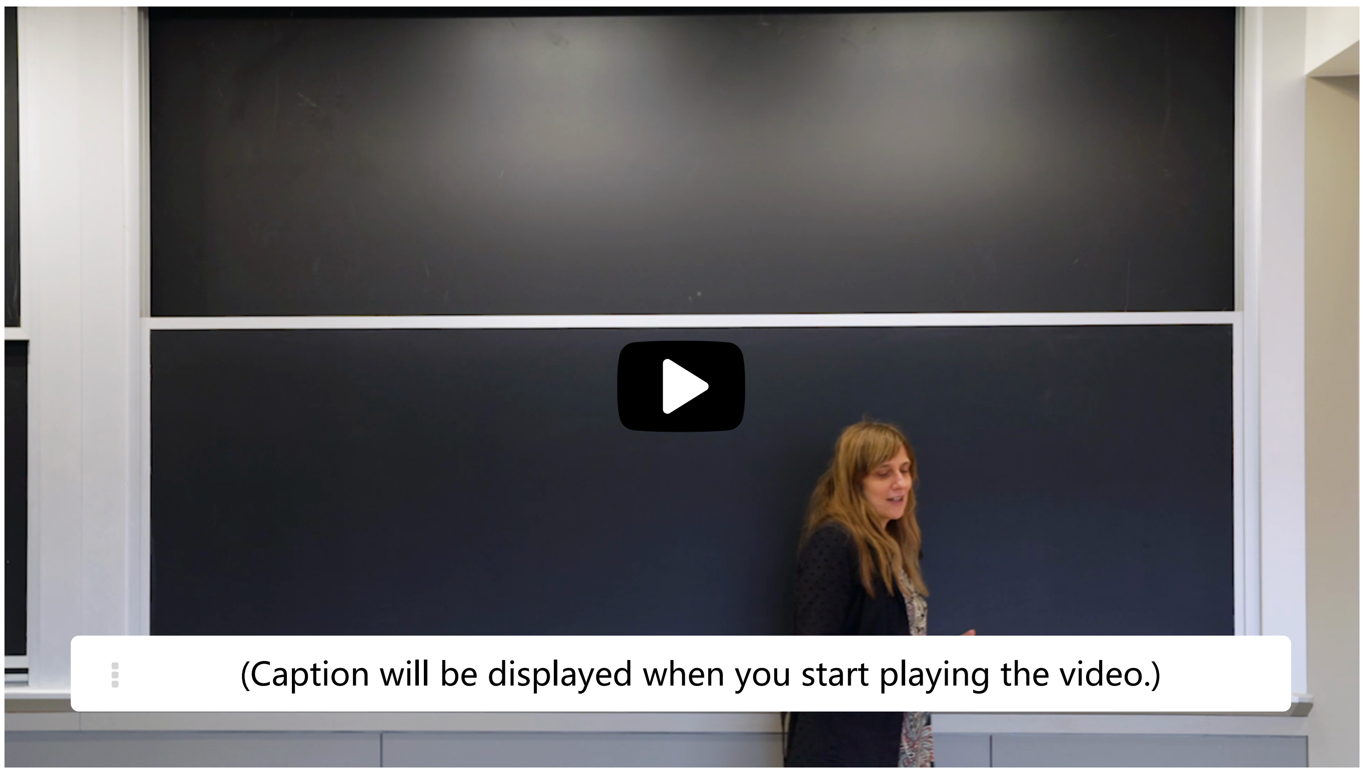
2. Recap of Maximum Likelihood Estimation for Multinomial and Gaussian Models

MLE for Multinomial and Gaussian Models



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Today, we will talk about mixture model and the EM

algorithm.

So first, let me start by reminding

you the types of distributions that you have already

seen in the class.

What we will do today will kind of combine two of them.

So the first distribution-- the first generative model

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MLE under Gaussian Noise I

1/1 point (graded)

Let $Y_i = \theta + N_i, i = 1, \ldots, n$, where θ is an unknown parameter and N_i are iid Gaussian random variables with zero mean. Upon observing Y_i's, what is the maximum likelihood estimate of θ?

Choose the correct expression from options below.

- $\hat{\theta} = \Pi_{i=1}^n Y_i$
- $\hat{\theta} = \frac{\Pi_{i=1}^n Y_i}{n}$
- $\hat{\theta} = \sum_{i=1}^n Y_i$
- $\hat{\theta} = \frac{\sum_{i=1}^n Y_i}{n}$ ✔

Solution:

Y_i's are iid Gaussian with mean θ. As seen before, the ML estimator of θ is $\sum_{i=1}^n \frac{Y_i}{n}$.

Submit You have used 1 of 2 attempts

Answers are displayed within the problem

MLE under Gaussian Noise II

0/1 point (graded)

Would the ML estimator change if the N_i's are **independent** Gaussians with **possibly different variances** $\sigma_1^2, \ldots, \sigma_n^2$ but **same zero mean**?

看错题了，我以为他问会不会不变，结果问的是会不会变

- Yes ✔
- No ✖

当然我觉得噪音的方差不一样，estimate不出来

Solution:

The log-likelihood (with possibly different variances) is

$$\log P\left(Y_1, \ldots, Y_n | \theta, \sigma_1^2, \ldots, \sigma_n^2\right) = -\frac{1}{2}\sum_{i=1}^{n} \log\left(2\pi\sigma_i^2\right) - \sum_{i=1}^{n} \frac{\left(Y_i-\theta\right)^2}{2\sigma_i^2}.$$

Note here we cannot take σ_i^2 out of the summation. Thus, to solve this, we need to take the derivative of the log-likelihood with respect to θ and σ_i^2 and setting them to zero.

We will have $\sigma_i^2 = \left(Y_i-\theta\right)^2$ and $\sum_{i=1}^{n} \frac{1}{Y_i-\theta} = 0$. Solving these equations may possibly give us different estimator for θ than before.

Submit You have used 1 of 1 attempt

Answers are displayed within the problem

Discussion

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Topic: Unit 4 Unsupervised Learning (2 weeks) :Lecture 16. Mixture Models; EM algorithm / 2. Recap of Maximum Likelihood Estimation for Multinomial and Gaussian Models