

MIT Professor Arnold I. Barnett
Is the guy the media calls when
an airliner goes down.

One in 10 Million

MIT's Arnold Barnett thrives in role as aviation safety expert

It's a Crime What Some

By ARNOLD BARNETT

The truism that statistics can be misleading has no more content than the statement that paragraphs can be misleading. But certain statistics that are indeed highly misleading have made their way into debates about crime, punishment and race. The resulting misconceptions have intensified already bitter disputes, and can only sow confusion among voters.

For example, in the controversy over whether innocent people are being executed, a 1-in-7 ratio has attained prominence. Newsweek sought to explain the ratio when it stated that "for every seven executions nationwide since the death penalty was reinstated in 1976, one death-row inmate has been set free." William F. Buckley Jr. probably reflected the common understanding of this statistic when he wrote that "if the figures work out retroactively, then one out of seven (of the 640) executed Americans was, in fact, innocent."

Greatly upset by the ratio, the Economist noted that "if an airline crashed once for every seven times it reached its destination, it would surely be suspended immediately." A bit of probing makes clear, however, that the ratio makes no sense.

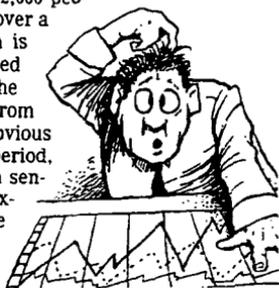
There is an obvious interest in the error rate for capital-sentencing, which is the number of innocents sentenced to death divided by the total number of people thus sentenced. Also of importance is the error rate for actual executions: the number of innocents executed divided by the total number executed. In an ideal world, both these rates would be zero.

The 1-to-7 ratio, however, represents neither of these rates but rather a con-

fused amalgam of their components. It divides the number of known innocents freed from death row by the number of executions. In other words, it divides the numerator of the error rate for capital-sentencing by the denominator of the rate for executions. Such a calculation is of no value: It is akin to computing an earnings-per-share statistic by dividing the earnings of one company by the number of shares of a completely different one.

Suppose that there are 2,000 people on death row and that, over a given period, one of them is found innocent and freed while one is executed. The only reliable inference from these statistics is the obvious point that, during this period, both executions and known sentencing errors were extremely rare. To divide one by the other while ignoring the 2,000 altogether does not demonstrate that executions are fraught with errors; it is a meaningless act that yields no insight.

Another confusing statistic appeared several months ago when the New York Times described a Columbia University/New York State study about police stops and searches of New York City residents. The "most basic finding" of the study, the Times reported, was that blacks were stopped six times as often on a per-capita basis as whites. And, "even when the numbers are adjusted to reflect higher crime rates in some minority neighborhoods," blacks were stopped 23% more often than whites.



William B.

Our Keynote speaker, Professor Barnett was published on the Op-Ed page of the Wall Street Journal on August 30, 2000. The examples he used were the same as in his Hershey speech to IACA.

People Do With Statistics

Hold on a minute. The original black/white stop ratio was six (as opposed to the value of one, which would mean equal stopping rates). After an adjustment that the researchers thought appropriate, the ratio fell to 1.23. Thus, instead of 600 blacks stopped for every 100 whites in comparable groups of equal size, 123 blacks were stopped. The disparity still exists, but it is far smaller. Put in percentage terms, the black/white excess fell from 500% to 23% (i.e. declined by a factor of 20).

It is unclear whether readers of the Times grasped this last point because, instead of working consistently with ratios or with percentages, the Times started with the former and then shifted to the latter. Matters were especially confusing because the Times narrative repeatedly suggested that the adjustment had reaffirmed the "basic" finding rather than nearly overturned it.

Over at National Review, an author noted that homicide in the U.S. plummeted in the 1990s, while executions soared, and discerned a deterrent effect of capital punishment. But this aggregate correlation misses a crucial local detail: Recent drops in killing have been greatest in places (e.g., New York City, Boston) where no death sentences have been carried out during the past three decades. Unless one believes that an execution in Virginia that goes unreported in the Bronx nonetheless

prevents some killings there, one should be wary of statistics that pool Virginia executions with Bronx murders.

There is more. A full-page ad from the American Civil Liberties Union, placed in several prominent magazines, showed a picture of Martin Luther King Jr. next to one of Charles Manson. The accompanying text declared that "the man on the left is 75 times more likely to be stopped by the police while driving than the man on the right." The basis of this finding was that "in Florida 80% of those stopped and searched were black and Hispanic, while they constituted only 5% of all drivers."

This analysis is baffling. It is hard to imagine that the 5% figure is accurate: Government statistics indicate that blacks and non-black Hispanics constitute 29% of all Florida residents, and that these groups drive approximately 20% of the state's vehicle miles. Moreover, applying the statistics to a comparison between Dr. King (who presumably represents innocence) and Manson (who presumably represents guilt) requires a strong tacit assumption: that race was the only determinant of auto stops in Florida. A car would not be stopped, for example, merely because it was going 110 miles per hour down Interstate 95. Simply stating such a premise suggests its absurdity.

We should not overreact to such frightful statistical "analyses." Some of them might reflect not deliberate distortion but rather innocent intellectual disorder. Furthermore, the fact that certain numbers are flawed need not invalidate the general point they try to advance. It could well be that there are some innocent people on death row, much as race could play an indefensible role in some police stops. Such possibilities should be investigated in sensible and unbiased ways.

In the meantime, certain widely cited statistics should be sent into exile.

Mr. Barnett is a professor of management science at the Massachusetts Institute of Technology.

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Actuaries,
Statistics,
and Sex (?)

Arnold Barnett
MIT

"46% of President Clinton's appointments to the federal bench are millionaires, as compared to 21% of President Reagan's and 32% of President Bush's."

National Review, 4/5/99

TIME magazine (2000):

"Oscar loves films with concise titles"

Best Picture	<u>Words in Title</u>
One Word	6
Two Words	4
Three Words	9
Four Words	0
Five Words	1

(Mean = 2.7 words)

(Median = 2.5 words)

39 American movies advertised
in the Boston Globe of 5/27/00:

Title Lengths:

Mean = 2.6 words

Median = 2 words

National Journal (1999):

Of the 234 sons of members of Congress who reached military age during the Vietnam War, only 28 (12%) served in Vietnam.

Overall US pattern:

- 2 million men turned 18 every year during the Vietnam War
- Average US troop strength in Vietnam was 250,000
- Usual tour of duty was one year

Based on these figures, one would estimate that 1 in 8 (12.5%) military-age American men served in Vietnam.

"For every seven executions nationwide since the death penalty was reinstated in 1976, one death-row inmate has been set free."

- - Newsweek, 5/31/99

What if anything does this statistic mean?

"If the figures work out retroactively, then one out of seven executed Americans was, in fact, innocent."

- - William F. Buckley Jr., 4/11/00

Two relevant error rates:

$$R = \frac{\text{\# wrongly executed}}{\text{total \# executed}}$$

$$U = \frac{\text{\# wrongly sentenced to death}}{\text{total \# sentenced to death}}$$

Why compare the denominator of R with the numerator of U?

Suppose that, in a given year:

- One person is executed
- Two people are freed from death row
- 10,000 remain on death row

What should we make of this pattern?

The number 828 came up in the Connecticut State Lottery on both 1/9/98 and 1/10/98

Time magazine announced that a "one in a million" event had occurred (1/29/98)

But:

Wouldn't Time have been just as excited if the number 454 had come up two days in a row?

Or if the two consecutive days had been Jan 5 and Jan 6 rather than Jan 8 and Jan 9?

In fact:

The chance of getting some number to come up two days in a row in the Connecticut lottery is 31% per year.

And wouldn't Time have been just as breathless if the same coincidence had occurred in New Jersey or California?

In 1995, New York's Metropolitan Transit Authority (MTA) announced a fare increase on its trains:

20% on New York City subways

9% on commuter rail lines

In response to criticism, the MTA said that the increase would hit suburbanites the hardest.

Really? Consider a typical suburbanite's fare increase:

	<u>Old Fare</u>	<u>New Fare</u>
Subway	\$1.25	\$1.50 (+20%)
Commuter Train	\$3.00	\$3.27 (+9%)
Total	\$4.25	\$4.77 (+12%)

How important is New York City's recent drop in homicide?

In 1990, New York City had 2300 homicides.

Given that its population was about 7.5 million, that works out to about one killing per 3300 residents that year.

At a risk of about 1 in 3300 of being murdered each year over a 70-year life, the total chance of dying of homicide is roughly

$$70 * (1/3300) = 1 \text{ in } 50$$

In 1999, there were about 650 killings in New York City.

That works out to one killing per 11,500 residents, and a lifetime murder risk of about 1 in 170.

The difference between 1 in 50 and 1 in 170 suggests that:

The net effect of NYC's drop in homicide between 1990 and 1999 - - assuming that it persists - - will be to save the lives of 1 in 70 newborn New Yorkers.

JD Power and Company (2000):

"The short-haul segment (of the domestic airline industry) has seen an overall decline in customer satisfaction, with only three carriers at or above the industry average compared to six in the 1999 study."

But consider a possibility:

(1999) _____

(2000) _____

New York Times (2000)

One classic measure of segregation:

The probability that a black student would
have white classmates

"Or, more precisely, what percentage of a
typical black student's classmates are likely
to be white."

More Precisely?

How safe is it to fly?

Measure of Safety:

Death Risk per Randomly
Chosen Flight

If a passenger picks a flight at random from among the set of interest (e.g. US domestic flights over 1990-99), what is the probability she will not survive it?

Death Risk per Flight, US
Domestic Jets, 1990-99:

1 in 12 million

At that level of risk:

A passenger who took one flight per day could on average travel for 32,000 years before succumbing to a fatal event.

Death Risk per International Jet Flight

in Two Airline Groups, 1987-96

First-World Carriers 1 in 3 million

Developing-World Carriers 1 in 400,000

Death Risk per International Jet Flight
Between First and Developing World,
1987-96, On Two Groups of Airlines

First-World Carriers 1 in 600,000

Developing-World Carriers 1 in 600,000

Ecological Fallacy?

The Boston Globe reported a study
that estimated that survivors of
heart attacks were twice as likely
as usual to have been angry
immediately before the attack.

The implication: angry hearts are
endangered hearts

"VIAGRA has shown improvement in erectile function in 4 out of 5 men compared with 1 out of 4 for sugar tablets."

-Ad, Conde-Nast Traveler, June 2000

What do these statistics mean about the effectiveness of VIAGRA?

Let Q = fraction of users who directly benefit from VIAGRA

Then Q can be approximated from the equation:

$$Q + .25(1-Q) = .8$$

which implies that $Q = .72$