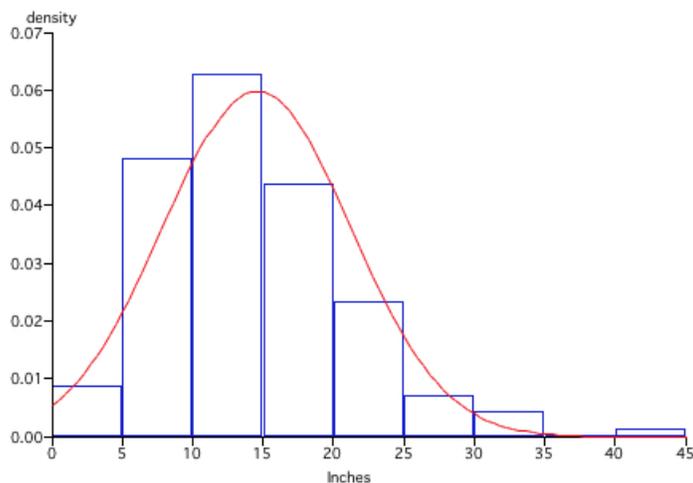


Midterm Answers

1. This study is tainted by survivorship bias, because it excludes people who didn't stay married long enough to be surveyed. A valid study would look at newlyweds, identify which couples have traits thought to be important, and then track their marriages over time. [Christina Breda Antoniadis, "The secret to a long-lasting marriage," Washington Post, February 11, 2016.]
2. Her expected value is $10(P) + (-11)(1-P) > 0$ if $P > 11/21 = 0.5238$
3. a. The Z value is $Z = (3.60 - 14.50)/6.68 = -1.63$, or 1.63 standard deviations below average. The probability that rainfall would be this low (or lower) is 0.052
 b. Rainfall distribution is skewed right because rainfall cannot be negative, but can be much higher than average:



4. Gianluca has seen 5 of the 52 cards, four of which are spades. The probability that at least one of the next two cards dealt will be a spade is 1 minus the probability that neither will be a spade:

$$1 - \frac{38}{47} \frac{37}{46} = 0.350$$

5. The probability of a double is $P = 6/36 = 1/6$, so the expected wait is $1/P = 6$ rolls.
6. The most common answer was 95 percent. Bayes' Rule gives the correct answer of about 2%:

$$\begin{aligned} P[D \text{ if } +] &= \frac{P[D]P[+ \text{ if } D]}{P[D]P[+ \text{ if } D] + P[\text{no } D]P[+ \text{ if no } D]} \\ &= \frac{0.001(1)}{0.001(1) + 0.999(0.05)} = 0.0196 \end{aligned}$$

Jonathan Shaw, Toward Precision Medicine, *Harvard Magazine*, May-June 2015, 17.

7. This calculation assumes that, with a 20-second pitch clock) the average time between pitches will be 20 seconds. Many times, there will be less than 20 seconds between pitches; so, the time saving will, on average, be more than 4 seconds, and the time saving will be more than 19 minutes and 48 seconds. <https://sports.yahoo.com/world-series-opener-personified-self-aware-baseball-hyper-obsessive-game-today-090139349.html> [Jeff Passan, How the World Series opener personified self-aware baseball, the hyper-obsessive game today, October 24, 2018]

8. This is a binomial problem with each player having a 10/72 chance of being selected each week. So,

a.
$$P[x \geq 6] = \sum_{x=6}^{11} \binom{11}{x} \left(\frac{10}{72}\right)^x \left(1 - \frac{10}{72}\right)^{11-x}$$
 (This is the probability calculated by the NFL)
$$= 0.001766$$

b. 1 minus the probability that none of the 72 players would be selected 6 or more times in 11 weeks:

$$1 - (1 - 0.001766)^{72} = 0.119$$

c. 1 minus the probability that no team would have a player selected 6 or more times in 11 weeks:

$$1 - (1 - 0.119)^{32} = 0.982$$

[Shalise Manza Young, NFL, NFLPA say there's 'no evidence' Panthers' Eric Reid was targeted for drug testing, Yahoo Sports, January 9, 2019]

9. This is the fallacious law of averages

10. The vertical axis has no origin and this magnifies the visual magnitude of the fluctuations in the unemployment rate. Also, the vertical heights of the numbers are not correct; for example, 8.6% is drawn substantially higher than 8.8%