

## UNCONVENTIONAL WISDOM

*New facts and hot stats from the social sciences* • By Richard Morin

# What are the Chances of *That*?!?

Dartmouth College mathematics professor J. Laurie Snell knows the oddest odds.

He's figured the odds that your next swallow of air will contain at least one molecule from the last earthly breath of Jesus Christ, Copernicus or Julius Caesar.

He also knows there's a good chance you aren't infected with HIV even if you test positive on the standard HIV-screening test.

He even knows when it's a good bet to play the lottery.

Not only does Snell know these things, he's using such examples to teach others how to think about numbers. These true but sometimes counterintuitive stories, culled from the pages of major newspapers, are the centerpieces of his classroom lectures. They're also featured on the hugely entertaining and informative Chance Web site ([www.dartmouth.edu/~chance](http://www.dartmouth.edu/~chance)) and in the Chance News, which he publishes with the help of Bill Peterson of Middlebury College and Charles Grinstead of Swarthmore College.

Recently, I asked Snell to select some of his all-time favorite stories from the newsletter, which he's published since 1991. Here are his picks:

**THE STATISTICS OF SHAKESPEARE** Two statisticians made news and the Chance newsletter when they tested claims that a 429-word poem discovered in 1985 was written by Shakespeare. Ronald Thisted and Bradley Efron first analyzed the occurrence of words in all of Shakespeare's works. Of the 884,647 words in the existing Shakespeare canon, 14,376 words appeared only once, 4,343 appeared twice and 2,292 three times. This suggests that a poem written by Shakespeare containing 429 words should contain about seven words he never used anywhere else (plus or minus three words), four words he had used elsewhere (plus or minus two words) and three that he had used twice (plus or minus two words). The newly discovered poem had nine new words, seven Shakespeare used only once elsewhere and five words he had used twice. That's high probability--but not proof, of course--that the Bard of Avon wrote the poem. A version of the same technique also has been used to show that James Madison probably penned the Federalist Papers and to establish the order in which Plato wrote his works.



**THE LAST BREATH OF COPERNICUS** Weather forecasters on Mount Washington posed this question to their public radio audience: What is the probability that a breath you take includes a molecule from Copernicus's last gasp? The odds are good--nearly 2 in 3--that some of your next inhalation was part of the 16th-century astronomer's final exhalation. To answer the question--a version of a problem first posed by the late physicist James Jeans--Snell used the facts about the total number of molecules in the atmosphere (about 10 to the 44th power) and the total number of molecules in the average breath (about 10 to the 22nd power) and performed a series of calculations to determine the probabilities. Even if you include only chemically stable nitrogen molecules in Copernicus's final snort, the odds are better than 50-50, or so Snell claims.

**FALSE POSITIVES** Even the smart kids in Snell's Dartmouth classes are surprised by the answer to our next probabilistic puzzle, which has appeared in various forms and guises in such publications as the New York Times and Parade magazine. Suppose 5 percent of the population were drug users. Now suppose a certain drug test accurately detected drug users and non-drug users 95 percent of the time. What are the chances that a person who tested positive actually was a drug user? The answer: only 50 percent, no better than a coin flip, Snell says. (It's not as complicated as it appears. Think about it this way: In any 100 tests, about five users would be expected to test positive because they're drug users and about five nonusers would register false positive because the test is wrong 5 percent of the time.) For the same reason, "even though the [standard] test for HIV is 99.8 percent accurate, if a randomly chosen student tests positive, that student has only about a 50-percent chance of being HIV positive," he said.



**BUSTING THE BIBLE CODE** Michael Drosnin earned his 15 minutes of fame a few years ago by writing a book in which he described how he searched the book of Genesis and selected letters at regular intervals (every 50th letter, for example). Embedded in these strings of letters were names and words, and some of these names and nearby words seemed to foretell the future. Statisticians howled, noting that chance alone assured that he would stumble upon many words and combinations of words that would appear to be remarkable coincidences, Snell said. Drosnin howled back, formally challenging his critics to search "Moby Dick" and find similarly spooky permutations. Australian computer scientist Brendan McKay did just that. The chilling but entirely coincidental list included such names as "M L King" which appeared near the phrase "to be killed by them" and "Kennedy" near "shoot" and "Lincoln" near "killed" and even "Princess Di" near "mortal in these jaws of death."

**LOTTERY LUCK** Another favorite stats story ran in the Denver Post on April 9, 1996. It seems that math professor Celestino Mendez of Metropolitan State College in Denver had urged his students to buy lottery tickets because, he told them, the "expected value" of that week's Colorado Lotto ticket had become greater than the price of a lottery ticket. The expected value, Mendez reminded his class, is determined by dividing the total number of tickets into the total amount of the prizes offered.

Thus, if 2 million tickets are sold and the total jackpot is \$1 million, the expected value of a single ticket is 50 cents--a bad bet (except for lottery sponsors). But with big jackpots, the expected value can be positive. On that particular day in April, Mendez told his students that he figured a \$1 ticket was worth \$1.14. After class, Mendez said he thought "I better put my money where my mouth is" and so he bought 10 Lotto tickets.

Mendez won, splitting the \$15 million prize with one other winner.

Actually, Mendez may deserve only partial credit. Snell says that once you take into account taxes, the way the payouts are made and the fact that you often have to share the jackpot, Mendez's investment in lottery tickets may not have been such a good bet, statistically speaking. (But hey, sometimes it's better to be lucky than smart.)

To be a really favorable bet, Snell calculates that "in the popular multi-state Powerball lottery, the jackpot would have to be slightly more than the largest Powerball jackpot so far, or more than \$270 million--for the expected value to be greater than the price of a lottery ticket."