Quiz 2 Study Guide   2.086/2.090 Fall 2012

NOTE: Quiz 2 requires a CALCULATOR; please bring a calculator with you to the quiz.

Quiz 2 will take place on Wednesday, October 10, at 7:30 PM, in Rooms 1-190 and 3-270. Students with last names beginning "A" through "L" should report to Room 1-190; students with last names beginning "M" through "Z" should report to Room 3-270. You will be given 90 minutes to complete the quiz.

Quiz 2 will be "open book": you may refer to the text and other class materials as well as your own notes and scripts. You will need a calculator (for arithmetic operations and simple functions) for Quiz 2; note, however, that laptops, tablets, and smartphones are not permitted. The quiz will consist exclusively of multiple-choice questions.

Quiz 2 is on the material of Unit II. In preparation for Quiz 2 you might find the study guide below useful. You should also review the textbook reading for Unit II, your notes from lecture, the MATLAB Exercises Recitation 3 and Recitation 4, as well as the questions in the Unit II Quiz Question Sampler. On Quiz 2 you are not responsible for the material of Chapter 11 of the text (on statistical estimation for the parameters of the normal density), however you are responsible for the material in Chapter 9 and Chapter 10 related to the normal density.

MATLAB: (Note that your MATLAB knowledge should be cumulative; we list below only the new aspects introduced in Unit II.)

Double-index arrays (assignment, indexing, dotted arithmetic operators). User-defined functions (syntax, inputs, outputs). The MATLAB built-in's `zeros`, `eye`, and `ones` and in particular `rand` and `randn`.

Math and Numerics:

Frequentist view of probabilities and probability distributions. Collectively exhaustive events, mutually exclusive events, and corresponding probability "rules."

Random variables (discrete and continuous); probability mass functions and probability density functions.

Mean, variance, and standard deviation.

Random vectors: conditional probabilities, marginal probabilities, and joint probabilities. Independence.

Bayes Theorem (with particular emphasis on the case of two random variables each of which can take on two outcomes).

Functions (and transformations) of random variables and random vectors.

The Bernoulli discrete random variable (r.v.): 0 and 1 outcomes; probability mass function; significance of the parameter θ; interpretation as coin flips; mean and variance and standard deviation as a function of θ.

The binomial r.v.: definition as a sum of n independent Bernoulli coin flips; outcome tables and probabilities; shape of the probability mass function.

The univariate and bivariate uniform (continuous) r.v.: probability density; interpretation of probability as relative area; generation over any interval or (by independence) rectangle using the `rand` function and affine transformation (scale and shift).

The univariate normal density (continuous) r.v.: shape and properties; mean μ and standard deviation σ; generation of normal r.v. realizations for any μ and σ using the `randn` function and affine transformation (scale and shift).

Generation of random variates (realizations of random variables) by the acceptance–rejection approach: correct choice of a bounding rectangle; random darts; criterion for accepting or rejecting a dart according to the y position of the dart relative to the probability density function $f_X(x)$; efficiency of the approach in terms of fraction of random darts accepted.

Bernoulli estimation: sample mean estimate $\hat{\theta}_n$ for the parameter θ; (two–sided) normal-approximation confidence intervals [lower limit, upper limit] for θ; criteria for validity of normal–approximation confidence intervals; relationship between confidence level γ and z_γ, and the particular value of z_γ for the confidence level $\gamma = 0.95$; confidence interval Half Length and RelErr; dependence on sample size `n`.

Monte Carlo area estimation (of a region D): random darts from the uniform distribution over a bounding rectangular region R; relationship between random darts and a Bernoulli "inside D" random variable B; relationship between the area of the region D (and the known area of the rectangle R) and the Bernoulli parameter θ; estimation of the area of D by estimation of the Bernoulli parameter θ.

2.086 Numerical Computation for Mechanical Engineers

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