

ECE 630: Statistical Communication Theory
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Exercise 1

These are the exercises that we will work in class to deepen your understanding of the related class material.

1. Madhow Problem 3.4, parts (a)-(d).
2. Madhow Problem 3.5
3. Consider a random variable X with pdf $p_X(x)$. The *characteristic function* $\phi_X(t)$ of X is defined as

$$\phi_X(t) = \mathbf{E}_X[e^{jtX}].$$

- (a) For $X \sim N(\mu, \sigma^2)$ find the characteristic function $\phi_X(t)$.
- (b) Let X and Y be independent random variables, show that $Z = X + Y$ has characteristic function $\phi_Z(t) = \phi_X(t) \cdot \phi_Y(t)$.
- (c) For independent Gaussian X and Y , show that $Z = X + Y \sim N(\mu_X + \mu_Y, \sigma_X^2 + \sigma_Y^2)$.