Optimization of Quantitative Financial Trading Strategies Based on Machine Learning: Prediction and Decision Models for Stock and Derivatives Markets

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Abstract: Machine learning has become a cornerstone of quantitative finance, which allows for data-driven forecasting, strategy optimization, and trading-by-dot decision making. It analyzes the application of machine learning models such as recurrent neural networks (RNNs), long short term memory (LSTM) networks, and reinforcement learning (RL) in order to generate optimal predictive models and adaptive trading techniques. The research is based on historical stock and derivative market data and follows a rigorous process that includes data preprocessing, feature engineering and model training using random forests and gradient boosting. Our experimental evidence shows that LSTM performs better on long-term trends and ensemble models on short-term trends. The RL model significantly enhances risk adjusted returns, with higher Sharpe ratios and lower drawdowns than standard strategies, suggesting real-time market flexibility. The study highlights the positive effects of machine learning in improving trading performance, which will be applicable to other trading scenarios.

Keywords: Machine Learning, Quantitative Finance, Predictive Modeling, Reinforcement Learning, Trading Strategy Optimization.

1. Introduction

Machine learning has had a dramatic impact on quantitative finance, by allowing for more data-based, flexible methods of forecasting, strategy-optimisation and decision-making in financial trading. Traditional quantitative finance approaches based on static, rule-based models or linear relationships are ill-equipped to represent modern financial markets. Machine learning, by contrast, is a set of powerful tools that can process vast amounts of market data, discover deep patterns, and make real-time changes to adapt to the changing conditions. This flexibility is critical in the world of trading, especially high-frequency trading (HFT) where trades are made in milliseconds, and low-frequency trading (LFT) where trend analysis for a long period of time is vital. In this paper, we investigate two main applications of machine learning to quantitative finance: prediction modelling and strategy optimization. Predictive modelling aims to make predictions about price movements and volatility in stock and derivatives markets using powerful machine learning techniques like random forests, gradient boosting and long short-term memory (LSTM) networks. They have been proven successful

Optimization Techniques In Quantitative Economic Models

Jati Kumar Sengupta,K. A. Fox

Optimization Techniques In Quantitative Economic Models:
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    Optimization Techniques in Quantitative Economic Models Jati Kumar Sengupta,K. A. Fox,1969   Mathematical Optimization and Economic Analysis Mikulás Luptácik,2009-10-03 Mathematical Optimization and Economic Analysis is a self contained introduction to various optimization techniques used in economic modeling and analysis such as geometric linear and convex programming and data envelopment analysis Through a systematic approach this book demonstrates the usefulness of these mathematical tools in quantitative and qualitative economic analysis The book presents specific examples to demonstrate each technique s advantages and applicability as well as numerous applications of these techniques to industrial economics regulatory economics trade policy economic sustainability production planning and environmental policy Key Features include A detailed presentation of both single objective and multiobjective optimization An in depth exposition of various applied optimization problems Implementation of optimization tools to improve the accuracy of various economic models Extensive resources suggested for further reading This book is intended for graduate and postgraduate students studying quantitative economics as well as economics researchers and applied mathematicians Requirements include a basic knowledge of calculus and linear algebra and a familiarity with economic modeling   Economic analysis and operations research ,1969   **Economic analysis and operations research: optimization techniques in quantitative economic models, by J.K.Sengupta and K.A.Fox** Jati Kumar Sengupta,Karl August Fox,   *Economic Analysis and Operation Research* ,1969   The Programming Approach and the Demise of Economics Franco Archibugi,2019-11-21 This trilogy deals with an epistemology of economics arguing for a radical overturning of conventional analysis and providing an alternative to political economy and social sciences based not on positivism but on a normative and programming paradigm Volume II builds on the work presented in Volume I to explore oppositions to the traditional and conventional teaching of economics and presents testimonies that are favourable to a trend towards a programming approach thereby giving

substance to the epistemological overturning of conventional analysis Such oppositions studied include the work of Ludvig von Mises and his theory of praxeology Ian Tinbergen and Wassily Leontif s preference for planning over forecasting science Bruno de Finetti and Daniel Bell s support for the base of utopia in economics the trend from the theory of planning towards the methodology of planning by Andreas Faludi neoclassic curiosity about the multi purposes approach and non economic commodities as investigated by Walter Isard as well as theories expressed by Herbert Simon Robert Lucas George Soros and Mark Blaug Volume III takes studies further and presents a concrete and practical example of how to build a Planning Accounting Framework PAF as associated with Frisch s plan frame explored in Volume II to demonstrate the extent to which decisions and negotiations can be routed in the social sciences   **Agricultural Economics Research** ,1970

Econometric Decision Models Josef Gruber,2013-06-29 This volume contains a refereed selection of revised papers which were originally presented at the Second International Conference on Econometric Decision Models University of Hagen FernUni versitat The conference was held in Haus Nordhelle a meeting place in the mountainous area Sauerland some 50 kilometers south of Hagen on August 29 September 1 1989 Some details about this conference are given in the first paper they need not be repeated here The 40 papers included in this volume are organized in 10 parts shown in the table of contents Included are such fashionable topics like optimal control cointegration and rational expec tations models In each part the papers have been arranged alphabetically by author unless there were good reasons for a different arrangement To facilitate the decision making of the readers all papers except a few short ones contain an abstract a list of keywords and a table of contents At the end of the proceedings volume there is a list of authors More than ten years ago I began to organize meetings of econometricians mainly called seminar or colloquium One major purpose of these meetings has always been to improve international cooperation of econometric model builders and model users from the East and the West Unprecedented changes to the better have taken place recently perestroika For a large fraction of participants from the Soviet Union the 1989 conference was the first conference in a Western country   *Economics Selections* ,1970   *The Organization and Retrieval of Economic Knowledge* Mark Perlman,2016-01-03   *Mathematical Programming for Economics and Business* Roger C. Pfaffenberger,David A. Walker,1976 Characteristics and types of models Linear programming Nonlinear programming Nonlinear programming algorithms Quadratic programming Integer programming Dynmic programming Recursive Calculus of variations Stochastic programming   *Optimization in Economics and Finance* Bruce D. Craven,Sardar M. N. Islam,2005 Extends the optimization techniques in a form that may be adopted for modeling social choice problems The models in this book provide possible models for a society s social choice for an allocation that maximizes welfare and utilization of resources A computer program SCOM is presented here for computing social choice models by optimal control   *Mathematical Reviews* ,2002   The American Economic Review ,1970 Includes the Hand book of the American Economic Association   **Stochastic Economics; Stochastic Processes, Control, and Programming** Gerhard

Tintner,Jatikumar Sengupta,1972 **Deep Learning Applications in Operations Research** Aryan Chaudhary,Biswadip Basu Mallik,Gunjan Mukherjee,Rahul Kar,2024-12-30 The model based approach for carrying out the classification and identification of tasks has led to progression of the machine learning paradigm in diversified fields of technology Deep Learning Applications in Operations Research presents the varied applications of this model based approach Apart from the classification process the machine learning ML model has become effective enough to predict future trends of any sort of phenomenon Such fields as object classification speech recognition and face detection have sought extensive applications of artificial intelligence AI and machine learning as well The application of AI and ML has also become increasingly common in the domains of agriculture health sectors and insurance Operations research is the branch of mathematics used to perform many operational tasks in other allied domains and the book explains how the implementation of automated strategies in optimization and parameter selection can be carried out by AI and ML Operations research has many beneficial aspects to aid in decision making Arriving at the proper decision depends on a number of factors this book examines how AI and ML can be used to model equations and define constraints to solve problems more easily and discover proper and valid solutions This book also looks at how automation plays a significant role in minimizing human labor and thereby minimizes overall time and cost Case studies examine how to streamline operations and unearth data to make better business decisions The concepts presented in this book can bring about and guide unique research directions to the future application of AI enabled technologies

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