2SC7190 – Risk Management on financial markets

Instructors: Gaoyue Guo
Department: DOMINANTE - MATHÉMATIQUES, DATA SCIENCES
Language of instruction: ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 80
On-site hours (HPE): 48,00

Description
Students enrolled in this course are asked to study a quantitative method in a financial risk management setting. Subjects are proposed by an industrial or academic partner.

Quarter number
ST7

Prerequisites (in terms of CS courses)
Stochastic Finance and Risk Modelling (ST7 MDS)

Syllabus
Each project deals with a quantitative method for risk management, e.g., pricing or hedging of a financial product, or asset allocation, portfolio management, client portfolio analysis, etc. Real financial or client data is provided by the project partner. Each project requires the coding of the method investigated.

List of 2021 subjects (may differ in 2022):
- Optimal portfolio allocation (in partnership with BNP Paribas)
- Optimization for insurance products (in partnership with Generali)
- Hybrid portfolio optimization (in partnership with Volga Technologies)
- Heuristic portfolio construction (in partnership ODDO BHF)

Class components (lecture, labs, etc.)
Project with regular supervision. Short lectures if needed.

Grading
Source code, technical report and oral presentation

ST7 – 72 – OPTIMIZATION OF NETWORK INFRASTRUCTURE FOR SMART CITIES

Dominante : SCOC (Systèmes Communicants et Objets Connectés)
Teaching Language : English
Campus: Paris-Saclay

Introduction

The advent of the Internet of Things and the proliferation of applications based on cheap sensor networks are now paving the way for the development of smart, connected and sustainable cities. Many cities in Europe (Antony, Dijon, Malaga, Santander, Barcelona, etc.) are in the process of creating intelligent environments with experiments deployed for better adaptive management of traffic and transport, for better management of energy and water consumption, for reduction of CO2 and pollution level, and for a better quality of life, etc. The creation and management of smart cities require high-speed communications infrastructures and edge networks for the collection, delivery and processing of a large amount of information (traffic sensors, cameras, localizable vehicles, profiles and movements of users / people, etc.), which will overload current telecommunications networks and / or require the development of new communication systems. It is estimated that the density of connected objects in smart cities will reach one million objects per km2 in the next years. Obviously, the optimization of communications networks is essential in this case. In this context, one of the main objectives of the fifth generation of communications systems is to be able to meet the needs of smart cities, in particular by allowing the communication of a large number of machines, the virtualization of network functions, and the intelligent data processing. This ST will present the current challenges and problems of smart cities, through interventions by the main actors in the field. The fundamental principles of game theory (rationality, Equilibria, etc.) will then be explained in detail and several practical examples of the use of this theory to solve smart city problems will also be presented and analyzed.

Prerequisites

Basics in Modelling and signal processing.

Context and Challenges Modules: These modules include seminars on smart cities (issues, challenges, and experiments), a Panel dedicated to markets and economic models confronting the visions of the main actors in the field, as well as presentations by industrial partners focusing on technological and scientific challenges.

Specific Course (60 HEE): *Game Theory for smart cities*

- **Brief description:** This course explains the fundamental principles of game theory (rationality, Nash equilibrium, correlated equilibria, etc.) and presents the solution of several types of games (finite games and mixed strategies, revolutionary games, repeated games, etc.). Several practical examples of the use of game theory in smart cities are presented and analyzed. In particular, the distributed optimization of telecommunications network infrastructures, the routing of data in networks and the problem of intelligent vehicle charging are studied.

Project : *Smart cities : the connected cities*

- **Partners :** Orange, Nokia, Thales
- **Place**: Paris-Saclay
- **Brief description:** The projects are centered around practical applications of optimization (combinatorial, convex) and game theory to the current problems of smart cities. The projects will be multidisciplinary and will serve to put into perspective the courses of ST7 and to introduce students to engineering problems and/or scientific research in the field.

  Examples of projects: collect and routing of data in smart cities, route optimization for cycling, optimization strategies for charging bikes at station, electrical consumed energy forecasting, etc.

  The practical context of the project is related to a precise service in smart cities (information gathering from sensors, temperature regulation, video surveillance, consumption of electric energy, route optimization for cycling, etc.) and it will be given as a complement to the courses. Students will propose and implement convex optimization or game theory algorithms seen in the courses. They will then test their approaches on potentially real data.