

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. For each of the following studies, identify the type of graph (histogram, side-by-side box plots, scatter diagram, or time series graph) that would be MOST appropriate.
 - a. Have test scores in Econ 57 risen or fallen in the past 20 years?
 - b. Do colleges that accept a large percentage of their students in early-decision programs have higher yields (percentage of accepted students that enroll)?
 - c. Can starting salaries be predicted from college grade point averages?
 - d. Are final exam scores independent of homework scores?
 - e. Is there more dispersion in the starting salaries of economics majors or history majors?

2. How might a statistician challenge this argument that appeared the *New York Times* in January 2014?
Punishment and surveillance by itself causes people to withdraw from political participation — acts of engagement like voting or political activism....In a large survey of mostly marginal men in American cities, the probability of voting declined by 8 percent for those who had been stopped and questioned by the police; by 16 percent for those who had experienced arrest; by 18 percent for those with a conviction; by 22 percent for those serving time in jail or prison.

3. You have two large cans and fifty red marbles and fifty blue marbles that you can divide however you want between the two cans, as long as you put exactly fifty marbles in each can. Afterward, the marbles in each can will be shuffled thoroughly; you will be blindfolded and then select one can at random from which you will select one marble at random. If this marble is red, you will be paid \$100. How do you divide the marbles in order to maximize your chances of winning 100 dollars? Show your work.

4. A carnival game has four boxes, into which the contestant tosses four balls:



Each box is deep enough to hold all four balls and the contestant is allowed to toss each ball until it lands in a box. The contestant wins the prize if each box has one ball. Assuming that balls are equally likely to land in any box (this is a game of chance, not skill), what is the probability of winning the game?

If it costs \$1 to play this game and the winning prize is \$5, how much profit can the carnival expect to make, on average, per play?

5. Consider a complete guesser on a multiple-choice test, where each question has 5 possible answers. The test might have 5, 20, or 50 questions. Without doing any calculations, will an increase in the number of questions increase or decrease the probability that this guesser will get
- exactly 20% of the questions right?
 - between 10% and 30% of the questions right?
 - more than 50% of the questions correct?
6. A survey of starting salaries obtained the data below. Display these data in a histogram.

starting salary (\$1000s)	number of people
30-40	50
40-50	10
50-70	40

7. Historical data show that 30% of the population like Movie A, and that 60% of the people who like Movie A also like Movie B while 10% of the people who don't like Movie A do like Movie B. If someone likes Movie B, what is the probability that he or she will also like Movie A?

8. A professor asked her students to flip a coin 100 times. One student diligently did the work, and wrote down the results. The other student is a bit of a slacker, and decided to make up fake coin tosses. Which student is the slacker? How do you know?

Student 1:

TTHHTHTTTTHTTTHTTTHTHTTTHTHHHTHTHHTHTTTHHTTTTHTTTHTH
TTHHTTTTTTTHTHHHHHTHTHTHTHTHTHHHHHTHHTTTTTHTTHTHTH

Student 2:

HTTHTTHTHHTTHTHTHTTHTHTTTHTTTHHTTHTTHTHTHTHTHTHTHTHTHTH
THTHTHTHHHTTHTHTHTHTHTTTHTHHHTHTHTHTHTHTHTHTHTHTHTHTHT

9. In the board game Monopoly, a player sent to jail can get out by rolling doubles with a pair of standard 6-sided dice or by paying a fine. On average, how many rolls will it take to roll doubles? (Ignore the rule that the player has to pay a fine to get out of jail after three attempts to roll doubles.)

10. You are going to do an experiment in which you roll several six-sided dice and record the sum of the numbers on these dice. You will repeat this experiment several times and make a histogram of the results. In which of these scenarios is your histogram more likely to be a very close approximation to a normal distribution? Explain your reasoning.

- a. 5 dice, 50,000 trials
- b. 50 dice, 5,000 trials