STAT 520: Introduction to Statistical Inference

Homework 1. Based on Chapter 2 of Trosset's textbook. Due Thursday, September 2nd. For questions that require `R` code, you must turn in your `R` code on Canvas. Your should comment your code using # to at least denote the problem if not the reason you are doing what you are doing.

Handwritten questions:

Question 1: Let $X = \{1, 4, \text{dog}, \text{cat}, \spadesuit, \heartsuit, \pi, e\}$ be the universe of possible outcomes. Define the subsets A, B, and C of X by $A = \{1, 4, \pi, e\}$, $B = \{1, \text{dog}, \text{cat}, \spadesuit, \heartsuit, \pi\}$, and $C = \{1, 4, \spadesuit, \heartsuit, \pi, e\}$.

a. Is A a subset of B? Why or why not.

b. Is A a subset of C? Why or why not.

c. Compute $A \cup B$ and $A \cap B$.

d. Compute A^c and B^c.

e. Compute $A^c \cup B^c$ and $A^c \cap B^c$.

f. Compute $(A^c \cup B^c)^c$ and $(A^c \cap B^c)^c$. What sets that you have already computed do these correspond to?

g. Compute $C \setminus A$ and $C \setminus B$.

Question 2: There are five Platonic solids. The tetrahedron has four sides, the cube has six sides, the octohedron has eight sides, the dodecahedron has twelvve sides, and the icosohedron has twenty sides. A standard set of six playing dice includes the five Platonic solids and also a ten-sided die.

a. How many ways are there to choose an ordered tuple of three dice from the set of six dice?

b. How many ways are there to choose a set of three dice from the set of six dice?

c. How many ways are there to choose a set of three dice from the set of six dice such that the set of three dice only contains platonic solids?

d. How many ways are there to choose a set of three dice from the set of six dice such that the set of three dice contains at exactly one die whose number of faces is divisible by three?

e. How many ways are there to choose a set of three dice from the set of six dice such that the set of three dice contains at least one die whose number of faces is divisible by three?

f. You are playing a game in which you roll the tetrahedron twice and the cube once on a given turn. The value of your turn in the sum of the three rolls. How many ways are there to get a value for a turn that is greater than ten?

g. You are playing a game in which you roll the tetrahedron twice and the cube once on a given turn. The value of your turn in the sum of the three rolls. How many ways are there to get a value for a turn that is divisible by three?

Computational questions:

Question 3: In `R`, define a vector `X` that contains the numeric values 1 through 8. Define a vector `A` that contains the numeric values 1, 2, 7, 8. Define a vector `B` that contains the numeric values 1, 3, 4, 5, 6, 8. Define a vector `C` that contains the numeric values 1, 2, 5, 6, 7, 8.

a. Use the `R` operator `%in%` and command `all` to repeat a and b of question 1 in `R`.

b. Use the `R` commands `union`, `intersection`, and `setdiff` to repeat c through g of question 1 in `R`.

c. Vectors in `R` generally allow for repeated values, for instance the vector `AA = c(1,2,7,8,1)`. As a vector `AA` this is different from `A` that we have defined even though they use the same set of values $\{1, 2, 7, 8\}$. Similarly, the vector `AAA=c(1,7,8,2)` is different from the vector `A` even though it uses the same values and uses each value only once. Describe how you might use your answer to part a to try to figure out if these vectors define the same sets.

Question 4: In `R`, define a vector `X` that contains the numeric values 4, 6, 8, 10, 12, and 20.

a. Use the `R` function `combn` to enumerate all of the ways to choose three values from `X`.

b. Store the output from your function call above in some variable. What is the class of this output? What sort of dimensions does it have?

c. Parts b through e of question 2 have you answering questions that are related to this output you have stored. Without being specific to any one question, how would you generally go about trying to answer questions like parts b through e of question 2?