

2 - Day Workshop: Mathematics for Financial Markets

Course objectives

The 2-day workshop “Mathematics for Financial Markets” is designed to provide a thorough introduction to mathematical tools used in the day-to-day business of asset and financial risk managers. Understanding these tools from calculus and linear algebra is key when doing asset allocation or portfolio optimization, they are the “language” of modern finance, especially investment management.

Starting with the basic mathematical terms, the first section covers the basic calculus used in financial markets. Key parts of this sections are differentiation, integration and optimization. The second section covers vector and matrix algebra which are key tools in modern portfolio management.

The concepts of each section are illustrated using many exercises and application. The last part of the workshop is devoted to a case study covering the construction of an efficient frontier in Excel.

Workshop background

The basis of everything done in asset and risk management is mathematics. For example, when calculating the return and risk of a portfolio the key ideas of calculus and matrix/vector algebra are used in order to see the risk/return profile of the portfolio. When looking at “all” possible portfolios, how can we determine what the “best” portfolio is? And what do “all” and “best” mean, i.e., how can they mathematically be defined? This workshop will present the mathematical tools necessary to quantitatively work in asset and risk management.

The application of mathematical formulas presented is the key aspect of this workshop. For example, the Taylor expansion is elaborated on in detail. The most important application of the Taylor expansion is in active fixed income portfolio management when using duration and convexity to quantify the effects interest rates hikes have on the portfolio value. In a low interest rate environment like nowadays this is crucial to know.

Who for?

The workshop is designed for junior and middle level managers working in finance, asset and risk management who want to get a structured introduction to quantitative methods in finance. Especially, professionals involved in asset allocation, portfolio optimization, fixed income or equity portfolio management will find this workshop very useful.

This workshop is very interactive: the concepts will be presented with many applications which are explained by the trainer and by using many exercises that have to be solved by the participants with the trainer’s support. A case study will be used to enhance the learning effort.

Basic investment knowledge and a strong interest in using mathematical concepts (high school level) are required. The participants should also have experience working with Microsoft Excel since many exercises are done in Excel. No VBA, however, is needed.

Benefits of the workshop

The workshop will enable you to:

- Get introduced to the application of mathematical concepts to the world of asset and financial risk management.
- Understand the basics in calculus and see how it is used to describe and solve financial concepts.
- Get familiar with vector/matrix calculation which is especially needed in modern portfolio management when calculating portfolio risk and return.
- Acquire a thorough understanding of how optimization methods are used to derive the optimal portfolio in the Markowitz efficient frontier framework.
- Learn about the minimum variance portfolio and see how it can be constructed in reality.
- Understand how interest rate risk management works using an advanced calculus tool and learn how this can also be used for efficient active fixed income portfolio management.
- See how modern asset and risk management is rooted in quantitative concepts.

Workshop agenda

The workshop covers the most important concepts in calculus as well as vector/matrix algebra as needed in modern asset and risk management. During the 2 days the key formulas and their application will be presented and it will be shown how they are used in practice. The course is designed around many example and practical cases.

Day 1	
09.00 – 09.15	Introduction and course description
09.15 – 10.45	Basic mathematical methods: <ul style="list-style-type: none"> • Types of numbers • Basic calculation rules • Fractions • Integer power • Fractional power • Quadratic identities
10.45 – 11.15	Coffee break
11.15 – 12.45	Basic calculus for financial markets (part 1): <ul style="list-style-type: none"> • Introduction to calculus for financial markets • Functions in one variable: <ul style="list-style-type: none"> - Linear and quadratic functions - Inverse functions - The exponential function - The natural logarithm <p>Application: Return calculation in portfolio management</p>
12.45 – 14.00	Lunch break
14.00 – 15.30	Basic calculus for financial markets (part 2): <ul style="list-style-type: none"> • Differentiation of functions in one variable: <ul style="list-style-type: none"> - Definitions - Rules for differentiation - Monotonic, concave and convex functions • Integration of functions in one variable • Functions with several variables • Differentiation of functions with several variables: <ul style="list-style-type: none"> - Partial derivative - Stationary points - Total derivative
15.30 – 16.00	Coffee break
16.00 – 17.00	Basic calculus for financial markets (part 3): <ul style="list-style-type: none"> • Optimization of functions with several variables • Optimization with constraints • Taylor expansion

Day 2	
09.00 – 09.15	Recap of days 1 and 2
09.15 – 10.45	Application: Interest rate management using the duration and convexity concepts: <ul style="list-style-type: none"> • Types of interest rates • Measuring interest rates • Zero rates • Bond pricing • Duration • Convexity
10.45 – 11.15	Coffee break
11.15 – 12.45	Basic linear algebra for financial markets (part 1): <ul style="list-style-type: none"> • Introduction to calculus for financial markets • Matrix algebra <ul style="list-style-type: none"> - Basic terminology - Laws of matrix algebra - Singular matrix - Determinates - Solutions of simultaneous linear equations - Quadratic forms - Definite matrices • Eigenvectors and eigenvalues <ul style="list-style-type: none"> - Matrices and linear transformation - Formal definition - The characteristic equation - Eigenvalues and eigenvectors of a 2 x 2 correlation matrix - Properties of eigenvalues and eigenvectors
12.45 – 14.00	Lunch break
14.00 – 15.30	Application: Using Excel to find eigenvalues and eigenvectors Application: Risk and return calculations in linear portfolios
15.30 – 16.00	Coffee break
16.00 – 17.00	Case study: Calculation of the efficient frontier and minimum variance portfolio in portfolio management

Disclaimer

The contents of this flyer and/or descriptions are for general information purposes only and are not intended as an individual recommendation or personal investment advice. All information, descriptions and calculations in the flyer were compiled with the utmost care and checked for accuracy. However, no liability can be accepted for the correctness, completeness and currentness of the information.