Assignment - Chapter 7

Complete the following problems related to Chapter 6. Upload to Canvas a single pdf containing your work before the deadline.

1. The set of all possible outcomes of a random experiment is known as the _____ of the experiment.

   (a) Random event

   (b) Dependent and independent events

   (c) Mutually exclusive events

   (d) Sample space

2. Suppose a random experiment involves drawing a card at random from a deck of well shuffled cards. What is the sample space of this random experiment?

3. Suppose a random experiment consists of flipping two coins. Then the sample space is written as $S = \{(H, H), (H, T), (T, H), (T, T)\}$. One possible outcome of this experiment is (H,T), which is also called as:

   (a) Sample space

   (b) Independent event

   (c) Probability

   (d) Random event

4. In American football league (NFL), the referee flips a coin to determine which team gets the first possession. To ensure that the coin is a fair coin, which of the following approaches is the best in probabilistic sense?

   (a) Repeat the coin toss 100 times, and if it lands on heads more than 60% of the time, conclude that it is biased.

   (b) Repeat the coin toss an infinite number of times. Observe whether the coin lands on heads half of the time, and on tails half of the time. That ensures the coin is a fair coin.

   (c) Use a magnet to check if the coin has equal attraction to both sides, confirming its fairness.

   (d) Toss the coin until it lands on heads. Similarly, toss the coin until it lands on tails. If both are equal then the empirical probability is equal to the theoretical probability.

5. If you roll a fair die 20 times, and you get number "1" on the die 3 times. Hence, the probability of getting a "1" while rolling a fair die is $3/20 = 0.15$. This approach of calculating probability is also called as:

6. Calculate the theoretical probability of rolling a "1" when you roll a fair die.

7. I have a standard deck of well shuffled cards and one card is drawn at a random. What is the probability that the card drawn is a face card?

8. A class contains 100 students; 30 of them like mathematics, 25 like physics, and 20 like both mathematics and physics. If a student is chosen at random, find the probability that they like mathematics OR physics.

9. A class contains 100 students; 30 of them like mathematics, 25 like physics, and 20 like both mathematics and physics. If a student is chosen at random, find the probability that they like neither mathematics OR physics.

10. A card is drawn at random from a standard deck of well shuffled cards. Calculate the probability that it is a black card or a face card.

11. A card is drawn at random from a standard deck of well shuffled cards. Let E be the event that it is a red card and let F be the event that it is a black card. Calculate the probability of the event "E or F". In other words, calculate $P(E \text{ OR } F)$:

12. Are the events E and F described in the previous question mutually exclusive events?

    (a) Yes, they are mutually exclusive events.

    (b) No, they are not mutually exclusive events.

13. A card is drawn at random from a standard deck of well shuffled cards. Recall that there are 13 hearts, 13 diamonds, 13 spades and 13 clubs in a standard deck of cards. If I draw a card at random, and without showing you the card, I tell you that the card is red, then what is the probability that it is a heart?

14. A card is drawn at random from a standard deck of well shuffled cards. What is the probability that the card drawn at random is a face card given that it is a black card?

15. Answer the next 11 questions using this table below. 540 individuals who work only a single job were surveyed regarding job satisfaction. The results are displayed in the table above.

16. If one individual is chosen at random, what is the probability that they are extremely satisfied with their job?

17. If one individual is chosen at random, what is the probability that they are an Astronaut?

18. If one individual is chosen at random, what is the probability that they are a Lawyer AND are not satisfied with their job?

19. If one individual is chosen at random, what is the probability that they are a professor AND are somewhat satisfied with their job?

20. If one individual is chosen at random, what is the probability that they are an Uber driver OR are not satisfied with their job?

21. Are the two events in the previous question (i.e. being an Uber driver and not satisfied with their job) mutually exclusive events?

    (a) No, they aren't mutually exclusive events.

    (b) Yes, they are mutually exclusive events.

22. If one individual is chosen at random, what is the probability that they are an astronaut or a lawyer?

23. Are the two events in the previous question (i.e. being an astronaut and a lawyer) mutually exclusive events?

    (a) Yes, they are mutually exclusive events.

    (b) No, they aren't mutually exclusive events.

24. Given that an individual is an Uber Driver, what is the probability that they are somewhat satisfied with their job?

25. Given that an individual is not satisfied with their job, what is the probability that they are a lawyer?

26. Are the events "extremely satisfied with the job" and "Uber driver" independent events?

    (a) Yes, the events are independent.

    (b) No, the events aren't independent.

27. If S is a sample space, and E and F are events with probabilities $P(E) = 0.5$, $P(F) = 0.4$ and $P(E \cap F) = 0.3$. What is $P(E|F)$?

28. If S is a sample space, and E and F are events with probabilities $P(E) = 0.5$, $P(F) = 0.4$ and $P(E \cap F) = 0.3$. What is $P(F|E)$?

29. The probability that it will be 30 degrees or below tomorrow morning is 0.5. When the temperature is that low, the probability that my car will not start is 0.7. What is the probability that tomorrow morning it will be 30 degrees or below AND my car will not start? Hint: Rearrange the formula for conditional probability.

30. A random experiment involves flipping a coin 10 times. Let an event E be get 10 heads in a row i.e. HHHHHHHHHH. Let an event F be getting the result HTHHTTHTHT. Which of the two events is more likely to happen?

    (a) Event E

    (b) Both are equally likely

    (c) Event F

31. You are playing a game of Ludo. The rules are: you roll a die and if you get a '6' on a die, it's your turn again. If you get any number other than '6', the game moves on and the other players will have their turn. It's your turn and you are about to win the game if you get 3 sixes in a row. What is the probability of you winning the game?

32. Mary is taking a multiple choice quiz with two questions. Each question has 5 possible solutions (a) - (e). Mary has no idea what the right answers might be, so she takes a random guess for each answer. What are the chances that she gets both questions wrong?

33. The Toddlers of the Lough soccer team in Cork, Ireland has no known connection to the Notre Dame Lacrosse team. The chances that the toddlers will win their game this weekend is 0.7 and the chances that the Notre Dame Lacrosse team will win their game this weekend is 0.999. It is reasonable to assume that the events that each team will win are independent, based on this assumption calculate the probability that both teams will win their games this weekend.