

Avviso di Seminari

Lunedì 21 e martedì 22 settembre 2026, ore 10.00 (entrambi i giorni)

AULA 5 – Palazzo delle Scienze

Hidden Markov Models and beyond: a flexible framework for semi-Markov dynamics

Pierfrancesco Alaimo Di Loro (Università LUMSA di Roma)

Marco Mingione (Università degli Studi di Roma “Foro Italico”)

Abstract: *Hidden Markov Models (HMMs) provide a powerful and interpretable framework for analyzing time-dependent data characterized by latent regimes and dynamic transitions. Building on the probabilistic structure of mixture models, they represent the observed process through a sequence of unobserved states evolving according to a Markov chain, with each state associated with distinct distributional characteristics. Their flexibility and broad applicability have made them popular statistical tools across a wide range of fields, including economics, finance, environmental sciences, epidemiology, and many others.*

A central feature of these models, often of primary scientific and practical interest, is their ability to capture the dynamic switching of an observed system between latent regimes over time. By explicitly modelling latent states and their transitions, HMMs provide a framework for characterizing both the marginal behaviour of the observations within each regime and their conditional dependence over time. Their extension to semi-Markov dynamics, known as Hidden semi-Markov Models (HSMMs), further allows modelling different persistence behavior within each regime, increasing flexibility without adding much modeling complexity.

This two-day workshop will introduce participants to mixture models, Hidden Markov Models, and their semi-Markov extensions, gradually developing the theoretical and computational foundations required to understand and apply these methods. Particular attention will be devoted to recent developments in nonhomogeneous HSMMs, which allow transition probabilities and state durations to depend on external time-varying covariates. Drawing on standard approaches in survival analysis, this formulation provides a natural framework for investigating the factors associated with regime changes and persistence, while preserving the interpretability of the underlying probabilistic structure. Recent contributions in the literature exploiting this perspective will be discussed, highlighting its potential advantages over standard implementations.

Alongside theoretical discussions and applications drawn from different fields, the workshop will include hands-on laboratory sessions. Participants will have the opportunity to implement the methods in R, explore their behaviour through simulated and real-world examples, and experiment with an R package currently under development for the estimation of these new models.

Webinar: [Link ai seminari](#)