



In the name of GOD.

Sharif University of Technology

## Stochastic Processes

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Hamid R. Rabiee

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Quiz 1 (15 minutes)

Probability Concepts - Review

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1. (a) Define **independence** and **uncorrelatedness** for two random variables,  $X$  and  $Y$ , each in a single sentence, and provide their corresponding mathematical formulas (**15 pts**).  
(b) Let  $X$  be a random variable with a uniform distribution,  $X \sim U(a, b)$ , and let  $Y = X^2$ . Are  $X$  and  $Y$  independent? Under what condition will  $X$  and  $Y$  be **uncorrelated**? Justify your answer (**25 pts**).
  
2. A random variable  $Y$  has a mean  $\mu_Y = 50$  and a variance  $\sigma_Y^2 = 25$ . Find an upper bound for the probability that  $Y$  deviates from its mean by more than 15, i.e., find an upper bound for  $P(|Y - 50| \geq 15)$  (**20 pts**).
  
3. Imagine a meteorologist states, "There is a **70% probability of rain tomorrow**." How would a strict **Frequentist** and a strict **Bayesian** interpret this statement differently? What does the "70%" refer to in each philosophy? (**20 pts**)
  
4. Consider the function  $F_X(x) = \frac{x^2}{1+x^2}$ . Does this function qualify as a valid CDF? Justify your answer by checking all necessary properties (4 Properties) (**20 pts**).