Probability Review

Probability terms

Term	Definition	Some Notation
Event	Result of observation / experiment	A, B
Intersection	The event that both A and B occur	$A \cap B$
Union	At least one of A or B occurs	A U B
Complement	The complement of A is the event that A does not occur	A^C
Mutually Exclusive	A and B are mutually exclusive if they cannot happen together	$P(A \cap B) = 0$
Independent	A and B are independent if A contains no information about the probability that B will occur (or vice versa).	$P(A\|B)=P(A)$ $P(B\|A)=P(B)$
Exhaustive	A and B are exhaustive events when at least one of A or B always occurs.	$P(A \cup B) = 1$

Probability Rules

- **Additive rule of probability**

  $P(A \text{ and/or } B) = P(A \cup B) = P(A) + P(B) – P(A \cap B)$

- **Conditional Probability**

  $P(B|A) = P(A \cap B)/P(A)$

- **Multiplicative rule of probability**

  $P(A \text{ and } B) = P(A \cap B) = P(A)P(B|A) = P(B)P(A|B)$

  For independent events: $P(A \text{ and } B) = P(A \cap B) = P(A)P(B)$

Bayes' Theorem

- Calculates the conditional probability of an event based on other known probabilities

  $P(A \mid B) = P(A \cap B)/P(B)$

  where $P(B) = P(A)P(B|A) + P(A^C)P(B|A^C)$

Diagnostic Testing/Screening

Notation:

D^+ = disease positive D^- = disease-free
T^+= test positive T^+ = test negative

Term	Definition	Notation
Sensitivity	Probability of testing positive given that the individual has the disease	$P(T^+\|D^+)$
Specificity	Probability of testing negative given that the individual does not have the disease	$P(T^-\|D^-)$
False positive probability	Probability of testing positive given that the individual does not have the disease	$P(T^+\|D^-)$
False negative probability	Probability of testing negative given that the individual does have the disease	$P(T^-\|D^+)$
Positive predictive value	Probability of disease given a positive test result	$P(D^+\|T^+)$
Negative predictive value	Probability of not having disease given a negative test result	$P(D^-\|T^-)$