

## Option 3A

### Données et Décisions Économiques et Financières (DDEFi)

**For international students, this page is also available in the following languages**

- [English](#): it contains dedicated information for international exchange students to help them prepare their mobility (e.g. Learning Agreement).

## L'option DDEFi en quelques lignes

Prenant la suite de l'option MMEFi (Mathématiques, Management, Economie et Finance), l'option 3A DDEFi offre aux élèves de 3ème année un choix diversifié d'enseignements centrés sur les mathématiques appliquées, l'économie et la finance et le traitement des données dans ces domaines.

L'option permet aux élèves de se spécialiser au fur et à mesure de l'avancement de la 3ème année du cursus ingénieur généraliste centralien de Marseille. Elle propose des cours autour de la finance de marché, l'actuariat, le financement et la stratégie de l'entreprise, le traitement des données économiques et financières.

Dans un monde technologique et économique complexe où les thématiques [ESG](#) (Environnement, Social et Gouvernance) sont de plus en plus présentes, les mathématiques et leurs applications sont au coeur des instruments de décision : qu'il s'agisse de modéliser, de mesurer et de contrôler les risques liés aux phénomènes économiques, aux instruments financiers ou aux évolutions du climat, les outils mathématiques associés à la compréhension fine des phénomènes offrent des compétences largement appréciées dans de nombreux secteurs d'activité.

En parallèle de l'option DDEFi, les élèves peuvent suivre l'un des Masters suivants :

- Master Aix-Marseille School of Economics (AMSE), [parcours Modélisation financière](#) (correspondant Centrale Méditerranée : Renaud Bourlès)
- Master Mathématiques Appliquées et Statistique, [parcours Data Science](#) (en cours d'organisation avec l'option DDEFi, correspondant Centrale Méditerranée : Christophe Pouet)

Vous pouvez visiter la [page dédiée aux Masters](#) pour connaître les conditions de suivi de ces Masters en parallèle de l'option DDEFi.

## Objectifs de la formation

Former des ingénieurs généralistes capables d'appréhender et de modéliser des situations complexes à partir de données financières et économiques pour élaborer des stratégies pertinentes de décision dans les domaines de la gestion, de la finance et de l'assurance. L'ingénieur généraliste de Centrale Méditerranée est capable de dialoguer avec les nombreux spécialistes intervenant en finance et en assurance et de faire la synthèse de points de vue venant de domaines différents. L'accent est mis sur les approches quantitatives et le traitement des données.

## Structure de la formation

Un syllabus pour l'année 2021-2022, valable aussi pour les années 2020-2021 et 2019-2020, est disponible au format pdf sur la [page des anciens programmes](#).

**L'option DDEFi permet de valider 24 ECTS pour les cours et 5 ECTS pour le projet**, soit un total de 29 ECTS. Ces unités d'enseignement sont rattachées du point de vue administratif au Semestre 9 et au Semestre 10. La période globale où ces unités d'enseignement sont enseignées va de début Septembre à fin Mars/début Avril (selon les années). Il revient donc à chacun de vérifier les périodes précises d'enseignement des différentes unités d'enseignement (par exemple en consultant la page dédiée à chaque unité d'enseignement).

### Dedicated information for international students

Si vous êtes étudiant en échange de crédits à Centrale Méditerranée, vous trouverez plus d'informations sur la [page de présentation en anglais](#).

If you are an incoming exchange student at Centrale Méditerranée, please check the [English webpage](#) with dedicated information for you.

**Very Important! A new programme DDEFi has been offered since academic year 2022-2023. If you plan to come as an exchange student for academic year 2023-2024, please check the latest information.**


A syllabus for academic year 2021-2022, also valid for academic years 2020-2021 and 2019-2020, is available on a dedicated webpage [old programmes](#).


### Corps professoral

Il est composé d'enseignants-chercheurs de Centrale Méditerranée, d'enseignants-chercheurs et chercheurs extérieurs (par exemple d'Aix-Marseille Université) ainsi que de nombreux intervenants professionnels, notamment des anciens élèves de l'option DDEFi. [Liste détaillée ici](#).

### Liste des unités d'enseignement

Vous pouvez cliquer sur les noms des UE pour avoir une description.

<b>Projet (de mi-Septembre à mi Avril: compte pour le S10)</b>					
Nom	Semestre	Code	ECTS	Volume horaire	Responsable
<a href="#">Projet DDEFi</a>	S10		5	100h	
<b>Temps 1 (de Septembre à mi-Novembre: compte pour le S9) : Tronc Commun</b>					
Nom	Semestre	Code	ECTS	Volume horaire	Responsable
<a href="#">Modèles et décisions</a>	S9		8	72h	R. Bourlès
<b>Temps 2 (de mi-Novembre mi-Février: compte pour le S9) : choix d'un parcours (1 cours au choix)</b>					
Nom	Semestre	Code	ECTS	Volume horaire	Responsable
<a href="#">Parcours Finance</a> 	S9		8	100h	
<a href="#">Parcours Données et décisions</a>	S9		8	100h	R. Bourlès

<b>Temps 3 (de mi-Février à mi-Avril: compte pour le S10) : choix d'une spécialisation</b>						
<b>Nom</b>	<b>Semestre</b>	<b>Code</b>	<b>ECTS</b>	<b>Volume horaire</b>	<b>Responsable</b>	
Spécialité : Mathématiques financières	S10		8	100h		R. Bourlès
Spécialité : Finance d'entreprise	S10		8	100h		R. Bourlès
Spécialité : Actuariat 	S10		8	100h		R. Bourlès
Spécialité : Analyse et données	S10		8	100h		R. Bourlès

Les élèves ayant suivi le Parcours Finance au Temps 2 suivent soit Mathématiques financières, soit Finance d'entreprise. Les élèves ayant suivi le Parcours Données et décisions au Temps 2 suivent soit Actuariat, soit Analyse et données.

Au Semestre 9, les élèves complètent l'option avec

- des UE du tronc commun 3A de management (3 ECTS)
- une UE Langues et Cultures Internationales (2 ECTS)
- la filière métier (9 ECTS) : celles qui ont le plus d'affinités avec l'option DDEFi sont Audit & Conseil (AUC), Entrepreneuriat (ENT), Recherche & Développement (R&D), Management Organisationnel (MO) et Production-Logistique (PRL).

Au Semestre 10, les élèves complètent l'option avec

- des UE du tronc commun 3A de management (1 ECTS)
- une UE Langues et Cultures Internationales (1 ECTS)
- le Travail de Fin d'Etudes (15 ECTS) : 4 à 6 mois à partir de mi-Avril

L'option DDEFi est l'héritière de l'option MMEFi () et des options MAF () et GP2I (). Des informations sur les anciens programmes peuvent être trouvées sur une [page spécifique](#).

## **Insertion professionnelle, poursuite d'études**

- Banques, finance : BP2S, BNP Paribas, Amundi,...
- Assurance, actuariat : Axa, Crédit Agricole Assurances,...
- Audit, conseil : Mazars, Deloitte, EY, Solucom,...
- Informatique, électronique, télécommunications : Orange, CGI,
- Industrie du luxe : Chanel, Guerlain, L'Oréal,...
- Transports : Renault,...

Pour une liste détaillée des stages des trois dernières années, vous pouvez consulter la page [Stages](#)

Pour les emplois occupés par les diplômés de l'option DDEFi à la sortie de Centrale Méditerranée ou après quelques années, les élèves admis dans l'option DDEFi pourront consulter les informations disponibles dans le groupe LinkedIn 3A "*Données et Décisions Economiques et Financières*", Centrale Méditerranée. L'adhésion à ce groupe dépend de l'admission dans l'option DDEFi.

Pour les élèves souhaitant approfondir leurs connaissances après l'obtention du diplôme d'Ingénieur généraliste de l'Ecole Centrale Méditerranée, une poursuite d'études est possible. Voici quelques

exemples de formations ayant accepté les élèves de l'option DDEFi par le passé :

- Mastères spécialisés [HEC](#), [ESSEC](#), [ESCP](#), [EM Lyon](#)
- Mastères spécialisés [ENSAE](#) (Actuariat, Finance de marché, Data Science)
- Mastère spécialisé [IFP School](#)
- Mastère spécialisé [Mines de Paris](#)
- [Master Mathématiques et applications](#) Université Paris Dauphine (Paris Sciences et Lettres) : MASEF, ISF, Actuariat
- Master [MFD](#) Ecole Nationale des Ponts et Chaussées et Université Gustave Eiffel
- Mastère spécialisé [Ecole Nationale des Ponts et Chaussées](#) M.S. Infrastructure Project Finance
- Master [M2MO](#) Université Paris Diderot
- Master [Probabilités et Finance](#) Sorbonne Université et Ecole Polytechnique
- Master [London School of Economics](#)
- MBA [Collège des Ingénieurs](#)

## Flux d'informations en statistiques, économie, finance et développement durable

### AMF

- [Tableau de bord des investisseurs particuliers actifs - n°15 - Juillet 2024](#) (2024/07/17 13:43)
- [L'AMF propose une méthodologie de calibration des seuils déterminant le régime de transparence applicables aux transactions sur obligations d'entreprise](#) (2024/07/16 12:11)

### BCE

- [July 2024 euro area bank lending survey](#) (2024/07/16 10:00)
- [Survey on the Access to Finance of Enterprises: moderate tightening in reported financing conditions](#) (2024/07/15 10:00)

### Parlement Européen

- Economie et Monnaie :
  - [Communiqué de presse - Accord sur la réforme de la gouvernance économique de l'UE](#) (2024/02/12 15:26)
  - [Communiqué de presse - Siège de l'Autorité de lutte contre le blanchiment: présentation des villes candidates](#) (2024/01/24 10:46)
- Budget :
  - [Press release - EU job seeker's aid worth €1.9 million for 390 dismissed workers in Denmark](#) (2024/04/08 18:00)
  - [Press release - EU job seeker's aid worth €3 million for 835 dismissed steel workers in Germany](#) (2024/04/08 17:57)
- Santé et Environnement :
  - [Communiqué de presse - Politique pharmaceutique de l'UE: les députés soutiennent une réforme globale](#) (2024/03/19 15:40)
  - [Communiqué de presse - Accord sur l'interdiction par l'UE des produits issus du travail forcé](#) (2024/03/05 12:21)

## Eurostat

- Economie et finance :
  - [European Statistical Monitor: July edition](#) de Eurostat (2024/07/17 11:00)
  - [Extra-EU exports supported 14.5% of EU jobs in 2022](#) de Eurostat (2024/07/16 11:00)

## ONU

- Développement économique :
  - [La Côte d'Ivoire, 10e pays africain à adhérer à la Convention sur l'eau](#) (2024/07/16 14:00)
  - [La vaccination des enfants dans le monde stagne, alerte l'ONU](#) (2024/07/15 14:00)
- Changement climatique :
  - [La Côte d'Ivoire, 10e pays africain à adhérer à la Convention sur l'eau](#) (2024/07/16 14:00)
  - [Légère baisse de la quantité de poussière dans l'atmosphère en 2023, selon l'OMM](#) (2024/07/12 14:00)

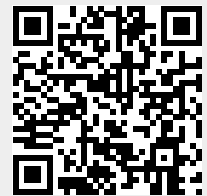
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### 3rd Year Track DDEFi

#### Data, Decisions in Economics and Finance

#### (Données, Décisions Economiques et Financières in French)

This page is also available in the following languages

- [French](#): mostly dedicated to Centrale Méditerranée degree-seeking students but some parts might also be useful to international exchange students.



### Graduate Program outlines

The graduate program is designed to offer a wide range of courses into several fields: Mathematical Finance, Insurance or Quantitative Management and Data Science related to the previous fields.

Technology and economy are more and more complex. Mathematics and their applications are at the heart of the decision tools needed in this world: they help to model, evaluate and control risks associated to industrial processes, economical phenomena or financial products. The knowledge of mathematical tools associated to a deep understanding of these phenomena is largely appreciated in many areas.

Depending on the student's status, the student can also attend a Master program in parallel with the track DDEFi :

- Master Aix-Marseille School of Economics (AMSE), track [Finance Quantitative et Assurance](#) (information contact at Centrale Méditerranée: Renaud Bourlès): only 2nd year course units.
- Master in Applied Mathematics and Statistics, track Data Science (information contact at Centrale Méditerranée: Christophe Pouet): only 2nd year course units.

### Goals

Prepare students to become highly skilled engineers able to recognize and model complex problems in order to develop adequate strategic decisions.

The main topics are finance, insurance, probability, statistics, scientific computing, optimization, mathematical modelling for risks in economy and finance, actuarial science, marketing, quantitative management.

### Important information for exchange students

**EXCHANGE STUDENTS: This section contains VERY IMPORTANT information to help you prepare your mobility.**

## Number of accepted students

The 3rd Year scientific tracks such as DDEFi have a limited number of accepted students. Priority is given to Centrale Méditerranée engineering degree students and Aix-Marseille University students. Nevertheless, the track DDEFi has always been able to accept exchange students (usually 3 or 4) and we will be very pleased to have you as an exchange student for one or two semesters depending on the requirements at your home university.

## Academic calendar

A new organization has been in place since academic year 2022-2023. Please carefully check the latest information here and inquire of your local coordinator if it fits your mobility window.

All course units offered in the track DDEFi are offered from early September to end of March/early April. Each course unit belong to one of the following semesters.

- Semester 9 (Fall-Winter): **Fall-Winter semester extends from early September to end of January/early February.** See below the programme structure to learn more about available courses.
- Semester 10 (Spring): **Spring semester for taught courses extends from end of January/early February to end of March/early April.** After early April, this is the internship period (work or research placement) which can be as long as 6 months. See below the programme structure to learn more about available courses.

Although each course unit belongs to a specific semester, some course units in Semester 9 (Fall-Winter) end only in March. Alternatively, some course units in Semester 10 (Spring) can start earlier than end of January, e.g. the course unit Actuarial Science belongs to Semester 10 (Spring) but starts in September and ends in March. Therefore it is very important for you to know your exact mobility window available at your home institution and to contact Centrale Méditerranée International Mobility Office or Prof. Christophe Pouet ( [christophe.pouet\[A-T\]centrale-med.fr](mailto:christophe.pouet@centrale-med.fr) with [A-T] replaced by @) for the track DDEFi if you need some advice.

If you can stay at Centrale Méditerranée from early September to early April, you will be able to validate 29 ECTS credits (including a 5 ECTS team project) with course units offered in the track DDEFi. Do not hesitate to contact Centrale Méditerranée International Mobility Office or Prof. Christophe Pouet to discuss your learning agreement in regard to the requirements of your home institution.

You can validate more ECTS credits if your home institution accepts to recognize other course units offered during Semester 9 and Semester 10 such as language courses, management courses, courses offered in one of the professional tracks.

## Language of instruction

If you intend to come for one year at Centrale Méditerranée, please note that depending on the

number of credits taken, your proficiency in French must be at least at intermediate level (level B1 or higher recommended).

**Please note that the instruction language is English for several course units in the track DDEFi.**

### **Number of credits for a full exchange year**

If you intend to come for one year, the Spring semester will certainly include a research or work placement (equivalent to a Master Thesis, 15 ECTS). Course units only worth 13 ECTS are offered at the beginning of the Spring semester to students who attend course units from DDEFi track.

**Please check the information below about credits.**

### **Availability of courses**

- Courses may be cancelled with very short notice (e.g. if not enough students sign up for the course), although that should happen very seldom in the 3rd year track DDEFi.
- Courses may be overbooked (too many students sign up) preventing you from taking the course. Priority is given to degree-seeking students.

### **Structure of the program**

The track DDEFi allows a student to validate 24 ECTS for courses and 5 ECTS for a team project. The number of ECTS credits thanks to DDEFi course units depends on your mobility period. In fact, the track DDEFi allows to validate

- S9 (Fall-Winter): 16 ECTS credits thanks to taught course units,
- S10 (Spring): 13 ECTS credits thanks to taught course units and the 5 ECTS team project which starts mid-September.

Please read CAREFULLY what is written below the table and do not hesitate to contact Centrale Méditerranée International Mobility Office or Prof. Christophe Pouet (cpouet[AT]centrale-marseille.fr with [AT] replaced by @) for the track DDEFi if you need some advice.

### **Academic Team**

Instructors are from Centrale Méditerranée, from other HEIs (such as Aix-Marseille Université or Kedge BS) or highly skilled practitioners from renowned companies including several Centrale Méditerranée alumni. Full list of instructors available in French [here](#)

### **List of course units**


**Warning! This programme is offered since academic year 2022-2023. There are minor differences in course contents but the main difference with previous academic years is**



**that taught course units are now worth 8 ECTS credits instead of 3 ECTS credits. This should ease the construction of your learning agreement.**

The DDEFi track offers 24 ECTS credits for the taught courses and 5 ECTS credits for the DDEFi project (team project with a private company).

The structure of the program DDEFi is the following

<b>Team Project (from mid-September to late March/early April)</b>						
English Name	French name	Code	ECTS	Semester	Contact hours	Coordinator
DDEFi project	<a href="#">Projet DDEFi</a>		5	S10 (Spring)	100h	R. Bourlès
<b>Period 1 (from early September to mid-November): Common core</b>						
English Name	French name	Code	Semester	ECTS	Contact hours	Coordinator
Models and Decisions	<a href="#">Modèles et décisions</a>		8	S9 (Fall-Winter)	100h	R. Bourlès
<b>Period 2 (from mid-November to late January/early February): Major (1 course unit to be chosen)</b>						
English Name	French name	Code	ECTS	Semester	Contact hours	Coordinator
Finance	<a href="#">Finance</a> 		8	S9 (Fall-Winter)	100h	R. Bourlès
Data and decisions	<a href="#">Données et décisions</a>		8	S9 (Fall-Winter)	100h	R. Bourlès
<b>Period 3 (from late January/early February to late March/early April): Specialised course unit (1 course unit to be chosen)</b>						
English Name	French name	Code	ECTS	Semester	Contact hours	Coordinator
Mathematical finance	<a href="#">Mathématiques financières</a>		8	S10 (Spring)	100h	
Corporate finance	<a href="#">Finance d'entreprise</a>		8	S10 (Spring)	100h	
Actuarial science	<a href="#">Actuariat</a>		8	S10 (Spring)	100h	
Data analysis	<a href="#">Analyse et données</a>		8	S10 (Spring)	100h	

If you attend the course unit Finance during Period 2, then you must choose between the course units Mathematical finance or Corporate finance. If you attend the course unit Data and decisions during Period 2, then you must choose between the course units Actuarial science or Data analysis.

If as an exchange student, you need more ECTS credits for your exchange semester than you can take in the track DDEFi, then you have to choose course units in the following offer (beware that most courses are in French)

- 3rd Year Common Core in Management: 3 ECTS during S9 (Fall-Winter), 1 ECTS during S10 (Spring)
- International cultures and foreign languages: 2 ECTS during S9 (Fall-Winter), 1 ECTS during S10 (Spring)

For example you can attend a course called French as a Foreign Language (the introduction week for international students has also an intensive French language course that can give ECTS credits, check with the International Mobility Office).

- Professional track: 9 ECTS during S9 (Fall-Winter)

The professional tracks that best complement the track DDEFi are Audit & Consulting (AUC), Entrepreneurship (ENT), Research & Development (R&D) and Production-Logistics (PRL).

**Alternative solution:** you can also attend courses in a Master programme or see if some joint courses between DDEFi track and Master programmes can be recognized as Master courses in your transcript of academic records.

**Please contact the DDEFi track deputy coordinator Prof. Christophe Pouet ([christophe.pouet\[A-T\]centrale-med.fr](mailto:christophe.pouet[A-T]centrale-med.fr) with [A-T] replaced by @) for more information.**

## Career prospects and postgraduate studies

DDEFi students are usually hired as interns or employees in the following areas:

- Banking, Finance: BP2S, BNP Paribas, Amundi,...
- Insurance, Actuarial Science: Axa, Crédit Agricole Assurances,...
- Audit, Consulting, Services: Mazars, E&Y, KPMG, Solucom,...
- Information Technology, Electronics, Telecommunication: Orange, CGI,...
- Luxury Industry: Chanel, Guerlain, L'Oréal,...
- Transportation: Renault, Airbus Helicopters,...

For a more complete list of companies, please check the webpage (in French) about [DDEFi internship](#).

After their graduation at Centrale Méditerranée, some students have successfully applied for one of the following graduate/postgraduate programmes:

- Mastères spécialisés [HEC](#), [ESSEC](#), [ESCP](#), [EM Lyon](#)
- Mastères spécialisés [ENSAE](#) (Actuariat, Finance de marché, Data Science)
- Mastère spécialisé [IFP School](#)
- Mastère spécialisé [Mines de Paris](#)
- [Master Mathématiques et applications](#) Université Paris Dauphine (Paris Sciences et Lettres) : MASEF, ISF, Actuariat
- Master [MFD](#) Ecole Nationale des Ponts et Chaussées et Université Gustave Eiffel
- Mastère spécialisé [Ecole Nationale des Ponts et Chaussées](#) M.S. Infrastructure Project Finance
- Master [M2MO](#) Université Paris Diderot
- Master [London School of Economics](#)
- MBA [Collège des Ingénieurs](#)

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# Projet DDEFi

- Titre en anglais : DDEFi project
- Code du cours : à venir
- Crédits ECTS : 5
- Période : de septembre à fin mars
- Responsable : Renaud Bourlès
- Tuteur(s) : professionnels, enseignants-chercheurs du corps professoral
- Evaluation : rapport, soutenance orale et évaluation du tuteur

## Description

Le projet DDEFi est un travail qui met les élèves en situation professionnelle dès le début de la 3A et qui les confronte à un problème complexe posé par une entreprise (PME, grand groupe, start-up), une association, une structure publique ou un chercheur. Il est proposé sous la forme d'un travail de groupe afin que les élèves puissent mettre en application les outils introduits dans les cours de gestion et de management dispensés dans le cursus ingénieur de Centrale Méditerranée.

Si vous êtes une entreprise ou une structure souhaitant proposer un sujet, vous pouvez contacter le responsable de l'UE, Renaud Bourlès, pour connaître les modalités de collaboration.

## Clients des projets

Les clients des projets sont des entreprises, des associations, des structures para-publiques, des laboratoires de recherche,...

L'option DDEFi remercie les entreprises qui confient régulièrement des projets aux élèves et contribuent ainsi à la formation des ingénieurs centraliens de Marseille : BNP-Paribas, BP2S, Axa, AOPS Conseil, E&Y, Marseille Innovation, Goji Markets, BonPlanCinema, InPact, Abel4Com, Happy Capital, [WeeFin](#).

## Exemples de projets

- Construction de pricers automatisés pour l'analyse du besoin en couverture pour une start-up financière
- Construction d'un indice de marché optimal (smart benchmark) limité aux entreprises dites "socialement responsables" pour un grand groupe financier
- Construction d'un outil d'analyse, de sélection, et de notation des entreprises pour une start-up financière
- Contribution au développement de la stratégie financière et commerciale d'une start-up
- Création d'un générateur de scénarii financiers et économiques pour un grand groupe financier
- Etude de l'impact du turnover sur les provisions des engagements sociaux (dans le cadre d'un contrat de recherche)
- Proposition de méthodes d'évaluation de stock-options (dans le cadre d'un contrat de recherche)
- Réalisation d'une étude de marché et d'un plan marketing pour une start-up
- Réalisation d'un outil de prévisions de trésorerie dans une activité de trading de matières

premières pour un grand groupe financier

- Réalisation d'un "benchmarking" de la gestion privée pour une start-up financière
- Validation de modèles d'inflation pour un grand groupe financier
- ...

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# Course unit: Models and Decisions

**Beware! Under construction.**

## Course metadata

- Title in French: Modèles et Décisions
- Course code: tba
- ECTS credits: 8
- Type: ground course
- Teaching hours: 100h
- Period: September to mid-November
- Language of instruction: English and French
- Coordinator: tba
- Instructor(s): Mitra Fouladirad, Christophe Pouet, Clément Depoutre (BNP Paribas), Gaël Leboeuf (Aix-Marseille Université)
- *Last update 04/07/2022 by C. Pouet*

## Brief description

This course unit is divided into four parts:

- **Risk and decision** (24 hours) taught by Clément Depoutre
- **Statistics and decisions** (24 hours) taught by Mitra Fouladirad and Christophe Pouet
- **Corporate finance** (24 hours) taught by Gaël Leboeuf
- **Data project: business issues understanding** (20 hours) taught by tba

## Learning outcomes

- Understand how to take decision under uncertainty
- Learn how to assess risk and how to compare risky situations
- Learn how to model, estimate and predict time series
- Understand how capital structure affects the value of the firm

## Course content

### Risk and decision

1. Introduction: diversification and mutualization
2. Risk measure
3. Expected utility
4. Supply and demand: the price of risk
5. The value of information
6. Market & Counterparty Risk Management

## Statistics and decisions

1. Reminder on probability: conditional expectation
2. Stochastic processes in discrete and continuous time
3. ARMA process: definition, existence, characteristics (autocovariance, partial autocovariance)
4. Estimation of ARMA processes: identification, parameters estimation and validation
5. Extensions: SARIMA, ARCH and GARCH processes

## Corporate finance

1. The Corporation
2. Introduction to Financial Statements Analysis
3. Financial Decision Making and the Law of One Price
4. The Time Value of Money
5. Investment Decision Rules
6. Fundamentals of Capital Budgeting
7. Capital Markets and The Pricing of Risk
8. Optimal Portfolio Choice and the Capital Asset Pricing Model
9. Estimating the Cost of Capital
10. Capital Structure in a Perfect Market
11. Mergers and Acquisitions

## Data Project: business issues understanding

tba

## Bibliography

You can check the availability of the books below at [Centrale Méditerranée library](#).

1. Risk and decision
  - [course ebook](#)
  - Gollier, C., Schlesinger, H. and Eeckhoudt, L. (2005). Economic and Financial Decisions Under Risk. Princeton University Press
2. Statistics and decisions
  - course handout
  - Brockwell, P.J. and Davis, R.A. (1991). Time Series: Theory and Methods. Second Edition. New York: Springer Verlag.
  - Box, J.E.P. and Jenkins, G.M. (1970). Time Series Analysis; Forecasting and Control. San Francisco: Holden Day.
3. Corporate finance
  - Berk, J. and DeMarzo, P. (2019) Corporate finance. Prentice Hall; 5th edition.
  - [Aswath Damodaran at NYU](#): Course and video materials, formulas, spreadsheets, estimated risk premium, Cost of capital by sector and more.
  - [The Vernimmen handbook homepage](#): Course and video materials, formulas, spreadsheets, corrected exercises and case studies, newsletter, financial data on 7,000 listed companies and more.

- [AMF](#). Annual reports and legal informations on French listed companies.
- [Yahoo! Finance](#). Financial data on listed companies.

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# Course unit: Data and Decisions

## Course metadata

- Title in French: Données et Décisions
- Course code: tba
- ECTS credits: 8
- Type: advanced course
- Semester 9 (Fall-Winter)
- Teaching period: Mid-November to Mid-February
- Teaching hours: 100h
- Language of instruction: French
- Coordinator: tba
- Instructor(s): François Brucker, Michaël Chalamel (L'Oréal), Franck Chevalier (EY), Emmanuel Daucé, Christophe Pouet
- *Last update 04/07/2022 by C. Pouet*

## Brief description

This course unit is divided into four parts:

- **Statistical learning** (24 hours) taught by Christophe Pouet.
- **Python for data science** (24 hours) taught by François Brucker and Emmanuel Daucé.
- **Advising using data** (24 hours) taught by Michaël Chalamel and Franck Chevalier.
- **Data Project: data sources and preprocessing** (24 hours) taught by tba.

## Learning outcomes

- Know how to model and program an estimation problem
- Know how to model and program a classification problem
- Know how to acquire and aggregate data
- Know how to use data to take decisions
- Understand the importance of data governance and data quality

## Course content

### Statistical learning

1. Introduction
  1. Classical problems: regression, classification
  2. Supervised, unsupervised and semi-supervised learning
  3. Curse of dimensionality
2. Regression
  1. Multiple linear regression, OLS method
  2. Shrinkage-type methods (LASSO, Ridge)
  3. k-nearest neighbors



### 3. Classification

1. Logistic regression
2. k-nearest neighbors
3. SVM
4. Rosenblatt perceptron and neuronal networks

## Python for data science

1. Dataframe: data exploration and data description
2. Spotting patterns using factor
  1. Principal Component Analysis
  2. Correspondence analysis
3. Prediction using trend analysis
  1. Linear regression
  2. Logistic regression
4. Data classification
  1. Classification using partitions
  2. Hierarchical methods

## Data-driven decision making

1. What is data?
2. How do we take decision?
3. Data governance and data quality
4. How to develop data-based decision making?
5. Data platform and data architecture

## Data Project: data sources and preprocessing

tba

## Bibliography

You can check the availability of the books below at [Centrale Méditerranée library](#).

1. Statistical Learning
  - James G., Witten D., Hastie T. and al. (2013). An introduction to statistical learning: with applications in R. New York: Springer
  - Hastie T., Tibshirani R. and Friedman J. (2013). The elements of statistical learning: data mining, inference, and prediction. New York: Springer.
  - Cornillon P-A., Matzner-Løber E. et al. (2010). Régression avec R. Paris: Springer.
2. Python for data science
  - Jannach, D., Zanker, M., Felfernig, A. and Friedrich, G. (2010). Recommender Systems: An Introduction. Cambridge.
3. Advising using data
  - tba

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# Course unit: Finance

**Beware! Under construction.**

## Course metadata

- Title in French: Finance
- Course code: tba
- ECTS credits: 8
- Type: advanced course
- Semester 9 (Fall-Winter)
- Teaching period: Mid-November to Mid-February
- Teaching hours: 100h
- Language of instruction: English
- Coordinator: tba
- Instructor(s): Grégoire Hug (WeeFin), Réda Rahal (BNP Paribas), Julien Belon (Arx Corporate Finance), Vincent Bonnamy (La Banque Postal Asset Management)
- *Last update 04/07/2022 by C. Pouet*

## Brief description

This course is taught by highly skilled professionals in finance. Some of them are Centrale Méditerranée alumni.

This course unit is divided into four parts:

- **Portfolio management** (24 hours) taught by Grégoire Hug.
- **Financial risk management** (24 hours) taught by Réda Rahal: this part is dedicated to credit risk and its role in banking regulation.
- **Applied finance** (24 hours) taught by Julien Belon and Vincent Bonnamy: this part is about the theoretical aspects of corporate and market finance applied in real life.
- **Data Project: data sources and preprocessing** (20 hours) taught by tba.

## Learning outcomes

- Understand the similarities in the concepts of market and corporate finance
- Understand how finance products can be used to manage risk
- Know how to organize an investment process
- Know how to evaluate and to value a company
- Understand the definition, measurement and pricing of credit risk
- Know how banks are regulated
- Know the various jobs of finance

## Course content

## Portfolio management

1. Introduction to portfolio management
2. Equity Investing and investment process
3. Fixed Income Investing - basics
4. Fixed Income Investing - advanced
5. Alternative asset classes and Performance Measurement
6. Asset management trends
7. Project: Portfolio construction

## Financial risk management

1. Introduction: bonds and OTC transactions
2. Modeling defaults: structural models and ratings
3. Structured financing: plain-vanilla, asset financing, securitization etc.
4. Banking regulation on credit risk

## Applied finance

1. Applied corporate finance – From startup to IPO... and LBO
  - Introduction / Presentation
  - Application areas of
  - Accounting Basic Methods
  - Valuation methods
  - We know how to value a company. Now what? Different types of operation
  - Introduction to Fintech and start-up ecosystem
2. Applied market finance – Options: Pricing, Hedging & Risk Management
  - Market finance: players and products
  - Future and forward: pricing & hedging
  - Options: replication and pricing
  - Sensitivity of options: the greeks
  - Volatility and stress tests

## Data Project: data sources and preprocessing

Tba

## Bibliography

You can check the availability of the books below at [Centrale Méditerranée library](#).

1. Portfolio management
  - Roland Portait, Patrice Poncet (2014). Market Finance.
  - Franck J. Fabozzi (2012). The Handbook of Fixed Income Securities.
2. Financial risk management
  - Gourieroux C. and Tiomo, A. (2007) Risque de crédit : une approche avancée, Economica.

- Merton R. (1998) Continuous time finance, Blackwell Publishers.
- Bruyere R., Cont R., Fery L., Jaeck C. and Spitz T. (2005). Credit derivatives, Wiley.
- Roncalli T. (2016). Risk Management & Financial Regulation ([website](#))

### 3. Applied finance

- Vernimmen, P. (2021). Finance d'entreprise. Dalloz.
- Hull, J. (2018). Options, Futures, and Other Derivatives, 10th Edition. Pearson

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# Course unit: Data and analytics

**Beware! Under construction.**

## Course metadata

- Title in French: Analyses et données
- Course code: tba
- Type: specialized course
- ECTS credits: 8
- Semester 10 (Spring)
- Teaching period: Mid-February to Mid-April
- Teaching hours: 100h
- Language of instruction: French
- Coordinator: tba
- Instructor(s): Augustin Amann (S4M), Vincent Archer (S4M), Aurélien Poissonier (DGAFP), Régis Chenavaz (Kedge BS), Antoine Winckels (Air France)
- *Last update 04/07/2022 by C. Pouet*

## Brief description

This course unit is divided into four parts:

- **Quantitative marketing** (24 hours) taught by Augustin Amann and Vincent Archer,
- **Data and macroeconomics** (24 hours) taught by Aurélien Poissonier,
- **Yield management** (24 hours) taught by Régis Chenavaz and Antoine Winckels,
- **Data Project: modeling and validation** (20 hours) taught by tba.

## Learning outcomes

- Know how to use data in a strategic approach
- Know how to present a model, its results and its insights
- Know how to assess data suitability to a specific issue
- Know how to model intertemporal strategic decisions
- Know how to combine model and data to take pricing decisions

## Course content

### Quantitative marketing

1. Data processing
  - Data: a story of representation
  - Data in business
  - From segmentation to dynamic targeting
2. Marketing from a Data Scientist point of view

- Context: the data world
- Scoring
- Statistics
- Correlations
- Automatic learning
- Supervised classification
- Perspectives

## Data and macroeconomics

This course aims at giving a broad view of macroeconomic data. It is structured around three questions:

1. Can we measure everything?
2. Can we sum everything?
3. Can we compare everything?

These questions will allow to tackle multiple sources for macroeconomic data, their methodology, their limits, and to discuss their common applications. At the end of the course, students should have acquired enough hindsight to use pertinent macroeconomic data to answer a practical question.

## Yield management

1. Dynamic pricing
  - Modeling firm's intertemporal price-setting decisions
  - The price-quality relationship
  - Modeling project: managerial decision in an intertemporal framework.
2. Application to yield management in air transport
  - Single leg resource management
  - Network resource management
  - Demand forecasting

## Data Project: modeling and validation

tba

## Bibliography

You can check the availability of the books below at [Centrale Méditerranée library](#).

1. Quantitative marketing
  - Abiteboul, S., « Sciences des données : de la logique du premier ordre à la Toile », Leçon inaugurale du Collège de France : [site de Serge Abiteboul au Collège de France](#) (vidéo et documents de la leçon inaugurale)
2. Data and macroeconomics
  - [INSEE](#)
  - [Eurostat](#)

- [Datagora](#)

### 3. Yield management

- Sorger, G. Reference price formation and optimal marketing strategies, In Optimal Control Theory and Economic Analysis 3, G. Feichtinger (editor), Elsevier Science Publishers (North-Holland, 1988).
- Talluri, K. T., Van Ryzin, G. J., The Theory and Practice of Revenue Management, Springer 2004.
- Belobaba, Peter. 16.75J Airline Management, Spring 2006. MIT OpenCourseWare.
- Frumin, Michael, and Moshe Ben-Akiva. 1.201J Transportation Systems Analysis: Demand and Economics, Fall 2008. MIT OpenCourseWare.

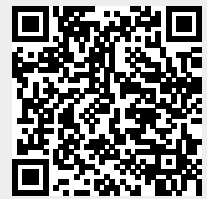
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# Course unit: Mathematical finance

**Beware! Under construction.**

## Course metadata

- Title in French: Mathématiques financières
- Course code: tba
- ECTS credits: 8
- Type: specialized course
- Semester 10 (Spring)
- Teaching period: Mid-February to Mid-April
- Teaching hours: 100h
- Language of instruction: English
- Coordinator: tba
- Instructor(s): Sébastien Darses (AMU), Ismaïl Akil (Bank of America Merrill Lynch), Abderrahim Ben Jazia (RSM Paris)
- *Last update 04/07/2022 by C. Pouet*

## Brief description

The aim of the course is to provide students with mathematical methods that allow valuating financial assets. Several instructors are Centrale Méditerranée alumni.

This course unit is divided into four parts:

- **Stochastic calculus and introduction to the Black-Scholes model** (24 hours) taught by Sébastien Darses.
- **Volatility models** (24 hours) taught by Ismaïl Akil.
- **Interest rate models** (24 hours) taught by Abderrahim Ben Jazia.
- **Data Project: modeling and validation** (20 hours) taught by tba.

## Learning outcomes

- Understand stochastic calculus and know how to apply its main results
- Know how to apply stochastic methods to price financial products
- Understand the mathematical contexts under which the classical financial mathematics models hold
- Know and understand the relevance and limits of financial mathematics models
- Understand the impact of volatility on the profit and losses of a hedged position
- Know how to build numerical methods for pricing financial products

## Course content

## Stochastic calculus and introduction to the Black-Scholes model

1. Gaussian variable and stochastic processes
2. Brownian motions
3. Stochastic integration and semi-martingales
4. Stochastic differential equations
5. Parabolic partial differential equations and semigroups
6. Measure change and Girsanov theorem
7. Introduction to financial mathematics

## Volatility models

1. Elementary financial mathematics notions
2. PDE: Black Scholes and risk neutral measure
3. Dupire's local volatility: advantages and drawbacks
4. Stochastic volatility (Heston and SABR)
5. Tutorial: discretization of the Heston's model

## Interest rate models

1. A Mathematical Toolkit
2. Interest rates, swaps and options
3. One-factor Short-Rates Models
4. Two-factor Short-Rates Models
5. The Heath-Jarrow-Morton (HJM) Model
6. The change of numeraire
7. Derivatives Pricing under the Libor Market Model

## Data Project: modeling and validation

tba

## Bibliography

You can check the availability of the books below at [Centrale Méditerranée library](#). - Stochastic calculus

- Evans, L. (2010). An Introduction to Stochastic Differential Equation. American Mathematical Society.
- Le Gall, J.-F. (2006). Intégration, Probabilités et Processus Aléatoires. Ecole Normale Supérieure de Paris

- Volatility models

- El Karoui, N. (2004) Couverture des risques dans les marchés financiers. Ecole Polytechnique

- Interest rate models

- Brigo, D., & Mercurio, F. (2007). Interest rate models-theory and practice: with smile, inflation and credit. Springer Science & Business Media
- Privault, N. (2012). An elementary introduction to stochastic interest rate modeling. World Scientific.

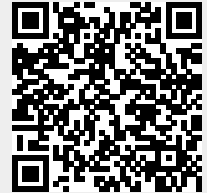
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# Course unit: Actuarial science

**Beware! Under construction.**

## Course metadata

- Title in French: Actuariat
- Course code: tba
- Type: specialized course
- ECTS credits: 8
- Semester 10 (Spring)
- Teaching period: Mid-February to Mid-April
- Teaching hours: 100h
- Language of instruction: English
- Coordinator: Renaud Bourlès
- Instructor(s): Mitra Fouladirad, Violaine Conti (AXA), Alban Davand (AXA), Rim Ennajar-Sayadi (AXA), Xavier Guerrault (AXA), Emmanuelle Mimart (AXA), Sofiane Ournidi (AXA), Thérèse Winterholer (AXA)
- *Last update 04/07/2022 by C. Pouet*

## Course description

The aim of the course is to present the main issues related to pricing of insurance products as well as the recent developments in actuarial sciences related to prudential regulation, disability insurance or long-term care.

Most of the instructors are from the French insurance company [Axa](#). Axa group is the 6th largest insurance company according to Forbes ranking 2021. See full ranking [here](#).

The course is divided into three parts:

- **Insurance economics** (24 hours) taught by tba,
- **Actuarial science 1** (24 hours) taught by tba,
- **Actuarial science 2** (24 hours) taught by tba,
- **Data Project: modeling and validation** (20 hours) taught by tba.

## Learning outcomes

- How to price simple life insurance products
- Understand the accounting specificities of insurance companies
- Know the current issues and the current regulations of the insurance market.

## Course content

## Insurance economics

### Actuarial science 1

1. Introduction to actuarial science
  - The model of life insurance
  - Non-life insurance specificities
2. Non-life insurance products
  - Characteristics of Non life insurance
  - Mechanisms of Non life Insurance
  - Technical Indicators
  - Pricing
  - Reserving

### Actuarial science 2

1. Life insurance products
  - Technical and financial margins
  - Fair Value and warranty hedging in life insurance
2. Insurance regulation
  - Valuing an insurance portfolio and its profitability
  - Solvency II : modèle interne, SCR computation, BEL,...
3. Asset-Liability Management in insurance
4. Duration models and experience tables
5. Long-term care risk
6. Reinsurance
7. Accounting standards

### Data Project: modeling and validation

tba

### Bibliography

- Tosetti A., Weiss F. et Poncelin T., Les outils de l'actuariat vie, Economica
- Charpentier A. et Dutang C., L'Actuariat avec R

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# Course unit: Corporate Finance

**Beware! Under construction.**

## Course metadata

- Title in French: Finance d'entreprise
- Course code: tba
- Type: specialized course
- ECTS credits: 8
- Semester 10 (Spring)
- Teaching period: Mid-February to Mid-April
- Teaching hours: 100h
- Language of instruction: English and French
- Coordinator: tba
- Instructor(s): Amaury Schoenauer (Caisse d'Épargne CEPAC), Mehdi El Alaoui (International Finance Corporation), Benoît Forgues (Rgreen), Olivier Vandooren (Sigée Finance), Julien Belon (Arx Corporate Finance), Hugues Chabaliér (2CFinance),

Mathieu Rebbi (EY)

- *Last update 04/07/2022 by C. Pouet*

## Brief description

This course unit is divided into four parts:

- **Structured finance** (24 hours) taught by Amaury Schoenauer,
- **Project finance** (24 hours) taught by Mehdi El Alaoui, Benoît Forgues and Olivier Vandooren,
- **Workshop in corporate finance** (24 hours) taught by Julien Belon, Hugues Chabaliér and Mathieu Rebbi,
- **Data Project: modeling and validation** (20 hours) taught by tba.

## Learning outcomes

- Know how to build a financial model and challenge its assumptions
- Understand how bankers can manage risks using structured finance
- Know the advantages and drawbacks of structured operations
- Understand how these operations can allow for financing large industrial projects
- Know the advantage and drawbacks of PPPs
- Understanding the specificities of start-up financing and advising

## Course content

## Structured finance

1. Main market players and rationale for using structured finance
2. Promoters Credits
  - Understanding the Promoter's logic
  - Understanding Credit Risk
  - Assessing the risks for the banker
3. Investor Credit
  - Conceptualization
  - Leverage and Loan to Value (LTV)
  - Debt Service Cover Ratio (DSCR) and Interest Cover Ratio (ICR)
  - Slicing of Debt
4. Due diligence and points of vigilance of the banker
  - Leases and Rental Conditions
  - Valuation Report
5. Other operations
6. Perspectives on Market Finance (Securitization)

## Project finance

1. The main steps of project finance
  - Tender
  - Structuring
  - Optimization
2. Financial modelling
  - The issue of circularity
  - Internal rate of return and gearing ratio
  - Case study
3. The case of renewable energy projects
  - Prices and costs of renewables
  - Bank versus funds
  - How to set the price of a project?

## Workshop in corporate finance

1. Financial modelling using Excel
2. The specificities of Transaction Services Advisory
3. Advising start-ups (on their business model and in making them viable)
4. Projects with real start-ups

## Data Project: modeling and validation

tba

## Bibliography

You can check the availability of the books below at [Centrale Méditerranée library](#).

1. Structured finance
  - Vernimmen, P. (2021). Finance d'entreprise. Dalloz.
2. Project finance
  - tba
3. Workshop in corporate finance
  - tba

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