UNIVERSITÀ DI TRENTO
Dipartimento di Matematica

DOTTORATO

CYCLE 33th
ORAL DEFENCE OF THE PHD THESIS

Tuesday 29 March 2022 – at 9:30 am
Seminar room "-1"

The event will take place online through the ZOOM platform.
To get the access codes please contact the secretary office

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PhD Student in Mathematics

Measure-valued affine and polynomial diffusions and applications to energy modeling

Abstract:
The central theme of this thesis is the study of stochastic processes in the infinite dimensional setup of (non-negative) measures. We introduce a class of measure-valued processes, which – in analogy to their finite dimensional counterparts – will be called measure-valued polynomial diffusions. We show the so-called moment formula, i.e. a representation of the conditional marginal moments via a system of finite dimensional linear PDEs. Furthermore, we characterize the corresponding infinitesimal generators obtaining a representation analogous to polynomial diffusions on R^m_+, in cases where their domain is large enough. In general, the infinite dimensional setting allows for richer specifications strictly beyond this representation. As a special case, we recover measure-valued affine diffusions, sometimes also called Dawson-Watanabe superprocesses. The polynomial framework is especially attractive from a mathematical finance point of view. Indeed, it allows to transfer some of the most famous finite dimensional models, such as the Black-Scholes one, to an infinite dimensional measure-valued setting.

We outline the applicability of our approach to energy markets term structure modeling by introducing a framework allowing to employ (non-negative) measure-valued processes to consider electricity and gas futures. Interpreting the process' spatial structure as time to maturity, we show how the Heath-Jarrow-Morton (HJM) approach can be translated to such framework, thus guaranteeing arbitrage free modeling in infinite dimensions. We derive an analogue to the HJM-drift condition, then considering existence of (non-negative) measure-valued diffusions satisfying this condition in a Markovian setting. To analyze mathematically convenient classes of models, we also consider measure-valued polynomial and affine diffusions allowing for tractable pricing procedures via the moment formula and Fourier approaches.

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CONTATTI
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