It’s Not What We Said, It’s Not What They Heard, It’s What They Say They Heard

Barry D. Nussbaum, President
American Statistical Association

Fall Technical Conference
Philadelphia, Pennsylvania
October 6, 2017
Variations in Terminology

The arsonist that set some of the California fires claimed the fires were caused by global warming. But then he told the truth and said the fires were caused by global climate change.
The Supreme Court of the United States gets “significance” right
Matrixx and Zicam

Between 1999 to 2004 Matrixx received reports that Zicam caused anosma (loss of sense of smell).

Most of the cases were apparently total and permanent loss of the ability to smell.

NOT SUCH A BIG SURPRISE: A lawsuit was filed
Matrixx and Zicam

However Matrixx did not disclose these reports and announced they had a “very strong momentum” and “poised for growth” (Zicam was roughly two thirds of its sales).

After a link between Zicam and anosmia was broadcast on television in 2004, Matrixx’s stock price dropped from $13.04 to $9.94 (a decline of 24%).
Matrixx’s argument

Matrixx argued that back in 2004 they should not have been required to disclose small numbers of unreliable reports as all drug companies receive anecdotal reports on alleged adverse health effects.

Matrixx also argued they should only face liability for securities fraud if the reports had been statistically significant.
The lower court and appeal

A suit was filed against Matrixx alleging its statements about business growth and Zicam’s safety were false and misleading.

The District Court dismissed the case but on appeal the Ninth Circuit Court of Appeals reversed and remanded (sent back).

Matrixx filed a petition for a writ of certiorari (review) which the Supreme Court accepted and considered in January, 2011.
The Supreme Court in a unanimous decision rejected Matrixx’s argument that information can be material only if it meets some standard of statistical evidence.

“Given that medical professionals and regulators act on the basis of evidence of causation that is not statistically significant, it stands to reason that in certain cases reasonable investors would as well” (Justice Sonia Sotomayor).
The Supreme Court said that the presence or absence of statistical significance is not the key factor as to whether an adverse effect is material.

“The lack of statistically significant data does not mean that the medical experts have no reliable basis for inferring a causal link between a drug and adverse events” Justice Sonia Sotomayor.

**Conclusion:** Statistical significance is only a part of the quantitative aspects in the interpretation of results.
My Two Cents

1. The Supreme Court did not explicitly say anything about the “effect size”. This was a pretty large effect.

2. Note correspondence with ASA Principle 3: Scientific conclusions and business or policy decisions should not be based only on whether a p-value passes a specific threshold.
USA vs. Chrysler Motors

The Problem

- Ancillary data showed large exceedences of carbon monoxide values in 1975 Chryslers
- 208,000 vehicles with large displacements are involved
- Vehicles were “in-use” at the time
- Must be measured according to dynamometer test
An Important Victory Using Basic Statistics (cont.)

- Statistical Concerns
  - What is the population?
  - How do you do a random selection?
  - How do you make sure they are representative?
  - What incentive do you give a vehicle owner?
  - How do you find properly maintained and used vehicles?
  - Are there any distributional assumptions
  - What is the sample size?
How many cars were included in the sample size?

a) 10
b) 30
c) 100
d) 1,000
e) All of the above
f) None of the above
How many cars were included in the sample size?

a) 10
b) 30
c) 100
d) 1,000
e) All of the above
f) None of the above
This Creates Two Issues
Issue 1: YOU
Issue 2: The Judge
What Did We Say?

The 95% one-sided confidence limit is 0.74

So we told the judge:

We are quite confident that at least 74% of these vehicles would fail.
A Digression for Chemistry

- **Urban dynamometer driving cycle (LA-4)**
  - The “average” morning commute
  - Temperature and humidity controlled
  - 7.5 miles with frequent stops
  - Average speed is 19.6 miles per hour
  - EPA measures tailpipe emissions
  - Carbon in = carbon out
  - So what can you estimate based on all this?
Simple Presentation of Data Used in Policy

Fig. 2
How long is the U.S. coastline?

a) 95,000 miles
b) 19,924 km
c) 66,645 miles
d) 58,618 miles
e) 66,419 miles
f) Any of the above
g) None of the above
EPA’s Report on the Environment

In the mid 1990s, there were 105.5 million acres of wetlands in the lower 48 states; based on estimates in the late 1980s, there were 170 million acres in Alaska, 52,000 acres in Hawaii.

The Great Lakes are 60.2 million acres and contain 18% of the world’s fresh water.

Ground water provides approximately 50% of the nation’s public water supply.

3.7 million miles of rivers and streams in the lower 48 states.

66,645 miles of coastline.

Fresh water withdrawals - millions of gallons per day, 1995:
- Total water withdrawals: 402,000
- Public supply: 49,200
- Rural domestic & livestock: 134,000
- Irrigation: 190,000
- Thermoelectric power: 8,890
The Richardson Effect
How long is the U.S. coastline?

a) 95,000 miles  
b) 19,924 km  
c) 66,645 miles  
d) 58,618 miles  
e) 66,419 miles  
f) **Any of the above**  
g) None of the above
Accuracy of Data Collection Efforts

The Government are very keen on amassing statistics. They collect them, add them, raise them to the n-th power, take the cube root and prepare wonderful diagrams.

But you must never forget that every one of these figures comes in the first instance from the village watchman, who just puts down what he damn pleases.

Sir Josiah Stamp
Inland Revenue Department
(England) 1896-1919
I didn't have any accurate numbers so I just made up this one.

Studies have shown that accurate numbers aren't any more useful than the ones you make up.

How many studies showed that?

Eighty-seven.
Summary

- Ensuring the proper interpretation of data is challenging
- KNOW the problem
- Getting the sample is the real trick
- Don’t make the model too complex
- Simple, digestible presentations for policy-makers are essential. Put yourself in their seat
- This sounds awfully simple but don’t be fooled, it is quite powerful!