

3F3 - STATISTICAL SIGNAL PROCESSING

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The following questions will help you understand the difference between the two types of random variables (namely continuous and discrete) and how they are mathematically described. These are some basic questions in probability which is essential knowledge from Part 1 and will be relied upon. Please discuss your solutions in supervisions. (Note the answers to these are to be found from Part 1.)

- (1) Explain the difference between a *discrete* random variable (rv) and a *continuous* random variable.
- (2) Explain the difference between a *probability density function* (pdf), a *probability mass function* (pmf) and a *cumulative distribution function* (cdf.) Which of these are associated with (a) a discrete random variable and (b) a continuous random variable?
- (3) Let X be a discrete random variable taking values in $0, 1, \dots$. Let $X = k$ occur with probability $\exp(-\lambda)\lambda^k/k!$ where $\lambda > 0$. (a) Sketch the cumulative distribution function for X and carefully indicate its points of discontinuity. (b) What is the definition of a *right continuous function* and explain why the cdf is such a function and not instead a left continuous function.
- (4) Explain why the cdf of a continuous random variable has no points of discontinuity.
- (5) The pdf of a Gaussian random variable is $p(x) = C \exp(ax^2 + bx)$ where C is a positive constant. (a) Find the mean and variance of this Gaussian random variable. (b) You overhear a conversation in which someone confidently asserts that “ $p(0)$ is the probability the Gaussian random variable takes the value 0.” Clarify this fundamental misunderstanding of how to interpret a pdf.

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