Portfolio Optimization
Overview

Prof. Dr. Philipp Baumann

University of Bern

Spring 2024

(as of February 18, 2024)

Outline

Outline

CV Philipp Baumann

- Born in Bern
- 2009: MSc in Business Administration, University of Bern
- 2013: PhD in Business Administration, University of Bern
- 2013–14: Research Scholar at IEOR Department, UC Berkeley
- 2014–15: Postdoc at IEOR Department, UC Berkeley
- Since 2015: Professor in Quantitative Methods/Operations Research, University of Bern
- Research:
  - Mathematical programming in finance and operations
  - Machine learning/Data mining

Contact

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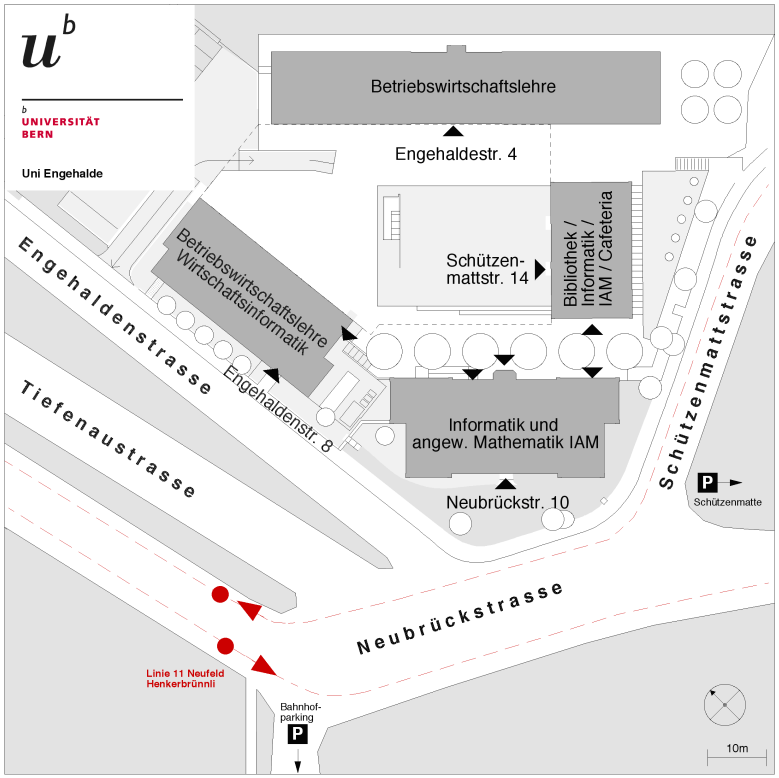

Outline

Course in context of master studies

- 2015 course scheme: course can be selected as
  - part of the *Management Science* module or
  - elective course
- No registration required for participation
- Required knowledge: completion of Bachelor degree in Business Administration or Economics
  - Introduction to Mathematics
  - Introduction to Statistics
  - Quantitative Methods in Business Administration I

Lecture

- Time: Monday, 8:15am to 10:00am
- Location: Engehalde E8, room 002
- Start: Feb 19, 2024
- Download of material for lecture: ILIAS
- Lecture includes
  - Explanations
  - Examples
  - Discussion of case studies

Exercises

- Time: Tuesday, 8:15am to 10:00am
- Location: Engehalde E8, room 002
- Download of exercises: ILIAS
- Types of exercises
  - Review of the lecture content
  - Formulation of optimization problems
  - Manual application of discussed methods
  - Application of discussed methods using Software Python

Project

- Available on ILIAS on Tuesday Mar 26
- Project is conducted in groups of two students
- Access to Software Python required
- Project tutorial: Tuesday Apr 16, 2024 (instead of exercises)
- Deadline for submission of solution: Tuesday Apr 23, 2024
- Grading: 8 extra points can be achieved
- Discussion of solutions on Tuesday Apr 30

Outline

Overview exam

- 6 ECTS
- Written exam
- Exam will cover lecture, exercises, and project
- Permitted aids:
  - Non-programmable hand-held calculator
  - Formulary (will be distributed before the exam)
  - List of symbols (will be distributed before the exam)
- Grading
  - Maximal attainable score in exam: 90 points
  - Maximal attainable score in project: 8 points
  - At most 90 points required for highest grade
  - Project points can be credited to exams in May 2024 and Sep 2024

Dates for final exam

- Dates (duration of final exam is 90 minutes)
  1. Monday May 27, 2024 from 8:15am to 10:00am
  2. Monday Sep 9, 2024 from 8:15am to 10:00am
- Location: will be announced on KSL after closing date for exam deregistration
- Discussion of past exam questions on Tuesday May 14, 2024
- Q&A on Tuesday May 21, 2024

Final exam: additional information

Exam on May 27, 2024

Closing date registration	May 20, 2024
Closing date deregistration	May 25, 2024
First date to access graded exam	May 31, 2024 (3pm–4pm)
Second date to access graded exam	Jun 7, 2024 (9am–10am)

Exam on Sep 9, 2024

Closing date registration	Sep 2, 2024
Closing date deregistration	Sep 7, 2024
First date to access graded exam	Sep 13, 2024 (9am–10am)
Second date to access graded exam	Sep 23, 2024 (2pm–3pm)

Registration and deregistration only via KSL

Outline

Structure

1. Basics of optimization
2. Introduction to portfolio optimization
3. Portfolio selection
   - Mean-variance model/Mean-absolute deviation model
   - Minimax model
   - Value-at-risk model/Conditional value-at-risk model
   - Models for fixed income securities
4. Portfolio management
   - Practical portfolio constraints
   - Portfolio rebalancing
   - Portfolio evaluation
5. Index tracking
   - Basics of market indices
   - Indexation models
   - Exchange traded funds

Learning outcomes I

The students are able to

- compute well-known risk measures for equities and fixed-income securities
- implement portfolio-selection models in Python and compute optimal portfolios for real-world data
- understand and apply models and methods to optimize fixed-income portfolios
- extend portfolio-selection models to account for real-world constraints such as for example transaction costs
- evaluate the performance of portfolios based on quantitative methods

Learning outcomes II

The students are able to

- implement various rebalancing strategies and discuss their pros and cons
- analyze structural properties of market indices
- implement index-tracking models in Python and compute optimal tracking portfolios for real-world data
- explain the structure and the mechanics of exchange traded funds

Overview

Literature (textbooks)

- Zenios (2008): Practical financial optimization: decision making for financial engineers, Blackwell, Cambridge
- Luenberger (2013): Investment Science, Oxford University Press, New York
- McKinney (2022): Python for Data Analysis. O'Reilly

Literature (papers on portfolio selection)

- Markowitz (1952): Portfolio selection. Journal of Finance (7), 77–91
- Konno Yamazaki (1991): Mean-absolute deviation portfolio optimization model and its applications to Tokyo stock market. Management Science (37), 519–531
- Young (1998): A minimax portfolio selection rule with linear programming solution. Management Science (44), 673–683
- Rockafellar Uryasev (2000): Optimization of conditional value-at-risk. Journal of Risk (2), 21–41
- Benati Rizzi (2007): A mixed integer linear programming formulation of the optimal mean/Value-at-Risk portfolio problem. European Journal of Operational Research (176), 423–434

Literature (papers on index tracking)


Rudolf Wolter Zimmermann (1999): A linear model for tracking error minimization. Journal of Banking and Finance (23), 85–103


Strub Baumann (2018): Optimal construction and rebalancing of index-tracking portfolios. European Journal of Operational Research (264), 370–387