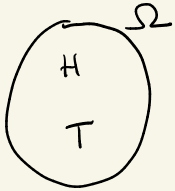
Sample space



Events

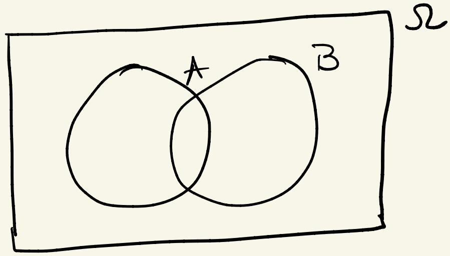
$\Omega = \{1,2,3,4,5,6\}$

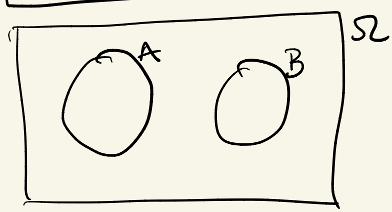
$A = \{2,4,6\}$

$A^c = \bar{A} = \{1,3,5\}$

$A \cup B$

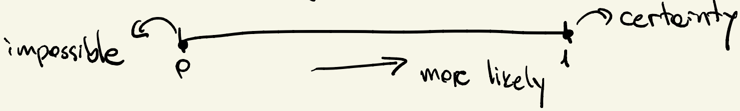
$A \cap B$





$A \cap B = \emptyset$

<u>Probability</u> = measure of the likelihood of an event



<u>Naive</u> <u>definition</u>

$$P(A) = \frac{\#\text{ outcomes favourable } A}{\#\text{ outcomes in } \Omega}$$

$$P(A) = \frac{3}{6} = \frac{1}{2}$$

P(⚅) = $\frac{1}{6}$

. Probability as relative frequency:

$$P(A) = \lim_{n\to\infty} \frac{\#(A)}{n}$$

. Axiomatic definition of probability

$$P: \Omega \to [0,1]$$

1) $A \subset \Omega$, $P(A) \geq 0$

2) $P(\Omega) = 1$

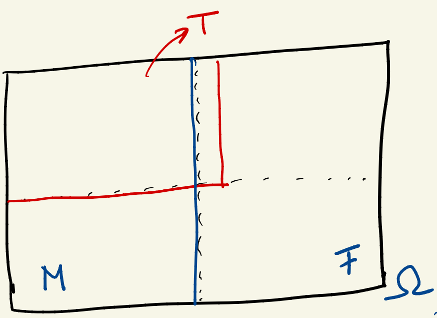
3) A and B are disjoint events, $P(A \cup B) = P(A) + P(B)$

Corollaries:

. $P(A^c) = 1 - P(A)$

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

• $P(A|B) = \dfrac{P(A \cap B)}{P(B)}$



$P(T) = 0.30$

$P(T|M) = 0.50$

$P(T|F) = 0.10$

$P(T \cap M)$

$$\boxed{P(T|M) = \frac{P(T \cap M)}{P(M)}}$$

• $P(A|B)\,P(B) = P(A \cap B)$ → Multiplicative Rule

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

- 0.8% women 40-50 have cancer
- If women has cancer, the mammogram will be positive with probability 90% $P(+ \mid \text{Cancer})$
- If woman does not have cancer, the mammogram will still be positive with probability 7%

$$P(\text{Cancer} \mid +) = \frac{P(\text{Cancer and } +)}{P(+)} = \frac{P(+ \mid \text{Cancer})\, P(\text{Cancer})}{P(+)}$$

$$= \frac{P(+ \mid \text{Cancer})\, P(\text{Cancer})}{P(+ \mid \text{Cancer})\, P(\text{Cancer}) + P(+ \mid \overline{\text{Cancer}})\, \underbrace{P(\overline{\text{Cancer}})}_{1-0.008}}$$

$$=$$