

STATISTICAL COMPUTATIONAL METHODS

Review of Probability Rules

(S, \mathcal{K}, P) is a probability space.

1. $P(\bar{A}) = 1 - P(A)$;

2. $0 \leq P(A) \leq 1$;

3. $P(\emptyset) = 0$;

4. $P(A \setminus B) = P(A) - P(A \cap B)$;

5. $A \subseteq B \Rightarrow P(A) \leq P(B)$;

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

7. **Poincaré's formula (inclusion - exclusion principle)**

$$P\left(\bigcup_{i=1}^n A_i\right) = \sum_{i=1}^n P(A_i) - \sum_{i < j} P(A_i \cap A_j) + \dots + (-1)^{n+1} P\left(\bigcap_{i=1}^n A_i\right);$$

8. **Classical Probability:**

$$P(A) = \frac{\text{nr. of favorable outcomes}}{\text{total nr. of possible outcomes}};$$

9. **Mutually Exclusive Events: A, B m. e. (disjoint, incompatible)**

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

10. **Conditional Probability:**

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, \quad P(B) \neq 0;$$

11. **Independent Events: A, B ind.**

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

12. $P(A \cap B) = P(A)P(B|A) = P(B)P(A|B)$;

13. **Multiplication Rule:**

$$P\left(\bigcap_{i=1}^n A_i\right) = P(A_1) P(A_2|A_1) P(A_3|A_1 \cap A_2) \dots P\left(A_n \middle| \bigcap_{i=1}^{n-1} A_i\right);$$

14. **Total Probability Rule:** $\{A_i\}_{i \in I}$ a partition of S $\left(S = \bigcup_{i \in I} A_i, A_i \cap A_j = \emptyset, i \neq j\right)$

$$P(E) = \sum_{i \in I} P(A_i)P(E|A_i).$$