

# Stochastic differential equations involving fractional Brownian motion

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**Timetable:** 12 hrs. All lectures in Torre Archimede, Room 2BC/30 and online via Zoom.  
Lectures on July 8, 11, 12, 13, 14, 15, always at 14.30–16.30.

**Course requirements:** A previous knowledge of the basic concepts of stochastic processes is required. Knowledge of stochastic calculus could help for the advanced parts of the course, but during the course the basic concepts will be introduced for the understanding.

**Examination and grading:** Seminar.

**SSD:** MAT/06 Probability and Mathematical Statistics

## Course contents:

The course will present following issues concerning stochastic differential equations with fractional Brownian motion: standard ones with smooth coefficients; the equations with unbounded coefficients and  $H > 1/2$ , the equations with unbounded coefficients and any  $H$ , together with the approximations and numerics; delayed and mixed equations. Some issues on discontinuous coefficients will be provided.

### Standard stochastic differential equations with fBm. (2 hours)

1. Integration with respect to fBm.
2. Elements of fractional and fractional stochastic calculus.
3. Stochastic differential equations with fBm and smooth coefficients.

### Equations with unbounded coefficients and $H > 1/2$ (2 hours):

1. Cox-Ingersoll-Ross equations with fBm.
2. Equations with unbounded drift.
3. Reflected Ornstein-Uhlenbeck equations.

### “Sandwiched” equations (4 hours):

1. What drifts allow to consider low values of  $H$  in SDE.
2. Approximations of solutions.

### Equations with delay, mixed equations and the case of discontinuous coefficients. (4h):

1. Equations with delay.
2. Mixed equations.
3. Discontinuous coefficients.