Unit 4 - Week 3 - Cramer-Rao Bound (CRB), Vector Parameter Estimation, Multi-Antenna Downlink Mobile Channel Estimation

Assignment-3

The due date for submitting this assignment has passed. **Due on 2017-08-15, 23:59 IST.**
As per our records you have not submitted this assignment.

1) Given the log-likelihood $\ln p(\mathbf{y}; h)$ of the parameter h and unbiased estimator $\hat{h}$, the quantity $\left(\int_{-\infty}^{\infty} \hat{h} \frac{\partial}{\partial h} \ln p(\mathbf{y}; h) p(\mathbf{y}; h) d\mathbf{y}\right)^2$ equals *1 point*

- 2
- 1
- 0
- $I(h)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
1

2) Given the log-likelihood $\ln p(\mathbf{y}; h)$ of the parameter h, the quantity $\left(E\left\{\frac{\partial}{\partial h} \ln p(\mathbf{y}; h)\right\}\right)^2$ equals, *1 point*

- 2
- 1
- 0
- $I(h)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
0

3) The Cramer-Rao Bound for parameter h is derived as, *1 point*

$E\left\{\frac{\partial}{\partial h}\ln p(\mathbf{y};h)\right\}$

$E\left\{\left(\frac{\partial}{\partial h}p(\mathbf{y};h)\right)^2\right\}$

$\frac{1}{E\left\{\left(\frac{\partial}{\partial h}\ln p(\mathbf{y};h)\right)^2\right\}}$

$E\left\{\left(\frac{\partial}{\partial h}\ln p(\mathbf{y};h)\right)^2\right\}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{E\left\{\left(\frac{\partial}{\partial h}\ln p(\mathbf{y};h)\right)^2\right\}}$

4) Consider now a slightly modified version of the wireless sensor network (WSN) estimation scenario described in class with each observation $y(k) = kh + v(k)$, for $1 \leq k \leq N$. Let the noise samples be IID Gaussian with mean zero and variance σ^2 each. The quantity $\frac{\partial}{\partial h}\ln p(\mathbf{y};h)$ is *1 point*

$\frac{1}{\sigma^2}\sum_{k=1}^{N}(y(k)-kh)^2$

$\frac{\sigma^2}{\sum_{k=1}^{N}k(y(k)-kh)^2}$

$\frac{\sigma^2}{\sum_{k=1}^{N}(y(k)-kh)^2}$

$\frac{1}{\sigma^2}\sum_{k=1}^{N}k(y(k)-kh)$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{\sigma^2}\sum_{k=1}^{N}k(y(k)-kh)$

5) Consider now a slightly modified version of the wireless sensor network (WSN) estimation scenario described in class with each observation $y(k) = kh + v(k)$, for $1 \leq k \leq N$. Let the noise samples be IID Gaussian with mean zero and variance σ^2 each. The Fisher information for the parameter h is, *1 point*

$\frac{N(N+1)}{2\sigma^2}$

$\frac{N}{\sigma^2}$

$\frac{\sigma^2}{N}$

None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
None of the above

Cases, Applications - Wireless Fading Channel Estimation, SLS Example

6) Consider now a slightly modified version of the wireless sensor network (WSN) estimation scenario described in class with each observation $y(k) = kh + v(k)$, for $1 \leq k \leq N$. Let the noise samples be IID Gaussian with mean zero and variance σ^2 each. The Cramer Rao Bound for the parameter h is, *1 point*

- $\frac{6}{N(N+1)(2N+1)}\sigma^2$
- $\frac{\sigma^2}{N}$
- $\frac{4}{N(N+1)}\sigma^2$
- $\frac{\sigma^2}{N^2}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{6}{N(N+1)(2N+1)}\sigma^2$

7) Consider now a slightly modified version of the wireless sensor network (WSN) estimation scenario described in class with each observation $y(k) = kh + v(k)$, for $1 \leq k \leq N$. Let the noise samples be IID Gaussian with mean zero and variance σ^2 each. The Cramer Rao Bound for the parameter h is, *1 point*

- Always Lower than the variance of the ML estimate
- Always Greater than the variance of the ML estimate
- Always Equal to the variance of the ML estimate
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
Always Equal to the variance of the ML estimate

8)Consider the multiple antenna downlink channel estimation problem described in class with $x_i(k)$ denoting the pilot symbol transmitted from the i^{th} antenna at time k, $y(k)$, h_i denoting the corresponding received symbol and fading channel coefficient for the i^{th} antenna respectively. Let number of antennas $M = 2$ and consider the transmission of $N = 3$ pilot vectors. The pilot matrix $\mathbf{X}$ is of size *1 point*

- 3×2
- 2×3
- 2×2
- 3×3

No, the answer is incorrect.
Score: 0

Accepted Answers:
3×2

9)Consider the multiple antenna downlink channel estimation problem described in class with $x_i(k)$ denoting the pilot symbol transmitted from the i^{th} antenna at time k, $y(k)$, h_i denoting the corresponding received symbol and fading channel coefficient for the i_{th} antenna respectively. Let number of antennas $M = 2$ and consider the transmission of $N = 3$ pilot vectors. Let the vector of received output symbols be *1 point* denoted by $\mathbf{y} = [y(1), y(2), \ldots, y(N)]^T$. The equivalent cost function to be minimized to compute the estimate of the channel vector h is,

- $\sum_{k=1}^{N} \sum_{i=1}^{M} (y(k) - h_i x(k))^2$
- $\frac{1}{2\sigma^2} \sum_{k=1}^{N} (y(k) - \mathbf{h}^T x(k))^2$
- $\sum_{k=1}^{N} |\mathbf{y} - \mathbf{X}\mathbf{h}|$
- $\sum_{k=1}^{N} \sum_{i=1}^{M} (y(k) - h_i)^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\frac{1}{2\sigma^2} \sum_{k=1}^{N} (y(k) - \mathbf{h}^T x(k))^2$

10) Consider a multi-antenna channel estimation scenario with $N = 3$ pilot vectors $\mathbf{x}(1) = [1, 2]^T, \mathbf{x}(2) = [3, -1]^T, \mathbf{x}(3) = [1, 1]^T$. Let the corresponding received vector be $\mathbf{y} = [2, 1, 2]^T$. The corresponding pilot matrix $\mathbf{X}$ is ***1 point***

- It is invertible
- It has orthogonal columns
- It has identical columns
- None of the above

No, the answer is incorrect.
Score: 0

Accepted Answers:
It has orthogonal columns

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