

Midterm Answers

1. The study did not consider whether the children actually read books. The availability of books may well have been a proxy for other socioeconomic factors. Children living in neighborhoods with oak trees might get better grades in school, but this doesn't mean that planting oak trees will raise grades.
2. These are the frequencies with which people involved in accidents were male or female, but the claim concerns the inverse probability—that a male or female will be in an accident.
3. Yes, if Gruden was above average at Monday Night Football and below average as a coach. [Hunter Felt, Monday Night Football: Has Jason Witten ruined a US television institution?," *The Guardian*, December 11, 2018.]

$$4. 0.9^6 = 0.531 \text{ versus } \binom{20}{11} 0.9^{11} 0.1^{20-11} + \binom{20}{12} 0.9^{12} 0.1^{20-12} + \dots + \binom{20}{12} 0.9^{20} 0.1^{20-20} = 0.999993$$

[The Supreme Court has not yet issued its ruling. Louisiana repealed its law in 2018 (but the repeal is not retroactive), leaving Oregon as the only state that allows non-unanimous (10-2) verdicts.]

5. Using Bayes' Rule,

$$\begin{aligned}
 P[TS \text{ if } +] &= \frac{P[TS]P[+ \text{ if } TS]}{P[TS]P[+ \text{ if } TS] + P[\text{no } TS]P[+ \text{ if } \text{no } TS]} \\
 &= \frac{\frac{1}{320,000} 0.99}{\frac{1}{320,000} 0.99 + \frac{319,999}{320,000} 0.02} \\
 &= 0.000154
 \end{aligned}$$

Using a contingency table,

	+ reading	- reading	Total
TS	0.99(1)	0.01(1)	1
no TS	0.02(319,999)	0.98(319,999)	319,999
Total	0.99(1) + 0.02(319,999)	0.01(1) + 0.98(319,999)	320,000

$$\begin{aligned}
 P[TS \text{ if } +] &= \frac{0.99(1)}{0.99(1) + 0.02(319,999)} \\
 &= 0.000154
 \end{aligned}$$

6. The probability of rolling a 7 is  $6/36 = 1/6$ . The probability of 4 non-7s is  $(5/6)^4 = 0.482$
7. This is analogous to the doubling-up system discussed in class. If it is a fair game, then each player's expected value is zero no matter what betting strategy is used. Whale's expected value is  $\$10,000(P) + (-\$90,000)(1 - P)$ , where P is Whale's probability of winning the match. The expected value is 0 if  $P = 0.9$ .
8. This 0.2035 probability is the probability that, if *Elvis is sighted*, the sighting will be east of the Mississippi before 2 p.m. It tells us nothing about the probability of spotting Elvis, here or anywhere else. They confused  $P(A \text{ if } B)$  with

P[B if A].

9. The expected value of each die is 1.5. Since they are independent, the expected value of the product is equal to the product of the expected values:  $1.5 * 1.5 = 2.25$ . We can also brute force this answer by considering all possible combinations of outcomes  $1 * 1(1/4) + 1 * 2(1/4) + 2 * 1(1/4) + 2 * 2(1/4) = 9/4 = 2.25$
10. There are no numerical units on the horizontal axis (the equal spacing is probably wrong and *revised* should come before *original*); the units on the vertical axis are upside down—enrollment seems to be declining when it is actually increasing.