



ECE-QE CS1-2016 - Rhea

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ECE Ph.D. Qualifying Exam

Communication, Networking, Signal and Image Processing (CS)

Question 1: Probability and Random Processes

August 2016

Question

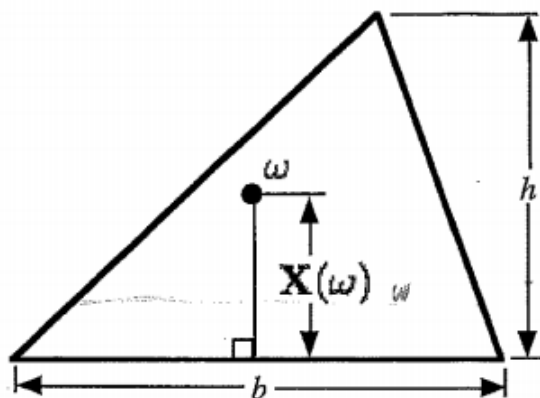
Part 1.

A friend tossed two fair coins, You asked "Did a coin land heads?" Your friends answers "yes." What is the probability that both coins landed heads? Justify your answer.

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Part 2.

A point ω is picked at random in the triangle shown below (all points are equally likely.) let the random variable $X(\omega)$ be the perpendicular distance from ω to the base as shown in the diagram.



- (a) Find the cumulative distribution function (cdf) of \mathbf{X} .
- (b) Find the probability distribution function (pdf) of \mathbf{X} .
- (c) Find the mean of \mathbf{X} .
- (d) What is the probability that $\mathbf{X} > h/3$.

[Answers and discussions](#)

Part 3.

Let X and Y be independent, jointly-distributed Poisson random variables with means λ and μ . Let Z be a new random variable defined as

$$Z = X + Y$$

(a) Find the probability mass function (pmf) of Z .

(b) Show that the conditional probability mass function (pmf) of X conditioned on the event $Z = n$ is binomially distributed, and determine the parameters of the binomial distribution (recall that there are two parameters " n " and " p ") required to specify a binomial distribution $b(n, p)$).

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Part 4.

Let $X(t)$ be a wide-sense stationary Gaussian random process with mean μ_x and autocorrelation function $R_x(\tau)$. Let

$$Y(t) = c_1 X(t) - c_2 X(t - T),$$

where c_1, c_2 and T are real numbers. What is the probability that $Y(t)$ is less than or equal to a real number γ ? Express your answer in terms of $c_1, c_2, \mu_x, \sigma_x^2$, and $R_x(\tau), \gamma$ and the "phi function"

$$\Phi(x) = \int_{-\infty}^x \frac{1}{\sqrt{2\pi}} e^{-z^2/2} dz$$

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