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MATH20722 - 2009/2010

General Information

- Title: Classical Probability
- Unit code: MATH20722
- Credit rating: 10
- Level: 2
- Pre-requisite units: MATH10141, MATH20701
- Co-requisite units: None
- School responsible: Mathematics
- Member of staff responsible: Dr. John Moriarty

Unit specification

Aims

The programme unit aims to

- provide the basic knowledge of facts and methods needed to state and prove the law of large numbers and the central limit theorem;
- introduce fundamental concepts and tools needed for the rigorous understanding of third and fourth level course units on probability and stochastic processes including their applications (e.g. Financial Mathematics).

Brief description

The law of large numbers and the central limit theorem are formulated and proved. These two results embody the most important results of classical probability theory having an endless number of applications.

Intended learning outcomes

On completion of this unit successful students will:

- understand the meaning and proof of the law of large numbers;
- understand the meaning and proof of the central limit theorem;
- be able to apply the methods of proof to related problems.

Future topics requiring this course unit

MATH37001 Martingales with Applications to Finance (level 3 semester 1)
MATH47101 Stochastic Calculus (level 4 semester 1)

Syllabus

1. Probability measures. Probability spaces. Random variables. Random vectors. Distribution functions. Density functions. Laws. The two Borel-Cantelli lemmas. The Kolmogorov 0-1 law. [4 lectures]

2. Inequalities (Markov, Jensen, Hölder, Minkowski). Modes of convergence (almost sure, in probability, in distribution, in mean). Convergence relationships. [4]
3. Expectation of a random variable. Expectation and independence. The Cesàro lemma. The Kronecker lemma. The law of large numbers (weak and strong). [6]
4. Fourier transforms (characteristic functions). Laplace transforms. Uniqueness theorems for Fourier and Laplace transforms. Convergence of characteristic functions: the continuity theorem. The central limit theorem. [10]

Textbooks

- D. Williams, *Probability with Martingales*, Cambridge University Press 1991.
- A.N. Shiryaev, *Probability*, Springer-Verlag 1996.

Learning and teaching processes

Two lectures and one examples class each week. In addition students are expected to do at least four hours private study each week on this course unit.

Assessment

Mid-semester coursework: weighting 20%
End of semester examination: two hours weighting 80%

Arrangements