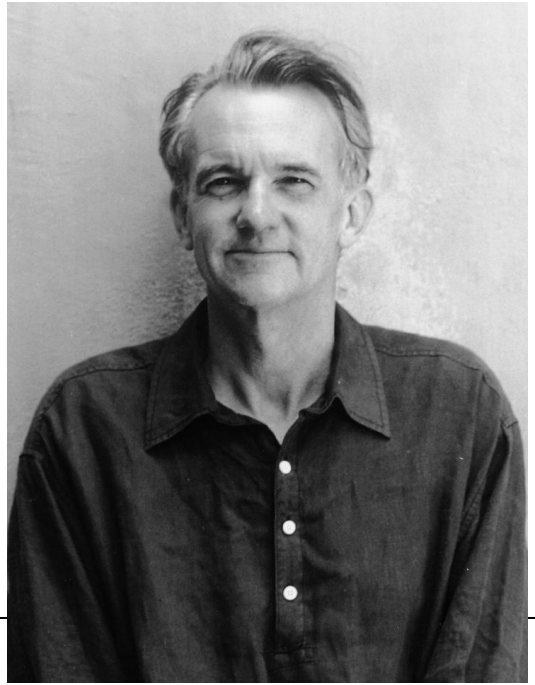
Edward Tufte

DATA VISUALIZATION PIONEER



Structure

1. LIFE AND WORK

EARLY LIFE + EDUCATION

WORK + PUBLISHED BOOKS

MISCELLANEOUS THOUGHTS ON VISUALIZATION

2. THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION

TUFTE'S PERSONALITY

DATA VISUALIZATION PRINCIPLES

1 Life and Work

Life

BORN 1942, KANSAS CITY, MO.

BS + MS, STATISTICS, STANFORD

PHD, POLITICAL SCIENCE, YALE

PROFESSOR AT PRINCETON, WOODROW WILSON SCHOOL

PROFESSOR AT YALE, POLITICAL SCIENCE, COMPUTER SCIENCE, STATISTICS

SENIOR CRITIC AT YALE, SCHOOL OF ART

Professional Affiliations

CONSULTED FOR:

BUREAU OF THE CENSUS

CENTERS FOR DISEASE CONTROL

THE NATIONAL SCIENCE FOUNDATION

NEWSWEEK

THE NEW YORK TIMES

HEWLETT-PACKARD

IBM, NBC, CBS

Professional Recognition

FELLOW:

AMERICAN ACADEMY OF ARTS AND SCIENCES

GUGGENHEIM FOUNDATION

CENTER FOR ADVANCED STUDY IN THE BEHAVIORAL SCIENCES

AMERICAN STATISTICAL ASSOCIATION

Work

ONE OF THE FOUNDERS OF DATA VISUALIZATION AS AN ACADEMIC FIELD

CONSIDERED TO BE THE PRIMARY AUTHORITY ON INFORMATION VISUALIZATION

DEVELOPED PRINCIPLES OF “GRAPHICAL EXCELLENCE” AND “GRAPHICAL INTEGRITY”

CATALOGED SUCCESSFUL HISTORICAL VISUALIZATIONS

Carte Figurative des pertes successives en hommes de l'Armée Française dans la campagne de Russie 1812-1813.

Dressée par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite.

Paris, le 20 Novembre 1869.

Les nombres d'hommes présents sont représentés par les largeurs des zônes colorées à raison d'un millimètre pour dix mille hommes; ils sont de plus écrits en travers des zônes. Le rouge désigne les hommes qui entrent en Russie, le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été puisés dans les ouvrages de M.M. Thiers, de Ségur, de Fezensac, de Chambray et le journal inédit de Jacob, pharmacien de l'Armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davoust qui avaient été détachés sur Minsk et Mohilow et ont rejoint vers Orscha et Witebsk, avaient toujours marché avec l'armée.

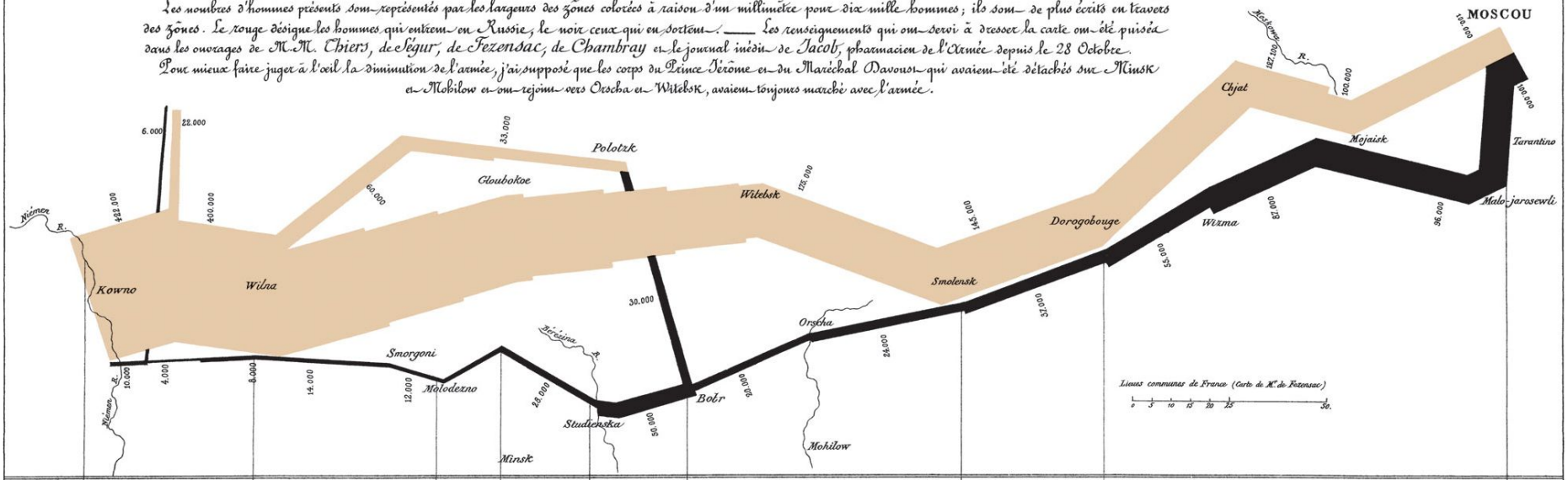
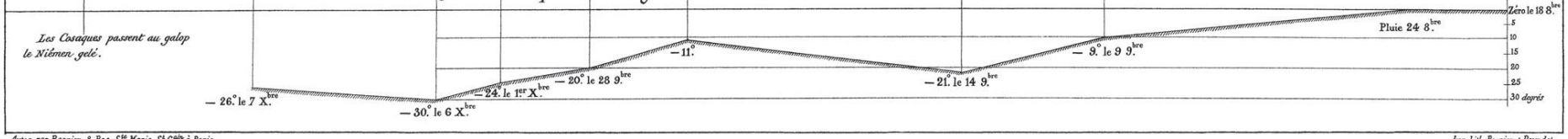
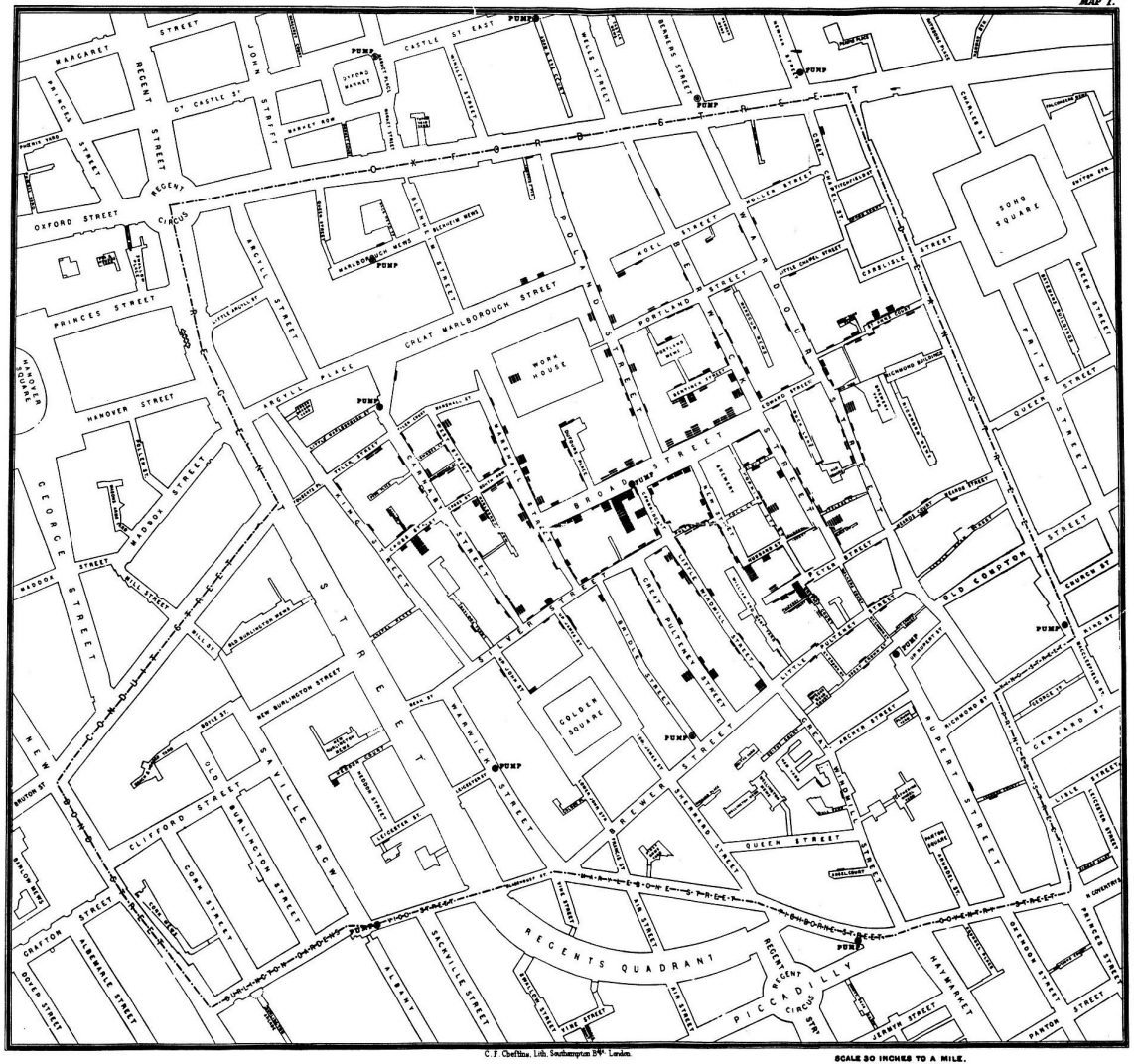


TABLEAU GRAPHIQUE de la température en degrés du thermomètre de Réaumur au dessous de zéro.



Autog. par Regnier, 8. Pas. Ste Marie St Gdre à Paris.

Imp. Lith. Regnier et Dourdet.



C. F. Cheffins, Lith. Southampton Bldgs. London.

SCALE 30 INCHES TO A MILE.

Books Published

1970 QUANTITATIVE ANALYSIS OF SOCIAL PROBLEMS

1974 DATA ANALYSIS FOR POLITICS AND POLICY

1978 POLITICAL CONTROL OF THE ECONOMY

1983 THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION

1990 ENVISIONING INFORMATION

1997 VISUAL AND STATISTICAL THINKING

1997 VISUAL EXPLANATIONS

2003 THE COGNITIVE STYLE OF POWERPOINT

2006 BEAUTIFUL EVIDENCE

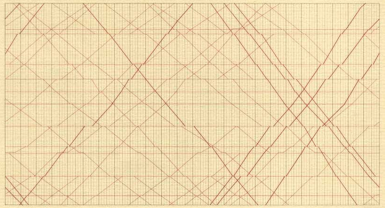
On Presentations

RULES:

1. SHOW UP EARLY

2. DISTRIBUTE A DOCUMENT, NOT A POWERPOINT
   A. PROVIDE A READING PERIOD

3. FINISH PRESENTING EARLY

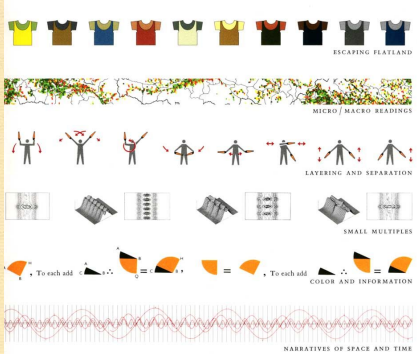


The Visual Display
of Quantitative Information

EDWARD R. TUFTE

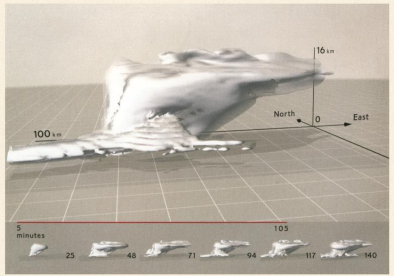
Edward R. Tufte

Envisioning Information



EDWARD R. TUFTE

VISUAL EXPLANATIONS



IMAGES AND QUANTITIES, EVIDENCE AND NARRATIVE

GOOGLE MAPS IS THE MOST WIDELY USED VISUALIZATION IN HUMAN HISTORY. ANYTHING THAT IS NOT PURE WORDS SHOULD BE EQUIVALENT TO THE METAPHOR OF GOOGLE MAPS.

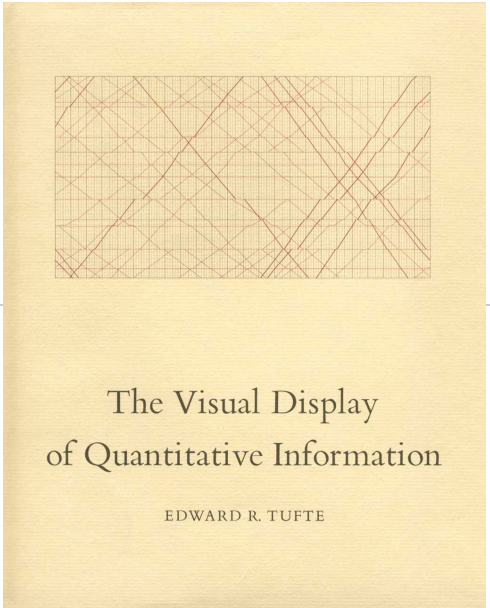
REACHING A CONCLUSION IS A FIRM HUMAN GOAL, BUT THE DATA MAY NOT ALWAYS SUPPORT A CONCLUSION.

SEEING HOW THE DATA ARE COLLECTED IS CRUCIAL — THE NUMBERS ON THE SCREEN HAVE GONE THROUGH A SELECTION PROCESS THAT IS OFTEN MASKED.

ZERO OUT THE INTERFACE AND IT BECOMES MORE BEAUTIFUL. THE READER IS THERE FOR THE DATA, NOT THE INTERFACE.

2

The Visual Display of Quantitative Information



Personal Quirks

VERY CRITICAL OF HIS OWN WORK

- CONSTANTLY ADDS AND REMOVES IDEAS FROM HIS WRITINGS
- ROUTINELY INVITES OTHERS TO CRITIQUE HIS WORKS IN-PROGRESS
- EVERY NEW EDITION OF HIS BOOKS CORRECTS TINY BLEMISHES

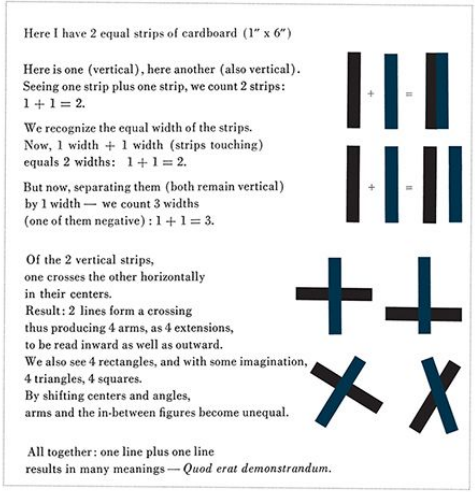
SELF PUBLISHED *THE VISUAL DISPLAY OF QUANTITATIVE INFORMATION*

- STRINGENT FORMATTING CHOICES, PUBLISHERS WOULD NOT AGREE
- TOOK OUT SECOND MORTGAGE ON HOME

Visual activation of negative areas of white space in these exhibits illustrates *the endlessly contextual and interactive nature of visual elements.* This idea is captured in a fundamental principle of information design: *1 + 1 = 3 or more.* In the simplest case, when we draw two black lines, a third visual activity results, a bright white path between the lines (note that this path appears even to have an angled end). And a complexity

of marks generates an exponential complexity of negative shapes. *Most of the time, that surplus visual activity is non-information, noise, and clutter.*[7] This two-step logic—recognition of 1 + 1 = 3 effects and the consideration that they generate noise—provides a valuable guide for refining and editing designs, for graphical reasoning, for subtraction of weight.[8]

In a little-known essay on 1 + 1 = 3 effects, Josef Albers conducts the demonstrations below, a visually sensitive and artistic approach to the cognitive contours of perceptual psychologists. Albers, seeing area and surface rather than border and edge, escapes the preoccupying magic of optical illusions to conceive a broad idea of negative space activation:



Josef Albers, "One Plus One Equals Three or More: Factual Facts and Actual Facts," in Albers, *Search Versus Re-Search* (Hartford, 1969), 17–18.

Keith Haring, Untitled 4/29/82, sumi ink on paper. © 1992 Estate of Keith Haring.

[7] Rare exceptions are the Turgot-Bretez map of Paris and the Nolli map of Rome: streets, absent of ink, are defined—tersely, clearly, and precisely—by the surrounding ink of blocks and buildings, creating subjective contours.

[8] Note the additional 1 + 1 = 3 effects, on this page, as the interaction between the examples and the surrounding type enlivens the white space, forming shapes, profiles, and paths. These reverberations are vivid because our examples are printed in black; strong light/dark contrasts accentuate the clutter of 1 + 1 = 3 or more.

Graphical Excellence

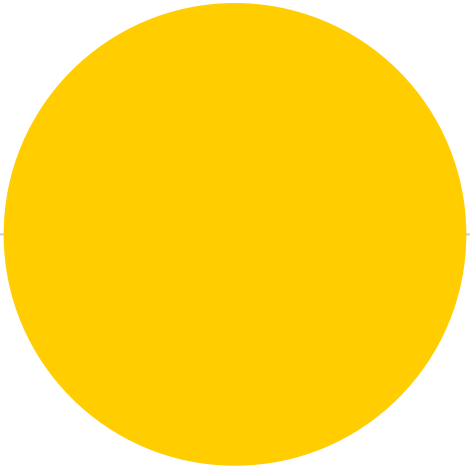
THE WELL-DESIGNED PRESENTATION OF INTERESTING DATA

A MATTER OF SUBSTANCE, STATISTICS, AND DESIGN

COMPLEX IDEAS COMMUNICATED WITH CLARITY, PRECISION, AND EFFICIENCY

NEARLY ALWAYS MULTIVARIATE

TELLS THE TRUTH ABOUT THE DATA



Graphical Excellence

GIVES VIEWER THE GREATEST NUMBER OF IDEAS IN THE SHORTEST TIME WITH THE LEAST INK IN THE SMALLEST SPACE POSSIBLE

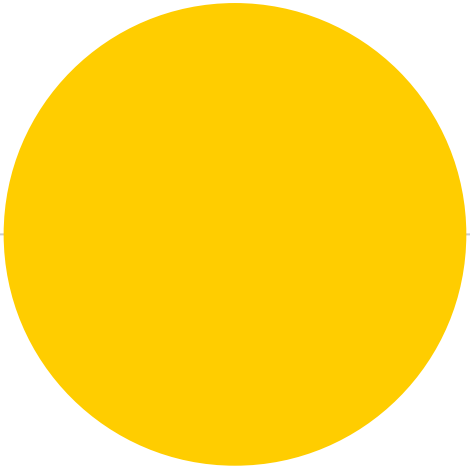
Graphical Integrity

REPRESENTATION OF NUMBERS SHOULD BE DIRECTLY PROPORTIONAL TO NUMERICAL QUANTITIES REPRESENTED

LIE FACTOR = SIZE OF EFFECT IN GRAPHIC / SIZE OF EFFECT IN DATA

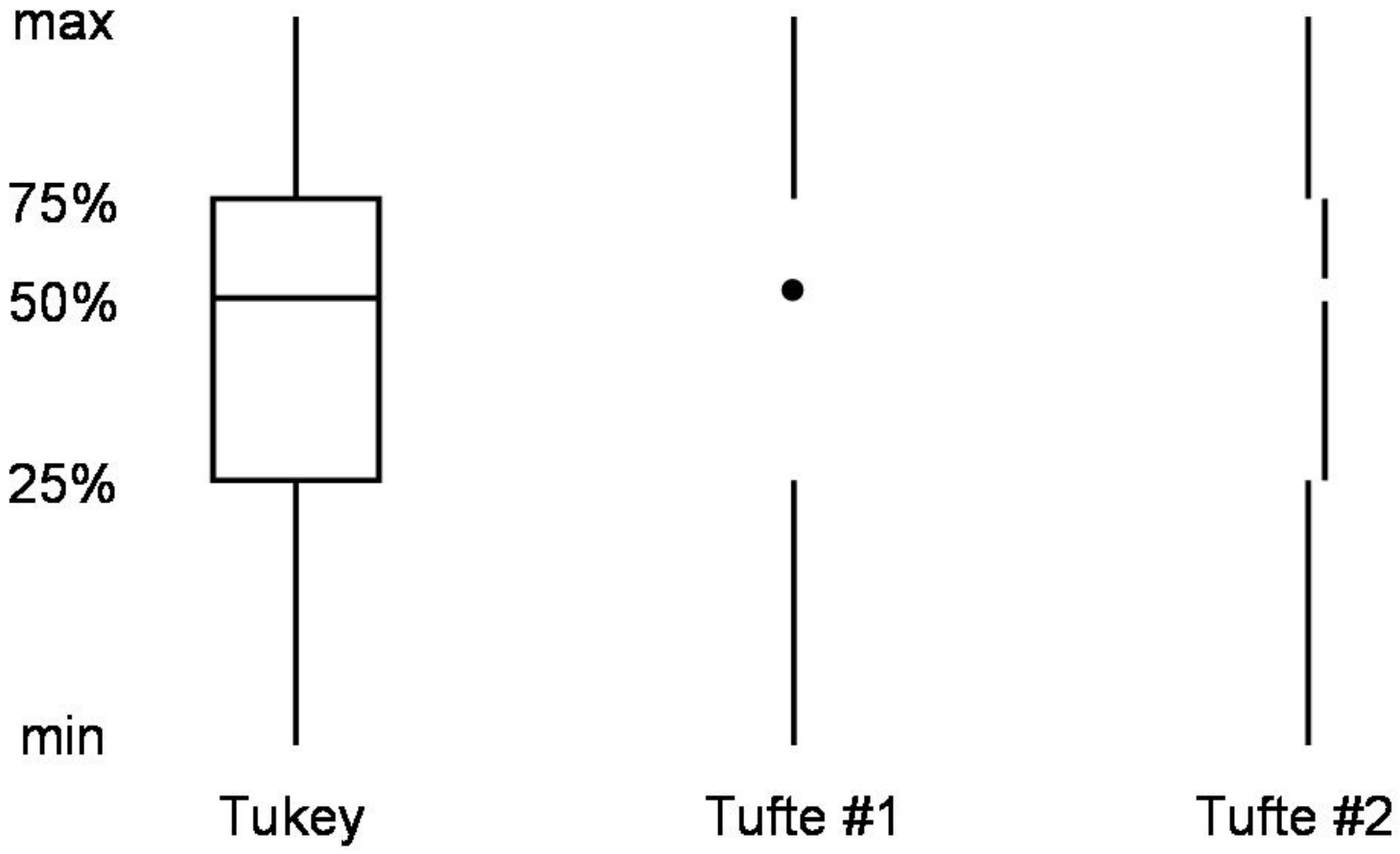
CLEAR, DETAILED, THOROUGH LABELING, SHOWING DATA IN CONTEXT

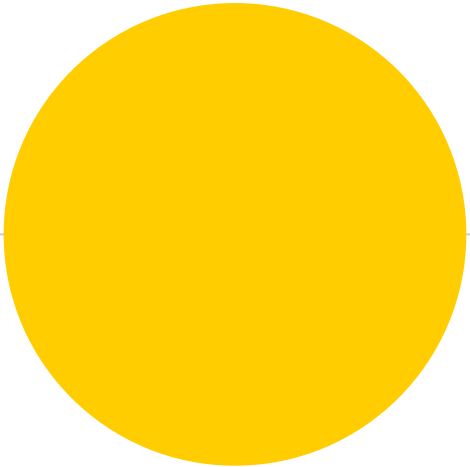
NUMBER OF INFORMATION CARRYING VARIABLES SHOULD NOT EXCEED NUMBER OF DIMENSIONS IN DATA



Maximize Data-Ink

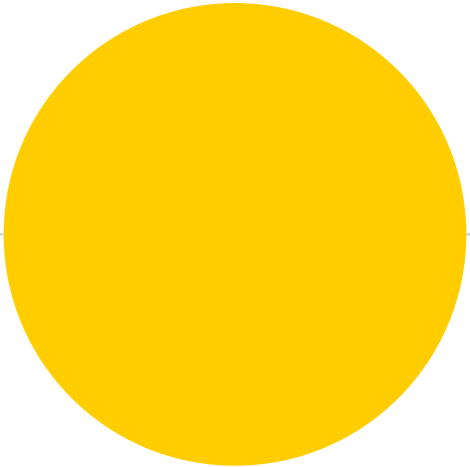
DATA-INK RATIO: DATA INK / TOTAL INK IN GRAPHIC


max
75%
50%
25%
min
Tukey
Tufte #1
Tufte #2



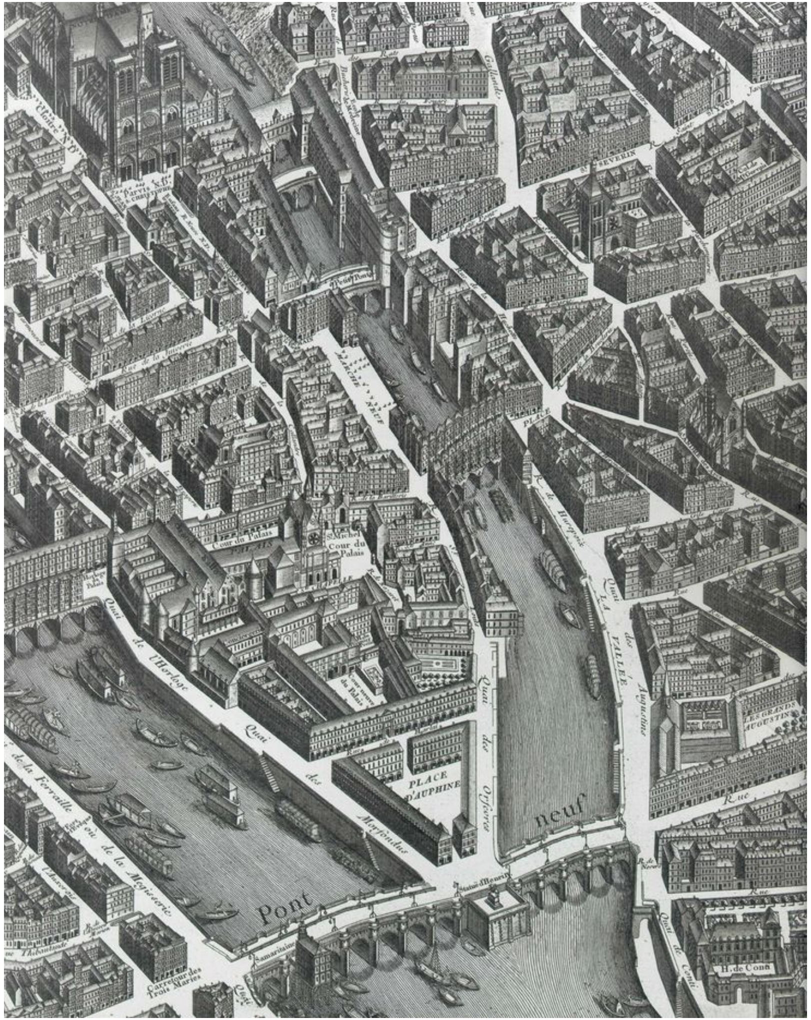
Forgo Chartjunk

CHARTJUNK: OVER-BUSY GRID LINES AND EXCESS TRICKS;
REDUNDANT REPRESENTATION OF SIMPLE DATA



Maximize Data Density

DATA DENSITY: NUMBER OF DATA POINTS / AREA OF DATA GRAPHIC


Pont
neuf
PLACE
D'AUPHINE
Quai de l'Horloge
Quai des Morfondus
Quai des Orfevres
Quai des Augustins
LA VALLÉE
Cour du Palais
St. Michel
Cour du Palais
MARCHÉ NEUF
PLACE
LES GRANDS AUGUSTINS
H. de Conti
Carrefour des Trois Maries
Quai de la Ferraille
Quai de la Megisserie
Samaritaine
Petit Pont
Parvis N. D.
Cloître N. D.
St. SEVERIN

Edward Tufte

DATA VISUALIZATION PIONEER