Zurich University of Applied Sciences
School of Management and Law

**Valid from** 2024.HS

# Module description: Quantitative Methods

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|---|---|
| **Module Code** | w.BA.XX.3QMeth-FLEX.XX |
| **ECTS Credits** | 3 |
| **Language of Instruction/Examination** | German |
| **Module Description** | In this module, students learn useful quantitative methods with which to solve key financial-mathematical and statistical problems and recognize their relevance for the banking and finance practice. |
| **Organizational Unit** | IWA Ltg. |
| **Module Coordinator** | Norbert Hilber |
| **Deputy Module Coordinator** | Thomas Gramespacher |
| **Program and Specialization** | • Business Administration - Specialization in Banking and Finance (FLEX) |
| **Legal Framework** | Academic Regulations BSc dated 29.01.2009, for the degree programs in Business Administration, International Management, Business Information Technology, Business Law, Business Law and Applied Law, first adopted on 12.05.2009 |
| **Module Category** | **Module Type**<br>Compulsory<br>**Program Phase**<br>Main Study Period |
| **Prerequisite Knowledge** | w.BA.XX.2Mathe1.XX, w.BA.XX.2Mathe2.XX, w.BA.XX.2Stat.XX |
| **Contribution to Program Learning Objectives (by the concerned Module)** | • Professional Competence<br>• Methodological Competence<br>• Social Competence<br>• Self-Competence |
| **Contribution to Program Learning Objectives** | **Professional Competence**<br>• Knowing and Understanding Content of Theoretical and Practical Relevance<br>• Apply, Analyze, and Synthesize Content of Theoretical and Practical Relevance<br>• Evaluate Content of Theoretical and Practical Relevance<br>**Methodological Competence**<br>• Problem-Solving & Critical Thinking<br>• Scientific Methodology<br>• Work Methods, Techniques, and Procedures<br>• Information Literacy<br>• Creativity & Innovation<br>**Social Competence**<br>• Oral Communication<br>• Teamwork & Conflict Management<br>• Intercultural Insight & Ability to Change Perspective<br>**Self-Competence**<br>• Self-Management & Self-Reflection<br>• Ethical & Social Responsibility<br>• Learning & Change |

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**Module Learning Objectives**

Students...
- can explain why matrices are useful in constructing portfolios.
- can explain the significance of partial derivatives and Taylor approximations.
- can understand basics of utility theory.
- can characterize distributions using moments.
- can explain the problem of skewed and leptokurtic return distributions for portfolio theory and risk management.
- can explain how options can be valued using arbitrage considerations.
- can determine the expected value and variance (of sums) of random variables and thus determine the expected portfolio return and the portfolio risk.
- can annualize mean and standard deviation of returns.
- can form partial derivatives and total differentials of functions with several independent variables.
- Can use matrix calculus to determine expected portfolio return and variance.
- can form 1st and 2nd order Taylor series of functions and use them in practical applications.
- can determine the shortfall probability and the value at risk of an investment using a parametric and historical approach.
- can calculate or approximate the price of European and American options using the binomial model.
- can interpret sensitivity ratios ("Greeks") of options.
- can estimate and assess interest rate risks of bonds by Taylor approximations (duration and convexity).
- can critically question quantitative models or assess whether model assumptions have been violated in application.
- are able to apply quantitative methods in the context of guided self-study in new problems (behavior of a bond in the case of interest rate changes).

**Module Content**

- Introduction to matrix calculus
- Mean-variance portfolio theory: location and dispersion measures; linear transformations of random variables; return and risk of a single asset; portfolio return and risk (sums of random variables); portfolios with multiple assets (matrix notation).
- Functions of several variables: Partial derivative; total differential; Taylor series
- Elements of utility theory: utility function, indifference curves; expected utility, safety equivalent; risk aversion, risk premium; measures of absolute and relative risk aversion; mean-variance utility functions.
- Aspects of risk management: skewness and kurtosis of return distributions; time aggregation of returns; shortfall probability; VaR methods.
- Option pricing: Binomial model (one- and two-stage model, no-arbitrage argument, risk-neutral valuation); sensitivity ratios: The "Greeks"; hedge ratios, and delta hedging.

**Links to other modules**

This module is linked to the following modules:
- w.BA.XX.2Stat-flex.XX
- w.BA.XX.2Mathe2-flex.XX

**Digital Learning Resources**

- Reader
- Teaching Videos
- Practice and Application Exercises (with Key)
- Multiple Choice Tests

**Methods of Instruction**

- Exercises

Social Settings Used:

**Type of Instruction**

| | Classroom Instruction | Guided Self-Study | Autonomous Self-Study |
|---|---|---|---|
| Large Class | - | - | |
| Small Class | 12 h | 34 h | |
| Group Instruction | - | - | |
| Practical Work | - | - | |
| Seminar | - | - | |
| **Total** | **12 h** | **34 h** | **44 h** |

# Module description: Quantitative Methods

**Performance Assessment**

| End-of-module exam | Form | Length (min.) | Weighting |
|---|---|---|---|
| Written exam | open book | 60 | 100.00 |
| **Permitted Resources** | Free choice calculator | With dictionary | |

| Others | Assessment | Format | Length (min.) | Weighting |
|---|---|---|---|---|
| - | - | - | - | - |

**Classroom Attendance Requirement**

None

**Compulsory Reading**

**Recommended Reading**

- Excerpts from textbooks/essays (see semester program and the materials set aside for this module at the library.

**Comments**