



# **Option Mathématiques et Décision**

# **Modules Spécifiques Option Mathématiques et Décision**

# Libelle english



## **MATHÉMATIQUES ET INGÉNIERIE DU RISQUE**

### **MATHEMATICS AND RISK ANALYSIS**

**Lecturers:** Marie-Christophette BLANCHET

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

#### **Objectives**

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The third year specialization « Applied mathematics and risk engineering » is devoted to mathematical modeling and numerical simulation of problems arising in engineering. Students study a wide range of stochastic and deterministic methods concerning ordinary and partial differential equations, optimization problems, discrete and time-continuous stochastic processes, statistics, together with the associated numerical methods. Opportunity is given to the best students to complete their formation with a master degree in one of the three following fields : applied mathematics, finance / insurance, biomathematics / biostatistics.

**Keywords :**

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#### **Programme**

#### **Learning outcomes**

- Up to date mathematical technics
- Tools for scientific monitoring
- Necessary background for an applied mathematics PhD

#### **Independent study**

**Objectifs :**

**Méthodes :**

#### **Core texts**

#### **Assessment**



## ADVANCED TOOLS FOR LEARNING : WHEN CONVEXITY MEETS SPARSITY

### PRACTICAL MATHEMATICS

Lecturers: Céline HARTWEG-HELBERT, Yohann DE CASTRO

| Lecturers : 15.0 | TC : 15.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : AN

### Objectives

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Sparsity and convexity are ubiquitous notions in Machine Learning and Statistics. In this course, we study the mathematical foundations of some powerful methods based on convex relaxation: L1-regularisation techniques in Statistics and Signal Processing; Nuclear Norm minimization in Matrix Completion. These approaches turned to be Semi-Definite representable (SDP) and hence tractable in practice. The theoretical part of the course will focus on the guarantees of these algorithms under the sparsity assumption. The practical part of this course will present the standard solvers of these learning problems.

**Keywords :** L1-regularization; Matrix Completion; Semi-Definite Programming; Proximal methods;

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### Programme

### Learning outcomes

### Independent study

Objectifs :

Méthodes :

### Core texts

Christophe Giraud, *INTRODUCTION TO HIGH-DIMENSIONAL STATISTICS*, Chapman and Hall/CRC  
Martin J. Wainwright *HIGH-DIMENSIONAL STATISTICS: A NON-ASYMPTOTIC VIEWPOINT*, Cambridge University Press  
Simon Foucart and Holger Rauhut *A MATHEMATICAL INTRODUCTION TO COMPRESSIVE SENSING*

### Assessment



## INTRODUCTION AUX MATHÉMATIQUES FINANCIÈRES

### INTRODUCTION TO MATHEMATICAL FINANCE

Lecturers: Marie-Christophette BLANCHET, Elisabeth MIRONESCU

| Lecturers : 14.0 | TC : 4.0 | PW : 0.0 | Autonomy : 0.0 | Study : 12.0 | Project : 0.0 | Language : FR

#### Objectives

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This course presents in detail the classical models used in mathematical finance in discrete and continuous times. It includes three sessions of numerical implementation. It is based on the Stochastics Processes course (MOD) given during the first part of the year.

**Keywords :** Mathematical finance, Cox-Ross-Rubinstein model, Black-Scholes model, stochastic calculus, pricing and hedging options.

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#### Programme

Cox-Ross- Rubinstein model  
Black-Scholes model and some extensions

#### Learning outcomes

#### Independent study

Objectifs :

Méthodes :

#### Core texts

Damien Lamberton et Bernard Lapeyre, *INTRODUCTION AU CALCUL STOCHASTIQUE APPLIQUÉ À LA FINANCE*, Ellipses, 1997  
Peter Tannkov et Nizar Touzi *CALCUL STOCHASTIQUE ET FINANCE (EN ANGLAIS)*, <http://www.cmap.polytechnique.fr/~touzi/Poly-MAP552.pdf>, 2018  
Damien Lamberton and Bernard Lapeyre *INTRODUCTION TO STOCHASTIC CALCULUS APPLIED TO FINANCE.*, Chapman and Hall 2nd Edition, 2008

#### Assessment

3 practical work sessions  
1 written exam



## **PROBLÈMES INVERSES ET IMAGERIE**

### **INTRODUCTION TO INVERSE PROBLEMS**

**Lecturers:** Abdel-Malek ZINE, Laurent SEPPECHER

| Lecturers : 20.0 | TC : 2.0 | PW : 0.0 | Autonomy : 0.0 | Study : 8.0 | Project : 0.0 | Language : FR

#### **Objectives**

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Keywords :

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#### **Programme**

#### **Learning outcomes**

#### **Independent study**

Objectifs :

Méthodes :

#### **Core texts**

#### **Assessment**



## PROJET IM

### PROJET IM

Lecturers: **Marie-Christophette BLANCHET**

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 8 | Project : 50 | Language : FR

### Objectives

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Through this project, students will identify mathematical problems/ barriers, propose solutions and implement them. They will also improve their communication skills to present the results (in written and oral forms).

**Keywords :** Modelization, Analysis, Simulations.

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### Programme

#### Learning outcomes

- Build a model
- Analyzis of a deternnistic or random model
- Use of an appropriated software to perform simulation

#### Independent study

**Objectifs :** rite a report, build a presentation.

**Méhodes :** Group Work, pair work.

#### Core texts

#### Assessment

Report and defense



# Filière Aide à la Décision pour l'Entreprise



## **SIMULATION DE DÉCISIONS OPÉRATIONNELLES**

### **PROCESS SIMULATION**

**Lecturers:** Sylvie MIRA , Emmanuel BOUTLEUX

| Lecturers : 12.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 32.0 | Project : 0.0 | Language : FR

### **Objectives**

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The main objective is to model information flows within an organization (production system, logistics platform, administration, communication network, ...). Whether designing or analyzing an organization, the evaluation phase is an unavoidable step. Indeed, before making often heavy investments, it is imperative to ensure that the solutions envisaged meet the objectives. This course provides training on both the principles and tools of mathematical analysis and simulation tools for the specification, modeling and evaluation of information flows.

This course will focus on practical applications of Petri nets modeling and event simulation software such as

**Keywords :** Information flows analysis, operationnal simulation and optimisation

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### **Programme**

Methods and concepts explanation  
Simulation on Petri networks within Witness software

### **Learning outcomes**

- Be able to use behaviour based models
- Be able to analyse a flow model
- Be able to use model results for decision

### **Independent study**

**Objectifs :** Competence acquisition on model and software

**Méhodes :** Group work on software

### **Core texts**

### **Assessment**

Group work on projet



## **FINANCE ET MARCHÉS**

### **BUSINESS GAME**

**Lecturers:** Sylvie MIRA

| Lecturers : 12.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 24.0 | Project : 0.0 | Language : FR

### **Objectives**

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The course aims to bring deep insights of commercial and financial key performance indicators and competencies to design decision support tools for financial and commercial strategy

**Keywords :** key performance indicators, customer relationship management, corporate strategy

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### **Programme**

- Corporate finance
- Commercial strategy

### **Learning outcomes**

- Be able to design key performance indicators (KPI)
- Be able to understand KPI to plan actions

### **Independent study**

**Objectifs :** Group work on KPI for corporate decision making

**Méthodes :** Case studies

### **Core texts**

### **Assessment**

Case studies



## **PILOTAGE ET MANAGEMENT**

### **DECISION SUPPORT SYSTEMS**

**Lecturers:** Sylvie MIRA

| Lecturers : 16.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

#### **Objectives**

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The course aims to place the students in a situation of decision-making in a company by working on their cognitive process and to give them the keys to designing and implementing management systems.

**Keywords :** Cognitive process, risks, management

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#### **Programme**

- Cognitiv process
- Risk / decision anaysis
- Management and dashboard

#### **Learning outcomes**

- Understand cognitive process activated in decision making
- Design a financial dashboard
- Assess financial impact of strategic decision

#### **Independent study**

**Objectifs :** Work group to understand analysed processes

**Méhodes :** Case studies

#### **Core texts**

SELMER, C., *CONCEVOIR LE TABLEAU DE BORD*, DUNOD, 2015

#### **Assessment**

Case studies



## PROJET ADE

### PROJECT

Lecturers: Sylvie MIRA

| Lecturers : 0.0 | TC : 50.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

### Objectives

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Keywords :

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#### Programme

Customised program to each project

#### Learning outcomes

- Be able to analyse an company's issue
- Be able to collect relevant data from technical aspects, markets and context
- Be able to implement a prospectiv analysis
- Be able to communicate clear and justified solutions

#### Independent study

Objectifs : Be able to bring within 3 monts a solution to a company's issue

Méhodes : Group work

#### Core texts

#### Assessment