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Seminar 2021/2022

Modeling and forecasting with Stochastic Differential Equations and other stochastic processes

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https://videoconf-colibri.zoom.us/j/86389857315

Many real world systems exhibit a stochastic behavior as a result of random influences or uncertainty. Examples of these type of stochastic dynamics occur throughout the physical, social and life sciences as well as in engineering, just to name a few domains.

Various methods of advanced modelling are needed for an increasing number of complex systems. For a model to describe the future evolution of the system, it must: (i) capture the inherently linear or non-linear behavior of the system; (ii) provide means to accommodate for noise due to approximations and measurement errors. This calls for methods that are capable of bridging the gap between physical world and statistical modelling.

We will give an overview on the modeling procedure and illustrate the main ideas on a couple of real world examples. Many other examples exist including in other fields of application, e.g. in population growth, the neurosciences, infectious diseases and epidemiology, the new green energy systems, financial markets, new materials and mechanical structures. Once the mode is fit, forecasting equations can be derived by applying statistical principles. Short term as well as long term forecasts can be computed.

We will depart from the fundamental concepts on stochastic differential equations and present the main up to date challenges in terms of modeling and forecasting. The need for using Stochastic Differential Equations also appears in a rather natural way in problems involving Big Data. We will make this relation evident in the exposition. Computer programs and languages like R or Matlab are useful in solving this type of modeling problems.

References

[1] Braumann, C.A. (2019). Introduction to Stochastic Differential Equations with Applications to Modeling in Biology and Finance. Wiley.

[2] Mao, X. (2007). Stochastic differential equations and their applications. Horwood Publishing.

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