

ECE 303: Introduction to Communication Principles

IN

Sequences and Series (MATH 161)

- Understands convergence of sequences and series.
- Knows series and sequence representations for $\exp(x)$.
- Can evaluate finite and infinite geometric sums.
- Knows Binomial theorem.

Differentiation (MATH 161, 261)

- Can compute partial and total derivatives.
- Knows chain rule.
- Knows and can apply Liebnitz rule.

Integration (MATH 161, 261)

- Can integrate by parts.
- Can compute 2D integrals.

Pre-requisites:

- MATH261, ECE311 or concurrent registration

* = Optional

As of 3/18/2013

Concepts:

- * Games and counting formulas.
- * Polling and the hypergeometric distribution.
- The probability space of outcomes and events.
- Probability measure
- Conditional probability, total probability, and Bayes' rule
- Random variables, cdfs, pmfs, and pdfs.
- Moments and their uses.
- Mean and conditional mean as minimum m.s.e. estimators.
- Classical distributions and their origins.
- Averaging and Chebyshev's inequality, WLLN.
- * Histograms and the multinomial distribution.
- Simulations
- Multiple random variables.
- Transformation of random variables
- The linear system theory of probability:
 - sums of IID random variables,
 - convolution of pdfs,
 - product of characteristic functions
- * Noise through linear systems.
- Binary communication and error probability.

Applications:

- Biomedical Engineering
- Communication
- Control and Robotics
- Finance
- Lasers and Optics
- Microelectronics and Semiconductor Processing
- Radar and Remote Sensing
- Reliability and Operations Research
- Signal/Image Processing

Tools:

- * MATLAB Programs and Simulations

OUT

Experiments & Probability Spaces

- Can specify probability space and probability measure for an experiment.
- Understands independence and conditional probability.
- Can apply Bayes Rule.

Random Variables

- Can compute pmf, pdf, cdf, characteristic functions, and moments.
- Can compute pdf for functions of independent random variables.

Probability Distributions

- Understands Bernoulli, binomial, geometric, and Pascal distributions from Bernoulli experiment.
- Understands exponential and Erlang distributions from Poisson experiment.
- * Can derive uniform, Rayleigh, chi-squared, Cauchy, and beta distributions from bivariate normal experiment.
- * Can derive hypergeometric distribution for polls.
- * Can derive multinomial distribution for histograms.

Binary Communication

- Can use standard Gaussian tables.
- Can compute error probability for binary communication.

Averaging

- Can use Chebyshev's inequality to design averages to meet specifications.
- Understands Weak Law of Large Numbers.

Simulations

- Can simulate samples and construct histograms.
- Can generate arbitrarily distributed random variables.

Correlation and Spectrum Analysis

- * Can compute correlation and spectrum for WSS random process (including white noise) through a linear time-invariant system.