

Inclass 15: MLE and MAP

[SCS4049] Machine Learning and Data Science

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Maximum likelihood estimate

Maximum likelihood estimation, or MLE, is on flavor of parameter estimation in machine learning. In order to perform parameter estimation, we need:

- some data $\mathbf{x}$
- some hypothesized generating function of the data $f(\mathbf{x}, \theta)$
- a set of parameters from that function θ
- some evaluation of the goodness of our parameters

Maximum likelihood estimate

In MLE, the objective function (evaluation) we chose is the likelihood of the data given our model. To find the best θ then, we need to find the θ which maximizes our evaluation function (the likelihood).

Therefore, in its general form the MLE is:

$$\hat{\theta}_{\text{MLE}} = \arg \max_{\theta} \mathcal{L}(\theta) \quad (1)$$

$$= \arg \max_{\theta} \log \mathcal{L}(\theta) \quad (2)$$

Maximum a posteriori estimate

- Maximum likelihood estimate

$$\hat{\theta}_{\text{MLE}} = \arg \max \mathcal{L}(\theta) \quad (3)$$

$$= \arg \max p(x_1, x_2, \dots, x_N \mid \theta) \quad (4)$$

- Maximum a posteriori estimate

$$\hat{\theta}_{\text{MAP}} = \arg \max p(\theta \mid x_1, x_2, \dots, x_N) \quad (5)$$

$$= \arg \max p(x_1, x_2, \dots, x_N \mid \theta)p(\theta) \quad (6)$$