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Homework 6 Maximum Likelihood

6. Maximum Likelihood Estimation

Course > Unit 3 Methods of Estimation > Estimation and Method of Moments > for a Multivariate Standard Normal

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6. Maximum Likelihood Estimation for a Multivariate Standard Normal

Let $\mathbf{X}_1,\ldots,\mathbf{X}_n\stackrel{i.i.d.}{\sim}\mathcal{N}\left(\mu,\mathbf{1}\right)$, where $\mu\in\mathbb{R}^d$ and $\mathbf{1}$ is the $d\times d$ identity matrix. (The \mathbf{X}_i are random vectors.)

Recall the pdf defining the distribution $\mathcal{N}(\mu, \mathbf{1})$ is

$$f\left(\mathbf{x}
ight) = rac{1}{\left(2\pi
ight)^{d/2}} \mathrm{exp}\left(-rac{1}{2}(\mathbf{x}-\mu)^T\mathbf{1}\left(\mathbf{x}-\mu
ight)
ight)$$

(a)

1/1 point (graded)

What is the likelihood function $L(\mathbf{X}_1, \dots, \mathbf{X}_n, \mu)$ for μ ?

(Enter (Sigma_i(norm(x_i-mu)^2)) for $\sum_{i=1}^n \|\mathbf{x}_i - \mu\|^2$.)

$$L\left(\mathbf{X}_{1},\ldots,\mathbf{X}_{n},\mu
ight)=egin{array}{c} \exp(-(\operatorname{Sigma_i(norm(x_i-mu)^2))/2})/(2*pi)^{((n*d)/2)} \end{array}$$

~

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You have used 1 of 3 attempts

✓ Correct (1/1 point)

(b)

1/1 point (graded)

Compute the maximum likelihood estimator $\,\hat{\mu}_{MLE}\,$ for $\,\mu$.

(Enter **barX_n** for the sample average.)

$$\hat{\mu}_{MLE} = oxed{f barX_n}$$

Prove to yourself that the result you obtained above indeed maximizes the likelihood function. Is this step necessary?

STANDARD NOTATION

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You have used 1 of 3 attempts

✓ Correct (1/1 point)

(c)

1/1 point (graded)

What is the distribution of $\hat{\mu}_{MLE}$?

$\hat{\mu}_{MLE}$	$\sim \mathcal{N}$	$(\mu,$	$\frac{1}{n}$ 1
FMLE	• •	(1-)	n^{-}

- $igcap \hat{\mu}_{MLE} \sim \mathcal{N}\left(\mu, \mathbf{1}
 ight)$
- $igcap \hat{\mu}_{MLE} \sim \mathcal{N}\left(0,rac{1}{n}\mathbf{1}
 ight)$
- $igcap \hat{\mu}_{MLE} \sim \mathcal{N}\left(\mu, rac{1}{\sqrt{n}} \mathbf{1}
 ight)$

~

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You have used 1 of 2 attempts

✓ Correct (1/1 point)

(d)

1/1 point (graded)

What is the asymptotic variance of $\, {f A} \hat{\mu}_{MLE} \,$? (here, A is a fixed $\, m imes d \,$ matrix)

(If applicable, enter **trans(A)** for the transpose of a matrix A.)

A*trans(A)

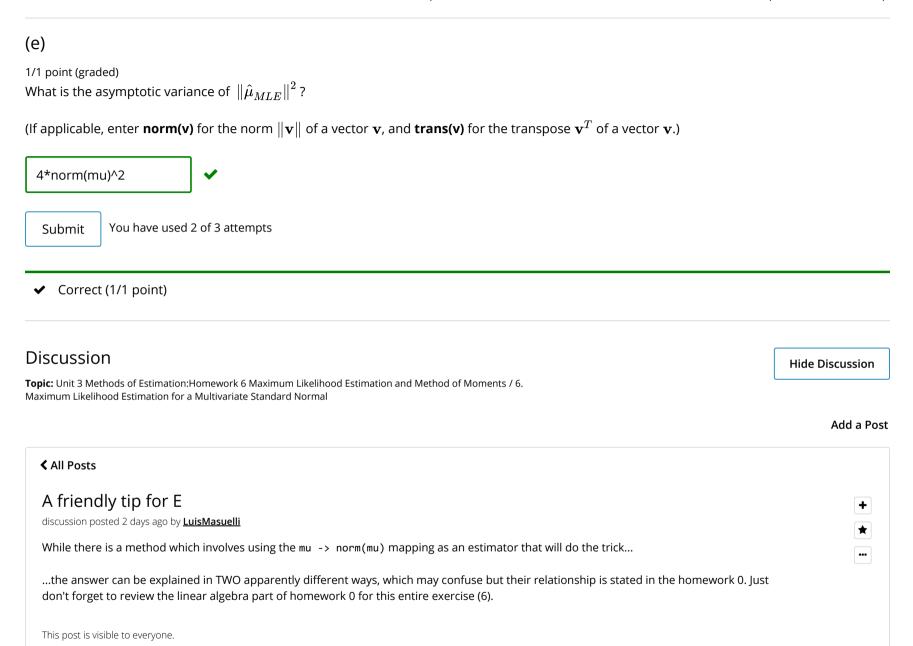


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