

## ***Factsheet: Probability***

### **For a single event $A$**

Theoretical Probability of event  $A$ :

$$P(A) = \frac{\text{Number of Outcomes for which } A \text{ Can Occur}}{\text{Number of All Possible Outcomes}}$$

Experimental Probability of event  $A$ :

$$P(A) = \frac{\text{Number of Experiments in which } A \text{ Occurred}}{\text{Number of Experiments Conducted}}$$

$$0 \leq P(A) \leq 1$$

$$P(\text{Not } A) = P(A') = 1 - P(A)$$

$$P(A) = 0$$

$A$  is impossible

$$P(A) = 1$$

$A$  will definitely happen

### **For two events $A$ and $B$**

Notation for **Conditional Probability** of  $A$  given  $B$

$$P(A|B)$$

Probability of  $A$  and  $B$

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

$A$  and  $B$  are **independent** if  $A$  does not affect  $B$  and  $B$  does not affect  $A$

Probability of  $A$  given  $B$  if  $A$  and  $B$  are independent

$$P(A|B) = P(A)$$

Probability of  $A$  and  $B$  if  $A$  and  $B$  are independent

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

Probability of  $A$  or  $B$

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

$A$  and  $B$  are **mutually exclusive** if they cannot both occur together

$A$  and  $B$  are mutually exclusive

$$P(A \cap B) = 0$$

Probability of  $A$  or  $B$  if  $A$  and  $B$  are mutually exclusive

$$P(A \cup B) = P(A) + P(B)$$

**Bayes Theorem:** 
$$P(A|B) = \frac{P(A)P(B|A)}{P(B)}$$

## For three events **A**, **B** and **C**

Probability of **A** and **B** and **C**

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

Probability of **A** and **B** and **C** if they are all **independent**  $P(A \cap B \cap C) = P(A)P(B)P(C)$

Probability of **A** or **B** or **C**

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

Probability of **A** or **B** or **C** if they are all **mutually exclusive**

$$P(A \cup B \cup C) = P(A) + P(B) + P(C)$$

## For multiple events

Bayes theorem for mutually exclusive events  $A_i$  one of which must occur

$$P(A_k | B) = \frac{P(A_k)P(B|A_k)}{\sum_i P(A_i)P(B|A_i)}$$

## Want to know more?

If you have any further questions about this topic you can make an appointment to see a **Learning Enhancement Tutor** in the **Student Support Service**, as well as speaking to your lecturer or adviser.

- 📞 Call: 01603 592761
- 💻 Ask: [ask.let@uea.ac.uk](mailto:ask.let@uea.ac.uk)
- 🔗 Click: <https://portal.uea.ac.uk/student-support-service/learning-enhancement>

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