EE7401 Probability and Random Processes

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Learning Outcomes

1. Explain probability concepts and random variables.
2. Understand distributions and expectation.
3. Explain basic detection and estimation.
4. Explain random processes and correlation function.
5. Describe random processes in linear systems.
6. Applications of probability and random processes.

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Teaching team:

- Tay Wee Peng (wptay@ntu.edu.sg): Weeks 1 – 7
- Anamitra Makur (eamakur@ntu.edu.sg): Weeks 8 – 13

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Looking for rigorous theory?

- Github: https://github.com/wptay/aipt
- Youtube: An Analytical Introduction to Probability Theory

Grading

Component	Weighting
Final Examination	60%
Quiz	15%
Homework 2	10%
Homework 3	10%
Readiness Assessment (RA)	5%

- No late submission of homework and RAs. Zero mark applies if no valid LOA/MC for Quiz.
- Quiz and Final Exam: Restricted Open Book. You are allowed to bring ONE double-sided A4-size reference sheet with texts handwritten or typed on the A4 paper (no sticky notes/post-it notes on the reference sheet).

Readiness Assessment

- RA solution to be scanned and uploaded as **a single pdf file** via NTULearn.

Standards	Criteria
Good (3 points)	Demonstrates a good understanding with thoughtful completion of all questions.
Average (2 points)	Demonstrates an understanding with some minor gaps.
Below Average (1 point)	Puts in efforts to complete the questions but has weak understanding with glaring mistakes.
Unsatisfactory (0 point)	No significant effort to complete the questions or did not submit any solutions.

Schedule

Week	Topic	Due
1	Probability space and Axioms, basic laws, conditional probability, Bayes rule, and independence	
2	Random variables, probability mass function (PMF), cumulative distribution function (CDF), probability density function (PDF), functions of random variables	
3	Joint, marginal and conditional distributions, mixed random variables, signal detection, functions of two random variables	
4	Expectation: mean and variance, covariance and correlation, Markov and Chebyshev inequalities, conditional expectation	RA1
5	Minimum MSE estimation, linear estimation, jointly Gaussian random variables, independence and conditional independence	RA2
6	Mean and covariance matrix, Gaussian random vectors, Gaussian random vectors	RA3
7	Different modes of convergence and convergence laws	Quiz

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Week	Topic	Due
8	Random processes. Correlation functions. Poisson process. Stationary process.	
9	Random processes in linear systems. Power spectrum.	Homework 1
10	Discrete-time processes, AR(1) process. Shot noise. Modulation, bandlimited process, sampling expansion.	
11	Optimum linear systems - Matched filter. Ergodicity. Measurement of power spectrum.	Homework 2
12	Discrete-time Markoff chains, continuous-time Markoff Chains.	
13	Mean square estimation, prediction, filtering, filtering and prediction.	

Padlet