STATISTICAL COMPUTATIONAL METHODS

Review of Probability Rules

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

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

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

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

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

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

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

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

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

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:

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

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:

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

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

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