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Math 323

Probability Notes

Study Sheets

Axioms

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

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

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 ore more sample points
- **The Null Event (ϕ)** The event that contains no outcomes $\{\}$
- **Union:**
  $A \cup B = \{e \mid e \in A \textbf{ or } e \in B\}$
- **Intersection:**
  $A \cap B = \{e \mid e \in A \textbf{ and } e \in B\}$
- **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 ϕ 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 $A_1, A_2, A_3, \ldots$ 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 $n_k = n - k + 1$

  $N = n(n-1)...(n-k+1) = n!$

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