

Midterm (75 minutes)

No calculators allowed. Just set up your answers, for example, $P = 49/52$. BE SURE TO EXPLAIN YOUR REASONING. If you want extra time, you can buy time at a price of 1 point a minute; for example, if your test is handed in 10 minutes after the scheduled finish time, 10 points will be subtracted from your test score.

1. Average grades are higher in senior-level college chemistry courses than in introductory chemistry courses, suggesting that students who get bad grades in an introductory chemistry course shouldn't give up taking chemistry courses. Identify the most important statistical bias in these data and describe a (hypothetical) controlled experiment that would get rid of this problem.
2. Yahtzee is a family game played with five 6-sided dice. In each turn, the player rolls the five dice and then can choose to keep some of the numbers and roll the remaining dice. After the second roll, the player can choose to keep more numbers and roll the remaining dice a final time. At the end of a recent Yahtzee game, professor Smith needed to roll at least one 5 in order to get a 35-point bonus and win the game. He rolled all five dice once, twice, and then a third time and did not get any 5s. What are the chances of this happening?
3. In the traditional game Tong, two players, E and O, simultaneously reveal a hand showing one, two, or three fingers. If the sum of the fingers on the two players' hands is even, O pays \$1 to E. If the sum is odd, E pays \$1 to O. If each player is equally likely to show one, two, or three fingers and their choices are made independently, what is the expected value of this game for E? For O?
4. Explain why you either agree or disagree with this reasoning in a student paper: "The survey was delivered electronically through Survey Monkey, and I distributed the link through Facebook. The sample was not entirely a random sample, it definitely has the faults of being a convenience sample, given the fact that only my friends on Facebook, and their friends, would have known of the survey. However, my reasoning was that each Pomona student represents Pomona as equally as the next person."

5. In his 1868 work, Carl Wunderlich concluded that temperatures above 100.4 degrees Fahrenheit should be considered feverish. In a 1992 study, Maryland researchers suggested that 99.9 degrees Fahrenheit was a more appropriate cutoff. If the oral temperatures of healthy humans are normally distributed with a mean of 98.23 and a standard deviation of 0.67 (the values estimated by the Maryland researchers), what fraction of these readings are above 100.4? Above 99.9?

6. Three prisoners, A, B and C, are in separate cells and sentenced to death. The governor has randomly selected one of them to be pardoned. The warden knows which one is pardoned, but is not allowed to tell. Prisoner A begs the warden to let him know the identity of one of the others who is going to be executed. "If B is to be pardoned, give me C's name. If C is to be pardoned, give me B's name. And if I'm to be pardoned, flip a coin to decide whether to name B or C."

The warden tells A that B is to be executed. Prisoner A is pleased because he believes that his probability of surviving has gone up from $1/3$ to $1/2$, as it is now between him and C. Prisoner A tells C the news, who is also pleased, because he reasons that A still has a $1/3$ chance to be pardoned, so his chance has gone up to $2/3$. What is the correct answer?

7. A 2010 survey found that the average employee at the WD Company had worked for the company for 20 years, suggesting that the average person who takes a job with WD works for the company for 20 years. Explain why these survey data might be consistent with a situation in which the average person who takes a job with WD works for the company for

a. less than 20 years.

b. more than 20 years.

8. James Fishkin, director of the Center for Deliberative Democracy at Stanford, recently argued that, “There is so little time for deliberation that some people make leadership choices based on whether they like a candidate’s hairstyle.” Fishkin proposes that 200-300 randomly selected citizens be asked to spend one to two days listening to experts debate a ballot initiative or candidate, and then vote. If 55 percent of all citizens would vote yes on a ballot initiative after listening to the experts, what is the *exact* probability that more than 50 percent of 250 randomly selected citizens would vote yes?
9. In a reverse-Martingale betting strategy, the gambler increases the size of the bet after a win and reduces the size of the bet after a loss. Consider, for example, a fair game where a bet of $\$X$ has a 50% chance of winning $\$X$ and a 50% chance of losing $\$X$. The player starts with a $\$1$ bet. If the player wins, the second bet is $\$2$. If the player loses, the second bet is $\$0.50$.
- What are the possible dollar outcomes of this two-bet strategy?
 - What is the expected value of this two-bet strategy?
 - What is this strategy counting on?
10. A researcher summarized a set of data with the histogram and boxplot shown below. Identify two reasons why you know that the researcher made a mistake.

