ECM9028 –

Advanced Probability for Communications

Course Brief :

This course intends to provide students with the necessary background on advanced probability theories for communications.

Instructor :

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Lecture Schedule :

Friday BCD (9:10am-10:00am, 10:10am-11:00am, 11:10am-12:00pm)

Class Room :

SC204

Teaching Assistant :

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Grading System :

The final grade of this course will be contributed equally from homework and a study report.

The study report is due on **January 8, 2021**. Late submission will be deducted 50% from its final grade. In the study report, students may try to apply what they have learned from this course to a self-created or application-oriented problem. For example, a partial solution with some conjectures on the unsolved part of the self-created problem will make an excellent report. It can also be a summary with a novel personal extension about a theoretical paper that you are interested in,

and that is relevant to what we have lectured. A copy of the studied paper must be attached when submitting the report.

Coverage :

- Patrick Billingsley, *Probability and Measure*, 3rd Edition, Wiley, 1995.
  - Section 6: Law of large numbers (including the strong law, and the weak law), Borel-Cantelli lemmas.
  - Section 9: Large deviations, the law of the iterated logarithm, moment generating functions versus large deviations, Chernoff's theorem.
  - Section 20: Random variables, convergence in probabilities.
  - Section 21: Characterization of relation between expectation values and (1) limits, (2) distributions, (3) moments.
    Several inequalities regarding expectation values will also be covered.
  - Section 22: Sums of independent random variables, and their relation with the strong/weak law and moment generating functions.
    Komogrov's zero-one law and maximal inequality will also be covered.
  - Section 25: Weak convergence in distributions.
  - Section 26: Characteristic functions inversion, uniqueness theorem, the continuity theorem.
  - Section 27: The central limit theorem, Lindeberg and Lyapounov theorems.
  - Section 28: Infinitely divisible distributions.
  - Section 37: Brownian motion.
- Advanced topics:
  - Berry-Esseen Theorem (William Feller, *An Introduction of Probability Theory and Application*, 2nd edition, Volume II, Wiley, 1971);
  - Basic order statistics selected from:
    - *Order Statistics*, 2nd edition, Herbert A. David, 1981;

* *Order Statistics: Applications*, N. Balakrishnan & C. R. Rao, 1998
* *Ordered Random Variables*, Mohammad Ahsanullah and Valery B. Nevzorov, Nova Science Publishers, Inc., 2001.