5. Constrained maximum likelihood estimator

Instruction:

What can we do when we have prior knowledge about the estimator? Imagine that an expert told you that the parameter θ lies between a and b. Would that additional knowledge change the MLE calculation? We will start by calculating just normal MLE and think about what we can do in part (c).

Let $X_1, \ldots, X_n$ be n i.i.d. random variables with probability density function

$$f_\theta(x) = \theta x^{-\theta-1}, \theta > 0, x \geq 1.$$

To encourage you to do the computations carefully rather than eliminate choices, you will be given only **1-2 attempts per question** .

(a)

1/1 point (graded)

What is the likelihood function for θ?

- $\theta^n \prod_{i=1}^n x_i^{-\theta-1}$
- $\theta^n \prod_{i=1}^n x_i^{-\theta-1} \mathbf{1}\{\min_i X_i \geq 1\}$
- $\theta^n \prod_{i=1}^n x_i^{-\theta-1} \mathbf{1}\{\min_i X_i < 1\}$
- $\theta^n \prod_{i=1}^n x_i^{-\theta-1} \mathbf{1}\{\max_i X_i \geq 1\}$
- $\theta^n \prod_{i=1}^n x_i^{-\theta-1} \mathbf{1}\{\max_i X_i < 1\}$
- $n \ln \theta - (\theta+1) \sum_{i=1}^n \ln X_i$

✔

Submit You have used 1 of 1 attempt

✔ Correct (1/1 point)

(b)

1/1 point (graded)

What is the maximum likelihood estimator for θ?

- $\dfrac{n}{\sum_{i=1}^n \ln X_i}$
- $-\dfrac{n}{\sum_{i=1}^n \ln X_i}$

- $\frac{\sum_{i=1}^{n} \ln X_i}{n}$
- $-\frac{\sum_{i=1}^{n} \ln X_i}{n}$
- $\frac{\sum_{i=1}^{n} X_i}{n}$
- $\frac{n}{\sum_{i=1}^{n} X_i}$

✔

Submit You have used 1 of 1 attempt

✔ Correct (1/1 point)

(c)

1/1 point (graded)

Suppose we have two numbers $0 < a < b$. We are interested in the value of θ that maximizes the likelihood in the set $[a, b]$.

Let $\hat{\theta}$ denote the maximum likelihood estimator you found in part (b) above, and let $\hat{\theta}_{\text{const}}$ denote the maximum likelihood estimator within the interval $[a, b]$, where $0 < a < b$. Choose all correct answers.

- ☐ If $b \leq \hat{\theta}$, then $\hat{\theta}_{\text{const}} = a$
- ☑ If $b \leq \hat{\theta}$, then $\hat{\theta}_{\text{const}} = b$

- [ ] If $b \leq \hat{\theta}$, then $\hat{\theta}_{\text{const}} = \hat{\theta}$
- [ ] If $a < \hat{\theta} < b$, then $\hat{\theta}_{\text{const}} = a$
- [ ] If $a < \hat{\theta} < b$, then $\hat{\theta}_{\text{const}} = b$
- [x] If $a < \hat{\theta} < b$, then $\hat{\theta}_{\text{const}} = \hat{\theta}$
- [x] If $a \geq \hat{\theta}$, then $\hat{\theta}_{\text{const}} = a$
- [ ] If $a \geq \hat{\theta}$, then $\hat{\theta}_{\text{const}} = b$
- [ ] If $a \geq \hat{\theta}$, then $\hat{\theta}_{\text{const}} = \hat{\theta}$

✔

Submit You have used 1 of 2 attempts

✔ Correct (1/1 point)

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Estimation vs Inference 1

I'm curious how did people find this unit compared to last one, i.e., estimation compared to inference. Personally, I found the topic of estimation to be more tractable than th...

[Staff] Request for an extra attempt to answer part 'b'

I have wrongly selected the answer of part 'b' because of oversight or perhaps overconfidence. Could you please provide one extra chance to answer this question. I have ans...

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