Homework 2

PSTAT 5A: Spring 2023, with Ethan P. Marzban

Instructions

- Please submit your work to Gradescope by no later than **11:59pm on Tuesday, April 18**. As a reminder, late homework will not be accepted.
- Recall that you will be asked to upload a **single** PDF containing your work for *both* the programming and non-programming questions to Gradescope.
  - You can merge PDF files using either Adobe Acrobat, or using adobe's online PDF merger at this link.

Problem 1: Picking Numbers

A random number generator picks a number from the set $\{1, 2\}$ at random, then picks another number from the set $\{1, 2, 3\}$ at random, and finally picks a third number from the set $\{1, 2\}$ at random. The number selected at each stage is recorded.

a) Use a tree diagram to specify the outcome space of this experiment.

b) Are we justified in using the classical approach to probability? Why or why not?

c) Use the classical approach to probability to compute the probabilities of the following events (being sure to use proper notation!):

i. E = "the first number selected is the number 1"

ii. F = "the second number selected is the number 2"

iii. G = "either the first number selected is the number 1 or the second number selected is the number 2 (or both)"

d) Compute the probability that the sum of the last two numbers selected is strictly greater than the first number. **Hint:** Remember the complement rule!

Problem 2: At the Movies

A recent survey at local cinemas revealed that, of the moviegoers surveyed, 75% purchase popcorn, 60% purchase a drink.

a. Is it possible for the events P = "a randomly selected moviegoer purchases popcorn" and D = "a randomly selected moviegoer purchases a drink" to be disjoint? Why or why not?

Now, suppose that it is also known that 40% of moviegoers purchase both popcorn and a drink.

b. What is the probability that a randomly selected moviegoer purchases *neither* popcorn *nor* a drink? **Hint:** Think about complements.

Problem 3: Soccer

Two soccer teams, the *Gauchos* and the *Bruins*, of equal level are pitted to play against each other. Because the two teams are of equal level, it is assumed that the probability that the *Gauchos* win a game is equal to the probability that the *Bruins* win a game. There is, however, a 10% chance that any given game will result in a tie. Consider the outcome of a single game.

a. What is the outcome space of this experiment?

b. What is the probability that the *Gauchos* will win a given game?

Problem 4: Hackers

Congratulations- you've turned to the dark side and are now a hacker! Your first order of business is to try and gain access to people's bank accounts on the *GauchoBank* website.

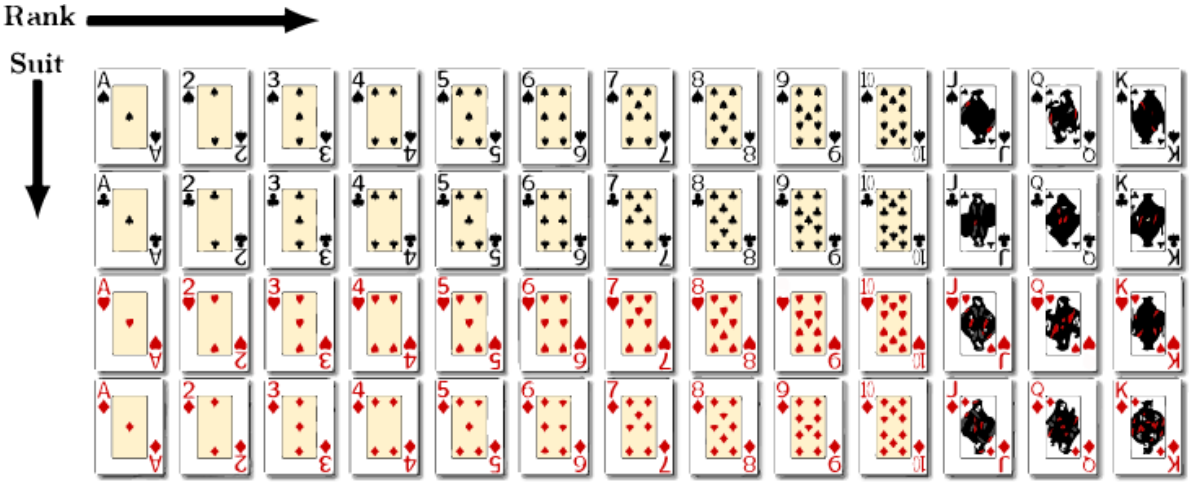
a. Suppose that passwords on the *GauchoBank* website are of the form: 5 letters (A through Z), followed by 3 digits (0 through 9), followed by 1 special character (!, @, #, $, or %). How many passwords are possible using this scheme?

b. You now find out that the password scheme is a little more complex than you originally thought: specifically, though the letters digits and special characters must remain consecutive, the order in which they appear *across these categories* is not fixed. That is, both `abcde12345%` and `%abcde12345` are valid passwords. How many passwords are possible using this scheme?

c. Now, suppose that passwords are constructed using the scheme outlined in part (b) above, and suppose you are now interested in hacking into Ethan's *GauchoBank* account. As such, you guess a password at random- what is the probability that you correctly guess Ethan's password? Justify your answer.

Problem 5: Counting Cards

A standard deck of cards contains 52 cards arranged into 4 **suits** (`spades`, `clubs`, `hearts`, and `diamonds`) and 13 **ranks** (`A`, `1` through `10`, `Jack`, `Queen`, and `King`):



a. If a card is drawn at random from a deck of 52 cards, what is the probability that it is a `heart`?

b. If a card is drawn at random from a deck of 52 cards, what is the probability that it is an Ace?

c. If a card is drawn at random from a deck of 52 cards, what is the probability that it is either a King or an Ace?

d. If a card is drawn at random from a deck of 52 cards, what is the probability that it is either a King or a `spade`?

Problem 6: Programming

Instructions

- Write your answers to this question in a new Jupyter notebook, and export your work to a PDF using the steps you saw in Lab01. **Be sure to merge this PDF with your PDF containing your work to the above questions before submitting!** (See instructions at the top of this homework).

Part (a): Create the following table in Python, and assign it to a variable called `star_trek`. Display the `star_trek` table by creating an running a cell containing just the code `star_trek`.

Name	Rank	Species	Homeworld
Kirk	Admiral	Human	Earth
Spock	Commander	Vulcan	Vulcan
Worf	Lt. Commander	Klingon	Q'onoS
Data	Lt. Commander	Android	Omicron Theta
Riker	Commander	Human	Earth

Part(b) Write code to extract the `Rank` column from the `star_trek` table.

Part(c) Write code to count the number of humans that are present in the `star_trek` table. As a hint, you can use the following template and fill in the blanks with appropriate methods:

```
_____.where("Species", _____)._____
```

As a further hint: remember that http://www.data8.org/datascience/tables.html contains a list of methods for tables.

Part (d) Add the following row to the `star_trek` table **WITHOUT** using the `.append()` method:

Name	Rank	Species	Homeworld
Sisko	Captain	Human	Earth

Display the modified `star_trek` table to ensure the addition was successful. **Hint:** There are two things you'll need to do: you'll need to first find a method to add a row to a table that isn't the `.append()` method, and you'll also need to perform variable re-assignment (recall when we did that on Lab1!)

Part (e) What is the probability that a randomly selected person from the `star_trek` table is a human from Earth? **Answer this question AFTER completing the addition of the row in part (d) above.** You don't need to use code for this part, but you should write your answer in a markdown cell.