Wizards of Odds

Yes, it's possible that you could be brained by a piece of space junk on your way to work. Or trampled by an escaped elephant. Or mauled by a great white. But what are the odds?

By Fred Kilbourne

WE ACTUARIES DEVOTE OUR LIVES TO PROBING and prodding the quantity QAV, where Q is risk (the probability that an event will occur), A is the cost of that (usually) untoward event, and V allows for the time value of money. This article is about Q.

"I've developed a new philosophy... I only dread one day at a time." This quote from Charlie Brown introduces *Risk: A Practical Guide for Deciding What's Really Safe and What's Really Dangerous in the World Around You* by David Ropeik and George Gray of the Harvard Center for Risk Analysis of the Harvard School of Public Health (Houghton Mifflin Co., 2002). Their book does indeed address dread and fear, but its dedication is to someone who was exemplary at keeping risk in perspective. The goal, of course, is to have your dread be rational, which requires that you take three steps:

- Quantify the risks you face (the enemy here is less ignorance than it is bias in overestimating some risks and underestimating others);
- To the extent you can influence these risks, optimize them (this assumes that you're unwilling to minimize your automobile accident risk by staying out of and away from cars);
- Get on with your life (this article is about the first step; you're on your own for the other two).

The actuary can appreciate the authors' definition of risk as "the probability that exposure to a hazard will lead to a negative consequence." Your death or dismemberment, for example. So *Risk* includes the lifetime odds of the average American meeting his or her demise by reason of a fatal:

Heart attack	1 in 4
Cancer	1 in 7
Stroke	1 in 23
Dementia	1 in 75
Auto accident	1 in 88
Gunshot (suicide)	1 in 210
Gunshot (homicide)	1 in 360
Gunshot (accident)	1 in 6,000
Lightning strike	1 in 39,000
Airliner crash	1 in 40,000
Bee sting	1 in 80,000
Dog bite	1 in 240,000
Bubonic plague	1 in 240,000
Malaria	1 in 1,200,000
Shark attack	1 in 3,700,000

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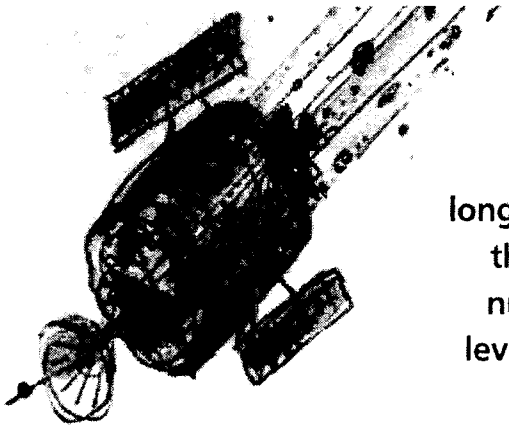

"Leventy" is the word that was coined long ago by my brother to denote the number that is one greater than the largest finite number you can come up with. And even leventy is but an infinitesimal portion of the smallest infinity you can imagine.

Consider heart attack versus shark attack. Do you have 1 million times the dread of the former versus the latter? OK, that doesn't do a very good job of showing risk evaluation bias, because you live in Kansas and vacation in Nebraska.

Well, then, how about this: The average heart attack does more damage to the body than does the average shark attack. And, returning to mortality, are you 455 times more fearful in a car than in a plane, as you should be? (OK, OK, adjust the odds for mileage, or vehicle, or driving style, but the basic point remains.) The basic point is, of course, that risk is best evaluated by substituting facts for appearances and demonstrations for impressions (the motto of the Society of Actuaries).

I recall being surprised but enlightened some years ago, when I was commuting by bicycle and flying a lot, to calculate that my chances of dying in a bike or car or plane accident the following year were each the same—about one in 10,000.

Most of *Risk* addresses several dozen known risks, from auto accidents to X-ray exposure. For each, the authors examine the hazard, the range of consequences, and what you can do to reduce your risk. Each is also evaluated on a "Risk Meter" on which the probabilities and consequences are graded from low to high. The social and psychological biases, which we must overcome if we're to "keep risk in perspective," are evident from a thorough reading of the book.

High-risk hazards, nearly all of which we tend to underestimate, include:

- Automobiles and tobacco
- Misuse of alcohol and food (think obesity)
- Iatrogenic injury (aka medical treatment, including medical error)

Low-risk (and in some cases no-risk) hazards, nearly all of which we tend to overestimate, include:

- Artificial sweeteners
- Apples and cranberries
- Electrical and magnetic fields
- Irradiated and genetically modified foods
- Lead and mercury

Some hazards require individual comment, but even these with the passage of time are often exposed as conforming to Mark Twain's comment quoted in *Risk* ("There is something fascinating about science. One gets such wholesale returns of conjecture out of such a trifling investment of fact."):

- Mad cow disease (Even better than SARS as a television event since, although the risk of contracting it is minuscule, it turns your brain into Swiss cheese.)
- Smallpox (More horrible than anthrax or a shark attack, it was eliminated as a public health hazard by concerted human activity—perhaps excepting terrorists.)
- DDT (A perfect example of overreaction by the civilized world to minimal human hazard in that millions have died of malaria in poor countries since mosquitoes have been protected from DDT.)
- Global warming (The jury is out, but where is Mark Twain when we need him most?) *USA Today*, more than other newspapers, keeps its readers up-to-date on the odds of succumbing to the menace du jour. While it usually presents annual rates, these can readily be converted to lifetime odds, with results that are generally (but not in every case) consistent with those in *Risk:*

Grim Reaper (one way or another)	1
Heart attack	5
Cancer	8
Stroke	26
Auto accident	93
Gunshot	130
Falling	260
Walking (in front of cars and trucks)	800
Drowning	1,000
Bicycling	6,700
Airliner (includes commuter flights)	13,000
Lightning	40,000
Shark attack	1,300,000
SAR	1,300,000
Roller coaster accident	4,000,000
Anthrax	6,000,000
Mad cow disease	—

One person has died in the United States of mad cow disease, but it was contracted elsewhere, so does that count? But it's hard not to dread a poorly understood disease that you contract simply by eating, that is caused not by a virus or bacterium but rather by a prion, that may afflict your cat but not your dog, and that eats holes in your brain before it kills you. The risk may be minuscule, but it fairly cries out to be overestimated.

Long odds, such as of contracting mad cow disease, are not only subject to considerable uncertainty (see the differing shark attack estimates above), but they can require access to very large numbers to make your point. An excellent source for this

search is the 1997 *Scientific American* article "The Challenge of Large Numbers" by Richard E. Crandall, which introduces the reader to such colossi as (the numbers in the list are powers of 10, or the number of zeros after the one):

- The number of grains of sand to fill the known universe (accurately estimated by Archimedes some years ago); 51
- The number of atoms in the universe (as can be estimated from readily available sources on your bookshelf); 80
- A googol (the word coined in 1938 by the 9-year-old nephew of mathematician Edward Kasner); 100
- A googolplex (being 1 followed by a googol of zeroes, a seriously large number); googol
- The fourth Ackermann number (the first three in his series are 1, 4, and roughly 10 to the 40th power); 3.6 trillion

According to Crandall, the fifth Ackermann number "is so large that it could not be written on a universe-size sheet of paper, even using exponential notation."

And yet even the largest Ackermann number is surpassed by "leventy," the word coined long ago by my brother (or was it my sister?) to denote the number that is one greater than (literally one-ups) the largest finite number you can come up with. And even leventy, as any mathematician will tell you, is but an infinitesimal portion of the smallest infinity you can imagine.

Back to the merely sublime, other sources have a different view of your mortality prospects. According to "Life: The Odds" by Gregory Baer and other sources in a Feb. 22, 2004, *San Diego Union-Tribune* article, these are your chances of being killed by:

Murder	240
Dog attack	9,000
Really big rock hits Earth (OK, low frequency, but the high severity brings the odds down.	20,000
Food poisoning	40,000
Legal execution	46,000
Mountain lion attack (California)	426,000
Shark attack	4,000,000
A big rock hits your house	2 trillion

Not all long odds relate to bad news, of course. There's also some chance that you will:

Bowl a perfect game (one try)	4,000
Find a four-leaf clover (one try)	10,000
Hit a hole-in-one (one round)	12,000
Get a royal flush (one hand)	650,000
Get a Congressional Medal of Honor (if you're in the military)	11,000
Win an Oscar (if you're in show business)	11,500
Get a Rhodes scholarship (if you're in college)	37,500
Become President of the USA	10 million
Be named a saint	20 million
Both of the previous two	(see Ackerman's sixth number)

And now for my disclaimers and caveats. I do not warrant or certify the numbers in this article, particularly as they apply to you. The data supporting them were taken from sources that have been known to be reliable, but haven't been audited or checked for accuracy nor even for plausibility. Actual results, especially yours, may vary, for the future is a willful child, put on a straight path by its parents (the past and present) but subject to straying under the wayward influence of its new environment (think anthrax or smallpox).

Finally, it's as important now as it was 65 years ago to pay careful attention to the wizard behind the curtain, who taught us that: medals can be more useful and less risky than courage; a paper heart can be worn on the chest or on the sleeve and can't be broken; and you may as well forget the brain and go for the diploma. ●

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