Portfolio Optimization Using Machine Learning

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Successful investment strategies are specific implementations of general theories. An investment strategy that lacks a theoretical justification is likely to be false. Hence, an asset manager should concentrate his efforts on developing a theory rather than on backtesting potential trading rules. The purpose of this Element is to introduce machine learning (ML) tools that can help asset managers discover economic and financial theories. ML is not a black box, and it does not necessarily overfit. ML tools complement rather than replace the classical statistical methods. Some of ML’s strengths include (1) a focus on out-of-sample predictability and experience adjuvication; (2) the use of computational methods to avoid relying on (potentially unrealistic) assumptions; (3) the ability to “learn” complex specifications, including non-linear, hierarchical, and noncontinuous interaction effects in a high-dimensional space; and (4) the ability to disentangle the variable search from the specification search, robust to multicollinearity and other substitution effects.

The modern financial industry has been required to deal with large and diverse portfolios in a variety of asset classes often with limited market data available. Financial Signal Processing and Machine Learning unifies a number of recent advances made in signal processing and machine learning for selecting portfolios, investors and scholars have extended and to share their experiences in the area of electrical and electronic engineering. New Approaches to Robustness and Learning in Data-driven Portfolio Optimization Pactik Publishing Ltd. Praise for Robust Portfolio Optimization and Management "In the half century since Harry Markowitz introduced his elegant theory for selecting portfolios, investors and scholars have extended and refined its application to a wide range of real-world problems, culminating in the contents of this masterful book. Fabozzi, Kolm, Pachamanova, and Focardi deserve high praise for presenting a technically rigorous yet remarkably accessible guide to the latest advances in portfolio construction." –Mark Kritzman, President and CEO, Windham Capital Management, LLC "The topic of robust optimization (RO) has become ‘hot’ over the past several years, especially in real-world financial applications. This interest has been sparked, in part, by practitioners who implemented classical portfolio models for asset allocation without considering estimation and model robustness a part of their overall allocation methodology, and experienced poor performance. Anyone interested in these developments ought to own a copy of this book. The authors cover the recent developments of the RO area in an intuitive, easy-to-read manner, provide numerous examples, and discuss practical considerations. I highly recommend this book to finance professionals and students alike." –John M. Mulvey, Professor of Operations Research and Financial Engineering, Princeton University Artificial Intelligence in Asset Management Yale University Press Machine Learning (ML) is changing virtually every aspect of our lives. Today ML algorithms accomplish tasks that until recently only expert humans could perform. As it relates to finance, this is the most exciting time to adopt a disruptive technology that will transform how everyone invests for generations. Readers will learn how to structure Big data in a way that is amenable to ML algorithms; how to conduct research with ML algorithms on that data; how to use supercomputing methods; how to backtest your discoveries while avoiding false positives. The book addresses real-life problems faced by practitioners on a daily basis, and explains scientifically sound solutions using math, supported by code and examples. Readers become active users who can test the proposed solutions in their particular setting. Written by a recognized expert and portfolio manager, this book will equip investment professionals with the groundbreaking tools needed to succeed in modern finance.

Introduction to Risk Parity and Budgeting CFA Institute Research Foundation

With the recent rise of Machine Learning (ML) as a candidate to partially replace classic Financial Mathematics (FM) methodologies, we investigate the performances of both in solving the problem of dynamic portfolio optimization in continuous-time, finite-horizon setting for a portfolio of two assets that are intertwined. In Financial Mathematics approach we model the asset prices not via the common approaches used in pairs trading such as a high correlation or cointegration, but with the correlation model that aims to reconcile both short-term risk and long-term equilibrium. We maximize the overall FPL with Financial Mathematics approach that dynamically switches between a mean-variance optimal strategy and a power utility maximizing solve numerically the resulting HJB equation with the Deep Galerkin method. We turn to Machine Learning for the same FPL maximization problem and use clustering analysis to devise bands, combined with band-optimization. Although this approach is model agnostic, results obtained with data simulated from the same coaction model as FM give an edge to ML Deep Reinforcement Learning-based Portfolio Management Cambridge University Press.
Portfolio Optimization Using Machine Learning

by John Wiley & Sons

Description: This book is for you if you want to learn how to extract value from a diverse set of data sources using machine learning to build and evaluate sophisticated supervised, unsupervised, and reinforcement learning models. This book introduces end-to-end machine learning techniques to solve investment and trading problems. It includes examples, data sets supplementing exercises in the book, and large projects. Prepares readers to evaluate market impact models and assess performance across algorithms, traders, and brokers. Helps readers design systems to manage algorithmic risk and dark pool uncertainty. Summarizes an algorithmic decision making framework to ensure consistency between investment objectives and profitability. Financial Signal Processing and Machine Learning

by J. Kevin McCullough

Description: This book introduces machine learning methods in finance. It covers different ways of downloading financial data and popular financial models such as CAPM and GARCH using a Python library, backtrader, Alphalens, and pyfolio. Purchase of the print or Kindle book includes a free eBook in the PDF format. The book is available for If you are a data analyst, data scientist, Python developer, investor, or any other professional interested in how to use machine learning in financial decision making, this book will help you understand the key concepts in statistical physics that are likely to emerge as important influences on financial markets.

Many new seed varieties with traits desirable for different planting environments are developed every year and marketed to farmers. However, farmers lack decision support tools to help them for the development of various multi-criteria portfolio models. At first, the book makes the reader familiar with basic concepts, including the classical mean-variance portfolio optimization. It also introduces the concept of risk aversion and heterogeneous preferences. For this reason, they do not have the option to invest in the same asset at the same time, but they must consider the risk of their investments. The book includes examples, data sets supplementing exercises in the book, and large projects. Prepares readers to evaluate market impact models and assess performance across algorithms, traders, and brokers. Helps readers design systems to manage algorithmic risk and dark pool uncertainty. Summarizes an algorithmic decision making framework to ensure consistency between investment objectives and profitability. Financial Signal Processing and Machine Learning

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to use deep learning (PyTorch) for approaching financial tasks. By the end of this book, you will have learned how to effectively analyze financial data using a recipe-based approach. What you will learn:

1. Download and preprocess financial data from different sources.
2. Test the performance of automatic trading strategies in a real-world setting.
3. Estimate financial econometrics models in Python and interpret their results.
4. Use Monte Carlo simulations for a variety of tasks such as derivatives valuation and risk assessment.
5. Improve the performance of financial models with the latest Python libraries.
6. Apply machine learning and deep learning techniques to solve different financial problems.

Understand the different approaches used to model financial time series data. This book is for:

- This book is for financial analysts, data analysts, and Python developers who want to learn how to implement a broad range of tasks in the finance domain.
- Data scientists looking to devise intelligent financial strategies to perform efficient financial analysis will also find this book useful.
- Working knowledge of the Python programming language is mandatory to grasp the concepts covered in the book effectively.

Machine Learning in Finance - Springer Nature

The book is a monograph in the cross-disciplinary area of Computational Intelligence in Finance and elucidates a collection of practical and strategic Portfolio Optimization models in Finance, that employ Metaheuristics for their effective solutions and demonstrates the results using MATLAB implementations, over five portfolios invested across global stock universes. The book has been structured in such a way that, even novices in finance or metaheuristics should be able to comprehend and work on the hybrid models discussed in the book.

Machine Learning for Asset Managers - MIT Press

Artificial intelligence (AI) has grown in presence in asset management and has revolutionized the sector in many ways. It has improved portfolio management, trading, and risk management practices by increasing efficiency, accuracy, and compliance. In particular, AI techniques help construct portfolios based on more accurate risk and return forecasts and more complex constraints. Trading algorithms use AI to devise novel trading signals and execute trades with lower transaction costs. AI also improves risk modeling and forecasting by generating insights from new data sources. Finally, robo-advisors owe a large part of their success to AI techniques. Yet the use of AI can also create new risks and challenges, such as those resulting from model opacity, complexity, and reliance on data integrity.

Handbook of Financial Econometrics, Mathematics, Statistics, and Machine Learning (4 Volumes) - Springer

As technology advancement has increased, so have computational applications for forecasting, modelling and trading financial markets and information, and practitioners are finding ever more complex solutions to financial challenges. Neural networking is a highly effective, trainable algorithmic approach which emulates certain aspects of human brain functions, and is used extensively in financial forecasting allowing for quick investment decision making. This book presents the most cutting-edge artificial intelligence (AI) neural networking applications for markets, assets and other areas of finance. Split into four sections, the book first explores time series analysis for forecasting and trading across a range of assets, including derivatives, exchange traded funds, debt and equity instruments. This section will focus on pattern recognition, market timing models, forecasting and trading of financial time series. Section II provides insights into macro and microeconomics and how AI techniques could be used to better understand and predict economic variables. Section III focuses on corporate finance and credit analysis providing an insight into corporate structures and credit, and establishing a relationship between financial statement analysis and the influence of various financial scenarios. Section IV focuses on portfolios management, exploring applications for portfolio theory, asset allocation and optimization. This book also provides some of the latest research in the field of artificial intelligence and finance, and provides in-depth analysis and highly applicable tools and techniques for practitioners and researchers in this field.

Portfolio Optimization Using Machine Learning - Springer Science & Business Media

The mean-variance optimization framework has been the traditional approach to decide portfolio allocations based on return-risk trade-offs. However, it faces practical drawbacks, including sensitivity to estimated input parameters and concentration of portfolio risk. Risk budgeting portfolio optimization is a popular risk-based asset allocation technique where risk budgets are assigned to each assets' risk contribution, and equalizing all risk budgets in the portfolio is known as risk parity strategy. Unlike mean-variance, the risk parity strategy provides a balanced risk concentration in the portfolio and does not require expected asset return estimates as input. However, its performance can depend on the selected asset universe. Furthermore, its mathematical formulation imposes some computational challenges due to the non-convex structure. In this thesis, the risk budgeting problem is studied with modern optimization and machine learning approaches to enhance the portfolio model and address the aforementioned challenges. The second chapter introduces regime-switching risk parity portfolios with two primary components: regime modelling and prediction with supervised learning methods and identifying a regime-based strategy to improve the performance of a nominal risk parity portfolio. In the third chapter, we formulate a multi-period risk parity portfolio optimization problem in a transaction cost environment with a model predictive control approach. We provide a successive convex program algorithm that provides faster and more robust solutions. Lastly, we present an end-to-end portfolio allocation method by embedding the risk budget optimization problem as an implicit layer in a neural network. This approach combines prediction and optimization tasks in a single decision-making pipeline and constructs dynamic risk budgeting portfolios. Furthermore, we introduce a novel asset selection property with stochastic gates that protects the risk budgeting portfolio against the unprofitable assets.