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Seven shuffles are needed to put gamble in card deck

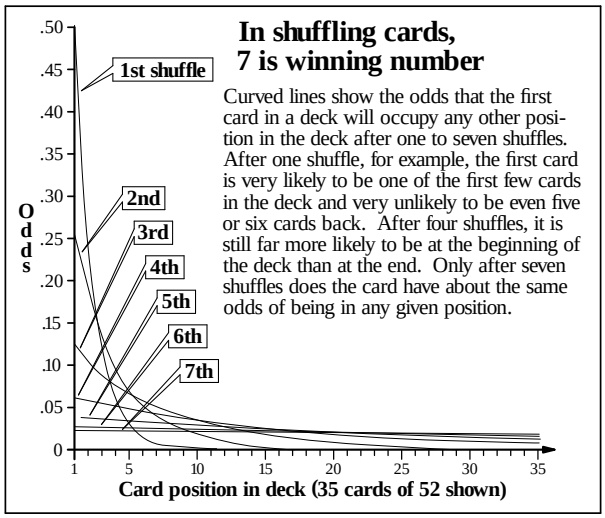
BY GINA KOLATA
New York Times Service

IT TAKES SEVEN ordinary, imperfect shuffles to mix a deck of cards thoroughly, researchers have found. Fewer are not enough and more do not significantly improve the mixing.

The mathematical proof, discovered after studies of results from elaborate computer calculations and careful observation of card games, confirms the intuition of many gamblers, bridge enthusiasts and casual players.

The finding has implications for everyone who plays cards and everyone, from casino operators to magicians, who has a stake in knowing whether a shuffle is random.

The mathematical problem was complicated because of the immense number of possible ways the cards in a deck can be arranged; any of 52 could be first in the deck, any of 51 could be second, 50 could be third and so on. Multiplied out, the number of possible permutations is 10 with 62 zeros after it.



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No one expected that the shuffling problem would have a simple answer, said Dave Bayer, a mathematician and computer scientist at Columbia University who is a co-author of the recent discovery. Other problems in statistics, like analyzing speech patterns to identify speakers, might be amenable to similar approaches, he said.

The new result "definitely solves the problem," said David Aldous, a statistician at the University of California at Berkeley. "All their calculations are right. It's a fascinating result."

Persi Diaconis, a mathematician and statistician at Harvard University who is the other author of the discovery, said the methods used are already helping mathematicians analyze problems in abstract mathematics that have nothing to do with shuffling or with any known real-world phenomenon.

Dr. Diaconis, who is also a magician, has invented numerous card tricks and has been carefully watching casino dealers and casual card players shuffle for the past 20 years. The usual shuffling produces a card order that "is far from random," he said. "Most people shuffle cards three or four times. Five times is considered excessive."

The realization that most shuffled decks are not actually random allows gamblers to improve their odds of winning. "There are people who go to casinos and make money on this," he said. "I know people who are out there doing that now."

In Las Vegas, cards are shuffled from four to seven times, at the discretion of the casino owners, said Richard Ingram, a Las Vegas enforcement agent for the Nevada gambling control board.

Dr. Diaconis said he almost never sees a dealer shuffle seven times.

He said his research also shows that when dealers shuffle several decks at once, they need to shuffle more. Two decks should be shuffled nine times, he said, and six decks should be shuffled 12 times, which is unheard of in the casinos.

At Trump Plaza in Atlantic City, N.J., blackjack dealers shuffle eight decks twice at the beginning of each game, said Howard Dreitzer, who is senior vice-president of casino operations. "We've tested these shuffles and feel that they are random," he said, adding that "no one has ever complained."

Bridge players usually shuffle about four times, except in some tournaments where a computer randomly mixes the cards, said Edgar Kaplan, who is editor and publisher of Bridge World magazine.

Asked whether he expected bridge players to change their shuffling habits, he replied, "There will be a few who will be affected and will doggedly shuffle seven times to the irritation of everyone else."

The article EM9015 reprinted above is used in Figure 7.1 of the STAT 220 Course Materials and in Statistical Highlight #40.