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"Figures Prove"

Fallacy Number Eight

IN *Life on the Mississippi* Mark Twain shows us what figures can do — if you combine them with imagination.

> In the space of 176 years the Lower Mississippi has shortened itself 242 miles. This is an average of a trifle over one mile and a third per year. Therefore, any calm person, who is not blind or idiotic, can see that in the Old Silurian Period, just a million years ago next November, the River was upward of 1,300,000 miles long, and stuck out over the Gulf of Mexico like a fishing rod. And by the same token, any person can see that 742 years from now the Lower Mississippi will be only a mile and three-quarters long, and Cairo and New Orleans will have joined their streets together …

THE NEW AUTHORITY

A witty Frenchman once remarked that Americans like ice cream and statistics, as both slip down so easily. The more decimal places in the statistics, I might add, the easier they slip. What Aristotle symbolized to the ancients, and Pliny to Columbus, "science" and "statistics" represent to the modern generation. Science of course well merits our interest, for ever since Galileo it has been transforming the world. Without science, especially medical science, probably half the world's present population would not be alive. When legitimate interest in science turns to blind worship, however, we have another example of the logical fallacy of *ad vere-*

cundiam. Instead of bowing to the great man, we bow down to four decimal places.

Favorite symbols for "science" are the microscope, the white coat, the beard. When an advertiser decides to use this pitch he gives us a picture of a stern-looking gentleman in a white coat and Vandyke beard, peering down a microscope, with the caption "Science says . . ." The *New Yorker* reports that a laboratory technician rushed into a barbershop on Fifty-eighth Street to borrow a couple of coats. "Some advertising men are up in the lab taking pictures," he explained. "They said we had to get some white jackets to wear because scientists always wear white jackets."

As an economist and accountant I have long been interested in fallacious deductions from statistics. Another author, Darrell Huff, has been interested enough to write a book about them.[1] It is well worth reading in toto, as you will see from the samples I shall presently quote. These fallacious deductions can be classified in a number of ways, as noted in Chapter 9, where statistical *post hocs* were examined with some care.[2] In the present chapter we will ride a few dizzy curves into the future — a form of travel known as extrapolation. We will then look at various illegitimate deductions from figures and scientific "laws."

RIDING CURVES

The Mark Twain story is a perfect case of dizzy extrapolation, where a curve is ridden one million years into the past, and 742 years into the future. Riding it, Mark "proved" that the Mississippi River did not belong on any real map — only in Cloud-Cuckoo Land.

Take a piece of cross-section paper, and a copy of the *World Almanac,* and with these plot the population of the

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[1] *How to Lie with Statistics*, Norton, 1954.
[2] Cohen and Nagel list eleven kinds of statistical fallacies.

U.S. from 1800 to 1860. Look, it doubles every twenty years, no doubt about it. Let us climb aboard this curve. By 1940 it has reached 503 million people; by 1960 just over a billion![3] But the actual U.S. population in 1940, according to the Census, was only 131 million. More than seventy years ago, in his second message to Congress, Lincoln fell into a similar error. He predicted that by 1930, the U.S. population would reach 251,689,914. All the Census could actually find in 1930 was 122,775,046.

The Population Reference Bureau calculates that the percentage of American sixty-five years of age and over has doubled since 1900.[4] Along with this trend has gone an increase in the proportion of older women. All correct so far. Then the Bureau takes off into the wild blue yonder. "In terms of voting power, ownership of land, and common stocks, the U.S. can be seen on the road toward a gerontomatriarchy — control by aging females." Anthropologists have not yet found a society completely controlled by females, aging or otherwise, though they have located societies where the ceremonial killing of the aged is practiced.[5]

Huff cites a report that in the five years between 1947 and 1952, television sets in American homes increased about 10,000 percent. "Project this," he says, "for the next five years and you'll find there'll soon be a couple billion of the things, heaven forbid, or 40 sets per family." If you want to be even sillier, he says, take a base year earlier than 1947 and "prove" that every American family will soon have 40,000 TV sets.

A statistical fallacy closely allied with extrapolation concludes that if a certain cause produces a certain effect, then twice the cause will produce twice the effect. If a glass of milk is good for you, two glasses are twice as good. Maybe, but

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[3] William Tell's note: Four billion by the year 2000.
[4] UP dispatch, May 8, 1955.

not five glasses. If one old-fashioned cocktail makes you feel fine, then ten will improve your well-being tenfold. More probably, however, they will make most people feel perfectly awful, assuming they can feel at all.

THE PROFIT ANGLE

Soon after I received my C.P.A. degree, I was retained to study the accounts of a large corporation. The company was claiming in a blaze of publicity that its profits were so small it was practically giving away the product. Net income was said to be a beggarly one cent for every dollar of sales. This did look modest indeed.

I found the figure correct — but not the conclusion. Digging deeper, I noted that average net earnings in recent years, measured against the company's investment, or net worth, were spectacular. Stockholders were earning far more than in other concerns in the same field. Thus the ratio of profit to sales was a true figure but irrelevant. In a business enterprise what really counts is the ratio of profit to *investment*.

By shifting the scale in drawing a chart you can favor an argument, while your opponent, by selecting another scale, can ruin it. Suppose you want to show profits rising like the Rocky Mountains. You make the dollar scale and the time scale look like this:

Profits in
dollars
$160
150
140
130
120
110
100
Time   1950   '51   '52   '53   '54   '55

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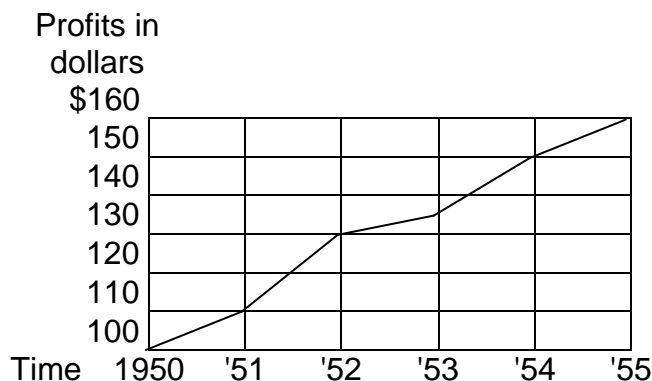
[5] Those Amazons, alas, were a discovery worthy of old Dr. Cook. Say Ralph Linton in *The Study of Man:* "It is questionable whether there is any society in existence which is completely dominated by women."

But your opponent wants to play down the profits. So he plots exactly the same figures, but with a wider time scale and a narrower dollar scale, like this:

Profits
in dollars

$200
160
120
80
40
0

Time   1950   '51   '52   '53   '54   '55
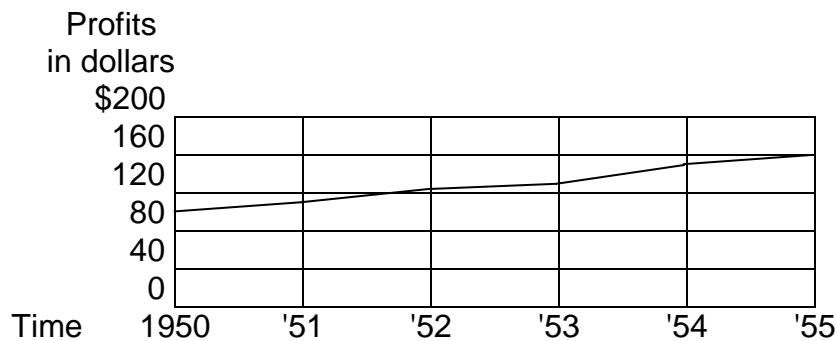
What a pedestrian showing for the period these "figures prove"!

Another joker lies in confusing an increase in *percentage* with an increase in *percentage points*. If your profits on investment go up from 5 percent one year to 10 percent the next, you have made a legitimate increase of 100 percent — an excellent showing on any set of books! But the same thing can be described with equal accuracy as "a rise of five percentage points" — which sounds like practically nothing at all.

Polls of public opinion have been known to confuse percentages with percentage points. They have also been known do drop the "D.K.'s," "don't knows," down the trap door in reporting results. For example, suppose 40 percent of respondents say "yes," 10 percent say "no," and 50 percent say "don't know." If a pollster throws out the "don't knows" and reports that 80 percent of the people are in favor and only 20 percent opposed, he gravely distorts the actual situation.[6]

A favorite statistical pastime in late December is forecasting business conditions for the new year. The experts toss in their

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[6] Responsible pollsters guard against these errors.

predictions, while businessmen listen spellbound. If the consensus of expert opinion is for a 10 percent rise, a smart operator may predict an increase of 11.53 percent. Not only does this figure top the field, but those two decimal points look most authoritative. He could equally well have used seventeen decimal places, and still the shape of next year's business would be only a guess. So many things can happen tomorrow which are unknown today — wars, peace scares, new inventions, storms, floods, strikes, the unending foolishness of politicians. The Valley National Bank of Phoenix, Arizona, in an ironical prospectus issued in 1954 put it this way:

> The most dependable forecast that anyone can make regarding 1955 is that, irrespective of what happens between now and the end of the year, all forecasters will be predicting an increase in business in 1956.

As I write this chapter, late in December, 1955, all the forecasters, except a few terrible-tempered Mr. Bangses, are predicting a roaring business for 1956.

DECIMAL PLACES

Decimal places exert an uncanny fascination, and the more there are the more impressive they appear. A graduate student in psychology aspiring for a master's degree may send out this questionnaire:

> In eating pickles would you say you
> ( )   Like them very much
> ( )   Like them somewhat
> ( )   Are indifferent to them
> ( )   Dislike them mildly
> ( )   Dislike them intensely
> Please check the statement that comes nearest to your feeling about pickles.

He sends it to 5,000 addresses and gets 470 replies, divided, in the order shown above: 108, 82, 67, 95, 118. From these

data it is legitimate to conclude that of the people who answered, slightly more dislike pickles than like them, and that's about all one can conclude. But our student boldly goes ahead. He sends his data to the calculating department of the university and receives the following results:

Strongly for pickles	22.98%
Mildly for pickles	17.45
Indifferent to pickles	14.25
Mildly against pickles	20.21
Strongly against pickles	25.11
Total	100.00%

It is easy to be impressed with these decimal places, all adding up neatly to 100.00 percent. But our student has never looked behind his figure to the actual human picture, where most of his list throw the questionnaire in the wastebasket with a snort, and where those who do answer tap their teeth with a pencil trying to make up their minds how in hell they do feel about pickles.

Figures are never any better than the physical data on which they are based, and stringing out the decimal places only serves to camouflage the error. In the pickles case, the physical data are subjective, uncertain, and incomplete. But it is no worse than some other figuring which consumes a good many man-years in our universities, and often applies to more important matters than pickles.

ASK FOR A BREAKDOWN

Huff cites an argument about fatal accidents due to motor-cars compared to railroads. Everyone present agrees that the automobile tops the field, but Mr. A. claims that the railroads hardly ever kill anyone nowadays. Mr. B. counters with the report that they killed 4,712 persons last year, not

including railroad employees. His figure is correct, and looks like a long way from "hardly anyone."

Mr. A., obviously a student of logical fallacies, demands a breakdown — what we should all request in such cases. The breakdown discloses that half the railroad victims were motorists who tried to argue with a locomotive at grade crossings, and most of the other half were riding the rods. Only 132 of the 4,712 fatalities were bona fide passengers. Thus Mr. A. has the best of the argument in the end — railroads kill relatively few ticket holders.

The high command of the Republican party seems to be following Mr. B. Recently it reported 8,008 government employees dismissed for "reasons of security." One major implication was that they were all Communists, with the further implication that the administration had been vigilant in rooting the subversives out. A breakdown, however, indicated that only a tiny fraction of the 8,008 had been fired for actual disloyalty. Political opponents call this kind of reporting the "numbers game," and logicians might call it a genuine *ad verecundiam*, where figures appear to prove something very different from the facts.

Huff tells how a national labor organization showed a chart with index numbers for corporation profits rising much more rapidly than index numbers for wages, after the depression of the thirties. The figures were correct, and at first glance it looked as if the downtrodden worker had been stepped on once again. A second glance, however, disclosed the fallacy of the reasoning. At the bottom of the depression, corporate profits as a class were in the red, but wages, while low, were still being paid. As better times crept back, the index of profits was bound to go up much more steeply than the index of wages.

Speaking of wages, the fast operator in statistics can always have a field day with averages. Let us take a very simple case, involving the income of everybody in a small business. The proprietor is accused of paying starvation wages. He replies that the average income for those working in his business is $3,000 — not so bad. But a breakdown shows:

1 Proprietor	$20,000	
1 Office worker	2,000	
8 Shop workers	8,000	(or $1,000 each)
10 workers get	$30,000	

The average, to be sure, is $3,000, but no one except the boss receives as much as that.

An "average of averages" can scramble things up even more. One of the first rules I learned as a cub accountant was to shy violently at an average of averages. Here is a case:

In a class of 10 children, 3 boys and 7 girls take a test in arithmetic. The boys average 70 percent; the girls average 90 percent. What is the average for the class?

If we average the averages, we get 80 percent for the class. (70+90=160, divided by 2=80)

But if we see the pitfall, we calculate the class average at the *correct figure of 84 percent.* (3 boys at 70=210, +7 girls at 90=630. 210+630=840, divided by 10=84)

A recruiting sergeant citing figures can convince most people that the death rate in the U.S. Army in war is less than the death rate in any big American city during the same period. "So enlist, you so-and-so's, and keep healthy!" What the sergeant fails to mention is that the city death rate includes sick people, old people, and infants, while the army death rate is based on healthy young men between eighteen and thirty-five.

DANGER: MEN FIGURING

After reviewing a large number of statistical fallacies, Huff gives us five trenchant warnings. Before meekly accepting a deduction from any set of figures, ask yourself:

1. Who says so?
2. How does he know?
3. What's missing?
4. Did somebody change the subject — i.e., shift the base, or the scale?
5. Does it make sense?

To which I might add that no figures are better than the original data, whatever the number of decimal places.

After developing his magnificent concept of proof, Pythagoras fell into the dismal swamp of mystic numbers — especially number 7. Some economic statisticians seem to be following him with their mystic index numbers for "production in general," including everything a nation produces, from apples to locomotives.[7] The more complicated the mathematical systems of averaging, chaining, and least squares, the more dubious the result. Mathematics cannot legitimately be used to jam together on paper things which are never jammed in the outside world except in freight-train wrecks.

The authority of mathematics was once used with devastating success at the Russian Court in the days of Catherine the Great.[8] The Empress was alarmed by the visit of Diderot, encyclopedist and materialist, and feared that he might undermine the faith of her court retainers. So she asked the noted mathematician Euler to put Diderot in his place. The Court was summoned to hear the debate. Euler led off by informing

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[7] See *Horses and Apples*, by Bassett Jones (John Day, 1934).

[8] Lancelot Hogben, *Mathematics for the Million* (Norton, 1937).

his opponent that the existence of God had been conclusively established. The proof lay, he said, in the equation:[9]

$$(a+b^n)/n = x$$

"Donc Dieu existe — répondez!" — Therefore God exists — reply!

Diderot was as terrified as any American college freshman by this equation. Instead of replying he fled the assembly, shut himself up in his chambers, and demanded a safe-conduct back to France.

And here is a practical mathematician from Britain. A roadside merchant was asked how he could sell rabbit sandwiches so cheaply. He replied: "Well, I have put in some horse meat too. But I mix 'em strictly fifty-fifty: one horse, one rabbit."

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[9] William Tell's note: given the difficulty of displaying equations in HTML, we use Excel notation.