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Courses » Probability and Random Variables / Processes for Wireless Communications

Announcements Course Ask a Question Progress

Unit 4 - Basics of Random Processes, Wireless Fading Channel Modeling

Course outline

How to access the portal

Basics of Probability, Conditional Probability, MAP Principle

Random Variables, Probability Density Functions, Applications in Wireless Channels

Basics of Random Processes, Wireless Fading Channel Modeling

Transformation of Random Variables and Rayleigh Fading Wireless Channel

Gaussian Random Variable and Linear Transformation

Special Case: IID Gaussian Random Variables

Application: Array Processing and Array Gain with Uniform Linear Arrays

Assignment 3

The due date for submitting this assignment has passed. **Due on 2017-02-14, 23:59 IST.** As per our records you have not submitted this assignment.

1) Consider the random variable $Y = g(X)$. Let g be a one to one function. Let $f_X(x)$ denote the PDF of X . The probability density function of the random variable Y is,

1 point

$f_X(x) |_{x=g^{-1}(y)}$

$\frac{f_X(x) |_{x=g^{-1}(y)}}{\left| \frac{dy}{dx} \right|_{x=g^{-1}(y)}}$

$f_X(x) |_{x=g^{-1}(y)} \times \left| \frac{dy}{dx} \right|_{x=g^{-1}(y)}$

$f_X(g^{-1}(y))$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$\frac{f_X(x) |_{x=g^{-1}(y)}}{\left| \frac{dy}{dx} \right|_{x=g^{-1}(y)}}$

2) Consider the random variable X with PDF $f_X(x) = Ke^{-\beta|x|}$ for $-\infty < x < \infty$. Let $Y = X^2$. The PDF of the random variable Y is,

1 point

$\frac{\beta}{2\sqrt{y}} e^{-\beta\sqrt{y}}$

$\frac{\beta^2}{2\sqrt{y}} e^{-\beta\sqrt{y}}$

$\beta^2 e^{-\beta\sqrt{y}}$

$\frac{\beta}{4\sqrt{y}} e^{-\beta\sqrt{y}}$

- Random Processes and Wide Sense Stationarity (WSS)
- WSS Example – Narrowband Wireless Signal with Random Phase
- Quiz : Assignment 3
- Assignment-3 Solutions

Gaussian Random Process, Noise, Bit-Error and Impact on Wireless Systems

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{\beta}{2\sqrt{y}} e^{-\beta\sqrt{y}}$$

3) Consider a Gaussian random variable X with mean 0 and variance σ^2 . Let $Y = 2X$. The probability density function $f_Y(y)$ of the random variable Y is, **1 point**



$$\frac{1}{\sqrt{8\pi\sigma^2}} e^{-\frac{y^2}{8\sigma^2}}$$



$$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{y^2}{2\sigma^2}}$$



$$\sqrt{\frac{2}{\pi\sigma^2}} e^{-\frac{2y^2}{\sigma^2}}$$



$$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{2y^2}{\sigma^2}}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{\sqrt{8\pi\sigma^2}} e^{-\frac{y^2}{8\sigma^2}}$$

4) Let X be a Gaussian random variable with mean 0 and variance σ^2 . The fourth moment of X i.e. $E\{X^4\}$ is, **1 point**



$$\sigma^4$$



$$3\sigma^4$$



$$5\sigma^4$$



$$7\sigma^4$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$3\sigma^4$$

5) Consider independent Gaussian random variables X_n distributed as $\mathcal{N}\left(\frac{1}{2^n}, \frac{1}{2^n}\right)$, $n = 0, 1, 2, \dots$. The random variable $Y = \sum_{n=0}^{\infty} \frac{1}{2^n} X_n$ is distributed as, **1 point**



$\mathcal{N}\left(\frac{4}{3}, \frac{4}{3}\right)$

$\mathcal{N}(2, 2)$

$\mathcal{N}\left(\frac{4}{3}, \frac{8}{7}\right)$

$\mathcal{N}\left(1, \frac{8}{7}\right)$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\mathcal{N}\left(\frac{4}{3}, \frac{8}{7}\right)$$

6) Consider an additive Gaussian noise channel $y = x + n$, where x is +1 or -1 with probability 0.5 each and the noise is Gaussian with mean 0 and variance σ^2 . What is the probability density function of the output y ,



$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{y^2}{2\sigma^2}}$



$\frac{1}{\sqrt{8\pi\sigma^2}} e^{-\frac{(y-1)^2}{2\sigma^2}} + \frac{1}{\sqrt{8\pi\sigma^2}} e^{-\frac{(y+1)^2}{2\sigma^2}}$



$\frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(y-1)^2}{2\sigma^2}} + \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(y+1)^2}{2\sigma^2}}$



$\frac{1}{2} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{y^2}{2\sigma^2}}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{1}{\sqrt{8\pi\sigma^2}} e^{-\frac{(y-1)^2}{2\sigma^2}} + \frac{1}{\sqrt{8\pi\sigma^2}} e^{-\frac{(y+1)^2}{2\sigma^2}}$$

7) Consider an antenna array with three antennas and inter antenna spacing $d=1\text{cm}$. Let y_1, y_2, y_3 be the signals received at antennas 1, 2, 3 respectively. For a radio signal of frequency 1 GHz arriving at an angle of 30° with respect to the vertical, what is the optimal combined signal for this antenna array? **1 point**



$y_1 + y_2 + y_3$



$y_1 + (0.6349 + 0.2549j)y_2 + (0.9836 - 1804j)y_3$



1 point

$$y_1 + \left(\frac{1}{\sqrt{2}} + \frac{j}{\sqrt{2}}\right)y_2 + \left(\frac{1}{\sqrt{2}} - \frac{j}{\sqrt{2}}\right)y_3$$



$$y_1 + (0.9836 + 0.1804j)y_2 + (0.9349 - 0.3549j)y_3$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$y_1 + (0.9836 + 0.1804j)y_2 + (0.9349 - 0.3549j)y_3$$

8) Consider an antenna array with three antennas and inter antenna spacing $d=1\text{cm}$. **1 point**
Let y_1, y_2, y_3 be the signals received at antennas 1, 2, 3 respectively. For a radio signal of frequency 1 GHz arriving at an angle of 30° with respect to the vertical, what is the array gain of the optimal combined signal for this antenna array??

- 3 dB
- 4.77 dB
- 5.32 dB
- 6 dB

No, the answer is incorrect.

Score: 0

Accepted Answers:

4.77 dB

9) Consider an antenna array with three antennas and inter antenna spacing $d=1\text{cm}$. **1 point**
Let y_1, y_2, y_3 be the signals received at antennas 1, 2, 3 respectively. For a radio signal of frequency 1 GHz arriving at an angle of 30° with respect to the vertical, signal power 4 dB, and IID zero-mean noise power -2dB, what is the noise power at the output of the optimal combiner??

- 3 dB
- 2 dB
- 2.77 dB
- 2.32 dB

No, the answer is incorrect.

Score: 0

Accepted Answers:

2.77 dB

10) Consider an antenna array with three antennas and inter antenna spacing $d=1\text{cm}$. **1 point**
Let y_1, y_2, y_3 be the signals received at antennas 1, 2, 3 respectively. For a radio signal of frequency 1 GHz arriving at an angle of 30° with respect to the vertical, signal power 4 dB, and IID zero-mean noise power -2dB, what is the SNR at the output of the optimal combiner??

- 10.77 dB
- 8.32 dB
- 6 dB
- 3.32 dB

No, the answer is incorrect.

Score: 0

Accepted Answers:

10.77 dB

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