

## Study Sheets

### Axioms

- For any event  $A$ ,  $P(A) \geq 0$
- $P(S) = 1$
- If  $A_1, A_2, A_3, \dots$  is an infinite collection of disjoint events, then

$$P(A_1 \cup A_2 \cup A_3 \cup \dots) = \sum_{i=1}^{\infty} P(A_i)$$

### Definitions:

- **Experiment:** Process of observation that leads to a single outcome that cannot be predicted with certainty.
- **Sample Point:** Most basic outcome of an experiment
- **Sample Space ( $S$ ):** Collection of all sample points, contains all outcomes
- **Event:** A certain collection of sample points
- **Simple Events:** One sample point
- **Compound Events:** Two or more sample points
- **The Null Event ( $\phi$ )** The event that contains no outcomes  $\{\}$
- **Union:**  
 $A \cup B = \{e \mid e \in A \text{ or } e \in B\}$
- **Intersection:**  
 $A \cap B = \{e \mid e \in A \text{ and } e \in B\}$
- **Complement:**  
 $A' = \{e \mid e \notin A\}$
- **Mutually Exclusive / Disjoint Events:**  
 $A \cap B = \phi$
- **De Morgan's Laws**  
 $(A \cup B)' = A' \cap B'$   
 $(A \cap B)' = A' \cup B'$

### Concepts:

- Empirical and Theoretical Probability
- S always occurs  $\phi$  never occurs

- **Complement Rule**

$$S = A \cup A'$$

$$P(A') = 1 - P(A)$$

$$P(S) = P(A) + P(A')$$

- **Addition Rule**

For any events A and B,

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

**Proof:**

$$P(A \cup B) = P(A) + P(B \cap A')$$

$$= P(A) + [P(B) - P(A \cap B)]$$

$$= P(A) + P(B) - P(A \cap B)$$

- **N Rule**

Suppose we have sets  $A_1, A_2, A_3, \dots$  and that any pair are mutually exclusive.

Let  $n_i$  be the number of elements in  $A_i$ . Then let N be the total number of elements.

If  $n_1$  is the total number of ways the first operation can be preformed then  $n_2$  is number of ways the second operation can be preformed.

$$N = n_1 n_2$$

Is the total amount of ways the two operations can be preformed.

**How many ways can you order N objects?**

First object  $n_1 = n$

Second object  $n_2 = n - 1$

kth object  $n_k = n - k + 1$

$$N = n(n - 1) \dots (n - k + 1) = n!$$

**1.1 A Find this this this and that!**