Course Descriptions Risk Management

Conversion courses

Advanced Computational Boot Camp

Credits: 1 ECTS

Course Objectives:
The aim of this course is to obtain an advanced knowledge of Excel, so that the assignments in the Duisenberg programme pose no technical difficulties. Apart from that, we know that Excel is used in every company, especially in financial firms, so that having advanced knowledge is a plus for any job qualification. The course covers Excel basics and worksheet functions, manipulating text, counting and summing techniques, lock-up functions, goal seek/solver, array formulas, conditional formatting and data validation, debugging formulas, macros, and VBA.

Learning outcomes:
At the end of the course, students are able to

- Do a regression analysis in Excel and report the outcomes in Word with the appropriate formatting;
- Transform large datasets into a usable format for analysis;
- Perform a portfolio analysis in Excel for a given time-series of return data;
- Create macros to perform a rolling portfolio analysis and Monte-Carlo simulation.

Statistics and Econometrics Refresher

Credits: 1 ECTS

Course Objectives:
This refresher course provides a condensed review of the basic statistics, probability, and econometrics entry level knowledge of the risk management course. The refresher deals with the basic notions of probability, distributions (normal, t, chi-squared, gamma, F), multivariate distributions including some matrix algebra, probability limits, central limit theorem, consistency, asymptotic normality, linear and non-linear regression model, maximum likelihood, linear time series, stationarity.

Learning Outcomes:
At the end of this course students are able to:

- Understand and work with the necessary tools in statistics, probability and econometrics at the level needed for the core course work in the Risk Management track and Corporate Finance and Banking track.

Programming

Credits: 1 ECTS

Course Objectives:
The aim of this course is to obtain a working knowledge of MATLAB, so that the assignments in the Duisenberg school of finance programmes pose no technical difficulties. MATLAB is a high-level programming language that can be used for data visualization, data analysis, numerical computations and algorithm development. Apart from that, it is widely used at quantitative finance and risk management positions in the financial industry, so having the foundations for developing advanced knowledge of it is a plus in any job qualification in this area.

Learning Outcomes:
At the end of this course students should be able to:

- Become familiar with the syntax of MATLAB and its interactive computing environment;
- Master array and matrix operations in MATLAB, as well as basic mathematical functions and operators;
- Create custom programs that allow for data analysis and numerical computations, and learn the basics of efficient programming;
- Understand and be able to implement numerical optimization routines in MATLAB (unconstrained optimization, linear programming, quadratic programming, nonlinear multivariate constrained optimization);
- Perform Monte Carlo simulations in MATLAB; understand and be able to implement variance reduction techniques.
- Understand and implement finite difference methods for partial differential equations.

Block I

Core Courses

Applied Risk Management (Block I, Block II, Block III and Block IV

Credits: 2 ECTS

Course Objectives:
In Applied Risk Management, students work in teams on real-life cases in the field of risk management. The cases are designed in collaboration with partners from the financial industry and help students to understand how the techniques used in the main courses are actually applied in a day-to-day risk management context inside organisations. The contents of the cases keep pace with the core coursework completed by the students earlier in their programme.

Learning Outcomes:
At the end of this course students are able to:
- Establish the link between their theoretical core coursework and actual risk management practice;
- Translate their theoretical knowledge into useful solution methods for concrete risk management problems;
- Understand the key issues in risk management problems;
- Implement risk management techniques at short notice;
- Investigate the robustness of their results to the assumptions made during the solution stage;
- Summarise their research findings and present and defend these in a clear and effective way to their peers.

Measure Theory & Stochastic Processes (Block I and Block II)

Credits: 7 ECTS

Course Objectives:
Continuous time stochastic processes are the corner stone of contemporary mathematical finance. The methods and concepts are used extensively for derivatives pricing and hedging decisions. The course starts with the fundamentals of measure theory as the basis for stochastic process calculus. Concepts that are covered include measures and measurability, sigma algebras, Lebesgue integration, conditional expectations, filtrations. The course proceeds with an in-depth coverage of stochastic processes, stochastic differential equations and stochastic integration. Both continuous sample path processes and jump processes are covered. The course also establishes the link between stochastic processes and dynamic optimisation problems in continuous time.

Learning Outcomes:
At the end of this course students are able to:
- Understand the basic concepts of measure theory;
- Understand stochastic processes with continuous sample paths;
- Understand jump processes and Levy processes;
- Understand and work with the concepts of stochastic integration, stochastic differential equations, and changes of measure;
- Set up a continuous time stochastic optimisation problem.

Financial Econometrics

Credits: 3.5 ECTS

Course Objectives:
This course aims to provide an introduction to modern econometric and time series techniques that are relevant for the analysis of financial data. It not only cover the necessary econometric theory, but also teaches the students how to apply the models and techniques to empirically relevant financial decision-making problems in portfolio management, asset allocation, and risk management.
In the first part of the course, we focus on modeling and forecasting the conditional mean of asset returns. We discuss relevant issues in "backtesting" of forecasting models, including recursive estimation, variable selection, selection among (and combination of) competing forecasting models, and the evaluation of forecasts. We cover regression models for describing returns on a single asset, as well as factor models for describing (the relations between) returns on multiple assets.
In the second part of the course, we discuss GARCH models for asset return volatility, from both a theoretical and empirical perspective. In addition to univariate models, we also consider multivariate models that describe the correlation among different asset returns. The use of high-frequency data to measure and forecast volatility and correlation is discussed as well.

Learning Outcomes:
At the end of this course students are able to:
- Understand (univariate and multivariate) econometric models for modeling and forecasting asset returns and volatility;

- Implement these models using standard packages or self developed code;
- Assess the quality of return and volatility forecasts, in particular in the context of risk management;
- Maintain a critical attitude towards the limitations of models used for modeling and forecasting returns and volatility.

Financial Accounting

Credits: 3.5 ECTS

Course Objectives:
Financial statements are relevant to the decisions of many individuals including investors, creditors, consultants, managers, auditors, directors, analysts, regulators and employees. This course is a rigorous introduction to financial accounting designed for business students with no prior knowledge of the subject. A key purpose of this course is to deal with the measurement of value (and value creation from the point of view of outside decision-makers) and the use of financial accounting information.

We adopt a user perspective, rather than a preparatory one, because most Master's students will become users of financial statements, internal (managers, executives) or external (investors, analysts etc.), rather than preparers of financial statements. However, in order to become users, students must also understand how the financial statements are constructed.

Learning Outcomes:
At the end of this course, the student will be able to **read** financial statements, make a **judgement** about the quality of the accounting processes adopted, and then **assess** the financial performance of a firm in comparison with its competitors. The student will also be able to **understand**, **analyse** and **evaluate** a range of accounting and finance issues relating to the analysis of financial statements and **appreciate** the sources of data that may be useful in analysing the position, performance and future business prospects of firms. Also, the student will have knowledge of several advanced topics such as (detecting) earnings management, consolidation and accounting for pensions.

Electives

Corporate Valuation

Credits: 3.5 ECTS

Course Objectives:
This course will cover modern principles and tools of valuation. It creates a strong foundation for the discounted cash flow model by analysing all features and assumptions implicit in any valuation analysis, starting from the term structure of interest rates, estimating discount rates, measuring cash flows, calculating growth rates. The course then moves on to value enhancement tools and techniques such as EVA and CFROI. It covers relative valuation techniques such as equity and firm value multiples, and the valuation consequences of cash, cross-holdings and stock options. The course seeks to ensure a full understanding of the explicit and implicit assumptions underlying modern valuation models.

Learning Outcomes:
At the end of the course students will have an understanding of:
- Conducting a corporate valuation using different valuation models, especially the DCF model;
- Inputs of valuation models, such as estimating cash flows, discount rates, and growth rates;
- The biases in valuation models;
- The implicit and explicit assumptions of valuation models;
- Relative valuation models and value enhancement tools.

Investments

Credits: 3.5 ECTS

Course Objectives:
The objective of this course is two-fold. First, to introduce students to the most commonly used quantitative tools and fundamental financial concepts: optimal portfolio selection,the relationship between risk and return, and market efficiency. Second, to introduce students to important classes of financial assets and investment vehicles: fixed income, public equity, and mutual funds. This course is internationally-oriented in that we consider and compare different financial markets (US, European, etc.) and adopt a global market perspective on several topics. The course is intended to provide you with both a lasting conceptual framework and, through the incorporation of

real-world data, a greater understanding of how real-life situations play out. Finally, in an effort to link theory to practice, most exercises assigned at the end of each session come from past CFA (Chartered Financial Analyst) exams.

Learning Outcomes:
At the end of this course students are able to:
Define the main concepts and use the tools of modern portfolio investment theory in:
- Optimal portfolio selection
- Capital asset pricing theory
- Performance evaluation
- Term structure of interest rates and fixed income portfolio management.

Math II: Dynamic optimisation

Credits: 3.5 ECTS

Course Objectives:
This course introduces the various concepts needed for mathematical optimization. Mathematical optimization is ubiquitous in economics and finance. The course starts with the fundamentals of unconstrained nonlinear optimization based on the theorems of Fermat and Weierstrass. Then, the problem is extended to constrained nonlinear optimization using the theorems of Langrange, Karush-Kuhn-Tucker and Fritz John. Dynamic optimization is covered using the calculus of variations (Euler's equations, transversality conditions, Euler-Lagrange equations) and optimal control (Pontryagin's maximum principle, and the Bellman equation for deterministic and stochastic optimal control problems). The last two weeks of the course introduce the students to programming using the matrix programming language Matlab.

Learning Outcomes:
At the end of this course students are able to:
- Understand and apply the techniques for static and dynamic optimization, both in their constrained and unconstrained version;
- Understand and exploit the link between optimization and economic and financial decision problems.
- Implement economic and financial optimization problems and solve them numerically using a programming language.

Block II

Core Courses

Derivatives

Credits: 3.5 ECTS

Course Objectives:
This course gives an introduction to derivative contracts. These contracts play an important role in today`s financial markets. Derivative contracts are traded on a large number of underlyings, such as equities, commodities, exchange rates, interest rates and credits and students should understand how these instruments can be used to hedge risks, speculate, transform payments streams from fixed to floating and vice versa etc.. Students should understand the differences between Exchange Traded and Over the Counter contracts and their differences in risk characteristics.
A main theme of the course is the pricing principle based on no arbitrage, where it is explained that the principle is very strong and does not depend on strong assumptions as compared to the assumptions used in asset pricing theory. Students should also learn how the models can be implemented and how traders are running their books and especially are able to reduce risks. Next there will be a focus on deviations from theoretical models that we see in day-to-day practice. Finally it is shown that more exotic derivatives are priced based on the same principles.

Learning Outcomes:
At the end of this course students are able to:
- Understand the main forms of derivative contracts;
- Understand the main pricing methodology of derivative contracts;
- Understand the no arbitrage principle;
- To choose appropriate derivative contracts as hedging instruments;
- Understand the way traders are running their books including hedging
- Implement a binomial tree model;
- Maintain a critical attitude towards the limitations of the standard models.

Asset Pricing

Credits: 3.5 ECTS

Course Objectives:
Financial markets assign values to various types of assets,

such as stocks, bonds, derivatives, etc. This course focuses on the underlying concepts and principles that allow us to understand why certain values arise. In particular, the course discusses the value of future and uncertain cash flows. The financial literature has developed several asset pricing techniques. In this respect, the course aims at bridging all of them. In particular, this concerns the beta-pricing method mainly used in corporate finance, the stochastic discount factor method, and the risk-neutral valuation method. The course will explain how these methods work, why they are formally equivalent, and when to use which one.

After the pricing basics have been discussed, the course will consider the implications for the variability of asset prices ('risk') and how the fundamental risk-return trade-off affects investment decisions. In particular, we will discuss the Martingale method. To close the circle, we use the optimal investment decisions of individual agents in an equilibrium framework to understand equilibrium market prices. Throughout, the theory will be illustrated mainly on stock and fixed-income markets, with occasional side-trips to derivative markets.

Learning Outcomes:
At the end of this course students are able to:
- Understand and use probability modelling for describing uncertainty in financial markets;
- Understand the relation between beta-pricing, SDF pricing, and risk-neutral valuation;
- Understand the basic assumptions, and limitations, underlying the formalisations;
- Implement the techniques in investment decision problems;
- Relate the mathematical concepts (measure, filtration, change-of-measure, Martingale, etc.) to their economic counterparts (value, information, state-of-the-world, risk, etc.);
- Assess the quality and consistency of asset pricing and risk models.

Electives

Financial Crises

Credits: 3.5 ECTS

Course Objectives:
This course provides an overview of the subprime crisis: how a relatively small problem in the US mortgage market triggered a worldwide financial meltdown and a protracted recession. The course then zooms out to factors behind the fragility of the international banking system, the theory of banking crises and directions on how to resolve them, required regulatory reforms, and the relation between macrofactors, financial crises, and growth.

Learning Outcomes:
At the end of this course students are able to:
- Understand the origins of financial crises;
- Understand the pros and cons of the various mechanisms that have used in the past to mitigate the effect of crises;
- Analyze the fragilities in the current financial system.

Block III

Core Courses

Enterprise Wide Risk Sources

Credits: 3.5 ECTS

Course Objectives:
The course provides an overview of the most important risk sources within banks and pension funds. By taking an enterprise wide perspective, the course presents a comprehensive view of how the various risk sources should best be monitored and managed. The first part of the course consists of four classes on banking.
The second part of the course deals with pension funds. The focus of this course is on practical knowledge and applicability. We discuss, amongst others, market risk, interest rate risk, liquidity risk, operational risk, and off balance sheet risk. We assess why management of these risks is critical in banks. We show how each of them may be monitored and mitigated. In practice these risks oftentimes materialize simultaneously, which greatly exacerbates the overall risk. Therefore, we give special care to how these risks aggregate and to how an appropriate comprehensive risk management framework may be organized.
A large number of mishaps are examined, which illustrate some of the things that go wrong in practice. Amongst others we review Enron, LTCM, Barings, Herstatt, Metallgesellschaft, the US S&L crisis, Orange County, Bear Stearns, and Lehman Brothers. Part of the course consists of an assignment, which is a real-life risk management case.
The second part of the course deals with pension funds. We discuss Asset and Liability Management (ALM) for financial

institutions, in particular pension funds. The techniques for ALM are covered, including the scenario approach. We highlight the difference between pure asset management and ALM from the pension fund perspective. We also look at the effect of pension fund regulation and pension system stability.

Learning Outcomes:
At the end of this course students are able to:
- Identify the different sources of risk;
- Understand how to develop a comprehensive risk management framework;
- Know some of the main risk management requirements set by the regulators;
- Understand when conventional risk management techniques do not suffice;
- Understand the ALM perspective of financial institutions;
- Understand and implement the models and techniques for scenario analysis in ALM;
- Apply their knowledge to a practical risk management case.

Fixed Income

Credits: 3.5 ECTS

Course Objectives:
This course gives an introduction to interest rate modeling in continuous time and the pricing of interest rate derivatives. We will cover the Black model that is used by the market to quote the prices of standard products like caps/floors and swaptions. We treat short-rate models, such as the Hull-White and the CIR model. We treat market models, such as the LIBOR Market Model and the Swap Market Model. Finally, we deal with the issues of pricing "exotic European" options using convexity correction techniques. Students should not only be aware of the theory, but should also be able to implement the models, interpret the outcomes, and assess the strong points as well as the limitations of term structure models.

Learning Outcomes:
At the end of this course students are able to:
- Understand standard interest rate derivatives such as caps/floors and swaptions;
- Calibrate term-structure models to market quotes for standard instruments;
- Understand the mathematics of arbitrage-free pricing for interest rate derivatives;
- Understand and implement short-rate models;
- Understand and implement affine term-structure models;
- Understand and implement Libor market models;
- Price and analyze the risk characteristics of exotic interest rate derivatives;
- Maintain a critical attitude towards the limitations of models used for interest rate derivatives.

Market & Systemic Risk Management

Credits: 3.5 ECTS

Course Objectives:
The main objective of this course is to develop and analyze a coherent framework for evaluating market risk at the level of the individual institution or portfolio and at the macro systemic level. The main tool that we exploit in devising this framework is the statistical theory about tail risk from Extreme Value Theory (EVT) in combination with standard concepts from finance and macro economics.

More in particular, the course offers different methods to measure and manage financial risk and performance with special emphasis on downside risk measures such as Value-at-Risk (VAR), semi-variance, CvaR, Stress tests, worst case and scenario analysis, etc. Various statistical techniques are studied which are specifically designed to measure breakdown probabilities. Most asset returns turn out to be heavy tailed. That is to say, very bad outcomes occur more frequently than the normal distribution predicts. Therefore, heavy tailed distributions are studied in detail, especially their additive properties.

Subsequently we investigate the EVT for the sake of stress testing and scenario analysis. These and other techniques are used to estimate and manage the VAR, both at the individual asset level and the portfolio level. The pc lab session implements the techniques. Given the link between proper risk management and stability of the financial system, we also pay attention to various aspects of risk management from a supervisory point of view. The inherent fragility of the financial system is explained and a scale for the system's stability is developed. The rigorous treatment of some of the techniques enables the student to independently analyze market risks and develop systemic risk indicators.

Learning Outcomes:
At the end of this course students are able to:
- Identify the more rigorous and quantitative techniques available to analyze and manage market risk and to evaluate systemic risk
- Use various statistical techniques specifically designed to measure breakdown probabilities and shortfall

- Identify and handle the additive properties of heavy tailed distributions both over time and cross sectionally
- Select and use appropriate techniques to estimate and manage VAR (at individual asset and portfolio level), portfolio management and systemic risk
- Develop a scale for evaluating the stability of the financial system
- Apply EVT to real life case

Electives

Advanced Derivatives

Credits: 3 ECTS

Course Objectives:
This course focuses on measuring and pricing credit risk. We will both look at historical default probabilities and risk-neutral probabilities and the interplay between the two. For example students should understand the reasons why CDO tranches could have high ratings while at the same time give attractive spreads to investors. They should understand the pivotal role of systemic risk.

In the course we will discus the importance of the Merton model, which allows to move from single name risk to multiple name risk via asset correlation, which is not only used in pricing but also in the regulatory framework. Alternative models for pricing and risk measurement, such as Copulas or multiple Poisson processes with different intensities will also be discussed.

After the course students should be able to understand the most recent literature and they will be asked to present a paper during the course.

Learning Outcomes:
At the end of this course students are able to:
- Understand pricing models for single name and multiple name credit risk:
- Understand the difference between physical and risk neutral default probabilities;
- Understand the Basle capital requirements for credit risk for banks;
- Implement standard pricing models for credit risk.
- Understand alternative models for correlation, such as copulas;
- Understand the importance of systemic risks and alternative ways to measure this;
- Calibrate default probabilities for low default portfolios.

Block IV

Core Courses

Credit Risk Management

Credits: 3.5 ECTS

Course Objectives:
Credit risk is one of the major risks in the banking book. However, the risk is not limited to the banking book alone. Credit risk arises everywhere where delivery and settlement of goods or services are not simultaneous. The aim of this course is to familiarise students with the various aspects of credit risk, credit risk models, and credit risk management. The emphasis is on models under the physical measure (rather than under the risk neutral measure).

The course starts with familiarising students with credit risk for individual counterparts and with models that exploit cross-sectional information on defaults. Next, students learn the specific complications of portfolio models for credit risk. Students will develop an understanding of the different mechanisms that introduce cross-sectional dependencies and time-variation in credit risk exposures, and the various models available to capture this. Students will not only become aware of the theory, but will also be able to implement the models, interpret the outcomes, and assess the strong points as well as the limitations of their credit risk analysis and advice.

Learning Outcomes:
At the end of this course students are able to:
- Understand the drivers of single-name and multi-name credit risk;
- Understand the main mechanisms to mitigate and manage credit risk;
- Understand the models used for single-name and multi-name credit risks;
- Implement these models using standard packages or self developed code;
- Assess the quality of credit risk models and assessments;
- Establish the link between credit risk models and the regulatory framework;
- Maintain a critical attitude towards the limitations of models used for credit risk.

International Corporate Finance and Risk Management

Credits: 3.5 ECTS

Course Objectives:
The course's goal is to give students the tools needed to apply finance principles to international business decisions, especially managing risks. Broadly speaking, we will explore the main features of the international financial markets and examine various aspects of multinational corporate risk management. The list of issues we will cover includes (among others): exchange rate risk management, country risk assessment, cross-border investment analysis, international taxation, mergers and acquisitions, and competitive strategy in a global marketplace.

Learning Outcomes:
At the end of the course students will have an understanding of (among other things):
- The working and importance of globalisation for corporate management;
- Trading and hedging with foreign currencies in international capital markets;
- Managing currency, economic, and political risks in foreign countries;
- Evaluating corporate investment in international markets.

Block V

Thesis

Credits: 10 ECTS

Course Objectives:
All students need to write a Master's thesis, which requires students to develop and show the ability to independently produce a piece of innovative research. Prior to the writing the thesis, all students attend the Master's Thesis Seminar, where they learn how to develop research questions, how to find data, how to structure a thesis and how to conduct empirical analysis. Moreover, all students need to present their own thesis proposal and obtain/provide feedback. The thesis is written in an area related to the track of specialisation. The thesis has to satisfy the standards of an independent academic piece of work, building on existing literature and combining both a theoretical analysis and hypothesis development and an empirical analysis of real-world, survey or experimental data.

Learning Outcomes:
After finishing their theses, students will be able to:
- Independently develop a research question;
- Understand the academic literature in the area of the Master's thesis;
- Independently work on a clearly defined research project;
- Build on existing literature and combine theoretical hypothesis development and an empirical analysis of data;
- Analyse data using statistical methods.

Assessment Method:
The final thesis will be assessed by the thesis supervisor.

Internship

Credits: 5 ECTS

Course Objectives:
This internship is designed to provide an opportunity for students to develop practical skills in dealing with financial issues related to the track of specialisation. It is also included in the programme to allow students to develop professional skills, such as presentation skills and interaction with clients and higher management. Students may wish to combine the mandatory internship with the writing of the final thesis. DSF has a number of partner institutions that are supportive of thesis work based on a student's placement.

Learning Outcomes:
By the end of the internship, students will:
- Have applied their academic knowledge in a practical context;
- Have learned institutional details in their specific track of specialisation;
- Have developed practical skills in dealing with financial issues related to the track of specialisation;
- Have developed professional skills, such as presentation skills and interaction with clients and higher management.