



## Letter to the Editor

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Letter in response to: Fulton, L. V., Mendez, F. A., Bastian, N. D., & Musal, R. M. (2012). “Confusion between odds and probability, a pandemic?” *Journal of Statistics Education*, 20(3) (<http://www.amstat.org/publications/jse/v20n3/fulton.pdf>)

### The Odds of Academic Usage of Statistics Terms in Everyday Contexts such as Lotteries

Kudos to Fulton, Mendez, Bastian, and Musal for bringing attention to the real-life use of the term ‘odds’ in contexts such as the Texas Lottery. In situations where precise likelihoods cannot be readily mathematically calculated (at least not by the general public), it will not be obvious whether the given “odds” are really odds or are instead probabilities, with the notable exception of a horse race when the odds for a given horse happen to be listed as 1:1. (As an aside, we note that displayed racetrack odds incorporate distortion because they correspond not to the true likelihood that an event will occur, but to the amount that the bookmaker will pay out on winning bets. See [Beam \(2012\)](#) for explicit connections between racetrack bets and probability models.)

While references to gambling or games of chance may be problematic in some cultures (e.g., [Abdelbasit 2010](#)), [Beam \(2012\)](#) reminds us that “much of probability theory has been motivated by gambling considerations [e.g., the correspondence between Fermat and Pascal]. Also, much of the application of probability in the modern world is toward gambling in various guises: lotteries, insurance, business investments, the stock market, etc” (p. 456). Thus, a state or multi-state lottery – because of its ubiquitousness – can potentially become an effective vehicle to promote statistical knowledge and literacy (e.g., [Henze & Riedwyl 1998](#); [Lesser 1997, 2003, 2004, 2011, 2012](#); [Mansfield 2012](#)). The idea that the Texas Lottery might end up reinforcing an error or misconception is ironic given that one quarter of the sales from Texas Lottery tickets goes to the Foundation School Fund to support public education in Texas ([http://www.txlottery.org/export/sites/lottery/SUPPORTING\\_Education/](http://www.txlottery.org/export/sites/lottery/SUPPORTING_Education/)).

That said, using the word “pandemic” in the article’s title may draw attention away from the fact that there are statistical misconceptions regarding the lottery that are far more critical than “odds versus probability.” The mathematical difference between  $1/n$  and  $1/(n + 1)$  for  $n > 70$  would arguably be insufficient to influence how or if people play the lottery, but this is likely *not* the case for a misunderstanding of terms such as “random” or “independent.”

The conflict between lay and academic uses of the word “random” is noted by [ASA \(2010\)](#) and thoroughly explored by researchers (e.g., [Fisher, Kaplan, & Rogness 2012](#); [Kaplan, Fisher & Rogness 2009, 2010](#); [Kaplan, Rogness, & Fisher under review](#)). If a person clings to interpreting the word “random” in a slang everyday sense as meaning “haphazard,” “unexpected” or “unusual,” then we can only wonder what such a person will make of this explanation the Texas Lottery gives at

[http://www.txlottery.org/export/sites/lottery/Games/Lotto\\_Texas/Pre-test\\_Results.html](http://www.txlottery.org/export/sites/lottery/Games/Lotto_Texas/Pre-test_Results.html): “A pre-test is an unofficial drawing that tests the machine and the ball set used for a *Lotto Texas* drawing. Pre-tests ensure that the drawing machine is working well and that balls are drawn in a random way.” Also, it appears that some players may choose their numbers under the influence of a false belief that certain numbers or six-number sets have a different probability than others because some numbers or sets of numbers are viewed as “less random” than others.

A component of the popular, everyday meaning of the word “independent” is the notion of “separate” (e.g., a country declares itself to be an independent country with its own separate territory), which is one reason why our students do not understand right away that disjoint nonempty events can actually *never* be independent. So, simply telling a lottery player that each drawing is independent may not force him/her to realize that the result of one drawing has no effect on another. In other words, people may just falsely interpret independent drawings as drawings that happen on separate occasions/days but not really believe that one drawing has no effect on another. The latter idea may be evidenced by the huge hunger and commercial market for so-called strategies such as tracking what numbers have been “hot” or “cold” and picking their next lottery numbers accordingly, based on false beliefs in streaks or in the gambler’s fallacy. Perhaps the Texas Lottery inadvertently partially enables this by posting ([http://www.txlottery.org/export/sites/lottery/Games/Lotto\\_Texas/Number\\_Frequency.html](http://www.txlottery.org/export/sites/lottery/Games/Lotto_Texas/Number_Frequency.html)) how many times each numbered ball has been drawn for more than six years’ worth of drawings. And even though ticket holders have only 180 days to claim prizes, the Texas Lottery posts the 6-ball sets of winning numbers from well more than 180 days’ worth of drawings ([http://www.txlottery.org/export/sites/lottery/Games/Lotto\\_Texas/Winning\\_Numbers/](http://www.txlottery.org/export/sites/lottery/Games/Lotto_Texas/Winning_Numbers/)).

In popular culture, the one-syllable (and therefore catchier?) words “chance” and “odds” are used far more often than “probability” or “likelihood,” but usually only in situations that are referring to likelihood in a generic manner rather than a specific numerical value. (Perhaps this is not unlike how popular culture may more often use the word “average” in a generic way than in a numerically precise way to invoke mean, median, or mode.) Examples of this range from hit songs (e.g., Phil Collins’ #1 hit “Against All Odds” from the 1984 same-titled movie) to hit movies or books (“may the odds be ever in your favor” is the tagline from *The Hunger Games*) and even to the title of CPB/Annenberg’s excellent 26-video series on introductory statistics (“Against All Odds”). We also note that there have been occasional books (e.g., [Scammon](#)

[1980](#)) for general audiences that use “odds” in a sustained, consistent and correct manner, including giving a correct explanation in the introduction.

There may be something to be gained by exploring why the word “odds” may be more persistent or popular than “probability” in everyday contexts. For people without the confidence or training to calculate precise probabilities, there may be something in the language of odds that better reflects their feeling of a “rough estimate.” Compare the difference in perceived precision between “the probability is .167” to “the odds are 5 to 1 against.” Also, the whole numbers that generally make up odds offer concreteness: for 5:1 odds against, we can visualize drawing a ball from a bucket that has 1 red ball and 5 black balls, or we can visualize winning \$5 for every \$1 we bet. This representation may have a great impact on how very small or very large likelihoods are perceived: comparing a probability of 90% to 99% seems less dramatic than comparing 9:1 odds in favor of an event to 99:1 odds. Exposing students to different representations of likelihood supports the Representation Standard of [NCTM \(2000\)](#).

The Texas Lottery may well be quite aware that their use of “odds” as a synonym for probability is technically incorrect, but do so anyway by making at least one of the following assumptions: (1) most players will not know the difference, (2) the numerical difference is negligible, (3) the five-syllable word “probability” sounds more academic and therefore may appeal less readily to the general public than the word “odds”, (4) some marketing strategy says the word choice will increase sales, perhaps for reasons similar to why some companies use words (e.g., “pak,” “nite,” “lite,” “krispie,” “kwik,” etc.) they know are misspelled.

Going beyond the specific context of lotteries, we should note that words like “odds,” “random,” and “independent” are but three of dozens of words that can be used very differently in everyday contexts than in academic statistics contexts. Whether framed as lexical ambiguity or movement among linguistic registers, this area has seen many research papers ([Kaplan, et al. 2009, 2010](#); [Lesser & Winsor 2009](#); [Lesser, Wagler, Esquinca, & Valenzuela in press](#)) and an invited session at the 2012 Joint Statistical Meetings.

There is no harm in vying for everyday usage to conform to academic statistical usage, and the battle that may be more within our immediate reach or means is to choose less ambiguous words in our instruction and curriculum. Discrepancies that are inevitably encountered in the broader world can (and should) be intentionally utilized by instructors as teachable moments, and instructors also have the opportunity to make pedagogical choices during discussions. To that end, we could keep our focus on the word ‘probability’ (not ‘odds’), in the same spirit as how [Kaplan, Rogness and Fisher \(2012\)](#) make a convincing case for using the word ‘variability’ instead of ‘spread.’ In addition to avoiding the pitfalls already discussed, there are probably reasons why introductory textbooks present rules of working with likelihoods in terms of probability not odds. Probabilities cannot exceed 1; odds can. Probabilities of two complementary events sum to 1; odds of two complementary events multiply to 1. Likelihoods of conjunctive or disjunctive events have nice equations when expressed in probabilities, but not when expressed with odds.

[Rejoinder to this Letter to the Editor](#) by Fulton, L. V., Mendez, F. A., Bastian, N. D., & Musal, R. M. (2013) is available in the *Journal of Statistics Education*, 21(1)

([http://www.amstat.org/publications/jse/v21n1/fulton\\_rejoinder.pdf](http://www.amstat.org/publications/jse/v21n1/fulton_rejoinder.pdf))

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