Probability & Distribution Theory - In class Assignment 01

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Probability Theory: Events and Operations

Each of the following experiments is accompanied by a real-world context and includes the specific observation being recorded. Write clear answers using appropriate set notation and logical reasoning.

Question 1

Experiment: A spinner equally divided into 8 sectors numbered from 1 to 8 is spun once, and the number at which it stops is recorded.

Let:

- A: the number is even
- B: the number is greater than 5
- C: the number is divisible by 4

Write:

- The sample space S
- The events A, B, C as subsets of S
- $A \cap B$, $A \cup C$, and B'

Question 2

Experiment: A day is selected at random from a week, and the name of the selected day is recorded.

Let:

- A: the day is a weekday
- B: the day name starts with "S"
- C: the day is Monday or Tuesday

Write:

- The sample space S
- The events A, B, C
- $A \cap B$, $A \cup C$, and B'

Question 3

Experiment: A customer picks a drink at random from a vending machine that offers 3 cola drinks, 2 orange juices, and 1 water bottle, and the label of the selected drink is recorded.

Let:

- A: selecting a cola
- B: selecting a non-cola drink
- C: selecting either a cola or water

Write:

- The sample space S
- The events A, B, C
- $A \cup C$, $A \cap B$, and B'

Question 4

Experiment: A user taps one app at random from 10 app icons on their smartphone home screen, and the category of the app is recorded. There are 4 Social, 2 Game, 3 Utility, and 1 Finance app.

Let:

- A: the app is social
- B: the app is not social
- C: the app is a Game or Finance app

Write:

- The sample space S
- The events A, B, C
- $A \cup C$, $A \cap B$, A'

Question 5

Experiment: A coin is tossed three times, and the full sequence of outcomes (in order) is recorded (e.g., HTH, TTT).

Let:

- A: exactly one head appears
- B: at least one tail appears
- C: the first toss is a head

Write:

- The sample space S
- The events A, B, C
- $A \cap B$, $A \cup C$, and B'

Question 6

Experiment: A person selects and watches one video from a streaming platform that offers five content categories: Music, Education, News, Sports, and Comedy. The category of the selected video is recorded.

Let:

- A: the video is informative (Education or News)
- B: the video is entertaining (Music or Comedy)
- C: the video is a Sports video

Write:

- The sample space S
- The events A, B, C
- $A \cup B$, $A \cap C$, A'

Question 7

Experiment: A fitness app records the number of minutes a randomly selected adult spends walking outdoors in a day.

Let:

- The sample space $S = [0, 300]$
- A: the person walks for less than 30 minutes
- B: the person walks for more than 150 minutes

Write:

- The events A, B
- $A \cup B$, $A \cap B$, and A'

Question 8

Experiment: An inspector selects a random part from a production line and checks if the part is defective, if it passes the length specification, and if it passes both length and width specifications.

Let:

- A: the part is defective
- B: the part passes length check
- C: the part passes both length and width checks

Write:

- Interpret A^c, $B \cap C$, and $A \cup B$

Question 9

Experiment: A family continues to have children until their first g