

Jumping to Coincidences

Defying Odds in the Realm of the Preposterous

Hanley JA The American Statistician August 1992, Vol 46, No. 3 p197-202

Lotteries..
Case #1

Same number 2-state winner

BOSTON (UPI) — Lottery officials say there is 1 chance in 100 million that the same four-digit lottery numbers would be drawn in Massachusetts and New Hampshire on the same night. That's just what happened Tuesday.

The number 8092 came up, paying \$5,842 in Massachusetts and \$4,500 in New Hampshire.

"There is a 1-in-10,000 chance of any four-digit number being chosen at any given time," Massachusetts Lottery Commission official David Ellis said.

"But the odds of it happening with two states at any one time are just fantastic," he said.

(a)

New Hampshire

0001 0002 .. Xxxx .. 8092.. 9999

M	0001	✓						
a	0002		✓					
s	.							
s	.							
	Xxxx			✓				
	.							
	8092					✓		
	.							
	9999							✓

(b) Massachusetts

8 pm

XXXX

New Hampshire

9 pm

XXXX

(c) event /
headline:

“winning number is **same**
in 2 states”

probability
calculated:

winning number is 8092
in 2 states

(d) $\text{prob}(\text{happens})$

$\neq \text{prob}(\text{happens}; \text{is noted})$

$\neq \text{prob}(\text{happens}; \text{is noted}; \text{is reported})$

Lotteries.. Case #2

The lucky number is...

By Bob Sales
Globe Staff

David Hughes' number is 461.

As an employee of the Massachusetts Lottery Commission, he is prohibited from playing it in the Game. But as the commission's manager of systems and programs, he is in the perfect position to monitor it.

The number, which corresponds to the number on his locker at the University of Minnesota in the '40s, has not hit during the Game's 22-month history.

"I watch for it," said Hughes, who also once lived at 461 Gerard av., Minneapolis. "In fact, sometimes I have to put in a slip to test a machine and that's the number I always use."

Hughes played the number unsuccessfully in the Maryland lottery.

Hughes, a numerologist, chose his number as rationally as the majority of the Game's customers do. The numbers game thrives on impulsiveness.

Sellers of Game tickets report that customers play birthdays, Social Security numbers, addresses, phone numbers and digits that occur to them in dreams.

"When a baby is born they'll bet the weight, the length, the birthday and the number of the room the mother is in," said Phil Masotta, who has sold \$6 million in winning lottery tickets in his Woburn delicatessen.

"I've had people come in and play a

number because the alarm went off at a certain time—like 703 or 820," said Benjy Beberman of Hancock's Tobacco Store in Quincy Square. "You'd be surprised at the number of people who come in and play the number on a ticket from the cleaners."

Just recently, Arthur Johnson of Schubert's Smoke Shop in South Boston did a double take when he sold a ticket to an officer from a nearby bank for the first time.

"He said he was playing the number on the purser's office when he was in the Navy years ago," said Johnson. "He said he saw the number on a license plate driving to work and he had to play it." The play was unsuccessful.

Sometimes, a number becomes a part of the public consciousness because it is prominent in the news. This is reflected in the play.

For instance, The Globe ran a picture of a Coast Guard boat rescuing a child on Page 1 on Jan. 27. The number of the boat—40533—was prominently displayed.

"I checked it," said Gene Ferris, manager of the Game Room in Prudential Center. "We had more than 200 tickets (on the first four digits). I would say that's an impulse play."

Actually, the winning number was close—3533—paying \$7132 for \$1. A three-digit play the final three figures, 533, paid \$988.

The following Monday the winning four-digit number was 1040, the num-

ber which appears on Federal Income Tax forms that were in the process of being distributed. The payoff was \$1994, more than \$3000 less than the average four-digit payoff.

Since the payoff is predicated on the play, this means a large number of bettors played the number.

"Nobody complained about the low payoff," Ferris reported. As a football coach once said, winning is everything.

Apparently seeking more for their money, bettors tend to play four different digits, rather than repeating numbers. There have been two notable exceptions to this pattern.

Although 0000 has never hit, it is always bet heavily. In other combinations, zero is lightly played.

The other exception occurred on July 7, 1977, when 56 percent of the bets made—more than 100,000 tickets—were on 7777. The winning number that day was 6409, paying \$7370 for a \$1 bet.

Other heavy plays predicated upon the calendar include Dec. 31 of each year when the play is on 1231, and July 11, 711. Neither has been a winner on the correct date.

During the Game's 22-month existence, the illegal numbers pool has switched its payoff from the racetrack parimutuel pool to the legal number. In that period, no winning number has ever been repeated, although the same four digits have won a second time in different sequence. Hughes, the expert, doesn't expect to see duplicate winners until about half of the 10,000 possibilities have been exhausted.

Boston Evening Globe of February 6, 1978: interview with lottery official David Hughes on how bettors choose numbers in Massachusetts Daily Lottery (the *Game*), played daily:

During the Game's 22-month existence (approx 660 draws), the illegal numbers pool has switched its payoff from the race-track parimutuel pool to the legal number.

In that period, **no winning number has ever been repeated**, although the same four digits have won a second time in different sequences.

Hughes, **the expert, doesn't expect to see duplicate winners until about half of the 10,000 possibilities have been exhausted.**

660 drawings in Massachusetts...

- no repeat (660 distinct numbers)
- “don't expect repeat until approx 5000 draws”

Implied...

Case # 1

unlikely events do happen

Case # 2

if fair, should not expect repeats

hasn't been a repeat ...

So... lottery is fair !

Reality

event not that unlikely

if fair, should expect repeats

prob(no repeat) = 22×10^{-9}

H_0 : H_1 : H_2 : data are wrong !

"Sorry... 7 separate #s had repeated...

Misinformation was a sin of omission and a too hasty glance at our listing of previous winning numbers"

Prob(numbers are all distinct)..

<u>10</u>	<u>50</u>	<u>100</u>	<u>200</u>	<u>300</u>	<u>660</u> draws
0.9995	0.8845	0.6085	0.1348	0.0107	2×10^{-10}

Lotteries, Case 3 (Montreal Gazette July 28, 1982)

Once or twice a year, the Quebec Super Loto pays out money accumulated from unclaimed prize-money by adding 500 cars as bonus prizes.

Instead of mechanically drawing the large list of winning numbers from the 2.4 million tickets sold for each drawing, the Loto generated the 500 winning numbers using a computer.

Date

25-07-82

Results



200 CUTLASS SUPREME

ND
ES
00
each

003A190	445A327	020B007	428B320	128C036	525C432
046A987	451A882	028B645	487B965	135C182	534C337
049A093	453A190	033B213	491B625	147C468	535C961
051A329	469A089	044B565	556B289	172C246	539C518
060A622	470A486	074B332	563B801	178C492	567C088
075A034	475A510	074B833	564B853	200C032	569C050
083A859	483A987	093B236	566B241	217C879	571C538
085A946	507A676	119B151	573B893	221C502	601C971
088A003	528A218	122B730	583B997	225C335	607C163
089A910	531A773	132B957	584B026	226C158	610C737
098A681	532A355	135B659	589B371	235C067	614C933
104A211	536A961	157B138	605B822	249C071	619C193
132A021	538A545	188B238	631B777	251C817	621C726
133A767	551A968	199B671	635B228	280C480	621C771
133A775	558A252	205B727	676B475	292C232	626C987
156A423	565A279	216B190	706B031	310C100	650C592
178A874	586A517	224B549	720B776	310C695	670C501
197A318	593A712	224B946	726B307	342C870	691C678
206A214	606A022	242B889	749B204	388C730	713C432
210A606	638A374	247B441	750B210	391C943	717C534
212A236	641A549	257B482	759B075	425C457	721C653
226A596	647A150	267B785	781B605	429C739	723C065
248A641	674A060	269B933	785B322	450C641	724C667
259A100	677A873	272B591	789B412	454C003	740C909
332A860	690A818	276B637	023C053	455C089	741C411
338A617	704A208	284B391	055C419	462C032	744C374
347A183	728A966	284B391	059C989	476C732	744C587
371A292	739A659	294B001	068C694	481C760	760C885
381A969	756A728	295B797	074C684	484C974	764C440
386A691	774A665	310B261	075C038	498C968	775C780
391A997	781A933	319B543	091C719	499C388	784C109
393A615	792A529	361B329	093C893	508C300	784C333
424A399	798A315	366B500	105C556	525C030	788C375
432A285	013B609				

23
58
18
94
58
02
22
21
19
95
64
02
64
11
36
31

\$10 ticket wins buyer two Olds

TORONTO (CP) — Antonio Gallardo has won two Oldsmobile Cutlass Supremes on a single \$10 Super Loto ticket.

Gallardo, who had been shopping for a new car, was given the ticket by his sister, visiting from California.

She bought him the ticket when she heard there were 500 cars being given as bonus prizes last Sunday.

Montreal Gazette
July 28, 1982

Little did she know that the ticket would get them both new cars.

"I just couldn't believe it," said Gallardo, 35, a library assistant.

In Montreal, a Loto Quebec Corp. official said the chance of a single bonus number coming up twice is one in 46,181,926.

And the chance of a ticket number coming up twice in the same type of car (200 of the 500 prize cars were Cutlasses) is one in 289,471,120.

$N = 2.4 \times 10^6$ tickets; $n = 500$ prizes... drawn by computer

- 1 number drawn twice

message..

Binomial

$$n = 500$$

$$\pi = (1/2.4) \times 10^{-6}$$

$$\text{prob}(2) = 2 \times 10^{-8} (!!!)$$

Reality

prob[SOME no. drawn twice]

not negligible

prob(500 distinct numbers)

$$= \prod_{i=0}^{n-1} (1 - i / N)$$

$$\approx (1 - 0.5n / N)^n = 0.95$$

$$\Rightarrow \text{prob}(\geq 2 \text{ repeats}) \approx 0.05$$

- Message..

"events happen more frequently than they should"

better to calculate prob. from viewpoint of indiv. player

you can beat the odds;
buy lots of tickets!

Reality

lottery officials should calculate probability of such an event

now, loto Québec sorts the numbers drawn and **checks** them !!!

Odds-Defying Jersey Woman Hits Lottery Jackpot 2d Time

By ROBERT D. McFADDEN

Defying odds in the results of the preposterous — 1 in 17 trillion — a woman who won \$1.9 million in the New Jersey state lottery last October has hit the jackpot again and yesterday laid claim with her fiancé to an additional \$1.5 million prize.

"Shocking — definitely shocking," said 32-year-old Evelyn Marie Adams, the manager of a 7-Eleven convenience store in Point Pleasant Beach, after she redeemed her ticket winning ticket in last Monday's Pick-6 Lotto game.

"They say good things come in threes, so . . ."

A Two-Time First

Actually, Mrs. Adams said she would probably not try for a third coup after last night's drawing, for which she had already bought a batch of tickets. "I'm going to quit playing," she said. "I'm going to give everyone else a chance."

She was the first two-time million-dollar winner in the history of New Jersey's lottery, state officials said. They added that they had never before heard of a person winning two million-dollar prizes in any of the nation's 22 state lotteries.

For aficionados of miraculous odds, the numbers were mind-boggling: In winning her first prize last Oct. 24, Mrs. Adams was up against odds of 1 in 3.2 million. The odds of winning last Monday, when numbers were drawn in

a somewhat modified game, were 1 in 5.2 million.

And after due consultation with a professor of statistics at Rutgers University, lottery officials concluded that the odds of one person winning the top lottery prize twice in a lifetime were 1 in about 17.3 trillion — that is, 17,300,000,000,000.

Mrs. Adams bought both her winning tickets at the convenience store she manages, a store owned by her fiancé, Herman Basehore, 45, who shared her winning ticket. The couple, who became engaged in December, plan to be married in April, sell the store and pur-

sue mutual interests in music.

Both are divorced. Mrs. Adams has a 10-year-old daughter by her previous marriage and Mr. Basehore, a French horn player and conductor who has a degree in music, has a 21-year-old son.

In last October's lottery, Mrs. Adams held 6 correct numbers out of 39 choices and split a \$7.9 million jackpot with Philip Matalucci Jr., of Cape May Courthouse. In this week's lottery, Mrs. Adams held 6 out of 42 numbers and shared half of a \$2.98 million jackpot, or \$1,486,815, with her fiancé.

The other \$1,486,815 in this week's lottery game was won by Ronald Mack, a 28-year-old Linden, N.J., truck driver, who will share the prize with his fiancé, 23-year-old Connie Steen, of Hopelawn. They had planned to be married in April 1987, but have now moved up their wedding date to this spring.

The winnings from the two lotteries will be paid out over the next 20 years. After 20 percent deductions for taxes, Mrs. Adams's average annual payout from the first jackpot will be \$158,400, and she and Mr. Basehore will each receive an additional \$29,800 a year on this week's jackpot, for a combined total of \$218,000 a year over the next 20 years.

Machine Picked Numbers

Mrs. Adams said she had been playing the state lottery since its inception and estimated that she had spent \$5,000 on tickets, raising her \$25-a-week purchases to \$100 a week after winning her jackpot last fall.

Though she described herself as a person who likes to gamble, she did not pick her own winning numbers. She let the ticket machine do it for her in both cases, a procedure called "Quick Pick."

The first winning number was 5-11-12-21-22-31; the second was 12-15-25-31-33-42.

Will luck change their lives?

"At the moment, with all the attention, it is rather overwhelming," said Mr. Basehore, who has owned his store for more than 14 years and has taught music in public schools. "We're still the same people. We really don't want to change. I had already made plans to sell this year, even before the first win."

Lottery Case 4 (from the New York Times of February 14, 1986)

ODDS-DEFYING JERSEY WOMAN HITS LOTTERY JACKPOT 2d TIME

Defying odds in the realm of the preposterous - 1 in 17 trillion - a woman who won \$3.9 million in the New Jersey state lottery last October has hit the jackpot again and yesterday laid claim to an additional \$1.5 million prize...

She was the first two-time million-dollar winner in the history of New Jersey's lottery, state officials said. They added that they had never before heard of a person winning two million-dollar prizes in any of the nation's 22 state lotteries

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And after due consultation with a professor of statistics at Rutgers University, lottery officials concluded that the odds of winning the top lottery prize twice in a lifetime were 1 in about 17.3 trillion - that is, 17,300,000,000,000.

New Jersey woman wins 6/49-type game twice!!

14 oct '85

11 feb '86

6 / 39

6 / 42

$$\text{prob} = 1/(3.5 \times 10^6) \times 1/(5.2 \times 10^6) = 1 / (17 \times 10^{12})$$

Assumptions

Reality

(i) 14 oct '85
& only
11 feb '86

had played weekly
for several years

several tickets / week

(ii) 1 ticket each time

more tickets after oct '85

4 - 5 tickets / week ...

Prob(win) = 10^{-6} per week

n = 200 weeks..

prob(win 2 times) = 2×10^{-8}

n = 1500 weeks (30 years)

prob(win 2 times) = 1×10^{-6}

10^6 persons (30 years)

average (# who win 2 times) = 1

50×10^6 persons (U.S.A.)

average (wait / repeat winner) = 4 yrs

REAL MEANING of $\text{Prob}(\bullet) = 1 / (17 \times 10^{12})$

5×10^9 persons (world population) x 3400 generations

NY Times was correct to
call the odds "preposterous" !!!

There are pitfalls in figuring the odds of seemingly rare events occurring

Several years ago, newspapers reported that in an apparent odds-defying event, a New Jersey woman won the state's lottery twice in a four-month period.

The chances of winning the lottery twice in a lifetime, one paper reported, were so staggeringly low that they bordered on the miraculous — one in about 17 trillion. Those calculations, the paper said, were given by the state's lottery officials who had consulted with a Rutgers University statistics professor.



**BEVERLY
ORNDORFF**

Science

larger than the estimated number of stars in the Milky Way galaxy.

Now the denominator, 17 trillion, is obviously a very large number. It's several thousand times larger than the number of people in the world, about 5.5 billion. It's more than 100 times

It's nearly five times larger than the U.S. national debt in dollars.

In fact, although the two wins of the New Jersey lottery jackpot may have been a miraculous event from that woman's point of view, the fact that *someone* would win a lottery twice is not necessarily a miracle, according to some statisticians who have subsequently studied the problem.

Furthermore, that particular woman's chances of winning the jackpot twice really weren't as small as the lottery officials claimed. Her chances were still small, but not nearly as tiny as one in 17 trillion.

That's all according to an analysis of the event that's included in a report by Dr. James A. Hanley, a biostatistician at McGill University in Montreal, in the current issue of the *American Statistician*.

Dr. Hanley's paper, sent to me by Dr. Paul D. Minton, a Richmond area consultant in statistical design, analysis and quality control, deals more generally with pitfalls in figuring the odds of seemingly rare events.

Birthdays..
Case #1

USA Today.

March 4 1987



^{AP}
ROSALIND HELMS: First
babes for Peoria, Ill., family.

Two sets of quints, same day

It was a statistician's dream: two sets of quintuplets born the same day in the USA.

But the experts couldn't agree on what statistic to use. Figures of one in 41 million, one in 70 million and one in 85 million were tossed out Tuesday — and that was just for the birth of one set of quints.

The Helms quintuplets, four girls and a boy, were born Monday night in Peoria, Ill. They were in critical condition Tuesday.

During the pregnancy, restaurant manager **Ron Helms** teased his wife, **Rosalind**, saying, "We were going to have five boys and have our own basketball team."

In Las Vegas, the birth of the Jenkins quints was marred by the death of one of the five sisters. The other four were in stable condition Tuesday.

Robin Jenkins, 30, who gave birth to the Nevada quintuplets 11 weeks early, didn't use fertility drugs.

But **Rosalind Helms**, 27, had taken the fertility drug Pergonal.

Births Case 1 (from USA TODAY on March 4, 1987)

Two sets of quints, same day

It was a statistician's dream: two sets of quintuplets born the same day [Monday March 2, 1987] in the USA [one set of four girls and a boy, in Peoria Ill. and a set of five girls in Las Vegas]. But the experts could not agree on what statistic to use.

Figures of one in 41 million, one in 70 million and one in 85 million were tossed out Tuesday - and that was just for the birth of one set of quints.

[The mother of the Nevada quintuplets, who were born 11 weeks early, didn't use fertility drugs; the mother of the Illinois quints had taken the fertility drug Pergonal].

4 Sisters Beat 1 in 17 Billion Odds — They All Share the Same Birthday

August 3 is a grand-slam event for Mary Wohlford — her first four daughters were born on that date in four different years.

The odds of that happening are a staggering 1 in 17 billion!

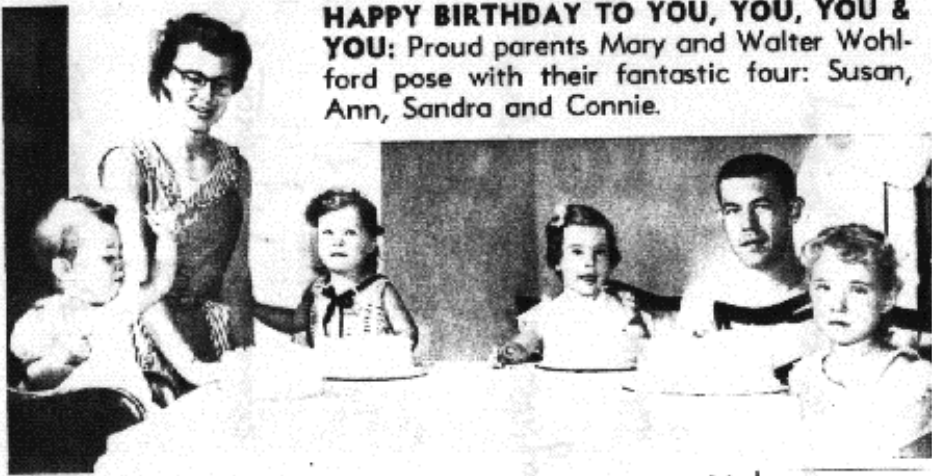
"When August 3 used to roll around, everyone would wonder, 'Will she or won't she?' — and I always did," said Mary.

Her first August 3 child, Connie, arrived in 1949. She was followed by Sandra in 1951, Ann in 1952 and Susan in 1954.

All were born in Freeport, Ill., and delivered by the same doctor in the same hospital in the very same room.

"The doctors and nurses were amazed, but it was not planned that way, and the girls weren't all due August 3," said 64-year-old Mary.

"It's just what happened. And it's a blessing — I don't have any problem remem-



HAPPY BIRTHDAY TO YOU, YOU, YOU & YOU: Proud parents Mary and Walter Wohlford pose with their fantastic four: Susan, Ann, Sandra and Connie.

bering birthdays." But the August 3 streak ended after Mary and her late husband Walter moved their growing family from Freeport to Dyersville, Ill.

"Maybe there was something in the Freeport water," jokes Mary. "After we moved in 1955, we had four more girls over the next nine years and none of them were born on August 3."

When that date rolled around every year, the

Wohlfords threw one big party and invited friends of all four girls.

"We treated each one alike — and each had her own cake," said Mary.

Added eldest daughter, Connie Holmes: "We didn't mind sharing our birthday and we never felt slighted. August 3 always turned into a big celebration — like Christmas and the Fourth of July rolled into one!"

— STEVE PLAMANN



TODAY: (Left to right) Susan, Ann, Sandra and Connie.

JUNE 28, 1970. BARRY SMITH
p. 19 NATIONAL ENQUIRER

Births Case 2 (from National Enquirer on June 28, 1990)

4 sisters beat 1 in 17 billion Odds - They All Share the Same Birthday

August 3 is a grand slam event for Mary Wohlford - her first four daughters were born on that date in four different years.

The odds of that happening are a staggering 1 in 17 billion.

Her first August 3 child, Connie, arrived in 1949. She was followed by Sandra in 1951, Ann in 1952 and Susan in 1954. All were born in Freeport, Ill. and delivered by the same doctor in the same hospital in the very same room. "The doctors and nurses were amazed, but it was not planned that way, and the girls weren't all due August 3" said the mother. But the August 3 streak ended after the parents moved their growing family from Freeport to Dyersville Ill. "Maybe there was something in the Freeport water" jokes the mother. "After we moved in 1955, we had four more girls over the next nine years and none of them were born on August 3rd."

Births Case 3 (from the Montreal Gazette in May , 1989)

Double trouble in Moose Jaw school

caption to a photograph showing six sets of twins

Every morning, teachers at Prince Arthur school in Moose Jaw, Saskatchewan see double - and it's not because of what they were up to the night before.

Six pairs of identical twins attend the school, which has an enrollment of 375. Identical births occur once in 270 births.

Births Case 4 (Montreal Gazette, week of May 8 , 1991)

Double trouble Down Under

caption to a photograph showing five sets of twins

It was a very busy week in the onbstetrics department of Baulkham Hills Private Hospital in Sydney Australia, as five mothers gave birth to twins. Hospital officials offered no explanation of the sudden run of multiple births, but the proud mothers are happy to pose with their infants. Everyone' s doing well.

Montreal Gazette, week of May 15 , 1991...

No Double trouble anywhere this week

no photograph, no twins

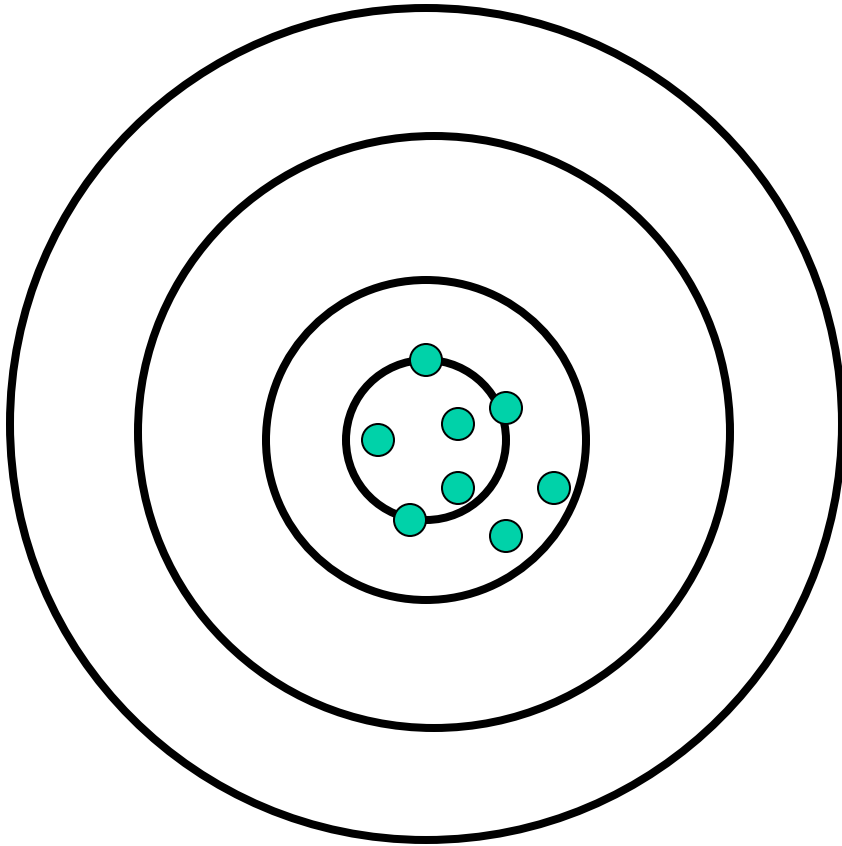
Montreal Gazette, week of May 22 , 1991...

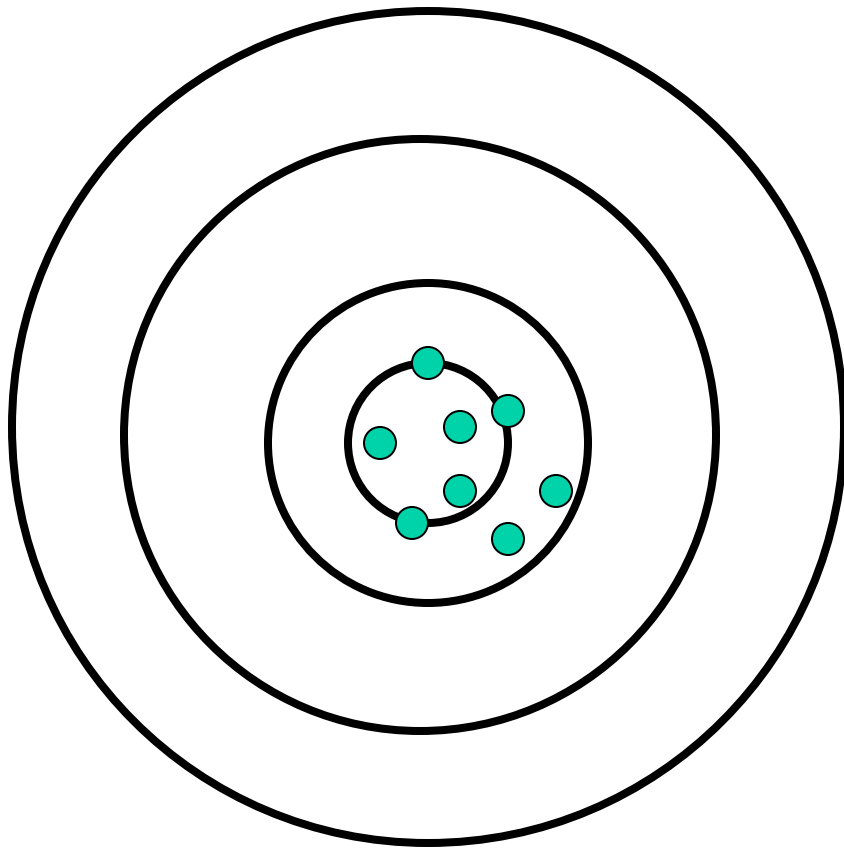
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Stay posted..

On the side of a a barn in Texas





- Texas Sharpshooter

CONCLUSIONS

- We tend to see sample space with selective vision
- Remedy: imagine headline BEFORE event and enumerate all the sub-events that would be eligible
- For claims that a very rare event occurred ...
be suspicious of probability calculations !

STRUCK BY LIGHTNING

THE CURIOUS
WORLD OF
PROBABILITIES

JEFFREY S.
ROSENTHAL

