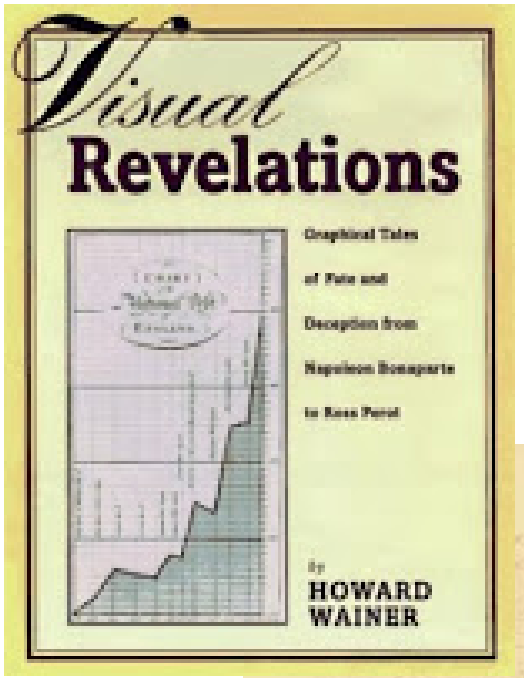
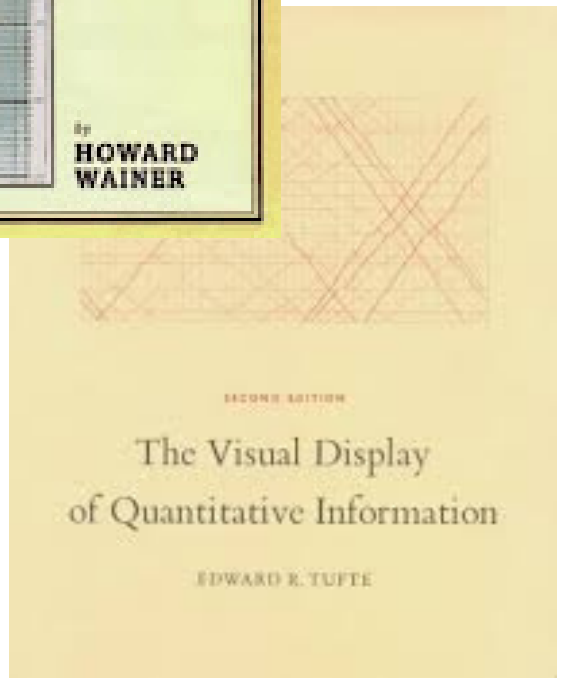
Graphical lies

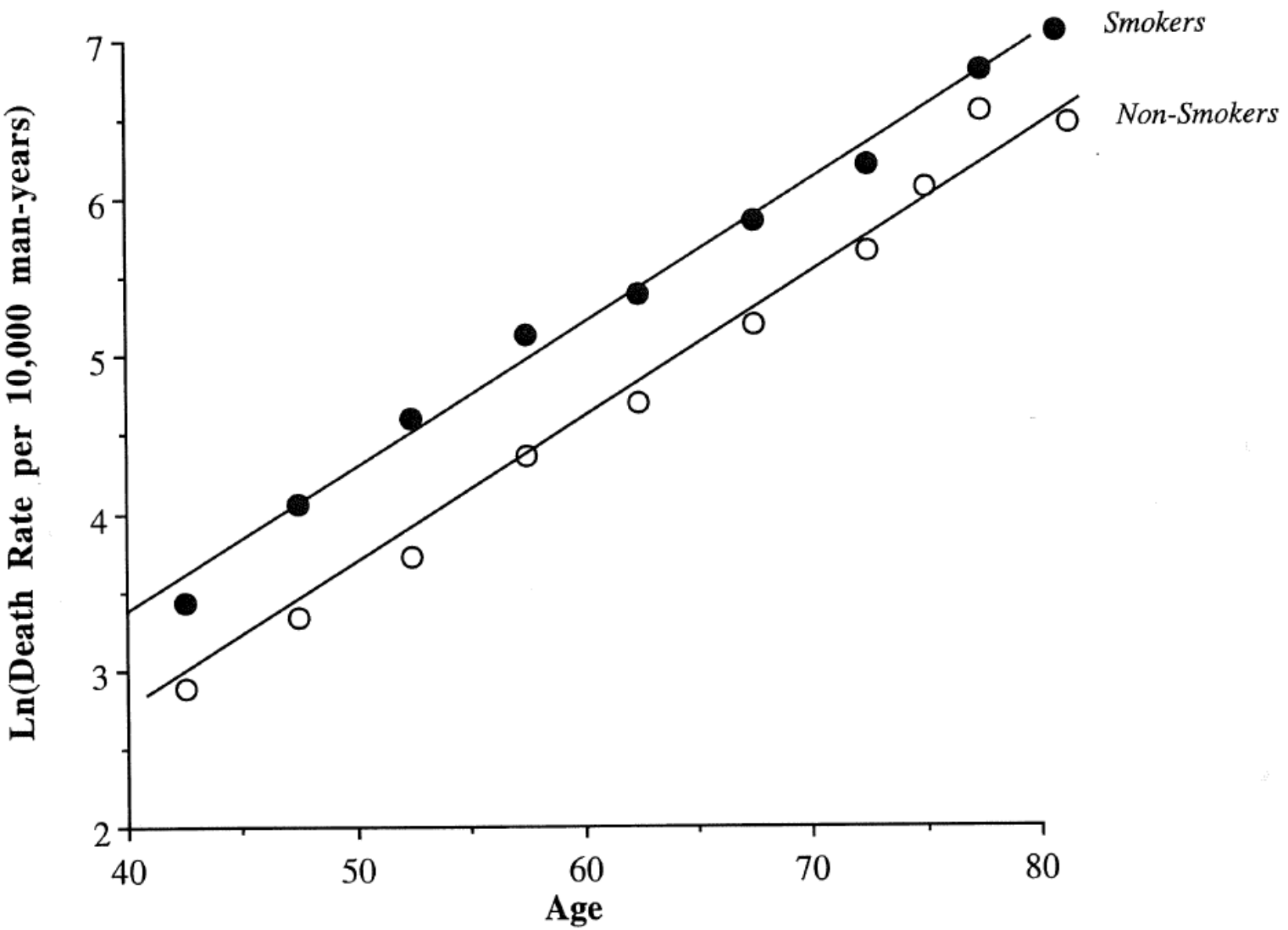


Howard Wainer

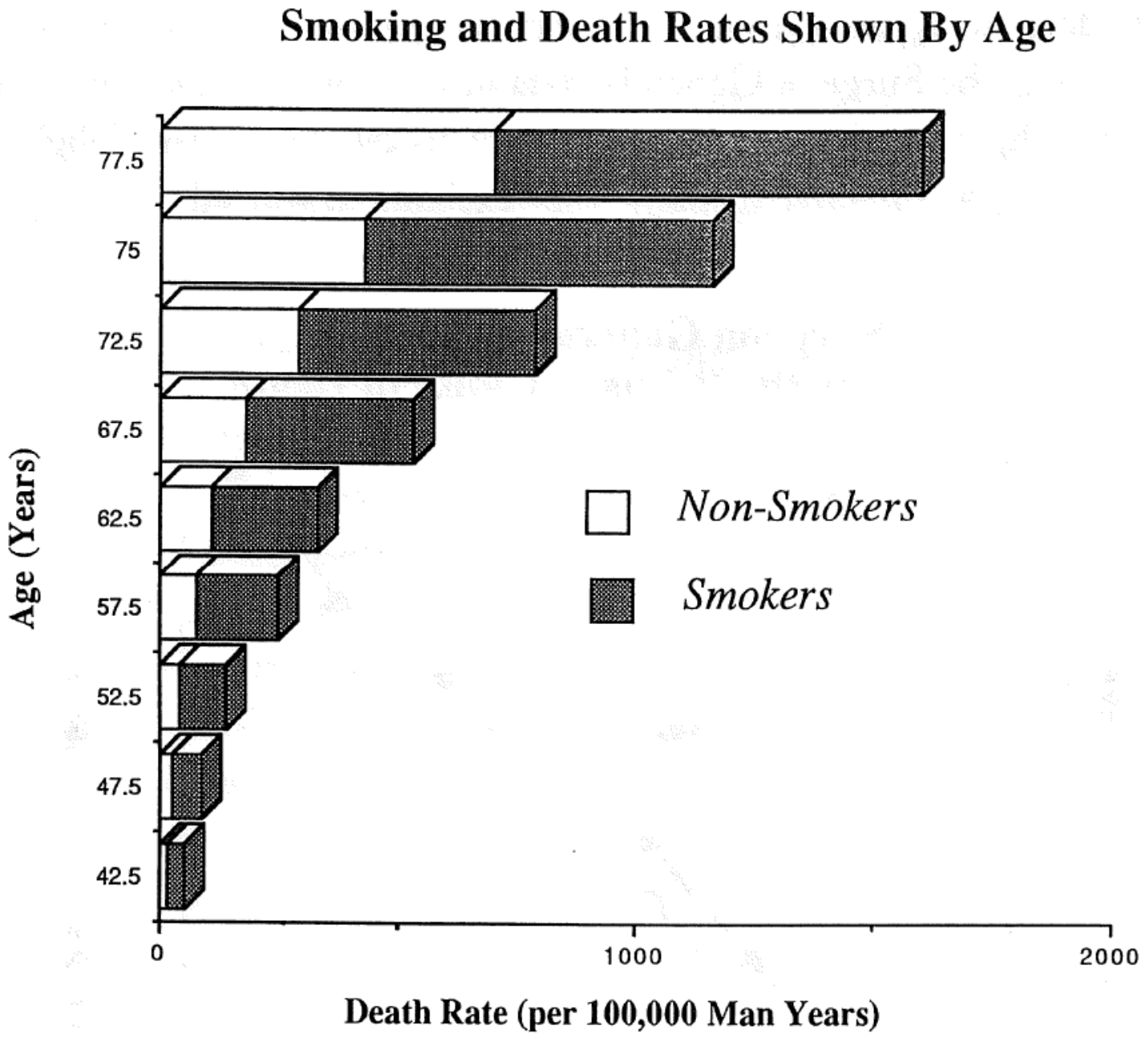


Edward Tufte

and others

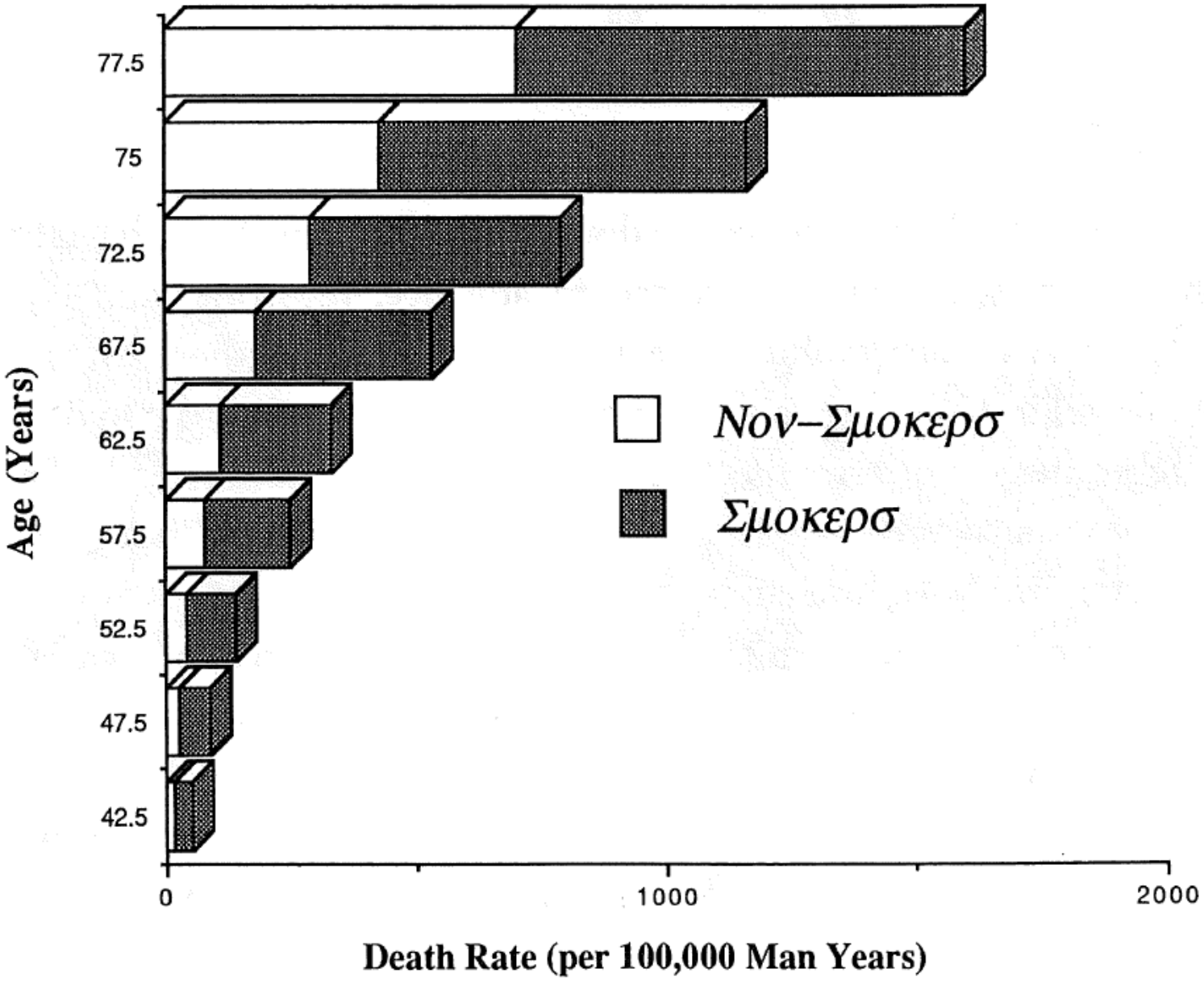


Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press.

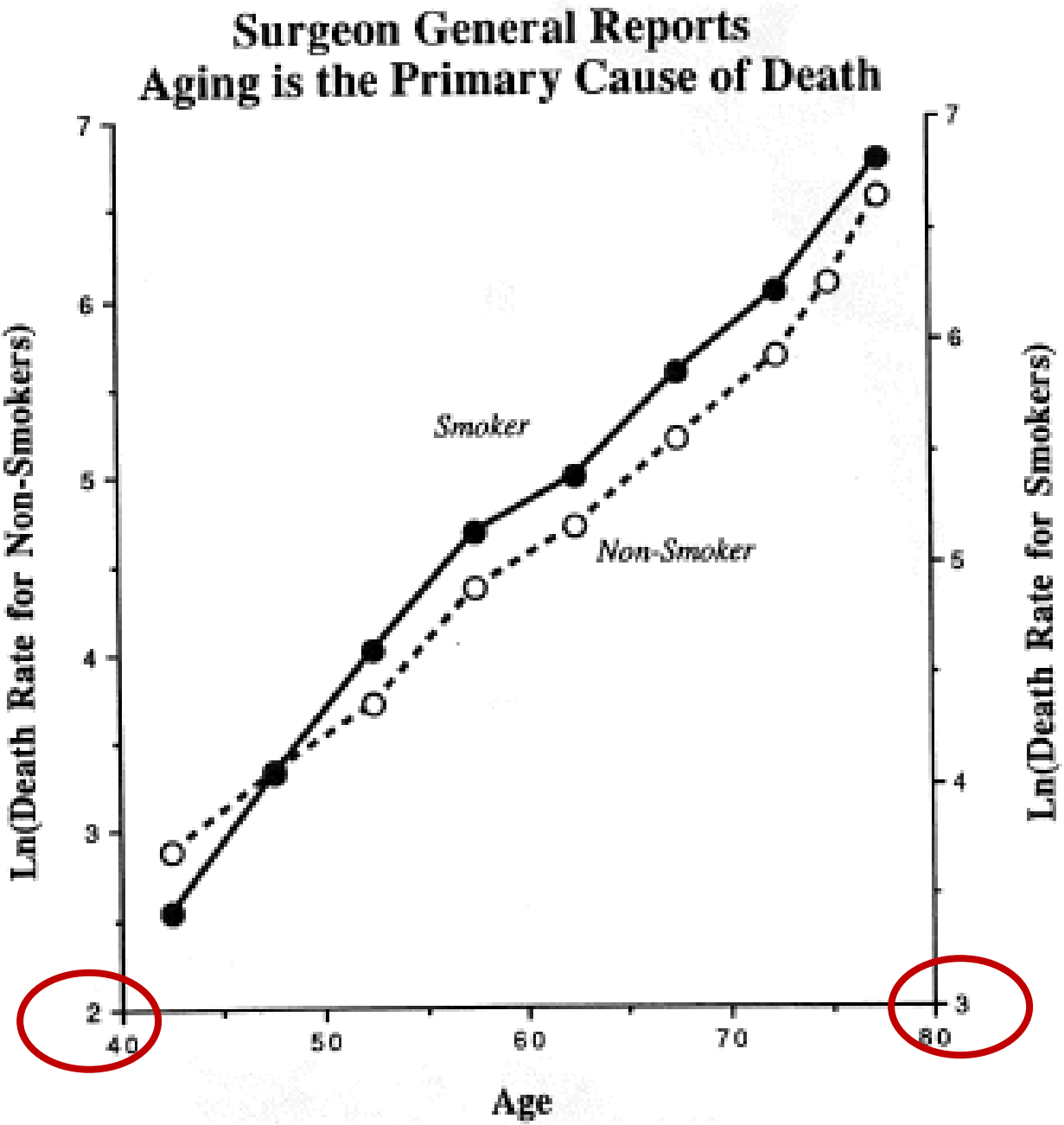


Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press.

Smoking and Death Rates Shown By Age



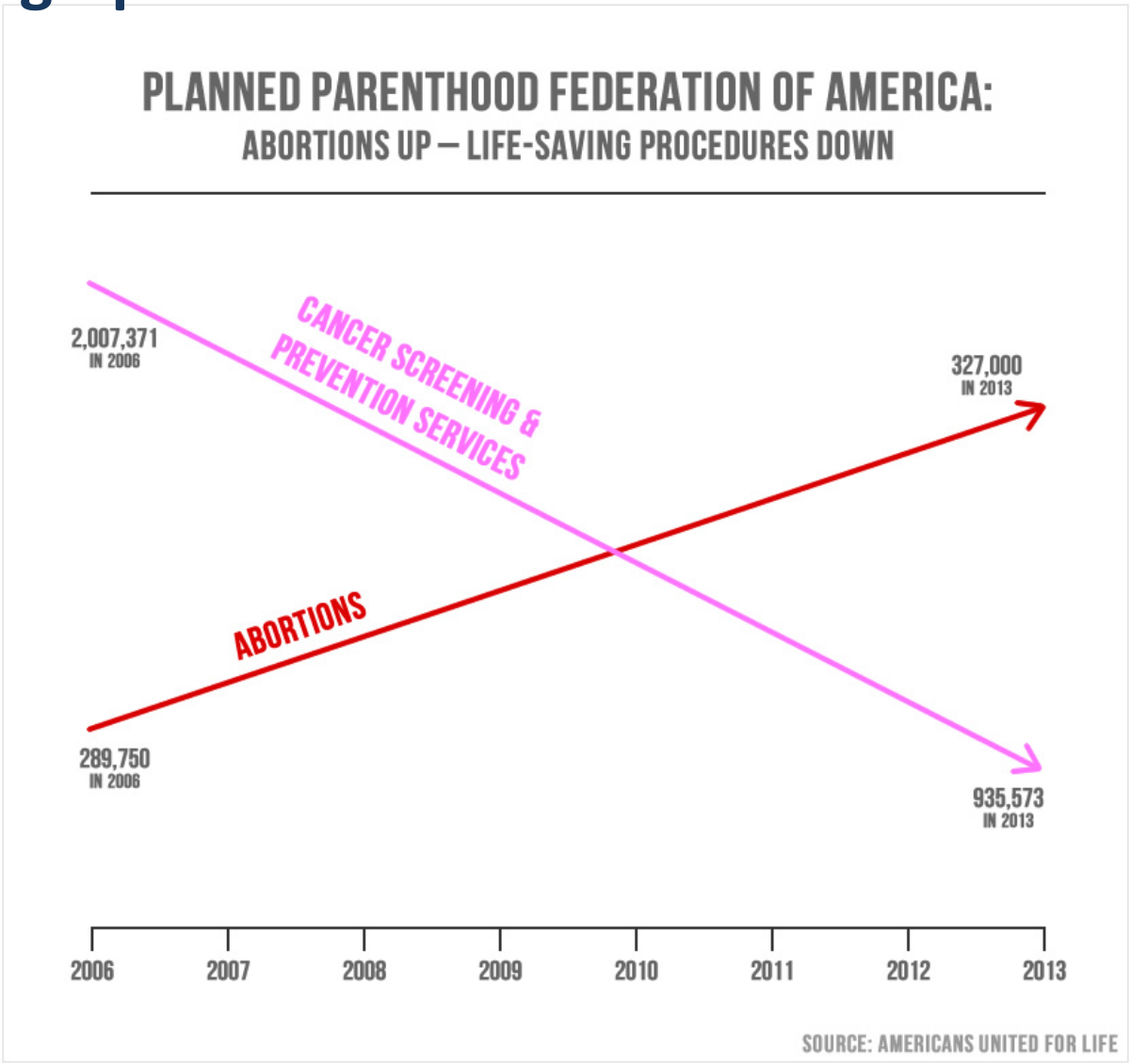
Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press.



Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press

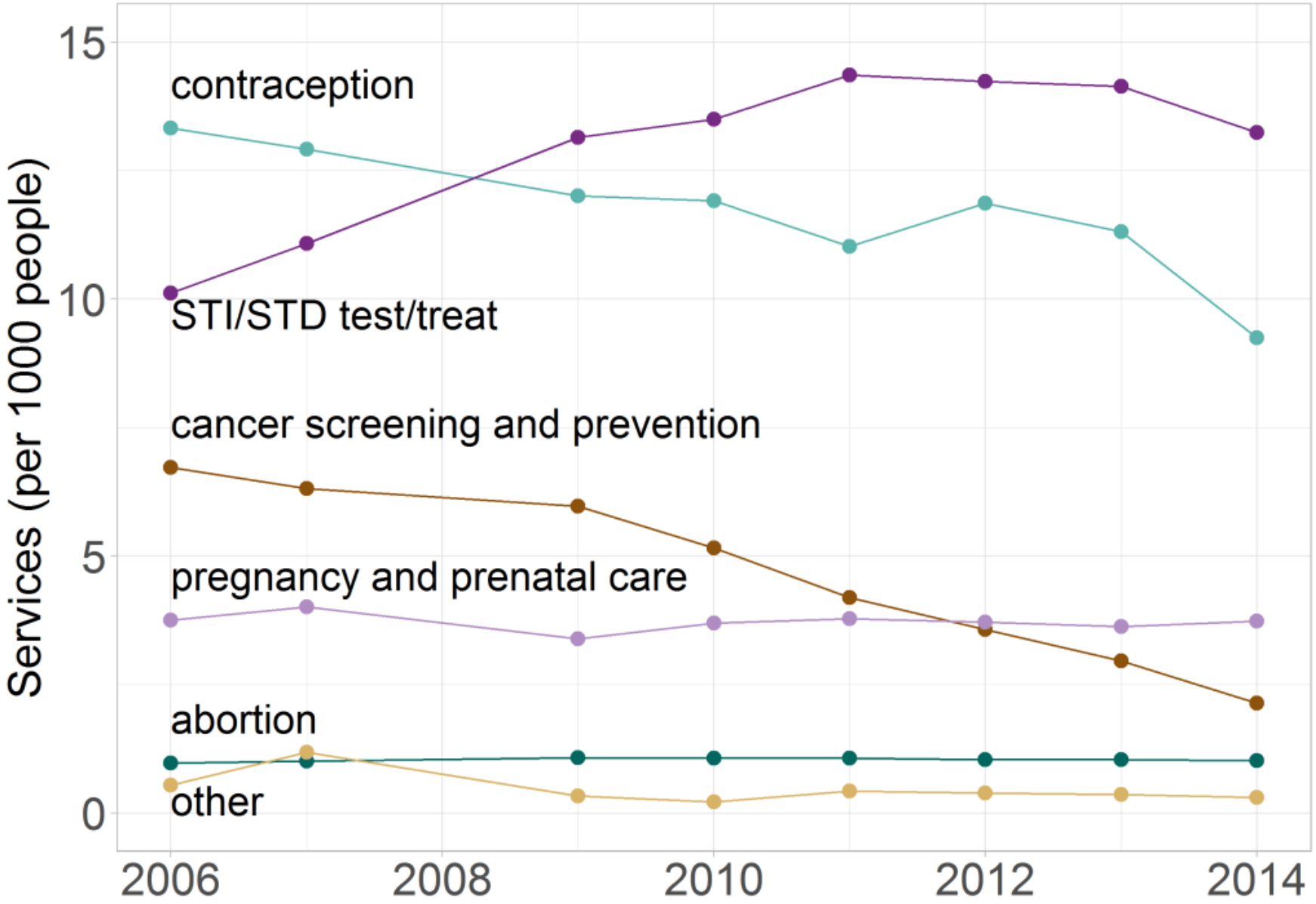
Sep. 29, 2015, Rep. Jason Chaffetz supported his assertion with this graph.

"In 2006, Planned Parenthood performed more prevention services and cancer screenings than abortions, but in 2013, there were more abortions."



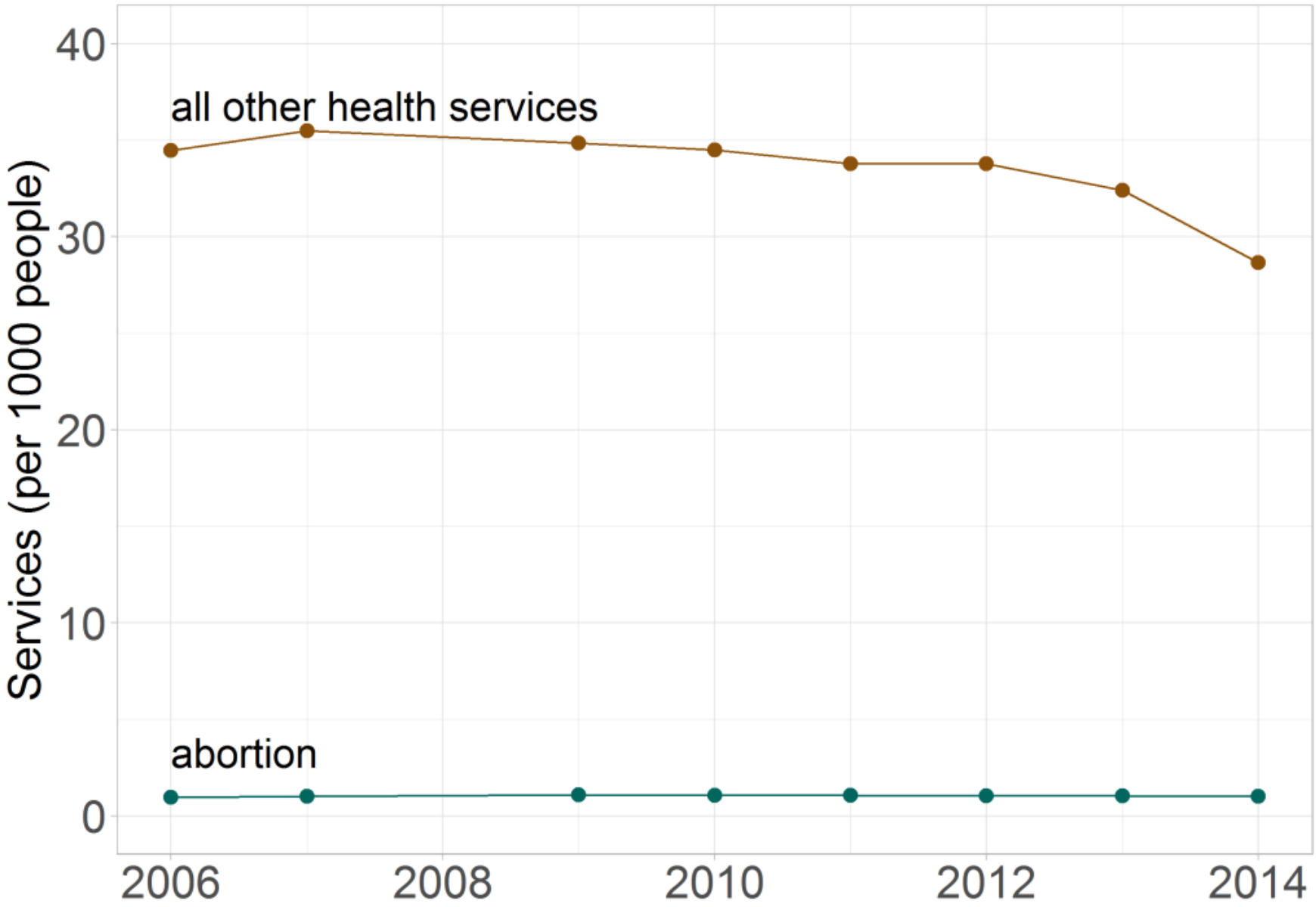
Linda Qui (2015-10-01) Chart shown at Planned Parenthood hearing is misleading and 'ethically wrong' www.politifact.com

All Planned Parenthood services, per capita

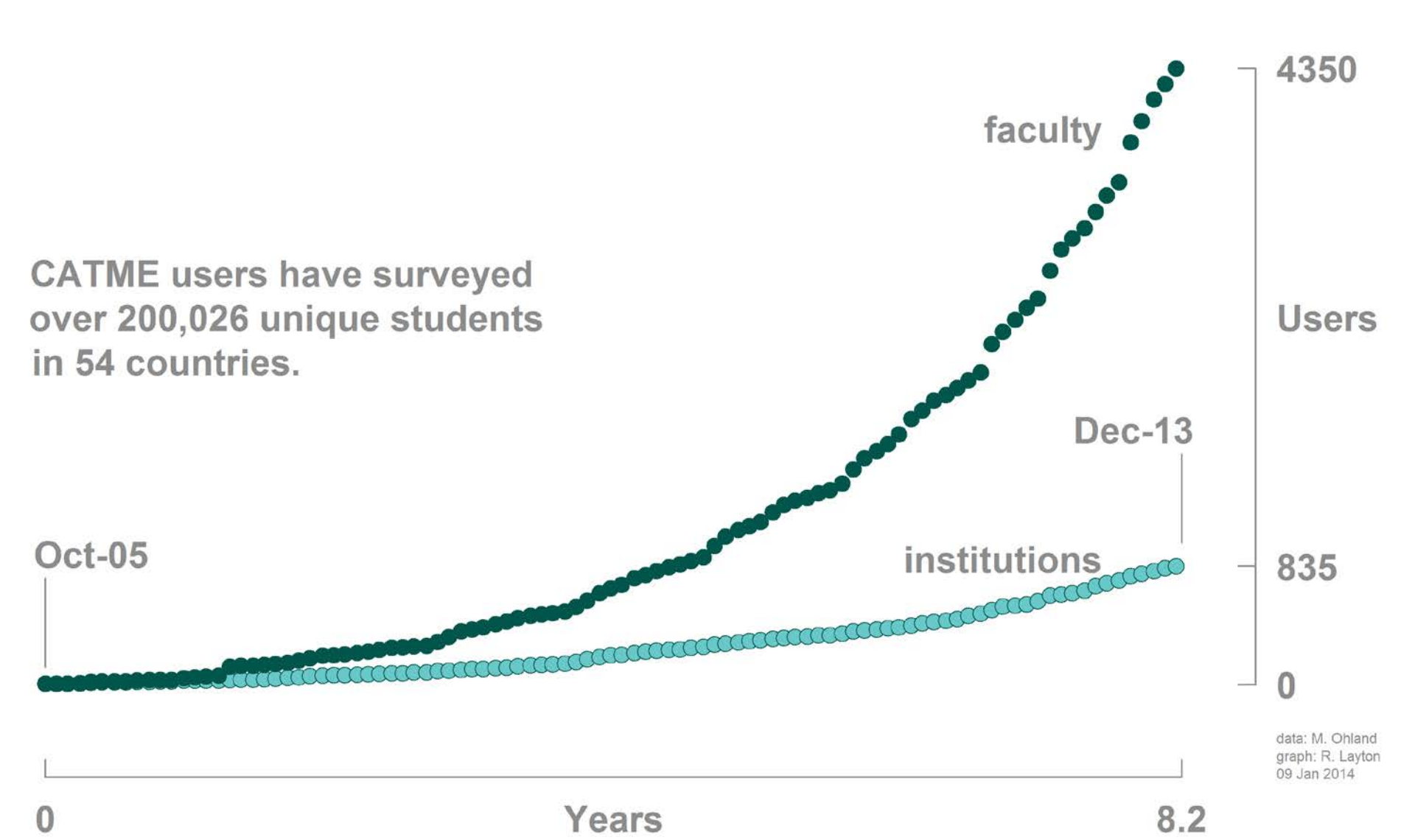


data source: Annual Reports, Planned Parenthood, 2006–2014

Abortion services compared to all other services



data source: Annual Reports, Planned Parenthood, 2006–2014

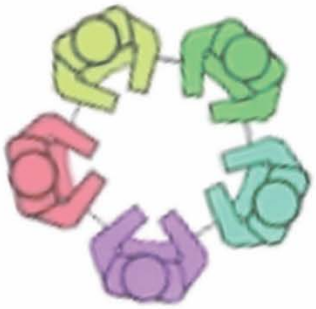


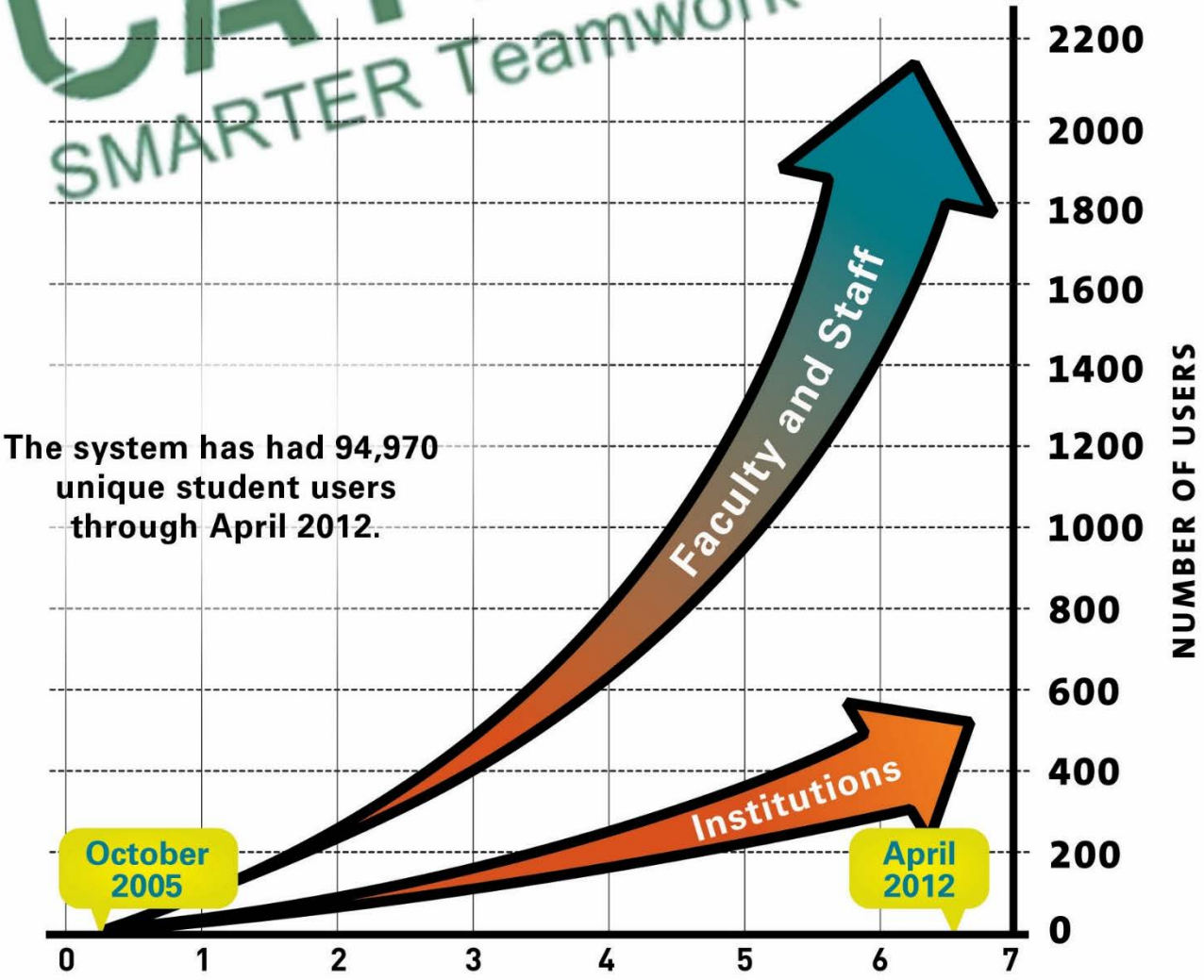
CATME
SMARTER Teamwork

data source: www.catme.org

CATME

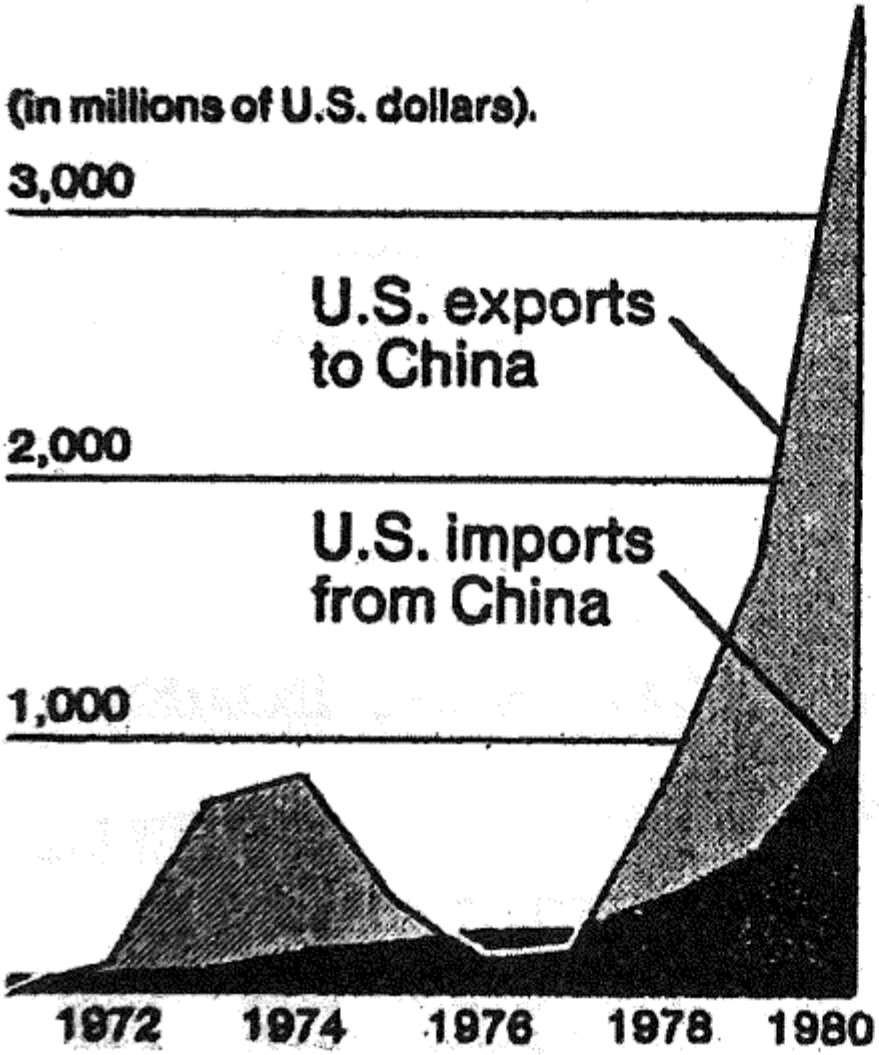
SMARTER Teamwork

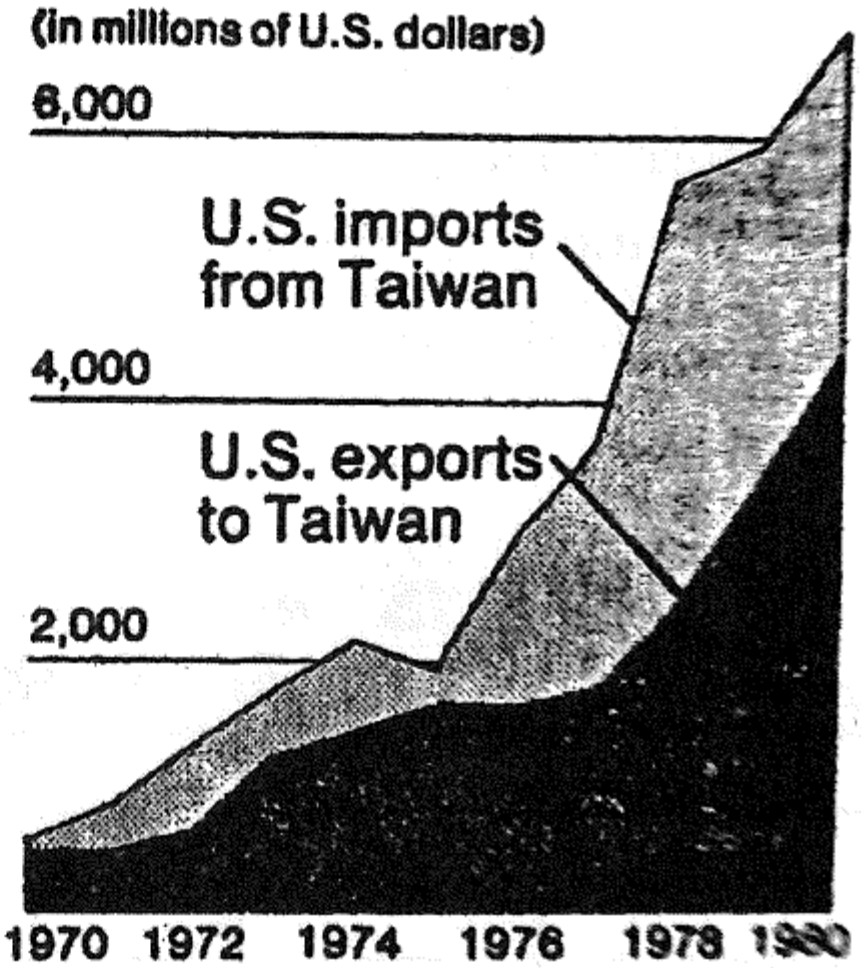




https://engineering.purdue.edu/ENE/Research/ResearchReport

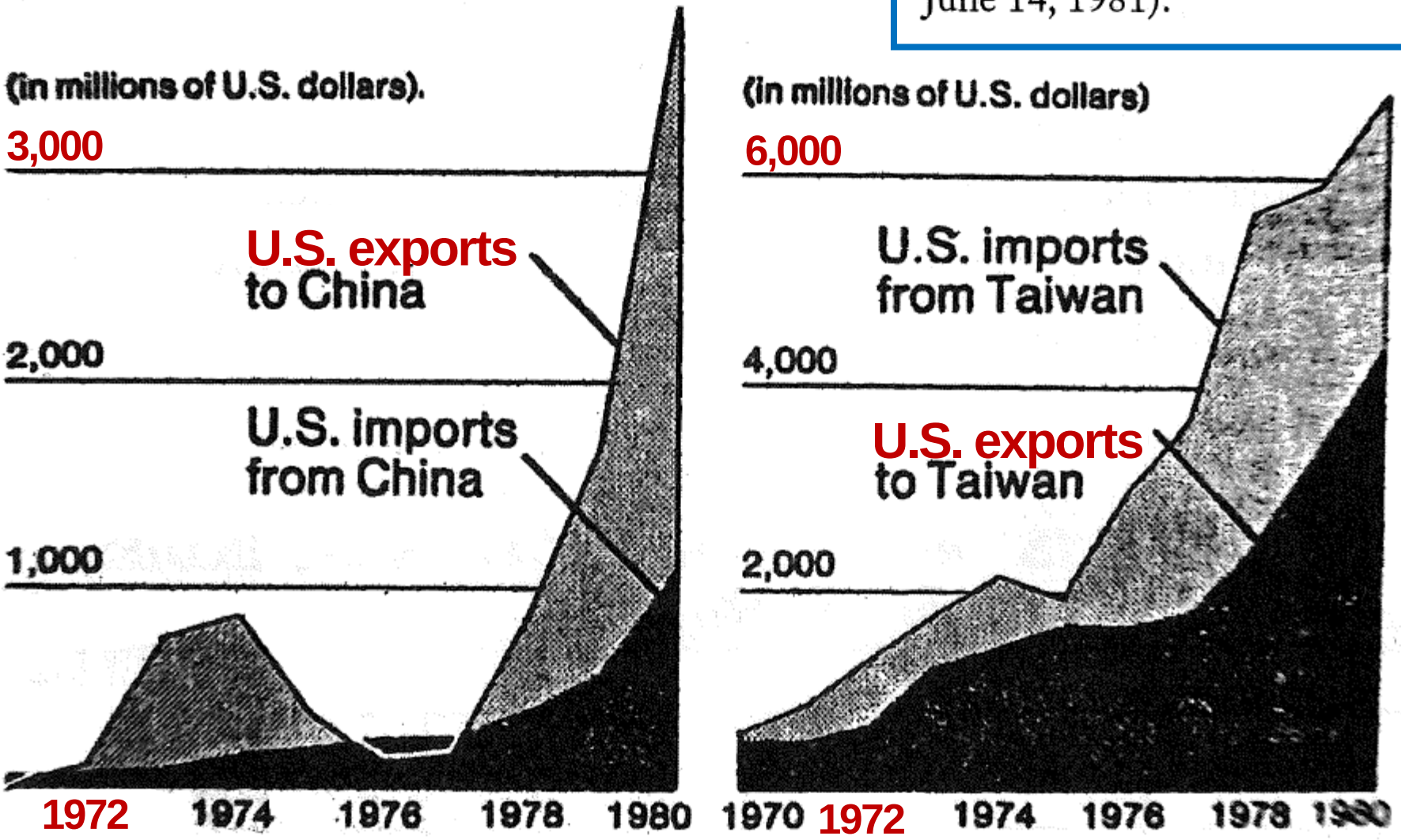
U.S. trade with China and Taiwan



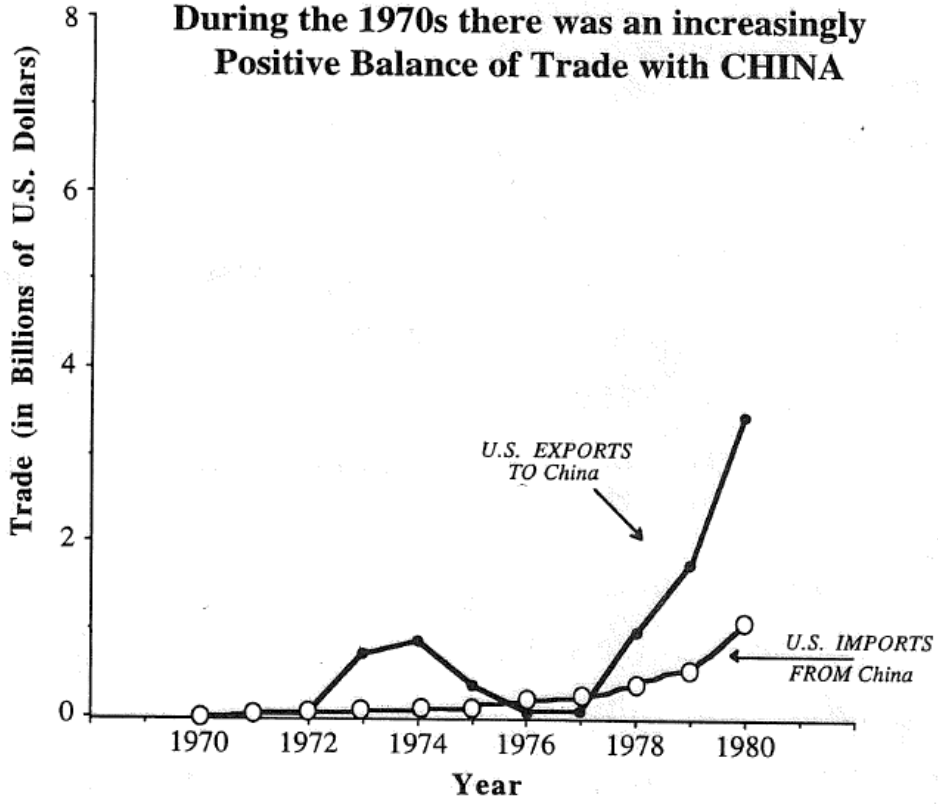


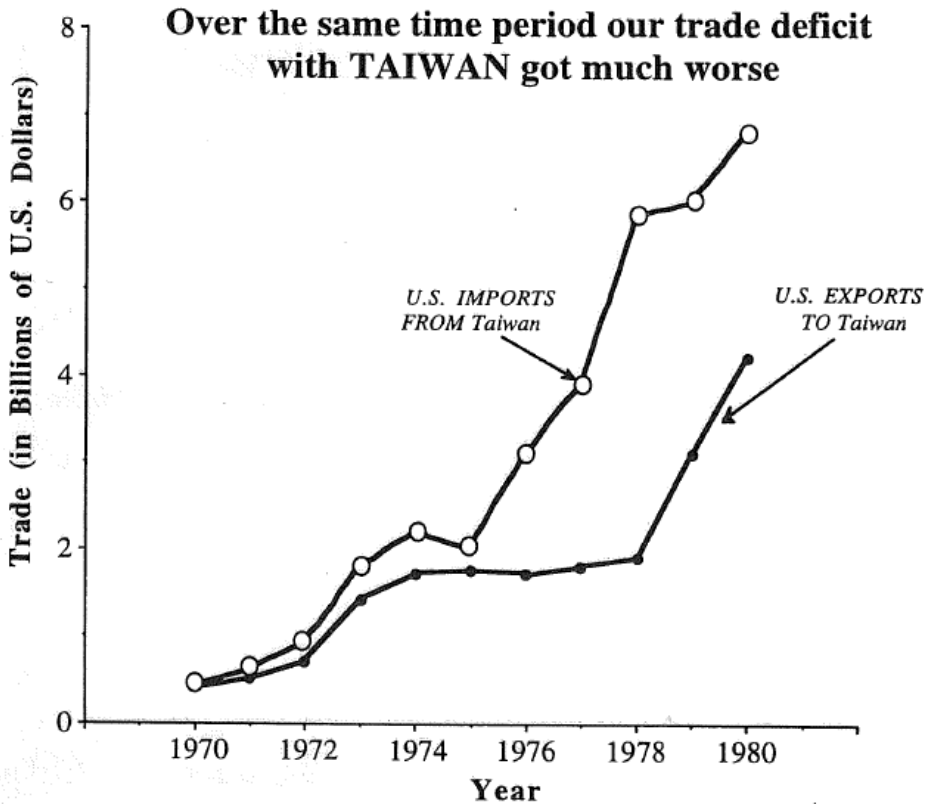
Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press

FIGURE 14. Reversing the metaphor in mid-graph while changing scales on both axes (from the *New York Times*, June 14, 1981).

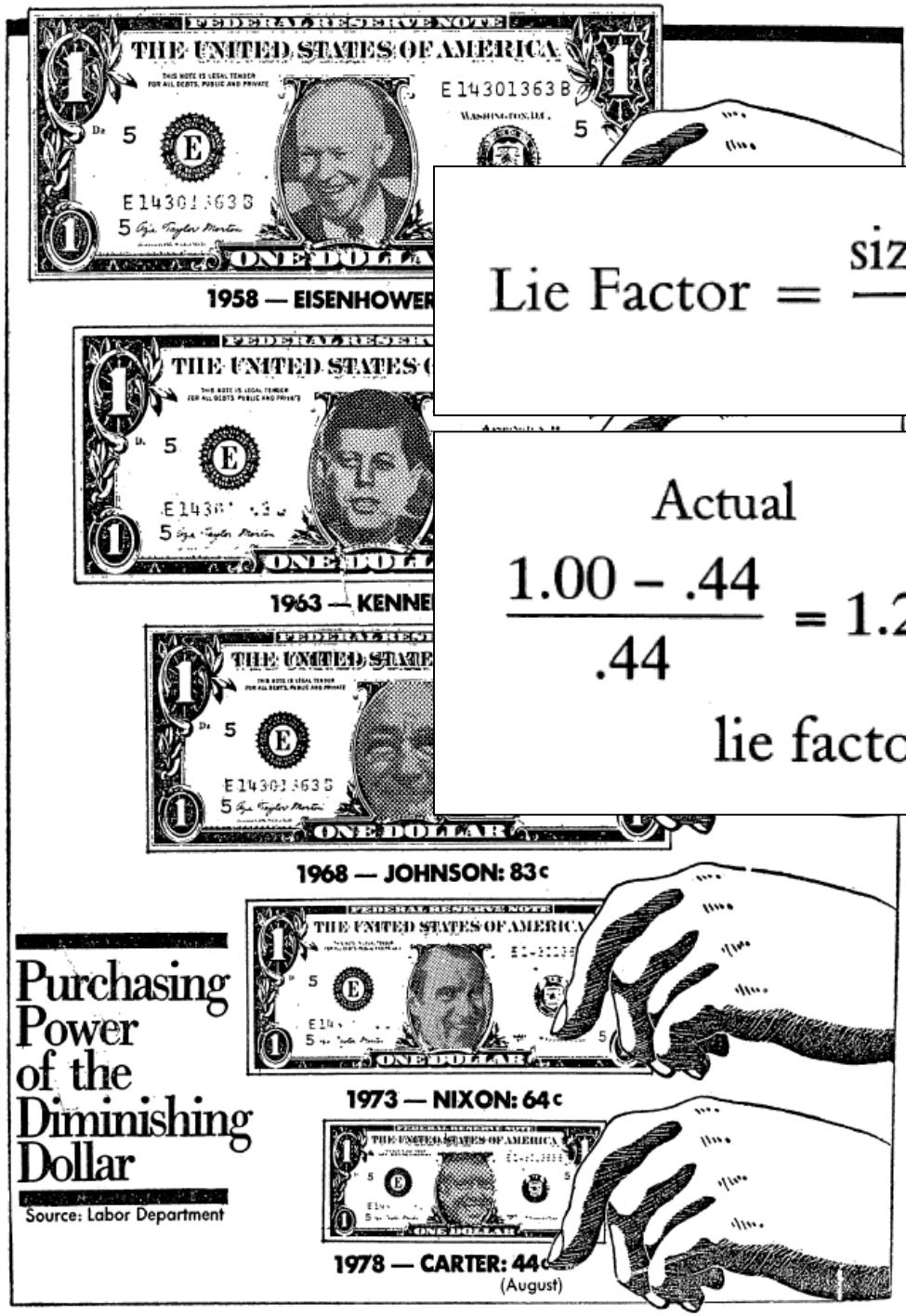


Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press





Wainer, Howard (2000) *Visual Revelations*. Mahwah, NJ: Psychology Press

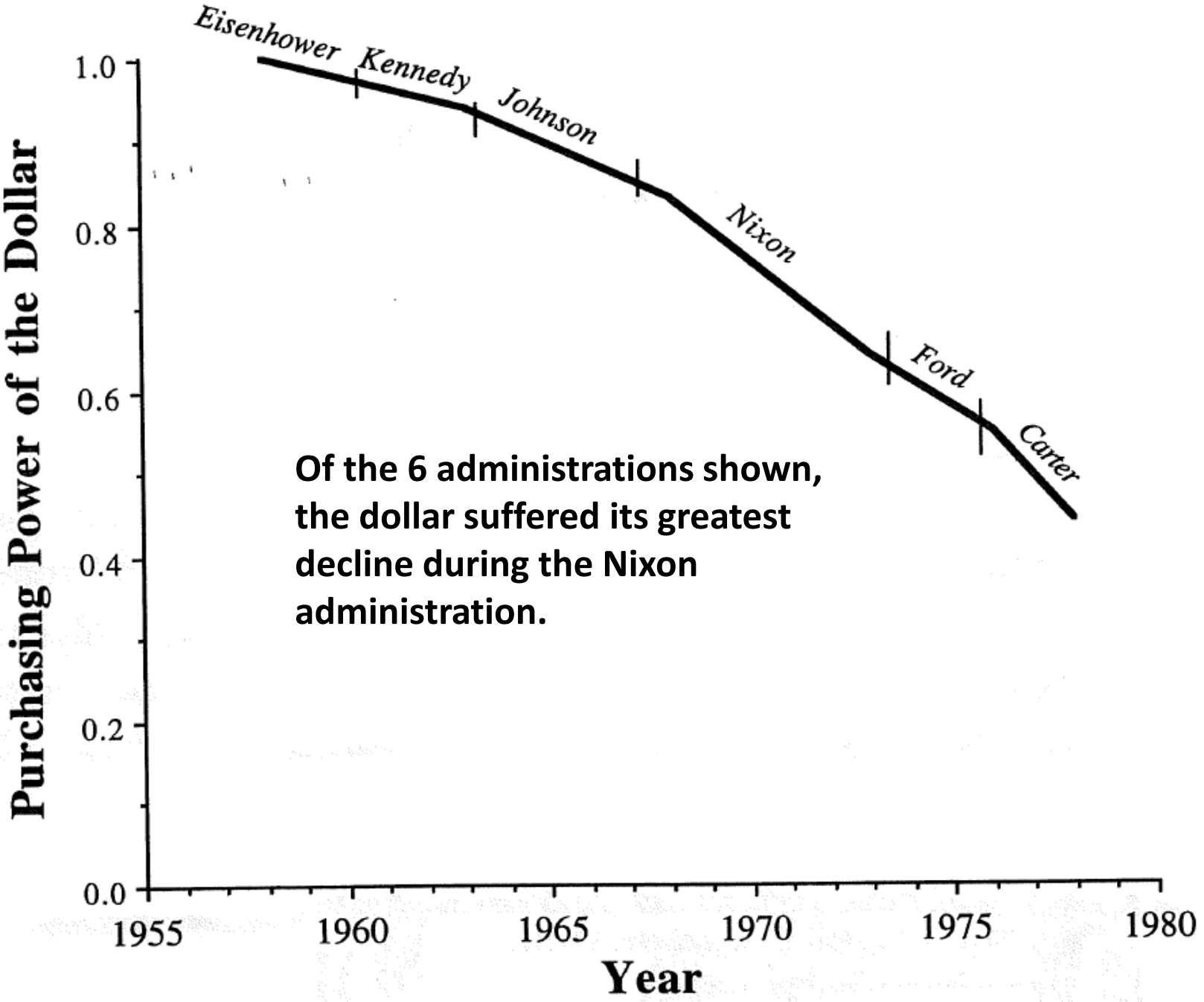


$$\text{Lie Factor} = \frac{\text{size of effect shown in graphic}}{\text{size of effect in data}}$$

$$\frac{\text{Actual}}{\frac{1.00 - .44}{.44} = 1.27} \qquad \frac{\text{Measured}}{\frac{22.00 - 2.06}{2.06} = 9.68}$$

$$\text{lie factor} = 9.68/1.27 = 7.62.$$

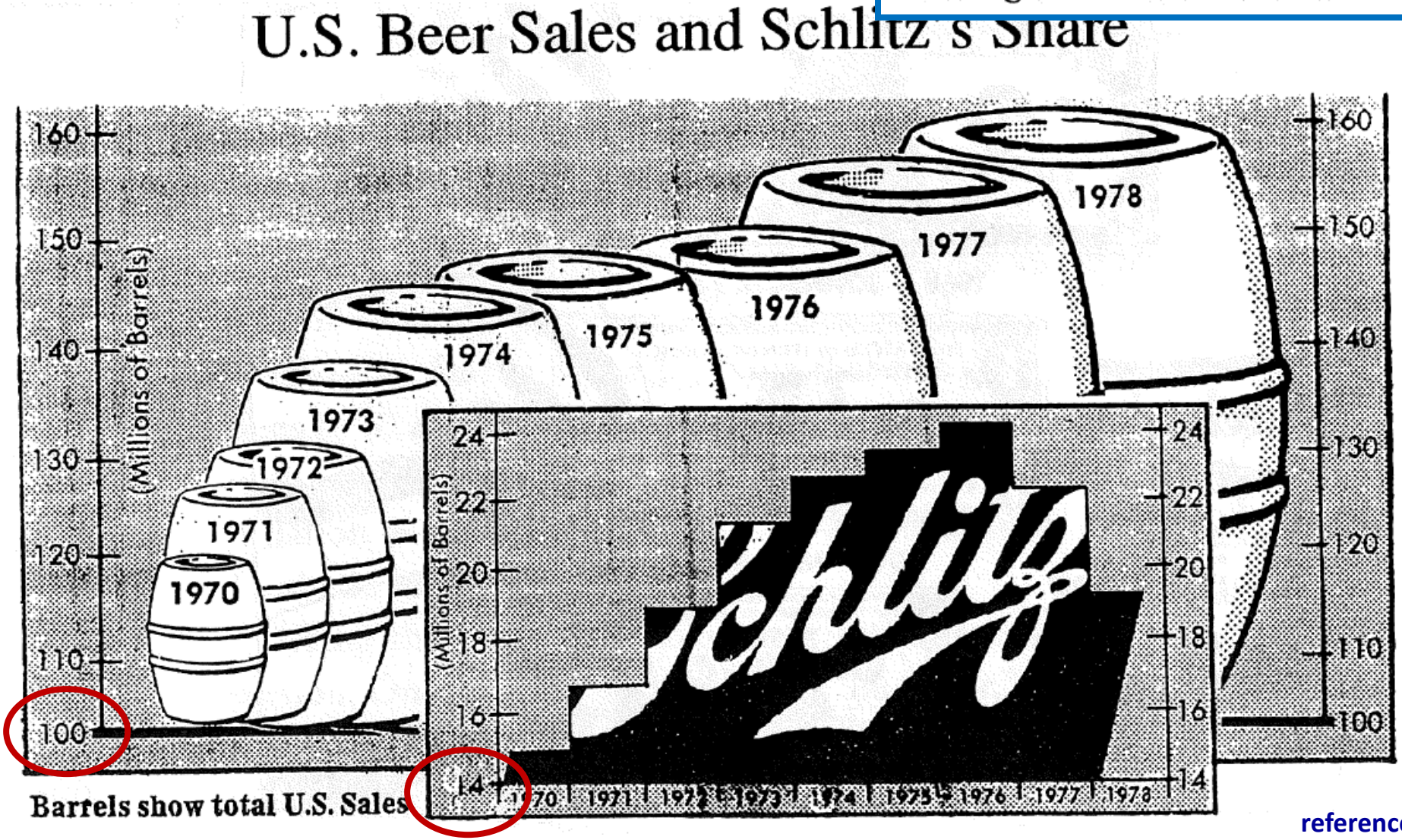
reference



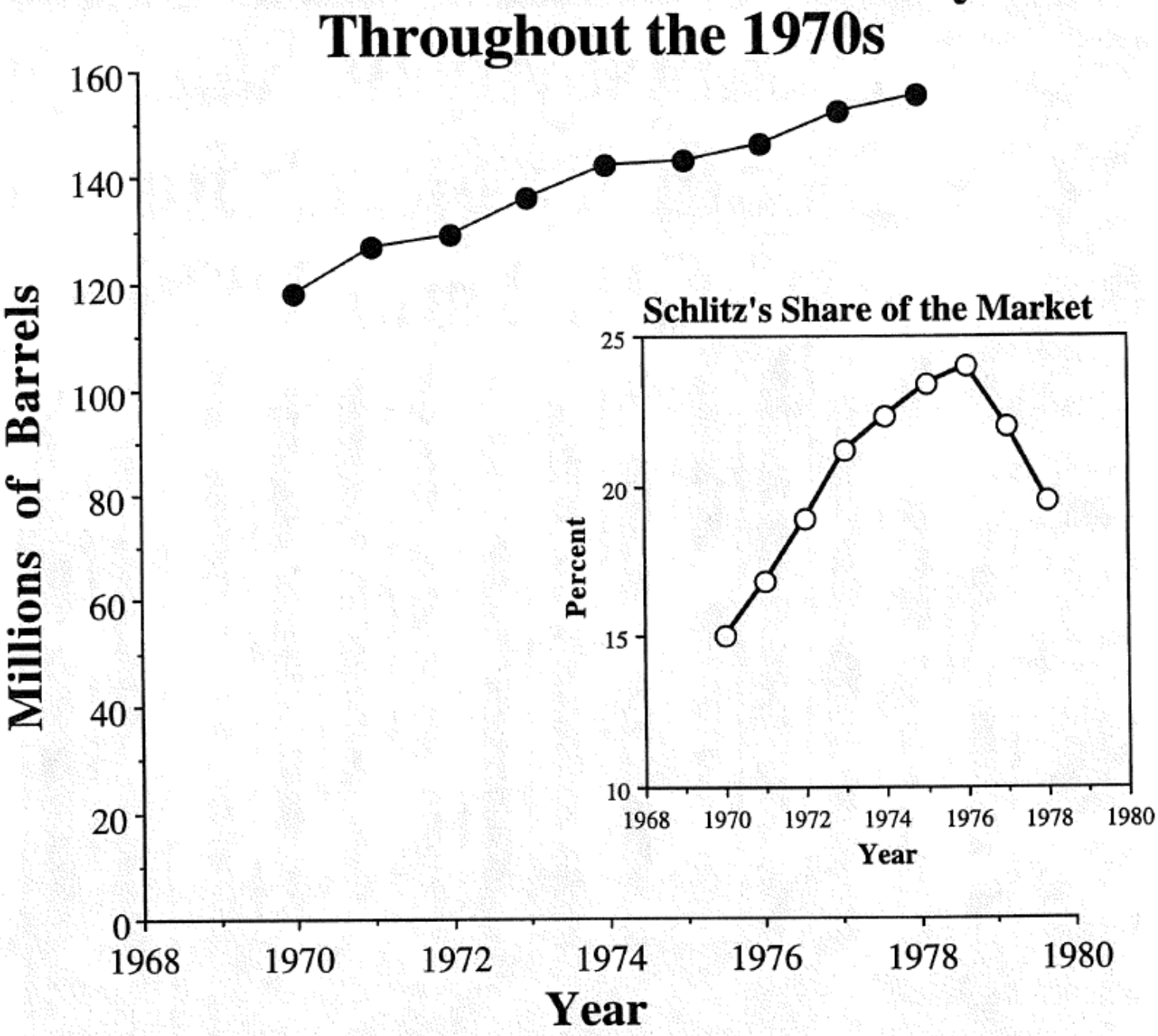
Of the 6 administrations shown, the dollar suffered its greatest decline during the Nixon administration.

reference

FIGURE 19. Cubing the visual effect and choosing the origin to yield a near record lie factor of over 131,000% (from the *Washington Post*).

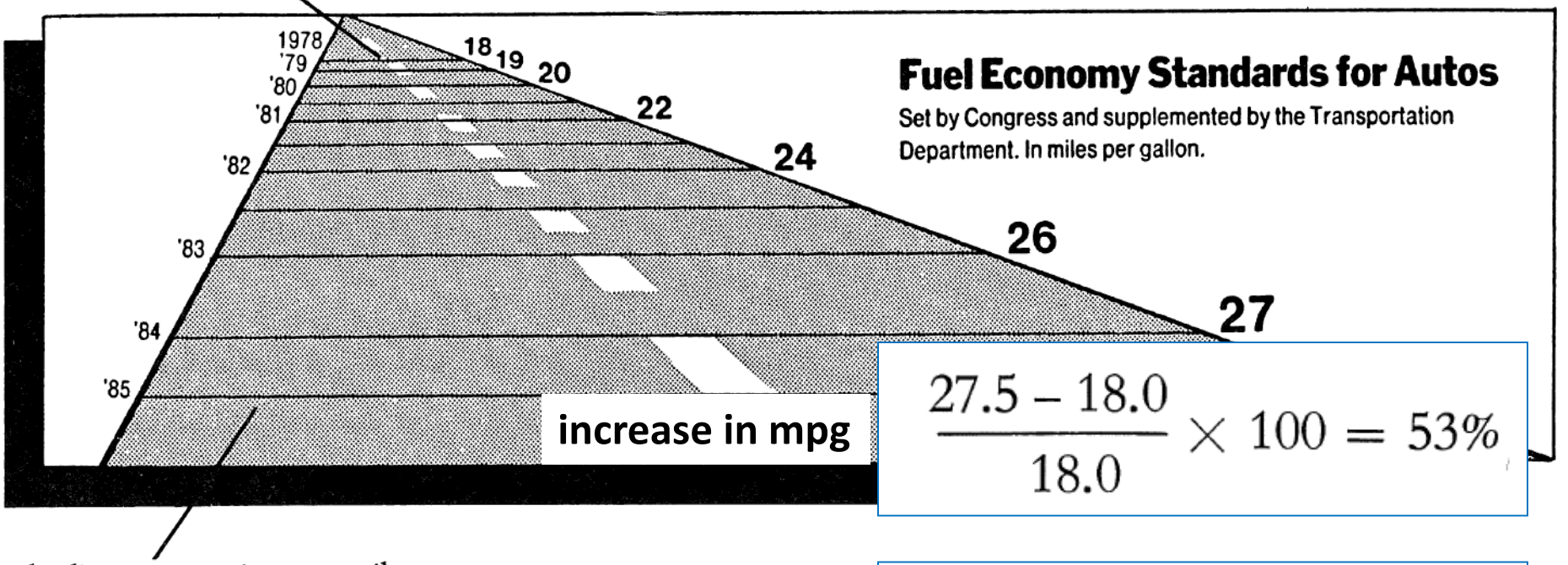


reference


U.S Beer Sales Grew Steadily Throughout the 1970s
Millions of Barrels
160
140
120
100
80
60
40
20
0
1968
1970
1972
1974
1976
1978
1980
Year
Schlitz's Share of the Market
Percent
25
20
15
10
1968
1970
1972
1974
1976
1978
1980
Year

reference

This line, representing 18 miles per gallon in 1978, is 0.6 inches long.



This line, representing 27.5 miles per gallon in 1985, is 5.3 inches long.

increase in mpg

$$\frac{27.5 - 18.0}{18.0} \times 100 = 53\%$$

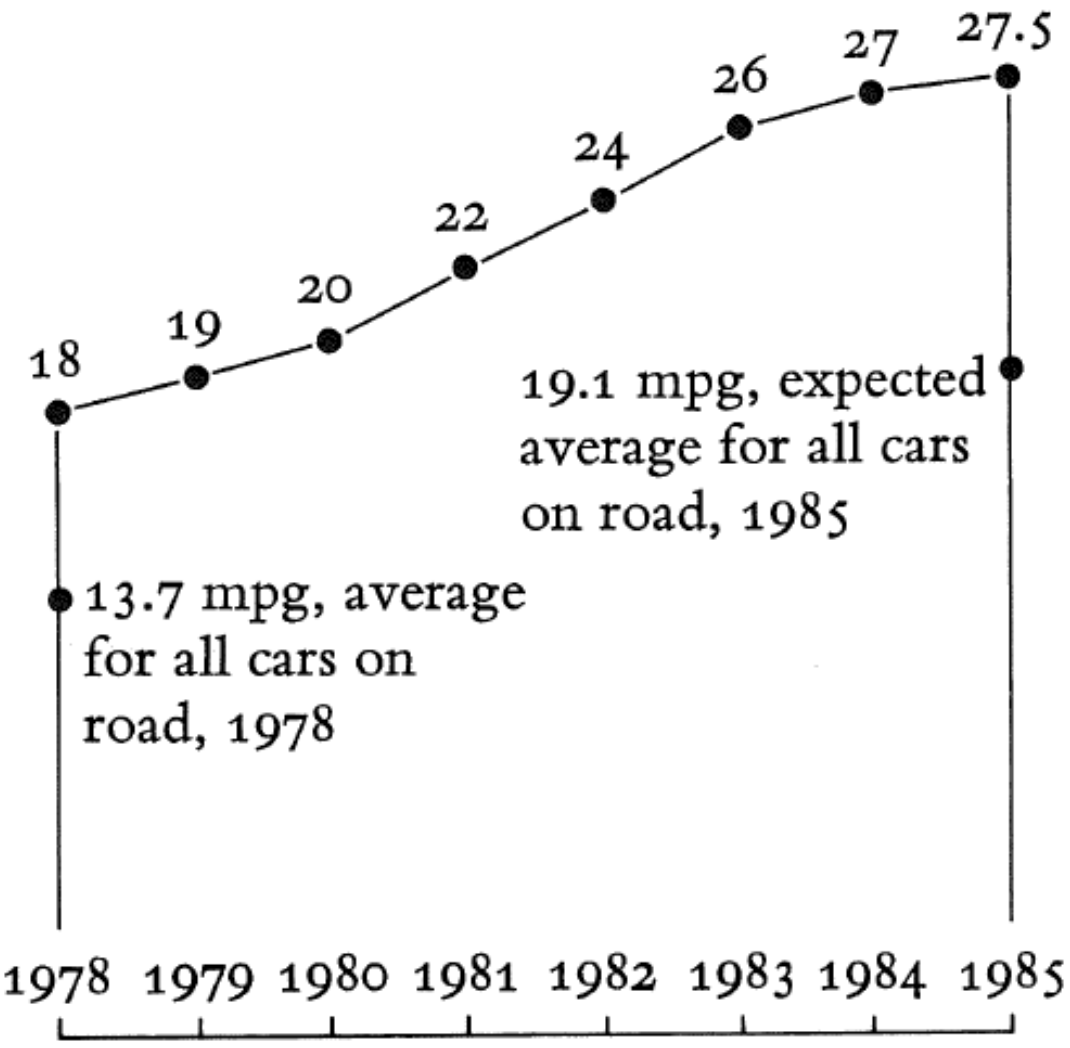
increase in graphical representation

$$\frac{5.3 - 0.6}{0.6} \times 100 = 783\%$$

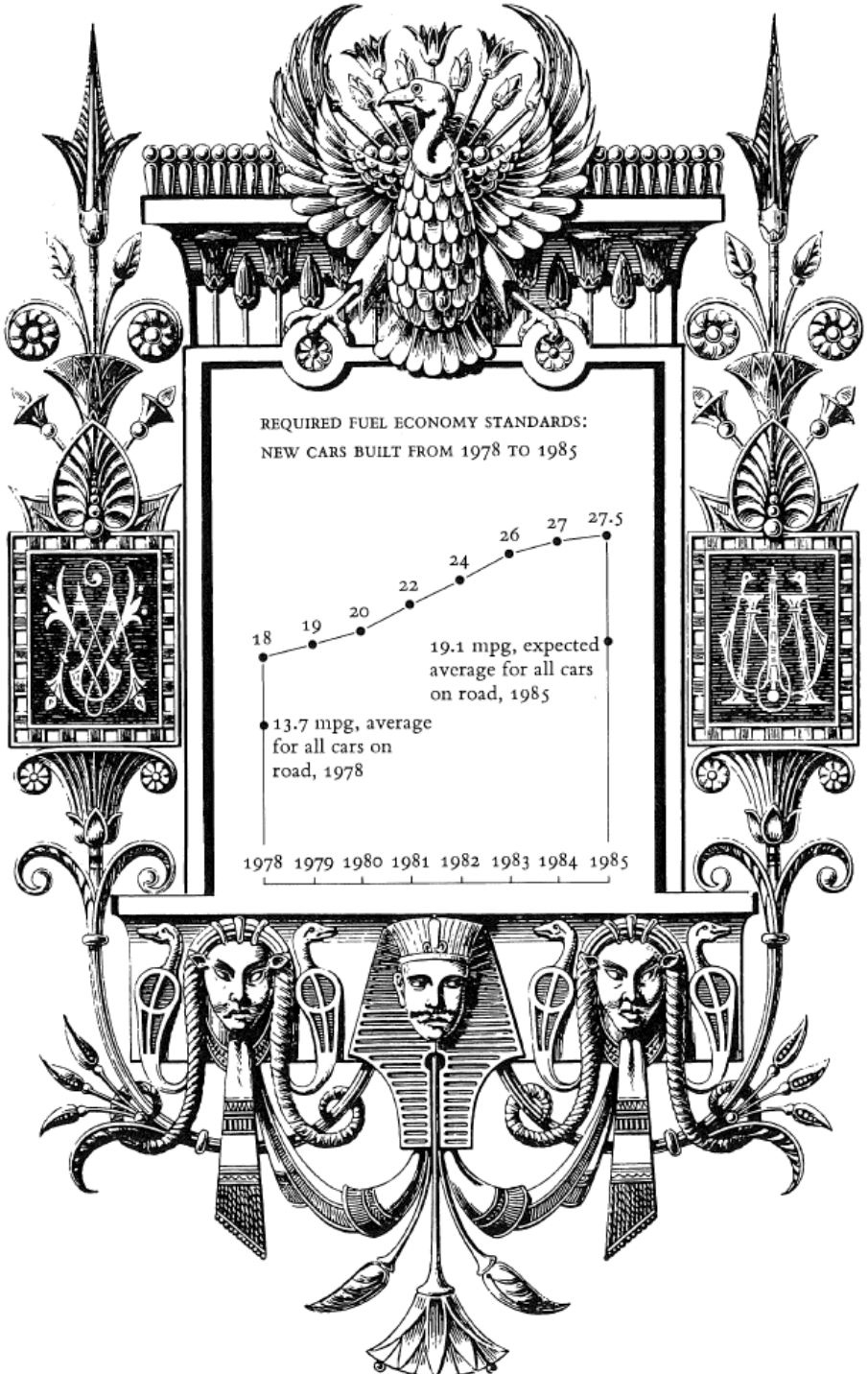
$$\text{Lie Factor} = \frac{783}{53} = 14.8$$

reference

REQUIRED FUEL ECONOMY STANDARDS:
NEW CARS BUILT FROM 1978 TO 1985

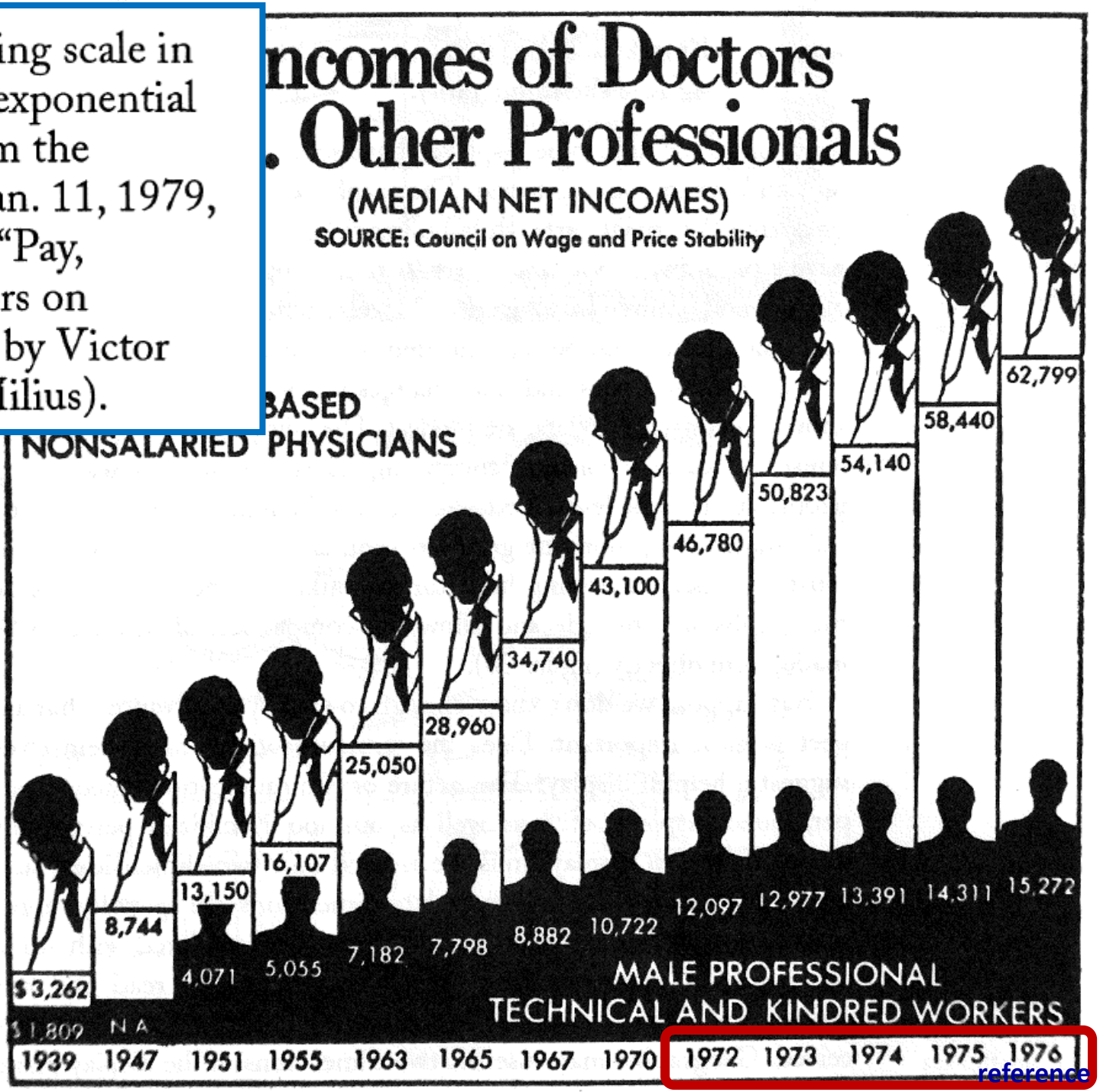


reference


REQUIRED FUEL ECONOMY STANDARDS:
NEW CARS BUILT FROM 1978 TO 1985
18
19
20
22
24
26
27
27.5
19.1 mpg, expected average for all cars on road, 1985
13.7 mpg, average for all cars on road, 1978
1978 1979 1980 1981 1982 1983 1984 1985

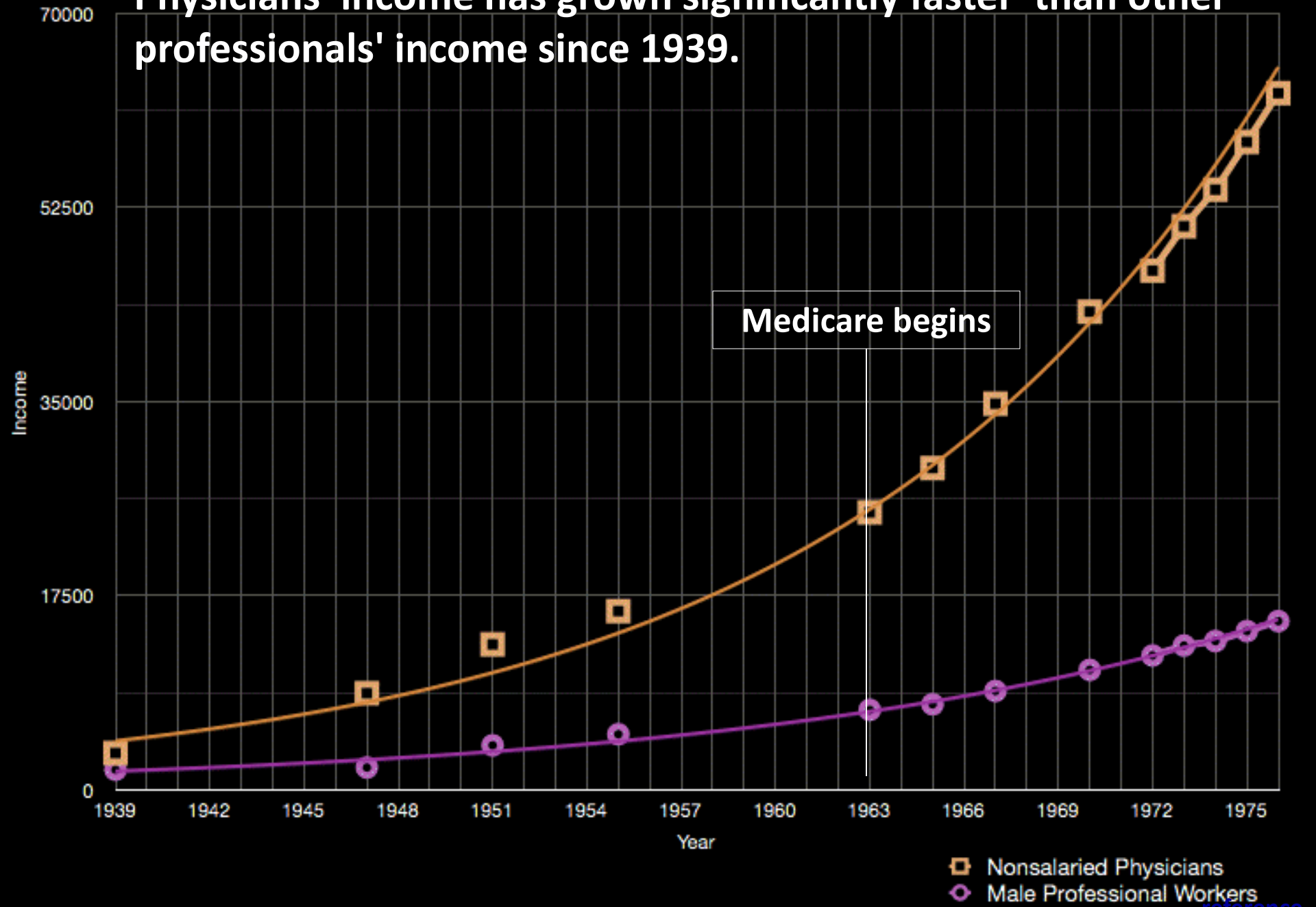
reference

FIGURE 25. Changing scale in mid-axis to make exponential growth linear (from the *Washington Post*, Jan. 11, 1979, in an article titled "Pay, Practices of Doctors on Examining Table" by Victor Cohn and Peter Milius).



reference

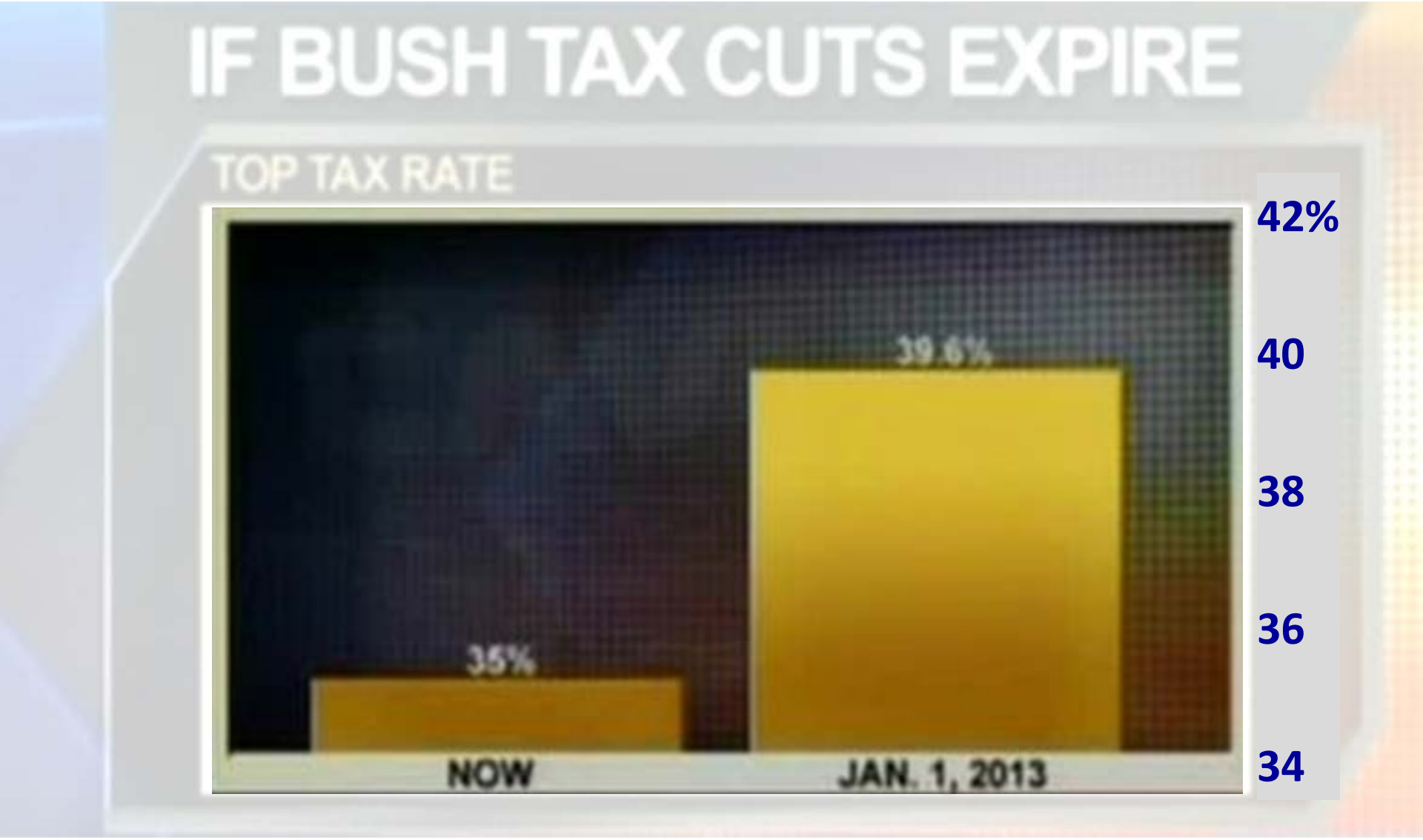
Physicians' income has grown significantly faster than other professionals' income since 1939.



reference

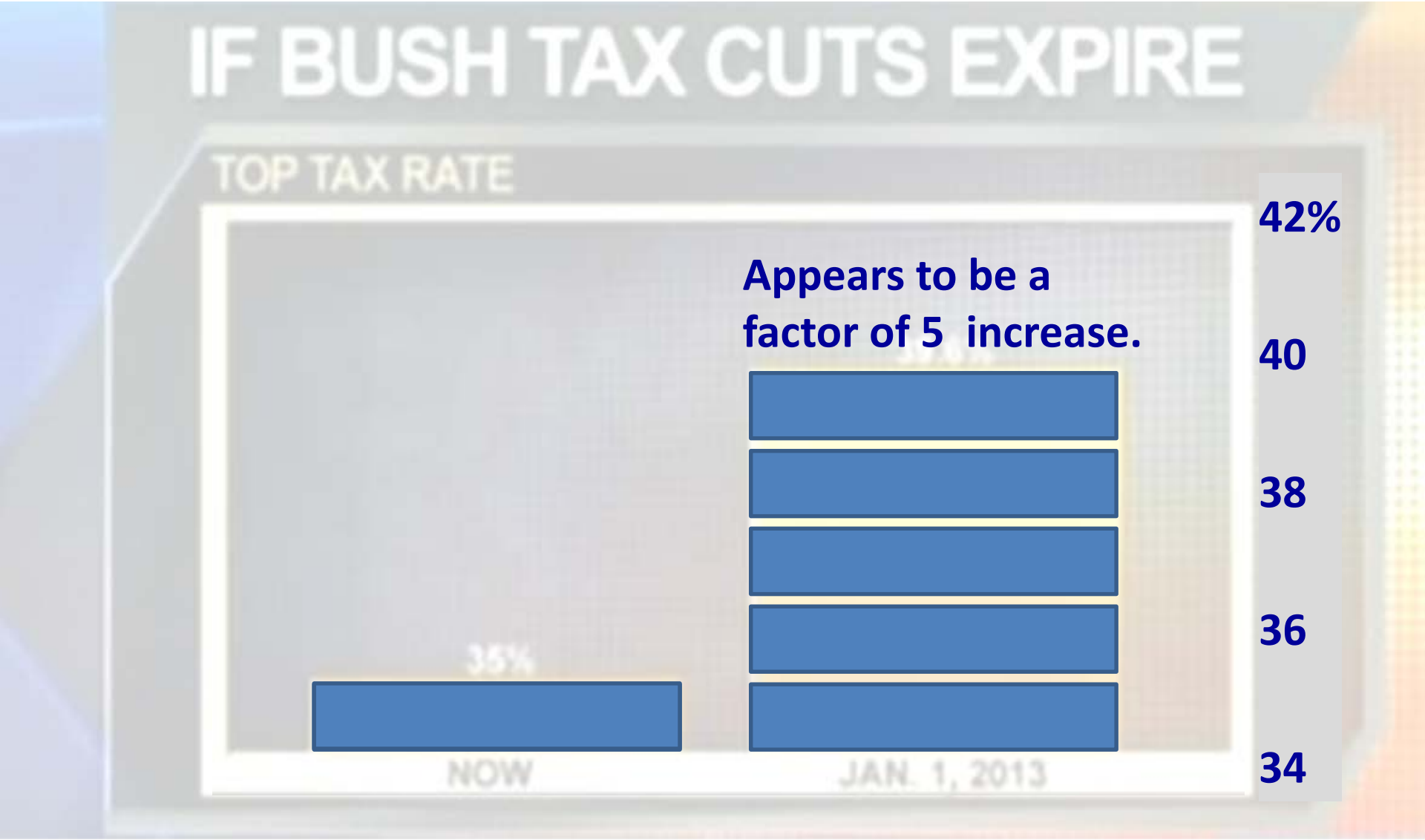
reference

Using bar graphs, stories are easily manipulated.



http://mediamatters.org/research/2012/10/01/a-history-of-dishonest-fox-charts/190225

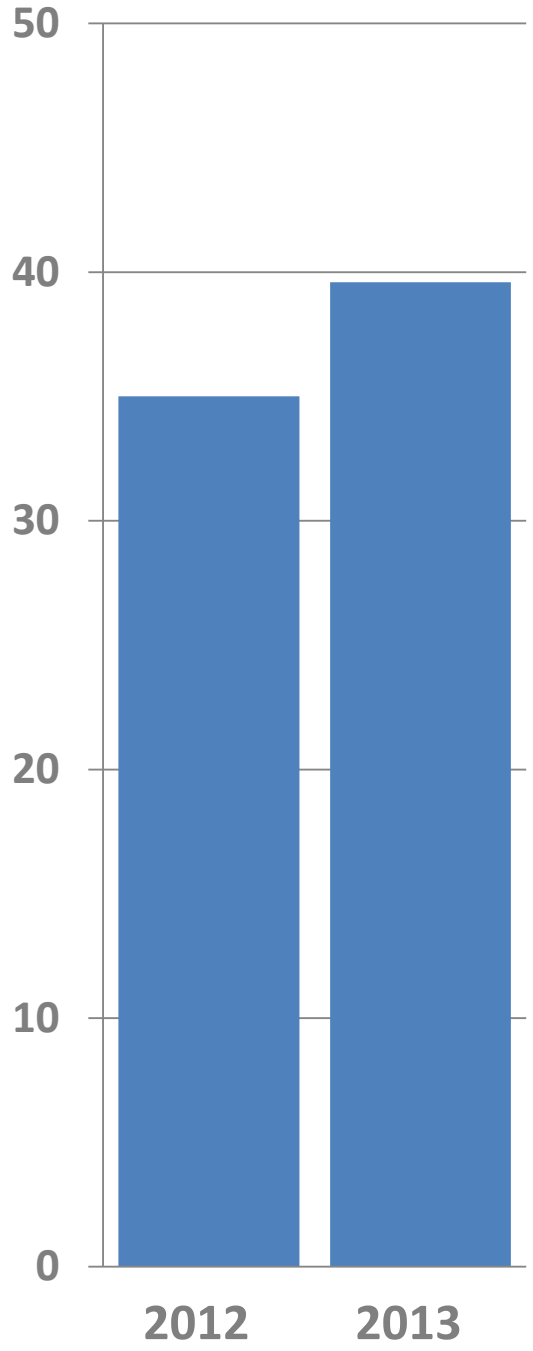
Using bar graphs, stories are easily manipulated.



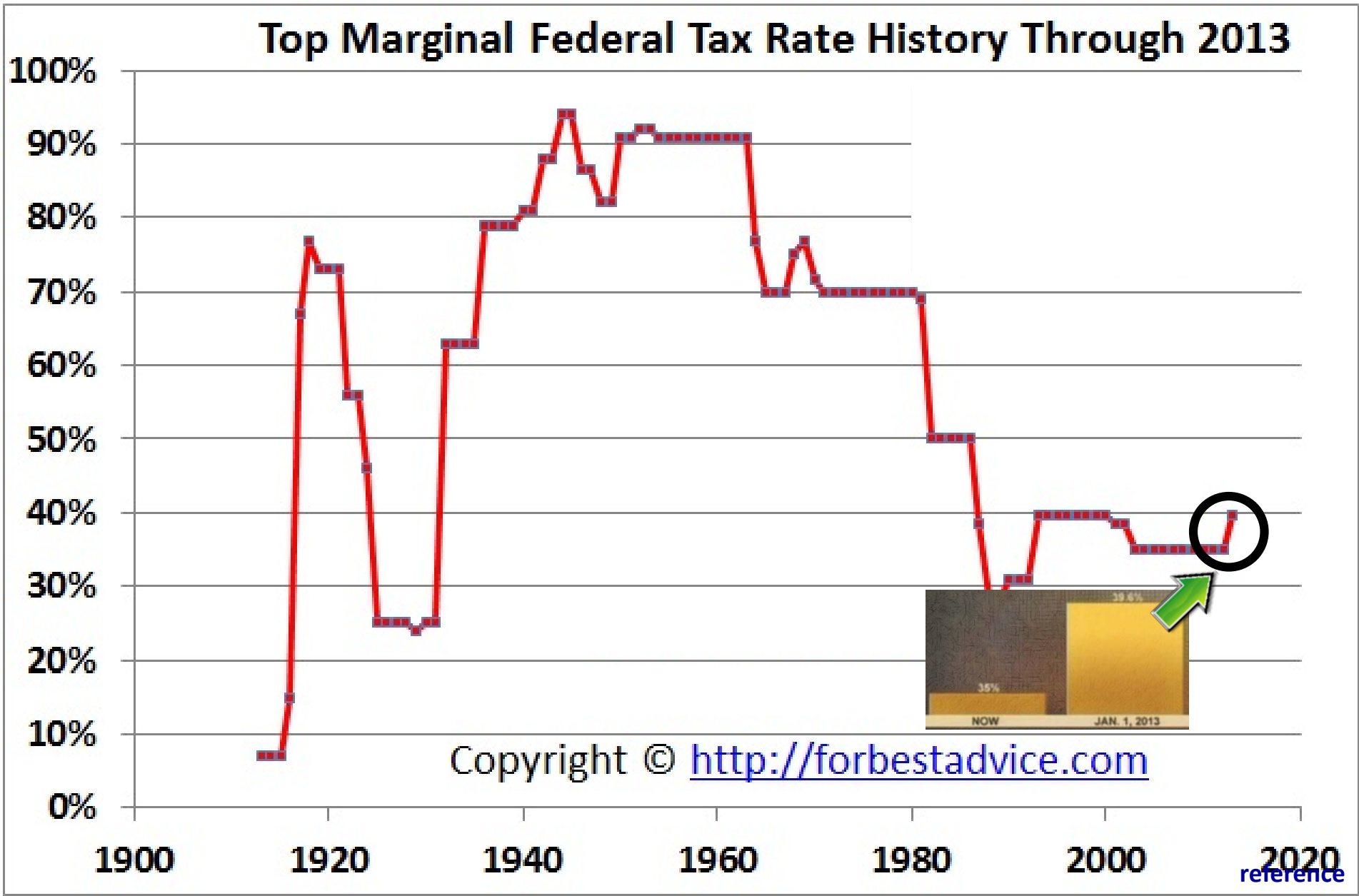
http://mediamatters.org/research/2012/10/01/a-history-of-dishonest-fox-charts/190225

Using bars, start scales at zero, and the rise seems less dramatic…

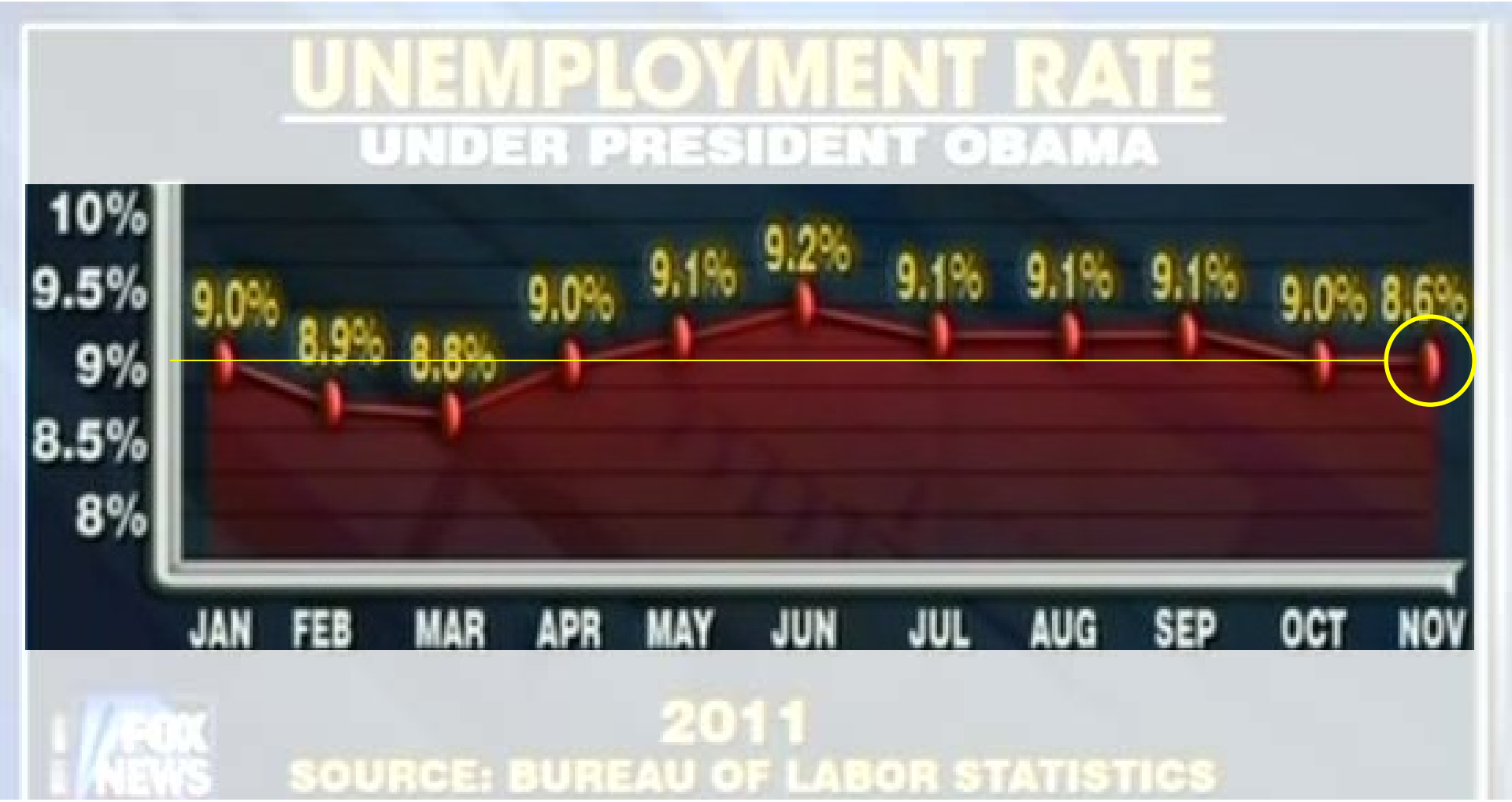
Top marginal US tax rate (%)



… until we add more data for context.



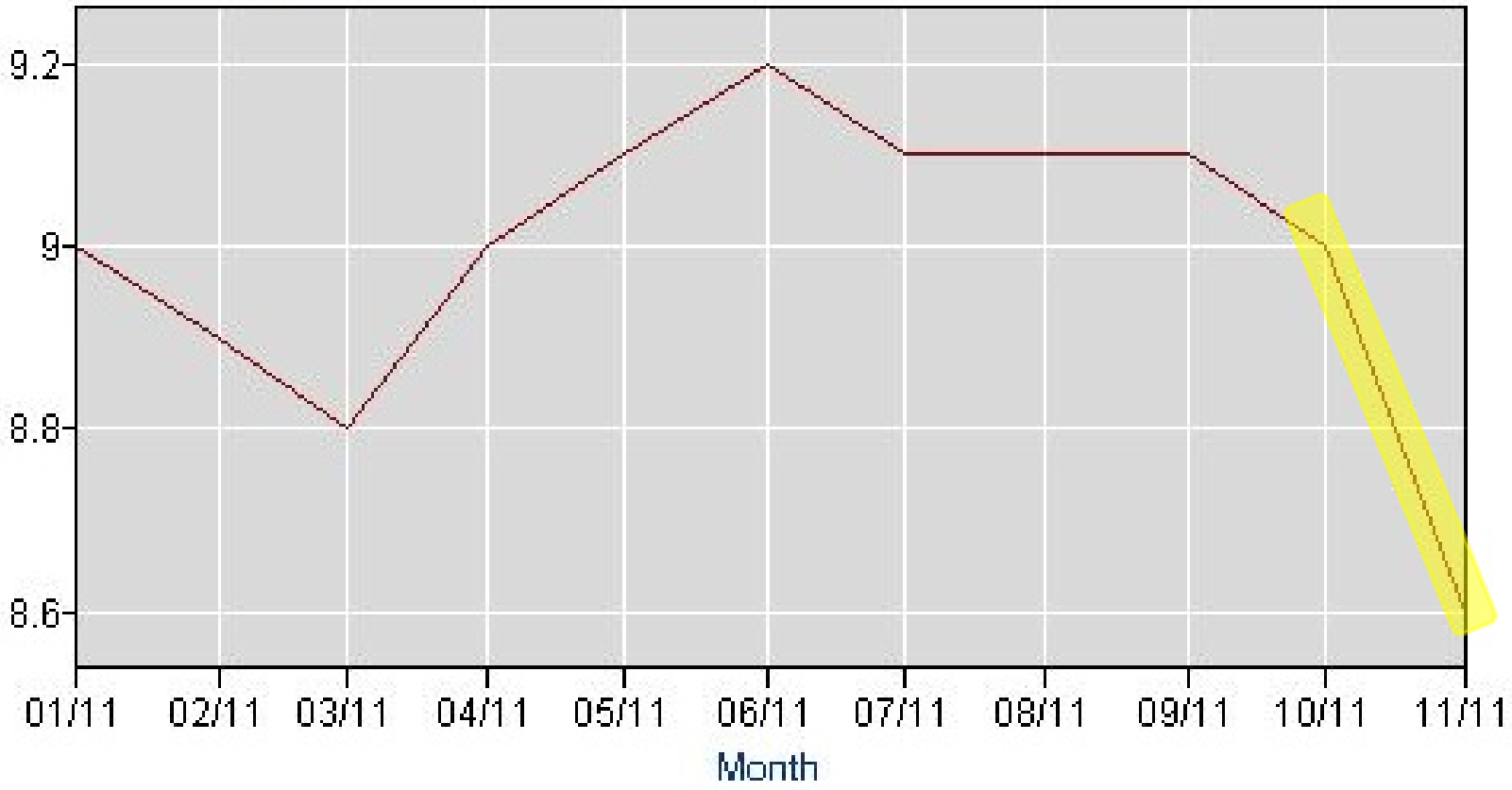
The November data label (8.6%) is correct. What is amiss?



http://mediamatters.org/research/2012/10/01/a-history-of-dishonest-fox-charts/190225

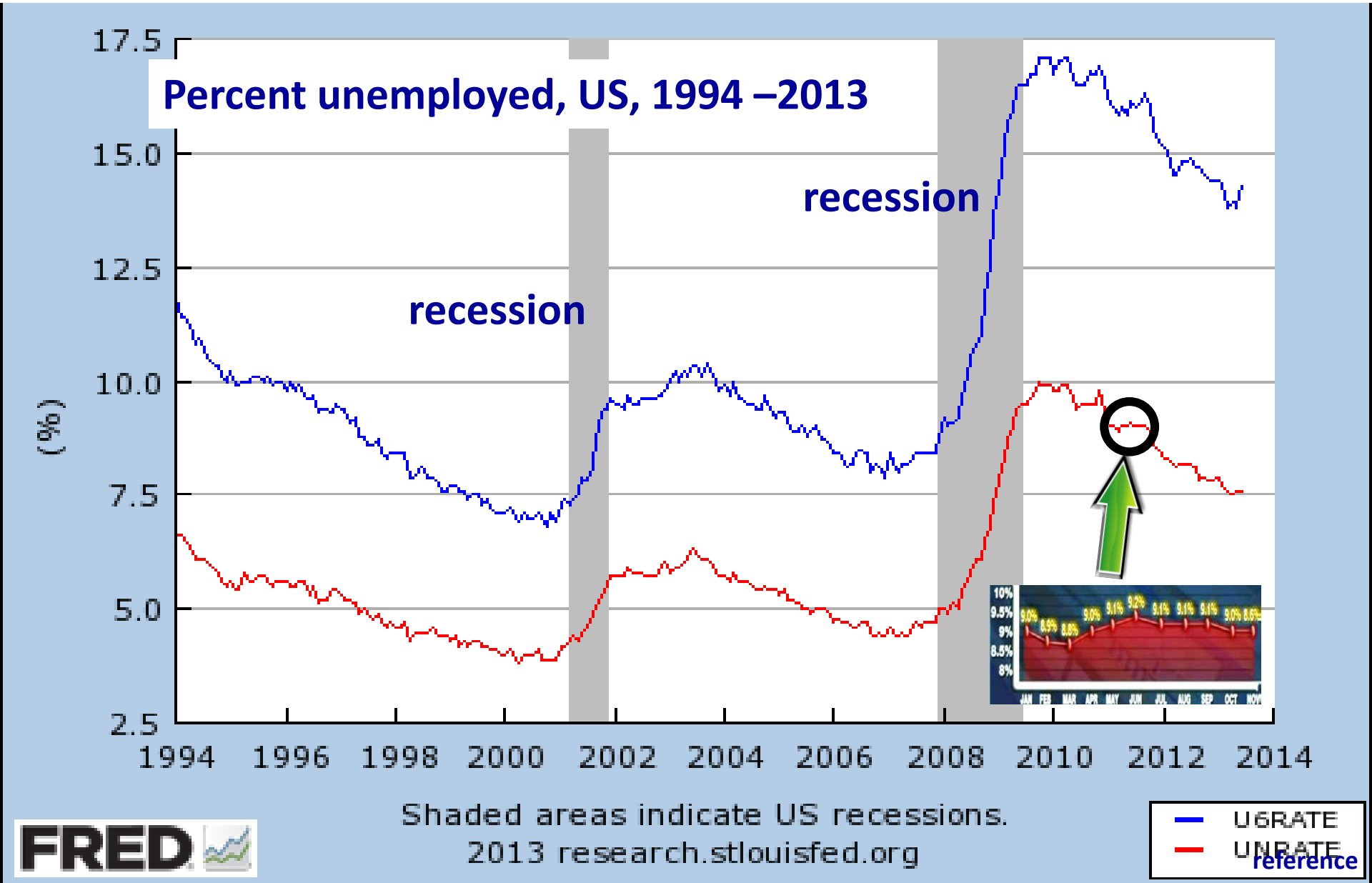
With the same data drawn truthfully, we see what appears to be a dramatic drop in unemployment…

Labor force status: Unemployment rate
Type of data: Percent or rate
Age: 16 years and over



Bureau of Labor Statistics

… until we add more data for context.



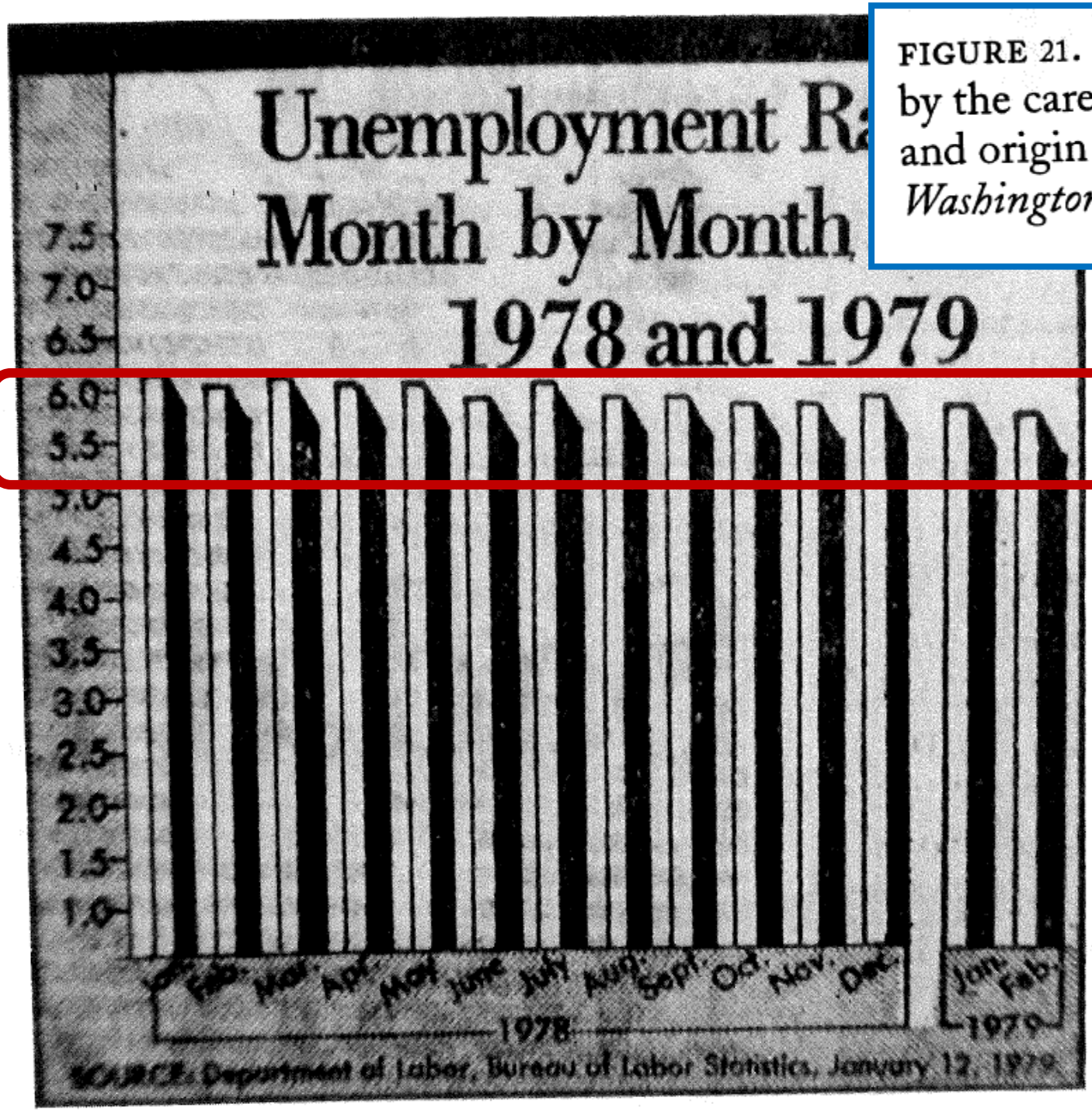
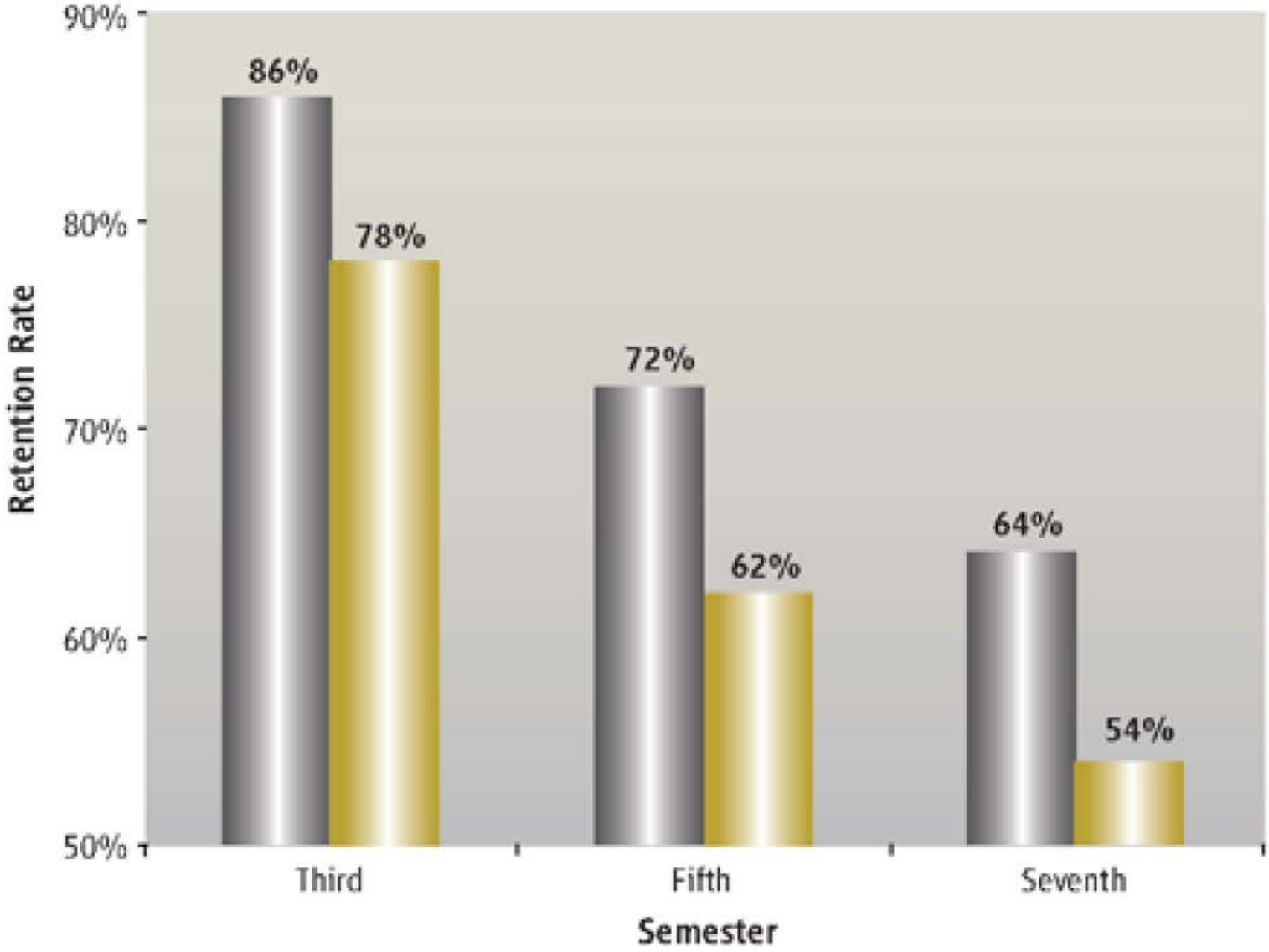


FIGURE 21. Hiding the effect by the careful choice of scale and origin (from the *Washington Post*).

reference

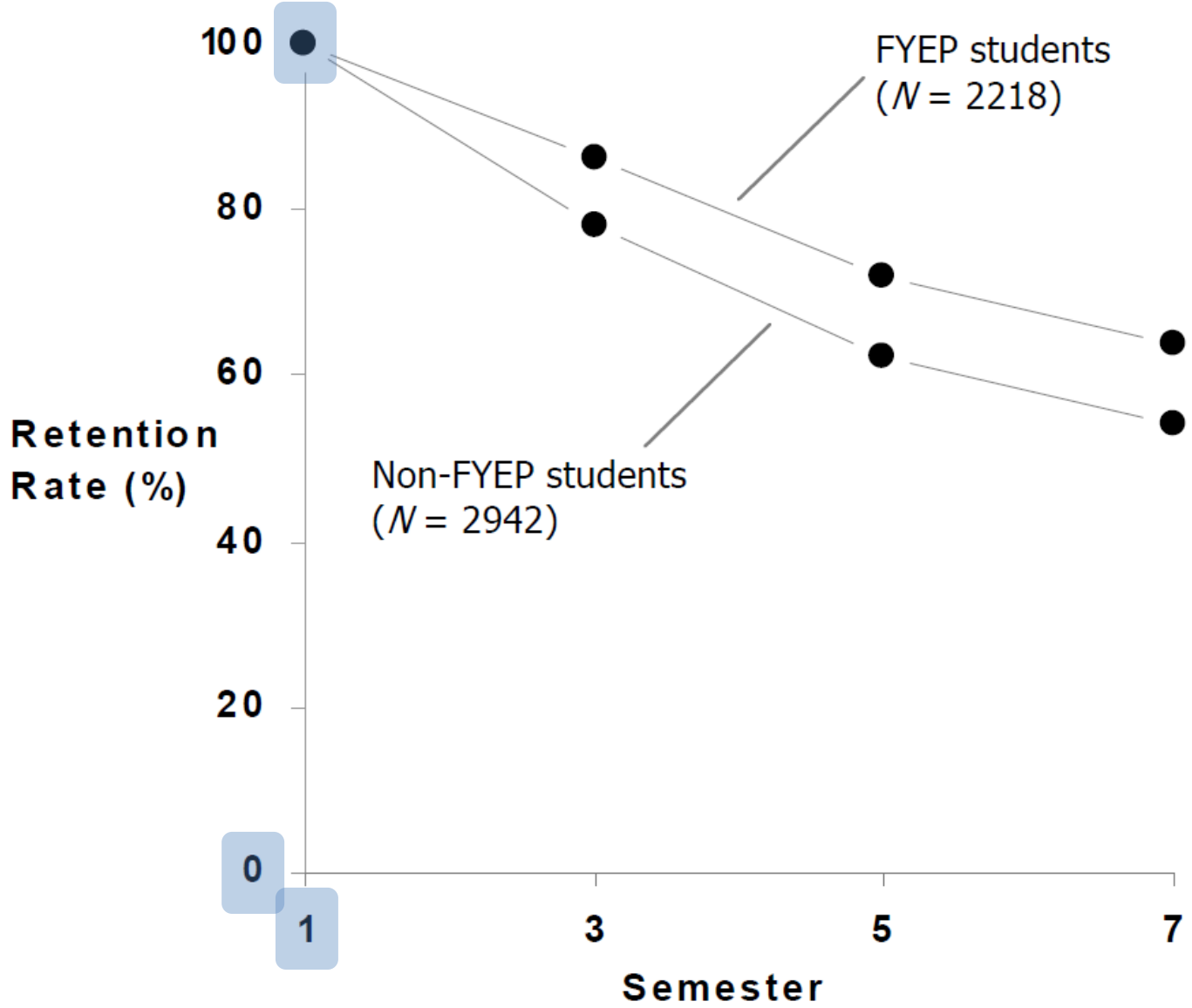

Unemployment Rate by Month
Since 1977
1977 Average Unemployment Rate
7.0
6.5
6.0
5.5
Percent Unemployment
Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec Jan Feb
1977
1978
1979

reference



Gains in retention. The FYEP course improved retention of engineering students into the third, fifth, and seventh semester. There were 2128 students who took the FYEP course (gray) and 2942 students who did not (gold). All retention gains over expected retention rates shown are significant ($P < 0.05$).

reference



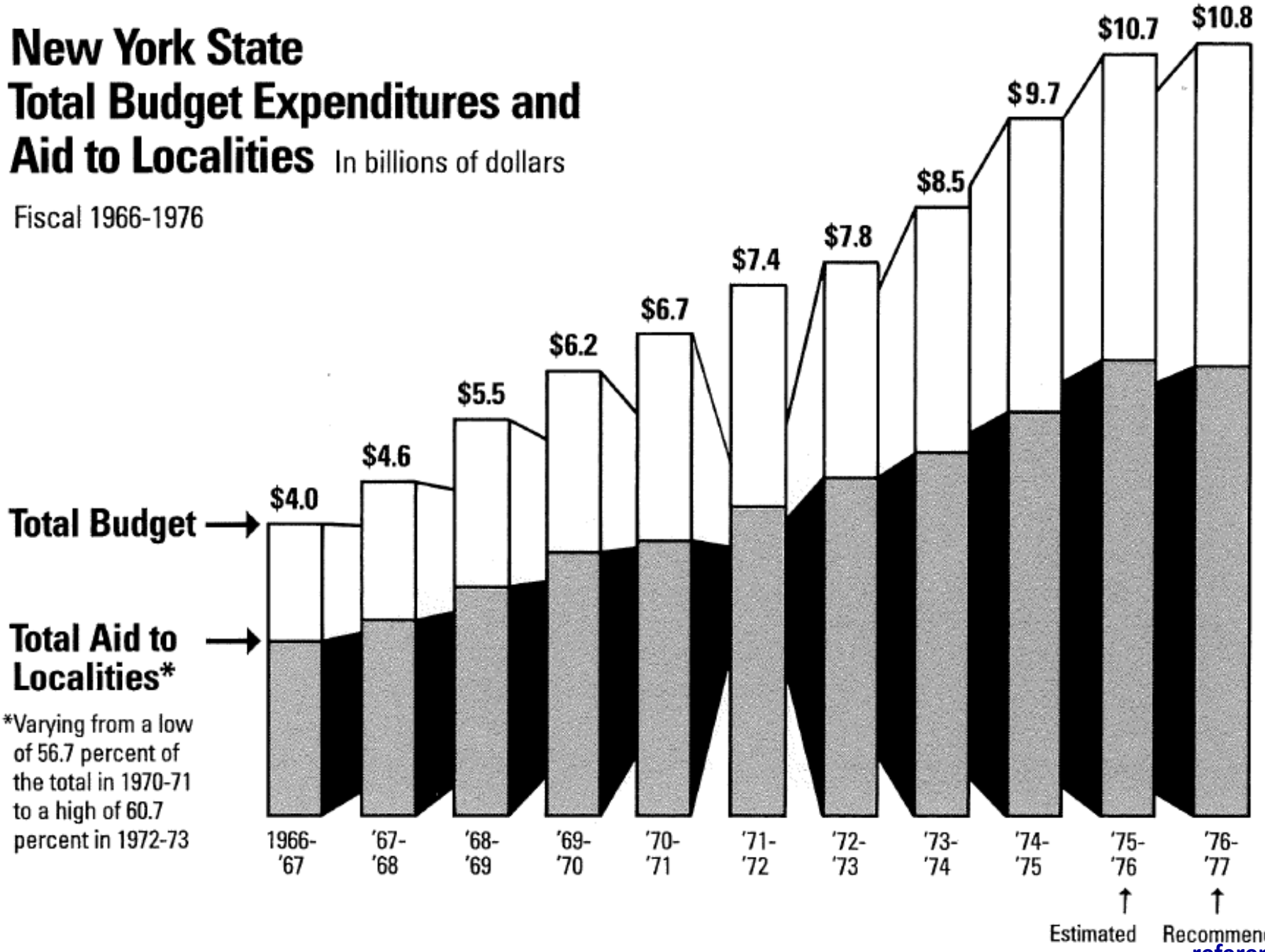
First-year gains in retention. The primary impact of the first-year engineering projects (FYEP) course is in the higher retention rate in the third semester. Subsequently, both groups lose students at about the same rate with a persistent 10% difference between FYEP and non-FYEP students.

reference

New York State Total Budget Expenditures and Aid to Localities

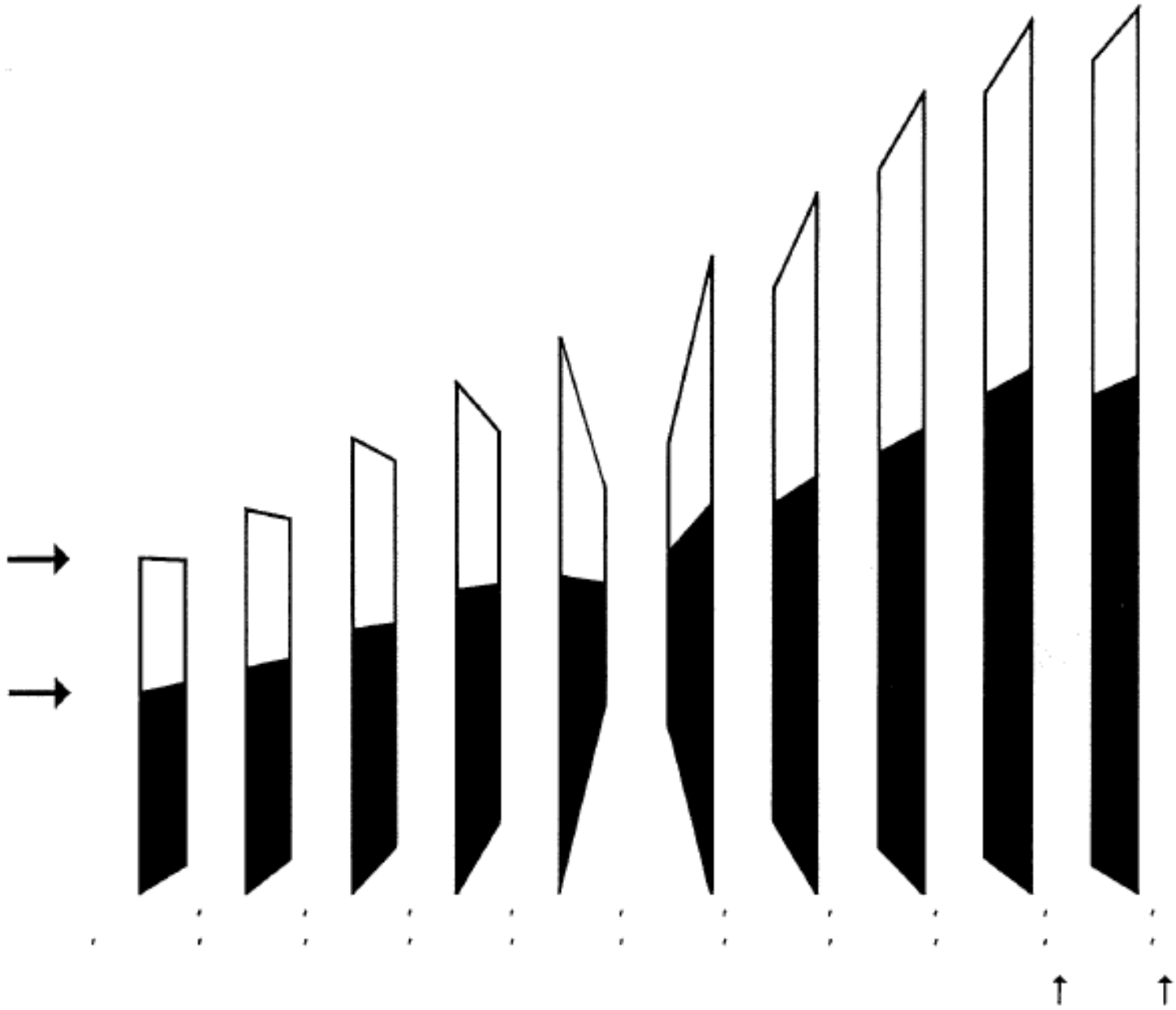
In billions of dollars

Fiscal 1966-1976



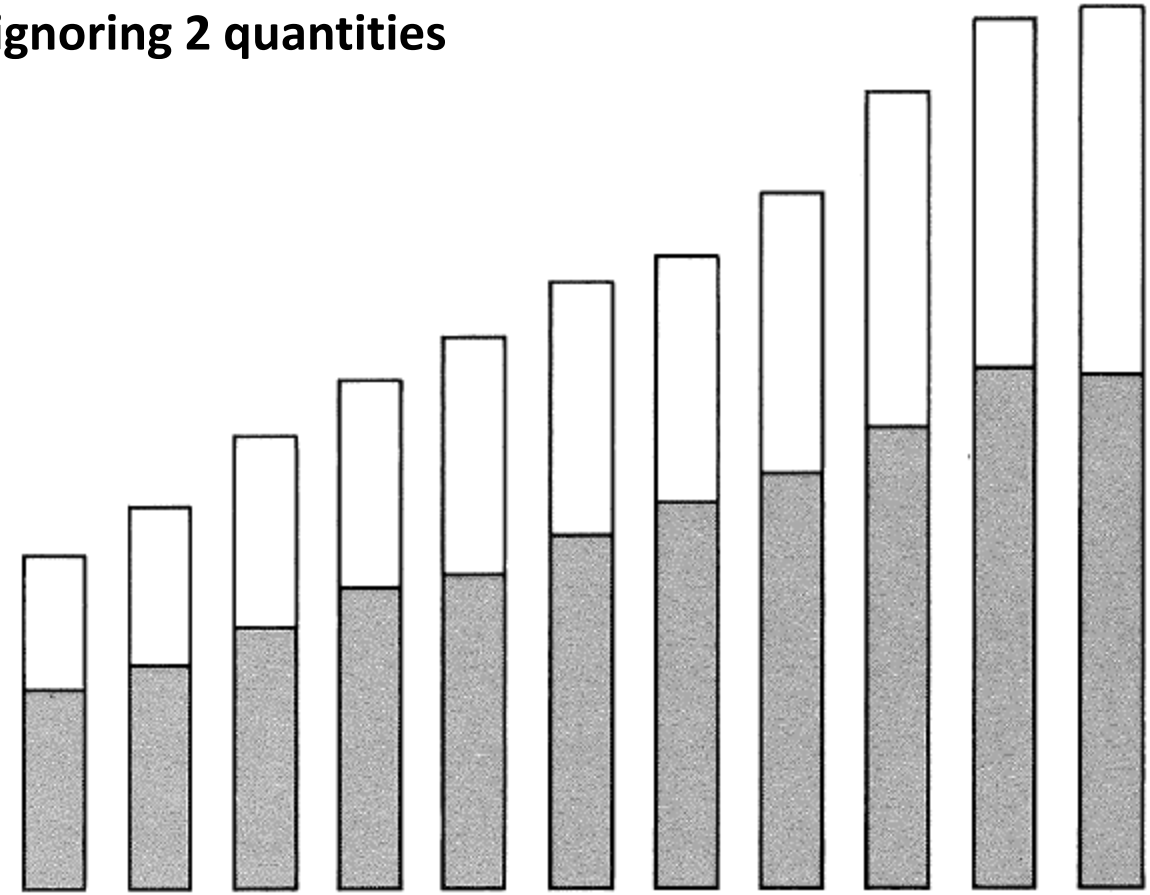
*Varying from a low of 56.7 percent of the total in 1970-71 to a high of 60.7 percent in 1972-73

reference

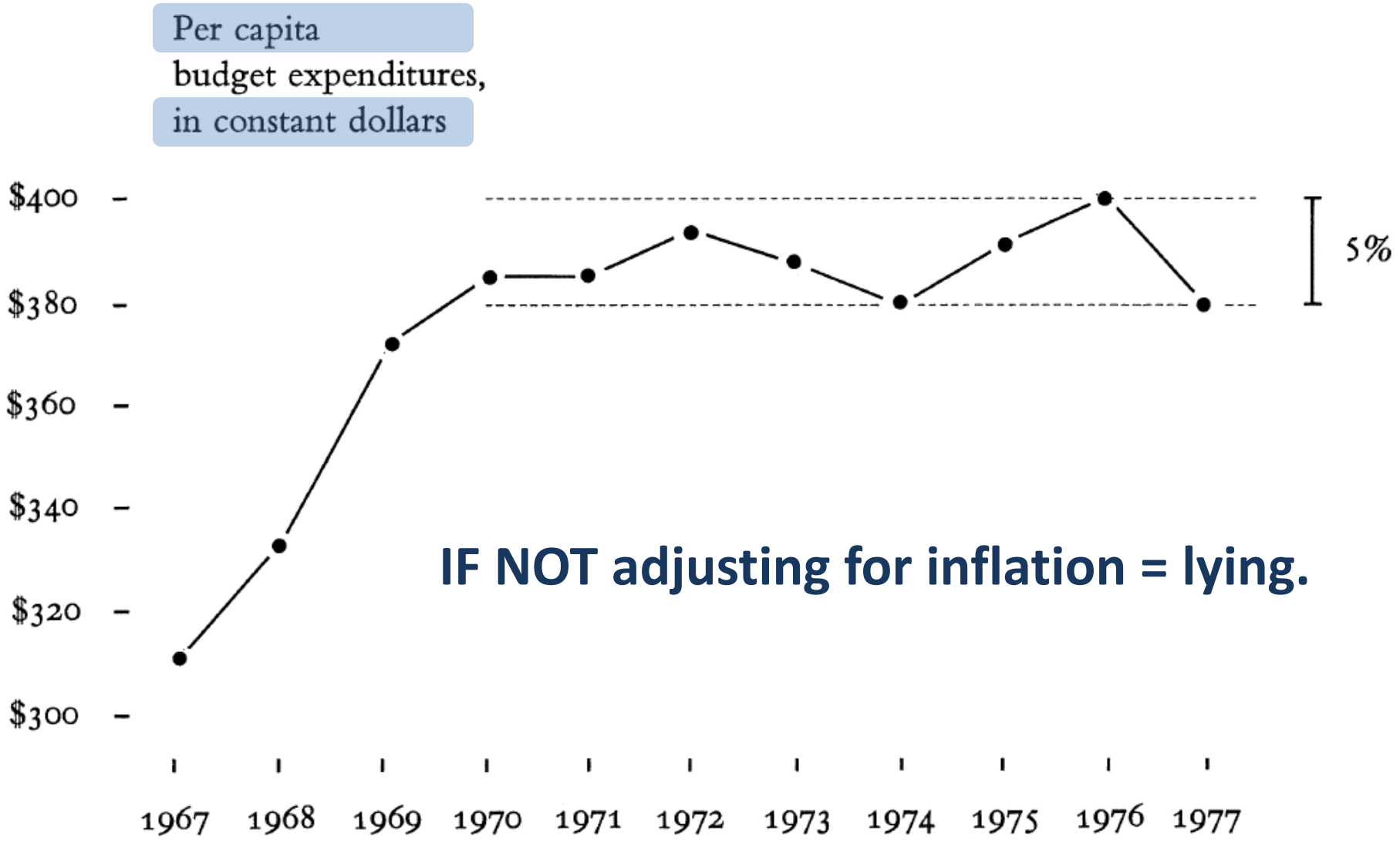

reference

Total Budget Expenditures

completely ignoring 2 quantities



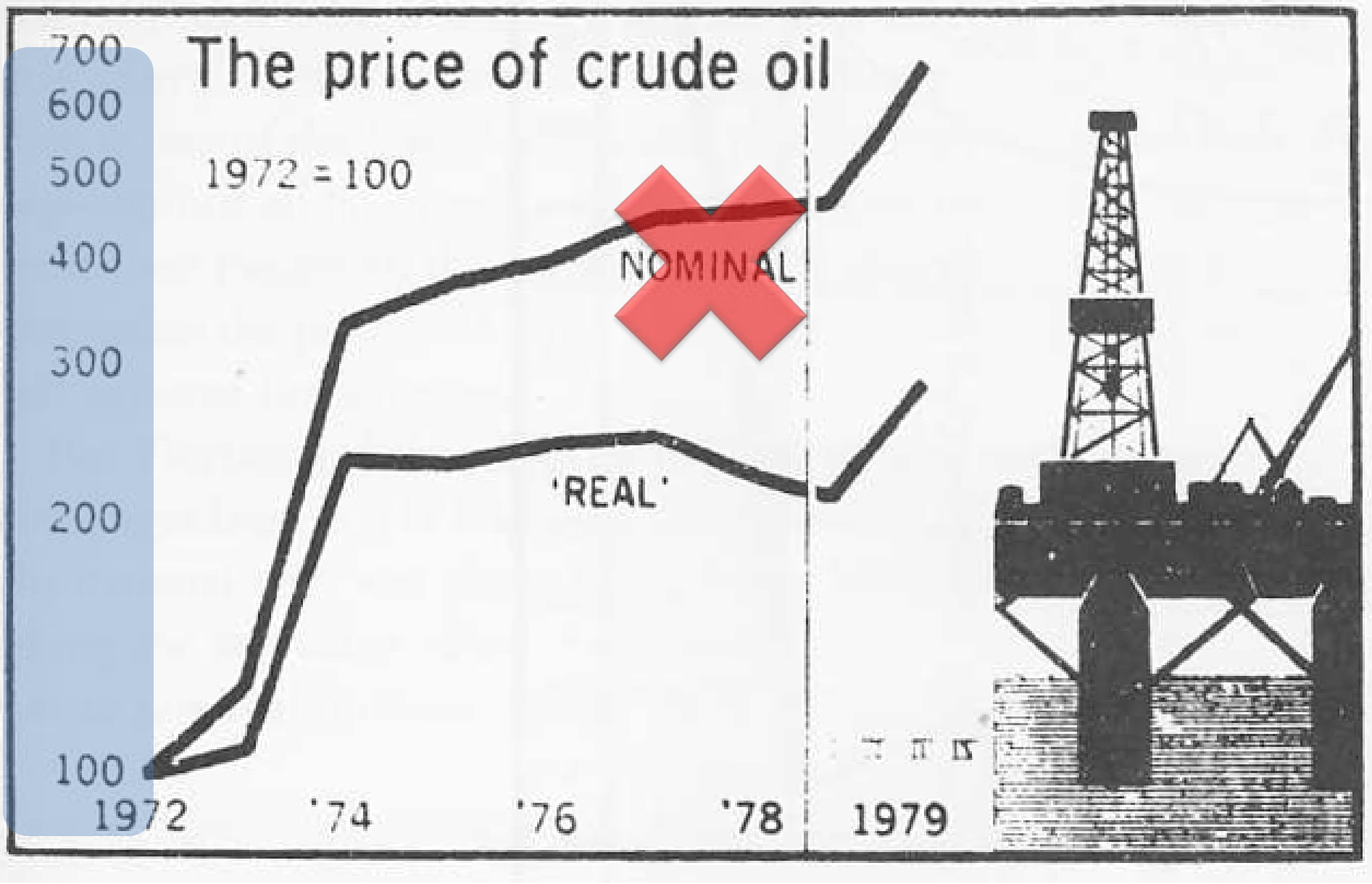
reference



IF NOT adjusting for inflation = lying.

reference

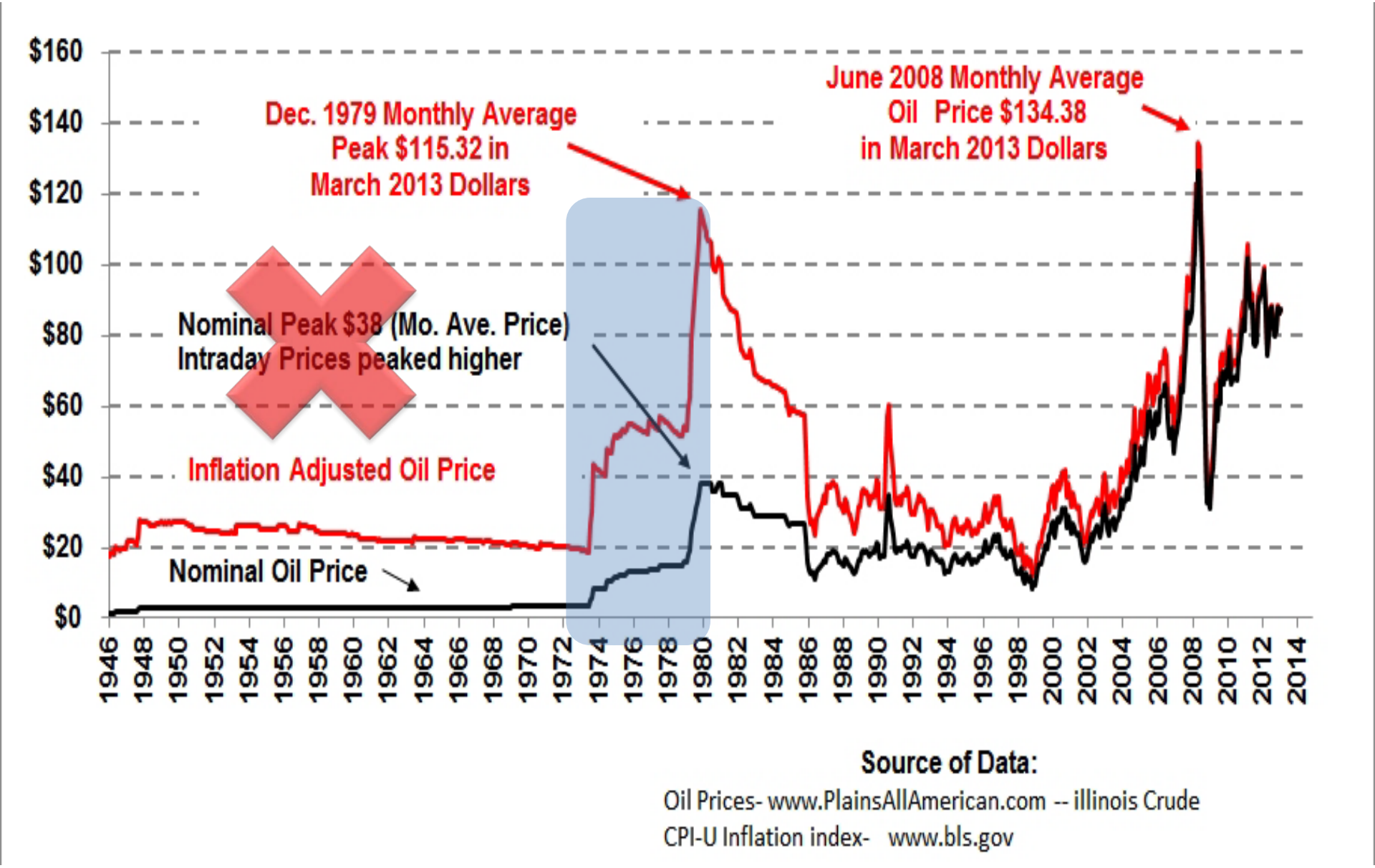
The price of crude oil is out of control.



Sunday Times (12/16/79) via Tufte

reference

Monthly crude oil prices, constant 2013 dollars

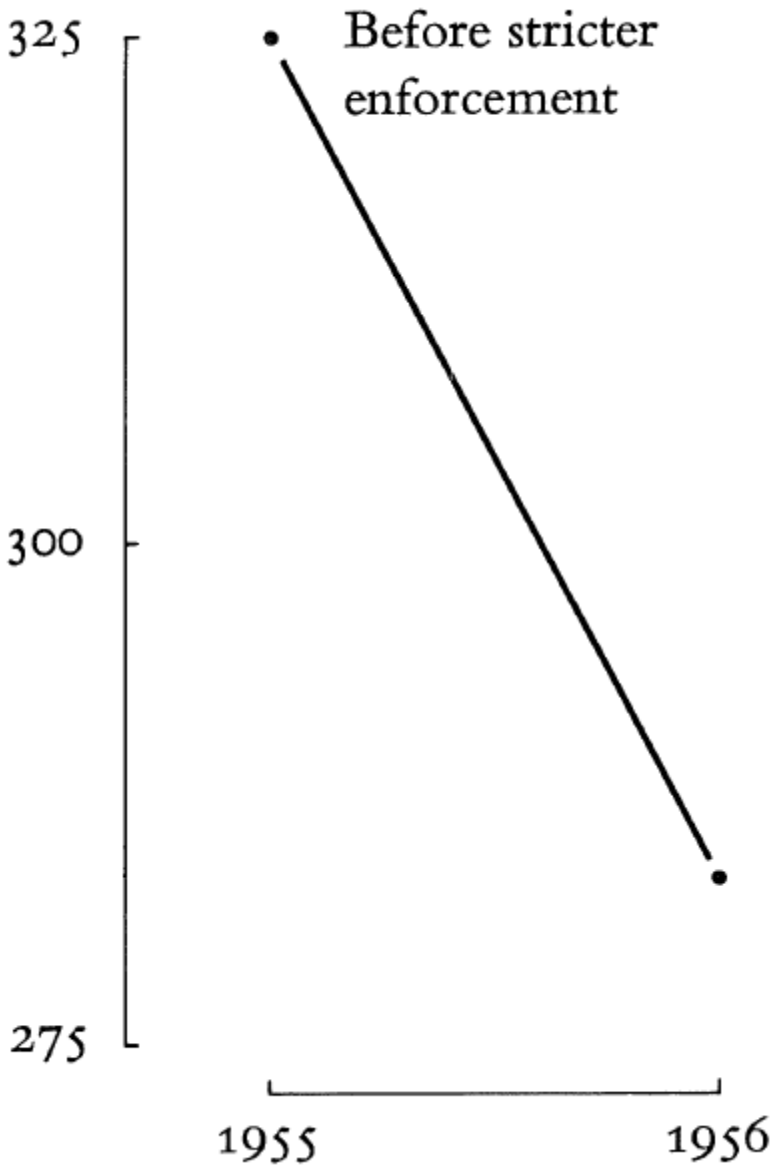


Source of Data:

Oil Prices- www.PlainsAllAmerican.com -- illinois Crude

CPI-U Inflation index- www.bls.gov

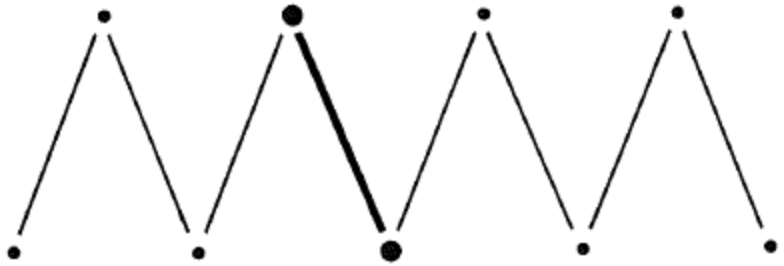
reference



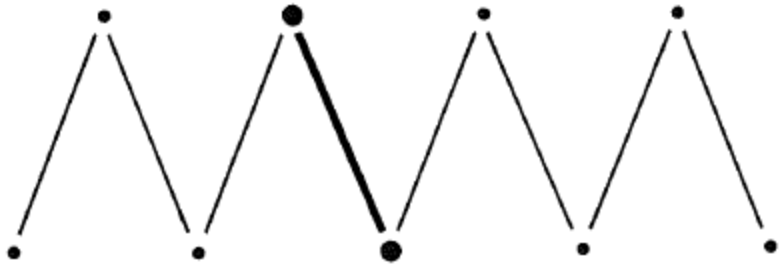
Connecticut Traffic Deaths,
Before (1955) and After (1956)
Stricter Enforcement by the Police
Against Cars Exceeding Speed limit

Compared to what?

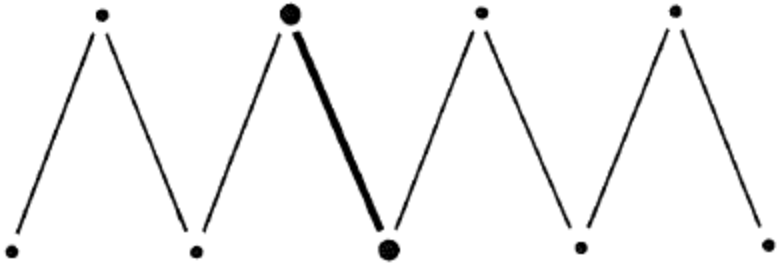
reference

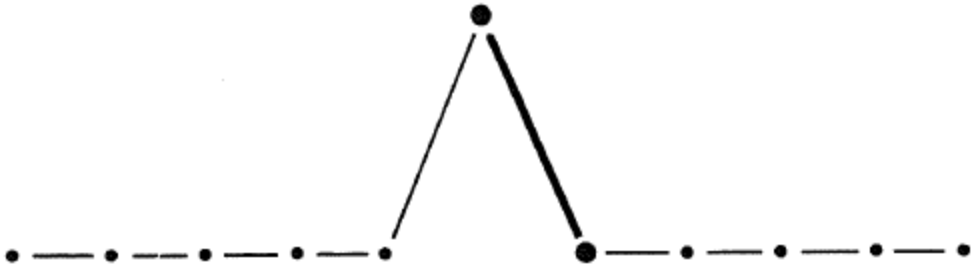


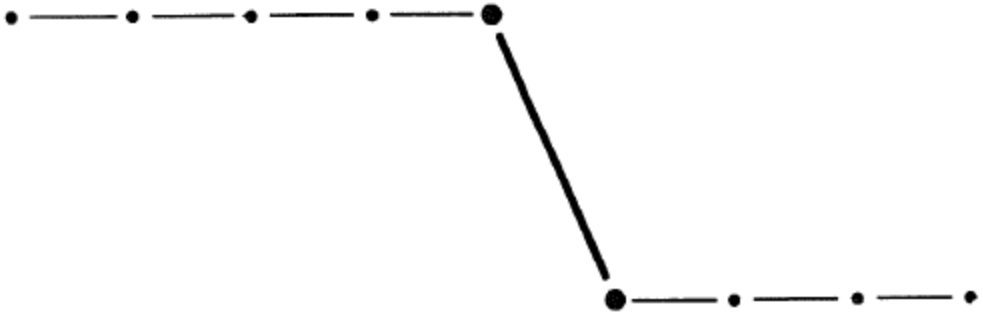
reference



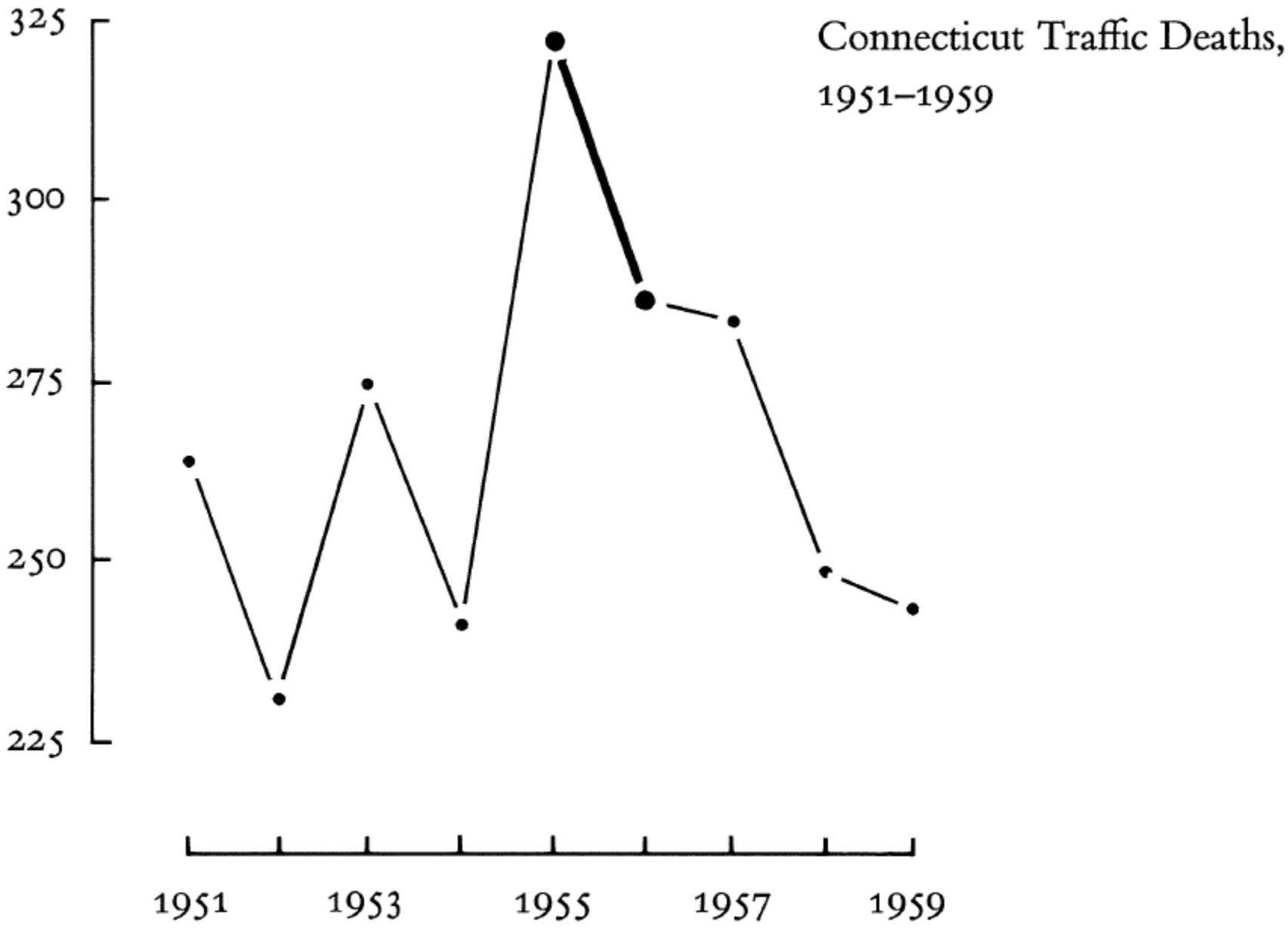
reference



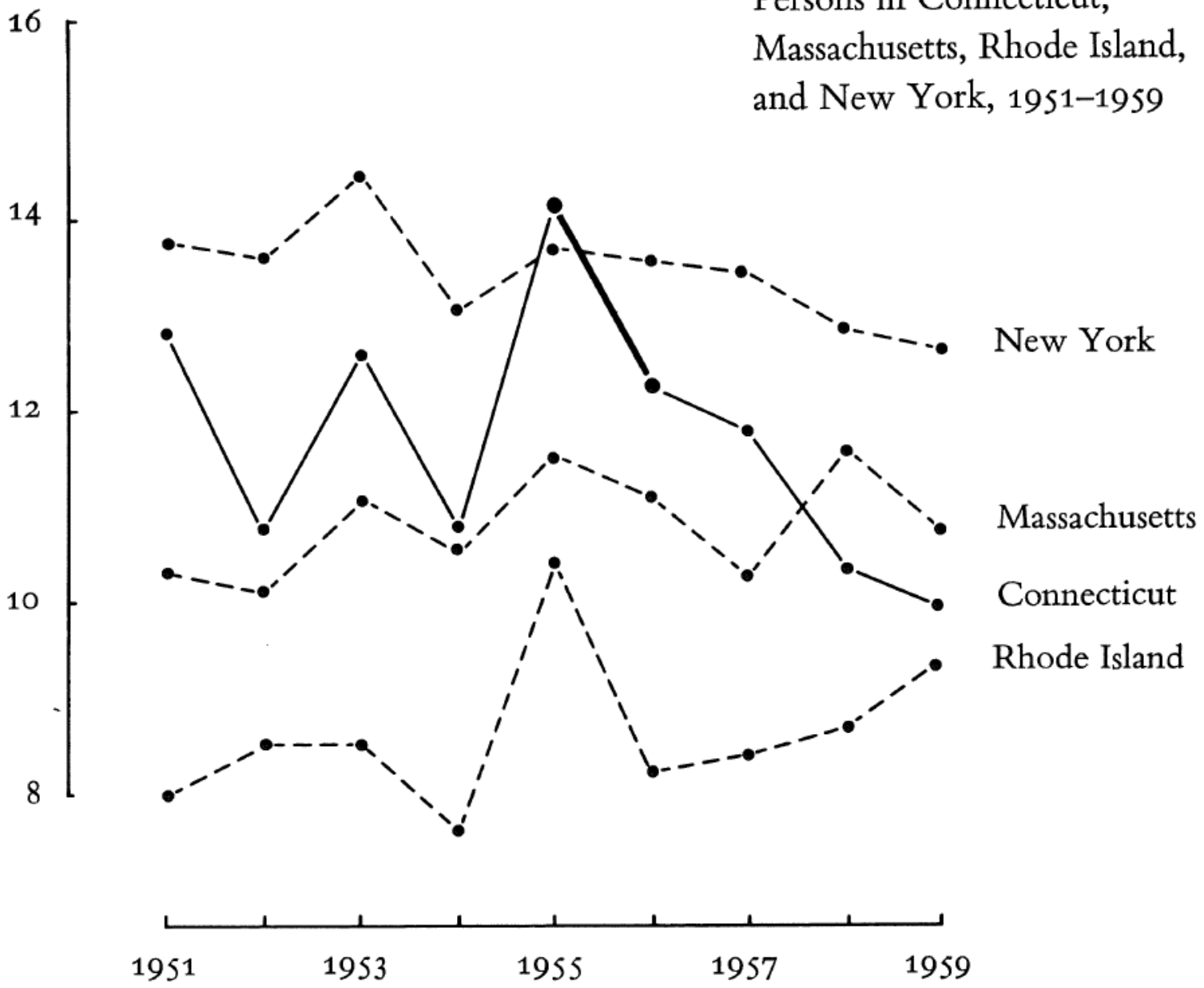




reference


Connecticut Traffic Deaths,
1951–1959
325
300
275
250
225
1951
1953
1955
1957
1959

reference


Traffic Deaths per 100,000 Persons in Connecticut, Massachusetts, Rhode Island, and New York, 1951–1959
16
14
12
10
8
1951
1953
1955
1957
1959
New York
Massachusetts
Connecticut
Rhode Island

reference

A graph from a recent paper on the progress of engineering students through a math sequence.

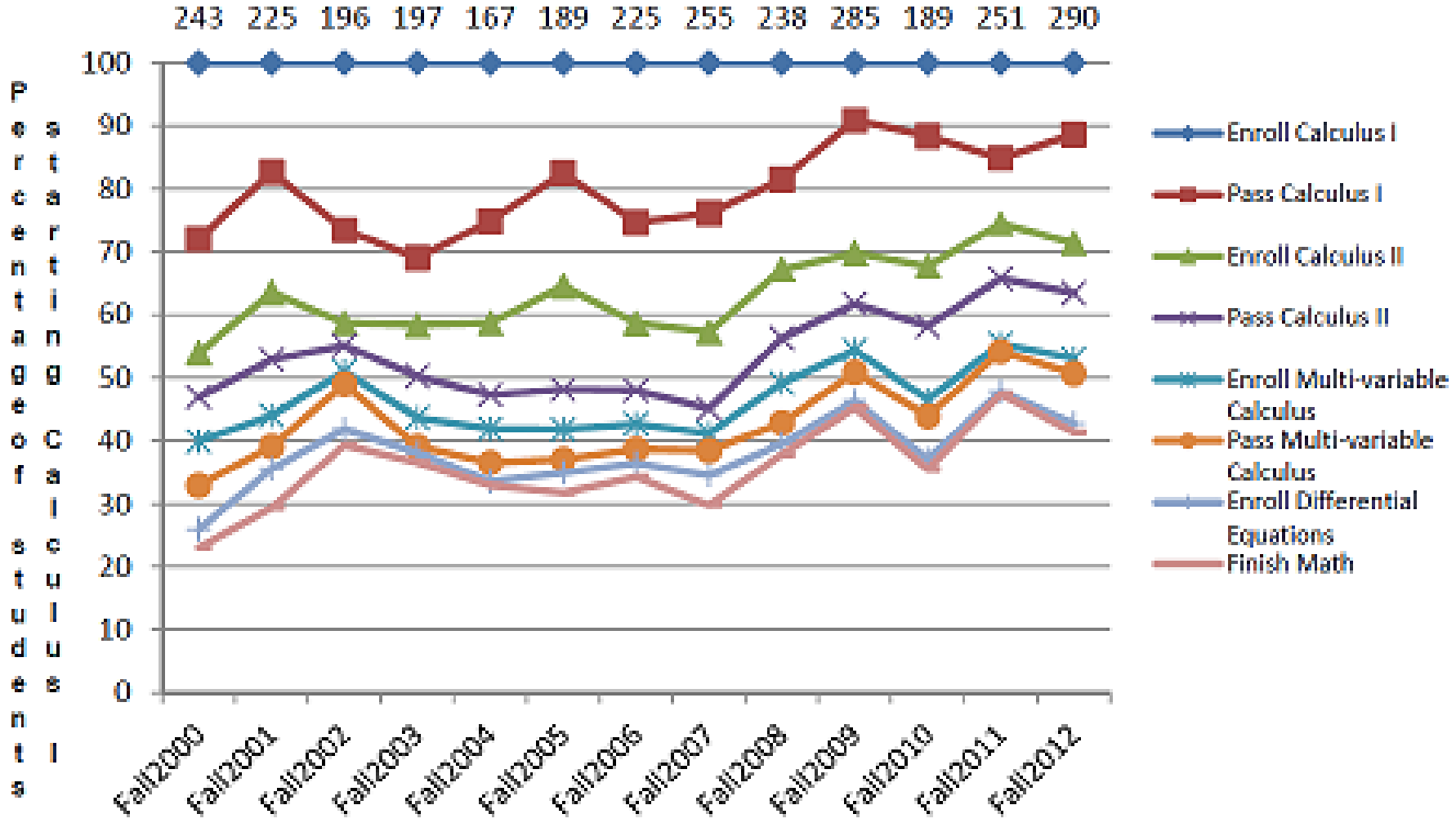


Figure 4. Female engineering student progress through the four-course mathematics sequence in consecutive semesters.

reference

The independent variable is time.

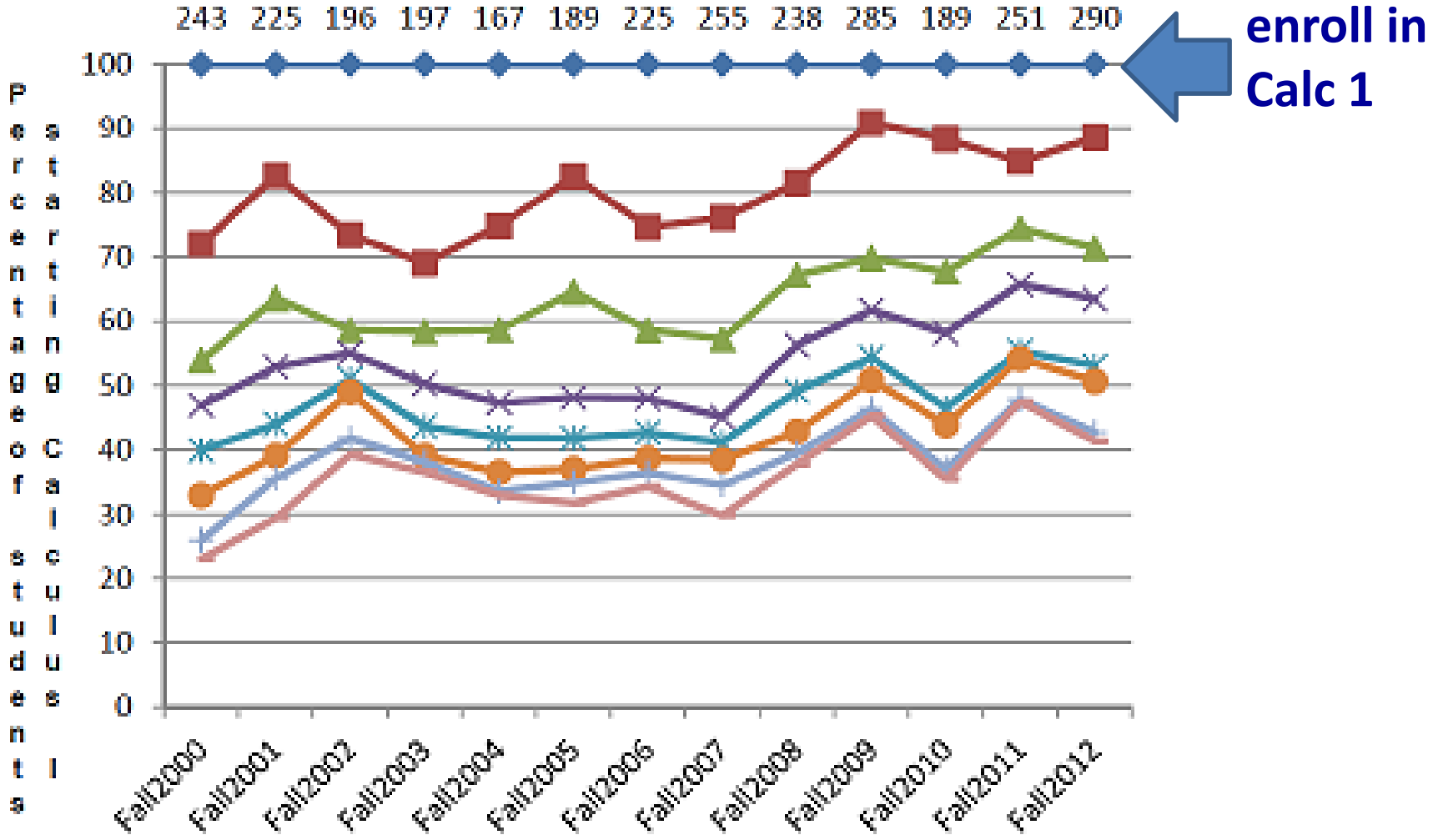


Figure 4. Female engineering student progress through the four-course ma
consecutive semesters.

reference

The independent variable is time, but the story lies in the differences between the lines.

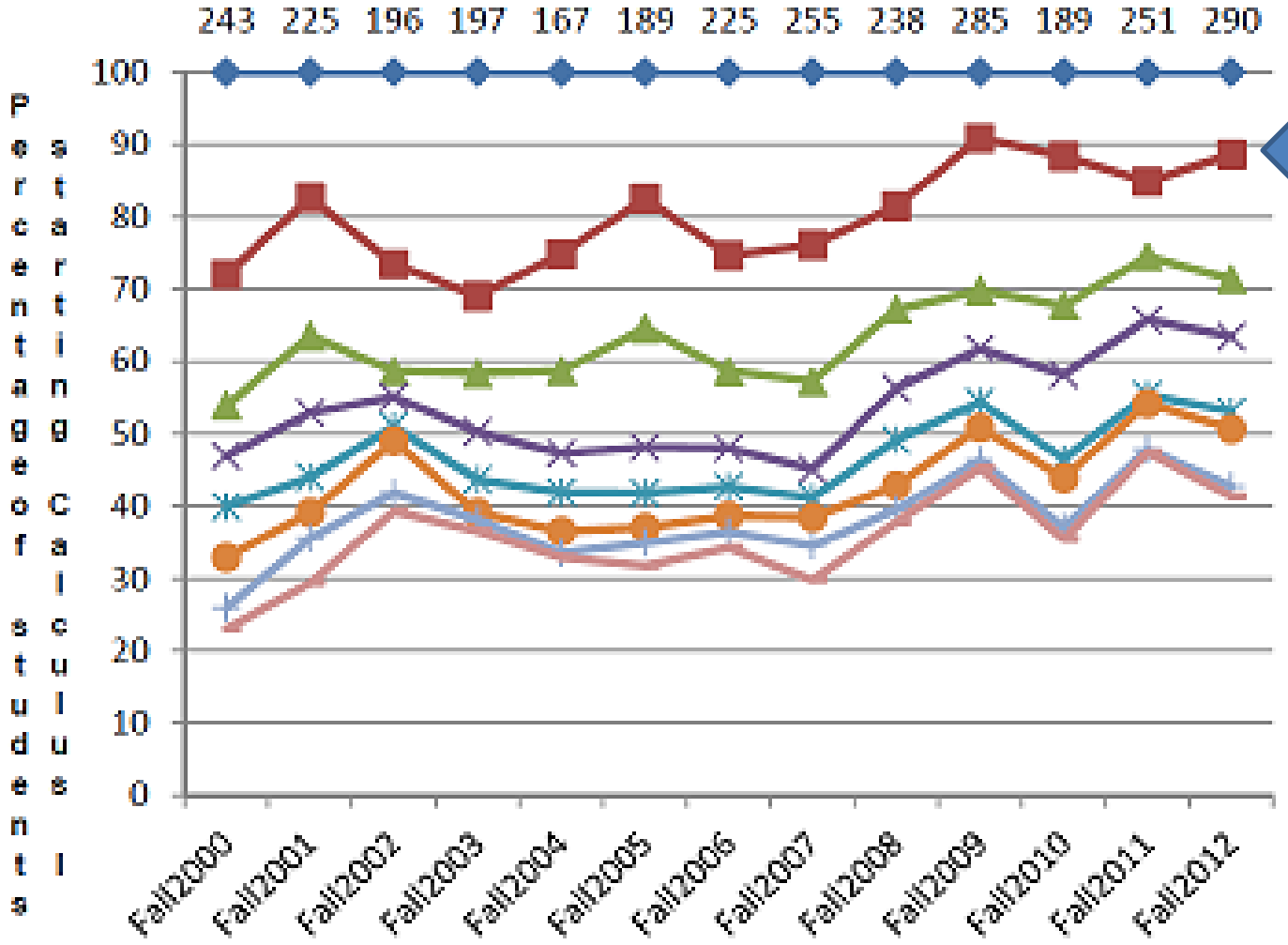


Figure 4. Female engineering student progress through the four-course ma
consecutive semesters.

reference

The independent variable is time, but the story lies in the differences between the lines.

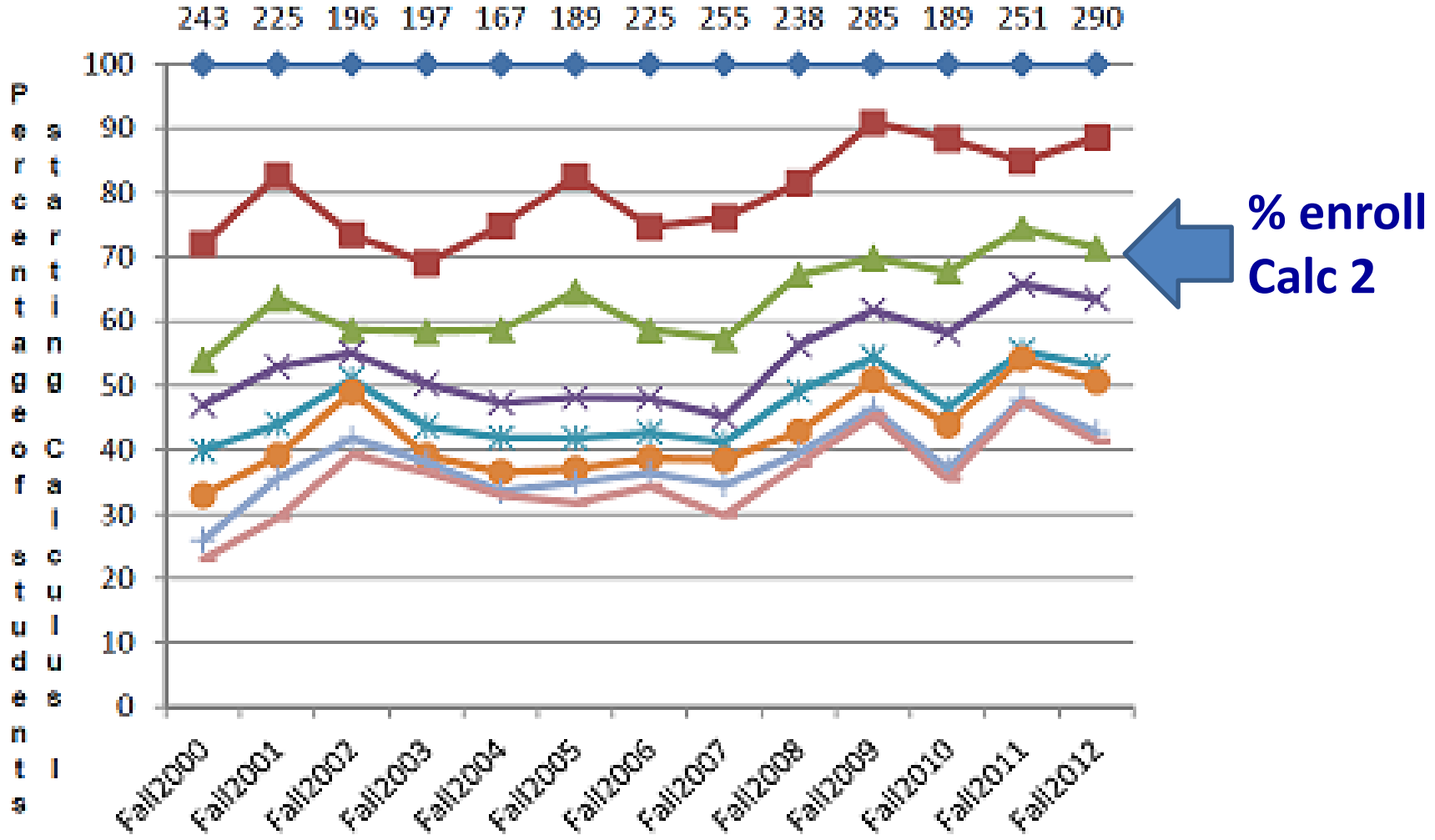


Figure 4. Female engineering student progress through the four-course ma
consecutive semesters.

reference

The independent variable is time, but the story lies in the differences between the lines.

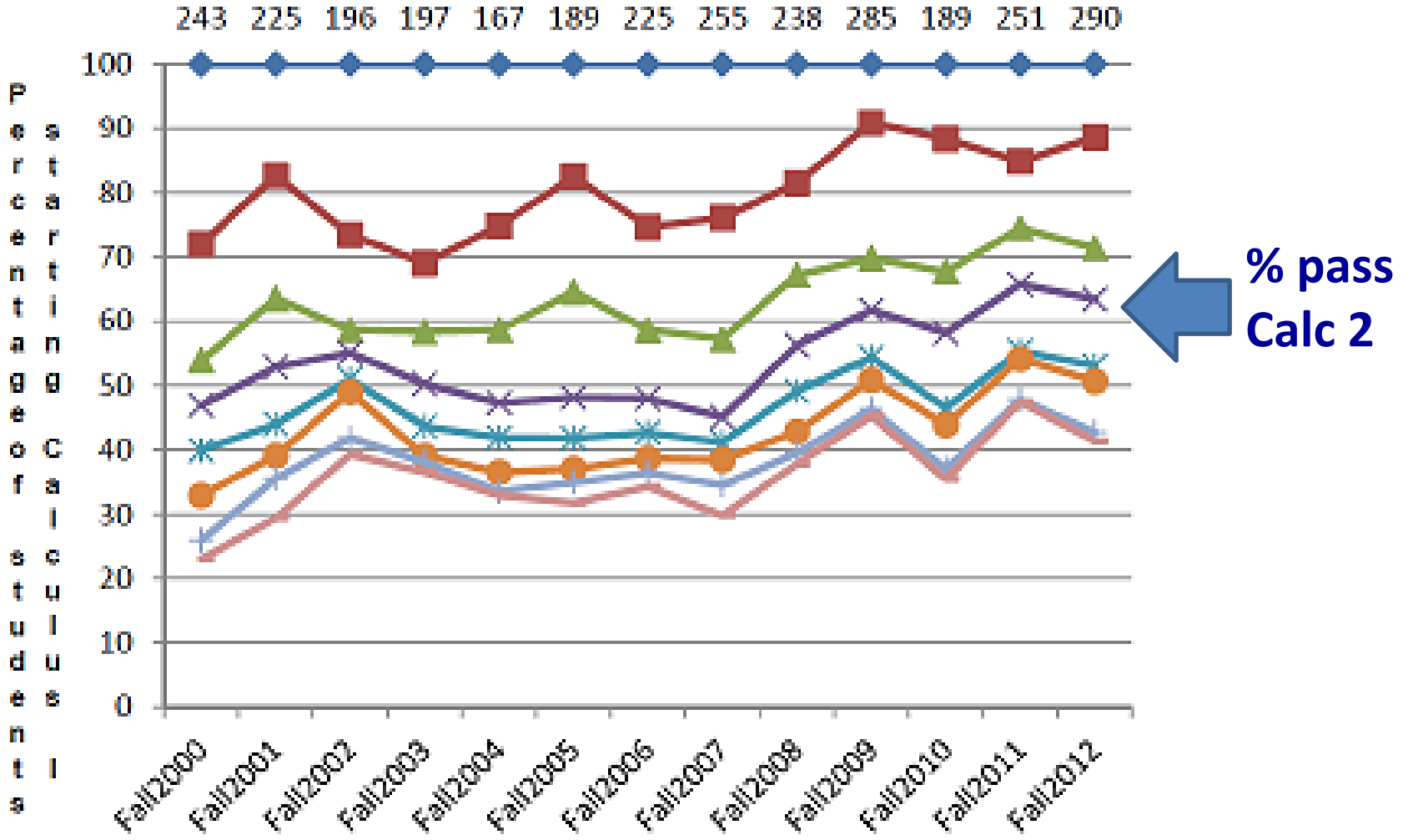


Figure 4. Female engineering student progress through the four-course ma
consecutive semesters.

reference

The independent variable is time, but the story lies in the differences between the lines.

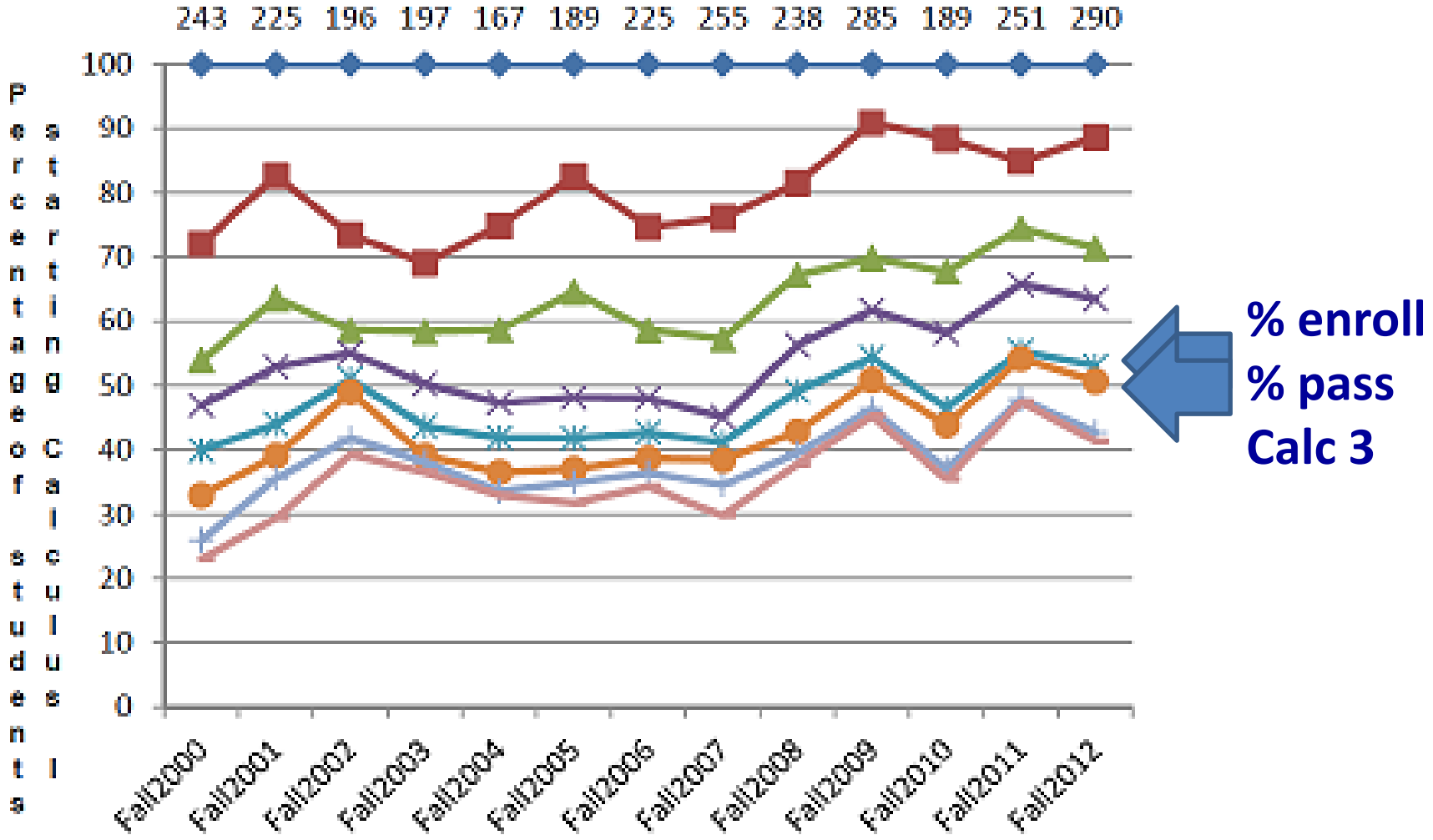
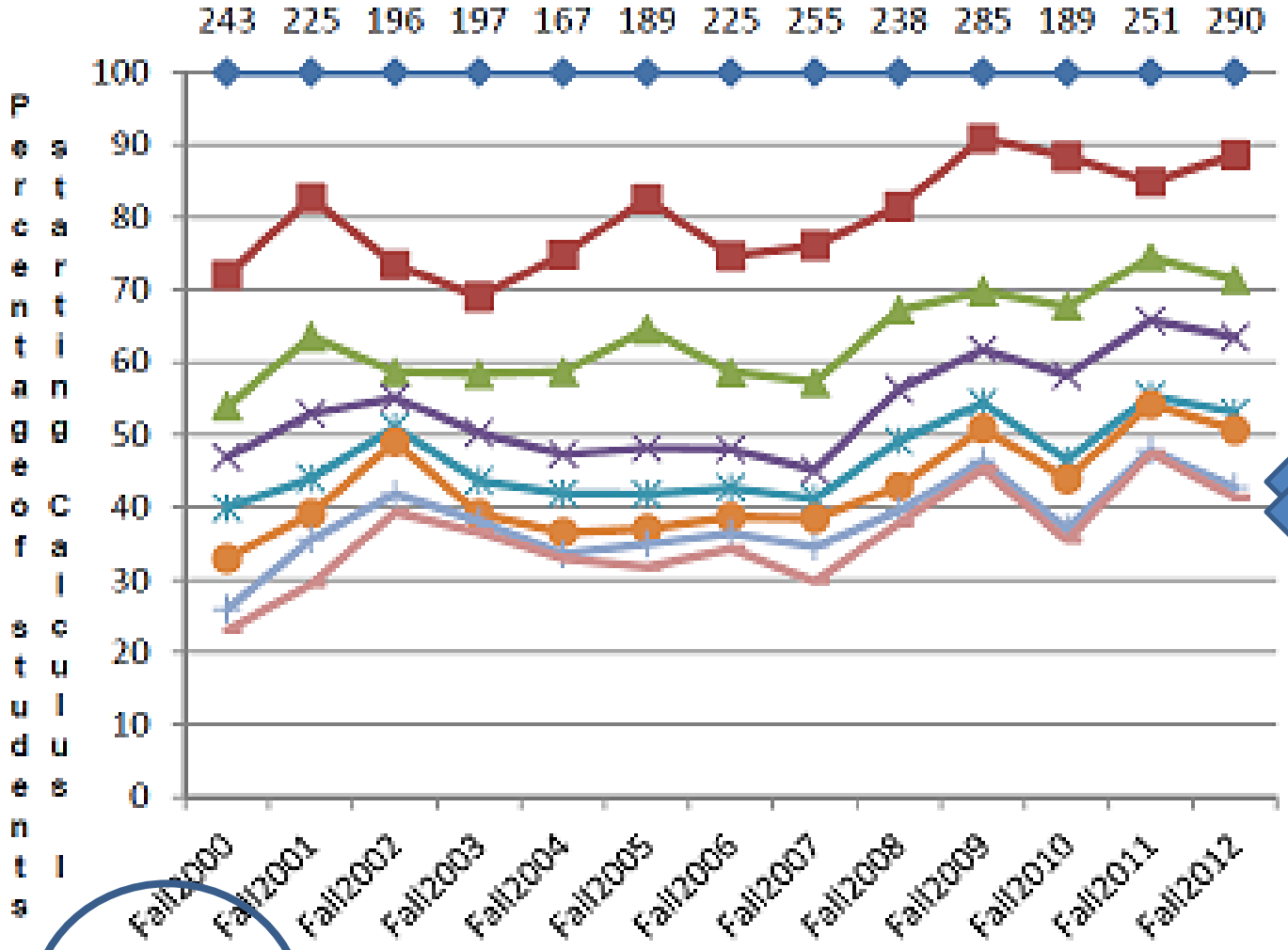


Figure 4. Female engineering student progress through the four-course ma
consecutive semesters.

reference

The independent variable is time, but the story lies in the differences between the lines … and gender.



% enroll
DEs
% finish
math seq

Figure 4. Female engineering student progress through the four-course ma
consecutive semesters.

reference

The same graph design for male students.

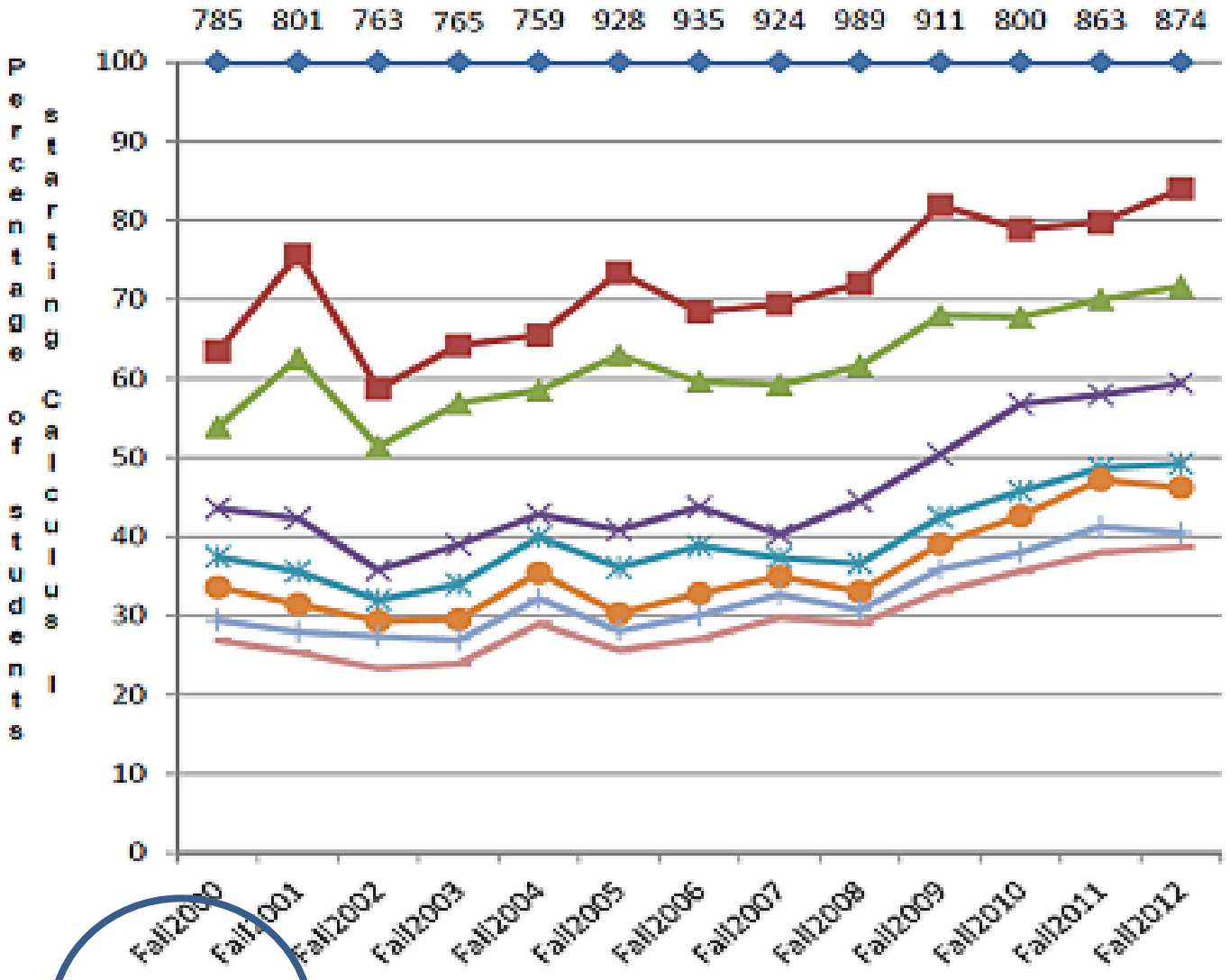
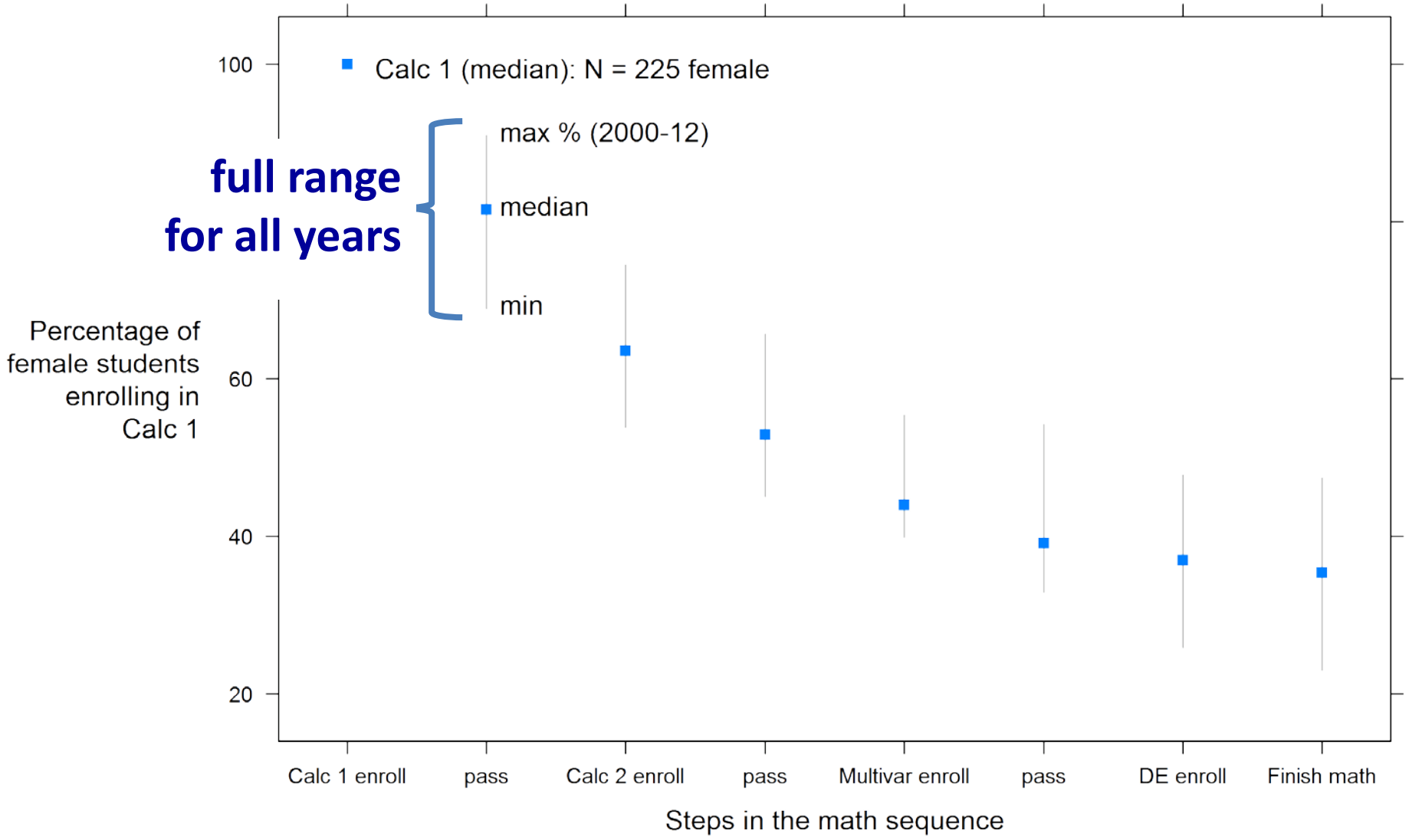


Figure 3. Male engineering student progress through the four-course mathe
consecutive semesters.

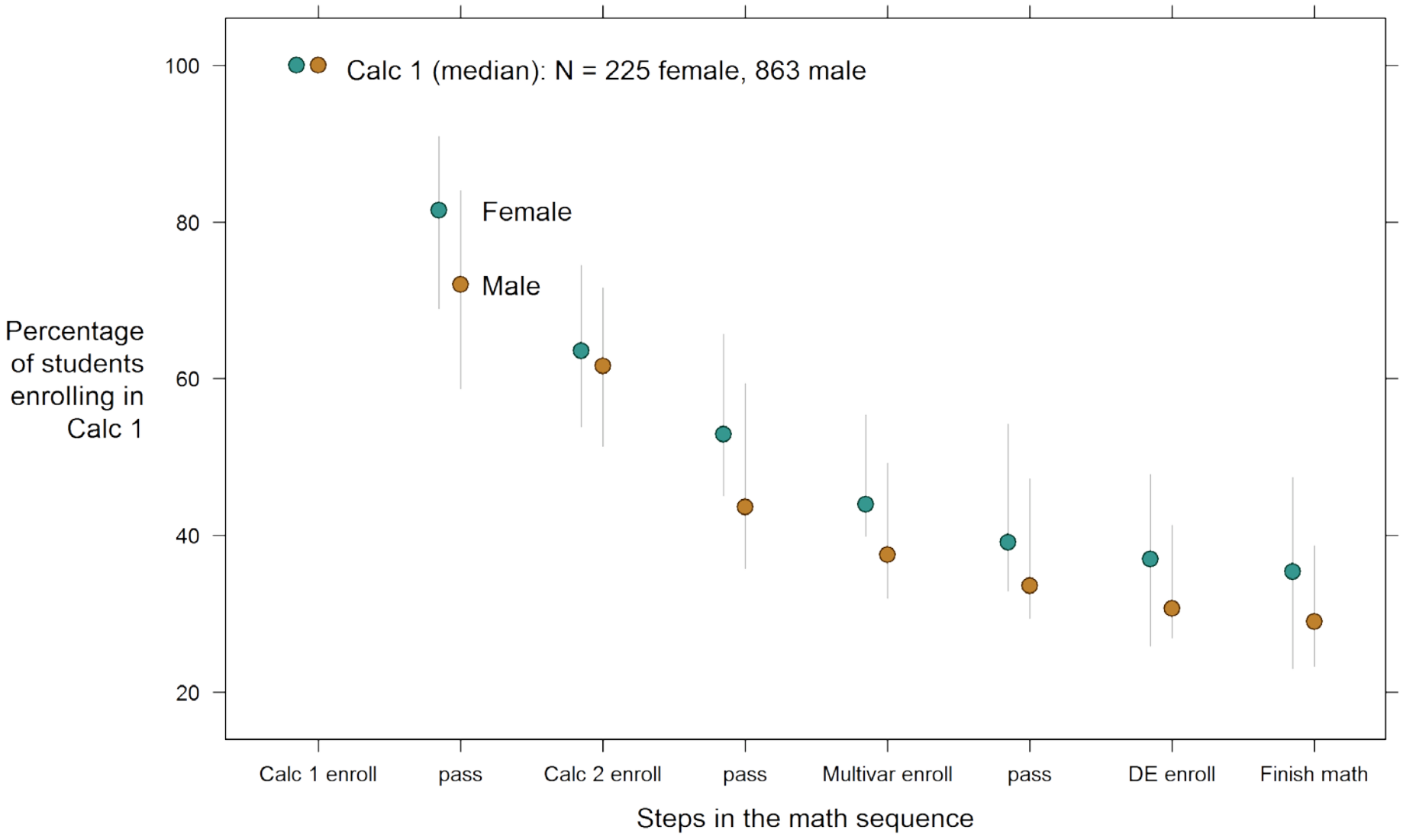
Comparing women & men not easy with this design.

reference

Steps in the math sequence are the independent variable (not time).



Dependencies are now directly observable.



The lie?
Concealing the story by emphasizing the trivial.

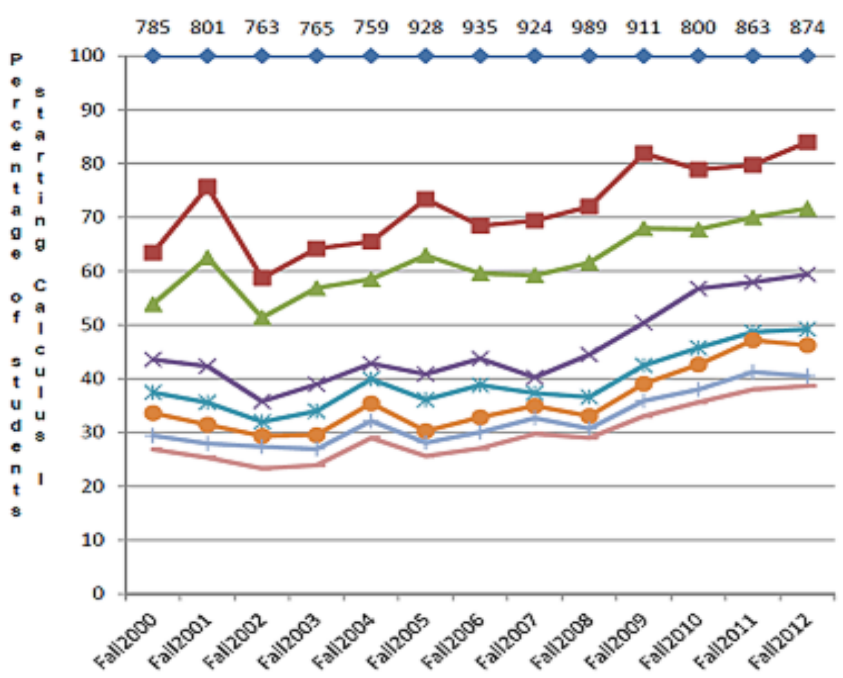


Figure 3. Male engineering student progress through the four-course mathe consecutive semesters.

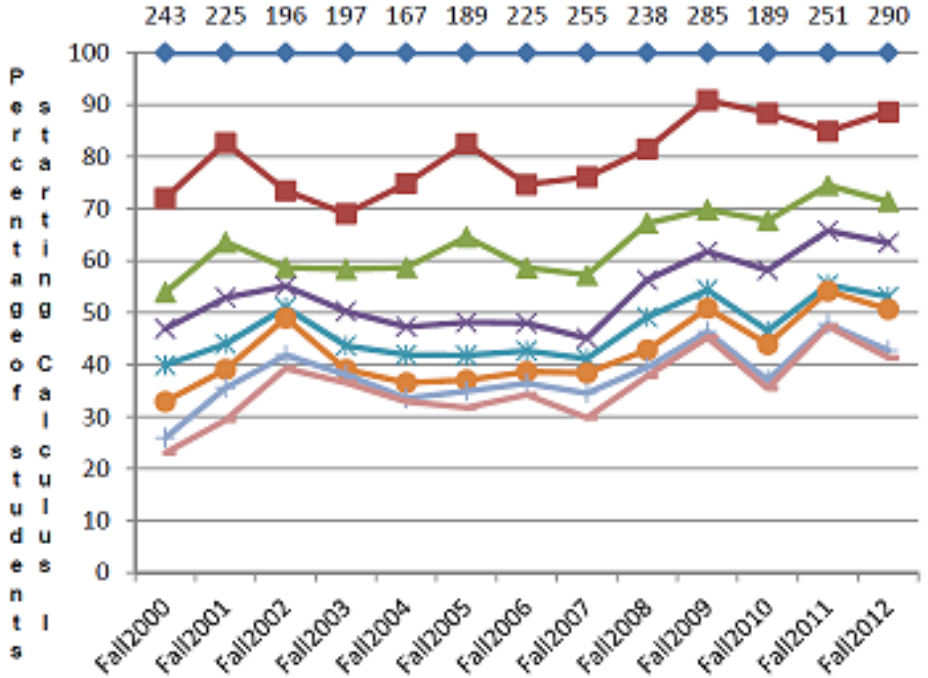


Figure 4. Female engineering student progress through the four-course ma consecutive semesters.

reference

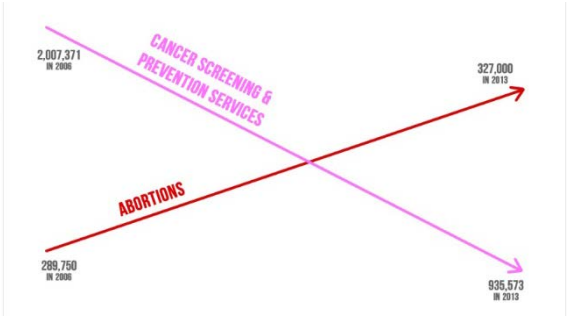
Edward Tufte

The main defense of the lying graphic is … "Well, at least it was approximately correct, we were just trying to show the general direction of change."

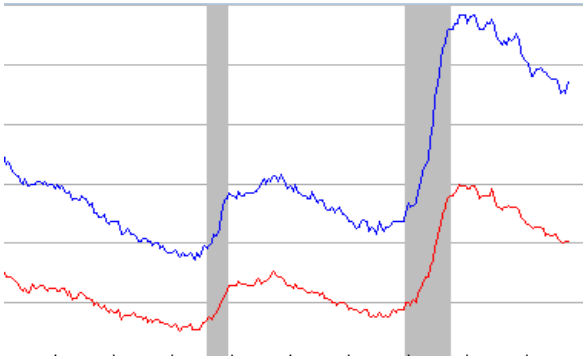
A second defense is, "although the design lies, the numbers are printed, as if not lying in one place justifies lying elsewhere."

reference

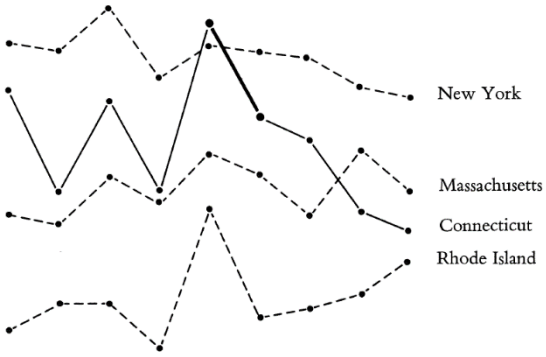
Implications for the designer.



Some graph designers abuse their power. Know the tricks used to deceive.



Avoid inadvertent deception due to laziness, bad design, and lack of context.



Don’t defend the lying graphic. Fix it!