# Homework 1

**Introduction to Probability and Statistics**
**EE 354 / CE 361 / MATH 310**

Spring 2024

**Note:** All questions are worth 10 points each.

## Question 1

A toddler randomly chooses a ball from a basket having 5 red, 5 black, and 5 white balls. Assume that a red ball is two times more likely to be picked up by the toddler than a white or black ball. Find the following probabilities:

a) The chosen ball is red.
b) The chosen ball is neither red nor black
c) The chosen ball is not black.
d) The chosen ball is red, white, or black.

## Question 2

Two 4-sided dice are thrown simultaneously. If the sum of two numbers obtained is 5, what is the probability that at least one of the 4-sided dice came out to be number 3.

## Question 3

A basket contains 5 red, 10 white, 10 black, and 5 orange balls. Assume that all balls are equally likely to be chosen. Two balls are chosen from the basket one after the other without replacement. Find the following probabilities:

a) Both the chosen balls are red.
b) The first chosen ball is red and the second chosen ball is orange

## Question 4

A certain professor at Habib University is in the habit of launching into a speech about classroom manners if he sees a student using his/her cellphone during a class. There is only 0.05 probability that not a single student will use his/her cellphone during a class. If the professor sees a student using the cellphone, there is 0.75 probability that he will launch into his speech about classroom manners. What is the probability that there will be a speech by the professor about classroom manners in the next class?

(Note: Assume that the professor is eagle-eyed and there is no chance that somebody can use the cellphone during class without him noticing it. Also, assume that the professor will only consider giving his speech if he sees someone using a cellphone.)

## Question 5

In a city with one hundred taxis, 1 is blue and 99 are green. A witness observes a hit-and-run by a taxi at night and recalls that the taxi was blue, so the police arrest the blue taxi driver who was on duty that night. The driver proclaims his innocence and hires you to defend him in court. You hire a scientist to test the witness's ability to distinguish blue and green taxis under conditions similar to the night of accident. The data suggests that the witness sees blue cars as blue 99% of the time and green cars as blue 2% of the time. What is the probability that taxi was actually blue given the witness's statement?

**Question 6**

Suppose that only two math courses are being offered on campus in a semester: Linear Algebra and Probability. Each student is allowed to enroll in at most one math course. As a result, 10% students are taking Linear Algebra, 15% students are taking Probability, and the other 75% students are not taking any math course. Suppose that 25% of the pages of Linear Algebra textbook have a theorem and 20% of the pages of the Probability text book have a theorem. If you randomly walk up to a table in the library and peek over the student's shoulder and the student happens to be reading a theorem in his/her math textbook, what is the probability that the student is enrolled in the Probability course.

(Note: Assume that students do not bother to read any books other than the textbook for their courses.)

**Question 7**

A hiker is starting a hike to his destination. There are four trails (Trail no. 1, 2, 3, and 4) that lead to his destination. However, each trail divides into two sub-trails along the way and only one of the two sub-trails leads to hiker's destination. The hiker has no map available. The hiker decides to choose one of the four trails by rolling a fair 4-sided die. The hiker also decides to choose between two sub-trails by flipping a fair coin. What is the probability that the hiker will reach his destination.

**Question 8**

Imad, an HU student, encounters two traffic lights on his way to campus in the morning. On a good day, the first light is red with a probability 0.1 and green with a probability 0.9. Also, on a good day, the second light is red with a probability 0.25 and green with a probability 0.75. On a bad day, he gets a red or green light with equal probabilities for both lights. With a probability 0.75, he will have a good day, and with a probability 0.25 he will have a bad day. What is the probability that he will have to encounter two red traffic lights next Monday.

**Question 9**

Consider two consecutive rolls of a fair 6-sided die. Are the following events independent?

A = {1st roll results in 1, 2, or 4}

B = {1st roll results in 1, 2, or 5}

Justify your answer.

**Question 10**

Consider two consecutive rolls of a fair 6-sided die. Are the following events independent?

A = {1st roll results in 1, 2, or 4}

B = {The result of both the rolls is the same}

Justify your answer.