

## Probability Theory, Part 2

### Types of Events

- Two events A and B are *mutually exclusive* if they cannot happen at the same time  
 $P(A \cap B) = 0$
- Two events A and B are *independent* if the probability of the first one happening is the same no matter how the second one turns out

### Properties of Independent Events

That A and B are independent means :

- $P(A|B) = P(A)$
- $P(B|A) = P(B)$
- $P(A \cap B) = P(A).P(B)$

### Diagnostic Testing

- Experiment : performing a diagnostic test for some disease
- Data : information on a random sample of n people who were tested and whose disease status is known

	Disease (D+)	No disease (D-)	
Test + (T+)	a	b	(a+b)
Test - (T-)	c	d	(c+d)
	(a+c)	(b+d)	n

- Want to learn : how good the test is
- There are four measures of how good a test is :

1. Sensitivity =  $P(T+|D+) = \frac{a}{a+c}$

$$2. \text{ Specificity} = P(T-|D-) = \frac{d}{b+d}$$

$$3. \text{ Predictive value of a positive test} = PV+ = P(D+|T+) = \frac{a}{a+b}$$

$$4. \text{ Predictive value of a negative test} = PV- = P(D-|T-) = \frac{d}{c+d}$$

### **Problem for Rare Diseases**

- Need very large number of people in the study to have enough people with the disease
- Solution : instead of choosing n people at random choose n people with disease and n people without disease