

MAT1844HF

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NONLINEAR DYNAMICAL SYSTEMS: STOCHASTIC PROPERTIES

COURSE INFORMATION

Instructor	Jacopo De Simoi
Office	PG 200A
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Lectures	Mon 11:00 AM – 1:00 PM BA6180 Wed 11:00 AM – 12:00 PM BA6180
Office Hours	Mon 2:00 PM – 3:00 PM Wed 12:00 PM – 1:00 PM

ABSTRACT

The goal of the course is to give an introduction to dynamical systems with a strong emphasis on their probabilistic and stochastic interpretation. We will focus on systems which present some form of hyperbolicity and introduce and compare two main tools of the modern approach: Spectral Theory and the Coupling Technique. We will see how to use these tools to prove limit theorems to various degrees of precision and refinement. We will then see these results at work by discussing averaging and homogenization of dynamical systems.

GRADING

Take-home problem sets throughout the term and in-class presentation. I will post a list of topics suitable for the presentations; suggestions for the presentation are also welcome.

PREREQUISITES

The course is an introduction to dynamical systems with a probabilistic flavor; basic notion on measure theory of probability and of real and functional analysis are expected to be known, but there will be an effort to make the course as self-contained as possible.

LIST OF TOPICS [TENTATIVE]

- Basic results in Ergodic Theory
 - Invariant measures
 - Von Neumann Ergodic Theorem
 - Birkhoff Ergodic Theorem
 - Ergodicity and mixing
- Topological and Smooth structure (expanding maps)
 - Existence of invariant measures
 - Transfer operators
 - Standard Pairs
 - Correlations and speed of decay
- Limit theorems
 - Law of Large numbers
 - Large Deviation principle
 - Central Limit Theorem
 - Local Central Limit Theorem
- Averaging (and Homogenization) of fast-slow systems

REFERENCES

I will regularly post and update lecture notes on my webpage; we will cover material that is presented in a number of books, among them:

- A. Katok and B. Hasselblatt, *Introduction to the modern theory of dynamical systems*, Cambridge University Press
- M. Brin and G. Stuck, *Introduction to dynamical systems* Cambridge University Press
- M. Viana and K. Oliveira, *Foundations of Ergodic Theory* Cambridge University Press
- L. Korolov and Ya. Sinai, *Theory of Probability and Random Processes* Universitext. Springer, Berlin,