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Courses » Applied Time-Series Analysis

Announcements Course Ask a Question Progress



# Unit 13 - Week 8: Spectral Representations & Estimation Theory

## Course outline

R-based Exam

How to access the portal?

Assignment 0

R Tutorials

Week 1: Introduction & Overview

Week 2: Review of Probability & Statistics

Week 3: Introduction to Random Processes, Auto- and Cross-Correlation Functions

Week 4: Auto- and cross-correlation functions (contd.), Models for Linear Stationary Processes

Week 5: Models for Linear Stationary & Non-Stationary Processes

Week 6: Models for Linear Non-Stationary Processes (contd.), Fourier Transforms

Week 7: Fourier Transforms, DFT and Periodogram

Week 8: Spectral Representations & Estimation Theory

Course Notes for Week 8

Lecture 33B: Spectral Representations of Random Processes -4

Lecture 33C: Spectral Representations of Random Processes -5

Lecture 34A: Spectral Representations of Random Processes -6

Lecture 34B: Spectral Representations of Random Processes -7

Lecture 35A: Introduction to Estimation Theory -1

Lecture 35B: Introduction to Estimation Theory -2

Lecture 35C: Introduction to Estimation Theory -3

Lecture 36A: Introduction to Estimation Theory 4

Lecture 36B: Goodness of Estimators 1 -1

Lecture 37A: Goodness of Estimators 1 -2

Lecture 37B: Goodness of Estimators 1 -3

## Week 8 Assignment

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

Due on 2018-03-23, 23:59 IST

1 point

- 1) Given below is the spectral density function  $\gamma_{vv}(\omega)$  of a stationary process  $v[l]$

$$\gamma_{vv}(\omega) = \frac{1}{2\pi (1.81 + 1.8 \cos 2\omega)}$$

Which of the following is an appropriate representation for  $v[k]$  with  $\sigma_e^2 = 1$ ?

- a.  $v[k] = \frac{1}{1 + 0.9q^{-2}} e[k]$
- b.  $v[k] = \frac{1}{1 - 0.9q^{-2}} e[k]$
- c.  $v[k] = \frac{1}{1 + 0.9q^{-1}} e[k]$
- d.  $v[k] = \frac{1}{1 - 0.9q^{-1}} e[k]$

- a
- b
- c
- d

No, the answer is incorrect.

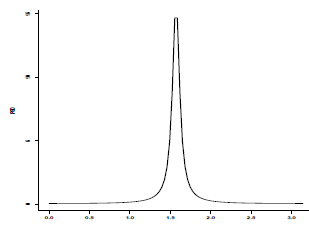
Score: 0

Accepted Answers:

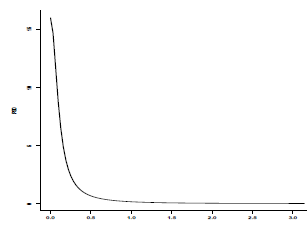
a

1 point

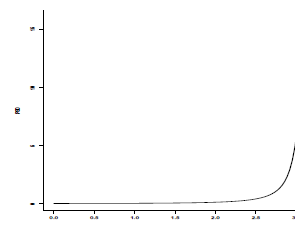
- 2) Which of the following best represents the filtering characteristics of the process  $v$  in Question 1?



(a)



(b)



(c)

- a
- b
- c

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

1 point

- Quiz : Week 8 Assignment
- Data set
- Solutions to Week-8 Assignment
- Week 8 Feedback

#### Week 9: Estimation Theory

#### Week 10: Estimation Methods

#### Week 11: Estimation methods (contd.)

#### Week 12: Estimation of Power Spectral Density & Time Series Models

#### Case Studies on Modelling

#### DOWNLOAD VIDEOS

#### Interactive Session

3. For the spectral density function of a stationary process  $v[k]$  given in Question : PACF of  $v[k]$  at lag  $l = 2$  is \_\_\_\_\_.

- a. 0
- b.  $-0.9$
- c. 0.9
- d. None of the above

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

b

4)

4. Consider the fluid level measurement example given in class. Suppose we change  $c$  assumed model to

$$y[k] = c_1 + c_2 e[k], \quad e[k] \sim \mathcal{N}(0, \sigma_e^2)$$

choosing a least squares optimization function, which one of the following statements are TRUE?

- a.  $c_1$  can be estimated uniquely but  $c_2$  cannot be
- b.  $c_2$  can be estimated uniquely but  $c_1$  cannot be
- c. Both  $c_1$  and  $c_2$  can be estimated uniquely
- d. Neither  $c_1$  nor  $c_2$  can be estimated uniquely

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

5)

5. Given a single observation  $y$  of an *exponential* white-noise process with p.d.f.  $f(y) =$  the log-likelihood function  $L(\theta = \lambda; y)$  is \_\_\_\_\_

- a.  $\lambda e^{-\lambda y}$
- b.  $-\lambda y$
- c.  $\log(y) - \lambda e^{-\lambda y}$
- d.  $\log(\lambda) - \lambda y$

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

d

6)



1 point

1 point

1 point

6. Suppose we re-define the parameter  $\theta$  for the problem in Question 5 as  $\theta = \frac{1}{\lambda}$ , the of the Fisher's Information of  $\theta$  contained in  $N$  observations of the *exponential* whit process is \_\_\_\_\_

- a.  $I(\theta) = -N\theta^2$
- b.  $I(\theta) = -N\lambda^2$
- c.  $I(\theta) = \frac{N}{\lambda^2}$
- d.  $I(\theta) = \frac{N}{\theta^2}$

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

d

7)

1 point

7. A constant signal of unknown amplitude  $A$  is observed by two different, but independent sensors whose variances are (known to be)  $\sigma^2$  and  $4\sigma^2$ , respectively. Suppose a total of  $N = N_1 + N_2$  observations, with  $N_1$  and  $N_2$  from sensor 1 and sensor 2, respectively, are obtained. Given that  $N_1, N_2 \geq 2$  (assume that sensor errors are Gaussian white), choose  $N_1$  and  $N_2$  such that the Fisher's information (about  $A$ ) in the appended data is maximized.

- a.  $N_1 = N - 2, N_2 = 2$
- b.  $N_1 = 2, N_2 = N - 2$
- c.  $N_1 = N_2 = N/2$
- d. None of the above

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

8)

1 point

8. For a periodic random process with  $N_p = 5$ , which of the following statements is correct?

- a.  $E(v[k + 5] - v[k])^2 = 0$
- b.  $\sigma_{vv}[l + 15] = \sigma_{vv}[l]$
- c.  $\sigma_{vv}[10] = \sigma_{vv}[0]$
- d. All of the above

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

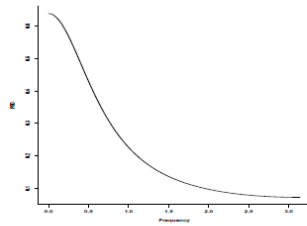
d

9)

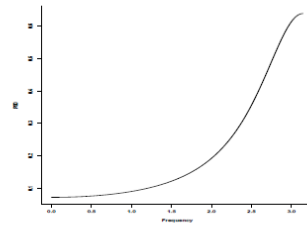
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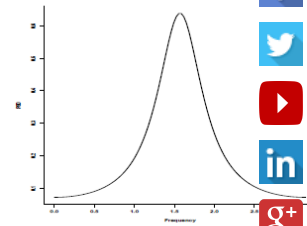
9. For the time series given in w8\_q9.Rdata, suppose we estimate the p.s.d of  $v[k]$  by a time-series model and using the expression (i.e., Eq. 10 in course notes on *spectral representations of random processes*) for the p.s.d. Which is the appropriate sketch of the p.s.d?



(a)



(b)



(c)



- a
- b
- c

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

10)

1 point

10. Generate a single realization consists of  $N = 100$  observations for the given MA(1) process and compute the sample mean.

$$v[k] = e[k] + 0.4e[k - 1], \quad e[k] \sim \mathcal{N}(0, 1)$$

Repeat this process for 10000 times. The variability of the sample mean is (approximate).

- a. 0.02
- b. 0.2
- c. 0.4
- d. 1

- a
- b
- c
- d

No, the answer is incorrect.

Score: 0

Accepted Answers:

a

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