Liquidity at Risk: joint stress testing of bank liquidity and solvency[1]

Rama Cont[2]
University of Oxford, England, United Kingdom

Artur Kotlicki
University of Oxford, England, United Kingdom

Laura Valderrama
International Monetary Fund, United States

Abstract

The traditional approach to the stress testing of financial institutions focuses on capital adequacy and solvency. Liquidity stress tests have been applied in parallel to and independently from solvency stress tests, based on scenarios which may not be consistent with those used in solvency stress tests. We propose a structural framework for the joint stress testing of solvency and liquidity: our approach exploits the mechanisms underlying the solvency-liquidity nexus to derive relations between solvency shocks and liquidity shocks. These relations are then used to model liquidity and solvency risk in a coherent framework, involving external shocks to solvency and endogenous liquidity shocks arising from these solvency shocks. We define the concept of "Liquidity at Risk", which quantifies the liquidity resources required for a financial institution facing a stress scenario. Finally, we show that the interaction of liquidity and solvency may lead to the amplification of equity losses due to funding costs which arise from liquidity needs.

[1] https://www.sciencedirect.com/science/article/pii/S0378426620301370?via%3Dihub#!

[2] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Pooling and valuation revisited

Hirbod Assa[1]
Kent Business School, England, United Kingdom

Abstract

Abstract In light of the COVID-19 outbreak and the associated economic losses, we aim to revisit the fundamental insurance paradigms in particular pooling and valuation in the presence of systematic risk. We consider a pool of policyholders whose losses can be widely correlated through common shock. We have observed that from a mathematical standpoint, insurance as a pooling approach can manage the risk if the principle of insurance (POI), that is to keep the systematic risk secure, holds. Our study suggests that valuation cannot be independent of the risk pool, and the premium needs to be adjusted according to the systematic risk. Ex-post policies are another consideration that can vanish the systematic safety loading by introducing contingent premiums. This approach is rather novel and is motivated by systematic events like COVID-19 economic losses. Finally, we look at the upper bounds for the pool valuation for two cases, first when we have no specific information about the dependency structure of the pool member losses, and second when the pool is influenced by a common shock.

[1] Speaker

Goodhart's law and risk optimization

Ruodu Wang[1]
University of Waterloo, Canada

Abstract

Goodhart's law, named after British economist Charles Goodhart, states that "When a measure becomes a target, it ceases to be a good measure". We discuss this law in the context of risk optimization in banking regulation, where the target measure is a regulatory risk measure. The two most important regulatory risk measures, Value-at-Risk (VaR) and Expected Shortfall (ES), have given rise to many debates over the past few years on their comparative advantages, where robustness issues become a crucial consideration. By introducing and analyzing the concept of robustness in optimization, we obtain a "second Goodhart's law for risk measures": As regulatory target, all risk measures cease to be good, but some risk measures are much worse than the others. In particular, VaR is seriously problematic in this regard, in sharp contrast to commonly used convex risk measures like ES. This talk is based on joint work with Paul Embrechts (ETH Zurich) and Alexander Schied (Waterloo).

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

On the Multilevel Monte-Carlo Simulation: Jump-Diffusion Assets with Superlinear Drift

Azadeh Ghasemifard[1]
University of Mazandaran, Babolsar, Iran

Mahdieh Tahmasebi
Tarbiat Modares University, Tehran, Iran

Abstract

This article is about the strong convergence of the Multilevel Monte-Carlo (MLMC) algorithm when applying with split-step backward Euler (SSBE) scheme to nonlinear jump-diffusion stochastic differential equations (SDEs). The importance of this research is that the underlying process does not enjoy from globally Lipschitz condition, and we consider the drift term as one-sided Lipschitz and the payoff function as only locally Lipschitz. We also confirm these theoretical results by numerical experiment for the
jump-diffusion process.

Keywords: multilevel Monte-Carlo, one-sided Lipschitz, split-step scheme, strong approximation.
Mathematics Subject Classi_cation [2018]: 65C30,65C05.91G80

[1] Speaker

COVID-19 and Hedge Funds Equity Ownership

Laleh Samarbakhsh[1]
Ryerson University, Canada

Abstract

This study investigates hedge funds equity ownership in light of the COVID-19 pandemic. Using the merged dataset of Lipper TASS hedge funds and the corresponding 13F filings, we find that with the start of the pandemic, hedge funds increased their equity ownership toward firms with less financial constraints, such as larger firms, firms with lower leverage and more profitability. Moreover, hedge funds increased their ownership in firms which had higher overall risk (political and non-political), and lower overall sentiment. Hedge funds also care about firms' exposure/sensitivity toward different political issues such as health care, technology & infrastructure, and security and defense. This suggests that hedge funds seek equity ownership in riskier stocks as a result of pandemic uncertainties.

Keywords: COVID-19; Equity Ownership; Hedge funds

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Central Bank Digital Currency (CBDC): From Research to Implementation by Central Banks

Hassan Omidi Firouzi[1]
JP Morgan Chase Bank, USA

Abstract

Central banks around the world are exploring the design and implications of central bank digital currencies (CBDCs). Various research projects dedicated to the design of CBDC for retail and wholesale applications have been carried out by central banks as well as by academics. In this talk, we'll discuss the economical and technological underpinnings for a CBDC design and will cover the current status of CBDC developments by the major players.

Keywords: Central Bank Digital Currency (CBDC), Cross-Border Payments, Cryptocurrency

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

A Forecasting Model for Limit Order Book in Tehran Stock Exchange Using Attention-based in LSTM Network

Parisa Davar[1]
Concordia University, Canada

Ali Foroush Bastani
Institute for Advanced Studies in Basic Sciences, Iran

Parvin Razzaghi
Institute for Advanced Studies in Basic Sciences, Iran

Hirbod Assa
Kent Business School, UK

Seyed-Mohammad-Mahdi Kazemi
Kharazmi University, Iran

Abstract

In this paper, we propose an attention mechanism in deep learning-based model to predict price movements in Limit Order Book (LOB) data of Tehran Stock Exchange (TSE). Our model is trained on the data from top-30 listing companies, utilizing an attention mechanism in stacked Long Short-Term Memory (LSTM) to capture longer time dependencies. Our paper addresses different issues missing in the literature by applying the attention mechanism for the first time to the high frequency market data. We have observed that how the volume of the LOB plays a major role in accurately predicting the mid-prices. However, we found out that the optimal numbers of the LOB levels are fewer than the total number of the reported levels. We observe that training a deep neural network, that is a combination of LSTM and attention mechanism, based on the top-30 will lead to an optimal structure of 2-layer stacked LSTM with one layer attention mechanism. Furthermore, we see a universal phenomenon that the algorithm can generalize the prediction of the companies prices outside the group of top-30.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Optimizing Dynamic Copulas Parameters and Portfolio VaR Estimation

Shirin Robaty
Khatam University, Tehran , Iran

Mohamad ali Rastegar
Tarbiyat Moalem University , Tehran , Iran

Robab Kalantari[1]
Khatam University, Tehran , Iran

Abstract

The goal of this research is to determine the optimal dynamic dependency of a Bitcoin and three important commodity markets portfolio. The dynamic dependency between the assets is evaluated using three Archimedean and two elliptical copula models, and then the portfolio's value-at-risk (VaR) is estimated. To determine dynamic dependency structure and parameters, the Copula models are optimized using the particle swarm optimization (PSO) algorithm. The rolling window method is used for this. The findings demonstrate a weak correlation between Bitcoin and other assets, as well as changes in dependency over time. When Bitcoin is employed, this observation validates the effect of portfolio diversity. The results also reveal that, in order, Student's-t and Gumbel copula perform the best and worst in estimating the dependency structure of the assets under consideration.

Keywords: Value-at-Risk, Bitcoin, Dynamic Copula, Particle Swarm Optimization

Mathematics Subject Classification [2018]: 13D45, 39B42

[1] Email: r.kalantari@khatam.ac.ir

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Prediction IBNR and RBNS loss reserve net of reinsurance treaties

Fatemeh Atatalab[1]
Shahid Beheshti University, Tehran, Iran

Amir Teimour Payandeh Najafabadi
Shahid Beheshti University, Tehran, Iran

Abstract

This article considers the problem of predicting claims' amounts that have been incurred but not reported (IBNR) and reported but not settled (RBNS) whenever a reinsurance contract exists. We examine the impact of several reinsurance treaties on loss reserve from the cedent company's viewpoint. Moreover, under each reinsurance treaty, the cedent's loss reserve has been predicted and their corresponding prediction errors will be estimated. The application of our findings has been given for a car collision insurance loss portfolio.

Keywords: Loss reserve, Insurance, Reinsurance treaty, Mean square error of prediction.

Mathematics Subject Classification [2018]: G22, C13

[1]speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Credit risk stress test: The case of an Iranian bank

Hamed Ahmadnezhad[1]
Tarbiat Modares University, Tehran, Iran

Mohamad Ali Rastegar
Tarbiat Modares University, Tehran, Iran

Reza Baradaran Kazemzadeh
Tarbiat Modares University, Tehran, Iran

Abstract

One of the main goals of banks is financial stability over time. To achieve this goal, banks need to identify and control the risks they may face in the future. One of the practical tools in this regard is Stress Test. Stress tests are effective tools in crisis management identifying possible destructive events. They are one of the most important requirements for banks in Basel 1 and 2. There are many ways to do a stress test, from a simple sensitivity analysis to a variety of scenario analyses. This article aims to perform a credit risk stress test using a scenario analysis method for an Iranian bank. First, macroeconomic and financial variables affecting the performance of the bank loan portfolio are selected. In the following a linear regression between the loan performance variables and the selected variables is performed. A Vector Auto-Regression (VAR) model is then implemented on the independent variables to discover the relationship between them and to generate scenarios. After generation of the scenarios finally, the probability of default values are evaluated under the baseline and stressed scenarios. The results show that consumer price index, gold price, rental rate, money volume and long-term interest rate have the most impact on credit portfolios.

Keywords: Stress Test, Credit Risk, Wilson Model, Vector Auto-Regression.

Mathematics Subject Classification [2018]: 13D45, 39B42

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Automated trading system using machine learning

Vahid Esmaeili[1]
Tarbiat Modares, Tehran, Iran

Mohammad Ali Rastegar
Tarbiat Modares, Tehran, Iran

Abstract

In this study, in order to predict the next minute's closing price of Ethereum, we use six technical Indicators and the close price of BTC as inputs of several machine learning models. After that, we design an automated trading system to take short or long positions. Finally, the models evaluate in terms of performance. Results show that the performance of models can beat the buy and hold model. The random forest model has the best performance among all models with 90% accuracy. After the random forest model, the XGBoost model, decision tree, and support vector machine had the best to the weakest performance, respectively.

Keywords: Algorithmic Trading, Machine Learning, Cryptocurrencies
Mathematics Subject Classification [2018]: 13D45, 39B42

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Granger causality analysis on five main cryptocurrencies, oil and gold markets

Sajad Jamalian[1]
Tarbiat modares university, Tehran, Iran

Mohammad Ali Rastegar Sorkheh
Tarbiat modares university, Tehran, Iran

Reza Baradaran Kazemzadeh
Tarbiat modares university, Tehran, Iran

Abstract

This paper analyses the Granger causality test between the five crypto currency with largest market cap (BTC, ETH,XRP, BNB, ADA) and oil-gold markets by using F-test , Chi square-test, Likelihood ratio test for research the relationship between them, also implement ARMA-GARCH models to find which model is most effective for forecasting future returns. Our findings verify the existence of relation between time series of the five cryptocurrency and oil-gold markets. Furthermore, the results imply the following:1) Bitcoin has the most impact on other time series and can be used for predicting future returns of other asset except BNB 2) ARMA-GARCH model are best fitted model for our all seven asset 3) No time series can predict the future return of Bitcoin and XRP is most influenced of Granger causality. It should be noted that, these are the preliminary results. In the future, we will use the Markov switching time varying copula method to construct joint distribution of time series and compute covars for calculate risk spillover among the named assets. The data used in this article are the price returns of the listed assets from April 26, 2017 to July 15, 2021.

Keywords: Granger causality, Bitcoin , ARMA-GARCH

Mathematics Subject Classification [2018]: 13D45, 39B42

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Joint Prediction of Stock Price/Correlation Pair Using Deep Multi-Task Networks

Donya Kholghi[1]
Institute for Advanced Studies in Basic Science, Zanjan, Iran

Parvin Razzaghi
Institute for Advanced Studies in Basic Sciences, Zanjan, Iran

Ali Fourosh Bastaani
Institute for Advanced Studies in Basic Sciences, Zanjan, Iran

Abstract

Stock price prediction is a great challenge due to the volatile and uncertain nature of the market. The correlation coe icient is a crucial issue in portfolio selection which depends on price history. Our aim here is to build a model that is capable of predicting correlation coe icient and price movement of stocks at the same time. To this end, we use the Multi-Task Learning (MTL) framework. The MTL model learns multiple tasks in parallel to make more accurate predictions [1]. The raw data used in this study is the adjusted closing price of 30 companies listed in Tehran Stock Exchange (TSE). Experimental results confirm that the proposed model performs well in predicting the price/correlation pair.

Keywords: Stock Market Prediction, Multi-Task Learning, LSTM Model, ARIMA Model, Convolutional LSTM Model.

AMS Mathematical Subject Classi ication [2018]: 91G99, 68T99

[1]speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Studying the efficiency of portfolio selecting models and comparing them from the perspective of Sharpe and Treynor ratios

Mina Roostapour Deilamany[1]
Amirkabir University of Technology, Tehran, Iran

Abstract

Optimizing portfolio is about maximizing return while controlling or reducing risk, for which various models have been created. Three of the best-known models are Markowitz, Sharpe, and Treynor, that the risk measure is used in them are variance, standard deviation, and beta coefficient. In this paper we study four innovative models and three above-mentioned models in selecting portfolio problem. The risk measure used in innovative models is based on both systematic and unsystematic risks. At the end, we implement each model and evaluate their performance on 30 companies of Iran Stock Exchange which have the highest market values and compare them from two perspectives, Sharpe ratio and Trainor ratio.

Keywords: Markowitz, Sharpe ratio, Treynor ratio, beta coefficient
Mathematics Subject Classification [2021]: 13D45, 39B42

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

A reduced-order model based on the cubic B-spline functions to investigate option pricing under jump-diffusion model

Mostafa Abbaszadeh[1]
Department of Applied Mathematics, Faculty of Mathematics and Computer Sciences, Amirkabir University of Technology, No. 424, Hafez Ave.,15914, Tehran, Iran

Abstract

The main aim of the current paper is to find a fast, stable and efficient numerical method for solving option pricing under jump-diffusion models. The consider model is a partial integro-differential equation with diffusion and advection terms. The first- and second-order derivatives are approximated by combining the cubic B-spline functions with the local pseudo-spectral technique. First, we discrete the space derivatives by the mentioned formulation which this procedure yields a system of ODEs. So, the second-order difference scheme is employed for solving the system of ODEs. To get an appropriate solution, we have to increase number of collocation points and also time steps to reach the final time. This procedure increases the used CPU time. To overcome this issue, we employ the proper orthogonal decomposition (POD) method to reduce size of final algebraic system of equation.

Keywords: Option pricing under jump-diffusion model, Cubic B-spline functions, Proper orthogonal decomposition
Mathematics Subject Classification [2018]: 65L60

[1]speaker

Subsidizing Inclusive Insurance to Reduce Poverty

Corina Constantinescu[1]
University of Liverpool, UK

Abstract

Considering a compound Poisson-type model for households' capital and using risk theory techniques, we determine the probability of a household falling under the poverty line. Microinsurance is then introduced to analyze its impact as an insurance solution for the lower income class. Our results validate those previously obtained with this type of model, showing that microinsurance alone is not sufficient to reduce the probability of falling into the area of poverty for specific groups of people, since premium payments constrain households' capital growth. This indicates the need for additional aid particularly from the government. As such, we propose several premium subsidy strategies and discuss the role of government in subsidizing microinsurance to help reduce poverty.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

No-Betting Pareto-Optima under Rank-Dependent Utility

Tim J. Boonen[1]
University of Amsterdam, The Netherlands

Mario Ghossoub
University of Waterloo, Canada

Abstract

In a pure-exchange economy with no aggregate uncertainty, we characterize in closed-form and in full generality Pareto-optimal allocations between two agents who maximize rank-dependent utilities (RDU). We then derive a necessary and sufficient condition for Pareto-optima to be no-betting allocations (i.e., deterministic allocations - or full insurance allocations). This condition depends only on the probability weighting functions of the two agents, and not on their (concave) utility functions. Hence with RDU preferences, it is the difference in probabilistic risk attitudes given common beliefs, rather than heterogeneity or ambiguity in beliefs, that is a driver of a bet. As by-product of our analysis, we answer the question of when sunspots matter in this economy.

Key Words and Phrases: Betting; Risk-Sharing, Pareto-Optimality, Sunspots, Rank-Dependent Utility.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Pricing equity-linked life insurance contracts with multiple risk factors by neural networks

Karim Barigou[1]
Université de Lyon, France

Abstract

This paper considers the pricing of equity-linked life insurance contracts with death and survival benefits in a general model with multiple stochastic risk factors: interest rate, equity, volatility, unsystematic and systematic mortality. We price the equity-linked contracts by assuming that the insurer hedges the risks to reduce the local variance of the net asset value process and requires a compensation for the non-hedgeable part of the liability in the form of an instantaneous standard deviation risk margin. The price can then be expressed as the solution of a system of non-linear partial differential equations. We reformulate the problem as a backward stochastic differential equation with jumps and solve it numerically by the use of efficient neural networks. Sensitivity analysis is performed with respect to initial parameters and an analysis of the accuracy of the approximation of the true price with our neural networks is provided.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Actuarial and financial valuation of catastrophe bonds

Saeid Safarveisi[1]
Katholieke Universiteit Leuven, Belgium

Hirbod Assa
Kent Business School, UK

Jia Shao
Coventry Universoty, UK

Abstract

Among different types of insurance-linked security instruments existing in capital markets, catastrophe bonds are important for insurance companies. Such a contract includes both financial and actuarial risks, making their valuation procedure quite complicated from a theoretical perspective. The financial valuation of catastrophe bonds is based on the idea of arbitrage-free pricing and a risk-neutral measure approach. In this paper, we provide a valuation based on the actuarial methodology in which the best estimate of discounted loss plus a risk margin are computed under the physical measure. To do so, we introduce the variance premium principle and achieve a closed-form formula for the catastrophe bond price.

Keywords: Catastrophe bonds, Physical measure, Risk-neutral measure, Variance premium principle, Monte-Carlo simulation
Subject: 91G20, 91G30

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

On VaR-ES distortion and its application in risk management

Liyuan Lin[1]
University of Waterloo, Canada

Hirbod Assa
Kent Business School, UK

Ruodu Wang
University of Waterloo, UK

Abstract

In quantitative risk management, value at risk (VaR) and expected shortfall (ES) are known as the major risk measures. The former has gained its popularity due to its simplistic approach toward risk as the risk quantile, and the second one is perceived to be very useful as a modification of VaR with more appealing properties, such as tail-sensitivity and sub-additivity. However, VaR is not in general promoting the major idea of reducing risk by diversification, and ES cannot be defined on all risk variables. As a result, there have been always a tendency to explore the relationship between the two. In this paper we study this relationship in a novel manner by exploring how ES transforms the distribution of a risk variable. This is essentially done by a distortion function. The main objective of the paper is that for a given distribution find numerical and theoretical ways to identify the distorted distribution. Particularly, this is important for us to explore the tail behavior of the distorted distribution and compare it with the original one.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Zero-interest green loans in France: Effectiveness and candidate barriers

Maryam Vahid[1]
École des ponts ParisTech, France

Abstract

Since 2009, France has been running a zero-interest green loan (ZIGL) program to encourage home energy retrofits. The number of ZIGLs issued on a yearly basis, however, is an order of magnitude lower than initially planned. Exploiting a difference-in-difference design, we estimate the causal effect of the program on home energy retrofits. We find a significant, positive effect that vanishes after two years. We discuss candidate barriers for under-participation in the program, including debt aversion and lack of information on the demand side, obfuscation on the supply side and interactions with other subsidy programs on the regulatory side.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

The Impact of Collateral and Stays on Financial Stability[1]

Samim Ghamamiy[2]
New York University, UC Berkeley, and SOFR Academy, USA

Abstract

We study the spread of losses and defaults in financial networks with two features: collateral requirements and resolution and bankruptcy stay rules. When collateral is committed to a firm's counterparties, a solvent firm may default if it lacks sufficient liquid assets to meet its payment obligations. Collateral requirements can thus increase the risk of contagion. Moreover, one firm may benefit from the failure of another if the failure frees collateral committed by the surviving firm, giving it additional resources to make other payments. Contract termination at default may also similarly improve the ability of other firms to meet their obligations. As a consequence of these features, the timing of payments and collateral liquidation must be carefully specified to establish the existence of payments that clear the network. Using this framework, we show that committed collateral in the form of initial margin in over-the-counter derivatives markets may increase contagion and risks to financial stability. We also compare networks under different stay rules in OTC markets. Our analysis shows that when _rms are not highly leveraged in terms of derivatives transactions, full contract termination may reduce contagion.

[1] This presentation is based on a recent paper titled "Collateralized Networks" joint with Paul Glasserman at Columbia Business School and Peyton Young at the London School of Economics. It is also based on two Risk articles, "Ghamami (2020a)" and "Ghamami (2020b)".

[2] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

On high-dimensional heavy tailed Lèvy process with possibly different tail indices

Mohsen Rezapour[1]
Department of Biostatistics and data science, The university of Texas, Health Science center at Houston, USA

Vahed Maroufy
Department of Biostatistics and data science, The university of Texas, Health Science center at Houston, USA

Hirbod Assa
Kent Business School, UK

Abstract

Rapid improvement in data collection electronic devices has granted access to a large amount of time-dependent data with high resolution and frequency. These data sets are realizations of continuous-time random processes recorded on an incredibly fine time resolution. High dimensional high-frequency data with extreme values commonly appear in various fields of science, such as the study of extreme events, big Electronic Health Records (EHR), gene expression analysis using RNA-Seq data, and high-dimensional portfolio optimization. Lèvy process with heavy-tailed components as a class of continuous-time random process were widely used in finance literature. In this talk, we are concerned with the dimensional reduction of data from a multivariate Lèvy process with heavy-tailed components in the domain of attraction of a stable law with possibly different stability indices, which allows us to model high dimensional continuous time series with different tail indices. For dimensionality reduction, instead of considering the sample variance-covariance matrix, we consider a scaled version of it, which enabled us to show that under some mild conditions, the asymptotic behavior of eigenvalues of this matrix is in the domain of attraction of a stable law with possible different tail indices. This achievement reveals that any statistical inference related to eigenvalues depends on the tail index of original random variables. Finally, we propose an algorithm to find the most critical variables based on our achievements. The novel algorithm is implemented in portfolio optimization for S&P 500 data. A comparison of Markowitz portfolio optimization based on our novel algorithm and the principal components is provided for more illustration.

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Applying deep learning algorithms based on a new spatial neural network for limit order book

Ghahremani, Masoud[1]

Kharazmi University, Tehran, Iran

Kazemi, Seyed-Mohammad-Mahdi

Associate Professor, Kharazmi University, Tehran, Iran

Assa, Hirbod

Associate Professor, Kent Business School, Canterbury, England

Abstract

Based on the idea presented in [Justin A. Sirignano, Deep learning for limit order books, Quantitative Finance (2018)], This paper applies a new neural network architecture (spatial neural network) for modeling in limit order book data of tehran stock exchange to check the performance of this model. The design of the architecture takes advantage of the specific structure of limit order books. The spatial neural network models the joint distribution of the state of the limit order book at a future time conditional on the current state of the limit order book. The models are trained and tested on the data of 30 companies of tehran stock exchange. Techniques from deep learning such as dropout are employed to improve performance and finally the results showed that The spatial neural network outperforms a standard neural network architecture.

Keywords: Limit order book, Deep learning, Machine learning, Big data

AMS Mathematical Subject Classi ication [2018]: 13D45, 39B42

[1]Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

RBF Based Multilevel Meshfree Approximation in Model Including Market Illiquidity

Abolfazl Mighani[1]

Institute for Advanced Studies in Basic Sciencesy, Zanjan, Iran

Ali Foroush Bastani

Institute for Advanced Studies in Basic Sciencesy, Zanjan, Iran

Abstract

This paper addresses application of multilevel Newton iteration along with the radial basis functions to be used for solving the parabolic partial differential equations derived from pricing European options in the Frey and Patie model. The linearization of the nonlinear PDE applied at each iteration helps to solve a system of linear PDEs by a multilevel collocation scheme. Finally, in order to evaluate the accuracy and robustness of the results gained in this paper, they are compared with the results from former numerical studies.

Keywords: Frey and Patie Model, Radial Basis Function, European Call Option, Multilevel Newton Iteration

AMS Mathematical Subject Classification [2018]: 91G80, 65N35

[1]speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Optimal Investment Strategy for a DC Pension Fund Plan in a Finite Horizon Time

Saman Vahabi[1]
Shahid Beheshti University, Tehran, Iran

Amir T. Payandeh
Shahid Beheshti University, Tehran, Iran

Abstract

This paper obtains an optimal strategy in a finite horizon time for a portfolio of a DC pension fund for an investor with the CRRA utility function. It employs the optimal stochastic control method in a financial market with two different asset markets, one risk free and another one risky asset with its jump follows either a finite or infinite activity Lévy process. Sensitivity of jump parameters in a uncertainty financial market has been studied.

Keywords: Optimal Strategy; Pension Plans; Finite/Infinite activity Lévy Processes; Pension Fund.
AMS Mathematical Subject Classification [2018]: 60G51, 11A55, 42A38, 60J50, 60E10.

[1]speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Applications of Actuarial Model in Automobile Insurance Claim

Zahra Majedi [1]
Saman Insurance Company, Tehran, Iran

Oreinab Afrooz Kelardehi
Razi Insurance Company, Tehran, Iran

Abstract

In this paper we apply actuarial models to detailed, micro-level automobile insurance records. As we know, third party insurance is an important major for both policyholders and insurance companies. We model claim frequency, type and severity of third party insurance claims by incorporating different individual and vehicle risk factors such as vehicle age, vehicle usage, vehicle capacity and number of claim discount. This allows the actuary to differentiate prices based on policyholder characteristics. In addition, by using various risk measures, including value at risk and tail value at risk we predict the insurance company capital requirement. Finally, we assess the effects of dependence structure on these measures by using copula models. The results show that the copula effect increases with the percentile.

Keywords: Third party liability insurance, Risk factors, Copula, Risk measures, Capital requirement,
Mathematics Subject Classification [2020]: 91G70, 62H05

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Optimal trading strategy from an agricultural producer perspective: Calibration and regularization

Karimi, Nader[1]
Amirkabir university, Tehran, Iran

Assa, Hirbod
Kent Business School, UK

Salavati, Erfan
Amirkabir university, Tehran, Iran

Adibi, Hojatollah
Amirkabir university, Tehran, Iran

Abstract

We study the decision problem of storing commodity for an agricultural producer who aims to sell the production in the futures market under the continuous time speculative storage model in the infinite horizon time. To do so, first we consider the log-Ornstein-Uhlenbeck process as the demand process and provide a novel demand function, capable of being an Snell envelope over all stopping times. Second, we propose novel calibration method which combines the quasi maximum likelihood method and Milstein method. Then we apply our method on both simulated and actual data for two families of value functions. Eventually, we use the Likelihood Ratio Test (LRT) for comparison of two models (storage model and no-storage model). Our results show that the proposed storage model is more efficient than the no-storage model.

Keywords: Log-Ornstein-Uhlenbeck process , Snell envelope, Quasi maximum likelihood method.

AMS Mathematical Subject Classification [2018]: 13D45, 39B42

[1]speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Numerical Analysis for European options under a new stochastic volatility model with a stochastic long-term mean

Rahimi, Vaz'he[1]
University of Tabriz, Tabriz, Iran

Ivaz, Karim
University of Tabriz, Tabriz, Iran

Ahmadian, Davood
University of Tabriz, Tabriz, Iran

Abstract

The paper analyzes the European call option prices under stochastic long-term mean in the Heston model numerically. First, discretization is performed using θ method. The proposed discrete equation reduces in three dimensions to one dimension by using the von Neumann method along with the Fourier transform. The consistency and stability of the method have been stablished, and subsequently convergence is concluded by the Lax theorem. At final, numerical results are performed by the well-known Crank Nicolson by setting the $\theta = \frac{1}{2}$.

Keywords: Stochastic volatility , Stochastic long-term mean, viscosity solution, 3-dimensional discrete Fourier transform
Mathematics Subject Classification [2018]: 13D45, 39B42

[1]speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Farsi Talk

Diagonally drift and diffusion-implicit balanced stochastic Runge–Kutta methods of strong Second-order for stiff stochastic differential systems

Rahimi, Vaz'he
University of Tabriz, Tabriz, Iran

Ahmadian, Davood[1]
University of Tabriz, Tabriz, Iran

Abstract

The paper aims to obtain the convergence and mean-square (M.S.) stability analysis of the second-order balanced stochastic Runge–Kutta method for the Itô multi-dimensional stochastic linear scalar and additive test differential equations. The control functions are used to improve and enhance the convergence and stability properties of the method. The strong convergence of the second-order balanced stochastic Runge–Kutta methods is analyzed. Moreover, the mean-square stability is investigated using the properties of Kronecker product. Finally to check their convergence order and stability properties some numerical experiments are performed.

Keywords: Stochastic differential equations, Numerical solutions, Balanced stochastic Runge–Kutta methods, Mean-square stability, Strong convergence.
Mathematics Subject Classification [2018]: 13D45, 39B42

[1] speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

On Credibility Premium for Finite Mixture Distributions

Amir T. Payandeh Najafabadia[1]
Shahid Beheshti University, Iran

Ehsan Jahanbania
Shahid Beheshti University, Iran

Abstract

Suppose random claim $X_1, \dots, X_n$ are sampled from a K-component finite mixture distribution. Moreover, supposed that claim information $X_1, \dots, X_n$ are accompanied with additional information $Z_1, \dots, Z_n$ where using such additional information, one may identify the probability of a given random claim belongs to a certain component. Under these assumptions, this article provides: (1) the credibility premium for finite mixture distributions and (2) the exact credibility premium for the finite mixture distributions, whenever claim distributions of all components are belong to the exponential family of distributions and their corresponding prior distribution conjugates with such a claim distribution.

Keywords: Finite mixture distributions, Credibility premium, Bayes estimator, Exponential family of distributions.
Classifications: 62F15, 62E15, 91B05, 91G99

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Some aspects of stock price movements and option pricing models

Ali Safdari Vaighani[1]
Allameh Tabataba'i University, Iran

Abstract

In most cases, pure diffusion models are not flexible enough to fit the empirical observations concerning the movements of stock prices. Many studies have been conducted to overcome the limitations of the Black–Scholes model. The main aspects of these researches involve three empirical stylized facts, namely the leptokurtic feature, volatility clustering effect, and implied volatility smile. The aim of this talk is to develop computational schemes and simulation methods for more realistic models arising in financial application.

Keywords: Financial data, Jump-diffusion, Black–Scholes model.
AMS Mathematical Subject Classification [2018]: 65M70, 91G80

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Galerkin Finite Element Method for Credit Rating Migration Problem Model with Galerkin Finite Element Method

Davood Damircheli[1]
Mississippi State University, Starkville, USA

Abstract

In this presentation, we propose a finite element method to study the problem of credit rating migration problem narrowed to a free boundary problem. Free boundary indeed separates the high and low rating region for a rm and causes some difficulties including discontinuity of second-order derivative of the problem. Exploiting the weak formulation of the problem utilized in the Galerkin method, the discontinuity of second-order derivative is averted. we show some convergence and stability of the proposed method. Numerical results illustrate how derived convergence results are consistent into practice ones.

Keywords: Credit rating migration problem, free boundary problem, Galerkin methods, Convergence analysis, Error estimate, Stability

[1] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Optimal investment-consumption problem: post-retirement with minimum guarantee[1]

Hassan Dadashi[2]
Institute for Advanced Studies in Basic Science (IASBS), Zanjan, Iran

Abstract

We study the optimal investment-consumption problem for a member of defined contribution plan during the decumulation phase. For a fixed annuitization time, to achieve higher final annuity, we consider a variable consumption rate. Moreover, to have a minimum guarantee for the final annuity, a safety level for the wealth process is considered. To solve the stochastic optimal control problem via dynamic programing, we obtain a Hamilton-Jacobi-Bellman (HJB) equation on a bounded domain. The existence and uniqueness of classical solutions are proved through the dual transformation. We apply the finite difference method to find numerical approximations of the solution of the HJB equation. Finally, the simulation results for the optimal investment-consumption strategies, optimal wealth process and the final annuity for different admissible ranges of consumption are given. Furthermore, by taking into account the market present value of the cash flows before and after the annuitization, we compare the outcomes of different scenarios.

Keywords: Defined contribution plan, Decumulation phase, Final annuity guarantee, HJB equation, Policy iteration method
AMS Subject Classification: 60J70, 93E20, 65N06

[1] https://doi.org/10.1016/j.insmatheco.2020.07.006
[2] Speaker

The 7th FINACT-IRAN National Conference on Financial and Actuarial Mathematics
August 10-12, 2021

Evaluation of Bond Options

Saghar Heidari[1]
Shahid Beheshti University, Tehran, Iran

Abstract

In this paper we study one of the interest rate contingent claims, bond options, that the valuation of these financial instruments have been investigated extensively in recent work in computational finance research. These options are written on bonds that their prices depend on interest rates. We consider the Hull and white model as a single-factor affine model to describe the dynamic of interest rate. Among bond options, American bond options whose their early exercise feature requires special treatment, have become more attractive in recent research. In pricing problem of American bonds options, the early exercise opportunity leads to free boundary problem, which no analytical solution is available. To face these difficulties and to find the free boundaries as well as the options price with partial differential equation approach, we apply a numerical method to solve the resulted partial differential equation with free boundary. Our numerical results demonstrate efficient, robust and accurate approximations of the free boundaries and option prices in comparison with some other approaches.

Keywords: American bond option, Hull and White model, free boundary problem, front-fixing method.
Mathematics Subject Classification [2018]: 13D45, 39B42

-

[2]speaker
Email: s heidari@sbu.ac.ir