

## MATH 689—Topics in Ergodic Theory

Fall 2009

**Instructor:** David Kerr

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**Lectures:** TR 12:45–2:00, room to be announced

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**Office hours:** by appointment

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**Course description:** The course will treat two main topics in the theory of measure-preserving group actions on a probability space. The first is Furstenberg's dynamical approach to Szemerédi's theorem on the existence of arbitrarily long arithmetic progressions in subsets of natural numbers with positive upper density, and the second is Popa's recent pair of cocycle superrigidity theorems with applications to orbit equivalence. Common themes will be stressed, notably weak mixing and compactness and dichotomies based around these two notions. No background in ergodic theory is required, but some functional analysis will be assumed (e.g., operators on Hilbert space). Prerequisite: MATH 608.

**Course resources:** The main resources for the course are the following articles:

- H. Furstenberg. *Recurrence in Ergodic Theory and Combinatorial Number Theory*. Princeton University Press, Princeton, NJ, 1981.
- H. Furstenberg, Y. Katznelson, and D. Ornstein. The ergodic theoretical proof of Szemerédi's theorem. *Bull. Amer. Math. Soc. (N.S.)* 7 (1982), 527-552.
- Terence Tao's lecture notes at <http://en.wordpress.com/tag/254a-ergodic-theory>
- S. Popa. Cocycle and orbit equivalence superrigidity for malleable actions of w-rigid groups. *Invent. Math.* 170 (2007), 243-295.
- S. Popa. On the superrigidity of malleable actions with spectral gap. *J. Amer. Math. Soc.* 21 (2008), 981-1000.
- A. Furman. On Popa's cocycle superrigidity theorem. *Int. Math. Res. Not.*, vol. 2007, article ID rnm073.

For basic references in ergodic theory the following books are recommended:

- *Ergodic Theory via Joinings* by Eli Glasner (American Mathematical Society, Providence, RI, 2003)
- *An Introduction to Ergodic Theory* by Peter Walters (Springer-Verlag, New York, 2000)
- *Ergodic Theory* by Karl Petersen (Cambridge University Press, Cambridge, 1989)

**Grading:** Grades will be based on attendance and assignments.

**Make-up policy:** In accordance with university regulations, late assignments will only be allowed for a university-approved excuse in writing. Whenever possible, students should inform the instructor before an assignment is due. Students are required to notify the instructor by the end of the next working day after missing an assignment. Otherwise, they forfeit their rights to a make-up.

**Support services:** The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities, in Room 126 of the Koldus Building or call 845-1637.

**Academic integrity:** The Aggie Code of Honor states "An Aggie does not lie, cheat, or steal or tolerate those who do." See <http://www.tamu.edu/aggiehonor> for university policy concerning academic dishonesty and the rules and procedures of the Honor Council.

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