Dishonest Chart Techniques

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Overview

1. Background and Motivation

2. Taxonomy of Dishonest Chart Techniques

3. Related Work

Background and Motivation

Dishonest Charts

- Visualizations can convey a misleading impression.
- Occur by accident or design.
- Data is always biased and never objective or neutral.
- Result from design choice or data manipulation.
- Effects on interpretation:
  - Patterns
  - Trends
  - Relationships

Taxonomy of Dishonest Chart Techniques

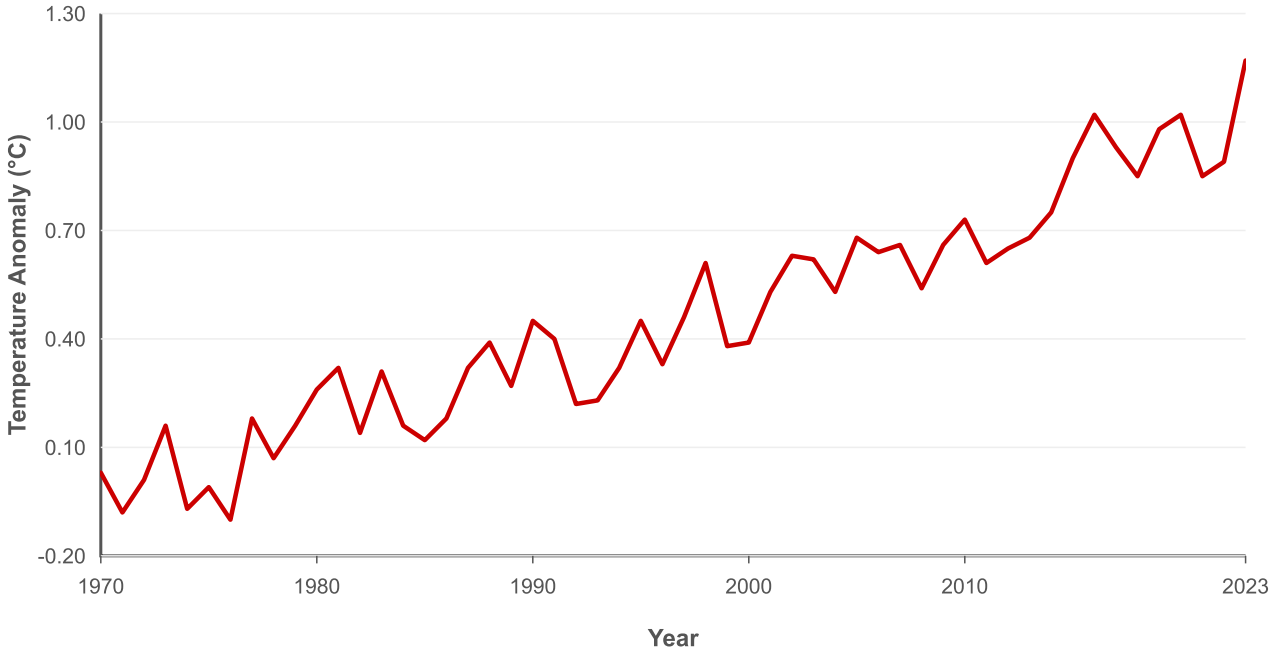
9 Dishonest Chart Techniques

- Cherry Picking
- Underbinning
- Axis Truncation
- Time Gap
- Oversmoothing
- Artificial Flattening or Steepening
- Manipulating the Visual Encoding
- Perspective Distortion
- Concealing Uncertainty

Cherry Picking

- Selecting only specific data points, groups, or timeframes that support desired outcome.
- Deliberately hides broader context or opposing trends.
  - Showing short-term cooling trend to deny long-term warming.

Cherry Picking Demo



Full Trend (1970 - 2023) **"The Hiatus" (1998 - 2011)**

NASA Goddard Institute for Space Studies (GISS). (2024). *Global Land-Ocean Temperature Index*. Retrieved from https://data.giss.nasa.gov/gistemp/. Interactive chart created by the authors.

Cherry Picking Example

- Judd et al. (2024) Climate Reconstruction.[1]
- Uses a massive 485-million-year geological timeline.
- Visually compresses and hides rate of modern warming.

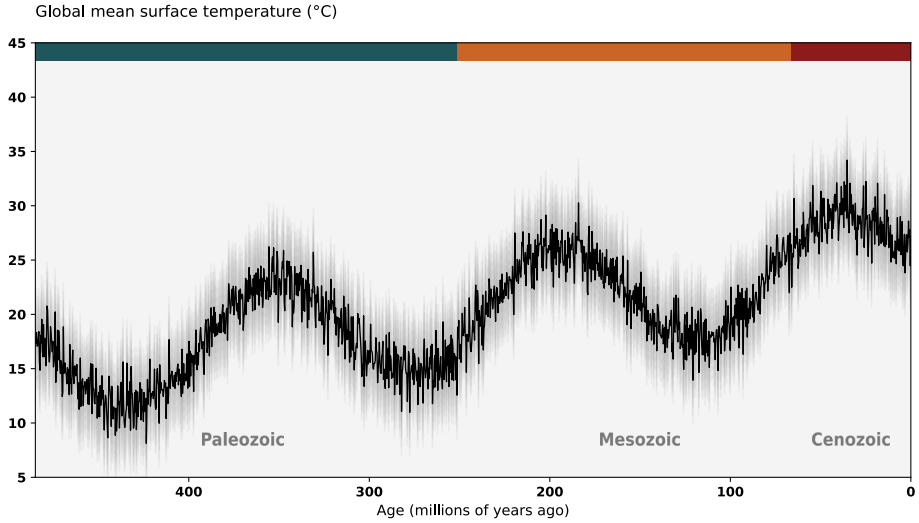


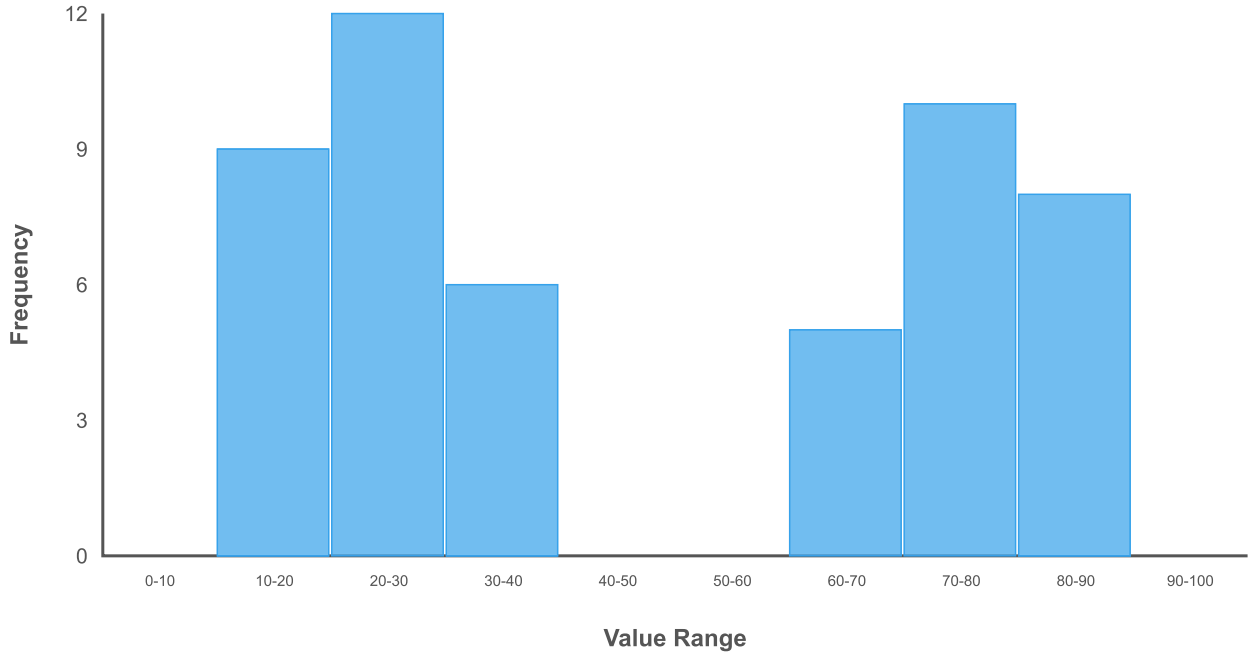
Chart recreated from original in Python by the authors.

[1] Judd, E. J., Tierney, J. E., Lunt, D. J., Montañez, I. P., Huber, B. T., Wing, S. L., & Valdes, P. J. (2024). A 485-million-year history of Earth's surface temperature. *Science*, *385*(6715). https://doi.org/10.1126/science.adk3705

Underbinning

- Reducing number of bins (e.g., in histograms or heatmaps).
- Obscures true underlying distribution.
- Hides:
  - Important clusters
  - Gaps
  - Outliers

Underbinning Demo



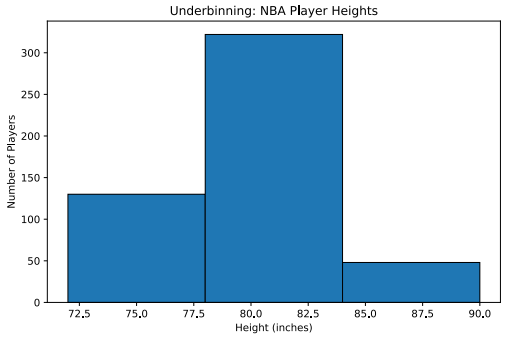
Number of Bins: 10

Minimum (Misleading) Maximum (Detailed)

Interactive chart created by the authors.

Underbinning Example

- Distribution of NBA player heights.[1]
- Too few bins (overly broad intervals).
- Data grouped into coarse categories, true distribution is hidden.



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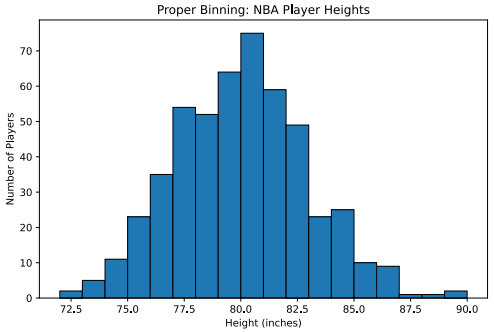


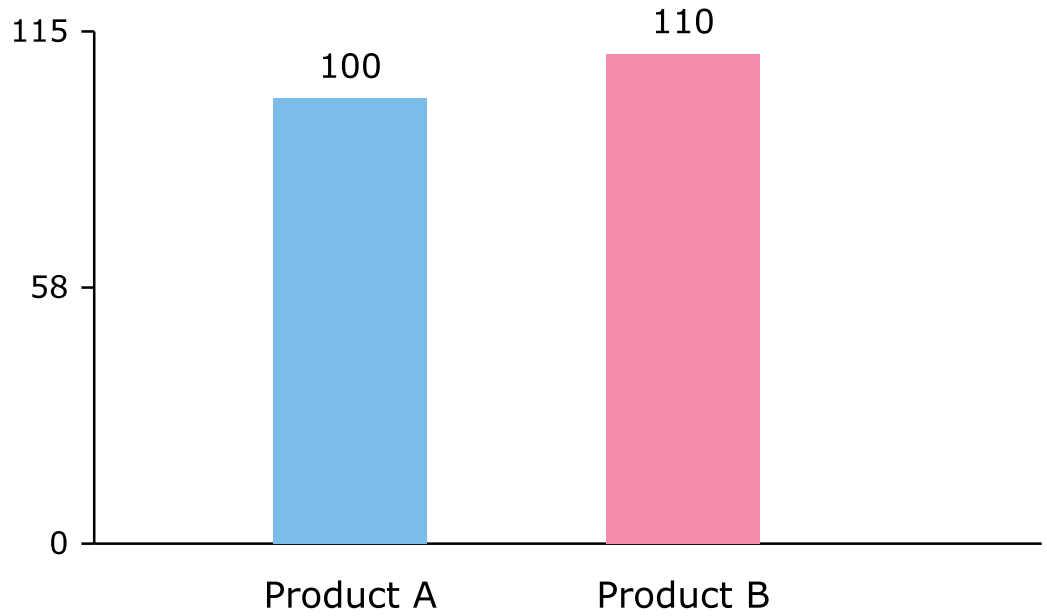
Chart recreated from original in Python by the authors.

[1] FlowingData. *Dishonest Charts*, from https://flowingdata.com/projects/dishonest-charts/

Axis Truncation

- Truncating the baseline
- Chart where y-axis does not start at zero.
- Differences appear larger.

Axis Truncation Demo



Same values: 100 vs. 110

Y-axis starts at: 0

Full axis: the difference looks proportional.

Interactive SVG created by the authors.

Axis Truncation Example

- Fox News Tax Cuts Broadcast (2012).[1]
- Truncated y-axis (starts at 34% instead of 0%).
- Exaggerates minor 4.6% tax increase, making second bar appear much larger.

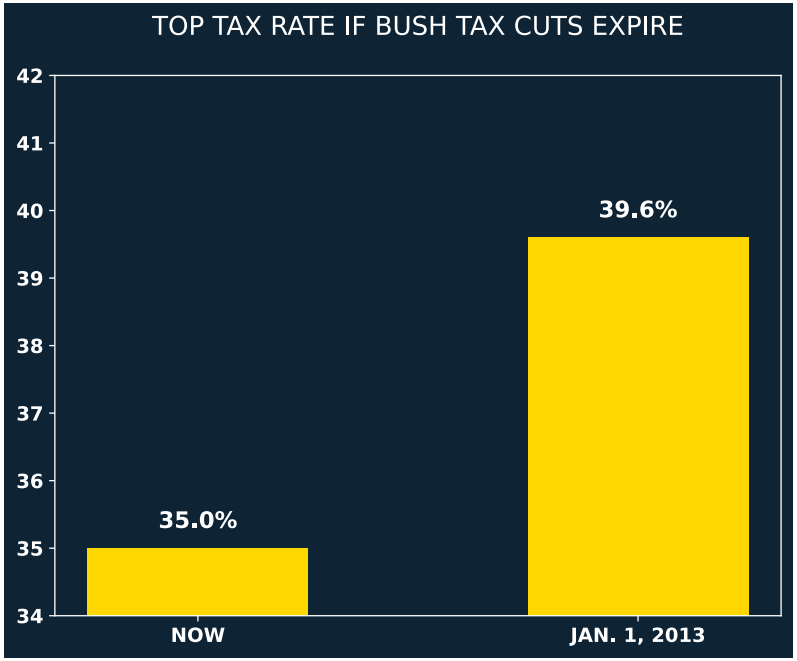


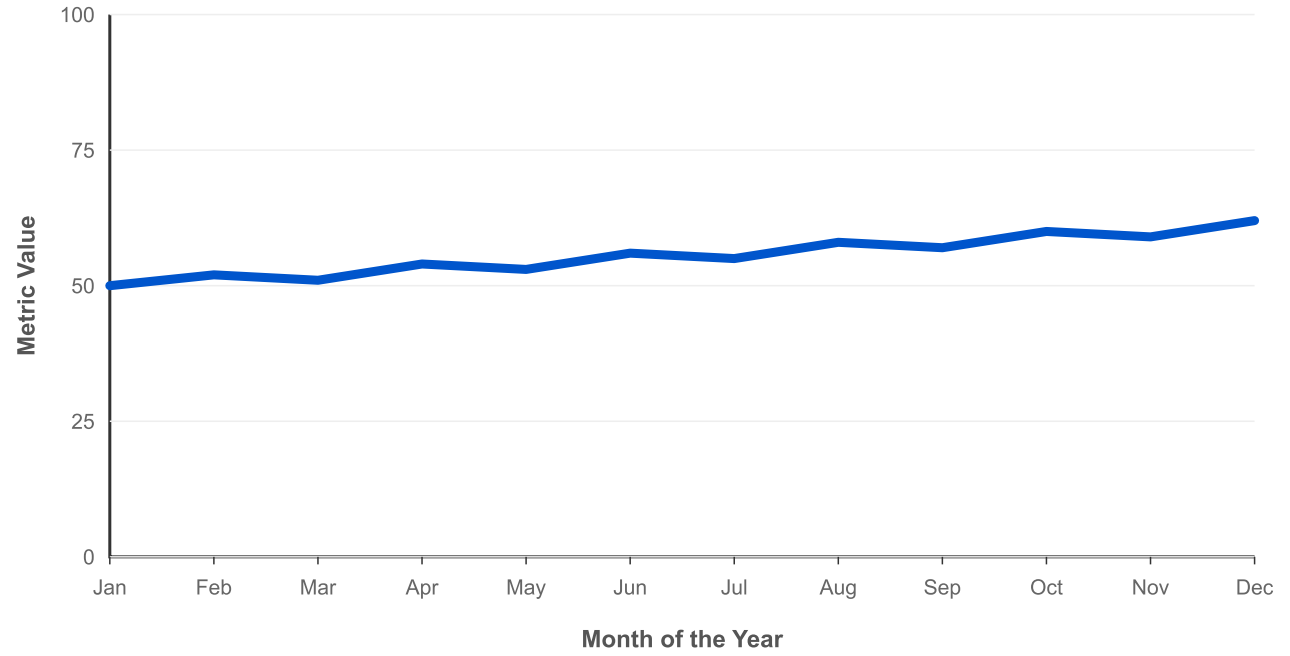
Chart recreated from original in Python by the authors.

[1] Fox News Network. (2012, August 1). *If Bush tax cuts expire* [Television broadcast]. Media Matters for America. https://peoplesgdarchive.org/item/10481/if-bush-tax-cuts-expire-fox-news-infographic

Artificial Flattening or Steepening

- Flattening chart's visual appearance:
  - Extreme aspect ratios.
  - Overly broad y-axis.

Artificial Flattening / Steepening Demo



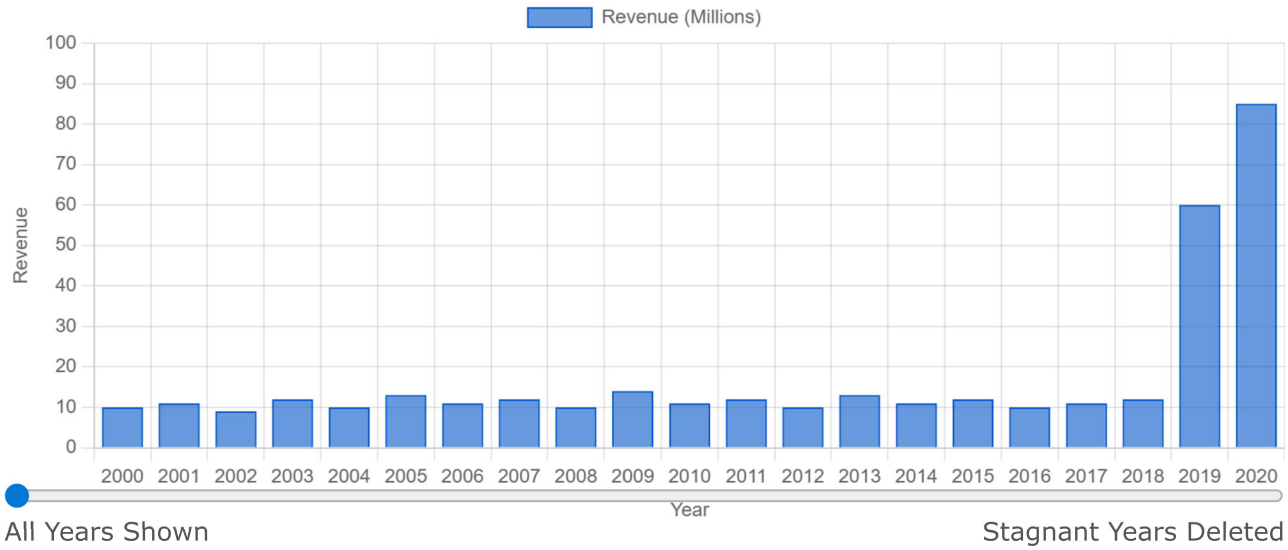
Steepened Flattened

Interactive chart created by the authors.

Time Gap

- Using uneven or irregular time intervals on continuous axis but spacing them evenly.

Time Gap Demo

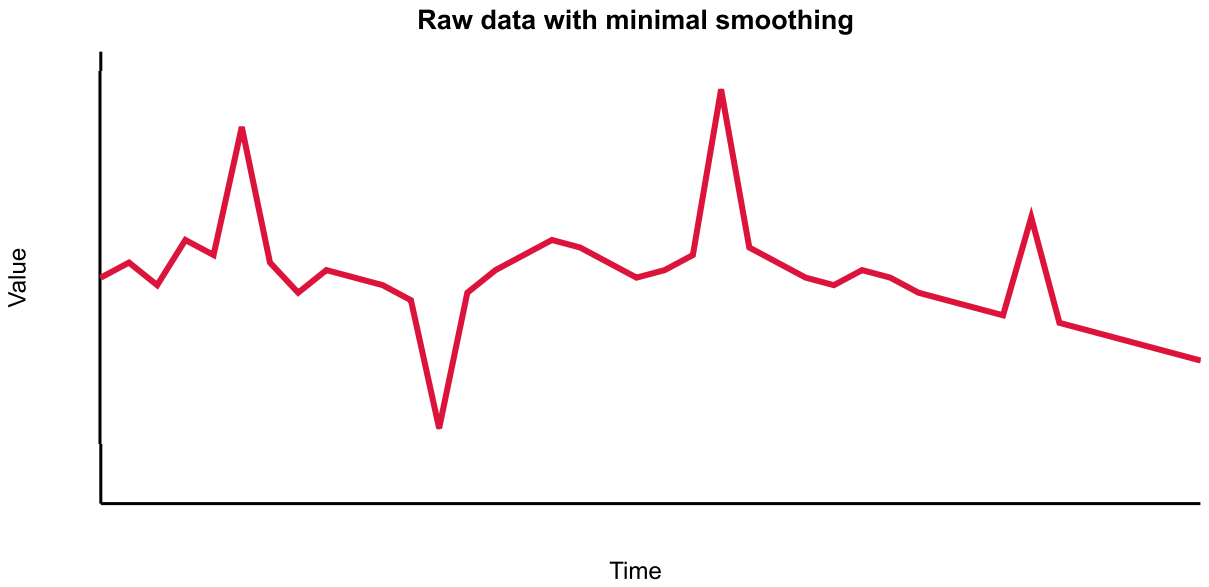


Interactive chart created by the authors.

Oversmoothing

- Applying aggressive smoothing algorithms or over-fitted curves to raw data points.
- Hides critical short-term fluctuations, volatility, or local extremes.

Oversmoothing Demo



Smoothing window: 1

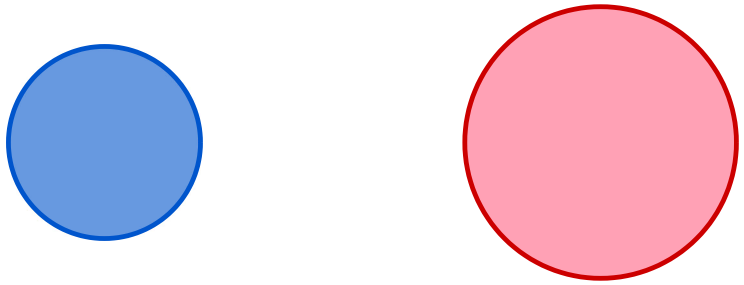
Low smoothing: short-term fluctuations are still visible.

Interactive SVG created by the authors.

Manipulating the Visual Encoding

- Manipulates choice of visual encoding.
- Often by misleading colour, size and shape (encoding).

Visual Encoding Demo 1: Size



Year 1 Year 2 (100% Increase)

2D Area 1D Radius

Interactive chart created by the authors.

Manipulating the Visual Encoding Example 1

- "Shrinking Family Doctor" (Time Magazine, 1990).[1]
- Maps a 1D percentage drop to a 2D icon's height.
- Viewers perceive area, making the 1990 doctor look drastically smaller than the data supports.

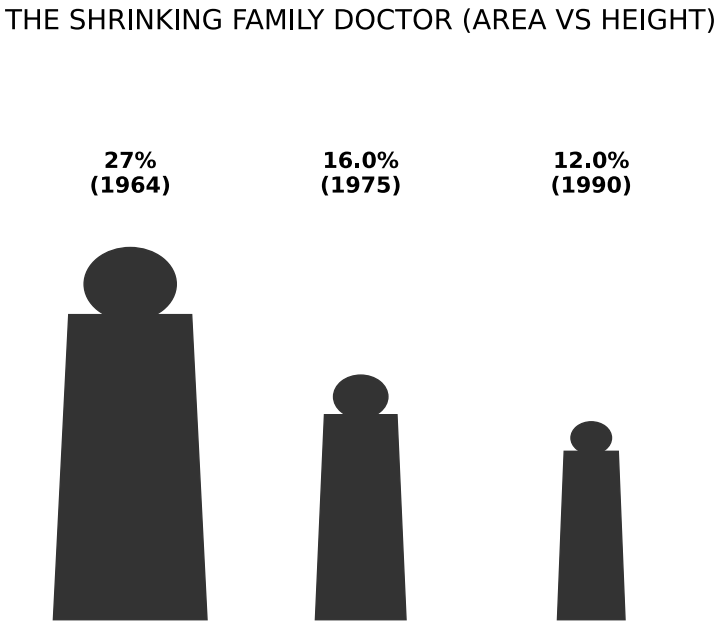
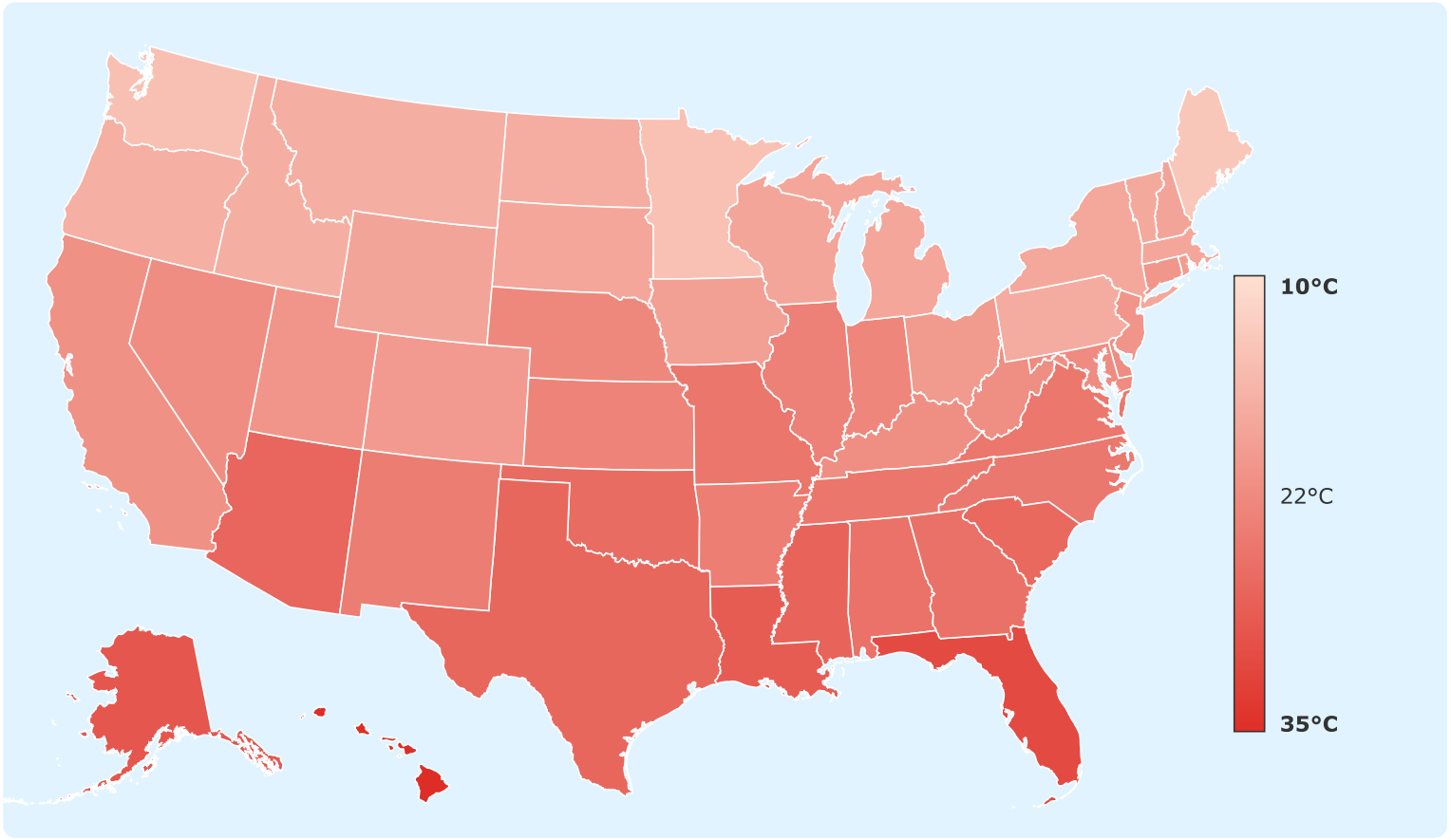


Chart recreated from original in Python by the authors.

[1] Time Magazine. (1990). *The Shrinking Family Doctor* [Data visualization]. InfoVis Wiki: The Lie Factor. Retrieved from https://infovis-wiki.net/wiki/Lie_Factor

Visual Encoding Demo 2: Color Mapping



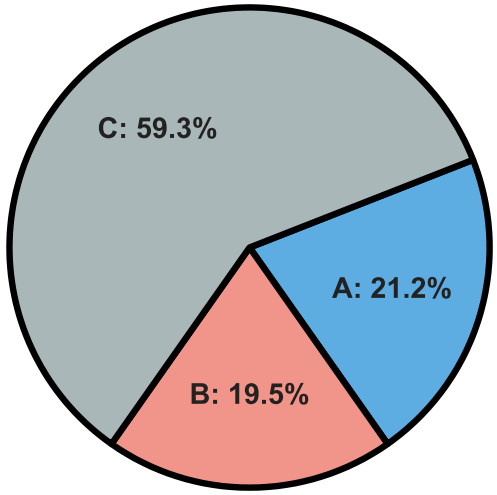
Sequential Palette Rainbow Palette

Interactive chart created by the authors.

Perspective Distortion

- Misuses 3d perspective.
- For example, tilting a pie chart to make foreground slices look larger.

Perspective Distortion Demo



Honest 2D pie chart

Perspective tilt: 0%

No tilt: slices are easier to compare by their actual angle.

Interactive SVG chart created by the authors.

Perspective Distortion Example

- *Context*: Apple Macworld Keynote (2008),presented by Steve Jobs.[1]
- *Misuse*: 3D tilt pushes the 19.5% slice into the middle.
- *Effect*: Perspective distortion makes 19.5% appear physically larger than 21.2%.

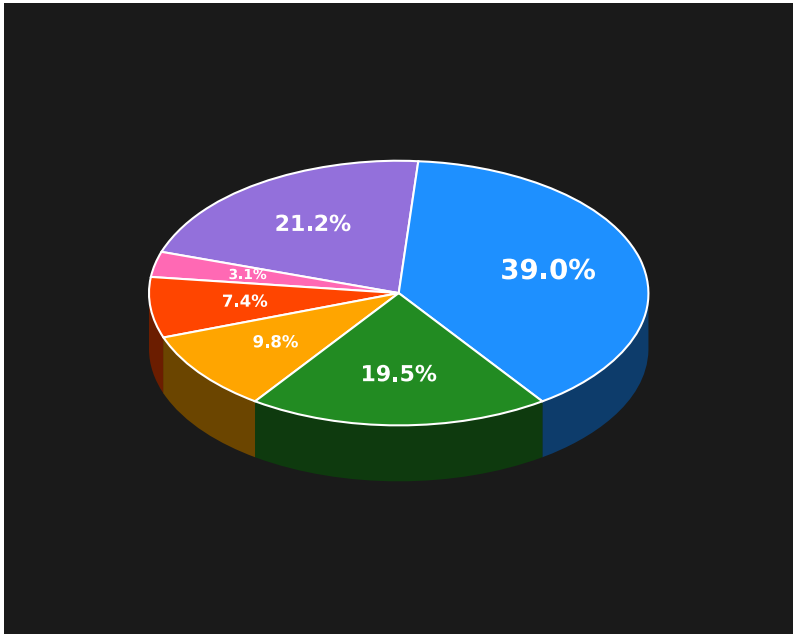


Chart recreated from original in Python by the authors.

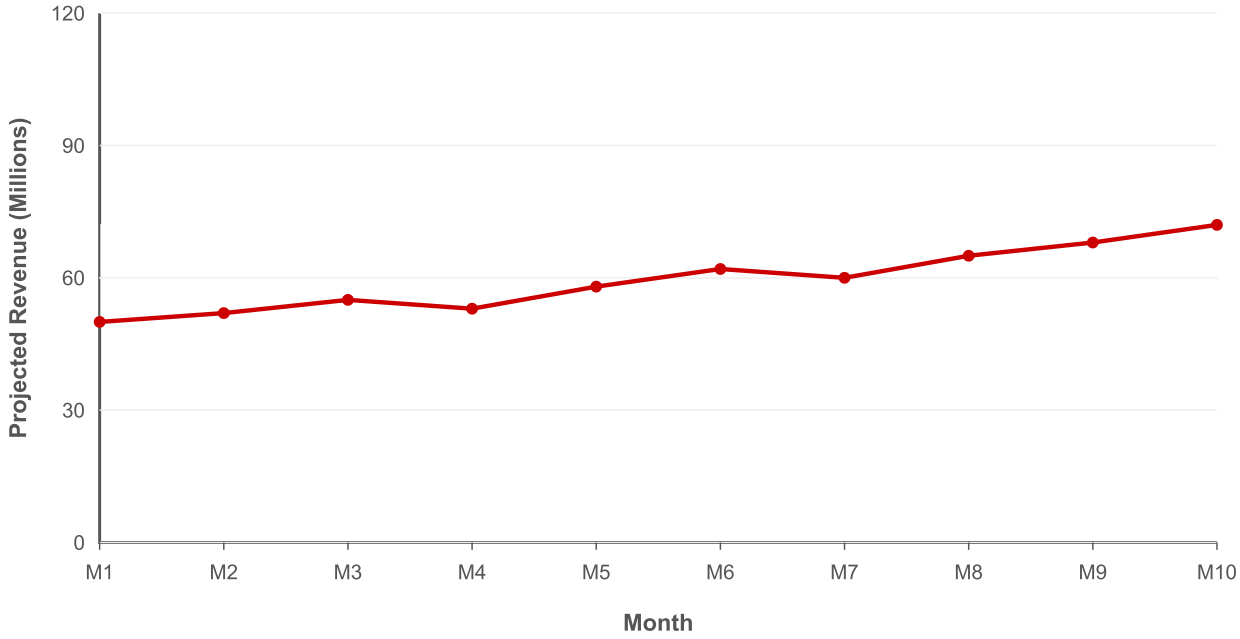
[1] Apple (2008, January 15). *Macworld San Francisco 2008 Keynote Address* [Presentation slide]. Macworld Conference & Expo. Retrieved from https://paragraft.wordpress.com/tag/infovis/

Concealing Uncertainty

- Not including:
  - Error bars.
  - Confidence intervals.
  - Variance indicators.

- Suggests absolute precision in data that actually estimates or forecasts where there is uncertainty.

Concealing Uncertainty Demo



Confidence Interval Shown: 0%

0% (Concealed / Misleading) 95% (Honest Forecast)

Interactive chart created by the authors.

Related Work

Related Work

- *Awesome Misleading Visualizations*: Curated GitHub List.
  https://github.com/UKPLab/awesome-misleading-visualizations
- *FlawViz*: Collection of Misleading Data Visualization.
  https://flawviz.github.io/
- *FlowingData*: Defensive Chart Techniques by Nathan Yau.
  https://flowingdata.com/projects/dishonest-charts/
- *How Charts Lie*: Book by Alberto Cairo.
  https://wwnorton.com/books/9781324001560

Questions?