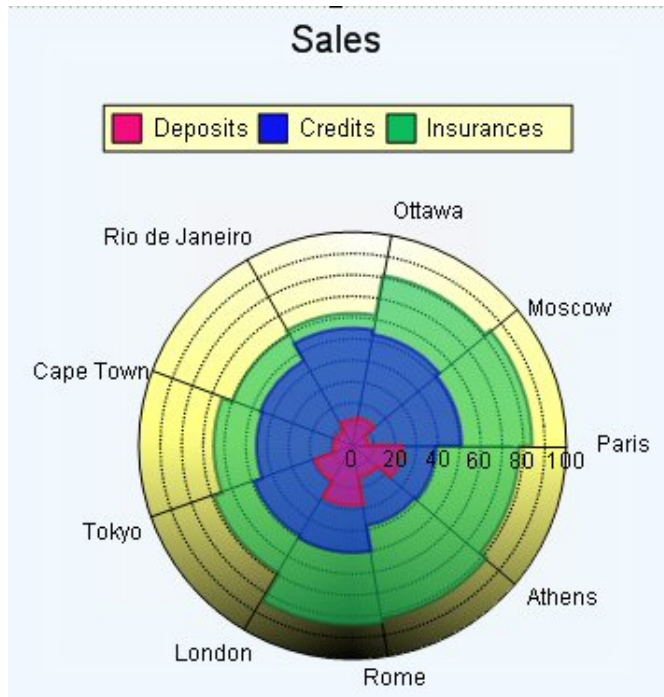
Bubble Chart

- Food supplements
- **Size** – popularity
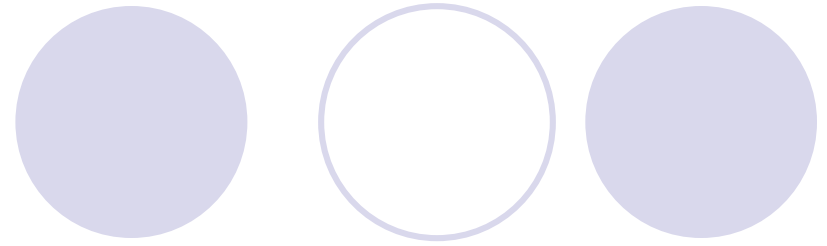- **Color** – evidence of benefits

- Race Bubble Chart
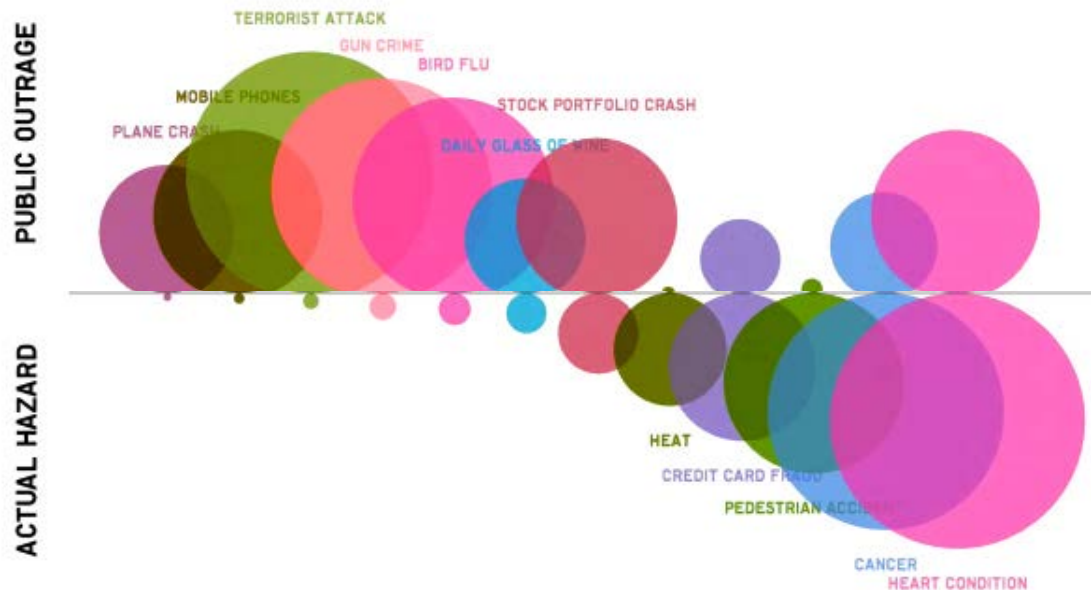- Improvement: Color and position are used for the same information
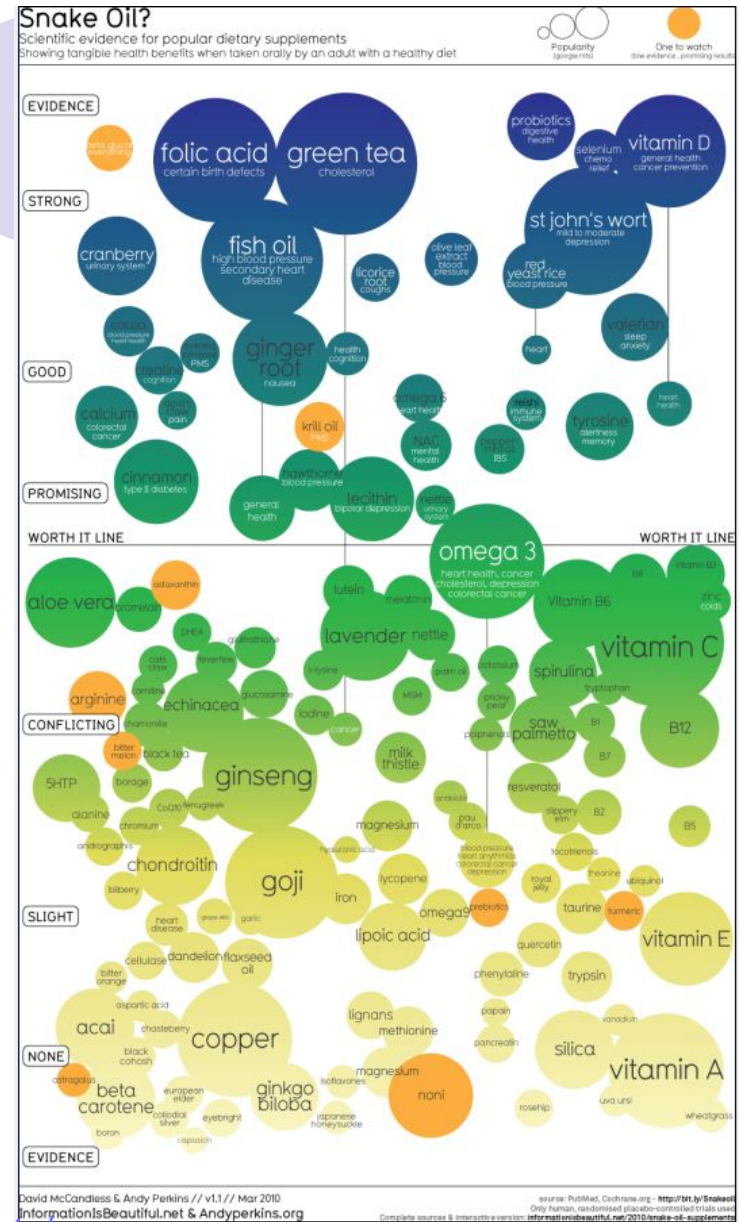
DavidMcCandless and Andy Perkins.
informationisbeautiful.net. v1.0, Jan 2010
http://www.informationisbeautiful.net/play/snake-oil-supplements/

Bubble Chart

- Size as a risk measure
- Risk perception and real hazards

- Mirroring for the contrast

http://www.colorful-data.net/
risk-perception-and-actual-hazards/

More Fun with Data Visualization

- Hans Rosling TED Talk
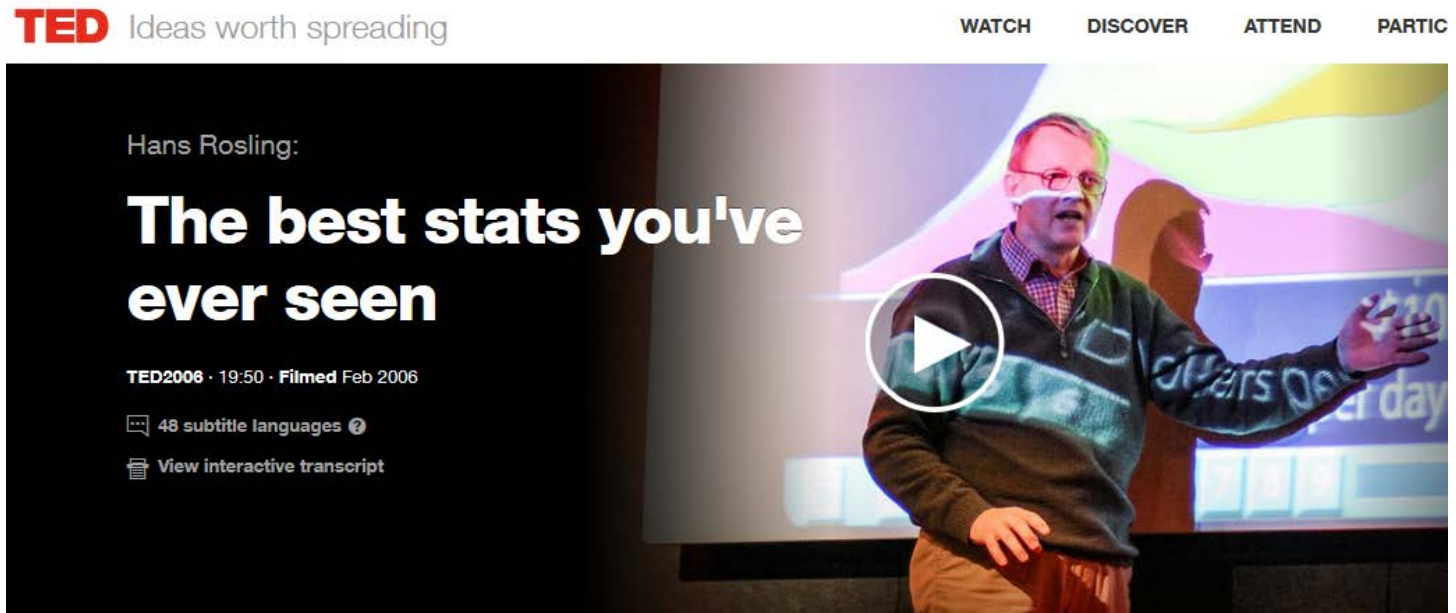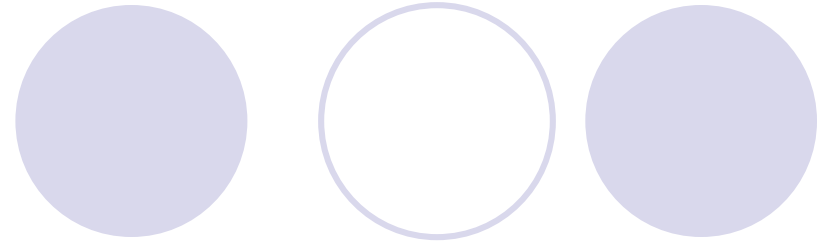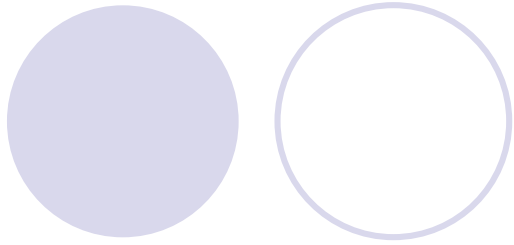
- Thank you for your attention
- Questions?