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Courses » Applied Time-Series Analysis

Announcements Course Ask a Question Progress



Unit 12 - Week 7: Fourier Transforms, DFT and Periodogram

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

- Course Notes for Week 7
- Lecture 28B: Fourier Transforms for Deterministic Signals -6
- Lecture 29A: Fourier Transforms for Deterministic Signals -7
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- Lecture 32A: Spectral Representations of Random Processes -1
- Lecture 32B: Spectral Representations of Random Processes -2
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- Quiz : Week 7 Assignment

Week 7 Assignment

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

Due on 2018-03-17, 23:59 IST

1)

1 point

Consider the periodic signal $x[k] = \{2, -2, 0, 1\}$ starting from $k = 0$ with fourier representation as:

$$x[k] = \sum_{n=0}^{N-1} c_n e^{j2\pi kn/N}$$

The values of c_3 and $\int_{-\pi}^{\pi} |X(\omega)|^2 d\omega$ are _____.

- $c_3 = \frac{2+3j}{4}, 18\pi$
- $c_3 = \frac{2-3j}{4}, 18\pi$
- $c_3 = \frac{2+3j}{4}, 9$
- $c_3 = \frac{2-3j}{4}, 9$

No, the answer is incorrect. Score: 0

Accepted Answers:

$$c_3 = \frac{2-3j}{4}, 18\pi$$

2)

1 point

Suppose a signal $x[k]$ has a Fourier transform:

$$X(\omega) = \frac{1}{1 - ae^{-j\omega}}$$

The Fourier transform of $x[2k + 1]$ is _____.

- $\frac{e^{j\omega}}{1 - ae^{-j\omega}}$
- $\frac{e^{j\omega}}{1 - ae^{-j\omega}}$
- $\frac{e^{j\omega}}{1 - ae^{-j\omega}}$
- $\frac{e^{j\omega}}{1 - ae^{-j\omega}}$

No, the answer is incorrect. Score: 0

Accepted Answers:

- Datasets
- Week 7 Feedback
- Week-7 assignment solutions

Week 8: Spectral Representations & Estimation Theory

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

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$$\frac{e^{jw}}{1 - ae^{-jw}}$$

3)

Consider a MA process as given below:

$$v[k] = 0.6e[k - 1] + e[k], \quad e[k] \sim \mathcal{N}(0, 1)$$

The p.s.d for the process is:

- $1.36 + 1.2 \cos \omega$
- $\frac{1}{2\pi} (1.36 + 1.2 \cos \omega)$
- $\frac{1}{2\pi} (1.36 + 1.2 \cos 2\omega)$
- $\frac{1}{2\pi} (1 + 0.6 \cos \omega)$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{2\pi} (1.36 + 1.2 \cos \omega)$$

4)

For the following discrete-time periodic signal

$$x[k] = \cos(2\pi f_0 k)$$

The value of the energy spectral density function $S_{xx}(f)$ at $f = 0.2$ is _____

- 0
- 0.25
- 0.25
- It is an ill-posed problem

No, the answer is incorrect.

Score: 0

Accepted Answers:

It is an ill-posed problem

5)

Given a process $y[k] = G(q^{-1})x[k]$, where $x[k] = 0.5^k$ is an energy signal and

$$G(q^{-1}) = \frac{1}{(1 - 1.1q^{-1})(1 - 0.1q^{-1})}$$

Which of the following statements is TRUE? (FRF - Frequency Response Function)

- Value of the FRF at $w = \frac{\pi}{3}$ is $0.34 - 0.93i$
- Energy density does not exist for the output signal $y[k]$.
- The FRF does not exist.
- Both (a) and (b).
- Both (b) and (c).

No, the answer is incorrect.

Score: 0

Accepted Answers:

Both (b) and (c).

1 point



1 point

1 point

6) The theoretical ACVF at lag l of a random process $v[k]$ is

1 point

$$\sigma_{vv}[l] = \begin{cases} 1.36, & l = 0 \\ 0.6, & |l| = 1 \\ 0.1, & |l| = 2 \\ 0, & \text{otherwise} \end{cases}$$

The expression for its spectral density $\gamma_{vv}(\omega)$:

- $\frac{1}{2\pi}(1.36 + 1.2\cos(\omega) + 0.2\cos(2\omega))$
- $\frac{1}{2\pi}(1.36 + 0.6\cos(\omega) + 0.1\cos(2\omega))$
- $(1.36 + 1.2\cos(\omega) + 0.2\cos(2\omega))$
- $(1.36 + 0.6\cos(\omega) + 0.1\cos(2\omega))$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{2\pi}(1.36 + 1.2\cos(\omega) + 0.2\cos(2\omega))$$

7) The spectral density of a stationary random process $v[k]$ is

1 point

$$\gamma(\omega) = 2\pi(1.61 + 1.6\cos(2\omega))$$

Which one of the following is an appropriate representation of $v[k]$?

- AR(1) process
- AR(2) process
- MA(1) process
- MA(2) process

No, the answer is incorrect.

Score: 0

Accepted Answers:

MA(2) process

8)

1 point

The noisy measurements of a periodic signal $y[k]$ is given in w7_q8.RData.

$$y[k] = \sum_{i=1}^m \left(a_i \sin(2\pi f_i k) + b_i \cos(2\pi f_i k) \right) + e[k]$$

where m is the number of periodic components present in the signal. Using R, estimate a_i , b_i and f_i .

- $y[k] = 1.16 \sin(0.4\pi k) + 3.78 \cos(0.4\pi k) + e[k]$
- $y[k] = -1.88 \sin(0.6\pi k) - 0.58 \cos(0.6\pi k) + e[k]$
- $y[k] = 3.78 \cos(0.4\pi k) + 1.16 \sin(0.4\pi k) - 1.88 \sin(0.6\pi k) - 0.58 \cos(0.6\pi k) + e[k]$
- $y[k] = 3.78 \cos(0.3\pi k) - 1.88 \sin(0.3\pi k) + e[k]$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$y[k] = 3.78 \cos(0.4\pi k) + 1.16 \sin(0.4\pi k) - 1.88 \sin(0.6\pi k) - 0.58 \cos(0.6\pi k) + e[k]$$

9)

For the data given in w7_q9.RData, the total number of periodic components present is

Hint

No, the answer is incorrect.

Score: 0


Accepted Answers:

(Type: Numeric) 1

10)

1 point

0 points

Consider the series given in w7_q10.RData. Which of the following is/are TRUE 

- A sinusoid of appropriate frequency is enough to model the series
- A sinusoid of appropriate frequency is not enough to model the series
- There are more than one periodic components present in the series
- None of the above

No, the answer is incorrect.

Score: 0

Accepted Answers:

A sinusoid of appropriate frequency is not enough to model the series
There are more than one periodic components present in the series



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