Econ 57
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Midterm Answers

1. There are several possible explanations: People living near truck routes may be disproportionately Trump supporters; Trump supporters may be more likely to put up signs; Trump-supporting truck drivers may be more likely to listen to this radio show and call in; and Trump-supporting truck drivers may have selective recall about the signs they saw.

2. The law of large numbers does not say that the number of heads must equal the number of tails; that is the fallacious law of averages. The law of large numbers says that, as the number of flips increases, it is increasingly likely that the fraction that are heads will be close to (not exactly equal to) 0.50.

3. It is a retrospective study with survivor bias. In any group of people, currently rich or poor, there are bound to be some common characteristics. A valid study would identify the characteristics ahead of time and then compare two groups over time, one with these characteristics and one without.

4. We are interested in the inverse probabilities: a comparison of the probability of being hospitalized for the vaccinated and the unvaccinated. We would use Bayes' rule to determine the relevant probabilities.

5. It is helpful to use hypothetical numbers, such as a population of 1 million of which 100,000 have been infected and 1,000 have died. Now increase the number of infected people from 100,000 to 200,000 and see how this change affects the various statistics.
   a. higher
   b. unchanged
   c. lower
   d. unchanged

6. It assumes independence.

7. This is an example of Simpson's Paradox (from Robert L. Wardrop, Simpson's Paradox and the Hot Hand in Basketball, The American Statistician, 49(1), 24-28). Player A made more first shots, with his 88.1% double-hit probability pulling up the overall double-hit probability. Here are the complete data:

	Larry Bird				Rick Robet				Total		
	Second				Second				Second		
First	Hit	Miss	Total	First	Hit	Miss	Total	First	Hit	Miss	Total
Hit	251	34	285	Hit	54	37	91	Hit	305	71	376
Miss	48	5	53	Miss	49	31	80	Miss	97	36	133
Total	299	39	338	Total	103	68	171	Total	402	107	509

8. a. 52 choose 4: $n = \binom{52}{4} = \frac{52(51)(50)(49)}{4(3)(2)(1)} = 270{,}725$

   b. This is like the birthday problem. The first hand you are dealt can be anything. The probability that the second hand you are dealt will not be the same as the first hand is (n-1)/n. If the first two hands are different, the probability that the third hand will be different from the first two hands is (n-2)/n. If the first three hands are different, the probability that the fourth hand will be different from the first three hands is (n-3)/n.

The probability that all 4 hands will be different is $p=1\left(\frac{n-1}{n}\right)\left(\frac{n-2}{n}\right)\left(\frac{n-3}{n}\right)=0.999977837438846$.

The probability of at least one identical hand is 1 – p = 1 – 0.9999778 = 0.0000222

9. Using Bayes' Rule,

$$\begin{aligned} P[\text{sober if } +] &= \frac{P[\text{sober}]P[+\text{ if sober}]}{P[\text{sober}]P[+\text{ if sober}]+P[\text{intoxicated}]P[+\text{ if intoxicated}]} \\ &= \frac{0.80(0.20)}{0.80(0.20)+0.20(0.85)} \\ &= 0.4848 \end{aligned}$$

10. The 3-dimensional look makes the red Lag 1 bars look larger than the green Lag 1.2 bars even when the numbers are the same, and exaggerates the differences when the red numbers are slightly larger. [Geva, T, Oestreicher-Singer, G, Efron, N, Shimshoni, Y (2017) Using Forum and Search Data for Sales Prediction. MIS Quarterly 41(1): 65-82.]