Chapter 4
Probability

1 The Probability of an Event

Properties:

- $P(A)$ must be between 0 and 1
- Let s be a simple event, $\sum_{s \in S} P(s) = 1$.

2 Permutations and Combinations

- Factorial: $n! = n(n-1)(n-2)...(2)(1)$ and $0! = 1$
  Example: Number of ways to arrange 5 people in a straight line.
- Permuations (Order is important): $P_r^n = \dfrac{n!}{(n-r)!}$
  Example: Number of ways to choose 3 people from 15 people to get a gold, silver and bronze medals respectively.
- Combinations (Order is NOT important): $C_r^n = \dfrac{n!}{(n-r)!r!}$
  Example: Number of ways to choose 6 people from 15 people to make a volley ball team.

3 Event Relations

- The Additive Rule for Unions: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- Conditional probability: $P(A|B) = \dfrac{P(A \cap B)}{P(B)}$ given that $P(B) \neq 0$
- Event A and B are independent $\iff P(A \cap B) = P(A) \cdot P(B)$
- Event A and B are independent $\iff P(A|B) = P(A)$ or $P(B|A) = P(B)$