9 Inference

PVK 2019: MAD

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Schedule

1. Theory
    1. Setup
    2. Maximum Likelihood
    3. Maximum Log-Likelihood
2. Exercises
3. Homework

Theory

Setup

- Data D
- Parameter(s) θ

Maximum Likelihood

- Assume we have some data D and a parametrized model, then

$$p(D \mid \theta)$$

- We want our model to describe the data as well as possible

$$\theta^* = \arg\max p(D \mid \theta)$$

Maximum Log Likelihood

- We are interested in finding

$$\theta^* = \arg\max p(D \mid \theta)$$

- We assume that the sample are independent

$$p(\, D \mid \theta\,) = p(\, x_1 \mid \theta\,) \cdot p(\, x_2 \mid \theta\,) \cdot \ldots$$

- For convenience solve the following

$$\theta^* = \arg\max \underbrace{\log p(D \mid \theta)}_{Log-likelihood\ function} = \arg\max \log p(x_1 \mid \theta) + \log p(\, x_2 \mid \theta\,) + \cdots$$

Maximum Log Likelihood cont. Example

- Given:
  - Data $D = \{(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)\}$
  - Model $p(\, y \mid x;\, \theta\,) = 1/\sqrt{2\pi} \cdot \exp - \frac{(y-\theta x)^2}{2}$

- Task:
  - Write down the log-likelihood function $l(\theta) = \log p(D \mid \theta)$
  - Find $\kappa(\theta)$ such $\arg\max \kappa(\theta)$ contains no unnecessary terms, in other words: Strap $l(\theta)$ from all terms which don't affect the $\arg\max\cdot$.
  - What does the resulting term compare to? (seen in one of the first lectures)

Exercises

none

Homework

none