



Arab Academy for Science & Technology and Maritime Transport – Cairo Branch

College of Engineering & technology
Electronics & Communication Engineering Department



Course: Statistical Communication Theory

Course Code: EC421

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Problem set: 1

Tutors: Eng. Mohamed Atef, Eng. Albeshir Adel

Weeks: 1,2,3

Revision of Statistics

P1] For each of the given Probability Density Functions:

$$a) f_R(r) = \frac{r}{b^2} e^{-\frac{r^2}{2b^2}}, \quad r \geq 0, b > 0$$

$$b) f_X(x) = \frac{1}{15} \sum_{n=0}^4 (n+1) \delta(x-n)$$

$$c) f_X(x) = \begin{cases} \frac{1}{b-a} & ; a \leq x \leq b \\ 0 & ; \text{Otherwise} \end{cases}$$

Evaluate the following:

- I. Plot the pdf.
- II. State the standard name of this distribution.
- III. The statistical mean.
- IV. The variance.
- V. The Cumulative Distribution Function

P2] Let X and Y be two **statistically independent** random variables. Let the sum $Z = \alpha X + \beta Y$, where α and β are arbitrary constants. Determine the variance $\text{var}(Z)$ in terms of $\text{var}(X)$ and $\text{var}(Y)$.

P3] Suppose a certain random variable has the Cumulative Distribution Function:

$$F_X(x) = \begin{cases} C_1 & ; x \leq 10 \\ K x^2 & ; 0 < x \leq 10 \\ C_2 & ; x > 10 \end{cases}$$

- a) Evaluate C_1 , C_2 and K .
- b) Find the values $P(X \leq 5)$, $P(5 < X \leq 7)$ and plot the corresponding Pdf.

P4] For a Gaussian R.V. having a mean $E[X] = 10$ and a second moment $E[X^2] = 500$. Find $P(X > 0)$, $P(X > 20)$, $P(10 < X \leq 20)$, $P(0 < X \leq 20)$.

P5] The joint pdf of the random variables X and Y is given by:

$$f_{x,y}(x, y) = \alpha e^{-\frac{x^2+y^2}{2}}$$

- a) Find the value of α .
- b) Find the marginal pdf of X and Y and specify whether they are **independent** or not.
- c) Find the conditional pdf of Y given X.
- d) Find the correlation $E(XY)$ of X and Y.