

Department of Electrical and Computer Engineering
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EECE CDM Assignment #1

1. Consider the transformation of the random variable x drawn from the probability density $f_X(x)$ to the new random variable y where

$$y = ax + \varepsilon$$

- a. Given that $a > 0$ and ε are constants find the PDF $f_Y(y)$
- b. Given that $a < 0$ and ε are constants find the PDF $f_Y(y)$

2. Consider the transformation of the random variable ε drawn from the probability density $f_\varepsilon(\varepsilon)$ to the new random variable y where

$$y = ax + \varepsilon$$

- a. Given that $a > 0$ find the PDF $f_Y(y)$ given ax
- b. Given that $a < 0$ and ε find the PDF $f_Y(y)$ given ax

3. Consider the 2-D random vector \underline{x} with samples drawn from a Gaussian distribution $\underline{x}: N_{\underline{x}}(\underline{\mu}, \Sigma)$. The statistics of \underline{x} are: The mean

$$E(\underline{x}) = [1, 2]^T$$

the covariance

$$\Sigma = \begin{bmatrix} \sigma_1^2 & r\sigma_1\sigma_2 \\ r\sigma_1\sigma_2 & \sigma_2^2 \end{bmatrix}$$

where $\sigma_1^2 = 1$, $\sigma_2^2 = 2$ and $r = 3/4$.

Using a reasonable number of vector samples \underline{y} given that $\underline{y}: N_{\underline{y}}(0, I)$

- a. Generate the test set \underline{x} making use the Cholesky factorization.
- b. Evaluate the marginal PDFs f_{X_1} and f_{X_2} and compare your finding to the exact result.
- c. Provide a contour plot of the joint PDF $f_{\underline{x}}$ and compare the result to the exact result.