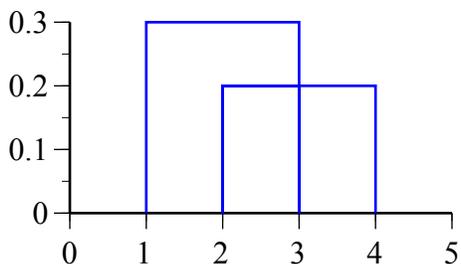


Midterm (75 minutes)

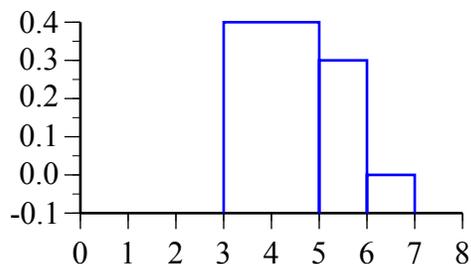
No calculators allowed. Just set up your answers, for example,  $P = 49/52$ . BE SURE TO EXPLAIN YOUR REASONING. If you want extra time, you can buy time at a price of 1 point a minute; for example, if your test is handed in 10 minutes after the scheduled finish time, 10 points will be subtracted from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

1. What is wrong with each of these histograms?

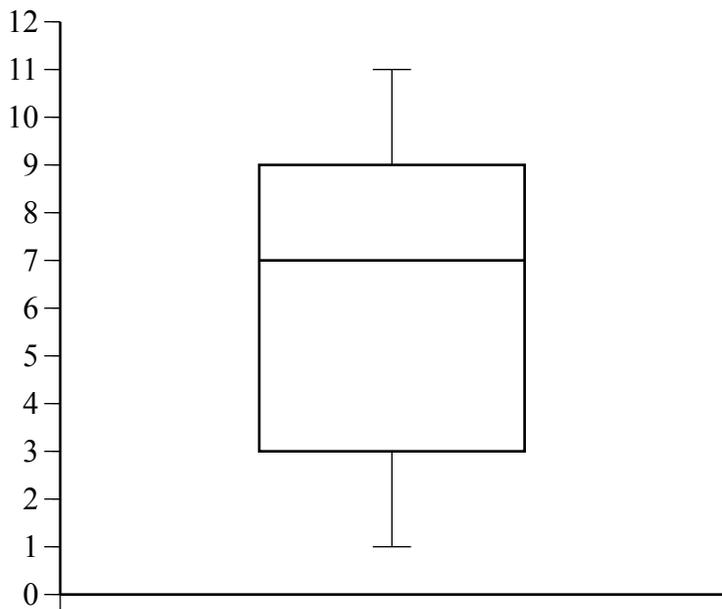
a.



b.



2. Draw a freehand sketch two side-by-side boxplots, one the boxplot shown below and one the boxplot if 2 is added to the value of all the observations in the boxplot below.



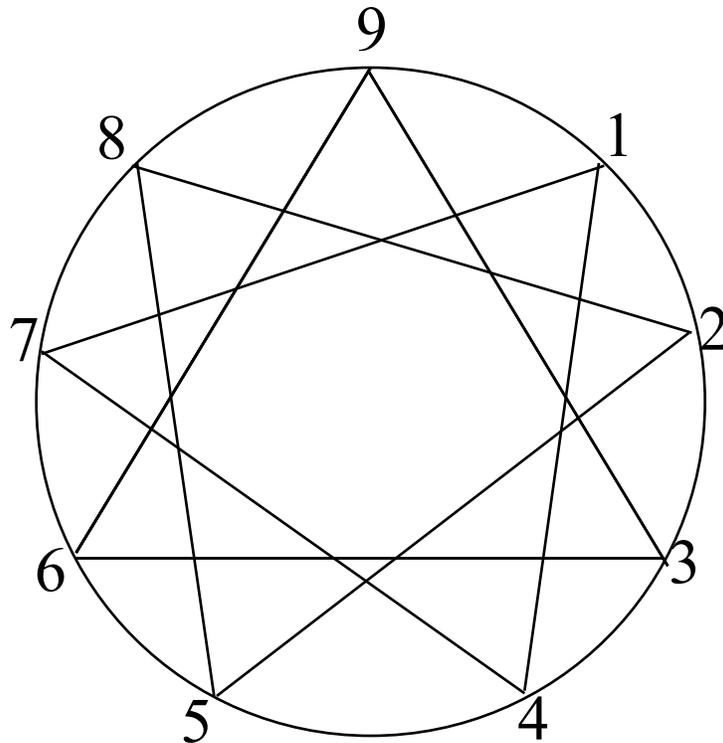
3. A 1950s study found that married men were in better health than men of the same age who never married or were divorced, suggesting that the healthiest path is for a man to marry and never divorce.
  - a. Explain why there might be sampling bias in this study.
  - b. Suppose that marriage is generally bad for a man's health. Explain how it could still be true that men who marry and stay married are in better health than: (i) men who don't marry; and (ii) men who marry and then divorce.
  - c. What would have to be done for a controlled experiment?

4. Identify the apparent statistical mistake in this commentary:

The median cost of a house in [Duarte] is a whopping \$4,276,462, making it the most expensive housing market in the country. It ranks No. 1 on Forbes' annual ranking of America's Most Expensive ZIP Codes.... [O]nly 12 homes are currently on the market. So a single high-priced listing (like the mammoth nine-bedroom, built this year, that's selling for \$19.8 million) is enough to skew the median price skyward.

5. Suppose that you choose 6 random characters (either letters or numbers) for a web site password, for example, ZDZMF2. Characters can be used more than once and no distinction is made between upper- and lower-case letters. Suppose that someone tries to enter your account by trying passwords with 6 randomly chosen characters, but only gets 3 tries before the web site locks the account for 24 hours. Because the attack program uses randomly selected characters, it may try the same 6 characters more than once.
  - a. What is the probability that 3 tries will be enough to access your account?
  - b. What is the expected wait until this program accesses your account?

6. The ancient Enneagram has nine personality types represented by the numbers 1 through 9 around a circle:



Three equilateral triangles can be drawn by connecting the points 9-3-6, 4-7-1, and 5-8-2. These three groupings correspond to three emotional states identified by modern psychological theory: (attachment (9-3-6), frustration (4-7-1), and rejection (5-8-2).

If the numbers 1 - 9 were randomly separated into three groups of three numbers, what is the probability that one group would contain the numbers 9, 3, and 6 (not necessarily in that order), another group would contain the numbers 4, 7, and 1, and the third group would contain the numbers 5, 8, and 2?

7. The annual returns on U.S. corporate stock and U.S. Treasury bonds over the next 12 months are uncertain. Suppose that these returns can be described by normal distributions with U.S. corporate stock having a mean of 15% and standard deviation of 20%, and U.S. Treasury bonds having a mean of 6% and standard deviation of 9%. If so, which asset is more likely to have a negative return? Explain your reasoning.

8. Suppose there are two kinds of households, Careless and Careful; 99% of households are Careful and 1% are Careless. In any given year, a home inhabited by a Careless household has a 0.010 probability of being destroyed by fire, and a home occupied by a Careful household has a 0.001 probability of being destroyed by fire. If a home is destroyed by fire, what is the probability that it was occupied by a Careless household?
9. Use the information in Question 8 to answer this question. Suppose that every home is worth \$100,000 and that an insurance company sells 1-year policies for \$500 that will pay either \$100,000 or nothing, depending on whether the home is destroyed by fire.
- Is the expected value of the amount the insurance company has to pay larger or smaller than \$500?
  - For a Careless household, is the expected value of the payoff larger or smaller than \$500?
  - For a Careful household, is the expected value of the payoff larger or smaller than \$500?
  - What potential problem do you see for this insurance company?
10. Each student who is admitted to a certain college has a 0.6 probability of attending this college and a 0.4 probability of going elsewhere. Each student's decision is independent of the decisions of other students. Compare a college that admits 1,000 students with a larger college that admits 2,500 students. Which college has the higher probability that the percentage of students admitted who attend the college will be
- exactly equal to 60%?
  - between 50% and 70%?
  - more than 80%?